



APPENDIX 8 – GROUNDWATER ASSESSMENT

NEW LENTON COAL PTY LTD
NEW LENTON COAL PROJECT



New Lenton Coal Project

PER Groundwater Assessment

Lenton Joint Venture

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Basis of Report

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Lenton Joint Venture (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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Appendices

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Appendix B	2022 Factual Field Work Report
Appendix C	Groundwater Quality Summary Statistics
Appendix D	Groundwater Modelling Technical Report (2023)
Appendix E	Independant Peer Reviewer Report
Appendix F	Additional Post-Mining Climate Scenario Groundwater Modelling
Appendix G	Groundwater Monitoring and Management Plan



1.0 Introduction

1.1 Overview

The Lenton Joint Venture (LJV) has engaged SLR Consulting Australia Pty Ltd (SLR) to undertake a groundwater assessment to support LJV's New Lenton Coal Project (New Lenton, the Project) Public Environment Report (PER) for submission to Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Guidelines for a draft PER for the Project (the Guidelines) were issued by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 19/12/2022. This document addresses the requirements of the Guidelines in relation to groundwater impact assessment.

SLR previously prepared a groundwater assessment for the Project in 2020 in support of Queensland State approvals, namely an Environmental Authority (EA) amendment application (SLR, 2020a) and an Associated Water License (AWL) application (SLR, 2020b), both of which were subsequently approved by the State. This PER Groundwater Assessment report builds upon that 2020 body of work.

1.2 Project Description

The Project is a proposed open-cut mine located within the northern part of the Bowen Basin and lies adjacent to the Isaac River, approximately 65 km north of Moranbah and 120 km south-west of Mackay. The regional locality is shown on **Figure 1-1**.

The proposed open-cut mine, to be developed on Mining Lease (ML) 70337, ML 700053 and ML 700054 (the Project Area), has a Life of Mine of approximately 18 years. The proposed Project includes two open-cut pits, the West Pit and East Pit (**Figure 1-2**). The current EA (EPML00475513) allows the Project to operate at the rate of two million tonnes per annum (Mtpa) Run-of-Mine (RoM) coal extraction.

The LJV owns the adjacent Burton Mine on ML 70109 and ML 70260. BCC acquired NHG's share of the LJV in July 2022 and recommenced mining operations after a period of care and maintenance by the previous owners. Burton Mine is located to the south-east of the Project (**Figure 1-3**).

The key elements of the New Lenton Project include:

- The mining of economic coal resource from the Burton Rider, Leichhardt and Vermont seams in two new pits on ML 70337: West Pit and East Pit.
- Construction of the re-alignment of the Suttor Developmental Road, with a new bridge over the Isaac River.
- Construction of haul roads, including haul road connection with the Burton Mine haul roads and a bed level crossing of the Isaac River.
- The emplacement of overburden in in-pit and out of pit waste rock dumps, with a final void remaining at the end of mine life.
- Construction of a mine infrastructure area (MIA) providing washdown, maintenance, spares laydown, and administration facilities for the Project's mining operations.
- Construction of the Ti-Tree Creek diversion to the north of the East pit and into the Isaac River.
- Mine water management infrastructure integrated with the existing systems at Burton Mine.



- Sediment dams and drains constructed to capture stormwater runoff from waste rock dumps (WRDS).
- Construction of levees adjacent to the Ti-Tree Creek diversion and Isaac River.

The Project will utilise infrastructure at Burton Mine as follows:

- Washing of coal at the coal handling and processing plant (CHPP).
- Mine infrastructure areas.
- Haulage of product coal on the haul road on ML 70109, to transport the train load-out (TLO)
- Management of rejects from coal washing within the Burton Mine's reject management systems.

Product coal will be railed to Port for export via the Goonyella rail line.

Throughout this report, the terms "the Project Area" and "Study Area" are defined as follows:

- The Project Area is the area within ML 70337, ML 700053 and ML 700054 (**Figure 1-3**) (i.e. the area subject to EA EPML00475513)
- The Study Area is the regional area surrounding the Project Area considered in detail within this assessment, necessary to inform the understanding of the regional scale groundwater system (**Figure 3-3**), and includes the area of the adjacent Burton Mine as necessary to consider the cumulative hydrogeological framework. The Study Area is also synonymous with the numerical groundwater model domain as discussed in **Section 6.0**.





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	0 12.5 25 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:800,000 at A4
Project Number:	620.31367.00000
Date Drawn:	28-Aug-2023
Drawn by:	XX

LEGEND

-  Locality
-  Major Watercourse
-  Road
-  New Lenton Project Area

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PROJECT LOCATION



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FIGURE 1-1

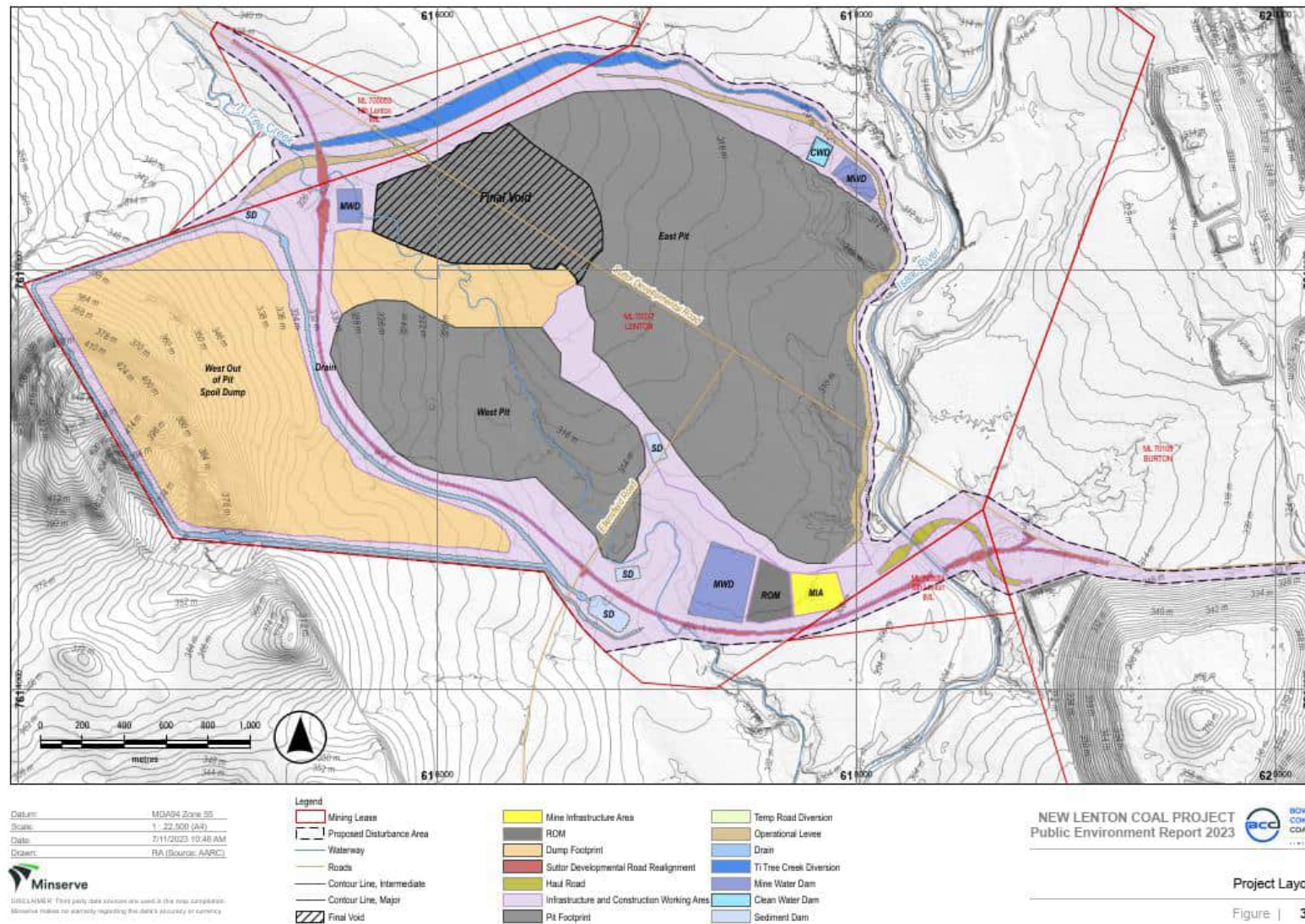


Figure 1-2 Project Overview





Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Esri, FAO, NOAA, USGS, Earthstar
Geographics, Esri, USGS

 0 1.3 2.5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:70,000 at A4

Project Number: 620.31367.00000

Date Drawn: 16-Jun-2023

Drawn by: RB

- LEGEND**
-  Major Watercourse
 -  Non-designated Watercourse
 -  Project Area (ML 70337, ML 700053 and ML 700054)
 -  Burton Mining Lease (ML 70109)

**NEW LENTON COAL PROJECT
PER GROUNDWATER
ASSESSMENT**

**NEW LENTON PROJECT AREA
AND BURTON MINE**



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FIGURE 1-3

2.0 Legislative Requirements and Guidelines

This section provides an overview of the legislative requirements and guidelines associated with the PER required for the Project, with respect to groundwater.

2.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is the Australian Government's main environmental legislation and is administered by DCCEE. The EPBC Act provides a legal framework to protect and manage matters of national environmental significance (NES), namely:

- Declared world heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and listed ecological communities
- Listed migratory species (protected under international agreements)
- Commonwealth marine areas
- Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- Water resources (concerning coal seam gas and large coal mining development)

Chapter 2 – Protecting the Environment of the EPBC Act provides a basis for the Minister to decide whether an action that has, will have or likely to have a significant impact on certain aspects of the environment should proceed.

A Referral for the Project, under the EPBC Act was lodged on 23/09/2020 (EPBC 2020/8778). On 22/10/2020, the delegate for the Minister for the Environment determined that the Project was a controlled action and would be assessed by PER, subject to the following controlling provisions for matters of national environmental significance (MNES):

- Listed threatened species and communities (sections 18 & 18A)
- A water resource, in relation to coal seam gas development and large coal mining development (sections 24D & 24E).

2.2 Relevant Guidelines for a PER

2.2.1 New Lenton Coal Project PER Guidelines

The PER Guidelines for the Project were issued by the DCCEE on 19/12/2022. The PER Guidelines provide guidance on the information to provide in the PER to allow the Minister to make an informed decision on whether or not to approve, under Part 9 of the EPBC Act, the taking of the action for the purposes of each controlling provision.

In particular, Section 5.2 of the PER Guidelines describes the requirements for the PER for assessment of impacts to groundwater and surface water, including:

- The submission to the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC);
- Compliance with guidelines (EPBC Act Significant Impact Guidelines 1.3 and IESC guidelines) and policy statements under the EPBC Act; and



- Detailed technical information that is expected to be included in the PER.

Table 2-1 identifies the section of this report where the requirements of the PER Guideline have been addressed.

Table 2-1 PER Requirements Checklist – 5.2 A water resource in relation to coal seam gas development and large coal mining development

PER Section	Item	Section in Report
5.2	The hydrology relevant to the proposed action area, including surface water and groundwater	
	Provide a regional overview of the project area, including a description of the geological basin, coal resource, surface water catchments, groundwater systems and water-dependent assets.	Sections 3.0, 4.0 and 5.0
	Describe any potential third-party users of water in areas potentially affected by the proposed project, including municipal, agricultural, industrial, recreational and environmental uses of water. Noting the proposed action has the potential to utilise existing infrastructure from the Burton Mine, the impacts on water resources and water-dependent assets from the transfer of mine affected water to or from Burton mine should be described.	Sections 5.13, 5.14 and 7.0 Mine water management/transfers addressed in WRM (2023)
	The PER must include a description and assessment of the impacts to water resources giving consideration to relevant departmental policies and guidelines, including the Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources (2013). These guidelines can be found at the following website: http://www.dcceew.gov.au/environment/epbc/publications/significant-impact-guidelines-13-coal-seam-gas-and-large-coal-mining-developments-impacts .	Section 2.0 and 7.0
	The PER must provide robust scientific information and supporting evidence for every assertion, assumption and/or conclusion made in the assessment of potential impacts, or lack of impacts, on water resources.	Throughout report
	The PER should refer to water quality objectives approved in the State environmental authority for the proposal where they are relevant to the assessment, and management and mitigation of impacts on EPBC protected matters.	Sections 5.12.3 and 8.0
5.2.1	Groundwater	
	The PER must identify and describe the occurrence of groundwater in the project area and its vicinity, including the relevant groundwater-bearing units and groundwater levels.	Section 5.10
	The groundwater assessment must include a groundwater risk assessment, to identify and quantify potential groundwater impacts. Where groundwater models are used, they (including conceptual models) must be constructed at a suitable spatial and temporal scale to be able to assess both site-specific and regional cumulative impacts. Any assumptions should be clearly described and justified.	Section 7.5 Section 6.0 and Appendix D



PER Section	Item	Section in Report
	Where faults are likely to be intercepted by mining or drawdown, resulting variable drawdown and groundwater flow should be considered.	Section 5.11.3 and Appendix D
	The groundwater impact information provided should allow an independent reviewer to consider the appropriateness of the underlying assumptions and conceptual models on which the risk assessment (and numerical/analytical models where relevant) are based.	Appendix E
	It is important for the risk assessment/modelling to clearly distinguish between impacts from the proposed project and other neighbouring mines or activities which may be impacting groundwater. For example, the PER must clearly identify the absolute amount of drawdown due to the proposal and the total predicted cumulative drawdown values. This must include details on how the estimated contributions to cumulative drawdown have been derived. Where available, data from other operations should be used in modelling for the proposal.	Section 6.0
	The PER must provide a discussion on the number and location of groundwater monitoring bores (both within and adjacent to the project site) to ensure there is adequate spatial coverage in all aquifers. Provide clear justification as to the representativeness of the bore sites chosen and whether any other monitoring bores may be required. Please note that any new monitoring bores must be located where they are unlikely to be removed for future mining activities.	Section 5.8, 5.9 and 8.1
	Site-specific data for all relevant hydraulic properties for each groundwater unit must be captured from the proposed monitoring network for input into the groundwater models.	Section 5.11.1
	The water resources assessment must consider climate change in modelling scenarios and in the water balance (e.g. through the use of the Climate Futures Tool), particularly if the action will require external water sources and/or has a long lifetime. Where climate change predictions have not been incorporated into the modelling, the PER must provide a discussion as to why it is not necessary for the proposed action.	Section 6.2.5 Section 6.7.3.1
	The PER must include an assessment of the direct, indirect and consequential impacts to all groundwater resources as a result of groundwater drawdown, as well as impacts to groundwater and surface water connectivity. Impacts to groundwater due to the proposed Ti-tree creek diversion is to be included.	Section 7.0
	The proponent must provide a draft groundwater management plan and comprehensive risk assessment to assess impacts of groundwater drawdown. The management plan and risk assessment should also account for the cumulative risk of drawdown from neighbouring mines.	Section 8.1 and Appendix G Section 7.5
	Considering groundwater drawdown and aquifer drainage may have impacts to groundwater quality, please include a discussion on potential changes to salinity and pH, and the	Section 7.3



PER Section	Item	Section in Report
	introduction of toxic levels of metals, metaloids and ammonia resulting from blasting activities.	
5.2.2	Final Voids	
	The precise location of the proposed final voids.	Section 6.7 and Figure 6-13
	An assessment of the design of the final voids and how the design will minimise impacts, as well as an assessment of the water quality of those voids.	Addressed elsewhere in PER
	Information in the referral documentation noted that the final voids will remain groundwater sinks post-mining. Provide details on the predicted water levels in the final voids, along with the expected groundwater level at which the voids will cease to be sinks and begin recharging local groundwater. Please provide and fully explain the reasoning behind the identified levels at which groundwater flows change.	Section 6.7.3 Section 6.7.5
	A discussion on whether through-flow groundwater conditions could be established. As the void water is predicted to become hyper-saline, provide discussion on whether this water has any potential to leave the pit lakes.	Section 6.7.5
5.2.3	Waste material	
	The PER must provide details on the capacity of the proposed out of pit waste dumps and the expected volumes of waste to be generated by the proposed action. This must include a discussion on the reshaping and backfilling of the Lenton east and Lenton west pits.	Addressed elsewhere in PER
	The PER must provide details on whether the adjacent Burton mine has the capacity to store the tailings from the proposed action.	Addressed elsewhere in PER
	The PER must also provide details on rehabilitation of the out of pit waste dumps, addressing any potential indirect impacts to EPBC matters and how this will be mitigated.	Addressed elsewhere in PER
5.2.4	Groundwater Dependent Ecosystems	
	Under the EPBC Act, you must consider impacts to all groundwater dependent ecosystems (GDEs), whether they are partially or wholly dependent on groundwater. The PER must include an assessment of direct, indirect and consequential impacts to GDEs, including potential GDEs in the vicinity. You must consider both surface water and groundwater impacts to GDEs within the proposed action area and within the zone of potential drawdown (e.g. impacts due to groundwater drawdown, reduction in surface water flow, etc.).	Section 5.14.1, 7.1.2 and 7.2
	The presence of GDEs in and adjacent to the project site must be tested, with the GDE assessment comprising both: desktop assessments (e.g. searches of the Queensland Government's Springs database, the Bureau of Meteorology's GDEs Atlas and Geoscience Australia's Water observations from space, etc.) used to identify potential GDEs for field assessment; and	Section 5.14.1 and 3D Environmental, 2023.



PER Section	Item	Section in Report
	- field assessments (e.g. soil moisture testing, leaf moisture testing, root depth drilling, etc.) to confirm the outcomes of the desktop assessments. The above databases can be found at the following websites: https://www.data.qld.gov.au/dataset/springs http://www.bom.gov.au/water/groundwater/gde/ https://www.ga.gov.au/scientific-topics/community-safety/flood/wofs The desktop and field assessments must consider the Australian GDE toolbox (2011) and the IESC GDE explanatory note. If GDE field verification surveys are not undertaken, the department is likely to apply a precautionary approach to the presence of GDEs and the assessment of potential impacts.	
	Provide the details and results of the above database searches and field studies, including observations of the vegetation present in the area and descriptions of the soil/geology encountered. A time series of satellite imagery of the potential GDEs in the vicinity may be able to be provided. Observing the state of the vegetation over time, given the neighbouring mining operations and corresponding groundwater drawdown, may help to demonstrate whether impacts to GDEs have occurred as a result of previous mining operations.	Section 5.14.1 and 3D Environmental, 2023.
	Field studies should consider the depth to the groundwater table when determining the extent of GDE occurrence. Provide the observations used to determine the depth to groundwater.	Section 5.14.1 and 3D Environmental, 2023.
	Sufficient evidence needs to be provided to support any conclusion that particular ecosystems are not groundwater dependent.	Section 5.14.1
5.2.5	Stygofauna	
	Provide details of field investigations undertaken (and any relevant previous published and/or unpublished studies) to determine the presence and composition of stygofauna communities in the region and proposed action area.	Section 5.14.4 and frc environmental (2023)
	Include the full results of any groundwater bores sampled (e.g. levels and water quality). Justification must be provided regarding the representativeness of the samples taken.	Section 5.14.4 and frc environmental (2023)
	The PER must provide an assessment of the suitability of local habitat for subterranean aquatic fauna. This assessment must be based on local geological, hydrological and other information, including the distribution of alluvium present in the proposed action area and likely hydrological connectivity with geological formations targeted for development. Stygofauna assessment guidance is available through the Queensland Government's Background information on sampling bores and stygofauna and Guideline for the environmental assessment of subterranean aquatic fauna. These documents can be found at the following websites: https://environment.des.qld.gov.au/__data/assets/pdf_file/0029/90767/biological-assessment-background-information-on-sampling-bores-for-stygofauna.pdf.	Section 5.14.4 and frc environmental (2023)



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	https://www.publications.qld.gov.au/dataset/subterranean-aquatic-fauna/resource/ba880910-5117-433a-b90d-2c131874a8e6.	
5.2.7	Surface water	
	A description of the surface water values of the project area and surrounding vicinity, including a discussion of the regional water quality and the local receiving environment. Further, a discussion of existing flood conditions must be provided.	Addressed elsewhere in PER
	Provide flood modelling that demonstrates the flooding system for existing Ti-tree Creek and for the projected diversion channel.	Addressed elsewhere in PER
	A description of the impacts to surface water, in relation to the Ti-Tree creek diversion, Isaac River and associated levees.	Addressed elsewhere in PER
	Water quality monitoring data, including baseline data and when and where samples have been obtained. The monitoring data must be provided in full in the PER to show the temporal and spatial trends in water quality.	Addressed elsewhere in PER
	Quantify current surface water flow regimes, both within and adjacent to the project site, to ensure there is sufficient baseline information to assess how the location, volume, velocity and timing of flows may change as a result of the proposed action.	Addressed elsewhere in PER
	A discussion on changes to surface water flows and quality from proposed controlled and uncontrolled water releases.	Addressed elsewhere in PER
	Information on the potential increase in soil instability and erosion resulting from construction and potential subsequent impacts on downstream water quality.	Addressed elsewhere in PER
	Cumulative Impacts The PER must identify and address potential and likely cumulative impacts on groundwater and surface water from the proposed action, Burton Mine and other nearby resource projects. Discussion should include cumulative impact considerations of impacts to water quality and quantity, and potential impacts to Groundwater Dependent Ecosystems in the region.	Section 6.6, 7.3, 7.1.2 Surface water addressed elsewhere in PER



2.2.2 EPBC Act Significant Impact Guidelines

The core purpose of the EPBC Act Significant Impact Guidelines 1.3 (DCCEEW, 2022) are to assist any person who proposes to take an action which involves a coal seam gas or a large coal mining development to decide whether the action has or is likely to have a significant impact on a water resource. The guidelines outline a “self-assessment” process, including detailed criteria, to assist persons in deciding whether or not referral may be required.

In terms of the definition of a significant impact to a water resource, the Significant Impact Guidelines 1.3 identify that *“whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the water resource that is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts”*, and then refer to the Significant Impact Guidelines 1.1 for further information on assessing the significance of impacts. In accordance with the Significant Impact Guidelines 1.1 the following matters should be considered by the proponent:

- Are there any matters of national significance located in the area of the proposed action (action is to be considered broader than the immediate area: e.g. do any downstream or upstream impacts or areas immediately adjacent need to be considered)?
- Considering the project at its broadest scope, is there potential for impacts, including indirect impacts, on matters of national environmental significance?
- Are there any proposed measures to avoid or reduce impacts of national environmental significance (and if so, is the effectiveness of these measures certain enough to reduce the level of impact below the “significant impact” threshold)?
- Are any impacts of the proposed action on matters of national environmental significance likely to be significant impacts (important, notable, or of consequence, having regard to their content or intensity)?

The Significant Impact Guidelines 1.3 also identify the requirement to consider cumulative impacts, noting that “existing operations may be taken into account in considering cumulative impacts” but that “a new approval for the existing operations will not be required”. As stated in the Significant Impact Guidelines 1.3:

- The term ‘cumulative impacts’ refers to the impacts of a number of different actions or other broader influences on a matter of national environmental significance which, when considered together, have a greater impact on that matter than each action or broader influence considered individually.
- The cumulative impact context may include existing developments that have an impact on particular water resources (i.e. existing operations), and other reasonably foreseeable developments (i.e. proposed operations) which may have an impact on particular water resources and/or the overall development of a region.
- The significance of an impact may also depend upon the context of other developments: an apparently small impact may still be a significant impact if there are substantial cumulative effects, factoring in existing and reasonably foreseeable prospective actions.
- The potential for the impact of an action to be significant is likely to be greater in a more developed system.
- Cumulative impacts should be considered at the local, aquifer or catchment, and regional scale.



The PER Guidelines for the Project state the PER should take into consideration the EPBC Act Significant Impact Guidelines.

2.2.3 IESC Information Guidelines

As stated in PER Guidelines, the Project will require submission to the IESC, which is a statutory body under the EPBC Act. The IESC provides advice to the Commonwealth Environment Minister on coal seam gas and large coal mining development proposals that are likely to have a significant impact on water resources.

The IESC have produced information guidelines (Commonwealth of Australia, 2018) which outline advice on the requirements for submission to IESC for coal seam gas and large coal mining development proposals. The information provided in the draft PER will form part of the submission to the IESC. A checklist is provided in the IESC information guidelines to ensure that the information requirements for the IESC review have been addressed in the PER. In general terms the requirements of the IESC and the robustness of the IESC's review of technical documentation are considered to be somewhat more technically stringent than those of the Queensland State departments, for example the Department of Environment and Science (DES) who reviewed and approved the Project's 2020 EA Amendment Application documentation, and the then Department of Natural Resources Mines and Energy (DNRME) who reviewed and approved the Project's 2020 AWL Application documentation.

Table 2-2 identifies the section(s) of this report where the requirements of the IESC information guidelines have been addressed.

Table 2-2 IESC Information Guidelines Checklist

Assessment Item – Description of Proposal	Section addressed in
Provide a regional overview of the proposed project area including a description of the geological basin; coal resource; surface water catchments; groundwater systems; water-dependent assets; and past, present and reasonably foreseeable coal mining and CSG developments.	Sections 3.0, 4.0 and 5.0
Describe the proposal's location, purpose, scale, duration, disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	Section 1.0 and Section 7.0
Describe the statutory context, including information on the proposal's status within the regulatory assessment process and any applicable water management policies or regulations	Section 2.0
Describe how impacted water resources are currently being regulated under state or Commonwealth law, including whether there are any applicable standard conditions.	Section 2.0
Assessment Item – Risk Assessment	
Identify and assess all potential environmental risks to water resources and water-related assets, and their possible impacts. In selecting a risk assessment approach consideration should be given to the complexity of the project, and the probability and potential consequences of risks.	Section 7.0 Section 7.5
Incorporate causal mechanisms and pathways identified in the risk assessment in conceptual and numerical modelling. Use the results of these models to update the risk assessment.	Section 5.15, 6.0, Appendix D and Section 7.5
Assess risks following the implementation of any proposed mitigation and management options to determine if these will reduce risks to an acceptable level based on the identified environmental objectives.	Section 7.5



Assessment Item – Description of Proposal	Section addressed in
The risk assessment should include an assessment of: - all potential cumulative impacts which could affect water resources and water-related assets, and - mitigation and management options which the proponent could implement to reduce these impacts.	Section 7.0 and 7.5 Section 8.0, and Appendix G
Assessment Item – Groundwater	
Context and Conceptualisation	
Describe and map geology at an appropriate level of horizontal and vertical resolution including: Definition of the geological sequence(s) in the area, with names and descriptions of the formations and accompanying surface geology, cross-sections and any relevant field data. Geological maps appropriately annotated with symbols that denote fault type, throw and the parts of sequences the faults intersect or displace.	Section 4.0
Provide data to demonstrate the varying depths to the hydrogeological units and associated standing water levels or potentiometric heads, including direction of groundwater flow, contour maps, and hydrographs. All boreholes used to provide this data should have been surveyed.	Section 4.0 and Section 5.10
Define and describe or characterise significant geological structures (e.g. faults, folds, intrusives) and associated fracturing in the area and their influence on groundwater – particularly groundwater flow, discharge or recharge. Site-specific studies (e.g. geophysical, coring/ wireline logging etc.) should give consideration to characterising and detailing the local stress regime and fault structure (e.g. damage zone size, open/closed along fault plane, presence of clay/shale smear, fault jogs or splays). Discussion on how this fits into the fault's potential influence on regional-scale groundwater conditions should also be included.	Section 4.3 and 5.11.3
Provide hydrochemical (e.g. acidity/alkalinity, electrical conductivity, metals, and major ions) and environmental tracer (e.g. stable isotopes of water, tritium, helium, strontium isotopes, etc.) characterisation to identify sources of water, recharge rates, transit times in aquifers, connectivity between geological units and groundwater discharge locations.	Section 5.10 and 5.12
Provide site-specific values for hydraulic parameters (e.g. vertical and horizontal hydraulic conductivity and specific yield or specific storage characteristics including the data from which these parameters were derived) for each relevant hydrogeological unit. In situ observations of these parameters should be sufficient to characterise the heterogeneity of these properties for modelling.	Section 5.11
Describe the likely recharge, discharge and flow pathways for all hydrogeological units likely to be impacted by the proposed development.	Section 5.10
Provide time series level and water quality data representative of seasonal and climatic cycles.	Section 5.10 and 5.12
Assess the frequency (and time lags if any), location, volume and direction of interactions between water resources, including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.	Section 5.10



Assessment Item – Description of Proposal	Section addressed in
Analytical and Numerical Modelling	
Provide a detailed description of all analytical and/or numerical models used, and any methods and evidence (e.g. expert opinion, analogue sites) employed in addition to modelling.	Section 6.0 and Appendix D
Provide an explanation of the model conceptualisation of the hydrogeological system or systems, including multiple conceptual models if appropriate. Key assumptions and model limitations and any consequences should also be described.	Section 5.15 and 5.10
Undertaken groundwater modelling in accordance with the <i>Australian Groundwater Modelling Guidelines</i> (Barnett et al. 2012), including independent peer review.	Section 6.0, Appendix D, and Appendix E
Consider a variety of boundary conditions across the model domain, including constant head or general head boundaries, river cells and drains, to enable a comparison of groundwater model outputs to seasonal field observations.	Section 6.0 and Appendix D
Calibrate models with adequate monitoring data, ideally with calibration targets related to model prediction (e.g. use baseflow calibration targets where predicting changes to baseflow).	Section 6.0 and Appendix D
Undertake sensitivity analysis and uncertainty analysis of boundary conditions and hydraulic and storage parameters, and justify the conditions applied in the final groundwater model (see Middlemis and Peeters 2018).	Section 6.0 and Appendix D
Describe each hydrogeological unit as incorporated in the groundwater model, including the thickness, storage and hydraulic characteristics, and linkages between units, if any.	Section 4.0, 5.10 and 5.11
Provide an assessment of the quality of, and risks and uncertainty inherent in, the data used to establish baseline conditions and in modelling, particularly with respect to predicted potential impact scenarios.	Section 5.8, 5.9, 6.8 and Appendix D
Describe the existing recharge/discharge pathways of the units and the changes that are predicted to occur upon commencement, throughout, and after completion of the proposed project.	Section 5.10 and 6.3 to 6.7
Undertake an uncertainty analysis of model construction, data, conceptualisation and predictions (see Middlemis and Peeters 2018).	Section 6.8 and Appendix D
Describe the various stages of the proposed project (construction, operation and rehabilitation) and their incorporation into the groundwater model. Provide predictions of water level and/or pressure declines and recovery in each hydrogeological unit for the life of the project and beyond, including surface contour maps for all hydrogeological units.	Section 6.0 and Appendix D
Provide a program for review and update of models as more data and information become available, including reporting requirements.	Section 8.1.6 (and Appendix G)
Identify the volumes of water predicted to be taken annually with an indication of the proportion supplied from each hydrogeological unit.	Sections 6.3, 6.5.1, and 6.7.4
Provide information on the magnitude and time for maximum drawdown and post-development drawdown equilibrium to be reached.	Sections 6.4 and 6.7.5.2
Undertake model verification with past and/or existing site monitoring data.	Section 6.0 and Appendix D



Assessment Item – Description of Proposal	Section addressed in
Impacts to Water Resources and Water-Dependent Assets	
Provide an assessment of the potential impacts of the proposal, including how impacts are predicted to change over time and any residual long-term impacts. Consider and describe: - any hydrogeological units that will be directly or indirectly dewatered or depressurised, including the extent of impact on hydrological interactions between water resources, surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water. - the effects of dewatering and depressurisation (including lateral effects) on water resources, water-dependent assets, groundwater, flow direction and surface topography, including resultant impacts on the groundwater balance. - the potential impacts on hydraulic and storage properties of hydrogeological units, including changes in storage, potential for physical transmission of water within and between units, and estimates of likelihood of leakage of contaminants through hydrogeological units. - the possible fracturing of and other damage to confining layers. For each relevant hydrogeological unit, the proportional increase in groundwater use and impacts as a consequence of the proposed project, including an assessment of any consequential increase in demand for groundwater from towns or other industries resulting from associated population or economic growth due to the proposal.	Section 7.0 and Appendix D
Describe the water resources and water-dependent assets that will be directly impacted by mining or CSG operations, including hydrogeological units that will be exposed/partially removed by open cut mining and/or underground mining.	Section 5.10, 5.13, 5.14 and 7.0
For each potentially impacted water resource, provide a clear description of the impact to the resource, the resultant impact to any water-dependent assets dependent on the resource, and the consequence or significance of the impact.	Section 5.10, 5.13, 5.14 and 7.0
Describe existing water quality guidelines, environmental flow objectives and other requirements (e.g. water planning rules) for the groundwater basin(s) within which the development proposal is based.	Section 2.0 and 5.12.3
Provide an assessment of the cumulative impact of the proposal on groundwater when all developments (past, present and/or reasonably foreseeable) are considered in combination.	Section 6.6
Describe proposed mitigation and management actions for each significant impact identified, including any proposed mitigation or offset measures for long-term impacts post mining.	Section 8.0 (and Appendix G)
Provide a description and assessment of the adequacy of proposed measures to prevent/minimise impacts on water resources and water-dependent assets.	Section 8.0 (and Appendix G)
Data and Monitoring	
Provide sufficient data on physical aquifer parameters and hydrogeochemistry to establish pre-development conditions, including fluctuations in groundwater levels at time intervals relevant to aquifer processes.	Section 5.10, 5.11 and 5.12
Provide long-term groundwater monitoring data, including a comprehensive assessment of all relevant chemical parameters to inform changes in groundwater quality and detect potential contamination events.	Section 5.12



Assessment Item – Description of Proposal	Section addressed in
Develop and describe a robust groundwater monitoring program using dedicated groundwater monitoring wells – including nested arrays where there may be connectivity between hydrogeological units – and targeting specific aquifers, providing an understanding of the groundwater regime, recharge and discharge processes and identifying changes over time.	Section 5.1, 8.1 and Appendix G
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy (NWQMS) guidelines (ANZG 2018) and relevant legislated state protocols (e.g. QLD Government 2013).	Section 8.1 (and Appendix G)
Develop and describe proposed targeted field programs to address key areas of uncertainty, such as the hydraulic connectivity between geological formations, the sources of groundwater sustaining GDEs, the hydraulic properties of significant faults, fracture networks and aquitards in the impacted system, etc., where appropriate.	Section 5.1, 8.2 and 3D Environmental (2023)
Assessment Item – Water-dependent assets	
Context and conceptualisation	
Identify water-dependent assets, including: water-dependent fauna and flora and provide surveys of habitat, flora and fauna (including stygofauna) (see Doody et al. 2019). Public health, recreation, amenity, Indigenous, tourism or agricultural values for each water resource.	Sections 5.12.3, 5.13 and 5.14
Estimate the ecological water requirements of identified GDEs and other water-dependent assets (see Doody et al. 2019).	Section 5.14 and 3D Environmental (2023)
Identify the hydrogeological units on which any identified GDEs are dependent (see Doody et al. 2019).	Section 5.14.1 and 3D Environmental (2023)
Identify GDEs in accordance with the method outlined by Eamus et al. (2006). Information from the GDE Toolbox (Richardson et al. 2011) and GDE Atlas (CoA 2017a) may assist in identification of GDEs (see Doody et al. 2019).	Section 5.14 and 3D Environmental (2023)
Provide an outline of the water-dependent assets and associated environmental objectives and the modelling approach to assess impacts to the assets.	Sections 5.13 and 5.14 6.0
Describe the conceptualisation and rationale for likely water-dependence, impact pathways, tolerance and resilience of water-dependent assets. Examples of ecological conceptual models can be found in Commonwealth of Australia (2015).	Section 5.14 and 3D Environmental (2023)
Describe the process employed to determine water quality and quantity triggers and impact thresholds for water-dependent assets (e.g. threshold at which a significant impact on an asset may occur).	Section 8.0 (and Appendix G)
Impacts, risk assessment and management of risks	
Provide an assessment of direct and indirect impacts on water-dependent assets, including ecological assets such as flora and fauna dependent on surface water and groundwater, springs and other GDEs (see Doody et al. 2019).	Section 5.14 and 7.0
Provide estimates of the volume, beneficial uses and impact of operational discharges of water (particularly saline water), including potential emergency discharges due to unusual events, on water-dependent assets and ecological processes.	Refer to WRM (2023)



Assessment Item – Description of Proposal	Section addressed in
Describe the potential range of drawdown at each affected bore, and clearly articulate of the scale of impacts to other water users.	Section 7.1.1
Assess the overall level of risk to water-dependent assets through combining probability of occurrence with severity of impact.	Section 7.5
Indicate the vulnerability to contamination (e.g. from salt production and salinity) and the likely impacts of contamination on the identified water-dependent assets and ecological processes.	Refer to WRM (2023)
Identify the proposed acceptable level of impact for each water-dependent asset based on leading-practice science and site-specific data, and ideally developed in conjunction with stakeholders.	Section 7.0 and 3D Environmental (2023)
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion and habitat fragmentation of water-dependent species and communities.	Refer to WRM (2023)
Propose mitigation actions for each identified impact, including a description of the adequacy of the proposed measures and how these will be assessed.	Section 8.0 (and Appendix G)
Data and Monitoring	
Identify an appropriate sampling frequency and spatial coverage of monitoring sites to establish pre-development (baseline) conditions, and test potential responses to impacts of the proposal (see Doody et al. 2019).	Section 5.7 and 5.8 Section 8.1 (and Appendix G), and Section 8.2
Develop and describe a monitoring program that identifies impacts, evaluates the effectiveness of impact prevention or mitigation strategies, measures trends in ecological responses and detects whether ecological responses are within identified thresholds of acceptable change (see Doody et al. 2019).	Section 8.0 (and Appendix G) and 3D Environmental (2023)
Consider concurrent baseline monitoring from unimpacted control and reference sites to distinguish impacts from background variation in the region (e.g. BACI design, see Doody et al. 2019).	Section 5.7 and 5.8 Section 8.1 (and Appendix G) Section 8.2 and 3D Environmental (2023)
Describe the proposed process for regular reporting, review and revisions to the monitoring program.	Section 8.1.6 (and Appendix G) Section 8.2 and 3D Environmental (2023)
Ensure ecological monitoring complies with relevant state or national monitoring guidelines (e.g. the DSITI guideline for sampling stygofauna (QLD Government 2015)).	Refer to 3D Environmental (2023) and frc environmental (2023)
Assessment Item – Cumulative Impacts	
Context and conceptualisation	
Provide cumulative impact analysis with sufficient geographic and temporal boundaries to include all potentially significant water-related impacts.	Section 6.6 and Appendix D



Assessment Item – Description of Proposal	Section addressed in
Consider all past, present and reasonably foreseeable actions, including development proposals, programs and policies that are likely to impact on the water resources of concern in the cumulative impact analysis. Where a proposed project is located within the area of a bioregional assessment consider the results of the bioregional assessment.	Section 6.6 and Appendix D
Impacts	
Provide an assessment of the condition of affected water resources which includes: • identification of all water resources likely to be cumulatively impacted by the proposed development • a description of the current condition and quality of water resources and information on condition trends • identification of ecological characteristics, processes, conditions, trends and values of water resources • adequate water and salt balances, and • identification of potential thresholds for each water resource and its likely response to change and capacity to withstand adverse impacts (e.g. altered water quality, drawdown).	Section 5.10 Section 5.12 Section 5.14 Section 8.1.4 (and Appendix G) Section 8.2 and 3D Environmental (2023)
Assess the cumulative impacts to water resources considering: • the full extent of potential impacts from the proposed project, (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts), and encompassing all linkages, including both direct and indirect links, operating upstream, downstream, vertically and laterally • all stages of the development, including exploration, operations and post closure/decommissioning • appropriately robust, repeatable and transparent methods • the likely spatial magnitude and timeframe over which impacts will occur, and significance of cumulative impacts, and opportunities to work with other water users to avoid, minimise or mitigate potential cumulative impacts.	Section 6.0 and Appendix D
Mitigation, monitoring and management	
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts. Evidence of the likely success of these measures (e.g. case studies) should be provided.	Section 8.0 (and Appendix G)
Identify cumulative impact environmental objectives.	Section 8.0 (and Appendix G)
Identify measures to detect and monitor cumulative impacts, pre and post development, and assess the success of mitigation strategies.	Section 8.0 (and Appendix G)
Describe appropriate reporting mechanisms.	Section 8.0 (and Appendix G)
Propose adaptive management measures and management responses.	Section 8.0 (and Appendix G)
Assessment Item – Final landform and voids – coal mines	
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface	Addressed elsewhere in PER



Assessment Item – Description of Proposal	Section addressed in
water flow, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.	
Assess the adequacy of modelling, including surface water and groundwater quantity and quality, lake behaviour, timeframes and calibration.	Section 6.2.4 and Appendix D
Provide an evaluation of stability of void slopes where failure during extreme events or over the long term (for example due to aquifer recovery causing geological heave and landform failure) may have implications for water quality.	Addressed elsewhere in PER
Provide an assessment of the long-term impacts to water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider: - groundwater behaviour – sink or lateral flow from void. - water level recovery – rate, depth, and stabilisation point (e.g. timeframe and level in relation to existing groundwater level, surface elevation). - seepage – geochemistry and potential impacts. - long-term water quality, including salinity, pH, metals and toxicity. - measures to prevent migration of void water off-site. For other final landform options considered sufficient detail of potential impacts should be provided to clearly justify the proposed option.	Section 6.7 and Appendix D Water quality addressed in WRM (2023)
Evaluate mitigating inflows of saline groundwater by planning for partial backfilling of final voids.	Addressed elsewhere in PER
Assess the probability of overtopping of final voids with variable climate extremes, and management mitigations.	Refer to WRM (2023)
Assessment Item – Acid-forming materials and other contaminants of concern	
Identify the presence and potential exposure of acid-sulphate soils (including oxidation from groundwater drawdown).	Addressed elsewhere in PER
Describe handling and storage plans for acid-forming material (co-disposal, tailings dam, and encapsulation).	Addressed elsewhere in PER
Identify the presence and volume of potentially acid-forming waste rock, fine-grained amorphous sulphide minerals and coal reject/tailings material and exposure pathways.	Addressed elsewhere in PER
Assess the potential impact to water-dependent assets, taking into account dilution factors, and including solute transport modelling where relevant, representative and statistically valid sampling, and appropriate analytical techniques.	Section 6.7.7 Section 7.3
Identify other sources of contaminants, such as high metal concentrations in groundwater, leachate generation potential and seepage paths.	Section 7.3
Describe proposed measures to prevent/minimise impacts on water resources, water users and water-dependent ecosystems and species.	Section 7.3 Section 8.0 (and Appendix G) Section 8.2 and 3D Environmental (2023)



3.0 Existing Environment

3.1 Climate

Historical climate data was obtained for the period January 1900 to March 2023 from the Scientific Information for Land Owners (SILO) database (Queensland Government, 2023) for the grid point closest to the Project Area (latitude -21.5, longitude 148.15) (**Table 3-1**). The SILO database provides the most comprehensive long-term dataset and is therefore the most useful for assessing long term rainfall and evaporation trends in the vicinity of the Project. The total average annual rainfall is 629 mm, with higher rainfall occurring over the summer months, from December to March. Evaporation exceeds rainfall in all months of the year, with the average annual evaporation of 1,935 mm exceeding average annual rainfall by over three times.

Table 3-1 Total Monthly Rainfall, Evaporation and Evapotranspiration (January 1900 to March 2023)

Average Total Monthly	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)	123	112	75	32	29	30	25	19	13	28	55	86	629
Evaporation (class A Pan) (mm)	203	167	172	139	113	92	102	129	168	209	216	224	1,935
Evapotranspiration (Moretons areal actual) (mm)	153	138	138	101	72	50	58	81	106	130	141	151	1,318

In order to place rainfall over the years into an historical context, cumulative rainfall departure (CRD) was calculated for the full data period (**Figure 3-2**). This is a summation of the monthly departures of rainfall from the long-term average monthly rainfall. A rising slope in the CRD plot indicates periods of rainfall above the long-term average, as is the case from January 2016 to June 2017, whereas a falling slope indicates periods when rainfall is below the long term average (e.g. June 2017 to May 2021). Rainfall volumes over the more recent period of the record (i.e. May 2021 to March 2023) have been higher than average, as is indicated by the rising slope in the CRD (**Figure 3-2**).





Figure 3-1 Average Monthly Evaporation, Evapotranspiration, Rainfall and Temperature (January 1900 to March 2023)



Figure 3-2 Cumulative Rainfall Departure and Total Monthly Rainfall



3.2 Topography and Drainage

The topography of the Project Area broadly slopes gently downward to the southeast towards the Isaac River, with elevations ranging from approximately 400 m above Australian Height Datum (mAHD) in the northwest to approximately 300 to 320 mAHD along the Isaac River. The Project Area is surrounded by escarpments, with elevations to the southwest (Burton Range) and east (Kerlong Range) rising to approximately 500 m AHD, and rising to 600 m AHD (Denham Range) to the north (**Figure 3-3**).

Three ephemeral watercourses traverse the Project Area:

- Isaac River: the primary watercourse, flows south through the eastern portion of the Project Area.
- Hill Creek: a tributary of the Isaac River, traverses the northern portion of the Project Area flowing eastward and joins the Isaac River at the northern boundary.
- Ti-Tree Creek: flows southeast merging with the Isaac River south of the Project Area. It is proposed to divert Ti-Tree Creek around the open cut mine pit workings.

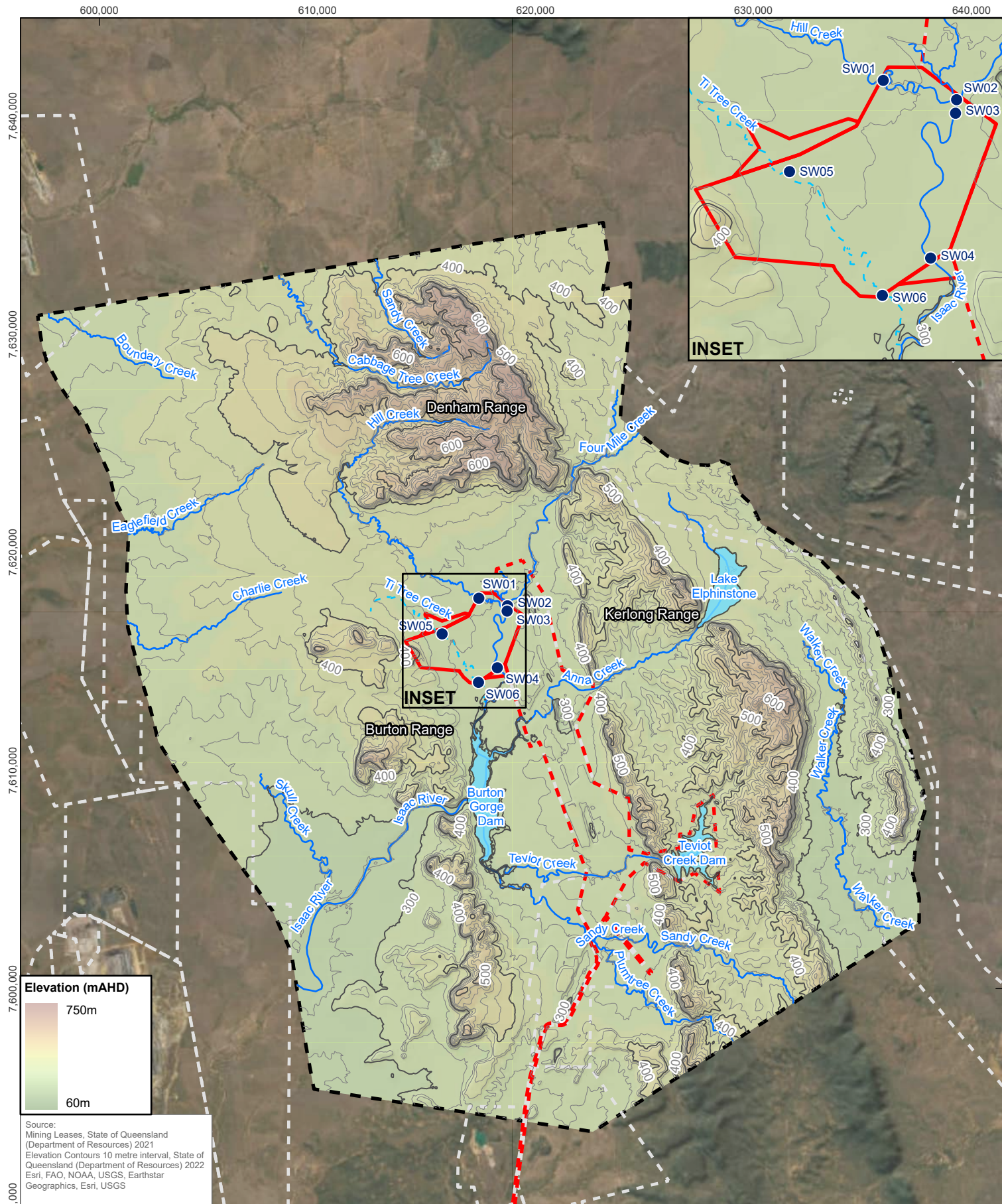
Surface water loggers installed into Hill Creek, Isaac River and Ti-Tree Creek show that these watercourses are mostly dry with surface water flow only sustained for hours to several days following rainfall events (**Figure 3-4** to **Figure 3-6**).

The headwaters of the Isaac River Catchment are located approximately 9 km to the north-northeast of the Project Area. This relatively small catchment area upstream of the Project Area results in Isaac River flows through the Project Area that typically only occur following heavy rainfall and which recede rapidly. The infrequency and temporal nature of observed surface flow in the Isaac River reported during Project fieldwork suggests that there is no groundwater baseflow to the Isaac River, either onsite, associated with onsite tributaries (Hill Creek and Ti-Tree Creek) or from upstream sources within the catchment area. Further discussion on the relationship between shallow groundwater and the Isaac River is provided in **Section 5.10.4**.

Located south of the Project Area and within the Burton Mining Lease (ML 70109), Anna Creek is an ephemeral watercourse and minor tributary of the Isaac River. Anna Creek flows south-easterly from Lake Elphinstone and has been diverted around mine infrastructure at the Burton Mine.

Burton Gorge Dam is situated on the Isaac River immediately east of the Burton Range, approximately 3.5 km south (downstream) of the Project Area where it joins downstream of Anna Creek, Teviot Creek and Sandy Creek (refer **Figure 3-7**). Daily water level elevation from the Burton Gorge Dam between 2017 to 2023 shows the water level in the dam to range between 292.9 and 301.7 mAHD with an average level of 295.4 mAHD (**Figure 3-3**).





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:230,000 at A4

Project Number: 620.31367.00000

Date Drawn: 22-Dec-2023

Drawn by: RB



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LEGEND

- Surface Water Sampling Location
- Major Watercourse
- - - Non-designated Watercourse
- Topographic Contour (100mAHD)
- Topographic Contour (20mAHD)
- Project Area (ML 70337, ML 700053 and ML 700054)
- - - Burton Mining Lease (ML 70109)
- Mining Lease
- Study Area (Model Domain)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

GROUNDWATER STUDY AREA TOPOGRAPHY AND DRAINAGE

FIGURE 3-3

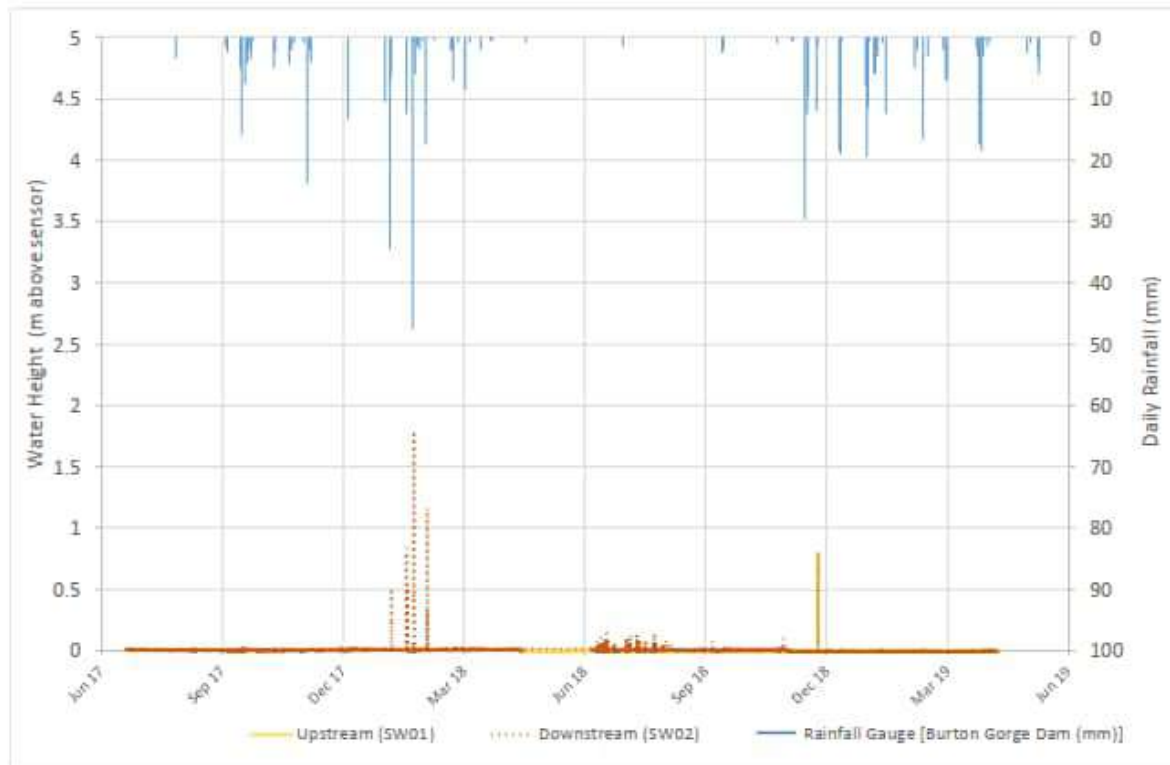


Figure 3-4 Surface water logger data Hill Creek (GHD, 2019)

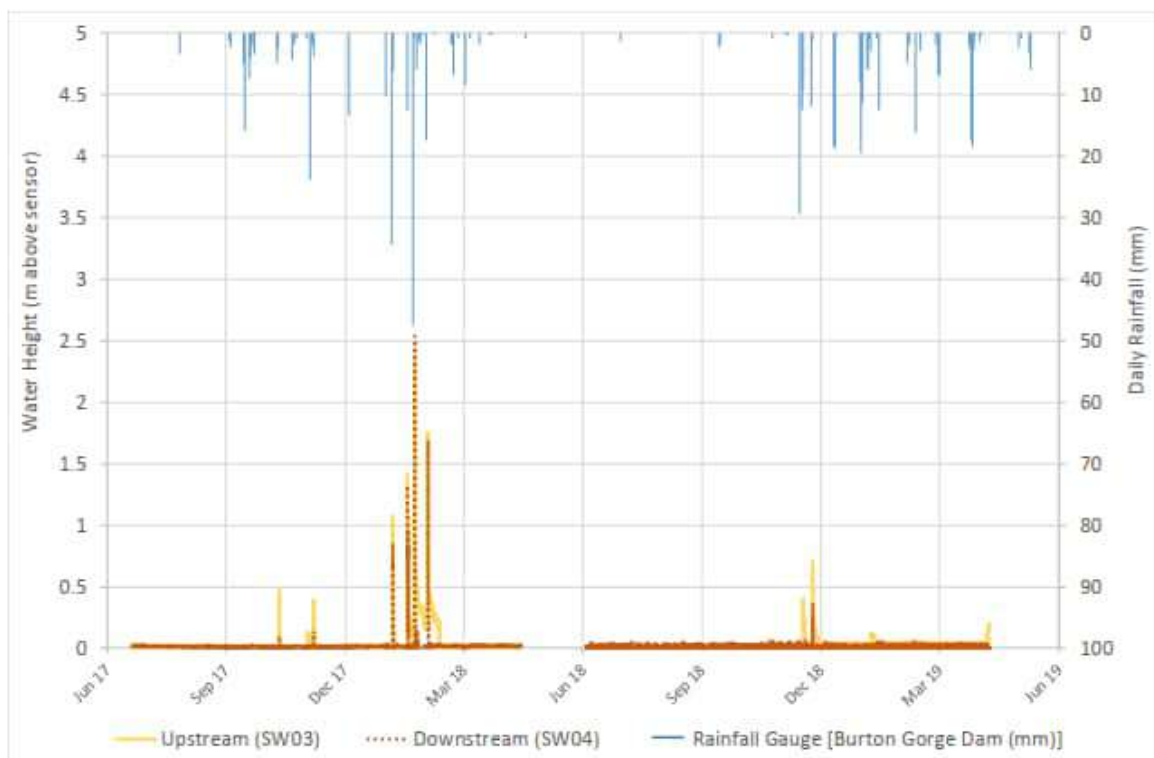


Figure 3-5 Surface water logger data Isaac River (GHD, 2019)



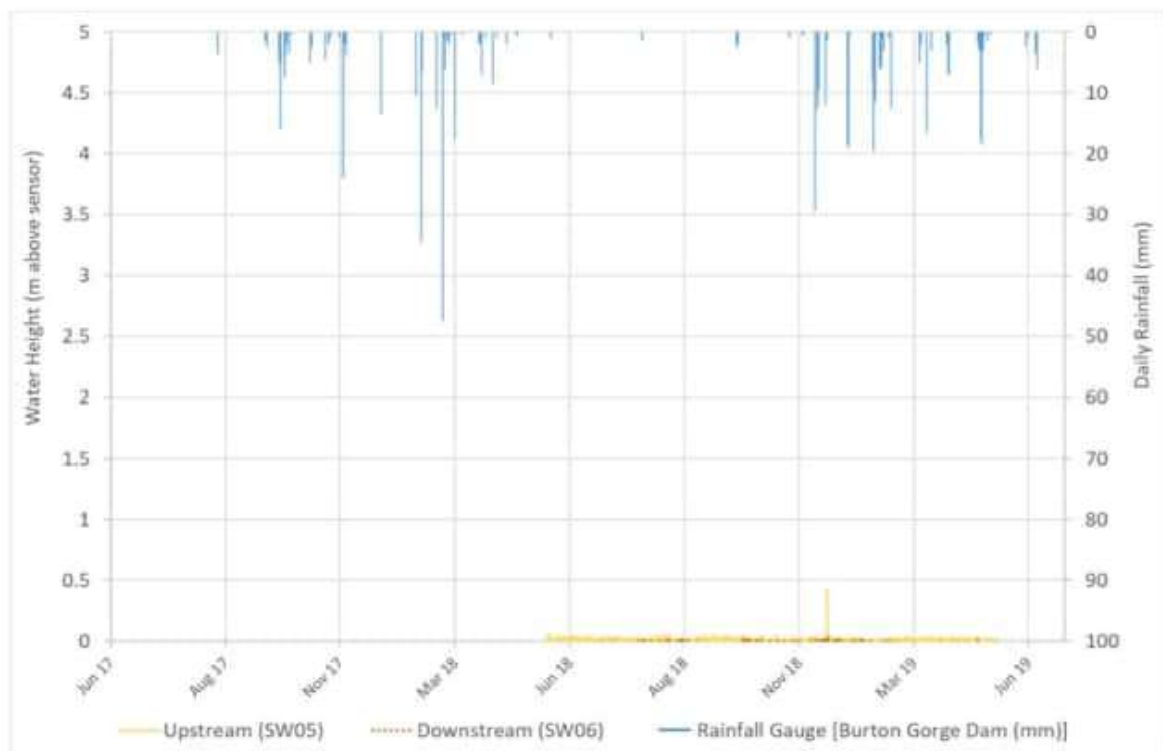


Figure 3-6 Surface water logger data Ti-Tree Creek (GHD, 2019)



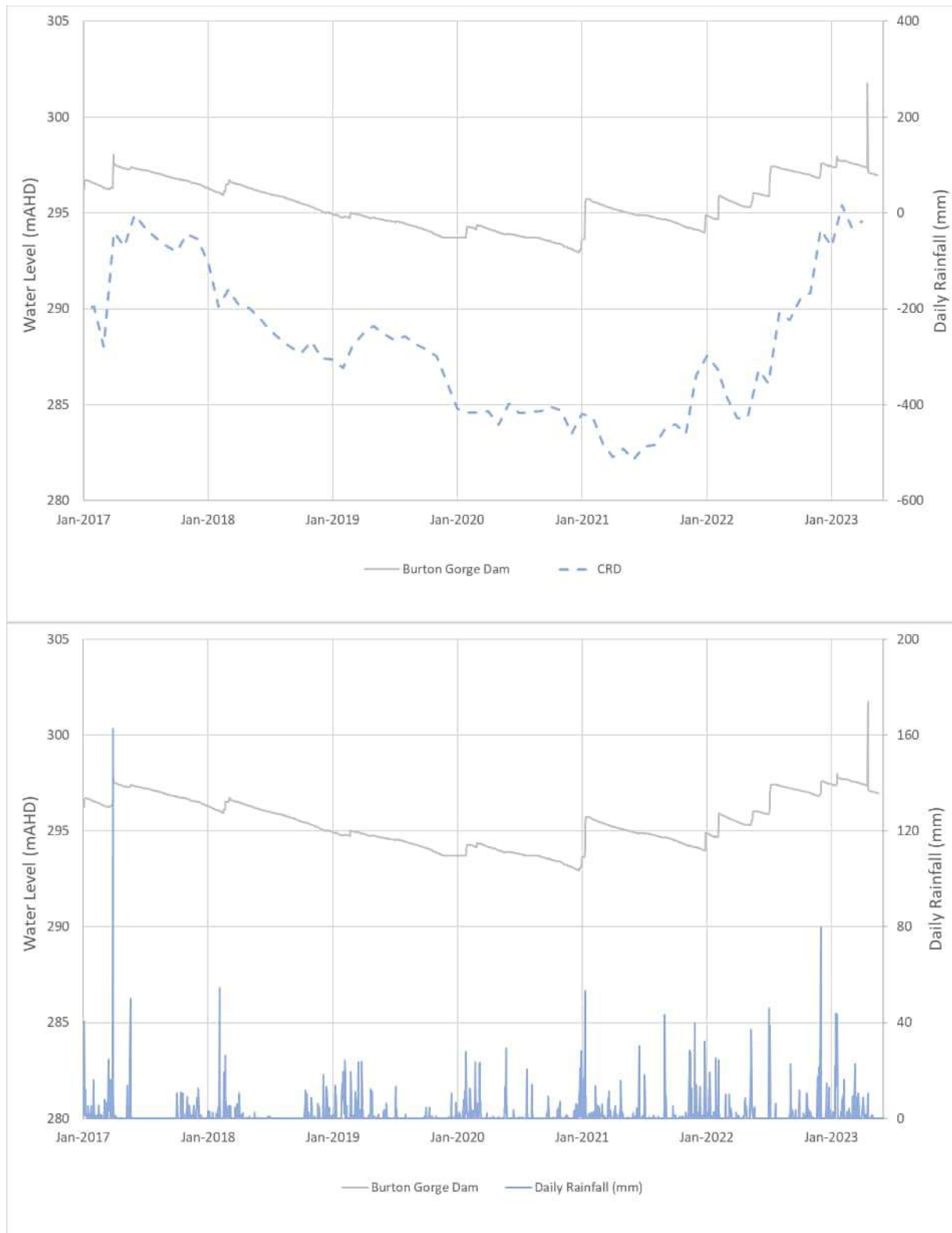


Figure 3-7 Water Level Elevation at Burton Gorge Dam compared to Rainfall



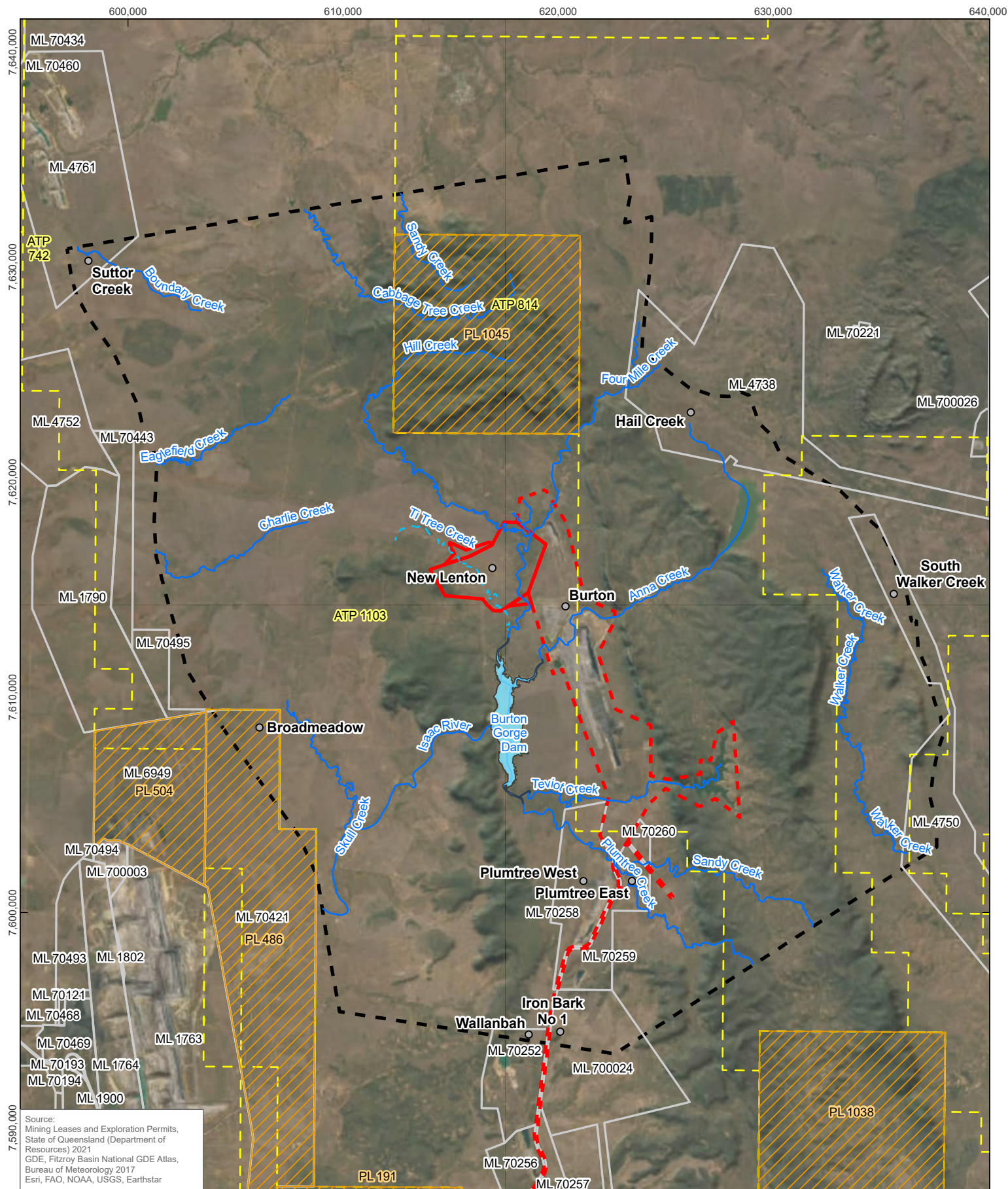
3.3 Land Use and Mining

Primary agricultural land use in the Project Area is cattle grazing, with most of the land within the Project Area and surrounding Study Area showing signs of historical and recent vegetation clearing assumed to be for this purpose (GHD, 2019). There are also several proposed and active coal mining operations in the Study Area. **Table 3-2** summarises the nearby resource extraction operations.

Table 3-2 Proposed and current resource operations in the Study Area

Operation	Status	Type	Planned Start	Estimated End	Distance from Project	Target Coal Resource	Lease
Burton	Operating	Open-cut	1998		Adjoining east and southeast	Rangal Coal Measures	ML70109, ML70260
Plumtree West	Care and Maintenance	Open-cut	2004	2022	10.2 km south	Rangal Coal Measures	ML70258
Plumtree East	Care and Maintenance	Open-cut	2004	2022	12.5 km south	Rangal Coal Measures	ML70259
Hail Creek	Operating	Open-cut	1971	2031	Mining operations 24 km northeast	Rangal and Fort Cooper Coal Measures	ML4738
Sutor Creek	Operating	Open-cut	1990	2032	21 km northeast	Rangal Coal Measures	ML4761
South Walker Creek	Operating	Open-cut	1974	2040	Mining operations 25 km southeast	Rangal Coal Measures	ML4750
Red Hill Expansion	Operating	Underground	2016	2037	9.5 km southwest	Moranbah Coal Measures	ML70421
Wallanbah	Care and Maintenance	Open-cut	2004	2022	19 km southwest	Rangal Coal Measures	ML70252
Iron Bark No 1	Operating	Underground	2017	2043	19 km southwest	Rangal Coal Measures	ML700024
Bowen Gas Project	Planned	Coal Seam Gas	2030		9.5 km southwest		PL486 and ATP1103
Eureka Petroleum	Planned	Coal Seam Gas	2025	2044	4 km north	Rangal and Fort Cooper Coal Measures	PLA1045





Source:
Mining Leases and Exploration Permits,
State of Queensland (Department of
Resources) 2021
GDE, Fitzroy Basin National GDE Atlas,
Bureau of Meteorology 2017
Esri, FAO, NOAA, USGS, Earthstar

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:230,000 at A4
Project Number: 620.31367.00000
Date Drawn: 22-Dec-2023
Drawn by: RB

LEGEND

- Coal Mine
- Major Watercourse
- - - Non-designated Watercourse
- Project Area (ML 70337, ML 700053 and ML 700054)
- Burton Mining Lease (ML 70109)

- Study Area (Model Domain)
- Mining Lease
- Exploration Permit for Petroleum
- Petroleum Lease

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PROPOSED AND CURRENT RESOURCE OPERATIONS IN THE STUDY AREA



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FIGURE 3-8

4.0 Geology

4.1 Regional Geology

The Project Area is located in the Bowen Basin, a basin spanning an extent of approximately 200,000 km² and is one of five major foreland sedimentary basins formed along the eastern side of Australia during the Permian period. The Bowen Basin extends in a north to south direction from Townsville, Queensland at its northern extent to Moree, New South Wales at its southern extent. In the southern parts, the extent of the Bowen Basin and the Great Artesian Basin (GAB) overlap (Geoscience Australia, 2017). The Study Area is located along the south-western section of the Nebo Synclinorium in the northern part of the Bowen Basin (GHD, 2019). The general stratigraphic sequence in the Bowen Basin in the vicinity of the Project Area is shown in **Table 4-1**. Surface geological mapping is presented in **Figure 4-2** and solid geological mapping is presented in **Figure 4-2**.

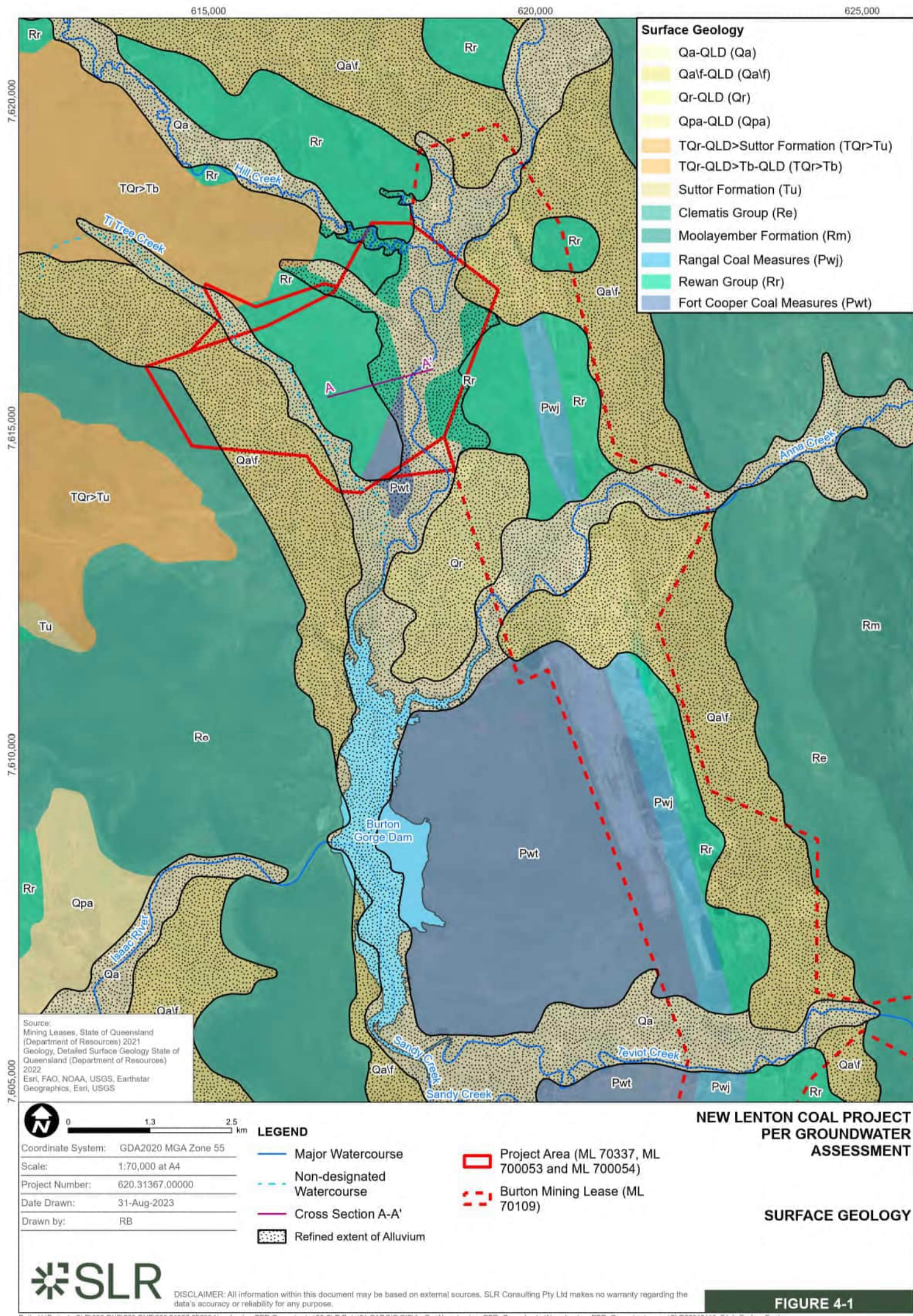
Table 4-1 General stratigraphic sequence in the Bowen Basin relevant to the Project Area

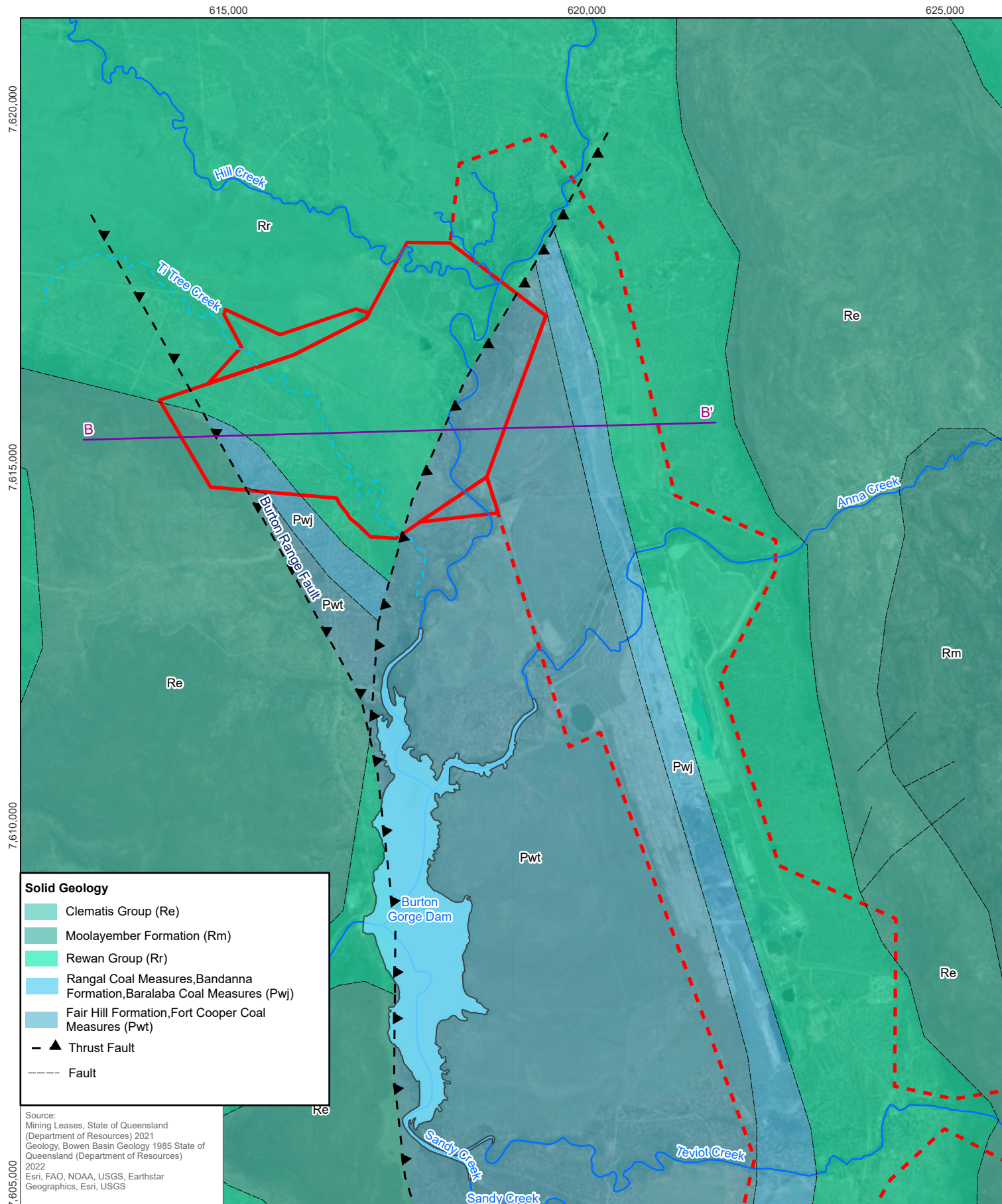
Period	Stratigraphic Unit		Map Code	Lithological Description	Thickness (m) (GHD, 2019, SLR, 2020b)
Quaternary	Quaternary (Isaac River) Alluvium		Qa	Clay, silt, sand, and gravel; flood-plain alluvium and alluvial fans	0 to 20
	Colluvial deposits		Qr, Qa/f	Clay, silt, sand, gravel, and soil; colluvial and residual deposits	0 to 20
			TQr	Clay, silt, sand, gravel, and soil; colluvial and residual deposits (generally on older land surfaces)	0 to 20
Tertiary	Suttor Formation		Tu	Quartz sandstone, clayey sandstone, mudstone, and conglomerate; fluvial and lacustrine sediments; minor interbedded basalt.	0 to 50
	Duaringa Formation		Tb	Mudstone, sandstone, conglomerate, siltstone, oil shale, lignite & basalt	0 to 50
Triassic	Mimosa Group	Moolayember Formation	Rm	Micaceous lithic sandstone, micaceous siltstone	Unknown
		Clematis Group	Re	Cross-bedded quartz sandstone, some quartz conglomerate and minor red-brown mudstone.	Unknown
		Rewan Group	Rr	Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanolithic pebble conglomerate (at base). Sandstone mudstone & minor conglomerate (at base).	0 to 1,570 (average 440)



Period	Stratigraphic Unit		Map Code	Lithological Description	Thickness (m) (GHD, 2019, SLR, 2020b)
Permian	Blackwater Group	Rangal Coal Measures	Pwj	Calcareous sandstone, calcareous shale, mudstone, and concretionary limestone including the following coal seams: - Burton Rider; - Leichhardt; and - Vermont.	20 to 70 Burton Rider - 2 Leichhardt and Vermont - 8
		Fort Cooper Coal Measures, Fair Hill Formation	Pwt	Lithic sandstone, conglomerate, mudstone, carbonaceous shale, coal, tuff, tuffaceous (cherty) mudstone.	30 to 60
		Moranbah Coal Measures	Pwb	Labile sandstone, siltstone, mudstone, coal, conglomerate in the east	Unknown
	Back Creek Group		Pb	Quartzose to lithic sandstone, siltstone, carbonaceous shale, minor coal and sandy coquinite	Unknown







Solid Geology

- Clematis Group (Re)
- Moolayember Formation (Rm)
- Rewan Group (Rr)
- Rangal Coal Measures, Bandanna Formation, Baralaba Coal Measures (Pwj)
- Fair Hill Formation, Fort Cooper Coal Measures (Pwt)
- ▲ Thrust Fault
- Fault

Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Geology, Bowen Basin Geology 1985 State of
Queensland (Department of Resources)
2022
Esri, FAO, NOAA, USGS, Earthstar
Geographics, Esri, USGS

0 1.3 2.5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:70,000 at A4

Project Number: 620.31367.00000

Date Drawn: 21-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- Cross Section B-B'
- Project Area (ML 70337, ML 700053 and ML 700054)
- Burton Mining Lease (ML 70109)

**NEW LENTON COAL PROJECT
PER GROUNDWATER
ASSESSMENT**

SOLID GEOLOGY



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FIGURE 4-2

4.2 Local Geology

The surficial geology and underlying solid geology in the vicinity of the Project Area is shown in **Figure 4-1** and **Figure 4-2**, respectively. The local geology (and hydrogeology) can be divided into three main units:

- the Quaternary to Tertiary sediments (including alluvium) and weathered horizons (regolith);
- Rewan group; and
- the Permian coal measures bedrock.

In addition, minor and isolated areas of Tertiary Basalt also occur.

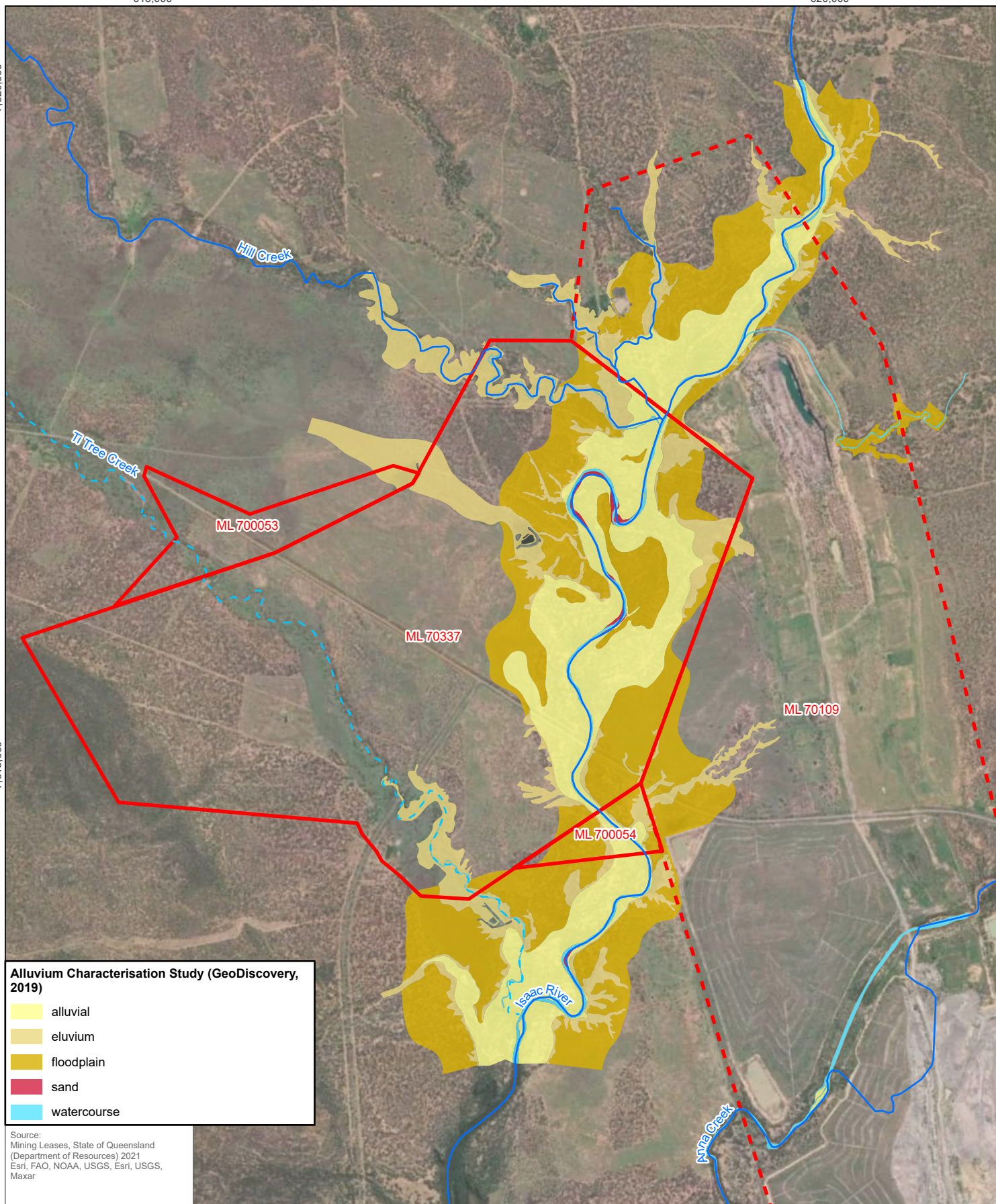
4.2.1 Quaternary to Tertiary Sediments and Regolith

Regional geological mapping shows that alluvium is localised along river channels (**Figure 4-1**). Quaternary floodplain alluvium associated with surface watercourses is comprised of clay, silt, sand, and gravel sediments. The thickness of the alluvium is greater close to the Isaac River channel and decreases with distance from the river. Borehole logs from targeted investigation drilling indicate that along the floodplain of the Isaac River and its tributaries, alluvium thickness ranges from less than 10 m up to 21 m (SLR, 2020b). From bores drilled in the Isaac River Alluvium and from hand auguring investigations (3D Environmental, 2023), it is observed that there is significant lithological heterogeneity in the alluvium with adjacent bores exhibiting variations in lithology with depth (SLR, 2020c). The lithology of these deposits are described as clay, sandy clay, clayey sand, sand, gravelly sand and gravel.

An electromagnetic (EM) survey was conducted by GeoDiscovery (2019) to further assist in characterising the alluvium, and in particular its textural heterogeneity. The transects were aligned with existing drilling data to aid in verifying the geophysical data. This EM survey showed that the majority of the near surface (0 – 20m depth) horizon identified as alluvium in surface mapping is of low to moderate resistivity, indicating a dominance of clay and weathered sediments over sand and gravel deposits. Only some areas close to the riverbed or within the meander belt show high resistivity indicating a dominance of sand and gravel deposits. These results are interpreted to indicate that the area mapped as ‘alluvium’ in State regional surface geology mapping is highly heterogenous, with the coarser grained alluvial sediments (that might form an aquifer) not as widespread as surface geology mapping suggests. On the basis of the assessment, it is apparent that mapped alluvial deposits are dominated by clay-based sediments with low hydraulic conductivity. The presence of higher hydraulic conductivity sediments only in the immediate proximity of the Isaac River channel is supported by hand auguring investigations at the Project along the Isaac River channel and its tributaries which showed the dominant lithologies to be fine to medium sand, coarse sand and clayey sand. The site mapped alluvium textural distribution as a result of the (EM) survey conducted by GeoDiscovery (2019) is shown in **Figure 4-3**. The revised modelled extent of the alluvium based on the site mapping is shown in **Figure 4-1**.

The regolith in the Project Area is mainly comprised of shallow Tertiary to Quaternary age colluvium and residual soils, derived from weathered underlying Triassic and Permian bedrock strata. The depth of weathering is variable across the Project Area ranging from 10 m to 50 mBGL, with an average of approximately 25 mBGL. The thickness and extent of the regolith material is presented in **Figure 4-4** is interpolated based on Project Area geological data and regional geology mapping.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:37,500 at A4

Project Number: 620.31367.00000

Date Drawn: 14-Nov-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- Project Area (ML 70337, ML 700053 and ML 700054)
- Burton Mining Lease (ML 70109)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

ALLUVIUM CHARACTERISATION MAPPING AS RESULT OF EM SURVEY BY GEODISCOVERY (2019)



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FIGURE 4-3

4.2.2 Basalt

Tertiary age basalt flows outcrop to the north-west of the Project within the broader Study Area. According to drillhole data, the Tertiary basalts include fresh, fractured and weathered layers with a thickness of up to 40m. Due to its limited and isolated occurrences within the vicinity of the Project, the Tertiary basalt has not been identified as a geologic unit of significance to the Project and its limited distribution in the northwest of the Study Area, outside the Project Area, suggests it is not a key regional geologic unit. The thickness and extent of surficial material which includes the basalt is presented in **Figure 4-4**.

4.2.3 Triassic age strata

Triassic age strata within and adjacent the Project Area consists of the Moolayember Formation, Clematis Group, and the Rewan Formation. The Moolayember Formation consists of micaceous lithic sandstone and micaceous siltstone and conformably overlies the Clematis Group. The Clematis Group comprises medium to coarse-grained cross bedded quartzose to sublabile micaceous sandstone, siltstone, mudstone and granule to pebble conglomerate. The Clematis Group conformably overlies the Rewan Formation.

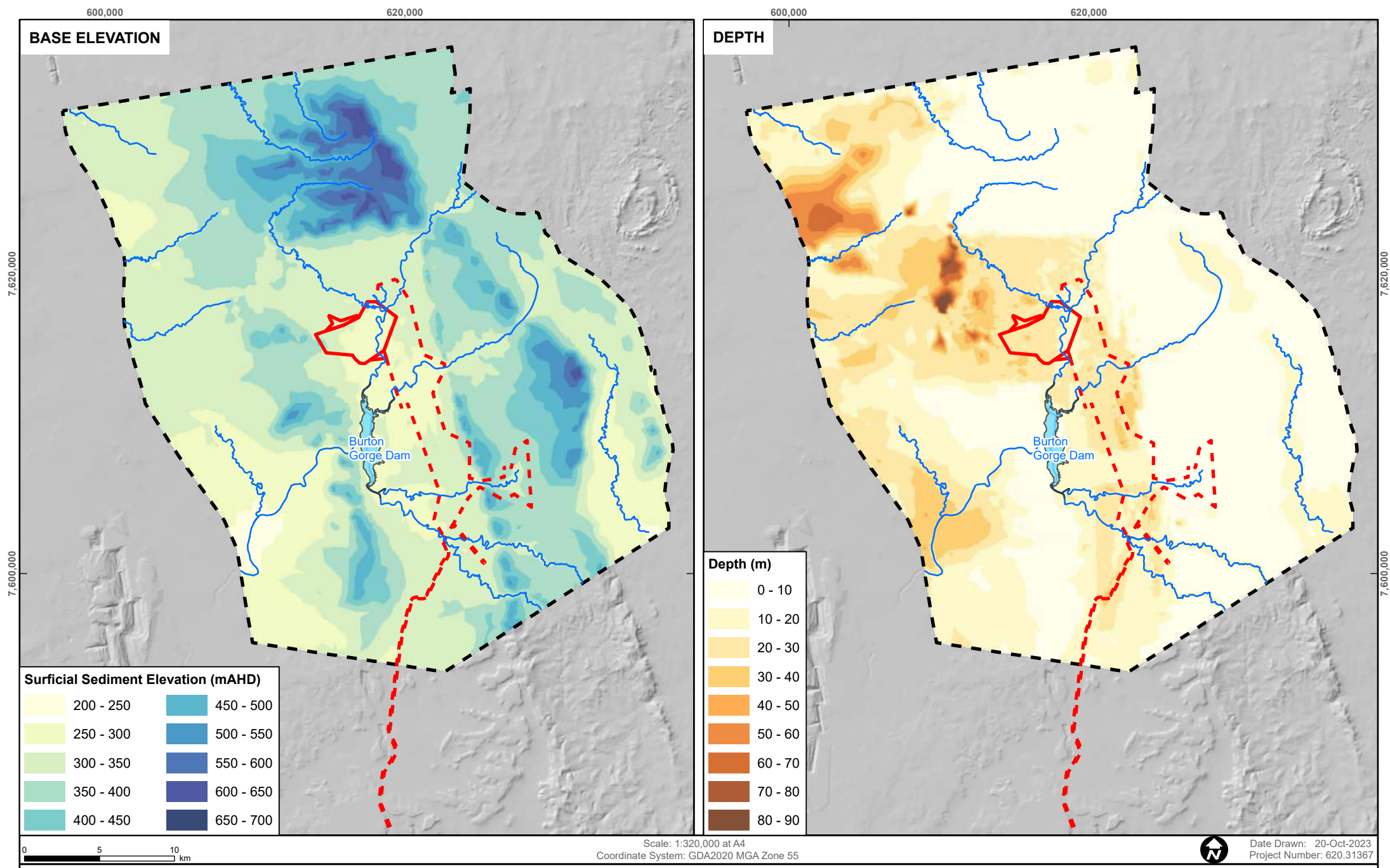
Both the Moolayember Formation and Clematis Group have been significantly eroded within the Project Area, such that the Moolayember Formation is absent from the Project Area and the Clematis Group is only present in the very west of the Project Area. The Rewan Formation is a lithic sandstone (Sagittarius Sandstone) with a clayey matrix interbedded with mudstones and siltstones with scattered carbonaceous plant material. The average thickness of the Rewan Formation is 440 m within the Project Area although there is significant structural control of the unit resulting in reduced thickness towards the east of the Project Area. The Rewan Formation unconformably overlies the Permian age Rangal Coal Measures over the majority of the Study Area. The contact is poorly defined between the Rewan Formation and underlying Rangal Coal Measures within the Project Area, with no distinct visual, chemical or physical marker that highlights the transition in rock facies that can be used to identify the contact, either in the field or through geophysical logging. The thickness and extent of the Triassic Strata based on site geological models, geological mapping and drill holes is presented in **Figure 4-5**.

4.2.4 Permian Coal Measures

The Rangal Coal Measures are the uppermost unit of coal-bearing strata in the Bowen Basin and the primary resource target within the Project Area. Mining target seams within the Rangal Coal Measures include the Burton Rider seam and the Leichhardt / Vermont coal sequence (Leichhardt Upper and Leichhardt Lower, Vermont Upper and Vermont Lower seams). On the eastern side of ML 70337 the Rangal Coal measures dip steeply to the northwest and subcrop near the Isaac River beneath the alluvium/regolith. Drilling logs for bores near the Isaac River (GW19_33 and GW19_36a) show coal seams within the Rangal Coal Measures subcropping beneath the weathered Rewan Group.

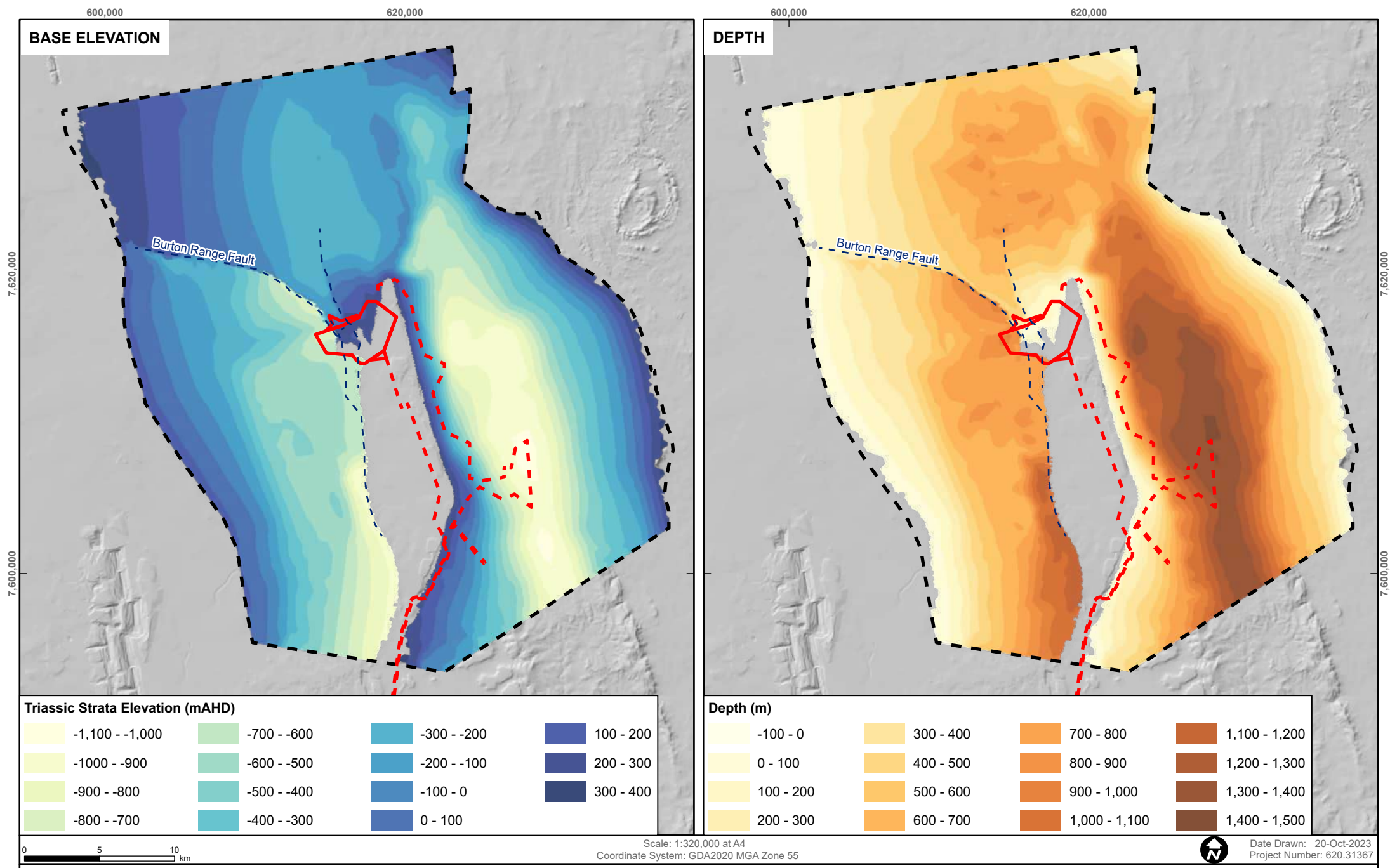
East of the Project at the northern extent of the Burton Mine east of the Isaac River, the Leichhardt and Vermont seams coalesce to form the Burton Seam. The typical thickness of the Burton Rider and Leichhardt / Vermont sequence is 1 to 2 m and 8 m (including 2 m of ash and tuff partings), respectively. The two sequences are separated by an average of 20 to 25 m of non-coal interburden comprised of sandstone, siltstone and minor mudstone. The thickness and extent of the Leichhardt/Vermont seams based on site geological models, geological mapping and drill holes is presented in **Figure 4-6**.





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FIGURE 4-4



Source:
Mining Leases, State of Queensland (Department of Resources) 2021

LEGEND

- - - Fault
- - - Study Area (Model Domain)

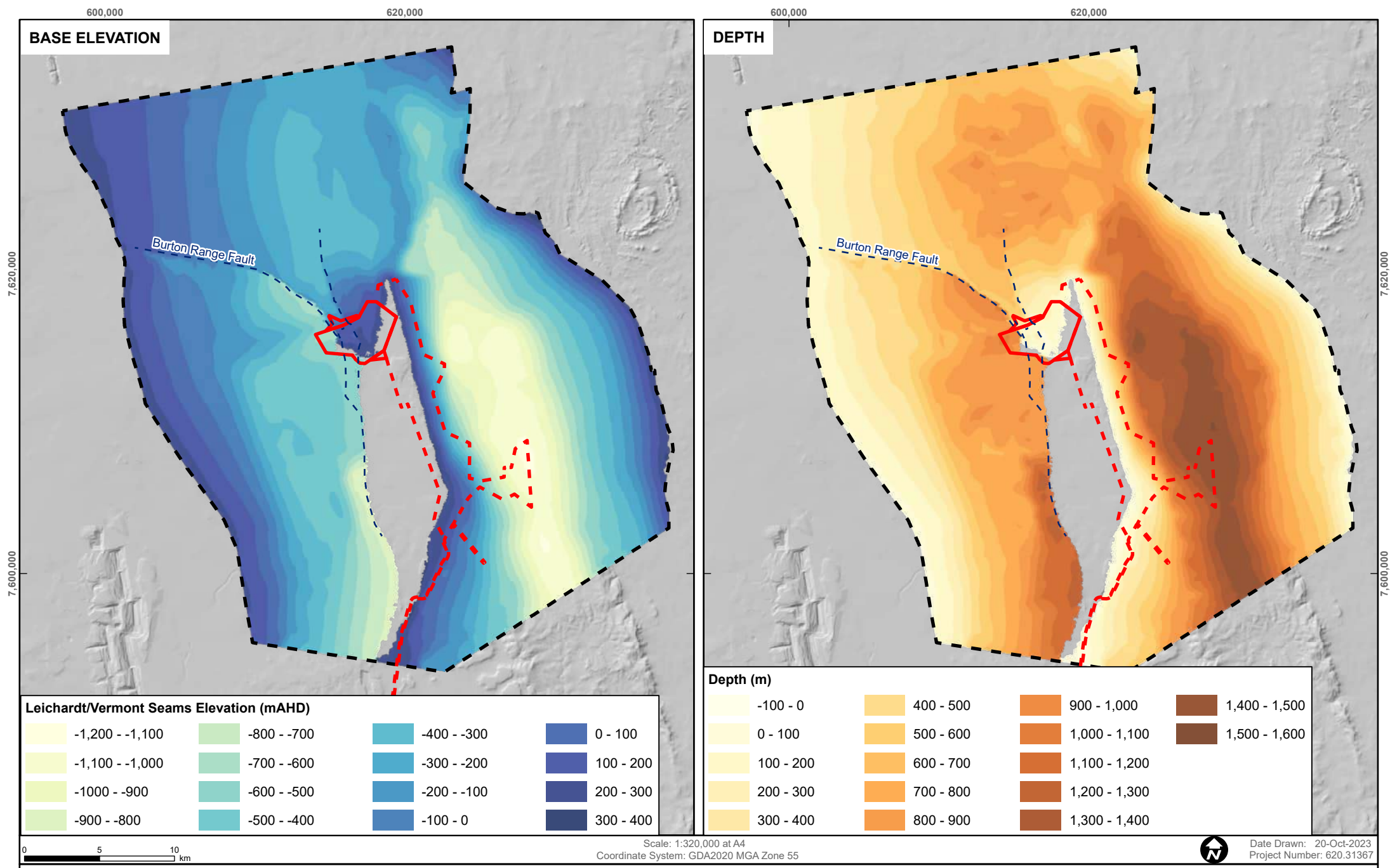
- Project Area (ML 70337, ML 700053 and ML 700054)
- Burton Mining Lease (ML 70109)

**BASE ELEVATION AND
DEPTH OF TRIASSIC STRATA**

FIGURE 4-5



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The Rangal Coal Measures are underlain by the Fort Cooper Coal Measures, with coal seams of the respective formations separated by an average thickness of approximately 99 m of interburden. The Yarrabee Tuff is a regional marker unit defining the transition from the Rangal Coal Measures to the Fort Cooper Coal Measures. The main seam of the Fort Cooper Coal Measures is the Girrah Seam that is typically 30 m thick and has a high ash content. The Girrah Seam is not a target seam for the Project.

4.3 Structural Geology

Extensive geological faulting is present over and surrounding the Project Area. The main structural feature of the Project Area is the Burton Range Fault, which is marked by the eastern boundary of the Burton Range. The Burton Range Fault crosses the Project Area from the southern boundary toward the north and northwest and is aligned adjacent to the western boundary of ML 70337. The fault has caused relatively large vertical displacements in the Permian geology (>700 m throw), isolating the Rangal Coal Measures on each side of the fault. Other faults with up to 200 m throw also isolate the coal seams of the Rangal Coal Measures within sections of the Project Area.

NHG (2019) defines the Project Area as comprising three structural geological zones including:

- Western zone (on the western side of the Burton Range Fault in ML 70337, **Figure 4-2** and **Figure 5-33**) – dominated by a north-northeast dipping monocline and bounded by the Burton Range Fault to the west and another fault to the east (up to 200 m throw).
- Complex central zone (between the Burton Range and smaller fault to the east in ML 70337, **Figure 4-2** and **Figure 5-33**) – zone criss-crossed by faults on the western part of the Lenton Syncline (20 to 190 m throw).
- Eastern zone (on the east side of both faults in ML 70337, **Figure 4-2** and **Figure 5-33**) – dominated by the Burton anticline.

These structural geological zones are visible in the conceptual cross section included as **Figure 5-33** (cross section location shown in **Figure 4-2**).



5.0 Hydrogeology

5.1 Field Program Development

Numerous field programs, developed to address key areas of uncertainty in regards to groundwater, have been carried out for the Project, including hydrogeological field campaigns by SGS (2014), GHD (2018), SLR (2020a), SLR (2022) and SLR (2023a). Each field program sought to build upon the previous programs and address residual gaps identified in the available information and dataset. The Project field programs have included:

- Hydrogeological drilling campaigns;
- Hydraulic testing;
- Geophysical surveys;
- Surface water surveys;
- GDE field studies; and
- Routine groundwater level monitoring and groundwater quality sampling.

5.2 Drilling Campaigns

A hydrogeological investigation of the Project Area was reported in SGS (2014). The report described the site's geology and hydrogeology, including documenting the installation of a groundwater monitoring bore network at the site and recommendations for additional monitoring bore locations.

Drilling and installation of an additional nine monitoring bores was reported in GHD (2018). These bores were installed to augment the existing monitoring bore network established by SGS. The report documented the drilling and installation of groundwater monitoring bores, and lithology encountered during drilling.

SLR (2020a) conducted a drilling program in 2019 installing groundwater monitoring bores screening the alluvium, regolith and Leichhardt / Vermont coal seams, targeting areas not covered in the SGS (2014) or GHD (2018) drilling campaigns, particularly in areas close to the Isaac River on the eastern boundary of the Project.

Most recently, additional bores were installed by SLR (2022) in the alluvium of the eastern tributaries of the Isaac River for the adjacent Burton Mine monitoring network.

5.3 Hydraulic Testing

Study Area groundwater hydraulic testing includes slug (rising and falling head) tests performed on Project Area monitoring bores by SGS (2014) and GHD (2019). Most recently, SLR (2023a) undertook slug testing of Project monitoring bores installed by SLR (2020a) for the purposes of this groundwater assessment report (refer **Appendix A**), and for some of the adjacent Burton Mine monitoring network bores completed by SLR (2022) (refer **Appendix B**).

5.4 Geophysics

An electromagnetic (EM) geophysical survey was conducted by GeoDiscovery in 2019 to better characterise the alluvium in the riparian zones of the Isaac River (further discussed in **Section 4.2.1**). Five EM transects perpendicular to and intersecting the Isaac River were conducted. The transects were aligned with existing drilling data provided by New Hope, including one with aligned with five bores from SLR's 2019 drilling campaign in order to tie in the geophysical data with drillhole data.



5.5 Isaac River Surface Water Field Survey

A walk over survey was conducted by LJV personnel in July 2023 to search for any permanent pools of water in the Isaac River (Reach Environmental, pers. comm. 20 July 2023). Locations of surveys, which were selected based on accessibility and potential for permanent pools upstream, adjacent and downstream of the Project area. The Isaac River was walked upstream and downstream of these locations. The survey followed a period of rainfall in the region, and despite that recent rainfall no permanent pools of water were identified. The walk over survey also identified the point at which the water embankment associated with the Burton Gorge Dam backs up along the Isaac River, recorded as 4.55 km upstream of the dam wall.

5.6 Local GDE Studies

Groundwater Dependent Ecosystem investigation field surveys have been conducted for the purpose of verifying groundwater dependence of mapped potential Aquatic and Terrestrial GDEs in relation to the Project.

Field surveys were completed by AARC (2019a), AARC (2019b), and most recently by 3D Environmental (2023) in accordance with the methods described in the GDE Toolbox (Richardson et al. 2011).

Stygofauna sampling was also undertaken recently by frc environmental (2023).

5.7 Routine Groundwater and Quality Monitoring

Routine groundwater and quality monitoring has been conducted on all Project monitoring bores since 2014. As new bores have been installed in ongoing drilling campaigns, routine monitoring has commenced at those new bores.

5.8 Monitoring Network and Data Availability

The Project groundwater monitoring network that resulted from the field programs described above is presented in **Table 5-1** and shown in **Figure 5-1**. Also provided in **Table 5-1** is an indication of the data availability from the monitoring network to inform this groundwater assessment. Baseline water quality and level monitoring has been generally undertaken at quarterly intervals over the time periods identified in **Table 5-1**, while level monitoring from some bores equipped with loggers has been undertaken at minimum of daily readings.

Groundwater monitoring data has previously been subject to an assessment in regards to data quality (SLR, 2020e). The data quality assessment reported therein included statistical analysis approaches as recommended by DSITI (2017) for identification of suspect data points within the monitoring database. As reported therein, no confirmed data outliers were identified in the database using the approaches described by DSITI (2017).



Table 5-1 New Lenton Groundwater Monitoring Network

Bore	Easting (GDA94 z55)	Northing (GDA94 z55)	Alternate Name	TOC (mAHD)	Bore Depth (mBGL)	Screen Interval (mBGL)	Monitored Unit	Water Quality Data	Water Level Data	status
GW01	617299	7618210	LEN489WB	326.8	15.2	6.17 – 12.17	Alluvium	2014 - 2018	2014 - 2023	Active
GW03	618094	7614389	LEN494WB	307.6	12.1	3.1 – 12.1	Alluvium	-	-	dry
GW04	617876	7615892	LEN490WB	311.3	16.8	13.8 – 16.8	Burton Rider/ weathered sandstone	2014 - 2019	2014 - 2023	Decommissioned
GW06	618097	7616723	LEN491WB	313.9	20.6	3.6 – 18.6	Alluvium	2014 - 2020	2014 - 2023	Active
GW07	617640	7613075	LEN492WB	299.5	24.5	9 – 18	Alluvium	2014 - 2023	2014 - 2023	Active
GW08	617041	7613900	LEN493WB	306.7	11.7	5.72 – 8.72	Alluvium	-	2019 - 2023	Active
GW09	617525	7614070	LEN495WB	307.1	24	6 – 18	Alluvium	2014 - 2018	2014 - 2023	Active
GW10	616032	7617014	LEN502WB	335.2	205.1	178.16– 190.16	Leichhardt / Vermont Seam	2014 - 2023	2014 - 2023	Active
GW11	616294	7616680	LEN499WB	332.3	150	114 – 126	Leichhardt / Vermont Seam	2014 - 2023	2017 - 2023	Active
GW13	616881	7615480	LEN505WB	319.3	192.4	170.5 – 179.5	Leichhardt / Vermont Seam	2014 - 2023	2017 - 2023	Active
GW15	617826	7616095	LEN504WB	312.8	13.5	9.5 – 12.9	Alluvium	-	-	dry
GW19	612323	7620097	LEN501WB	376.7	26.5	22.9 – 25.9	Alluvium/Weathered Sandstone	2014 - 2014	2014 - 2017	dry
GW19_33	618664	7617348	LEN540WB	312	16	11.1 – 12.6	Alluvium/Regolith	2019 - 2023	2019 - 2023	Active



Bore	Easting (GDA94 z55)	Northing (GDA94 z55)	Alternate Name	TOC (mAHD)	Bore Depth (mBGL)	Screen Interval (mBGL)	Monitored Unit	Water Quality Data	Water Level Data	status
GW19_36a	617987	7615810	LEN538WB	310	17	10.5 – 13.5	Weathered Sandstone (Rewan)	-	2019 - 2023	Active
GW19_37a	618034	7615771	LEN539WB	309.6	26	16.5 – 20.0	Alluvium	2019 - 2023	2019 - 2023	Active
GW19_40	617777	7615979	LEN541WB	311.6	86	65.0 – 78.5	Leichhardt / Vermont Seam	2019 - 2023	2019 - 2023	Active
GW19_41a	617843	7615917	LEN542WB	311.3	56	44.0 – 50.0	Leichhardt / Vermont Seam	2019 - 2023	2019 - 2023	Active
GW19_41b	617853	7615911	LEN543WB	311.3	17.5	14.25 – 17.25	Weathered Sandstone (Rewan)	2019 - 2023	2019 - 2023	Active
GW20	612676	7618392	LEN500WB	355.5	33.9	24 – 30	Basalt	2014 - 2015	2014 - 2017	Active
GW22	614463	7622201	LEN496WB	401.7	11.6	5 – 8	Alluvium	-	-	dry
GW23	617807	7622169	LEN498WB	369.9	11.6	5 – 8	Alluvium	-	-	dry
GW26	619185	7616679	LEN503WB	315.7	9.6	6 – 9	Alluvium	-	-	dry
GW27a	617885	7614847	-	310.7	173	134 – 170	Girrah Seam	2018 - 2020	2018 - 2023	Active
GW27b	617873	7614855	-	310.9	19.1	7 – 19	Alluvium	-	2019 - 2023	Active
GW28a	617192	7616641	-	318.6	206	194 – 203	Leichhardt / Vermont Seam	2018 - 2020	2018 - 2023	Active
GW29a	618081	7616561	-	313.6	83.6	62 – 80	Sandstone	2019 - 2023	2018 - 2023	Active
GW30a	618084	7617395	-	318.5	112.2	97 – 109	Leichhardt / Vermont Seam	2018 - 2023	2018 - 2023	Active



Bore	Easting (GDA94 z55)	Northing (GDA94 z55)	Alternate Name	TOC (mAHD)	Bore Depth (mBGL)	Screen Interval (mBGL)	Monitored Unit	Water Quality Data	Water Level Data	status
GW30b	618088	7617382	-	318.5	76.2	70 – 73	Burton Rider Coal Seam	2018 - 2023	2018 - 2023	Active
GW30c	618094	7617368	-	318.2	31.1	23 – 29	Weathered Sagittarius Sandstone	2018 - 2023	2018 - 2023	Active
GW31A	617624	7617680	LEN523WB		165.2	153 – 162	Leichhardt / Vermont Seam	2018 - 2023	2018 - 2023	Active
GW31b	617621	7617680	LEN524WB	321.9*	21.2	17 – 20	Weathered Sandstone	2018 - 2023	2018 - 2023	Active
LEN486	615735	7615593	Lenton	325.9*	129.8	117.8 – 126.8	Leichhardt / Vermont Seam	2014 - 2023	2017 - 2023	Active

* Ground Level



5.9 Other Relevant Monitoring

Given the close (adjacent) proximity of the Project to the Burton Mine, monitoring bores for the neighbouring Burton Mine have been incorporated into this groundwater assessment. The groundwater monitoring network at Burton includes 46 current and historic monitoring bores.

The locations and details of the Burton monitoring network are presented in **Table 5-2** and locations shown in **Figure 5-2**. Also provided in **Table 5-2** is an indication of the data availability from the Burton monitoring network to inform this groundwater assessment.



Table 5-2 Burton Groundwater Monitoring Network Details

Site Name	Easting (GDA 94 z55)	Northing (GDA 94 z55)	TOC (mAHD)	Bore Depth (mBGL)	ML	Monitored Unit	Monitored Pit	Water Quality Data	Water Level Data
BD1247P	620264	7616055	331.4	174	70109	Permian	Burton	2018 - 2023	2006 - 2023
BD1248P	622890	7606690	337.8	182	70109	Vermont Seam	Ellensfield	2010 - 2023	2006 - 2023
BD 1250P	622560	7607860	346.01	225	70109	Vermont Seam	Ellensfield	2006 - 2023	2006 - 2023
BD613C	623101	7605268	322.8	124	70109	Vermont Seam	Ellensfield	2006 - 2023	2006 - 2023
DDH6	619304	7618185	319	102	70109	Leichhardt / Vermont Seam	Burton	2006 - 2023	1998 - 2023
Anna Creek Upstream	622625	7613803	317.9	19.5	70109	Alluvium	-	2023 - 2023	2022 - 2023
Anna Creek Downstream	619750	7612501	307.5	15.4	70109	Alluvium	-	2023 - 2023	2022 - 2023
Teviot Creek Upstream	623121	7605179	323.6	9.28	70109	Alluvium	-	2023 - 2023	2022 - 2023
Teviot Creek Downstream	622372	7605260	318.6	17	70109	Alluvium	-	2023 - 2023	2022 - 2023
Sandy Creek ¹	622618	7602562	-	6	70109	Alluvium	-	-	-
BD1032	622341	7608875	356	334	70109	Alluvium	Burton	2006 - 2023	1998 - 2023
BD 1249P	620770	7610360	318.4	114	70109	Girrah Seam	Burton	2006 - 2011	2006 - 2012
BD 1251P	619955	7611136	305.7	77.9	70109	UN1, UN2, UN3, UN4, UN5, UN6, BOW	-	2006 - 2010	2006 - 2011
DDH58R	621670	7608858	352	168.1	70109	Permian	Plumtree	-	1999 - 2001
DDH55	621663	7608596	354	98.5	70109	Girrah Seam	Burton	-	1999 - 2012



Site Name	Easting (GDA 94 z55)	Northing (GDA 94 z55)	TOC (mAHD)	Bore Depth (mBGL)	ML	Monitored Unit	Monitored Pit	Water Quality Data	Water Level Data
DDH54	621645	7608294	361	-	70109	Permian	-	-	1999 - 2000
DDH56	621844	7609629	336	-	70109	Permian	-	-	1999 - 2001
BD459C	619642	7617652	282	-	70109	Leichhardt / Vermont Seam	-	-	1999 - 2000
BD883	620101	7615152	312	-	70109	Permian	-	-	1999 - 2001
BD894	619977	7615948	328	-	70109	Leichhardt / Vermont Seam	-	-	1999 - 2001
BD905	619748	7616932	-	-	70109	Leichhardt / Vermont Seam	-	-	1999 - 2001
BD1039	620983	7613460	316	-	70109	Leichhardt / Vermont Seam	Burton	-	1999 - 1999
BD1019	621599	7611439	319	295	70109	Leichhardt / Vermont Seam	Burton	-	1998 - 2010
DDH45	621065	7613656	313	278.3	70109	Leichhardt / Vermont Seam	Burton	2006 - 2011	1998 - 2011
DDH16 (Coal)	621979	7610515	325	319	70109	Coal	Burton	-	1998 - 2011
DDH19 (Coal)	621412	7612412	316	295	70109	Permian	Burton	-	1998 - 2011
DDH25	621748	7610438	325	216.6	70109	Permian	Burton	-	1998 - 2010
BD1020	621896	7611374	324	-	70109	Permian	Burton	-	1998 - 1998
BD634	621714	7609677	329	-	70109	Permian	Burton	-	1998 - 1999
TH077P	621884	7609330	352	-	70109	Permian	Burton	-	1998 - 2001
TH078P	622045	7608740	356	-	70109	Permian	Burton	-	1998 - 2001



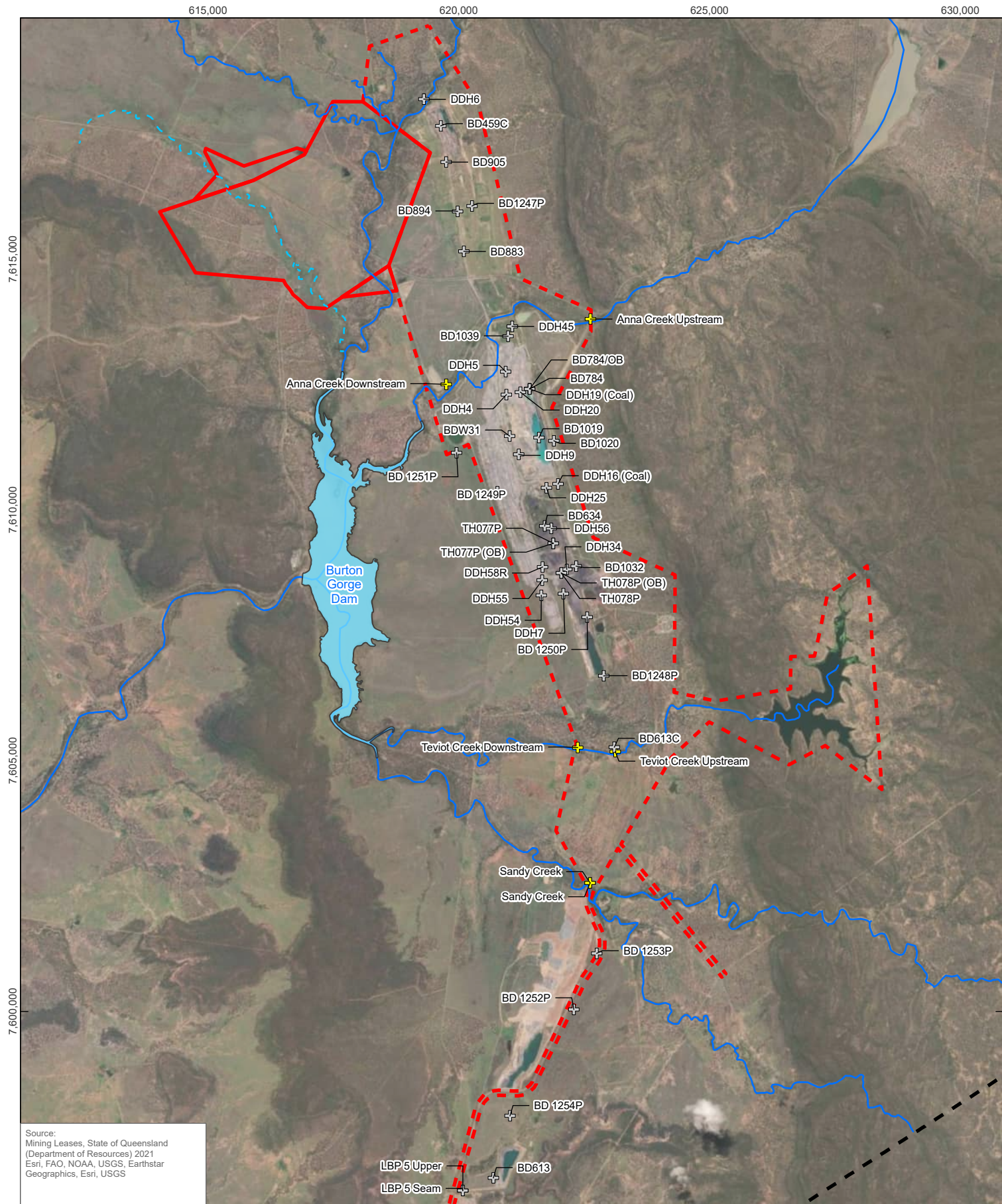
Site Name	Easting (GDA 94 z55)	Northing (GDA 94 z55)	TOC (mAHD)	Bore Depth (mBGL)	ML	Monitored Unit	Monitored Pit	Water Quality Data	Water Level Data
DDH4	620949	7612295	304	-	70109	Permian	Burton	-	1998 - 1999
DDH5	920935	7612754	-	-	70109	Permian	Burton	2012 - 2012	1998 - 2012
DDH7	622086	7608327	327	-	70109	Permian	Burton	-	1998 - 1998
DDH9	621195	7611105	317	-	70109	Permian	Burton	-	1998 - 2000
DDH20	621228	7612344	317	-	70109	Leichhardt / Vermont Seam	Burton	-	1998 - 2000
BD784/OB	621413	7612408	316	-	70109	Permian	-	-	1998 - 2010
DDH34	622153	7608812	357	-	70109	Girrah Seam	-	-	1998 - 2000
TH077P (OB)	621884	7609330	352	-	70109	Permian	-	-	1998 - 2001
TH078P (OB)	622045	7608740	356	-	70109	Permian	-	-	1998 - 2001
BD784	621413	7612408	316	296.9	70109	Leichhardt / Vermont Seam	Burton	-	-
BDW31	621014	7611470	307	-	70109	Permian	Burton	-	-
LBP 5 Upper	620080	7596430	334	-	ML70259	Permian	-	2014 - 2017	2014 - 2017
BD 1254P	621022	7597920	346.5	264	ML70259	Vermont Seam	Plumtree	2006 - 2017	2006 - 2017
BD 1253P	622751	7601157	323.6	168.1	ML70258	Permian	Plumtree	2006 - 2006	2006 - 2006
BD 1252P	622294	7600039	334.5	183.1	ML70259	Leichhardt / Vermont Seam	Plumtree	2006 - 2017	2006 - 2017
BD613	620690	7596682	333.5	138	ML70259	Vermont Lower Seam, Girrah Seam	-	-	-

TOC = Top of Casing

HSU = Hydrostratigraphic Unit

¹ dry, hole abandoned





 0 1 2 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:100,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 11-Dec-2023
 Drawn by: RB

LEGEND

Monitored Unit

-  Alluvium
-  Permian
-  Non-designated Watercourse
-  Major Watercourse

-  Project Area (ML 70337, ML 700053 and ML 700054)
-  Burton Mining Lease (ML 70109)
-  Study Area (Model Domain)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK (BURTON)



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FIGURE 5-2

5.10 Groundwater Distribution, Flow, Recharge and Discharge

5.10.1 Hydrostratigraphy

Extensive groundwater investigations undertaken at and surrounding the Project Area (GHD, 2019 and SLR, 2020c) and have helped define the hydrostratigraphy in the vicinity of the Project Area as shown in **Table 5-3**.

Table 5-3 Hydrostratigraphy of the Study Area

Geological unit	Coal sequences	Average thickness (m)	Groundwater unit type
Alluvium (Quaternary)		~ 14	Unconfined aquifer (where saturated)
Basalt (Tertiary)		~ 50	Semi confined aquifer
Regolith		~ 25	Unconfined aquifer (where saturated)
Rewan Group (Triassic)		~ 500	Aquitard
Rangal Coal Measures (Permian)	Overburden	~ 50	Aquitard
	Burton Rider Seam	~ 1.5	Confined aquifer
	Interburden	~ 26	Aquitard
	Leichhardt/Vermont Coal seams	~ 8	Confined aquifer
	underburden	~ 100	Aquitard
Fort Cooper Coal Measures (Permian)		~ 200	Aquitard**

** The entire unit may be conceptualised as an aquitard with thin aquifer lenses (coal seams)

The four main aquifers identified at the Project include:

- Quaternary alluvium, where saturated, associated with the creeks and Isaac River;
- Regolith where saturated (mainly comprised of weathered bedrock);
- Tertiary basalt aquifers; and
- Permian fractured rock aquifers.

5.10.1.1 Alluvium

Groundwater presence in the alluvium is variable. Borehole logs and geophysical investigations at the Project indicate that much of the alluvium is dry, with coarser-grained potentially groundwater bearing alluvial sediments not present extensively throughout the surface mapped alluvial extent but rather restricted to the area of the river meander belt close to the existing channel. That is, site investigations show that the alluvium is only saturated in immediate proximity to the current river channel.

Hand auguring investigations at the Project along the Isaac River channel and its tributaries intersected perched alluvial groundwater at locations adjacent the main river channel but not in the alluvium within the tributaries away from the channel (3D Environmental, 2023). The hand auguring investigations also demonstrated that, at least at the time of the investigation (January 2023 following a wetter than average climatic period), the alluvium contained groundwater in both the basal alluvial sediments at 10 to 14 m depth but also a separate shallow perched (likely seasonally variable) groundwater system resting on relatively shallow alluvial clays close to the existing river channel at approximately 4 m depth (3D



Environmental, 2023). That is, a dual natured groundwater system within the alluvium is interpreted. Further discussion on the recorded groundwater levels in the alluvium is provided in **Section 5.10.2.1**. The shallow perched alluvial waters from auger holes was also noted to be very fresh ($EC < 300 \mu S/cm$) whereas the deeper regional basal alluvial water reports much higher salinities (517 to 16,500 $\mu S/cm$ EC, averaging 5,604 $\mu S/cm$ EC), further suggesting a dual natured groundwater system in the alluvium but that the two components are not well hydraulically connected. Further discussion on water quality of the shallow perched alluvial water is provided in **Section 5.10.4** and of the deeper regional basal alluvial water in **5.12**.

Groundwater level monitoring data from bores where saturation was recorded in the basal alluvial sediments show that the basal alluvial groundwater is hydraulically disconnected from both the shallow seasonally variable perched alluvial groundwater table and the Isaac River channel, with the river channel losing to the underlying groundwater system and forming the “perched water” in some areas as it seeps down. Further discussion on the recorded groundwater levels in the alluvium in relation to the Isaac River streambed level is provided in **Section 5.10.2.1**. A conceptual cross section through the Isaac River alluvium demonstrating its stratigraphy and perched and basal groundwater presence is shown in **Figure 5-3**, with the section location shown on **Figure 4-1**.



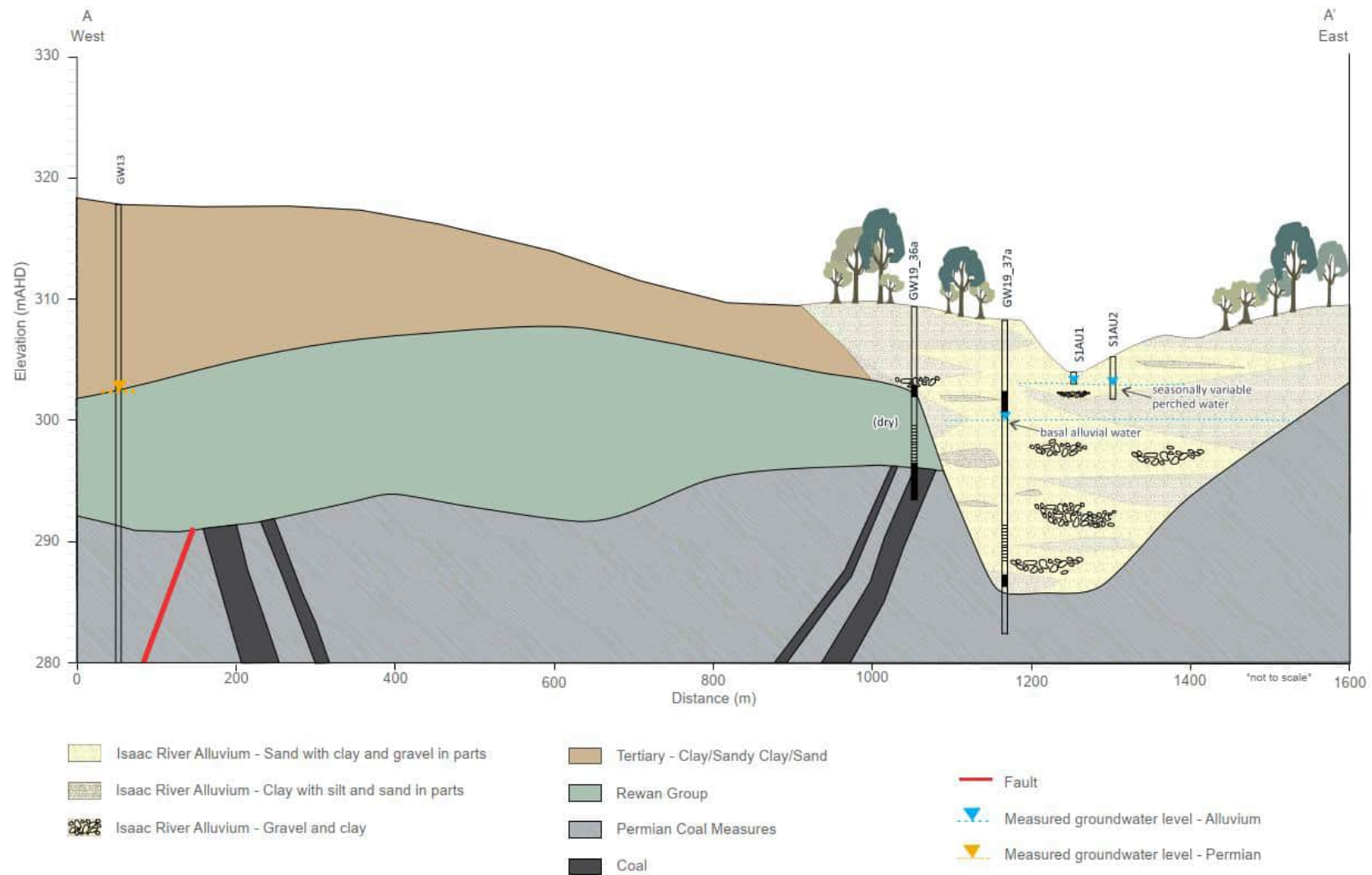


Figure 5-3 Conceptual Cross Section – Isaac River Alluvium



5.10.1.2 Regolith

The regolith, comprising of shallow weathered Triassic and Permian strata overlying fresh bedrock and has been identified as hosting groundwater at various locations across the Study Area.

5.10.1.3 Basalt

Tertiary age basalt flows outcrop to the north-western extent of the Project. Within the Project Area the limited extent and discontinuity of this unit likely offers limited aquifer potential. Given the limited and isolated occurrence of basalt in the vicinity of the Project it has not been identified as a hydrostratigraphic unit of significance to the Project Area.

5.10.1.4 Triassic Aged Strata

Triassic age strata within the Study Area consists of the Moolayember Formation, Clematis Group, and the Rewan Formation. The Moolayember Formation, where it exists outside the Project Area, overlies the Clematis Group and is generally considered a regional scale aquitard within the Bowen Basin. The Clematis Group, where it exists outside the Project Area, is generally considered a major aquifer particularly for the sandstones within the unit, although its presence in the Study Area is isolated and disconnected from the major regional occurrence of the Clematis Group aquifer. Both the Moolayember Formation and Clematis Group have been significantly eroded within the Study Area, such that the Moolayember Formation is absent from the Project Area itself, and the Clematis Group is only present across a limited section of the Study Area to the west of the Burton Range Fault, west of the Project Area. As such, neither unit is considered a significant hydrostratigraphic unit in the context of the Project.

The Rewan Formation, overlying the Permian age Rangal Coal Measures, dominates a significant outcrop area within the Project. The Rewan Formation is generally considered a major regional scale aquitard within the Bowen Basin, limiting groundwater connectivity between the underlying Permian coal measures and any overlying shallower groundwater systems. There is limited groundwater occurrence within the Rewan Formation itself, associated mainly with localised fracturing and weathered horizons.

5.10.1.5 Permian Coal Measures

During drilling at and surrounding the Project Area, groundwater was identified within the coal seams of the Rangal Coal Measures and the Fort Cooper Coal Measures. Groundwater within these Permian age coal measures is preferentially contained within, and flows via, the coal seams themselves along fractures and cleats, whilst the adjoining sandstone and siltstone interbeds act as low hydraulic conductivity confining units. Due to the limited vertical hydraulic connection between the individual coal seams, the Permian age Coal Measures are conceptualised to comprise multiple confined aquifers (coal seams) that are interbedded with aquitards (overburden, interburden, and underburden). Groundwater was typically not encountered within the overburden / interburden associated with the Permian age coal measures at the Project Area during drilling investigations.

5.10.2 Groundwater Levels and Flow Direction

5.10.2.1 Alluvium

Several groundwater bores installed into the basal parts of the Quaternary alluvium in the Project Area are dry, indicating the alluvium is unsaturated and does not form an aquifer at these locations. Where groundwater is present in the basal alluvium closer to the Isaac River main channel however, groundwater elevations in most alluvial bores installed are reported



between 292 and 303 m AHD (4 to 16 mBTC) (**Figure 5-4** and **Figure 5-5**), with groundwater flow generally southward, coincident with flow direction of the Isaac River and general topographic trends. Higher levels reported at monitoring bore GW07 south of the Project Area are likely attributed to proximity to the tail waters of the Burton Gorge Dam, which artificially raises alluvial groundwater levels south of the Project Area (SLR, 2020c). Review of available monitoring data from bores within the Project Area suggests that groundwater levels within the basal Quaternary alluvium are up to 2 m higher than that of the underlying Permo-Triassic sandstone, indicating a downwards hydraulic gradient and alluvium groundwater levels not supported by groundwater flow from the underlying bedrock. Groundwater in several bores, particularly those screened within the basal Quaternary alluvium, have been noted to respond to rainfall events indicating relatively rapid recharge from rainfall (**Figure 5-4** and **Figure 5-5**).

In the Project Area, alluvial groundwater levels do not appear affected by historic operations at the neighbouring Burton Mine. However, bores screened in the basal alluvium do show a general decreasing water level trend correlating to reduced rainfall observed over the same period (**Figure 5-4** and **Figure 5-5**) as demonstrated by the rainfall cumulative departure plot.

Data suggests however that there is no indication of any groundwater discharge to the riverbed or surface water given the general depths to groundwater of more than 8 m in the basal alluvium. In January 2023, shallow perched alluvial water levels were measured in auger holes immediately adjacent the Isaac River channel (3D Environmental, 2023). Water levels from the shallow perched alluvial water intersected in hand augering were around 5 m above groundwater levels in nearby bores monitoring the base of the alluvial sediments:

- Bore GW19_33: 7.7 mBTC or 7.1 mBGL (27-03-2023); near auger holes S13AU2 (4 mBGL) and S13AU1 (1 mBGL) (24-02-2023); and
- Bore GW19_37a: 10 mBTC or 9.3 mBGL (27-03-2023); near auger holes S1AU1 (0.7 mBGL) and S1AU2 (2.8 mBGL) (21-02-2023).

This indicates vertical hydraulic gradients exist within the alluvium and between the riverbed and the alluvium that would facilitate river sourced shallow perched groundwater to seep downwards to the deeper regional groundwater system hosted in the basal alluvial sediments. However, the intervening clay layers within the alluvial profile that exist above the groundwater system hosted in the basal alluvial sediments would inhibit the degree to which this downwards seepage occurs. It is these clay layers that facilitate the formation of the seasonably variable perched water approximately 5 m above the deeper alluvial groundwater levels, and the presence of the perching suggests a significant degree of hydraulic disconnection between the perched water and the deeper regional alluvial system.

Groundwater level contours for the basal Quaternary alluvium in the vicinity of the Project Area were developed by SLR using the most recent groundwater level data (from New Lenton and Burton monitoring network bores) and dam water level data for the Burton Gorge Dam (**Figure 5-6**). Groundwater levels in the alluvium in the vicinity of the Project Area flow southwest along Isaac River. The spatial extent of the aquifer in the vicinity of the Project Area shown in **Figure 5-6** is limited to near the Burton Gorge Dam and along the Isaac River. The alluvium is dry along the Isaac River near GW01, and along the rivers western edge within the Project Area near GW27b, GW09, GW08 and 60 m west of GW19_37a (at GW19_36a screened in the regolith). The contours point downwards along the flow direction of the Isaac River indicative of the rivers losing conditions. The water level in the Burton Gorge Dam is higher than the groundwater level directly adjacent to it and therefore the groundwater flow direction is towards the north in the direction of the Isaac River. This results in the convergence of groundwater flow between where it flows north and northeast from the Burton Gorge Dam and flows southwest along the Isaac River.



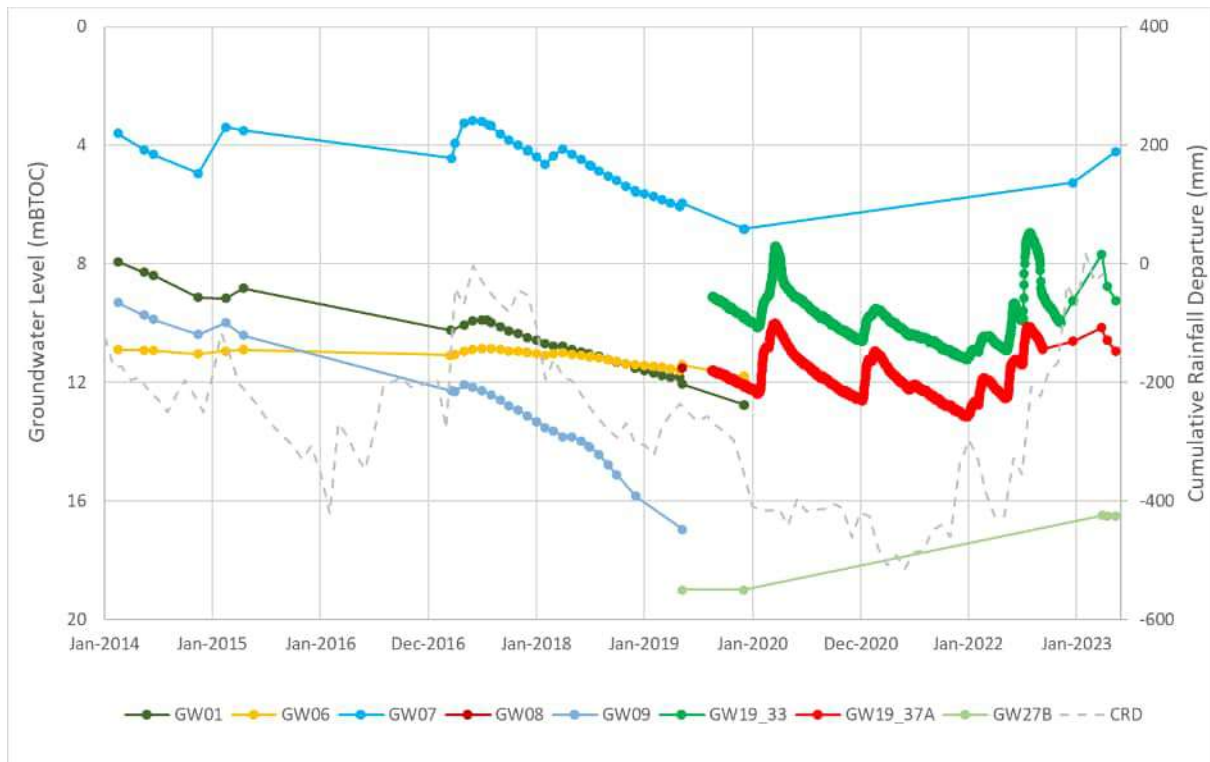


Figure 5-4 Groundwater Level (mBTC) – Alluvium Bores

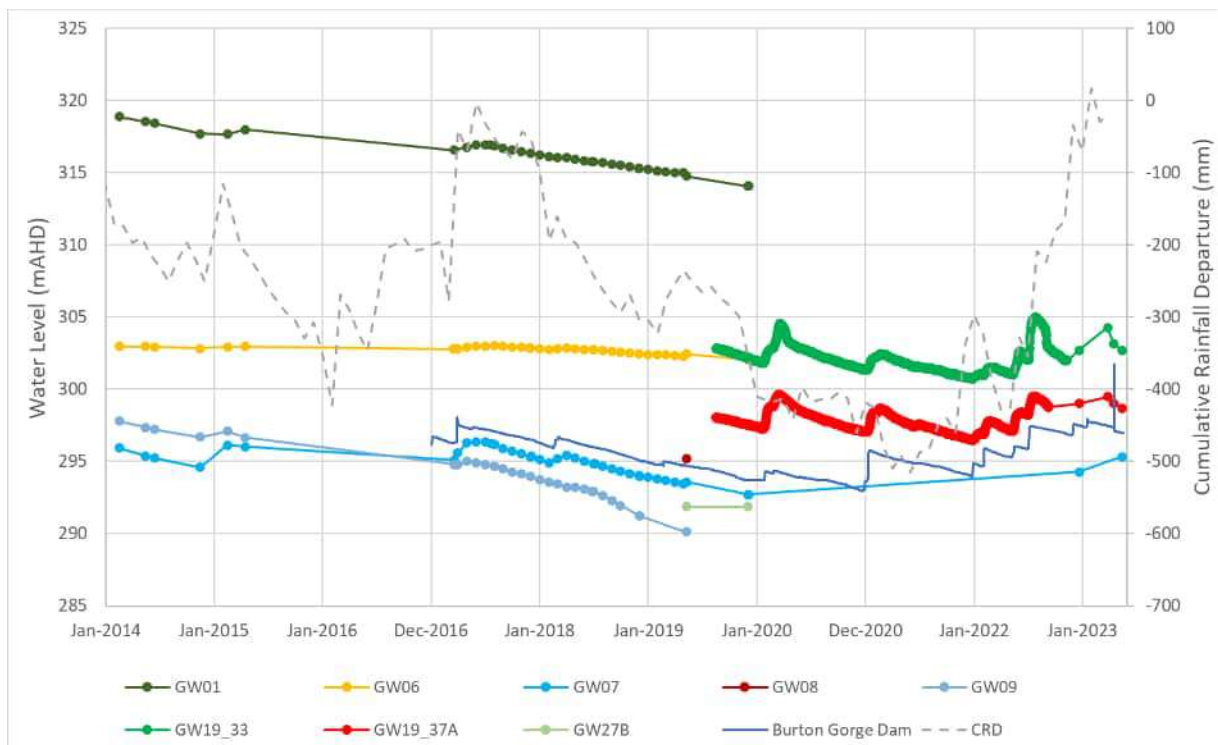


Figure 5-5 Groundwater Level (mAHD) – Alluvium Bores





Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Esri, FAO, NOAA, USGS, Earthstar
Geographics, Esri, USGS



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:35,000 at A4

Project Number: 620.31367.00000

Date Drawn: 22-Dec-2023

Drawn by: RB

LEGEND

- Water Level Measurement (mAHD)
- Groundwater Elevation Contour (mAHD)
- Major Watercourse
- - - Non-designated Watercourse
- ▭ Project Area (ML 70337, ML 700053 and ML 700054)
- - - Burton Mining Lease (ML 70109)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

GROUNDWATER ELEVATION CONTOURS - ALLUVIUM



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FIGURE 5-6

5.10.2.2 Regolith

Recent monitoring data collected from within the Project Area shows groundwater levels in the regolith ranging from approximately 15 to 16 mBTC and 296 to 307 mAHd with one bore (GW19_36a) currently dry (**Figure 5-7** and **Figure 5-8**). Groundwater level data indicates that the inferred groundwater flow direction in the regolith, where present and saturated, is expected to follow topography, and has the potential to interact with groundwater within the alluvium where present along drainage alignments and rivers. Groundwater flow within the alluvial and regolith aquifers is limited and controlled by compartmentalisation due to lithological extent of the strata. On a regional scale however, where groundwater is present within the regolith, flow is expected to follow topography.

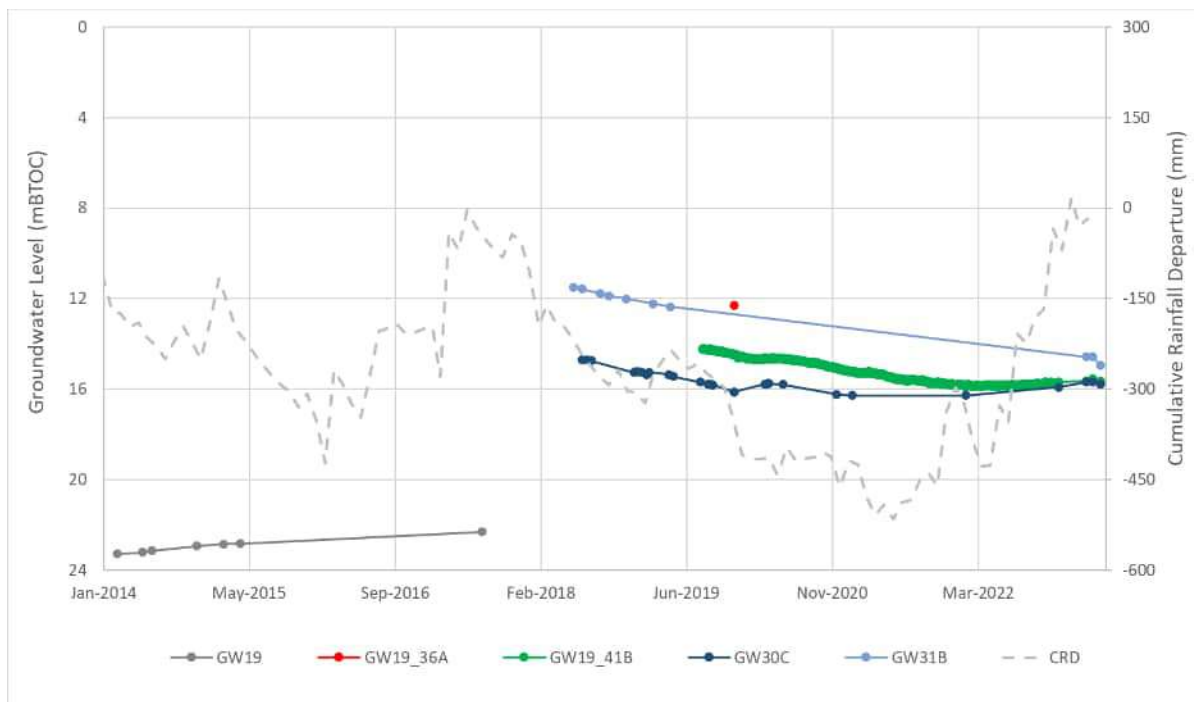


Figure 5-7 Groundwater Level (mBTC) – Regolith Bores



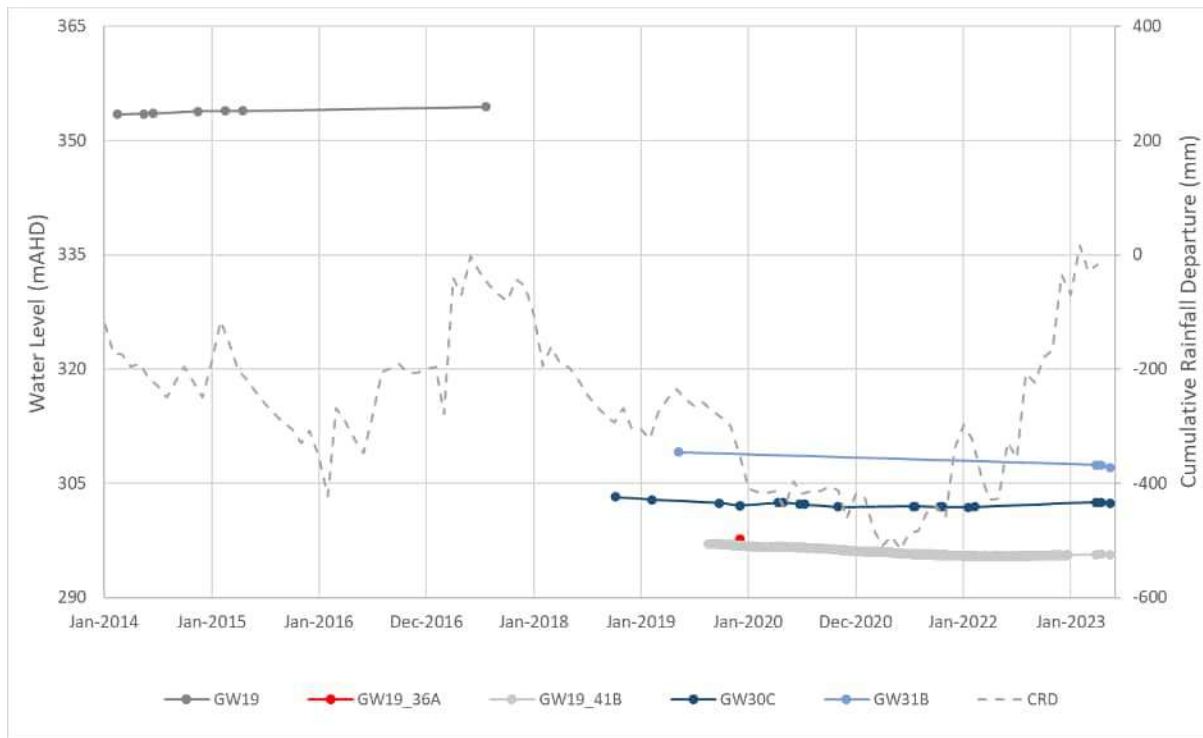


Figure 5-8 Groundwater Level (mAHD) – Regolith Bores

5.10.2.3 Basalt

Minor occurrences of Tertiary age basalts are mapped within the northwest part of the Study Area but due to its limited and isolated occurrence within the Study Area, the Tertiary basalt has not been identified as a hydrostratigraphic unit of significance to the Project. There is one bore installed into the basalt (GW20). Groundwater level data for GW20 is available from 2014 to 2017 and shows groundwater level elevation to be approximately 345 mAHD and 10 mBTC (Figure 5-9 and Figure 5-10). There is insufficient data to infer flow direction in the basalt but given the semi-confined nature of this unit, it is also likely to follow topographic gradients.



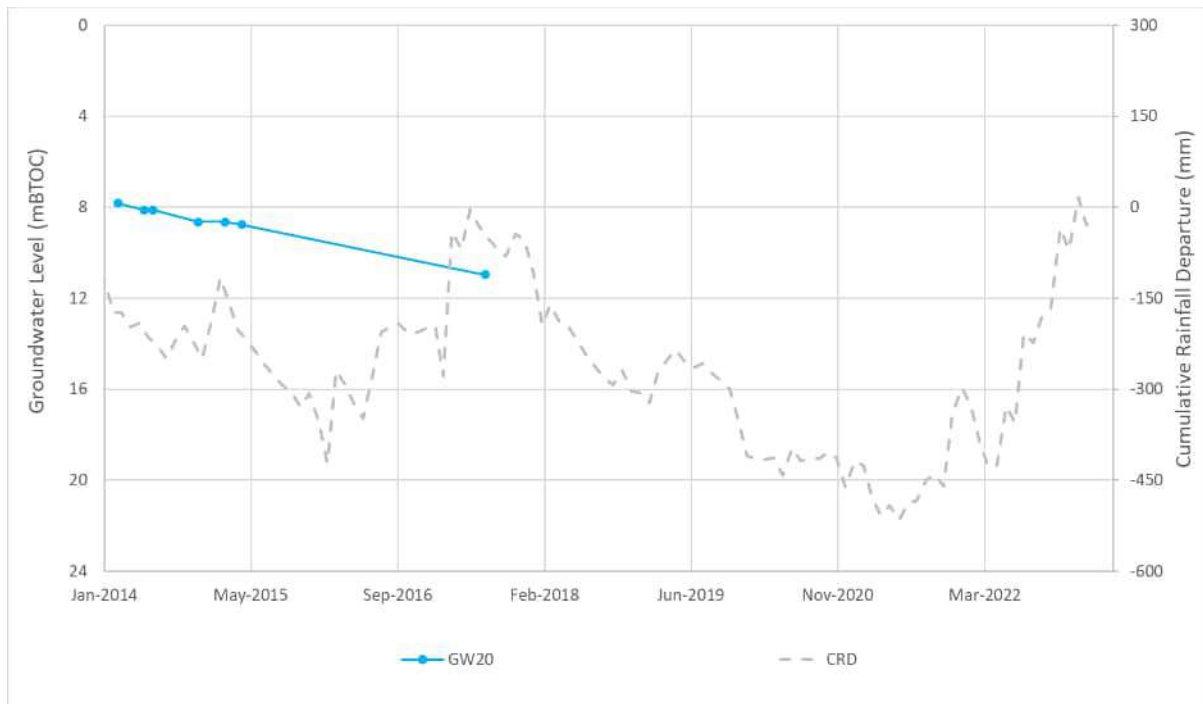


Figure 5-9 Groundwater Level (mBTC) – Basalt Bore

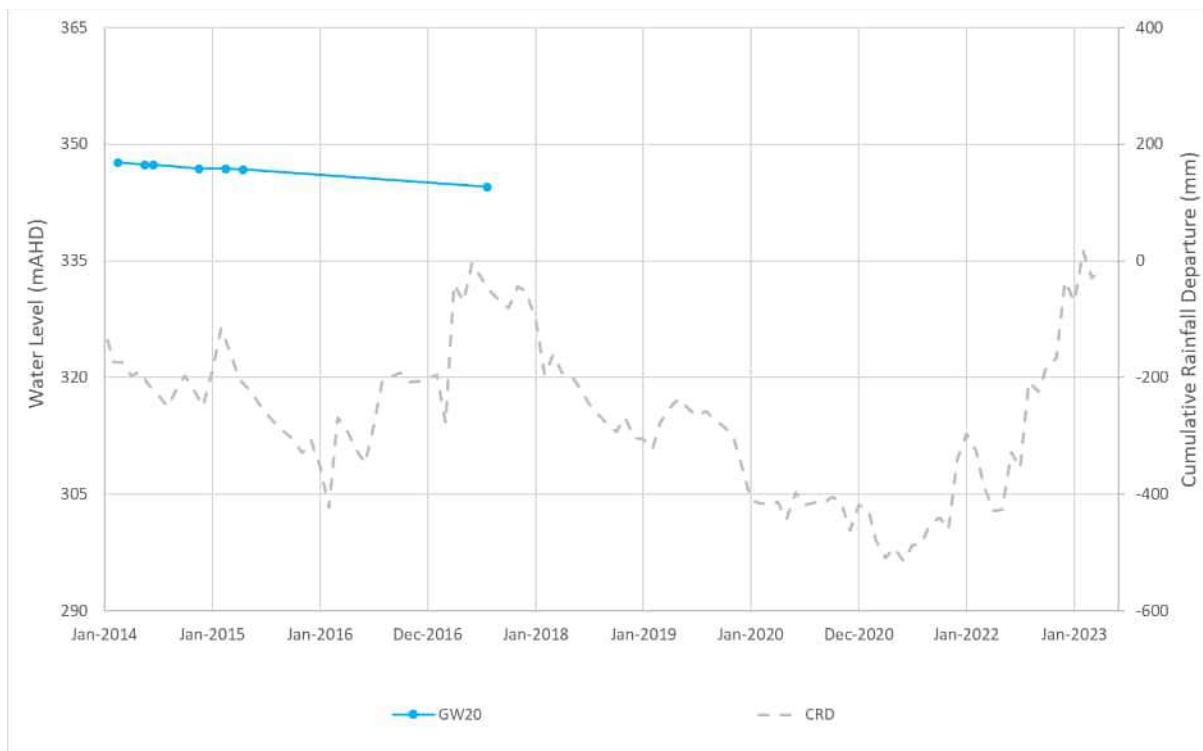


Figure 5-10 Groundwater Level (mAHD) – Basalt Bore



5.10.2.4 Triassic Aged Strata

The Rewan Formation outcrops over the majority of the Study area and overlies the Permian Rangal Coal Measures. In the Bowen Basin, the Rewan Formation is acknowledged as a regional scale aquitard. Within the Project Area, no groundwater bores intercepted water in the Rewan Formation (except in the weathered bedrock/regolith above the fresh Rewan Formation). The Rewan Formation is up to 1000m thick over the Study Area further distant from the Project Area.

The Rewan Formation is generally considered a major regional scale aquitard within the Bowen Basin, limiting groundwater connectivity between the underlying Permian coal measures and any overlying shallower groundwater systems. There is limited groundwater occurrence within the Rewan Formation itself, associated mainly with localised fracturing and weathered horizons.

5.10.2.5 Permian Coal Measures

Groundwater levels for bores screened in the Permian coal measures are presented in **Figure 5-11**. Historical data for bores screened in the Permian coal measures show groundwater levels to range from approximately 296 and 305 mAHD in the Leichhardt/Vermont Seam (GW10, GW11, GW13, GW19_40, GW19_41A, GW28A, GW29A, GW31A and LEN486); 294 to 295 mAHD in the Girrah Seam (GW27a); and 302 to 303 mAHD in the Burton Rider Seam (GW30b) (**Figure 5-11**).

Groundwater levels have remained relatively stable over the monitored period with minimal responses to rainfall events, suggesting low rates of rainfall recharge. Permian coal seam bores in proximity to the Permian subcrop beneath the alluvium display a stronger response to rainfall than other Permian coal seam bores further from the outcrop, suggesting the potential for a localised hydraulic connection between these two units with rainfall/surface flow infiltration passing through the alluvium into the coal seams.

At the Burton Mine, the impact of historical mining from 1998 to present can be observed in the Permian coal measures with depressurization of coal seams and subsequent recovery following backfilling of voids. Water level declines of up to 90m (down to 240mAHD) are observed follow by recovery back to within 10m of pre-mining levels in most bores, indicating capacity of the Permian groundwater system to recover rapidly and significantly from mining activities. A hydrograph for Permian bores near Burton North and Burton Widening Pits is presented as **Figure 5-12**.

A potentiometric surface for the Permian Coal Measures in the vicinity of the Project Area was developed using the most recent groundwater level data (from New Lenton and Burton monitoring network bores) and void water level data (for Burton Mine) (**Figure 5-13**).

Groundwater levels show that flow potential in the Permian is southeast from New Lenton towards Burton North Pit and towards Burton Widening. There is a strong overall gradient towards the Burton Widening Pit which is interpreted to form a significant groundwater sink in the Permian. The effect of structural (i.e. faulting) control on the groundwater system is evident, with the north-south trending Burton Range Fault that separates the western portion of New Lenton and limits the spatial extent of the aquifer to the south of the Project Area.



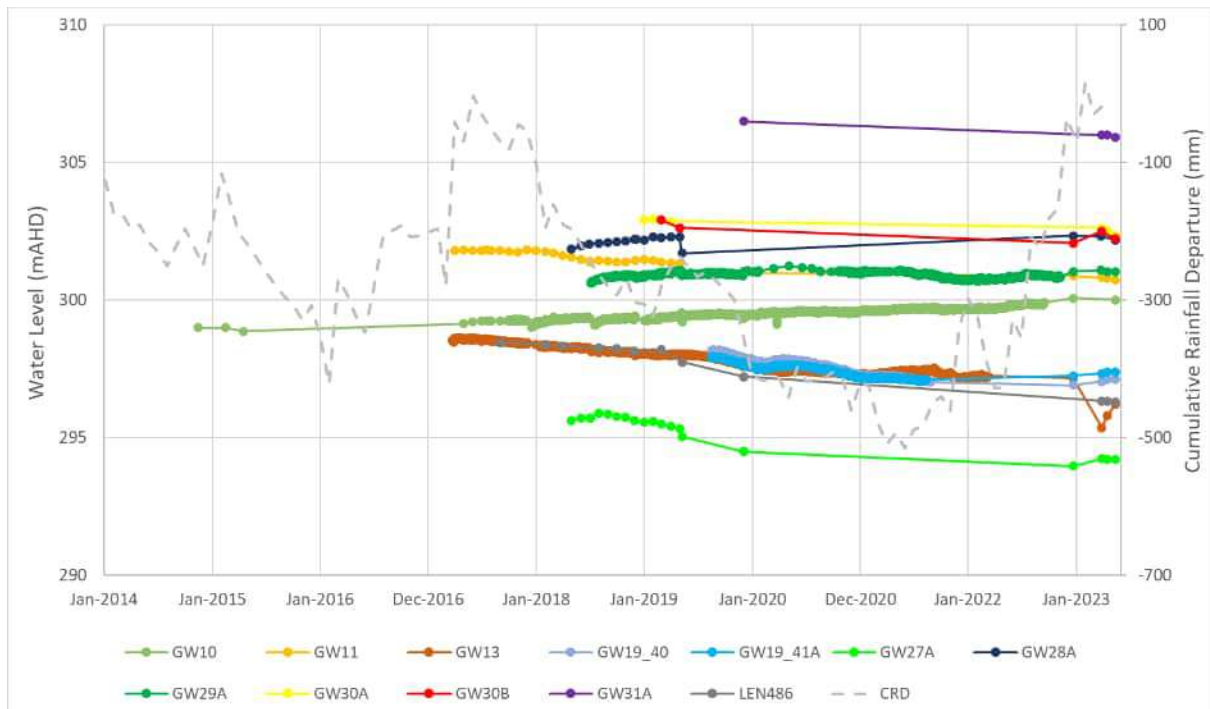


Figure 5-11 Groundwater Level Elevation (mAHD) – New Lenton Permian Bores

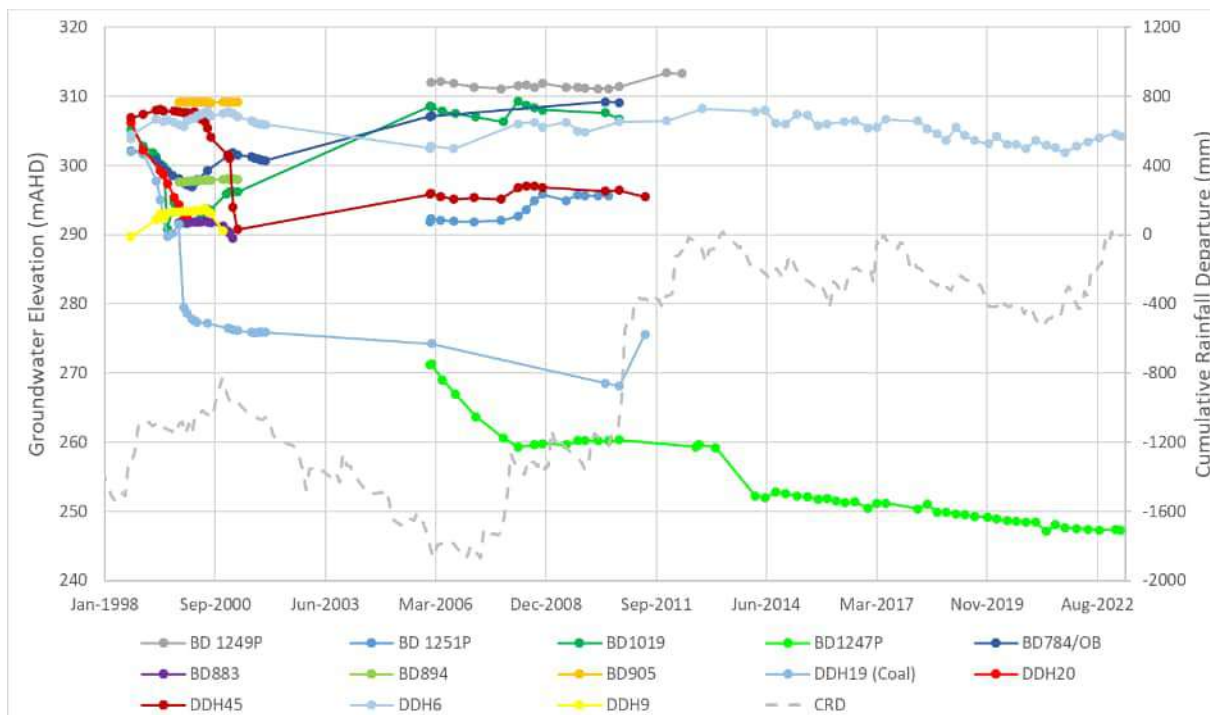
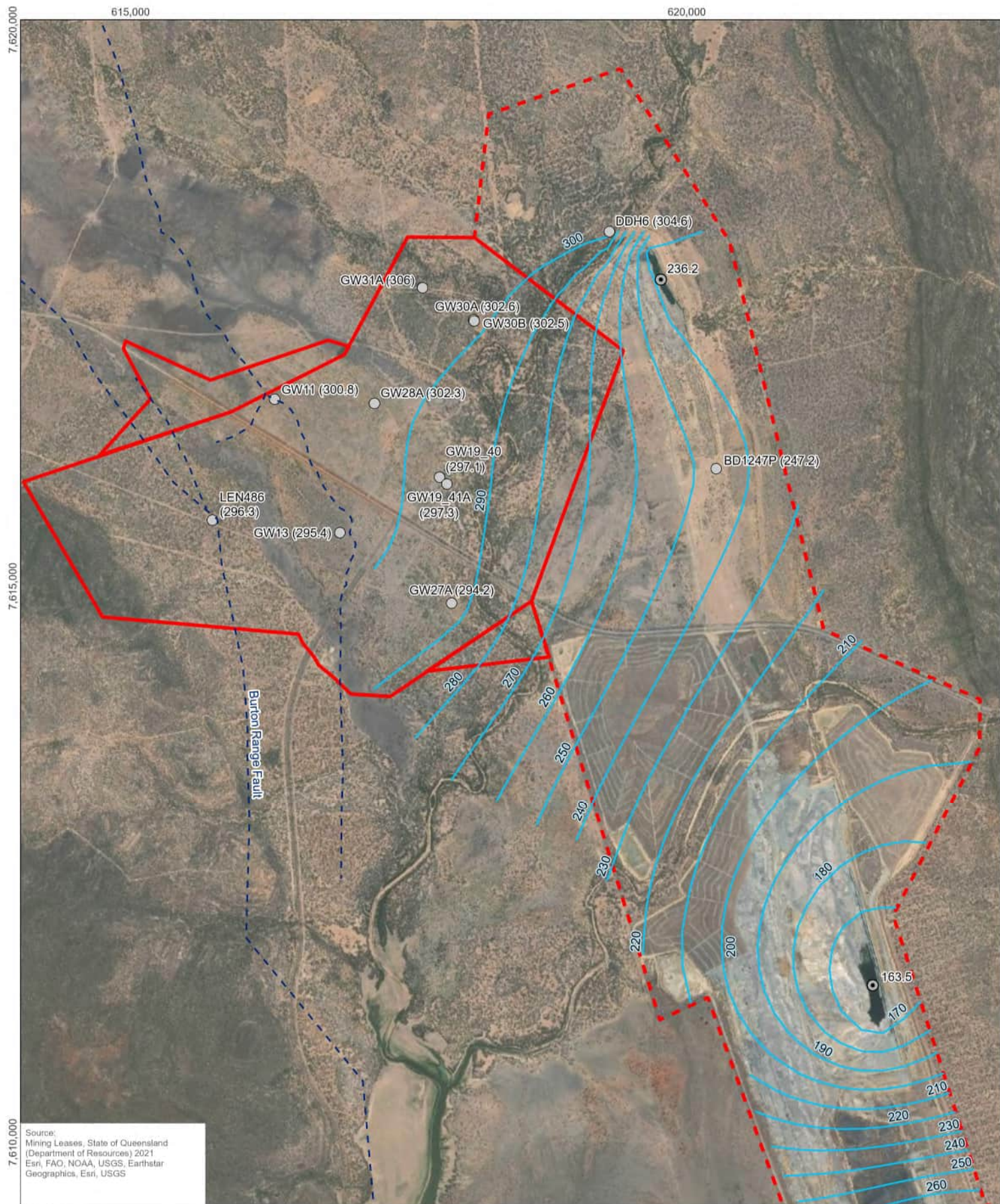


Figure 5-12 Groundwater Level Elevation (mAHD) – Permian Bores Burton North and Burton Widening





Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Esri, FAO, NOAA, USGS, Earthstar
Geographics, Esri, USGS

 0 0.8 1.5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:45,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 18-Jun-2023
 Drawn by: RB

LEGEND

-  Groundwater level (mAHD)
-  Void water level (mAHD)
-  Groundwater Elevation Contour (mAHD)
-  Fault
-  Project Area (ML 70337, ML 700053 and ML 700054)
-  Burton Mining Lease (ML 70109)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

GROUNDWATER ELEVATION CONTOURS - PERMIAN



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 5-13

5.10.3 Recharge and Discharge

Recharge to the water table occurs via diffuse rainfall recharge and leakage of surface water along creeks and drainage lines following significant rainfall events. Discharge of shallow groundwater occurs primarily via evapotranspiration, seepage into existing mine pits and mine dewatering from the neighbouring Burton Mine, and vertical seepage into underlying deeper layers.

Regionally, discharge from shallow groundwater (mainly alluvium) occurs via evapotranspiration from vegetation growing along creek beds and minor short duration baseflow events after significant rainfall/flooding. Infiltration to underlying formations is likely to be limited to areas in connection with relatively high permeability units such as coal seams and possibly faults.

Water levels in the alluvium are generally above the regolith or coal measures but below riverbed elevations, suggesting that river discharge to alluvium contributes to leakage recharge to underlying units.

Recharge to the alluvium is considered to be mostly from streamflow infiltration or flooding (losing streams), with direct infiltration of rainfall also occurring rapidly where there is no substantial clay present in the shallow sub-surface. Clay horizons within the alluvial sequence inhibit, or at least delay, streamflow derived recharge to the basal alluvial aquifer, and result in perching of alluvial groundwater in shallow horizons above the more regional basal alluvial saturated aquifer that would then leak downwards to the deeper basal alluvial aquifer. Downstream of the Project Area, the Isaac River is dammed by the Burton Gorge Dam with a permanent surface water body (refer **Figure 4-1**), which would result in increased alluvial groundwater recharge and maintenance of elevated alluvial groundwater levels via dam seepage in this area.

The regolith is recharged from rainfall infiltration and leakage of surface water along creeks and drainage lines following episodic rainfall events.

In the Permian coal measures, recharge and discharge mechanisms are influenced by the outcropping/subcropping of Permian units. In these areas, the coal seams are exposed to semi-confined conditions which favour groundwater flow between the coal measures, the regolith and the alluvium. These conditions are limited to areas where the coal seams subcrop, where coal seams are in direct contact with the regolith or alluvium. Vertical recharge also occurs via diffuse vertical flow from units overlying the Permian coal measures.

5.10.3.1 Recharge Estimation

The chloride mass balance (CMB) method was used to estimate the recharge rate for each main aquifer in the Study Area.

Chloride is conservative in nature and it can be assumed that the predominant source of chloride in groundwater is derived from rainfall. The CMB method provides an accepted means of estimating average long term recharge rates to an aquifer. To estimate the annual recharge rate, the average annual rainfall of the site area is multiplied by the approximate chloride concentration in rainfall and then divided by the chloride concentration of the groundwater. The estimated annual recharge can then be divided by the average annual rainfall to calculate the estimated recharge percent of annual rainfall.

The average annual rainfall used for the CMB calculation was 590 mm per year and was obtained through the Scientific Information for Landowners (SILO) database using a datapoint near the Project Area (latitude -21.60, longitude 148.15). Groundwater chloride concentrations were taken from available laboratory data from Project monitoring bores as well as bores from the neighbouring Burton Mine, between 2006 and 2023.



In the absence of a direct measurement, a representative mean chloride concentration in rainfall including contributions by deposition can be estimated from Hutton (1976). As there was no local data available for chloride concentrations in rainfall, the approximate concentration was calculated based on the well-established relationship between chloride concentration in rainfall and distance from the ocean (Hutton 1976). Assuming a distance of 120 km from the site to the ocean the estimated concentration of chloride in rainwater is 2.45 mg/L.

It is important to note the limitations of the CMB analysis. These include:

- The chloride concentration in rainfall recharging groundwater at the site is not measured, but assumed from literature and thus subject to uncertainty.
- The analysis is only valid for the area covered by the monitoring bores used to obtain groundwater chloride concentrations for the CMB, i.e. generally speaking, the extent of the site monitoring network. Thus it would be expected there may be some variability between the CMB estimates and actual recharge rates occurring over the entire Study Area.
- The analysis assumes all chloride in groundwater within an aquifer is derived from direct rainfall recharge to that aquifer, and does not account chloride that might enter an aquifer from inter-aquifer leakage.
- The analysis is limited by the period of time covered by the chloride in groundwater dataset, particularly for the alluvium aquifer which would be expected to respond relatively rapidly to climatic variability. Thus the recharge estimates derived from the CMB, particularly for the alluvium, likely represent the recent past recharge rates more than the longer term.

The results of the CMB analysis are provided in **Table 5-4**. As expected, the recharge rates for the alluvium and regolith are much higher than the Permian (average of 0.3% to 8.6% of annual rainfall, compared to 0.1% of annual rainfall, **Table 5-4**). The highest recharge rate is estimated at GW19_33 which is screened across the alluvium and weathered Rewan Formation. Relatively high recharge rates identified for this bore demonstrate heterogeneity in alluvial/regolith groundwater recharge and possibly preferential recharge zones.

Table 5-4 CMB estimated long term recharge rate (mm/year)

Aquifer	Alluvium	Alluvium / Regolith	Regolith	Permian
count (samples)	44	2	10	264
count (bores)	8	1	3	28
min	0.2	38.0	0.2	0.1
max	9.8	62.9	2.9	3.9
average	2.0	50.4	1.3	0.7
average (% of rainfall)	0.3	8.6	0.2	0.1

5.10.4 Groundwater - Surface Water Interaction

Watercourses within the Project Area are ephemeral and no permanent waterholes have been identified, including along the Isaac River main channel where it traverses the eastern part of the Project Area. There are also no registered groundwater springs or seeps in the Study Area.



A walk over survey was conducted by LJV personnel in July 2023 to search for any permanent pools of water and despite recent rainfall none were identified (Reach Environmental, pers. comm. 20 July 2023). Furthermore, dry season ground-truthing at the Project (AARC, 2024; 2019b) have also identified groundwater does not discharge to the surface or maintain surface pools. As previously discussed, Project monitoring data shows that surface water flow is only sustained for hours to several days following rainfall events (refer to **Section 3.2**). This indicates a distinct lack of groundwater discharge to these watercourses. However, some shallow groundwater recharge is expected to occur directly through the creek beds to the underlying unconsolidated shallow strata (i.e. alluvium) during significant flow events i.e. in the downwards direction.

Measured alluvium/regolith groundwater levels remain well below the base of the surface water channels including the Isaac River, despite some significant variability in basal alluvial groundwater levels in the monitoring record; except for near Burton Gorge Dam where groundwater levels are artificially raised (i.e. near GW07) (**Figure 5-14**).

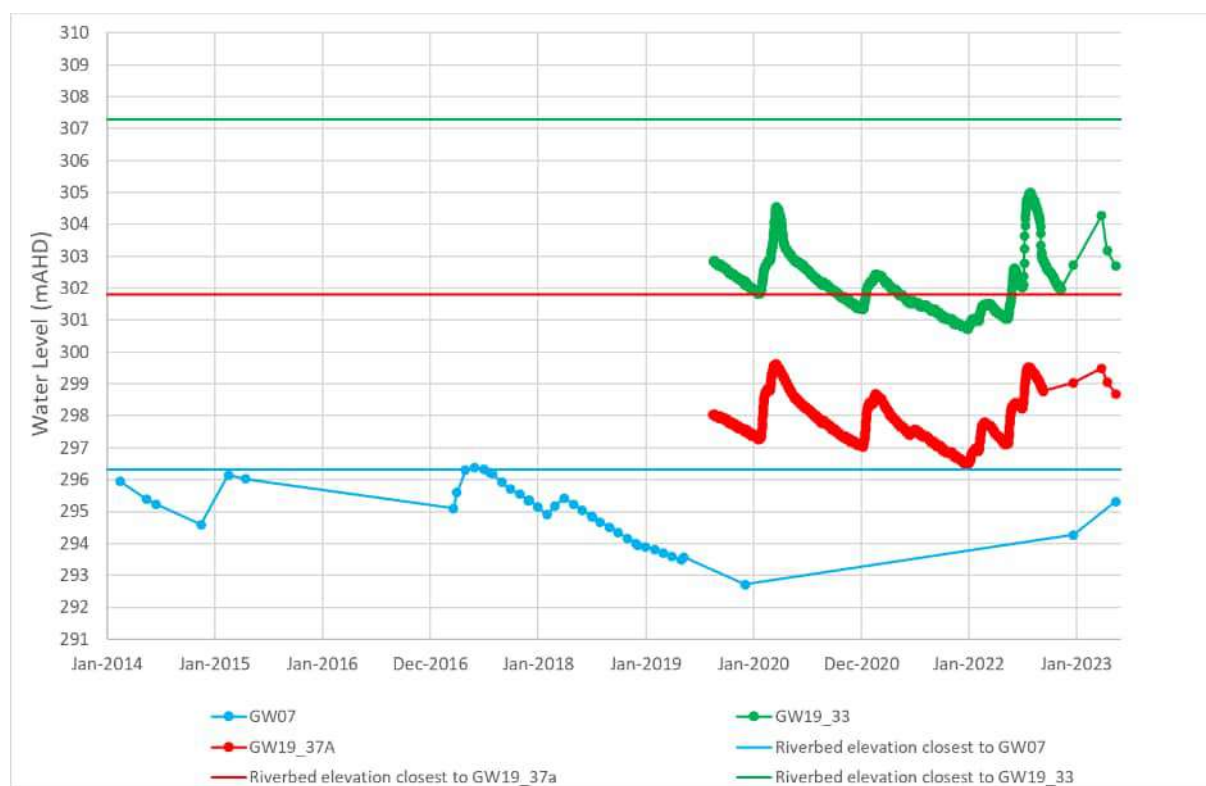
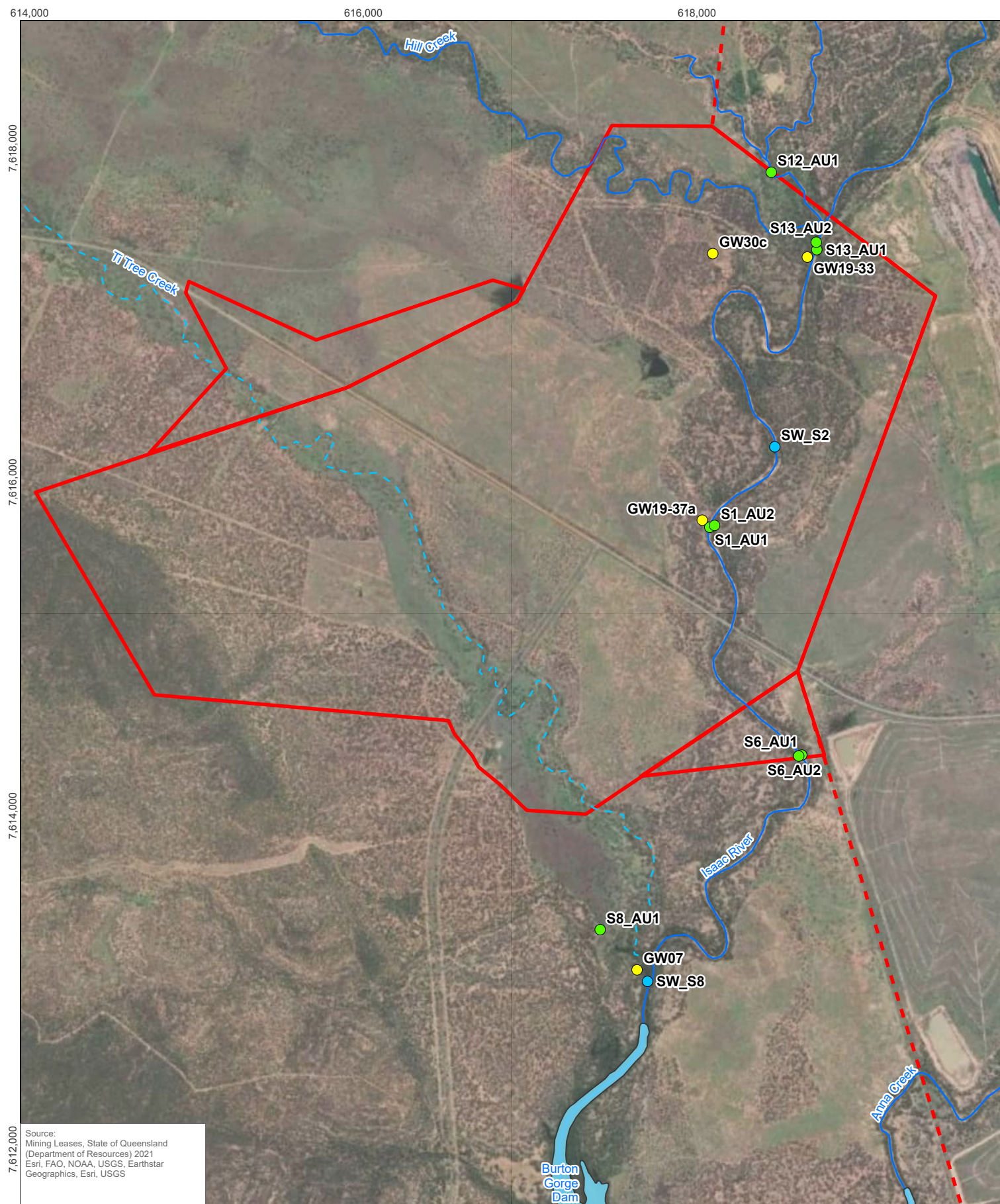


Figure 5-14 Alluvium/regolith bores and closest riverbed elevation

In January 2023, isotopic data (stable isotopes of water) were analysed from groundwater samples collected from Project bores and shallow auger holes from the Isaac River channel and tributaries, as well as two surface water pools in the Isaac River channel following a streamflow event (one in the Burton Gorge Dam tailwaters and one from a temporary pool within the Project Area), as a means to characterise surface water-groundwater interaction (locations shown in **Figure 5-15**) (3D Environmental, 2023).

Similarities between the evaporative fractionation of isotopes between the surface water (labelled SW samples), perched water from auger samples (labelled AU samples) and monitoring bores (labelled GW samples) support the theory that the sampled pooled water associated with the Isaac River channel is a temporary feature and is losing to the below groundwater in the alluvium/regolith (**Figure 5-16**).





Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Esri, FAO, NOAA, USGS, Earthstar
Geographics, Esri, USGS

0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:30,000 at A4

Project Number: 620.31367.00000

Date Drawn: 22-Dec-2023

Drawn by: RB

LEGEND

Isaac River Sampling Location

- Hand auger
- Monitoring Bore
- Surface Water
- Major Watercourse

- - - Non-designated Watercourse
- Project Area (ML 70337, ML 700053 and ML 700054)
- Burton Mining Lease (ML 70109)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

3D ENVIRONMENTAL (2023) WATER SAMPLING LOCATIONS



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FIGURE 5-15

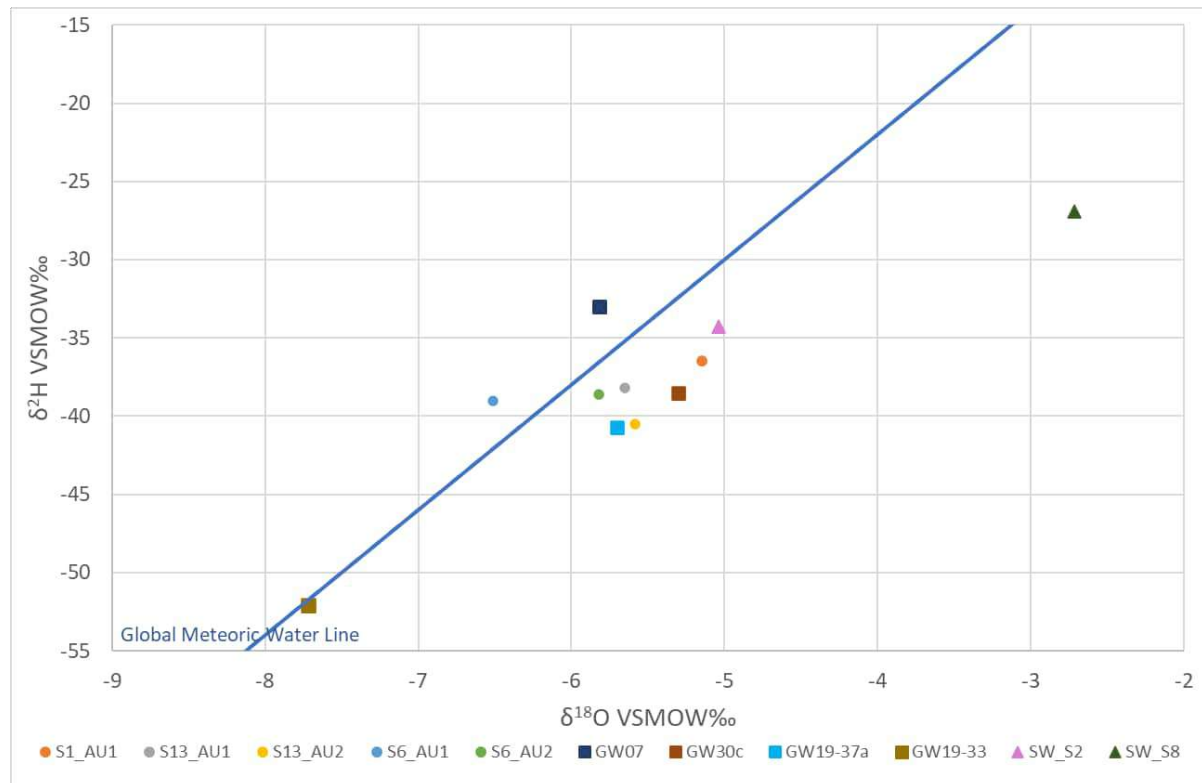


Figure 5-16 Isotopic analysis – Perched Shallow Alluvium from Auger Holes (circles), Basal Alluvium from Bores (squares) and Isaac River Surface Water (triangles)

The isotopic ratios at SW_S8 (Burton Gorge Dam tailwater) show a greater evaporative signature compared to the other samples suggesting that the surface water backed up in the Burton Gorge Dam impoundment has been stagnant for a significant length of time, and significantly longer than the residual pool of water at SW_S2; and that the surface water at SW_S8 is more disconnected from groundwater than SW_S2, further supporting the concept that the pool at SW_S2 is a temporary feature following recent rainfall.

Figure 5-16 also shows that both basal alluvial/regolith groundwater at most bores, and perched alluvial groundwater from auger samples, is similar to the residual pool of water at SW_S2, suggesting the river surface water is a recharge source for the alluvial groundwater samples at these locations. Perched alluvial sample S6_AU1, the basal alluvial sample from GW07 and basal alluvium/regolith sample from GW19-33 show a relatively un-evaporated signature, indicative of relatively rapid diffuse rainfall derived recharge but not the river surface water recharge source seen in the other samples. The different signatures of the S6_AU1, GW19-33 and GW07 bore samples compared to other shallow groundwater samples also indicate that the groundwaters within the shallow units are somewhat separate and not hydraulically well connected across the extent of the Project Area.

The shallow perched alluvial waters sampled by 3D Environmental (2023) from auger holes adjacent the Isaac River was also noted to be very fresh ($\text{EC} < 300 \mu\text{S/cm}$) suggesting recharge is responsive to rainfall and ephemeral river flows and hydraulic separation from the deeper regional basal alluvial water table that reports much higher salinities (517 to 16,500 $\mu\text{S/cm}$ EC, averaging 5,604 $\mu\text{S/cm}$ EC, refer **Section 5.12.1**). This implies that the perched water is susceptible to depletion during reduced rainfall, facilitated by evapotranspiration. The lateral extent of the perched water is thought to be controlled by the narrow extent of coarse sediment, which pinches out towards the floodplain.



The riverbed sands are conceptualised as being dry for the majority of the year and groundwater does not supply a baseflow component to the Isaac River, i.e. the river does not receive significant inflows from groundwater resources. This conceptualisation was based on:

- The ephemeral nature of the Isaac River and its tributaries within the Study Area only flowing following relatively intense rainfall events.
- The limited distribution of coarser channel sands with effective groundwater transmission and storage capacity.
- Groundwater level data from drilling on site indicates that, where groundwater in the alluvium does occur outside of the immediate river channel, groundwater was only encountered in the basal alluvium and the depth to groundwater was generally greater than 8 mBGL.

Burton Gorge Dam is located on the Isaac River immediately downstream of the Project Area. Due to the dam impoundment lake being hydraulically connected to the groundwater of the alluvium and regolith, and the fact that the tail water of the impoundment extends to within around 3 km of the Project Area, it is considered the only potential surface water receptor of groundwater drawdown arising from the Project.

5.11 Hydraulic Properties

Study Area groundwater hydraulic testing includes slug (rising and falling head) tests performed on Project Area monitoring bores by SGS (2014), GHD (2019) and by SLR for the purposes of this groundwater assessment report (refer **Appendix A**), and for some of the adjacent Burton Mine monitoring network bores by SLR (2022) (refer **Appendix B**). This section presents a summary of the available field hydraulic data and comparison to reported hydraulic properties within literature ranges.

5.11.1 Site-specific Hydraulic Conductivity Data

The database of available field results for horizontal hydraulic conductivity at the Project and Burton Mine is summarised in **Table 5-5** and presented graphically as **Figure 5-17**. Field tests from SLR, GHD and SGS are symbolised separately on the plot.

Figure 5-17 shows that the estimated hydraulic conductivity of the alluvium is variable across the available dataset, ranging from 0.01 to 0.3 m/day, which reflects the heterogeneous nature of the alluvial sediments.

Estimated hydraulic conductivity for the regolith was higher than all other formations (1.2 to 4.6 m/day).

Estimated hydraulic conductivity for the Permian coal measures ranged from 0.001 to 0.02 m/day for the coal seams and 0.003 to 0.09 m/day for the interburden and interburden/coals seams.

Figure 5-17 also shows that the hydraulic conductivity of the Permian coal measures generally declines with depth, due to increasing overburden pressure reducing the aperture of secondary porosity features. This is typical of the Permian coal measures in the Bowen Basin (e.g. SLR, 2021).



Table 5-5 Summary Results of all Site-Specific Hydraulic Conductivity Testing (m/day)

Source	Bore	Monitored/Tested Unit	min	max	mean	mean (geo)
SLR (2022)	Anna Creek Downstream	Alluvium	0.3	0.3	0.3	0.3
	Anna Creek Upstream	Alluvium	0.15	0.23	0.19	0.18
SLR (2023a)	GW19_33	Alluvium/Regolith	0.03	0.7	0.2	0.14
	GW19_37a	Alluvium	0.014	0.035	0.022	0.021
	GW19_41a (interburden and coal)	Permian	0.003	0.006	0.005	0.005
	GW19_41a (coal)	Permian	0.01	0.024	0.016	0.016
	GW19_40 (interburden and coal)	Permian	0.006	0.092	0.019	0.013
	GW19_40 (coal)	Permian	0.01	0.028	0.018	0.016
GHD (2018)	GW28a	Leichhardt / Vermont Seam	0.001	0.001	0.001	0.001
	GW30a	Leichhardt / Vermont Seam	0.006	0.011	0.009	0.008
	GW31a	Leichhardt / Vermont Seam	0.001	0.002	0.002	0.001
	GW30b	Burton Rider Seam	0.006	0.015	0.011	0.011
	GW27a	Girrah Seam	0.003	0.007	0.006	0.005
	GW30c	Regolith	1.18	1.45	1.35	1.34
	GW31b	Regolith	1.48	4.61	3.81	3.62
	GW29a	RCM (interburden)	0.009	0.036	0.019	0.018
SGS (2014)	GW04	Burton Rider/ weathered sandstone	2.6 – 3.3	range only		
	GW01, GW07	Alluvium	0.14	0.15	0.15	0.14
	GW20	Tertiary basalts	0.002	one result only		
	GW10, GW11, GW13, LEN486	Leichhardt / Vermont coal sequence	0.0001	0.02	0.009	0.003



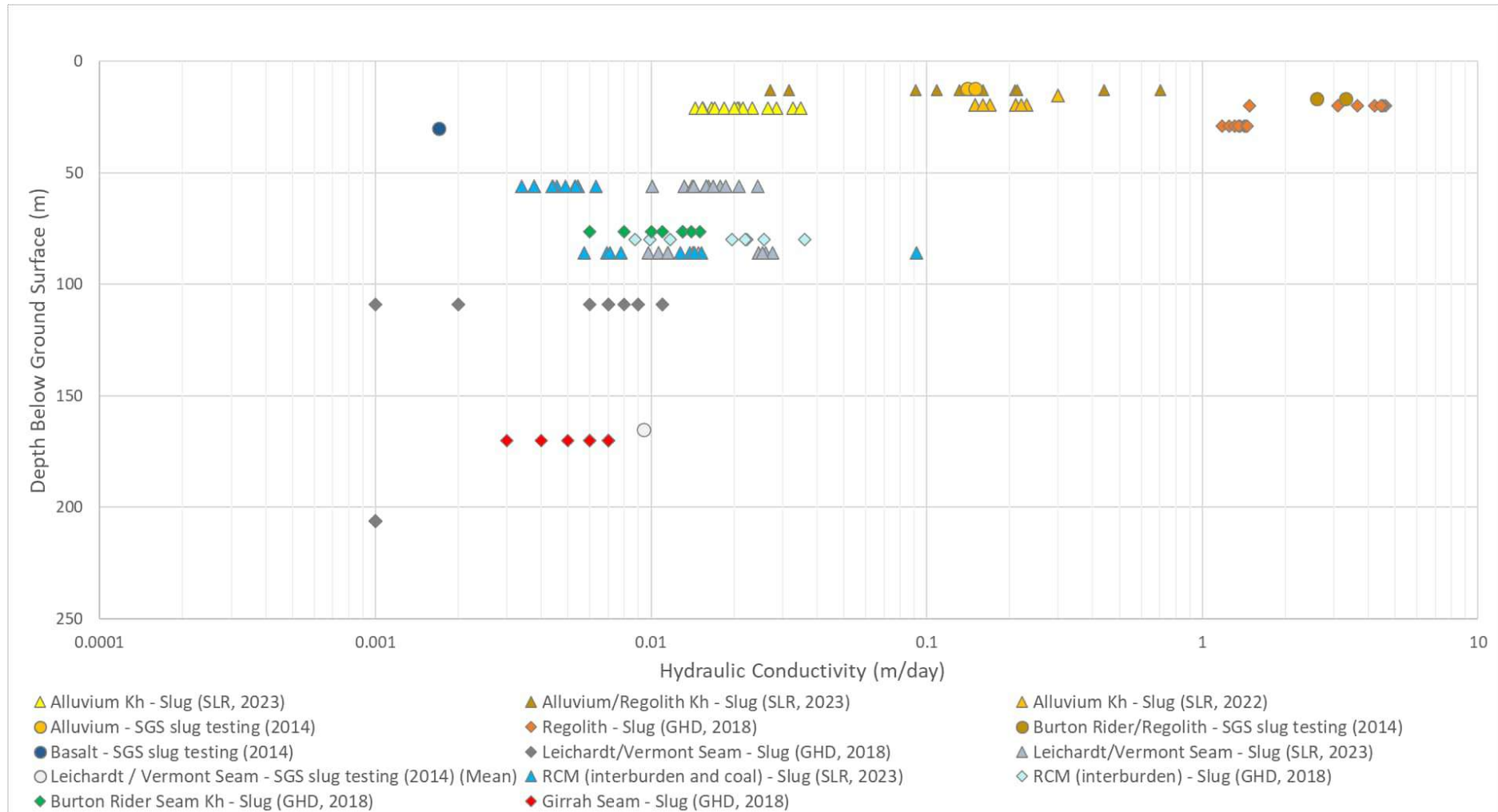
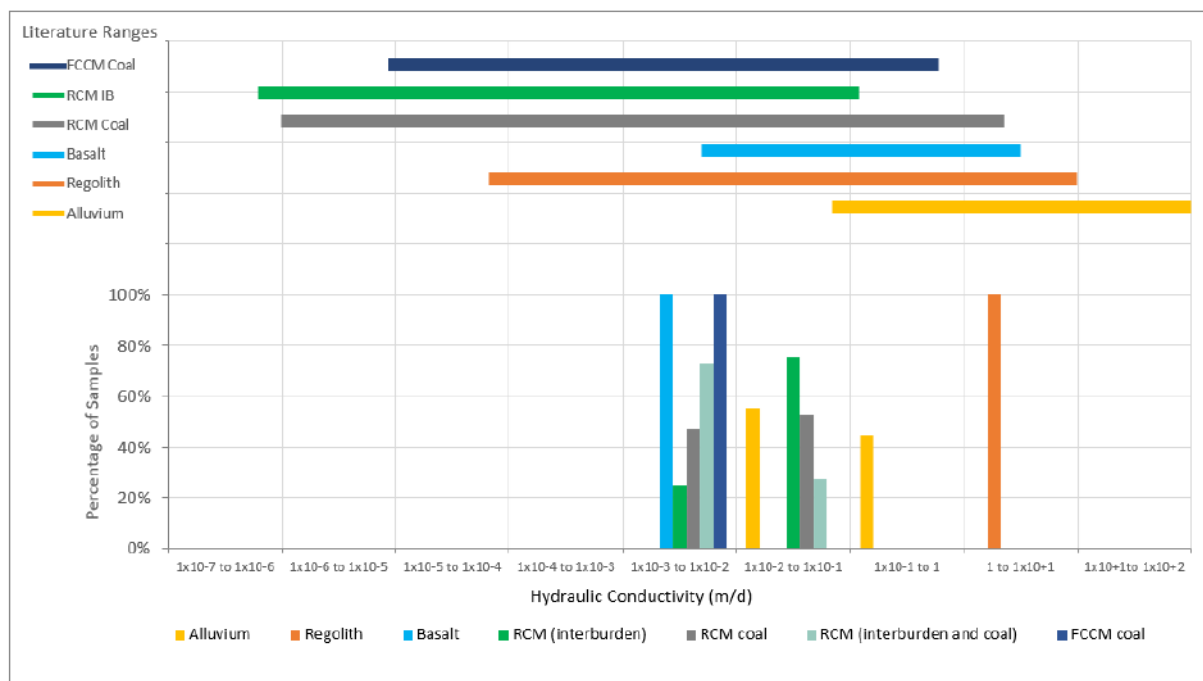


Figure 5-17 Graphical Summary of Results for all Site-Specific Hydraulic Conductivity Testing



5.11.2 Hydraulic Conductivity Ranges & Comparison to Literature Data

A histogram of the spread of estimated horizontal hydraulic conductivity from field testing at New Lenton and Burton is presented in **Figure 5-18**. The results are compared to the range of horizontal hydraulic conductivity obtained from publicly available data based on a number of other studies within the Bowen Basin (SLR, 2023b).



RCM = Rangal Coal Measures, FCCM = Fort Cooper Coal Measures, RCM IB = Rangal Coal Measures Interburden

Figure 5-18 Histogram of Horizontal Hydraulic Conductivity Distribution

The comparison shows that the field results for alluvium, regolith, Rangal Coal Measures and Fort Cooper Coal Measures within the Study Area generally fall within the range of field data collected through other studies across the Bowen Basin. Results recorded from the limited number of tests in the basalt (i.e. at GW20 only) is lower than expected when compared to the documented ranges from literature, reflecting the heterogenous nature of a fractured rock aquifer. Results recorded from the alluvium also had a lower range compared to literature values (0.01 vs 0.1), which reflects the heterogenous nature of the alluvium. Results recorded in literature from the limited number of tests in the Rangal Coal Measures interburden and interburden/coal were higher than expected when compared to regional data for the coal seams. It is expected that in general across the Study Area the coal seams of the Permian coal measures have a higher hydraulic conductivity than the majority of the interburden/overburden, consistent with many other regional studies (SLR, 2021). This is due to the dual porosity of the coal seams, with a primary matrix porosity and a second (dominant) porosity provided by fractures (joints and cleats), which supports the concept of the coal seams themselves forming the dominant groundwater zones of the Permian units.

5.11.3 Faulting

As discussed in **Section 4.3**, extensive thrust faulting and associated folding is present over and surrounding the Project Area. As identified by Jourde *et al.* (2002), faulting can result in higher permeabilities within strata parallel with the fault plane, and lower permeabilities within strata perpendicular to the fault plane. However, this can also be dependent on whether faults are currently active (Paul *et al.*, 2009). Faulting has been inactive within the



Bowen Basin for over 140 million years (Clark *et al.*, 2011), indicating that the fault zones are less likely to act as conduits to flow; this relates to filling of the fractured pore spaces over time through hydrothermal alteration and mineralisation (Uysal *et al.*, 2000). Drill core logs from within the Study Area show that where fractures and faults have been geologically logged, many fractures are “healed” with calcite and siderite (SLR, 2021). This indicates that although the system contains a fracture network, many of the existing fractures are cemented, which reduces the effective permeability of the fracture when compared to any open fracture network.

The differing response to mining activities observed within some monitoring bores may indicate low hydraulic conductivity, and/or compartmentalisation of the groundwater system as a result of structural controls (i.e. faulting), which are known to be significant in and adjacent the Project Area (JBT, 2016). Faults truncate the bedrock, juxtaposing coal seams against lower permeability interburden bedrock. In some cases, these faults may cause damming on one side of the fault, resulting in long groundwater residence times (JBT, 2016). The large offset (>700 m throw) Burton Range Fault on the western side of the Project Area is currently predicted to act as a barrier to east-west groundwater flow with the juxtaposition of the Triassic strata on the west to the Permian Coal Measures on the east.

Downhole hydraulic testing was conducted on fault zones in the Rangal Coal Measures for the Winchester South Project south of the Project Area (SLR, 2020d). This testing is deemed directly applicable to the Project as the tested geologies are practically identical. Fault zones were confirmed to be intersected at these drill holes due to the presence of fracturing, calcite infills, and slickensides in core obtained from the drill holes, all of which are considered an indicative marker of faulting. Testing results showed relatively low hydraulic conductivity values ranging from 6.93×10^{-5} to 2.07×10^{-3} m/day, one to two orders of magnitude lower than regional data values for the unfaulted Rangal Coal Measures (refer **Figure 5-18**). These properties indicate that the faulting zones intercepted and tested are ‘healed’ and not pathways for preferential groundwater flow, given their hydraulic conductivities are generally lower than the adjacent Permian coal measures strata.

Laboratory geotechnical analysis of core samples of interburden immediately above and below coal seams proximal to a fault zone was also undertaken in support of the groundwater assessment for the Winchester South Project south of the Project Area (SLR, 2020d). The samples recorded vertical hydraulic conductivity (K_v) of 50% to 160% of horizontal hydraulic conductivity (K_h); i.e. although some samples show a typical K_v of somewhat less than K_h , some samples also suggest greater K_v than K_h , which may be indicative of preferential vertical flow pathways associated with faulting. However, it was also noted that these areas of increased K_v are limited vertically, with samples collected from the same drill hole at horizons further above and below the fault zone (interburden and Rewan Group) returning a lower K_v of between 11% and 76% of K_h . This highlights the limitations of bore scale test methods (such as core or slug testing) that may bias results compared to methods that yield more aquifer scale estimates of hydraulic properties, such as pumping tests.

The impact of faults on groundwater flow within the Study Area was also assessed as part of the Bowen Gas Project (Arrow Energy, 2012). Kinnon (2010) assessed the movement of water and gas across a series of faults in the Bowen Basin using stable isotope and water quality analysis to assess zones of potential recharge, water mixing and flow pathways. Higher gas production rates were also observed on either side of a major fault, with differences in isotopic compositions of produced water for wells north and south of the major fault line at similar depths, implying little communication across the fault boundary, and suggesting that the fault acts as a horizontal permeability barrier to water and gas flow. The results of the study showed that hydrogeological compartmentalisation was evident and that this was due to the structural geology (faulting) in the basin.



Based on a detailed literature review of the effect of faulting on groundwater flow, Coffey (2014) developed a conceptual model for fault zone hydraulic characterisation in the Bowen Basin (**Figure 5-19**), largely based on Jourde *et al.* (2002) and Flodin *et al.* (2001). This conceptualisation provided a means of inferring hydraulic conductivities of the fault core and the fault damage zone from regional hydraulic conductivity, with the fault core typically one to three orders of magnitude lower conductivity than the regional host rock, and the damage zone approximately an order of magnitude higher.

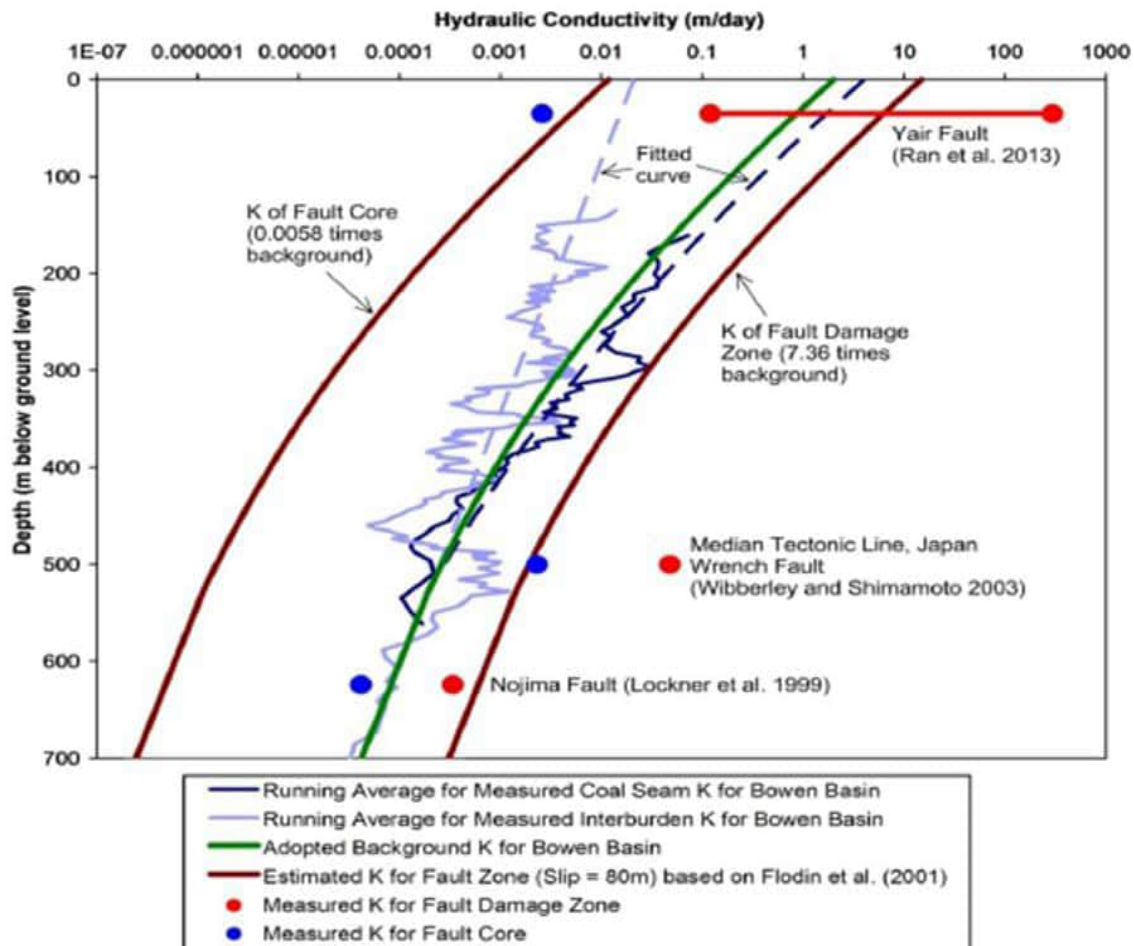


Figure 5-19 Faulting Conceptual Model Developed by Coffey (2014)



5.12 Baseline Water Quality

This section reports on the chemical characteristics and the resulting possible beneficial uses of groundwater within the various hydrogeological units within the Project Area. Baseline water quality data has been collected for the Project Area monitoring bores between 2006 and 2023. The baseline water quality is discussed from **Section 5.12.1** to **5.12.3** and summary statistics of historical data provided as **Appendix C**.

5.12.1 EC and pH

Baseline (pre-Project between 2006 and 2023) groundwater quality monitoring data collected for the Project monitoring bores (**Figure 5-20** to **Figure 5-23**) indicates the following:

- Alluvium: Mildly acidic to moderately alkaline pH (6.3 to 8.4, averaging near neutral at 7.1) and fresh to saline water quality (517 to 16,500 $\mu\text{S}/\text{cm}$ EC, averaging 5,604 $\mu\text{S}/\text{cm}$ EC).
- Regolith: Mildly acidic to mildly alkaline pH (6.7 to 7.9, averaging near neutral at 7.1) and mildly brackish to saline water quality (1,549 to 12,400 $\mu\text{S}/\text{cm}$ EC, averaging 9,902 $\mu\text{S}/\text{cm}$ EC); and
- Permian coal seams: Mildly acidic to moderately alkaline pH (6.3 to 8.5, averaging 7.5) and mildly brackish to saline water quality (2,030 to 18,450 $\mu\text{S}/\text{cm}$ EC, averaging 9,921 $\mu\text{S}/\text{cm}$ EC).

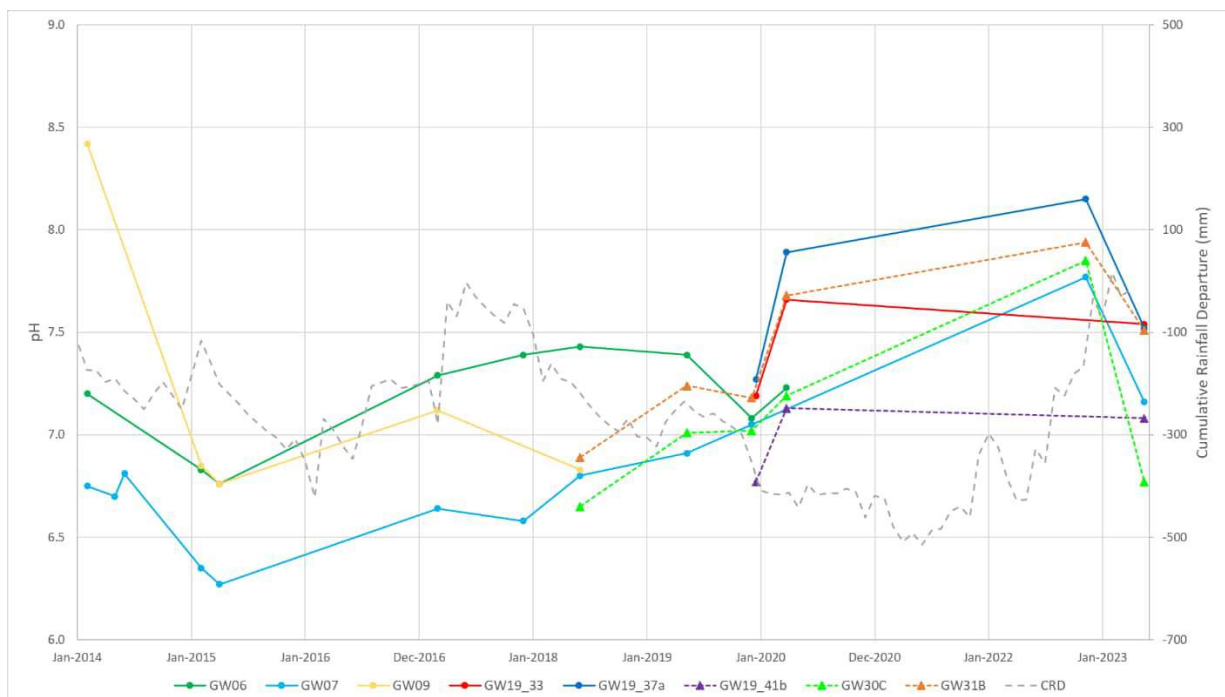


Figure 5-20 Baseline Groundwater pH – Alluvium and Regolith Bores



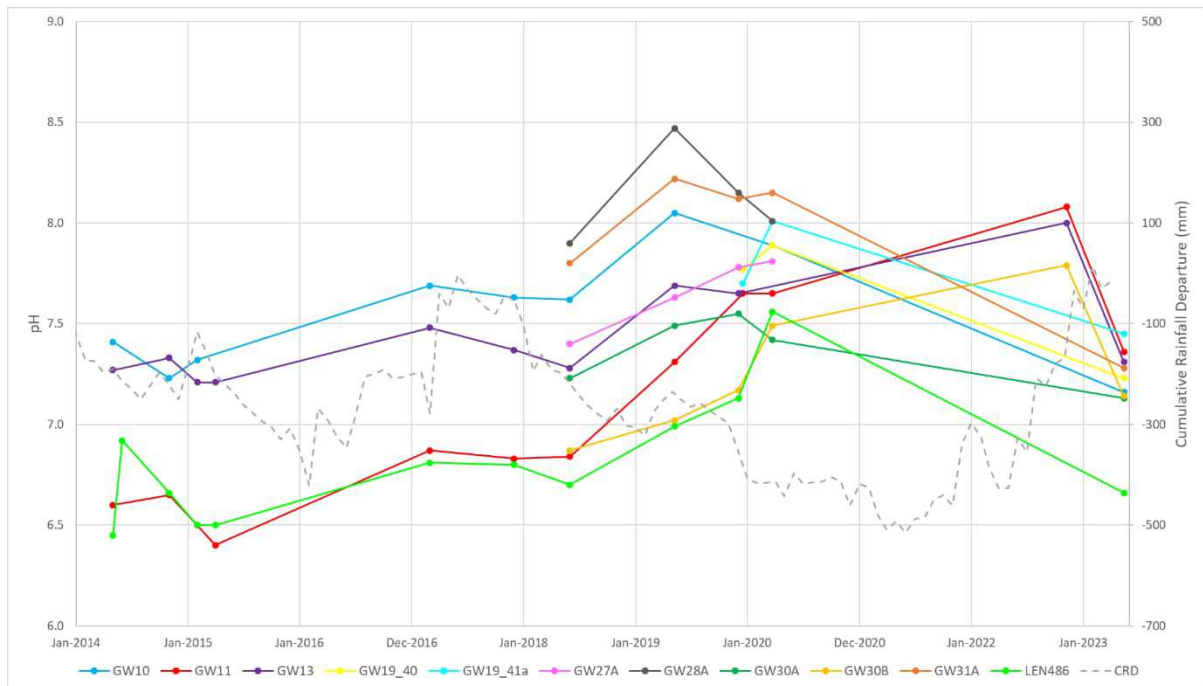


Figure 5-21 Baseline Groundwater pH – Permian Bores

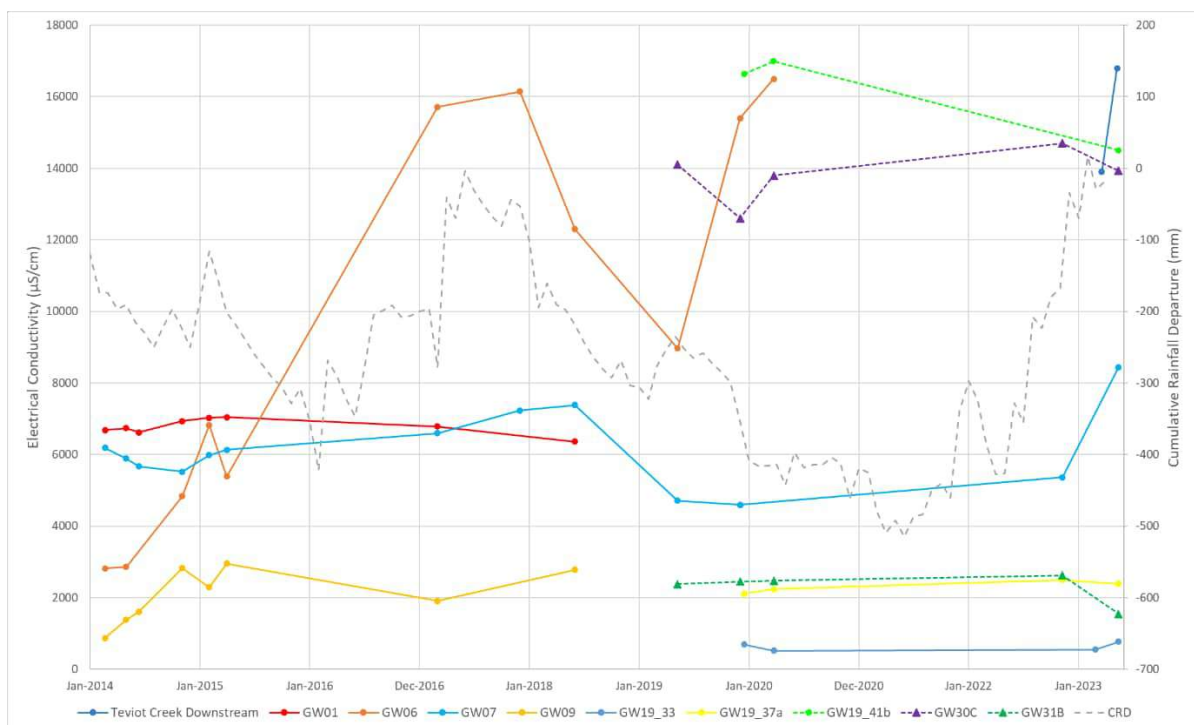


Figure 5-22 Baseline Groundwater EC - Alluvium and Regolith Bores



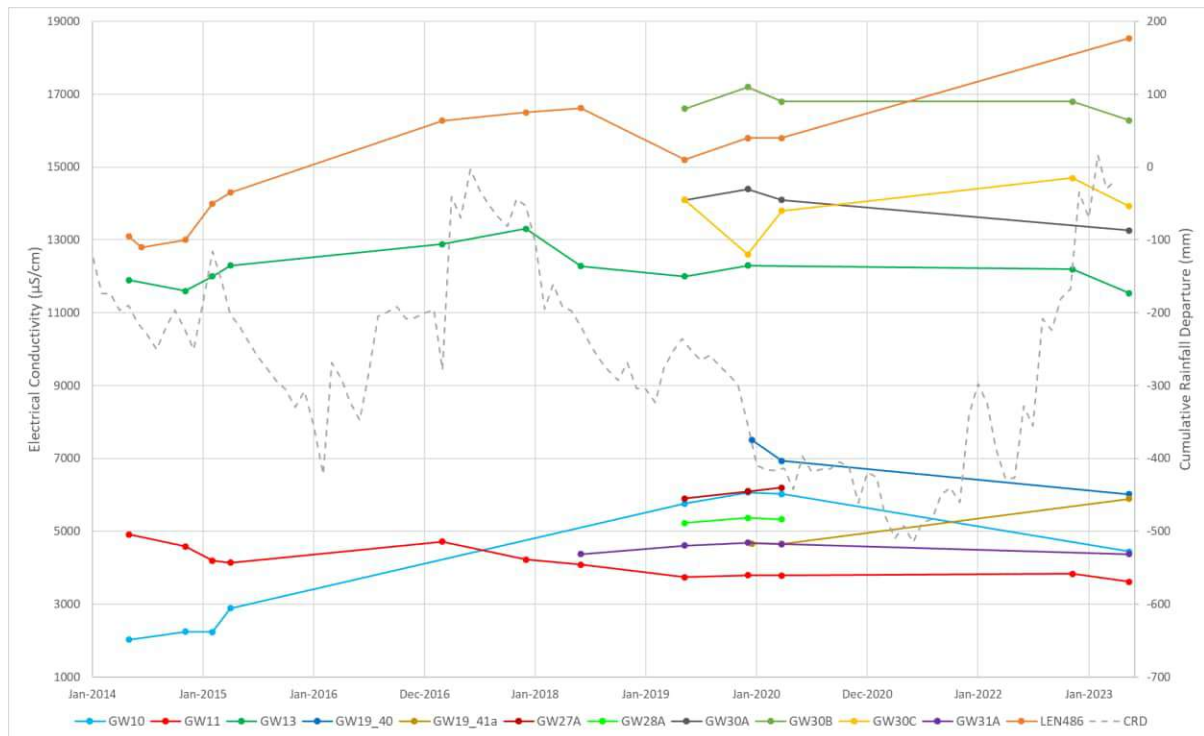


Figure 5-23 Baseline Groundwater EC - Permian Bores

5.12.2 Water Type

The proportions of the major anions and cations were used to determine the hydrochemical facies of groundwaters sampled. The anion-cation balance from Project Area monitoring bores is shown on the Durov plots in **Figure 5-24** to **Figure 5-26**. The results show the following:

- Alluvium bores GW06, GW07 and GW01 are Na-Cl water dominant, whilst GW09 and GW19-37a are Na-SO₄ water dominant and GW19-33 (alluvium/regolith) is of Mg-HCO₃ water dominance (**Figure 5-24**).
- Basalt bore GW20 is of Na-HCO₃ water dominance. Regolith bores GW19, GW30c and GW31b are Na-Cl water dominant (**Figure 5-25**).
- All Permian coal measures bores are of Na-Cl water dominance (**Figure 5-26**).



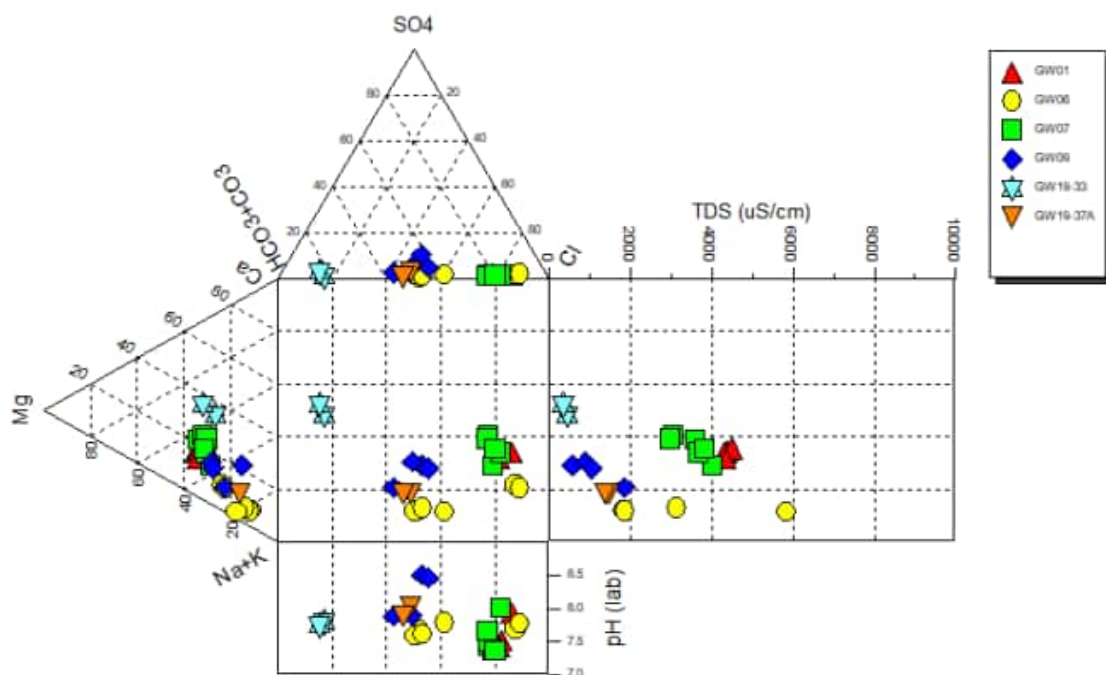


Figure 5-24 Durov Diagram – Alluvium Bores

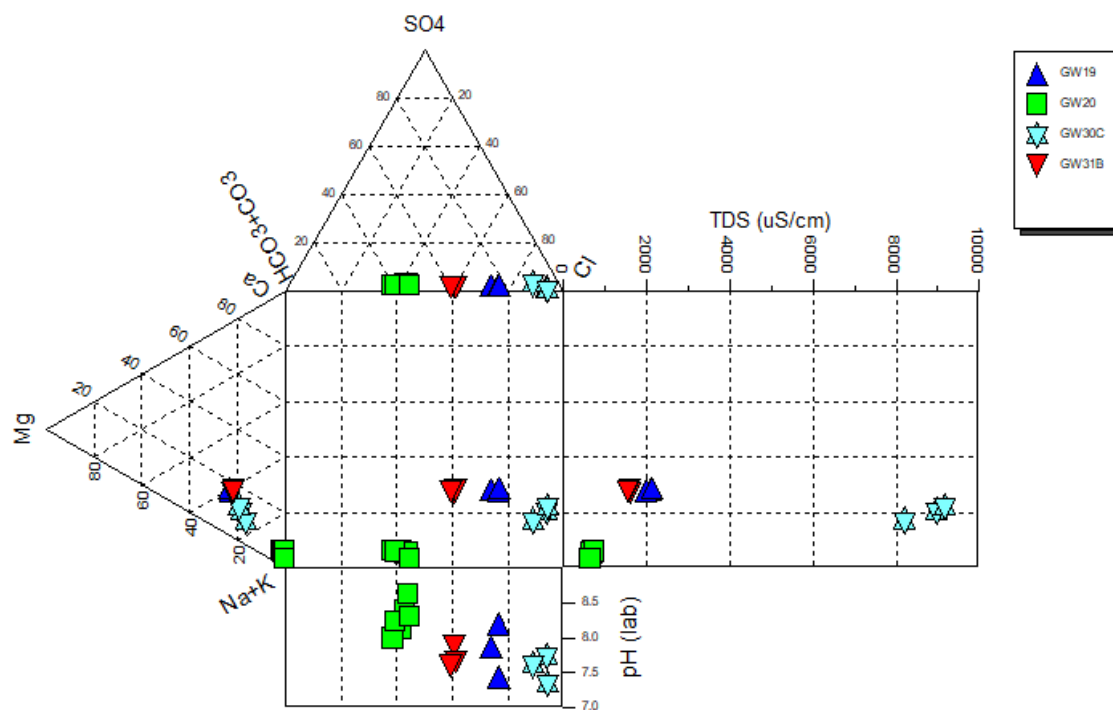


Figure 5-25 Durov Diagram – Basalt and Regolith Bores



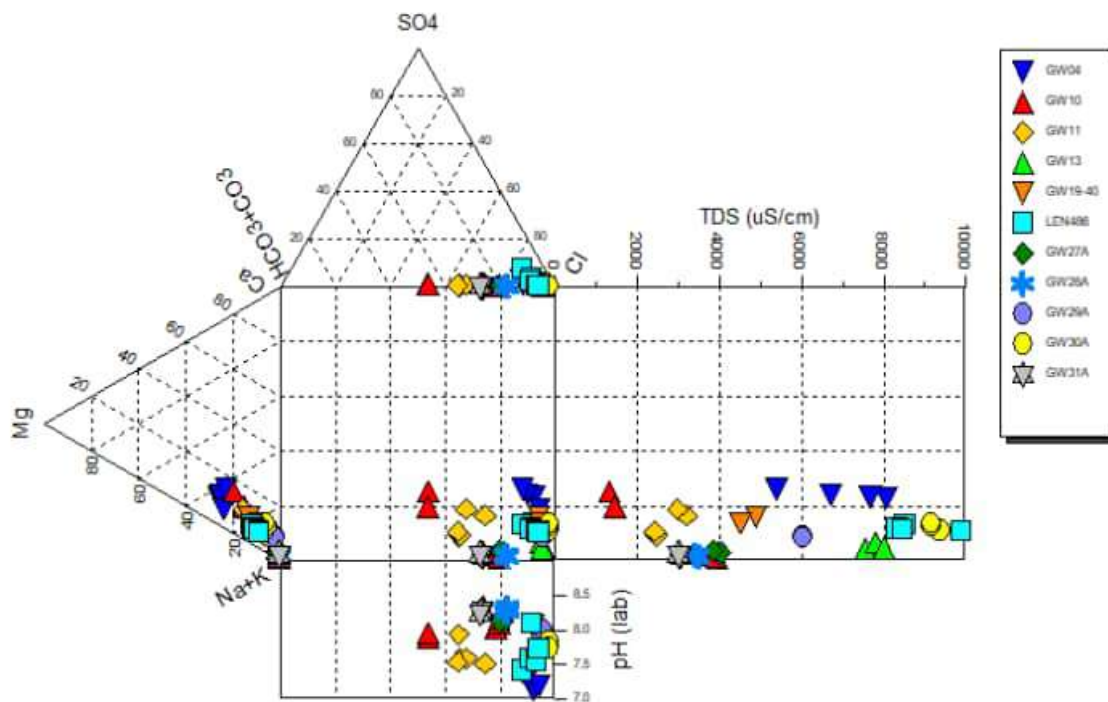


Figure 5-26 Durov Diagram – Permian Bores

5.12.3 Beneficial Groundwater Use

Groundwater resources within the vicinity of the Project are scheduled under the Queensland *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (under the *Environmental Protection Act 1994*) as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310 – Fitzroy Basin groundwaters). The legislated Environmental Values (EVs) for these groundwaters (**Table 5-6**) are:

- Biological integrity of aquatic ecosystems – these occur where groundwater baseflow supports streams and water holes to some extent (e.g. seasonally or permanently).
- Human use EVs:
 - Suitability of water supply for irrigation – where groundwater is used to grow crops and pastures for commercial purposes.
 - Farm water supply/use – where groundwater is used to provide domestic supply and support growing of domestic produce.
 - Stock watering – where groundwater is used to provide stock water supplies.
 - Drinking water supply – where groundwater is used for potable water supply.
 - Primary recreation – where groundwater supports recreational use that involves direct contact and a high probability of being swallowed, e.g. diving, swimming, water skiing.
 - Cultural and spiritual values – where groundwater supports both indigenous and non-indigenous values, e.g. recreational fishing, heritage, ecology.



Table 5-6 Environmental Values of Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin

Environmental Values (DEHP, 2011)											
Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human Consumption	Primary Recreation	Secondary Recreation	Visual Recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
✓	✓	✓	✓			✓			✓		✓

Note that the review of groundwater receptors presented in this report indicates no evidence of use of groundwater for the Drinking water EV.

The EPP Water and Wetland Biodiversity provides water quality objectives (WQOs) for the scheduled EVs in Fitzroy Basin groundwaters. WQOs are long-term goals for water quality management and the purpose of the WQOs is to support and protect EVs. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural, economic).

Where groundwater quality analysis results exceed a particular WQO for a particular EV, it is considered indicative that the groundwater may be unsuitable for supporting that particular EV.

The WQOs for groundwater in the Project Area are shown in **Table 5-7**.

WQ1310 also provides limited WQOs specifically for aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs vary across the Fitzroy Basin and are defined on the basis of groundwater Chemistry Zones. These WQOs are classified by groundwater depth ('shallow' being <30 m depth, and 'deep' being >30 m depth). The management intent of each WQO zone is to maintain each of 20th, 50th and 80th percentile values. However, the Project Area lies outside of any of the defined Chemistry Zones within WQ1310, noting that Chemistry Zones are not defined in areas where there is insufficient information available to establish a WQO (DEHP, 2011). Regardless of the lack of defined WQOs specifically for underground aquatic ecosystem protection in groundwaters in the Project Area, the WQO parameters identified for underground aquatic ecosystem protection in Fitzroy Basin groundwaters under WQ1310 remain relevant to the protection of the aquatic ecosystem EV. These parameters are shown in **Table 5-7** for completeness.

Table 5-7 Water Quality Objectives for Isaac River Sub-basin Environmental Values (WQ1310)

Water Quality Indicator	Unit	Isaac River Sub-basin EVs		Aquatic ecosystem protection in Fitzroy Basin groundwaters ³	
		Irrigation ¹	Stock ²	Shallow (<30m)	Deep (>30m)
EC	µS/cm	-	7463 ^{4*}	n/a ⁵	n/a ⁴
pH	-	-	-	n/a ⁵	n/a ⁴
Hardness	mg/L as CaCO ₃	-	-	n/a ⁵	n/a ⁴



Water Quality Indicator	Unit	Isaac River Sub-basin EVs		Aquatic ecosystem protection in Fitzroy Basin groundwaters ³	
		Irrigation ¹	Stock ²	Shallow (<30m)	Deep (>30m)
Alkalinity	mg/L	-	-	n/a ⁵	n/a ⁴
Bicarbonate	mg/L	-	-	n/a ⁵	n/a ⁴
Calcium	mg/L	-	-	n/a ⁵	n/a ⁴
Chloride	mg/L	-	-	n/a ⁵	n/a ⁴
Sodium	mg/L	-	-	n/a ⁵	n/a ⁴
Sulfate	mg/L	-	-	n/a ⁵	n/a ⁴
Nitrate	mg/L	-	-	n/a ⁵	n/a ⁴
Silicon Dioxide	mg/L	-	-	n/a ⁵	n/a ⁴
Fluoride	mg/L	1	2	n/a ⁵	n/a ⁴
Copper	mg/L	0.2	1*	n/a ⁵	n/a ⁴
Beryllium	mg/L	0.1	-	-	-
Aluminium	mg/L	5	5	-	-
Arsenic	mg/L	0.1	0.5	-	-
Boron	mg/L	0.5	5	-	-
Cadmium	mg/L	0.01	0.01	-	-
Chromium	mg/L	0.1	1	-	-
Cobalt	mg/L	0.05	1	-	-
Lead	mg/L	2	0.1	-	-
Manganese	mg/L	0.2	-	n/a ⁵	n/a ⁵
Mercury	mg/L	0.002	0.002	-	-
Molybdenum	mg/L	0.01	0.15	-	-
Nickel	mg/L	0.2	1	-	-
Selenium	mg/L	0.02	0.02	-	-
Uranium	mg/L	0.01	0.2	-	-
Vanadium	mg/L	0.1	-	-	-
Zinc	mg/L	2	20	n/a ⁵	n/a ⁵
Iron	mg/L	0.2	-	n/a ⁵	n/a ⁵
Lithium	mg/L	2.5	-	-	-
Magnesium	mg/L	-	-	n/a ⁵	n/a ⁵
SAR	mg/L	-	-	n/a ⁴	n/a ⁴
RAH	meq/L	-	-	n/a ⁴	n/a ⁴

1. Table 9 of DEHP (2011) Isaac River Sub-basin Environmental Values and Water Quality Objectives: Irrigation water (Long term value)

2. Table 10 and Table 11 of DEHP (2011) Isaac River Sub-basin Environmental Values and Water Quality Objectives: Stock (* = cattle)

3. Table 14 of DEHP (2011) Isaac River Sub-basin Environmental Values and Water Quality Objectives.

4. Converted from TDS as $TDS = 0.67 \times EC$



5. n/a = not applicable; parameter identified in WQ1310 however the Project lies outside of WQ1310 Chemistry Zones and therefore a WQO is not defined for this parameter.
6. “-” = parameter not identified in WQ1310.

In the absence of any defined WQO relevant to the Project area in the EPP Water and Wetland Biodiversity for aquatic ecosystems, as demonstrated above, the ANZG (2018) guideline for aquatic ecosystem protection for slightly to moderately disturbed systems (95% level of protection) is provided in **Table 5-8** as a surrogate indicator.

Table 5-8 Water Quality Guidelines for Aquatic Ecosystem Protection (ANZG, 2018)

Water Quality Indicator	Unit	Guideline Value
pH	-	6.5 - 8.5
Aluminium	mg/L	0.055 ¹
Arsenic	mg/L	0.013 ²
Boron	mg/L	0.94
Cadmium	mg/L	0.0002
Chromium	mg/L	0.001 ³
Cobalt	mg/L	0.0014 ⁴
Copper	mg/L	0.0014
Lead	mg/L	0.0034
Manganese	mg/L	1.9
Mercury	mg/L	0.0006 ⁵
Molybdenum	mg/L	0.034 ⁴
Nickel	mg/L	0.011
Selenium	mg/L	0.005 ⁵
Uranium	mg/L	0.0005 ⁴
Vanadium	mg/L	0.006 ⁴
Zinc	mg/L	0.008

1. pH >6.5
2. More conservative value for As(V) used
3. More conservative value for Cr(VI) used
4. No level of species protection defined
5. 99% level of protection as recommended for slightly to moderately disturbed systems (for bioaccumulating toxicants)

A comparison to the 80th percentile of available Project Area water quality data to the relevant EV protection guideline levels provided in **Table 5-7** and **Table 5-8** is presented in **Table 5-9** and summarised below.

Alluvium monitoring bore data generally suggests that alluvial groundwater from the Project Area is unsuitable for supporting the irrigation water EV with respect to fluoride, boron, iron, manganese, molybdenum or uranium. Alluvium groundwater data also generally indicates it is not suitable for supporting the aquatic ecosystems EV with respect to boron, chromium, cobalt, copper, nickel, uranium, vanadium or zinc. The 80th percentile values at the alluvial bores did not exceed any of the stock watering EV guidelines, except for EC (salinity) at GW06, suggesting that alluvial groundwater is mostly suitable for stock watering.

Regolith monitoring bore data generally suggests that groundwater from the regolith is unsuitable supporting the irrigation water EV with respect to boron, iron, manganese or uranium. Regolith groundwater data also suggests that is generally unsuitable to support the aquatic ecosystems EV with respect to cobalt, copper, nickel, uranium or zinc. The data also



suggests that regolith groundwater is generally unsuitable for supporting the stock watering EV with respect to EC (salinity).

Groundwater quality data from the bore screened in the basalt (GW20) suggests that it is not suitable for supporting the aquatic ecosystems EV with respect to pH, cadmium and copper. The 80th percentile statistics for this bore did not exceed any of the stock watering or irrigation EV guidelines, suggesting that the basalt groundwater is suitable for supporting the stock watering and irrigation EVs.

As with the Alluvium and Regolith, Permian monitoring bore data generally suggests that Permian groundwater at the Project Area is also unsuitable supporting the irrigation EV with respect to fluoride, boron, iron, manganese or molybdenum and the aquatic ecosystems EV with respect to pH, aluminium, arsenic, boron, cobalt, copper, molybdenum, uranium or zinc. The 80th percentile values at the Permian bores are above the stock watering EV with respect to EC (salinity) at four out of eleven bores, suggesting that Permian groundwater is suitable to support stock watering across most Permian bores, but approximately one third of Permian bores report groundwater salinities above stock tolerance levels.

Generally speaking, there is a high degree of observed variability in groundwater quality between hydrostratigraphic units, and between individual bores within individual hydrostratigraphic units. This inherent variability has been incorporated within the Project's site specific groundwater quality impact trigger derivation SLR (2020e).



Table 5-9 Comparison of Project Area monitoring bore data with WQOs for Isaac River sub-basin EVs

Parameter		pH^	EC	Fluoride	Aluminium	Arsenic	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Uranium	Vanadium	Zinc
		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Irrigation (DEHP, 2011) ¹				1	5	0.1	0.1	0.5	0.01	0.1	0.05	0.2	0.2	2	0.2	0.002	0.01	0.2	0.02	0.01	0.1	2
Stock (DEHP 2011) ²			7463	2	5	0.5		5	0.01	1	1	1		0.1		0.002	0.15	1	0.02	0.2		20
Aquatic (ANZG 2018) ³		6.5 - 8.0			0.055	0.013		0.94	0.0002	0.001	0.0014	0.0014		0.0034	1.9	0.0006	0.034	0.011	0.005	0.0005	0.006	0.008
Alluvium	GW19_33	7.3 - 7.6	655	-	0.026	0.0044	0.0005*	0.07	0.00005*	0.0008	0.0016	0.0046	1.964	0.0005*	0.6612	0.00005*	0.0005*	0.0124	0.005*	0.0014	0.005*	0.022
	GW19_37a	7.4 - 8	2396	-	0.048	0.0084	0.0005*	0.23	0.00005*	0.0011	0.0007	0.1252	1.634	0.0011	0.4178	0.00005*	0.0128	0.0244	0.005*	0.002	0.005*	0.0336
	GW07	6.6 - 7	6010	0.46	0.005	0.0005*	0.0005*	0.292	0.0002	0.0005*	0.0032	0.002	0.12	0.0005*	0.7296	0.00005*	0.0052	0.007	0.005*	0.008	0.005*	0.013
	GW01	6.5 - 6.8	7030	0.6	0.005	0.0052	0.0005*	0.334	0.00014	0.0005*	0.0027	0.0006	0.054	0.0005*	0.76	0.00005*	-	0.0056	0.005*	0.011	0.014	0.0052
	GW06	7 - 7.4	12828	1.66	0.005	0.0056	0.0005*	1.526	0.00005*	0.0005*	0.0005*	0.0008	3.156	0.0005*	1.0364	0.00005*	-	0.006	0.005*	0.029	0.005*	0.0066
	GW09	6.8 - 7.4	2830	0.54	0.005	0.0052	0.0005*	0.22	0.00011	0.0005*	0.0005*	0.0024	0.248	0.0005*	0.3368	0.00005*	-	0.0018	0.005*	0.0074	0.008	0.0195
Regolith	GW31B	7.2 - 7.7	2530	-	0.005	0.0005*	0.0005*	0.29	0.00005*	0.0005*	0.0005*	0.0005*	0.025	0.0005*	0.021	0.00005*	0.0033	0.0005*	0.005*	0.002	0.005*	0.008
	GW30C	6.8 - 7.2	14340	-	0.005	0.0005*	0.0005*	0.54	0.00005*	0.0005*	0.0005*	0.0005*	3.24	0.0005*	0.238	0.00005*	0.0025	0.001	0.005*	0.008	0.005*	0.006
	GW19_41b	6.8 - 7.1	17648	-	0.005	0.0005*	0.0005*	0.338	0.00005*	0.0009	0.0074	0.1508	1.276	0.0005*	1.156	0.00005*	-	0.0206	0.005*	0.0146	0.005*	0.0424
Basalt	GW20	7.5 - 8.1	1160	-	0.044	0.0005*	0.0005*	0.077	0.00068	0.0005*	0.0005*	0.0026	0.07	0.0005*	0.011	0.00005*	-	0.0005*	0.005*	0.0005*	0.005*	0.0025
Permian	GW30B	7 - 7.5	16960	0.2	0.01	0.012	0.0005*	0.36	0.00005	0.0005*	0.0005*	0.0005*	1.96	0.0005*	0.111	0.00005*	0.0042	0.006	0.005*	0.0005*	0.005*	0.023
	GW10	7.3 - 7.8	5976	1.16	0.048	0.0074	0.0005*	0.94	0.00005*	0.0005*	0.0005*	0.0014	0.356	0.0005*	0.0444	0.00005*	0.036	0.0038	0.005*	0.0005*	0.005*	0.0062
	GW11	6.6 - 7.6	4434	0.2	0.01	0.0006	0.0005*	0.4	0.00005*	0.0005*	0.0005*	0.0005*	0.666	0.0005*	0.0294	0.00005*	0.0025	0.0012	0.005*	0.0005*	0.005*	0.0134
	GW13	7.3 - 7.7	12300	0.3	0.008	0.011	0.0005*	0.644	0.00005*	0.0005*	0.0005*	0.001	0.624	0.0005*	0.0264	0.00005*	0.0132	0.0032	0.005*	0.0005*	0.005*	0.013
	GW28A	8 - 8.3	5354	1.5	0.06	0.0094	0.0005*	0.782	0.00005*	0.0007	0.0005*	0.0024	0.025	0.0005*	0.0198	0.00005*	-	0.002	0.005*	0.0005*	0.005*	0.0068
	GW30A	7.2 - 7.5	14280	0.3	0.016	0.0052	0.0005*	0.332	0.00005*	0.0005*	0.001	0.0006	1.338	0.0005*	0.0628	0.00005*	0.0005*	0.0054	0.005*	0.0006	0.005*	0.0214
	GW31A	7.7 - 8.2	4674	0.9	0.062	0.0036	0.0005*	0.586	0.00005*	0.0005*	0.0005*	0.0006	0.116	0.0005*	0.0096	0.00005*	0.024	0.002	0.005*	0.0006	0.005*	0.006
	LEN486	6.5 - 7	15800	0.14	0.005	0.001	0.0005*	1.314	0.00005*	0.0005*	0.0008	0.002	3.39	0.0005*	0.1028	0.00005*	0.009	0.006	0.005*	0.0008	0.005*	0.013
	GW27A	7.5 - 7.8	6140	0.6	0.02	0.001	0.0005*	0.46	0.00005*	0.0005*	0.0005*	0.0006	0.204	0.0005*	0.01	0.00005*		0.0008	0.005*	0.0005*	0.005*	0.0082
	GW19_40	7.4 - 7.8	7396	-	0.036	0.0052	0.0005*	0.38	0.00005*	0.0005*	0.0038	0.0005*	1.208	0.0005*	0.2544	0.00005*	0.007	0.0078	0.005*	0.0026	0.005*	0.0064
	GW19_41a	7.6 - 7.9	4668	-	0.026	0.0026	0.0005*	0.332	0.00005*	0.0005*	0.0008	0.0005*	0.71	0.0005*	0.4126	0.00005*	0.001	0.0032	0.005*	0.0022	0.005*	0.0134

1. DEHP 2011 Isaac River Sub Basin WQO - Irrigation long term value (Table 5-7)
2. DEHP 2011 Isaac River Sub Basin WQO - Stock (Table 5-7)
3. ANZG Aquatic ecosystem protection (Table 5-8)
Highlighted values exceed relevant WQO
^ = 20th & 80th percentile values
* = LOR x 0.5 per DES (2021)
Red highlight = exceeds multiple guideline values



5.13 Groundwater Usage - Anthropogenic

A search of the Queensland Government's Registered Groundwater Bore Database (GWBD) (DoR, 2023) was carried out for registered bores within 10 km of the Project Area. The search returned 19 bores with registered uses as mine monitoring, petroleum exploration, and unknown (1 bore) (**Figure 5-27**). The bore listed as unknown (RN85414) is located approximately 8.7 km northeast of ML 70337, and is 27.4 m deep.

A landholder bore census was conducted by GHD in December 2018 for an area extending 10 km from the Project Area (GHD, 2019). The census identified eight unregistered bores (**Table 5-10** and **Figure 5-27**). The results of the survey indicated that one of the bores was in use while the others were not currently in use.

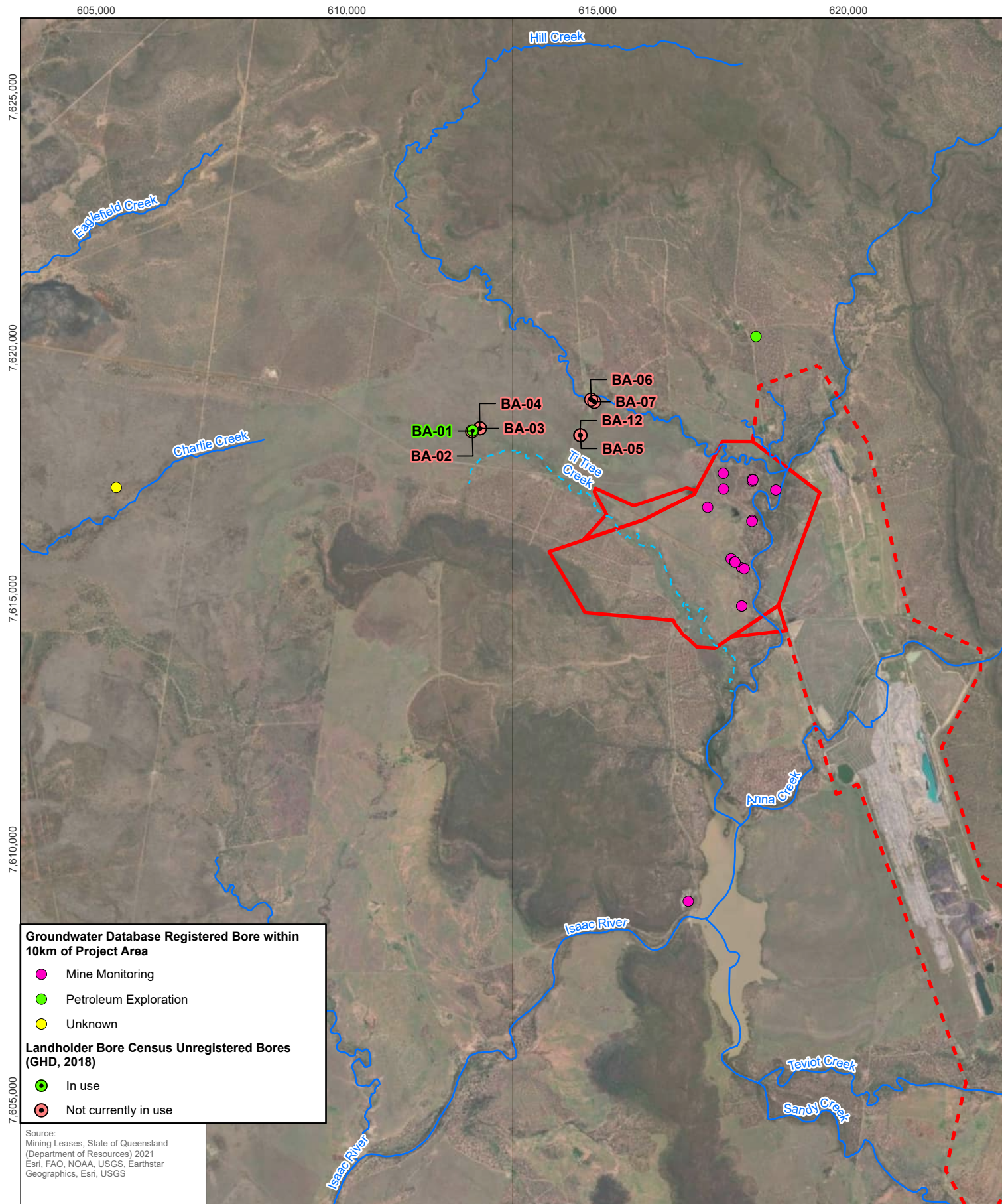
No information is available for which aquifer the potential third party water supply bores are screened in. A comparison of available bore depths with the Study Area model layers (refer **Section 6.2.2**) infers that BA02, BA03, BA04 and RN85414 are screened in the regolith, while BA01 and BA05 are screened in the Triassic Strata.

Table 5-10 Unregistered groundwater bores within 10 km of Project Area

Bore	Easting	Northing	Status	Depth (m)	Survey Date
BA-01	612505	7618350	In use	51.05	2018
BA-05	614658	7618258	not currently in use	40.3	2018
BA-06	614868	7618966	not currently in use (blocked)	unknown	2018
BA-07	614931	7618923	not currently in use (filled)	unknown	2018
BA-12	614649	7618257	not currently in use (casing and rods in hole)	unknown	2018
BA-02	612494	7618333	Not currently in use	37.38	2018
BA-03	612652	7618396	Not currently in use	39	2018
BA-04	612652	7618396	Not currently in use	40.32	2018

A search of the water entitlements database did not identify any active third-party water licences for groundwater abstraction within the Study Area.





0 1.3 2.5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:100,000 at A4

Project Number: 620.31367.00000

Date Drawn: 23-Oct-2023

Drawn by: RB

LEGEND

- Major Watercourse (Solid blue line)
- Non-designated Watercourse (Dashed blue line)
- Project Area (ML 70337, ML 700053 and ML 700054) (Red solid line)
- Burton Mining Lease (ML 70109) (Red dashed line)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

REGISTERED BORES AND BORE CENSUS



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 5-27

5.14 Groundwater Usage – Environmental

5.14.1 Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is a natural ecosystem that requires “access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services” (Richardson, S., et al., 2011).

5.14.2 National Atlas of Groundwater Dependent Ecosystems

The BoM’s National Atlas of Groundwater Dependent Ecosystems (GDE Atlas) (BoM, 2017) classifies ecosystems based on the potential for dependence on groundwater through multiple lines of scientific evidence. Ecosystems have been mapped as either:

- High potential for groundwater dependence (indicating a strong possibility the ecosystem is interacting with groundwater);
- Moderate potential for groundwater dependence; or
- Low potential for groundwater dependence (indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

Desktop mapping of potential aquatic and terrestrial GDEs in the GDE Atlas indicates that areas with possible low, moderate and high potential for groundwater interaction occur in the vicinity of the Project Area (**Figure 5-28**).

5.14.3 Local GDE Studies

A GDE field assessment was completed by 3D Environmental in February 2023 (3D Environmental, 2023) in accordance with the methods described in the GDE Toolbox (Richardson et al. 2011). The survey focused on areas mapped as potential Aquatic and Terrestrial GDEs in the GDE Atlas (**Figure 5-28**), which are associated with woody vegetation occupying creek channels, floodplain vegetation and vegetation associated with older residual surfaces. In total, 13 sites were chosen for targeted GDE assessment, to provide representative coverage of the major vegetation types, landform elements and drainage systems that were most likely to demonstrate groundwater dependence (**Figure 5-29**). Emphasis was placed on habitats which are mapped as ‘High Potential’ GDEs in the BOM GDE Atlas, although field sampling included Moderate and Low Potential areas also, as well as areas where no groundwater dependence was indicated, particularly Ti-Tree Creek where the Project’s drainage diversion is planned.

The methodology included testing using several methods for the purpose of using multiple lines of evidence to assess groundwater dependence including:

- Leaf Water Potential (LWP) - Provides indication as to whether trees are utilizing saturated zones or soil moisture.
- Soil Moisture Potential (SMP) - Hand augering profiling to characterize SMP for areas where LWP indicates potential groundwater usage.
- Xylem Stable Isotope Sampling and Analyses and water sampling - Comparison of isotopic ratios of water contained in vegetation with those found in various sources of water to help define predominant source of water used.



600,000

610,000

620,000

630,000

640,000

7,640,000

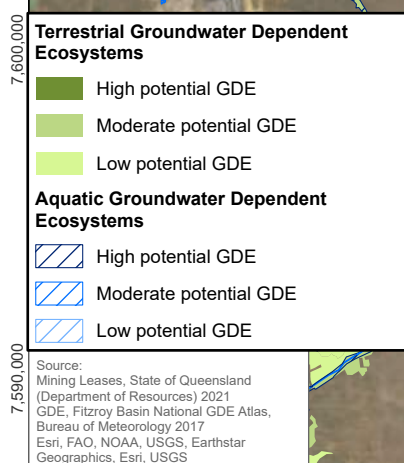
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7,600,000

7,590,000



0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:230,000 at A4

Project Number: 620.31367.00000

Date Drawn: 22-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- Transect
- Project Area (ML 70337, ML 700053 and ML 700054)
- Burton Mining Lease (ML 70109)
- Study Area (Model Domain)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

MAPPED POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS



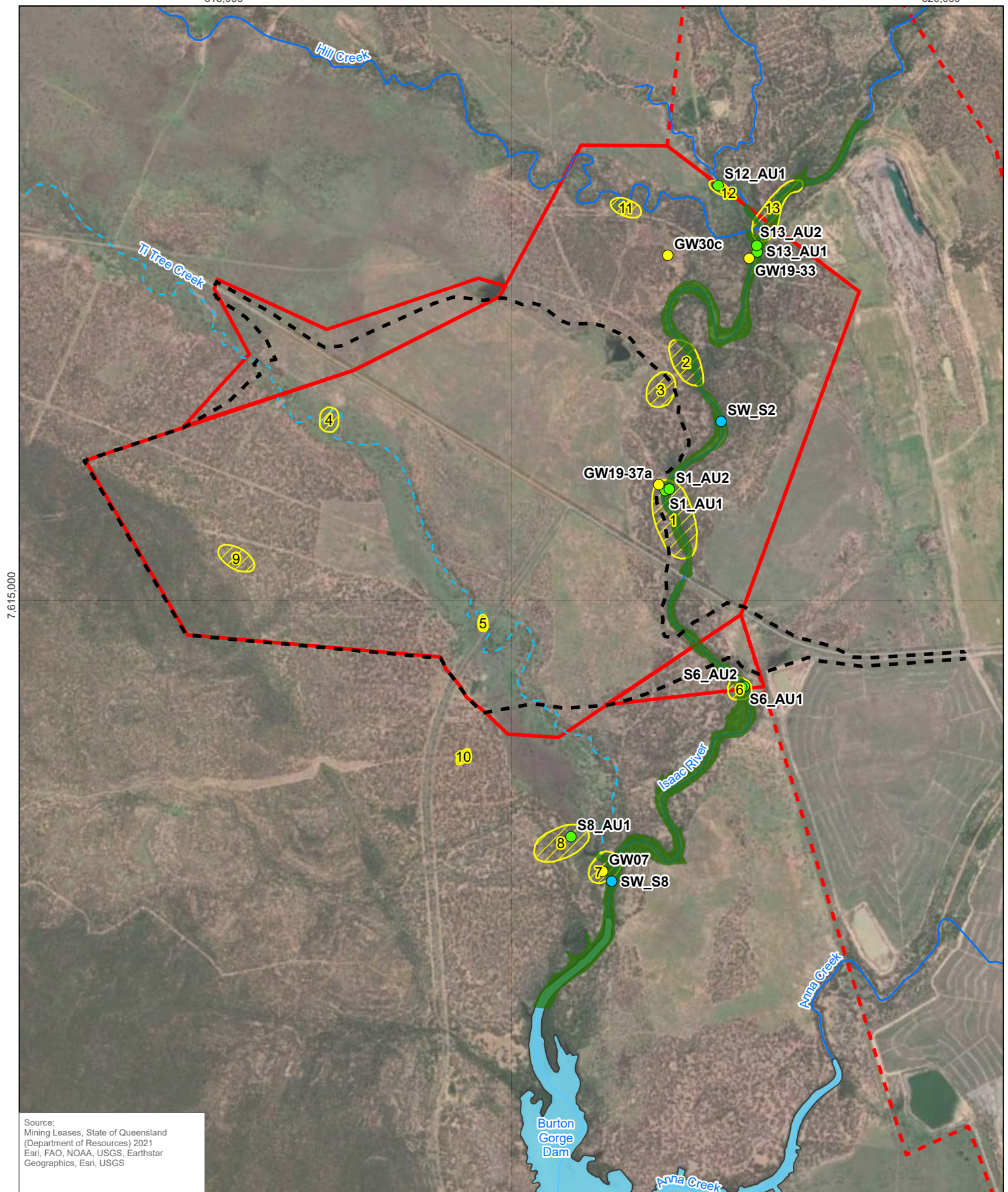
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 5-28

Path: H:\Projects-SLR\620-BNE\620-BNE\620.31367.00000 New Lenton PER Groundwater\03 SLR Data\01 CAD\GIS\GIS\ArcPro\New_Lenton_PER_Groundwater\New_Lenton_PER_Groundwater.aprx\SLR62031367_F5-28_MappedPotentialGDEs

615,000

620,000



Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Esri, FAO, NOAA, USGS, Earthstar
Geographics, Esri, USGS



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:35,000 at A4

Project Number: 620.31367.00000

Date Drawn: 22-Dec-2023

Drawn by: RB

LEGEND

Isaac River Sampling Location

- Hand auger
- Monitoring Bore
- Surface Water
- Major Watercourse
- - - Non-designated Watercourse

- Project Area (ML 70337, ML 700053 and ML 700054)
- Burton Mining Lease (ML 70109)
- Assessment Area
- Proposed Disturbance Area
- Known/Likely GDE Area
- Mining Lease

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

3D ENVIRONMENTAL (2023) LOCAL GDE ASSESSMENT AREAS AND KNOWN/LIKELY GDE AREAS



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 5-29

Path: H:\Projects-SLR\620-BNE\620-BNE\620.31367.00000 New Lenton PER Groundwater\03 SLR Data\01 CAD\GIS\GIS\ArcPro\New_Lenton_PER_Groundwater\New_Lenton_PER_Groundwater.aprx\SLR62031367_F5-29_3D_Environmental_2023_Local_GDE_AssessmentAreas_and_Known_Likely_GDE_Areas

Data interpretation followed a structured approach in which multiple lines of evidence were filtered to provide an assessment of groundwater dependence. The biophysical measurement of LWP formed the assessment, followed by the adjunct comparison with SMP, with stable isotope data used to provide supplementary evidence where ambiguity remained. The data from the assessment by 3D Environmental (2023) can be summarised as follows:

- Data from the Isaac River Sites (Site 1, Site 2, Site 6, Site 7 and Site 13, **Figure 5-29**) demonstrate a clear indication that at the time of the assessment riparian vegetation at these sites was utilising groundwater from a shallow seasonally variable perched water table hosted in alluvial sand but resting on alluvial clay, above the deeper regional alluvial water table. That is, the riparian vegetation at these sites can be classed as a Terrestrial GDE. This interpretation is consistent between all assessment parameters including LWP, SMP and stable isotopes, including direct observation of a perched water table intersected during shallow soil augering.
- For sites on older alluvial / residual landforms (Site 3, Site 9 and Site 10, **Figure 5-29**), any significant utilisation of groundwater has been excluded by the strongly negative LWP values and considerable depth to groundwater sources, below the rooting depth of relatively shallow rooted poplar box and ironbark. That is, the riparian vegetation at these sites is not a Terrestrial GDE.
- For sites on Ti-Tree Creek (Site 4, Site 5 and Site 8, **Figure 5-29**) use of groundwater at Site 4 is excluded by strongly negative LWP values. For Site 5 and Site 8, LWP values are considerably higher, although these high LWP values can be accounted for in the shallow soil profile, as suggested by both SMP and downhole stable isotope analysis. This is also in agreement with the lack of intersection of a perched shallow water table at Site 8 (S8_AU1). There is no indication that vegetation at Site 5 and Site 8 are utilising groundwater to any degree. That is, the riparian vegetation at these sites is likely not a Terrestrial GDE.
- Data from northern tributary streams, including Site 11 (Hill Creek) and Site 12 (unnamed tributary) suggests soil moisture accounts for the moisture being utilised by riparian vegetation at these localities. This agrees with soil auger profiling which did not identify a perched water table. Soil moisture is being supplied in the shallow portion of the soil profile (>1 mBGL) directly above the contact between the unconsolidated soil profile and weathered bedrock (regolith). That is, the riparian vegetation at these sites is not a Terrestrial GDE.

The assessment by 3D Environmental (2023) also noted the following uncertainties in relation to the GDE impact assessment:

- The seasonality and persistence of the perched groundwater system that was supporting GDEs at the time of the assessment, and whether any connectivity between the perched groundwater system and the deeper basal alluvial groundwater unit exists, noting the current lack of evidence for a hydraulic linkage.
- Whether riparian vegetation that was utilising groundwater hosted in the seasonally variable perched groundwater system has developed a dimorphic root system that has capacity to utilise the seasonally variable perched system when present, shifting to utilisation of the deeper basal alluvial groundwater unit when the perched system is depleted.

As previously discussed, water levels from the hand augered holes showed that water levels in the seasonally variable perched water table on the Isaac River were around 5 m above groundwater levels in nearby bores monitoring the base of the alluvial sediments, suggesting



that the identified GDEs would rely on the perched water (when seasonally available) but not the deeper more regional alluvial groundwater hosted in the basal alluvial sediments.

An ecohydrological conceptual model produced by 3D Environmental (2023) for the Project showing the seasonal relationship between the perched water, groundwater and GDEs is presented as **Figure 5-30** (wet season), **Figure 5-31** (dry season) and **Figure 5-32** (post wet season flooding baseflow).

Based on the assessment, 3D Environmental (2023) inferred the spatial extent of Terrestrial GDEs to be highly confined to close to the Isaac River channel (**Figure 5-29**), and do not extend any significant distance upstream along tributary watercourses. Possible seasonal Aquatic GDEs were noted due to the Isaac River being only considered consistent with the definition of an Aquatic GDE during flood events where recharged water from overbank flow may discharge back into the river channel as low volume seepage / baseflow (3D Environmental, 2023). Previous field investigations in the Project Area (AARC, 2019b) however have identified that groundwater does not discharge to surface water or maintain surface water pools, and as a result does not support aquatic GDEs. In 2023, a walk over survey was conducted by LJV personnel in July 2023 to search for any permanent pools of water and despite recent rainfall none were identified (Reach Environmental, pers. comm. 20 July 2023). Furthermore, as previously discussed, Project monitoring data shows that surface water flow is only sustained for hours to several days following rainfall events (refer to **Section 3.2**), indicating a distinct lack of groundwater discharge to these watercourses. Recent dry season ground-truthing along the Isaac River and its tributaries in the area of the Project (AARC, 2024) also confirmed the results of these previous investigations.

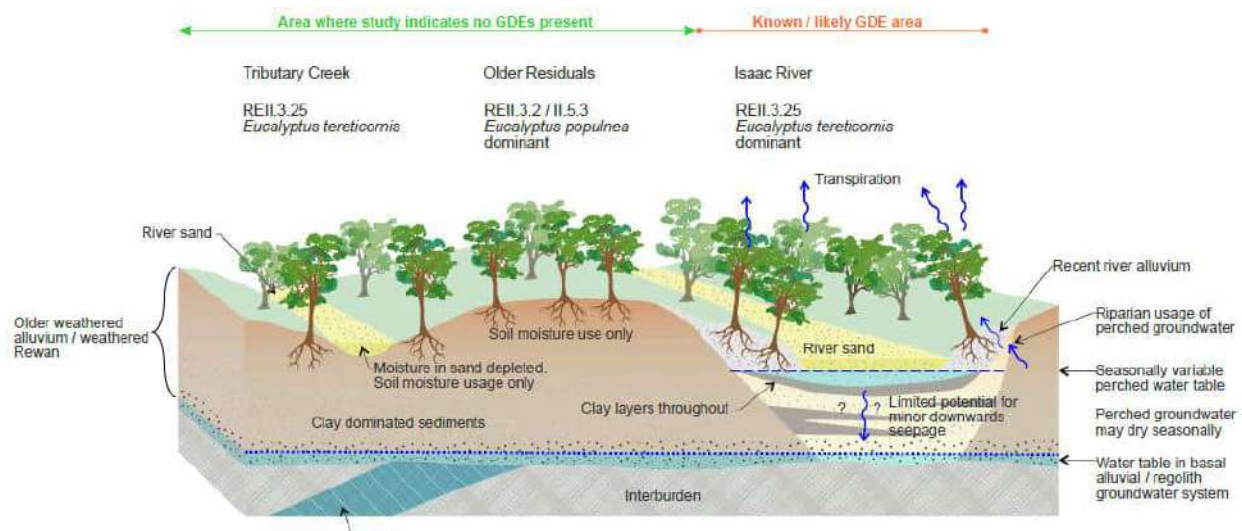


Figure 5-30 3D Environmental Ecohydrological Conceptual Model – Dry Season



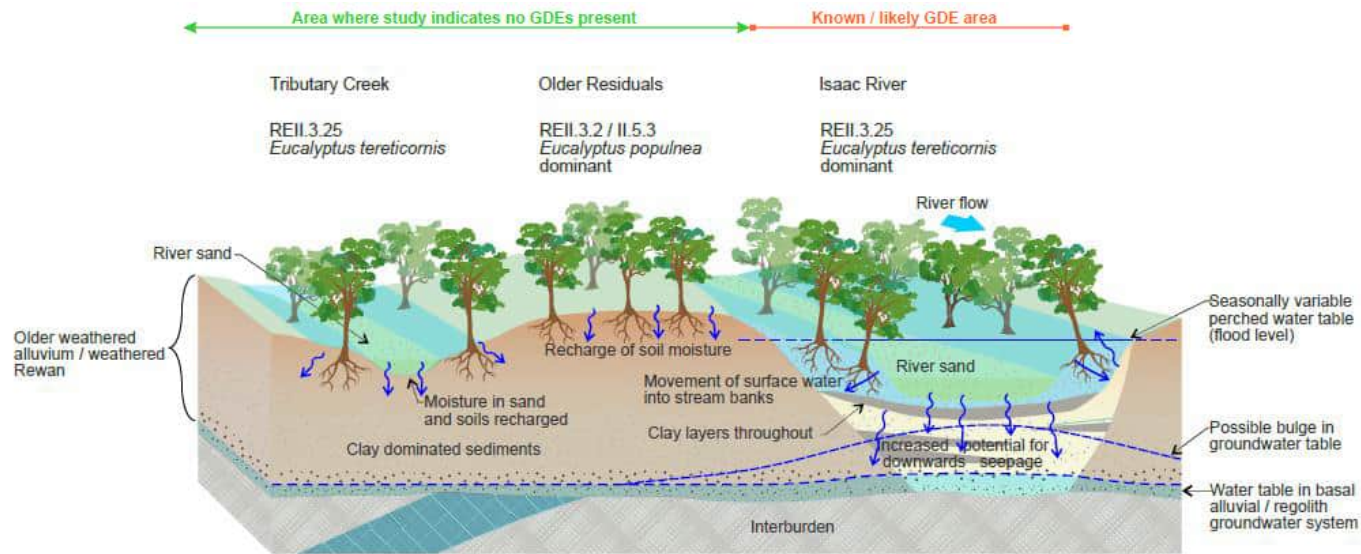


Figure 5-31 3D Environmental Ecohydrological Conceptual Model – Wet season

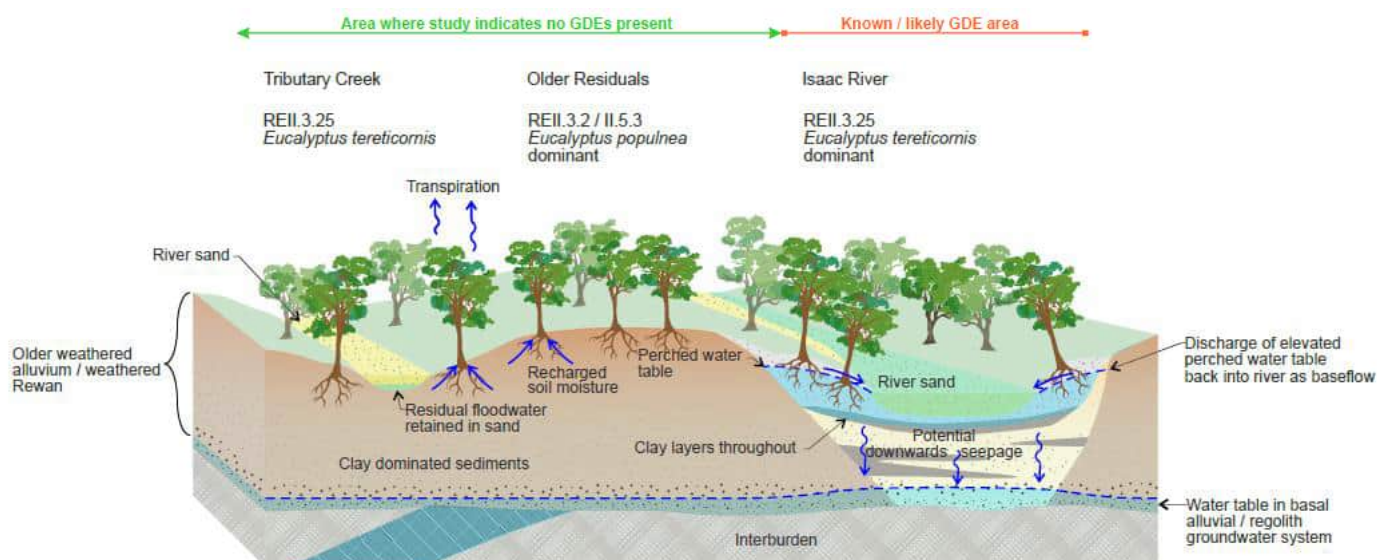


Figure 5-32 3D Environmental Ecohydrological Conceptual Model – Post Flooding Baseflow

The riparian vegetation fringing the Isaac River presents the only Terrestrial GDE identified during the assessment and was concluded to be supported by shallow perched alluvial water which is seasonally recharged and hydraulically disconnected from the basal alluvial groundwater system. The field assessment was completed during a wetter than average period, and the perched alluvial groundwater features may only exist temporarily, drying during extended drought periods, accelerated by evapotranspiration. In this sense, this perched, and most likely discontinuous feature is likely to be seasonal with riparian trees demonstrating facultative dependence on the resource, with a shift to utilisation of soil moisture when the seasonally variable perched water is depleted (3D Environmental, 2023). The interpretation that these GDEs demonstrate facultative dependence is consistent with previous GDE field studies at the Project by AARC (2019a) which suggested that potential GDEs along the Isaac River are not solely reliant on groundwater for survival, with these



vegetation communities capable of surviving on residual rainfall derived soil moisture present in unsaturated shallow soil layers.

The GDE field study by 3D Environmental (2023) also concluded that the Regolith and Permian aquifers are not considered to be a suitable resource to support GDEs due to depth to groundwater being considerably deeper (>10mBGL) than the maximum rooting depth of the vegetation present (poplar box and narrow leaf ironbark) (3D Environmental, 2023).

5.14.4 Stygofauna

fr environmental (2023) was commissioned to assess the potential impacts to stygofauna relating to the Project, to support the PER. The assessment comprised a stygofauna pilot study in accordance with the Queensland Guideline for the Environmental Assessment of Subterranean Aquatic Fauna (DoSITIA, 2015). The survey involved:

- 1: Desktop review to determine the suitability of groundwater ecosystems of the Project Area to provide habitat for stygofauna on the basis of geological, hydrological and water quality characteristics of local groundwater ecosystems, and included:
 - review of previous studies to determine the recorded presence of stygofauna in the Project area and surrounds, and more broadly in the Isaac River sub-catchment
 - review of hydrogeological data for the Project Area, and
 - review of groundwater pH, electrical conductivity (EC) and total dissolved solids (TDS) data within and surrounding the Project Area.
- 2: Field survey which included sampling of 15 bores within and surrounding the Project Area. For the purpose of the field survey two classes of stygofauna were considered:
 - stygobites: obligate groundwater aquatic fauna that have specialised adaptations (e.g. lack of eyes and pigmentation, elongated appendages for tactile sensing of surrounds, etc.) to underground life and that live within groundwater systems for their entire life.
 - stygoxenes: aquatic fauna that facultatively use groundwater ecosystems, but are not dependent on groundwater to complete their life cycle.

The field survey recorded a total of five stygofauna taxa which included four stygoxene taxa and one stygobite (i.e. Bathynellidae, only recorded at GW19_33). Full results of groundwater bore samples are provided in **Table 5-11**.

Overall, the study concluded that the environmental values of stygofauna of the Project Area and surrounds were of moderate value based on based on the presence of a stygobitic species and suitable hydrogeological conditions for stygofauna.



Table 5-11 Stygofauna sampling results (frc environmental, 2023)

Bore	Stygofaunal Taxon	Count	Class
GW06	Acarina sp. 2 (mite)	1	stygoxene
	Oligochaeta (segmented worm)	1	stygoxene
GW07	Acarina sp. 1 (mite)	1	stygoxene
GW10	–	–	–
GW11	–	–	–
GW13	–	–	–
GW19	–	–	–
GW29a	Acarina sp. 1 (mite)	1	stygoxene
GW30b	–	–	–
GW30c	Acarina sp. 1 (mite)	2	stygoxene
GW31a	–	–	–
GW31b	Acarina sp. 1 (mite)	1	stygoxene
DDH6	Acarina sp. 1 (mite)	3	stygoxene
GW19_33	Bathynellidae sp. 1 (syncarida)	1	stygobite
	Harpacticoid sp.1 (copepoda)	2	stygoxene
	Acarina sp. 1 (mite)	1	stygoxene
GW19_36	–	–	–
GW19_37a	Acarina sp. 1 (mite)	3	stygoxene

5.14.5 Springs

The Queensland Government maintains an inventory of identified springs in the Queensland Springs Database (DES, 2020). As previously discussed a review of the database found that no springs were mapped within the vicinity of the Project Area.

5.14.6 Wetlands

A search of the EPBC Act 'Protected Matters' database (DEWA, 2020) found that there are no internationally or nationally important wetlands in the vicinity of the Project Area. The closest wetland of international importance is located approximately 220 km southeast of the Project Area (i.e. wetlands of the Shoalwater and Corio Bays Area). Lake Elphinstone is the closest nationally important wetland, located approximately 10 km east and upstream of the Project Area. Due to the significant distance from the Project Area, neither of the internationally or nationally important wetlands will be impacted by the Project.

5.15 Conceptual Model Summary

A conceptual hydrogeological model (CHM) of the groundwater regime has been developed based on the review of the hydrogeological information for the Project Area presented in the above report sections. A conceptual cross section is presented as **Figure 5-33** with location shown in **Figure 4-2**. A zoomed in conceptual cross section through the Isaac River alluvium demonstrating its stratigraphy and perched and basal groundwater presence is shown in **Figure 5-3**, with the section location shown on **Figure 4-1**.

The Project Area is located within the northern part of the Bowen Basin, which comprises Permian aged coal measures that have been subject to regional deformation, including



folding and faulting. Extensive thrust faulting and associated folding is present over and surrounding the Project Area. The main structural feature is the Burton Range Fault, which has caused the displacement and uplift of the Rangal Coal Measures where it is able to be mined at surface. Surficial cover consists of unconsolidated Quaternary sediments and regolith. Quaternary alluvium is mapped along the creek lines including Isaac River, Hill Creek and Anna Creek.

The main hydrogeological units include:

- Quaternary alluvium – unconfined aquifer (water-bearing strata of unconsolidated silt, sand, or gravel) localised along Isaac River, Hill Creek and Anna Creek where groundwater is hosted in the basal alluvial sediments, and a secondary more limited seasonably variable perched water table disconnected from the basal system and hosted in shallow alluvial sediments immediately adjacent the Isaac River channel;
- Regolith – (other shallow non-alluvial weathered material) unconfined with potential to interact with the alluvium where saturated;
- Permian coal measures with:
 - Low permeability interburden units with aquitard properties; and
 - Coal seams that exhibit water bearing properties associated with secondary porosity through cracks and fissures.

Several Project groundwater bores installed into the Quaternary alluvium are dry, indicating the alluvium is unsaturated and does not form an aquifer at these locations. Where groundwater is present in the basal alluvium closer to the Isaac River main channel however, groundwater levels in the alluvium are relatively flat, with flow generally towards and coincident with the Isaac River surface flow direction. Where it occurs, groundwater within the basal alluvium is recorded at depths of around 8 to 11 mBGL, typically significantly disconnected from the streambed elevation. Immediately below and adjacent the Isaac River channel and banks, limited seasonably recharged perched water is present around 5 m above the groundwater in the basal alluvium/regolith (around 1 to 4 mBGL).

The inferred groundwater flow direction in the regolith, where present and saturated, is expected to follow topography, and has the potential to interact with groundwater within the alluvium where present along drainage alignments and rivers.

Losing conditions from the Isaac River to the underlying alluvium and regolith are evident during flow periods and recharge to shallow groundwater is considered to be primarily from streamflow or flooding, with direct infiltration of rainfall also occurring rapidly where there are no substantial clay barriers in the shallow sub-surface. Perching of recharged water inhibits the downwards migration of recharged water to the basal alluvium aquifer. Discharge of shallow groundwater occurs primarily via evapotranspiration, including from Terrestrial GDEs that access the seasonably variable perched water but not the deeper basal alluvial groundwater.

Water quality data for the alluvium indicates a high degree of spatial and temporal variability. Elevated salinity levels at some Project Area bores in the alluvium likely support the concept of a highly heterogenous alluvial system with only some parts receiving regular freshwater contribution from surface flows. Groundwater in the alluvium is suggested to be mostly suitable for stock watering but is not suitable for irrigation and freshwater aquatic ecosystems. Regolith water quality data indicates that groundwater in the regolith is generally unsuitable for aquatic ecosystems, irrigation or stock watering.

In the Permian strata, groundwater is encountered in both the coal seams and the interburden units. The coal seams within the Rangal Coal Measures are typically considered the main aquifer units and may be significantly more permeable than the interburden



material of interbedded mudstone, siltstone, and sandstone. The Permian coal seams are classified as a dual-porosity, dual-permeability medium with water stored and transmitted through both the primary matrix porosity and secondary fracture porosity. Groundwater within these coal measures is considered confined and sub-artesian.

Recharge to the coal measures occurs where the coal seams outcrop or subcrop beneath the alluvium or regolith. The interburden material (sandstone and siltstone) typically has a low vertical hydraulic conductivity and limits the downward vertical movement of water. When groundwater levels are locally reduced in the coal seams due to mining, these interburden units will provide a source of water by vertical leakage into the depressurised coal seams. Discharge from this unit is dominated by evaporation and groundwater extraction from mining activities at the neighbouring Burton Mine.

Regionally groundwater levels in the Permian coal seams correlate with ground surface elevations (GHD, 2019; SLR, 2020c), with groundwater flow dominantly horizontal through the coal seams themselves following the regional topography, but locally influenced by existing mining at the Burton Mine.

Review of water quality data indicates water within the Permian coal measures ranges from brackish to saline and is suggested to generally only be suitable for supporting the stock watering EV.



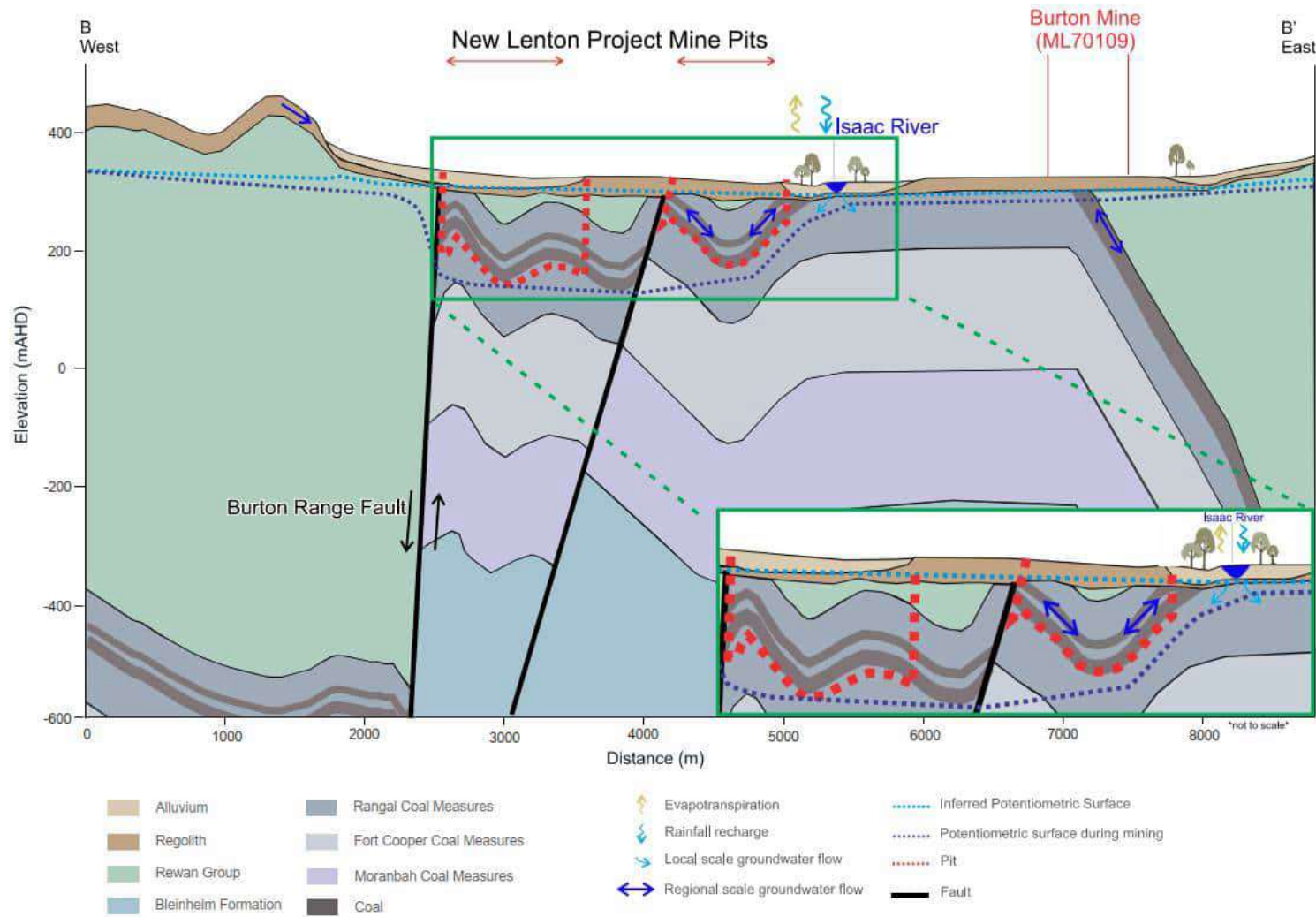


Figure 5-33 Conceptual Hydrogeological Model



6.0 Groundwater Simulation Model

6.1 Overview

Significant groundwater modelling simulation work has previously been completed for the Project. A groundwater model was developed by GHD (2019) as part of a Project groundwater assessment for an EA Amendment application. The GHD (2019) numerical groundwater model underwent subsequent audit by SLR (2019) including a peer review and examination of digital files. Further numerical modelling was then undertaken by SLR (2020g), to support the successful EA amendment process and also the successful application of an Associated Water Licence (AWL) for the Project. That is, the SLR (2020g) version of the model was accepted by the State of Queensland for multiple environmental approvals at the Project.

For the purposes of the PER and during the early stages of the PER groundwater assessment development, feedback on the 2020 numerical groundwater model was provided by an independent peer reviewer engaged by the LJV. The peer reviewer acknowledged that the 2020 model was generally fit for purpose for the PER, however the following areas for potential improvement were identified:

- Geological heterogeneity apparent in the alluvium within and near the Project Area (see **Section 4.2.1**) could be better captured by revised model parameterisation (the use of pilot points in the alluvium was suggested);
- Calibration validation or re-calibration with history matching to data collected post-2019 (see **Section 5.10**) would be advantageous;
- Uncertainty Analysis methods adopted in the modelling should be updated to conform with current leading practice as documented within the IESC's own guidelines; and
- Uncertainty in post-mining recovery modelling should be considered, as recommended in recently released Queensland State guidelines.

It was therefore decided to undertake a revision and update of the 2020 numerical groundwater model for the purpose of the PER. The subsequently updated 2023 numerical groundwater model is reported in the *New Lenton and Burton 2023 Groundwater Modelling Technical Report (Appendix D)* and is the version of the model used to support this groundwater assessment.

6.2 Model Details

This section provides a summary of the design and development of the 2023 updated numerical groundwater model used to support this groundwater assessment. Full details of the numerical groundwater model are included within the *New Lenton and Burton 2023 Groundwater Modelling Technical Report – Appendix D*.

6.2.1 Model Objectives

Numerical modelling was undertaken in support of the groundwater assessment for Project to assess the potential impacts due to mining on the local groundwater regime. The objectives of the predictive modelling were to:

- predict the incremental and cumulative drawdown in the groundwater system;
- predict water take from the groundwater system;



- predict the incremental and cumulative change in groundwater levels at identified groundwater users (i.e. registered bores, landholder bores, or GDEs) due to the proposed mining;
- predict incremental changes in baseflow along the Isaac River due to the proposed mining;
- predict incremental changes in alluvial water resources due to the proposed mining;
- estimate groundwater inflows to the mining voids; and
- determine where groundwater impact mitigation/control measures may be required.

The predictions are required for the incremental impacts of the proposed mining at the Project, and for cumulative impacts considering both the Project and adjacent Burton mines.

6.2.2 Model Design

The updated model was developed based on the updated conceptual groundwater model, presented within **Section 5.15**. Conceptualisation of the groundwater regime and the calibration of the model against observed data are key to achieving a reliable numerical model. Conceptualisation is a simplified overview of the groundwater regime (i.e. the distribution and flow of groundwater) based on available data and experience. Consistency between numerical model results and the conceptual understanding of the groundwater regime increases the credibility of the numerical model predictions.

Numerical modelling was undertaken using Geographic Information Systems (GIS) in conjunction with MODFLOW-USG, which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a version of the popular MODFLOW code (McDonald and Harbaugh, 1988) developed by the USGS. USGS MODFLOW has been the most widely used code for groundwater modelling in the past and has long been considered an industry standard.

The model has been discretised into 19 layers. The model layer structure is presented in **Table 6-1**. Those layers identified in the table as east/west of Burton Range Fault (BRF) represent the geological units displaced by the fault and are represented by different layers based on their location on either side of the fault; i.e. the model simulates the fault via layers being offset on either side of the fault.

It should be noted that the model is unable to simulate the dual natured alluvial groundwater system discussed in the conceptualisation (**Section 5.15**). In particular, a perched water table within layer 1 is unable to be represented in the model, and groundwater present in layer 1 of the model represents only the basalt alluvial groundwater system discussed in **Section 5.15**. Nevertheless, assessment of potential impacts on the seasonally variable perched water table has been undertaken qualitatively in the Project's GDE Assessment (3D Environmental, 2023).



Table 6-1 Model Layering

Layer	Geological Age	Lithology	Average Thickness (m)	Spatial Extent
1	Quaternary/Tertiary	Alluvium & Shallow Regolith	5.0	Model domain
2		Regolith & Basalt	14.2	Model domain
3	Triassic	Triassic (top)	175.3	West of BRF
4		Triassic (top)	148.2	East of BRF
5		Triassic (middle)	176.6	West of BRF
6		Triassic (middle)	148.2	East of BRF
7		Rewan (bottom)	176.5	West of BRF
8		Rewan (bottom)	148.2	East of BRF
9	Permian	Overburden (RCM)	48.2	West of BRF
10		Overburden (RCM)	47.7	East of BRF
11		Burton Rider Seam (RCM)	1.5	West of BRF
12		Burton Rider Seam (RCM)	1.8	East of BRF
13		Interburden (RCM)	26.0	West of BRF
14		Interburden (RCM)	25.2	East of BRF
15		Leichhardt/Vermont Seams (RCM)	8.2	West of BRF
16		Leichhardt/Vermont Seams (RCM)	8.3	East of BRF
17		Underburden (RCM)	100.0	West of BRF
18		Underburden (RCM)	99.8	East of BRF
19		Coal Measures (FCCM)	100.0	Model domain

6.2.3 Model Calibration

The updated numerical model includes a steady state and a transient calibration (1998 to 2023). The transient calibration captures historical mining at Burton Mine although it should be recognised that detailed historic mine progression data were not available, and so historic mining at Burton was synthesised in the model on the basis of analysis of available aerial imagery. Mining was represented in the model using the MODFLOW-USG drain package, with the drain cells set to the base of the target coal seam for each pit.

Calibration of the model was carried out with the objective being to replicate the groundwater levels measured in the New Lenton and Burton monitoring networks, and other available observations including government and historical mine-monitoring bores, in accordance with Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

The model achieved a scaled root mean square (SRMS) error of 10.7%. While there is no universally recommended SRMS error guidelines, the Australian Groundwater Modelling Guidelines suggests that setting SRMS targets as 5 or 10% may be appropriate in some circumstances (Barnett et al, 2012). A detailed description of the calibration procedure is provided in **Appendix D**.



6.2.4 Model Performance and Limitations

The model confidence level (Class 1, Class 2 or Class 3 in order of increasing confidence) based on the Australian Groundwater Modelling Guidelines (Barnett et al. 2012) was previously widely used in the industry to provide a classification of model performance and limitations. The latest version of the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023) introduces a new concept on how model confidence can be assessed. The document also indicates that this change will follow in the next iteration of the Australian Modelling Guidelines and the new concept for assessing model confidence is hence applied for this model.

The latest version of the IESC Explanatory Note for Uncertainty Analysis defines a model fit for purpose when model results are:

- Usable -- Relevant to the decision-making process, providing information about the uncertainty in conceptualisations and modelling simulations in a way that allows decision-makers to understand the effects of uncertainty on project objectives and the effects of potential bias. The relevant Quantities of Interests (QoI) in this context are the groundwater inflows and drawdowns to assess licensing, site water management and drawdown impacts.
- Reliable -- Demonstrate that the range of model outcomes is consistent with the system knowledge and honours historical observations and provides objective evidence that uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated. The calibration performance was deemed acceptable, and a rigorous UA was undertaken to further improve confidence in the modelling outputs.
- Feasible -- Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the Project. This study is an update of an earlier model, which shows that there are several model revisions therefore mitigating budget and time trade-offs. Updated technical datasets are included in the most recent revision. The model has been peer reviewed for each revision. The model builds and associated review process are therefore deemed commensurate with the Project related risk to the groundwater environment.

In order to assess these three points above, the four sources of scientific uncertainty (structural, parametrisation, measurement error, predictions) have been qualitatively assessed with regards key aspects of the groundwater model, as presented in **Table 6-2**.

Overall, the model is considered fit for purpose to achieve the objectives outlined in **Section 6.2.1** based on the data provided and the Project timeframe. Updates could be conducted in future to further refine the model, but this would be dependent on the purpose of the modelling and availability of data to inform future changes.



Table 6-2 Groundwater Model and Data Limitations

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	The model has an unstructured Voronoi grid that includes detailed cell refinement around site, neighbouring mines and along drainage features.
	Layers	Fit for purpose	Top of layer 1 incorporates site LiDAR data
		Fit for purpose	Representation of alluvium is based site transient electromagnetic (TEM) data. and CSIRO Regolith mapping (Wilford et al (2016)).
	Conceptualisation – Geological Structure	Fit for purpose, future improvements possible where new data collected	The local structure of the geology is based on detailed data at site (Burton and New Lenton Mine geology models), and regional model geometry (outside of site) interpolated based on publicly available data, such as geological mapping and the CSIRO Regolith data set. The geological units displaced by the Burton Range Fault (BRF) are represented by different layers based on their location either on the western or eastern side of the fault; i.e. the model simulates the fault via layers being offset on either side of the fault. The structure of the coal seams was checked to ensure it matches observed and mapped geology. The predictions of drawdown adjacent to mining was checked and the model generally shows a reasonable fit between modelled and observed trends.
	Conceptualisation – GDEs	Fit for purpose, future improvements possible	A GDE conceptualisation for the PER was completed by 3D Environmental (2023). Terrestrial GDEs are confirmed to be present in the riparian zone of the Isaac River and are at least partially reliant on a shallow seasonably variable perched water table in the alluvium. The perched water table appears hydraulically separated from the regional basal alluvial groundwater system represented in the model.
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose	The conceptualisation concluded that surface water features are highly ephemeral with flow in the river only occurring for a few days per year. The observed groundwater levels for the alluvium bores indicated that a baseflow to Isaac River is unlikely to exist. The infrequency and temporal nature of observed surface flow in the Isaac River reported during Project fieldwork suggests that there is no groundwater baseflow to the Isaac River, either onsite, associated with onsite tributaries



Type	Part	Status	Comment
			(Hill Creek and Ti-Tree Creek) or from upstream sources within the catchment area. The permanent Burton Gorge Dam, Teviot Creek Dam and Lake Elphinstone impoundments / surface water features are likely to be local groundwater recharge features and are explicitly represented in the model using River cells assigned measured stage levels.
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose	Site monitoring network includes bores mapped within alluvium that was used to inform saturated extent of alluvium locally at site and for calibration targets.
Parameterisation	Hydraulic Conductivity – Shallow layers	Fit for purpose	The simulation of the Alluvium and Regolith in the model involves the use of pilot points in Layer 1 and Layer 2. Pilot points were used to simulate heterogeneity in the alluvium system.
	Hydraulic Conductivity – Depth Dependence	Fit for purpose	Field testing of hydraulic conductivity (horizontal and to a lesser extent vertical) has been conducted in the region and at site. Hydraulic conductivity test results from the other sites within the model domain were also considered. The data shows a general decline in hydraulic conductivity with depth that is replicated in the model.
	Spoil Properties	Fit for purpose, future improvements possible	Limited site-specific data is available for the spoil. Spoil properties were adjusted during calibration using with the bounds for spoil parameters set using previous studies.
	Rivers	Fit for purpose	The conceptualisation concluded that Isaac River is highly ephemeral with flow in the river only occurring for a few days per year. The observed groundwater levels for the alluvium bores indicated that a baseflow to Isaac River is unlikely to exist. The infrequency and temporal nature of observed surface flow in the Isaac River reported during Project fieldwork suggests that there is no groundwater baseflow to the Isaac River, either onsite, associated with onsite tributaries (Hill Creek and Ti-Tree Creek) or from upstream sources within the catchment area.



Type	Part	Status	Comment
			The river cells representing Isaac River were assigned a stage height of zero for each stress period in the model. To represent the shallow groundwater recharge due to rainfall derived streamflow in the model, an enhanced recharge factor was applied along Isaac River during specific stress periods. In order to be consistent with the conceptualisation, zero baseflow for Isaac River was used as a target during the calibration process.
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and calibrated recharge rates.
Measurement Error	Observation Data Quality	Fit for purpose	Bore logs and construction details available for most site bores, and long-term site water level data available for various units.
	Landholder Bore Data Quality	Fit for purpose, future improvements possible	Impacts on registered landholder bores are influenced by the assumptions of the bore design, target geology and use. Field census survey data has been utilised where available.
	Temporal spread	Fit for purpose	Timeseries water level data from the site as well as for the tertiary and Permian coal measures.
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose	Transient (1998 to 2023) calibration model set up and a depth dependence function used and calibration to water levels conducted using automated (PEST-IES).
	Predictive	Fit for purpose	Model captures approved mining at Burton and proposed open cut mining at New Lenton. No other neighbouring mines were identified within the model domain.
	Sensitivity and uncertainty	Fit for purpose	Uncertainty analysis covered the entire model simulation period (Pre-mining, during mining and post-mining). Uncertainty analysis has been conducted by stochastic modelling using an adapted Monte Carlo method with modern software packages. The Latin Hypercube Sampling (LHS) method was used to create random realisations. The uncertainty analysis quantified the variability in predictions with changes in maximum predicted drawdowns, mine inflows, impact on alluvium flow and impacts on surface water flow during mining and in post mining.



6.2.5 Model Predictions

Transient predictive modelling was undertaken to simulate both the proposed mining at the Project and the planned mining at the neighbouring Burton Mine from July 2023 to January 2042. The predictive model timing used quarterly stress periods to January 2024, followed by annual stress periods until January 2040 and biennial stress periods thereafter.

Three transient predictive numerical model scenarios were run:

- Cumulative – proposed mining at New Lenton plus future approved mining at Burton.
- Approved – approved future mining at Burton.
- Null – no historic or future mining within the region.

Project-only (incremental) impacts are derived from the difference between the Cumulative and Approved model scenarios, whilst cumulative impacts are derived from the difference between the Cumulative and Null model scenarios.

Consideration of climate change was not considered warranted within the predictive modelling through to the end of mining given the relatively short lifespan of the Project.

6.3 Predicted Groundwater Interception

Predicted groundwater inflows to the proposed West and East open cut pits at the Project are presented in **Figure 6-1**. The groundwater inflows to the West Pit are predicted to peak in 2027 at 524 ML/year, while for East Pit a peak of 856 ML/year is predicted in 2030. The total groundwater inflow to the Project pits is predicted to reach a maximum of 1026 ML/year in 2030, coinciding with operations commencing at the second pit (East Pit) at New Lenton. The model predicts an average of 434.5 ML/year groundwater take over the duration of mining at the Project.

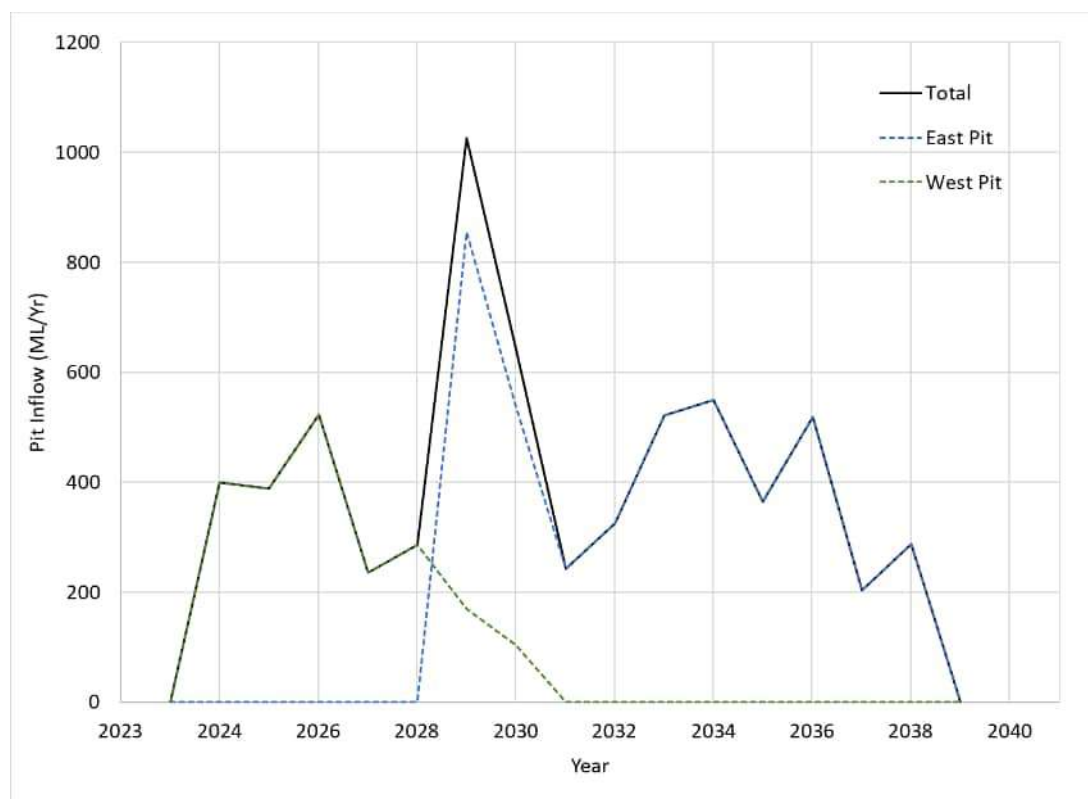


Figure 6-1 Predicted Project Mine Pit Inflows



It should be noted that this total volume includes water removed in rock material with mining, as well as water evaporated from the surface of the pit walls and floor. It is therefore an over-estimate of groundwater that could report to the site water balance or require physical management within the mine water management system.

6.4 Predicted Maximum Incremental Groundwater Level Drawdown

The process of mining reduces water levels in surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of depressurisation in a confined aquifer and zone of drawdown within the water table. Depressurisation and drawdown are greatest at the working coal-face, and gradually reduces with distance from the mine.

Maximum incremental drawdown due to the proposed mining at the Project was obtained by comparing the difference in predicted groundwater levels for the Approved scenario (Burton only) and the Cumulative scenario (New Lenton and Burton). The maximum incremental drawdowns due to the proposed mining at the Project, at any point during active mining, are shown in **Figure 6-2** to **Figure 6-6** for the key model layers. The maximum drawdown is a combination of the maximum drawdown values recorded at each cell at any time from the start of active mining at the Project (January 2025) to one year after end of the mining at the Project (December 2040).

There are no areas with predicted drawdowns of >1 m that intersect known private bores.

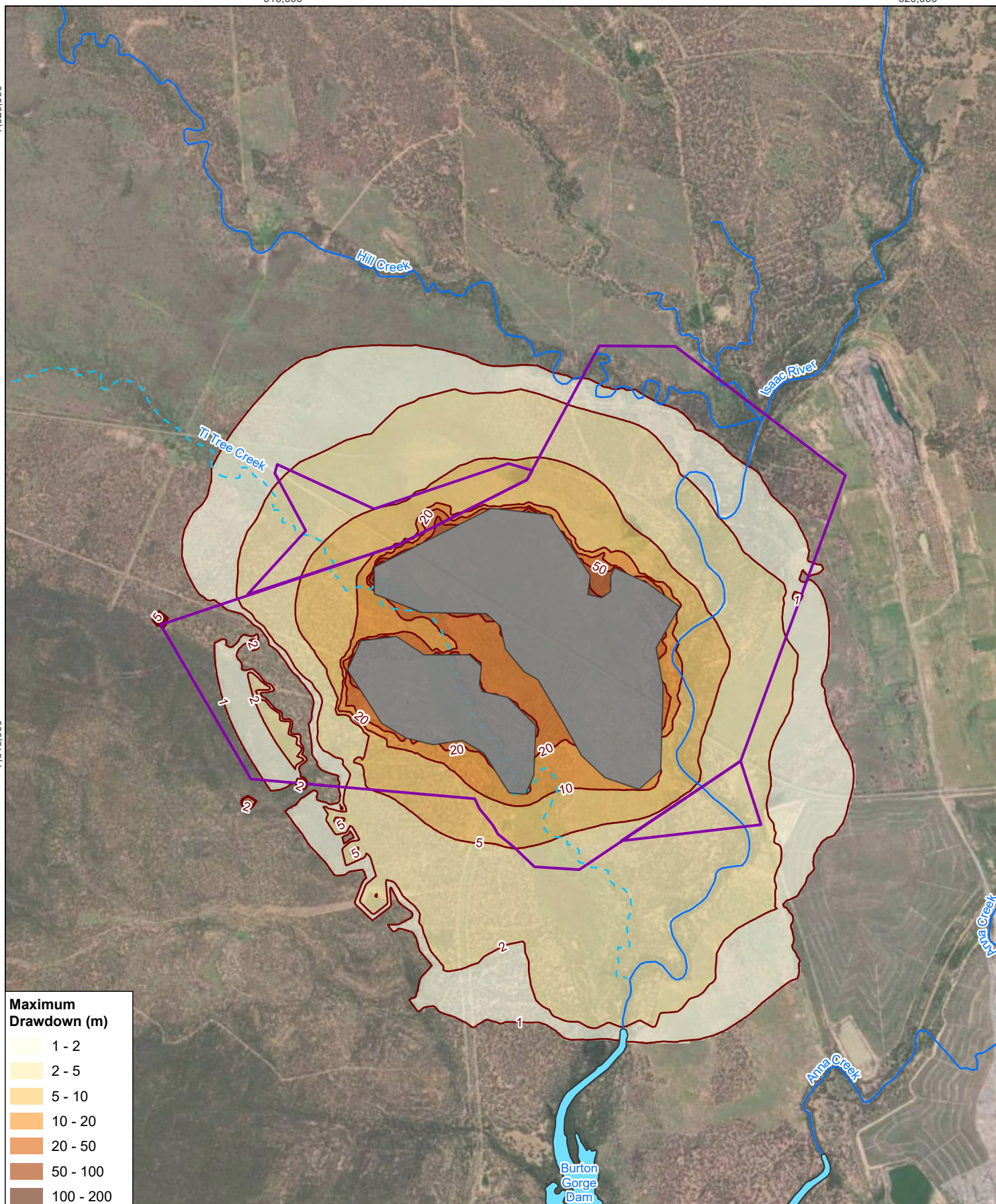
Figure 6-2 shows that the 1 m contour of the predicted maximum incremental water table drawdown extends approximately 2 km to the north and south of the Project mine pits and 1 km to the east and west. Note that this drawdown does not represent any particular aquifer unit but the shallowest saturated unit at any particular location. This area intersects with the area mapped as containing known/likely terrestrial GDEs by 3D Environmental (2023) along the Isaac River (refer to **Section 5.14.3**). Potential impacts to GDEs are further discussed in **Section 7.1.2**.

Figure 6-3 shows the maximum incremental drawdown predicted within the Isaac River alluvium due to proposed mining at the Project reaches up to 12 m in magnitude along the south-eastern edge of East Pit, where the Isaac River is within 150 m of the mine pit crest. Predicted drawdown of approximately 2 m in the alluvium extends 2 km downstream and 1 km upstream of East Pit at the Project.

Figure 6-4 shows the maximum incremental drawdown predicted in the Regolith (model layer 2). Predicted drawdowns extents are very similar to that for the water table (refer **Figure 6-2**), which is expected given the Regolith contains the water table in areas outside mapped alluvium.

Figure 6-5 and **Figure 6-6** show the extent of maximum predicted depressurisation of the Permian coal seams (Burton/Rider and Leichhardt/Vermont seams, respectively). Predicted depressurisation of the Permian coal seams extends 2.5 km to the northeast, as the Permian units sub-crop to the south and west of the Project pits and the model layers are not present.





Maximum Drawdown (m)

1 - 2
2 - 5
5 - 10
10 - 20
20 - 50
50 - 100
100 - 200



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 07-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- - - Non-designated Watercourse
- Maximum Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

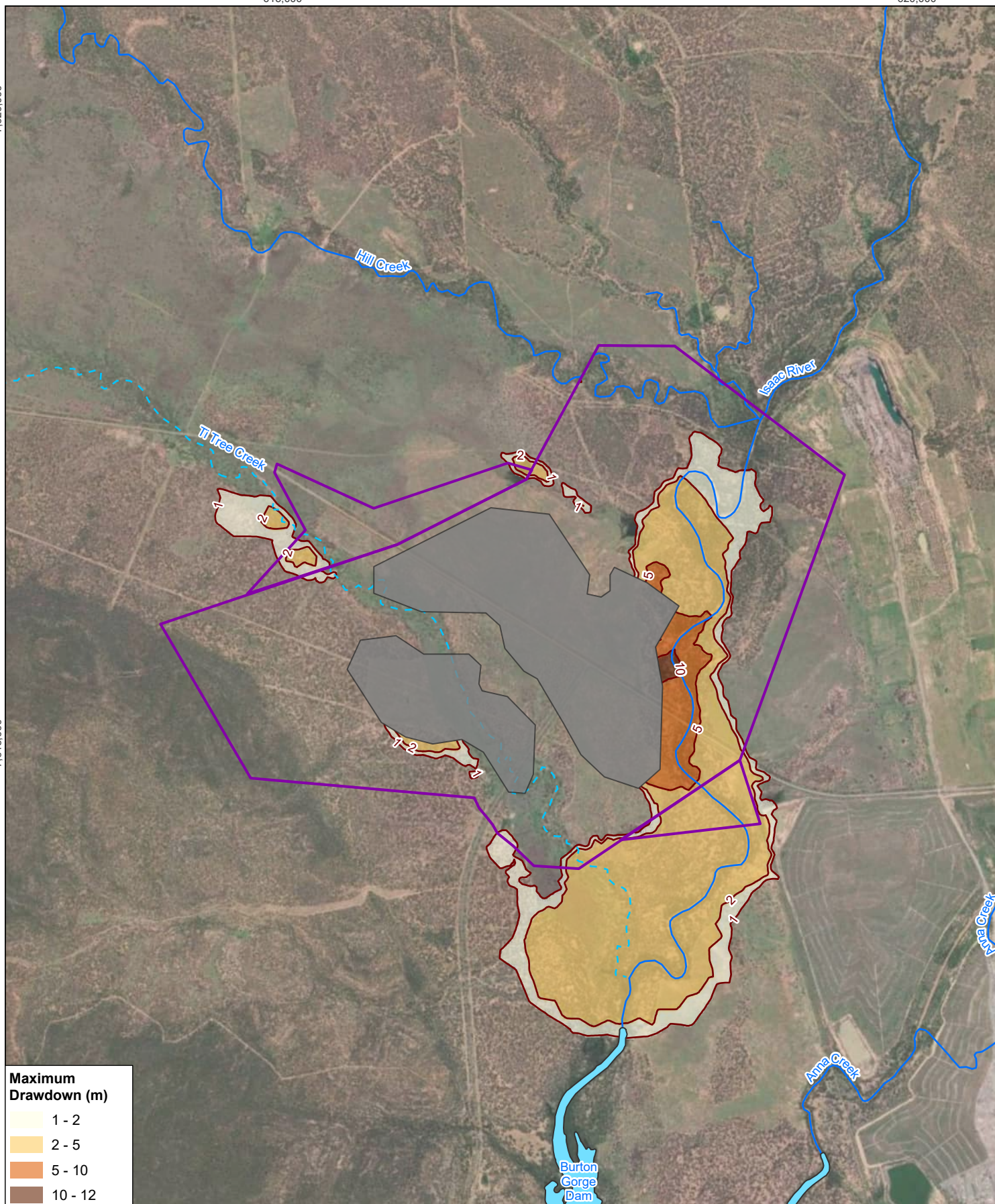
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MAXIMUM INCREMENTAL WATER TABLE DRAWDOWN (2025-2040)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-2



Maximum Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 12



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- Maximum Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

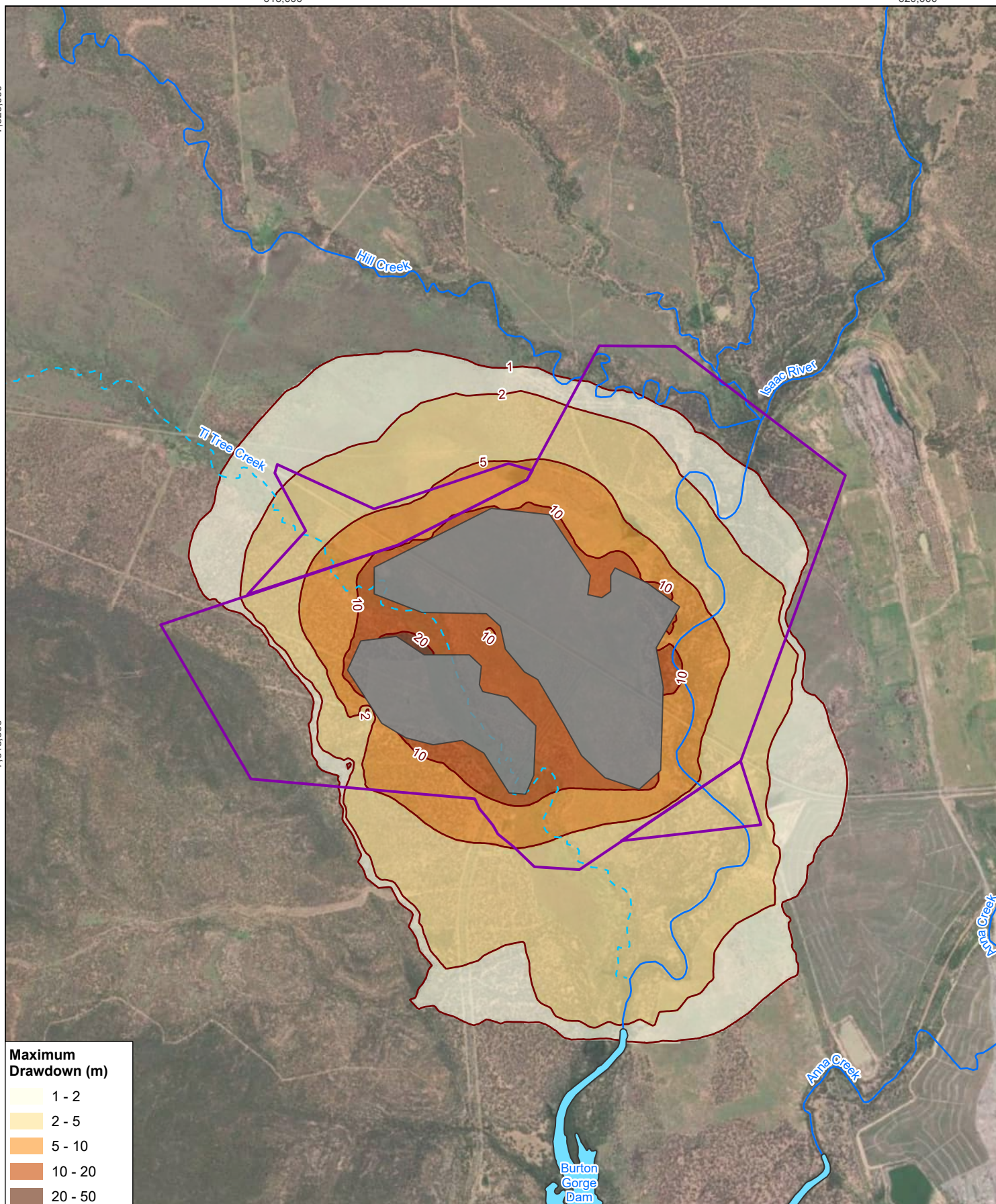
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MAXIMUM INCREMENTAL DRAWDOWN IN THE ALLUVIUM (2025-2040)



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FIGURE 6-3



Maximum Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 03-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- Maximum Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

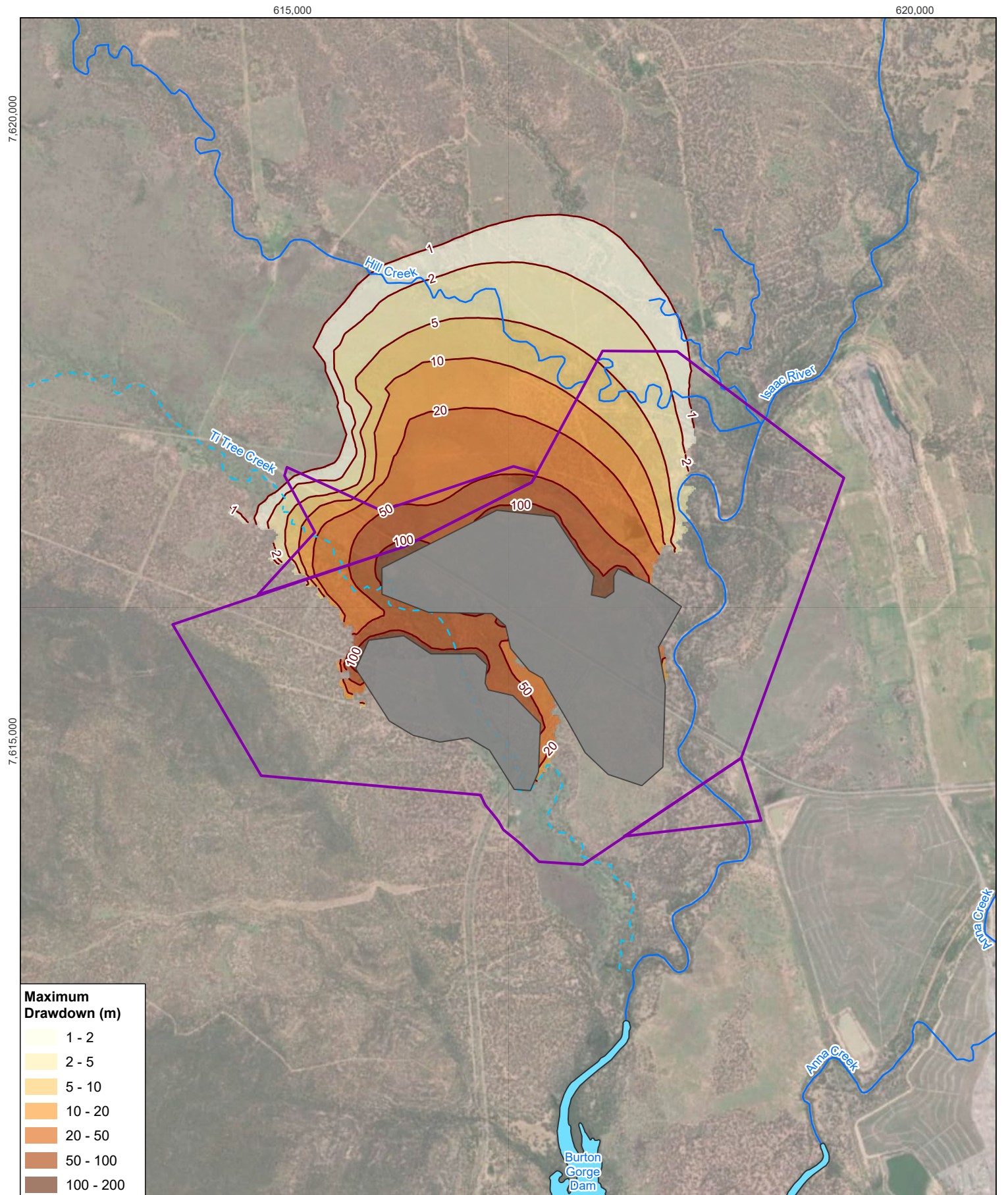
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MAXIMUM INCREMENTAL DRAWDOWN IN THE REGOLITH (2025-2040)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-4



 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:40,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 03-Dec-2023
 Drawn by: RB

LEGEND
 Major Watercourse
 Non-designated Watercourse
 Maximum Drawdown Contour (m)
 New Lenton Mining Lease
 New Lenton Pit Extent

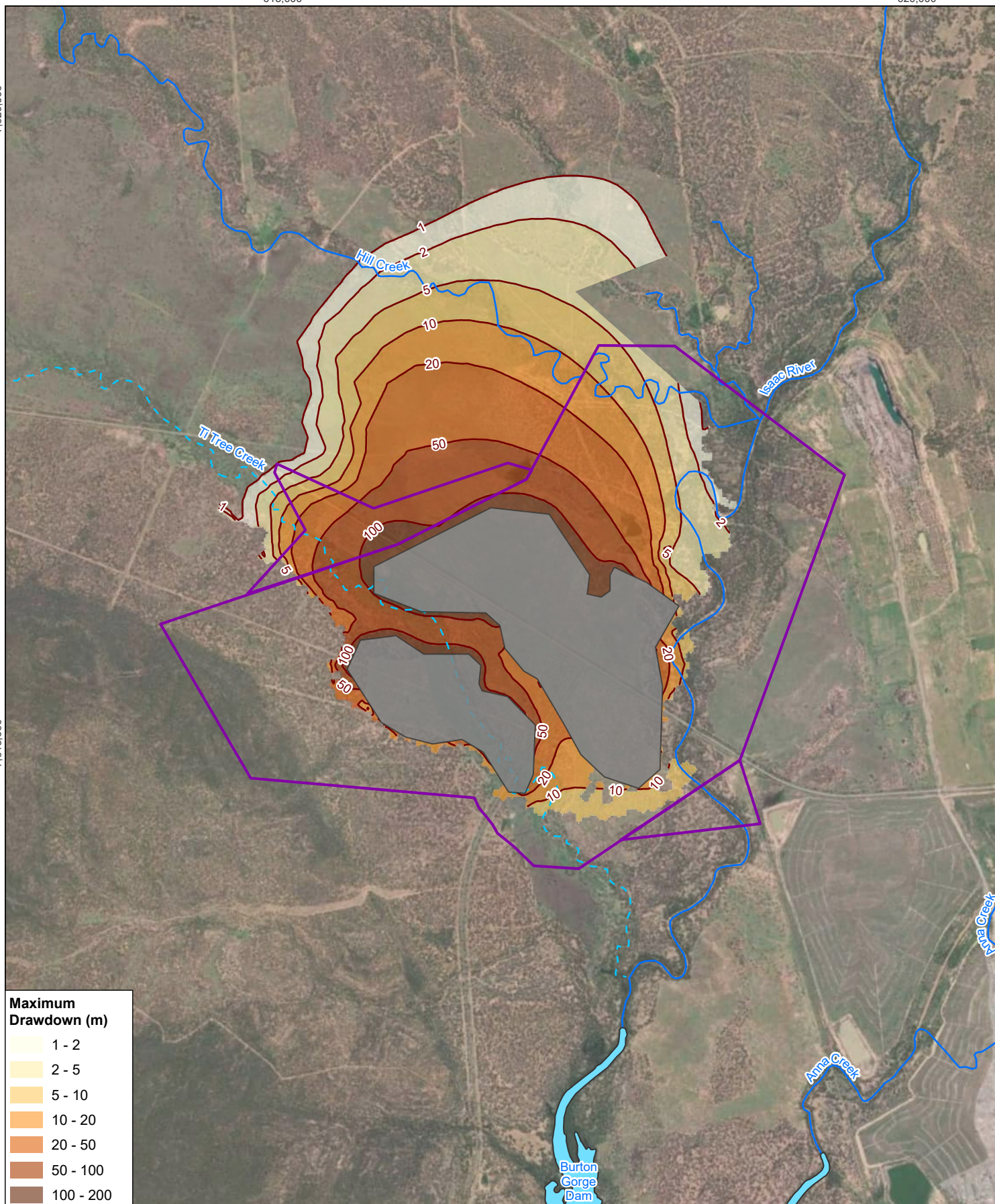
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MAXIMUM INCREMENTAL DRAWDOWN IN THE BURTON/RIDER SEAM (2025-2040)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-5



Maximum Drawdown (m)

1 - 2
2 - 5
5 - 10
10 - 20
20 - 50
50 - 100
100 - 200



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- - - Non-designated Watercourse
- Maximum Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MAXIMUM INCREMENTAL DRAWDOWN IN THE LEIGHARDT/VERMONT SEAM (2025-2040)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-6

6.5 Incidental Water Impacts

6.5.1 Influence on Alluvium

The change in alluvial water resources was calculated by comparing water budgets for alluvial zones using the Approved and Cumulative scenarios of the predictive model. The alluvial resources in the area include the mapped Quaternary Alluvium localised along Isaac River, Hill Creek, Anna Creek and other minor drainage lines.

Figure 6-7 presents the predicted incremental direct and indirect take for mapped Quaternary alluvium within the model domain, calculated as the difference between the Approved and Cumulative scenarios. In regards to indirect alluvial take, this is in the form of a predicted decrease in total flux to the alluvium from surrounding hard rock across the model domain, due to the proposed mining at the Project.

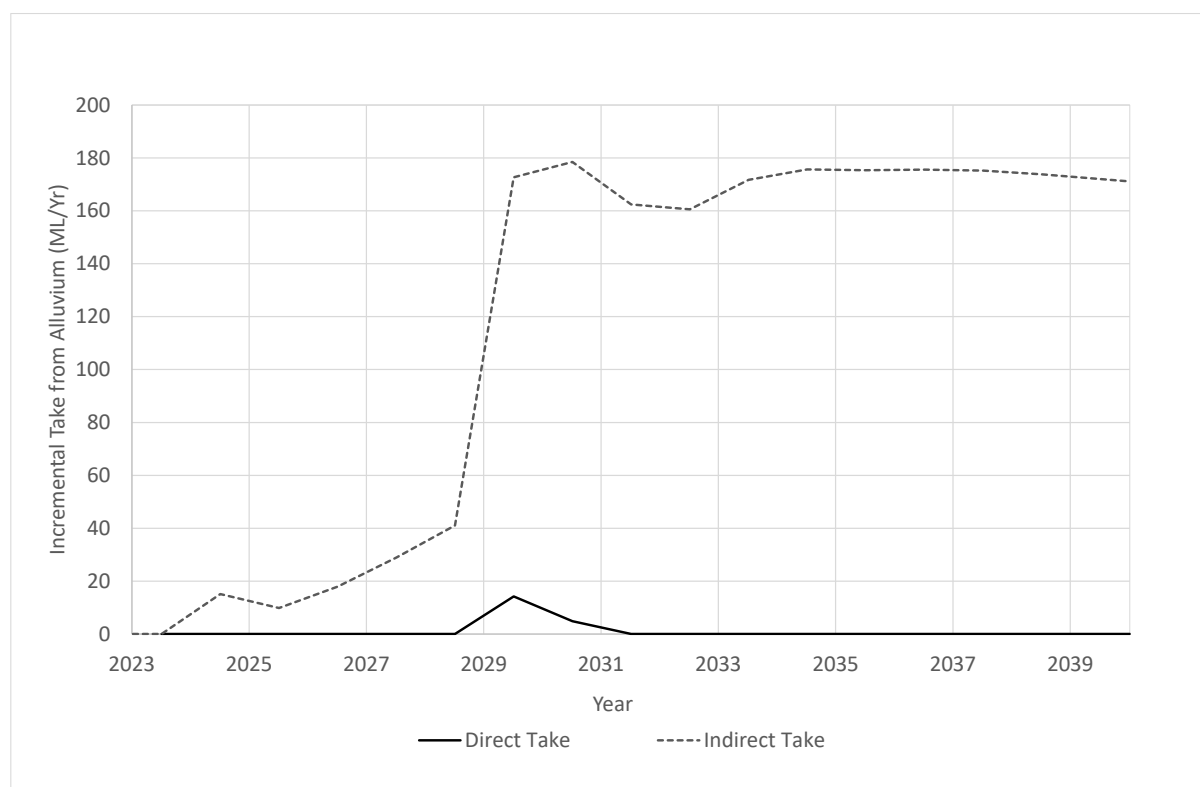


Figure 6-7 Predicted Incremental Groundwater Loss of Water from the Alluvium as a Result of the Project

6.5.2 Influence on River Flow

The predicted change in surface water flow due to proposed mining at the Project was calculated by comparing the river cell flow budget for the Isaac River (within 3 km of the Project Area) for the Approved and Cumulative scenarios. The model predicted no baseflow in either the Approved or Cumulative scenario therefore no change to Isaac River baseflow was identified due to simulated mining at the Project.

Model predictions are consistent with the conceptualisation, i.e. that the alluvium associated with the Isaac River near the site does not supply a baseflow component to the Isaac River.



6.6 Cumulative Impacts

The maximum cumulative drawdowns are obtained by the calculating the maximum difference in heads between the Cumulative and Null scenarios at each cell at any time, from the end of the calibration period (July 2023) to one year after the end of the proposed mining at the Project (December 2040).

Figure 6-8 to Figure 6-12 show the maximum predicted cumulative drawdown for the water table, as well as depressurisation within individual model layers. This includes drawdown within the alluvium and Regolith, and depressurisation within the Burton/Rider and Leichhardt/Vermont seams.

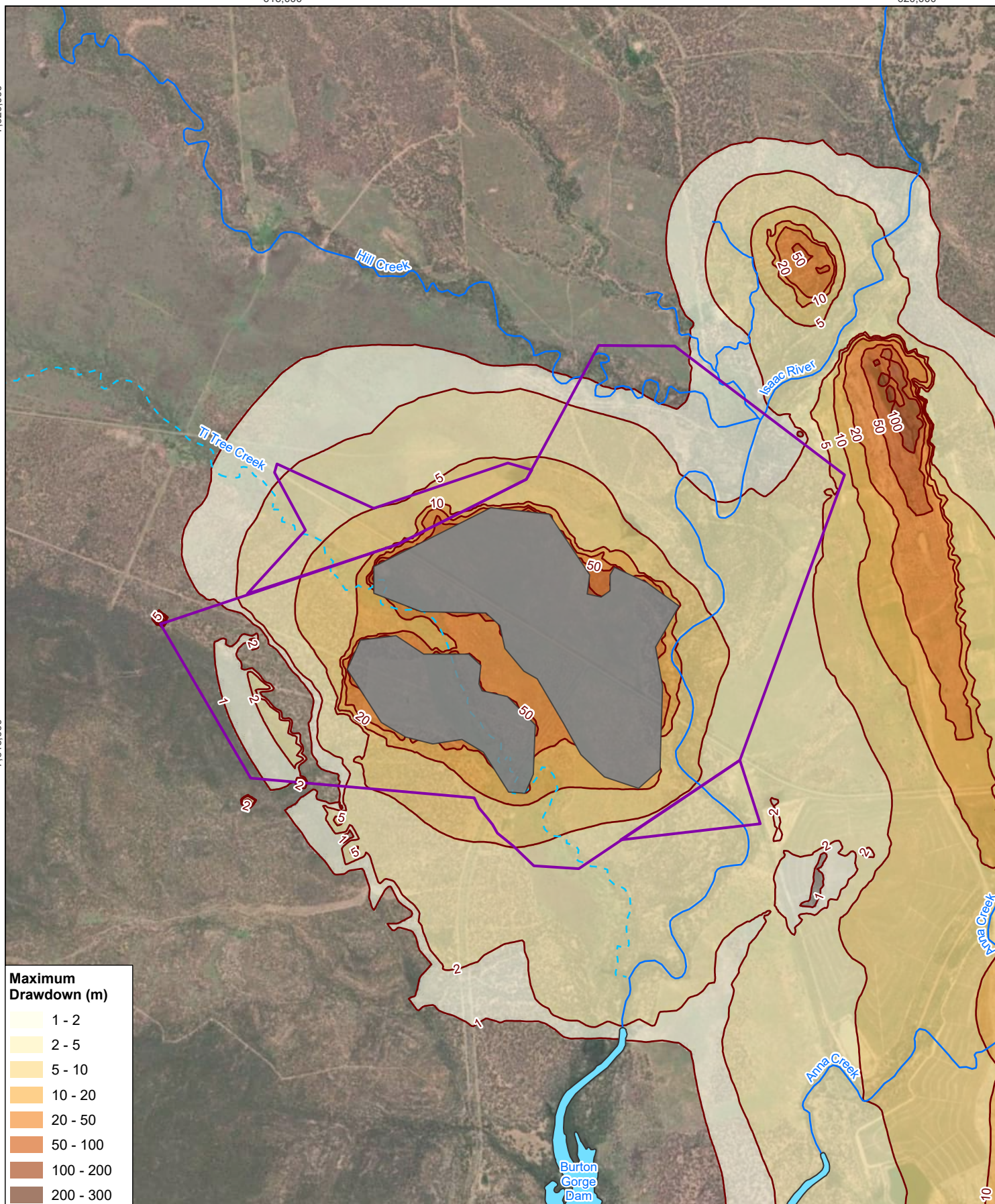
Figure 6-8 shows that water table drawdown is greatest within or closely around the mining areas, and gradually reduces with distance from the mines. It should be noted that the figure presents maximum drawdown in the uppermost saturated model layer, including the Triassic units that overlie the Permian coal measures.

Figure 6-9 shows that cumulative drawdown is predicted in the alluvium where drainage lines run between the mine pits at the Project and Burton Mine. The predicted maximum cumulative drawdown extent in the Isaac River alluvium extends a further 3 km upstream than the predicted incremental drawdown extent shown in **Figure 6-3**. In the area of predicted incremental drawdown in the alluvium (refer **Figure 6-3**), the predicted cumulative drawdown map (**Figure 6-9**) shows negligible increase in drawdown magnitude between the incremental and cumulative predictions (i.e. Burton Mine doesn't exacerbate the New Lenton Project predicted drawdown), although Burton Mine contributes its own drawdown to the north along the Isaac River.

Figure 6-10 shows the maximum predicted cumulative drawdown extent in the Regolith, which as expected extends further to the southeast and northeast than the predicted incremental drawdown shown in **Figure 6-4** and is similar to the extent of cumulative drawdown in the water table shown in **Figure 6-8**.

The greatest cumulative depressurisation occurs in the deeper coal seams that are mined at Burton and the Project. **Figure 6-11** and **Figure 6-12** show drawdowns in the Permian Burton/Rider and Leichhardt/Vermont seams around the Project interact with depressurisation around the northern-most Burton pits. However, the extent of depressurisation in the coal seams is limited to the west of the Project by the sub-crop of the Permian coal seams.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 03-Dec-2023

Drawn by: <ACP>arb/ACP>

LEGEND

- Major Watercourse
- - - Non-designated Watercourse
- Maximum Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

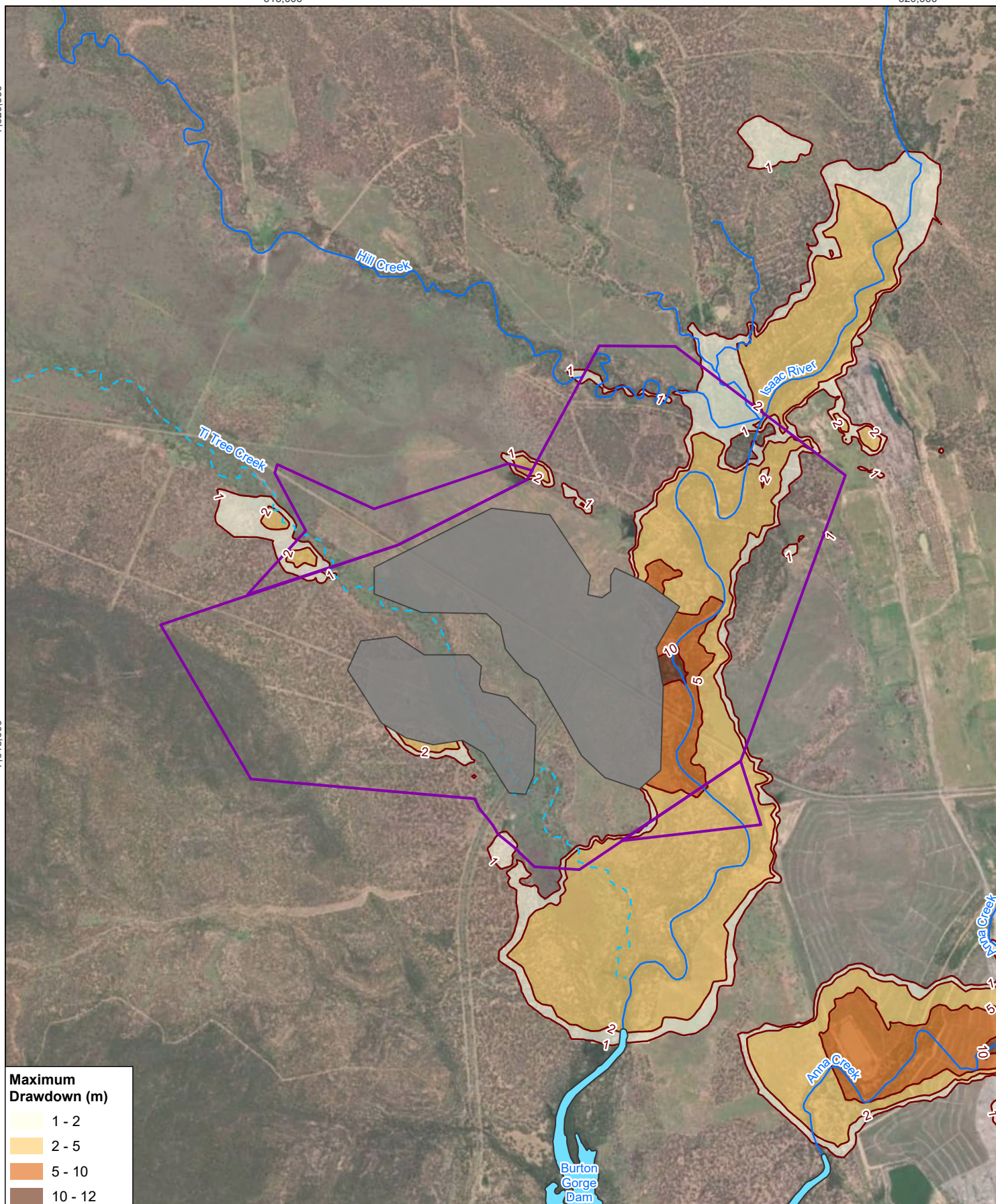
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MAXIMUM CUMULATIVE WATER TABLE DRAWDOWN (2025-2040)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-8



Maximum Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 12



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- Maximum Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

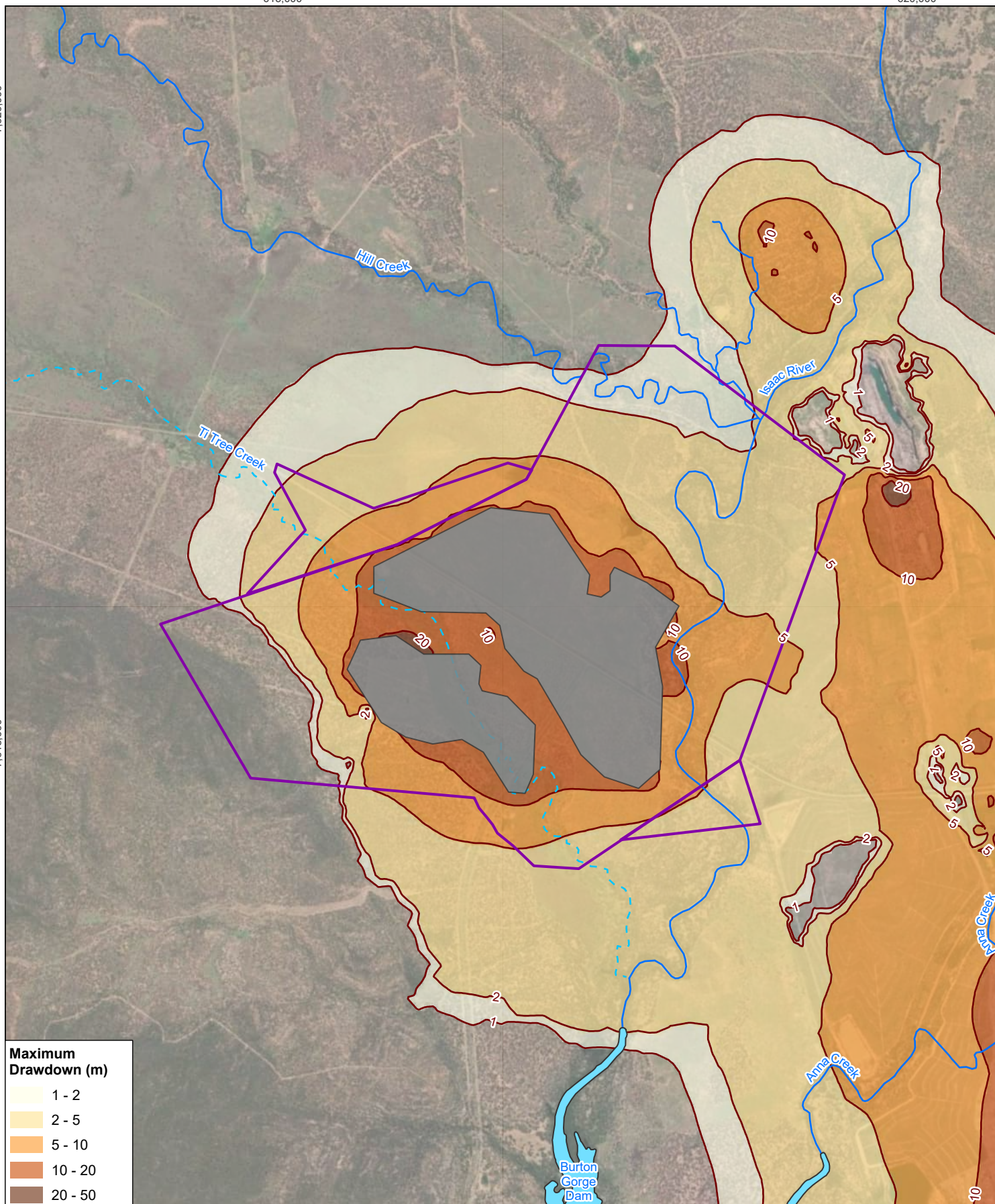
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MAXIMUM CUMULATIVE DRAWDOWN IN THE ALLUVIUM (2025-2040)



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FIGURE 6-9



Maximum Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 03-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- Maximum Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

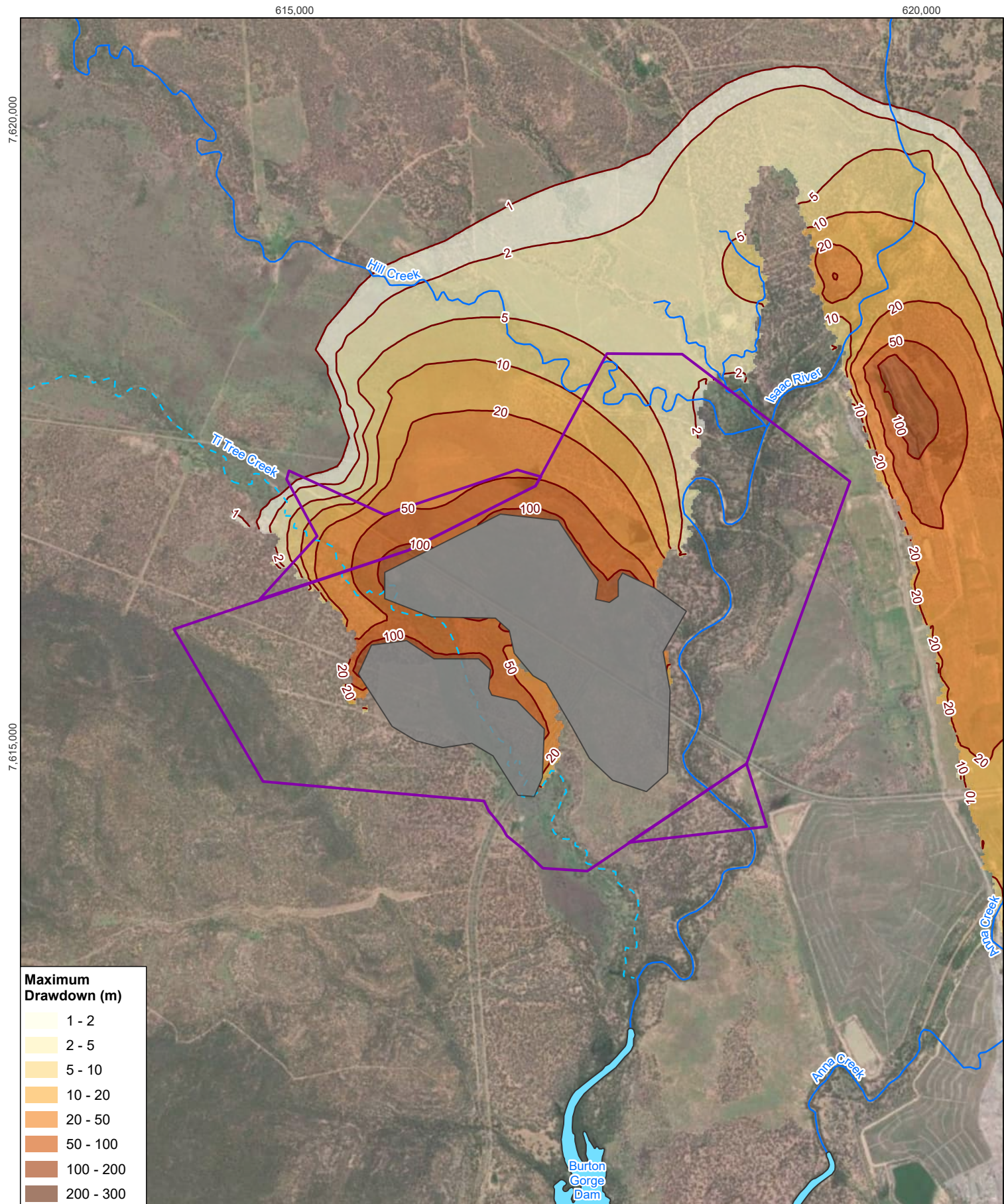
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MAXIMUM CUMULATIVE DRAWDOWN IN THE REGOLITH (2025-2040)



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FIGURE 6-10

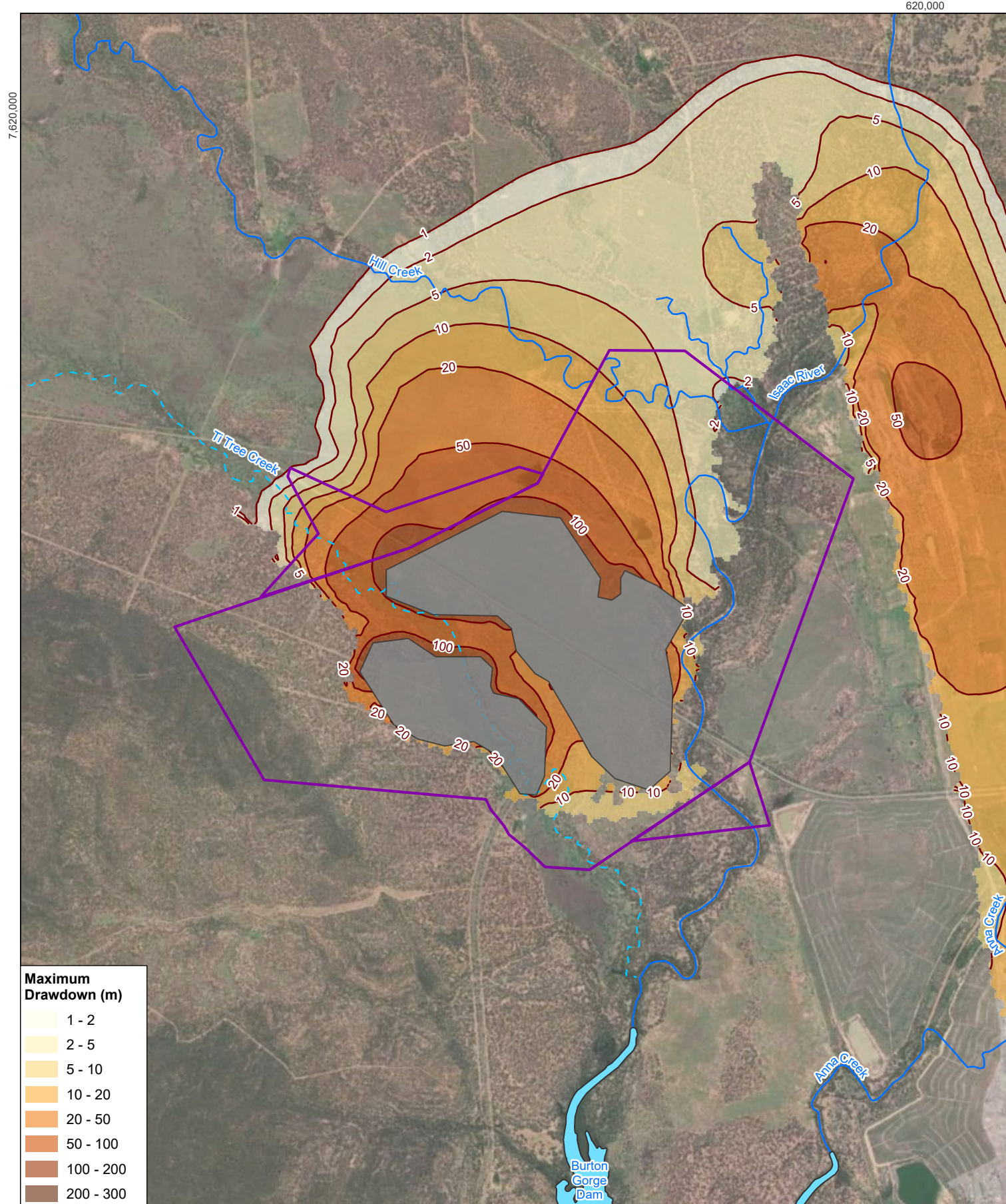


	00.51 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:40,000 at A4
Project Number:	620.31367.00000
Date Drawn:	03-Dec-2023
Drawn by:	RB



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FIGURE 6-11



Coordinate System: GDA2020 MGA Zone 55

 Scale: 1:40,000 at A4

 Project Number: 620.31367.00000

 Date Drawn: 14-Dec-2023

 Drawn by: RB

NEW LENTON COAL PROJECT
PER GROUNDWATER
ASSESSMENT

PREDICTED MAXIMUM
CUMULATIVE DRAWDOWN
IN THE LEICHHARDT/VERMONT SEAM
(2025-2040)



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FIGURE 6-12

6.7 Post-Mining Simulation

Post-mining groundwater impacts at the Project were investigated with a numerical groundwater recovery model for the proposed final landform.

6.7.1 Model Setup

Transient predictive modelling was used to simulate groundwater responses following the cessation of all mining operations in the model domain, encompassing both Project and the adjacent Burton Mine, given that the post-mining landforms at the two sites are likely to interact in a groundwater sense.

The post-mining recovery model starts at the end of mining at the Project (2040) and continues for approximately 730 years (2040 to 2770). Simulated mining at Burton Mine is ceases by 2036. The recovery model consists of biennial stress periods for the first 20 years post-mining, followed by stress periods of increasing length of up to 100-years.

Three transient predictive recovery model scenarios have been developed, to allow the assessment of incremental and cumulative post-mining impacts on the groundwater system:

- Cumulative – Post-mining at the Project plus at the Burton Mine;
- Approved – Post-mining at the Burton Mine, no mining at New Lenton anytime in the past or future; and
- Null – No mining within the region anytime in the past or future.

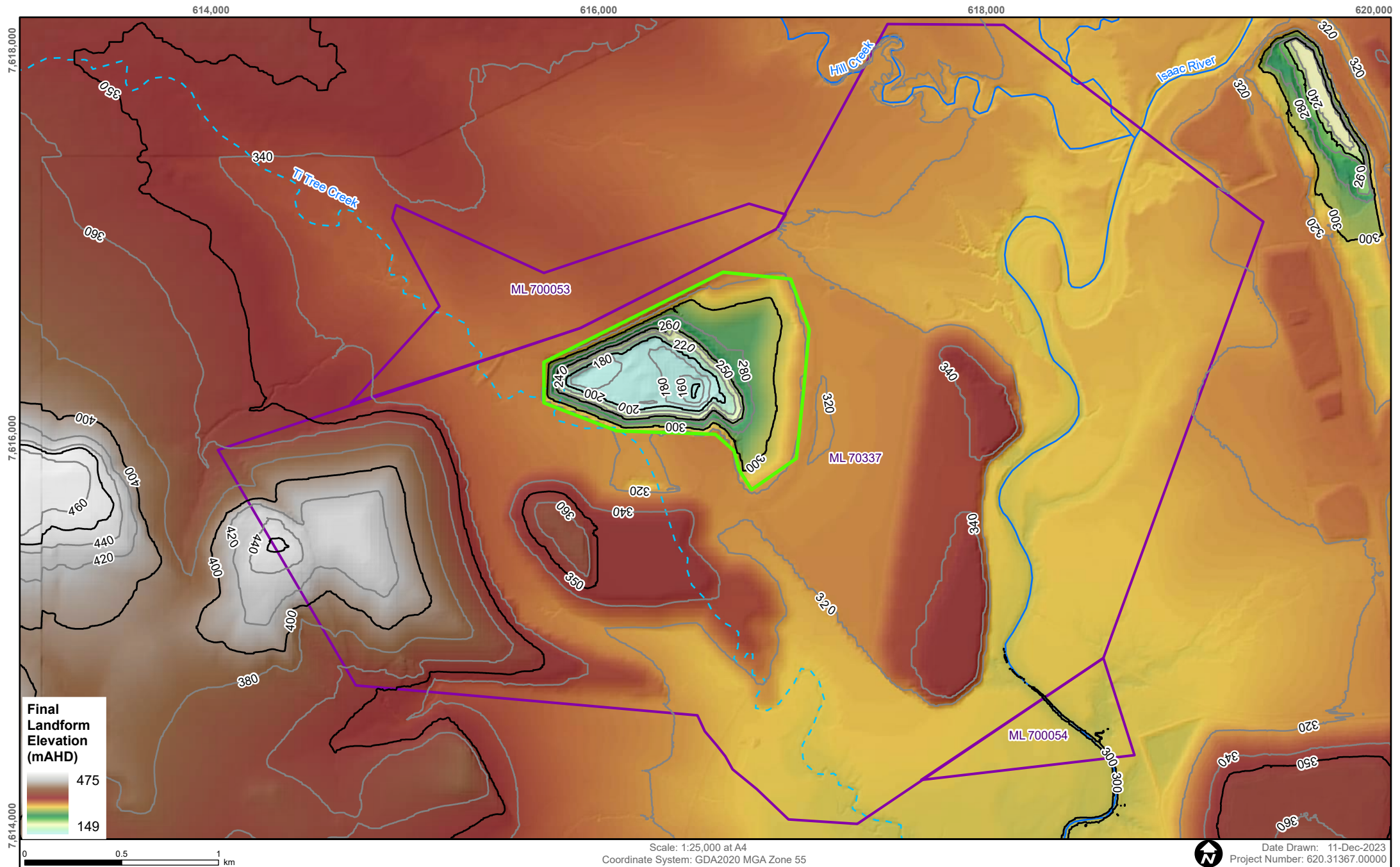
Project-only (incremental) post-mining impacts are derived from the difference between the Cumulative and Approved model scenarios, whilst cumulative post-mining impacts are derived from the difference between the Cumulative and Null model scenarios.

The proposed final landforms for the Project and the adjacent Burton Mine were provided by LJV and are replicated in the model, including areas of spoil emplacement within mined out pits and the residual void. **Figure 6-13** shows the extent of the residual void within the final landform for the Project. The residual void area represents the maximum possible extent of a lake forming up to the crest/spill level.

At the end of mining all drain cells (representing pit dewatering in areas of active mining) are removed from the groundwater model. Using the TVM package, the properties of the residual void cells are assigned high horizontal and vertical hydraulic conductivities (1,000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, specific storage of $5.0 \times 10^{-6} \text{ m}^{-1}$), to simulate free water movement within the residual void.

Climate related boundary conditions (i.e., recharge and evapotranspiration) outside of void lakes in the recovery model were set at constant rates (i.e., long term averages from SILO grid point observations for the site) for the duration of the post-mining simulation, consistent with the values used in the predictive modelling. Climate related boundary conditions on residual void itself (where a lake forms) are discussed in **Section 6.7.3** below.





6.7.2 Integration with Residual Void Water Balance Model

Figure 6-14 presents a conceptual diagram of the post-mining modelling setup adopted for the post-mining simulation. As shown in **Figure 6-14**, the residual void will accumulate water over time due to direct rainfall, surface water runoff and groundwater inflow from both spoil and natural rock as groundwater levels recover. Whilst the numerical groundwater model can reliably account for the groundwater inflow component, the surface components of direct rainfall, surface water runoff, as well as evaporative loss from the void lake, are considered to be better accounted for within a surface water balance model.

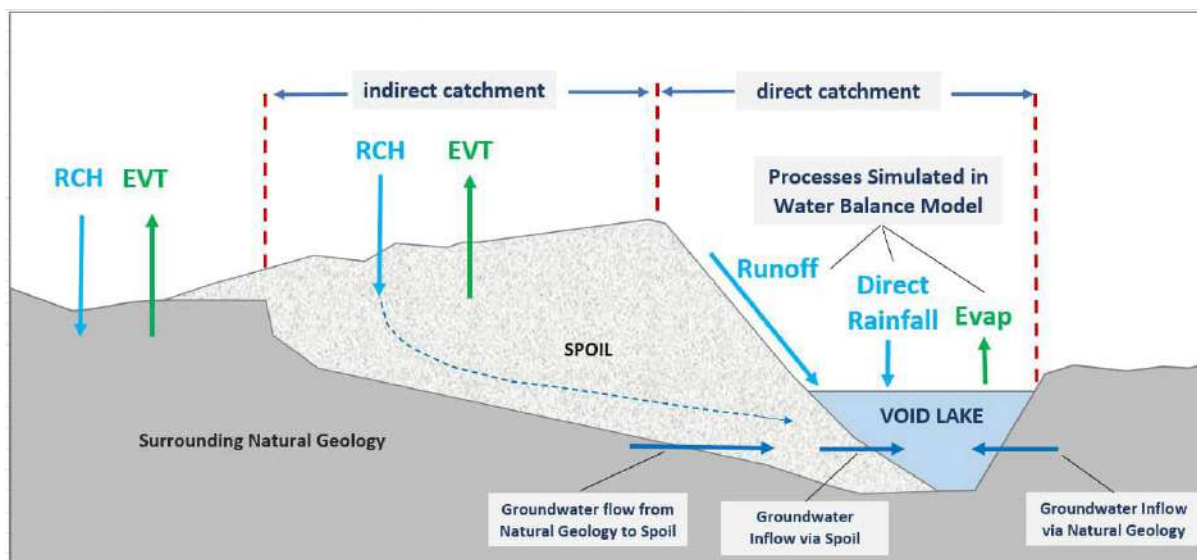


Figure 6-14 Residual Void Recovery Model Conceptual Diagram

The groundwater model was therefore used to predict the following fluxes to the residual void:

- Groundwater inflow to the pit shell from the surrounding geology, including inflow from the natural geology to the spoil backfill and inflow from the natural geology directly to the residual void; and
- Groundwater inflow originating from the indirect catchment (i.e. areas of spoil backfill that receive rainfall recharge that then flows through the spoil into the residual void).

Project residual void water levels were not predicted by the groundwater model, but were estimated by the balance between groundwater inflow and the direct rainfall and rainfall runoff from the surrounding catchment against the evaporation loss from the lake surface through iterative surface water balance modelling (WRM, 2023).

The iterative modelling approach was undertaken in a stepwise manner as follows:

1. Initial predicted groundwater inflows with time to the Project's final landform residual void were incorporated in the water balance model prepared by WRM (2023).
2. The residual void lake levels with time were then predicted by the WRM (2023) water balance model, incorporating groundwater (Step 1) and surface water fluxes and processes.
3. To refine the groundwater model prediction of residual void groundwater inflows, the daily residual void water elevations derived from the WRM (2023) water balance modelling (Step 2) were then replicated within the numerical groundwater recovery model for the final landform using the time variant constant head boundary (CHD)



condition, adopting a simplified average of the WRM (2023) daily results over the relevant groundwater model stress period length.

4. Refined groundwater model predictions for fluxes to the residual void from Step 3 were then input back into the WRM (2023) water balance model, to derive updated residual void lake levels with time.
5. Refined groundwater model prediction of residual void groundwater inflows were then again made, using the daily residual void water elevations derived from the WRM (2023) water balance modelling (Step 4) replicated within the numerical groundwater recovery model.
6. Since the refined groundwater model predictions of residual void groundwater inflows resulting from Step 5 were now in agreement with what was used as groundwater model input to the water balance modelling (i.e. the predicted groundwater inflows with time to the void per Step 3), it was considered by WRM (2023) that further iterations between the two models were not required and therefore the Step 5 groundwater model results were adopted for reporting in this groundwater assessment.

Results from the iterative modelling process are discussed in the following sections.

6.7.3 Residual Void Lake Recovery

Figure 6-15 provides a graphical representation of the final simulated recovery of water levels in the East Pit residual void, based on the iterative groundwater and surface water balance modelling described above in **Section 6.7.2**. Note that, as discussed above, the void lake levels simulated in the groundwater recovery model are a simplified (time averaged) version of the WRM (2023) reported lake levels because of the inherent difference in time step setup between the two types of model. **Figure 6-15** shows that residual void water level recovery is a slow process with the recovery rate declining as the lakes reach equilibrium conditions. The equilibrium conditions are reached after approximately 300 years. The predicted equilibrated water level in the residual void at 300 years post-mining is included on **Figure 6-15** and approximates 271 mAHD in the time-averaged level adopted in the groundwater model, noting that WRM (2023) report that the equilibrium lake level fluctuates between 270 and 278 mAHD. This difference is not considered significant enough to invalidate the convergence between the two types of model, or affect the groundwater model predictions described later in this report.



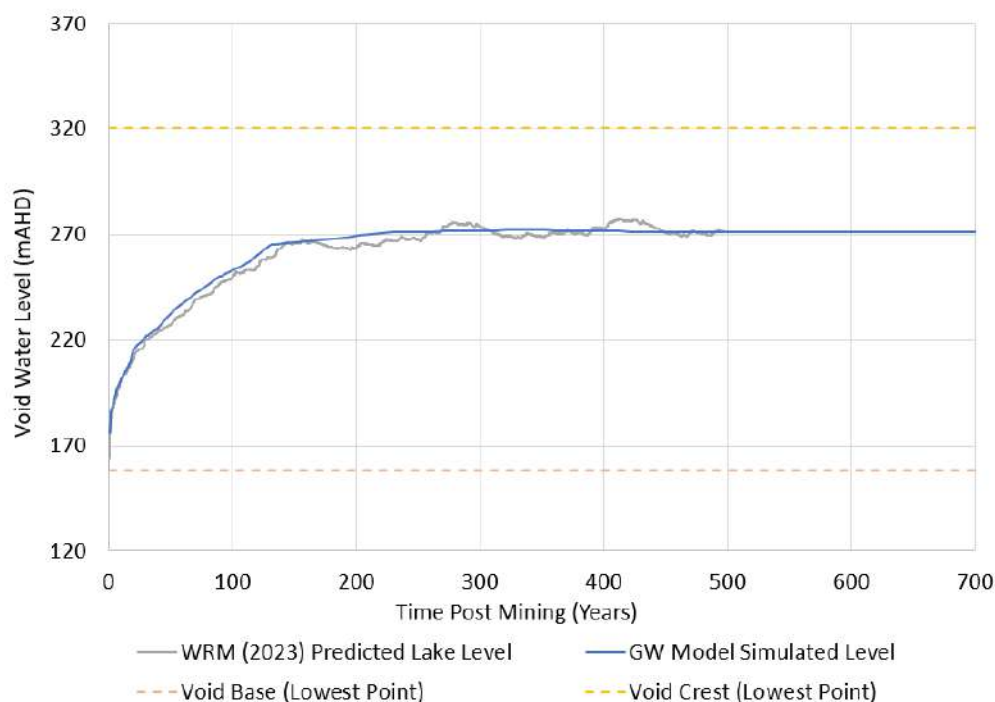


Figure 6-15 Simulated Void Water Level Recovery Post-mining – East Pit Void

6.7.3.1 Climate Change Consideration

The WRM (2023) modelling included consideration of the affect of climate change on the residual void water balance, and the resulting lake levels that drive equilibrium groundwater levels in the surrounding environment. The potential impacts of climate change on residual void behaviour were assessed using the projections and methodologies given in the CSIRO and BoM report entitled *Climate Change in Australia Technical Report* (CSIRO and BoM, 2015). Three future climate scenarios were considered ('best case', 'maximum consensus case' and 'worst case'), with climate variable inputs (rainfall and evaporation) to the water balance model adjusted to undertake the climate change assessment.

The water balance modelling results show that the residual void water levels will be lower than under baseline climatic conditions for both the 'best case' and 'maximum consensus case' climate scenarios. For the 'worst case' climate scenario, the residual void water levels will be slightly higher than under baseline climatic conditions. The WRM (2023) results show the following:

- For the 'best case' climate scenario, the equilibrium and peak water level is around 45 m lower than under baseline climate conditions;
- For the 'maximum consensus case' climate scenario, the equilibrium and peak water level is around 30 m lower than under baseline climate conditions; and
- For the 'worst case' climate scenario, the equilibrium and peak water level is around 4.3 m higher than under baseline climate conditions.

The climate change assessment demonstrated that there is no risk of void lake overflow even under the most conservative climate change scenarios. The assessment also demonstrated that the void lake level under the 'worst case' climate scenario is very similar to the baseline climate scenario, and therefore there would be minimal effect on resulting groundwater levels at equilibrium between the 'worst case' climate change scenario and the baseline climate scenario results described herein.



6.7.4 Residual Void Groundwater Inflow

The groundwater inflows to the East Pit residual void predicted by the groundwater model are shown in **Figure 6-16**. The inflows are partitioned between flow into the residual void through spoil, and that which flows into the residual void through only surrounding natural geological formations (i.e. where the natural geology remains exposed to the void shell).

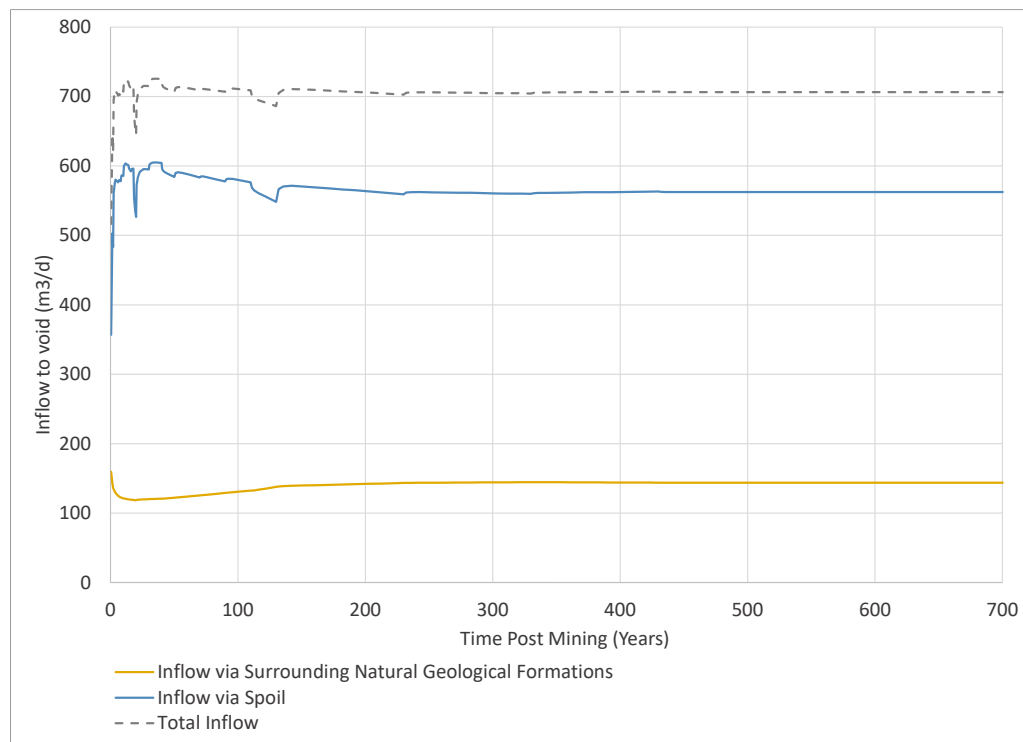


Figure 6-16 Simulated Residual Void Groundwater Inflows – East Pit Void

Figure 6-16 shows there are periods of variable groundwater inflows predicted by the groundwater model in the first 50 to 100 years post-mining when groundwater levels remain suppressed. The figure also shows variability in the predicted inflow magnitudes over the first 50 years post-mining. During this transition period, groundwater fluxes to the void are largely controlled by variable levels predicted by the WRM (2023) surface water balance model. The groundwater inflow to the void is predicted to stabilise between 200 to 500 years post closure consistent with the stabilisation of void lake levels.

The post-mining equilibrium groundwater flux to the East Pit shell (i.e. the area previously mined and now containing either spoil backfill or the residual void) is summarised in **Table 6-3**. This flux is indicative of the total long-term average take from the groundwater system, and includes a component of flow directly to the void from natural geologic formations as presented in **Table 6-4**.

Table 6-3 Equilibrium Groundwater Inflows to the Pit Shell from Natural Geological Formations – East Pit

Residual Void	Equilibrium Inflow Rate – Natural Geological Formations (m³/day)
East Pit Void	635.5



Table 6-4 shows the predicted post-mining equilibrium groundwater inflows that enter the East Pit residual void lake. The table indicates that approximately 80% of the long-term groundwater inflow to the voids comes via the spoil, which is a composition of both direct rainfall recharge to spoil areas and groundwater inflows from natural geologic formations.

The groundwater contribution to the residual void is approximately 47% of the total void inflow including surface water components reported in WRM (2023), meaning that the void water balance and resulting lake level predictions are roughly as sensitive to surface water components (runoff & direct rainfall) as groundwater inflow.

Table 6-4 Equilibrium Groundwater Inflow – East Pit Void

Residual Void	From Spoil (m ³ /day)	From Natural Geological Formations (m ³ /day)	Total (m ³ /day)
East Pit Void	562.3	143.8	706.1

6.7.5 Predicted Post-Mining Groundwater Levels

6.7.5.1 Groundwater Level Recovery

To demonstrate the groundwater system transient response following the end of mining through to post-mining equilibrium conditions, predictive hydrographs showing the change in groundwater levels over time at ‘dummy bore’ locations have been produced from the post-mining groundwater recovery model. The hydrographs have been developed just outside the residual void at East Pit for each of the units present adjacent the residual void, being the Regolith, Burton/Rider and Leichhardt/Vermont seams. The hydrographs are shown in **Figure 6-17** to **Figure 6-20**, with the hydrograph locations shown on **Figure 6-23** through to **Figure 6-25**. The hydrographs include the following nomenclature and features: for the Regolith, Burton/Rider seam (BR Seam) and Leichhardt/Vermont seam (LV Seam), and with locations north (N), east (E), south (S) and west (W) of the residual void.

The hydrographs demonstrate that at all times post-mining, groundwater levels in each aquifer unit surrounding the residual void remain above the predicted void lake level, meaning no potential for outflow from the void lake to the groundwater system and permanent inflow only (sink) conditions are maintained post-mining. Furthermore, the hydrographs show void lake levels remain below the base of the shallow groundwater system (regolith) at all times, further suggesting no potential for void lake outflow to that unit.

The hydrographs also demonstrate that groundwater levels in the Permian Coal Measures are expected to partially recover following the end of mining, over timeframes similar to the establishment of equilibrium void lake conditions (i.e. approximately 250 years). Some recovery of groundwater levels in the Regolith is also apparent, also somewhat lesser in magnitude than the recovery for the Permian Coal Measures. The residual groundwater level drawdown at equilibrium for these units is driven by the ongoing evaporation-driven groundwater discharge to the residual void lake and governed by the residual void lake elevation itself. The residual drawdown is further discussed further in **Section 6.7.5.2** below.

The hydrographs also demonstrate very little effect on groundwater levels from the residual void inflow flux variability in the early post-closure period as shown and discussed in **Section 6.7.4**.



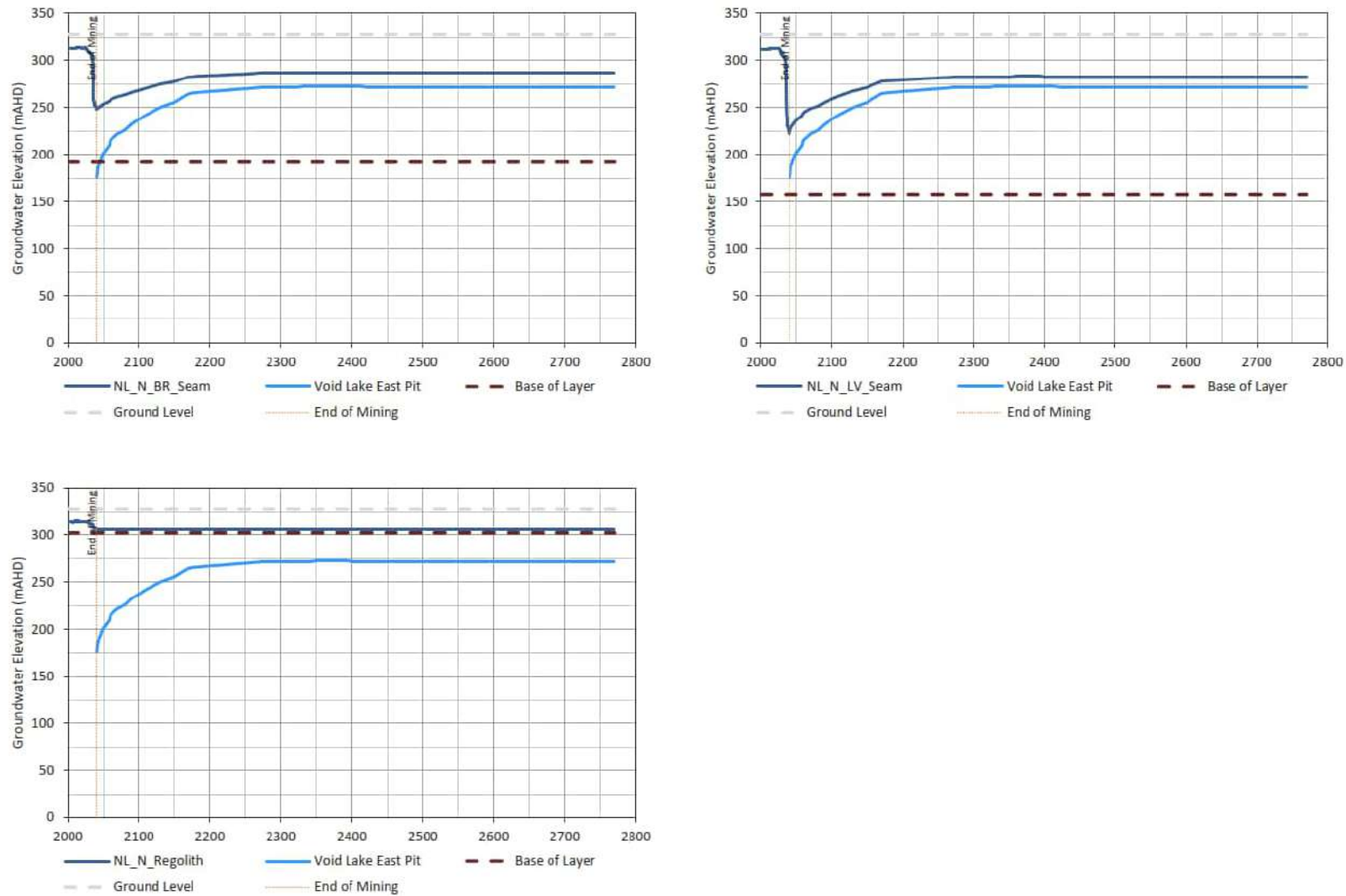


Figure 6-17 Predictive Hydrographs to the north of East Pit Void



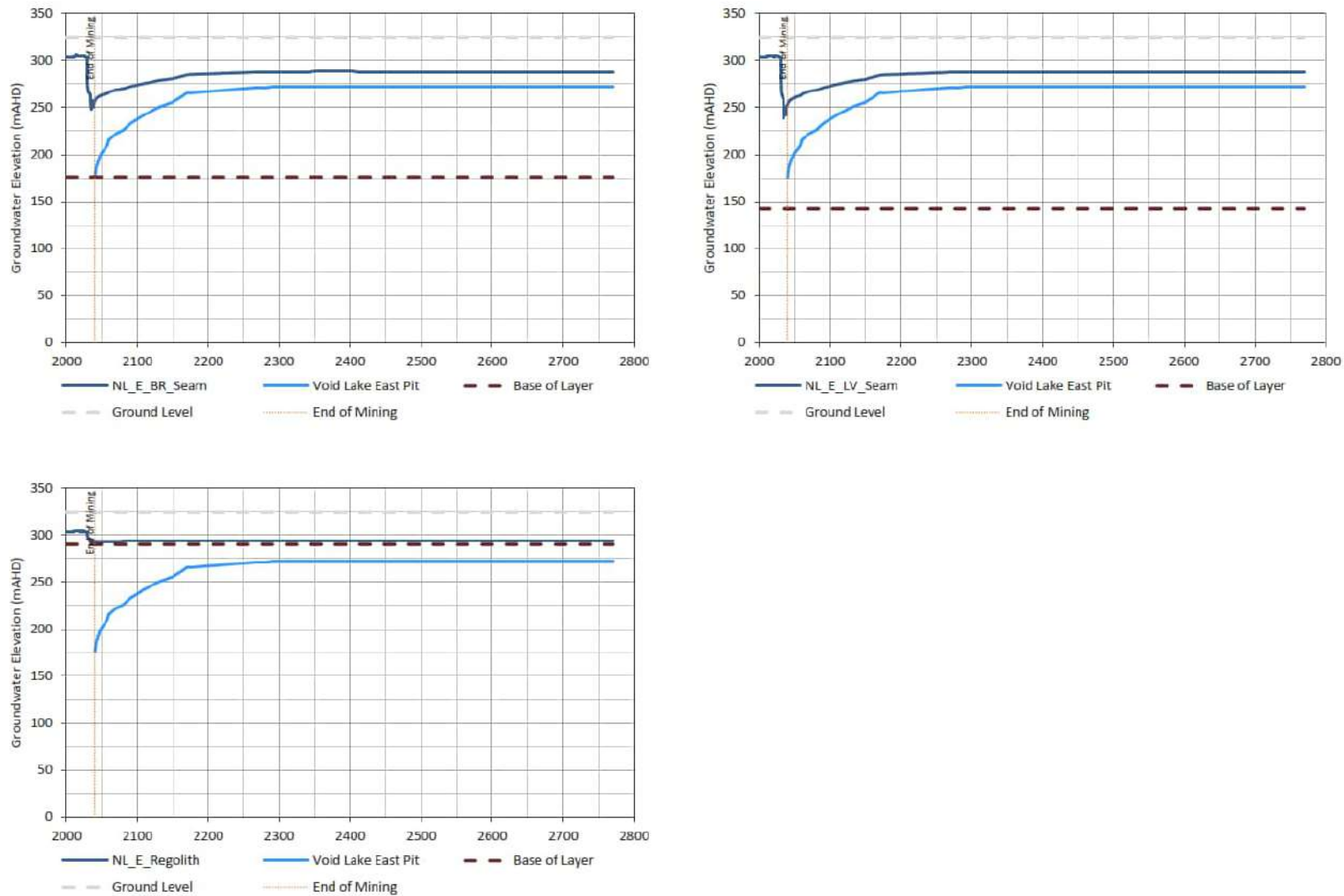


Figure 6-18 Predictive Hydrographs to the east of East Pit Void



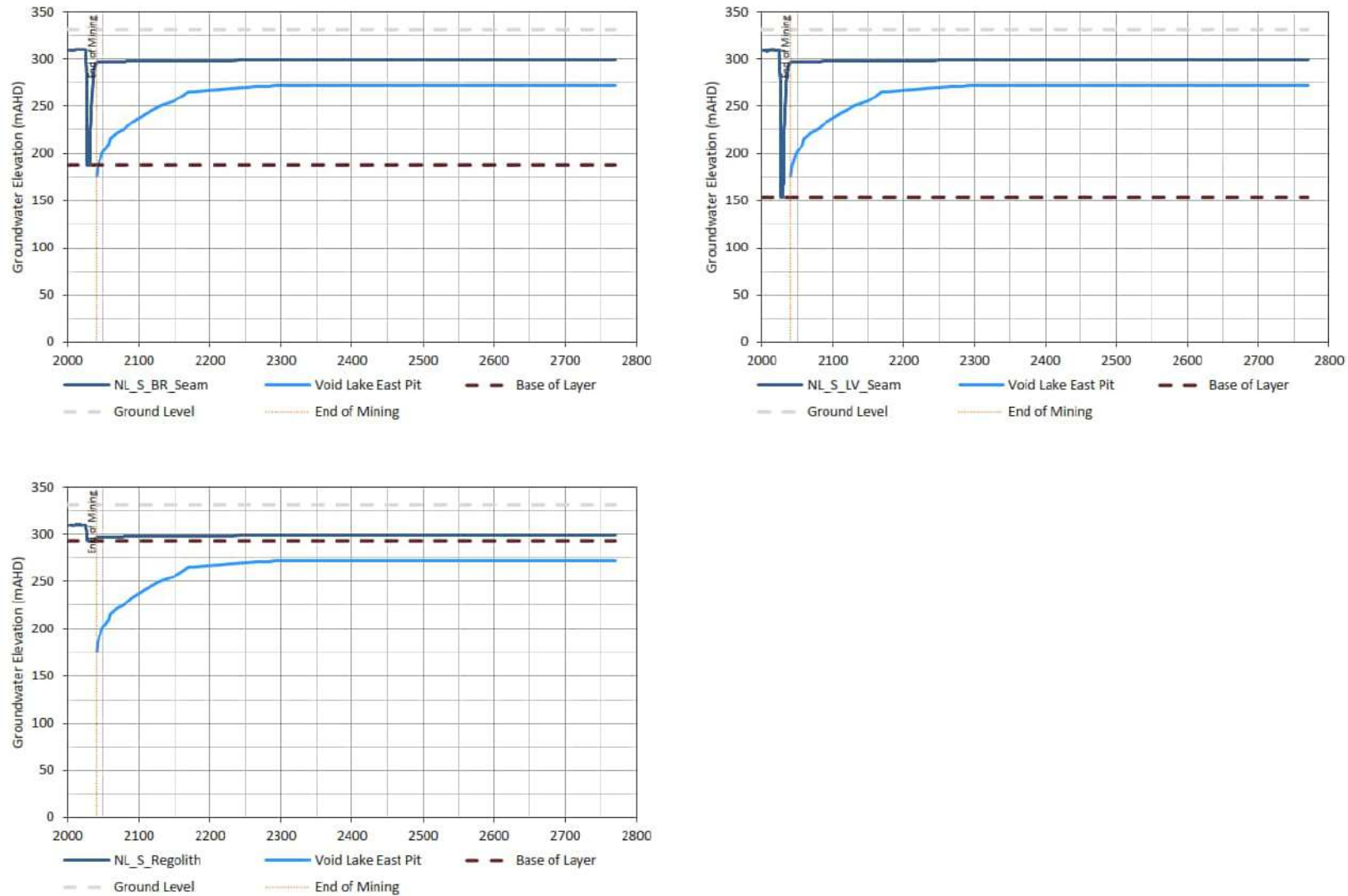


Figure 6-19 Predictive Hydrographs to the south of East Pit Void



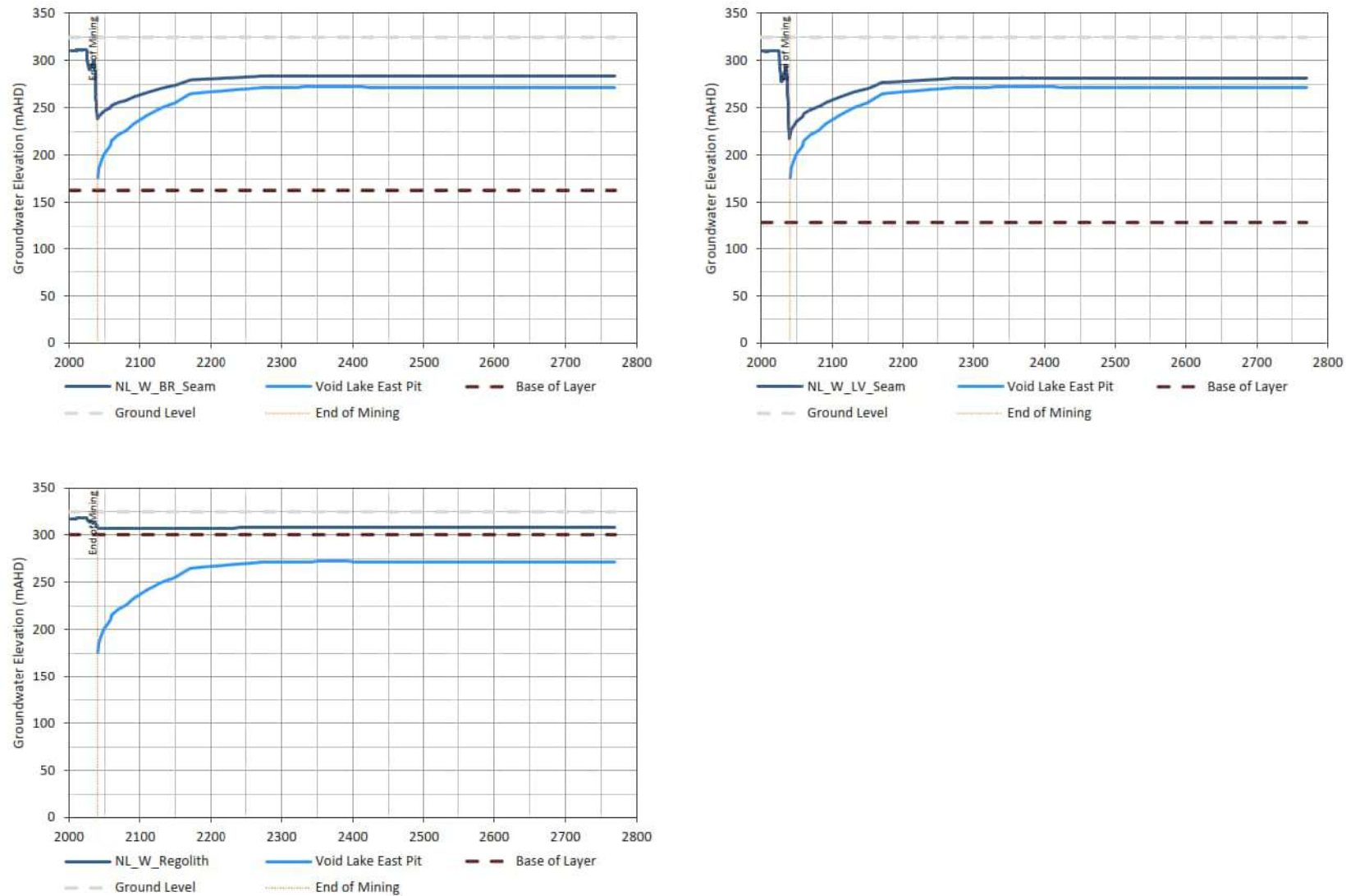


Figure 6-20 Predictive Hydrographs to the west of East Pit Void



6.7.5.2 Residual Groundwater Level Drawdown at Post-Mining Equilibrium

The predicted equilibrium incremental residual groundwater level drawdown in the water table is shown in **Figure 6-21**, noting this does not represent any particular aquifer unit but the shallowest saturated unit at any particular location. Predicted equilibrium residual drawdown for the Alluvium, Regolith, Burton/Rider and Leichhardt/Vermont seam layers are shown on **Figure 6-22** to **Figure 6-25**.

There are no areas with predicted post-mining equilibrium drawdowns of >1 m that intersect known private bores.

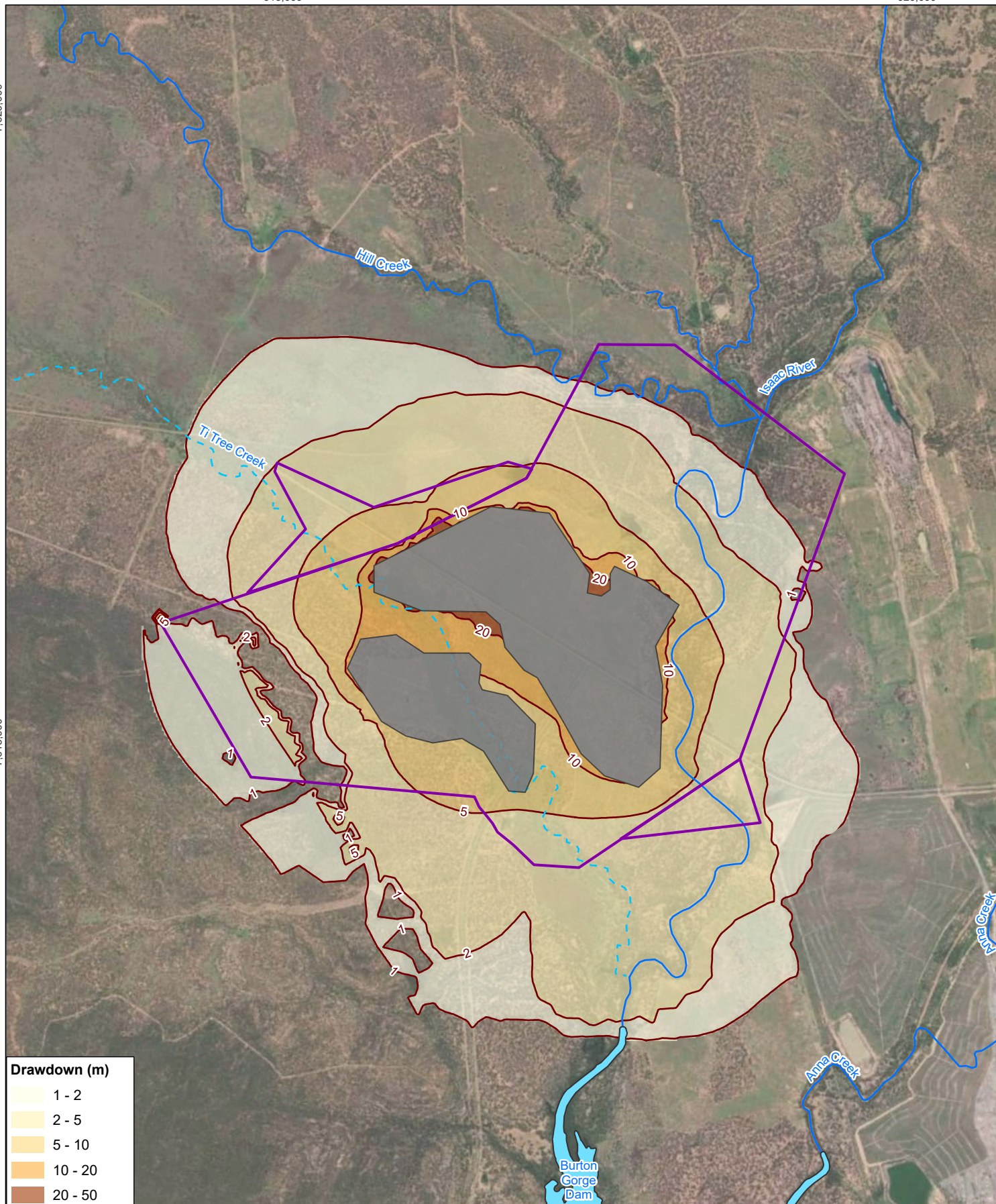
Figure 6-21 shows that the 1 m contour of the predicted maximum incremental water table drawdown at post-mining equilibrium is similar in extent to the maximum incremental extent during mining (**Figure 6-2**), however drawdown magnitudes are lesser within the Project area due to recovery post-mining. Note that this drawdown does not represent any particular aquifer unit but the shallowest saturated unit at any particular location. The drawdown extent continues to intersect with the area mapped as containing known/likely terrestrial GDEs by 3D Environmental (2023) along the Isaac River (refer to **Section 5.14.3**). Potential impacts to GDEs are further discussed in **Section 7.1.2**.

Figure 6-22 shows the maximum incremental drawdown predicted within the Isaac River alluvium at post-mining equilibrium remains similar in extent and magnitude as maximum incremental drawdown during mining (**Figure 6-3**), dominantly remaining within the Project Area but also extending southwards up to approximately 2 km downstream of the Project.

Figure 6-23 shows the maximum incremental drawdown predicted in the Regolith (model layer 2) at post-mining equilibrium. Predicted post-mining drawdowns extents are very similar to that for the water table (refer **Figure 6-21**), which is expected given the Regolith contains the water table in areas outside mapped alluvium. Within the Project Area drawdown magnitudes in the Regolith are lesser than the maximums predicted during mining (refer **Figure 6-4**) due to recovery post-mining.

Figure 6-24 and **Figure 6-25** show the extent of predicted depressurisation of the Permian coal seams (Burton/Rider and Leichhardt/Vermont seams, respectively) at post-mining equilibrium. The 1 m drawdown contour extends approximately 1 km further to the northwest than the maximum extent during mining (refer **Figure 6-5** and **Figure 6-6**), however drawdown magnitudes are significantly less close to the Project Area as a result of post-mining recovery.



**Drawdown (m)**

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 03-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

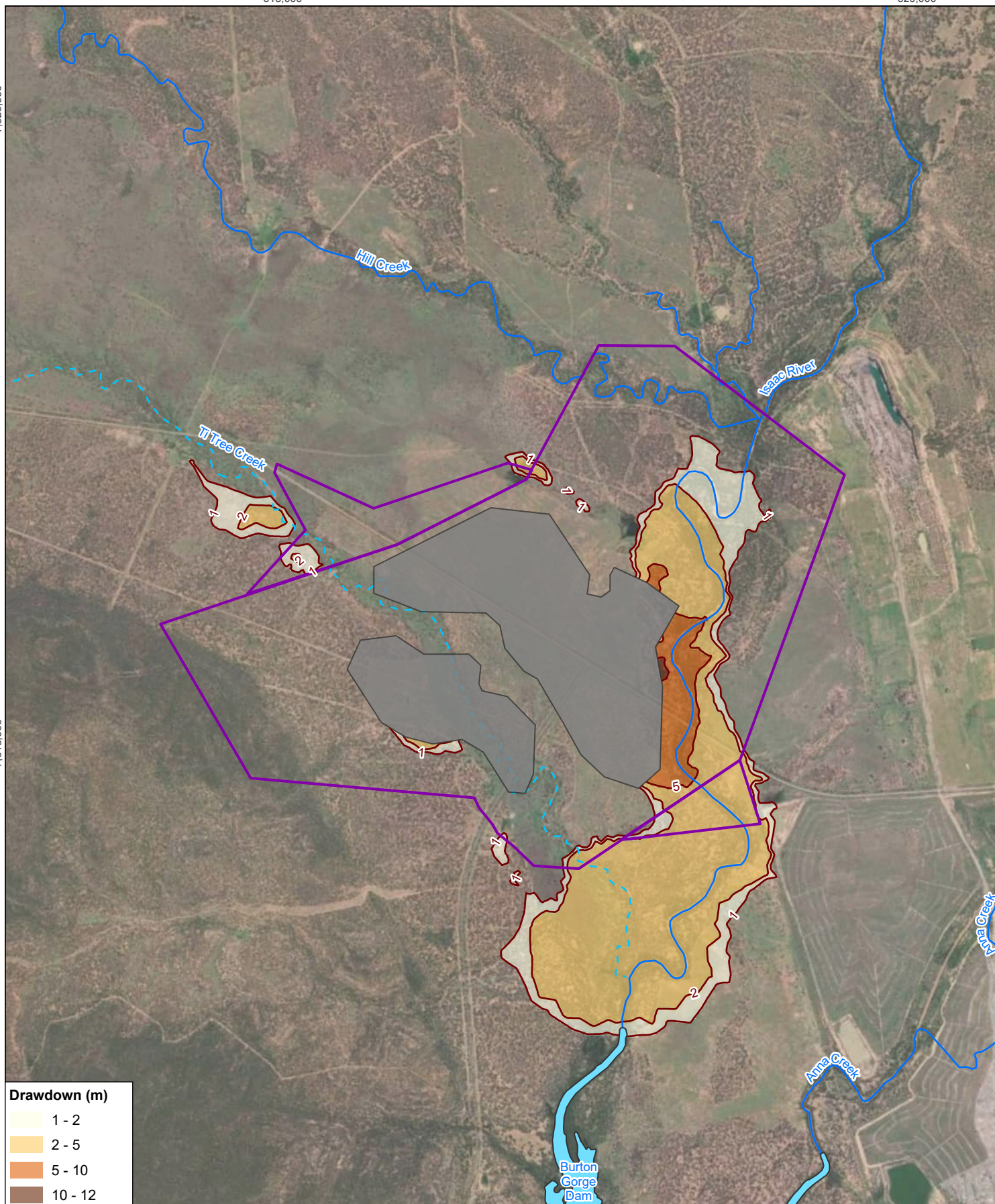
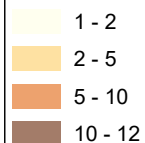
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED RESIDUAL INCREMENTAL WATER TABLE DRAWDOWN (POST-MINING EQUILIBRIUM)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-21

**Drawdown (m)**

0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- - - Non-designated Watercourse
- Drawdown Contour (m)
- New Lenton Mining Lease
- New Lenton Pit Extent

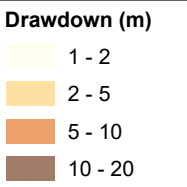
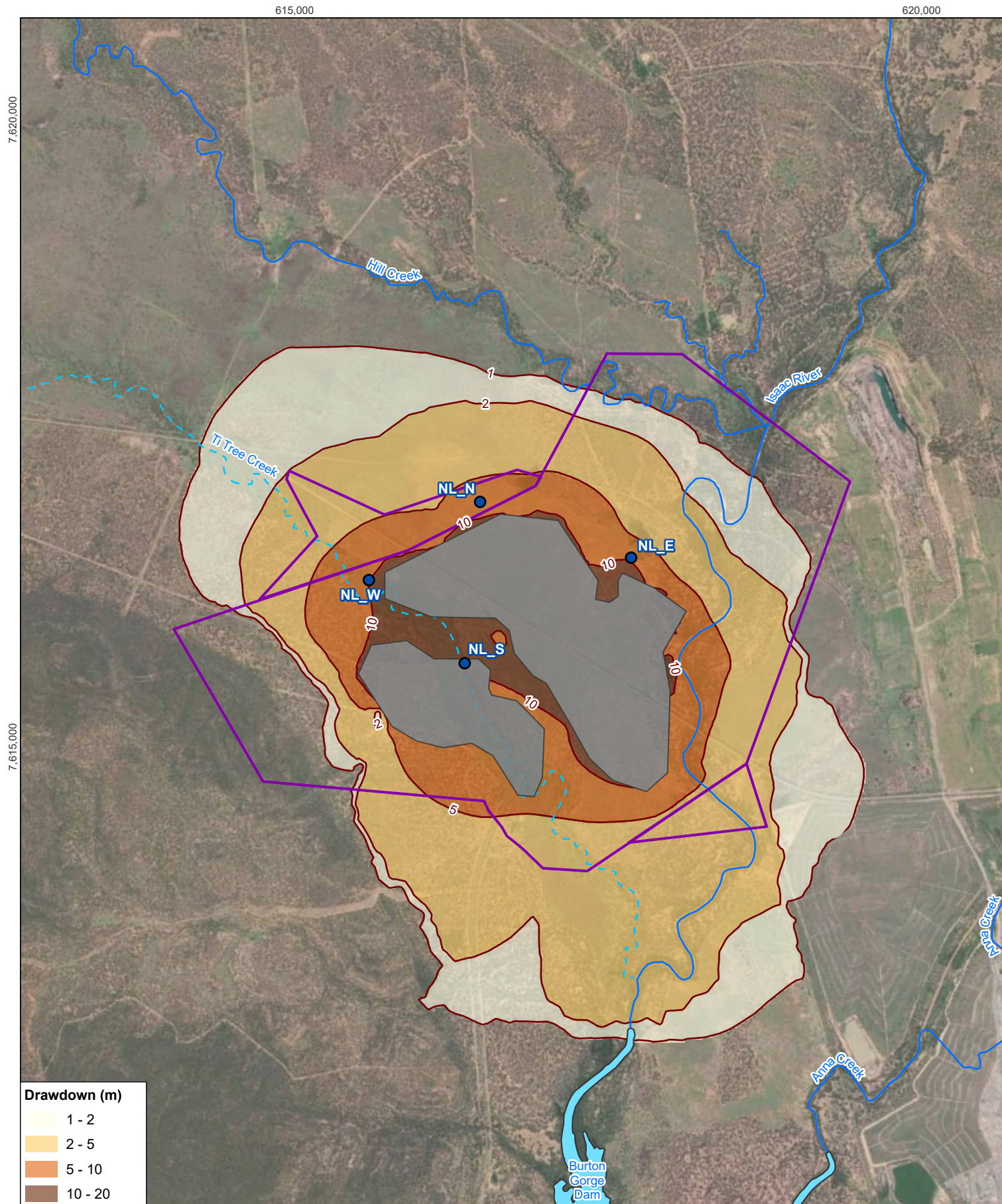
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN ALLUVIUM (LAYER 1) (POST-MINING EQUILIBRIUM)



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FIGURE 6-22



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 12-Dec-2023

Drawn by: RB

- LEGEND**
- Hydrograph Location
 - Major Watercourse
 - - - Non-designated Watercourse
 - Drawdown Contour (m)
 - ▭ New Lenton Mining Lease
 - ▭ New Lenton Pit Extent

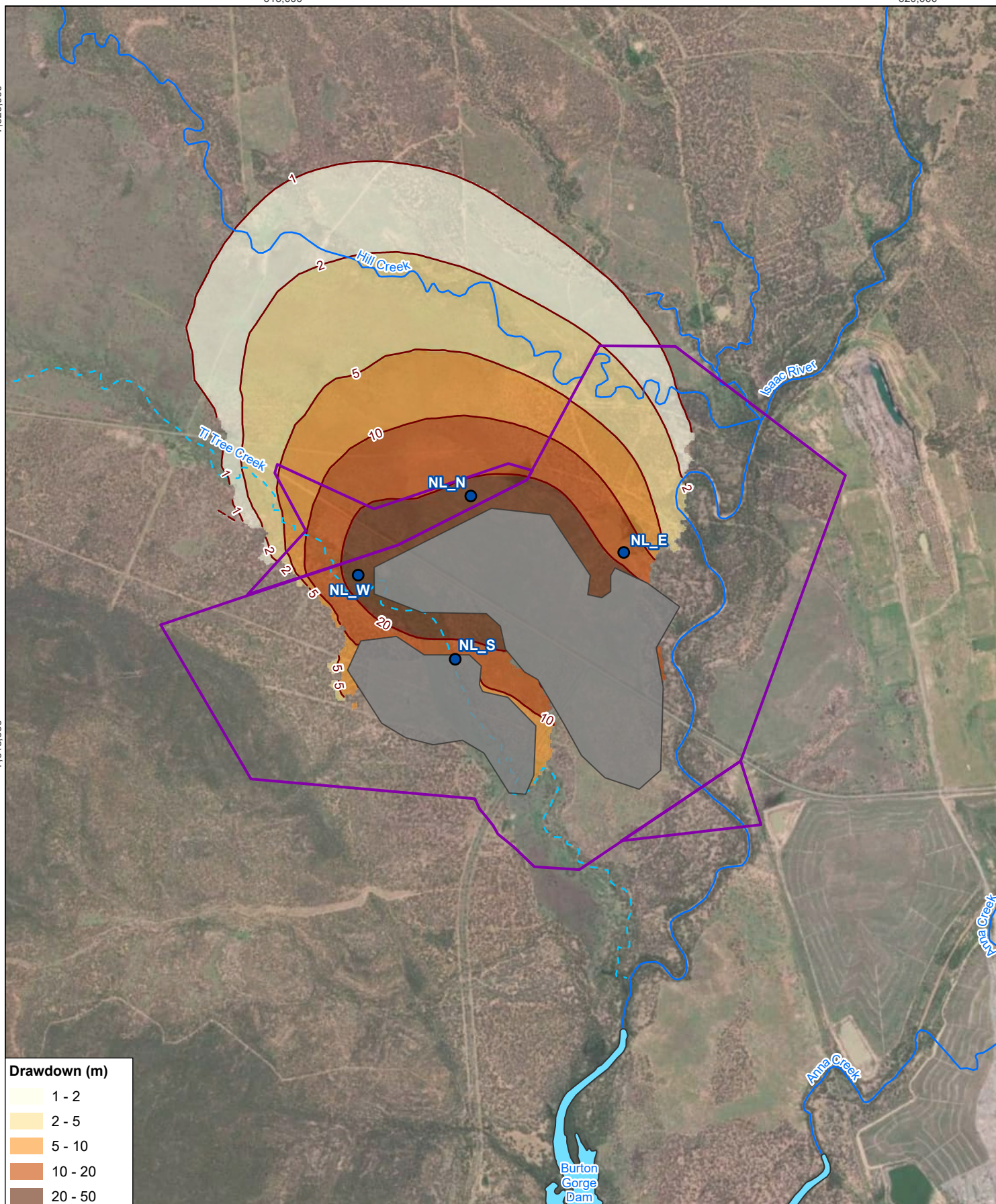
**NEW LENTON COAL PROJECT
PER GROUNDWATER
ASSESSMENT**

**PREDICTED RESIDUAL INCREMENTAL
DRAWDOWN IN REGOLITH (LAYER 2)
(POST-MINING EQUILIBRIUM)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-23



Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 12-Dec-2023

Drawn by: RB

LEGEND

- Hydrograph Location
- Major Watercourse
- - - Non-designated Watercourse
- Drawdown Contour (m)
- ▭ New Lenton Mining Lease
- ▭ New Lenton Pit Extent

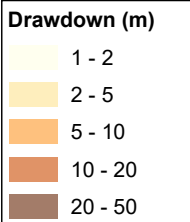
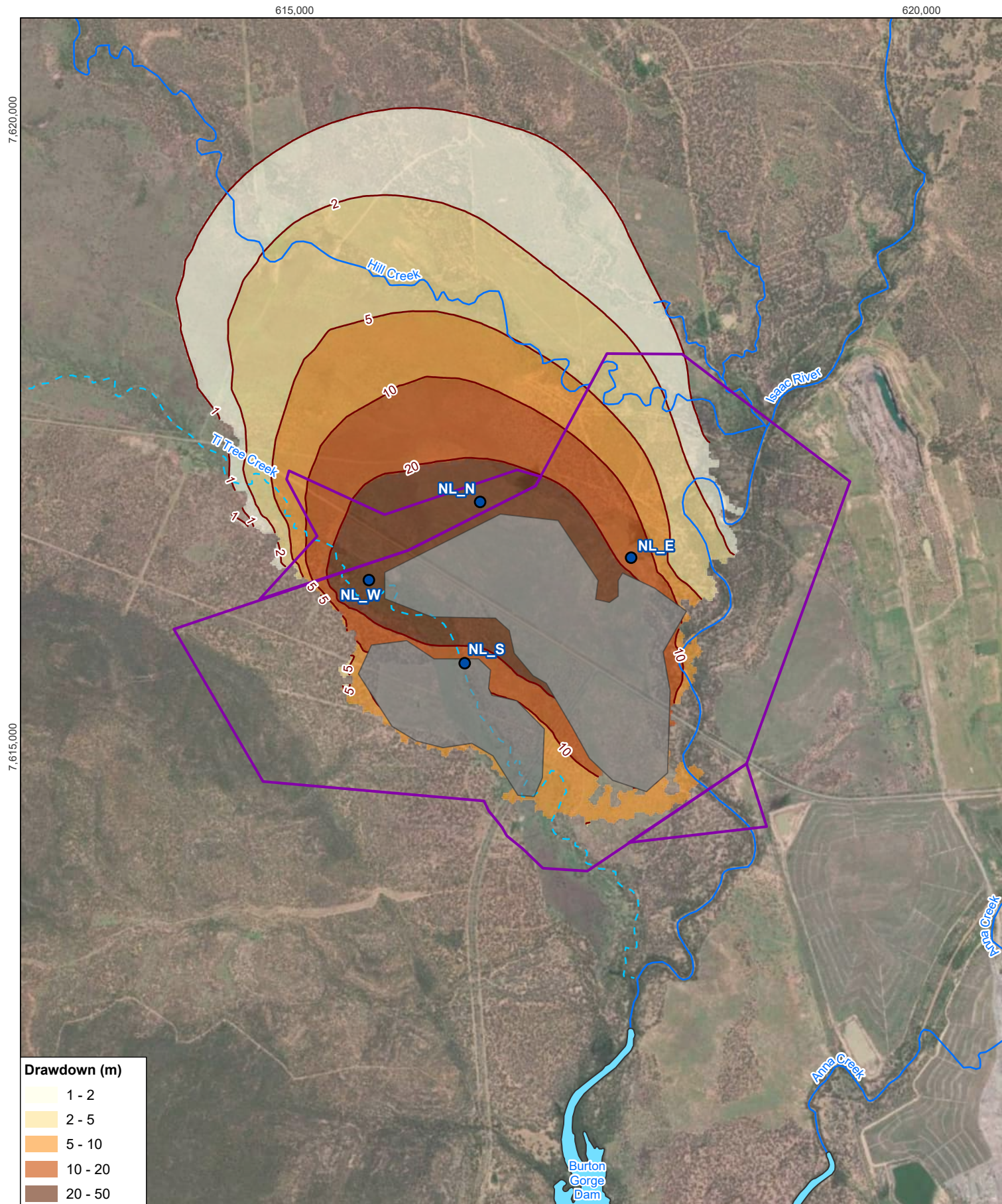
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN BURTON/RIDER (LAYER 12) (POST-MINING EQUILIBRIUM)



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FIGURE 6-24



 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:40,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 14-Dec-2023
 Drawn by: RB

- LEGEND**
-  Hydrograph Location
 -  Major Watercourse
 -  Non-designated Watercourse
 -  Drawdown Contour (m)
 -  New Lenton Mining Lease
 -  New Lenton Pit Extent

**NEW LENTON COAL PROJECT
PER GROUNDWATER
ASSESSMENT**

**PREDICTED RESIDUAL INCREMENTAL
DRAWDOWN LEICHHARDT/VERMONT SEAM
(LAYER 16) (POST-MINING EQUILIBRIUM)**



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FIGURE 6-25

6.7.6 Potential for Additional Post-Mining Impacts to Receptors

6.7.6.1 GDEs

Predictive hydrographs have been derived from the groundwater recovery model, to understand the nature of likely groundwater level change in the interpreted source aquifer for identified potential natural and anthropogenic groundwater receptors in the vicinity of the Project. The aim of the hydrographs is to assess the potential for additional impacts to these potential receptors in the period post-mining, i.e. identify additional potential impacts beyond those that have occurred during active mining operations through to the end of mining in 2040. Note that the hydrographs are derived from the Cumulative model case, i.e. are attributable to the effects of both the Project and the adjacent Burton Mine.

The GDE field study by 3D Environmental (2023) concluded that riparian vegetation associated with the Isaac River floodplain and alluvium presents the only GDEs identified within the vicinity of the Project (i.e. Terrestrial GDEs). The location of the Terrestrial GDEs identified by 3D Environmental (2023) are restricted to a narrow passage along the Isaac River (refer to **Section 5.14.3**). The GDE predictive hydrograph locations are generated at equal intervals along the Isaac River area mapped as containing known/likely GDEs by 3D Environmental (2023), and extending further north and south along the reach of the river to consider potential GDE areas beyond the specific areas surveyed by 3D Environmental (2023). The hydrograph locations are shown in

Figure 6-26, as shown, hydrographs are made for a total of 12 sites along the Isaac River (GDEI 1 to GDEI 12).

The predictive hydrographs for the water table at the GDE sites are provided **Figure 6-27** to **Figure 6-29**. The end of mining/start of post-mining period (i.e. the year 2040) is shown on the hydrographs – labelled as “end of mining” on the dotted orange line. The water table hydrographs indicate that for the majority of sites along the Isaac River there is no additional water table drawdown predicted to occur over the post-mining period (i.e. after the year 2040). As shown in the figures, only minimal additional drawdown is predicted to occur post-mining at sites GDEI 2 and 3 just south of the Project Area, and at site GDEI 8 near the northern boundary of the Project Area. These results indicate that additional post-mining impacts to any potential GDEs would not be anticipated.

Some water table recovery is evident over the post-mining period at sites GDEI 4, 5, 6, and 7 inside the Project Area, however generally speaking the water table in these areas remains depressed from its the pre-Project elevations as a result of drawdown that occurs during the active mining phase of the Project (as discussed in **Section 6.7.5.2**).

It should be noted however that the predictions refer to the regional water table and not to the seasonally variable perched water table that is thought to support the GDEs (refer **Section 5.10.2.1** and **5.10.4**). As previously discussed, any impacts to the seasonally variable perched table would be contingent on hydraulic connection with the regional water table represented in the model, with evidence suggesting any such connection is limited.



BA01
BA04
BA03
BA02

BA05

Hill Creek

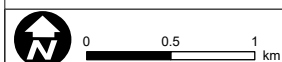
Ti Tree Creek

ML700053

ML70337

ML700054

Source:
Mining Leases, State of Queensland
(Department of Resources)



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:45,000 at A4

Project Number: 620.31367.00000

Date Drawn: 12-Dec-2023

Drawn by: RB

LEGEND

- Potential GDE
- Receptor Bore
- Non-designated Watercourse
- River
- New Lenton Mining Lease
- New Lenton Pit Extent

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

POTENTIAL RECEPTOR LOCATIONS



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FIGURE 6-26

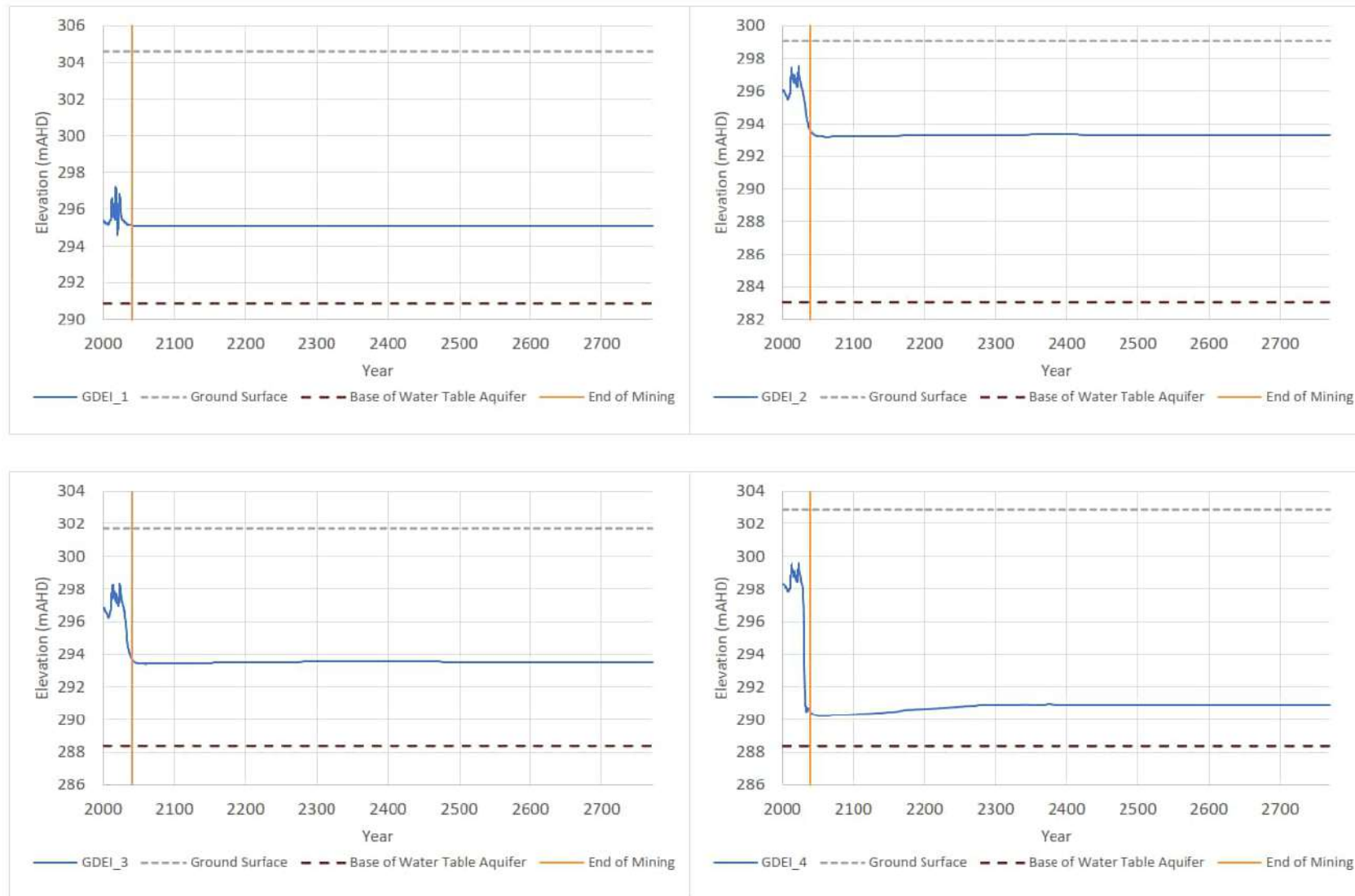


Figure 6-27 Water Table Hydrographs at Potential GDEs (sites GDEI 1 to 4)



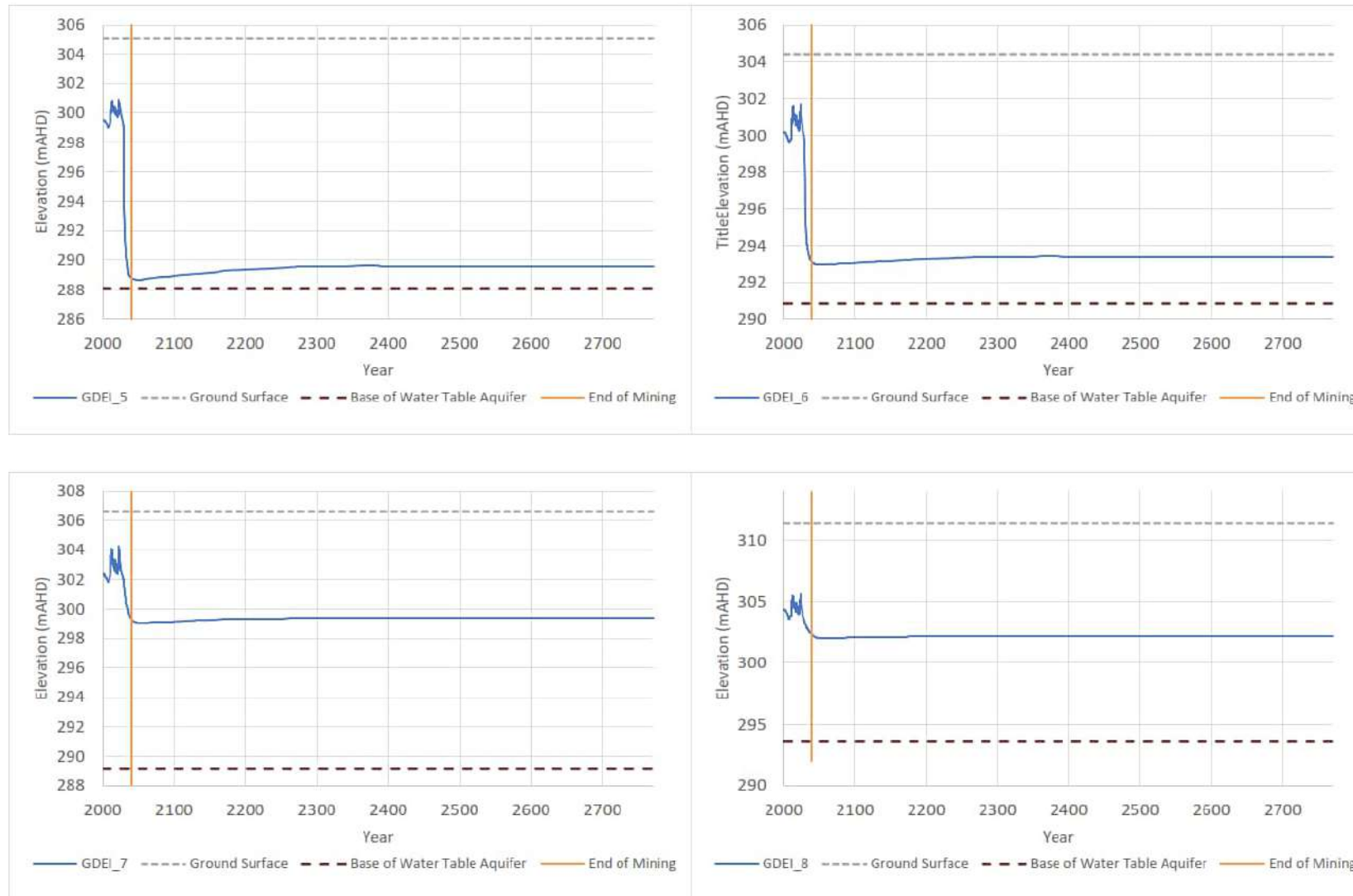


Figure 6-28 Water Table Hydrographs at Potential GDEs (sites GDEI 5 to 8)



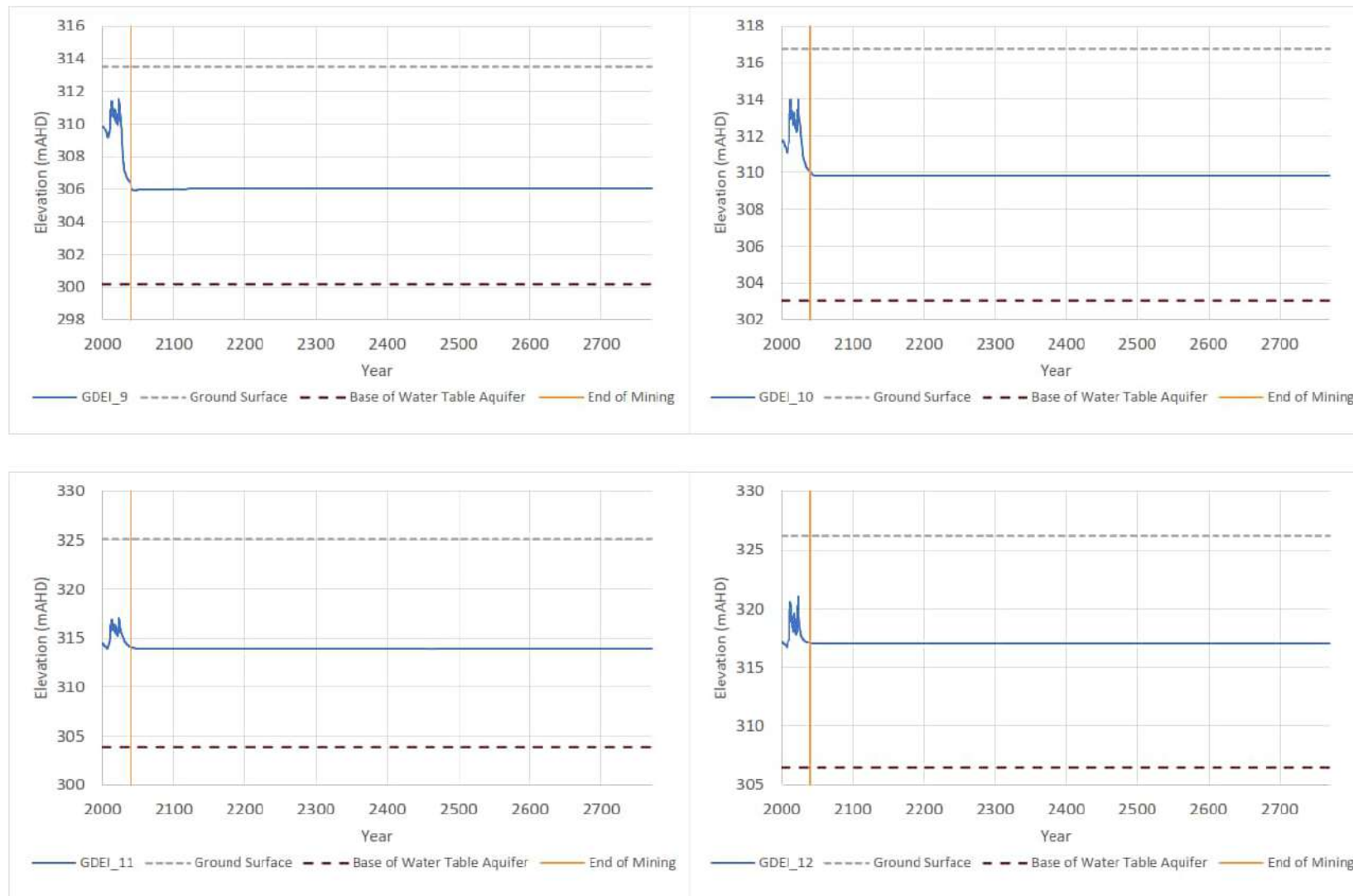


Figure 6-29 Water Table Hydrographs at Potential GDEs (sites GDEI 9 to 12)



6.7.6.2 Third Party Bores

Predictive hydrographs for the six third party water supply bores with sufficient information to attribute a source aquifer (refer **Section 5.13**) are shown in **Figure 6-30** and **Figure 6-31**. The location of these bores is provided in **Figure 6-26**. The end of mining/start of post-mining period is shown on the hydrographs. Note that the hydrographs are derived from the Cumulative model case, i.e. are attributable to the effects of both the Project and the adjacent Burton Mine.

Minimal additional groundwater drawdown is predicted at these third party bores over the post-mining period, which is considered to be a result of delayed propagation of impacts from the active mining phase of the Project rather than as a result of the final landform itself. That is, there is <1 m of maximum cumulative drawdown predicted to occur at these bores as a result of all mining within the Study Area during the post-mining period (i.e. after 2040). This drawdown magnitude remains less than the relevant 5 m drawdown 'bore trigger threshold' for consolidated aquifers (i.e. the Triassic Strata for BA01 and BA05), and 2 m drawdown 'bore trigger threshold' for unconsolidated aquifers identified in Chapter 3 of the *Water Act 2000*. Therefore, this predicted drawdown is much less than the threshold at which drawdown impacts may need to be further investigated for the purposes of determining any requirement to 'make good' a bore impairment.

As shown in **Figure 6-30** to **Figure 6-31**, most of the third party bores are predicted to show up to 0.5 m groundwater level recovery in the post-mining period from the lowest point that occurs during active mining activities.

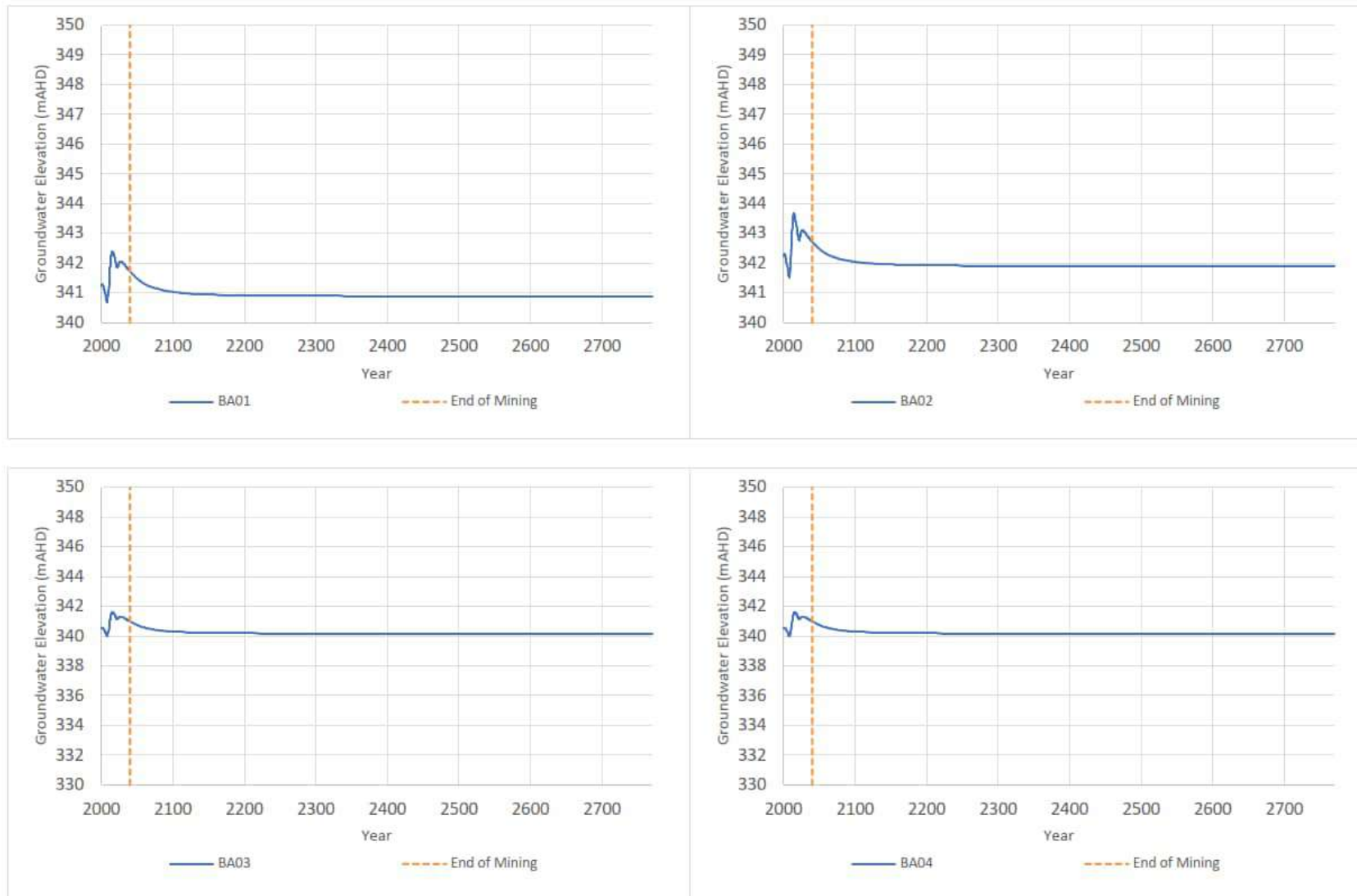


Figure 6-30 Predictive Hydrographs Third Party Water Supply Bores (BA01 to BA04)



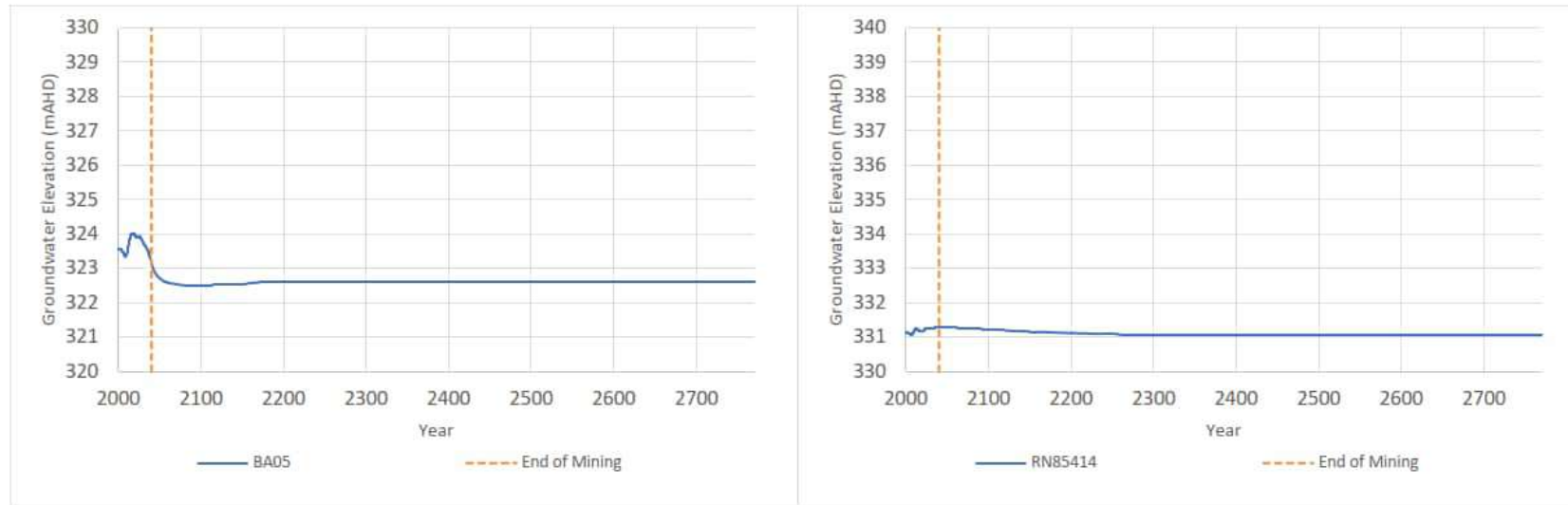


Figure 6-31 Predictive Hydrographs Third Party Water Supply Bores (BA05 and RN85414)



6.7.7 Flow Path Simulation (Particle Tracking)

Particle tracking was undertaken to illustrate the simulated post-mining groundwater flow field (advection) in the vicinity of the mined pits using mod-PATH3DU (MP3DU) (S.S. Papadopoulos & Associates, Inc., 2018). Particle tracking can be considered as the advection component contributing to solute transport, and thus can also assist with identifying potential contaminant flow paths.

Particles were placed around and within the residual void and across spoil emplacements in the recovery groundwater model. MP3DU simulates the movement of these particles through the groundwater flow field from the end of mining, during recovery through to the end of the recovery simulation (730 years). MP3DU used the transient head outputs from the groundwater recovery flow model to simulate the particle flow paths.

The particles were placed at the ground surface of the model around the pit shells, residual void and across areas of spoil backfill and out of pit spoil dumps. **Figure 6-32** shows the initial location of particles on the final landform. The particles were released at the start of the post-mining simulation, with the movement of the particles then recorded during the post-mining simulation. It should be noted that the MP3DU code automatically moves the particle from the model surface to the shallowest saturated layer at the commencement of the simulation. For many of the particles this represents the Permian layers as the shallow layers (alluvium if present, and regolith) are partly unsaturated across the Project Area at the commencement of the post-mining simulation (including areas of spoil backfill).

Figure 6-32 also shows the predicted movement of water particles in the 730-year recovery simulation. The colours along the predicted particle flow paths indicates the model layer the particle was simulated to be moving through, with the colour scale classification representing particles moving from shallow to deep model layers. The flow path analysis indicates generally the particles move toward the residual void lake, with particles that enter the void lake remaining there once they have entered the lake. Particles commencing in the residual void remain in the residual void for the duration of the simulation, indicating no potential for water discharge to the surrounding groundwater environment. Note that the void lake extents shown on the map are at steady state equilibrium (maximum level/extent) however many particles enter the lakes before equilibrium when the lake is much lower in elevation and has smaller extent, and thus appear to traverse the lake on the map. Regardless of this visualisation nuance, no particle leaves a void lake after entering the lake. Similarly, some particles appear to have tracks that are counter to head gradients or other particle tracks on the map; this is again related to the fact that the head contours shown on the map are at steady state equilibrium and do not represent the transient head changes that occur over the post-mining recovery period that drive particle movement pre-equilibrium, particularly in the first 200 years post-closure.

Importantly, no particles are shown to enter the shallow groundwater system adjacent the Project Area (i.e., along Isaac River Alluvium). Therefore, the model indicates no potential for offsite discharge to the alluvium of any potentially poor quality water arising within the final landform.

6.7.8 Climate Sensitivity

As presented in **Appendix F**, additional climate scenario groundwater modelling has been undertaken to assess the effect of climate change on the post-mining groundwater predictions.

The numerical groundwater model discussed in the previous sections was adopted for consideration of climate change in the post-mining model predictions. No changes to the model were made other than the simulation of additional transient post-mining recovery model scenarios, whereby the time-variant CHD conditions applied to the residual voids



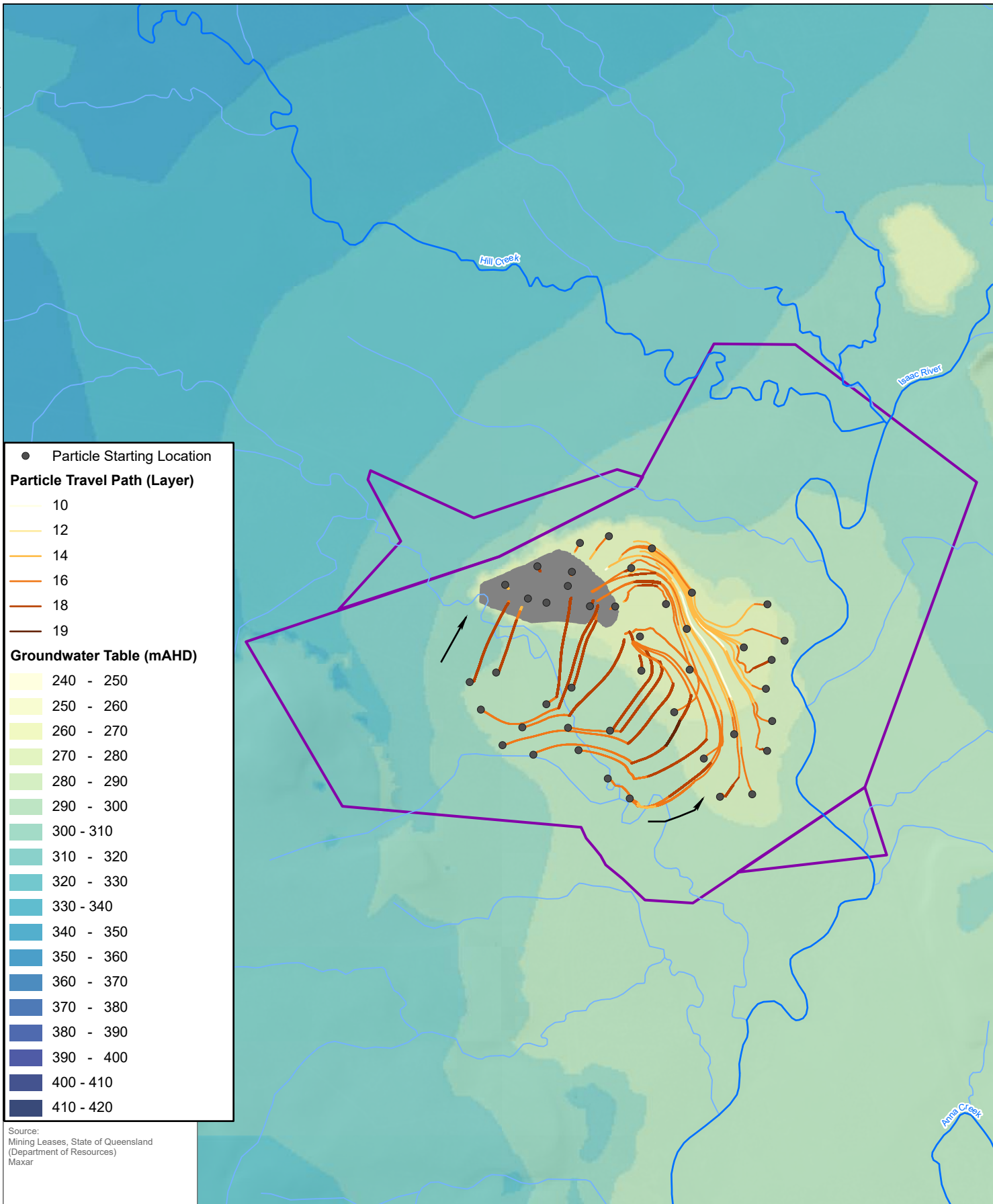
were updated to reflect the predicted void lake levels from the PER's void water balance modelling (WRM, 2023). Two additional climate scenarios were modelled, being the 'best case' and 'worst case' climate scenarios reported the void water balance prepared by WRM (2023).

Results indicate:

- Lake water levels in the residual void recover at a similar rate for the three climate scenarios, reaching equilibrium conditions after approximately 300 years.
- Equilibrium lake water levels vary by an approximate 46 m range across the climate scenarios, and are very similar between the 'worst case' scenario and the base case reported in the preceding sections, such that minimal difference in groundwater model outputs would be expected between these two scenarios. The 'best case' scenario results in void lake levels approximately 46 m below the levels predicted in the 'worst case' scenario.
- Total groundwater inflow volumes to the residual void in the two climate extremes vary over a range of less than 6% of the base case groundwater inflows reported in the preceding sections, considered very small. That is, the climate extremes do not result in a significant change in predicted groundwater inflow volumes to the residual void.
- Predicted groundwater levels and residual drawdown in all aquifers are almost identical between the 'worst case' scenario and the base case reported in the preceding sections, which is to be expected given the very similar void lake levels in these scenarios. Very minor additional drawdown is predicted for the 'best case' scenario, driven by the lower void lake levels under that scenario. The additional drawdown would not result in a meaningful change in impact assessment outcomes.
- The climate extremes do not result in a significant change in predicted groundwater flux associated with alluvium or the Isaac River. That is, any change in alluvium or River water quantity impacts resulting from the climate extremes is negligible compared to the base case reported in the preceding sections.
- Particle tracking simulations show no change in the predicted fate of groundwater movement in the final landform under the climate extremes compared to the base case reported in the preceding sections. That is, all groundwater emanating from the landform continues to be captured by the final void.



7,620,000



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:37,500 at A4

Project Number: 620.31367.00000

Date Drawn: 01-Dec-2023

Drawn by: RB

LEGEND

- River
- Watercourse and Drainage
- SW Lake/Dam
- New Lenton Mining Lease
- Void Lake

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

PREDICTED MOVEMENT OF PARTICLES



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FIGURE 6-32

6.8 Uncertainty Analysis

A Monte Carlo uncertainty analysis (IESC, 2018) was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis. A full description of the uncertainty analysis is provided in **Appendix D**, and a summary is presented herein.

Uncertainty analysis results are presented herein in terms of different uncertainty percentiles including the 10th, 33rd, 50th, 67th and 90th percentile prediction bounds. Based on Table 4 of the IESC (2018) guidelines these represent:

- <10th percentile indicates it is very likely the outcome is larger than this value.
- 10th - 33rd indicates it is likely that the outcome is larger than this value.
- 33rd - 67th indicate it is as likely as not that the outcome is larger or smaller than this value.
- 67th - 90th indicates it is unlikely that the outcome is larger than this value.
- >90th percentile indicates it is very unlikely the outcome is larger than this value.

6.8.1 Number of Realisations

1,200 model realisations were generated each with unique parameter distributions. Parameters were assumed to possess a log-normal distribution, with the Latin Hypercube Sampling method used to create random realisations from parameter distribution. 200 of the realisations met calibration criteria assigned based on the statistics for the optimally calibrated realisation (SRMS < 12%, Isaac River baseflow (near site) < 70 m³/d) after running through the calibration model (refer **Section 6.2.3**). 162 of the realisations from the existing calibration ensemble also met the calibration criteria and were adopted for the uncertainty analysis in addition to the 200 accepted realisations from the Monte Carlo ensemble, comprising a total of 362 realisations used in the uncertainty analysis.

The predictive model was run using the 362 parameter sets. The results from the predictive model were used to conduct statistical analyses to assess if additional realisations were likely to provide results that would significantly change the reported predictive results. The 95 % confidence interval was calculated for predicted mine pit inflow and the maximum predicted incremental drawdown from the 362 realisations.

Figure 6-33 and **Figure 6-34** show the 95 % confidence intervals of the predicted mine pit inflow and groundwater drawdowns respectively, as well as the variance of the median and maximum for these two model outputs as more realisations are added to the uncertainty analysis. For example, the 95% confidence interval for the simulated mine inflow is calculated by first estimating the inflow for each realisation and then calculating the 95 % confidence interval of the simulated mine inflow as each realisation is added to the dataset.

As shown in **Figure 6-33** and **Figure 6-34**, additional realisations beyond the 362 realisations are unlikely to significantly increase or decrease the confidence intervals of predictions of simulated mine inflow and the maximum incremental drawdown.



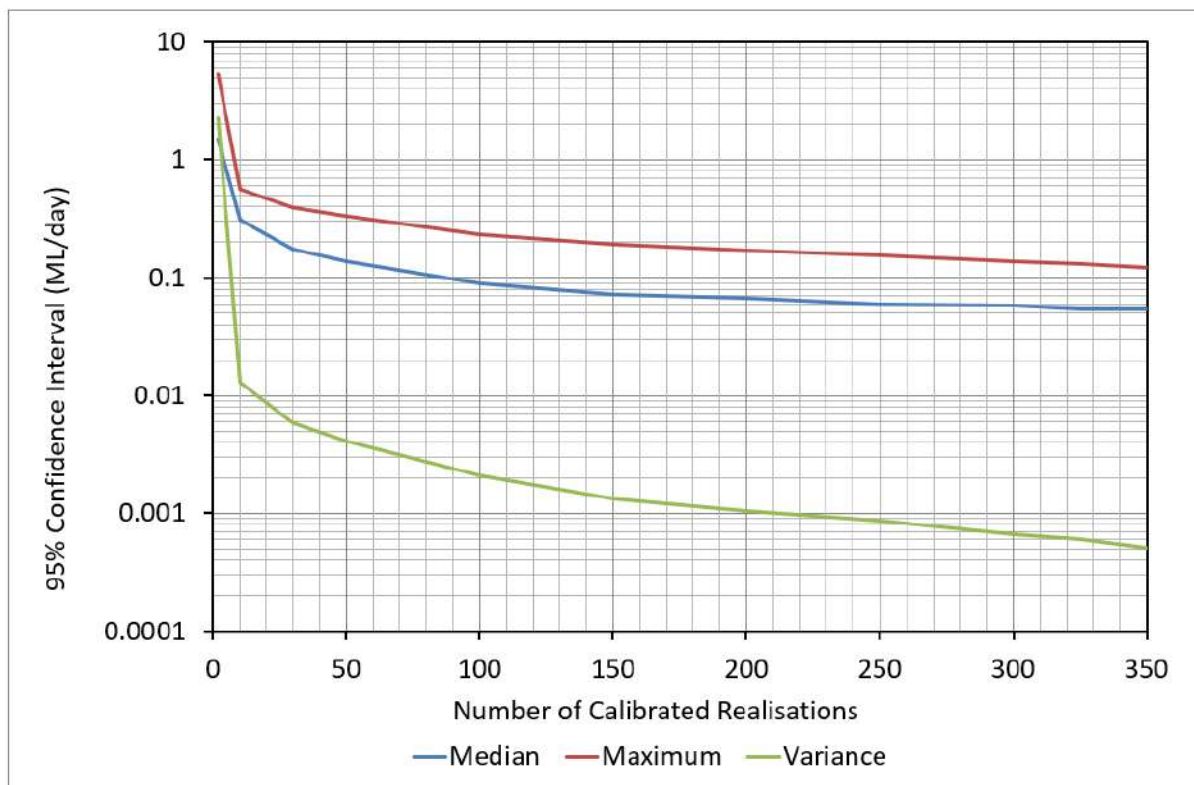


Figure 6-33 95 % Confidence Interval for Predicted Mine Inflows

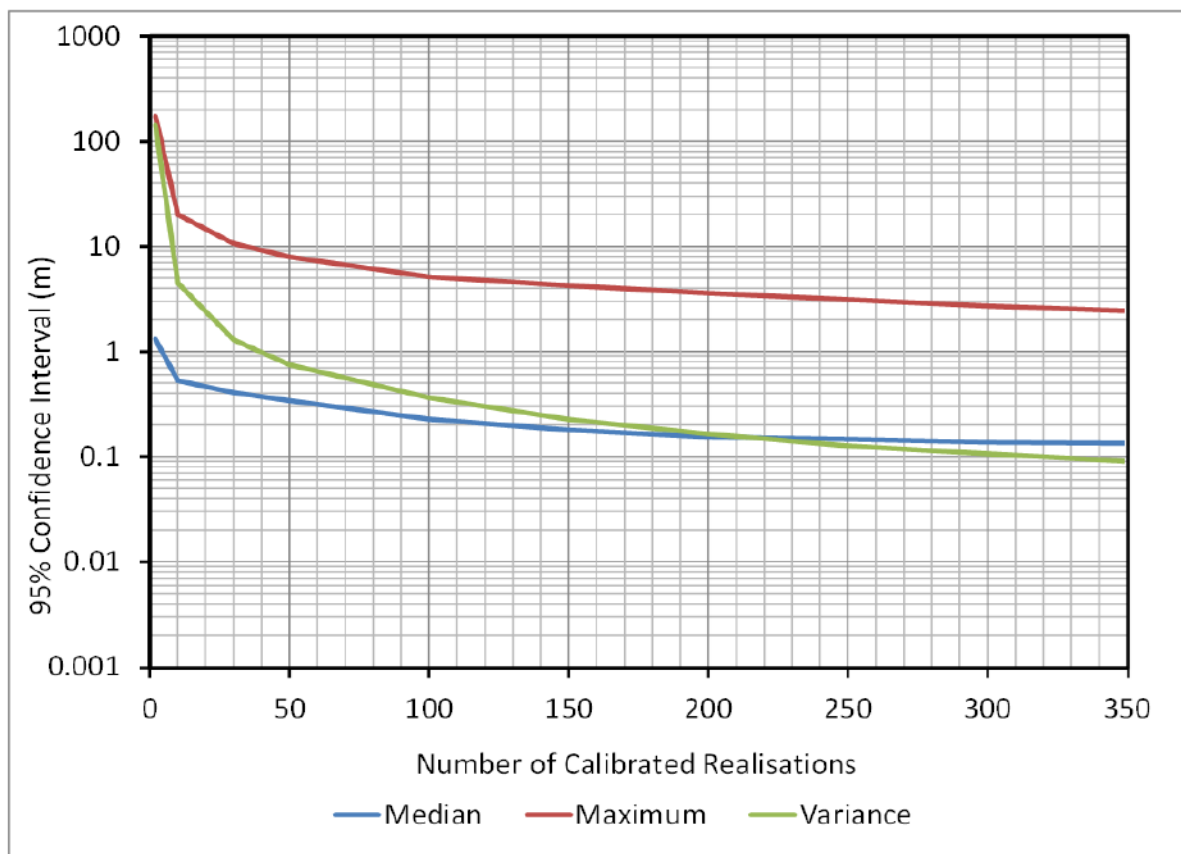


Figure 6-34 95 % Confidence Interval for Maximum Incremental Drawdown



6.8.2 Uncertainty of Mine Inflows during Active Mining

Figure 6-35 presents the uncertainty of predicted total groundwater inflows to the Project open cut pits. The figure also shows the predicted inflows for the calibrated prediction model per **Section 6.3**. The bounds in the figure demonstrate the uncertainty within the predicted groundwater inflow rate. The bounds show that the calibrated prediction model is roughly consistent with the 50th percentile.

As shown in **Figure 6-35**, the maximum total mine inflow in the uncertainty analysis is 2,862 ML/year (7.84 ML/day) for 2030 (very unlikely that the outcome is larger than this value). The 10th to 90th range in mine inflows for the year 2030 is 600 ML/year (1.64 ML/day) to 1,749 ML/year (4.79 ML/day).

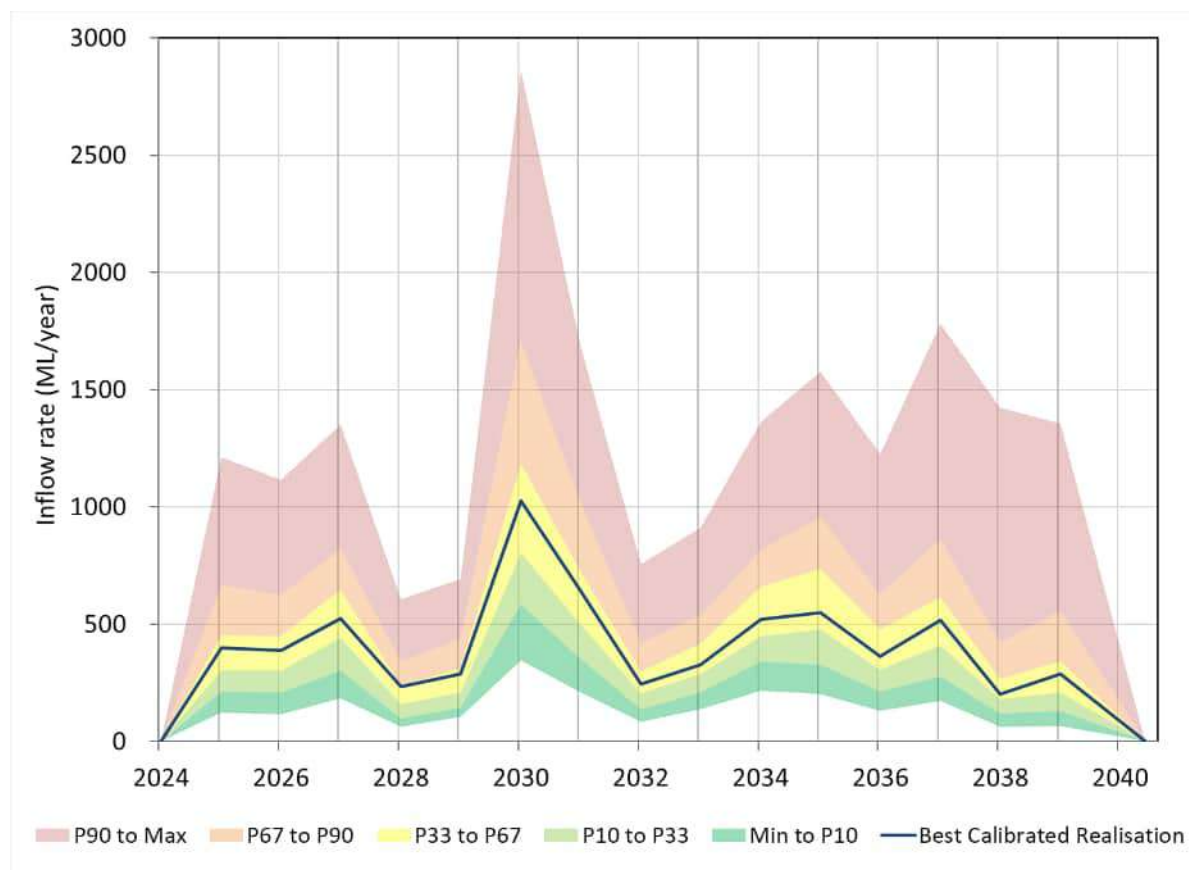


Figure 6-35 Uncertainty of New Lenton Mine Inflows

6.8.3 Uncertainty of Post-Mining Residual Void Inflows

Figure 6-36 presents the uncertainty of predicted total groundwater inflows to East Pit residual void. The figure also shows the predicted inflows for the calibrated prediction model per **Section 6.7.4**. The plot shows that the calibrated prediction model is again roughly consistent with the 50th percentile.

As shown in **Figure 6-36**, The 10th to 90th range in inflows is 101 ML/year (0.28 ML/day) to 402 ML/year (1.10 ML/day). In accordance with the uncertainty analysis definitions it is very unlikely the inflows are higher or lower than this range.



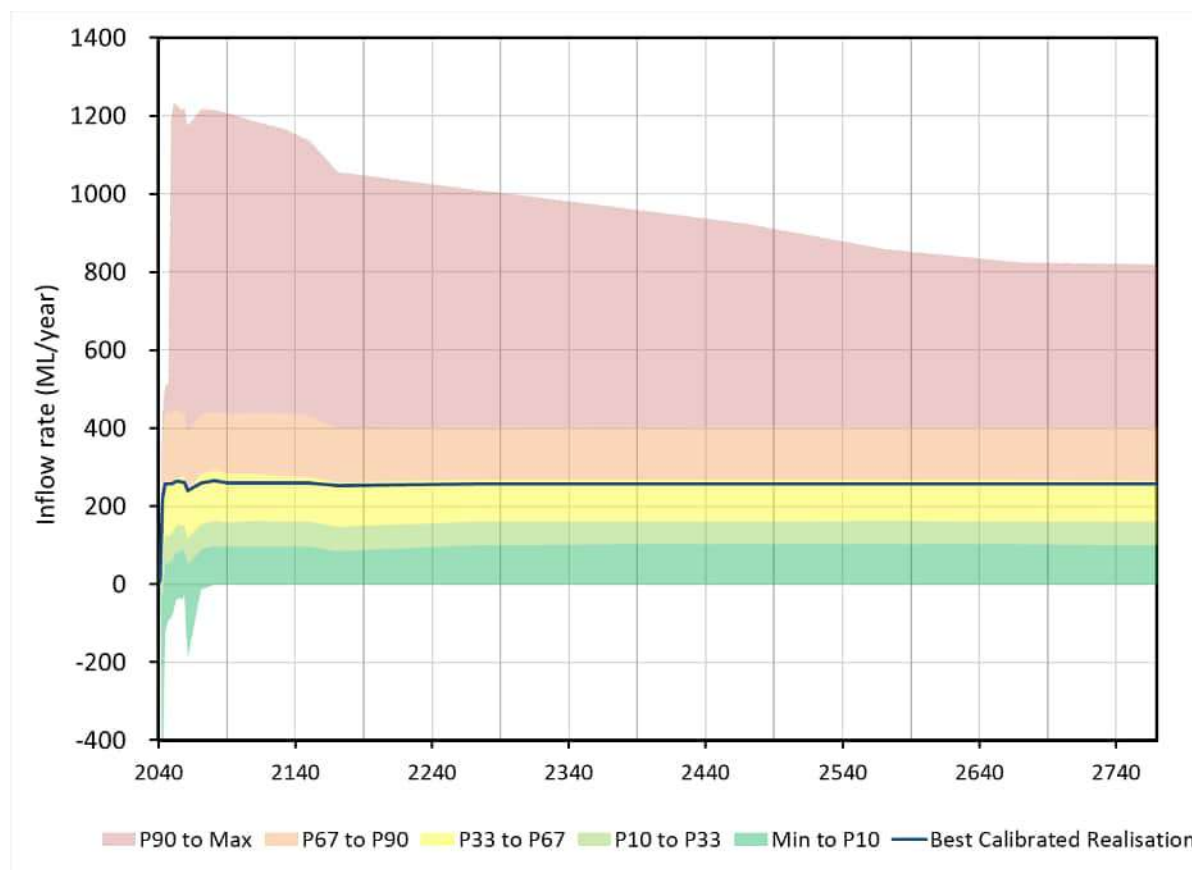


Figure 6-36 Uncertainty of Residual Void Inflows

The uncertainty associated with the total post-mining equilibrium flux to the residual void pit shell was assessed through calculation of the 10th, 50th and 90th percentiles and is summarised in **Table 6-5**. This includes the inflow from natural geological formations to the void and to the partially backfilled pit shell as described in **Section 6.7.4**.

Table 6-5 Uncertainty in Equilibrium Groundwater Inflows to the Pit Shell from Natural Geological Formations

Residual Void	Equilibrium Inflow Rate – Natural Geological Formations (m3/day)			
	10 th Percentile	50 th Percentile	Best Calibrated Realisation	90 th Percentile
East Pit	208.9	494.5	635.5	1006.9

Table 6-6 shows the uncertainty in predicted post-mining equilibrium groundwater inflows to the residual void. The 10th, 50th and 90th percentiles are provided for each component of the total inflow to the void.



Table 6-6 Uncertainty in Equilibrium Groundwater Inflows to the Residual Void

Residual Void	Percentile ¹	From Spoil (m ³ /day)	From Natural Geological Formations (m ³ /day)	Total (m ³ /day)
East Pit Void	10 th	219.2	19.7	276.8
	50 th	460.4	94.4	589.5
	Best Calibrated Realisation ²	562.3	143.8	706.1
	90 th	858.1	263.5	1102.6

1. The percentiles presented for spoil, natural geological formations and total inflow to the residual voids have been calculated independently for each flux prediction. Discrepancy between the sum of the components and the total inflow for each percentile indicate differences in the parameter combinations in the uncertainty ensemble that result in differing distributions for each individual inflow component.
2. See **Section 6.7.4**.

6.8.4 Uncertainty of Groundwater Drawdowns during Active Mining

To illustrate the level of uncertainty in the extent of predicted incremental drawdown due to the proposed mining at the Project, the maximum extent of the 1 m predicted drawdown for the 10th, 50th and 90th percentiles was compared to the maximum extent of the 1 m drawdown from the calibrated prediction model per **Section 6.4**. This comparison was produced for the Alluvium (**Figure 6-37**), Regolith (**Figure 6-38**), Burton/Rider seam (**Figure 6-39**) and Leichhardt/Vermont seam (**Figure 6-40**).

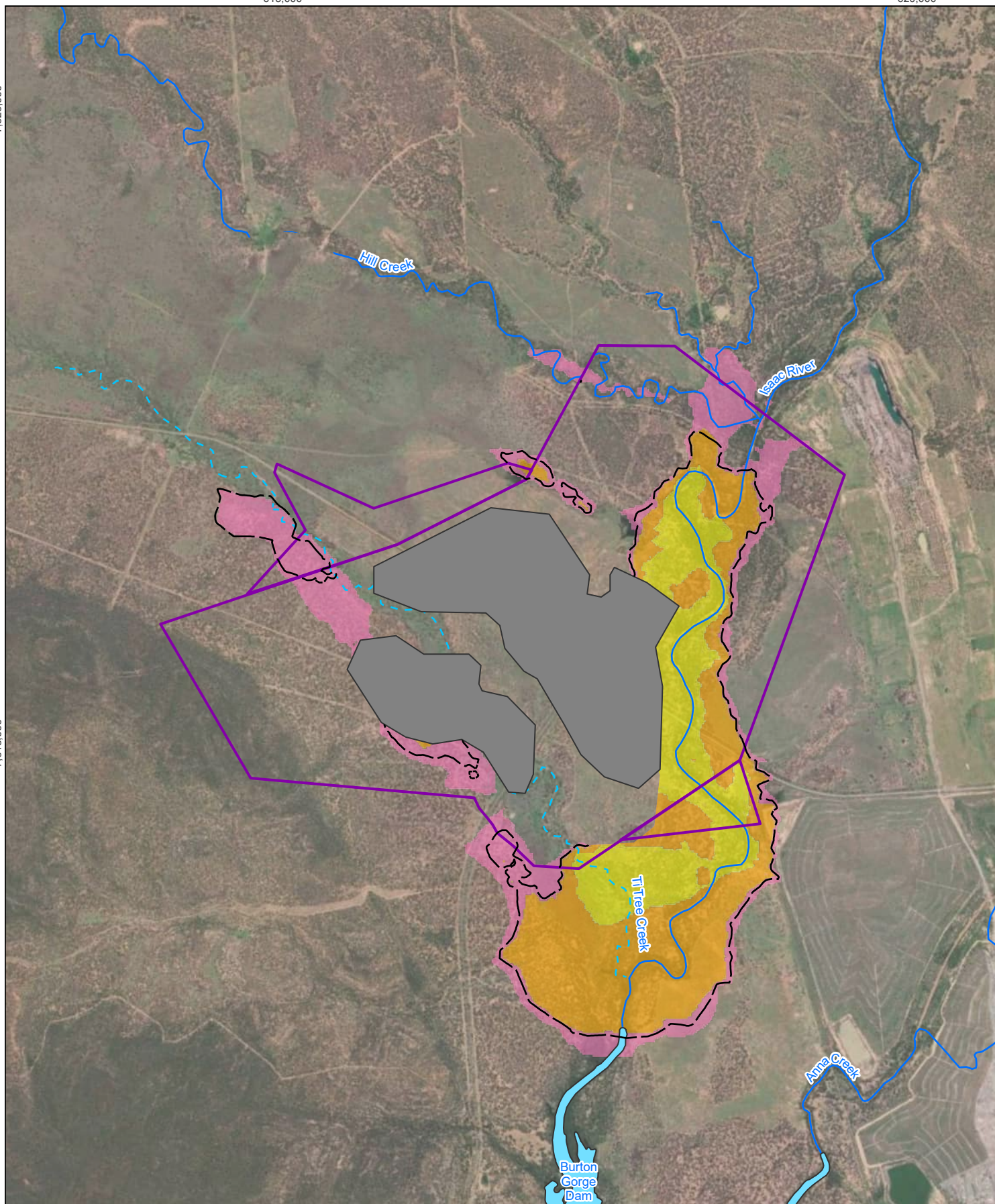
The 90th percentiles shown in **Figure 6-37** to **Figure 6-40** indicate the predicted maximum incremental drawdown extent exceeded by 10% of model realisations. Therefore, drawdown extent greater than the 90th percentile area is considered a very unlikely outcome (IESC, 2018). The 10th percentile lines in the figures show the predicted maximum incremental drawdown extent exceeded by 90% of tested realisations. Therefore, it is very likely that the actual extent will be greater than that shown for the 10th percentile (IESC, 2018). The 50th percentile contour shows the predicted maximum incremental drawdown extent exceeded 50% of tested realisations. Therefore, these predictions are considered as likely outcomes.

Figure 6-37 shows the uncertainty analysis for the predicted incremental drawdown impacts greater than 1 m for the Alluvium as a result of the proposed mining at the Project. The 50th and 90th percentiles in the figure indicate incremental drawdown exceeding 1 m extending approximately 2 km to the northeast and southwest of the Project mine pits. The 50th percentile shown in **Figure 6-37** shows predicted incremental maximum drawdown consistent with the extent of incremental drawdown predicted by the calibrated model (**Section 6.4**).

Figure 6-38 shows the uncertainty in the extent of predicted maximum incremental drawdown impacts greater than 1 m in the regolith. The 90th percentile in the figure indicates the model predicts it is very unlikely incremental drawdown exceeding 1 m will extend more than approximately 2 km from the pits. The 50th percentile shown in **Figure 6-38** shows predicted incremental maximum drawdown consistent with the extent of incremental drawdown predicted by the calibrated model (**Section 6.4**).

Figure 6-39 and **Figure 6-40** show the uncertainty in the extent of predicted 1 m maximum incremental drawdown in the Burton/Rider and Leichhardt/Vermont seams, respectively. The figures show that the 90th percentile drawdown in the Permian coal seams extends primarily to the north, reaching approximately 4 km from the Project pits. **Figure 6-39** and **Figure 6-40** show consistency between the calibrated prediction model (**Section 6.4**) and the 50th percentile predicted incremental drawdown.





0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 62620.31367.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

— Major Watercourse

- - - Non-designated Watercourse

□ New Lenton Mining Lease

■ New Lenton Pit Extent

1m Drawdown

■ 10th Percentile

■ 50th Percentile

■ 90th Percentile

- - - Calibrated Prediction Model 1m Drawdown

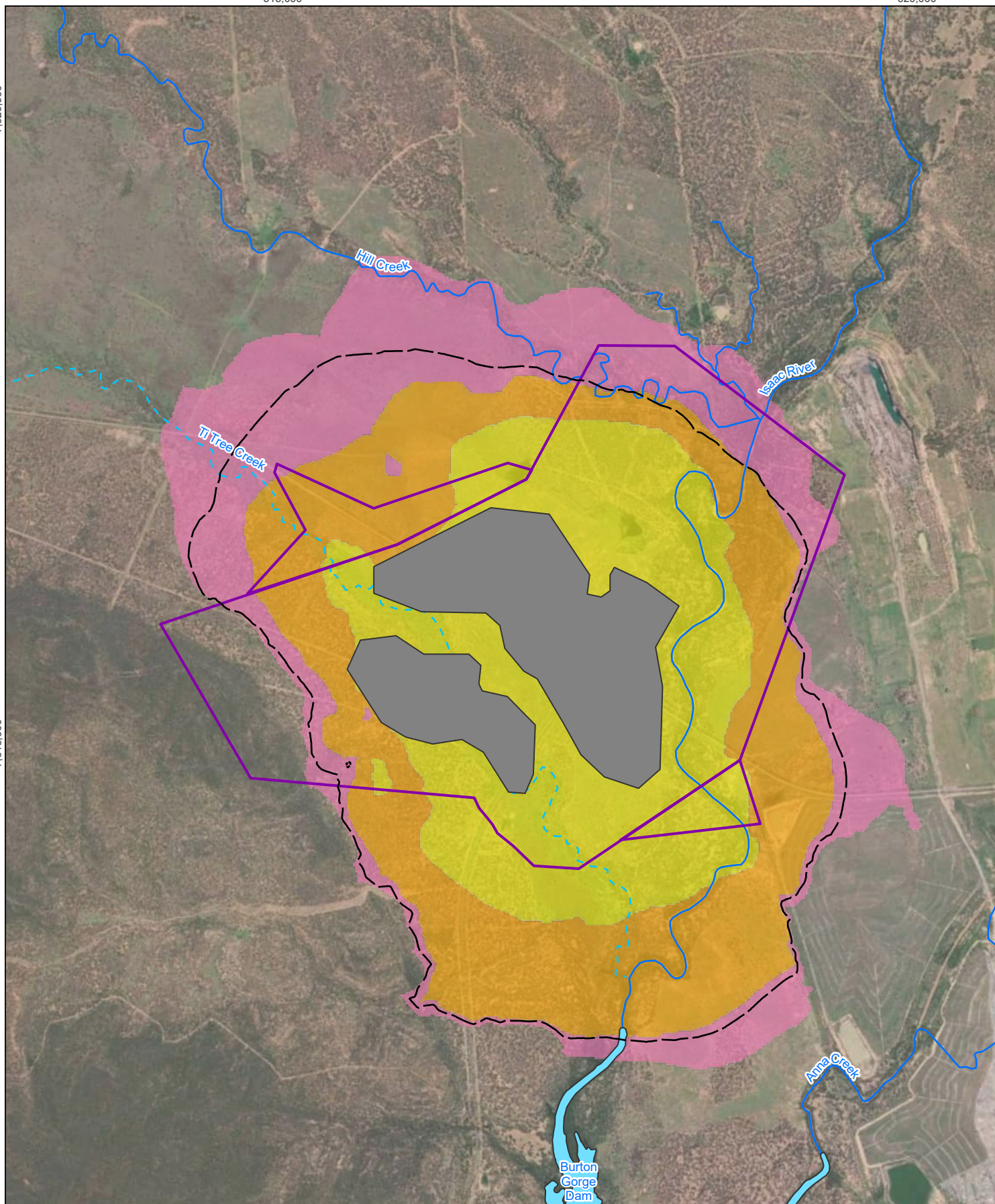
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED 1M MAXIMUM INCREMENTAL DRAWDOWN EXTENT IN ALLUVIUM (LAYER 1)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-37



 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:40,000 at A4
 Project Number: 62620.31367.00000
 Date Drawn: 12-Dec-2023
 Drawn by: RB

LEGEND

- | | |
|--|---|
|  Major Watercourse | 1m Drawdown |
|  Non-designated Watercourse |  10th Percentile |
|  New Lenton Mining Lease |  50th Percentile |
|  New Lenton Pit Extent |  90th Percentile |
| |  Calibrated Prediction Model 1m Drawdown |

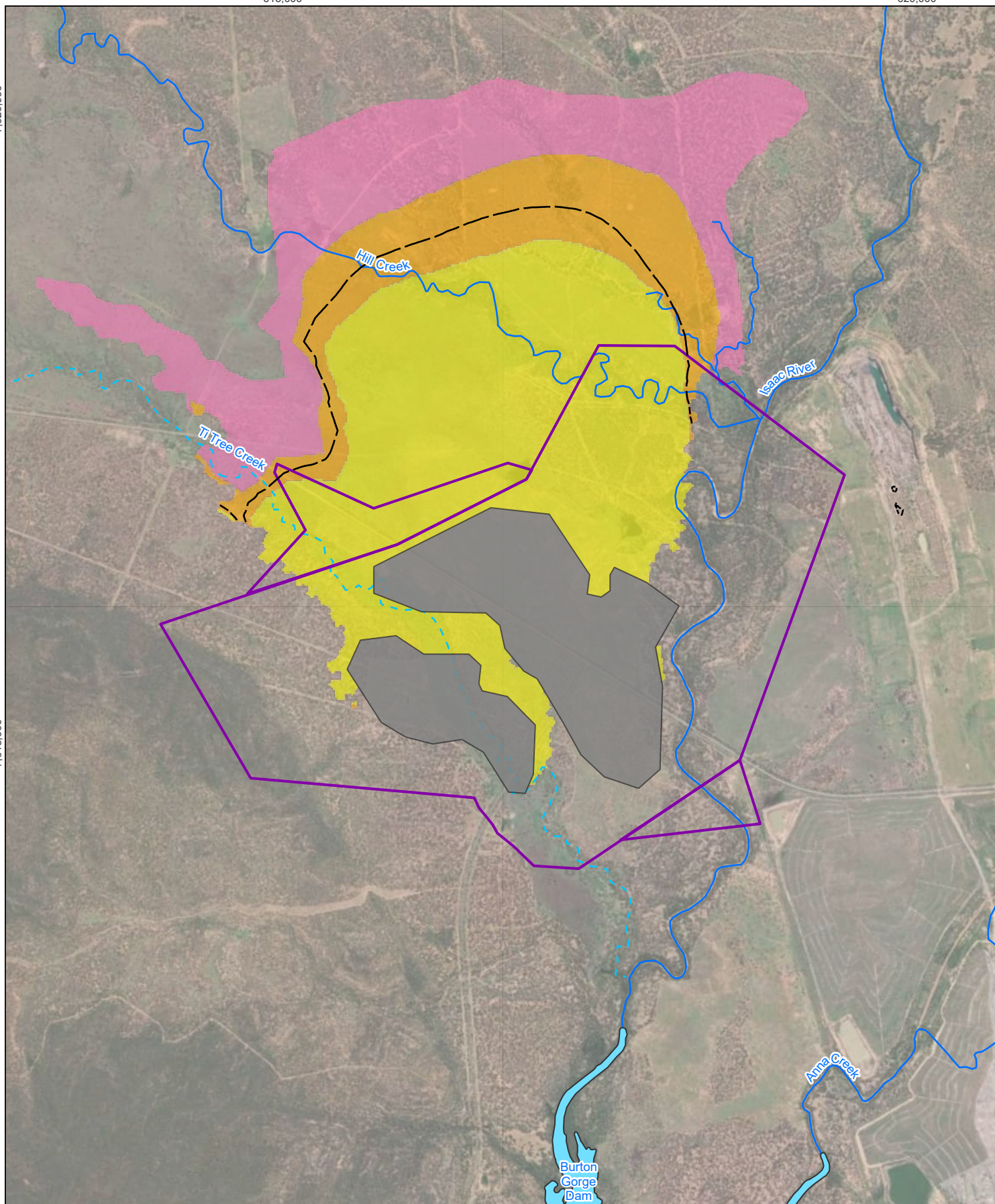
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED 1M MAXIMUM INCREMENTAL DRAWDOWN EXTENT IN REGOLITH (LAYER 2)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-38



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 62620.31367.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- Non-designated Watercourse
- New Lenton Mining Lease
- New Lenton Pit Extent

1m Drawdown

- 10th Percentile
- 50th Percentile
- 90th Percentile

- Calibrated Prediction Model 1m Drawdown

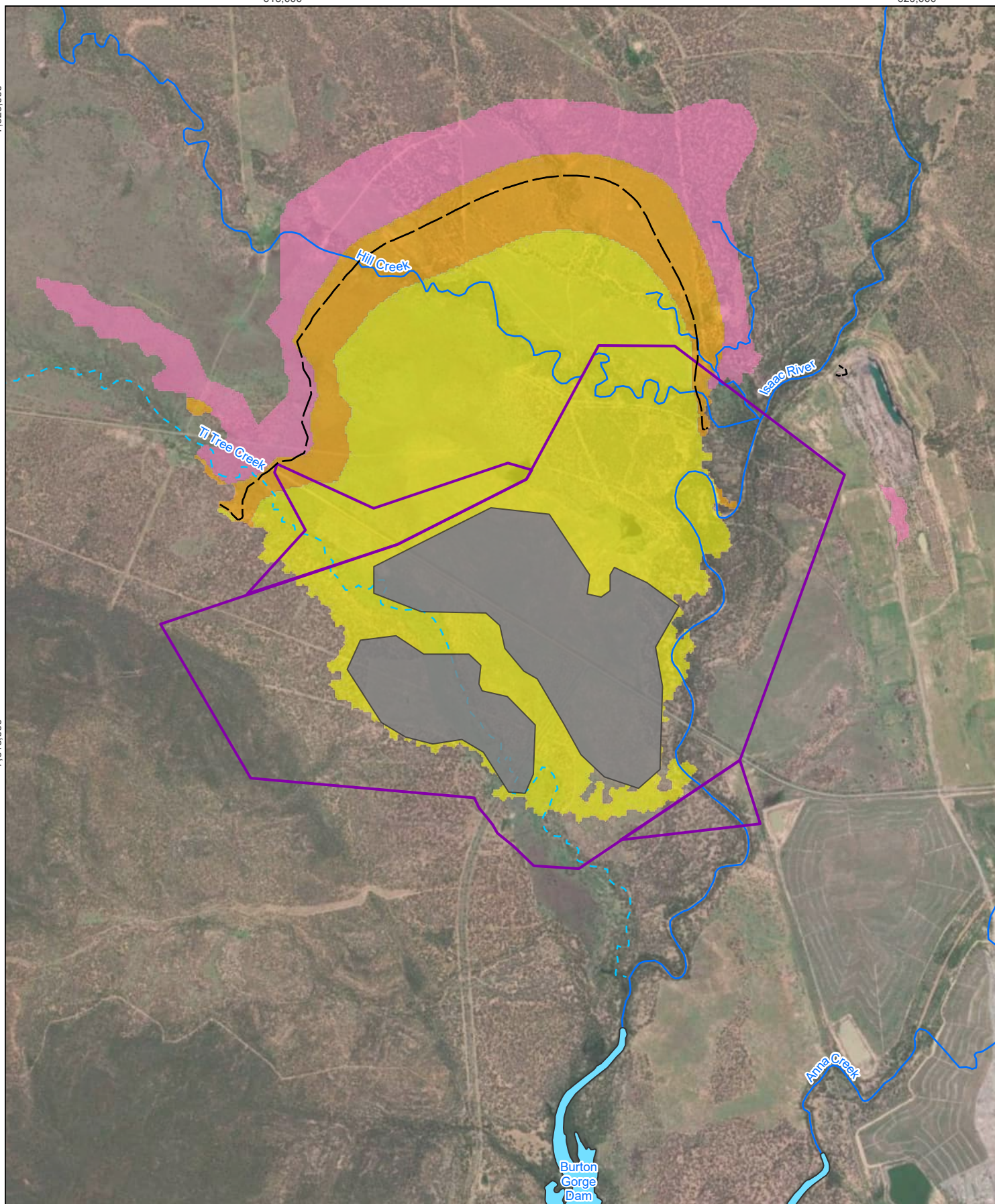
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED 1M MAXIMUM INCREMENTAL DRAWDOWN EXTENT IN BURTON/RIDER SEAM (LAYER 12)



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FIGURE 6-39



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 62620.31367.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

— Major Watercourse

- - - Non-designated Watercourse

▭ New Lenton Mining Lease

▭ New Lenton Pit Extent

1m Drawdown

▭ 10th Percentile

▭ 50th Percentile

▭ 90th Percentile

- - - Calibrated Prediction Model 1m Drawdown

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED 1M MAXIMUM INCREMENTAL DRAWDOWN EXTENT IN LEICHHARDT/VERMONT SEAM (LAYER 16)



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FIGURE 6-40

6.8.5 Uncertainty of Groundwater Drawdowns Post-Mining

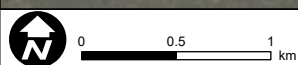
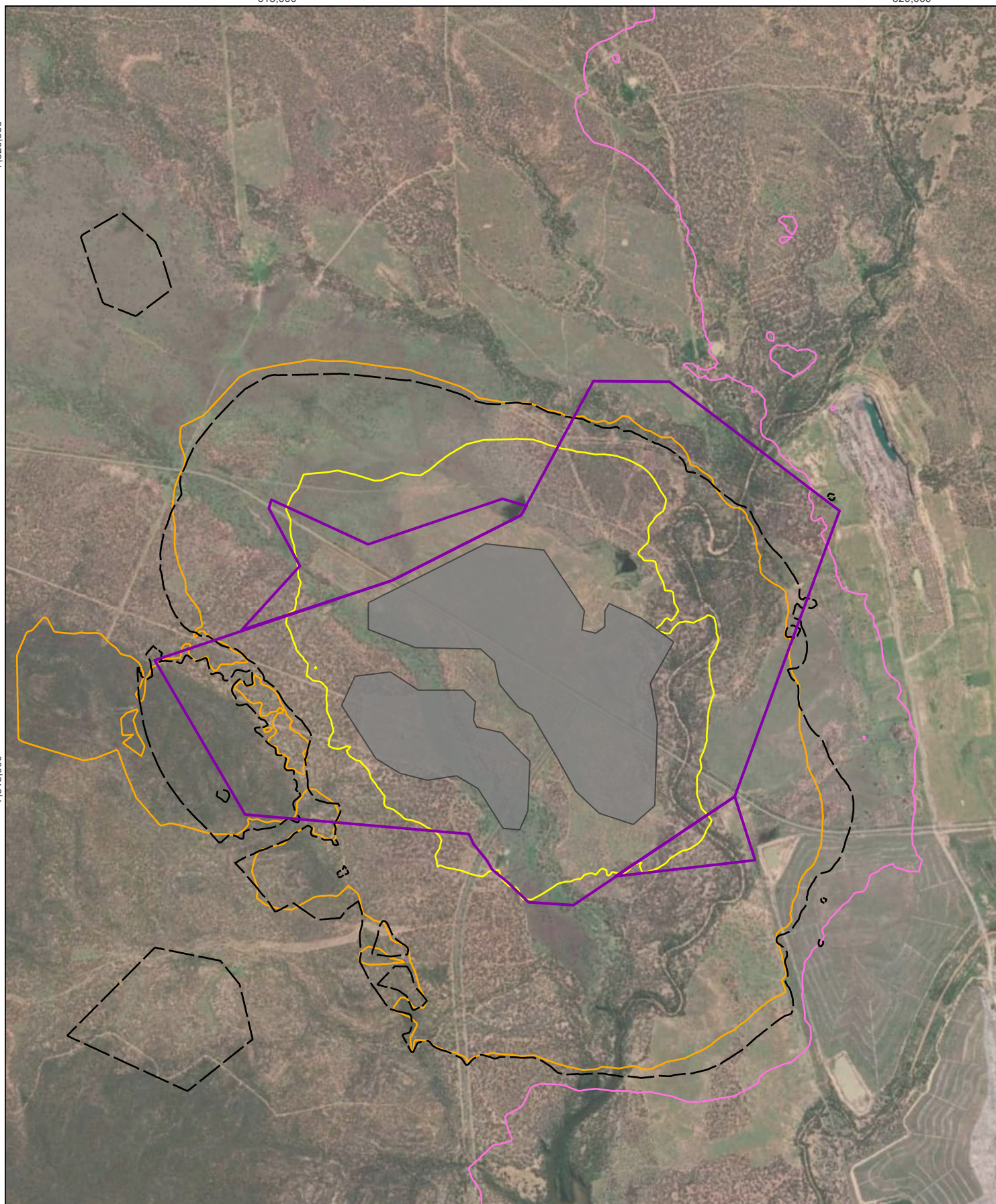
To illustrate the uncertainty in the extent of predicted post-mining residual drawdown, the maximum extent of the 1 m predicted incremental post-mining equilibrium drawdown for the 10th, 50th and 90th percentiles was compared to the maximum extent of the 1 m incremental post-mining equilibrium drawdown from the best calibrated realisation.

The 90th percentiles shown in the following figures indicates the predicted residual drawdown extent exceeded by 10% of tested realisations. Therefore, a drawdown extent greater than the 90th percentile area is an unlikely outcome. The 10th percentile lines in the figures show the predicted residual drawdown extent exceeded by 90% of tested realisations, therefore it is highly likely that the actual drawdown extent will be greater than that shown for the 10th percentile. The 50th percentile lines show the predicted residual drawdown extent exceeded 50% of tested realisations. These predictions are considered as likely outcomes.

The extent of the predicted incremental drawdown of the water table at post-mining equilibrium is shown on **Figure 6-41**. The incremental drawdown extent predicted by the best calibrated realisation and the 10th, 50th and 90th percentiles for the alluvium, regolith and Burton/Rider and Leichhardt/Vermont seams are shown in **Figure 6-42** to **Figure 6-45**, respectively.

The 90th percentile residual incremental drawdown in the coal seams, presented in **Figure 6-44** (Burton/Rider seam) and **Figure 6-45** (Leichhardt/Vermont seam) indicate significant extent of this predicted impact for the 90th percentile beyond that of the 50th percentile, stretching approximately 16 km to the north-west of the Project, along the Burton Range fault, reaching the western model boundary. The extent of this prediction is likely attributable to a combination of structural limitations of the model and extreme parameter combinations in a small number of the realisations derived during the Monte Carlo analysis. While lateral connectivity has been applied to model cells on either side of the fault, realisations in which both the horizontal and vertical conductivity for the adjacent layers (i.e. Burton/Rider, Leichhardt/Vermont seams in lateral connection to the two lower Rewan layers) differ by between 4 to 7 orders of magnitude on either side of the fault have resulted in residual drawdown extent predictions such as those shown for the 90th percentile. As such, the extent of the 90th percentile predictions shown in **Figure 6-44** and **Figure 6-45** should be considered an unlikely outcome resulting from the structural representation of the fault in the model and some extreme parameter combinations included in the uncertainty ensemble.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 21-Dec-2023

Drawn by: RB

LEGEND

- New Lenton Mining Lease
- New Lenton Pit Extent

1m Drawdown Contour

- Best Calibrated Realisation
- 10th Percentile
- 50th Percentile
- 90th Percentile

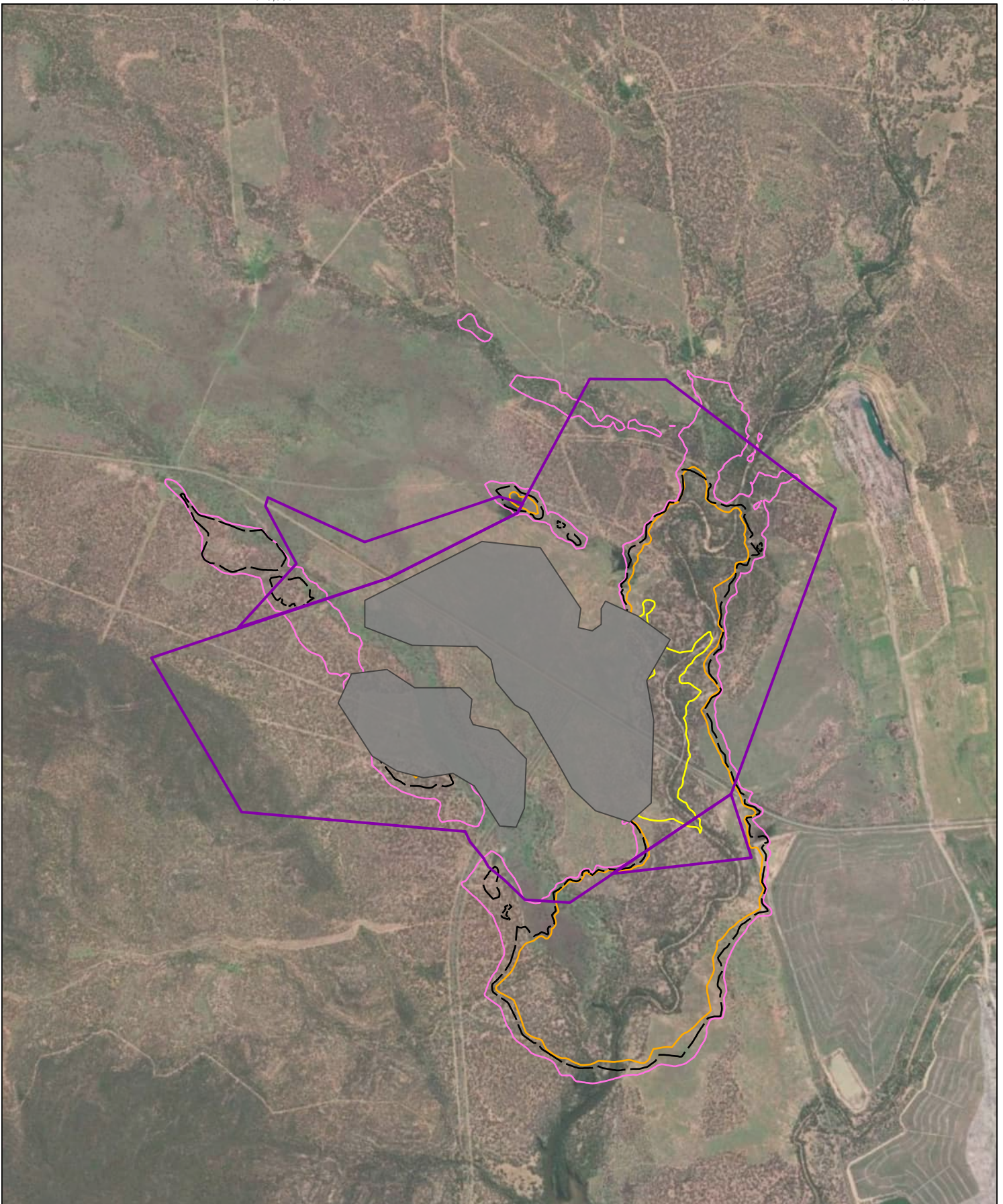
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED RESIDUAL INCREMENTAL GROUNDWATER TABLE DRAWDOWN (POST-MINING EQUILIBRIUM)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-41



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 21-Dec-2023

Drawn by: RB

LEGEND

- New Lenton Mining Lease
- New Lenton Pit Extent

1m Drawdown Contour

- Best Calibrated Realisation
- 10th Percentile
- 50th Percentile
- 90th Percentile

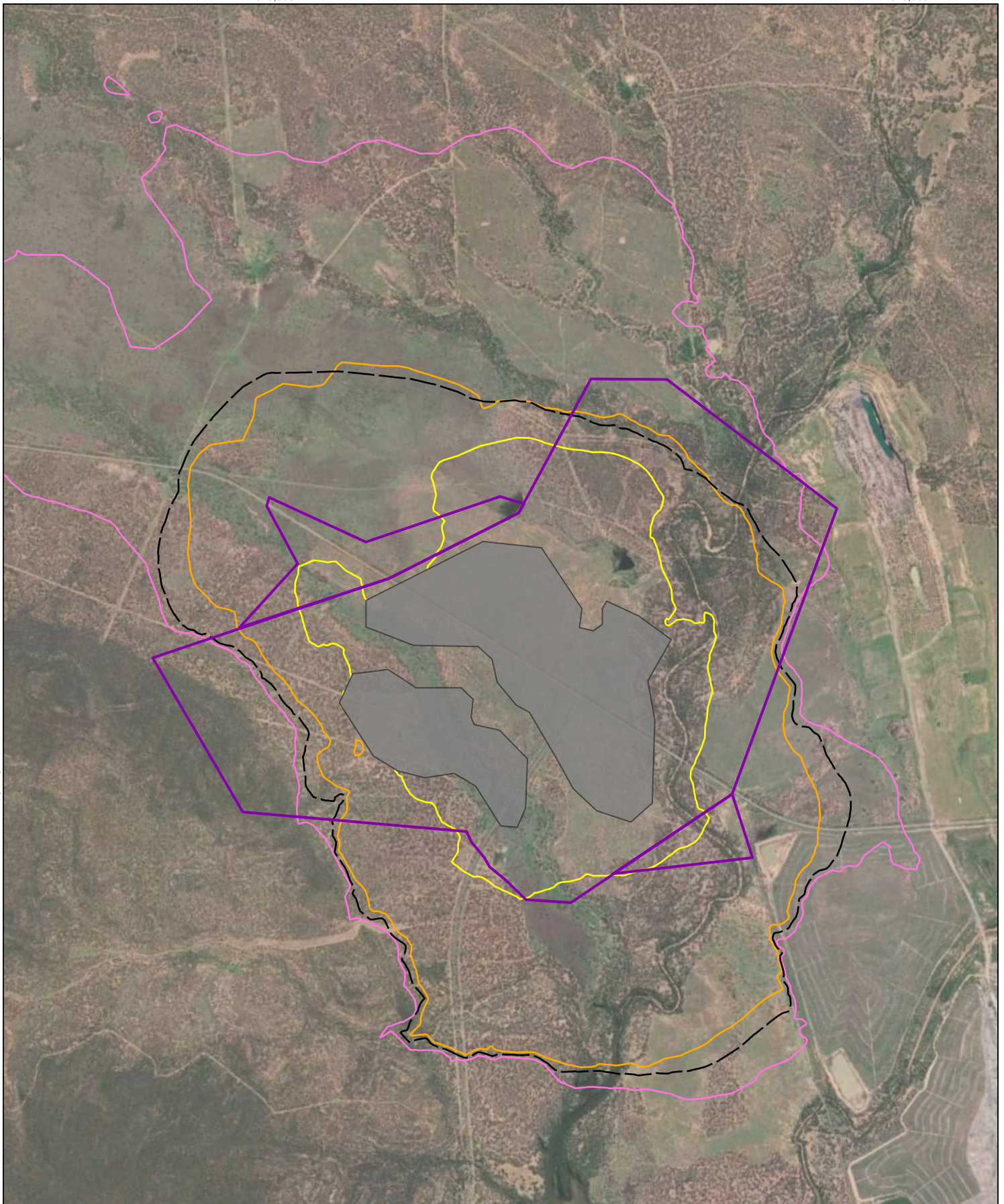
NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN ALLUVIUM (LAYER 1) (POST-MINING EQUILIBRIUM)



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FIGURE 6-42



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 21-Dec-2023

Drawn by: RB

LEGEND

- New Lenton Mining Lease
- New Lenton Pit Extent

1m Drawdown Contour

- Best Calibrated Realisation
- 10th Percentile
- 50th Percentile
- 90th Percentile

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN REGOLITH (LAYER 2) (POST-MINING EQUILIBRIUM)



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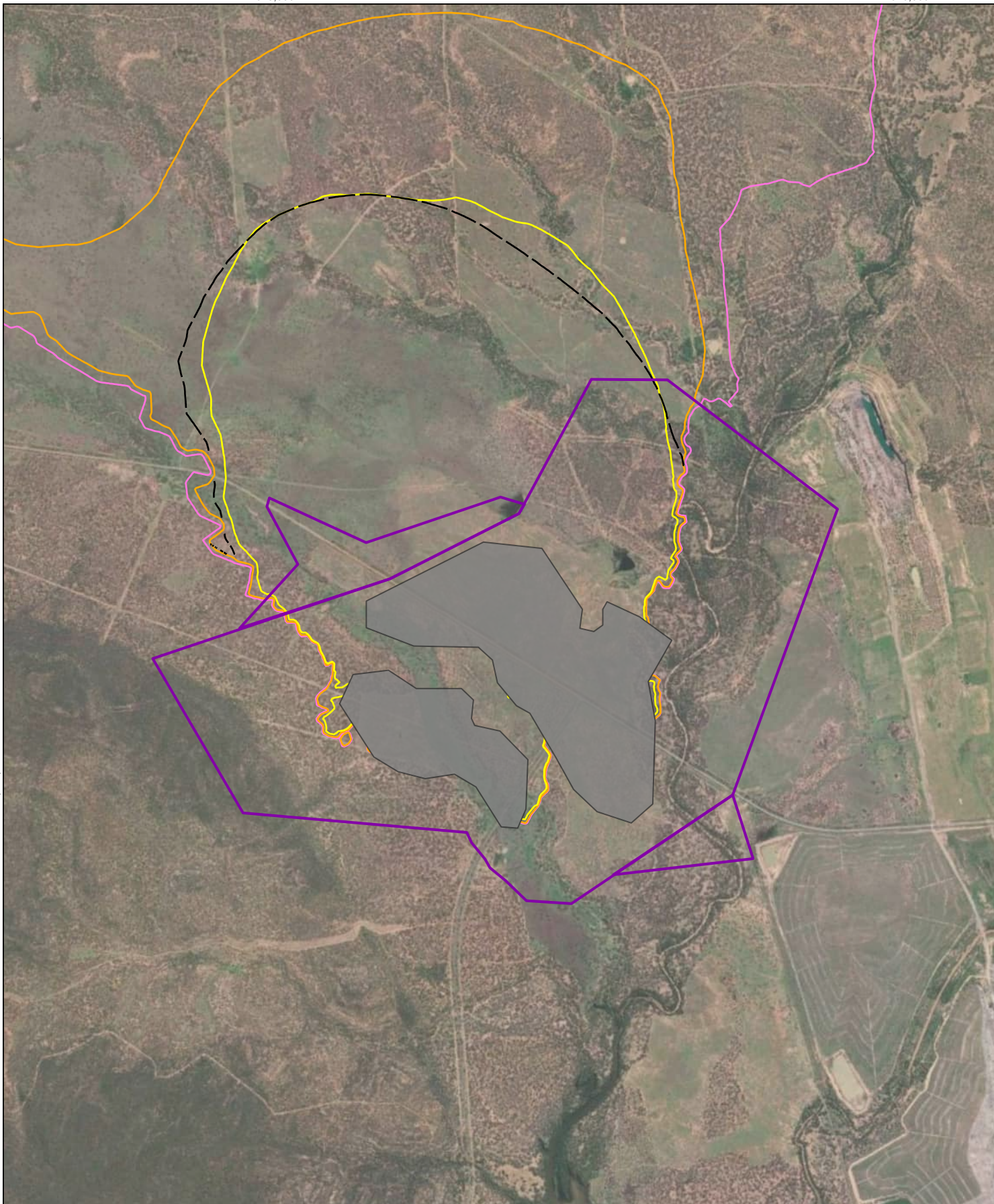
FIGURE 6-43

615,000

620,000

7,620,000

7,615,000



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 21-Dec-2023

Drawn by: RB

LEGEND

- New Lenton Mining Lease
- New Lenton Pit Extent

1m Drawdown Contour

- Best Calibrated Realisation
- 10th Percentile
- 50th Percentile
- 90th Percentile

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN BURTON/RIDER SEAM (LAYER 12) (POST-MINING EQUILIBRIUM)



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FIGURE 6-44

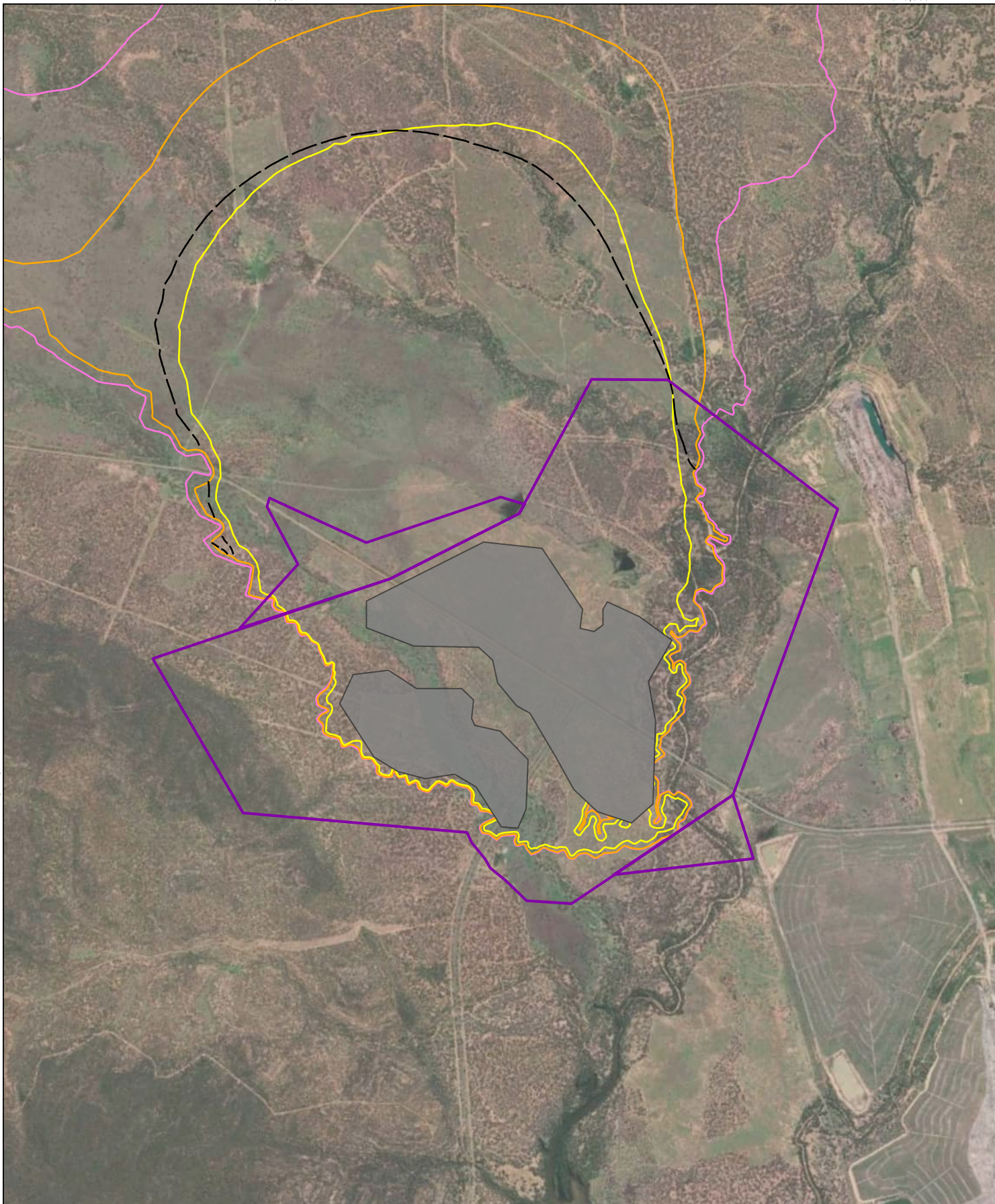
Path: H:\Projects-SLR\620-BNE\620-BNE\620.31367.00000 New Lenton PER Groundwater\03 SLR Data\01 CAD\GIS\GIS\ArcPro\New_Lenton_PER_Groundwater\New_Lenton_PER_Groundwater.aprx\SLR62031367_F6-51_Uncertainty_in_Predicted_Residual_Incremental_Drawdown_in_Burton_Rider_Seam_(Layer 12)_Post-Mining_Equilibrium

615,000

620,000

7,620,000

7,615,000



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 21-Dec-2023

Drawn by: RB

LEGEND

- New Lenton Mining Lease
- New Lenton Pit Extent

1m Drawdown Contour

- Best Calibrated Realisation
- 10th Percentile
- 50th Percentile
- 90th Percentile

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

UNCERTAINTY IN PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN LEICHHARDT/VERMONT SEAM (LAYER 16) (POST-MINING EQUILIBRIUM)



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FIGURE 6-45

6.8.6 Uncertainty of Drawdown at Water Supply Bores

The uncertainty analysis results showed no water supply bores are predicted to experience 90th percentile maximum incremental drawdowns greater than the relevant bore drawdown threshold trigger.

There is one water supply bore predicted to experience 90th percentile (i.e. very unlikely to occur) maximum cumulative drawdowns greater than the relevant *Water Act 2000* bore drawdown threshold trigger on a cumulative impact basis (i.e. the Project plus Burton Mine) (**Table 6-7** and refer **Figure 5-27**). Bore census results from December 2018 (GHD, 2019) for the unregistered bore BA05 show the bore as not currently in use, with the previous use being stock watering. The bore has a recorded depth of 40.3 m and is thought to be screened in the Triassic Strata based on a comparison with the model layers.

Table 6-7 Predicted Drawdown at Water Supply Bores exceeding the relevant Bore Trigger Threshold

Bore	Easting	Northing	Model Layer	90th Percentile Maximum Drawdown Due to Project (m)	90th Percentile Maximum Cumulative Drawdown (m)	Use
BA05	614659	7618259	4	3.9	5.3	Inactive; Previously used for stock watering

Note: Coordinates in GDA20 Z55

6.8.7 Uncertainty of Influence on Alluvium and Surface Water Flow

Table 6-8 shows the uncertainty range of predicted incremental alluvium flux change for all Alluvium mapped within the model domain.

The uncertainty results indicate that the 90th percentile decrease in leakage from the Triassic and Permian units to the Alluvium is up to 1.94 ML/day (708 ML/year).

As shown in **Table 6-8**, the 50th percentile change in flux to the Alluvium does not exceed 1 ML/day in any year, consistent with the predictions reported in **Section 6.5.1**.



Table 6-8 Uncertainty of Decrease in Flux to Alluvium (ML/day) - Alluvium

Year	10th percentile	50th percentile	Calibrated Prediction Model	90th percentile
2023	0.00	0.00	0.00	0.00
2024	0.00	0.00	0.00	0.00
2025	0.00	0.04	0.14	0.23
2026	0.00	0.06	0.09	0.26
2027	0.01	0.07	0.13	0.26
2028	0.02	0.10	0.19	0.31
2029	0.03	0.15	0.25	0.41
2030	0.40	0.97	1.42	1.85
2031	0.33	0.76	1.06	1.32
2032	0.27	0.61	0.76	1.05
2033	0.27	0.57	0.71	0.98
2034	0.25	0.53	0.70	0.94
2035	0.27	0.54	0.70	0.96
2036	0.27	0.54	0.70	0.93
2037	0.27	0.54	0.70	0.93
2038	0.27	0.54	0.70	0.94
2039	0.28	0.54	0.69	0.94
2040	0.26	0.54	0.68	0.91



7.0 Impacts on Water Resources

The following sections provide a summary of the groundwater modelling results reported in the previous section in the context of potential Project related groundwater impacts to water resources.

7.1 Potential Impact on Existing Groundwater Users

7.1.1 Privately-Owned Supply Bores

Chapter 3 of the *Water Act 2000* provides bore drawdown threshold triggers of 2 m for unconsolidated aquifers, and 5 m for consolidated aquifers. These are thresholds that are provided within the Water Act to aid in the assessment of the potential for impacts to bores that may be of a magnitude significant enough to warrant consideration of make good measures to restore water supply.

There are no known privately-owned water supply bores within the unconsolidated (Alluvium and Regolith) or consolidated (Permian coal measures) aquifers that lie within the predicted extent of Project related drawdown greater than 1 m (refer **Figure 5-27** and **Figure 6-3** through **Figure 6-6**).

The uncertainty analysis results showed no water supply bores are predicted to experience 90th percentile maximum incremental drawdowns greater than the relevant bore drawdown threshold trigger.

There is one water supply bore predicted to experience 90th percentile maximum cumulative (i.e. resulting from the Project plus Burton Mine) drawdowns greater than the relevant bore drawdown threshold trigger (i.e. 5 m) during mining. The unregistered bore BA05 is located north of the Project and is thought to be screened in the Triassic Strata based on a comparison of the bore's recorded depth with model layers. As per Table 4 of the IESC (2018) guideline, in terms of likelihood of exceedance, a percentile greater than 90% means that it is very unlikely that the maximum cumulative drawdown will be greater than 5 m at this bore.

7.1.2 Ecological Sites

The GDE field study by 3D Environmental (2023) used multiple lines of evidence to assess the groundwater dependence of vegetation. The study included the measurement of LWP, SMP, stable isotopes and physical observations. Based on the results of the field survey, it was concluded that riparian vegetation associated with the Isaac River floodplain and alluvium (Terrestrial GDEs; TGDEs) presents the only GDEs identified within the Project study area (i.e. as defined by 3D Environmental, 2023). The location of the Terrestrial GDEs identified by 3D Environmental (2023) are restricted to a narrow passage along the Isaac River (**Figure 7-1**).

Predicted maximum incremental alluvium drawdown shows the area mapped as containing known/likely terrestrial GDEs by 3D Environmental (2023) (**Figure 7-1**) is expected to experience drawdowns of typically between 1 and 5 m, but up to 12 m drawdown in a small area (**Figure 6-2**).

Potential impacts to the identified Terrestrial GDEs were assessed by 3D Environmental (2023) following the steps set out in the GDE Toolbox (Richardson et al 2011). The major impact mechanisms and potential impacts to groundwater vegetation in the Study Area as discussed by 3D Environmental (2023) include:

- Direct Clearing: within the disturbance footprint will impact 2.21 ha of mapped TGDEs on the Isaac River (**Figure 7-1**); however, these impacts will be mitigated by



reducing construction width of linear infrastructure and rehabilitating construction disturbance.

- Depressurisation / dewatering: Drawdown of the basal alluvial groundwater unit may result in faster drying of the soil profile, and possibly reduced seasonal persistence of the hydraulically separate overlying perched groundwater unit relied upon by the GDEs, if hydraulic linkage between these two units occurs. The magnitude of impact will depend on the degree of disconnection (if any) between the seasonally variable perched and the basal alluvial groundwater units, and whether any vegetation associated with the mapped Terrestrial GDE areas have developed deeper rooting systems which penetrate to the basal alluvial groundwater unit.

The risk to GDE function due to depressurisation/dewatering is however ameliorated due to the following factors:

- The limited to no hydraulic connectivity between the perched and basal alluvial groundwater systems based on the current understanding of the interactions between these two groundwater units.
- Tree species which characterise the riparian GDE areas, particularly forest red gum (*Eucalyptus tereticornis*), are resilient and have capacity to adapt to the possible minor reductions in soil moisture availability that may propagate above areas of groundwater drawdown.
- The groundwater hosted in the seasonally variable perched groundwater unit that supports GDEs is subject to natural volume fluctuations in response to changing seasonal conditions and may dry for significant periods. This means that dependent vegetation will be adapted to varying degrees of moisture availability.
- The seasonally variable perched groundwater system that supports GDEs on the frontage of the Isaac River is supported and recharged by surface flows. The impact of the Project on surface flows is negligible.

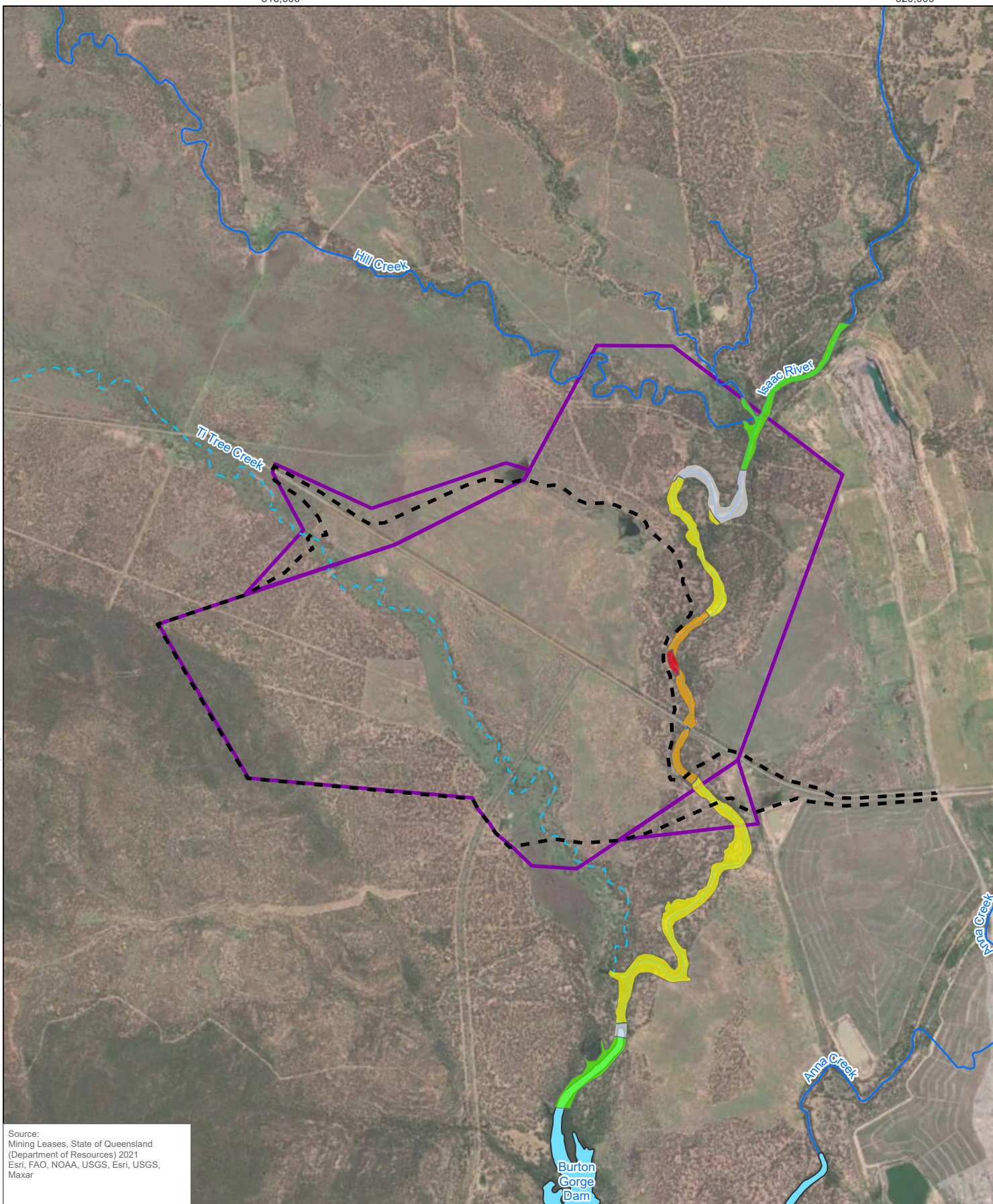
The assessment by 3D Environmental (2023) identified four types of GDE 'Risk Zones' for the potential for Project related activities to impact GDE function. The "Risk Zones" range and are identified as:

- Areas where drawdown of 10m to 12m in the basal alluvial groundwater unit interacts with mapped GDEs on the Isaac River (Risk Zone 1 - Highest Risk).
- Areas where drawdown >5m to <10m in the basal alluvial groundwater unit interacts with mapped GDEs on the Isaac River (Risk Zone 2).
- Areas where drawdown >2m to <5m in the basal alluvial groundwater unit interacts with mapped GDEs on the Isaac River (Risk Zone 3).
- Areas where groundwater drawdown (<2m) in the basal alluvial groundwater unit interacts with GDEs mapped on the Isaac River (Risk Zone 4 - Lowest Risk).

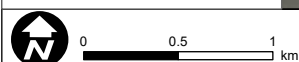
The "Risk Zone" areas which intersect with the 'known/likely' GDE area mapped by 3D Environmental are shown on **Figure 7-1**.

Mapped known/likely GDE areas outside of the area of groundwater drawdown in the alluvium are not considered to be at risk from Project development.





Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Esri, FAO, NOAA, USGS, Esri, USGS,
Maxar



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 21-Dec-2023

Drawn by: RB

LEGEND

- Major Watercourse
- - - Non-designated Watercourse
- ▭ New Lenton Mining Lease
- - - Proposed Disturbance Area

- Risk Zone 1 (10 to 12m)
- Risk Zone 2 (>5 to <10m)
- Risk Zone 3 (2 to 5m)
- Risk Zone 4 (>1 to <2m)
- Outside Drawdown (<1m)

NEW LENTON COAL PROJECT PER GROUNDWATER ASSESSMENT

GDE IMPACT RISK ZONES (3D Environmental, 2023)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 7-1

To detect potential impacts to the health and function of Terrestrial GDEs associated with the Project a GDE Monitoring and Management Plan (GDEMMP) will be prepared (see **Section 8.2**). The GDEMMP is designed to accommodate for uncertainties in ecological response of GDEs to disturbance. This GDEMMP will provide methods for the early detection of impacts through development of trigger thresholds of ecological condition and proposes mitigations to be applied should decline in ecological condition be linked to project related mining operations. With implementation of the GDEMMP, it is considered that the risk to GDE's posed by mine development ranges from 'Low' (Risk Zone 1) to Insignificant (Risk Zone 4) (3D Environmental, 2023).

As discussed in **Section 7.2** there are no predicted groundwater-related impacts to surface drainage as a result of the Project and therefore no associated impacts to GDEs are expected. Furthermore, as mentioned earlier, dry season ground-truthing at the Project (AARC, 2024; 2019b) have identified groundwater does not discharge to the surface or maintain surface pools, and as a result does not support aquatic GDEs and therefore no associated impacts to aquatic GDEs could occur.

7.2 Potential Impacts on Surface Drainage

The Isaac River is the major drainage feature of the region. It is located to the east of the Project and flows north-northeast to south-southwest in the vicinity of the Project.

A natural hydraulic gradient exists between the Isaac River and the associated alluvium that results in seepage from the Isaac River to the alluvium (i.e. a losing system). The change in groundwater levels induced by mining has the potential to increase the hydraulic gradient between the Isaac River and associated alluvium. However, the model does not predict that the average rate of seepage from the Isaac River to the alluvium will increase over the life of the Project and therefore there are no predicted groundwater-related impacts to surface drainage as a result of the Project.

Diversion of Ti-Tree Creek has the potential to influence groundwater conditions, particularly for the shallow groundwater system if surface flows in Ti-Tree Creek are a significant source of groundwater recharge. In the groundwater modelling methodology adopted for this assessment (**Section 6.0** and **Appendix D**), recharge is distributed in zones across the model domain according to outcropping geology, and the numerical groundwater model assigns a proportion of annual rainfall to each of these zones based on the recharge parameters derived during the model calibration process. Where open cut mining for the Project is proposed in areas where existing streams are mapped (i.e. Ti-Tree Creek), recharge from these streams is removed from the groundwater numerical model since no recharge is applied in active mining areas in the model. Therefore, the results derived from the numerical groundwater model presented in this Groundwater Assessment account for the reduction in recharge to the shallow groundwater system that might result from diverting Ti-Tree Creek.

7.3 Potential Impacts on Groundwater Quality

This section describes the potential sources and pathways of groundwater contamination associated with the Project.

7.3.1 Out of Pit Waste Rock Emplacement Areas

As the mining operations progress, waste rock material would be placed within selected out-of-pit waste rock emplacement areas (refer **Figure 1-2**). The out-of-pit waste rock emplacement areas may produce seepage as a result of rainfall inundation, that theoretically could alter the existing groundwater quality. Runoff from disturbed areas outside the open cut pit and infrastructure areas, such as waste rock emplacement areas (both active and under rehabilitation) would be captured in the sediment and mine-affected water dams and



managed under the mine water management system. The system would be designed to capture and reuse water, and operated to minimise off-site discharges including discharge to groundwater.

During mining, the inward hydraulic flow gradients from the waste emplacement areas to the open cut voids would inhibit any seepage to the shallow regional groundwater system. Therefore, there would be no mechanism for seepage from the out-of-pit waste rock emplacement to impact on groundwater quality in the alluvium and regolith. Post-mining, model particle tracking results (**Section 6.7.7**) indicate that the residual void continues to form a hydraulic sink for water emanating within out of pit waste rock emplacement areas such that there is no discharge offsite to the surrounding environment.

7.3.2 In Pit Waste Rock Emplacement Areas

The in-pit waste rock emplacement areas would be rehabilitated progressively as the mining operations progress. The Project would involve progressively backfilling the open cut pits as space becomes available with water levels within backfilled areas predicted to recover back towards pre-mining levels. During mining, the inward hydraulic flow gradients from the waste emplacement areas to the open cut voids would inhibit the potential for any seepage outflow. Post-mining, model particle tracking results (**Section 6.7.7**) indicate that the residual void continues to form a hydraulic sink for water emanating within in pit waste rock emplacement areas such that there is no discharge offsite to the surrounding environment.

7.3.3 Blasting

Blasting activities have the potential to release metals, metaloids and ammonia associated with chemical reactions during the blasting process. During mining, the inward hydraulic flow gradients to the open cut voids would inhibit the potential for any outflow of such potential contaminants. Post-mining, model results indicate that the residual void continues to form a hydraulic sink such that there is no discharge offsite to the surrounding environment.

7.3.4 Final Void

A final void is proposed within the Project Area to remain in perpetuity. Modelling predicts that the final void water levels would equilibrate to between approximately 270 and 278 mAHD from approximately 300 years following the cessation of mining.

The predicted equilibrated final void water levels are approximately 30 m below the pre-mining groundwater levels, which means the final void would act as a sink to groundwater flow with no potential for outflow to the surrounding groundwater system.

Water within the final void would evaporate from the final void water body surface and draw in groundwater from the surrounding strata and runoff from the final void catchment areas. As the final void would act as a sink, evaporation from the final void water body would overtime concentrate salts in the final void water body. However, the gradual increase in salinity of the final void water body would not pose a risk to the surrounding groundwater regime as the final void would remain as a groundwater sink in perpetuity.

7.3.5 Workshops and Storage

All workshop and fuel/chemical storage areas at the Project are developed in accordance with current Australian Standards. This includes refuelling areas and chemical storage areas to be designed with adequate bunding and equipped for immediate spill clean-up. These controls represent standard practice and a legislated requirement at mining operations for preventing the contamination of the groundwater regime. Therefore, there is considered to be limited potential for groundwater contamination to occur with relation to workshops and fuel/chemical storage.



7.4 Potential Impacts on Aquifer Physical Integrity and Hydraulic Properties

The process of open pit mining proposed at the Project will result in the removal of the aquifer and aquitard units within the mine pit footprints.

It is considered that there is no potential for any other impacts to the physical integrity of any of the identified aquifer and aquitard units, since there is no mechanism for physical impacts to the geology to propagate away from the open pits (for example, as might occur associated with underground mining subsidence). As such, there would in turn be no potential for impacts to the hydraulic properties of the identified aquifer and aquitard units outside of the open pit footprints.

7.5 Risk Assessment

A risk assessment matrix has been developed to summarise the potential impacts on water resources arising from the Project's groundwater impacts discussed in the previous report sections. For each of the key groundwater related risks identified, the following were considered and recorded as part of the risk assessment:

- Brief description of the risk;
- Likely cause;
- Potential consequence;
- Potential likelihood; and
- Risk rating and rank.

To undertake the risk assessment, it is useful to define (in a descriptive sense) the various levels of consequence of a particular event and the likelihood of such an event occurring. Descriptions of the categories that were used to rank the likelihood of a risk are provided in **Table 7-1**.

Table 7-1 Consequence Assessment

Rating		Description
5	Severe	Environmental damage or effect (permanent; >10 years)
4	High	Long term (2 to 10 years) impact
3	Moderate	Medium term (<2 years impact)
2	Low	Short term (<1 year) impact
1	Negligible	No lasting environmental damage or effect

The level of risk for each potential impact was determined by combining consequences defined in **Table 7-1** with likelihood as defined in **Table 7-2**. The numerical modelling uncertainty analysis discussed in **Section 6.8** allows quantification of the likelihood of a particular impact occurring. The resulting risk analysis matrix (combining consequence and likelihood) is presented in **Table 7-3**.



Table 7-2 Likelihood Assessment

Likelihood	Probability	Basis of Rating
A	Highly Likely	Expected to occur
B	Likely	More likely to occur than not to occur
C	Possible	As likely to occur as not to occur
D	Unlikely	More likely to not occur than to occur
E	Highly Unlikely	Very unlikely to occur

Table 7-3 Risk Analysis Matrix

		Likelihood				
		E	D	C	B	A
Consequence	5	Insignificant	Low	High	High	High
	4	Insignificant	Low	Moderate	High	High
	3	Insignificant	Low	Moderate	Moderate	Moderate
	2	Insignificant	Low	Low	Low	Low
	1	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

The risk assessment is presented as **Table 7-4**.

It should be noted that risks to terrestrial GDEs are specifically explored in more detail within the 3D Environmental (2023) report.



Table 7-4 Risk Assessment

Potential Receptor	Risk Description	Likely cause	Potential Impact	Consequence	Likelihood	Risk Rating
Third party bores.	Loss of supply (yield) from third party bores.	Drawdown of groundwater levels in the bore source aquifer.	Reduction in, or complete loss of, supply (yield) from third party bores.	High (4). Drawdown and therefore reduction or loss of bore yield may persist in the long term.	Highly Unlikely (E). Modelling results indicate no third party bores will be subject to incremental drawdowns exceeding the relevant <i>Water Act 2000</i> bore trigger threshold, even at the 90 th percentile predictive uncertainty. Only one non-active third party bore is predicted to experience 90th percentile maximum cumulative (i.e. resulting from the Project plus Burton Mine) drawdowns greater than the relevant bore drawdown threshold trigger. There is no indication that this bore would be equipped for water supply anytime in the future.	Insignificant
Third party bores.	Reduction in water quality at third party bores.	Release of contaminants (including salts) to the groundwater system from the Project that enter the bore source aquifer and migrate to the bore.	Bore water quality no longer suitable for the intended use.	High (4). Water quality change may persist in the long term.	Highly Unlikely (E). During mining, the inward hydraulic flow gradients to the open cut voids would inhibit any migration of water outwards to the regional groundwater system. Post-mining, model results indicate that the residual void continues to form a hydraulic sink for water emanating within the final landform such that there is no discharge offsite to the surrounding environment. Therefore, there would be no mechanism for contaminants in water leave the site and travel to a third party bore.	Insignificant
Surface water systems (including potential aquatic GDEs).	Reduction in flow in surface water systems	Drawdown of groundwater levels in the shallow groundwater system either reduces baseflow to the surface	Impact to environmental receptors reliant on flow in surface water systems	High (4). Surface flow changes may persist in the long term.	Highly Unlikely (E). Baseline groundwater system characterisation indicates that where it occurs, groundwater within the basal alluvium is recorded at depths of around 8 to 11 mBGL, typically significantly disconnected from the streambed elevation. Watercourses within the Project Area are highly ephemeral where surface water flow is only sustained for hours to several days following rainfall events. Overall these factors indicate a distinct lack of	Insignificant



Potential Receptor	Risk Description	Likely cause	Potential Impact	Consequence	Likelihood	Risk Rating
		water system or increases leakage out of the surface water system.			groundwater discharge to these watercourses such that there is no groundwater baseflow and therefore no potential for groundwater drawdown to manifest as a decrease in surface water flow.	
Surface water systems (including potential aquatic GDEs).	Reduction in water quality in surface water systems.	Release of contaminants (including salts) to the groundwater system from the Project that then enter the surface water systems.	Surface water quality no longer suitable for environmental users.	High (4). Water quality change may persist in the long term.	Highly Unlikely (E). Notwithstanding the fact that groundwater does not discharge to surface water systems under current conditions, during mining the inward hydraulic flow gradients to the open cut voids would inhibit any migration of water outwards to the regional groundwater system. Post-mining, model results indicate that the residual void continues to form a hydraulic sink for water emanating within the final landform such that there is no discharge offsite to the surrounding environment. Therefore, there would be no mechanism for contaminants in water leave the site in groundwater and discharge to surface water systems.	Insignificant
Terrestrial GDEs	Loss of groundwater availability to Terrestrial GDEs	Drawdown of groundwater levels in the perched groundwater system utilised by TGDEs	Decline in health of TGDEs	Refer to GDE Study (3D Environmental, 2023)	Refer to GDE Study (3D Environmental, 2023)	Refer to GDE Study (3D Environmental, 2023)
Terrestrial GDEs	Reduction in water quality used by	Release of contaminants (including salts) to the groundwater system from	Decline in health of TGDEs	Refer to GDE Study (3D Environmental, 2023)	Refer to GDE Study (3D Environmental, 2023)	Refer to GDE Study (3D Environmental, 2023)



Potential Receptor	Risk Description	Likely cause	Potential Impact	Consequence	Likelihood	Risk Rating
	Terrestrial GDEs.	the Project that then enter the perched groundwater system utilised by TGDEs.				



8.0 Management and Mitigation Measures

8.1 Groundwater Monitoring and Management Program

A dedicated Groundwater Monitoring and Management Program (GMMP) has been prepared to monitor and manage the potential impacts on groundwater at and surrounding the Project. The GMMP has been developed to satisfy the relevant requirements of the Project's EA, AWL, Progressive Rehabilitation and Closure Plan (PRCP) and to support approval under the EPBC Act. It outlines the groundwater monitoring plan for the Project and associated groundwater impact limits and triggers that will invoke further assessment and groundwater impact management during the life of the Project and in the early years post-closure.

The GMMP is provided as **Appendix G** and key components are summarised in the following sections.

8.1.1 Groundwater Monitoring Network

The GMMP monitoring network includes reference and compliance bores as detailed in **Table 8-1** and shown in **Figure 8-1**. Compliance bores are bores that have impact criteria thresholds established in the GMMP, whereas reference bores are bores primarily intended to provide for background monitoring data outside of the potential mining impact area that would support the assessment of any limit or trigger breach at a compliance bore.

The monitoring network contains sufficient monitoring points in terms of spatial spread of monitoring across all formations of interest to develop sufficient pre-mining groundwater conditions. A process of continual improvement of the monitoring network (see **Section 8.1.6**) will ensure continued appropriateness of the monitoring program to assess groundwater impacts from the development of the Project.



Table 8-1 Project GMMP Monitoring Network

Bore	Easting ¹	Northing ¹	Casing RL (mAHD)	Bore Depth	Screen (mBGL)	Aquifer	Status	Current AWL Bore?	Current EA Bore?	GMMP Bore Type
GW01	617299	7618210	326.8	15.2	6.17 – 12.17	Alluvium	dry	Reference	Interpretation	Reference
GW19	612323	7620097	376.7	26.5	22.9 – 25.9	Alluvium/Regolith	dry	Reference	-	Reference
GW20	612676	7618392	355.5	33.9	24 – 30	Basalt	Active	Reference	-	Reference
GW22	614463	7622201	401.7	11.6	5 – 8	Alluvium	dry	Reference	-	Reference
GW23	617807	7622169	369.9	11.6	5 – 8	Alluvium	dry	Reference	-	Reference
GW06	618097	7616723	313.9	20.6	3.6 – 18.6	Alluvium	dry	Compliance	Compliance	Compliance
GW03	618094	7614389	307.6	12.1	3.1 – 12.1	Alluvium	dry	Compliance	Compliance	Compliance
GW09	617525	7614070	307.1	24	6 – 18	Alluvium	Active	Compliance	Compliance	Compliance
GW19_37a	618034	7615771	309.6	26	16.5 – 20.0	Alluvium	Active	Compliance	Compliance	Compliance
GW08	617041	7613900	306.7	11.7	5.72 – 8.72	Alluvium	dry	Compliance	Compliance	Compliance
GW07	617640	7613075	299.5	24.5	9 – 18	Alluvium	Active	Reference	Compliance	Compliance
GW26	619185	7616679	315.7	9.6	6 – 9	Alluvium	dry	Compliance	-	Compliance
GW19_33	618664	7617348	312	16	11.1 – 12.6	Alluvium/Regolith	Active	Compliance	Compliance	Compliance
GW30c	618094	7617368	318.2	31.1	23 – 29	Regolith	Active	Compliance	Compliance	Compliance
GW31b	617621	7617680	322*	21.2	17 – 20	Regolith	Active	Compliance	Compliance	Compliance
GW30b	618088	7617382	318.5	76.2	70 – 73	Permian (Burton Seam)	Active	Compliance	Compliance	Compliance
GW10	616032	7617014	335.2	205.1	178.16–190.16	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW13	616881	7615480	319.3	192.4	170.5 – 179.5	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW30a	618084	7617395	318.5	112.2	97 – 109	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance



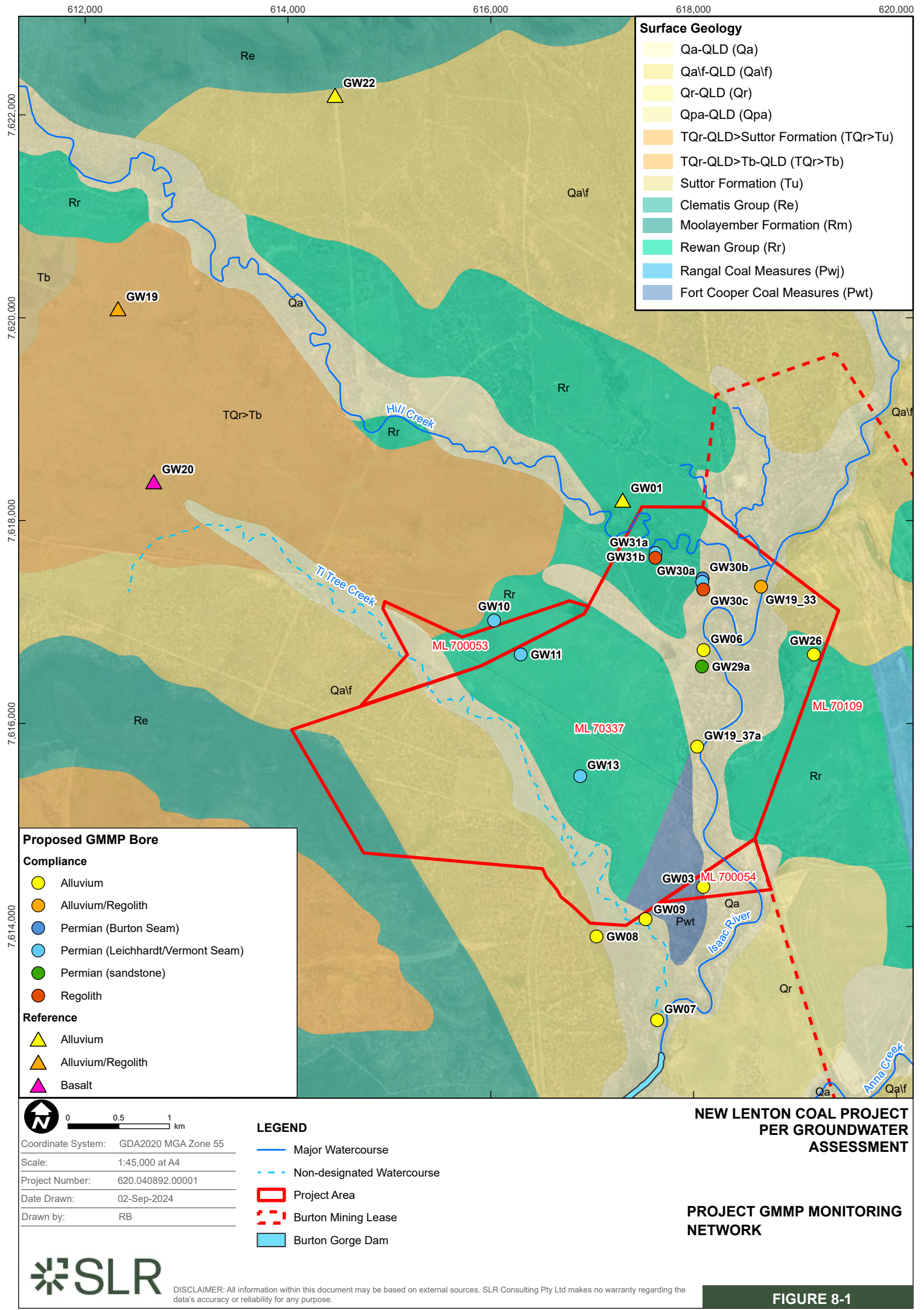
Bore	Easting ¹	Northing ¹	Casing RL (mAHD)	Bore Depth	Screen (mBGL)	Aquifer	Status	Current AWL Bore?	Current EA Bore?	GMMP Bore Type
GW31a	617624	7617680	321.9*	165.2	153 – 162	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW11	616294	7616680	332.3	150	114 – 126	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW29a	618081	7616561	313.6	83.6	62 – 80	Permian (sandstone)	Active	Compliance	Compliance	Compliance

¹ Coordinates are GDA94 z55

* Ground level

L/V = Leichhardt / Vermont Seam





8.1.2 Monitoring Regime – Baseline and During Mining

Routine monitoring includes groundwater level and quality monitoring as detailed in the below sections. Details of monitoring protocols and QA/QC procedures are provided in the GMMP document (**Appendix G**).

Routine monitoring prior to the commencement of the mining operation (i.e. baseline period) will provide for continued assessment and characterisation of the pre-mining groundwater system, including quantification of natural variability. Continuing to capture data to quantify natural variability is important on the context of allowing the LJV to distinguish any future mining related impacts from inherent natural variability later during the Project's operational phase. Consistent with condition D2 of the EA, the baseline monitoring program will continue until the during-mining monitoring phase commences.

Routine monitoring during the mining operation will provide early warning of any variation in response of the groundwater system to that predicted. This will enable the LJV to undertake mitigation measures to minimise any potential groundwater related impacts, such as to surrounding groundwater users and the environment, e.g. through the implementation of make-good measures.

8.1.2.1 Groundwater Levels

Groundwater level monitoring will be undertaken through manual measurements and the use of automatic level loggers as detailed below.

Manual Measurements

Manual groundwater level monitoring will be undertaken as follows:

- On a quarterly basis for compliance bores where Groundwater Level Trigger Thresholds and Level Reference Values have been established.
- On a quarterly basis for reference bores.
- On a bi-monthly (every 2 months) basis for compliance bores where Groundwater Level Trigger Thresholds or Level Reference Values are not yet defined, until such time as they are established or its determined that a bore is permanently dry.

Data Loggers

Groundwater level monitoring will be undertaken using automated level loggers in each of the GMMP bores listed in **Table 8-1**. The status of current data logger installation across the GMMP bores is provided in **Table 8-2**. It is noted that there are currently loggers installed within six non-GMMP bores within the mining disturbance area i.e. at GW19_40, GW19_41a, GW19_41b, GW27a, GW28a and LEN486, including seven groundwater level loggers and one barometric logger. It is recommended to move the loggers to the GMMP bores that do not have loggers prior to the commencement of mining operations, including the barometric logger currently installed within GW19_41b. Of the bores listed in the table below, it is noted that even if some bores are listed as dry, then the logger installation would allow measurement of groundwater levels if the bore becomes saturated. Furthermore, the resetting of loggers in dry bores at quarterly intervals will act to mitigate instrument drift due to being dry.

Pursuant to condition 42 of the AWL, logging intervals will be set to record a measurement at daily intervals.

A barometric pressure logger will be installed to the GMMP bores (or moved from GW19_41b which is in the proposed mining footprint) and the water level logger data will be barometric pressure corrected using the barometric pressure logger data prior to any analysis.



Loggers will be downloaded at least every three months. At the time of each download, a manual water level measurement will be recorded at each bore using a conventional groundwater level monitoring e-tape to confirm logger data accuracy. Any discrepancies observed in the automated monitoring data when compared to the manual measurements will be immediately investigated and where necessary the loggers reset or replaced to ensure data reliability. Loggers installed into dry bores should be reset at each monitoring event if the bore remains dry to mitigate instrument drift.

Table 8-2 GMMP Bore Data Logger Status

Bore	Aquifer	Status	Bore Type	Logger installed?
GW01	Alluvium	dry	Reference	N - repurpose logger from bores in mining footprint
GW19	Alluvium/Regolith	dry	Reference	N - repurpose logger from bores in mining footprint
GW20	Basalt	Active	Reference	N - repurpose logger from bores in mining footprint
GW22	Alluvium	dry	Reference	N - repurpose logger from bores in mining footprint
GW23	Alluvium	dry	Reference	N - repurpose logger from bores in mining footprint
GW06	Alluvium	dry	Compliance	Y (bore dry)
GW03	Alluvium	dry	Compliance	N - repurpose logger from bores in mining footprint
GW09	Alluvium	Active	Compliance	Y (bore dry)
GW19_37a	Alluvium	Active	Compliance	Y
GW08	Alluvium	dry	Compliance	N - repurpose logger from bores in mining footprint
GW07	Alluvium	Active	Compliance	Y
GW26	Alluvium	dry	Compliance	N - repurpose logger from bores in mining footprint
GW19_33	Alluvium/Regolith	Active	Compliance	Y
GW30c	Regolith	Active	Compliance	Y
GW31b	Regolith	Active	Compliance	Y
GW30b	Permian (Burton Seam)	Active	Compliance	Y
GW10	Permian (L/V Seam)	Active	Compliance	Y
GW13	Permian (L/V Seam)	Active	Compliance	Y
GW30a	Permian (L/V Seam)	Active	Compliance	Y
GW31a	Permian (L/V Seam)	Active	Compliance	Y
GW11	Permian (L/V Seam)	Active	Compliance	Y
GW29a	Permian (sandstone)	Active	Compliance	Y

L/V seam = Leichhardt/Vermont Seam



8.1.2.2 Groundwater Quality

Overview

Groundwater quality sampling will be undertaken as follows:

- On a quarterly basis for compliance bores where Groundwater Quality Limits have been established.
- On a quarterly basis for reference bores.
- On a bi-monthly (every 2 months) basis for compliance bores where Groundwater Quality Limits are not yet defined, until such time as they are established, or it is determined that a bore is permanently dry.

Parameter Suite

The groundwater quality parameter suite identified in **Table 8-3** has been selected to detect the potential changes in groundwater quality outlined as they may relate to causing harm to the relevant groundwater EVs (further detail provided in **Appendix G**).



Table 8-3 Groundwater Quality Parameter Suite

Parameter Group	Parameter	Unit	Method
Physico-chemical parameters	pH		Field
	Electrical Conductivity (EC)	µS/cm	Field and Lab
	Total Dissolved Solids (TDS)	mg/L	Lab
Major Ions	Sodium	mg/L	Lab
	Calcium	mg/L	Lab
	Magnesium	mg/L	Lab
	Potassium	mg/L	Lab
	Chloride	mg/L	Lab
	Sulfate	mg/L	Lab
	Carbonate	mg/L	Lab
	Bicarbonate	mg/L	Lab
Nutrients	Ammonia as N	mg/L	Lab
Metals (dissolved and total)	Aluminium	mg/L	Lab
	Arsenic	mg/L	Lab
	Boron	mg/L	Lab
	Cadmium	mg/L	Lab
	Cobalt	mg/L	Lab
	Chromium	mg/L	Lab
	Copper	mg/L	Lab
	Mercury	mg/L	Lab
	Lead	mg/L	Lab
	Manganese	mg/L	Lab
	Molybdenum	mg/L	Lab
	Nickel	mg/L	Lab
	Silver	mg/L	Lab
	Selenium	mg/L	Lab
	Uranium	mg/L	Lab
	Vanadium	mg/L	Lab
	Zinc	mg/L	Lab



8.1.3 Monitoring Regime – Post-Mining

Pursuant to condition PRCP6 of the PRCP, monitoring and maintenance must be carried out in accordance with the monitoring and maintenance program described in the rehabilitation planning part relating to the PRCP schedule; and any requirement under the PRCP schedule, as detailed within this Section, and **Section 8.1.5** of this report. Details of QA/QC procedures (specifically relating to post-mining record keeping) are provided in the GMMP document (**Appendix G**).

The GMMP groundwater monitoring program will continue unchanged in the post-mining period until relinquishment of the EA and MLs, with the exception of incorporating any additional requirements that may arise through the PRCP implementation process.

The post-mining monitoring program will also include additional monitoring for the residual void lake as follows:

- Void Water Level - Quarterly survey consistent with the frequency of groundwater level monitoring at groundwater bores.
- Void Water Quality – Quarterly sampling consistent with the frequency and parameter suite (**Section 8.1.2.2**) for groundwater quality monitoring at groundwater bores.

The GMMP will continue to be implemented during the post-mining period until such time as mining lease relinquishment is achieved, in accordance with relevant State regulatory approvals associated with satisfactory completion of implementation of the PRCP. These statutory obligations will include assessment and demonstration that the ongoing risk to groundwater associated with the final landform has been successfully managed and mitigated.

Consistent with condition RM8 of the PRCP, LJV will continue groundwater monitoring after the completion of final landform establishment and surface preparation (i.e. post-mining and completion of landform construction and topsoiling):

- Quarterly for water quality a minimum period of 5 consecutive years, at but not limited to compliance bores and for all quality characteristics; and
- Quarterly for groundwater level for 10 consecutive years.

After 5 years of rehabilitation monitoring, a review is to be undertaken to determine if there is a requirement for additional monitoring, or if post-mining groundwater system behaviour is sufficiently consistent with model predictions of minimal potential for groundwater environmental impact such that monitoring can be discontinued.

8.1.4 Groundwater Impact Criteria, Triggers and Investigation Procedures

8.1.4.1 Groundwater Level Reference Values

Groundwater Level Reference Values (i.e. Pre-mining baseline levels) established in the GMMP will be compared to the measured groundwater level for a bore at any point in time. The resulting computed groundwater level drawdown will be compared to the Level Trigger Thresholds for that bore (refer **Table 8-4**), where a computed groundwater level drawdown greater than the Level Trigger Threshold constitutes an exceedance under the EA.

Groundwater Level Reference Values for compliance bores are provided in **Table 8-4** and have been established based on the statistical analysis of the historical dataset of each bore as detailed in **Appendix G**. Note that no Groundwater Level Reference Values are provided for GMMP reference bores, or for dry bores (refer **Table 8-1**).



Table 8-4 Groundwater Level Reference Values

Aquifer	Compliance Bore	20 th Percentile (mAHD)
Alluvium	GW06	Dry bore, no Reference Level proposed
Alluvium	GW03	Dry bore, no Reference Level proposed
Alluvium	GW09	Dry bore, no Reference Level proposed
Alluvium	GW19_37a	297.8
Alluvium	GW08	Dry bore, no Reference Level proposed
Alluvium	GW07	294.0
Alluvium	GW26	TBA
Alluvium/Regolith	GW19_33	301.5
Regolith	GW30c	301.8
Regolith	GW31b	307.1
Permian (Burton Seam)	GW30b	301.4
Permian (L/V Seam)	GW10	299.2
Permian (L/V Seam)	GW13	296.1
Permian (L/V Seam)	GW30a	301.8
Permian (L/V Seam)	GW31a	305.9
Permian (L/V Seam)	GW11	300.8
Permian (sandstone)	GW29a	300.9

TBA = insufficient baseline data to compute reference levels at the present time.
L/V Seam = Leichhardt / Vermont Seam

8.1.4.2 Groundwater Level Drawdown Triggers (Level Trigger Thresholds)

Groundwater level drawdown triggers (Level Trigger Thresholds) established in the GMMP are used to establish groundwater level impact compliance criteria for the Project.

The predictive results of the New Lenton Project numerical groundwater model (**Appendix D**) have been utilised to develop bore specific groundwater Level Trigger Thresholds as detailed in **Appendix G**.

The Groundwater Level Trigger Thresholds are presented in **Table 8-5**. Note that no Level Trigger Thresholds are provided for GMMP reference bores (refer **Table 8-1**), or for dry bores.



Table 8-5 Groundwater Level Trigger Thresholds

Aquifer	Compliance Bore	Level Trigger Threshold (m)
Alluvium	GW06	Dry bore, no Level Trigger Threshold proposed
Alluvium	GW03	Dry bore, no Level Trigger Threshold proposed
Alluvium	GW09	Dry bore, no Level Trigger Threshold proposed
Alluvium	GW19_37a	7.1 ^{1,2}
Alluvium	GW08	Dry bore, no Level Trigger Threshold proposed
Alluvium	GW07	3.8 ¹
Alluvium	GW26	3.6 ³
Alluvium/Regolith	GW19_33	3.4 ⁴
Regolith	GW30c	4.7 ⁴
Regolith	GW31b	3.7 ⁴
Permian (Burton Seam)	GW30b	9.2 ¹
Permian (L/V Seam)	GW10	86.3 ¹
Permian (L/V Seam)	GW13	75.1 ¹
Permian (L/V Seam)	GW30a	10.1 ¹
Permian (L/V Seam)	GW31a	23.8 ¹
Permian (L/V Seam)	GW11	108.3 ^{1,2}
Permian (sandstone)	GW29a	15.2 ¹

L/V Seam = Leichhardt / Vermont Seam

1. Maximum cumulative 90th percentile modelled drawdown prediction.
2. Maximum drawdown limited to base of model layer.
3. Based on the range of natural variability observed at this bore.
4. Based on the average range of natural variability observed at all existing alluvium/regolith bores.

8.1.4.3 Groundwater Quality

Groundwater Quality Limits established in the GMMP are used to establish groundwater quality impact compliance criteria for the Project.

Groundwater Quality Limits for compliance bores have been established in accordance with the DES (2021) guideline *“Using monitoring data to assess groundwater quality and potential environmental impacts”* as detailed in **Appendix G**.

The Groundwater Quality Limits are presented in **Table 8-6**. Note that no Groundwater Quality Limits are provided for GMMP reference bores (refer **Table 8-1**).



Table 8-6 Groundwater Quality Limits for Compliance Bores

Analyte	pH (Field)	EC (Lab)	Ca	NH ₃ -N	SO ₄	Al	As	B	Cd	Co	Cr	Cu	Hg	Pb	Mn	Mo	Ni	Ag	Se	U	V	Zn
Unit	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GW06	6.5 - 8.5	TBD	TBD	0.9	TBD	0.055	0.013	TBD	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	0.008
GW03	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW09	6.5 - 8.5	TBD	TBD	0.9	42	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	TBD
GW19_37a	6.5 - 8.5	2500	1000	0.9	31	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.025	0.00005	0.005	0.002	0.006	TBD
GW08	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW07	6.5 - 8.5	8661	271	0.9	51	0.055	0.013	0.94	0.0002	0.004	0.001	0.0046	0.00006	0.0034	1.9	0.034	0.021	0.00005	0.005	0.012	0.006	0.038
GW26	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW19_33	6.5 - 8.5	720	63	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.018	0.00005	0.005	TBD	0.006	0.019
GW30c	6.5 - 8.5	15875	357	0.9	185	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	0.008
GW31b	6.5 - 8.5	2739	90	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.002	0.006	TBD
GW30b	6.5 - 8.5	18285	679	3.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.029
GW10	6.5 - 8.5	6244	60	1.3	25	0.055	0.013	0.94	0.0002	0.0014	TBD	0.0014	0.00006	0.0034	1.9	0.049	0.027	0.00005	0.005	0.0005	0.006	0.009
GW13	6.5 - 8.5	12700	143	3.5	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.024
GW30a	6.5 - 8.5	15600	299	3.6	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.023
GW31a	6.5 - 8.5	4820	23	1.0	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW11	6.5 - 8.5	4161	106	1.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.018
GW29a	6.5 - 8.5	9870	140	TBD	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.02

Note: Dissolved metals

TBD = To be defined once sufficient data becomes available



8.1.5 Groundwater Exceedance Criteria and Investigation Procedure

Consistent with condition D4 of the EA and RM8 of the PRCP the results of groundwater quality monitoring from compliance bores (**Table 8-1**) must not exceed the bore specific Groundwater Quality Limits (**Table 8-6**) on three consecutive occasions.

Consistent with condition D5 of the current EA and RM8 of the PRCP the results of groundwater level monitoring from compliance bores (which are not dry) (**Table 8-1**) must not exceed any of the Groundwater Level Trigger Thresholds (**Table 8-5**).

A breach of the Groundwater Level Trigger Thresholds is confirmed where a comparison of the measured groundwater for a compliance bore at any point in time with the Reference Level for that bore results in a groundwater level drawdown greater than the Groundwater Level Trigger Threshold.

Any breach should be confirmed through conducting a data review and/or resample at the affected bore.

Pursuant to condition D7 of the current EA, if any monitoring result from groundwater compliance bores identified in **Table 8-1** exceed any of the Groundwater Quality Limits stated in **Table 8-6** on three consecutive occasions, or exceed any of the Groundwater Level Trigger Thresholds stated in **Table 8-5**, LJV must notify the administering authority within twenty-four (24) hours via WaTERS.

Following the initial notification given under EA condition D7, as per condition D8 of the EA, within fourteen (14) days of the notification, the LJV must commence an investigation to determine if the exceedance is a result of:

- a) Mining activities authorised under the EA; or
- b) Natural variation; or
- c) Neighbouring land use resulting in groundwater impacts.

If required, this investigation will be completed by a by an independent and appropriately qualified specialist in accordance with ANZECC and ARMCANZ (2000).

The investigation will include as a minimum:

- Comparison of the results for the bore subject to the breach with those from other bores, including comparison of Compliance bore results against Interpretation bore results;
- Review of groundwater flow pathways;
- Comparison to baseline groundwater monitoring results;
- A review of authorised mining activities that may be responsible for the breach;
- The prevailing and preceding natural conditions (e.g. meteorological conditions);
- A review of neighbouring land use and groundwater use; and
- A review of the physical integrity of the bore network (i.e. when an issue is identified by anomalous monitoring results).

Pursuant to condition D9 of the EA, the resulting investigation report will be sent to the administering authority of the EA via WaTERS within three (3) months of notification of the monitoring exceedance under D7.



Pursuant to condition D10 of the EA, if the result of the above investigation determines that the exceedance was the result of mining authorised under the EA, then investigations must be undertaken by LJV to establish whether environmental harm has occurred or may occur.

If an investigation is required due to the exceedance being deemed a result of approved mining (as per condition D10 of the EA), then pursuant to condition D11 of the EA, within twenty-eight (28) days of the investigation, LJV Will:

- Implement short-term measures to mitigate the potential for environmental harm; and
- Develop long-term mitigation measures to address any existing groundwater contamination and prevent recurrence of groundwater contamination; and
- If environmental harm has occurred as a result of groundwater drawdown exceedances, LJV must:
 - Determine any actions required to reduce the potential for environmental harm; and
 - Determine any mitigation measures required to limit the drawdown in the affected groundwater resource.

Further discussion on impact mitigation is provided in **Appendix G**.

8.1.6 Reporting, Review and Improvement Process

During the life of New Lenton Project operations, data collected through the GMMP will be used to assess the mine's actual impact on groundwater resources, and if deemed necessary update and refine the numerical groundwater model and its predictions of future impacts. These outcomes will in turn be used to review and improve the GMMP through a continual Reporting, Review and Improvement process as outlined below and detailed in **Appendix G**. More detail is provided on this matter, specifically relating to monitoring network maintenance, in the GMMP document (**Appendix G**).

8.1.6.1 Annual Groundwater Monitoring Reports

LJV will conduct an annual review of the environmental performance of the GMMP. The annual review will be reported in an Annual Groundwater Monitoring Report (AGMR) and will satisfy requirements under EA condition D15 and AWL condition 47 and will include:

- A review of the updated groundwater quality and level data to allow for identification of any outliers e.g. through the comparison of baseline data and outlier analysis in accordance with the procedures identified in DES (2021);
- The standing water level of all groundwater bores listed within **Table 8-1** (consistent with EA D15 and AWL condition 47);
- The groundwater quality of all groundwater bores listed within **Table 8-1** (consistent with EA condition D15);
- An assessment of long-term water quality and water level trends at all groundwater bores listed within **Table 8-1** (consistent with EA condition D15);
- A comparison of groundwater quality against the trigger levels listed within **Table 8-6**;
- Details of any review undertaken of the groundwater conceptual model (consistent with EA condition D15);



- Details of the numerical underground water model and any review undertaken of the numerical underground water model since the previous AGMR (consistent with AWL condition 47);
- Maps showing the actual water level drawdown contours for each aquifer (AWL condition 47);
- An assessment of any differences between the groundwater level impact predicted and actual impacts for corresponding period (consistent with EA Condition D15 and AWL condition 47);
- Details of any bores which are predicted by the numerical underground water model to be located in the affected area (consistent with AWL condition 47);
- Raw data provided in a format as requested by the chief executive (consistent with AWL condition 47).

Pursuant to EA condition D15 and condition 48 of the AWL, the AGMR is required to be completed and submitted to the administering authority commencing after the first year of mining activities, the first AGMR must be provided to the chief executive within three months of the end of the first water year (i.e. the period from the commencement of take of underground water), and subsequent AGMRs must be provided to the chief executive within three months of the end of each relevant water year.

8.1.6.2 Groundwater Monitoring and Management Program Review

Consistent with condition D14 of the EA, the GMMP will include a review process to identify improvements to the program, where deemed warranted as part of an AGMR.

The GMMP will be reviewed and modified as necessary over the mine life based on revisions to the Project's groundwater model, reviews of monitoring results and/or changed mining conditions, as identified in any AGMR. This might include:

- Revision of assessment outcomes if updated numerical groundwater modelling is available;
- Revision of monitoring parameters and/or frequency; and/or
- Expanding the existing groundwater monitoring network over time to enable ongoing groundwater impact evaluations.

Pursuant to condition 43 of the AWL, revisions of the GMMP must be undertaken by an appropriately qualified person, and submitted to the chief executive for approval.

Where an AGMR deems it required, the GMMP will be reviewed by an appropriately qualified person, with a report provided on the outcome of the review to the administering authorities of the EA and AWL within 3 months of completion of any GMMP review.

A review of the GMMP may include:

- an assessment of the outcome of the groundwater management and monitoring program against the objectives in the Project's EA and performance against compliance criteria;
- a review of the adequacy of the monitoring locations, frequencies and Groundwater Quality Limits specified in the EA with respect to any updated groundwater impact predictions; and
- a review of the adequacy of the groundwater monitoring program with respect to any updated groundwater impact predictions, including for the post-closure period.



As required, the GMMP may be updated or revised based on the outcomes of the review process. The administering authorities will be consulted in relation to any significant changes to the GMMP and as necessary will be re-issued any new versions of the document.

Consistent with conditions 43 and 44 of the AWL and D14 of the EA, the GMMP may be updated to address any comments provided by the administering authorities as necessary as part of the review and improvements process.

It is noted that the GMMP is also intended to support EPBC Act approvals related to groundwater at the Project.

8.1.6.3 Groundwater Impact Prediction, Validation and Review

During the life of the Project (starting from commencement of the take of associated water), as deemed required data collected through the GMMP may be used to review and if deemed necessary update and refine the Project groundwater model and its impact predictions consistent with AWL conditions 49 and 50. In addition to the AWL requirement these reviews, the need for such a review may also be identified within the AGMR as described above, and in particular if an assessment of any differences between the groundwater level impact predicted and actual impacts for corresponding period determines that a significant departure from model predictions has occurred. Consistent with AWL condition 49, the review must provide a revised report, including:

- a) information about a revised numerical underground water model based on a transient calibration;
- b) incorporation of measured mine dewatering volumes and underground water monitoring data;
- c) any revised hydrogeological conceptualisation and assumptions of the model,
- d) including:
 - (i) any revised geological interpretation;
 - (ii) any revised hydrogeological parameters or assumptions on recharge; and
 - (iii) any assumptions of outflows from springs and other water users;
- e) an update of predicted impacts including:
 - (i) any revised predicted impacts on springs and watercourses dependent on underground water flow, and other users, including any changes to the affected area;
 - (ii) any revised predicted underground water inflows into mine workings during mining operations and post closure;
 - (iii) maps showing the revised prediction of the total water level impact from the commencement of underground extraction to post closure;
 - (iv) maps showing the difference between these predicted water level impacts and the water level impacts as predicted at the time of application for this water licence;
 - (v) sensitivity analysis; and
- f) an evaluation of the accuracy of the predicted impacts from the model.



8.2 Groundwater Dependent Ecosystems Monitoring and Management Plan

In accordance with the report prepared by 3D Environmental (2023), a Project Groundwater Dependent Ecosystems Monitoring and Management Plan (GDEMMP) is recommended to address the Project's potential impacts to GDEs and to address uncertainties identified in the field. The following provides a summary of the GDEMMP components recommended by 3D Environmental (2023). For more details, refer to 3D Environmental (2023).

8.2.1 GDE Baseline Data Collection and Monitoring

3D Environmental (2023) recommends that additional baseline data be collected to further characterise the seasonal ecohydrological function and baseline condition of GDEs on the Isaac River potentially impacted by the Project. The purpose of the baseline data collection is to provide a basis for detection of future declines in ecological condition that can be linked to detected changes in groundwater levels and physio-chemical indicators that are resultant from the mining operation. Therefore, the monitoring of GDE function and condition will be based on vegetation indices to provide a baseline for ecological health and define trigger thresholds for initiation of investigative action. The indices best applied to define trigger thresholds, including potential parameters applied during investigative actions include Leaf Area Index (LAI), LWP, NDVI and temporal assessment of stable isotopes in twig xylem, water, and soils are described in 3D Environmental (2023).

In addition, the GDEMMP will aim to address any uncertainties identified in field assessment including:

1. The seasonality and persistence of the perched groundwater system that was supporting GDEs at the time of the assessment.
2. The degree of connectivity between the perched groundwater system and the deeper basal alluvial groundwater system, undertaken in conjunction with the groundwater monitoring and management program.
3. Whether groundwater usage is restricted to the seasonally variable perched groundwater unit, or deeper dimorphic root systems have developed enabling utilisation of the basal alluvial groundwater unit when the perched groundwater unit dries.

The recommended period for baseline data collection in the GDEMMP would be two years, after which a review of requirements for ongoing monitoring can be undertaken, and methods tailored to reflect the revised assessment of level of risk to GDE function.

8.2.2 GDE Impact Mitigation

The GDEMMP will include development of possible impact mitigation measures, if the results of the baseline data collection and monitoring under the GDEMMP deem them warranted. Should impacts to GDEs be detected, possible impact mitigation measures under the GDEMMP may include, but would not be limited to:

1. Injection of water into the tree root zone for any trees that show significant signs of drought stress that can be linked to groundwater drawdown;
2. Infill planting where riparian tree death can be linked to groundwater drawdown; and/or
3. Environmental offsets should other mitigations fail to limit decline in GDE condition.



8.3 Groundwater Impact Management and Mitigation Measures

At the present time it is not considered that application of groundwater impact management and mitigation measures are necessary for the Project. Information on groundwater impact management and mitigation measures are detailed in the Project's GMMP document (**Appendix G**) and key parts are summarised below.

Where it is identified that there is potential for environmental harm in any investigation undertaken following a breach of the Groundwater Quality Limits or Level Trigger Thresholds as outlined in **Section 8.1.5** (and provided in **Appendix G**), an action plan to mitigate potential environmental harm will be developed by a suitably qualified person. These mitigation measures will be implemented within 3 months of the completion of the exceedance investigation.

The selection of the most effective mitigation measures will be based on providing the best outcome for protection of the affected groundwater resource and/or user as determined by the investigation into the potential for environmental harm. The selection of the most effective mitigation measures therefore will only be possible following the completion of the investigation into the potential for environmental harm.

In the event that any formal groundwater investigation conclusively identifies that Project operations have adversely impacted a neighbouring groundwater bore user (affected groundwater user), the LJV will attempt in 'good faith' to negotiate suitable mitigation measures (i.e. Make Good) in a timely manner to rectify the identified groundwater impact in accordance the LJV's obligations under the Water Act. The LJV will involve an appropriately qualified environmental specialist to assist with development of the mitigation measures. The development of suitable mitigation measures will be based on the outcomes of an appropriate scientific investigation.

Design and implementation of possible groundwater management practices to minimise impacts on water levels within the Isaac River alluvium to mitigate impacts to GDEs would be considered by the LJV in the event that implementation of the Project's Groundwater Dependent Ecosystems Monitoring and Management Plan (see **Section 8.2**) deems such actions required.



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Appendix A

2023 Factual Field Work Report

New Lenton Coal Project

PER Groundwater Assessment

Lenton Joint Venture

SLR Project No.: 620.31367.00000

9 October 2024





New Lenton Project & Burton Mine

2023 Groundwater Factual Field Work Report

Lenton Joint Venture

GPO Box 1465, Brisbane

Prepared by: Jade Darvell

SLR Consulting Australia

Level 16, 175 Eagle Street, Brisbane QLD 4000,
Australia

SLR Project No.: 620.31367.00000

4 August 2023

Revision: 01

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
01	4 August 2023	Jade Darvell	Derwin Lyons	Derwin Lyons

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Lenton Joint Venture (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.



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Appendices

Appendix A AQTESOLV Slug Test Analysis



1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) were commissioned by the Lenton Joint Venture (LJV) to undertake a groundwater bore census baseline survey for Burton Mine, and hydraulic (slug) testing of six groundwater monitoring bores at the adjacent New Lenton Project. This factual report provides a summary of the work undertaken.

2.0 Bore Locations

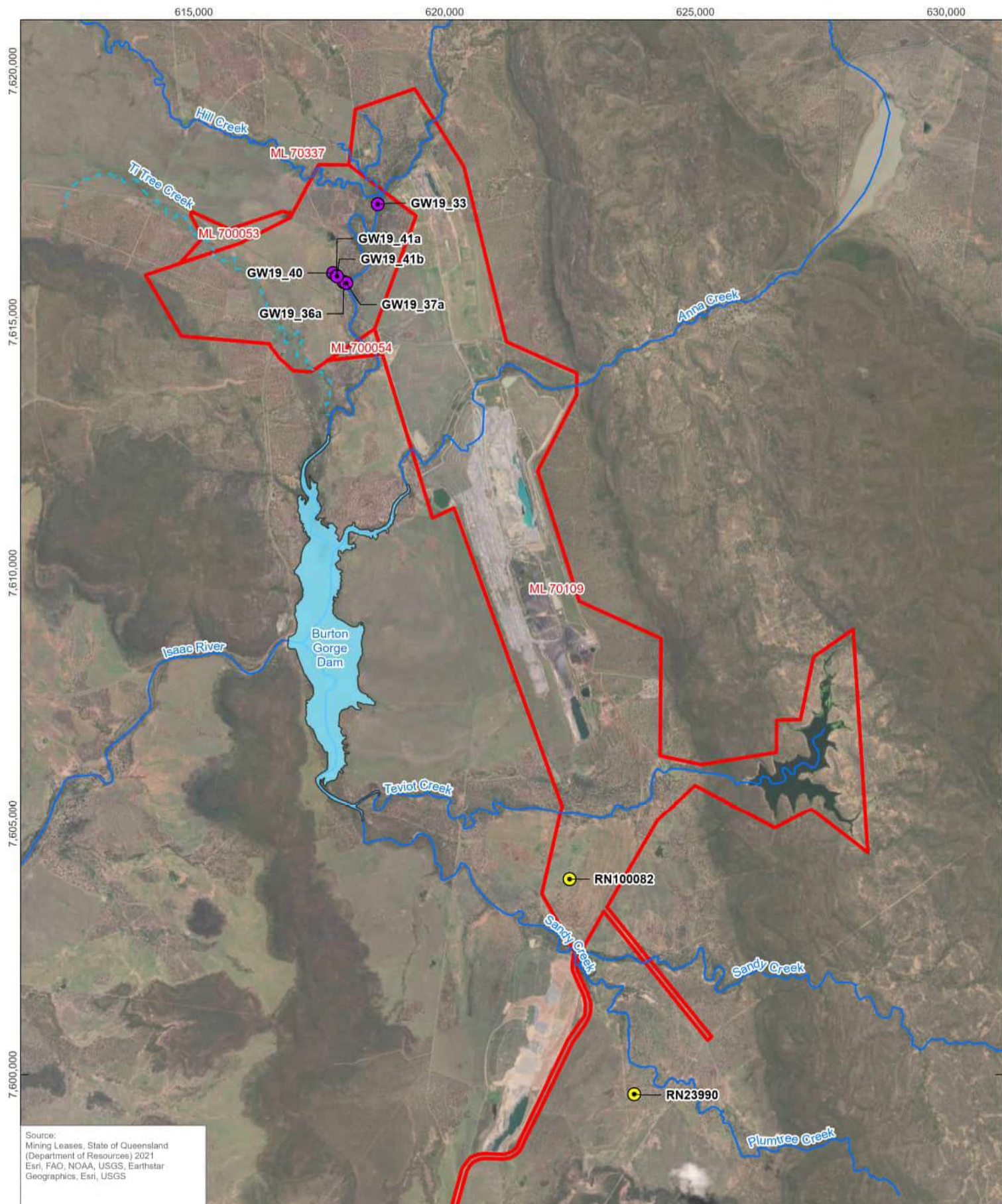
Table 2-1 provides a summary of the groundwater bores subject to slug testing (New Lenton Project) and bore census baseline survey (registered bores located within/near the Burton Mine).



Table 2-1 New Lenton and Burton Bore Locations

Bore Name	Easting (AGD84 z55)	Northing (AGD84 z55)	Purpose
GW19_36a	617872	7615620	Slug Test
GW19_37a	617923	7615597	Slug Test
GW19_33	618552	7617169	Slug Test
GW19_40	617662	7615797	Slug Test
GW19_41a	617731	7615739	Slug Test
GW19_41b	617740	7615731	Slug Test
RN100082	622376	7603712	Baseline Survey
RN23990	623665	7599428	Baseline Survey





Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Esri, FAO, NOAA, USGS, Earthstar
Geographics, Esri, USGS

 0 1.3 2.5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:100,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 07-Aug-2023
 Drawn by: RB

LEGEND

- Major Watercourse
- - - Non-designated Watercourse
- New Lenton Coal Project (ML 70337, ML 700053, ML 700054) and Burton Mine (ML 70109)

Groundwater Bore

- Baseline Survey
- Slug Test

**NEW LENTON PROJECT AND
BURTON MINE 2023 GROUNDWATER
FACTUAL FIELD WORK REPORT**

BORE LOCATIONS



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 3-1

3.0 Bore Census Baseline Survey

Registered bores RN100082 and RN23990 were visited on the 19th May 2023 by an experienced SLR hydrogeologist and LJV personnel to survey locations, condition, serviceability, depth and groundwater levels. The details of the bore survey are provided in **Table 3-1**.

Table 3-1 Bore Survey Details

Registered Number	100082	23990
Easting (ADG84 z55)	622376	623665
Northing (ADG84 z55)	7603712	7599428
Diameter (mm)	130	155
Stick up (m)	0.15	0.22
Casing type	steel (core drill rod)	steel (core drill rod)
Cap type	screw on steel type	screw on steel type
SWL (mBTC)	20.12	35.86
Total Depth (m)	>100 m	883
Aquifer	unknown	Fort Cooper Coal Measures
notes	oil encountered when dipping bore	



Neither bore was equipped for water supply at the time of the survey.

Measurement of bore depths was not possible at either of the bores with the 100 m dip tape not reaching the bottom in either bore, however the Queensland Government's Registered Groundwater Bore Database (GWDB) lists the RN23990 bore as 883 m deep.

As detailed in **Table 3-1**, RN100082 had a SWL of 20.12 mBTC and oil was encountered whilst dipping the bore. Photos taken at RN100082 are provided as **Figure 3-2**.

As detailed in **Table 3-1**, RN23990 had a SWL of 35.86 mBTC and oil was encountered whilst dipping the bore. Photos taken at RN23990 are provided as **Figure 3-3**.



Figure 3-2 Photos taken at RN100082 showing the general area and arrow pointing to bore (left) and the bore cap (right)





Figure 3-3 Photos taken at RN23990 showing the general area and arrow pointing to bore (left) and the bore cap (right)

4.0 Hydraulic Testing

Hydraulic testing, or a slug tests, were conducted at New Lenton Project bores GW19_36a, GW19_37a, GW19_33, GW19_40, GW19_41a, GW19_41b between the 17th and 22nd May 2023. The methodology to complete these tests is as follows:

- The groundwater level was recorded as well as bore specifications (bore diameter, saturated column length);
- An automated groundwater level logger was programmed to record datapoints at a frequency that relates to the expected duration of a complete slug test (falling and rising test). The logger was lowered into the bore below the level at which the test slug would be submerged. The logger was secured at the surface to ensure that there was no movement throughout the slug test;
- The slug was rapidly lowered into the water column so that it is completely submerged but not in contact with the logger. This caused a rise in the water level and creates a hydraulic head sufficient to cause groundwater flow into the aquifer (falling head test). The logger recorded the change in water level as the displaced water recovered back to a standing water level to 95% of the pre-test levels.
- The slug was then rapidly removed from the water column. This caused a fall in the water level that creates a 'void' that is filled by water flowing back into the bore from the surrounding aquifer (rising head test). The logger records the change in water level as the water recedes back to static water level equilibrium.
- Multiple falling and rising head tests were conducted at each bore.



- Industry standard AQTESOLV software was used to analyse the data and to model the hydraulic properties of each slug test dataset. Slug test results are provided in **Table 4-1** and the analysis solutions are provided in **Appendix A**.

Table 4-1 Summary of Hydraulic Testing

Method	Bore	GW19_33	GW19_41a	GW19_41a	GW19_40	GW19_40	GW19_37a
Geology analysed	Test	Alluvium/ regolith	interburden and coal	coal	interburden and coal	coal	alluvium
BOWER & RICE	FHT 1	0.091	0.005	0.018	0.013	0.012	0.033
	FHT 2	0.11	0.005	0.016	0.006	0.010	0.017
	FHT 3	0.027	0.005	0.016	-	-	0.023
	FHT 4	-	-	-	-	-	0.021
	RHT 1	0.15	0.003	0.010	0.014	0.026	0.028
	RHT 2	0.44	0.004	0.013	0.092	0.028	0.021
	RHT 3	0.16	0.004	0.014	0.007	0.011	0.015
	RHT 4	-	-	-	-	-	0.022
	count	6	6	6	5	5	8
	mean	0.162	0.004	0.015	0.026	0.017	0.022
	min	0.027	0.003	0.010	0.006	0.010	0.015
	max	0.44	0.005	0.018	0.092	0.028	0.033
HVORSLEV	FHT 1	0.13	0.006	0.024	0.015	0.015	0.027
	FHT 2	0.15	0.005	0.021	0.007	0.012	0.017
	FHT 3	0.03	0.005	0.019	-	-	0.014
	FHT 4	-	-	-	-	-	0.018
	RHT 1	0.21	0.004	0.014	0.014	0.025	0.035
	RHT 2	0.70	0.004	0.016	0.014	0.025	0.020
	RHT 3	0.21	0.005	0.017	0.008	0.014	0.015
	RHT 4	-	-	-	-	-	-
	count	6	6	6	5	5	7
	mean	0.24	0.005	0.018	0.012	0.018	0.021
	min	0.032	0.004	0.014	0.007	0.012	0.014
	max	0.70	0.006	0.024	0.092	0.028	0.035

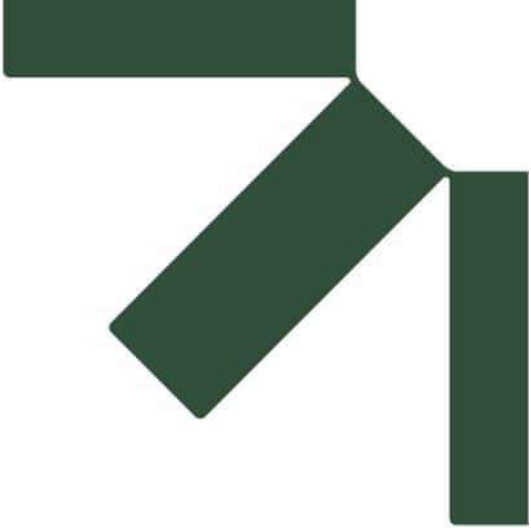


5.0 References

Bouwer, H. and R.C. Rice, (1976). *A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells*, Water Resources Research, vol. 12, no. 3, pp. 423-428.

Hvorslev, M.J., (1951). *Time Lag and Soil Permeability in Ground-Water Observations*, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50.





Appendix A AQTESOLV Slug Test Analysis

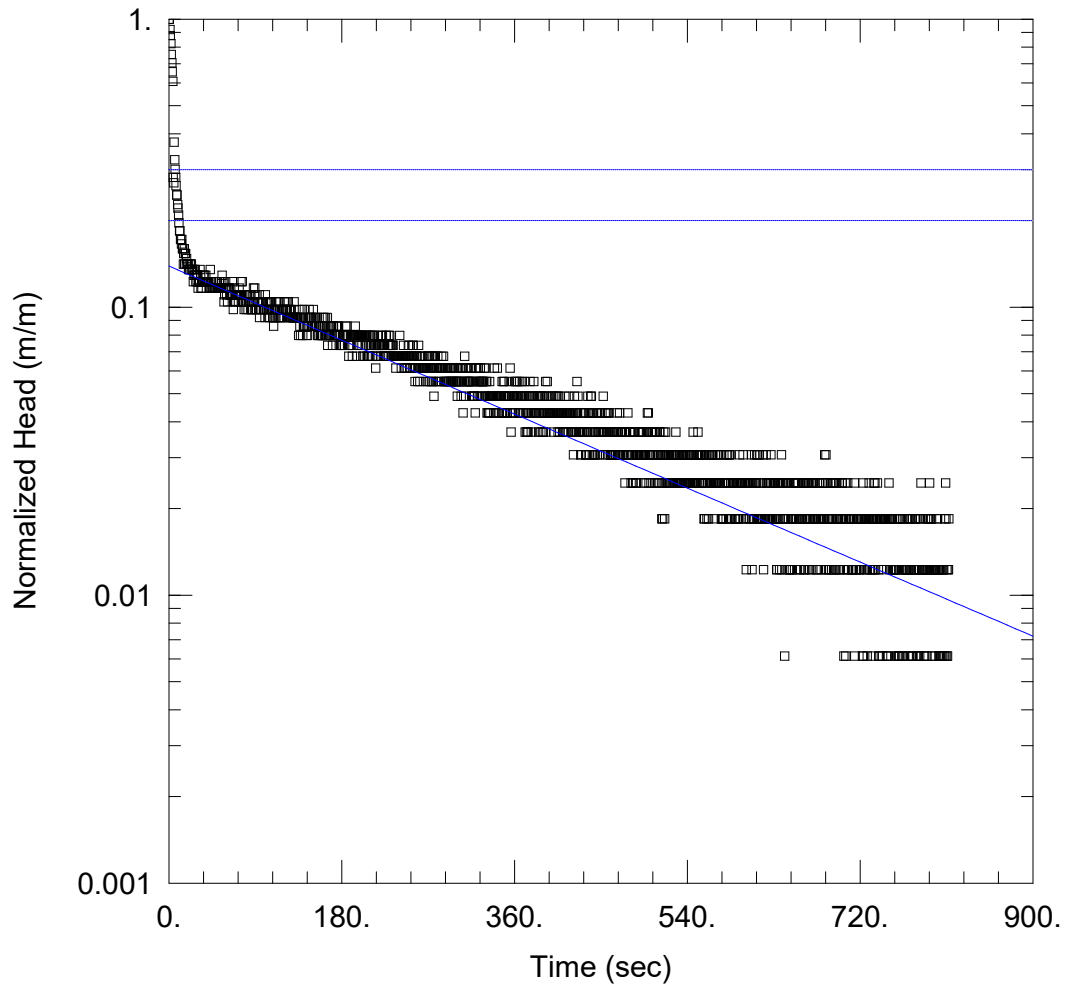
New Lenton Project & Burton Mine

2023 Groundwater Factual Field Work Report

Lenton Joint Venture

SLR Project No.: 620.31367.00000

4 August 2023



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 FHT_1 Bouwer Rice_v1.aqt

Date: 05/24/23

Time: 14:04:40

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 1.63 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

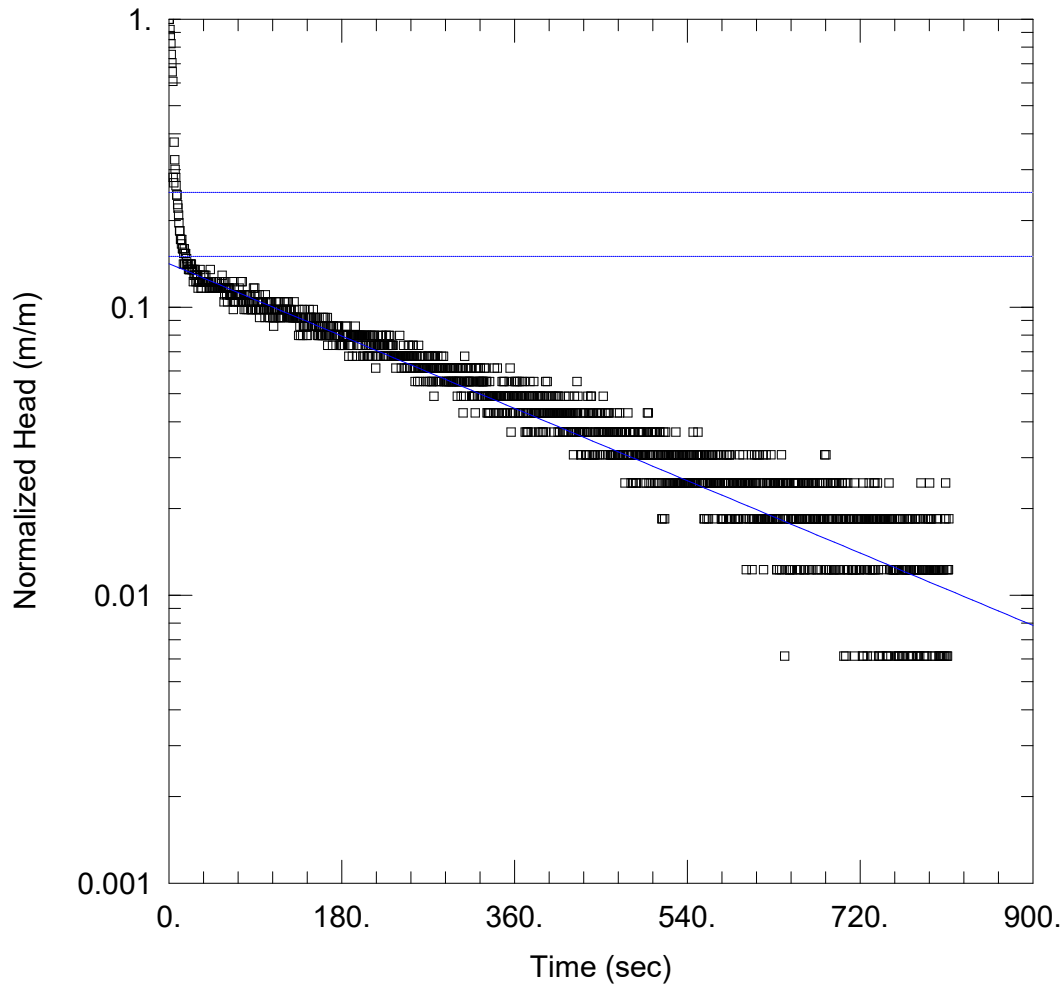
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.09103$ m/day

$y_0 = 0.2262$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 FHT_1_Hvorslev_v1.aqt

Date: 05/24/23

Time: 14:05:05

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 1.63 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

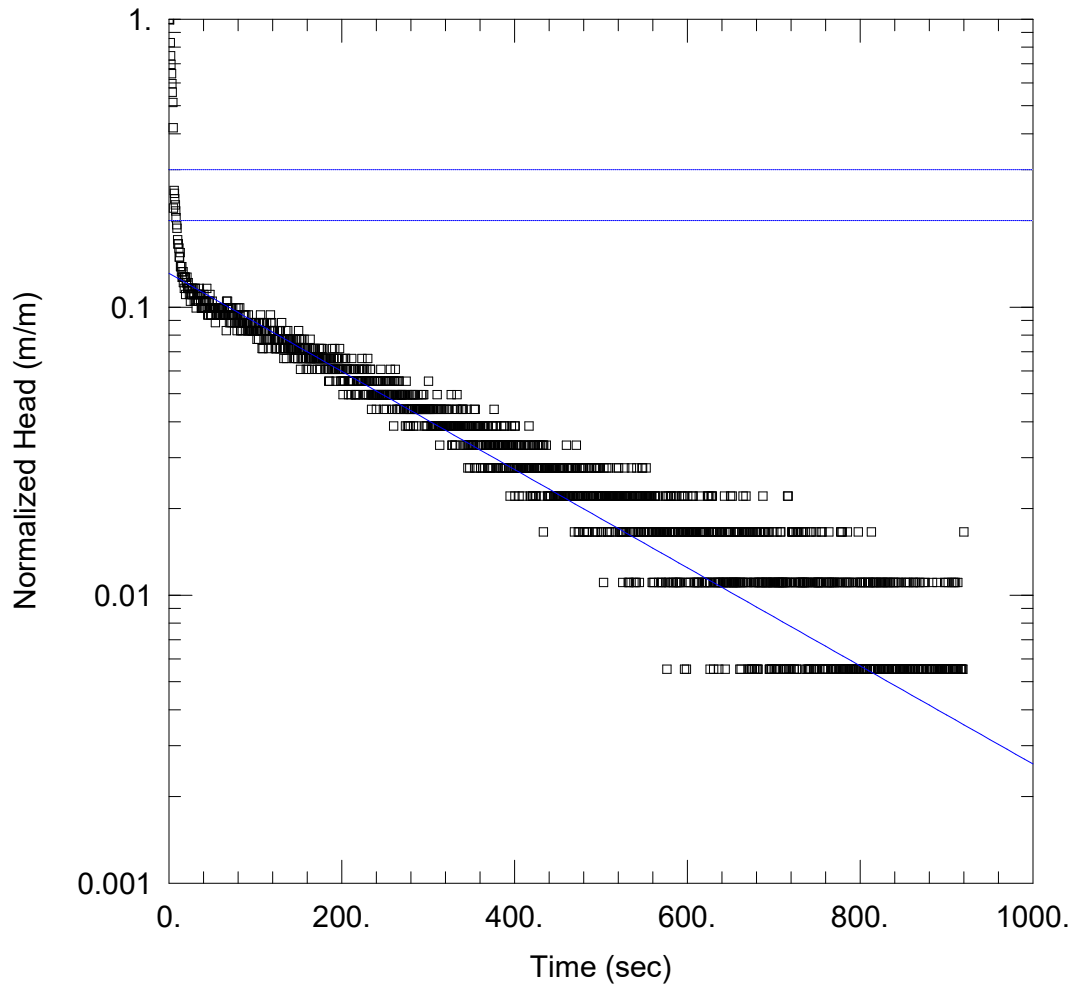
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.1318$ m/day

$y_0 = 0.2308$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 FHT_2 Bouwer Rice v1.aqt

Date: 05/24/23

Time: 14:06:57

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 1.81 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

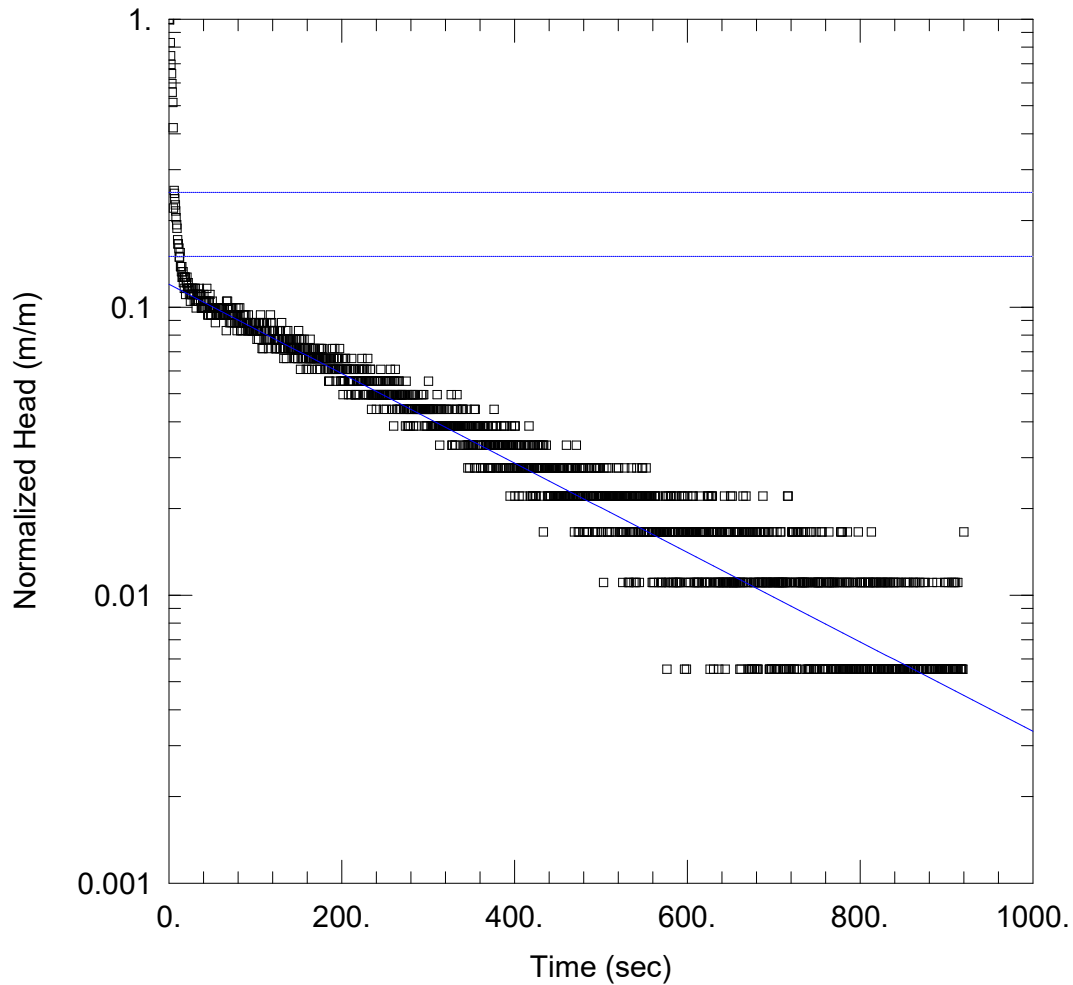
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.1087$ m/day

$y_0 = 0.2373$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 FHT_2 Hvorslev_v1.aqt

Date: 05/24/23

Time: 14:07:53

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 1.81 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

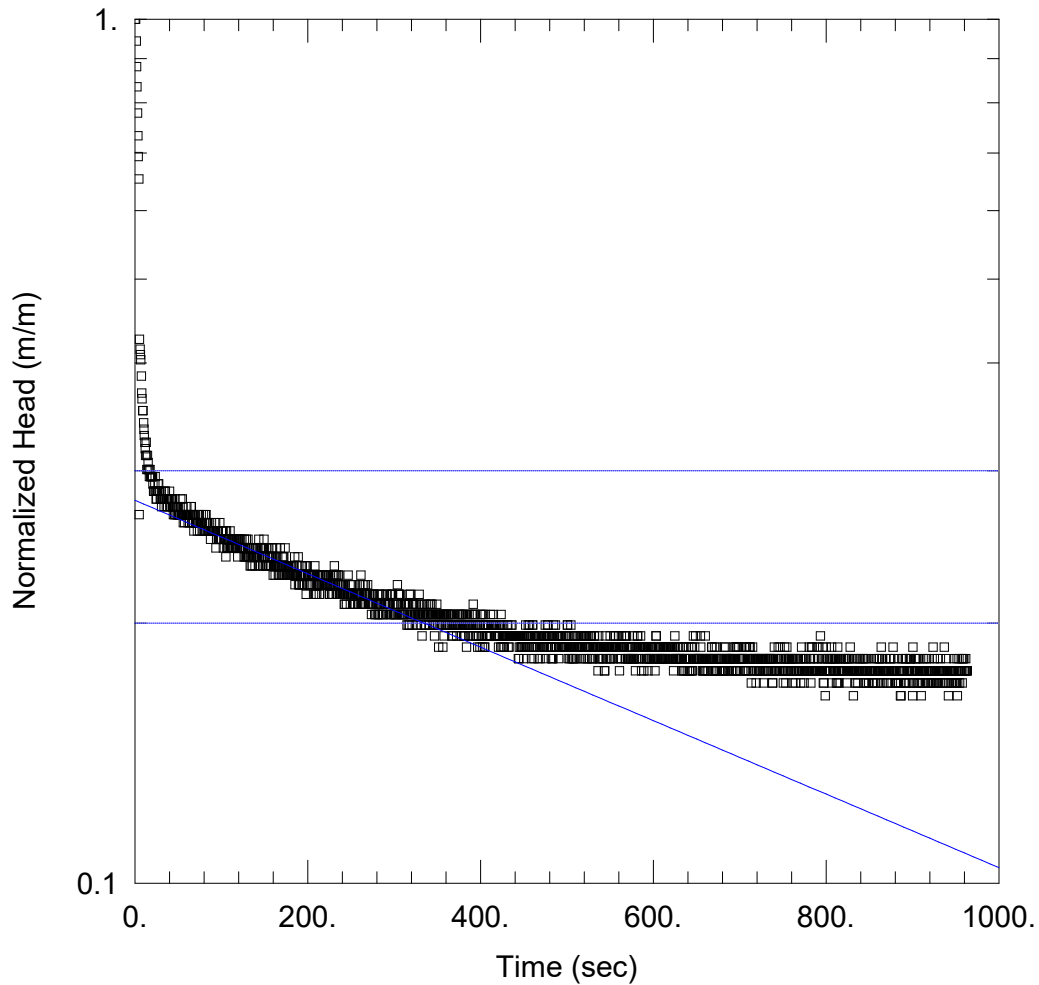
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.1465$ m/day

$y_0 = 0.2174$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 FHT_3 Bouwer Rice_v1.aqt

Date: 05/24/23

Time: 14:08:33

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 1.76 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

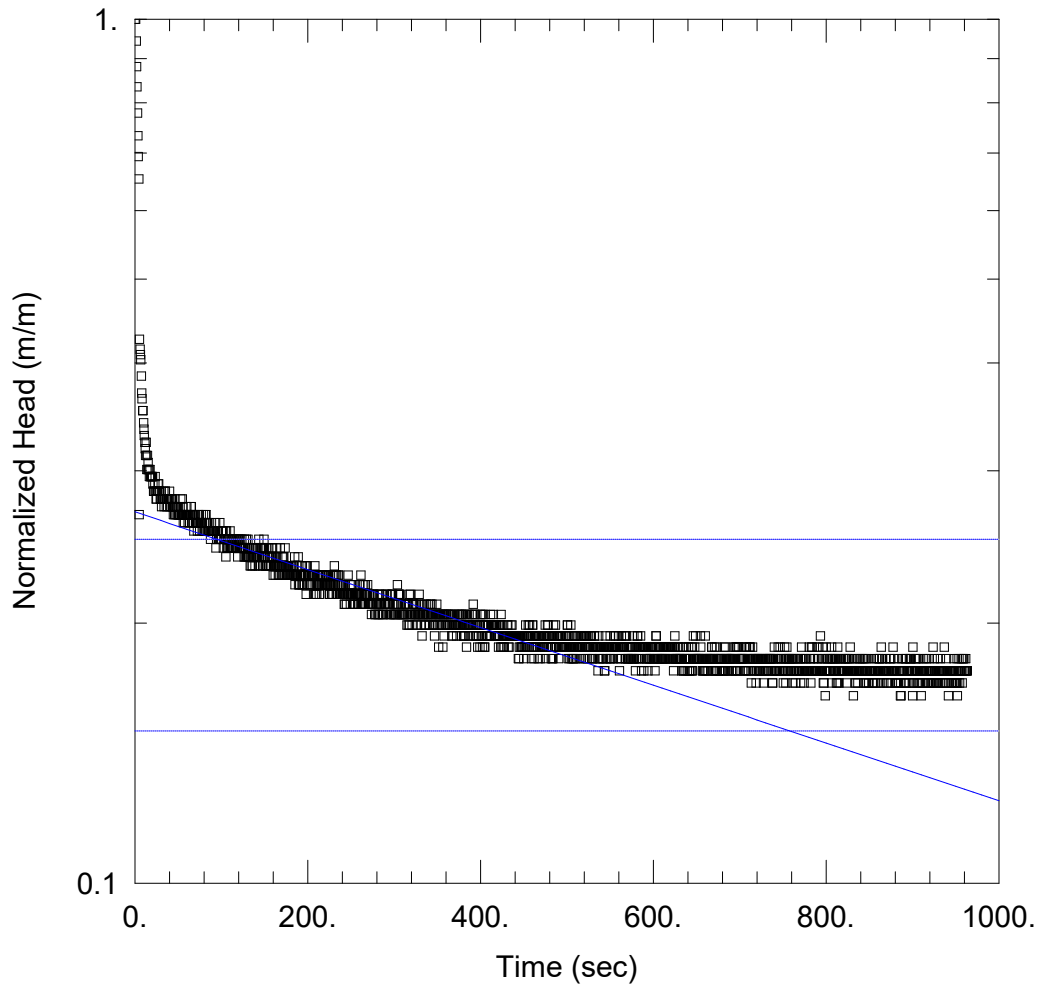
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.02711$ m/day

$y_0 = 0.4882$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 FHT_3 Hvorslev_v1.aqt

Date: 05/24/23

Time: 14:09:58

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 1.76 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

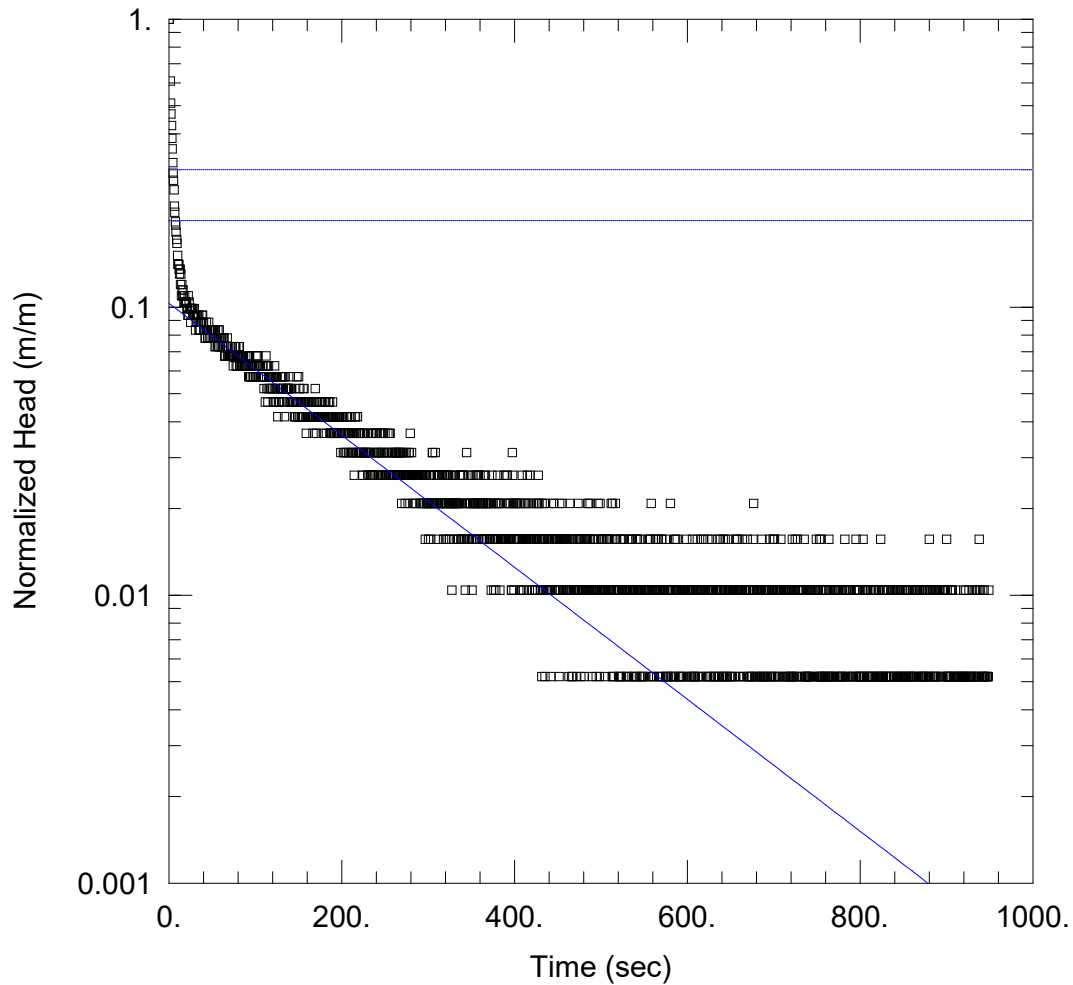
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.03156$ m/day

$y_0 = 0.4733$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 RHT_1 Bouwer Rice v1.aqt

Date: 05/24/23

Time: 14:10:53

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 1.92 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

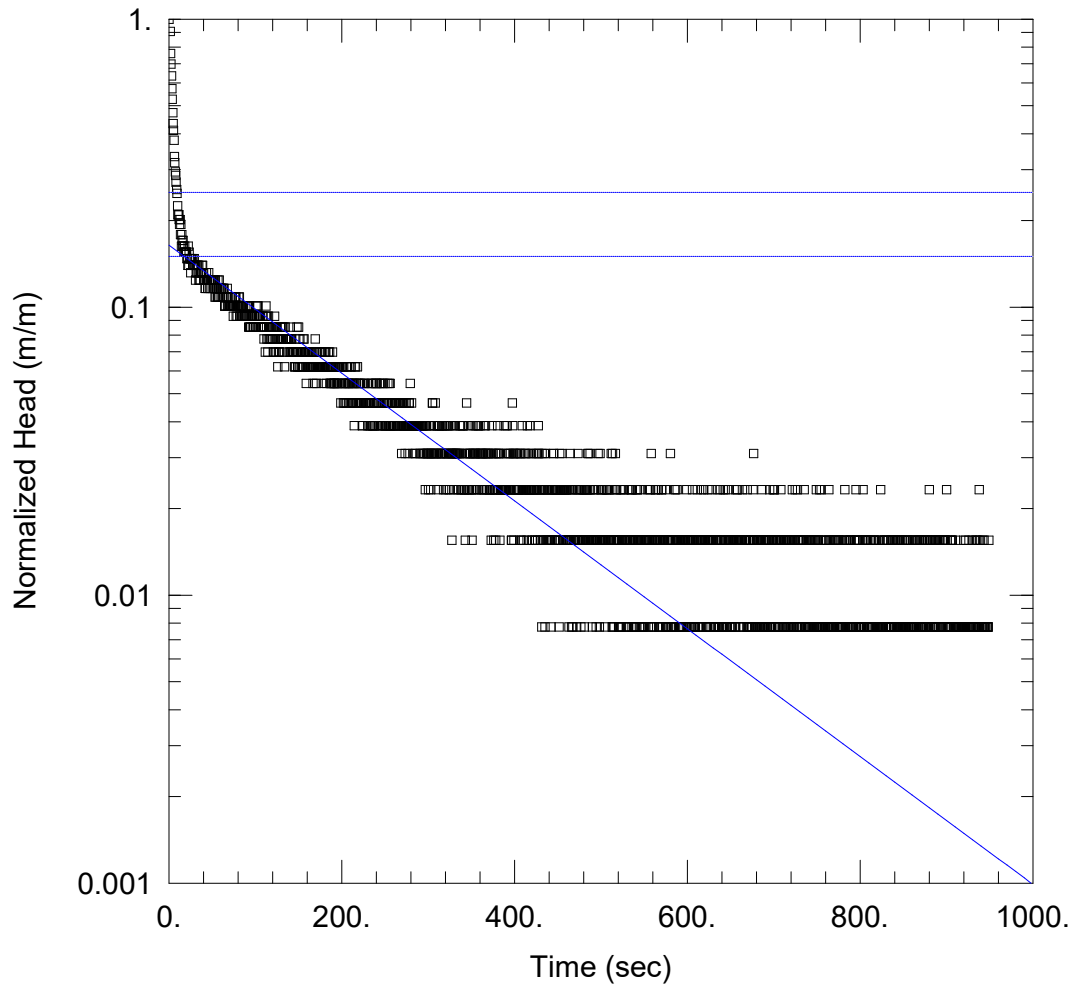
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.1461$ m/day

$y_0 = 0.198$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 RHT_1 Hvorslev_v1.aqt

Date: 05/24/23

Time: 14:11:53

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 1.29 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

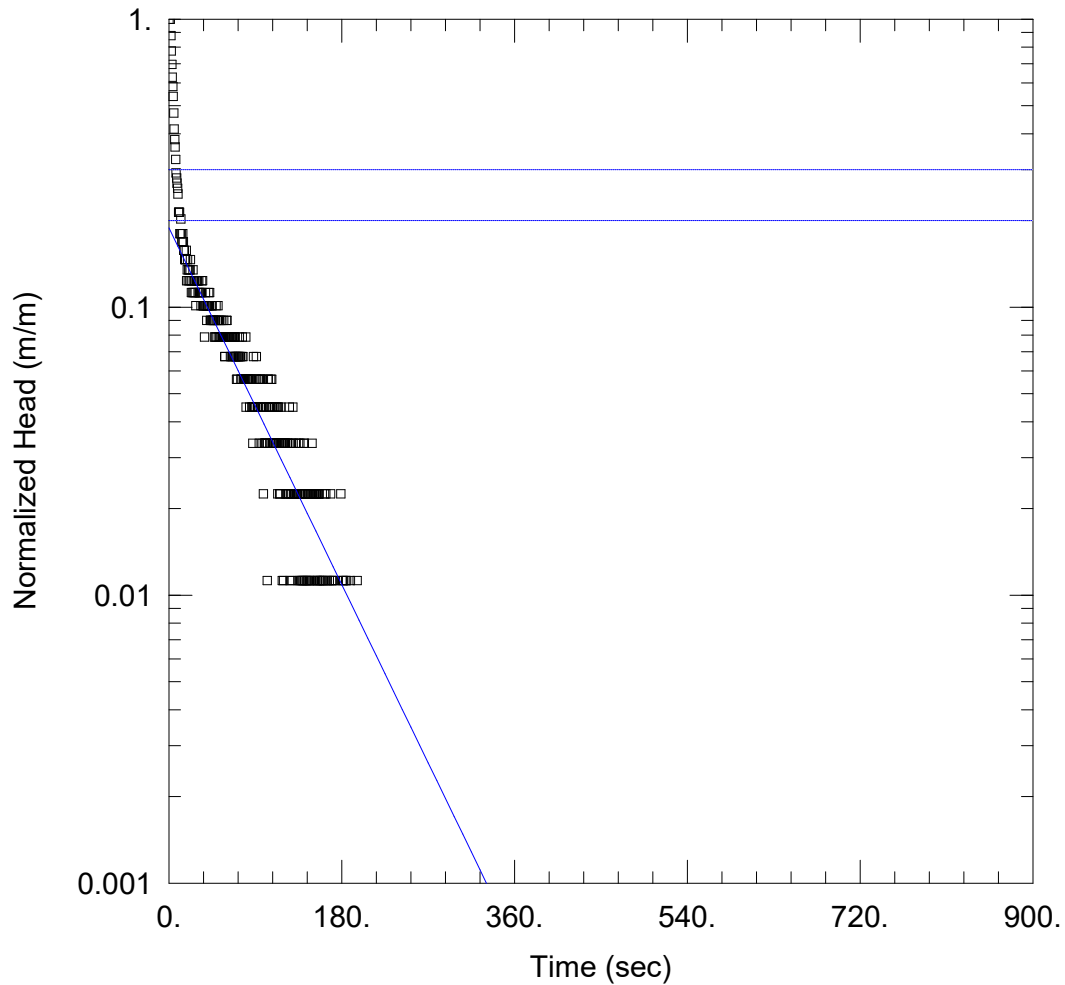
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.2094$ m/day

$y_0 = 0.2114$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 RHT_2 Bouwer-Rice_v1.aqt

Date: 05/24/23

Time: 14:15:12

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 0.89 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

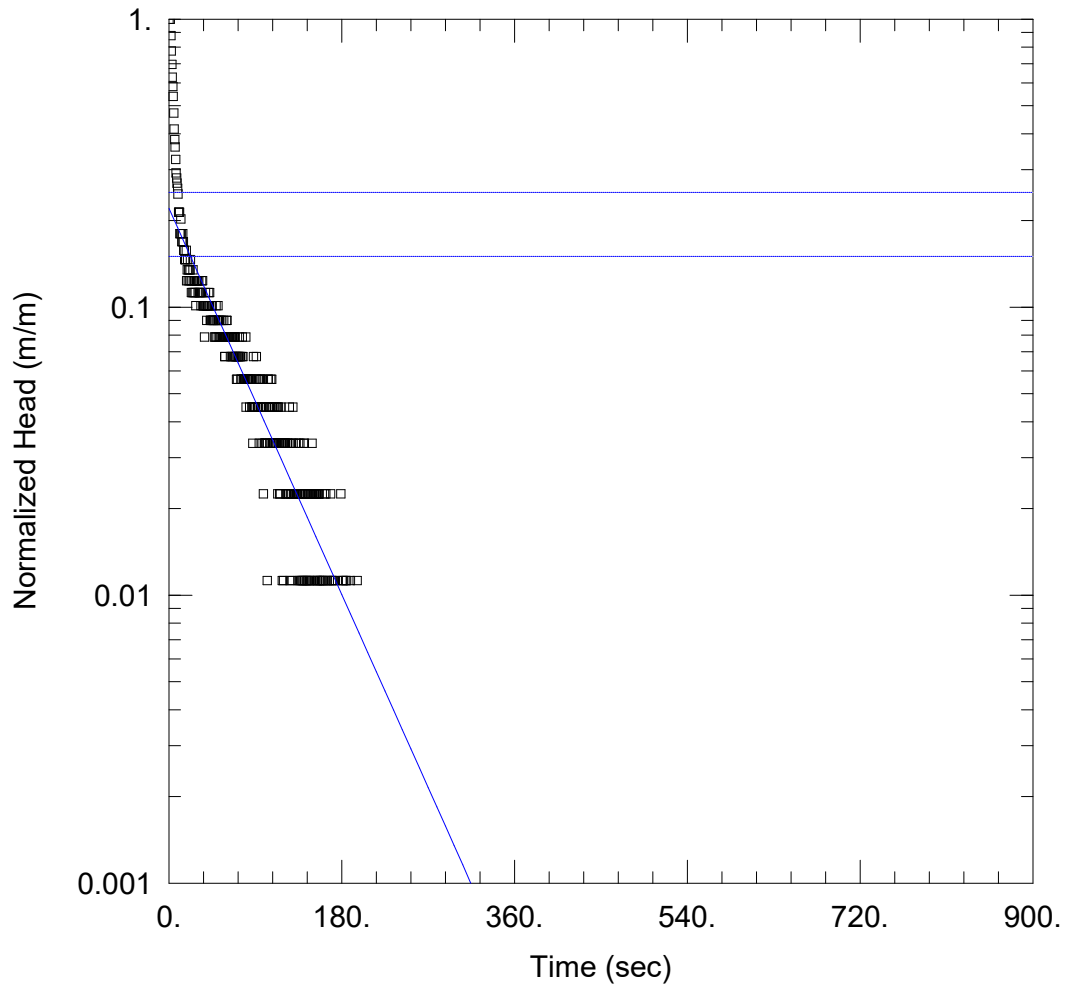
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.4386$ m/day

$y_0 = 0.1675$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 RHT_2 Hvorslev_v1.aqt

Date: 05/24/23

Time: 14:15:58

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (GW19_33)

Initial Displacement: 0.89 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

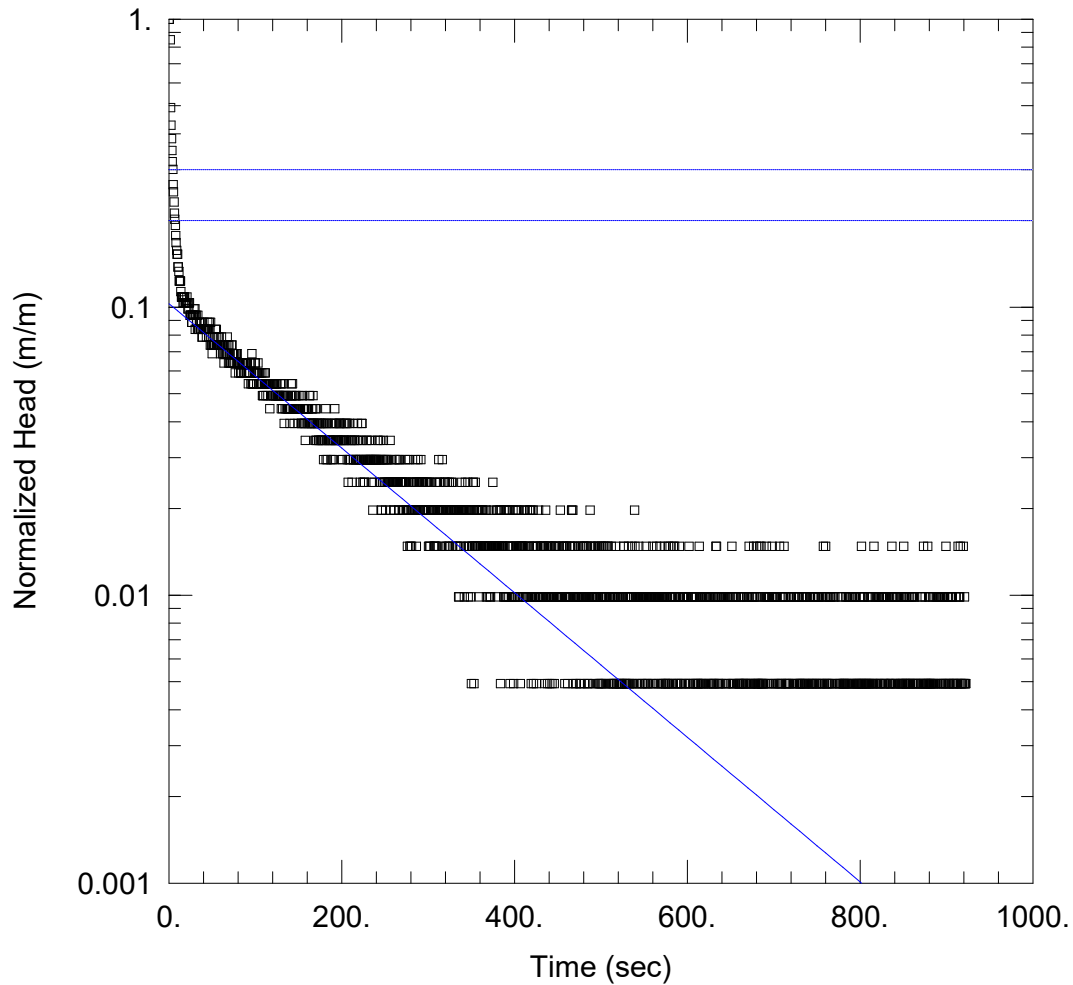
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 0.7029 m/day

y0 = 0.1959 m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 RHT_3 Bouwer-Rice_v1.aqt

Date: 05/24/23

Time: 14:18:19

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 2.03 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

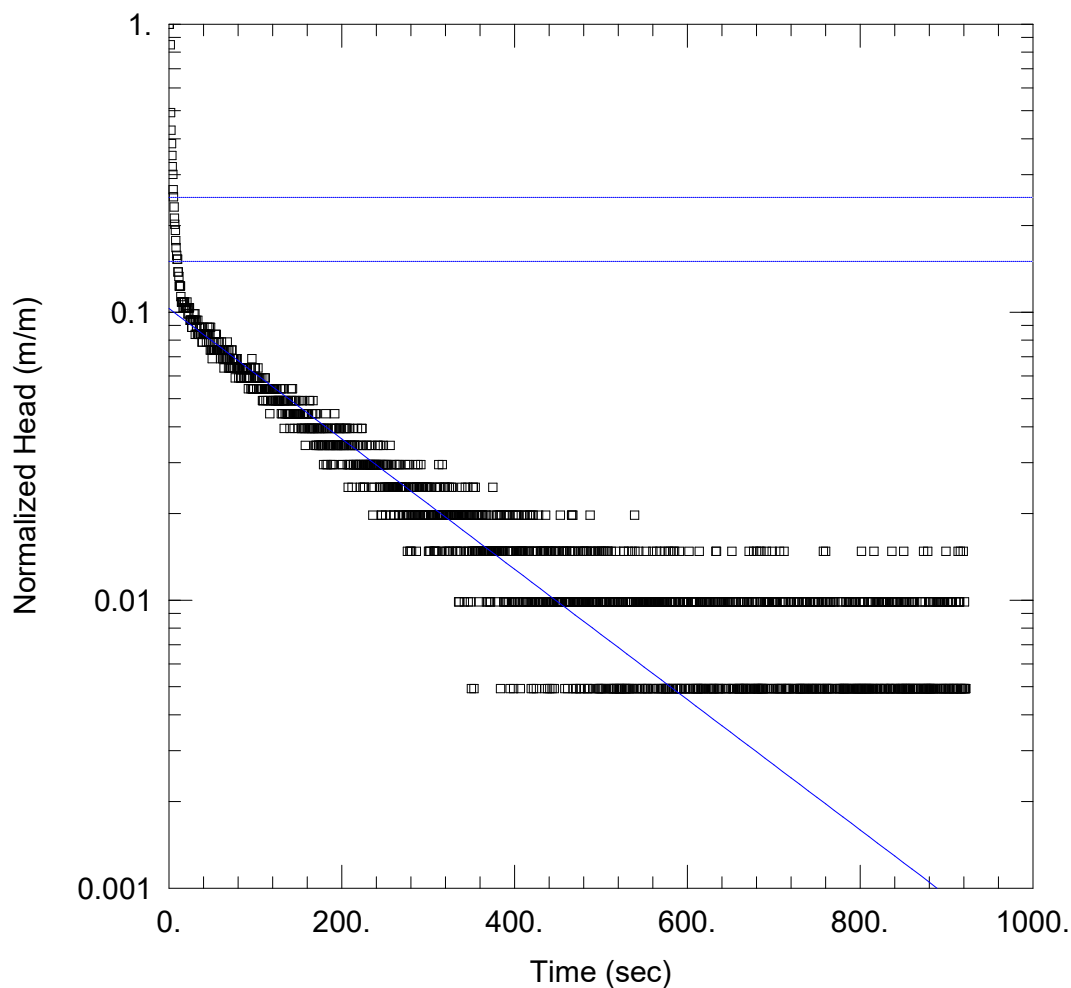
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.16$ m/day

$y_0 = 0.2087$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_33 RHT_3 Hvorslev_v1.aqt

Date: 05/24/23

Time: 14:21:07

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_33

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 3.49 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_33)

Initial Displacement: 2.03 m

Static Water Column Height: 3.49 m

Total Well Penetration Depth: 10.11 m

Screen Length: 6.8 m

Casing Radius: 0.025 m

Well Radius: 0.076 m

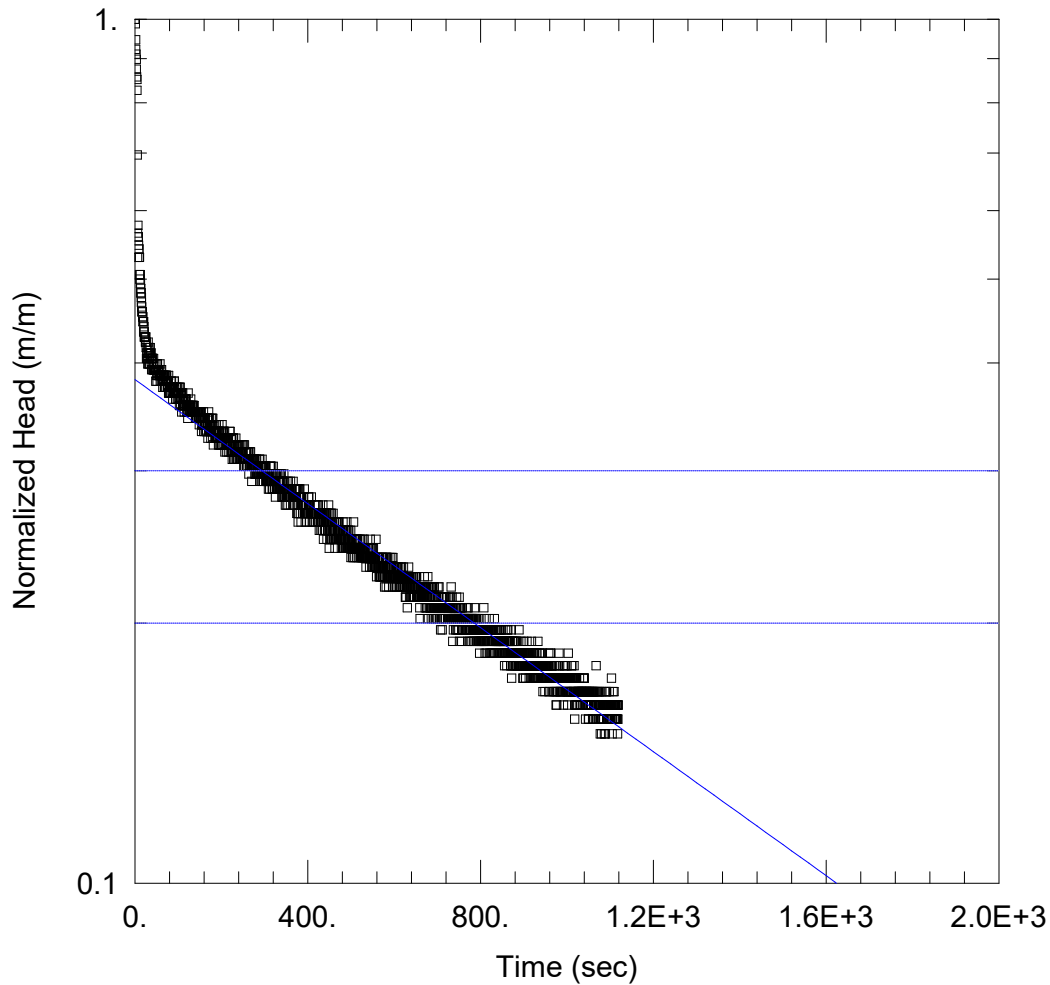
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.2136$ m/day

$y_0 = 0.2089$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_1 Bouwer Rice.aqt

Date: 05/24/23

Time: 14:41:26

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.68 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

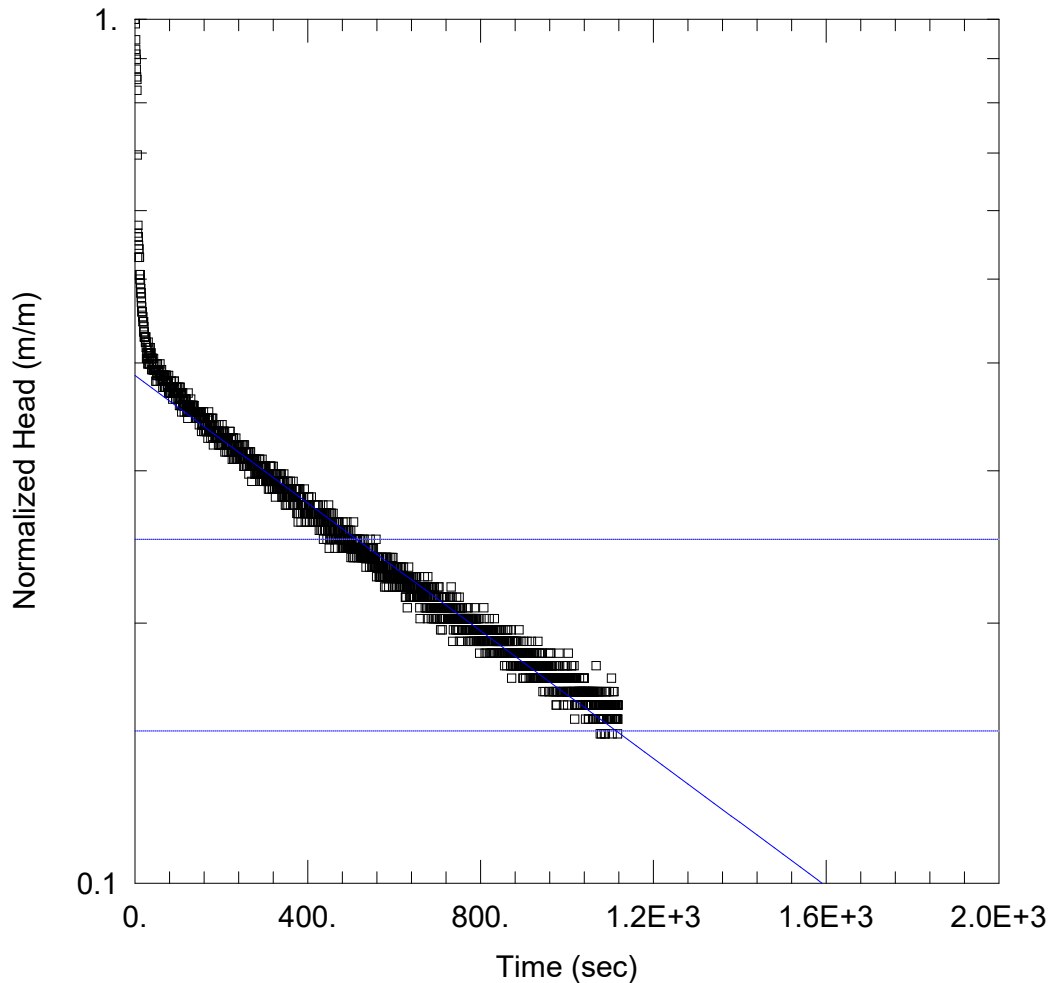
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.01787$ m/day

$y_0 = 0.6428$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_1 Hvorslev.aqt

Date: 05/24/23

Time: 14:44:36

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.68 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

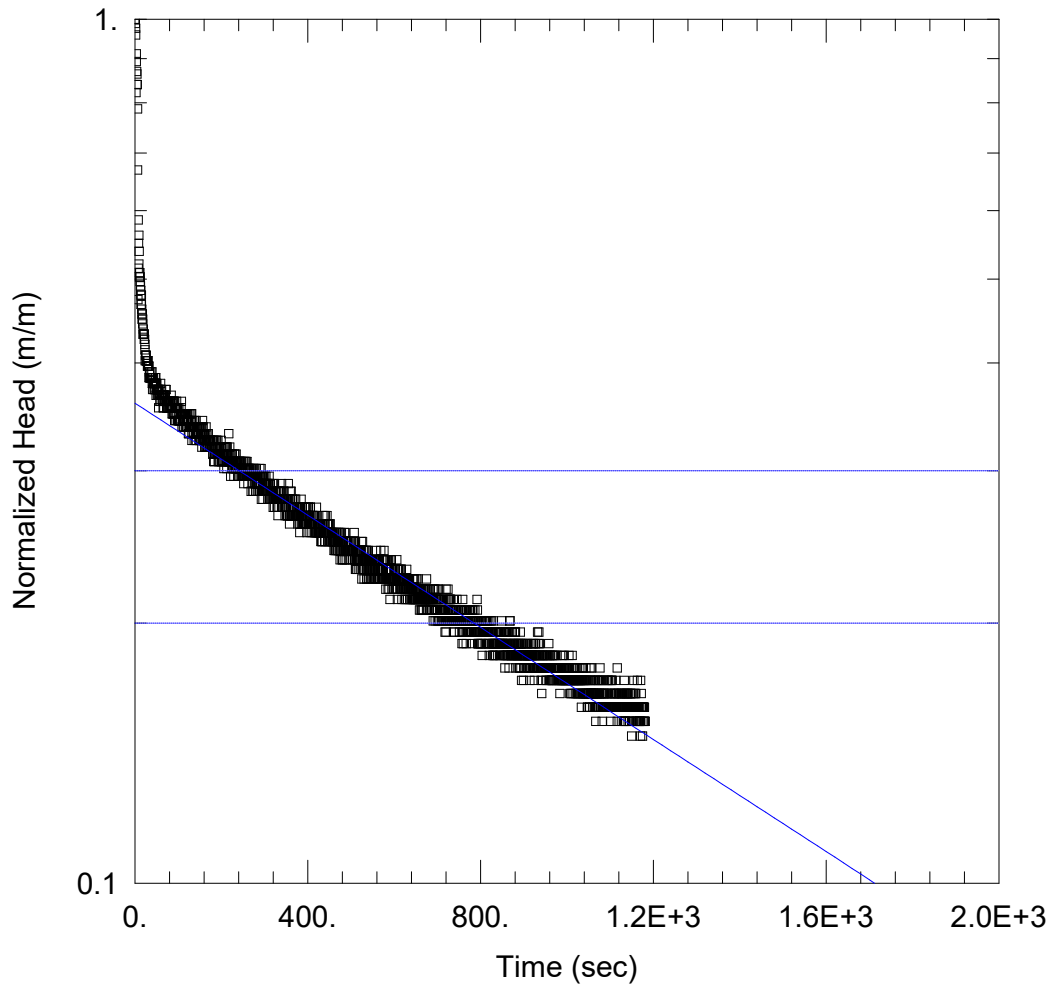
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.02434$ m/day

$y_0 = 0.6499$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_2 Bouwer Rice.aqt

Date: 05/24/23

Time: 14:45:57

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.69 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

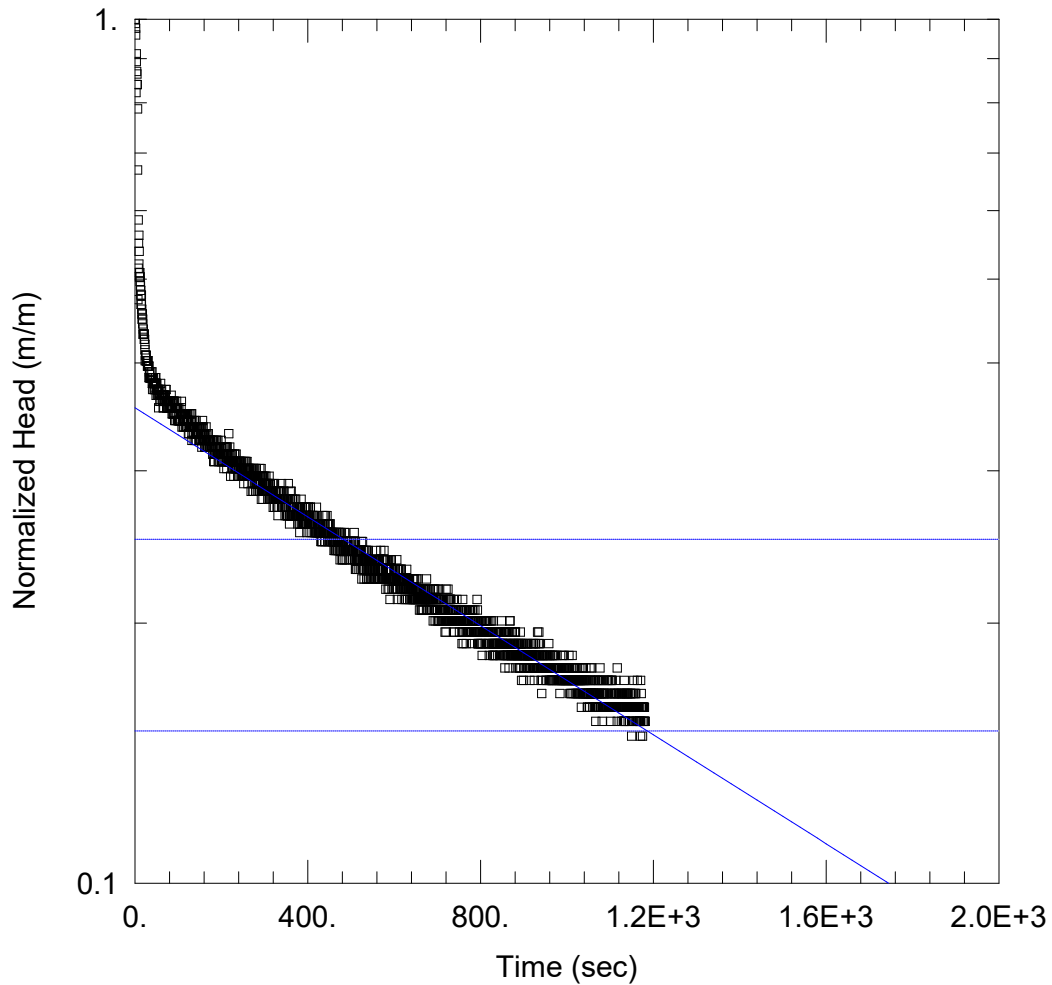
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.01615$ m/day

$y_0 = 0.6074$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 14:49:53

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.69 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

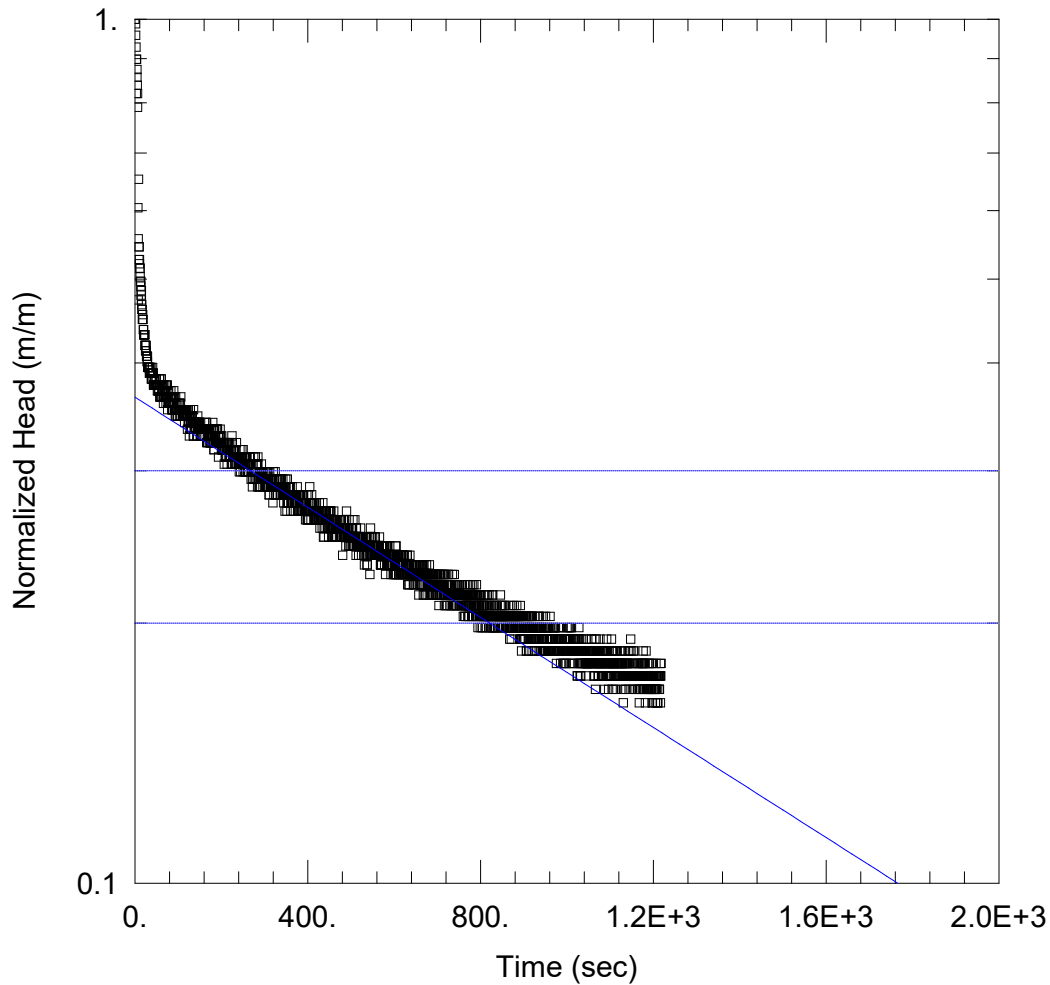
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.02078$ m/day

$y_0 = 0.5998$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_3 Bouwer Rice.aqt

Date: 05/24/23

Time: 14:51:00

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.67 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

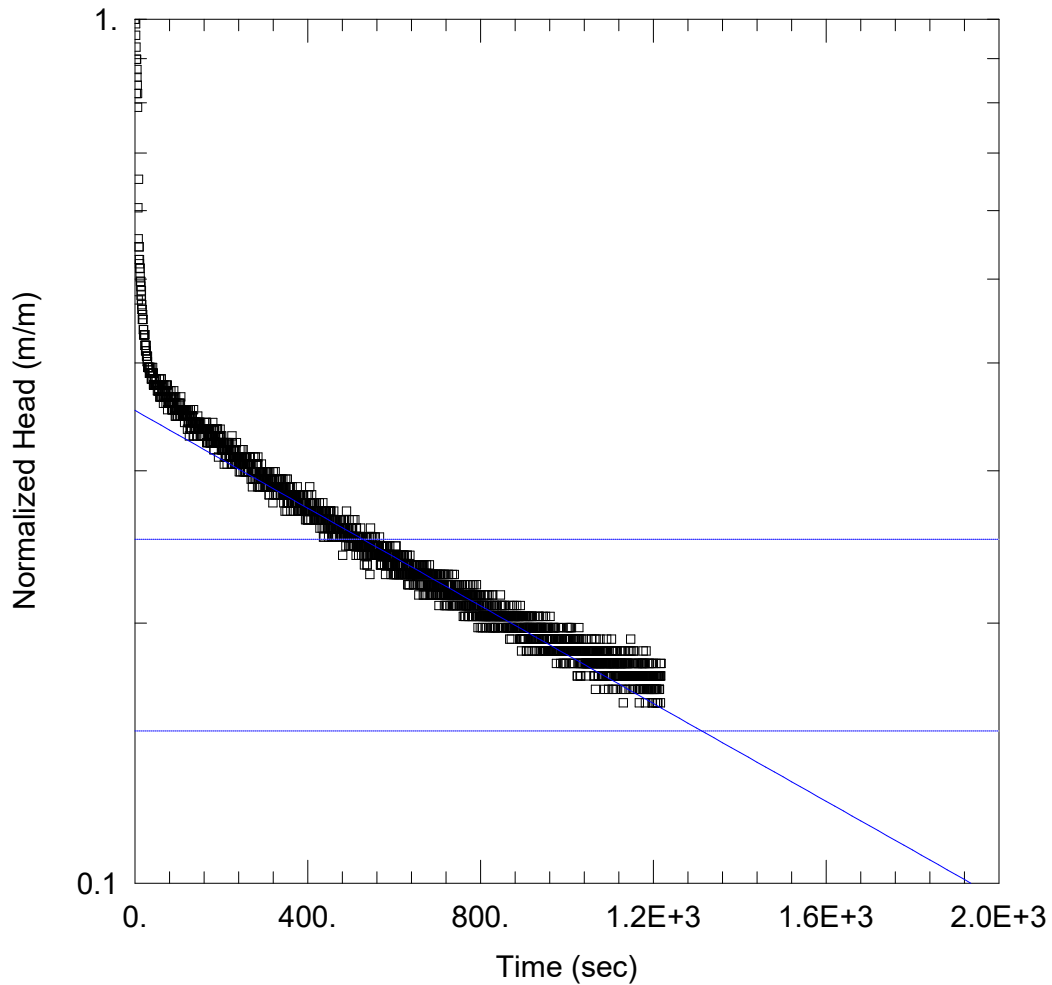
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.01586$ m/day

$y_0 = 0.6097$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_3 Hvorslev.aqt

Date: 05/24/23

Time: 14:52:00

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.67 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

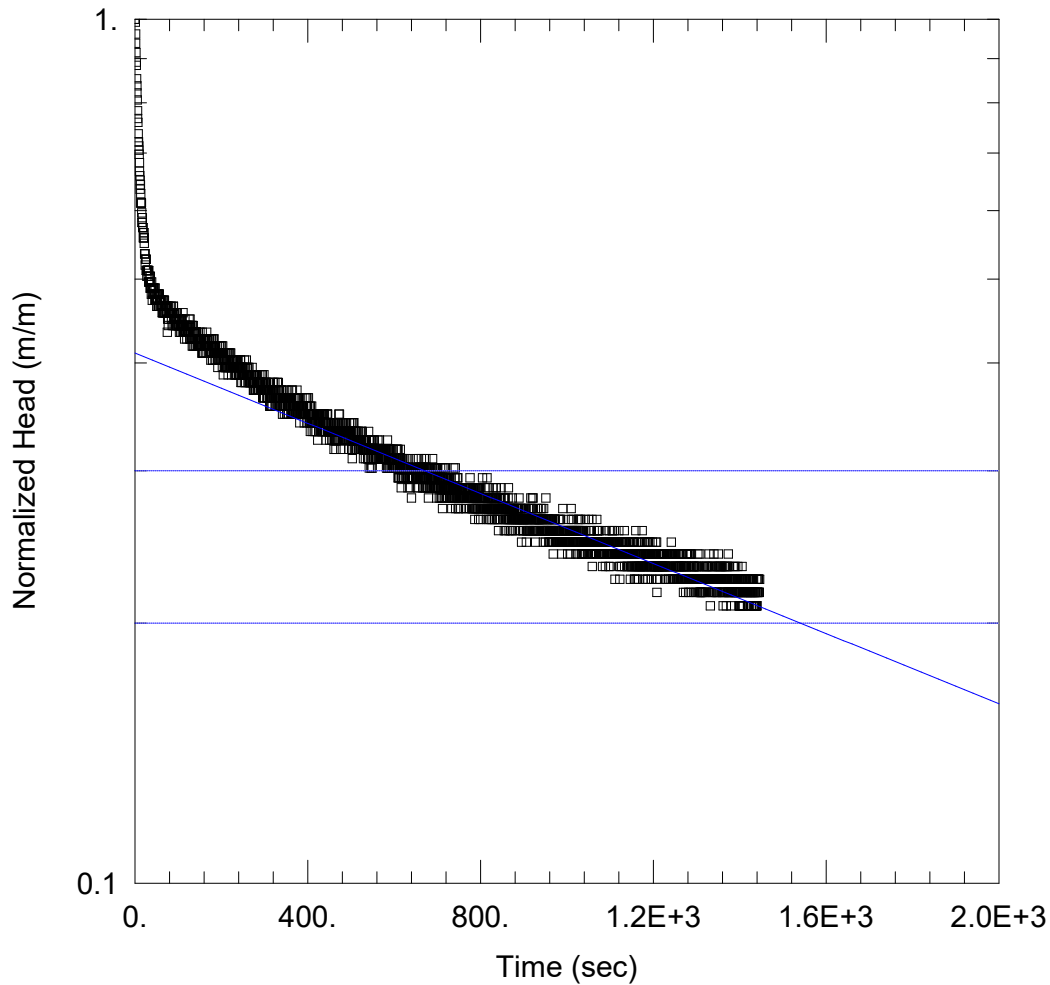
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01863$ m/day

$y_0 = 0.5885$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_1 Bouwer_Rice.aqt

Date: 05/24/23

Time: 14:55:57

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.29 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

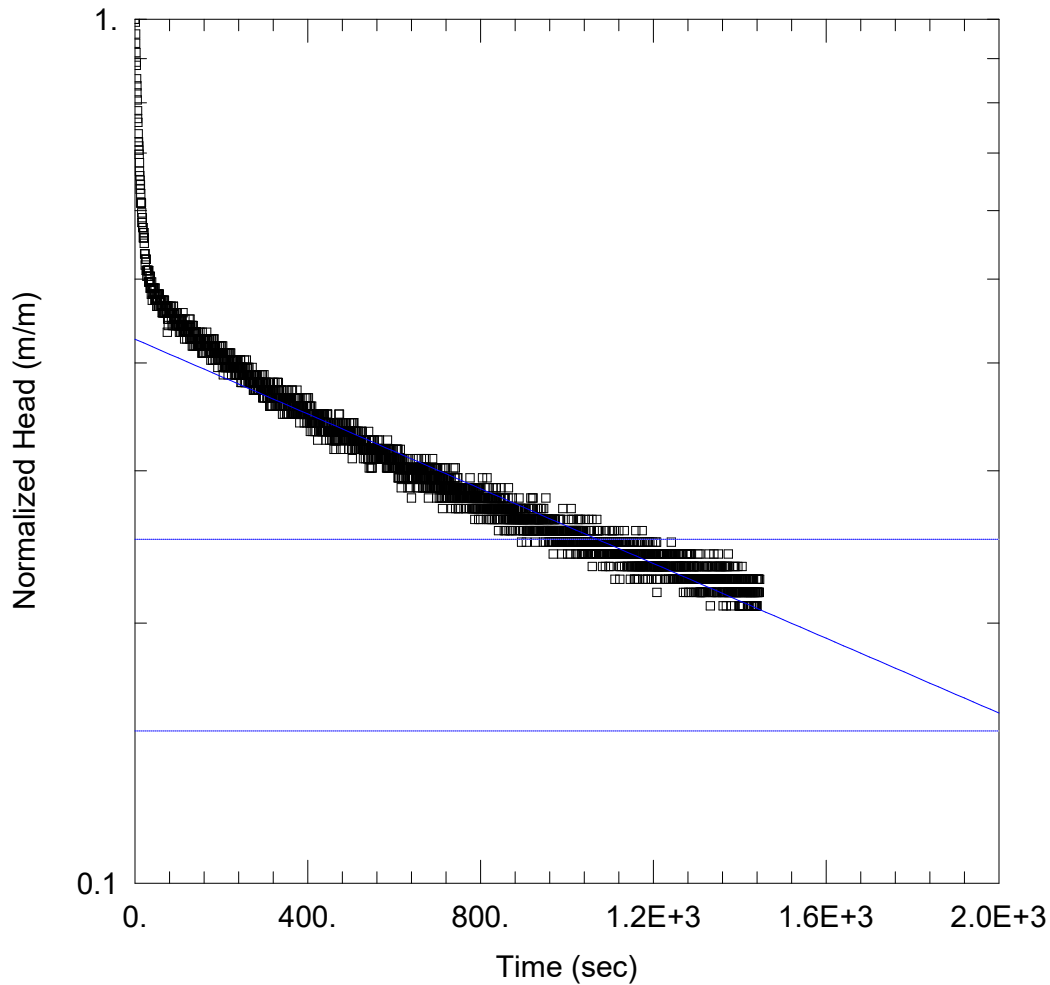
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.0101$ m/day

$y_0 = 0.5296$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_1 Hvorslev.aqt

Date: 05/24/23

Time: 14:58:03

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.29 m

Static Water Column Height: 13.89 m

Total Well Penetration Depth: 42.11 m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

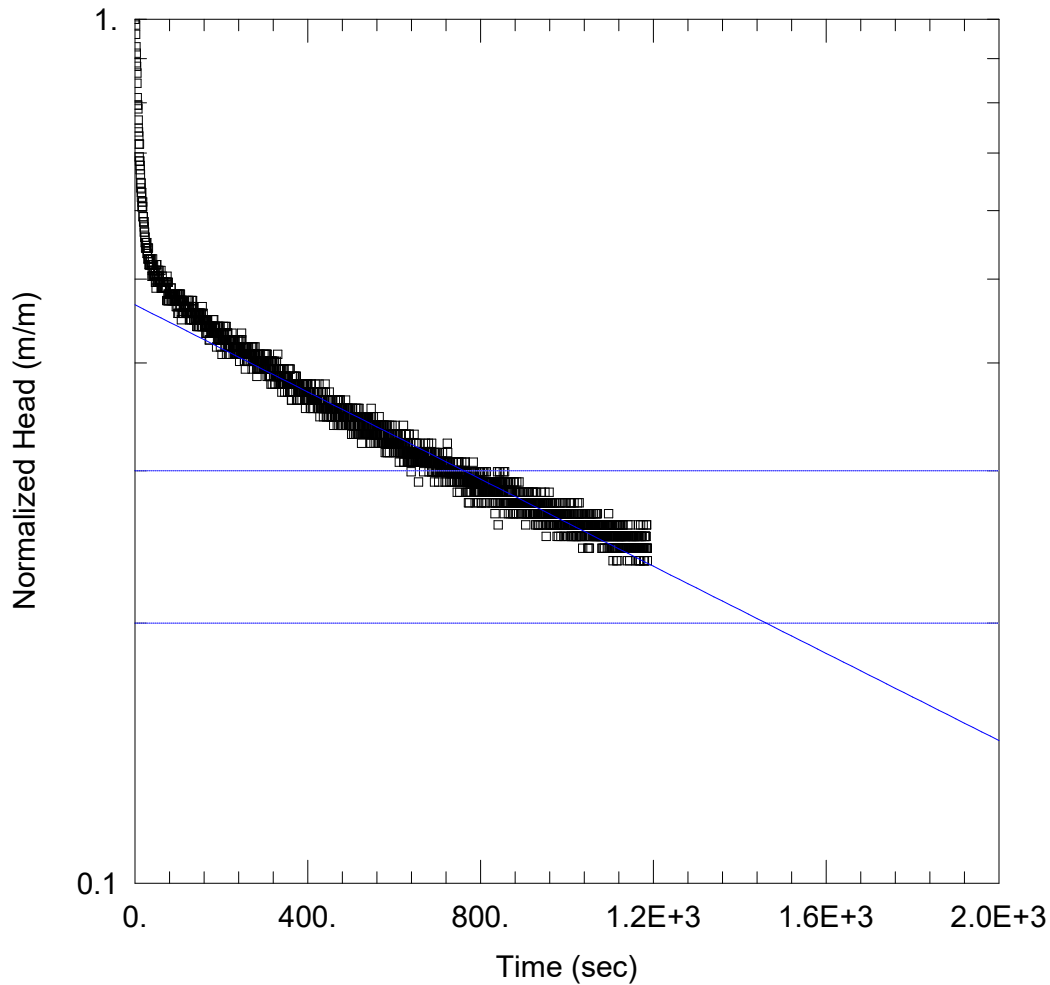
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01425$ m/day

$y_0 = 0.5497$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT 2 Bouwer Rice.aqt

Date: 05/24/23

Time: 09:47:52

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.27 m

Static Water Column Height: 13.89 m

Total Well Penetration Depth: 42.11 m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

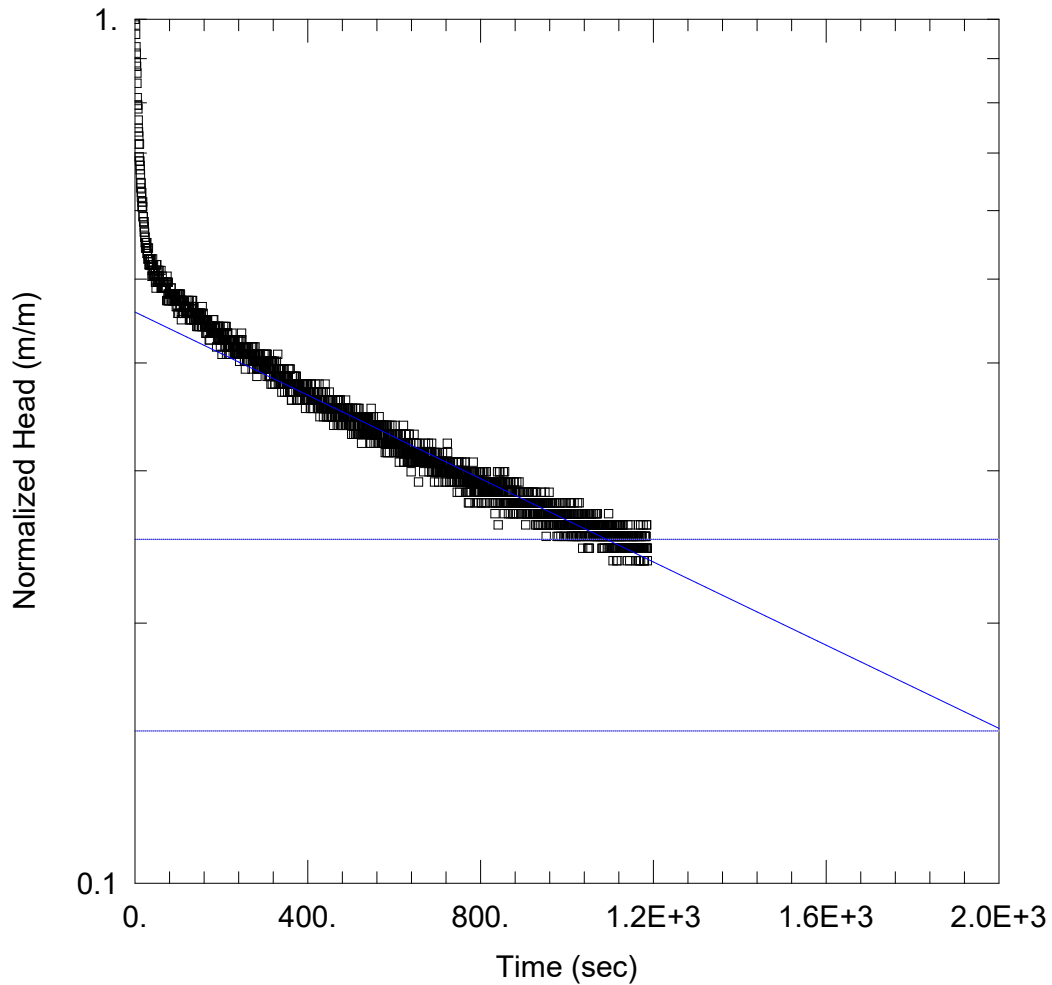
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.01408$ m/day

$y_0 = 0.5931$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 15:01:36

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.27 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

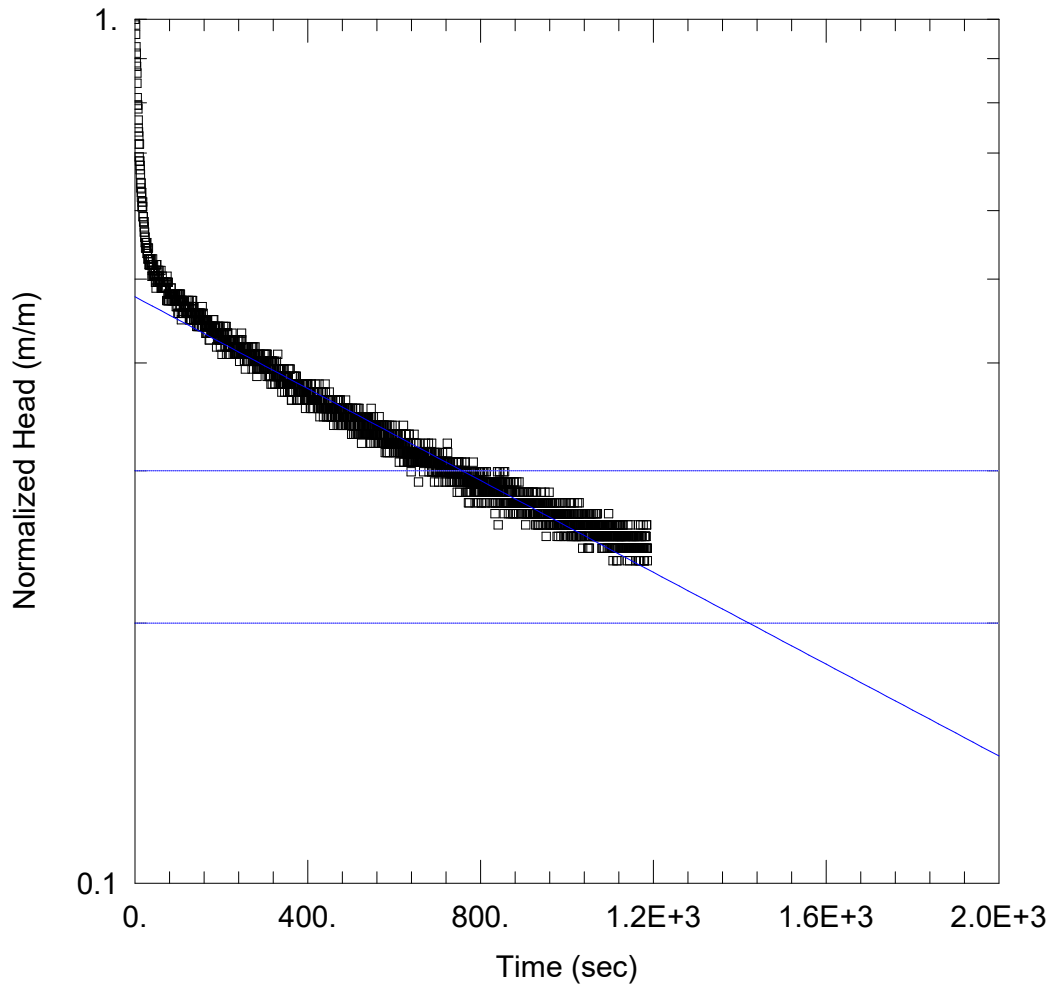
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01586$ m/day

$y_0 = 0.5815$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT 2 Bouwer Rice.aqt

Date: 05/24/23

Time: 15:02:12

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.27 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

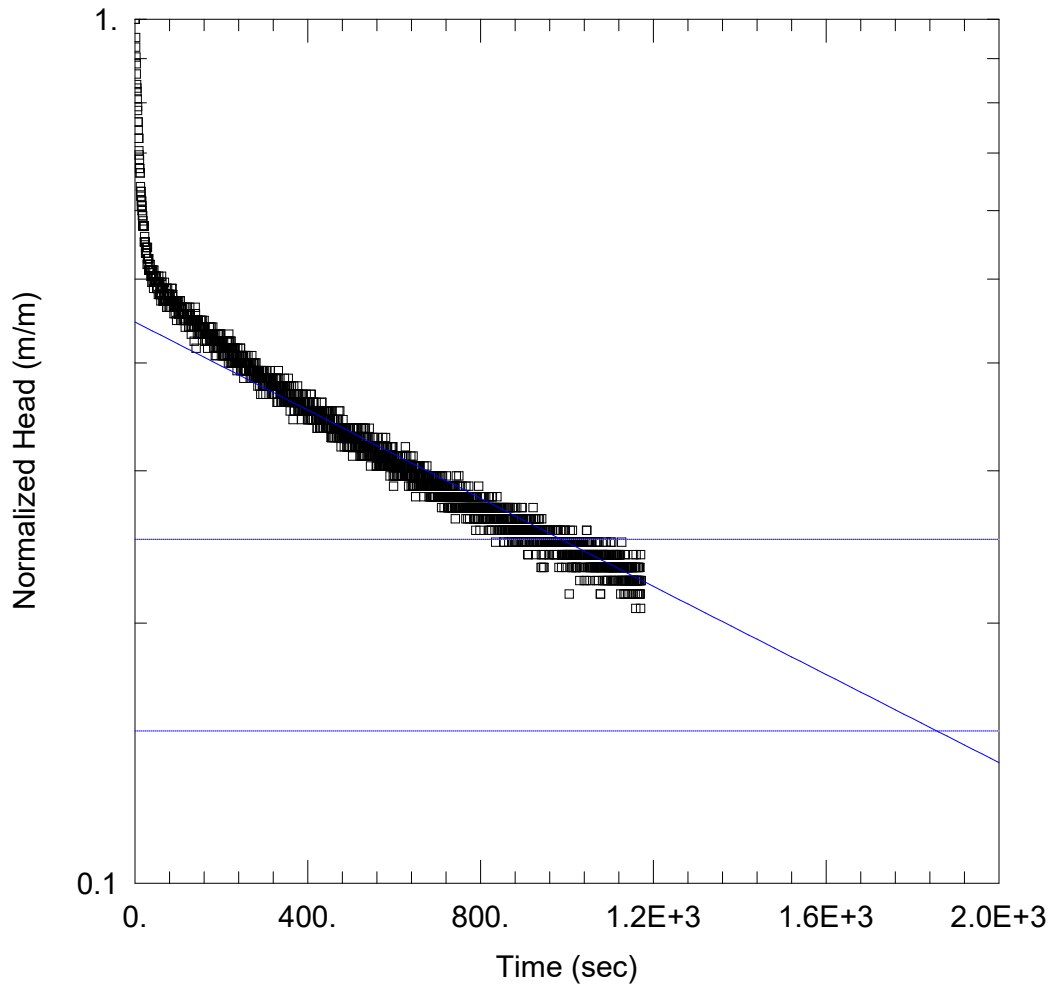
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.01323$ m/day

$y_0 = 0.6059$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_3 Hvorslev.aqt

Date: 05/24/23

Time: 15:06:43

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 5. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.25 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

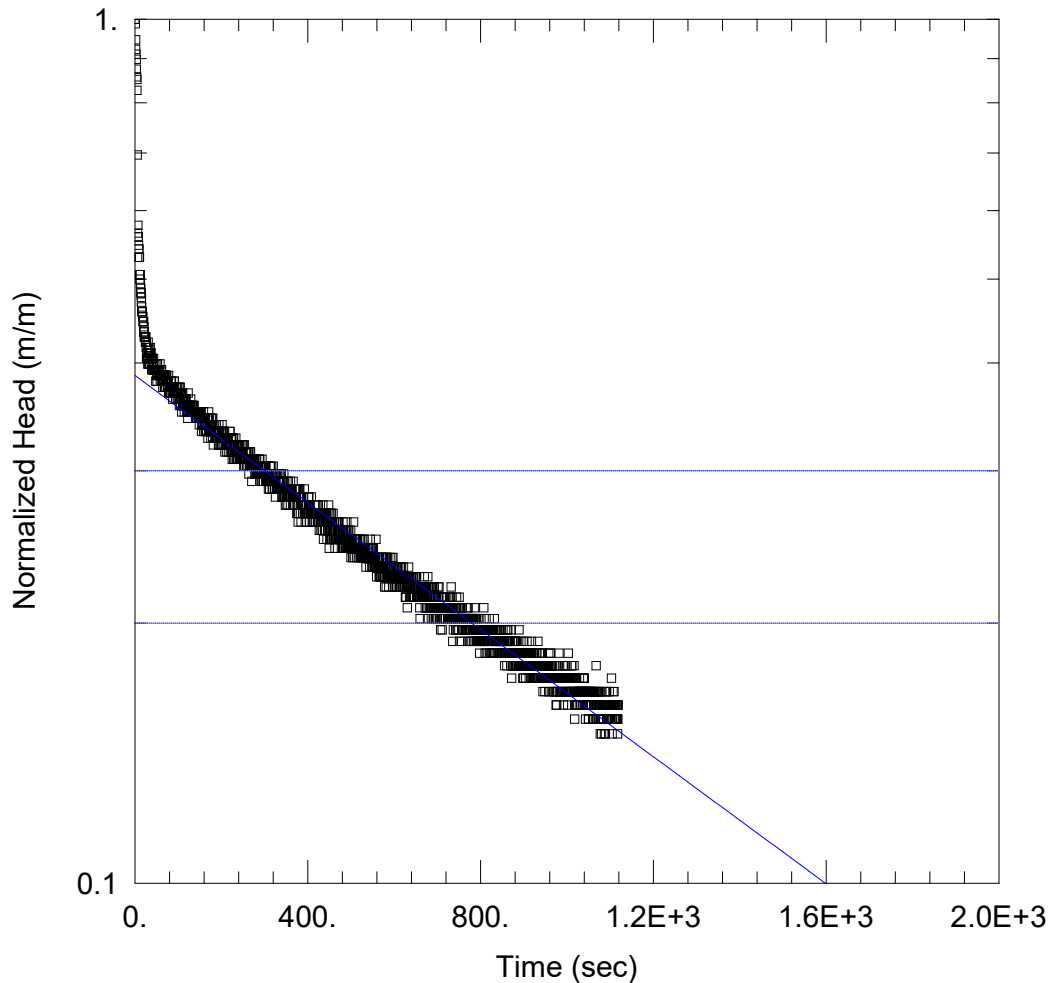
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.0168$ m/day

$y_0 = 0.5576$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_1 Bouwer Rice.aqt

Date: 05/24/23

Time: 14:25:30

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.68 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

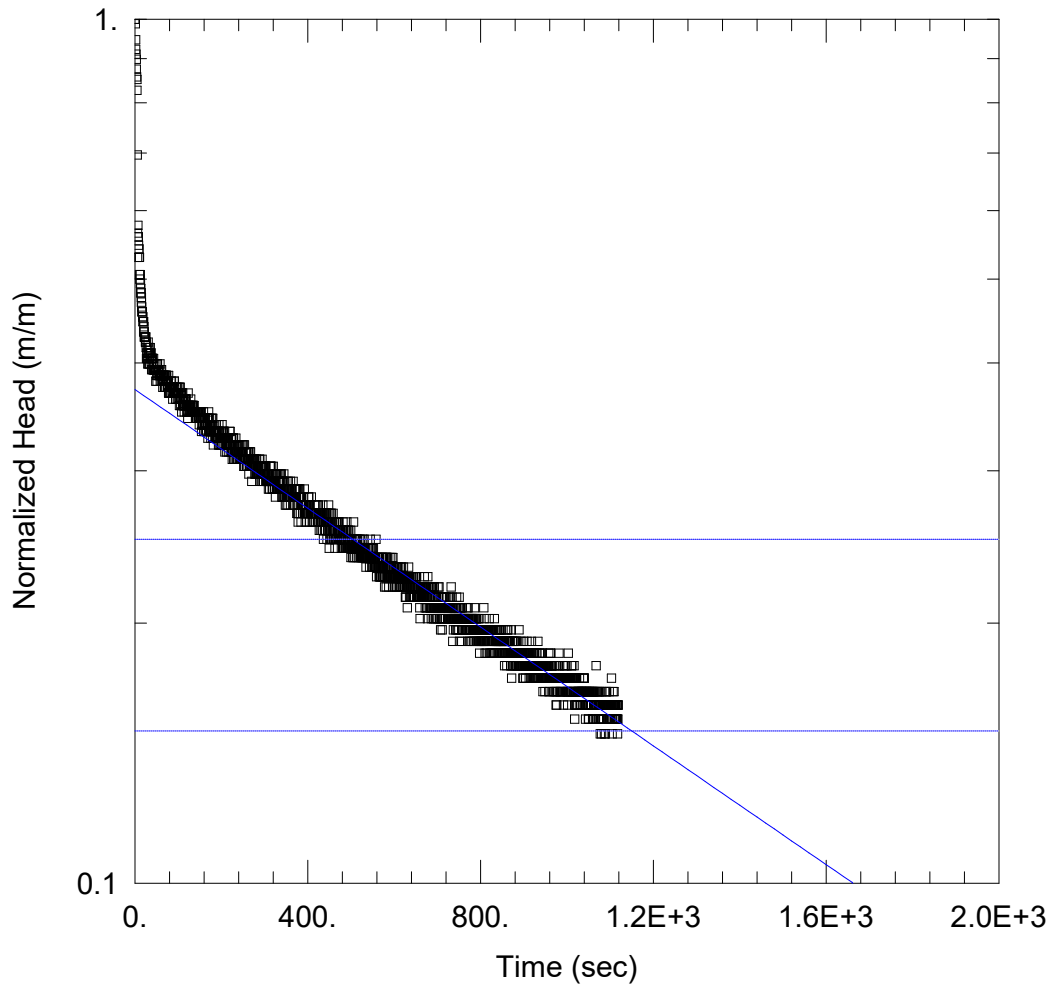
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.005443$ m/day

$y_0 = 0.6498$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_1 Hvorslev.aqt

Date: 05/24/23

Time: 14:24:51

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.68 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

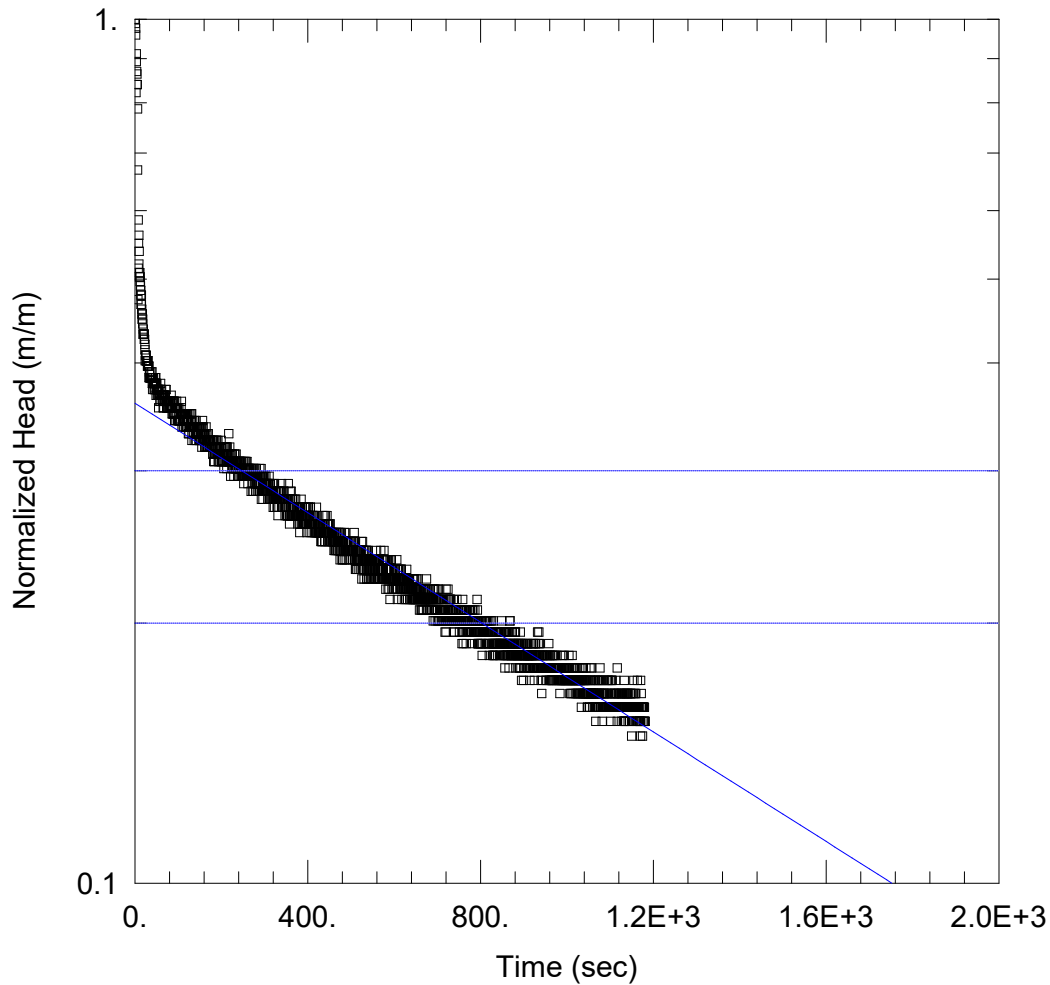
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.006289$ m/day

$y_0 = 0.626$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_2 Bouwer Rice.aqt

Date: 05/24/23

Time: 14:26:40

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.69 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

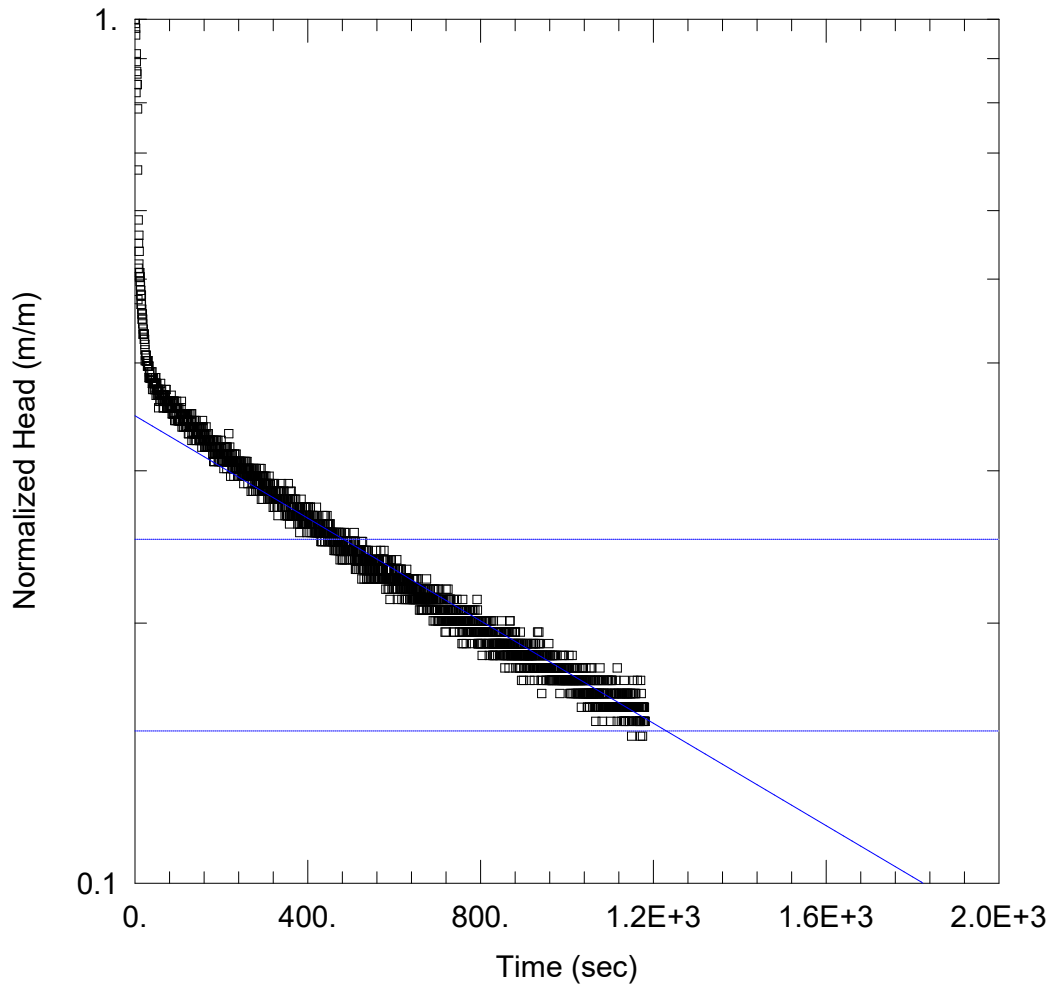
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.004694$ m/day

$y_0 = 0.6074$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 14:27:22

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.69 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

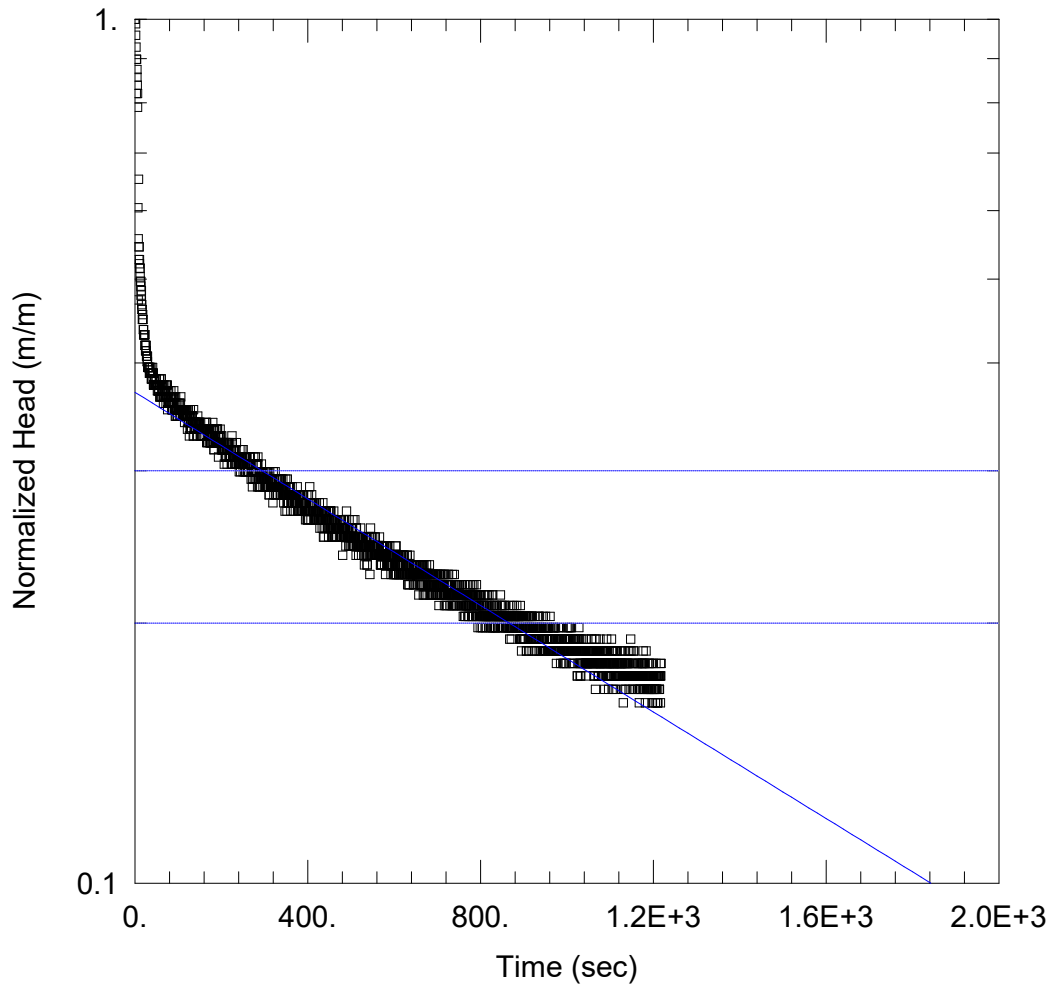
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.005425$ m/day

$y_0 = 0.5871$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_3 Bouwer Rice.aqt

Date: 05/24/23

Time: 14:28:43

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.67 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

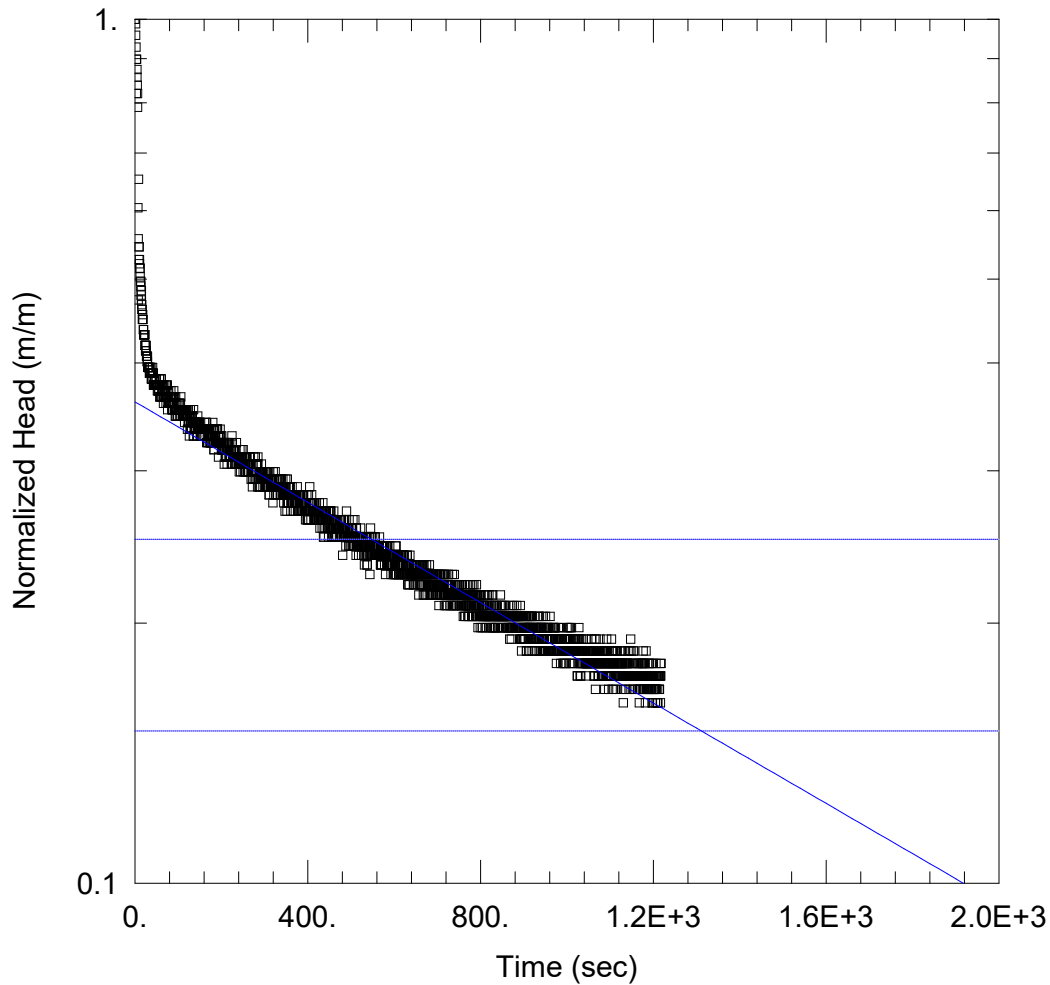
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.004564$ m/day

$y_0 = 0.6177$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a FHT_3 Hvorslev.aqt

Date: 05/24/23

Time: 14:29:19

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.67 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

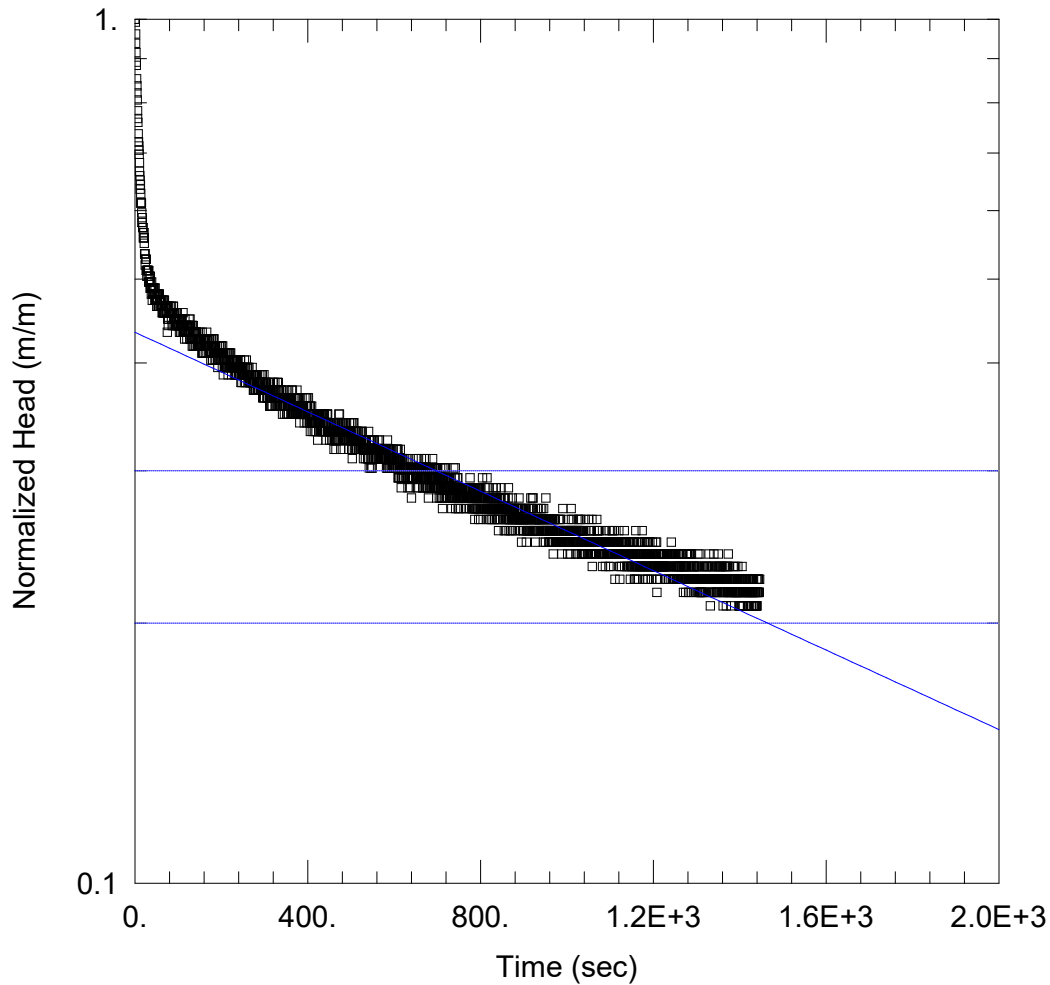
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.005315$ m/day

$y_0 = 0.6021$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_1 Bouwer_Rice.aqt

Date: 05/24/23

Time: 14:31:11

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.29 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

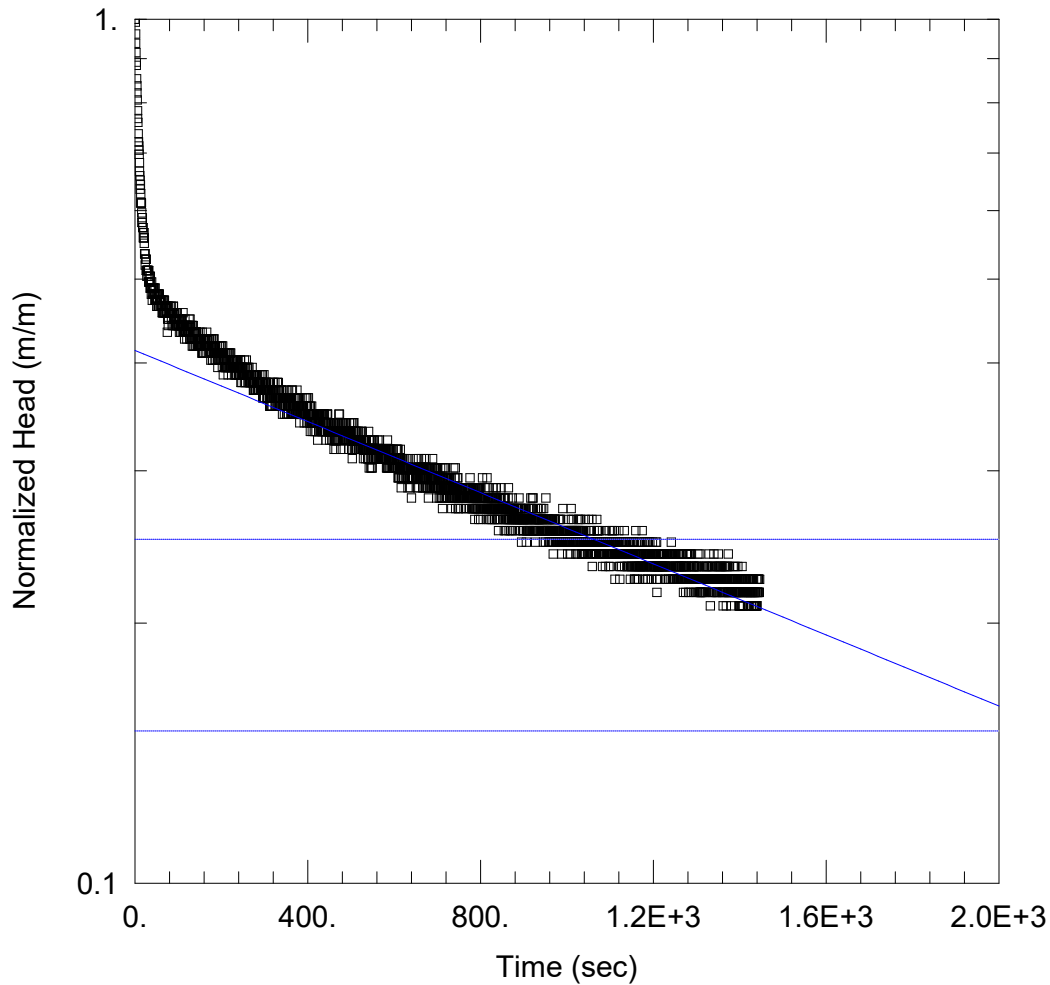
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.003403$ m/day

$y_0 = 0.5599$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_1 Hvorslev.aqt

Date: 05/24/23

Time: 09:29:19

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.29 m

Static Water Column Height: 13.89 m

Total Well Penetration Depth: 42.11 m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

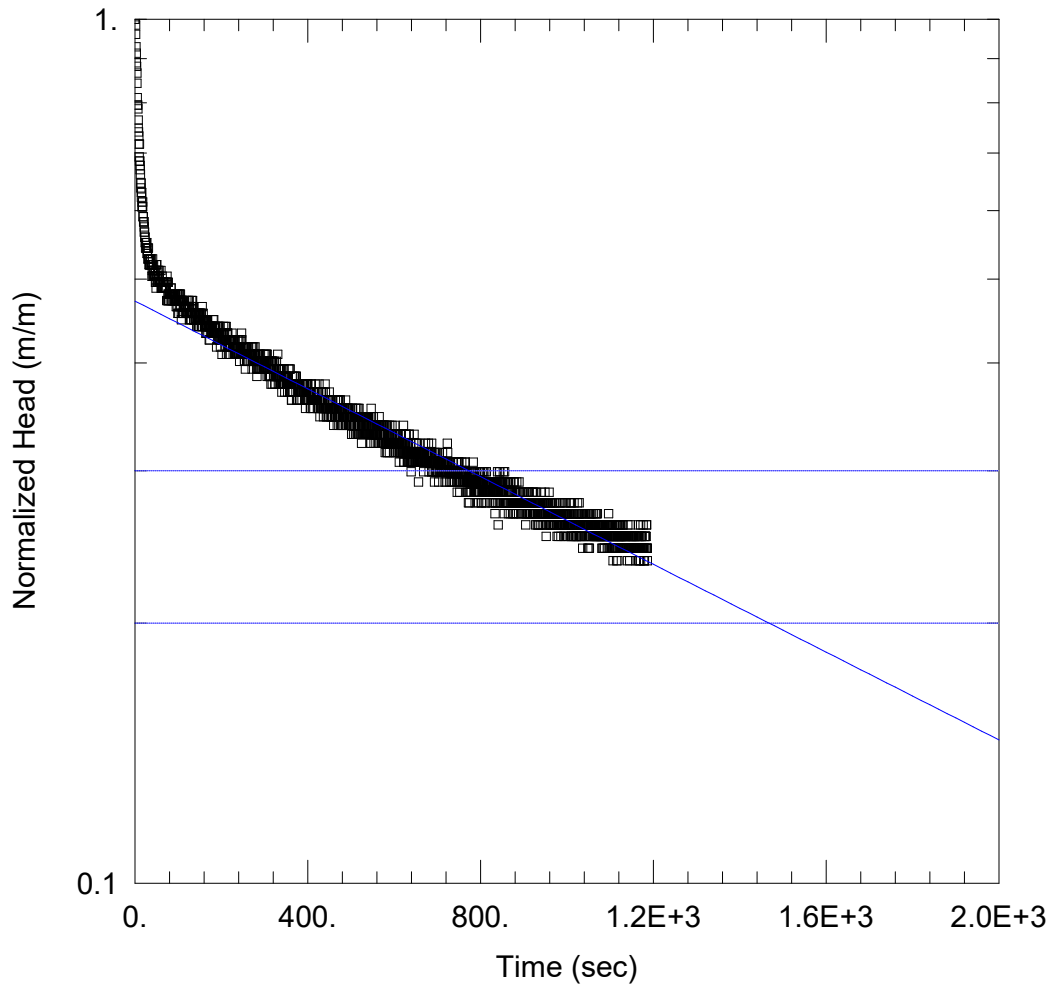
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.003765$ m/day

$y_0 = 0.5334$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_2 Bouwer_Rice.aqt

Date: 05/24/23

Time: 14:32:20

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.27 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

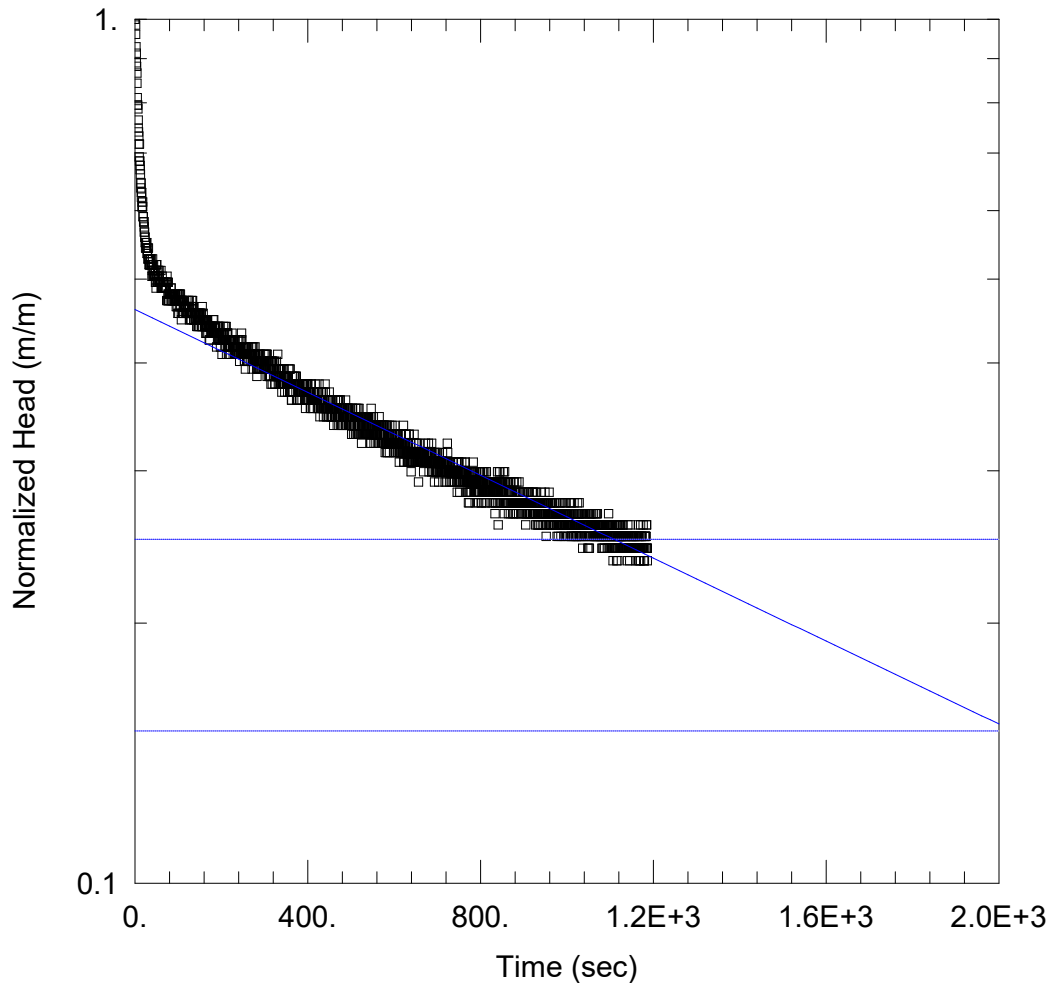
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.003759$ m/day

$y_0 = 0.599$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 14:33:27

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.27 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

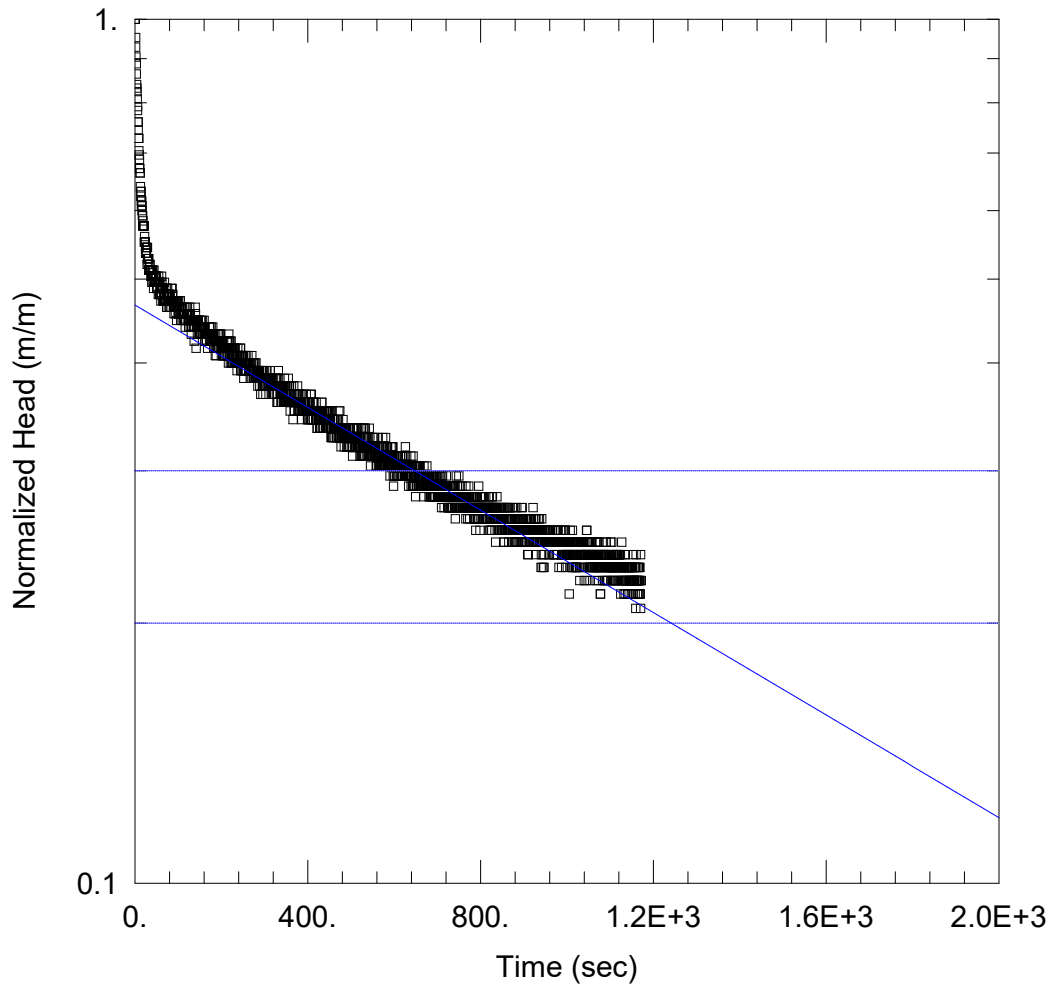
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.00439$ m/day

$y_0 = 0.5857$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_3 Bouwer_Rice.aqt

Date: 05/24/23

Time: 14:34:27

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.25 m

Static Water Column Height: 42.11 m

Total Well Penetration Depth: 18. m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

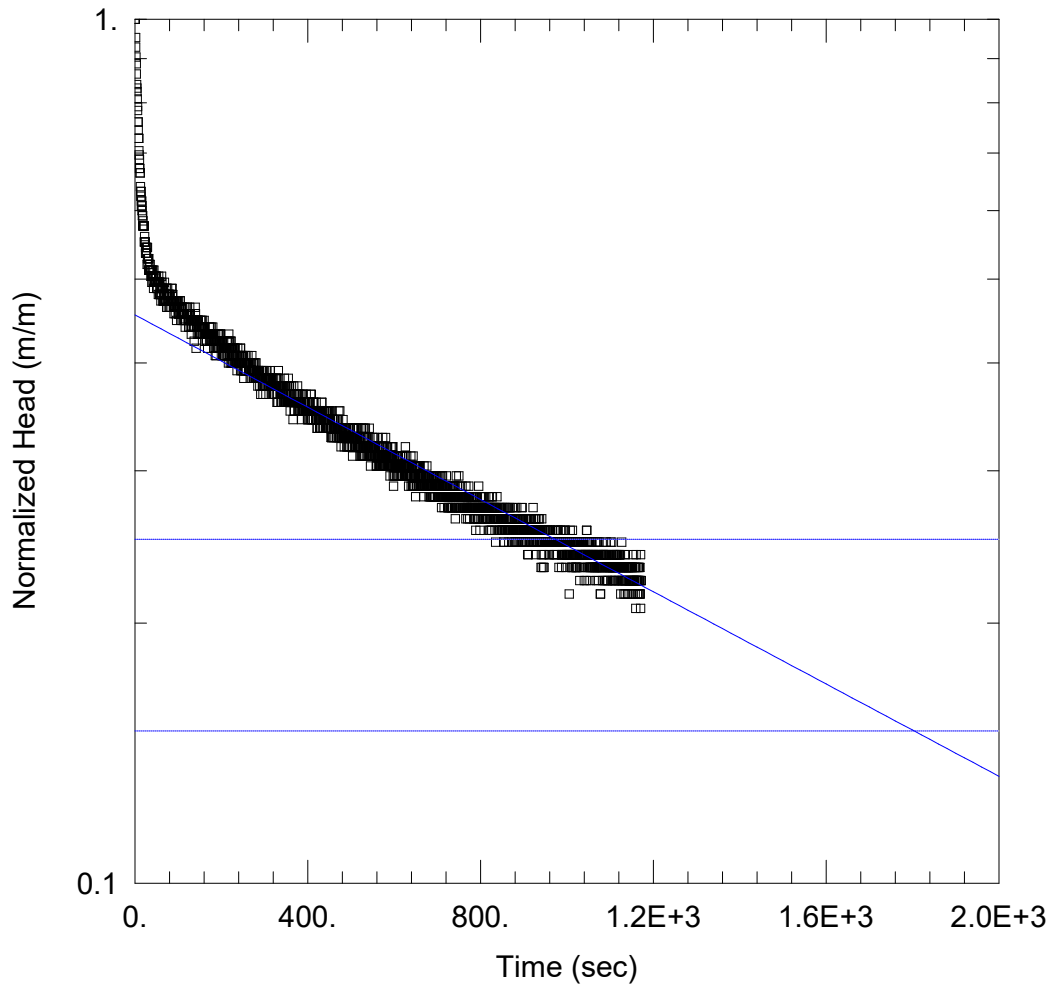
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.004391$ m/day

$y_0 = 0.5835$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_41a RHT_3 Hvorslev.aqt

Date: 05/24/23

Time: 09:53:28

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_41a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 18. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_41a)

Initial Displacement: 1.25 m

Static Water Column Height: 13.89 m

Total Well Penetration Depth: 42.11 m

Screen Length: 18. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

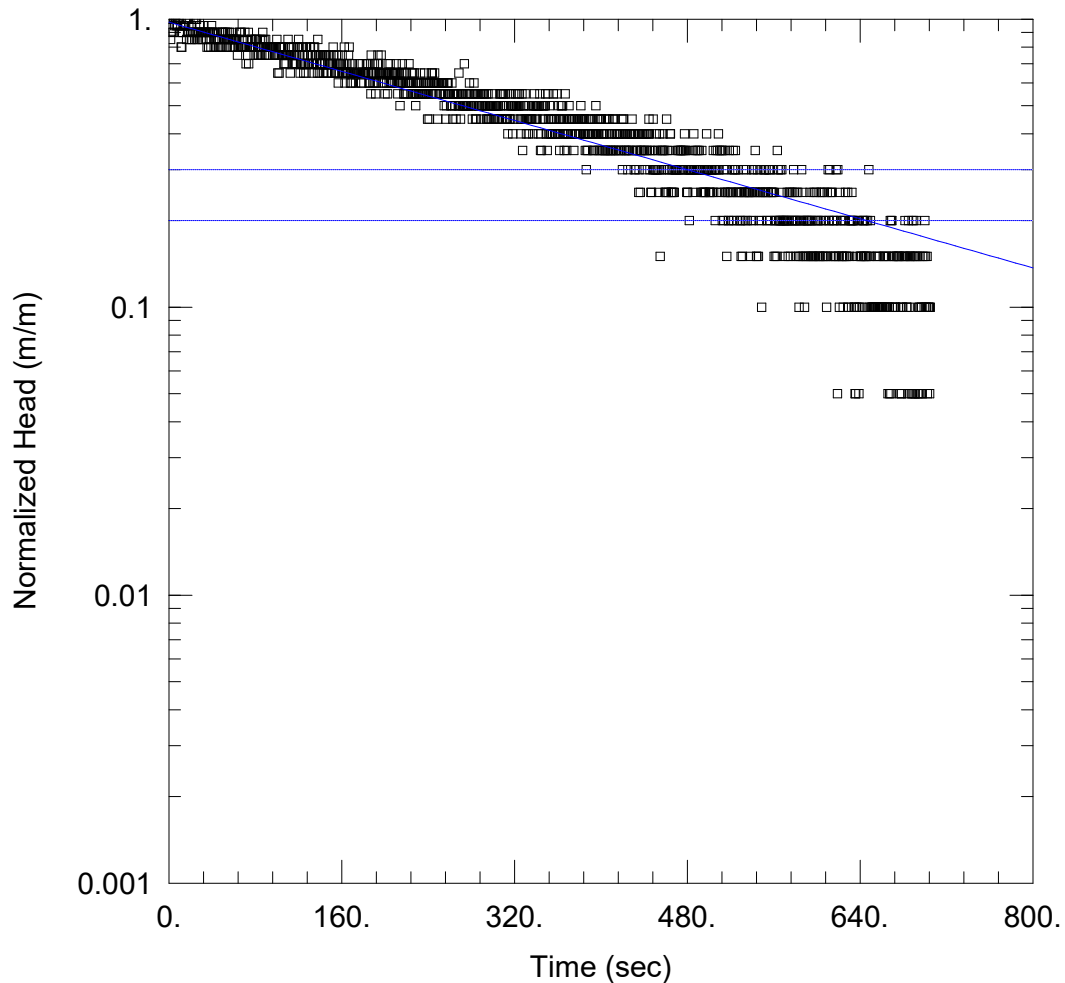
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.004885$ m/day

$y_0 = 0.5682$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) FHT_1 Bouwer-Rice.aqt

Date: 05/24/23

Time: 11:16:18

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

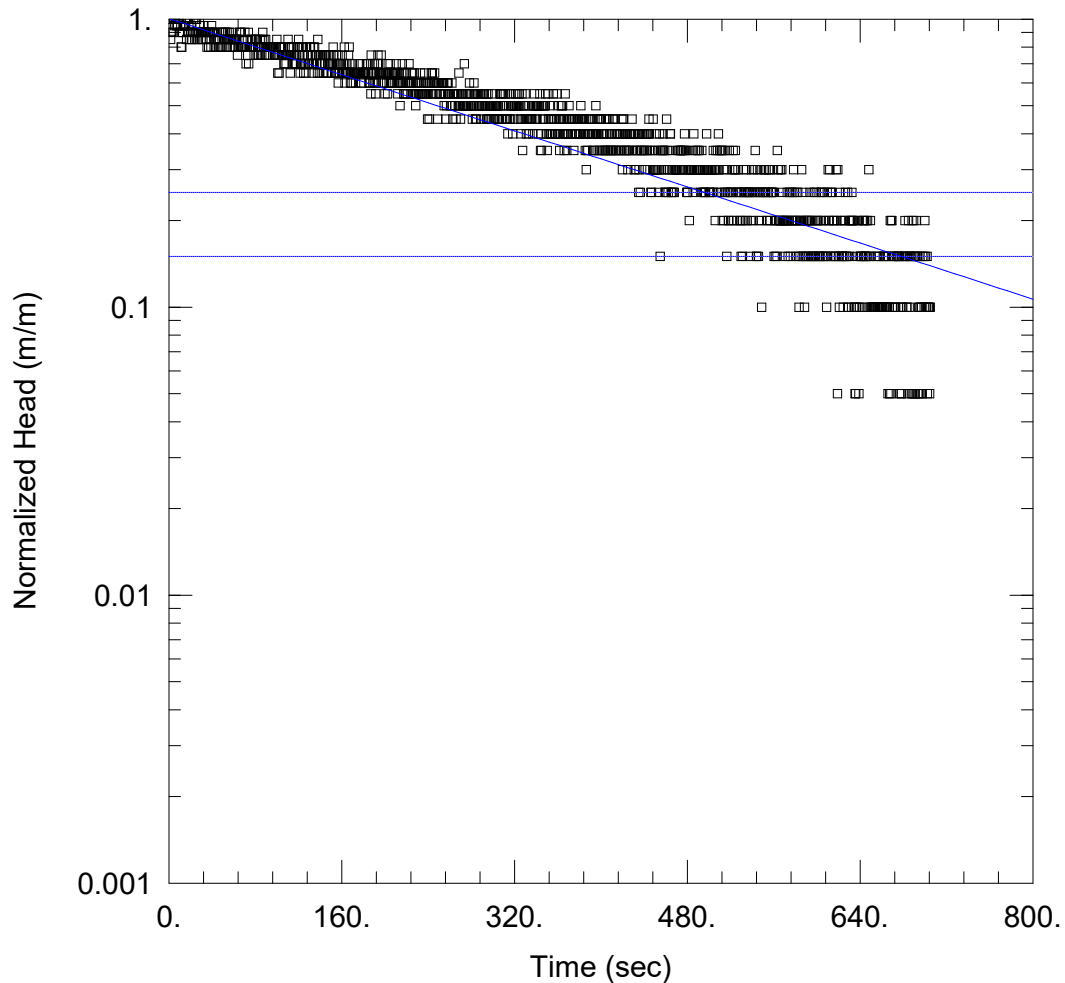
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 0.0115 m/day

y0 = 0.1951 m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) FHT_1 Hvorslev.aqt

Date: 05/24/23

Time: 11:17:28

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

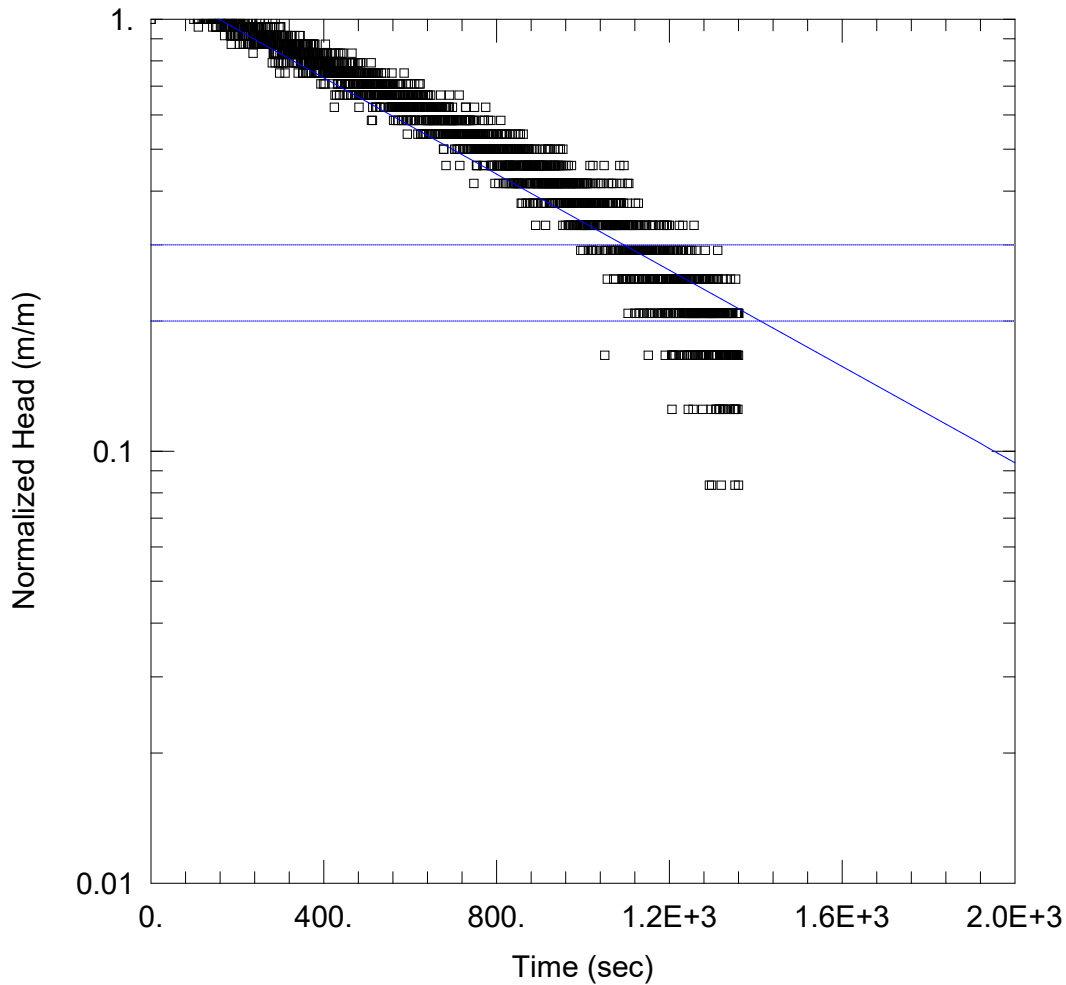
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01485$ m/day

$y_0 = 0.2008$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) FHT_2 Bouwer-Rice.aqt

Date: 05/24/23

Time: 11:34:57

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 16. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.24 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

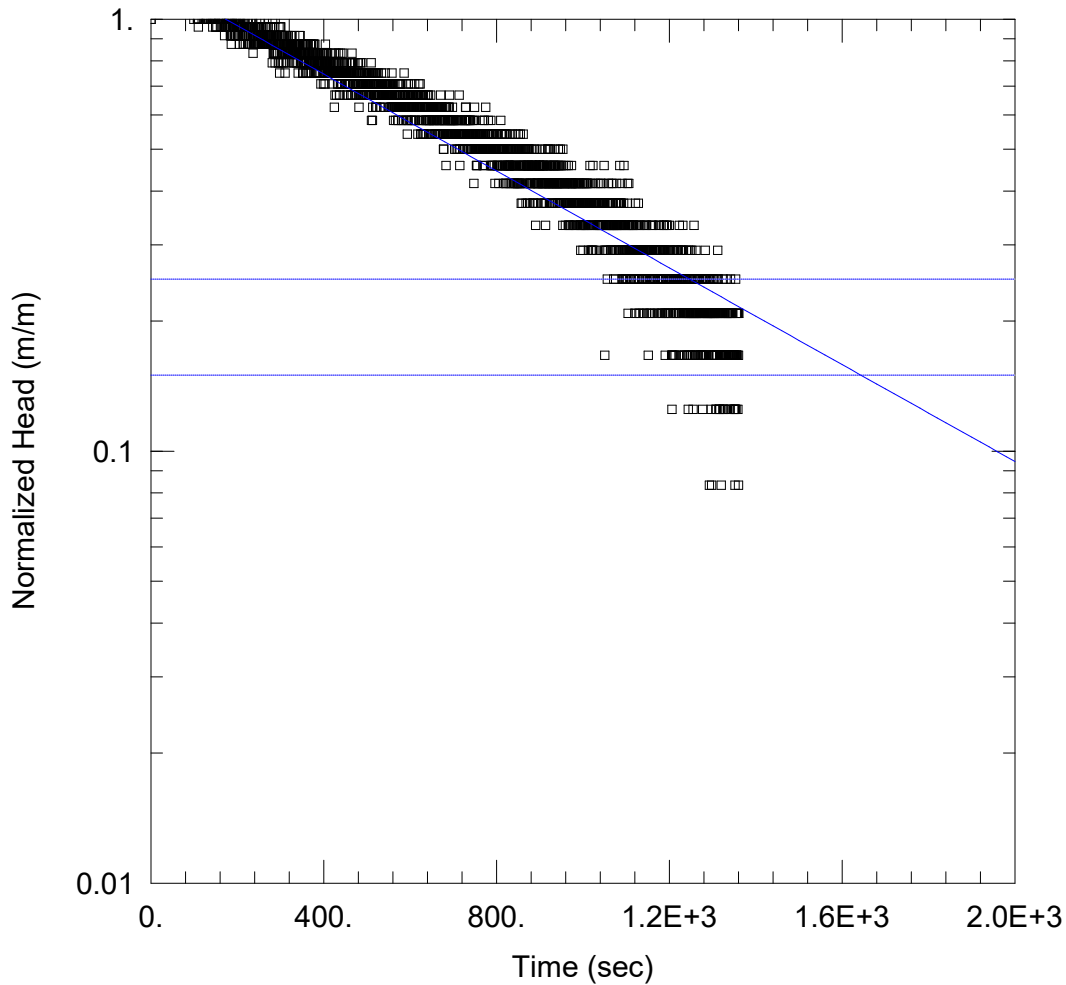
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.009786$ m/day

$y_0 = 0.2932$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) FHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 11:39:59

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 16. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.24 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

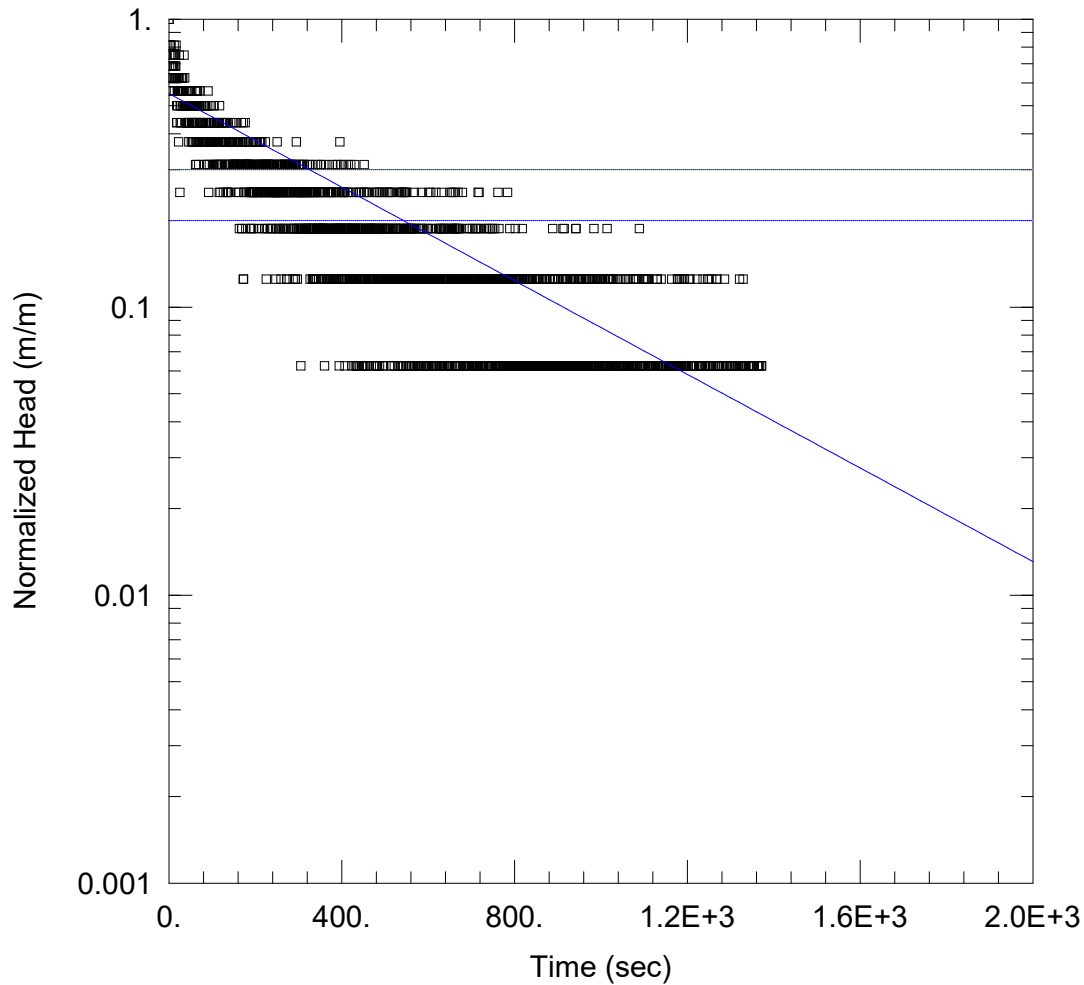
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01154$ m/day

$y_0 = 0.2999$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) RHT_1 Bouwer-Rice.aqt

Date: 05/24/23

Time: 11:22:35

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 16. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.16 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

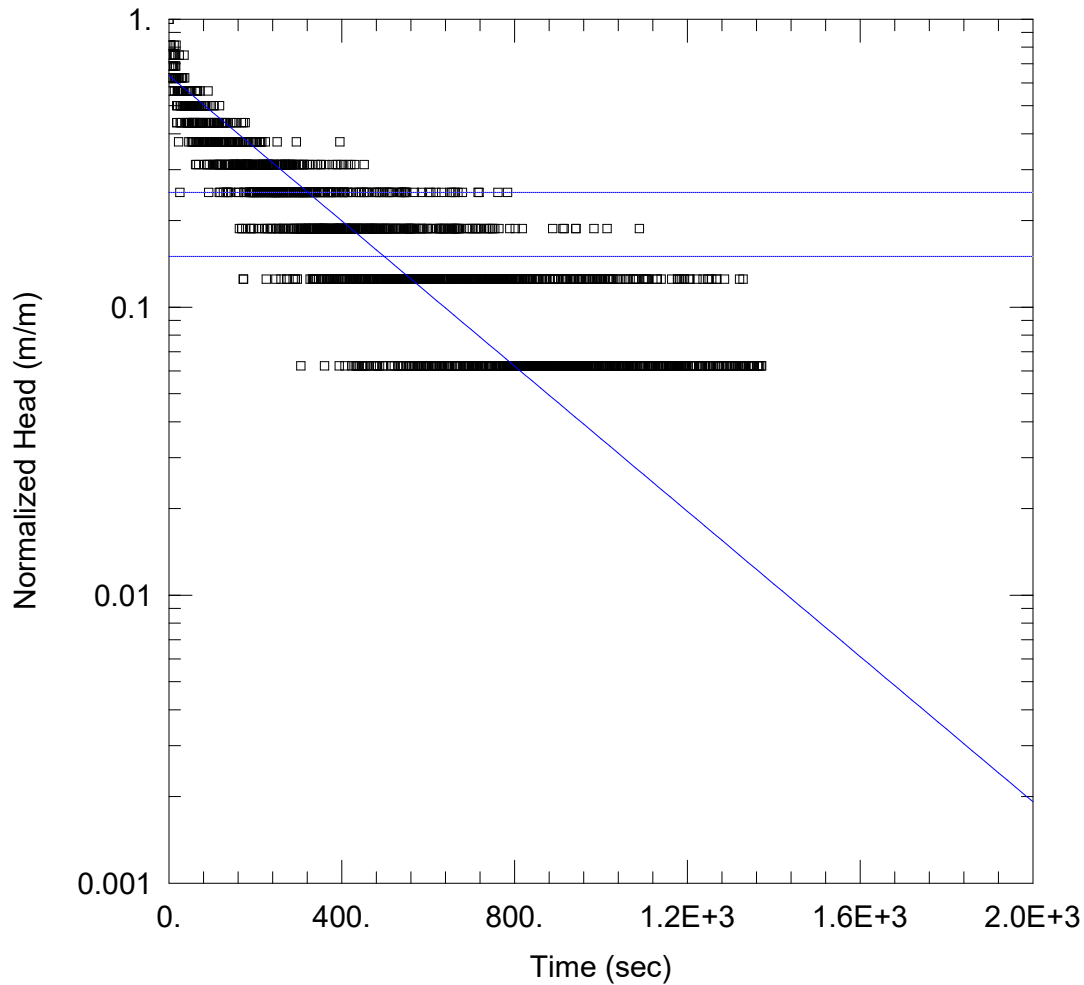
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.02595$ m/day

$y_0 = 0.1018$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) RHT_1 Hvorslev.aqt

Date: 05/24/23

Time: 11:24:45

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 16. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.16 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

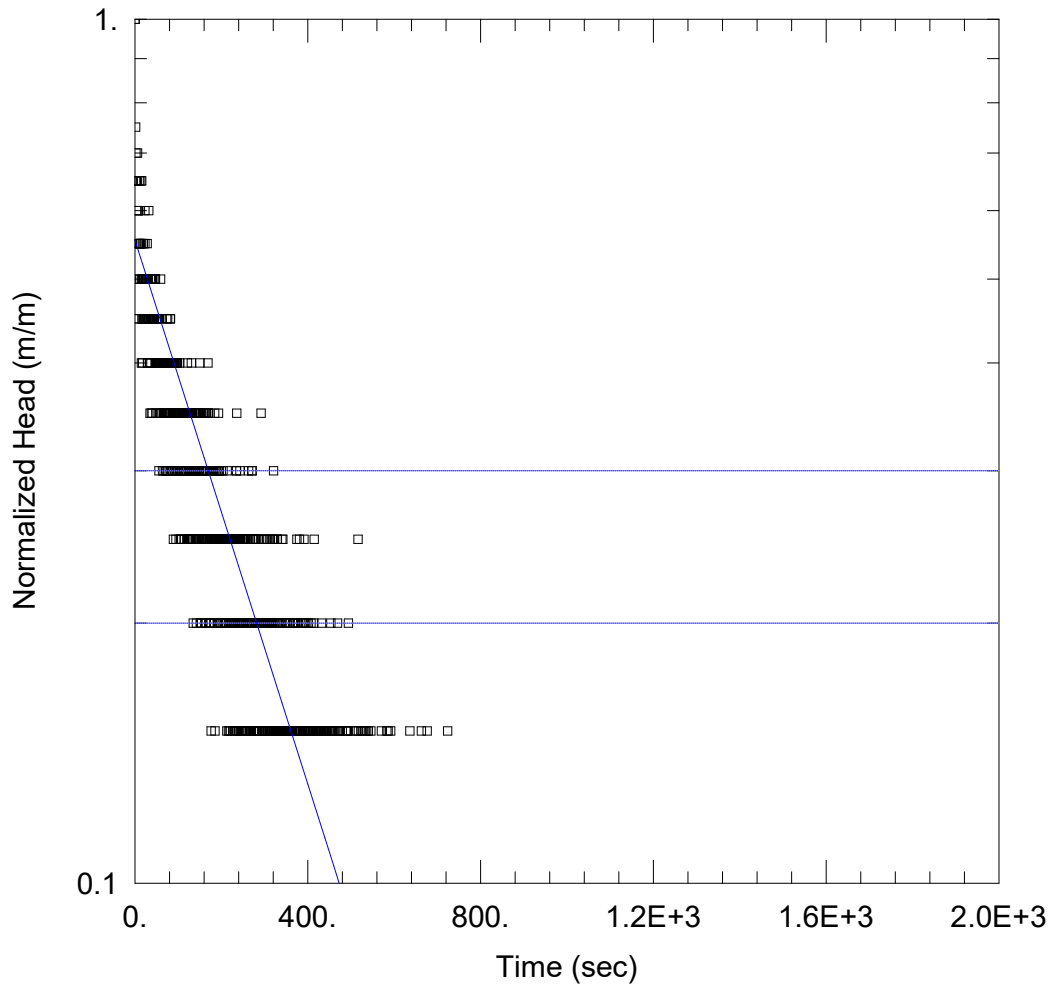
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.0246$ m/day

$y_0 = 0.09826$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) RHT_2 Bouwer-Rice.aqt

Date: 05/24/23

Time: 11:46:42

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 16. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

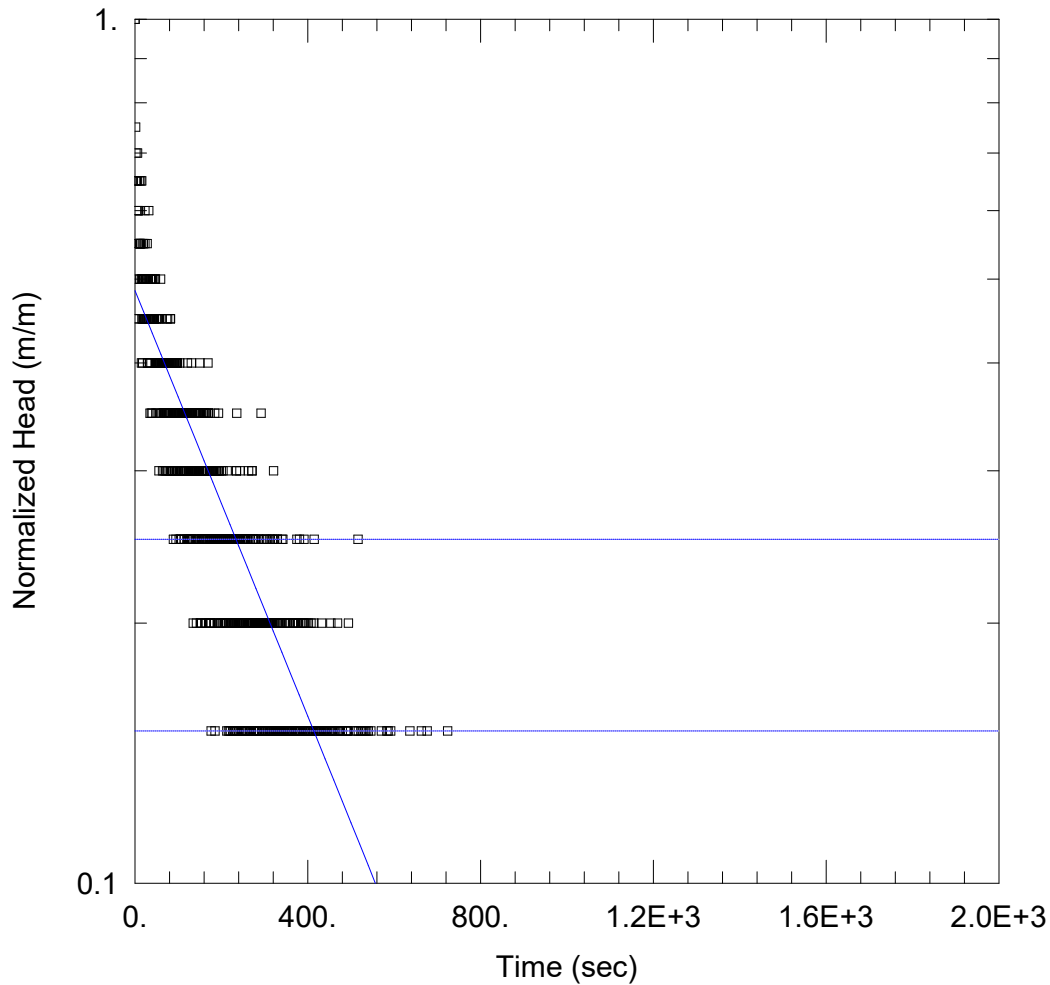
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.02765$ m/day

$y_0 = 0.1109$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) RHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 11:48:50

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 16. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

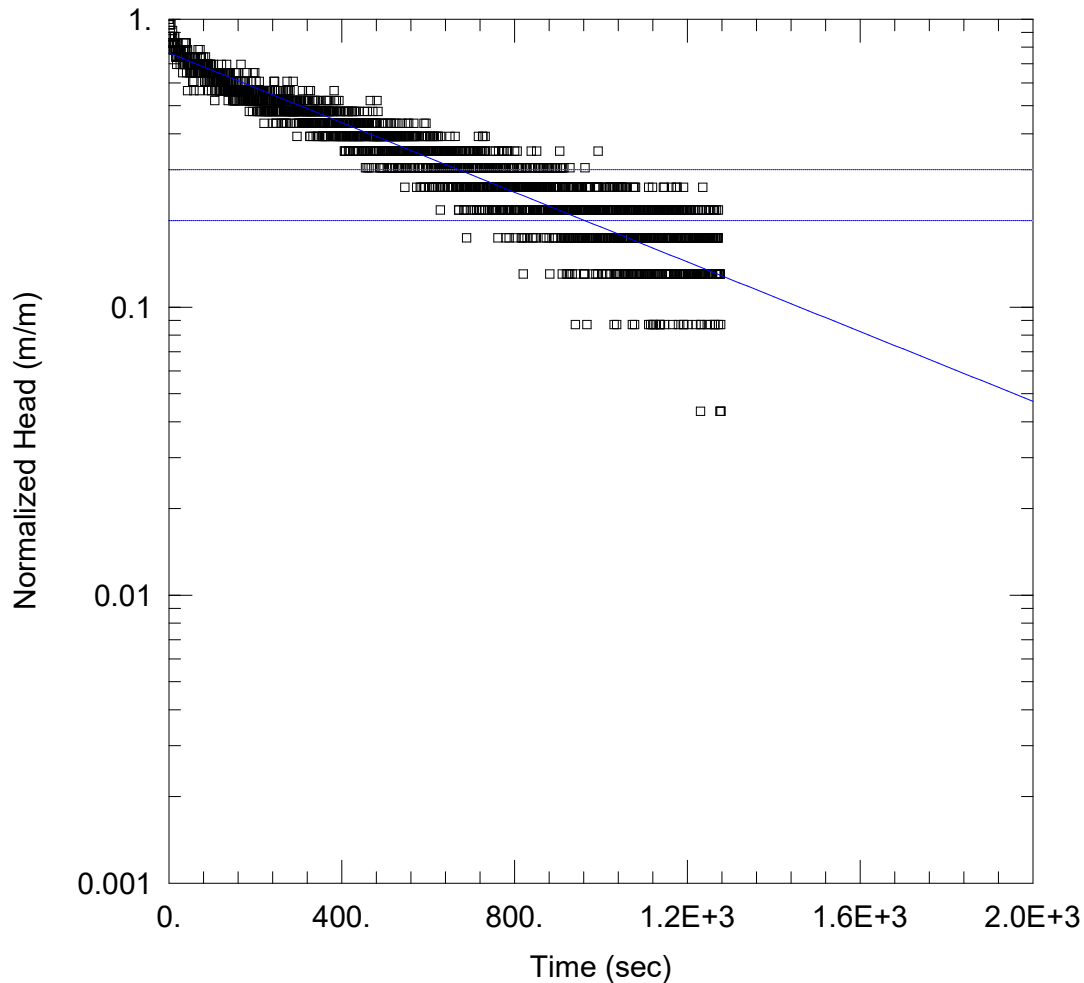
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.02536$ m/day

$y_0 = 0.09701$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) RHT_3 Bouwer-Rice.aqt

Date: 05/24/23

Time: 12:01:45

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 16. m

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.23 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

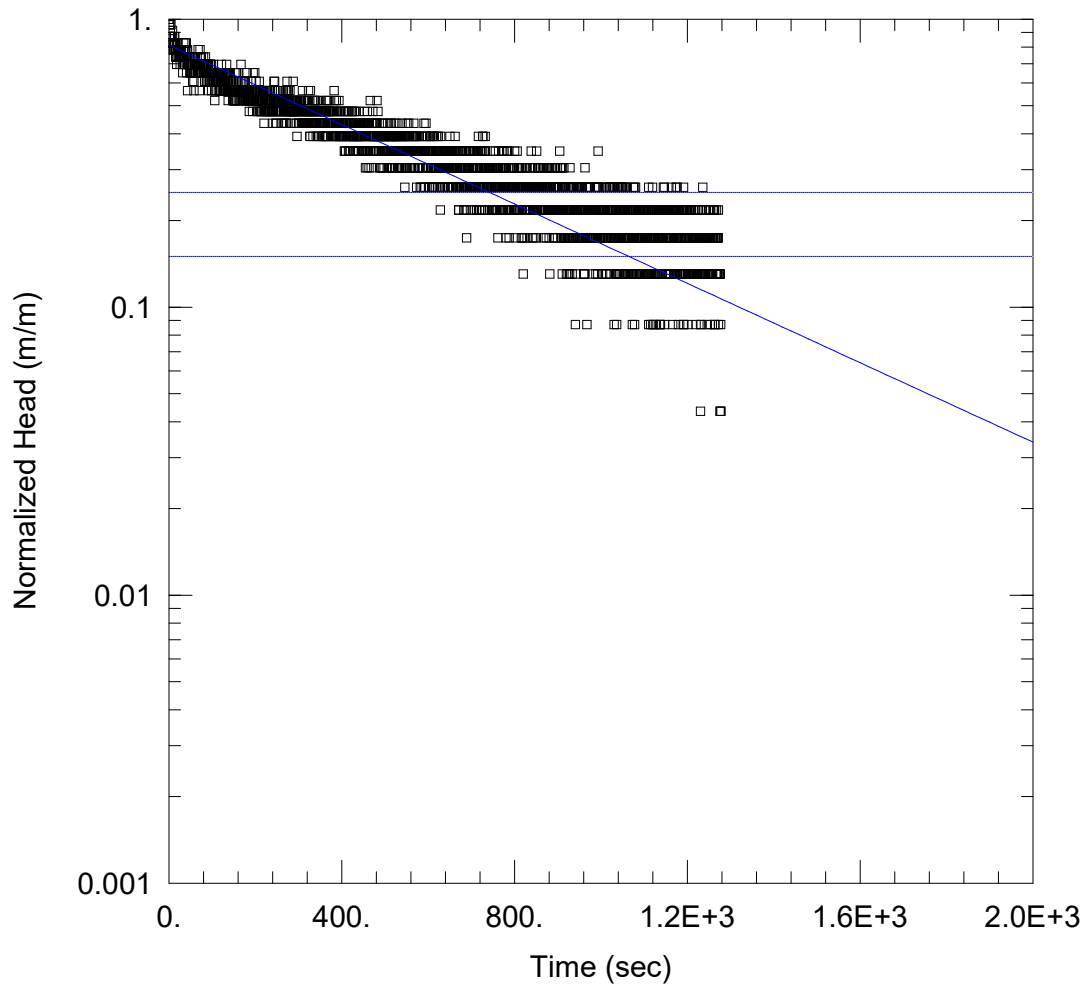
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 0.01063 m/day

y0 = 0.1755 m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 (coal) RHT_3 Hvorslev.aqt

Date: 05/24/23

Time: 12:02:23

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 16. m

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.23 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

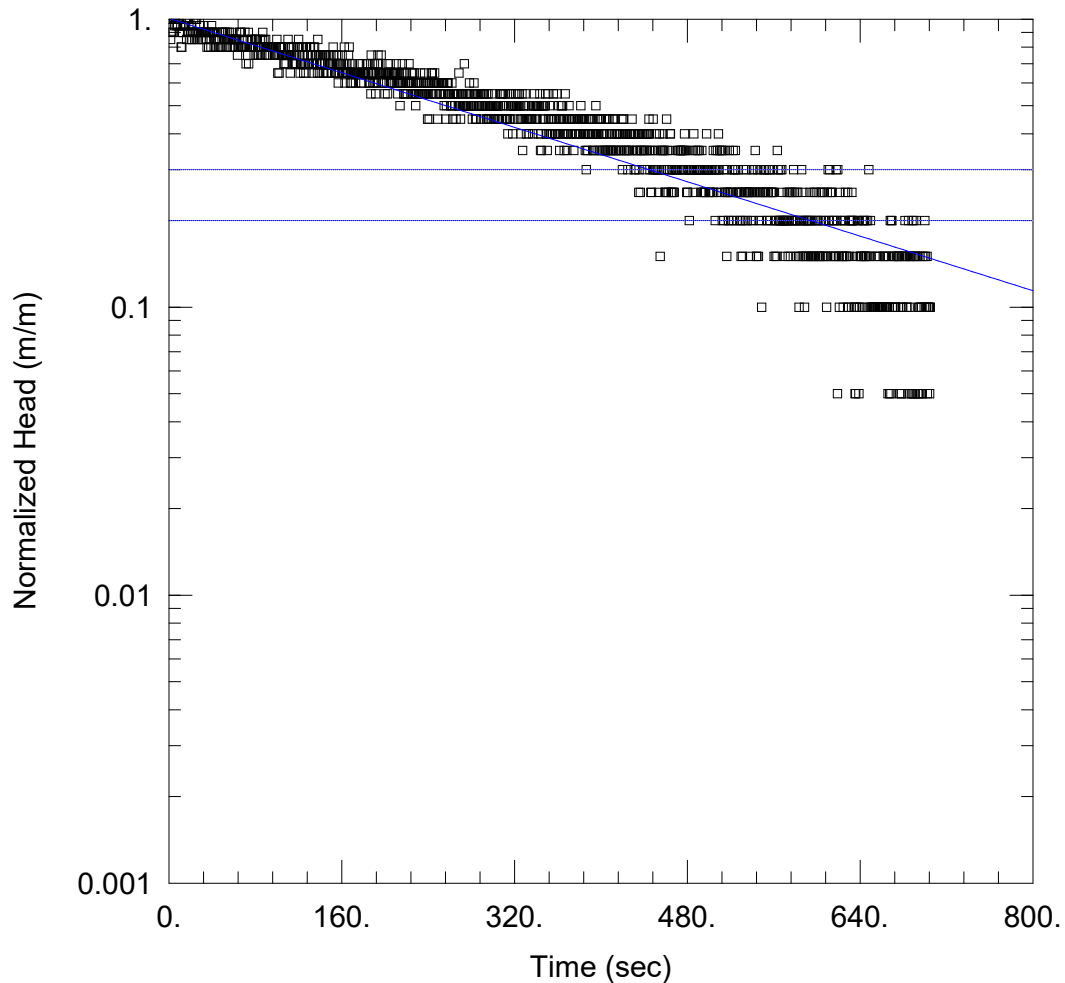
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 0.01419 m/day

y0 = 0.1868 m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 FHT_1 Bouwer-Rice.aqt

Date: 05/24/23

Time: 11:13:13

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

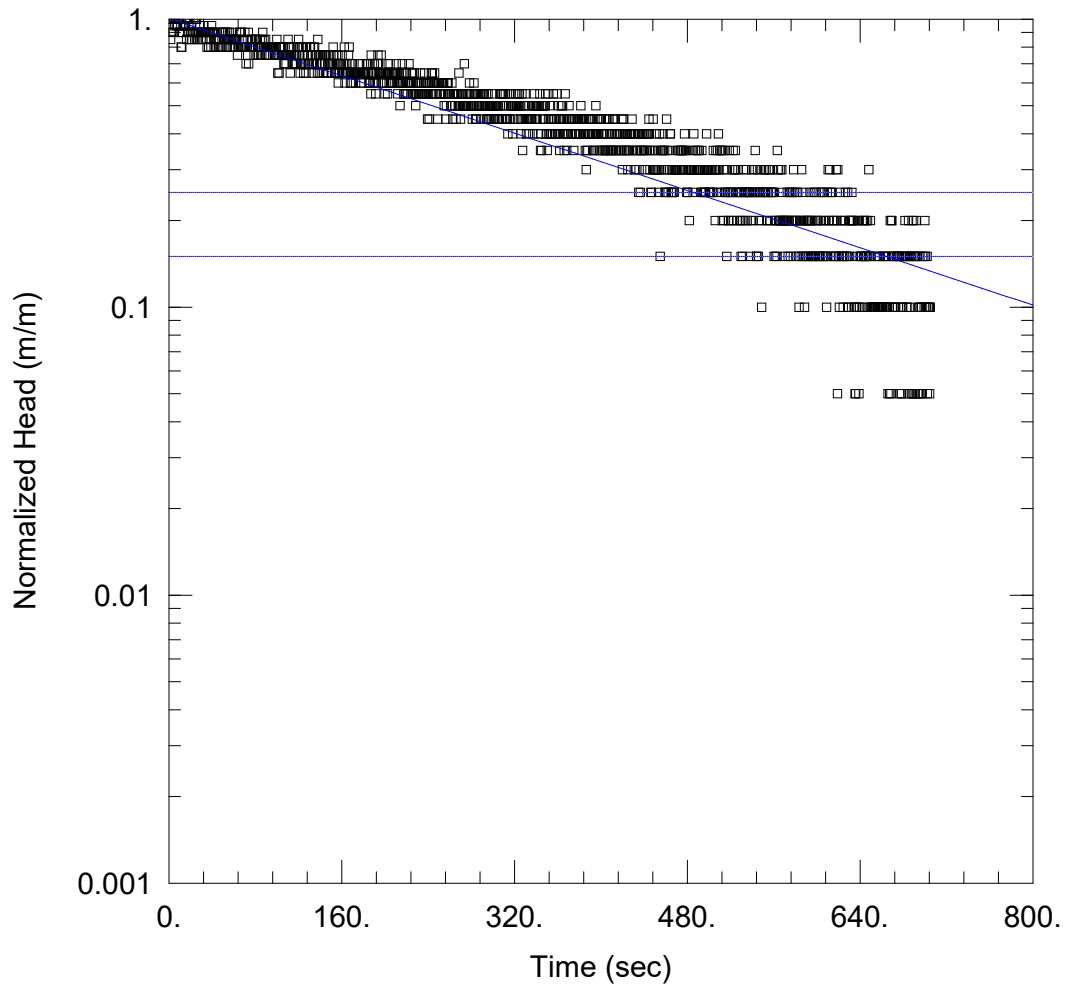
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 0.01275 m/day

y0 = 0.2012 m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 FHT_1_Hvorslev.aqt

Date: 05/24/23

Time: 11:14:08

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

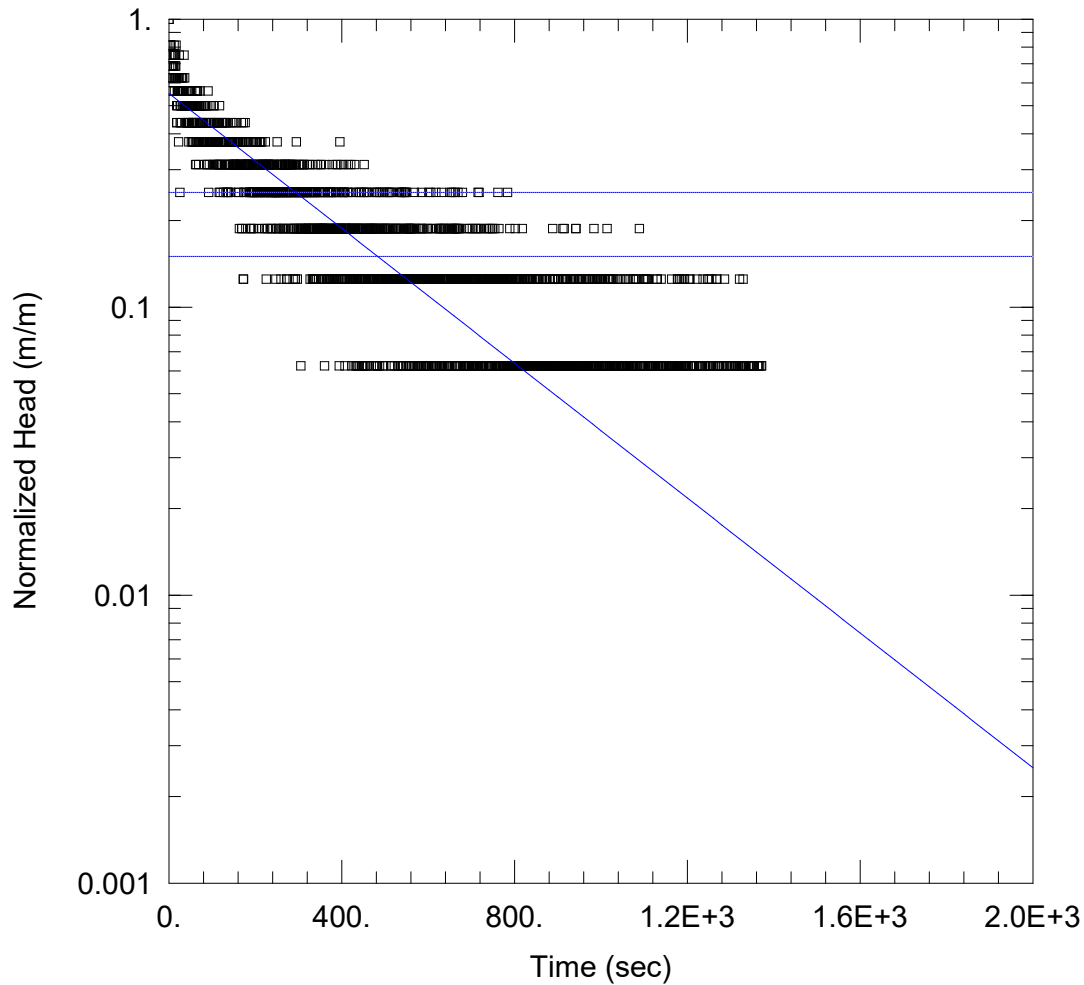
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 0.01519 m/day

y0 = 0.2012 m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 RHT_1_Hvorslev.aqt

Date: 05/24/23

Time: 11:25:52

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.16 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

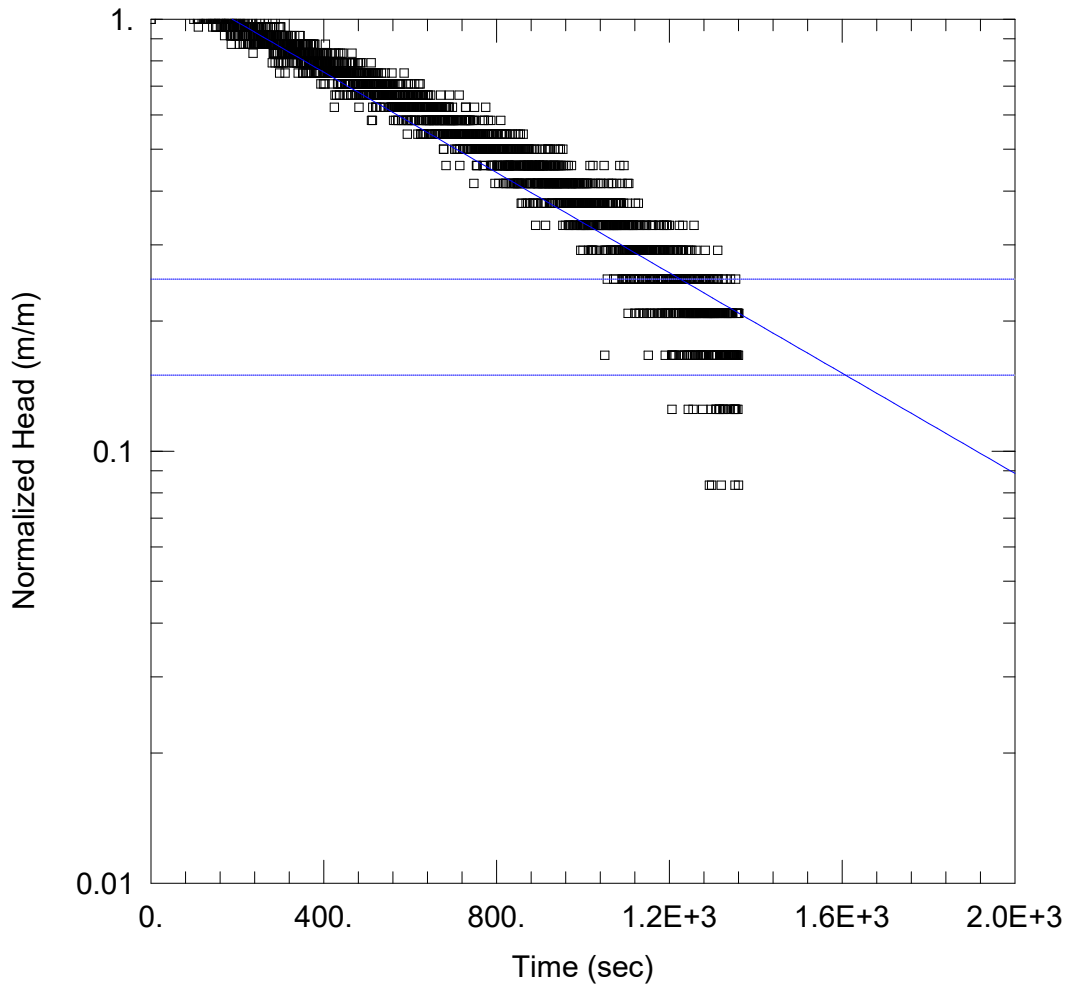
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01428$ m/day

$y_0 = 0.08826$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 FHT_2_Hvorslev.aqt

Date: 05/24/23

Time: 11:31:36

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.24 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

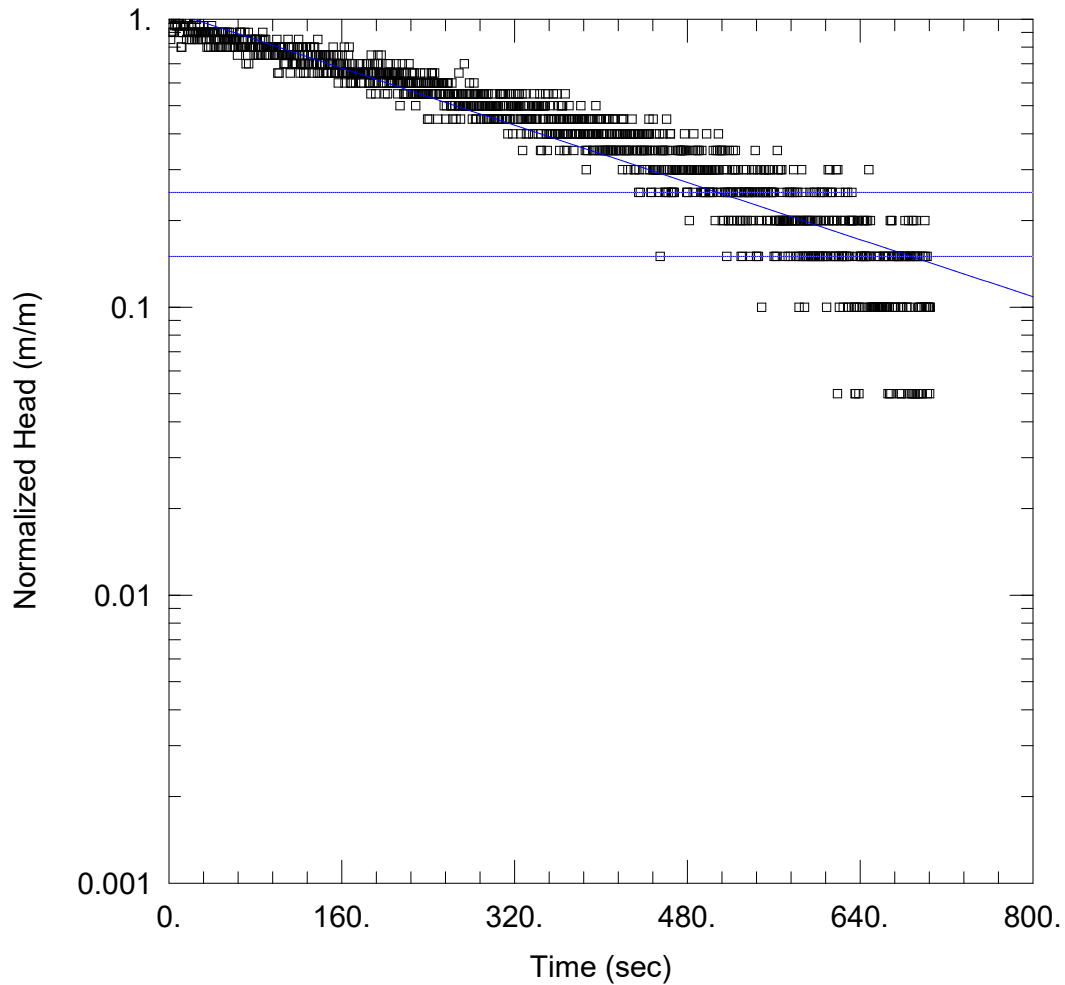
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.007083$ m/day

$y_0 = 0.3087$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 FHT_1 Bouwer-Rice.aqt

Date: 05/24/23

Time: 10:43:21

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 14.54 m

Total Well Penetration Depth: 71.6 m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

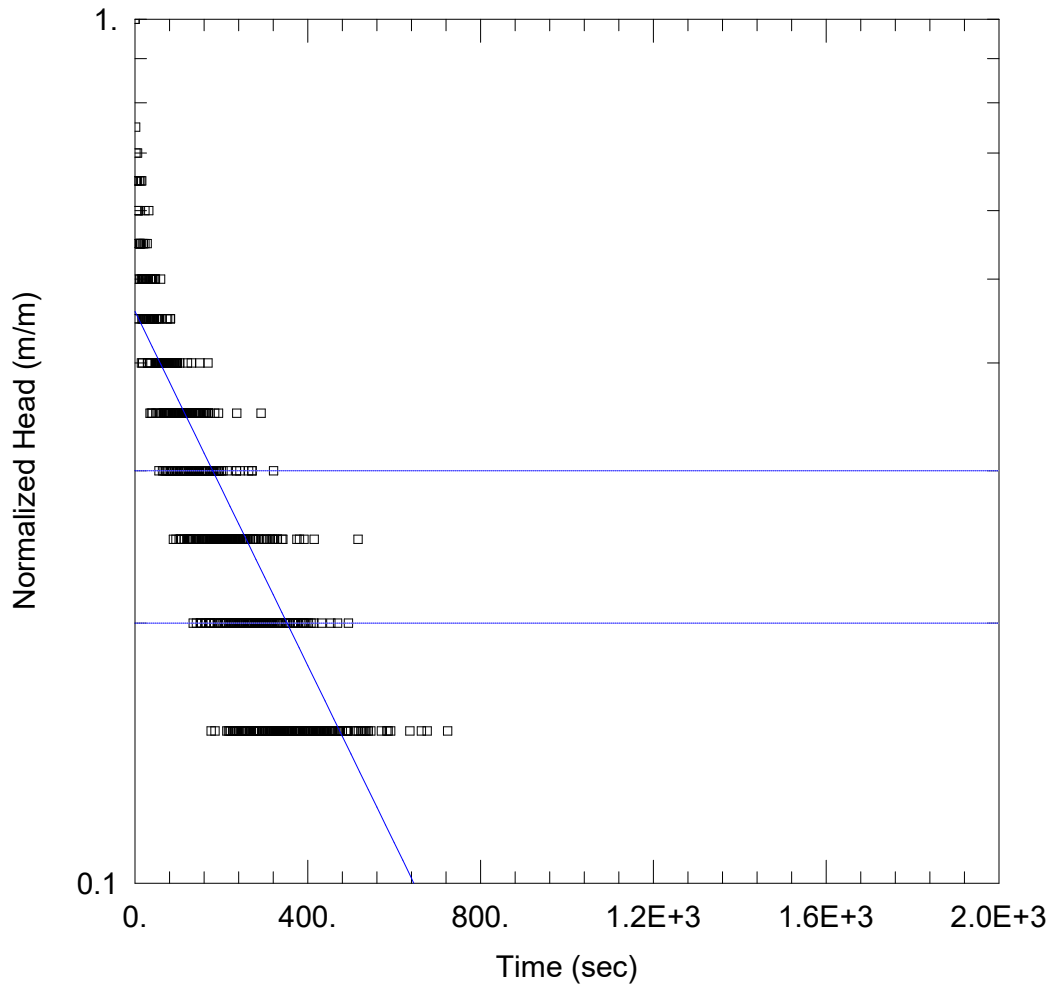
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.02204$ m/day

$y_0 = 0.2135$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 RHT_2 Bouwer-Rice.aqt

Date: 05/24/23

Time: 11:43:16

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

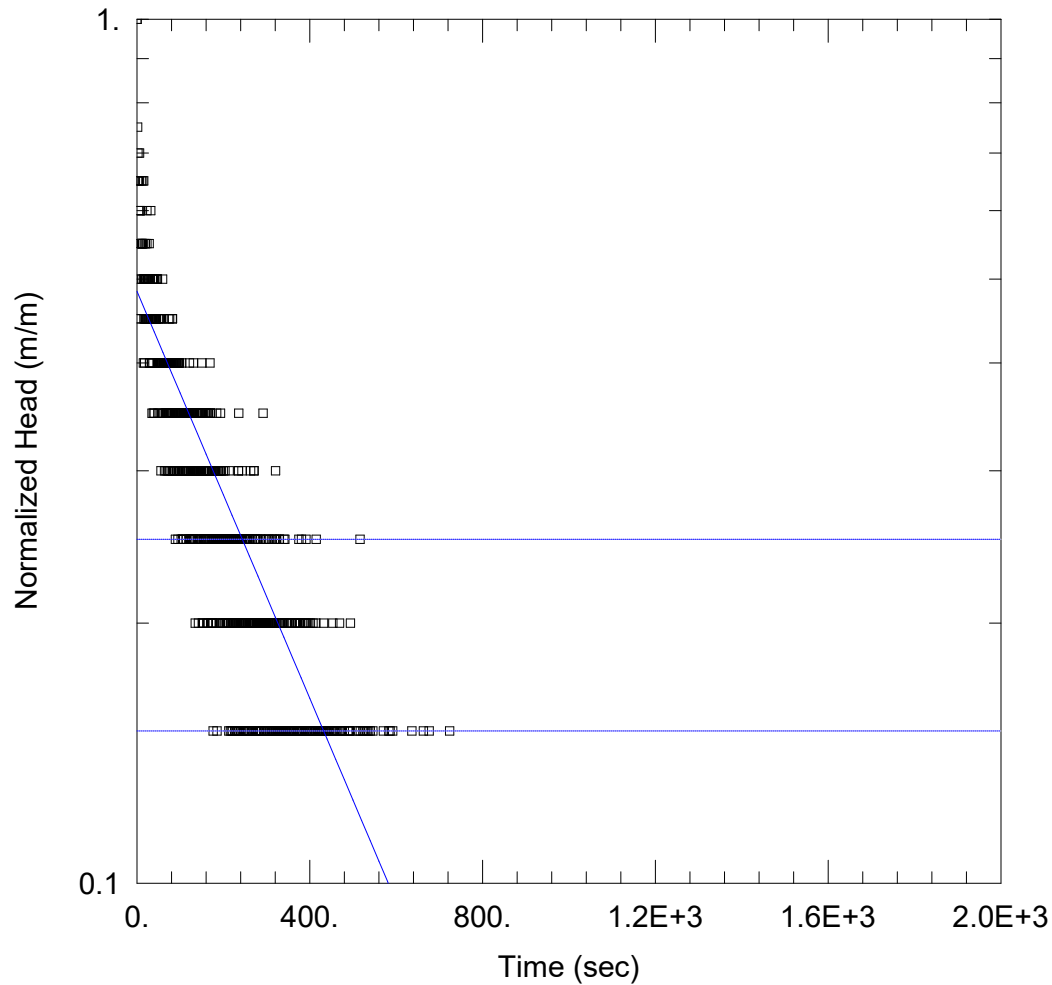
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.01105$ m/day

$y_0 = 0.09177$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 RHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 11:45:00

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.2 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

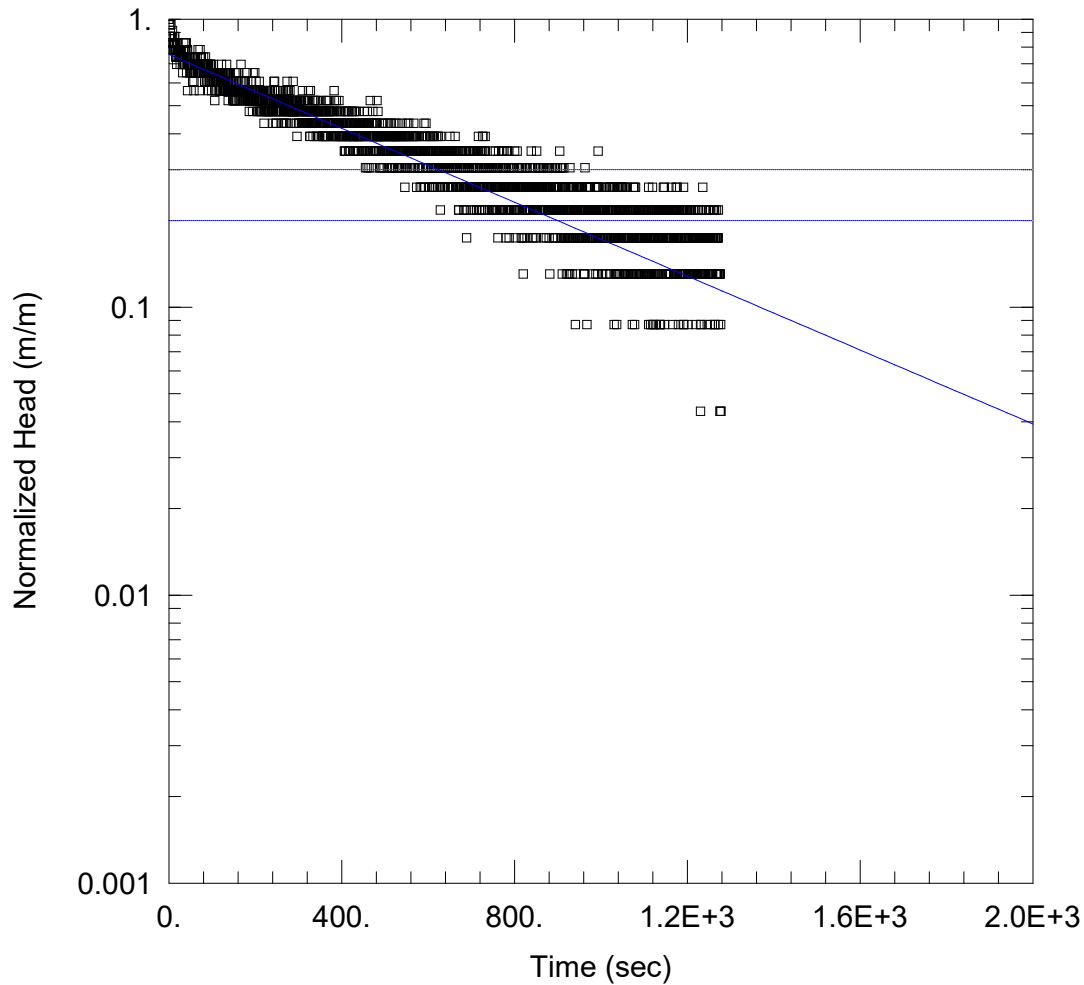
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01437$ m/day

$y_0 = 0.09681$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 RHT_3 Bouwer-Rice.aqt

Date: 05/24/23

Time: 11:56:39

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.23 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

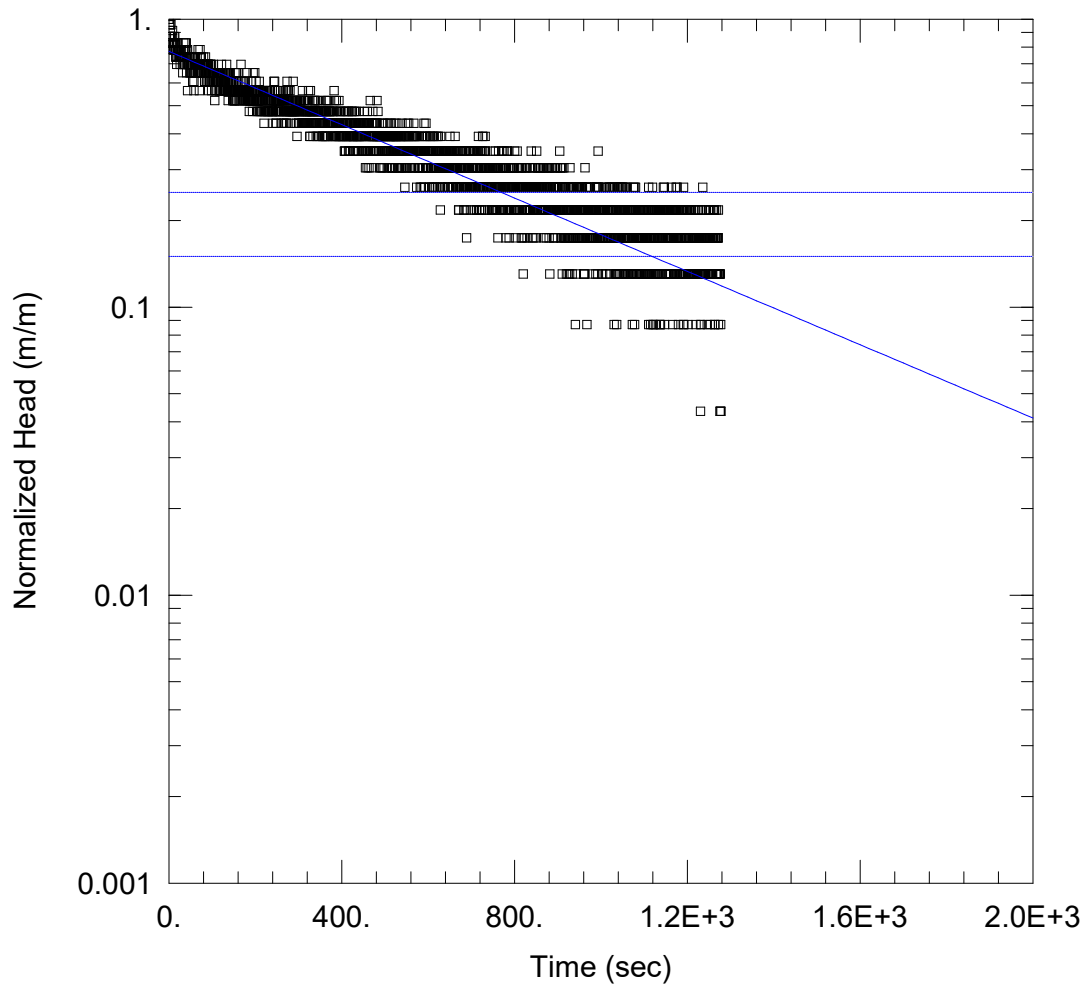
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.006919$ m/day

$y_0 = 0.1734$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_40 RHT_3 Hvorslev.aqt

Date: 05/24/23

Time: 12:00:22

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_40

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 27. m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_40)

Initial Displacement: 0.23 m

Static Water Column Height: 71.46 m

Total Well Penetration Depth: 27. m

Screen Length: 27. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

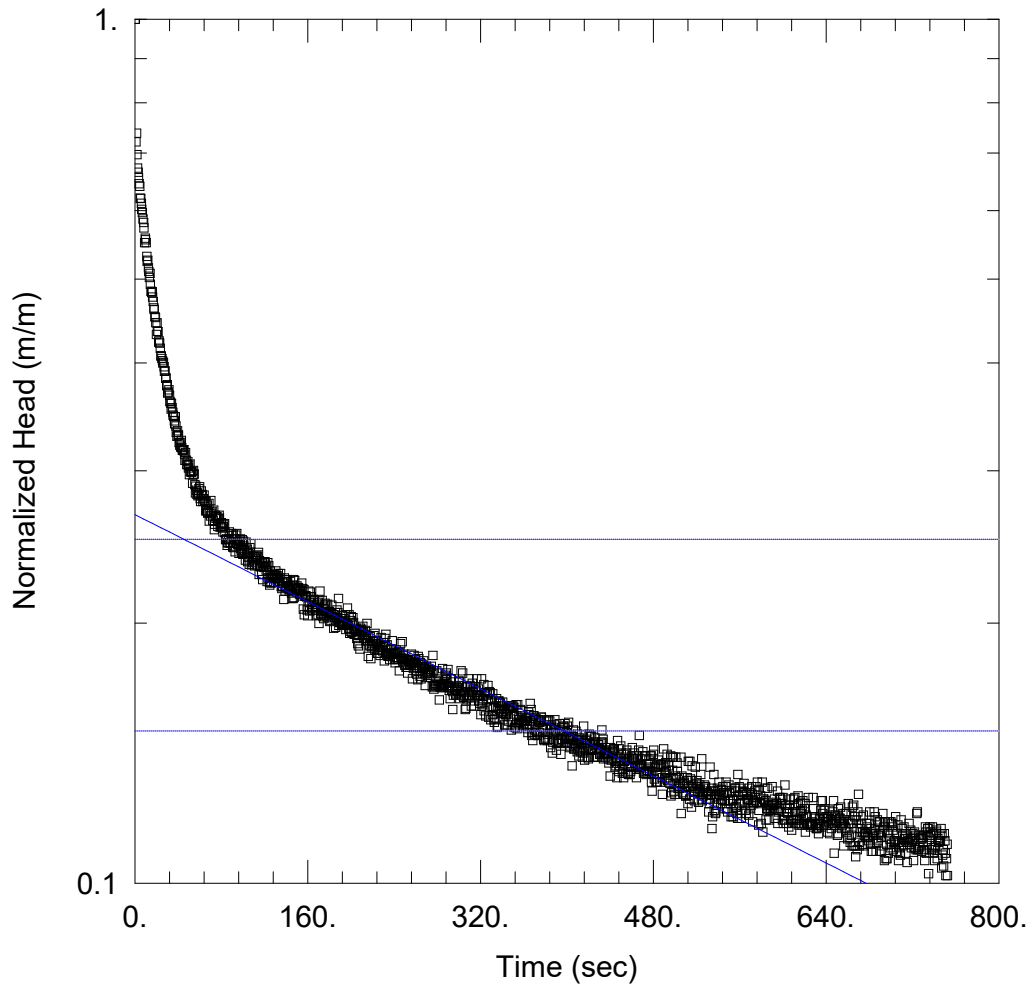
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.007767$ m/day

$y_0 = 0.1777$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a RHT_4 Hvorslev.aqt

Date: 05/24/23

Time: 12:59:37

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.902 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

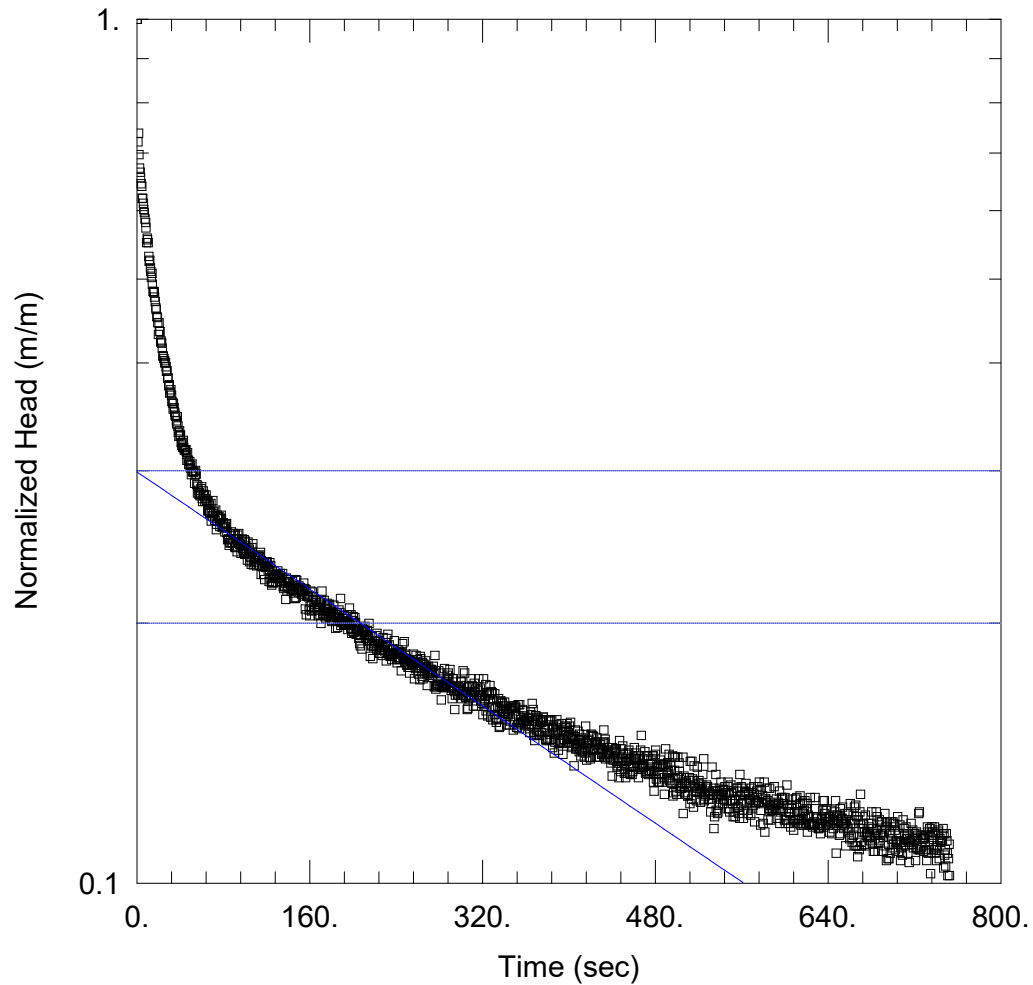
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.02084$ m/day

$y_0 = 0.5078$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a RHT_4 Bouwer_Rice.aqt

Date: 05/24/23

Time: 12:58:46

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.902 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

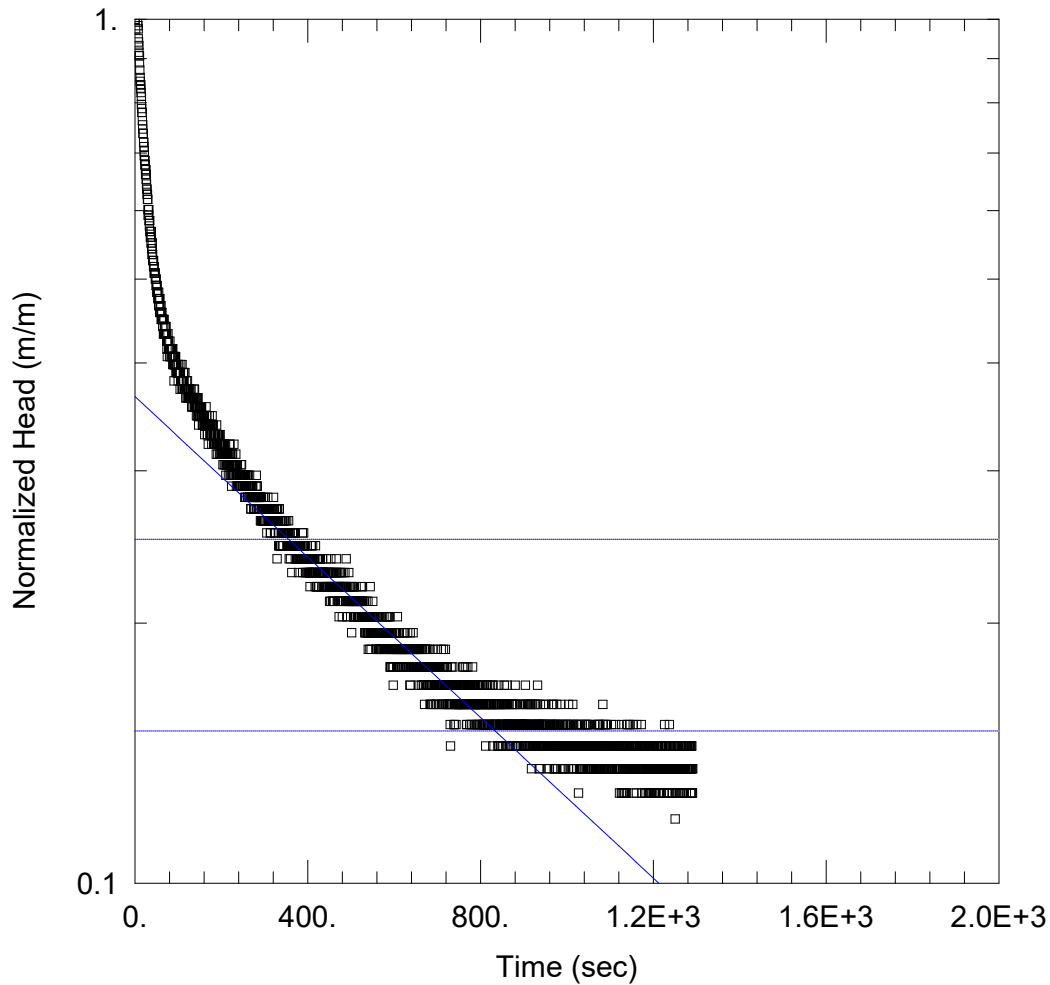
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.02153$ m/day

$y_0 = 0.569$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a RHT_3 Hvorslev.aqt

Date: 05/24/23

Time: 12:53:21

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.18 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

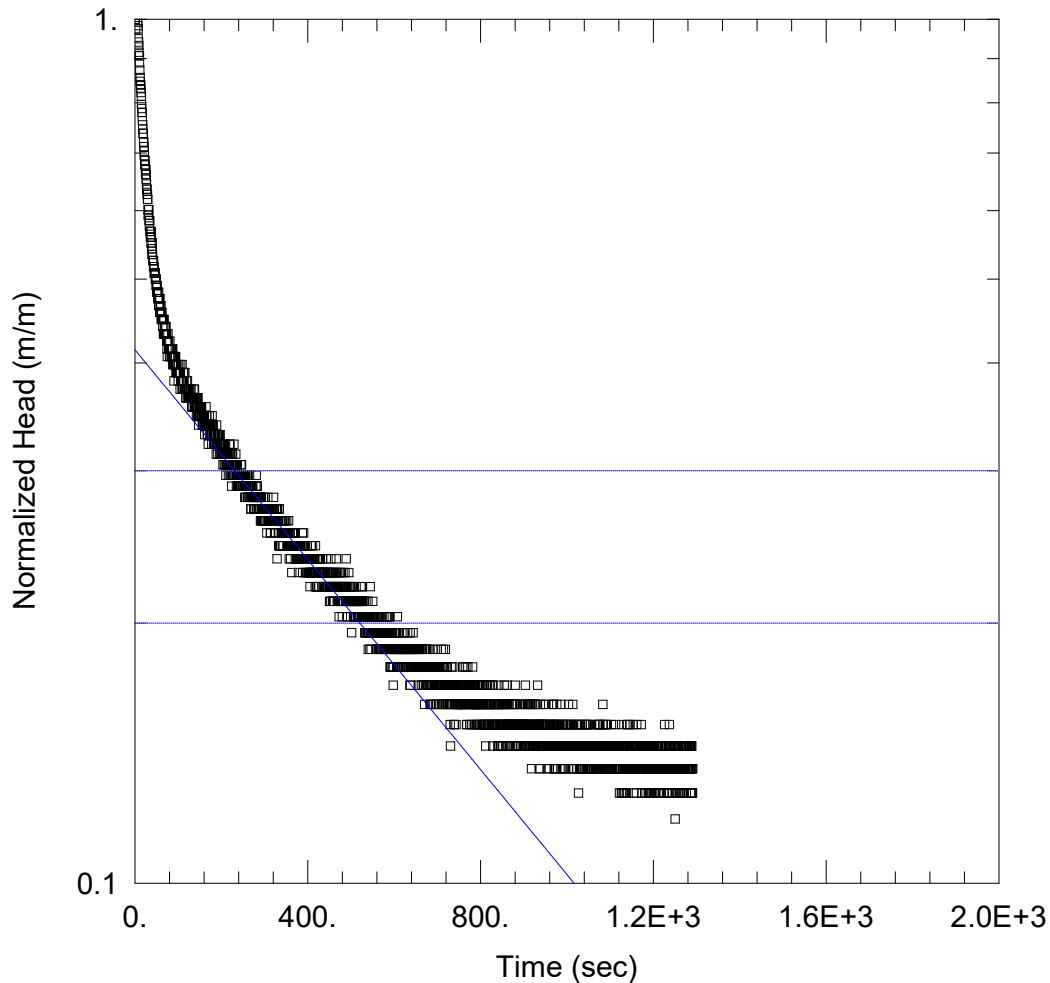
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01536$ m/day

$y_0 = 0.4315$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a RHT_3 Bouwer_Rice.aqt

Date: 05/24/23

Time: 12:54:07

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.18 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

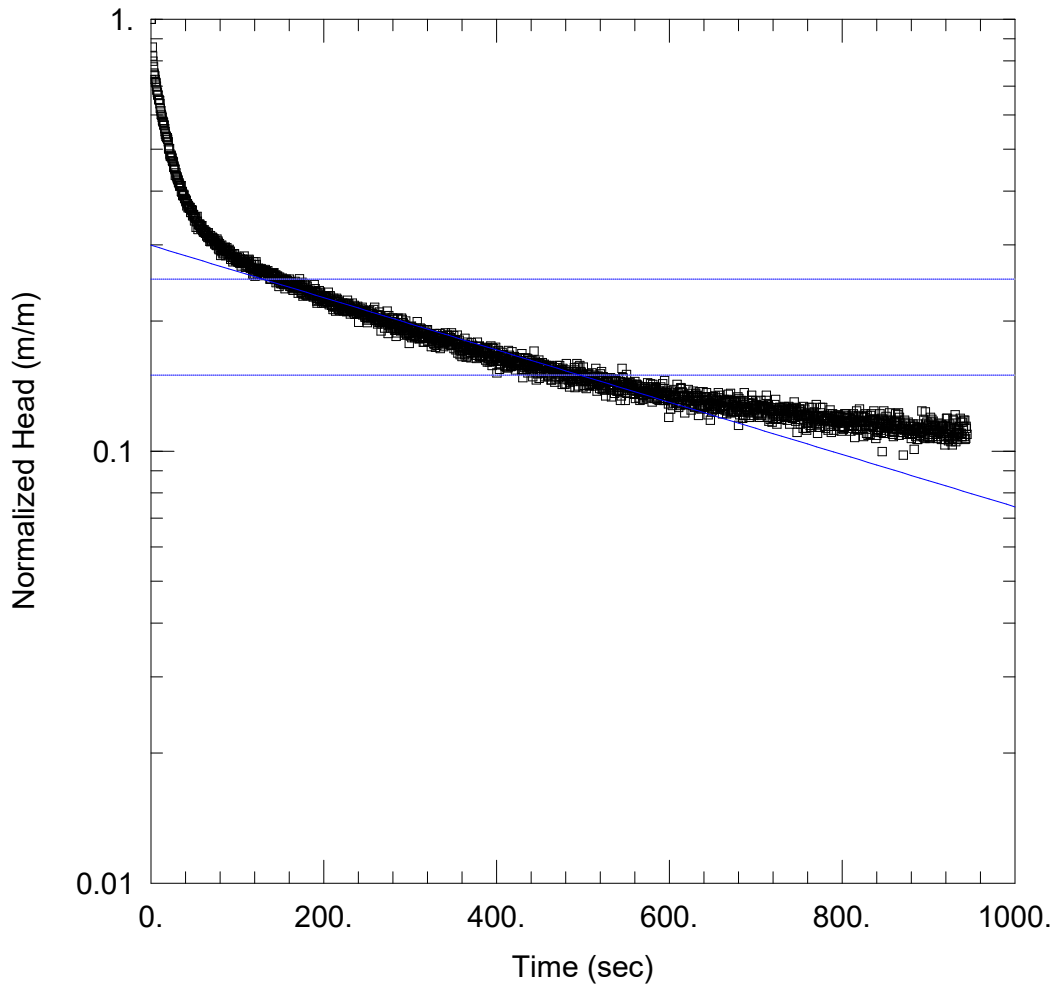
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.01544$ m/day

$y_0 = 0.4887$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a RHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 12:47:03

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.655 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

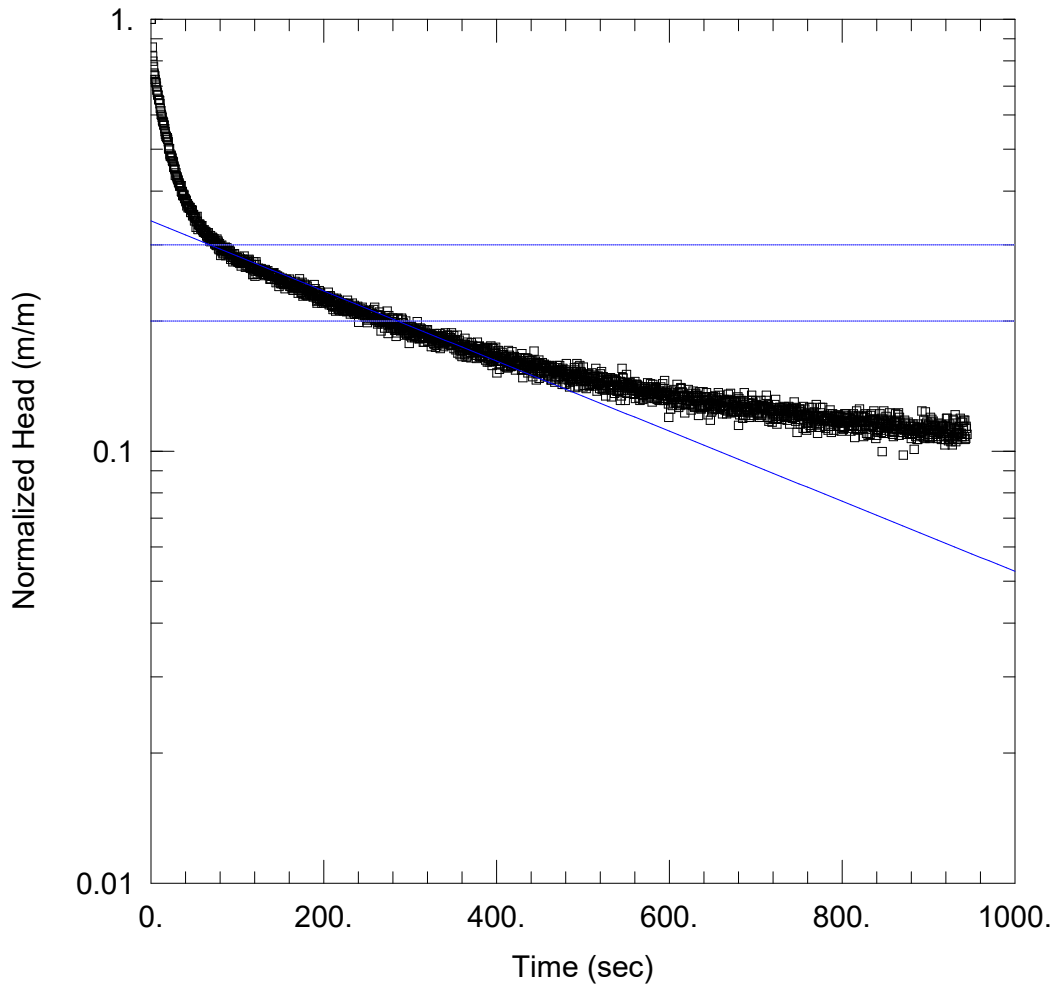
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.02002$ m/day

$y_0 = 0.4957$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a RHT_2 Bouwer_Rice.aqt

Date: 05/24/23

Time: 12:46:15

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.655 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

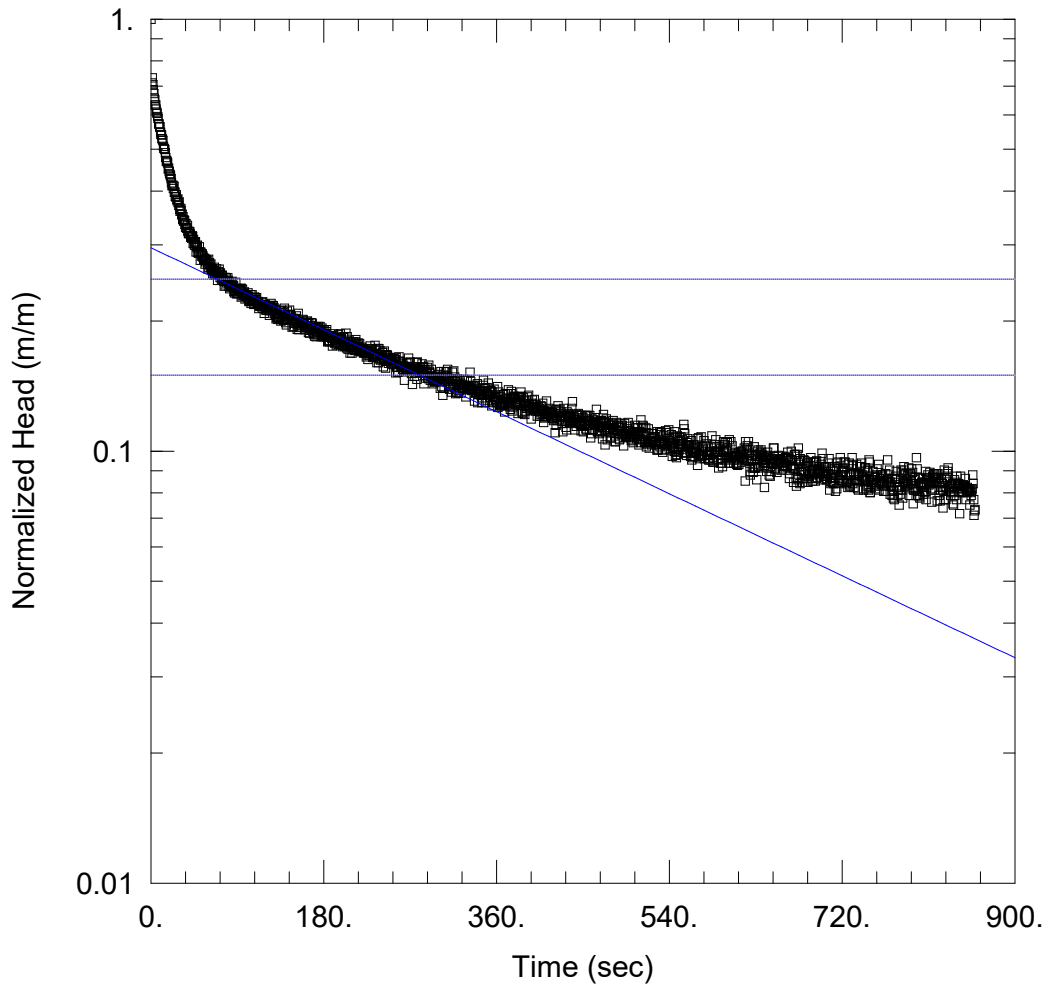
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.02062$ m/day

$y_0 = 0.5644$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a RHT_1_Hvorslev.aqt

Date: 05/24/23

Time: 12:41:24

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (New Well)

Initial Displacement: 1.76 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

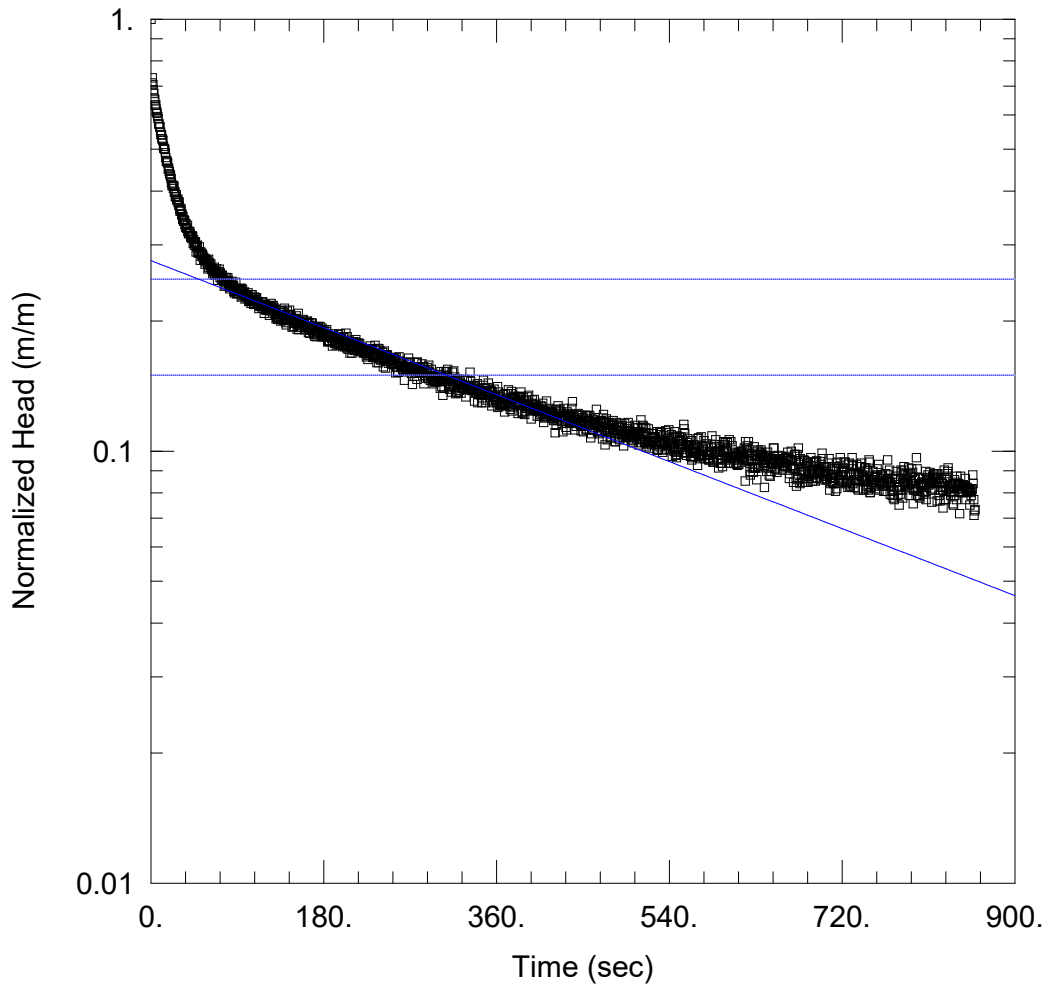
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.03488$ m/day

$y_0 = 0.5203$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a RHT_1 Bouwer_Rice.aqt

Date: 05/24/23

Time: 12:31:01

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (New Well)

Initial Displacement: 1.76 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

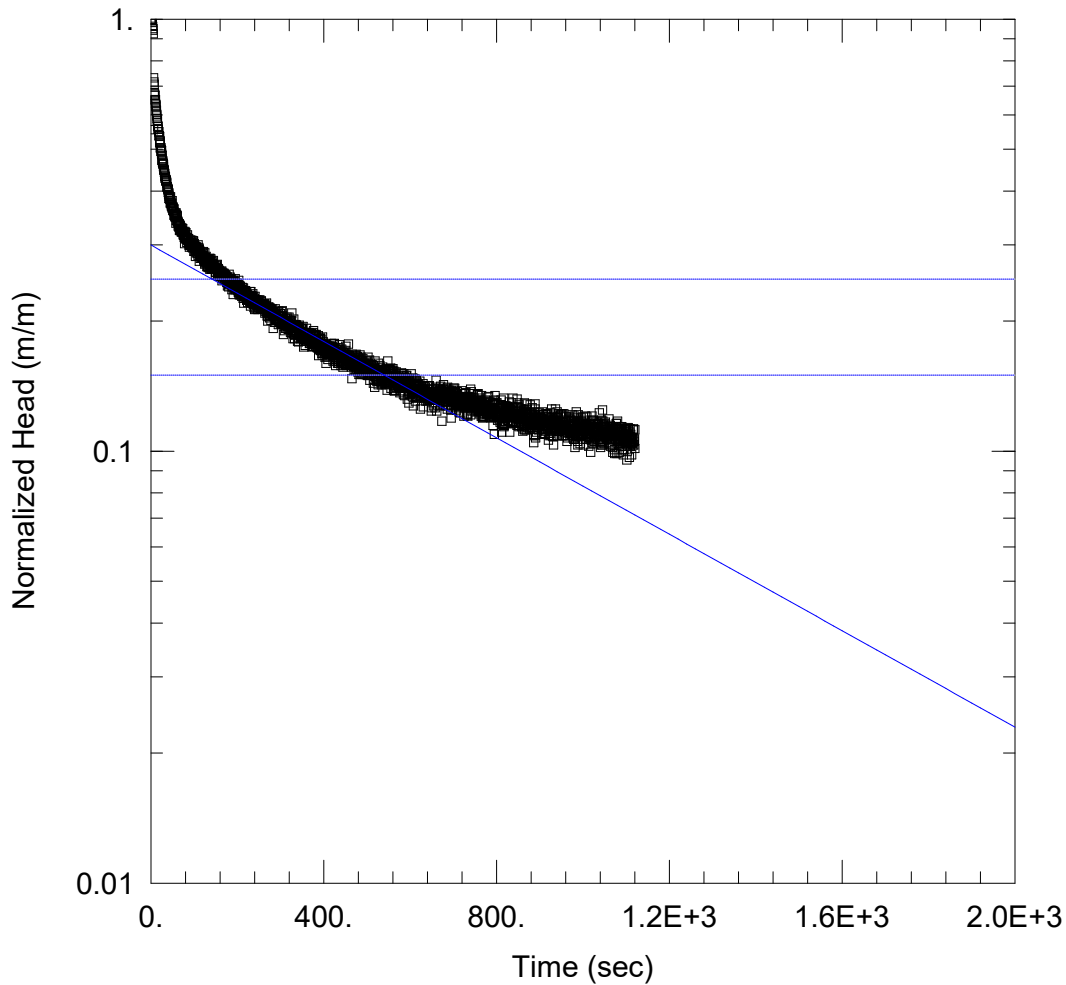
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.02849$ m/day

$y_0 = 0.4857$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a FHT_4 Hvorslev.aqt

Date: 05/24/23

Time: 12:56:19

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.509 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

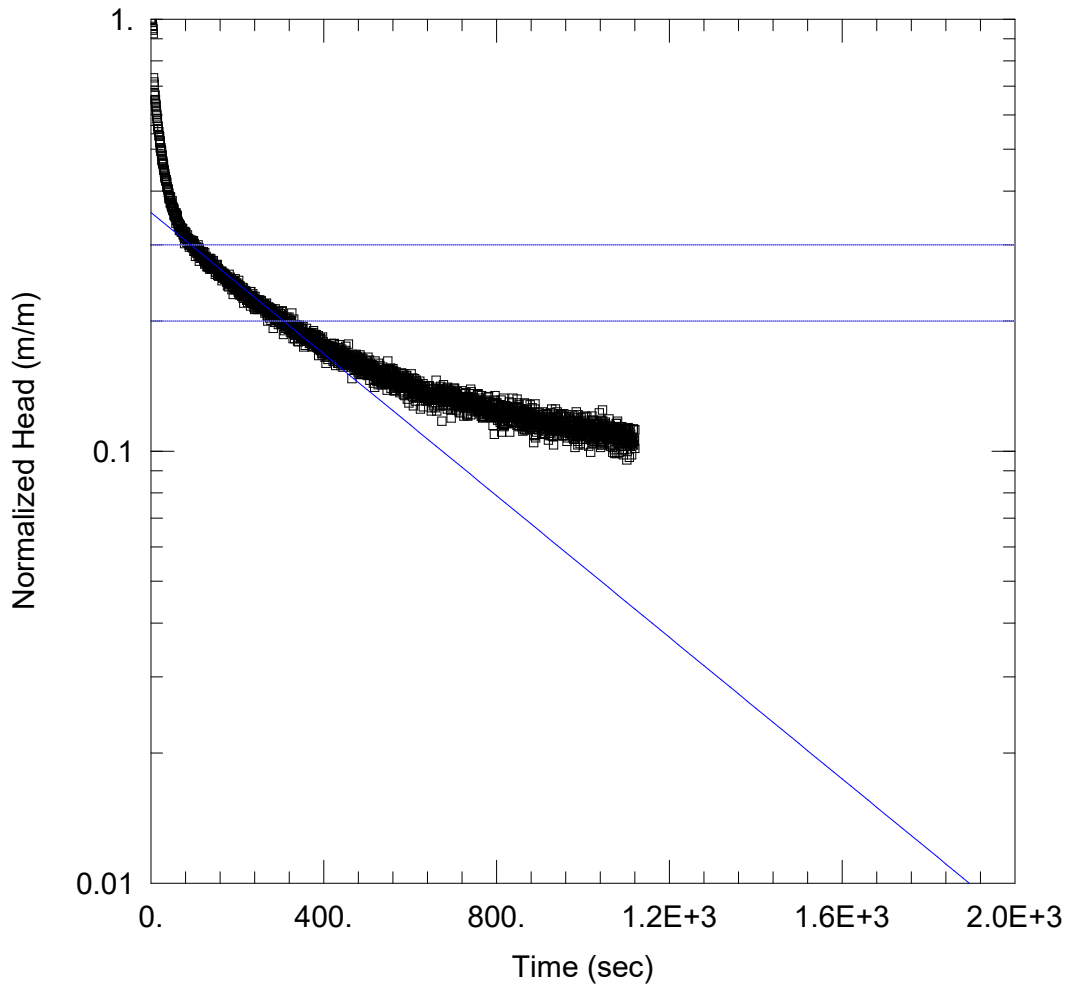
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01845$ m/day

$y_0 = 0.4526$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a FHT_4 Bouwer Rice.aqt

Date: 05/24/23

Time: 12:55:14

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.509 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

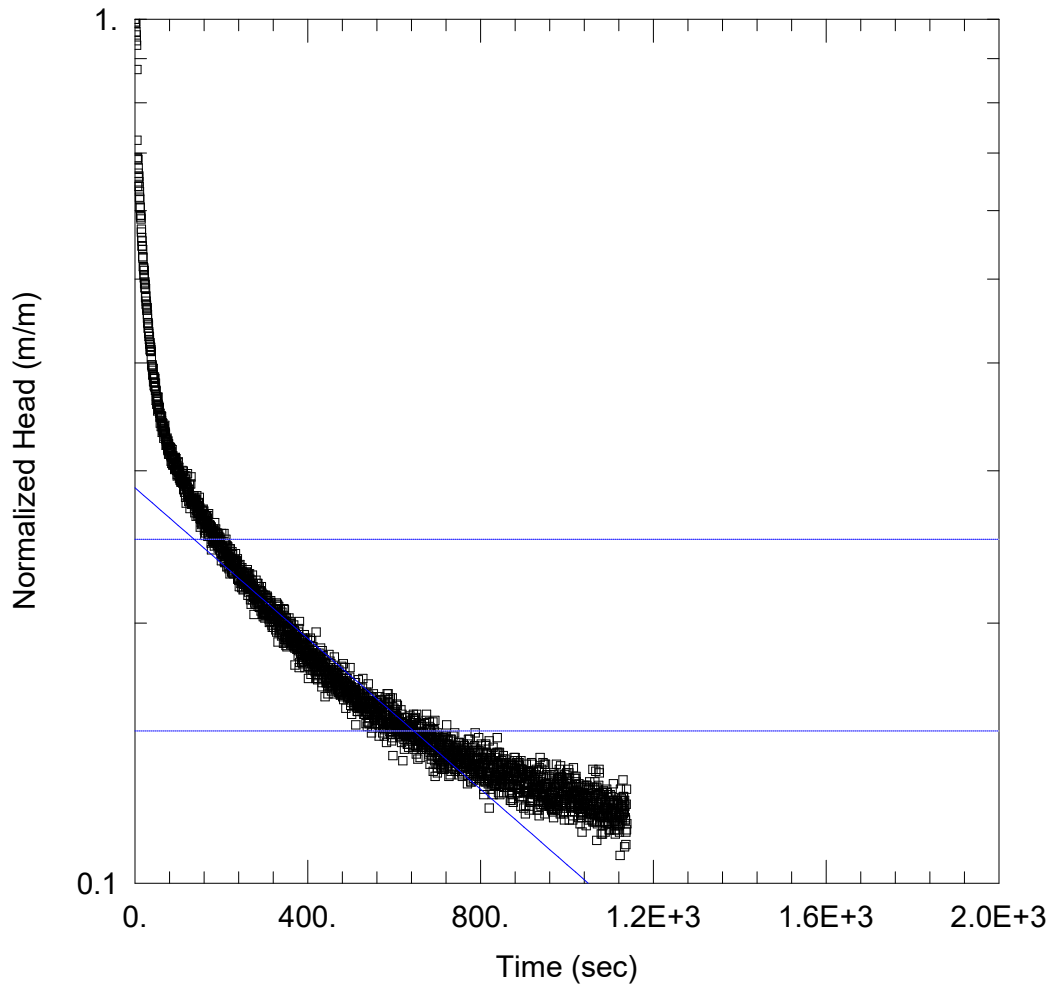
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.02084$ m/day

$y_0 = 0.5386$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a FHT_3 Hvorslev.aqt

Date: 05/24/23

Time: 12:50:17

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.588 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

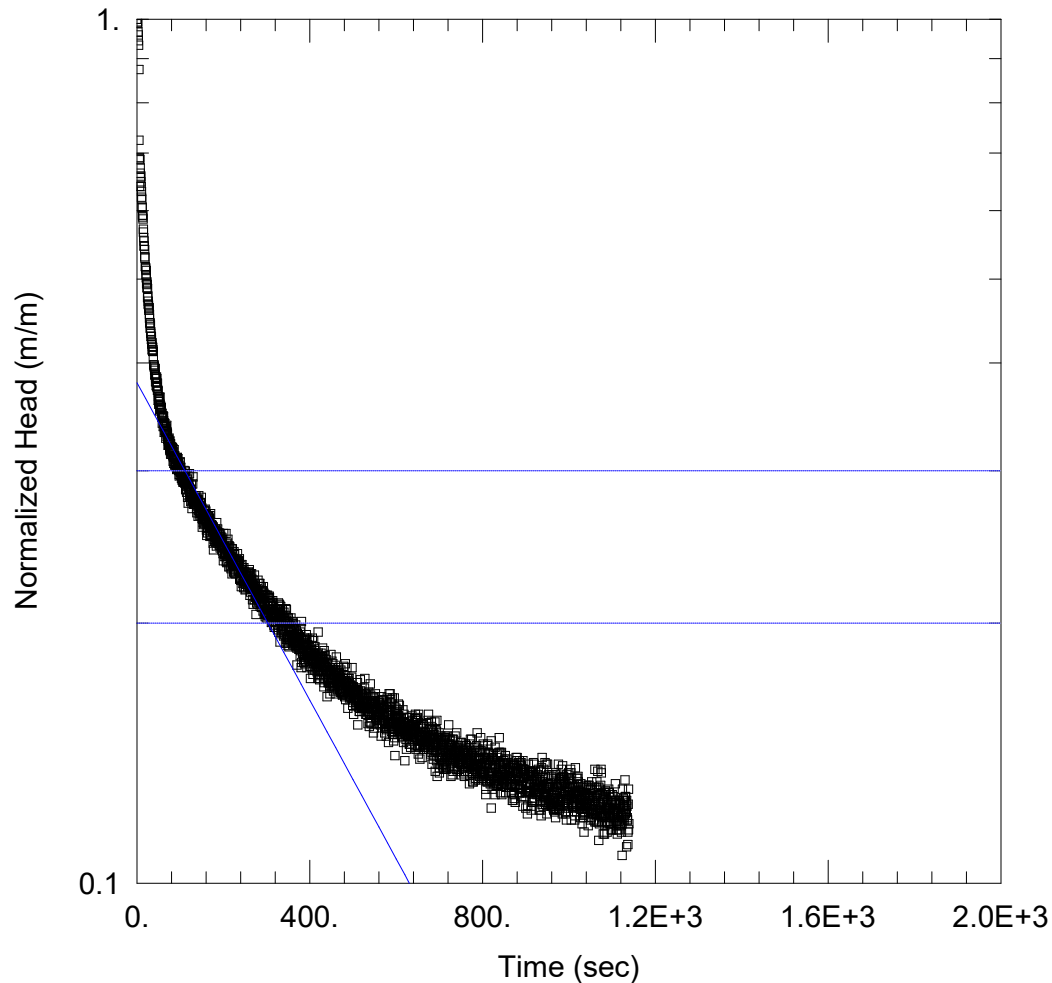
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01442$ m/day

$y_0 = 0.4554$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a FHT_3 Bouwer Rice.aqt

Date: 05/24/23

Time: 12:49:41

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.588 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

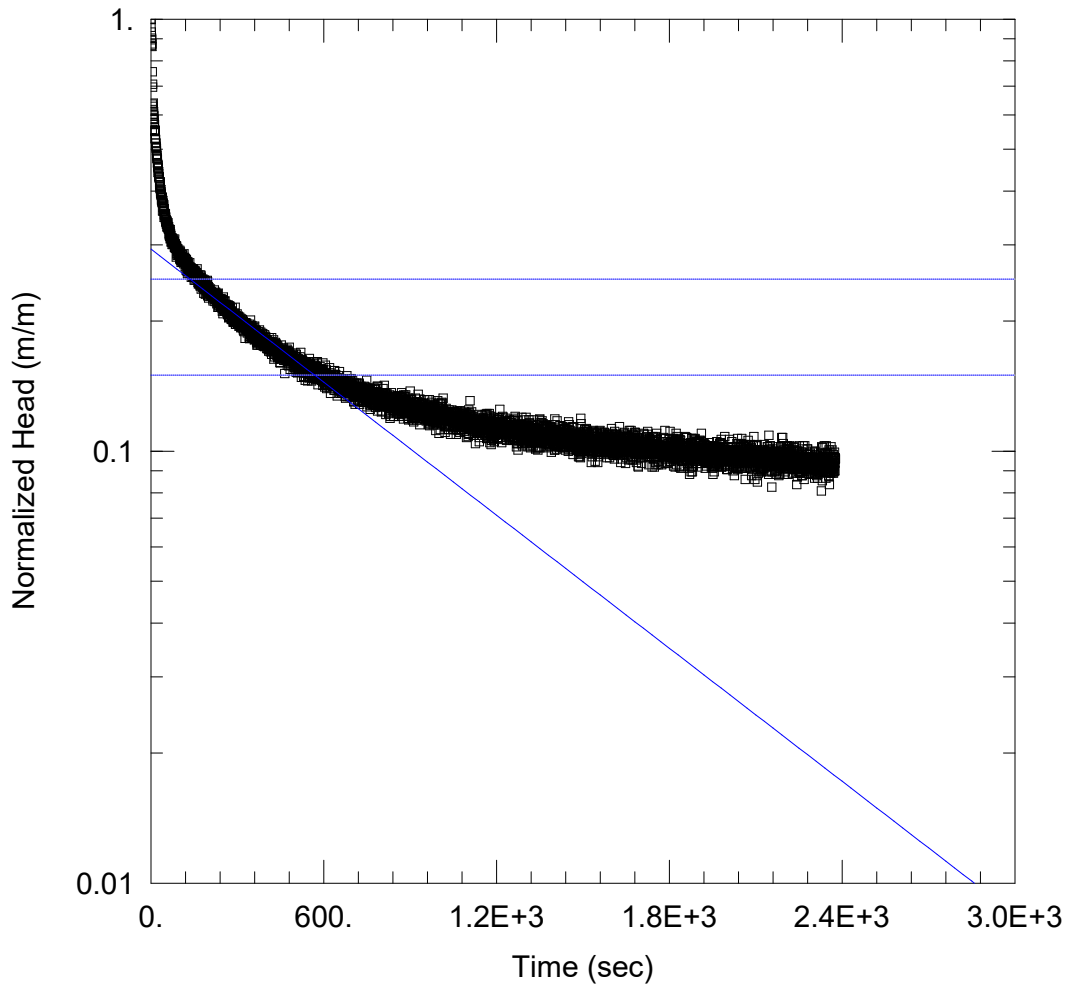
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.02335$ m/day

$y_0 = 0.6027$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a FHT_2 Hvorslev.aqt

Date: 05/24/23

Time: 12:44:19

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.72 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

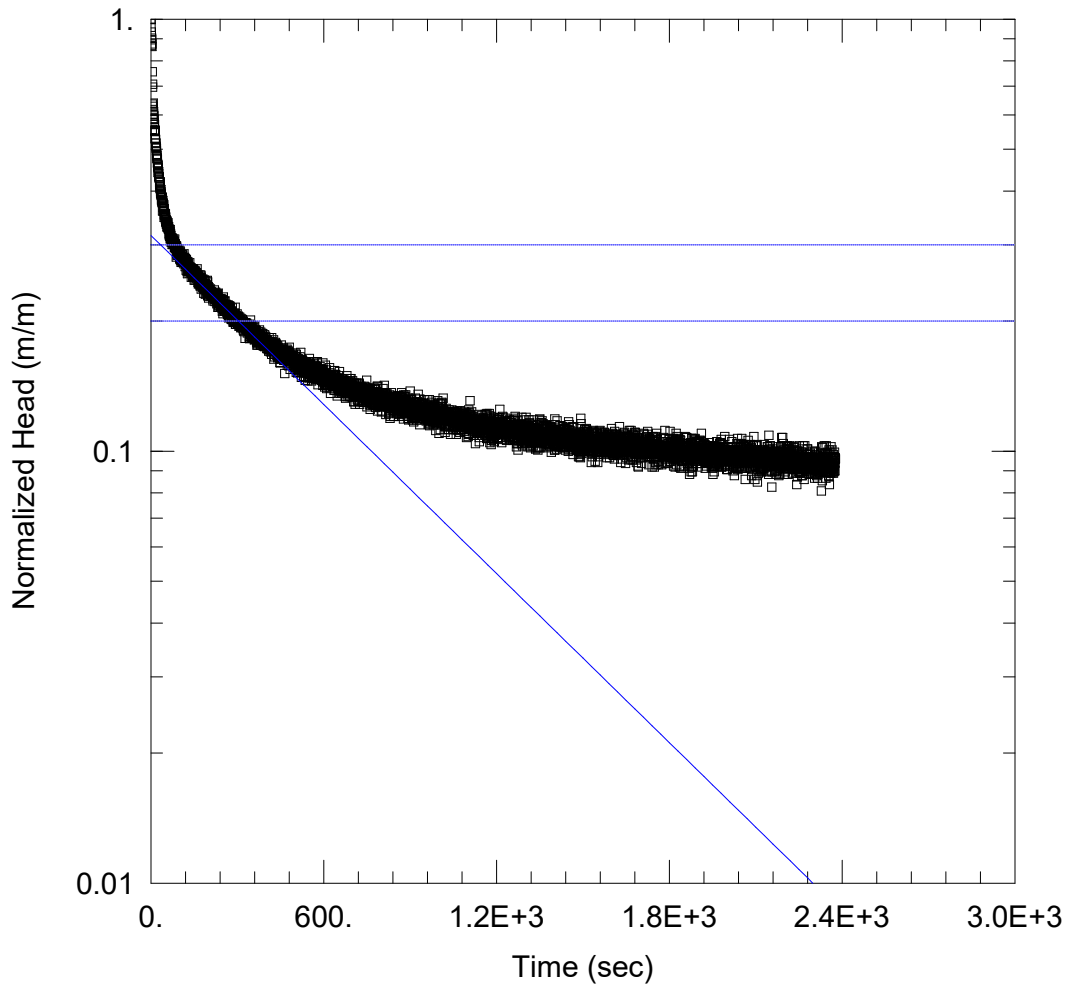
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.01698$ m/day

$y_0 = 0.5048$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a FHT_2 Bouwer Rice.aqt

Date: 05/24/23

Time: 12:43:40

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (GW19_37a)

Initial Displacement: 1.72 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

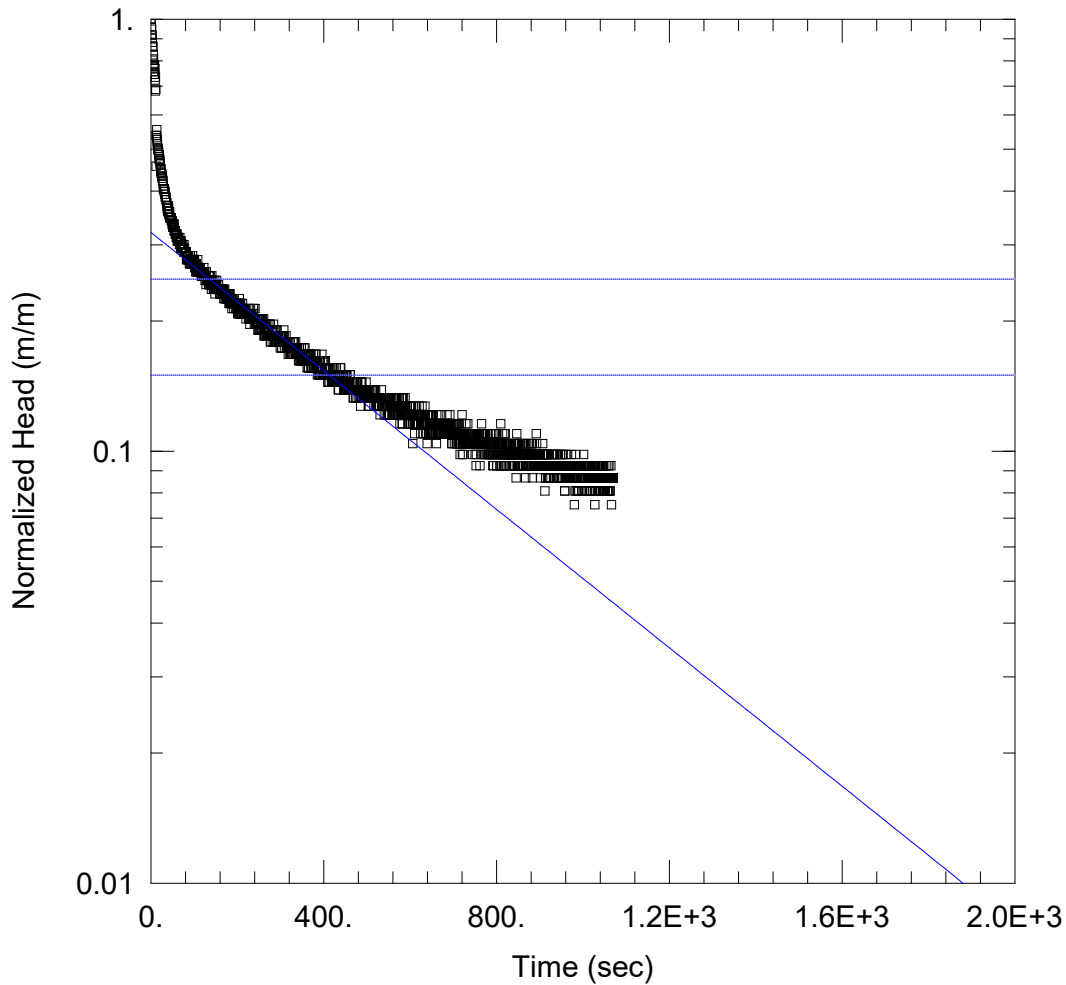
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.01658$ m/day

$y_0 = 0.5429$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a FHT_1 Hvorslev.aqt

Date: 05/24/23

Time: 13:58:04

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (New Well)

Initial Displacement: 1.73 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

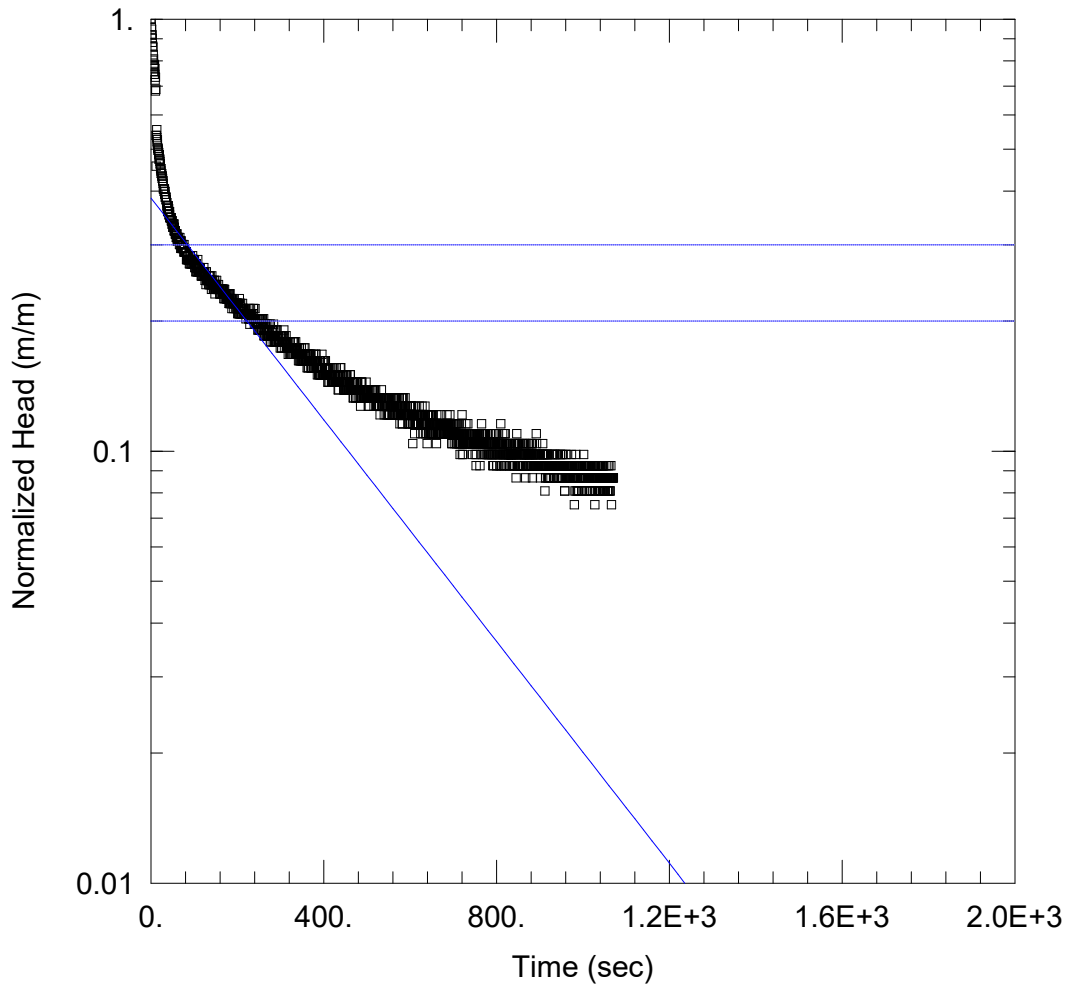
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

$K = 0.0265$ m/day

$y_0 = 0.5548$ m



WELL TEST ANALYSIS

Data Set: H:\...\GW19_37a FHT_1 Bouwer Rice.aqt

Date: 05/24/23

Time: 13:57:51

PROJECT INFORMATION

Company: SLR

Location: Brisbane

Test Well: GW19_37a

Test Date: 17/05/2023

AQUIFER DATA

Saturated Thickness: 9.96 m

Anisotropy Ratio (K_z/K_r): 0.1

WELL DATA (New Well)

Initial Displacement: 1.73 m

Static Water Column Height: 9.96 m

Total Well Penetration Depth: 16.04 m

Screen Length: 13. m

Casing Radius: 0.025 m

Well Radius: 0.076 m

SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

$K = 0.03261$ m/day

$y_0 = 0.6664$ m

Appendix B

2022 Factual Field Work Report

New Lenton Coal Project

PER Groundwater Assessment

Lenton Joint Venture

SLR Project No.: 620.31367.00000

9 October 2024



GROUNDWATER BORE INSTALLATION

Factual Fieldwork Report

Prepared for:

Bowen Coking Coal Limited
Level 7
167 Eagle Street
Brisbane QLD 4000

SLR Ref: 623.30193.00000-R01
Version No: -v1.0
November 2022



PREPARED BY

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Bowen Coking Coal Limited (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
623.30193.00000-R01-v1.0	14 November 2022	Luke Rettke	Manfred Thienenkamp Manfred Thienenkamp	Manfred Thienenkamp

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2	DRILLING CAMPAIGN	4
2.1	Bore Locations and Construction Details.....	4
3	GROUNDWATER LEVELS.....	6
4	BORE DEVELOPMENT	6
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APPENDICES

Appendix A: Bore Logs
Appendix B: Slug Test Analysis
Appendix C: Site Photographs

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) were commissioned by Bowen Coking Coal to undertake a drilling program of five groundwater monitoring bores at the Burton Coal Mine (ML 70109 and ML 70260).

This factual report provides a summary of the drilling work and presents the construction details of all newly installed bores as well as a summary of groundwater levels and hydraulic conductivity analysis for bores where groundwater was encountered at the time of drilling.

2 Drilling Campaign

The October 2022 drilling program was carried out from the 7th to 16th October 2022 before the summer wet season. Drilling and bore construction activities were undertaken by Geodrill under the supervision of a QLD Class 2 licensed water bore driller. Blade and roller with compressed air was the primary drilling method used during construction of the bores.

Drilling and bore construction activities were carried out under the guidance of an appropriately qualified hydrogeologist. The hydrogeologist's duties included:

- Geological logging of drill cuttings; and
- Advising bore construction based on the observed lithology and project requirements.

2.1 Bore Locations and Construction Details

Table 1 provides a summary of all groundwater bores installed, consisting of 5 single bore sites. All groundwater bores were constructed with 50 mm DN Class 12 uPVC casing and 50 mm DN Class 12 screen with a slot size of 0.5 mm. Bores are screened to the base of the alluvial strata.

Screened intervals included a gravel filter pack and was sealed using a bentonite plug placed directly above the filter pack, followed by cement grout to the surface. **Appendix A** presents graphic logs for each groundwater bore constructed during the programme.

Table 1 Groundwater bore locations and construction details

Bore (Site ID) (Borehole_Name)	Construction Start Date	Construction Finish Date	Easting (GDA94 z55)	Northing (GDA94 z55)	Total Depth (mbgl) ¹	Stick-Up (m)	Screen (mbgl)	Filter Pack (mbgl)	Bentonite (mbgl)	Grout (mbgl)	SWL ² (mbTOC) ³	Date of SWL measurement	Comments
Anna Creek Upstream (ACU) (BDS007)	15/10/2022	16/10/2022	622625	7613803	19.5	0.78	13.0 – 16.0	2.0 – 16.0	1.5 – 2.0	0.0 – 1.5	11.21	16/10/2022	Holl collapsed to 16.0 m prior to installation.
Anna Creek Downstream (ACD) (BDS002)	07/10/2022	10/10/2022	619750	7612501	15.4	0.81	11.5 – 14.5	10.2 – 14.5	9.5 – 10.2	0.0 – 9.5	8.14	16/10/2022	Hole collapsed to 14.5 m prior to installation.
Teviot Creek Upstream (TCU) (BDS004)	09/10/2022	09/10/2022	623121	7605179	9.28	0.55	3.0 – 6.0	2.5 – 9.28	2.0 – 2.5	0.0 – 2.0	??	16/10/2022	Blank casing installed below screen from 6.0 to 9.0 m.
Teviot Creek Downstream (TCD) (BDS003)	08/10/2022	09/10/2022	622372	7605260	17.0	0.54	12.5 – 15.5	5.1 – 12.5	4.6 – 5.1	0.0 – 0.5	15.67	16/10/2022	Hole collapsed to 15.5 m prior to installation. Bore washout above bentonite to 0.5 m.
Sandy Creek (SCD) (BDS005)	10/10/2022	10/10/2022	622618	7602562	-	-	-	-	-	-	-	-	Hole abandoned and backfilled.

¹ metres below ground level

² Standing Water Level

³ metres below Top Of Casing

3 Groundwater Levels

Following construction, all bores were dipped with an interface probe by an SLR hydrogeologist to identify the presence of groundwater. Groundwater was encountered at Anna Creek Upstream, Anna Creek Downstream, and Teviot Creek Downstream bores with Teviot Creek Upstream and Sandy Creek bores being dry. **Table 2** presents the post development groundwater levels taken after development was completed.

Table 2 Pre-development groundwater levels

Borehole ID	Measurement Date	Depth to Water (mTOC) ¹
Anna Creek Upstream	16/10/2022	11.21
Anna Creek Downstream	16/10/2022	8.14
Teviot Creek Upstream	16/10/2022	Dry
Teviot Creek Downstream	16/10/2022	15.67
Sandy Creek ²	-	-

¹ Top of casing

² Hole abandoned and backfilled

4 Bore Development

Groundwater bores were developed using the airlift technique until the water recovered was determined to be suitable clear and free of fines in accordance with the Minimum Construction Requirements for Water Bores in Australia (NUDLC, 2020). Teviot Creek Upstream and Teviot Creek Downstream were only able to be partially developed using the airlift technique due to the low recharge rate from the screened formation. These bores may need to be re-developed at a later date using the airlift technique in conjunction with water injection or another suitable method.

Table 3 presents a summary of field water quality parameters recorded during the bore development process.

Table 3 Summary of bore development

Borehole ID	Method	Development Date	Duration of Development	Flow rate (L/min)
Anna Creek Upstream	Airlift	16/10/2022	60 min	1.5
Anna Creek Downstream	Airlift	15/10/2022	40 min	4
Teviot Creek Upstream	Airlift	dry	dry	dry
Teviot Creek Downstream	Airlift	15/10/2022	15 min	Dry

5 Hydraulic Testing

Hydraulic testing, or a slug tests, were conducted at bores Anna Creek Downstream and Anna Creek Upstream on the 16th of October 2022 in accordance with industry guidelines. The methodology to complete these tests is as follows:

- The groundwater level was recorded as well as bore specifications (bore diameter of the well, saturated column length, and the diameter and length of slug);
- The logger was programmed to record datapoints at a frequency that relates to the expected duration of a complete slug test (falling and rising test). The logger was lowered into the well below the level at which the test slug would be submerged. The logger was secured at the surface to ensure that there was no movement throughout the slug test;
- The slug was rapidly lowered into the water column so that it is completely submerged but not in contact with the logger. This caused a rise in the water level and creates a hydraulic head sufficient to cause groundwater flow into the aquifer (falling head test). The logger recorded the change in water level as the displaced water recovered back to a standing water level to 95% of the pre-test levels.
- The slug was then rapidly removed from the water column. This caused a fall in the water level that creates a 'void' that is filled by water flowing back into the well from the surrounding aquifer. The logger records the change in water level as the water recedes back to static water level equilibrium.
- AQTESOLV software was used to analyse the data and to model the hydraulic properties of each slug test dataset. Slug test results are provided in Error! Reference source not found. and the analysis solutions can be found in **Appendix B**.

Table 4 Summary of the hydraulic tests

Well	Test ID	Solution	Hydraulic Conductivity (m/day)	Average K (m/day)
Anna Creek Downstream	ACD_RH1	Hvorslev	0.2989	0.2971
	ACD_RH2		0.2953	
Anna Creek Upstream	ACU_RH1	Hvorslev	0.2068	0.2182
	ACU_RH2		0.2130	
	ACU_RH3		0.2336	
	ACU_RH4		0.2194	
	ACU_RH1	Bouwer and Rice	0.1480	0.1562
	ACU_RH2		0.1525	
	ACU_RH3		0.1673	
	ACU_RH4		0.1571	

6 References

Bouwer, H. and R.C. Rice, (1976). *A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells*, Water Resources Research, vol. 12, no. 3, pp. 423-428.

Hvorslev, M.J., (1951). *Time Lag and Soil Permeability in Ground-Water Observations*, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50.

NUDLC, (2020). *Minimum Construction Requirements for Water Bores in Australia*. National Uniform Drillers Licensing Committee. Fourth Edition. September 2020.

Duffield, G.M., (2007). *AQTESOLV for Windows Version 4.5*, HydroSOLVE, Inc., Reston, VA.

Appendix A:

Bore Logs

CLIENT Bowen Coking Coal PROJECT NAME Burton PRCP Alluvial Bore Installation
PROJECT NUMBER 623.30193.00000 PROJECT LOCATION Burton Mine
DATE STARTED 7/10/22 COMPLETED 10/10/22 R.L. SURFACE _____ DATUM _____
DRILLING CONTRACTOR Geodrill
EQUIPMENT Blade and Roller w/Compressed Air HOLE LOCATION 619750 E 7612501 N
HOLE SIZE 121 mm LOGGED BY Manfred Thienenkamp CHECKED BY _____
NOTES Flow about 4 L/min. Hole collapsed to 14.55 m.

Method	Water	Well Details	Depth (m)	Graphic Log	Material Description	Unit	Drilling and Bore Information
					SANDY CLAY & FINE SAND - grey-brown-yellow mottled		
					SANDY CLAY & FINE SAND - brown-yellow mottled, moist		
					SANDY CLAY & FINE SAND - brown-yellow mottled, less sandy, carbonate nodules, moist		
					SANDY CLAY - orange, dry		
					SILTY SANDY CLAY - light brown, sand fraction consists of different coloured sandstone grains and piezolites and carbonate nodules: alluvium dark grey and yellow, rounded quartz (max 2 mm)		
					CLAY - light brown, hard, dry		
					CLAY & ALLUVIUM SAND & GRAVEL - well rounded, up to 0.8 cm		
					SANDY GRAVELY CLAY - yellow-brown, up to 0.5 cm, dry		
					SAND & CLAY - orange clay, coarse quartz sand up to 0.3 cm		Approx 0.25 L/s @ 8 m
					CORE LOSS		
			10				

8.14 mBTC

CLIENT Bowen Coking Coal

PROJECT NAME Burton PRCP Alluvial Bore Installation

PROJECT NUMBER 623.30193.00000

PROJECT LOCATION Burton Mine

DATE STARTED 7/10/22

COMPLETED 10/10/22

R.L. SURFACE

DATUM

DRILLING CONTRACTOR Geodrill

EQUIPMENT	Blade and Roller w/Compressed Air
------------------	-----------------------------------

HOLE LOCATION 619750 E 7612501 N

HOLE SIZE 121 mm

LOGGED BY Manfred Thienenkamp

CHECKED BY

NOTES Flow about 4 L/min. Hole collapsed to 14.55 m.

Method	Water	Well Details	Depth (m)	Graphic Log	Material Description	Unit	Drilling and Bore Information
					SAND - coarse, rounded, up to 0.5 cm		
					SANDY GRAVEL - coarse, up to 3 cm		Approx 0.5 L/s @ 12 m
					CLAY - yellow, dry		
					SANDSTONE - very weathered		
					BDS002 (ACD) terminated at 15.4m bgl.		

CLIENT Bowen Coking Coal **PROJECT NAME** Burton PRCP Alluvial Bore Installation
PROJECT NUMBER 623.30193.00000 **PROJECT LOCATION** Burton Mine
DATE STARTED 8/10/22 **COMPLETED** 9/10/22 **R.L. SURFACE** _____ **DATUM** _____
DRILLING CONTRACTOR Geodrill
EQUIPMENT Blade and Roller w/Compressed Air **HOLE LOCATION** 622625 E 7613803 N
HOLE SIZE 121 mm **LOGGED BY** Manfred Thienenkamp **CHECKED BY** _____
NOTES No recharge. Hole collapsed to 15.5 m

Method	Water	Well Details	Depth (m)	Graphic Log	Material Description	Unit	Drilling and Bore Information
					SAND - brown, fine grained, moist		
					SAND - red-brown, fine grained, moist		
					PEBBLY SAND - red-brown, fine grained, some round pebbles up to 1 cm		
					GRAVEL SAND - red-brown, medium grained, gravel up to 1 cm, approximately 50 % sand and 50 % gravel		
					SANDY GRAVEL - red-brown, medium grained, gravel up to 1 cm, approximately 80 % gravel and 20 % sand		
					SANDY GRAVELLY CLAY - grey-brown, fine to coarse grained, some rounded pebbles up to 3 cm, approximately 60 % clay and 40 % sand		
			10				

CLIENT Bowen Coking Coal

PROJECT NAME Burton PRCP Alluvial Bore Installation

PROJECT NUMBER 623.30193.00000

PROJECT LOCATION Burton Mine

DATE STARTED 8/10/22

COMPLETED 9/10/22

R.L. SURFACE

DATUMDRILLING CONTRACTOR Geodrill

EQUIPMENT Blade and Roller w/Compressed Air

HOLE LOCATION 622625 E 7613803 N

HOLE SIZE 121 mm

LOGGED BY Manfred Thienenkamp

CHECKED BY

NOTES No recharge. Hole collapsed to 15.5 m

Method	Water	Well Details	Depth (m)	Graphic Log	Material Description	Unit	Drilling and Bore Information
		15.67 mBTOC ▼			SANDY GRAVELLY CLAY - grey-brown, fine to coarse grained, some rounded pebbles up to 3 cm, approximately 60 % clay and 40 % sand <i>(continued)</i>		
					CLAY - dark grey, high plasticity, some coal fragments		Harder
					BDS003 (TCD) terminated at 17m bgl.		

CLIENT Bowen Coking Coal **PROJECT NAME** Burton PRCP Alluvial Bore Installation
PROJECT NUMBER 623.30193.00000 **PROJECT LOCATION** Burton Mine

DATE STARTED 9/10/22 **COMPLETED** 9/10/22 **R.L. SURFACE** **DATUM**

DRILLING CONTRACTOR Geodrill

EQUIPMENT Blade and Roller w/Compressed Air **HOLE LOCATION** 623121 E 7605179 N

HOLE SIZE 121 mm **LOGGED BY** Manfred Thienenkamp **CHECKED BY**

NOTES

Method	Water	Well Details	Depth (m)	Graphic Log	Material Description	Unit	Drilling and Bore Information
					SAND - red-brown, fine grained, dry		
					CLAY - orange-brown, dry		
					SANDSTONE - weathered with clay		
					BDS004 (TCU) terminated at 9m bgl.		
			10				



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12 Cannan St
South Townsville, QLD, 4810
Telephone: (07) 4722 8000

CLIENT Bowen Coking Coal **PROJECT NAME** Burton PRCP Alluvial Bore Installation
PROJECT NUMBER 623.30193.00000 **PROJECT LOCATION** Burton Mine
DATE STARTED 10/10/22 **COMPLETED** 10/10/22 **R.L. SURFACE** _____ **DATUM** _____
DRILLING CONTRACTOR Geodrill
EQUIPMENT Blade and Roller w/Compressed Air **HOLE LOCATION** 622618 E 7602562 N
HOLE SIZE 121 mm **LOGGED BY** Manfred Thienenkamp **CHECKED BY** _____
NOTES Hole abandoned and backfilled.

Method	Water	Well Details	Depth (m)	Graphic Log	Material Description	Unit	Drilling and Bore Information
					SANDY CLAY - light brown, fine grained		
					SILTY CLAY - grey-brown, some pisolites, possibly very weathered rock		
					CLAY - dark grey-dark brown, very weathered rock, angular rock chips		
					SANDSTONE - light brown, weathered		
					BDS005 (SCD) terminated at 6m bgl.		
			10				

CLIENT Bowen Coking Coal **PROJECT NAME** Burton PRCP Alluvial Bore Installation
PROJECT NUMBER 623.30193.00000 **PROJECT LOCATION** Burton Mine
DATE STARTED 15/10/22 **COMPLETED** 15/10/22 **R.L. SURFACE** _____ **DATUM** _____
DRILLING CONTRACTOR Geodrill
EQUIPMENT Blade and Roller w/Compressed Air **HOLE LOCATION** 622625 E 7613803 N
HOLE SIZE 121 mm **LOGGED BY** Manfred Thienenkamp **CHECKED BY** _____
NOTES Flow about 1.5 L/min. Hole collapsed to 16.0 m when removing rods.

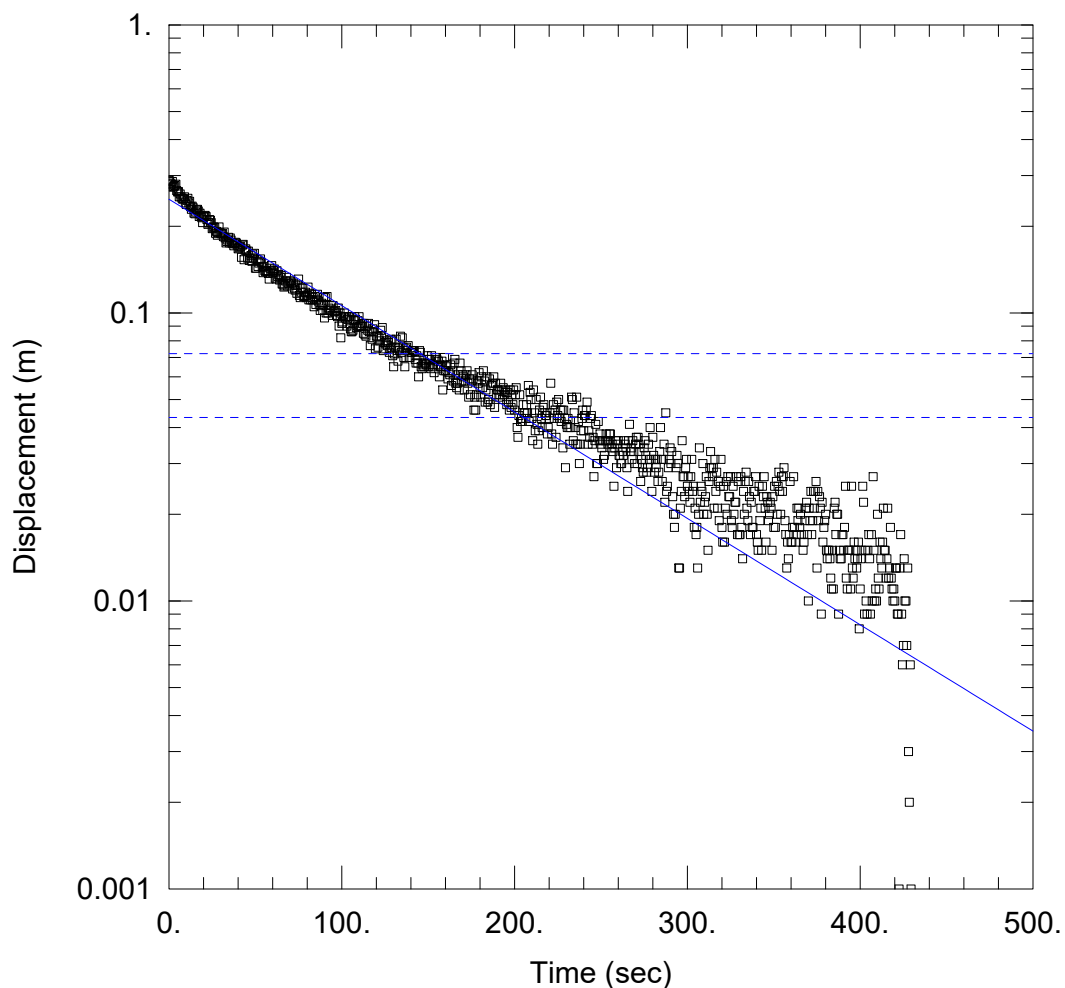
Method	Water	Well Details	Depth (m)	Graphic Log	Material Description	Unit	Drilling and Bore Information
					SAND - light brown, fine to medium grained (85/15), damp		
					SAND - light brown, fine to medium grained (80/20), damp		
					CLAYEY PEBBLY SAND - light brown, fine to medium grained (70/30), pebbles up to 1 cm		
					CLAYEY SAND - light brown, fine to medium grained sand (60/30), approximately 10% clay		
					CLAYEY SAND - light brown, fine to medium grained sand (60/20), approximately 20% clay		

CLIENT Bowen Coking Coal **PROJECT NAME** Burton PRCP Alluvial Bore Installation
PROJECT NUMBER 623.30193.00000 **PROJECT LOCATION** Burton Mine
DATE STARTED 15/10/22 **COMPLETED** 15/10/22 **R.L. SURFACE** _____ **DATUM** _____
DRILLING CONTRACTOR Geodrill
EQUIPMENT Blade and Roller w/Compressed Air **HOLE LOCATION** 622625 E 7613803 N
HOLE SIZE 121 mm **LOGGED BY** Manfred Thienenkamp **CHECKED BY** _____
NOTES Flow about 1.5 L/min. Hole collapsed to 16.0 m when removing rods.

Method	Water	Well Details	Depth (m)	Graphic Log	Material Description	Unit	Drilling and Bore Information
					CLAYEY SAND - light brown sand with light brown-grey clay, fine to medium grained sand (60/20), approximately 20% clay		
					SANDY CLAY - grey, medium grained sand, approximately 70% clay and 30% sand		
					CORE LOSS - harder drilling, hole not clearing out, mix of materials coming up		
					BDS007 (ACU) terminated at 19.5m bgl.		
			20				

Appendix B:

Slug Test Analysis



WELL TEST ANALYSIS

Data Set: C:\...\Anna Creek Downstream.aqt

Date: 10/26/22

Time: 10:38:59

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Downstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 6.36 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.289 m

Static Water Column Height: 6.36 m

Total Well Penetration Depth: 6.36 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

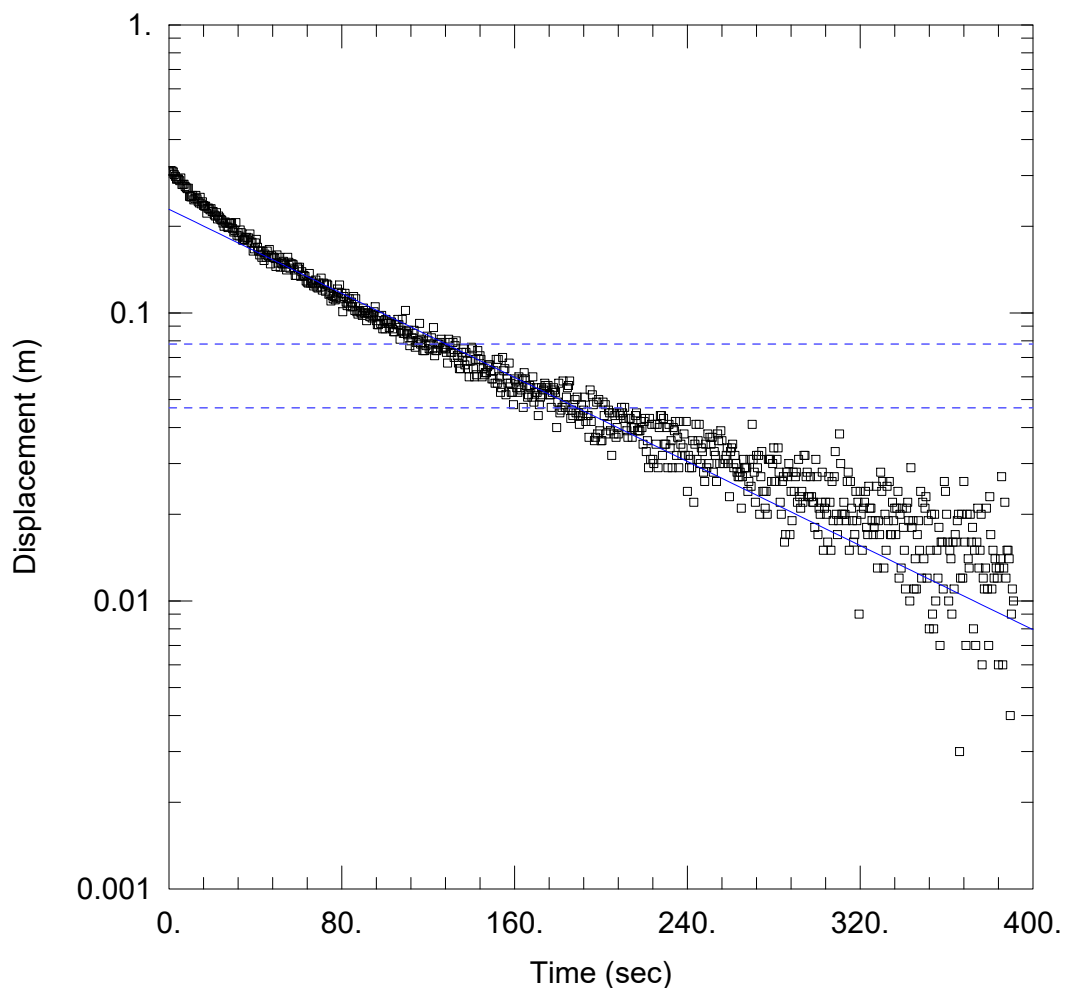
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.2989$ m/day

$y_0 = 0.2482$ m



WELL TEST ANALYSIS

Data Set: C:\...\Anna Creek Downstream.aqt

Date: 10/26/22

Time: 11:04:15

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Downstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 6.36 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.312 m

Static Water Column Height: 6.36 m

Total Well Penetration Depth: 6.36 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

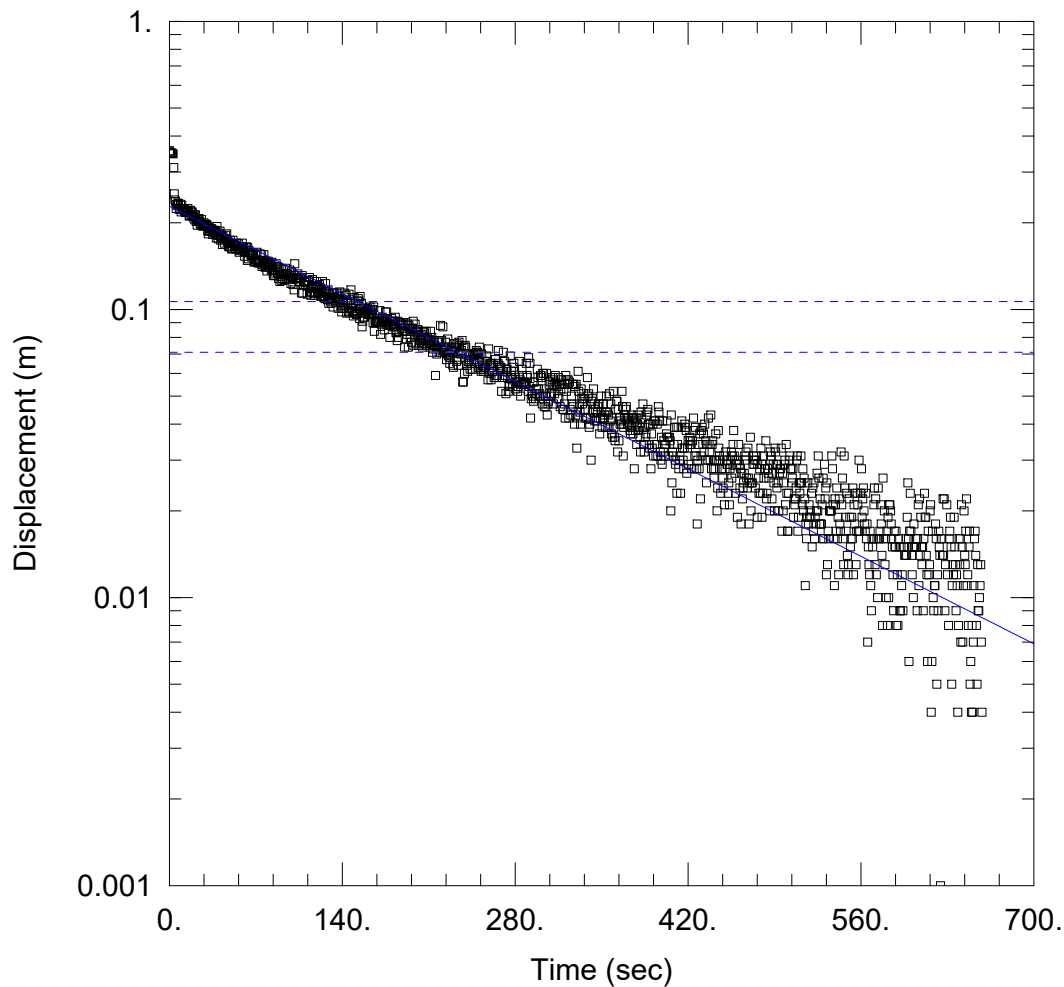
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.2953$ m/day

$y_0 = 0.229$ m



WELL TEST ANALYSIS

Data Set: C:\Users\gintuser\Desktop\Luke\Burton\Anna Creed Upstream 1\Run 1.aqt

Date: 10/26/22

Time: 09:10:17

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Upstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 4.85 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.355 m

Static Water Column Height: 4.85 m

Total Well Penetration Depth: 4.85 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

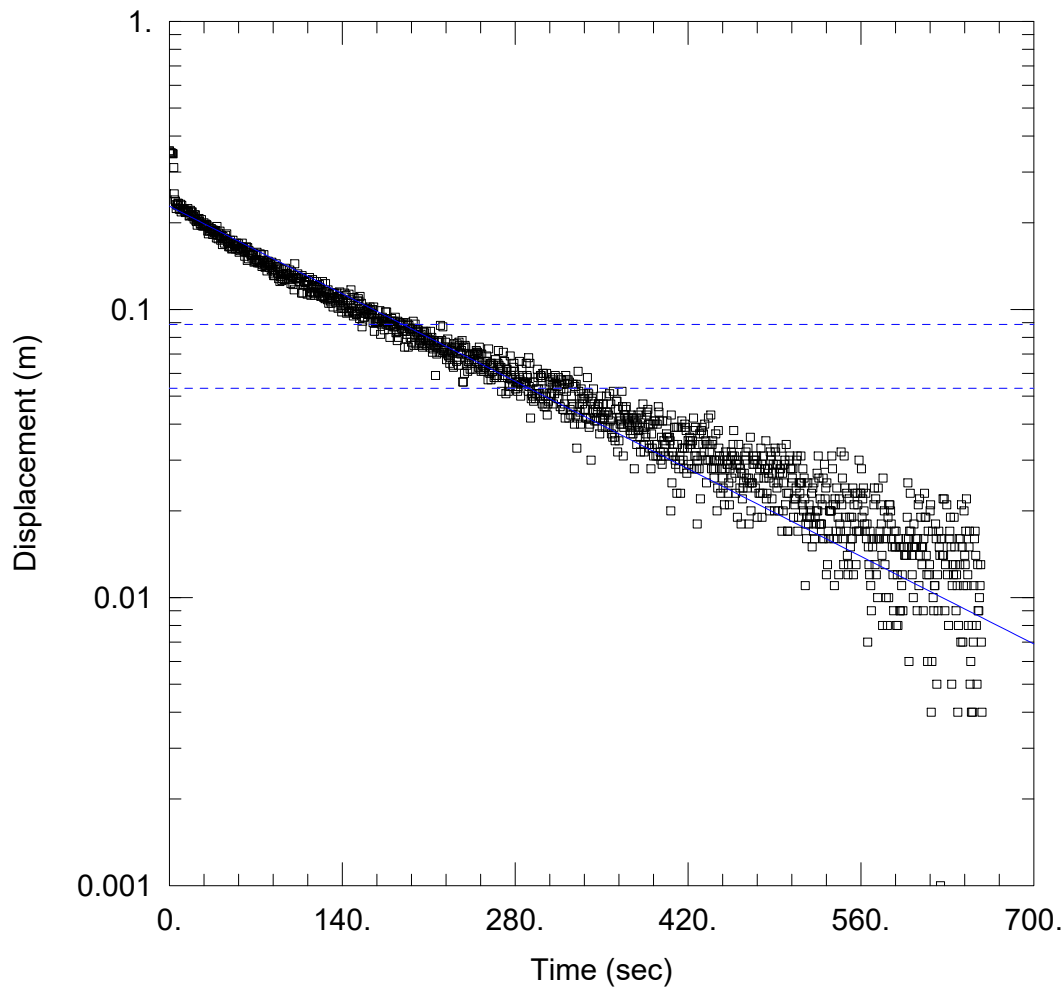
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.148$ m/day

$y_0 = 0.2282$ m



WELL TEST ANALYSIS

Data Set: C:\Users\gintuser\Desktop\Luke\Burton\Anna Creed Upstream 1\Run 1.aqt

Date: 10/26/22

Time: 09:11:39

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Upstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 4.85 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.355 m

Static Water Column Height: 4.85 m

Total Well Penetration Depth: 4.85 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

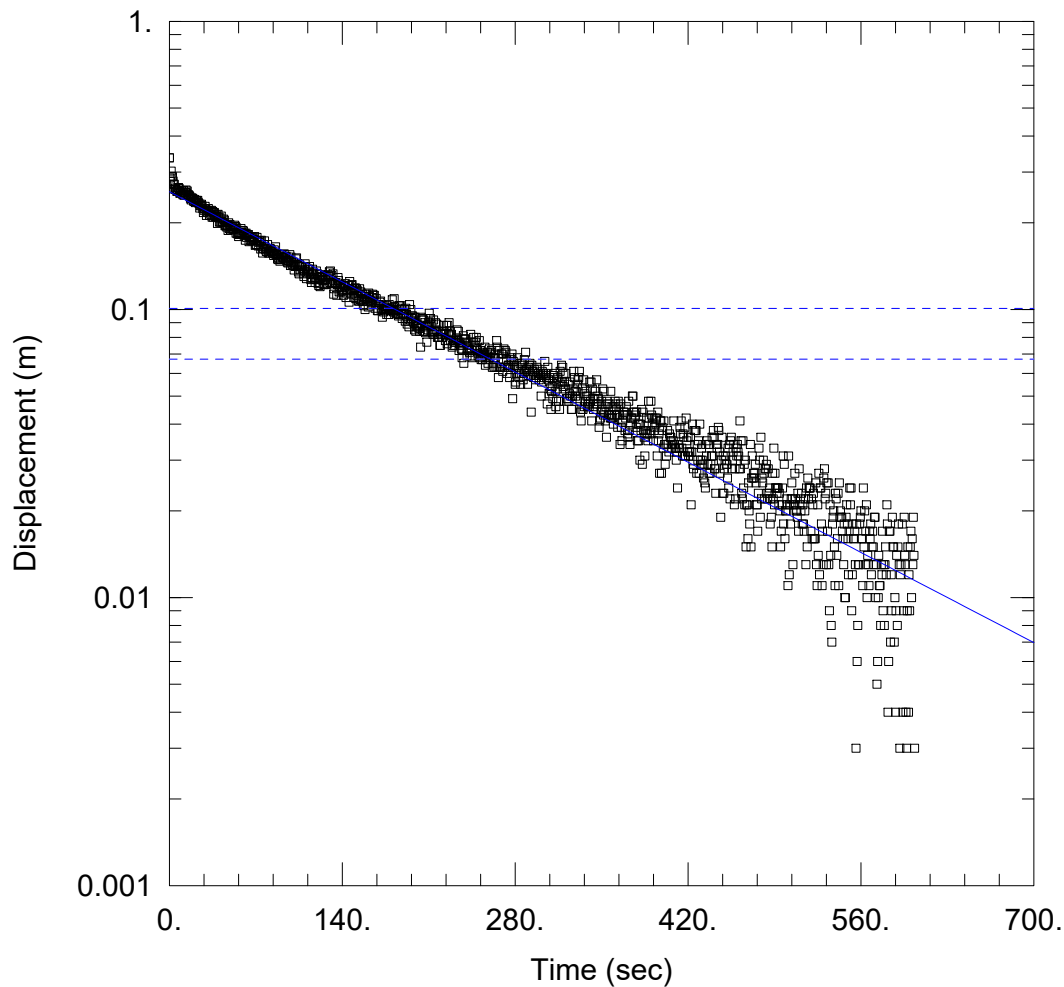
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.2068$ m/day

$y_0 = 0.2282$ m



WELL TEST ANALYSIS

Data Set: C:\Users\gintuser\Desktop\Luke\Burton\Anna Creed Upstream 1\Run 1.aqt

Date: 10/26/22

Time: 09:25:22

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Upstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 4.85 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.336 m

Static Water Column Height: 4.85 m

Total Well Penetration Depth: 4.85 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

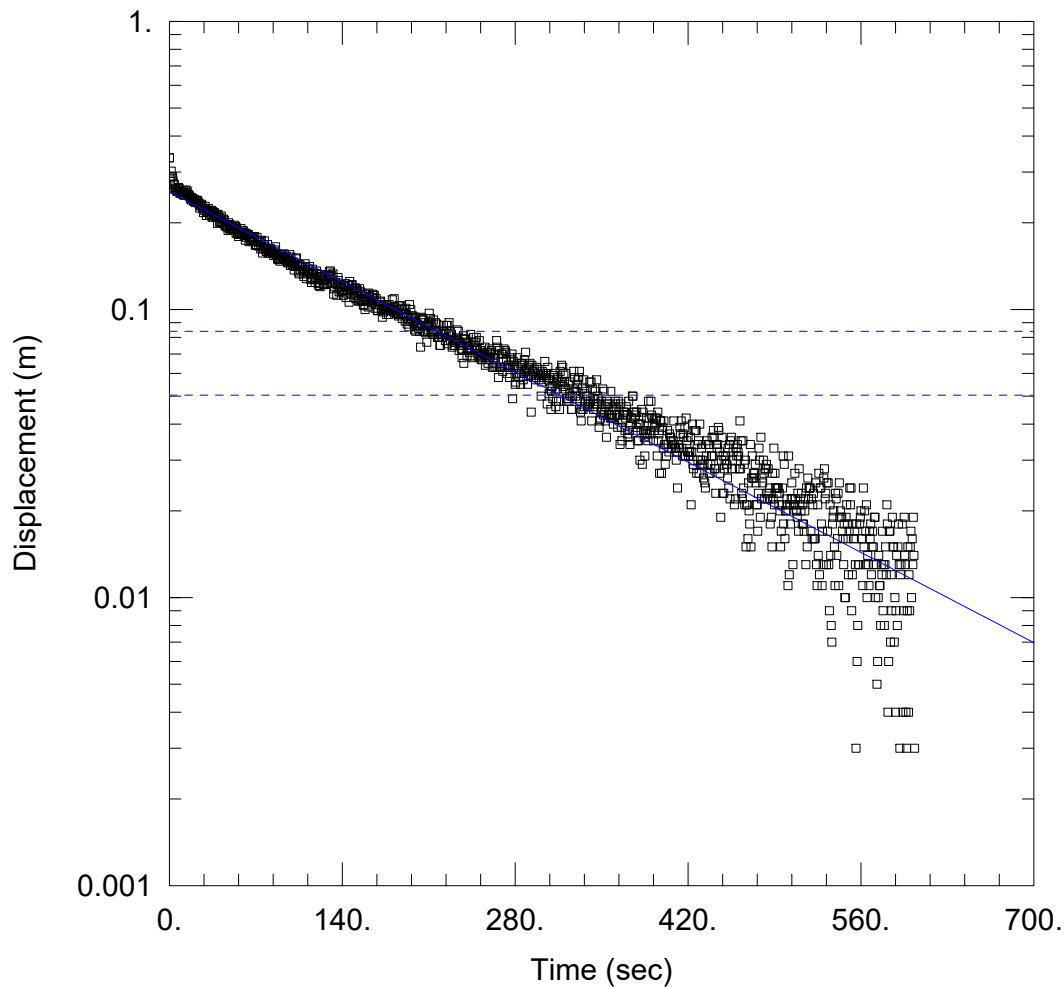
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.1525$ m/day

$y_0 = 0.2563$ m



WELL TEST ANALYSIS

Data Set: C:\Users\gintuser\Desktop\Luke\Burton\Anna Creed Upstream 1\Run 1.aqt

Date: 10/26/22

Time: 09:26:37

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Upstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 4.85 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.336 m

Static Water Column Height: 4.85 m

Total Well Penetration Depth: 4.85 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

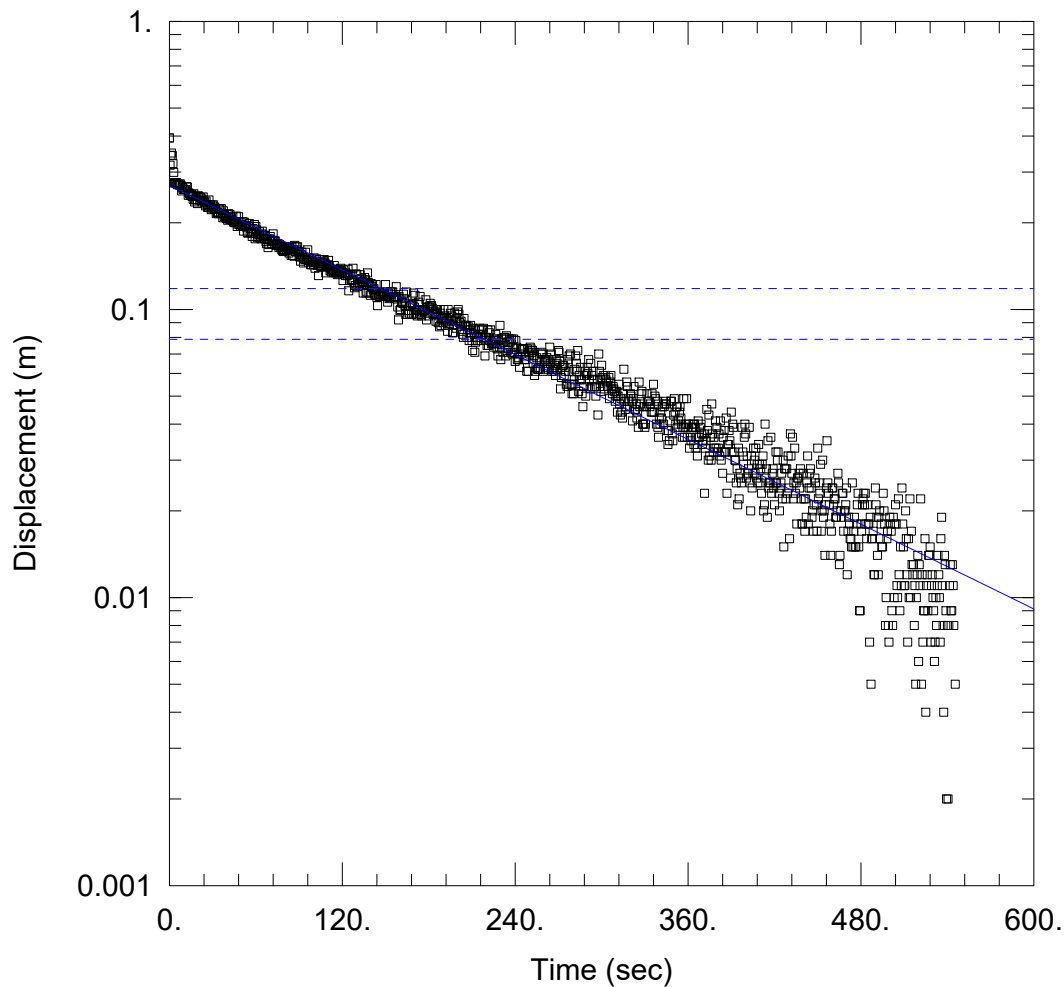
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.213$ m/day

$y_0 = 0.2564$ m



WELL TEST ANALYSIS

Data Set: C:\Users\gintuser\Desktop\Luke\Burton\Anna Creed Upstream 1\Run 1.aqt

Date: 10/26/22

Time: 09:29:31

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Upstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 4.85 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.394 m

Static Water Column Height: 4.85 m

Total Well Penetration Depth: 4.85 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

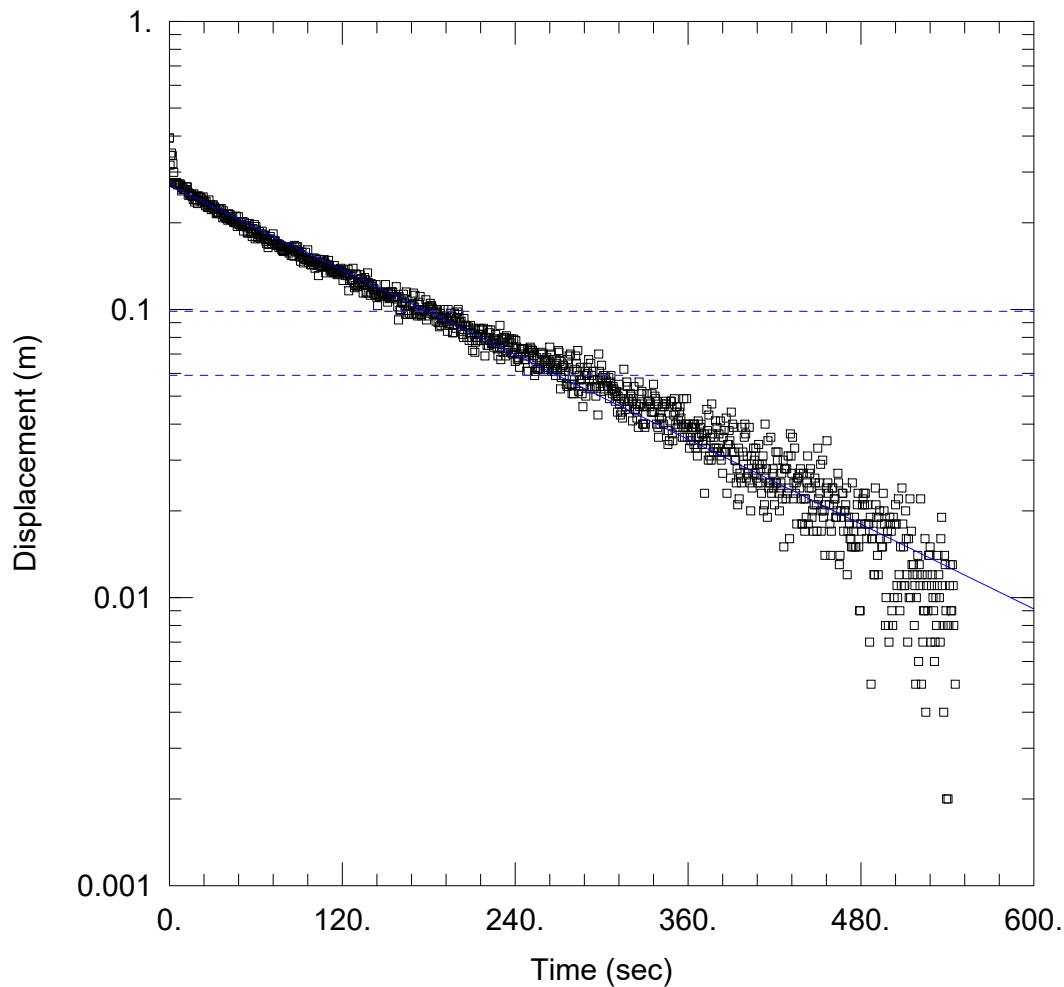
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.1673$ m/day

$y_0 = 0.2703$ m



WELL TEST ANALYSIS

Data Set: C:\Users\gintuser\Desktop\Luke\Burton\Anna Creed Upstream 1\Run 1.aqt

Date: 10/26/22

Time: 09:28:46

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Upstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 4.85 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.394 m

Static Water Column Height: 4.85 m

Total Well Penetration Depth: 4.85 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

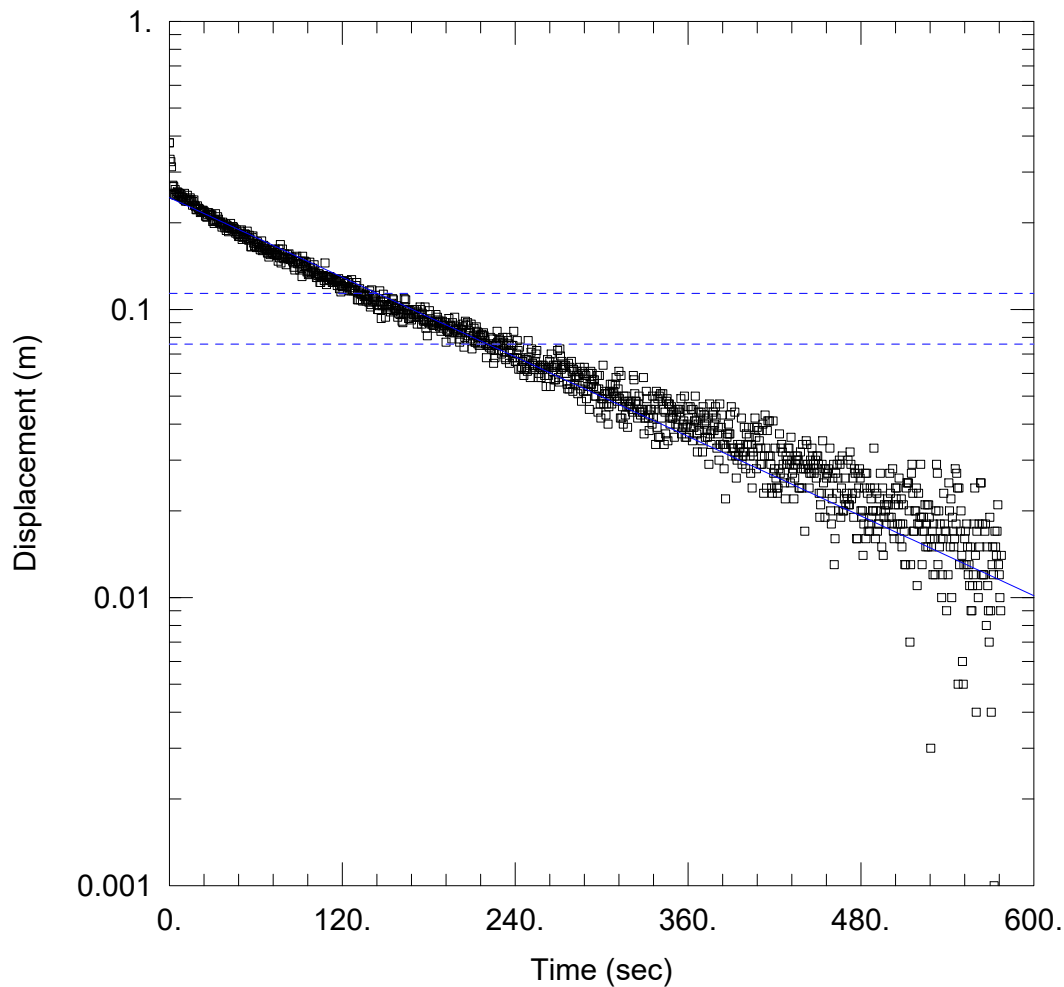
SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

$K = 0.2336$ m/day

$y_0 = 0.2703$ m



WELL TEST ANALYSIS

Data Set: C:\Users\gintuser\Desktop\Luke\Burton\Anna Creed Upstream 1\Run 1.aqt

Date: 10/26/22

Time: 09:32:57

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Upstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 4.85 m

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (New Well)

Initial Displacement: 0.379 m

Static Water Column Height: 4.85 m

Total Well Penetration Depth: 4.85 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

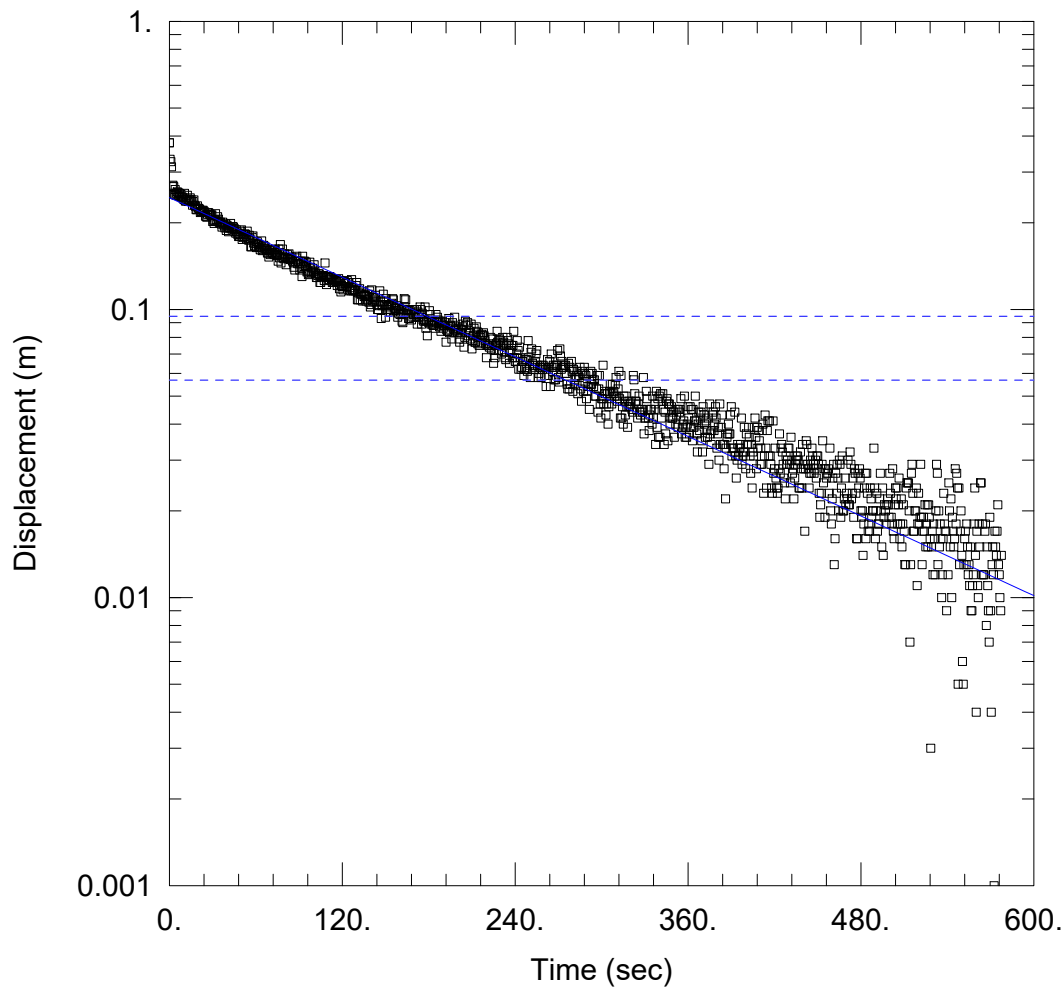
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.1571$ m/day

$y_0 = 0.2445$ m



WELL TEST ANALYSIS

Data Set: C:\Users\gintuser\Desktop\Luke\Burton\Anna Creed Upstream 1\Run 1.aqt

Date: 10/26/22

Time: 09:33:50

PROJECT INFORMATION

Company: SLR CONSULTING

Client: Bowen Coking Coal

Project: 623.30193.00000

Location: Townsville

Test Well: Anna Creek Upstream

Test Date: 16/10/2022

AQUIFER DATA

Saturated Thickness: 4.85 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (New Well)

Initial Displacement: 0.379 m

Static Water Column Height: 4.85 m

Total Well Penetration Depth: 4.85 m

Screen Length: 3. m

Casing Radius: 0.025 m

Well Radius: 0.0605 m

SOLUTION

Aquifer Model: Unconfined

Solution Method: Hvorslev

K = 0.2194 m/day

y0 = 0.2445 m

Appendix C:

Site Photographs



Figure 1 Coarse rounded sand max 0.5cm, Anna Creek Downstream 10-12m.



Figure 2 Very weathered sandstone, Anna Creek Downstream 15-15.4m



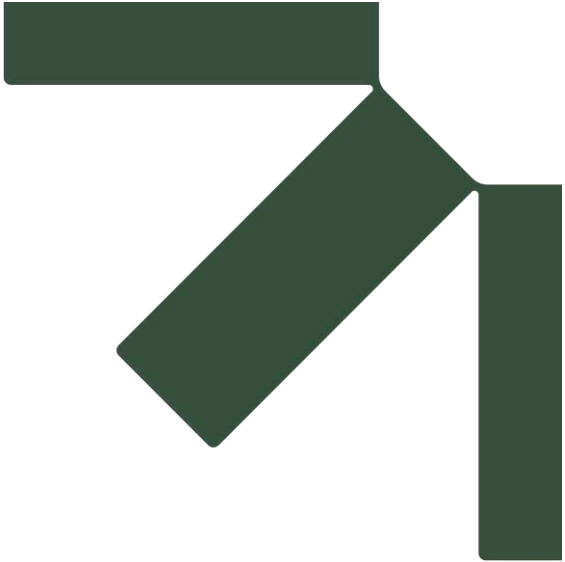
Figure 3 Teviot Creek Downstream. 16-17m, dark grey plastic clay + coal in alluvial wash from strata above



Figure 4 Drill cuttings of Teviot Creek up-stream, progress from top left to bottom right. Weathered sandstone from about 7m onwards.



Figure 5 Development of Teviot Creek Downstream after 15 minutes



Appendix C

Groundwater Quality Summary Statistics

New Lenton Coal Project

PER Groundwater Assessment

Lenton Joint Venture

SLR Project No.: 620.31367.00000

9 October 2024

Monitoring Network	Aquifer	Bore	statistic	Field_pH	Field_EC	Temp Field	TDS	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Sodium	Potassium	Diss_Aluminu m	Diss_Antimo ny	Diss_Arsenic	Diss_Molybde num	Diss_Seleni um	Diss_Silver	Diss_Iron	Tot_Aluminu m	Tot_Antimon y	Tot_Arsenic	Tot_Molybde num	Tot_Selenium	Tot Silver	Tot_Iron	Diss_Mercury	Tot_Mercury	Lab_EC	Lab_pH	
Lenton	Alluvium	GW01	Total Number	6	6	0	8	8	8	8	8	8	8	8	8	8	8	5	4	5	0	5	4	5	6	5	6	0	6	5	6	5	6	6	6	6
Lenton	Alluvium	GW01	from	01-02-2014	01-02-2014	-	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	01-05-2014	01-05-2014	01-05-2014	-	01-05-2014	01-05-2014	01-05-2014	20-02-2014	20-02-2014	20-02-2014	-	20-02-2014	20-02-2014	20-02-2014	01-05-2014	20-02-2014	20-02-2014	20-02-2014	
Lenton	Alluvium	GW01	to	01-06-2018	01-06-2018	-	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	-	01-06-2018	01-06-2018	01-06-2018	01-04-2015	01-04-2015	01-04-2015	-	01-04-2015	01-04-2015	01-04-2015	01-06-2018	01-04-2015	01-04-2015	01-04-2015	
Lenton	Alluvium	GW01	Min	6.47	5827	-	3660	0.5	0.5	582	582	38	1730	223	763	0.5	0.005	5.00E-04	5.00E-04	127	0.005	5.00E-04	0.025	6.46	5.00E-04	5.00E-04	-	0.005	5.00E-04	7.08	5.00E-05	5.00E-05	6620	7.03		
Lenton	Alluvium	GW01	5th %ile	6.4725	5961.25	-	3677.5	0.5	0.5	607.55	607.55	38.35	1733.5	150.45	224.4	764.4	0.5	0.005	5.00E-04	5.00E-04	-	0.005	5.00E-04	0.025	6.81	5.00E-04	6.25E-04	-	0.005	0.0005	7.81	5.00E-05	0.00005	6635	7.1275	
Lenton	Alluvium	GW01	20th %ile	6.48	6364	-	3946	0.5	0.5	665	665	39.8	1740	202.8	244.6	775	0.5	0.005	5.00E-04	5.00E-04	-	0.005	5.00E-04	0.025	7.86	5.00E-04	1.00E-03	-	0.005	0.0005	10	5.00E-05	0.00005	6680	7.42	
Lenton	Alluvium	GW01	Median	6.645	6718.5	-	4360	0.5	0.5	704.5	704.5	44	1840	244.5	280	808.5	0.75	0.005	5.00E-04	5.00E-04	-	0.005	5.00E-04	0.025	31.2	5.00E-04	3.50E-03	-	0.005	0.0005	42.5	5.00E-05	0.00005	6835	7.495	
Lenton	Alluvium	GW01	80th %ile	6.81	6900	-	4542	0.5	0.5	745.2	745.2	49.8	2128	257.2	302.8	832.8	1	0.005	5.00E-04	5.20E-03	-	0.005	5.00E-04	0.054	48.4	5.00E-04	4.00E-03	-	0.005	0.0008	65.1	5.00E-05	0.00005	7030	7.6	
Lenton	Alluvium	GW01	95th %ile	6.81	6960	-	4576.5	0.5	0.5	749.95	749.95	53.6	2160	269.8	315.9	876.95	1.65	0.005	5.00E-04	0.0193	-	0.005	0.0005	0.141	54.775	5.00E-04	7.00E-03	-	0.005	0.0017	85.425	0.00005	0.00005	7037.5	7.8475	
Lenton	Alluvium	GW01	Max	6.81	6980	-	4580	0.5	0.5	751	751	55	2160	274	318	899	2	0.005	5.00E-04	0.024	-	0.005	0.0005	0.17	56.9	5.00E-04	8.00E-03	-	0.005	0.002	92.2	5.00E-05	0.00005	7040	7.93	
Lenton	Alluvium	GW01	Tau	-0.138013	-0.2	-	0	1	1	0.357143	0.357143	0.327327	-0.0741249	-0.142857	-0.714286	0	-0.130066	1	1	-0.632456	-	1	1	0.316228	-0.466667	1	-0.690066	-	1	-0.632456	-0.466667	1	1	0.733333	0.066667	
Lenton	Alluvium	GW01	2-sided-p	0.848312	0.707114	-	1	1	1	0.26551	0.26551	0.318568	0.900004	0.710523	0.0187411	1	0.78353	1	1	0.288844	-	1	1	0.723674	0.259656	1	0.0851679	-	1	0.288844	0.259656	1	1	0.0602891	1	
Lenton	Alluvium	GW01	Trend	No	No	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	No	No	No	No	No	No	-	No	No	No	No	No	No	No	No
Lenton	Burton Rider/Regolith	GW04	Total Number	9	9	0	10	10	10	10	10	10	10	10	10	10	10	7	6	7	0	7	6	7	6	5	6	0	6	5	6	7	6	6	7	
Lenton	Burton Rider/Regolith	GW04	from	01-02-2014	01-02-2014	-	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	01-05-2014	01-05-2014	01-05-2014	-	01-05-2014	01-05-2014	01-05-2014	20-02-2014	20-02-2014	20-02-2014	-	20-02-2014	20-02-2014	20-02-2014	01-05-2014	20-02-2014	01-05-2014	20-02-2014	
Lenton	Burton Rider/Regolith	GW04	to	09-05-2019	09-05-2019	-	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	-	09-05-2019	09-05-2019	09-05-2019	01-04-2015	01-04-2015	01-04-2015	-	01-04-2015	01-04-2015	01-04-2015	09-05-2019	01-04-2015	09-05-2019	09-05-2019	
Lenton	Burton Rider/Regolith	GW04	Min	6.28	7210	-	5140	0.5	0.5	566	566	17	2710	235	226	1120	5	0.005	5.00E-04	5.00E-04	-	0.005	5.00E-04	1.76	0.005	5.00E-04	0.009	-	0.005	5.00E-04	2.09	5.00E-05	5.00E-05	8300	6.81	
Lenton	Burton Rider/Regolith	GW04	5th %ile	6.284	7902	-	5248	0.5	0.5	587.15	587.15	17.9	2746	240.85	226.9	1129	5.45	0.005	5.00E-04	0.00215	-	0.005	5.00E-04	3.596	0.00625	5.00E-04	0.01075	-	0.005	5.00E-04	3.78	5.00E-05	5.00E-05	8545	6.906	
Lenton	Burton Rider/Regolith	GW04	20th %ile	6.416	9013.2	-	5396	0.5	0.5	623.4	623.4	20.6	2814	248	228.8	1148	6	0.005	5.00E-04	7.80E-03	-	0.005	5.00E-04	8.142	0.01	5.00E-04	0.016	-	0.005	5.00E-04	8.85	5.00E-05	5.00E-05	9280	7.142	
Lenton	Burton Rider/Regolith	GW04	Median	6.58	9270	-	6115	0.5	0.5	639.5	639.5	25	3155	258.5	255.5	1405	6	0.005	5.00E-04	0.016	-	0.005	5.00E-04	9.33	0.045	5.00E-04	0.0165	-	0.005	5.00E-04	10.35	5.00E-05	5.00E-05	9920	7.3	
Lenton	Burton Rider/Regolith	GW04	80th %ile	6.694	11753	-	7748	0.5	0.5	661.8	661.8	30.4	4272	264.4	404	1862	7	0.005	5.00E-04	2.10E-02	-	0.005	5.00E-04	9.84	0.05	5.00E-04	0.019	-	0.005	2.40E-03	10.6	5.00E-05	5.00E-05	11800	7.39	
Lenton	Burton Rider/Regolith	GW04	95th %ile	7.3	16161.2	-	11052	0.5	0.5	682.35	682.35	47.95	5446.5	287.45	557.9	2845	7.55	0.005	1.63E-03	0.0217	-	0.005	5.00E-04	10.119	0.05	5.00E-04	0.01975	-	0.005	8.10E-03	10.75	5.00E-05	5.00E-05	12250	7.81	
Lenton	Burton Rider/Regolith	GW04	Max	7.7	18482	-	13500	0.5	0.5	690	690	61	6270	305	674	3610	8	0.005	2.00E-03	0.022	-	0.005	5.00E-04	10.2	0.05	5.00E-04	0.02	-	0.005	1.00E-02	10.8	5.00E-05	5.00E-05	12400	7.99	
Lenton	Burton Rider/Regolith	GW04	Tau	0.253546	-0.722222	-	-0.822222	1	1	0.111111	0.111111	-0.733333	-0.955556	-0.414039	-0.80904	-0.822222	-0.105409	1	0.57735	0.39036	-	1	1	-0.142857	0	1	0.552052	-	1	-0.632456	0.276026	1	1	-1	0.19518	
Lenton	Burton Rider/Regolith	GW04	2-sided-p	0.401678	0.00914915	-	0.00128218	1	1	0.720515	0.720515	0.00420755	0.000172241	0.123778	0.00167173	0.00128218	0.769342	1	0.241567	0.287611	-	1	1	0.763891	1	1	0.1806	-	1	0.288844	0.56609	1	1	0.00853492	0.648582	
Lenton	Burton Rider/Regolith	GW04	Trend	No	Yes-Downward	-	Yes-Downward	No	No	No	No	Yes-Downward	Yes-Downward	No	Yes-Downward	Yes-Downward	No	No	No	No	-	No	No	No	No	No	No	-	No	No	No	No	No	Yes-Downward	No	
Lenton	Alluvium	GW06	Total Number	9	10	0	11	11	11	11	11	11	11	11	11	11	11	8	7	8	0	8	7	8	5	4	5	0	5	4	5	8	5	8	8	
Lenton	Alluvium	GW06	from	01-02-2014	01-02-2014	-	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	01-05-2014	01-05-2014	01-05-2014	-	01-05-2014	01-05-2014	01-05-2014	20-02-2014	20-02-2014	20-02-2014	-	20-02-2014	20-02-2014	20-02-2014	01-05-2014	20-02-2014	20-02-2014	20-02-2014	
Lenton	Alluvium	GW06	to	23-03-2020	23-03-2020	-	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	-	24-03-2020	24-03-2020	24-03-2020	01-04-2015	01-04-2015	01-04-2015	-	01-04-2015	01-04-2015	01-04-2015	24-03-2020	01-04-2015	24-03-2020	24-03-2020	
Lenton	Alluvium	GW06	Min	6.76	2481	-	1830	0.5	0.5	737	737	0.5	466	33	37	498	0.5	0.005	5.00E-04	5.00E-04	-	0.005	5.00E-04	1.76	0.005	5.00E-04	0.009	-	0.005	5.00E-04	3.85	5.00E-05	5.00E-05	2820	7.34	
Lenton	Alluvium	GW06	5th %ile	6.788	2692.05	-	1845	0.5	0.5	796	796	0.5	489	34	40	531	0.5	0.005	5.00E-04	6.75E-04	-	0.005	5.00E-04	0.24025	0.008	5.00E-04	1.58E-02	-	0.005	0.0005	3.988	5.00E-05	0.00005	2834	7.424	
Lenton	Alluvium	GW06	20th %ile	6.98	4774	-	3150	0.5	0.5	1160	1160	0.5	876	44	96	1040	0.5	0.005	5.00E-04	1.40E-03	-	0.005	5.00E-04	0.648	0.017	5.00E-04	2.12E-02	-	0.005	0.0005	4.402	5.00E-05	0.00005	3652	7.592	
Lenton	Alluvium	GW06	Median	7.23	10528.5	-	5830	0.5	0.5	1360	1360	14	2090	68	202	1870	1	0.005	5.00E-04	3.00E-03	-	0.005	5.00E-04	1.085	0.41	5.00E-04	2.40E-02	-	0.005	0.0005	4.78	5.00E-05	0.00005	6105	7.685	
Lenton	Alluvium	GW06	80th %ile	7.39	15431.2	-	10000	0.5	0.5	3150	3150	52	3770	79	388	2730	1	0.005	5.00E-04	5.60E-03	-	0.005	5.00E-04	3.156	1.074	5.00E-04	2.56E-02	-	0.005	0.0005	6.336	5.00E-05	0.00005	12828	7.776	
Lenton	Alluvium	GW06	95th %ile	7.414	15951.95	-	10350	0.5	0.5	3835	3835	128	5550	316	471	3050																				

Monitoring Network	Aquifer	Bore	statistic	Field pH	Field EC	Temp Field	TDS	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Sodium	Potassium	Diss_Aluminu m	Diss_Antimo ny	Diss_Arsenic	Diss_Molybde num	Diss_Seleniu m	Diss_Silver	Diss_Iron	Tot_Aluminiu m	Tot_Antimon y	Tot_Arsenic	Tot_Molybde num	Tot_Selenium	Tot_Silver	Tot_Iron	Diss_Mercury	Tot_Mercury	Lab_EC	Lab_pH		
Lenton	Permian	GW13	Tau	0.440386	-0.2	-	0.302653	1	1	0.442761	0.442761	0.177016	0.049467	0.386463	0.17155	-0.170589	-0.198762	0.397706	0.178174	0.0920087	-	1	-0.235702	-0.159132	0.276026	-	0.138013	-	1	0.316228	0.466667	1	1	0.540062	0.617213		
Lenton	Permian	GW13	2-sided-p	0.0724947	0.474274	-	0.273987	1	1	0.0542842	0.0542842	0.5196	0.928444	0.149113	0.574708	0.489117	0.509589	0.19546	0.802587	0.785924	-	1	0.561276	0.588506	0.56609	-	0.848312	-	1	0.723674	0.259656	1	1	0.0951083	0.0845387		
Lenton	Permian	GW13	Trend	No	No	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	No	No	No	No	-	No	No	No	No	No	No	No	No	No	No	
Lenton	Alluvium/Regolith	GW19	Total Number	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	2	3	0	3	2	3	3	2	3	0	3	2	3	3	3	3	3	3	
Lenton	Alluvium/Regolith	GW19	from	-	-	-	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	-	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	-	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	
Lenton	Alluvium/Regolith	GW19	to	-	-	-	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	13-06-2014	04-11-2014	-	04-11-2014	13-06-2014	04-11-2014	04-11-2014	13-06-2014	04-11-2014	-	04-11-2014	13-06-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014
Lenton	Alluvium/Regolith	GW19	Min	-	-	-	1990	0.5	0.5	388	388	30	764	107	90	428	5	0.005	5.00E-04	1.70E-02	-	0.005	5.00E-04	0.71	0.005	5.00E-04	2.10E-02	-	0.005	5.00E-04	0.92	5.00E-05	5.00E-05	0.460	7.44		
Lenton	Alluvium/Regolith	GW19	5th %ile	-	-	-	2000	0.5	0.5	391.2	391.2	30.1	764.2	107.1	90.1	430.1	5.1	0.005	5.00E-04	1.74E-02	-	0.005	5.00E-04	0.721	0.9385	5.00E-04	2.12E-02	-	0.005	0.0005	2.388	5.00E-05	0.00005	3075	7.483		
Lenton	Alluvium/Regolith	GW19	20th %ile	-	-	-	2030	0.5	0.5	400.8	400.8	30.4	764.8	107.4	90.4	436.4	5.4	0.005	5.00E-04	1.86E-02	-	0.005	5.00E-04	0.754	3.739	5.00E-04	2.18E-02	-	0.005	0.0005	6.792	5.00E-05	0.00005	3120	7.612		
Lenton	Alluvium/Regolith	GW19	Median	-	-	-	2090	0.5	0.5	420	420	31	766	108	91	449	6	0.005	5.00E-04	2.10E-02	-	0.005	5.00E-04	0.82	9.34	5.00E-04	2.30E-02	-	0.005	0.0005	15.6	5.00E-05	0.00005	3210	7.87		
Lenton	Alluvium/Regolith	GW19	80th %ile	-	-	-	2114	0.5	0.5	439.2	439.2	32.2	805	109.8	92.8	456.8	6	1.964	5.00E-04	2.22E-02	-	0.005	5.00E-04	2.272	24.076	5.00E-04	2.42E-02	-	0.005	0.0005	39.9	5.00E-05	0.00005	3252	8.068		
Lenton	Alluvium/Regolith	GW19	95th %ile	-	-	-	2126	0.5	0.5	448.8	448.8	32.8	824.5	110.7	93.7	460.7	6	2.9435	5.00E-04	0.0228	-	0.005	0.0005	2.998	31.444	5.00E-04	2.48E-02	-	0.005	0.0005	52.05	0.00005	0.00005	3273	8.167		
Lenton	Alluvium/Regolith	GW19	Max	-	-	-	2130	0.5	0.5	452	452	33	831	111	94	462	6	3.27	5.00E-04	0.023	-	0.005	0.0005	3.24	33.9	5.00E-04	2.50E-02	-	0.005	0.0005	56.1	5.00E-05	5.00E-05	3280	8.2		
Lenton	Alluvium/Regolith	GW19	Tau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19	2-sided-p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19	Trend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19_33	Total Number	3	4	0	2	3	3	3	3	3	2	2	2	3	2	3	2	3	1	3	3	3	3	1	0	1	1	1	1	3	1	2	2		
Lenton	Alluvium/Regolith	GW19_33	from	17-12-2019	17-12-2019	-	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	14-05-2023	17-12-2019	17-12-2019	17-12-2019	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	17-12-2019	14-05-2023	17-12-2019	17-12-2019	
Lenton	Alluvium/Regolith	GW19_33	to	14-05-2023	14-05-2023	-	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	14-05-2023	24-03-2020	14-05-2023	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020		
Lenton	Alluvium/Regolith	GW19_33	Min	7.19	486	-	336	0.5	0.5	237	237	2	23	41	22	40	2	0.005	5.00E-04	5.00E-04	0.0005	0.005	5.00E-04	0.025	2.82	-	0.001	0.001	0.005	5.00E-04	3.16	5.00E-05	5.00E-05	517	7.75		
Lenton	Alluvium/Regolith	GW19_33	5th %ile	7.225	495	-	341.6	0.5	0.5	245.5	245.5	2.1	237.5	22.2	41.6	2	0.005	5.25E-04	0.0005	0.0005	0.005	5.00E-04	0.0545	2.82	-	0.001	0.001	0.005	5.00E-04	3.16	5.00E-05	5.00E-05	525.65	7.7525			
Lenton	Alluvium/Regolith	GW19_33	20th %ile	7.33	522	-	358.4	0.5	0.5	271	271	2.4	26	44	22.8	46.4	2	0.005	6.00E-04	5.00E-04	0.0005	0.005	5.00E-04	0.143	2.82	-	0.001	0.001	0.005	5.00E-04	3.16	5.00E-05	5.00E-05	551.6	7.76		
Lenton	Alluvium/Regolith	GW19_33	Median	7.54	650	-	392	0.5	0.5	322	322	3	30.5	48.5	24	56	2	0.005	7.50E-04	0.0005	0.0005	0.005	5.00E-04	0.32	2.82	-	0.001	0.001	0.005	5.00E-04	3.16	5.00E-05	5.00E-05	603.5	7.775		
Lenton	Alluvium/Regolith	GW19_33	80th %ile	7.612	761.2	-	425.6	0.5	0.5	349.6	349.6	4.8	35	53	25.2	63.8	2	0.026	9.00E-04	4.40E-03	0.0005	0.005	5.00E-04	1.964	2.82	-	0.001	0.001	0.005	5.00E-04	3.16	5.00E-05	5.00E-05	655.4	7.79		
Lenton	Alluvium/Regolith	GW19_33	95th %ile	7.648	769.3	-	442.4	0.5	0.5	363.4	363.4	5.7	37.25	55.25	25.8	67.7	2	0.0365	9.75E-04	0.00635	0.0005	0.005	5.00E-04	2.786	2.82	-	0.001	0.001	0.005	5.00E-04	3.16	5.00E-05	5.00E-05	681.35	7.7975		
Lenton	Alluvium/Regolith	GW19_33	Max	7.66	772	-	448	0.5	0.5	368	368	6	38	56	26	69	2	0.04	1.00E-03	0.007	0.0005	0.005	5.00E-04	3.06	2.82	-	0.001	0.001	0.005	5.00E-04	3.16	5.00E-05	5.00E-05	690	7.8		
Lenton	Alluvium/Regolith	GW19_33	Tau	-	0.333333	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19_33	2-sided-p	-	0.734095	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19_33	Trend	-	No	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW19_37a	Total Number	4	4	0	2	3	3	4	4	4	2	2	2	4	2	4	2	4	2	4	4	4	4	2	0	2	2	2	4	2	3	2	2		
Lenton	Alluvium	GW19_37a	from	17-12-2019	17-12-2019	-	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	08-11-2022	17-12-2019	17-12-2019	17-12-2019	08-11-2022	-	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	17-12-2019	08-11-2022	17-12-2019	17-12-2019		
Lenton	Alluvium	GW19_37a	to	14-05-2023	14-05-2023	-	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	14-05-2023	24-03-2020	14-05-2023	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	08-11-2022	24-03-2020	24-03-2020		
Lenton	Alluvium	GW19_37a	Min	7.27	1054	-	1370	0.5	0.5	620	671	3	358	48	47	393	4	0.005	5.00E-04	6.00E-03	1.20E-02	0.005	5.00E-04	0.025	0.07	-	1.00E-02	1.00E-02	0.005	5.00E-04	0.91	5.00E-05	5.00E-05	2110	7.89		
Lenton	Alluvium	GW19_37a	5th %ile	7.3075	1192.9	-	1374.5	0.5	0.5	629	672.35	6.3	359	48.05	47.05	394.95	4	0.005	5.00E-04	6.30E-03	1.21E-02	0.005	5.00E-04	0.14425	0.08	-	1.01E-02	0.0105	0.005	0.0005	0.9445	5.00E-05	0.00005	2123	7.897		
Lenton	Alluvium	GW19_37a	20th %ile	7.42	1609.6	-	1388	0.5	0.5	656	676.4	16.2	362	48.2	47.02	400.8	4	0.005	5.00E-04	7.20E-03	1.22E-02	0.005	5.00E-04	0.502	0.11	-	1.02E-02	1.20E-02	0.005	0.0005	1.048	5.00E-05	0.00005	2162	7.918		
Lenton	Alluvium	GW19_37a	Median	7.705	2113	-	1415	0.5	0.5	697.5	697.5	26.5	368	48.5	47.5	416.5	4	0.0125	5.00E-04	8.00E-03	1.25E-02	0.005	5.00E-04	1.125	0.17	-	1.05E-02	0.015	0.005	0.0005	1.255	5.00E-05	0.00005	2240	7.96		
Lenton	Alluvium	GW19_37a	80th %ile	7.994	2302.8	-	1442	0.5	0.5	717.4	717.4	29.2	374	48.8																							

Monitoring Network	Aquifer	Bore	statistic	Field pH	Field EC	Temp Field	TDS	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Sodium	Potassium	Diss_Aluminu m	Diss_Antimo ny	Diss_Arsenic	Diss_Molybde num	Diss_Seleniu m	Diss_Silver	Diss_Iron	Tot_Aluminu m	Tot_Antimon y	Tot_Arsenic	Tot_Molybde num	Tot Selenium	Tot Silver	Tot Iron	Diss_Mercury	Tot Mercury	Lab EC	Lab pH	
Lenton	Permian	GW27A	80th %ile	7.792	6191.2	-	3974	0.5	0.5	674.2	674.2	0.5	1658	39.8	7.4	1314	7.4	0.02	5.00E-04	1.00E-03	-	0.005	5.00E-04	0.204	-	-	-	-	-	-	5.00E-05	-	6140	8.22		
Lenton	Permian	GW27A	95th %ile	7.8055	6271.3	-	4016	0.5	0.5	674.8	674.8	0.5	1682	42.2	8.6	1446	8.6	0.02	5.00E-04	0.001	-	0.005	5.00E-04	0.366	-	-	-	-	-	-	5.00E-05	-	6185	8.22		
Lenton	Permian	GW27A	Max	7.81	6298	-	4030	0.5	0.5	675	675	0.5	1690	43	9	1490	9	0.02	5.00E-04	0.001	-	0.005	5.00E-04	0.42	-	-	-	-	-	-	5.00E-05	-	6200	8.22		
Lenton	Permian	GW27A	Tau	1	0	-	0.948683	1	1	-0.105409	-0.105409	1	0.136228	-0.527046	0.632456	0.737865	0.632456	0.258199	1	0	-	1	1	-0.948683	-	-	-	-	-	-	1	-	0.912871	0		
Lenton	Permian	GW27A	2-sided-p	0.0894294	1	-	0.0432627	1	1	1	1	1	0.613354	0.312216	0.288844	0.129551	0.288844	0.77283	1	1	-	1	1	0.0432627	-	-	-	-	-	-	1	-	0.148562	1		
Lenton	Permian	GW27A	Trend	No	No	-	Yes-Upward	No	No	No	No	No	No	No	No	No	No	No	No	No	-	No	No	Yes-Downward	-	-	-	-	-	-	No	-	No	No		
Lenton	Permian	GW28A	Total Number	4	4	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	4	4	0	0	0	0	0	0	0	4	0	3	3	
Lenton	Permian	GW28A	from	01-06-2018	01-06-2018	-	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	-	01-06-2018	01-06-2018	01-06-2018	-	-	-	-	-	-	01-06-2018	-	09-05-2019	09-05-2019	
Lenton	Permian	GW28A	to	23-03-2020	23-03-2020	-	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	-	24-03-2020	24-03-2020	24-03-2020	-	-	-	-	-	-	24-03-2020	-	24-03-2020	24-03-2020	
Lenton	Permian	GW28A	Min	7.9	5090	-	2880	0.5	0.5	506	517	0.5	1420	12	4	1020	5	0.02	5.00E-04	8.00E-03	-	0.005	5.00E-04	0.025	-	-	-	-	-	-	5.00E-05	-	5230	8.27		
Lenton	Permian	GW28A	5th %ile	7.9165	5108	-	2958	0.5	0.5	506.15	519.7	0.5	1423	12.45	4	1038	5.15	0.0215	5.00E-04	8.15E-03	-	0.005	5.00E-04	0.025	-	-	-	-	-	-	5.00E-05	-	5240	8.27		
Lenton	Permian	GW28A	20th %ile	7.966	5162	-	3192	0.5	0.5	506.6	527.8	0.5	1432	13.8	4	1092	5.6	0.026	5.00E-04	8.60E-03	-	0.005	5.00E-04	0.025	-	-	-	-	-	-	5.00E-05	-	5270	8.27		
Lenton	Permian	GW28A	Median	8.08	5370	-	3430	0.5	5.25	521	535	0.5	1440	16	4	1150	6	0.045	5.00E-04	9.00E-03	-	0.005	5.00E-04	0.025	-	-	-	-	-	-	5.00E-05	-	5330	8.27		
Lenton	Permian	GW28A	80th %ile	8.278	5530	-	3472	0.5	18.4	535	535.8	1.1	1456	18.2	4	1160	6	0.06	5.00E-04	9.40E-03	-	0.005	5.00E-04	0.025	-	-	-	-	-	-	5.00E-05	-	5354	8.306		
Lenton	Permian	GW28A	95th %ile	8.422	5530	-	3485.5	0.5	27.85	535	536.7	1.775	1474	19.55	4	1160	6	0.06	5.00E-04	0.00985	-	0.005	0.0005	0.025	-	-	-	-	-	-	0.00005	-	5366	8.324		
Lenton	Permian	GW28A	Max	8.47	5530	-	3490	0.5	31	535	537	2	1480	20	4	1160	6	0.06	5.00E-04	0.01	-	0.005	0.0005	0.025	-	-	-	-	-	-	5.00E-05	-	5370	8.33		
Lenton	Permian	GW28A	Tau	0	-0.182574	-	0.666667	1	-0.547723	0.547723	-0.547723	-0.707107	0.547723	-0.333333	1	0.912871	0.707107	0.547723	1	-0.547723	-	1	1	1	-	-	-	-	-	-	1	-	-	-		
Lenton	Permian	GW28A	2-sided-p	1	1	-	0.308179	1	0.470101	0.470101	0.470101	0.371093	0.734095	1	0.148562	0.371093	0.470101	1	0.470101	-	1	1	1	1	-	-	-	-	-	-	1	-	-	-		
Lenton	Permian	GW28A	Trend	No	No	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	No	No	No	-	-	-	-	-	-	No	-	-	-		
Lenton	Permian	GW29A	Total Number	4	4	0	3	4	4	4	4	4	4	3	3	3	4	3	4	3	4	1	4	4	4	1	0	1	1	1	1	4	1	3	3	
Lenton	Permian	GW29A	from	09-05-2019	09-05-2019	-	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	14-05-2023	09-05-2019	09-05-2019	09-05-2019	14-05-2023	-	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	09-05-2019	14-05-2023	09-05-2019	09-05-2019
Lenton	Permian	GW29A	to	14-05-2023	14-05-2023	-	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	24-03-2020	14-05-2023	24-03-2020	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020		
Lenton	Permian	GW29A	Min	7.41	5620	-	6020	0.5	0.5	276	276	0.5	3200	103	28	1670	12	0.005	5.00E-04	6.00E-03	0.003	0.005	5.00E-04	0.19	22.4	-	0.019	0.003	0.005	5.00E-04	24.6	5.00E-05	5.00E-05	9260	7.91	
Lenton	Permian	GW29A	5th %ile	7.446	6076	-	6020	0.5	0.5	276	276	0.575	3205	105.3	28.1	1692.5	12	0.005	5.00E-04	0.00615	0.003	0.005	5.00E-04	0.2215	22.4	-	0.019	0.003	0.005	5.00E-04	24.6	5.00E-05	5.00E-05	9261	7.911	
Lenton	Permian	GW29A	20th %ile	7.554	7444	-	6020	0.5	0.5	276	276	0.8	3220	112.2	28.4	1760	12	0.005	5.00E-04	6.60E-03	0.003	0.005	5.00E-04	0.316	22.4	-	0.019	0.003	0.005	5.00E-04	24.6	5.00E-05	5.00E-05	9264	7.914	
Lenton	Permian	GW29A	Median	7.65	8725	-	6020	0.5	0.5	280	280	1.5	3250	126	29	1835	12	0.005	5.00E-04	0.0075	0.003	0.005	5.00E-04	0.46	22.4	-	0.019	0.003	0.005	5.00E-04	24.6	5.00E-05	5.00E-05	9270	7.92	
Lenton	Permian	GW29A	80th %ile	7.73	8834	-	6122	0.5	2.3	300.8	302.8	2	3406	139.2	29.6	1870	12	0.019	5.00E-04	8.80E-03	0.003	0.005	5.00E-04	0.56	22.4	-	0.019	0.003	0.005	5.00E-04	24.6	5.00E-05	5.00E-05	9426	7.968	
Lenton	Permian	GW29A	95th %ile	7.82	8883.5	-	6173	0.5	4.325	319.7	323.95	2	3484	145.8	29.9	1892.5	12	0.03475	5.00E-04	0.0097	0.003	0.005	5.00E-04	0.605	22.4	-	0.019	0.003	0.005	5.00E-04	24.6	5.00E-05	5.00E-05	9504	7.992	
Lenton	Permian	GW29A	Max	7.85	8900	-	6190	0.5	5	326	331	2	3510	148	30	1900	12	0.04	5.00E-04	0.01	0.003	0.005	5.00E-04	0.62	22.4	-	0.019	0.003	0.005	5.00E-04	24.6	5.00E-05	5.00E-05	9530	8	
Lenton	Permian	GW29A	Tau	-0.182574	-1	-	-	1	0.707107	0.182574	0.182574	0.182574	-	-	-	-1	0.707107	-	0	-	1	1	0.666667	-	-	-	-	-	-	-	1	-	-	-		
Lenton	Permian	GW29A	2-sided-p	1	0.0894294	-	-	1	0.371093	1	1	1	-	-	-	0.0894294	-	0.371093	-	1	-	1	1	0.308179	-	-	-	-	-	-	1	-	-	-		
Lenton	Permian	GW29A	Trend	No	No	-	No	No	No	No	No	No	-	-	-	No	-	No	-	No	-	No	No	No	-	-	-	-	-	-	No	-	-	-		
Lenton	Permian	GW30A	Total Number	5	5	0	4	5	5	5	5	5	4	4	4	5	4	5	4	5	1	5	5	5	1	0	1	1	1	1	1	5	1	3	3	
Lenton	Permian	GW30A	from	01-06-2018	01-06-2018	-	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	14-05-2023	01-06-2018	01-06-2018	01-06-2018	14-05-2023	-	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	01-06-2018	14-05-2023	09-05-2019	09-05-2019	
Lenton	Permian	GW30A	to	14-05-2023	14-05-2023	-	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	14-05-2023	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020		
Lenton	Permian	GW30A	Min	7.13	13130	-	9160	0.5	0.5	179	179	0.5	5000	222	107	2540	18	0.005	5.00E-04	5.00E-04	0.005	5.00E-04	1.16	0.13	-	2.00E-03	5.00E-04	0.005	5.00E-04	1.88	5.00E-05	5.00E-05	14100	7.74		
Lenton	Permian	GW30A	5th %ile	7.15	13156	-	9160	0.5	0.5	179.6	179.6	0.5	5018	229.05	107	2556	18	0.005	5.00E-04	8.00E-04	5.00E-04	0.005	5.00E-04	1.166	0.13	-	2.00E-03	0.0005	0.005	5.00E-04	1.88	5.00E-05	0.00005	14100	7.742	
Lenton	Permian	GW30A	20th %ile	7.21	13234	-	9160	0.5	0.5	181.4	181.4	0.5	5072	250.2	107	2604	18	0.005	5.00E-04	1.70E-03	5.00E-04	0.005	5.00E-04	1.184	0.13	-	2.00E-03	5.00E-04	0.005	0.0005	1.88	5.00E-05	0.00005	14100	7.748	
Lenton	Permian	GW30A	Median	7.42	13510	-	9230	0.5	0.5	185	185	1	5170	277.5	109.5	2720	18	0.005																		

Monitoring Network	Aquifer	Bore	statistic	Field pH	Field EC	Temp Field	TDS	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Licarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Sodium	Potassium	Diss_Alumini um	Diss_Antimo ny	Diss_Arsenic	Diss_Molybd enum	Diss_Seleniu m	Diss Silver	Diss Iron	Tot_Aluminum m	Tot_Antimon y	Tot Arsenic	Tot Molybde num	Tot Selenium	Tot Silver	Tot Iron	Diss Mercury	Tot Mercury	Lab_EC	Lab pH
Lenton	Permian	LEN486	5th %ile	6.4775	7272.9	-	8270.5	0.5	0.5	558.4	558.4	0.8	4311	167.55	153.1	2586	18.55	0.005	5.00E-04	0.0005	0.009	0.005	5.00E-04	0.415	0.01125	5.00E-04	0.00925	0.004	0.005	5.00E-04	3.105	5.00E-05	5.00E-05	12880	7.32
Lenton	Permian	LEN486	20th %ile	6.532	13320	-	8464	0.5	0.5	588.4	588.4	1	4488	171.8	158.8	2624	19.2	0.005	5.00E-04	5.00E-04	0.009	0.005	5.00E-04	0.57	0.03	5.00E-04	0.013	0.004	0.005	5.00E-04	3.21	5.00E-05	5.00E-05	13060	7.482
Lenton	Permian	LEN486	Median	6.75	14155	-	9625	0.5	0.5	630	630	2	5225	182	172	2780	22	0.005	5.00E-04	0.0005	0.009	0.005	5.00E-04	1.4	0.05	7.50E-04	0.014	0.004	0.005	5.00E-04	4.01	5.00E-05	5.00E-05	14300	7.58
Lenton	Permian	LEN486	80th %ile	6.976	16457	-	10216	0.5	0.5	679.8	679.8	118.4	5478	195	182	2980	22.8	0.005	5.00E-04	1.00E-03	0.009	0.005	5.00E-04	3.39	0.05	1.40E-03	0.019	0.004	0.005	5.00E-04	4.38	5.00E-05	5.00E-05	15800	7.72
Lenton	Permian	LEN486	95th %ile	7.3235	17484	-	10300	0.5	0.5	725.6	725.6	335.6	5507	200.5	199.4	3180	24	0.015	5.00E-04	0.0165	0.009	0.005	5.00E-04	3.735	0.4315	1.85E-03	0.02875	0.004	0.005	5.00E-04	8.49	5.00E-05	5.00E-05	15800	7.942
Lenton	Permian	LEN486	Max	7.56	18540	-	10300	0.5	0.5	734	734	512	5540	206	206	3120	24	0.03	5.00E-04	0.019	0.009	0.005	5.00E-04	3.85	5.74	2.00E-03	0.032	0.004	0.005	5.00E-04	9.86	5.00E-05	5.00E-05	15800	8.09
Lenton	Permian	LEN486	Tau	0.43082	0.424242	-	0.759895	1	1	-0.38964	-0.38964	-0.470318	0.687043	0.246183	0	0.701358	0.193952	0.426401	1	-0.38925	0	0	1	-0.844072	0.596285	0.547723	-0.690066	-	1	1	-0.2	1	0.841375	0.319142	
Lenton	Permian	LEN486	2-sided-p	0.0628535	0.0641036	-	0.000899434	1	1	0.0757527	0.0757527	0.0346301	0.0249195	0.301389	1	0.00117218	0.438956	0.154729	1	0.160814	-	1	0.000441563	0.158709	0.470101	0.0851679	-	1	1	0.00289023	0.287333				
Lenton	Permian	LEN486	Trend	No	No	-	Yes-Upward	No	No	No	No	Yes-Downward	Yes-Upward	No	No	No	Yes-Upward	No	No	No	No	No	No	Yes-Downward	No	No	No	-	No	No	No	No	Yes-Upward	No	

Monitoring Network	Aquifer	Bore	statistic	Temp Lab	Ionic Balance	Suspended Solids (SS)	Total Anions	Total Cations	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C6 - C9 Fraction	C10 - C36 Fraction (sum)	C10 - C16 Fraction	C10 - C40 Fraction (sum)	C16 - C34 Fraction	C34 - C40 Fraction	C6 - C10 Fraction	Diss_Cadmium	Diss_Chromium	Diss_Copper	Diss_Lead	Diss_Nickel	Diss_Zinc	Diss_Barium	Diss_Beryllium	Diss_Boron	Diss_Cobalt	Diss_Manganese	Diss_Uranium	Diss_Vanadium	Total Hardness as CaCO3	Nitrogen (Total)	Total Kjeldahl Nitrogen as N	Tot_Phosphorus			
Lenton	Alluvium	GW01	Total Number	0	8	0	8	8	0	0	0	0	0	0	0	0	0	0	5	5	5	5	5	5	4	4	4	4	4	4	6	10	7	8				
Lenton	Alluvium	GW01	from	-	20-02-2014	-	20-02-2014	20-02-2014	-	-	-	-	-	-	-	-	-	-	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014						
Lenton	Alluvium	GW01	to	-	01-06-2018	-	01-06-2018	01-06-2018	-	-	-	-	-	-	-	-	-	-	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-04-2015	01-06-2018	01-03-2017	01-06-2018						
Lenton	Alluvium	GW01	Min	-	0.55	-	63	59.6	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	5.00E-04	3.00E-03	0.0025	0.199	5.00E-04	0.28	5.00E-04	0.119	0.008	0.01	1640	0.02	0.1	0.04				
Lenton	Alluvium	GW01	5th %ile	-	0.585	-	63.21	60.65	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	5.00E-04	3.00E-03	0.0025	0.20185	5.00E-04	0.2815	5.00E-04	0.12965	0.0083	0.01	1662.5	0.083	0.1	0.047				
Lenton	Alluvium	GW01	20th %ile	-	1.382	-	64.08	64.4	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	0.0005	3.00E-03	0.0025	0.2104	5.00E-04	0.286	5.00E-04	0.1616	0.0092	0.01	1730	0.216	0.12	0.064				
Lenton	Alluvium	GW01	Median	-	3.055	-	67.1	70.55	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.0005	0.0005	5.00E-04	0.003	0.0025	0.2255	5.00E-04	0.29	5.00E-04	0.195	0.0105	0.01	1835	0.35	0.25	0.22			
Lenton	Alluvium	GW01	80th %ile	-	3.718	-	74.06	74.06	-	-	-	-	-	-	-	-	-	-	1.40E-04	0.0005	0.0006	5.00E-04	0.0056	0.0052	0.2394	5.00E-04	0.334	2.70E-03	0.76	0.011	0.014	1910	0.84	1.18	0.612			
Lenton	Alluvium	GW01	95th %ile	-	4.114	-	75.8	75.21	-	-	-	-	-	-	-	-	-	-	4.10E-04	0.0005	0.0009	5.00E-04	0.0104	0.0058	0.2466	5.00E-04	0.3835	5.18E-03	1.39	0.011	0.0185	1917.5	1.91	1.61	1.1445			
Lenton	Alluvium	GW01	Max	-	4.17	-	76.5	75.7	-	-	-	-	-	-	-	-	-	-	5.00E-04	0.0005	0.001	5.00E-04	0.012	0.006	0.249	5.00E-04	0.4	6.00E-03	1.6	0.011	0.02	1920	2	1.7	1.33			
Lenton	Alluvium	GW01	Tau	-	-0.0714286	-	0.0714286	-0.285714	-	-	-	-	-	-	-	-	-	-	0	1	-0.316228	1	0.597614	-0.119523	0.333333	1	0.182574	0.707107	0	-0.912871	0.235702	-0.2	-0.584307	-0.09759	-0.571429			
Lenton	Alluvium	GW01	2-sided-p	-	0.901539	-	0.901539	0.386476	-	-	-	-	-	-	-	-	-	-	1	1	0.723674	1	0.267257	1	0.734095	1	1	0.371093	1	0.148562	1	0.707114	0.0247639	0.879257	0.0634865			
Lenton	Alluvium	GW01	Trend	-	No	-	No	-	-	-	-	-	-	-	-	-	-	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes-Downward	No	No	No		
Lenton	Burton Rider/Regolith	GW04	Total Number	0	10	0	10	10	0	0	0	0	0	0	0	0	0	0	7	7	7	7	7	7	6	6	6	6	6	7	12	8	10					
Lenton	Burton Rider/Regolith	GW04	from	-	20-02-2014	-	20-02-2014	20-02-2014	-	-	-	-	-	-	-	-	-	-	-	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014						
Lenton	Burton Rider/Regolith	GW04	to	-	09-05-2019	-	09-05-2019	09-05-2019	-	-	-	-	-	-	-	-	-	-	-	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019				
Lenton	Burton Rider/Regolith	GW04	Min	-	0.005	-	89.2	80.1	-	-	-	-	-	-	-	-	-	-	0.00005	0.0005	0.0005	0.0005	0.0005	0.0025	0.002	0.0005	0.1	0.002	0.775	0.002	0.005	1650	0.005	0.2	0.025			
Lenton	Burton Rider/Regolith	GW04	5th %ile	-	0.28625	-	90.73	80.595	-	-	-	-	-	-	-	-	-	-	0.00005	0.0005	0.0005	0.0005	0.0005	0.0025	0.24675	0.0005	0.14	0.002	0.77775	0.002	0.005	1659	0.005	0.2175	0.08575			
Lenton	Burton Rider/Regolith	GW04	20th %ile	-	1.55	-	92.92	81.28	-	-	-	-	-	-	-	-	-	-	0.00005	0.0005	0.0005	0.0005	0.0005	0.0025	0.981	0.0005	0.26	0.002	0.786	0.002	0.005	1682	0.005	0.25	0.184			
Lenton	Burton Rider/Regolith	GW04	Median	-	3.805	-	101.9	94.6	-	-	-	-	-	-	-	-	-	-	0.00005	0.0005	0.0005	0.0005	0.0005	0.006	1.08	0.0005	0.285	0.0025	0.8025	0.002	0.005	2110	0.25	0.3	0.23			
Lenton	Burton Rider/Regolith	GW04	80th %ile	-	7.262	-	132.6	127.8	-	-	-	-	-	-	-	-	-	-	0.00033	0.0005	0.0066	0.0005	0.0018	0.0096	1.12	0.0005	0.3	0.003	0.841	0.005	0.005	2364	0.38	0.4	0.342			
Lenton	Burton Rider/Regolith	GW04	95th %ile	-	8.1765	-	167.6	184.35	-	-	-	-	-	-	-	-	-	-	0.00047	0.00225	0.0122	0.00295	0.0258	0.031	1.1575	0.0005	0.315	0.003	0.85225	0.005	0.005	3192	0.445	0.4	0.412			
Lenton	Burton Rider/Regolith	GW04	Max	-	8.82	-	191	228	-	-	-	-	-	-	-	-	-	-	0.0005	0.003	0.014	0.004	0.036	0.04	1.17	0.0005	0.32	0.003	0.856	0.005	0.005	3540	0.5	0.4	0.43			
Lenton	Burton Rider/Regolith	GW04	Tau	-	-0.0666667	-	-0.955556	-0.822222	-	-	-	-	-	-	-	-	-	-	0.592157	0	-0.0563436	0.178174	0.281718	0.102869	-0.0666667	1	0.2	-0.258199	0.333333	-0.730297	1	-0.714286	0.197028	0.53936				
Lenton	Burton Rider/Regolith	GW04	2-sided-p	-	0.858028	-	0.000172241	0.00128218	-	-	-	-	-	-	-	-	-	-	0.128275	1	1	0.802587	0.503001	0.875393	1	1	0.707114	0.662521	0.45237	0.105192	1	0.0354981	0.480595	0.604571	0.0388794			
Lenton	Burton Rider/Regolith	GW04	Trend	-	No	-	Yes-Downward	Yes-Downward	-	-	-	-	-	-	-	-	-	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes-Downward	No	No	Yes-Downward
Lenton	Alluvium	GW06	Total Number	0	11	0	11	11	0	0	0	0	0	0	0	0	0	0	8	8	8	8	8	8	7	7	7	7	7	8	13	9	11					
Lenton	Alluvium	GW06	from	-	20-02-2014	-	20-02-2014	20-02-2014	-	-	-	-	-	-	-	-	-	-	-	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014						
Lenton	Alluvium	GW06	to	-	24-03-2020	-	24-03-2020	24-03-2020	-	-	-	-	-	-	-	-	-	-	-	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020				
Lenton	Alluvium	GW06	Min	-	0.56	-	27.9	26.4	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	5.00E-04	5.00E-04	5.00E-04	0.0025	0.001	5.00E-04	0.05	5.00E-04	0.0005	0.0005	235	0.005	0.5	0.07				
Lenton	Alluvium	GW06	5th %ile	-	0.8	-	29.9	28.15	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	5.00E-04	5.00E-04	5.00E-04	0.0025	0.2167	5.00E-04	0.185	5.00E-04	0.01565	0.00545	0.005	245.15	0.005	0.66	0.08			
Lenton	Alluvium	GW06	20th %ile	-	1.8	-	51.4	56.5	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	0.0005	5.00E-04	7.00E-04	0.0025	0.7454	5.00E-04	0.514	5.00E-04	0.053	0.018	0.005	376.4	0.011	1.2	0.1			
Lenton	Alluvium	GW06	Median	-	2.91	-	104	100	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.0005	0.0005	5.00E-04	0.002	0.0025	1.36	5.00E-04	1.13	5.00E-04	0.076	0.024	0.005	631	1.4	2	0.1			
Lenton	Alluvium	GW06	80th %ile	-	5.62	-	178	167	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.0005	0.0008	5.00E-04	0.006	0.0066	1.832	5.00E-04	1.526	5.00E-04	1.0364	0.029	0.005	2048	4.82	7.42	0.18			
Lenton	Alluvium	GW06	95th %ile	-	11.14	-	191	171	-	-	-	-	-	-	-	-	-	-	8.25E-05	0.000825	0.00425	5.00E-04	0.01125	0.01415	2.046	5.00E-04	1.737	8.50E-04	1.345	0.0307	0.005	2732.5	11.7	12.7	0.64			
Lenton	Alluvium	GW06	Max	-	16.3	-	194	174	-	-	-	-	-	-	-	-	-	-	1.00E-04	0.001	0.006	5.00E-04	0.013	0.018	2.1	5.00E-04	1.8	1.00E-03	1.39	0.031	0.005	2750	14.7	14.7	0.67			
Lenton	Alluvium	GW06	Tau	-	0.146795	-	0.709091	0.709091	-	-	-	-	-	-	-	-	-	-	-0.357143	-0.214286	-0.157243	1	-0.518875	-0.267261	0.428571	1	-0.333333	0.534522	0.714286	0.238095	1	0.857143	-0.32686	-0.555556	0.23355			
Lenton	Alluvium	GW06	2-sided-p	-	0.584648	-	0.00309348	0.00309348	-	-	-	-	-	-	-	-	-	-	0.382733	0.662521	0.742308	1	0.102358	0.473542	0.229556	1	0.367521	0.211299	0.0354981	0.548006	1	0.00443399	0.140399	0.047604	0.377456			
Lenton	Alluvium	GW06	Trend	-	No	-	Yes-Upward	Yes-Upward	-	-	-	-	-	-	-	-	-	-	No	No	No	No	No	No	No	No	No	No	No	Yes-Upward	No	No	Yes-Upward	No	Yes-Downward	No		
Lenton	Alluvium	GW07	Total Number	0	12	2	12	12	2	2	2	2	2	2	2	2	2	2	11	11	11	11	11	11	10	8	10	10	10	9	14	12	12					
Lenton	Alluvium	GW07	from	-	20-02-2014	08-11-2022	20-02-2014	20-02-2014	08-11-2022	08-11-2022	08-11-2022	08-11-20																										

Monitoring Network	Aquifer	Bore	statistic	Temp Lab	Ionic Balance	Suspended Solids (SS)	Total Anions	Total Cations	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C6 - C9 Fraction	C10 - C36 Fraction (sum)	C10 - C16 Fraction	C10 - C40 Fraction (sum)	C16 - C34 Fraction	C34 - C40 Fraction	C6 - C10 Fraction	Diss_Cadmium	Diss_Chromium	Diss_Copper	Diss_Lead	Diss_Nickel	Diss_Zinc	Diss_Barium	Diss_Beryllium	Diss_Boron	Diss_Cobalt	Diss_Manganese	Diss_Uranium	Diss_Vanadium	Total Hardness as CaCO3	Nitrogen (Total)	Total Kjeldahl Nitrogen as N	Tot_Phosphorus	
Lenton	Permian	GW13	Tau	-	0.250065	-	0.141421	-0.116405	-	-	-	-	-	-	-	-	-	-	-0.347833	1	0.121716	1	0.416622	0.329393	0.366233	1	0.30989	0.353553	0.571662	1	1	0.39036	0.294653	0.629253	0.40452	
Lenton	Permian	GW13	2-sided-p	-	0.367232	-	0.647162	0.715378	-	-	-	-	-	-	-	-	-	-	0.29627	1	0.749119	1	0.134562	0.23403	0.208413	1	0.294507	0.332922	0.0452013	1	1	0.287611	0.213829	0.0153222	0.126849	
Lenton	Permian	GW13	Trend	-	No	-	No	No	-	-	-	-	-	-	-	-	-	-	No	No	No	No	No	No	No	No	No	Yes-Upward	No	No	No	-	-	Yes-Upward	No	
Lenton	Alluvium/Regolith	GW19	Total Number	0	3	0	3	3	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3		
Lenton	Alluvium/Regolith	GW19	from	-	01-05-2014	-	01-05-2014	01-05-2014	-	-	-	-	-	-	-	-	-	-	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014		
Lenton	Alluvium/Regolith	GW19	to	-	04-11-2014	-	04-11-2014	04-11-2014	-	-	-	-	-	-	-	-	-	-	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014	13-06-2014	13-06-2014	13-06-2014	13-06-2014	13-06-2014	13-06-2014	04-11-2014	04-11-2014	04-11-2014	04-11-2014		
Lenton	Alluvium/Regolith	GW19	Min	-	1.51	-	30	31.5	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	5.00E-04	5.00E-04	5.00E-04	5.00E-04	0.0025	0.243	5.00E-04	0.3	5.00E-04	0.293	0.0005	0.005	638	0.2	0.2	0.24
Lenton	Alluvium/Regolith	GW19	5th %ile	-	1.703	-	30.13	31.61	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	5.00E-04	5.00E-04	5.00E-04	5.00E-04	0.0025	0.28785	5.00E-04	0.3005	5.75E-04	0.29615	0.000575	0.005	638.6	0.21	0.21	0.24
Lenton	Alluvium/Regolith	GW19	20th %ile	-	2.282	-	30.52	31.94	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	0.0005	5.00E-04	5.00E-04	5.00E-04	0.0025	0.4224	5.00E-04	0.302	8.00E-04	0.3056	0.0008	0.005	640.4	0.24	0.24	0.24
Lenton	Alluvium/Regolith	GW19	Median	-	3.44	-	31.3	32.6	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.0005	0.0005	5.00E-04	0.001	0.0025	0.6915	5.00E-04	0.305	1.25E-03	0.3245	0.00125	0.005	644	0.3	0.3	0.24	
Lenton	Alluvium/Regolith	GW19	80th %ile	-	3.836	-	32.02	33.14	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.0014	0.002	2.60E-03	0.0022	0.007	0.9606	5.00E-04	0.308	1.70E-03	0.3434	0.0017	0.005	656	0.72	0.72	0.744	
Lenton	Alluvium/Regolith	GW19	95th %ile	-	4.034	-	32.38	33.41	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.00185	0.00275	3.65E-03	0.0028	0.00925	1.09515	5.00E-04	0.3095	1.93E-03	0.35285	0.001925	0.005	662	0.93	0.93	0.996	
Lenton	Alluvium/Regolith	GW19	Max	-	4.1	-	32.5	33.5	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.002	0.003	4.00E-03	0.003	0.01	1.14	5.00E-04	0.31	2.00E-03	0.356	0.002	0.005	664	1	1	1.08	
Lenton	Alluvium/Regolith	GW19	Tau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19	2-sided-p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19	Trend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19_33	Total Number	0	2	1	2	2	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	3	2	3	3	3	3	2	2	2	3	2	
Lenton	Alluvium/Regolith	GW19_33	from	-	17-12-2019	14-05-2023	17-12-2019	17-12-2019	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019		
Lenton	Alluvium/Regolith	GW19_33	to	-	24-03-2020	14-05-2023	24-03-2020	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020		
Lenton	Alluvium/Regolith	GW19_33	Min	-	1.24	306	5.51	5.65	0.025	0.17	0.16	0.01	0.33	0.05	0.3	0.3	0.05	0.01	0.00005	0.0005	0.001	0.0005	0.003	0.0025	0.113	0.0005	0.025	0.0005	0.024	0.0005	0.005	193	0.7	0.6	0.05	
Lenton	Alluvium/Regolith	GW19_33	5th %ile	-	1.3195	306	5.612	5.767	0.025	0.17	0.16	0.01	0.33	0.05	0.3	0.3	0.05	0.01	0.00005	0.0005	0.001	0.0005	0.0037	0.00325	0.1177	0.0005	0.025	0.00055	0.0294	0.0005	0.005	195.7	0.72	0.6	0.05	
Lenton	Alluvium/Regolith	GW19_33	20th %ile	-	1.558	306	5.918	6.118	0.025	0.17	0.16	0.01	0.33	0.05	0.3	0.3	0.05	0.01	0.00005	0.0005	0.001	0.0005	0.0058	0.0055	0.1318	0.0005	0.025	0.0007	0.0456	0.0005	0.005	203.8	0.78	0.6	0.05	
Lenton	Alluvium/Regolith	GW19_33	Median	-	2.035	306	6.53	6.82	0.025	0.17	0.16	0.01	0.33	0.05	0.3	0.3	0.05	0.01	0.00005	0.0005	0.001	0.0005	0.01	0.01	0.16	0.0005	0.025	0.001	0.078	0.0005	0.005	220	0.9	0.6	0.05	
Lenton	Alluvium/Regolith	GW19_33	80th %ile	-	2.512	306	7.142	7.522	0.025	0.17	0.16	0.01	0.33	0.05	0.3	0.3	0.05	0.01	0.00005	0.0008	0.0046	0.0005	0.0124	0.022	0.199	0.0005	0.07	0.0016	0.6612	0.0014	0.005	236.2	1.02	1.56	0.05	
Lenton	Alluvium/Regolith	GW19_33	95th %ile	-	2.7505	306	7.448	7.873	0.025	0.17	0.16	0.01	0.33	0.05	0.3	0.3	0.05	0.01	0.00005	0.00095	0.0064	0.0005	0.0136	0.028	0.2185	0.0005	0.0925	0.0019	0.9528	0.00185	0.005	244.3	1.08	2.04	0.05	
Lenton	Alluvium/Regolith	GW19_33	Max	-	2.83	306	7.55	7.99	0.025	0.17	0.16	0.01	0.33	0.05	0.3	0.3	0.05	0.01	0.00005	0.001	0.007	0.0005	0.014	0.03	0.225	0.0005	0.1	0.002	1.05	0.002	0.005	247	1.1	2.2	0.05	
Lenton	Alluvium/Regolith	GW19_33	Tau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19_33	2-sided-p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium/Regolith	GW19_33	Trend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW19_37a	Total Number	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	2	4	4	4	4	2	2	2	4	2	
Lenton	Alluvium	GW19_37a	from	-	17-12-2019	08-11-2022	17-12-2019	17-12-2019	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019		
Lenton	Alluvium	GW19_37a	to	-	24-03-2020	14-05-2023	24-03-2020	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020		
Lenton	Alluvium	GW19_37a	Min	-	0.84	11	24.6	23.5	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	5.00E-04	5.00E-04	5.00E-04	6.00E-03	0.0025	0.21	5.00E-04	0.12	5.00E-04	0.215	0.0005	0.005	313	0.8	0.3	0.01	
Lenton	Alluvium	GW19_37a	5th %ile	-	0.94	12.75	24.61	23.535	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	5.00E-04	7.25E-04	5.00E-04	7.35E-03	0.003625	0.2256	5.00E-04	0.1305	5.00E-04	0.23315	0.000575	0.005	313.35	0.8	0.375	0.0125	
Lenton	Alluvium	GW19_37a	20th %ile	-	1.24	18	24.64	23.64	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	5.00E-04	0.0014	5.00E-04	1.14E-02	0.007	0.2724	5.00E-04	0.162	5.00E-04	0.2876	0.0008	0.005	314.4	0.8	0.6	0.02	
Lenton	Alluvium	GW19_37a	Median	-	1.84	28.5	24.7	23.85	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	0.0005	0.006	5.00E-04	0.0185	0.011	0.3385	5.00E-04	0.2	5.00E-04	0.3455	0.0015	0.005	316.5	0.8	0.8	0.035	
Lenton	Alluvium	GW19_37a	80th %ile	-	2.44	39	24.76	24.06	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	0.0011	0.01252	1.10E-03	0.0244	0.0336	0.3938	5.00E-04	0.23	7.00E-04	0.4178	0.002	0.005	318.6	0.8	1.52	0.05	
Lenton	Alluvium	GW19_37a	95th %ile	-	2.74	44.25	24.79	24.165	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	0.001775	0.2548	1.78E-03	0.0271													

Monitoring Network	Aquifer	Bore	statistic	Temp Lab	Ionic Balance	Suspended Solids (SS)	Total Anions	Total Cations	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C6 - C9 Fraction	C10 - C36 Fraction (sum)	C10 - C16 Fraction	C10 - C40 Fraction (sum)	C16 - C34 Fraction	C34 - C40 Fraction	C6 - C10 Fraction	Diss_Cadmium	Diss_Chromium	Diss_Copper	Diss_Lead	Diss_Nickel	Diss_Zinc	Diss_Barium	Diss_Beryllium	Diss_Boron	Diss_Cobalt	Diss_Manganese	Diss_Uranium	Diss_Vanadium	Total Hardness as CaCO3	Nitrogen (Total)	Total Kjeldahl Nitrogen as N	Tot_Phosphorus
Lenton	Permian	GW27A	80th %ile	-	2.24	-	59.82	59.66	-	-	-	-	-	-	-	-	-	-	0.00005	0.0005	0.0006	0.0005	0.0008	0.0082	6.212	0.0005	0.46	0.0005	0.01	0.0005	0.005	124.8	2.52	2.84	0.094
Lenton	Permian	GW27A	95th %ile	-	4.28	-	60.78	65.54	-	-	-	-	-	-	-	-	-	-	0.00005	0.0005	0.0009	0.0005	0.0088	6.788	0.0005	0.49	0.0005	0.01	0.0005	0.005	125.7	3.48	3.56	0.166	
Lenton	Permian	GW27A	Max	-	4.96	-	61.1	67.5	-	-	-	-	-	-	-	-	-	-	0.00005	0.0005	0.001	0.0005	0.002	6.98	0.0005	0.5	0.0005	0.01	0.0005	0.005	126	3.8	3.8	0.19	
Lenton	Permian	GW27A	Tau	-	0.316228	-	0.316228	0.316228	-	-	-	-	-	-	-	-	-	-	1	1	-0.316228	1	0.632456	0.119523	0.527046	1	-0.316228	1	-0.258199	1	1	-0.182574	0.83666	0.707107	0.527046
Lenton	Permian	GW27A	2-sided-p	-	0.613354	-	0.613354	0.613354	-	-	-	-	-	-	-	-	-	-	1	1	0.723674	1	0.288844	1	0.312216	1	0.613354	1	0.77283	1	1	1	0.0960923	0.371093	0.312216
Lenton	Permian	GW27A	Trend	-	No	-	No	No	-	-	-	-	-	-	-	-	-	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	
Lenton	Permian	GW28A	Total Number	0	4	0	4	4	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	3	4
Lenton	Permian	GW28A	from	-	01-06-2018	-	01-06-2018	01-06-2018	-	-	-	-	-	-	-	-	-	-	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	09-05-2019	01-06-2018	09-05-2019	01-06-2018
Lenton	Permian	GW28A	to	-	24-03-2020	-	24-03-2020	24-03-2020	-	-	-	-	-	-	-	-	-	-	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020
Lenton	Permian	GW28A	Min	-	0.32	-	50.7	45.7	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	5.00E-04	5.00E-04	5.00E-04	0.0025	2.48	5.00E-04	0.65	5.00E-04	0.014	0.0005	0.005	46	0.005	1.6	0.01
Lenton	Permian	GW28A	5th %ile	-	0.3575	-	50.745	46.51	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	5.75E-04	5.00E-04	5.75E-04	0.002875	2.501	5.00E-04	0.6605	5.00E-04	0.01445	0.0005	0.005	46.8	0.24425	1.63	0.031
Lenton	Permian	GW28A	20th %ile	-	0.47	-	50.88	48.94	-	-	-	-	-	-	-	-	-	-	5.00E-05	5.00E-04	0.0008	5.00E-04	8.00E-04	0.004	2.564	5.00E-04	0.692	5.00E-04	0.0158	0.0005	0.005	49.2	0.962	1.72	0.094
Lenton	Permian	GW28A	Median	-	0.645	-	51.2	51.3	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.0005	0.0015	5.00E-04	0.0055	2.71	5.00E-04	0.745	5.00E-04	0.017	0.0005	0.005	54	1.75	1.9	0.155	
Lenton	Permian	GW28A	80th %ile	-	2.788	-	51.8	51.58	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.0007	0.0024	5.00E-04	0.002	0.0068	2.808	5.00E-04	0.782	5.00E-04	0.0198	0.0005	0.005	61.2	2.1	2.2	0.164
Lenton	Permian	GW28A	95th %ile	-	5.1145	-	52.25	51.67	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.000925	0.00285	5.00E-04	0.002	0.0077	2.817	5.00E-04	0.7955	5.00E-04	0.02295	0.0005	0.005	64.8	2.325	2.35	0.1685
Lenton	Permian	GW28A	Max	-	5.89	-	52.4	51.7	-	-	-	-	-	-	-	-	-	-	5.00E-05	0.001	0.003	5.00E-04	0.002	0.008	2.82	5.00E-04	0.8	5.00E-04	0.024	0.0005	0.005	66	2.4	2.4	0.17
Lenton	Permian	GW28A	Tau	-	0	-	0.333333	1	-	-	-	-	-	-	-	-	-	-	1	0.707107	0.333333	1	0.547723	0.333333	0.333333	1	-0.333333	1	-0.547723	1	1	-	0.666667	-	0.333333
Lenton	Permian	GW28A	2-sided-p	-	1	-	0.734095	0.0894294	-	-	-	-	-	-	-	-	-	-	1	0.371093	0.734095	1	0.470101	0.734095	0.734095	1	0.734095	1	0.734095	1	1	-	0.308179	-	0.734095
Lenton	Permian	GW28A	Trend	-	No	-	No	No	-	-	-	-	-	-	-	-	-	-	No	No	No	No	No	No	No	No	No	No	No	No	No	-	No	-	No
Lenton	Permian	GW29A	Total Number	0	3	1	3	3	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	4	4	3	4	4	4	4	3	3	4	3	3
Lenton	Permian	GW29A	from	-	09-05-2019	14-05-2023	09-05-2019	09-05-2019	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019
Lenton	Permian	GW29A	to	-	24-03-2020	14-05-2023	24-03-2020	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020
Lenton	Permian	GW29A	Min	-	1.67	35600	96	88.1	0.05	0.23	0.12	0.01	0.4	0.05	0.4	0.3	0.1	0.01	0.00005	0.0005	0.0005	0.0005	0.0005	0.012	21.2	0.0005	0.47	0.0005	0.03	0.0005	0.005	372	2.3	2.3	0.04
Lenton	Permian	GW29A	5th %ile	-	1.989	35600	96.12	88.11	0.05	0.23	0.12	0.01	0.4	0.05	0.4	0.3	0.1	0.01	0.00005	0.0005	0.0005	0.0005	0.0005	0.01215	21.215	0.0005	0.482	0.0005	0.03	0.0005	0.005	378.2	2.34	2.36	0.044
Lenton	Permian	GW29A	20th %ile	-	2.946	35600	96.48	88.14	0.05	0.23	0.12	0.01	0.4	0.05	0.4	0.3	0.1	0.01	0.00005	0.0005	0.0005	0.0005	0.0005	0.0126	21.26	0.0005	0.518	0.0005	0.03	0.0005	0.005	396.8	2.46	2.54	0.056
Lenton	Permian	GW29A	Median	-	4.86	35600	97.2	88.2	0.05	0.23	0.12	0.01	0.4	0.05	0.4	0.3	0.1	0.01	0.00005	0.0005	0.0005	0.0005	0.00075	0.0135	21.75	0.0005	0.575	0.0005	0.0315	0.0005	0.005	434	2.7	2.9	0.08
Lenton	Permian	GW29A	80th %ile	-	7.044	35600	101.28	90.96	0.05	0.23	0.12	0.01	0.4	0.05	0.4	0.3	0.1	0.01	0.00005	0.0005	0.0007	0.0005	0.0014	0.0164	22.2	0.0005	0.624	0.0005	0.0342	0.0005	0.005	469.4	2.94	3.62	0.368
Lenton	Permian	GW29A	95th %ile	-	8.136	35600	103.32	92.34	0.05	0.23	0.12	0.01	0.4	0.05	0.4	0.3	0.1	0.01	0.00005	0.0005	0.000925	0.0005	0.00185	0.0191	22.2	0.0005	0.651	0.0005	0.03555	0.0005	0.005	487.1	3.06	4.205	0.512
Lenton	Permian	GW29A	Max	-	8.5	35600	104	92.8	0.05	0.23	0.12	0.01	0.4	0.05	0.4	0.3	0.1	0.01	0.00005	0.0005	0.001	0.0005	0.002	22.2	0.0005	0.66	0.0005	0.036	0.0005	0.005	493	3.1	4.4	0.56	
Lenton	Permian	GW29A	Tau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-0.707107	1	0.182574	0.333333	-0.912871	-	-0.333333	1	0.547723	1	-	-	-	0.666667	-
Lenton	Permian	GW29A	2-sided-p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0.371093	1	1	0.734095	0.148562	-	0.734095	1	0.470101	1	-	-	-	0.308179	-
Lenton	Permian	GW29A	Trend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No	No	No	No	No	No	No	-	No	No	No	No	-	-	-	No	-
Lenton	Permian	GW30A	Total Number	0	4	1	4	4	1	1	1	1	1	1	1	1	1	1	5	5	5	5	5	5	5	4	5	5	5	5	4	3	4	4	4
Lenton	Permian	GW30A	from	-	01-06-2018	14-05-2023	01-06-2018	01-06-2018	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	09-05-2019	01-06-2018	09-05-2019	01-06-2018
Lenton	Permian	GW30A	to	-	24-03-2020	14-05-2023	24-03-2020	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020
Lenton	Permian	GW30A	Min	-	0.16	50	145	134	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	5.00E-04	5.00E-04	5.00E-04	1.00E-03	0.012	26.4	5.00E-04	0.19	5.00E-04	0.045	0.0005	0.005	995	0.005	3.3	0.005
Lenton	Permian	GW30A	5th %ile	-	0.6325	50	145.45	134.75	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	5.00E-04	5.00E-04	5.00E-04	1.20E-03	0.0132	27.3	5.00E-04	0.212	5.00E-04	0.0474	0.0005	0.005	1006.5	0.49925	3.39	0.01175
Lenton	Permian	GW30A	20th %ile	-	2.05	50	146.8	137	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	5.00E-05	5.00E-04	0.0005	5.00E-04	1.8												

Monitoring Network	Aquifer	Bore	statistic	Temp Lab	Ionic Balance	Suspended Solids (SS)	Total Anions	Total Cations	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C6 - C9 Fraction	C10 - C36 Fraction (sum)	C10 - C16 Fraction	C10 - C40 Fraction (sum)	C16 - C34 Fraction	C34 - C40 Fraction	C6 - C10 Fraction	Diss_Cadmiu m	Diss_Chromi um	Diss_Copper	Diss_Lead	Diss_Nickel	Diss_Zinc	Diss_Barium	Diss_Berylliu m	Diss_Boron	Diss_Cobalt	Diss_Mangan ese	Diss_Uraniu m	Diss_Vanadiu m	Total Hardness as CaCO3	Nitrogen (Total)	Total Kjeldahl Nitrogen as N	Tot_Phospho rus
Lenton	Permian	LEN486	5th %ile	-	0.161	1170	138.65	137.55	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	0.00005	0.0005	0.0005	0.0005	0.0005	0.00425	1.0135	0.0005	0.631	0.0005	0.046	0.0005	0.005	1086	0.005	1.5	0.0455
Lenton	Permian	LEN486	20th %ile	-	0.58	1170	148.2	138.2	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	0.00005	0.0005	0.0005	0.0005	0.0005	0.008	5.534	0.0005	1.172	0.0005	0.0484	0.0005	0.005	1152	0.014	1.9	0.05
Lenton	Permian	LEN486	Median	-	4.13	1170	161	141.5	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	0.00005	0.0005	0.0005	0.0005	0.002	0.009	9.56	0.0005	1.225	0.0005	0.0525	0.0005	0.005	1160	2	2.3	0.085
Lenton	Permian	LEN486	80th %ile	-	6.456	1170	166	153	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	0.00005	0.0005	0.002	0.0005	0.006	0.013	10.24	0.0005	1.314	0.0008	0.1028	0.0008	0.005	1248	2.9	3.1	0.2
Lenton	Permian	LEN486	95th %ile	-	7.0905	1170	167.8	161	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	0.000175	0.0015	0.002	0.0005	0.009	0.026	10.84	0.0005	1.374	0.00255	0.26765	0.0064	0.005	1308	3.905	4.5	0.324
Lenton	Permian	LEN486	Max	-	7.36	1170	170	161	0.025	0.05	0.025	0.01	0.025	0.05	0.05	0.05	0.05	0.01	0.0003	0.002	0.002	0.0005	0.01	0.03	11.2	0.0005	1.41	0.003	0.341	0.01	0.005	1340	5.4	5.4	0.39
Lenton	Permian	LEN486	Tau	-	0.106873	-	0.697863	0.728879	-	-	-	-	-	-	-	-	-	-	-0.255841	0.587754	-0.557013	1	-0.26697	0	-0.0898933	1	0.314627	-0.614636	-0.250065	-0.614636	1	-0.0870388	0.293903	0.785356	0.0465242
Lenton	Permian	LEN486	2-sided-p	-	0.680042	-	0.00233805	0.00148892	-	-	-	-	-	-	-	-	-	-	0.429195	0.03514	0.0419616	1	0.303062	1	0.787616	1	0.243035	0.0383258	0.367232	0.0383258	1	0.831484	0.167465	0.00127625	0.889969
Lenton	Permian	LEN486	Trend	-	No	-	Yes-Upward	Yes-Upward	-	-	-	-	-	-	-	-	-	-	No	Yes-Upward	Yes-Downward	No	No	No	No	No	No	Yes-Downward	No	Yes-Downward	No	No	No	Yes-Upward	No

Monitoring Network	Aquifer	Bore	statistic	Fluoride	Ammonia as N	Nitrate as N	Nitrite as N	Diss_Strontium	Diss_Tin	Field_TDS	Fluoride	Tot_Boron	Tot_Barium	Tot_Beryllium	Tot_Cadmium	Tot_Cobalt	Tot_Chromium	Tot_Copper	Tot_Manganese	Tot_Nickel	Tot_Lead	Tot_Vanadium	Tot_Zinc	Tot_Uranium	Nitrite + Nitrate as N	Reactive Phosphorus as P	d18O	d2H	Turbidity	Total Phosphorus as P	Dissolved Oxygen	1,2-Dichloroethane	Toluene-D8	4-Bromofluorobenzene	Total Nitrogen as N	
Lenton	Alluvium	GW01	Total Number	2	2	2	2	2	2	1	6	5	5	5	6	5	6	6	5	6	6	5	6	5	5	0	0	0	0	0	0	0	0	0	0	
Lenton	Alluvium	GW01	from	01-04-2015	01-03-2017	01-03-2017	01-03-2017	01-03-2017	01-03-2017	01-06-2018	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW01	to	01-03-2017	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW01	Min	0.6	0.02	0.02	0.005	2.33	0.0005	4069	0.4	0.25	0.248	0.0005	0.00005	0.005	0.013	0.007	0.296	0.013	0.002	0.03	0.012	0.23	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW01	5th %ile	0.6	0.021	0.027	0.005	2.3425	0.0005	4069	0.425	0.256	0.2524	0.0005	0.00005	0.0052	0.01425	0.00775	0.3016	0.01425	0.00225	0.032	0.01775	0.012	0.23	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW01	20th %ile	0.6	0.024	0.048	0.005	2.38	0.0005	4069	0.5	0.274	0.2656	0.0005	0.00005	0.0058	0.018	0.01	0.3184	0.018	0.003	0.038	0.029	0.012	0.23	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW01	Median	0.6	0.03	0.09	0.005	2.455	0.0005	4069	0.5	0.29	0.312	0.001	0.000125	0.015	0.057	0.031	0.632	0.0515	0.012	0.09	0.067	0.012	0.25	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW01	80th %ile	0.6	0.036	0.132	0.005	2.53	0.0005	4069	0.5	0.31	0.3568	0.002	0.0003	0.0196	0.092	0.057	0.8304	0.08	0.018	0.11	0.121	0.013	0.35	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW01	95th %ile	0.6	0.039	0.153	0.005	2.5675	0.0005	4069	0.575	0.34	0.3772	0.002	0.003825	0.0274	0.128	0.21375	1.1376	0.15425	0.02775	0.14	0.18925	0.013	0.35	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW01	Max	0.6	0.04	0.16	0.005	2.58	0.0005	4069	0.6	0.35	0.384	0.002	0.005	0.03	0.14	0.266	1.24	0.179	0.031	0.15	0.212	0.013	0.35	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW01	Tau	-	-	-	-	-	-	-	0.0860663	-0.6	-0.6	-0.67082	0.596285	-0.8	-0.6	-0.466667	-0.8	-0.466667	-0.466667	-0.8	-0.6	0.258199	-0.223607	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW01	2-sided-p	-	-	-	-	-	-	-	1	0.220671	0.220671	0.191695	0.158709	0.0864107	0.132855	0.259656	0.0864107	0.259656	0.0864107	0.132855	0.77283	0.794003	-	-	-	-	-	-	-	-	-	-		
Lenton	Alluvium	GW01	Trend	-	-	-	-	-	-	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	-	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	Total Number	4	3	4	4	4	4	1	6	5	5	5	6	5	6	6	5	6	6	5	6	5	6	1	0	0	0	0	0	0	0	0	0	
Lenton	Burton Rider/Regolith	GW04	from	01-04-2015	01-03-2017	01-03-2017	01-03-2017	01-03-2017	01-03-2017	01-06-2018	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	09-05-2019	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	to	01-06-2018	01-06-2018	09-05-2019	09-05-2019	09-05-2019	09-05-2019	01-06-2018	09-05-2019	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	01-04-2015	09-05-2019	09-05-2019	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	Min	0.4	0.34	0.005	0.005	10.4	0.0005	5863	0.3	0.25	0.624	0.0005	0.00005	0.002	0.0005	0.0005	0.373	0.0005	0.0005	0.005	0.0025	0.002	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	5th %ile	0.4	0.34	0.005	0.005	10.415	0.0005	5863	0.325	0.254	0.7092	0.0005	0.00005	0.002	0.0005	0.001125	0.4464	0.0005	0.0005	0.005	0.0025	0.0022	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	20th %ile	0.4	0.34	0.005	0.005	10.46	0.0005	5863	0.4	0.266	0.9648	0.0005	0.00005	0.002	0.0005	0.003	0.6666	0.0005	0.0005	0.005	0.0025	0.0028	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	Median	0.4	0.34	0.005	0.005	10.9	0.0005	5863	0.4	0.32	1.08	0.0005	0.000275	0.002	0.0005	0.004	0.789	0.0005	0.0005	0.005	0.0115	0.005	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	80th %ile	0.44	0.346	0.027	0.005	11.34	0.0005	5863	0.4	0.372	1.176	0.0005	0.0006	0.003	0.0005	0.012	0.8214	0.0005	0.002	0.005	0.016	0.0068	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	95th %ile	0.485	0.349	0.05175	0.005	11.385	0.0005	5863	0.4	0.528	1.194	0.0005	0.00075	0.003	0.000875	0.01275	0.8346	0.000875	0.0035	0.005	0.01675	0.0122	0.04625	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	Max	0.5	0.35	0.06	0.005	11.4	0.0005	5863	0.4	0.58	1.2	0.0005	0.0008	0.003	0.001	0.013	0.839	0.001	0.004	0.005	0.017	0.014	0.06	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	Tau	0.707107	-	0.707107	1	-0.333333	1	-	-0.11547	-0.948683	0.2	1	0.745356	-0.258199	0.57735	0.552052	0	0.57735	0.0860663	1	0.138013	-0.948683	0.57735	-	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	2-sided-p	0.371093	-	0.371093	1	0.734095	1	-	1	0.0432627	0.806496	1	0.0699674	0.77283	0.241567	0.1806	1	0.241567	1	1	0.848312	0.0432627	0.241567	-	-	-	-	-	-	-	-	-	-	
Lenton	Burton Rider/Regolith	GW04	Trend	No	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	-	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	Total Number	3	3	6	6	6	6	1	8	4	4	4	5	4	5	5	4	5	5	4	5	4	No	7	3	0	0	0	0	0	0	0	0	
Lenton	Alluvium	GW06	from	01-04-2015	01-03-2017	01-03-2017	01-03-2017	01-03-2017	01-03-2017	01-06-2018	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	20-02-2014	09-05-2019	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	to	01-12-2017	14-05-2023	14-05-2023	24-03-2020	24-03-2020	24-03-2020	01-06-2018	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	Min	1	0.03	0.005	0.005	3.85	0.0005	7715	0.5	0.32	0.242	0.0005	0.00005	0.001	0.0005	0.004	1.17	0.007	0.0005	0.005	0.0025	0.0005	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	5th %ile	1.06	0.031	0.005	0.005	3.8925	0.0005	7715	0.57	0.32	0.2468	0.0005	0.00006	0.00115	0.0005	0.0046	1.215	0.0076	0.0006	0.005	0.0036	0.0005	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	20th %ile	1.24	0.034	0.005	0.005	4.02	0.0005	7715	0.78	0.32	0.2612	0.0005	0.00009	0.0016	0.0005	0.0064	1.35	0.0094	0.0009	0.005	0.0069	0.0005	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	Median	1.6	0.04	0.005	0.005	6.165	0.0005	7715	1	0.395	0.427	0.0005	0.0002	0.002	0.002	0.015	1.57	0.01	0.002	0.005	0.011	0.00125	0.005	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	80th %ile	1.66	0.046	0.005	0.005	12.3	0.0005	7715	1.2	0.522	0.5944	0.0005	0.00038	0.0028	0.003	0.0332	1.77	0.0112	0.0124	0.005	0.0328	0.0044	0.005	0.008	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	95th %ile	1.69	0.049	0.02	0.02	13.725	0.0005	7715	1.33	0.5805	0.6106	0.0005	0.00062	0.0037	0.006	0.0338	1.8825	0.0118	0.0166	0.005	0.0382	0.0071	0.005	0.0095	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	Max	1.7	0.05	0.025	0.025	14.2	0.0005	7715	1.4	0.6	0.616	0.0005	0.0007	0.004	0.007	0.034	1.92	0.012	0.018	0.005	0.04	0.008	0.005	0.01	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW06	Tau	-	-	-0.34641	-0.34641	0.333333	1	-	-0.2965	0.547723	1	0	0	-0.182574	0	-1	0	-0.105409	-0.4	1	-0.6	0.547723	1	-	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	2-sided-p	-	-	0.558185	0.558185	0.45237	1	-	0.37908	0.470101	0.0894294	1	1	1	1	0.0274863	1	1	0.462433	1	0.220671	0.470101	1	-	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	Trend	-	-	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	-	-	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW07	Total Number	3	5	8	8</																													

Monitoring Network	Aquifer	Bore	statistic	Fluoride	Ammonia as N	Nitrate as N	Nitrite as N	Diss_Strontium	Diss_Tin	Field_TDS	Fluoride	Tot_Boron	Tot_Barium	Tot_Beryllium	Tot_Cadmium	Tot_Cobalt	Tot_Chromium	Tot_Copper	Tot_Manganese	Tot_Nickel	Tot_Lead	Tot_Vanadium	Tot_Zinc	Tot_Uranium	Nitrite + Nitrate as N	Reactive Phosphorus as P	d18O	d2H	Turbidity	Total Phosphorus as P	Dissolved Oxygen	1,2-Dichloroethane-D4	Toluene-D8	4-Bromofluorobenzene	Total Nitrogen as N
Lenton	Permian	GW13	Tau	-0.235702	-0.4	-0.0890871	0.218218	0.787726	-0.34641	-	-0.109109	0.4	0.6	-	0.276026	0.597614	0.138013	0.414039	0.2	0.333333	0.447214	-	0.690066	0.316228	-0.0524142	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW13	2-sided-p	1	0.462433	0.886017	0.617075	0.0513301	0.558185	-	0.867632	0.462433	0.220671	-	0.56609	0.267257	0.848312	0.338888	0.806496	0.45237	0.314063	-	0.0851679	0.723674	1	-	-	-	-	-	-	-	-	-	
Lenton	Permian	GW13	Trend	No	No	No	No	No	No	-	No	No	No	-	No	No	No	No	No	No	No	-	No	No	No	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	Total Number	0	0	0	0	0	0	0	3	2	2	2	3	2	3	3	2	3	3	2	3	2	3	0	0	0	0	0	0	0	0	0	0
Lenton	Alluvium/Regolith	GW19	from	-	-	-	-	-	-	-	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	to	-	-	-	-	-	-	-	04-11-2014	13-06-2014	13-06-2014	13-06-2014	04-11-2014	13-06-2014	04-11-2014	04-11-2014	13-06-2014	04-11-2014	04-11-2014	13-06-2014	04-11-2014	13-06-2014	04-11-2014	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	Min	-	-	-	-	-	-	-	0.1	0.28	0.235	0.0005	0.0005	0.0005	0.0005	0.0005	0.337	0.001	0.001	0.001	0.005	0.0025	0.005	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	5th %ile	-	-	-	-	-	-	-	0.1	0.282	0.2476	0.000575	0.00005	0.002125	0.00175	0.00145	0.37515	0.0026	0.0019	0.00925	0.00705	0.002	0.0055	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	20th %ile	-	-	-	-	-	-	-	0.1	0.288	0.2854	0.0008	0.00005	0.007	0.0055	0.0043	0.4896	0.0074	0.0046	0.022	0.0207	0.002	0.007	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	Median	-	-	-	-	-	-	-	0.1	0.3	0.361	0.00125	0.00005	0.01675	0.013	0.01	0.7185	0.017	0.01	0.0475	0.048	0.002	0.01	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	80th %ile	-	-	-	-	-	-	-	0.16	0.312	0.4366	0.0017	0.00026	0.0265	0.0328	0.0358	0.9474	0.0494	0.0238	0.073	0.129	0.002	0.028	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	95th %ile	-	-	-	-	-	-	-	0.19	0.318	0.4744	0.001925	0.000365	0.031375	0.0427	0.0487	1.06185	0.0656	0.0307	0.08575	0.002	0.037	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	Max	-	-	-	-	-	-	-	0.2	0.32	0.4744	0.001925	0.000365	0.031375	0.0427	0.0487	1.1	0.071	0.033	0.09	0.183	0.002	0.04	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	Tau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	2-sided-p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19	Trend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19_33	Total Number	0	1	3	3	2	2	1	3	1	1	0	1	1	1	1	1	1	1	0	1	1	3	2	1	1	1	1	1	1	1	1	1
Lenton	Alluvium/Regolith	GW19_33	from	-	14-05-2023	17-12-2019	17-12-2019	17-12-2019	17-12-2019	14-05-2023	17-12-2019	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	17-12-2019	17-12-2019	25-02-2023	25-02-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Alluvium/Regolith	GW19_33	to	-	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	24-03-2020	25-02-2023	25-02-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Alluvium/Regolith	GW19_33	Min	-	0.9	0.13	0.005	0.501	0.0005	503	0.3	0.1	0.201	-	0.00005	0.004	0.013	0.1	0.099	0.01	0.006	-	0.065	0.002	0.13	0.005	-7.717284175	-52.09381325	161	0.53	0.0048	0.101	0.0989	0.0962	2.4
Lenton	Alluvium/Regolith	GW19_33	5th %ile	-	0.9	0.138	0.0085	0.51215	0.0005	503	0.3	0.1	0.201	-	0.00005	0.004	0.013	0.1	0.099	0.01	0.006	-	0.065	0.002	0.142	0.005	-7.717284175	-52.09381325	161	0.53	0.0048	0.101	0.0989	0.0962	2.4
Lenton	Alluvium/Regolith	GW19_33	20th %ile	-	0.9	0.162	0.019	0.5456	0.0005	503	0.3	0.1	0.201	-	0.00005	0.004	0.013	0.1	0.099	0.01	0.006	-	0.065	0.002	0.178	0.005	-7.717284175	-52.09381325	161	0.53	0.0048	0.101	0.0989	0.0962	2.4
Lenton	Alluvium/Regolith	GW19_33	Median	-	0.9	0.21	0.04	0.6125	0.0005	503	0.3	0.1	0.201	-	0.00005	0.004	0.013	0.1	0.099	0.01	0.006	-	0.065	0.002	0.25	0.005	-7.717284175	-52.09381325	161	0.53	0.0048	0.101	0.0989	0.0962	2.4
Lenton	Alluvium/Regolith	GW19_33	80th %ile	-	0.9	0.354	0.046	0.6794	0.0005	503	0.36	0.1	0.201	-	0.00005	0.004	0.013	0.1	0.099	0.01	0.006	-	0.065	0.002	0.4	0.005	-7.717284175	-52.09381325	161	0.53	0.0048	0.101	0.0989	0.0962	2.4
Lenton	Alluvium/Regolith	GW19_33	95th %ile	-	0.9	0.426	0.049	0.71285	0.0005	503	0.39	0.1	0.201	-	0.00005	0.004	0.013	0.1	0.099	0.01	0.006	-	0.065	0.002	0.475	0.005	-7.717284175	-52.09381325	161	0.53	0.0048	0.101	0.0989	0.0962	2.4
Lenton	Alluvium/Regolith	GW19_33	Max	-	0.9	0.45	0.05	0.724	0.0005	503	0.4	0.1	0.201	-	0.00005	0.004	0.013	0.1	0.099	0.01	0.006	-	0.065	0.002	0.5	0.005	-7.717284175	-52.09381325	161	0.53	0.0048	0.101	0.0989	0.0962	2.4
Lenton	Alluvium/Regolith	GW19_33	Tau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19_33	2-sided-p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium/Regolith	GW19_33	Trend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lenton	Alluvium	GW19_37a	Total Number	0	2	4	4	2	2	1	4	2	2	0	2	2	2	2	2	2	2	0	2	2	4	2	1	2	2	2	2	2	2	2	2
Lenton	Alluvium	GW19_37a	from	-	08-11-2022	17-12-2019	17-12-2019	17-12-2019	17-12-2019	14-05-2023	17-12-2019	08-11-2022	08-11-2022	-	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	-	08-11-2022	08-11-2022	17-12-2019	17-12-2019	24-02-2023	24-02-2023	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022
Lenton	Alluvium	GW19_37a	to	-	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-02-2023	24-02-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Alluvium	GW19_37a	Min	-	0.2	0.005	0.005	3.05	0.0005	1545	0.2	0.25	0.283	-	0.00005	0.0005	0.002	0.815	0.321	0.022	0.0005	-	0.029	0.002	0.005	0.005	-5.6964281	-40.7530085	3.5	0.02	0.0042	0.1	0.0997	0.0959	0.3
Lenton	Alluvium	GW19_37a	5th %ile	-	0.2615	0.005	0.005	3.11	0.0005	1545	0.215	0.2515	0.28855	-	0.00005	0.000575	0.00215	0.8184	0.32175	0.02375	0.000725	-	0.0331	0.002	0.005	0.005	-5.6964281	-40.7530085	4.03	0.02	0.19899	5.445	4.914715	5.491105	0.415
Lenton	Alluvium	GW19_37a	20th %ile	-	0.446	0.005	0.005	3.29	0.0005	1545	0.26	0.256	0.3052	-	0.00005	0.00008	0.0026	0.8286	0.324	0.029	0.0014	-	0.0454	0.002	0.005	0.005	-5.6964281	-40.7530085	5.62	0.02	0.78336	21.48	19.35976	21.67672	0.76
Lenton	Alluvium	GW19_37a	Median	-	0.815	0.005	0.005	3.65	0.0005	1545	0.3	0.265	0.3385	-	0.00005	0.00125	0.0035	0.849	0.3385	0.0395	0.00275	-	0.07	0.002	0.005	0.005	-5.6964281	-40.7530085	8.8	0.02	1.9521	53.55	48.24985	54.04795	1.45
Lenton	Alluvium	GW19_37a	80th %ile	-	1.184	0.007	0.005	4.01	0.0005	1545	0.3	0.274	0.3718	-	0.00005	0.0017	0.0044	0.8694	0.333	0.05	0.0041	-	0.0946	0.002	0.007	0.005	-5.6964281	-40.7530085	11.98	0.02	3.12084	85.62	77.13994	86.41918	2.14
Lenton	Alluvium	GW19_37a	95th %ile	-	1.3685	0.00925	0.005	4.19	0.0005	1545	0.3	0.2785	0.38845	-	0.00005	0.001925	0.00485	0.8796	0.33525	0.05525	0.004775	-	0.1069	0.002	0.00925	0.005	-5.6964281	-40.7530085	13.57	0.02	3.70521	101.655	91.584985	102.604795	2.485
Lenton	Alluvium	GW19_37a	Max	-	1.43	0.01	0.005	4.25	0.0005	1545	0.3	0.28	0.394	-	0.00005	0.002	0.005	0.883	0.336	0.057	0.005	-	0.11												

Monitoring Network	Aquifer	Bore	statistic	Fluoride	Ammonia as N	Nitrate as N	Nitrite as N	Diss. Strontium	Diss. Tin	Field TDS	Fluoride	Tot. Boron	Tot. Barium	Tot. Beryllium	Tot. Cadmium	Tot. Cobalt	Tot. Chromium	Tot. Copper	Tot. Manganese	Tot. Nickel	Tot. Lead	Tot. Vanadium	Tot. Zinc	Tot. Uranium	Nitrite + Nitrate as N	Reactive Phosphorus as P	d18O	d2H	Turbidity	Total Phosphorus as P	Dissolved Oxygen	1,2-Dichloroethene-D4	Toluene-D8	4-Bromofluorobenzene	Total Nitrogen as N	
Lenton	Permian	GW27A	80th %ile	0.6	1.93	0.012	0.005	8.844	0.0008	4004	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.02	-	-	-	-	-	-	-	-	-	
Lenton	Permian	GW27A	95th %ile	0.6	1.93	0.033	0.005	10.236	0.0017	4004	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.02	-	-	-	-	-	-	-	-	-	
Lenton	Permian	GW27A	Max	0.6	1.93	0.04	0.005	10.7	0.002	4004	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.02	-	-	-	-	-	-	-	-	-	
Lenton	Permian	GW27A	Tau	-	-	-0.632456	1	0.737865	0.632456	-	-0.182574	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.707107	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW27A	2-sided-p	-	-	0.288844	1	0.129551	0.288844	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.371093	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW27A	Trend	-	-	No	No	No	No	-	No	-	-	-	-	-	-	-	-	-	-	-	-	-	No	No	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	Total Number	1	1	4	4	4	4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0
Lenton	Permian	GW28A	from	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	09-05-2019	-	-	-	-	-	-	-	-	-	-	-	-	-	09-05-2019	09-05-2019	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	to	01-06-2018	01-06-2018	24-03-2020	24-03-2020	24-03-2020	24-03-2020	01-06-2018	24-03-2020	-	-	-	-	-	-	-	-	-	-	-	-	-	24-03-2020	24-03-2020	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	Min	1.5	0.96	0.005	0.005	2.46	0.0005	3503	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	5th %ile	1.5	0.96	0.005	0.005	2.5035	0.0005	3503	1.21	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	20th %ile	1.5	0.96	0.005	0.005	2.634	0.0005	3503	1.24	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	Median	1.5	0.96	0.005	0.005	2.815	0.0005	3503	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	80th %ile	1.5	0.96	0.005	0.005	3	0.0005	3503	1.42	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	95th %ile	1.5	0.96	0.005	0.005	3.135	0.0005	3503	1.48	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	Max	1.5	0.96	0.005	0.005	3.18	0.0005	3503	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	Tau	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	2-sided-p	-	-	1	1	0.0894294	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW28A	Trend	-	-	No	No	No	No	-	No	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW29A	Total Number	0	1	4	4	3	3	1	4	1	1	0	1	1	1	1	1	1	1	1	0	1	1	4	3	0	0	1	1	1	1	1	1	1
Lenton	Permian	GW29A	from	-	14-05-2023	09-05-2019	09-05-2019	09-05-2019	09-05-2019	14-05-2023	09-05-2019	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	09-05-2019	09-05-2019	-	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW29A	to	-	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	24-03-2020	-	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW29A	Min	-	2.52	0.005	0.005	21.9	0.0005	8619	0.3	0.66	25.6	-	0.0001	0.015	0.028	0.046	0.34	0.038	0.03	-	0.224	0.004	0.005	0.005	-	-	37100	0.51	0.0013	0.103	0.0992	0.0989	4.4	
Lenton	Permian	GW29A	5th %ile	-	2.52	0.005	0.005	21.99	0.0005	8619	0.315	0.66	25.6	-	0.0001	0.015	0.028	0.046	0.34	0.038	0.03	-	0.224	0.004	0.005	0.0115	-	-	37100	0.51	0.0013	0.103	0.0992	0.0989	4.4	
Lenton	Permian	GW29A	20th %ile	-	2.52	0.005	0.005	22.26	0.0005	8619	0.36	0.66	25.6	-	0.0001	0.015	0.028	0.046	0.34	0.038	0.03	-	0.224	0.004	0.005	0.031	-	-	37100	0.51	0.0013	0.103	0.0992	0.0989	4.4	
Lenton	Permian	GW29A	Median	-	2.52	0.005	0.005	22.8	0.0005	8619	0.45	0.66	25.6	-	0.0001	0.015	0.028	0.046	0.34	0.038	0.03	-	0.224	0.004	0.005	0.07	-	-	37100	0.51	0.0013	0.103	0.0992	0.0989	4.4	
Lenton	Permian	GW29A	80th %ile	-	2.52	0.007	0.005	24.36	0.0005	8619	0.5	0.66	25.6	-	0.0001	0.015	0.028	0.046	0.34	0.038	0.03	-	0.224	0.004	0.007	0.082	-	-	37100	0.51	0.0013	0.103	0.0992	0.0989	4.4	
Lenton	Permian	GW29A	95th %ile	-	2.52	0.00925	0.005	25.14	0.0005	8619	0.5	0.66	25.6	-	0.0001	0.015	0.028	0.046	0.34	0.038	0.03	-	0.224	0.004	0.00925	0.088	-	-	37100	0.51	0.0013	0.103	0.0992	0.0989	4.4	
Lenton	Permian	GW29A	Max	-	2.52	0.01	0.005	25.4	0.0005	8619	0.5	0.66	25.6	-	0.0001	0.015	0.028	0.046	0.34	0.038	0.03	-	0.224	0.004	0.01	0.09	-	-	37100	0.51	0.0013	0.103	0.0992	0.0989	4.4	
Lenton	Permian	GW29A	Tau	-	-	0.707107	1	-	-	-	-0.912871	-	-	-	-	-	-	-	-	-	-	-	-	-	0.707107	-	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW29A	2-sided-p	-	-	0.371093	1	-	-	-	0.148562	-	-	-	-	-	-	-	-	-	-	-	-	-	0.371093	-	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW29A	Trend	-	-	No	No	-	-	-	No	-	-	-	-	-	-	-	-	-	-	-	-	-	No	-	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW30A	Total Number	1	2	5	5	4	4	1	4	1	1	0	1	1	1	1	1	1	1	0	1	1	4	3	0	0	1	1	1	1	1	1	1	1
Lenton	Permian	GW30A	from	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	14-05-2023	09-05-2019	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	09-05-2019	09-05-2019	-	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW30A	to	01-06-2018	14-05-2023	14-05-2023	14-05-2023	24-03-2020	24-03-2020	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	-	14-05-2023	14-05-2023	14-05-2023	24-03-2020	-	-	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW30A	Min	0.3	3.08	0.005	0.005	40.1	0.0005	8637	0.2	0.36	42.4	-	0.00005	0.0005	0.002	0.003	0.05	0.005	0.001	-	0.046	0.0005	0.005	0.02	-	-	25.1	0.025	0.0033	0.103	0.1	0.102	3.9	
Lenton	Permian	GW30A	5th %ile	0.3	3.082	0.005	0.005	40.355	0.0005	8637	0.2	0.36	42.4	-	0.00005	0.0005	0.002	0.003	0.05	0.005	0.001	-	0.046	0.0005	0.005	0.024	-	-	25.1	0.025	0.0033	0.103	0.1	0.102	3.9	
Lenton	Permian	GW30A	20th %ile	0.3	3.088	0.005	0.005	41.12	0.0005	8637	0.2	0.36	42.4	-	0.00005	0.0005	0.002	0.003	0.05	0.005	0.001	-	0.046	0.0005	0.005	0.036	-	-	25.1	0.025	0.0033	0.103	0.1	0.102	3.9	
Lenton	Permian	GW30A	Median	0.3	3.11	0.005	0.005	42.85	0.0005	8637	0.2	0.36	42.4	-	0.00005	0.0005	0.002	0.003	0.05	0.005	0.001	-	0.046	0.0005	0.005	0.06	-	-	25.1	0.025	0.0033	0.103	0.1	0.102	3.9	
Lenton	Permian	GW30A	80th %ile	0.3	3.112	0.005	0.005	47.3	0.0005	8637	0.2	0.36	42.4	-	0.00005	0.0005	0.002	0.003	0.05	0.005	0.001	-	0.046	0.0005	0.005	0.126	-	-	25.1	0.025	0.0033	0.103	0.1	0.102	3.9	
Lenton	Permian	GW30A	95th %ile	0.3	3.118	0.005	0.005	51.125	0.0005	8637	0.2	0.36	42.4	-	0.00005	0.0005	0.002	0.003	0.05	0.005	0.001	-	0.046	0.0005	0.005	0.159	-	-	25.1	0.025	0.0033	0.103	0.1	0.102	3.9	
Lenton	Permian	GW30A	Max	0.3	3.12	0.005	0.005	52.4	0.0005	8637	0.2	0.36	42.4	-	0.00005	0.0005	0.002	0.003	0.05	0.005	0.001	-	0.046	0.0005	0.005	0.17	-	-	25.1	0.025						

Monitoring Network	Aquifer	Bore	statistic	Fraction minus BTEx (F1)	Fraction minus Naphthalene	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Total Xylenes	Sumof BTEx	Naphthalene
Lenton	Alluvium	GW01	Total Number	0	0	0	0	0	0	0	0	0	0
Lenton	Alluvium	GW01	from	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	to	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	Min	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	5th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	20th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	Median	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	80th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	95th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	Max	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW01	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	Total Number	0	0	0	0	0	0	0	0	0	0
Lenton	Burton Rider/Regolith	GW04	from	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	to	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	Min	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	5th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	20th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	Median	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	80th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	95th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	Max	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Burton Rider/Regolith	GW04	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	Total Number	0	0	0	0	0	0	0	0	0	0
Lenton	Alluvium	GW06	from	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	to	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	Min	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	5th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	20th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	Median	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	80th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	95th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	Max	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW06	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW07	Total Number	2	2	2	2	2	2	2	2	2	2
Lenton	Alluvium	GW07	from	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022
Lenton	Alluvium	GW07	to	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Alluvium	GW07	Min	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW07	5th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW07	20th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW07	Median	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW07	80th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW07	95th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW07	Max	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW07	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW07	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW07	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	Total Number	0	0	0	0	0	0	0	0	0	0
Lenton	Alluvium	GW09	from	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	to	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	Min	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	5th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	20th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	Median	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	80th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	95th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	Max	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW09	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW10	Total Number	1	1	1	1	1	1	1	1	1	1
Lenton	Permian	GW10	from	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW10	to	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW10	Min	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW10	5th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW10	20th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW10	Median	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW10	80th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW10	95th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW10	Max	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW10	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW10	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW10	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW11	Total Number	2	2	2	2	2	2	2	2	2	2
Lenton	Permian	GW11	from	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022
Lenton	Permian	GW11	to	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW11	Min	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW11	5th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW11	20th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW11	Median	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW11	80th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW11	95th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW11	Max	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW11	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW11	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW11	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW13	Total Number	2	2	2	2	2	2	2	2	2	2
Lenton	Permian	GW13	from	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022
Lenton	Permian	GW13	to	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW13	Min	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW13	5th %ile	0.01	0.056	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW13	20th %ile	0.01	0.074	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW13	Median	0.01	0.11	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW13	80th %ile	0.01	0.146	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW13	95th %ile	0.01	0.164	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW13	Max	0.01	0.17	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025

Monitoring Network	Aquifer	Bore	statistic	Fraction minus BTEX (F1)	Fraction minus Naphthalene	Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Total Xylenes	Sumof BTEX	Naphthalene
Lenton	Permian	GW13	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW13	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW13	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	Total Number	0	0	0	0	0	0	0	0	0	0
Lenton	Alluvium/Regolith	GW19	from	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	to	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	Min	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	5th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	20th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	Median	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	80th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	95th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	Max	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19_33	Total Number	1	1	1	1	1	1	1	1	1	1
Lenton	Alluvium/Regolith	GW19_33	from	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Alluvium/Regolith	GW19_33	to	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Alluvium/Regolith	GW19_33	Min	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium/Regolith	GW19_33	5th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium/Regolith	GW19_33	20th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium/Regolith	GW19_33	Median	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium/Regolith	GW19_33	80th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium/Regolith	GW19_33	95th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium/Regolith	GW19_33	Max	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium/Regolith	GW19_33	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19_33	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium/Regolith	GW19_33	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW19_37a	Total Number	2	2	2	2	2	2	2	2	2	2
Lenton	Alluvium	GW19_37a	from	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022	08-11-2022
Lenton	Alluvium	GW19_37a	to	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Alluvium	GW19_37a	Min	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW19_37a	5th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW19_37a	20th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW19_37a	Median	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW19_37a	80th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW19_37a	95th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW19_37a	Max	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Alluvium	GW19_37a	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW19_37a	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Alluvium	GW19_37a	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW19_40	Total Number	1	1	1	1	1	1	1	1	1	1
Lenton	Permian	GW19_40	from	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW19_40	to	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW19_40	Min	0.05	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_40	5th %ile	0.05	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_40	20th %ile	0.05	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_40	Median	0.05	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_40	80th %ile	0.05	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_40	95th %ile	0.05	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_40	Max	0.05	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_40	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW19_40	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW19_40	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW19_41a	Total Number	1	1	1	1	1	1	1	1	1	1
Lenton	Permian	GW19_41a	from	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW19_41a	to	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023	14-05-2023
Lenton	Permian	GW19_41a	Min	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_41a	5th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_41a	20th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_41a	Median	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_41a	80th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_41a	95th %ile	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_41a	Max	0.01	0.05	0.0005	0.001	0.001	0.001	0.001	0.001	0.0005	0.0025
Lenton	Permian	GW19_41a	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW19_41a	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW19_41a	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	Total Number	0	0	0	0	0	0	0	0	0	0
Lenton	Regolith	GW19_41b	from	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	to	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	Min	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	5th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	20th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	Median	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	80th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	95th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	Max	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Regolith	GW19_41b	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	Total Number	0	0	0	0	0	0	0	0	0	0
Lenton	Basalt	GW20	from	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	to	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	Min	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	5th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	20th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	Median	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	80th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	95th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	Max	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	Tau	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	2-sided-p	-	-	-	-	-	-	-	-	-	-
Lenton	Basalt	GW20	Trend	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW27A	Total Number	0	0	0	0	0	0	0	0	0	0
Lenton	Permian	GW27A	from	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW27A	to	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW27A	Min	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW27A	5th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW27A	20th %ile	-	-	-	-	-	-	-	-	-	-
Lenton	Permian	GW27A	Median	-	-	-	-	-	-	-	-	-	-

[illegible]

Monitoring Network	Aquifer	Bore	statistic	Field_pH	Field_EC	Temp Field	TDS	Lab_pH	Lab_EC	Suspended Solids (SS)	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Sodium	Potassium	Diss Aluminium	Diss Antimony	Diss Arsenic	Diss Beryllium	Diss Boron	Diss Cadmium	Diss Chromium	Diss Cobalt	Diss Copper	Diss Iron	Diss Selenium	Diss Silver	Diss Lead	Diss Molybdenum	Diss Mercury	Diss Nickel	Diss Zinc	Diss Barium	Diss Manganese	Diss Uranium	
Burton	Permian	BD 1250P	Total Number	36	36	27	22	21	23	2	2	2	2	22	22	22	22	22	22	22	22	11	2	22	2	2	20	20	9	20	11	4	11	20	11	22	20	20	2	2	9
Burton	Permian	BD 1250P	from	25-02-2014	25-02-2014	25-02-2016	01-02-2006	01-02-2006	01-02-2006	01-05-2012	19-03-2023	19-03-2023	19-03-2023	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-02-2006	29-09-2009	19-03-2023	01-02-2006	01-05-2012	01-05-2012	01-02-2006	01-02-2006	29-09-2009	01-02-2006	29-09-2009	01-05-2012	29-09-2009	01-02-2006	29-09-2009	01-02-2006	01-02-2006	01-02-2006	01-05-2012	01-05-2012	29-09-2009	
Burton	Permian	BD 1250P	to	09-05-2023	09-05-2023	09-05-2023	01-05-2013	13-09-2012	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	13-09-2012	13-09-2012	13-09-2012	13-09-2012	13-09-2012	09-05-2023	09-05-2023	09-05-2023	13-09-2012	13-09-2012	09-05-2023	13-09-2012	13-09-2012	13-09-2012	13-09-2012	13-09-2012	13-09-2012	
Burton	Permian	BD 1250P	Min	6.73	7510	24.6	4630	6.55	7950	10	0.5	0.5	723	456	284	1990	80	93	1600	8	0.005	5.00E-04	5.00E-04	5.00E-04	0.36	5.00E-05	5.00E-04	5.00E-04	5.00E-04	0.025	0.005	5.00E-04	5.00E-04	5.00E-04	5.00E-05	5.00E-04	0.0025	0.199	0.02	0.005	
Burton	Permian	BD 1250P	5th %ile	6.82	8013.75	25.22	4650	6.69	8094	10.15	0.5	0.5	723.15	483.1	290.1	2287.5	92.05	96.4	1682.5	9.1	0.005	5.00E-04	5.00E-04	5.00E-04	0.3635	5.00E-05	5.00E-04	5.00E-04	5.00E-04	0.025	0.005	5.00E-04	5.00E-04	5.00E-04	5.00E-05	5.00E-04	0.0025	0.199	0.0251	0.005	
Burton	Permian	BD 1250P	20th %ile	6.9	8280	26.32	6480	6.76	10056	10.6	0.5	0.5	723.6	522	302.4	3440	163	155.4	2018	12	0.005	5.00E-04	5.00E-04	5.00E-04	0.374	5.00E-05	5.00E-04	5.00E-04	0.001	0.025	0.005	5.00E-04	5.00E-04	5.00E-04	5.00E-05	5.00E-04	0.0025	0.2026	0.0404	0.005	
Burton	Permian	BD 1250P	Median	6.995	9060	27.9	8075	7.16	12000	11.5	0.5	0.5	724.5	582	340	3945	207.5	215	2355	15	0.005	5.00E-04	5.00E-04	5.00E-04	0.395	7.50E-05	0.002	5.00E-04	0.002	0.22	0.005	5.00E-04	5.00E-04	5.00E-04	0.002	0.01	0.208	0.071	0.005		
Burton	Permian	BD 1250P	80th %ile	7.15	10340	28.9	9244	7.46	10988	12.4	0.5	0.5	725.4	640	366.2	4768	386	294.6	2640	19	0.005	5.00E-04	5.00E-04	5.00E-04	0.416	2.00E-04	0.0032	5.00E-04	0.002	0.26	0.005	5.00E-04	5.00E-04	0.001	5.00E-05	0.0038	0.0182	0.2134	0.1016	0.005	
Burton	Permian	BD 1250P	95th %ile	7.33	10825	29.84	10795	7.58	11717	12.85	0.5	0.5	725.85	719.95	413.85	6654.5	561.7	331.95	3077	20	0.005	5.00E-04	0.00295	5.00E-04	0.4265	3.00E-04	0.00975	5.00E-04	0.004	0.37	0.005	0.00125	5.00E-04	0.001	0.0001925	0.01225	0.04235	0.2161	0.1169	0.005	
Burton	Permian	BD 1250P	Max	7.42	11120	29.9	14500	9.82	26400	13	0.5	0.5	726	726	468	7330	725	411	3120	21	0.005	5.00E-04	0.006	5.00E-04	0.43	3.00E-04	0.024	5.00E-04	0.004	0.42	0.005	0.002	5.00E-04	0.001	5.00E-04	0.017	0.068	0.217	0.122	0.005	
Burton	Permian	BD 1250P	Tau	0.0032001	-0.254778	0.00573903	-0.87013	0.468905	-0.704952	-	-	-	-	0.402597	0.44783	-0.885035	-0.932419	-0.748052	-0.686541	1	-	-	-0.10858	-	-	-0.436041	-0.0177115	1	-0.31257	-0.419524	1	0.255841	1	0.330289	0.154132	0.0767499	-0.347489	-	-	1	
Burton	Permian	BD 1250P	2-sided-p	0.989122	0.030271	0.98325	1.7046E-08	0.00337029	2.92123E-06	-	-	-	-	0.00948083	0.00399601	1.02355E-08	1.87192E-09	7.88882E-10	1.83182E-06	1.55622E-05	1	-	-	0.561471	-	-	0.0174662	0.940653	1	0.0890188	0.0961793	1	0.429195	1	0.261572	0.42478	0.68361	0.0409091	-	-	1
Burton	Permian	BD 1250P	Trend	No	Yes-Downward	No	Yes-Downward	Yes-Upward	Yes-Downward	-	-	-	-	Yes-Upward	Yes-Upward	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	No	-	No	-	-	Yes-Downward	No	No	No	No	No	No	No	No	No	No	No	Yes-Downward	-	-	No
Burton	Alluvium	Anna Creek Downstream	Total Number	2	2	2	2	0	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	2	2	2	0	2	2	0	0	0	0	0	0	0
Burton	Alluvium	Anna Creek Downstream	from	19-03-2023	19-03-2023	19-03-2023	19-03-2023	-	19-03-2023	-	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023	19-03-2023
Burton	Alluvium	Anna Creek Downstream	to	09-05-2023	09-05-2023	09-05-2023	09-05-2023	-	09-05-2023	-	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	
Burton	Alluvium	Anna Creek Downstream	Min	7.5	3600	23.9	1870	-	2750	-	0.5	0.5	201	201	8	800	111	65	268	13	0.005	5.00E-04	5.00E-04	-	-	-	-	-	-	0.025	0.005	5.00E-04	-	0.005	5.00E-05	-	-	-	-	-	
Burton	Alluvium	Anna Creek Downstream	5th %ile	7.51	4360	24.075	1948	-	2770	-	0.5	0.5	211.15	211.15	12.55	809.4	114.25	69.7	271.9	13.45	0.00525	5.00E-04	0.000525	-	-	-	-	-	0.02825	0.005	5.00E-04	-	0.00545	5.00E-05	-	-	-	-	-		
Burton	Alluvium	Anna Creek Downstream	20th %ile	7.54	6640	24.6	2182	-	2930	-	0.5	0.5	241.6	241.6	26.2	837.6	124	83.8	283.6	14.8	0.006	5.00E-04	6.00E-04	-	-	-	-	-	-	0.038	0.005	5.00E-04	-	0.0068	5.00E-05	-	-	-	-	-	
Burton	Alluvium	Anna Creek Downstream	Median	7.6	11200	25.65	2650	-	2950	-	0.5	0.5	302.5	302.5	53.5	894	143.5	112	307	17.5	0.0075	5.00E-04	0.00075	-	-	-	-	-	-	0.0575	0.005	5.00E-04	-	0.0095	5.00E-05	-	-	-	-	-	
Burton	Alluvium	Anna Creek Downstream	80th %ile	7.66	15760	26.7	3118	-	3070	-	0.5	0.5	363.4	363.4	80.8	950.4	163	140.2	330.4	20.2	0.009	5.00E-04	9.00E-04	-	-	-	-	-	-	0.077	0.005	5.00E-04	-	0.0122	5.00E-05	-	-	-	-	-	
Burton	Alluvium	Anna Creek Downstream	95th %ile	7.69	18040	27.225	3352	-	3130	-	0.5	0.5	393.85	393.85	94.45	978.6	172.75	154.3	342.1	21.55	0.00975	5.00E-04	0.000975	-	-	-	-	-	-	0.08675	0.005	5.00E-04	-	0.01355	5.00E-05	-	-	-	-	-	
Burton	Alluvium	Anna Creek Downstream	Max	7.7	18800	27.4	3430	-	3150	-	0.5	0.5	404	404	99	988	176	159	346	22	0.01	5.00E-04	0.001	-	-	-	-	-	-	0.09	0.005	5.00E-04	-	0.014	5.00E-05	-	-	-	-	-	
Burton	Alluvium	Anna Creek Downstream	Tau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Burton	Alluvium	Anna Creek Downstream	2-sided-p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Burton	Alluvium	Anna Creek Downstream	Trend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Burton	Permian	DDH6	Total Number	36	36	27	9	8	10	1	2	2	2	9	9	9	9	9	9	9	7	2	9	1	1	7	7	5	7	7	3	7	7	7	9	7	7	1	1	5	
Burton	Permian	DDH6	from	25-02-2014	25-02-2014	25-02-2016	01-02-2006	01-02-2006	01-02-2006	31-10-2012	19-03-2023	19-03-2023	19-03-2023	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-02-2006	29-09-2009	19-03-2023	01-02-2006	31-10-2012	31-10-2012	01-02-2006	01-02-2006	29-09-2009	01-02-2006	29-09-2009	31-10-2012	29-09-2009	01-02-2006	29-09-2009	01-02-2006	29-09-2009	01-02-2006	01-02-2006	01-02-2006	31-10-2012	31-10-2012	29-09-2009
Burton	Permian	DDH6	to	09-05-2023	09-05-2023	09-05-2023	26-03-2013	09-05-2023	31-10-2012	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	09-05-2023	09-05-2023	09-05-2023	31-10-2012	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	
Burton	Permian	DDH6	Min	6.26	1650	22.5	2910	6.51	4750	21	0.5	0.5	635	500	64	1140	121	78	789	7	0.005	5.00E-04	5.00E-04	5.00E-04	0.24	5.00E-05	5.00E-04	5.00E-04	0.025	0.005	5.00E-04	5.00E-04	5.00E-05	5.00E-04	5.00E-05	5.00E-04	0.0025	0.172	0.004	0.0005	
Burton	Permian	DDH6	5th %ile	6.4525	5557.5	23.79	3162	6.5485	5330.5	21	0.5	0.5	635.85	505.2	66.4	1332	125.4	84.4	893.4	8.2	0.005	5.00E-04	5.00E-04	5.00E-04	0.24	5.															

Monitoring Network	Aquifer	Bore	statistic	Field_pH	Field_EC	Temp Field	TDS	Lab_pH	Lab_EC	Suspended Solids (SS)	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Sodium	Potassium	Diss Aluminium	Diss Antimony	Diss Arsenic	Diss Beryllium	Diss Boron	Diss Cadmium	Diss Chromium	Diss Cobalt	Diss Copper	Diss Iron	Diss Selenium	Diss Silver	Diss Lead	Diss Molybdenum	Diss Mercury	Diss Nickel	Diss Zinc	Diss Barium	Diss Manganese	Diss Uranium		
Burton	Permian	BD1032	20th N/A	7.568	17058	25.26	10680	7.07	16914	15	0.5	0.5	71.8	64	0.5	5676	753.8	72	2620	13	0.005	5.00E-04	5.00E-04	0.0005	0.12	0.00005	0.0005	0.0005	0.0072	0.052	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.0005	0.0156	32.3	1.52	0.0005		
Burton	Permian	BD1032	Median	7.61	17175	26.55	13350	7.08	17260	15	0.5	0.5	73	68.5	1.5	5950	790.5	73	2720	15.5	0.0075	5.00E-04	0.0005	0.0005	0.12	0.00005	0.0005	0.0005	0.008	0.16	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.00075	0.018	32.3	1.52	0.0005		
Burton	Permian	BD1032	80th N/A	7.652	17292	27.84	14660	7.28	17614	15	0.5	0.5	74.2	72.6	2	6396	830.4	75.4	2792	17.4	0.038	5.00E-04	5.00E-04	0.0005	0.12	0.0001	0.002	0.0005	0.009	0.254	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.0024	0.0214	32.3	1.52	0.0005		
Burton	Permian	BD1032	95th N/A	7.673	17350.5	28.485	16005	8.555	18118	15	0.5	0.5	74.8	119.55	2.35	6729.5	854.65	76	2991.5	20	0.0695	5.00E-04	0.001025	0.0005	0.12	0.000245	0.00245	0.0005	0.0109	0.2585	0.005	5.00E-04	0.0005	0.0005	1.00E-04	0.00835	0.03185	32.3	1.52	0.0005		
Burton	Permian	BD1032	Max	7.68	17370	28.7	16200	9.82	18700	15	0.5	0.5	75	128	3	6970	880	76	3000	20	0.08	5.00E-04	0.002	0.0005	0.12	0.0003	0.003	0.0005	0.012	0.26	0.005	5.00E-04	0.0005	0.0005	2.00E-04	0.01	0.039	32.3	1.52	0.0005		
Burton	Permian	BD1032	Tau	-	-	-	0.486195	0.149592	0.230769	-	-	-	-	-0.111748	-0.0180024	0.230769	-0.318881	0.2005	0.357592	-0.205879	-0.182574	-	-	-	-	-0.379869	0.151947	-	-0.277166	-0.666667	-	1	1	1	0.145371	0.417786	-0.365528	-	-	-		
Burton	Permian	BD1032	2-sided-p	-	-	-	0.0183952	0.58156	0.299665	-	-	-	-	0.620647	1	0.273561	0.125311	0.369342	0.0882368	0.346427	1	-	0.321062	-	-	0.138701	0.585409	-	0.258295	0.308179	-	1	1	1	0.619796	0.0893828	0.160401	-	-	-		
Burton	Permian	BD1032	Trend	-	-	-	Yes-Upward	No	No	-	-	-	-	No	No	No	No	No	No	No	No	-	-	-	-	No	No	-	-	-	-	No	No	No	No	No	-	-	-	-		
Burton	Permian	BD1248P	Total Number	35	33	26	9	10	11	1	2	2	2	9	9	9	9	9	9	9	9	2	9	1	1	7	7	7	7	9	3	9	7	9	7	7	1	1	7	1	7	
Burton	Permian	BD1248P	from	25-02-2014	27-05-2014	19-05-2016	01-04-2010	01-04-2010	01-04-2010	12-09-2012	19-03-2023	19-03-2023	19-03-2023	01-04-2010	01-04-2010	01-04-2010	01-04-2010	01-04-2010	01-04-2010	01-04-2010	01-04-2010	19-03-2023	01-04-2010	12-09-2012	12-09-2012	01-04-2010	01-04-2010	01-04-2010	01-04-2010	01-04-2010	12-09-2012	01-04-2010	01-04-2010	01-04-2010	01-04-2010	01-04-2010	12-09-2012	12-09-2012	01-04-2010	12-09-2012	01-04-2010	
Burton	Permian	BD1248P	to	09-05-2023	09-05-2023	09-05-2023	09-05-2023	01-05-2013	09-05-2023	12-09-2012	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	09-05-2023	12-09-2012	12-09-2012	12-09-2012	12-09-2012	12-09-2012	09-05-2023	09-05-2023	09-05-2023	12-09-2012	09-05-2023	09-05-2023	09-05-2023	12-09-2012	12-09-2012	12-09-2012	12-09-2012	12-09-2012	12-09-2012	
Burton	Permian	BD1248P	Min	6.56	21260	24.1	16100	6.89	18400	84	0.5	0.5	587	279	0.5	8410	686	652	3350	26	0.005	5.00E-04	5.00E-04	5.00E-04	0.27	5.00E-05	5.00E-04	5.00E-04	2.00E-03	0.025	0.005	5.00E-04	5.00E-04	5.00E-04	5.00E-05	5.00E-04	0.0025	9.16	3.85	0.0005		
Burton	Permian	BD1248P	5th N/A	6.702	22276	24.7025	16940	7.016	20750	84	0.5	0.5	590.15	359.4	0.5	8478	713.6	654.4	3478	27.2	0.005	6.00E-04	5.00E-04	5.00E-04	0.27	5.00E-05	5.00E-04	5.00E-04	2.30E-03	0.115	0.005	5.00E-04	5.00E-04	5.00E-04	5.00E-05	5.00E-04	0.00355	9.16	3.85	0.0005		
Burton	Permian	BD1248P	20th N/A	6.808	23256	25.8	18320	7.242	24500	84	0.5	0.5	599.6	484.2	0.8	8634	764	660.4	3748	31.4	0.005	9.00E-04	5.00E-04	5.00E-04	0.27	6.00E-05	8.00E-04	5.00E-04	0.0032	0.88	0.005	5.00E-04	5.00E-04	1.40E-03	5.00E-05	8.00E-04	0.0062	9.16	3.85	0.0006		
Burton	Permian	BD1248P	Median	6.93	24160	27	21300	7.34	25200	84	0.5	0.5	618.5	515	2	9990	806	662	4460	36	0.005	1.50E-03	1.00E-03	5.00E-04	0.27	1.00E-04	0.002	5.00E-04	0.005	13	0.005	5.00E-04	5.00E-04	3.00E-03	5.00E-05	0.0025	0.008	9.16	3.85	0.001		
Burton	Permian	BD1248P	80th N/A	7.002	27218	28.6	22520	7.484	28000	84	0.5	0.5	637.4	551.6	109.8	10200	842.8	771.2	4848	38.8	0.016	2.10E-03	3.80E-03	5.00E-04	0.27	2.00E-04	0.0037	1.80E-03	0.005	22.38	0.017	1.60E-03	5.00E-04	0.0038	5.00E-05	0.0045	0.0114	9.16	3.85	0.0028		
Burton	Permian	BD1248P	95th N/A	7.143	29320	29.15	25400	7.654	31500	84	0.5	0.5	646.85	624.8	134.4	10980	865	796.4	4968	40	0.04	2.40E-03	0.0074	5.00E-04	0.27	4.10E-04	0.0047	4.10E-03	0.0057	26.34	0.023	0.004	3.65E-03	0.0062	0.00005	0.005	0.0211	9.16	3.85	0.0044		
Burton	Permian	BD1248P	Max	7.31	31840	29.68	27200	7.78	32600	84	0.5	0.5	650	650	142	11500	869	806	5040	40	0.05	2.50E-03	0.009	5.00E-04	0.27	5.00E-04	0.005	5.00E-03	0.006	26.7	0.025	0.005	5.00E-03	0.007	5.00E-05	0.005	0.025	9.16	3.85	0.005		
Burton	Permian	BD1248P	Tau	0.0494083	0.489564	0.28441	0.555556	-0.0898933	0.149592	-	-	-	-	0.277778	-0.725324	0.647952	-0.277778	0.222222	0.277778	-0.435194	-0.166667	-	0.30429	-	-	-0.205738	0.0500626	-0.281178	0.431476	-0.277778	-	0.327327	0.178174	-0.176777	1	0.617213	0.142857	-	-	-0.450564		
Burton	Permian	BD1248P	2-sided-p	0.690342	6.80685E-05	0.0460051	0.047604	0.787616	0.58156	-	-	-	-	0.348083	0.010593	0.021098	0.348083	0.465512	0.348083	0.13781	0.842686	-	0.324182	-	-	0.504076	1	0.503001	0.272341	0.348083	-	0.316047	0.802587	0.592628	1	0.0870866	0.36891	-	-	0.218863		
Burton	Permian	BD1248P	Trend	No	Yes-Upward	Yes-Upward	Yes-Upward	No	No	-	-	-	-	No	Yes-Downward	Yes-Upward	No	No	No	No	No	-	-	-	-	No	No	-	-	-	-	No	No	No	No	No	No	-	-	No		
Burton	Permian	DDH5	Total Number	0	0	0	1	1	1	1	0	0	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Burton	Permian	DDH5	from	-	-	-	31-10-2012	31-10-2012	31-10-2012	31-10-2012	-	-	-	-	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	-	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012
Burton	Permian	DDH5	to	-	-	-	31-10-2012	31-10-2012	31-10-2012	31-10-2012	-	-	-	-	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	-	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012	31-10-2012
Burton	Permian	DDH5	Min	-	-	-	2910	8.13	4750	21	-	-	-	500	64	1140	121	78	789	7	0.005	-	5.00E-04	0.0005	0.24	0.00005	0.002	0.0005	0.0005	0.025	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.016	0.0025	0.172	0.004	0.0005		
Burton	Permian	DDH5	5th N/A	-	-	-	2910	8.13	4750	21	-	-	-	500	64	1140	121	78	789	7	0.005	-	0.0005	0.0005	0.24	0.00005	0.002	0.0005	0.0005	0.025	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.016	0.0025	0.172	0.004	0.0005		
Burton	Permian	DDH5	20th N/A	-	-	-	2910	8.13	4750	21	-	-	-	500	64	1140	121	78	789	7	0.005	-	5.00E-04	0.0005	0.24	0.00005	0.002	0.0005	0.0005	0.025	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.016	0.0025	0.172	0.004	0.0005		
Burton	Permian	DDH5	Median	-	-	-	2910	8.13	4750	21	-	-	-	500	64	1140	121	78	789	7	0.005	-	0.0005	0.0005	0.24	0.00005	0.002	0.0005	0.0005	0.025	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.016	0.0025	0.172	0.004	0.0005		
Burton	Permian	DDH5	80th N/A	-	-	-	2910	8.13	4750	21	-	-	-	500	64	1140	121	78	789	7	0.005	-	5.00E-04	0.0005	0.24	0.00005	0.002	0.0005	0.0005	0.025	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.016	0.0025	0.172	0.004	0.0005		
Burton	Permian	DDH5	95th N/A	-	-	-	2910	8.13	4750	21	-	-	-	500	64	1140	121	78	789	7	0.005	-	0.0005	0.0005	0.24	0.00005	0.002	0.0005	0.0005	0.025	0.005	5.00E-04	0.0005	0.0005	5.00E-05	0.016	0.0025	0.172	0.004	0.0005		
Burton	Permian	DDH5	Max	-	-	-	2910	8.																																		

Monitoring Network	Aquifer	Bore	statistic	Field_pH	Field_EC	Temp Field	TDS	Lab_pH	Lab_EC	Suspended Solids (SS)	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Sodium	Potassium	Diss Aluminum	Diss Antimony	Diss Arsenic	Diss Beryllium	Diss Boron	Diss Cadmium	Diss Chromium	Diss Cobalt	Diss Copper	Diss Iron	Diss Selenium	Diss Silver	Diss Lead	Diss Molybdenum	Diss Mercury	Diss Nickel	Diss Zinc	Diss Barium	Diss Manganese	Diss Uranium	
Burton	Permian	BD 1253P	Tau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	BD 1253P	2-sided-p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	BD 1253P	Trend	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	Total Number	14	14	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burton	Permian	LBP 5 Upper	from	25-02-2014	25-02-2014	25-02-2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Burton	Permian	LBP 5 Upper	to	24-05-2017	24-05-2017	24-05-2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Burton	Permian	LBP 5 Upper	Min	6.35	13560	24.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	5th %ile	6.4345	13716	24.825	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	20th %ile	6.562	14736	24.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	Median	6.83	17855	25.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	80th %ile	6.998	18342	26.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	95th %ile	7.0515	20645	26.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	Max	7.11	22400	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	Tau	-0.472527	-0.596694	-0.0666667	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	2-sided-p	0.0214887	0.00366272	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	LBP 5 Upper	Trend	Yes-Downward	Yes-Downward	No	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Burton	Permian	DDH45	Total Number	0	0	0	11	10	10	0	0	0	0	11	11	11	11	11	11	11	1	0	11	0	0	11	11	1	11	1	0	1	11	1	11	11	11	11	0	0	1
Burton	Permian	DDH45	from	-	-	-	01-02-2006	01-02-2006	01-02-2006	-	-	-	-	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-02-2006	01-06-2011	-	01-02-2006	-	-	01-02-2006	01-02-2006	01-06-2011	01-02-2006	01-06-2011	-	01-06-2011	01-02-2006	01-06-2011	01-02-2006	01-06-2011	01-02-2006	01-02-2006	-	-	01-06-2011
Burton	Permian	DDH45	to	-	-	-	01-06-2011	01-06-2011	01-06-2011	-	-	-	-	01-06-2011	01-06-2011	01-06-2011	01-06-2011	01-06-2011	01-06-2011	01-06-2011	01-06-2011	-	01-06-2011	-	-	01-06-2011	01-06-2011	01-06-2011	01-06-2011	01-06-2011	-	01-06-2011	01-06-2011	01-06-2011	01-06-2011	01-06-2011	01-06-2011	01-06-2011	-	-	01-06-2011
Burton	Permian	DDH45	Min	-	-	-	11200	6.75	18500	-	-	-	-	98	0.5	6440	677	105	2850	15	0.005	-	5.00E-04	-	-	0.00005	0.0005	0.0005	0.006	1.64	-	5.00E-04	0.0005	0.0005	5.00E-05	0.0005	0.01	-	-	0.0005	
Burton	Permian	DDH45	5th %ile	-	-	-	11750	6.7905	18635	-	-	-	-	101	0.5	6475	691.5	114.5	2970	18	0.005	-	0.00005	-	-	0.00005	0.0005	0.0005	0.008	1.64	-	5.00E-04	0.0005	0.0005	5.00E-05	0.0005	0.0155	-	-	0.0005	
Burton	Permian	DDH45	20th %ile	-	-	-	13100	6.856	18952	-	-	-	-	105	0.5	6650	707	124	3090	21	0.005	-	5.00E-04	-	-	0.00005	0.0005	0.0005	0.012	1.64	-	5.00E-04	0.0005	0.0005	5.00E-05	0.0005	0.022	-	-	0.0005	
Burton	Permian	DDH45	Median	-	-	-	13800	6.995	19530	-	-	-	-	111	0.5	6800	765	134	3300	26	0.005	-	0.00005	-	-	0.00005	0.001	0.0005	0.013	1.64	-	5.00E-04	0.0005	0.0005	5.00E-05	0.0005	0.03	-	-	0.0005	
Burton	Permian	DDH45	80th %ile	-	-	-	14800	7.098	20000	-	-	-	-	117	0.5	7250	784	139	3400	28	0.005	-	2.00E-03	-	-	0.0003	0.001	0.0005	0.016	1.64	-	5.00E-04	0.0005	0.0005	5.00E-05	0.0025	0.039	-	-	0.0005	
Burton	Permian	DDH45	95th %ile	-	-	-	15400	7.269	20110	-	-	-	-	123.5	2	8055	791.5	148.5	3415	32	0.005	-	0.002	-	-	0.00035	0.0035	0.0005	0.0165	1.64	-	5.00E-04	0.0005	0.0005	5.00E-05	0.005	0.043	-	-	0.0005	
Burton	Permian	DDH45	Max	-	-	-	15800	7.35	20200	-	-	-	-	124	2	8490	796	152	3420	35	0.005	-	0.002	-	-	0.0004	0.005	0.0005	0.017	1.64	-	5.00E-04	0.0005	0.0005	5.00E-05	0.006	0.045	-	-	0.0005	
Burton	Permian	DDH45	Tau	-	-	-	0.330289	0.224733	0	-	-	-	-	-0.186989	-0.0635642	-0.500086	-0.236364	-0.611216	-0.183494	-0.261785	-	-	-0.179787	-	-	-0.323875	0.064775	-	-0.533939	-	-	-	1	-	1	0.213201	-0.527273	-	-	-	
Burton	Permian	DDH45	2-sided-p	-	-	-	0.184351	0.418962	1	-	-	-	-	0.478594	0.906186	0.0417025	0.350201	0.0121956	0.482192	0.307076	-	-	0.542344	-	-	0.229377	0.865614	-	0.0324358	-	-	-	1	-	1	0.441383	0.0292725	-	-	-	
Burton	Permian	DDH45	Trend	-	-	-	No	No	No	-	-	-	-	No	No	Yes-Downward	No	Yes-Downward	No	No	-	-	No	-	-	No	No	-	Yes-Downward	-	-	-	No	-	No	No	Yes-Downward	-	-	-	

[illegible]

Appendix D

Groundwater Modelling Technical Report (2023)

New Lenton Coal Project

PER Groundwater Assessment

Lenton Joint Venture

SLR Project No.: 620.31367.00000

9 October 2024



New Lenton & Burton

2023 Groundwater Modelling Technical Report

Lenton Joint Venture

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SLR Project No.: 620.31367.00000

11 September 2024

Revision: 4.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
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3.0	20 December 2023	Derwin Lyons	Brian Rask	Derwin Lyons
2.0	19 December 2023	Dariarne Edwards	Brian Rask Arash Mohajeri	Derwin Lyons
1.0	1 December 2023	Dariarne Edwards	Arash Mohajeri Brian Rask	Derwin Lyons

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Lenton Joint Venture (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.



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Appendices

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1.0 Introduction

1.1 Overview

Bowen Coking Coal (BCC) acquired the New Hope Group's (NHG) stake in the Lenton Joint Venture (LJV) in 2022, comprising owner-operatorship of both the proposed New Lenton Coal Project (referred to as New Lenton, New Lenton Project, or the Project) and adjacent existing Burton Coal Mine (referred to as Burton Mine or Burton). The LJV has engaged SLR Australia Pty Ltd (SLR) to develop groundwater assessments to support:

- A New Lenton Coal Project Public Environment Report (PER) for submission to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- A Progressive Rehabilitation and Closure Plan (PRCP) for Burton Mine for submission to the Queensland Department of Environment and Science (DES) under the *Environment Protection Act 1994* (EP Act).

This report presents the development of the numerical groundwater model that forms part of both the aforementioned groundwater assessments. The location of the Burton Mine mining leases (MLs) and New Lenton MLs are shown in **Figure 1-1**.

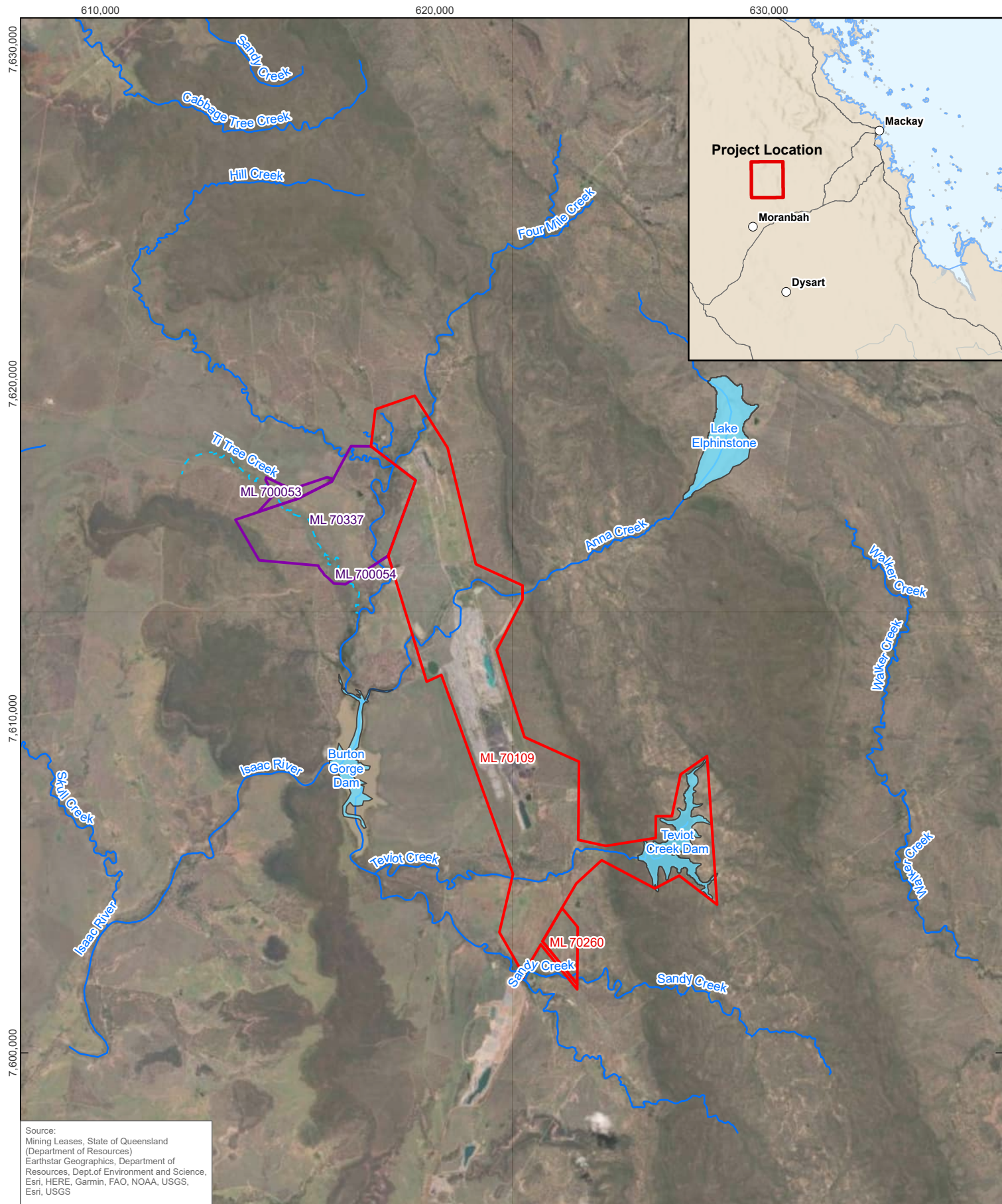
Burton Mine is an open-cut coal mine located approximately 90 km southwest of Mackay in Queensland's Bowen Basin. When operating, the mine produces hard and semi-hard coking and thermal coal for export markets. Burton Mine is approved through Environmental Authority (EA) EA0001002, which includes Mining Leases (ML) 70109 and 70260, Mineral Development Licences (MDL) 315 and 349 and Exploration Permit Coal (EPC) 857. The Burton Mine commenced in 1995 and operated until December 2016, thereafter placed on care and maintenance. As part of LJV's acquisition and strategy for continued mining and development, three additional pits will be mined, extending the Life of Mine (LOM) to approximately 2035. The LJV recommenced mining operations at Burton Mine in 2023.

The New Lenton Project is a proposed open-cut mine approximately 2 km to the west of Burton Mine. The proposed open-cut mine, to be developed on ML 70337, ML 700053 and ML 700054, has a Life of Mine of approximately 18 years and includes two open-cut pits, the West Pit and East Pit. Mining operations are proposed by LJV to commence in 2025.

1.2 Previous Groundwater Modelling

Significant groundwater modelling has previously been completed for the New Lenton Project, with that previous modelling also including the Burton Mine for cumulative impact assessment purposes. A groundwater model was developed by GHD (2019) as part of an early New Lenton Project groundwater assessment. Further numerical modelling was then undertaken by SLR (2020), to support the successful EA amendment process and also the successful application of an Associated Water Licence (AWL) for the New Lenton Project. That is, the SLR (2020) version of the model was accepted by the State of Queensland for multiple environmental approvals at the New Lenton Project.





Source:
Mining Leases, State of Queensland
(Department of Resources)
Earthstar Geographics, Department of
Resources, Dept. of Environment and Science,
Esri, HERE, Garmin, FAO, NOAA, USGS,
Esri, USGS

0 2.5 5 km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:150,000 at A4
Project Number: 620.31208.00000
Date Drawn: 15-Dec-2023
Drawn by: AS

LEGEND

- Non-designated Watercourse
- River
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

PROJECT LOCATION



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FIGURE 1-1

For the purposes of the New Lenton PER and during the early stages of the PER groundwater assessment development, feedback on the 2020 numerical groundwater model was provided by an independent peer reviewer engaged by the LJV. The peer reviewer acknowledged that the SLR (2020) model was generally fit for purpose for the PER, however the following areas for potential improvement were identified:

- Geological heterogeneity apparent in the alluvium of the Isaac River could be better captured by revised model parameterisation (the use of pilot points in the alluvium was suggested).
- Calibration validation or re-calibration with history matching to data collected post-2019 would be advantageous;
- Uncertainty Analysis methods adopted in the modelling should be updated to conform with current leading practice as documented within the IESC's own guidelines; and
- Uncertainty in post-mining recovery modelling should be considered, as recommended in recently released Queensland State guidelines.

It was therefore decided by LJV to undertake a revision and update of the 2020 numerical groundwater model. The subsequently updated 2023 numerical groundwater model is reported herein.

1.3 Project Descriptions

1.3.1 New Lenton Project

The proposed open-cut mine pits at New Lenton target the Burton/Rider and Leichhardt/Vermont seams of the Rangal Coal Measures and extend 2.7 km northwest-southeast and 2.3 km southwest-northeast. The southeastern extent of the East Pit reaches 150 m from the Isaac River. The West Pit has a land surface area of approximately 0.72 km² while the East Pit covers approximately 1.98 km².

The proposed mining schedule provided by LJV indicates open-cut mining will commence in the West Pit in 2025 and in the East Pit in 2029, with planned cessation of mining by 2040.

The current EA (EPML00475513) allows the Project to operate at the rate of two million tonnes per annum (Mtpa) Run-of-Mine (RoM) coal extraction.

Other key elements of the New Lenton Project include:

- Construction of the re-alignment of the Suttor Developmental Road, with a new bridge over the Isaac River.
- Construction of haul roads, including haul road connection with the Burton Mine haul roads and a bed level crossing of the Isaac River.
- The emplacement of overburden in in-pit and out of pit waste rock dumps, with a final void remaining at the end of mine life.
- Construction of a mine infrastructure area (MIA) providing washdown, maintenance, spares laydown, and administration facilities for the Project's mining operations.
- Construction of the Ti-Tree Creek diversion to the north of the East pit and into the Isaac River.
- Mine water management infrastructure integrated with the existing systems at Burton Mine.



- Sediment dams and drains constructed to capture stormwater runoff from waste rock dumps (WRDS).
- Construction of levees adjacent to the Ti-Tree Creek diversion and Isaac River.

The Project will utilise infrastructure at Burton Mine as follows:

- Washing of coal at the coal handling and processing plant (CHPP).
- Mine infrastructure areas.
- Haulage of product coal on the haul road on ML 70109, to transport the train load-out (TLO)
- Management of rejects from coal washing within the Burton Mine's reject management systems.

Product coal will be railed to Port for export via the Goonyella rail line.

The proposed final landform for New Lenton Mine contains one residual final void at East Pit.

1.3.2 Burton Mine

Open-cut mining at Burton Mine targets the Burton/Rider and Leichhardt/Vermont seams of the Rangal Coal Measures. All historic and additional planned mine pits occur the north of the haul road to the train load out on ML 70109, extending approximately 17 km from just north of the Isaac River to Sandy Creek at the south and including the following pits:

- Isaac Pit (future)
- Burton North (historical and future)
- Burton Widening (historical)
- Burton South (future)
- Ellensfield (historical)
- Ellensfield South (future)
- Plumtree North (future)

Note that for the purposes of the Burton Mine PRCP, Burton Mine is defined as that occurring on ML 70109 and ML 70260 (per EA0001002), but excluding former active Burton Mine leases ML 70258, ML 70252 and ML 70256 to the south of ML 70109, that are no longer part of Burton Mine and are owned by parties other than the LJV.

Additional open-cut mining at Burton commenced in 2023 after a period of Care and Maintenance. Future mining will occur at the Ellensfield South pit, followed by Plumtree, North, Burton North, Isaac, and Burton South pits. Mining of these additional pits is expected to be completed by 2036. Historically mined pits will be partially backfilled with spoil material during active mining at adjacent pits.

The proposed final landform for Burton Mine contains five residual final voids: The Isaac Pit, Burton North Pit, Burton South Pit, Ellensfield Pit and Plumtree North Pit.

1.4 Groundwater Assessment & Modelling

1.4.1 Overview & Objectives

The numerical groundwater modelling detailed in this report is being undertaken in support of hydrogeological assessments that will form part of the following submissions:



- PER for submission to DCCEEW under the EPBC Act - New Lenton Project; and
- PRCP for submission to DES under the EP Act - Burton Mine.

The numerical groundwater modelling objectives are outlined separately for each of the hydrogeological assessments in the following sections.

1.4.1.1 New Lenton PER

In support of the groundwater assessment for the New Lenton PER, numerical groundwater modelling is being undertaken to predict impacts of the proposed mining on the local groundwater regime. The objectives of the groundwater modelling are to:

- Predict the groundwater inflow to the mine workings as a function of mine position and timing;
- Simulate and predict the incremental and cumulative extent and area of influence of dewatering;
- Simulate and predict the incremental and cumulative extent and area of influence in post-mining;
- Predict impacts on surface water fluxes due to the proposed mining and in post mining;
- Predict incremental changes in alluvial water resources due to the proposed mining and post mining;
- Predict the incremental and cumulative change in groundwater levels at identified groundwater users (i.e. registered bores, landholder bores, or GDEs) during the proposed mining and post mining;
- Predict the potential for seepage from the voids to groundwater i.e., do the final voids act as groundwater sinks or potential sources of seepage to groundwater; and
- Estimate groundwater inflows to the mining voids.

1.4.1.2 Burton Mine PRCP

In support of the groundwater assessment for the Burton Mine PRCP, numerical groundwater modelling is being undertaken to assess the potential groundwater related impacts at Burton Mine on completion of mining and once conditions stabilise post rehabilitation (i.e. groundwater equilibrium). A focus of the groundwater assessment is demonstrating suitability of the landform for the intended post mining land use (PMLU) and non-use management areas (NUMAs) with respect of the Burton groundwater system. As such, the objectives of the groundwater modelling are to:

- Simulate the post mining groundwater level recovery using the final landform provided by LJV and estimate the potential for seepage from the voids to groundwater i.e., do the final voids act as groundwater sinks or potential sources of seepage to groundwater; and
- Predict the long-term effect of the proposed post-mining landform on the local groundwater regime (i.e. predict residual drawdowns and post-mining groundwater flux to the residual voids).



1.4.2 Groundwater System Conceptualisation

Conceptualisation of the groundwater regime and the calibration of the model against observed data are key to achieving a reliable numerical model. Conceptualisation is a simplified overview of the groundwater regime (i.e. the distribution and flow of groundwater) based on available data and experience. Consistency between numerical model results and the conceptual understanding of the groundwater regime increases the credibility of the numerical model predictions. The conceptualisation of the groundwater regime is presented in the New Lenton Mine PER (SLR, 2023).

Confidence in the numerical model is increased by calibration of numerical model results against observed data. A well calibrated model has demonstrated the ability to simulate groundwater levels that approximate observed levels at specific locations.



2.0 Groundwater Simulation Model

2.1 Model Details

2.1.1 Model Design

2.1.1.1 Model Code

Numerical modelling was undertaken using Geographic Information Systems (GIS) in conjunction with MODFLOW-USG, which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a version of the popular MODFLOW code (McDonald and Harbaugh, 1988) developed by the USGS. USGS MODFLOW has been the most widely used code for groundwater modelling in the past and has long been considered an industry standard.

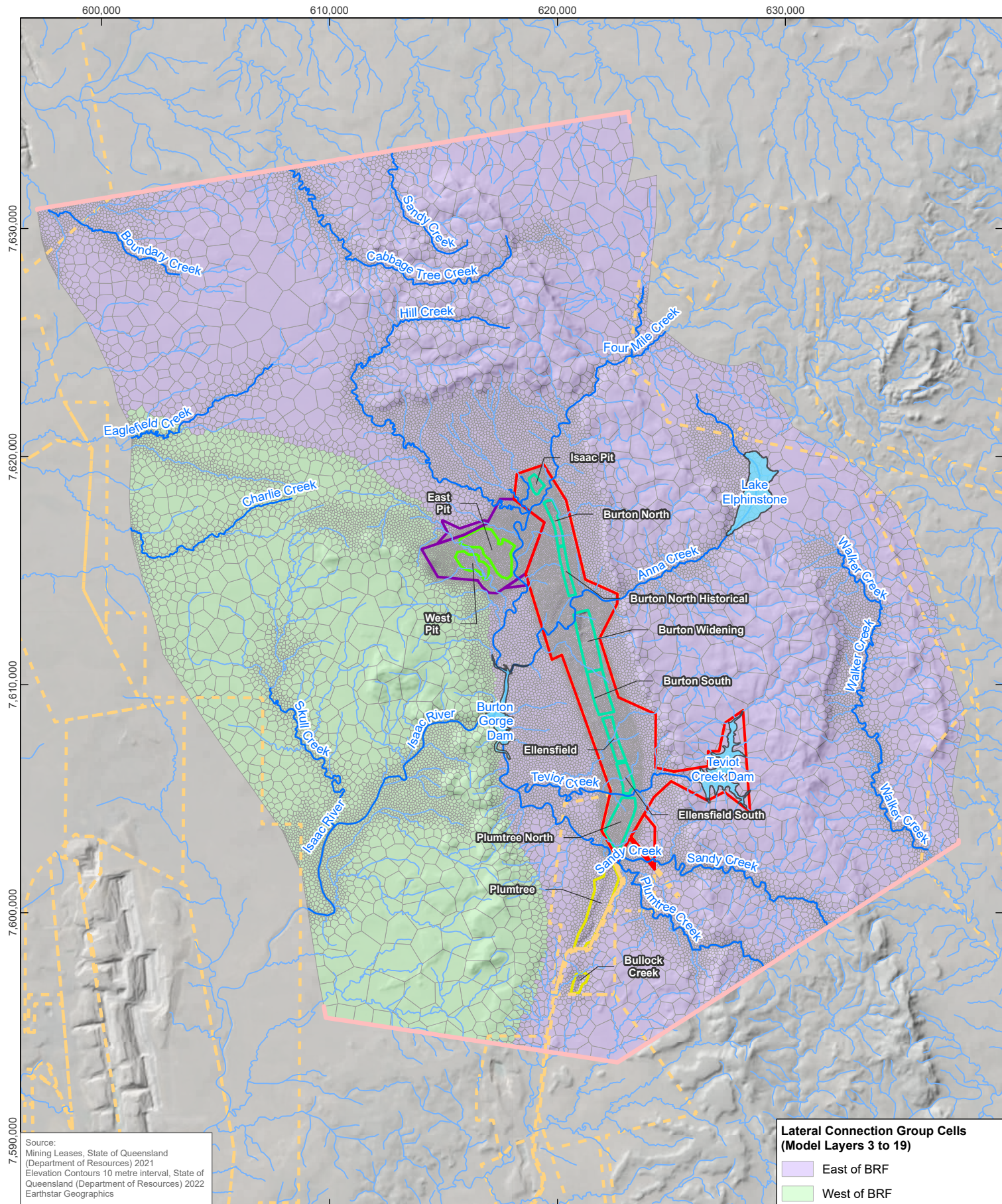
2.1.1.2 Model Extent and Mesh Design

The model domain is shown in **Figure 2-1**. The model extent was designed to be large enough to incorporate the New Lenton and Burton mines and to prevent boundary influence on model mining drawdowns. The model domain was selected based on the following considerations:

- The model extent to the south was set 9 km from the edge of approved future mine pits at Burton, and includes the historically mined Plumtree East and Plumtree West pits, which are now on mining leases that no longer form part of Burton Mine, that are to the south of Burton Mine mining areas, and which are owned by parties independent of the LJV. (referred to as former Burton Mine pits in **Figure 2-1**);
- The western boundary of the model was set approximately 14 km from the proposed pits at New Lenton mine and the eastern boundary was set approximately 10 km from approved pits at Burton mine. The western and eastern boundaries were represented by the outcrop of the Back Creek Group, which is considered to be the regional low permeability basement for the purpose of this modelling; and
- The northern boundary of the model was set approximately 15 km from the edge of approved pits at Burton mine, far enough to have no effect the model predictions.

To allow stable numerical modelling of the large spatial area of the model domain, an unstructured grid with varying Voronoi cell sizes was designed using Algomesh 2 (HydroAlgorithmics Pty Ltd, 2020). Varying Voronoi cell sizes allowed refinement around areas of interest, while a coarser resolution elsewhere reduces the total cell count to a manageable size.





Source:
Mining Leases, State of Queensland
(Department of Resources) 2021
Elevation Contours 10 metre interval, State of
Queensland (Department of Resources) 2022
Earthstar Geographics

**Lateral Connection Group Cells
(Model Layers 3 to 19)**

East of BRF
West of BRF

0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 29-Aug-2024

Drawn by: RB

LEGEND

- River
- Watercourse and Drainage
- Non-designated Watercourse
- Model Grid
- General Head Boundary
- Surrounding Mine
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits
- SW Lake/Dam

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

MODEL MESH AND GENERAL HEAD BOUNDARIES



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FIGURE 2-1

In developing the model grid, splines and maximum cell size constraints were included to delineate specific areas for the refinement of grid cell geometry, this included:

- 100 to 150 m irregular shaped Voronoi cells used for the Isaac River;
- 150 to 200 m irregular shaped Voronoi cells used for other creeks or drainage lines;
- 120 m irregular shaped Voronoi cells used for the Burton Gorge Dam;
- 100 to 150 m maximum cell size constraint for mapped alluvium within the model domain;
- 60 m irregular shaped Voronoi cells used for the New Lenton and Burton mine pits;
- 150 m irregular shaped Voronoi cells used for the historically mined open-cut pits to the southern extent of the model; and
- 200 m irregular shaped Voronoi cells aligned along the mapped major fault feature (Burton Range Fault).

2.1.2 Layers and Features

The model domain was vertically discretised into 19 layers, each layer comprising a cell count, up to 32,342. The total number of cells in the model is 291,564. This is after pinching out areas in Layer 1 to 19 where a layer is not present based on the structural geology. The geological units displaced by the Burton Range Fault (BRF) are represented by different layers based on their location either on the western or eastern side of the fault; i.e. the model simulates the fault via layers being offset on either side of the fault.

The model layers are listed in **Table 2-1**. The table includes the average thickness and comments on the relevance of the layer for the project. The top of layer 1 was developed based on LiDAR data for the mine areas. Outside of these areas the Digital Elevation Model (DEM) from Geoscience Australia (2021) was used.

Site geology data (i.e., bore and drill hole data) from New Lenton and Burton mines show the depth and lithology of alluvial deposits along the floodplain of the Isaac River are significantly heterogenous. The extent of alluvium was based on mapped surface geology. Alluvium associated with the Isaac River near the mines was refined using the surface geology mapping interpreted from site transient electromagnetic (TEM) data.

The depth of alluvium was based on the New Lenton and Burton geological models, drill holes and available public domain data (i.e., DNRM bores). Outside the extent of alluvium, Layer 1 was assigned as regolith with a nominal thickness of 1 m. The bottom of Layer 2 represents either the base of the regolith or the base of the basalt unit, where it is present based on QLD detailed geology and public bore data. The bottom of the regolith was based on the New Lenton and Burton geological models and the CSIRO (2015) regolith depth mapping.

Layers 3 to 8 represent the Triassic strata of the Rewan and Clematis Formation on either side of the BRF. The Triassic strata were represented using 3 layers on either side of the fault to allow increased vertical resolution and numerical stability, as the Triassic reaches up to 1 km in thickness within the model domain. The base of the Rewan Group (layers 7 and 8) was constructed based on the New Lenton and Burton geological models and solid geology mapping.

The structure of the Permian coal measures in the groundwater model was based on the New Lenton and Burton geological models and the available drill logs. Outside of the geological model coverage, nominal thicknesses were applied based on average thicknesses from the geological models. The Burton and Leichhardt/Vermont seams have



been represented as continuous units from north to south, with the bottom elevation and thickness of the target seam at each pit area defined by the relevant site geological models.

The adjacent cells in the model were horizontally connected via use of Lateral Connection Groups in AlgoMesh, as shown in **Figure 2-1**.

Different geologies in different layers of the model are presented using hydraulic property zones. Due to the significant heterogeneity identified in the alluvium, hydraulic parameters were assigned using pilot points in Layer 1. The modelled hydraulic property zones are shown in **Appendix A**.

Table 2-1 Model Layers

Layer	Geological Age	Lithology	Average Thickness (m)	Spatial Extent
1	Quaternary/Tertiary	Alluvium & Shallow Regolith	5.0	Model domain
2		Regolith & Basalt	14.2	Model domain
3	Triassic	Triassic (top)	175.3	West of BRF
4		Triassic (top)	148.2	East of BRF
5		Triassic (middle)	176.6	West of BRF
6		Triassic (middle)	148.2	East of BRF
7		Rewan (bottom)	176.5	West of BRF
8		Rewan (bottom)	148.2	East of BRF
9	Permian	Overburden (RCM)	48.2	West of BRF
10		Overburden (RCM)	47.7	East of BRF
11		Burton Rider Seam (RCM)	1.5	West of BRF
12		Burton Rider Seam (RCM)	1.8	East of BRF
13		Interburden (RCM)	26.0	West of BRF
14		Interburden (RCM)	25.2	East of BRF
15		Leichhardt/Vermont Seams (RCM)	8.2	West of BRF
16		Leichhardt/Vermont Seams (RCM)	8.3	East of BRF
17		Underburden (RCM)	100.0	West of BRF
18		Underburden (RCM)	99.8	East of BRF
19		Coal Measures (FCCM)	100.0	Model domain

2.1.3 Timing

A combined steady-state and transient model was developed, as follows:

- Steady-state stress period to represent pre-mining conditions (i.e., prior to 1998);
- Transient calibration stress periods with annual time intervals from January 1998 to January 2011 and quarterly time intervals from January 2011 to July 2023 to allow representation of seasonal fluctuation of the groundwater system as seen in observation data; and
- Transient predictive stress periods from July 2023 to June 2770 with time intervals of increasing length (quarterly until January 2024, annual during the predictive mining period and biannual to 100 yearly in post-mining).



To assist the model in overcoming the numerical difficulties, MODFLOW-USG Adaptive Time-Stepping (ATS) option was used. The ATS option of MODFLOW automatically decreases time-step size when the simulation becomes numerically difficult and increases it when the difficulty passes. The minimum time step size used in the simulations was 0.1 day.

To solve the flow equations, MODFLOW-USG Sparse Matrix Solver (SMS) package. The SMS package uses a combination of strategies including preconditioning, acceleration, linear and non-linear methods, ordering, and term dropping to solve the simultaneous equations produced by the model. The Head Change Criterion for Convergence (HICLOSE) criteria set for 0.001 m.

2.1.4 Boundary Conditions

The model boundary conditions are presented in **Figure 2-1**. The general head boundary (GHB) condition was used primarily to represent the regional flow into and out of the model area. GHB cells have been assigned in all model layers along the general head boundaries indicated in **Figure 2-1**. Groundwater enters the model where the water level set in the GHB is higher than the modelled water level in the adjacent cell and leaves the model when the water level is lower in the GHB. The GHB water levels were assigned based on the topographic gradients beyond the model boundaries and most recently recorded water levels at monitoring bores.

In MODFLOW, the GHB conductance is calculated as KLW/D where K is the hydraulic conductivity of the model cell, L is the length of the boundary condition in the cell, W is the width of the boundary condition, and D is the distance from the general head boundary to the model boundary. For all GHB cells in the model, D was set to 1 km from the model boundary. GHB conductance is variable in the model as it is calculated using the modelled hydraulic conductivity of the cell in which the GHB was assigned.

The Eastern and Western boundaries are aligned with the outcropping Permian formations and therefore, no flow conditions were assigned to these boundaries.

2.1.5 Stresses

2.1.5.1 Surface Drainage

River cells in the model are shown in **Figure 2-2**. Isaac River and water dams within the model domain were simulated using MODFLOW-USG River package (RIV). The features included in the RIV package are presented in **Table 2-2**.

The groundwater-surface water interactions are conceptualised as limited. Isaac River is the main surface water feature within the model domain. Based on surface water logger monitoring at New Lenton, the Isaac River within the model domain is classified as ephemeral (SLR, 2023), i.e. no long-term baseflow contribution from the groundwater is expected. Rather, surface water is expected to recharge the groundwater during short term rainfall events. Daily rainfall and recorded streamflow data indicate an estimated relationship whereby streamflow occurs in the Isaac River when daily rainfall exceeds approximately 30 mm/day, which predominantly occurs within the first quarter of each year.

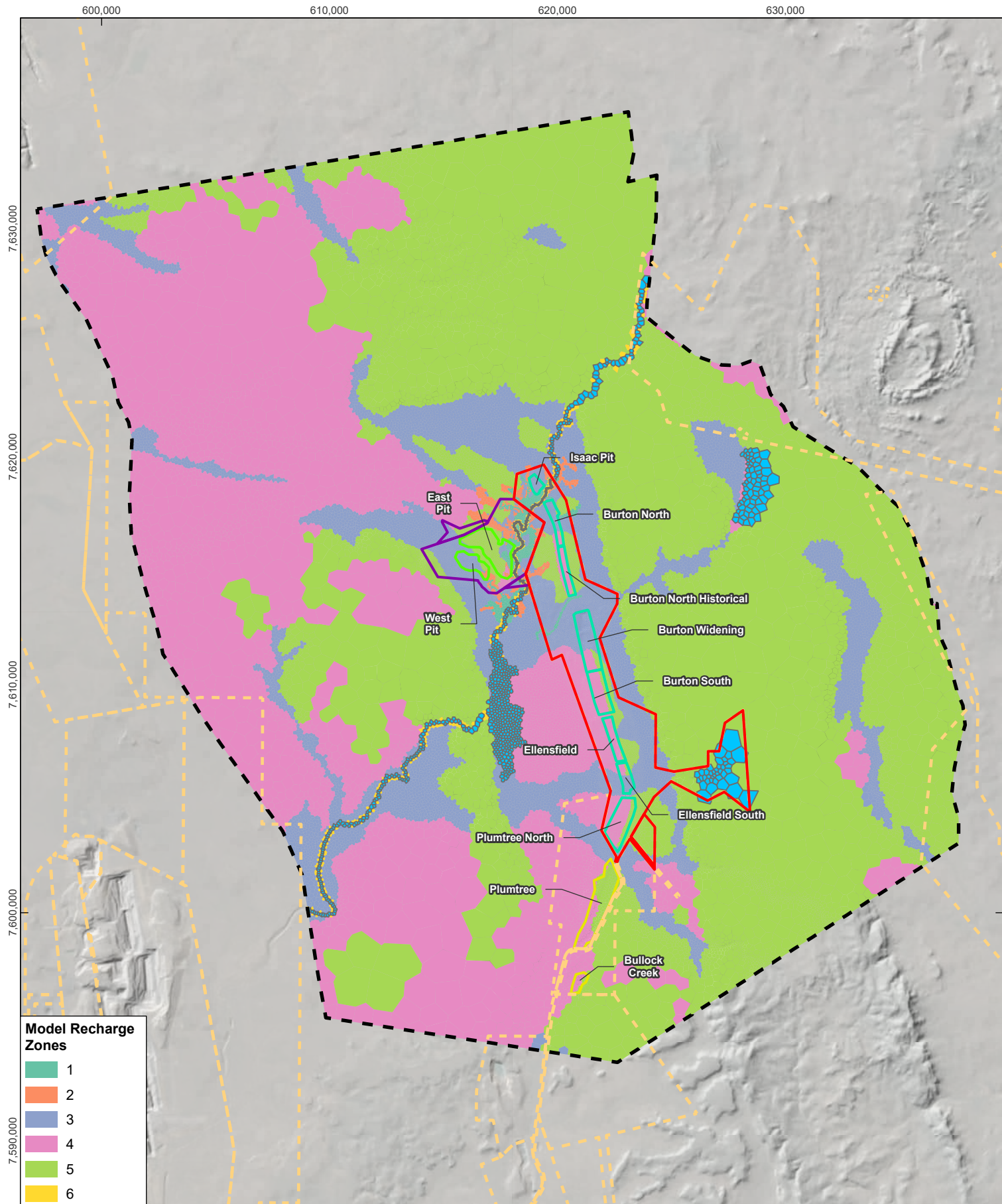
SLR (2020) model simulated stage height with a long term annual average level applied to the model. However, given the stress periods (i.e., time slices) in the model were quarterly or annual, the stage height for Isaac River persisted in the model for a much longer period than it does in reality. This design approach resulted in the simulation of what is naturally an ephemeral river reach as a perennial river in the model.

To overcome this model design limitation, the river cells representing Isaac River were assigned a stage height of zero for each stress period in the model. To represent the shallow



groundwater recharge due to rainfall derived streamflow in the model, an enhanced recharge factor was applied along the Isaac River during specific stress periods, dependent on the recharge rates used in the model. This is explained in more detail in **Section 2.1.5.2**.





Model Recharge Zones

- 1
- 2
- 3
- 4
- 5
- 6



0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 16-Dec-2023

Drawn by: AS

LEGEND

- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Surrounding Mine

- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits
- Model River Cells

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED RECHARGE ZONES
AND RIVER CELLS**



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FIGURE 2-2

Table 2-2 River and Surface Water Features in the Model

Boundary	River Stage (m)	Width (m)	Riverbed Thickness (m)
Isaac River	Long-term Average - 0	10	1
Burton Gorge Dam	Historical Quarterly Average (when available) Steady-state simulation – Long-term Average Prediction simulation – Long-term Average	500	3
Teviot Creek Dam	Historical Quarterly Average (when available) Steady-state simulation – Long-term Average Prediction simulation – Long-term Average	150	2
Lake Elphinstone	Approximate Fixed Stage - 4	150	2

As discussed in SLR (2023) conceptualisation report, the infrequency and temporal nature of observed surface flow in the Isaac River reported during Project fieldwork suggests that there is no groundwater baseflow to the Isaac River, either onsite, associated with onsite tributaries (Hill Creek and Ti-Tree Creek) or from upstream sources within the catchment area. In order to be consistent with the conceptualisation, zero baseflow for Isaac River was used as a target during the calibration process. Simulated baseflow occurs when the water table exceeds the minimum elevation assigned to a river cell. The minimum elevation for river cells representing the Isaac River was assigned based on LiDAR (i.e. extending from the northeastern boundary of the Burton Mine leases to the downstream outlet of Burton Gorge Dam to the Isaac River). The minimum river elevation was based on SRTM toward the eastern and western model boundaries where LiDAR was not available. No offset was applied to the SRTM surface elevation data used in the RIV package.

The water dams were assigned stage heights based on available surface water monitoring data.

River conductance is defined in MODFLOW as the hydraulic conductivity of the riverbed materials (K_v) divided by the vertical thickness of the riverbed materials, multiplied by the area (width times the length) of the river in the cell. The riverbed K_v for each surface water feature was adjusted during the calibration process.

The river width for Isaac River was assumed to be fixed in the model. The river width was estimated using aerial photography. Riverbed thickness for the Isaac River was assigned based on hand augering investigations at New Lenton. Riverbed thickness and width for the dams and lakes in the model were estimated based on the overall geometry of each feature, based on aerial photography. The river lengths were calculated as length of the river in the model cells. Therefore, the river conductance is variable due to the non-constant spatial discretisation in each of the model river cells.

2.1.5.2 Recharge and Evapotranspiration

The dominant mechanism for recharge to the groundwater system is through diffuse infiltration of rainfall through the soil profile and subsequent deep drainage to underlying groundwater systems. Diffuse rainfall recharge to the model was represented using the MODFLOW-USG Recharge package (RCH).



The starting values adopted in the calibration process were derived using LUMPREM2, which is a soil moisture store model developed by Watermark Numerical Computing (Doherty, 2021). LUMPREM2 was built to complement a groundwater model. It uses daily rainfall as its input and supplying groundwater recharge as its output. Recharge is accumulated over user-defined lengths of time (i.e., groundwater model stress periods).

LUMPREM2 provides basic simulation of water balance within the unsaturated zone, with inputs and outputs that include rainfall, irrigation, evapotranspiration, runoff, recharge and macropore recharge. For this work, the LUMPREM2 model used daily rainfall and potential evaporation to simulate water movement in the unsaturated zone and generated a time series of recharge rates. Daily rainfall and evaporation data were obtained from the Scientific Information for Land Owners (QLD Government SILO, 2023) point data using the location (Latitude: -21.60, Longitude: 148.15).

Figure 2-3 shows the conceptual model on which the LUMPREM2 numerical model is based. LUMPREM2 has two stores, the upper store simulates processes in the plant root zone. It receives water from rainfall and loses water through the vegetation extraction and drainage to the lower store and micropore drainage, the latter only occurring when the upper store is full. The lower store simulates processes below the plant root zone and above the water table. The groundwater recharge is calculated as the sum of drainage from the lower store, overflow from the lower store and macropore recharge from the upper store (Watermark Numerical Computing, 2021). That is, simulated groundwater recharge only occurs when there has been sufficient rainfall to fill either the upper store or the lower store, with higher relative rates of simulated recharge occurring when rainfall has been sufficient to fill the lower store.

Two equations are included in the LUMPREM2 model to establish the relationship between the evaporation and drainage rate and the volume of water stored within the soil moisture store. Further details about the LUMPREM2 model and the equations used are provided in the manual (Watermark Numerical Computing, 2021).

LUMPREM2 parameter 'ks_br' which is the saturated hydraulic conductivity used in the LUMPREM2 model was set to 1.9 m/day. 'Gamma_br' which is the parameter determining the rate of evaporate versus stored water relationship, was set to 1.5. 'M', the parameter determining the rate of drainage versus stored water relationship was set to 0.3. The volume of the lower soil moisture store was set to 100 mm and volume of upper soil moisture store was set to 15 mm.

The daily recharge output by the LUMPREM2 model is compared against the actual daily rainfall in **Figure 2-4**.



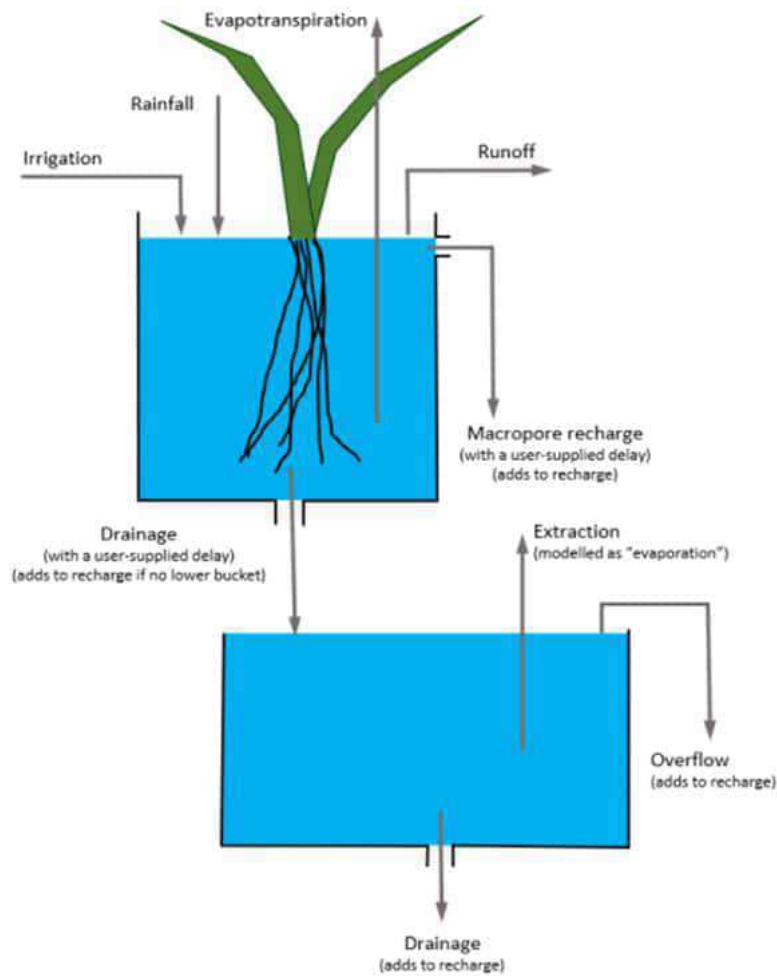


Figure 2-3 The LUMPREM2 Conceptual Model (from LUMPREM2 Manual, 2021)

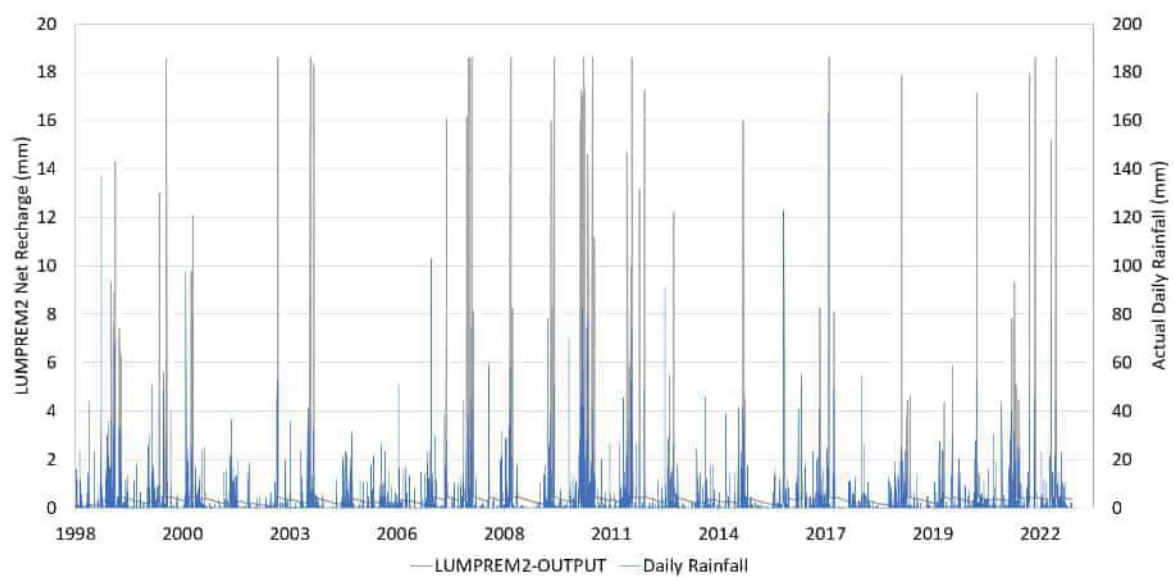


Figure 2-4 LUMPREM2 Recharge and Actual Rainfall



Spatial variability in recharge was simulated by dividing the model area to multiple recharge zones. The recharge zones were established based on surface geology and a factor was applied to the net recharge values output by LUMPREM2, for each zone. The model included 6 recharge zones, as presented in **Figure 2-2** and listed below:

- Highly Productive Alluvium near site;
- Eluvium near site;
- Floodplain Alluvium;
- Permian Regolith;
- Triassic Regolith; and
- Isaac River.

Recharge rates for spoil material were applied as independent zones for each pit to reflect the variability in material properties.

The recharge factor for each of the zones was adjusted independently during the calibration with upper and lower bounds set based on the conceptual hydrogeological model.

The MODFLOW Evapotranspiration (EVT) package was used to simulate evapotranspiration from the groundwater system. The model area was divided to 3 EVT zones based on vegetation mapping. No EVT was applied where surface water lakes were simulated. The EVT zones in the model were:

- Zone 1: Riparian zone along Isaac River;
- Zone 2: Forest – mid to high density; and
- Zone 3: Shrub & bare land surface.

Evapotranspiration was represented in the upper most cells of the model to an extinction depth that was adjusted within zone-specific bounds during the calibration. An average rate of evapotranspiration was set based on the BOM Evapotranspiration estimate map, for which a factor was calibrated based on each zone.

Recharge and EVT were used to represent the interaction between the surface water and groundwater system along the Isaac River. Groundwater recharge due to rainfall derived streamflow was represented using an additional multiplier, applied to the Isaac River recharge zone for stress periods where the LUMPREM2 net recharge output exceeded 0.5 mm/day. The factor applied for these high rainfall periods was adjusted during the calibration period. EVT cells with a greater extinction depth were used on either side of Isaac River to simulate the removal of water to a depth consistent with deep-rooted vegetation in the riparian zone.

2.1.5.3 Mining

The MODFLOW-USG Drain package (DRN) was used to simulate mine dewatering in the model for New Lenton, Burton Mine and adjacent historically mined pits to the south (formerly part of Burton Mine). Drain boundary conditions allow a one-way flow of water out of the model. When the computed water level drops below the stage elevation of the drain, the drain cells become inactive. This is an effective way of theoretically representing the removal of water seeping into a mine over time, with the actual removal of water being via evaporation and sump pumping. A nominally high conductance of 100 m²/day was applied to the drain cells to fully desaturate the relevant layers during mining.



Drain cells were applied in all layers from surface to the base of the layer representing the lowest mined seam (Burton/Rider or Leichhardt/Vermont seams) at each pit, and progressed quarterly (where temporal discretisation allowed this) or annually according to the schedule shown in **Figure 2-5**. Drain cells were held active for a period of 2 years before the simulation of subsequent backfilling with spoil or mine water storage.

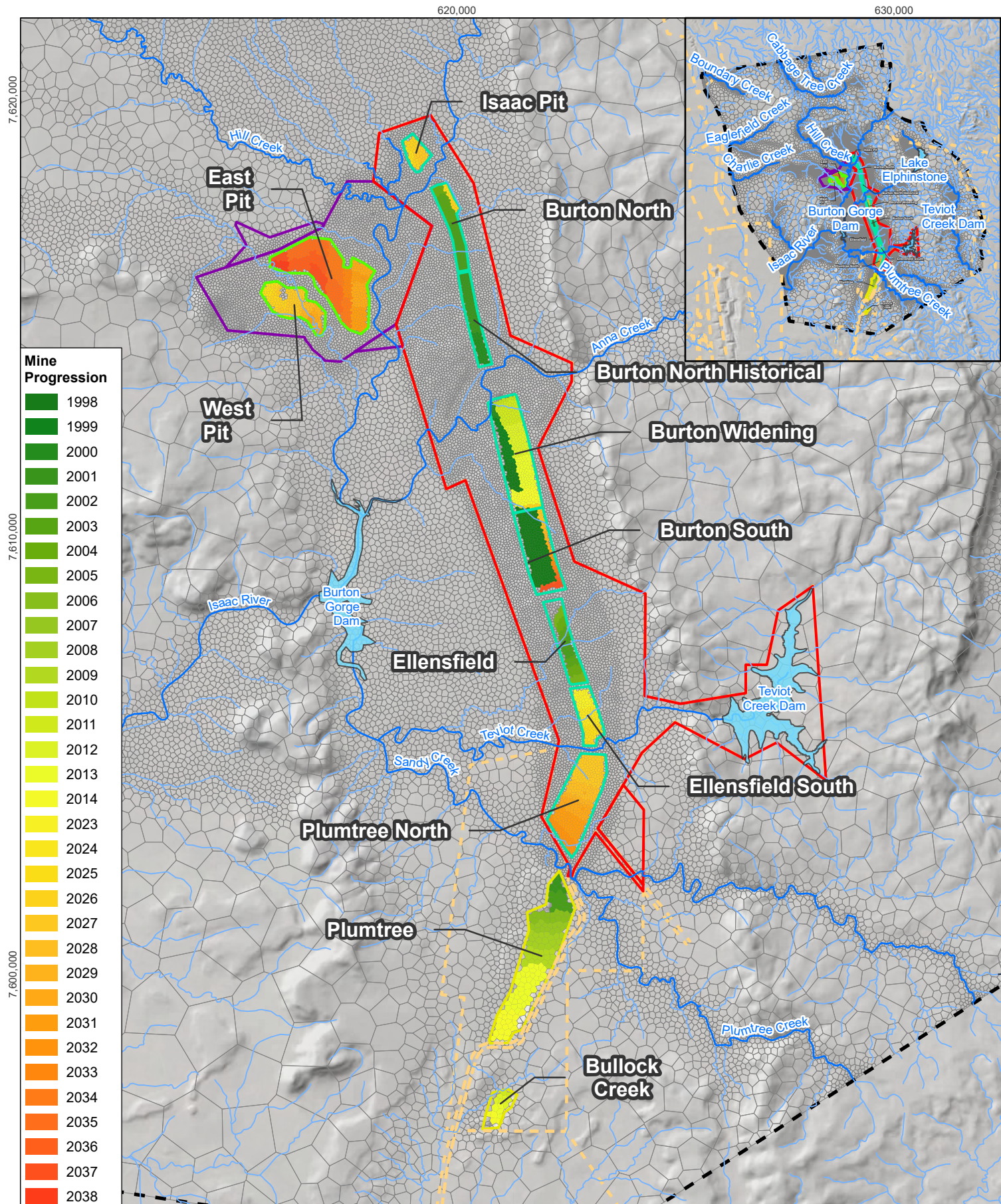
In the calibration model, the drain cells applied for the Burton mine (including Plumtree and Bullock Creek pits, formerly part of Burton Mine) were interpolated from limited mine schedule information and Google Satellite aerial photography. In the predictive model, drain cells at New Lenton and Burton were applied based on the annual future mine progression plans provided by LVJ. The modelled progression and timing of mining is presented in **Figure 2-5**.

Mackie Environmental Research (MER) (2009) indicates that spoil and waste rock are more permeable than the undisturbed strata. Backfilling open cut mine areas with spoil was simulated using the MODFLOW-USG Time-Variant Materials (TVM) package. The model cell properties were updated to spoil properties guided by operational mine plans and historical aerial photography. Hydraulic conductivity and storage properties applied to the spoil were adjusted during the calibration process, within the bounds provided in **Appendix B**.

Where mine pits were not backfilled and have been used for water storage or allowed pit lakes to form, the TVM package was used to assign high horizontal and vertical hydraulic conductivities (1,000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, storage coefficient of $5.0 \times 10^{-6} \text{ m}^{-1}$), to simulate free water movement within the cells representing voids.

The adjacent historic pits formerly considered part of the Burton Mine (Plumtree and Bullock Creek) were assumed to be mined to the base of the Leichhardt/Vermont seam and backfilled to the current landform provided by LVJ, approximately two years after the completion of mining at each pit. In the absence of further information, the progression of drain cells and changes to cell properties with the TVM package to represent backfilling and residual voids (as described above) were applied according to this assumption.





 0 1 2 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:115,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: RB

LEGEND

-  River
-  Watercourse and Drainage
-  SW Lake/Dam
-  Model Domain
-  Model Grid
-  Surrounding Mine
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

MODELLLED MINE PROGRESSION

FIGURE 2-5

2.1.5.4 Water Storages and Tailings

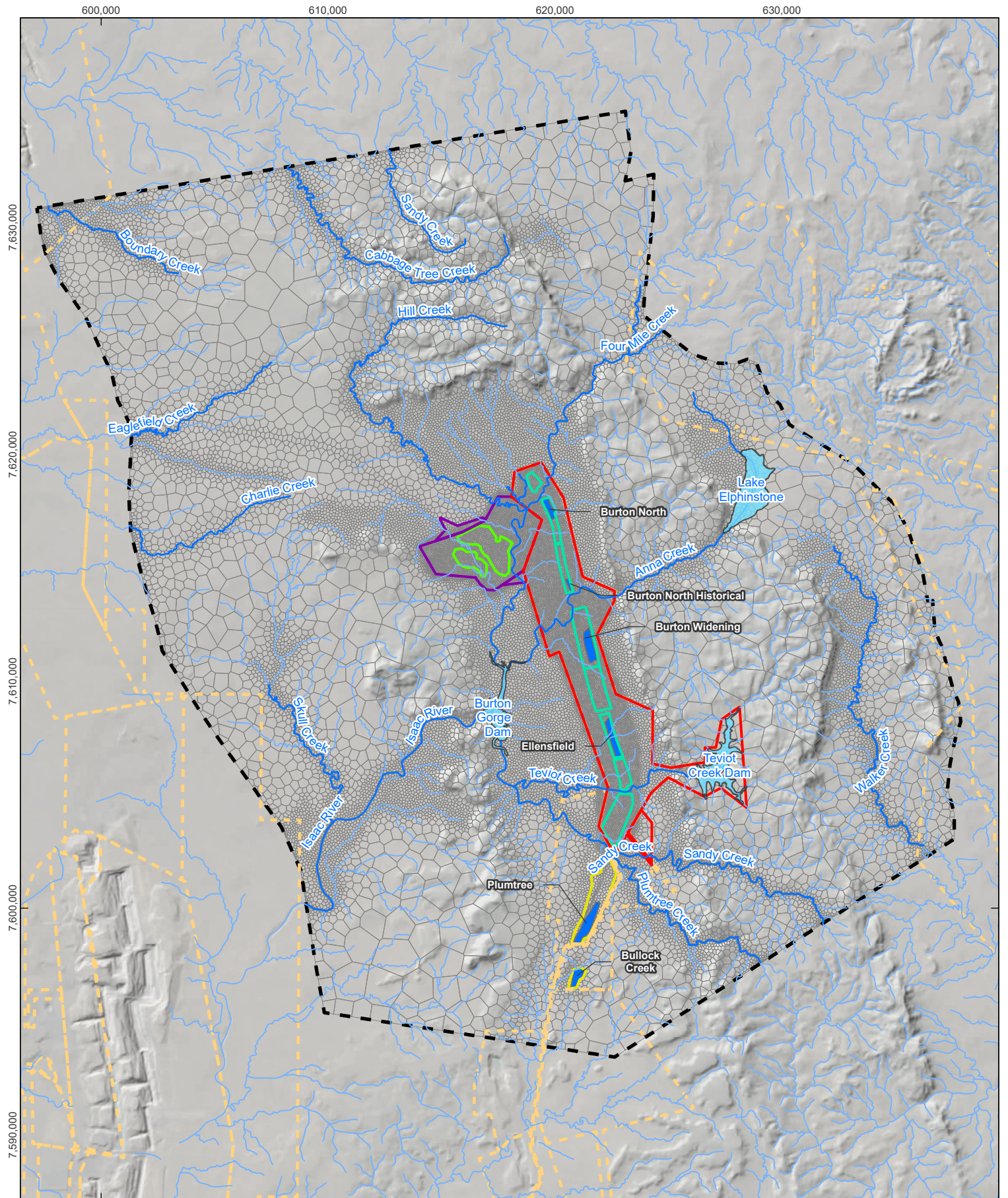
There are several water storage facilities across the Burton site. The locations of the water storages are shown in **Figure 2-6**. The main mine water storage facilities were replicated in the model using the MODFLOW-USG Constant Head (CHD) package, which allowed water levels to vary with time. For the calibration model, quarterly averages of the available historical levels for storages (provided by LJV) and surface levels from available LiDAR were used for the interpolation of surface water levels from the cessation of mining at each pit to the end of calibration. The levels applied using the CHD package are provided in **Table 2-3**.

Table 2-3 Representation of Historical Water Storages in CHD Package

Water Storage Location	Historical CHD Start Date	Historical CHD End Date	Historical CHD Start Level (approx. base of pit) (mAHD)	Historical CHD End Level (mAHD)
Burton North	01/01/2006	01/01/2023	220.0	236.2
Burton North Historical	01/01/2004	01/01/2023	285.0	294.9
Burton Widening	01/01/2014	01/01/2023	131.7	162.2
Ellensfield	31/12/2000	01/01/2023	240.0	285.6
Plumtree	01/07/2012	01/01/2023	286.0	294.8
Bullock Creek	01/04/2013	01/01/2023	300.0	304.9

Once a model cell has been prescribed a head condition using the CHD package, it is removed from the regular active flow cells in the model. To allow the simulation of prescribed heads for water storages during history-matching, followed by active flow modelling in the same cells in the predictive period, the MODFLOW-USG Transient IBOUND (TIB) package was used to specify transient boundary conditions. The TIB package allows specification of regular active flow cells in each stress period and facilitates the re-activation of cells previously assigned a head boundary condition.





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: RB

LEGEND

- River
- Watercourse and Drainage
- SW Lake/Dam
- Water Storage Location
- Model Domain
- Model Grid
- Burton Mining Lease
- New Lenton Mining Lease
- Surrounding Mine
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

BURTON MINE WATER STORAGE LOCATIONS



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FIGURE 2-6

2.2 Model Calibration

Automated calibration utility PESTPP-IES (White, 2018), which is an iterative ensemble smoother, was used to match the available groundwater level data. The job of an ensemble smoother is to assimilate data in a “batch” sense. To accomplish this, PESTPP-IES begins the model parameterisation process with a collection of random parameter fields (i.e. realisations) drawn from the prior parameter probability distribution. Through a series of iterative adjustments, PESTPP-IES modifies the parameter values in the realisations that make up the ensemble to satisfy calibration constraints.

An initial ensemble size of 350 realisations was used and the PESTPP-IES calibration was run for 7 optimisation iterations. The results presented in this section are from the realisation that yielded the lowest simulated error. However, where possible, results have been provided for all 250 realisations resulting from the final optimisation of the ensemble.

2.2.1 Calibration Dataset

PESTPP-IES and manual calibration were used to match the available transient water level data and conceptualised baseflow targets. The groundwater levels recorded between January 1998 to June 2023 were used for the model calibration. In all, target water levels were established for 73 bores including:

- New Lenton bores: 887 groundwater level observations from 27 bores.
- Burton bores: 813 groundwater level observations from 31 bores.
- Other bores: 118 groundwater level observations from 15 bores, including government and historical mine-monitoring bores.

Groundwater targets were selected where valid information on bore construction or geology information was available for the site including as documented in JBT (2016). The locations of the calibration bores are shown in **Figure 2-7**.

Transient water level targets were pre-processed using the PEST (Doherty, 2018) observation list processor utility (OLPROC). OLPROC converts transient field data such that each observation is expressed as displacement from the initial measurement at each location. The revised observation data set therefore comprised two groups of calibration targets:

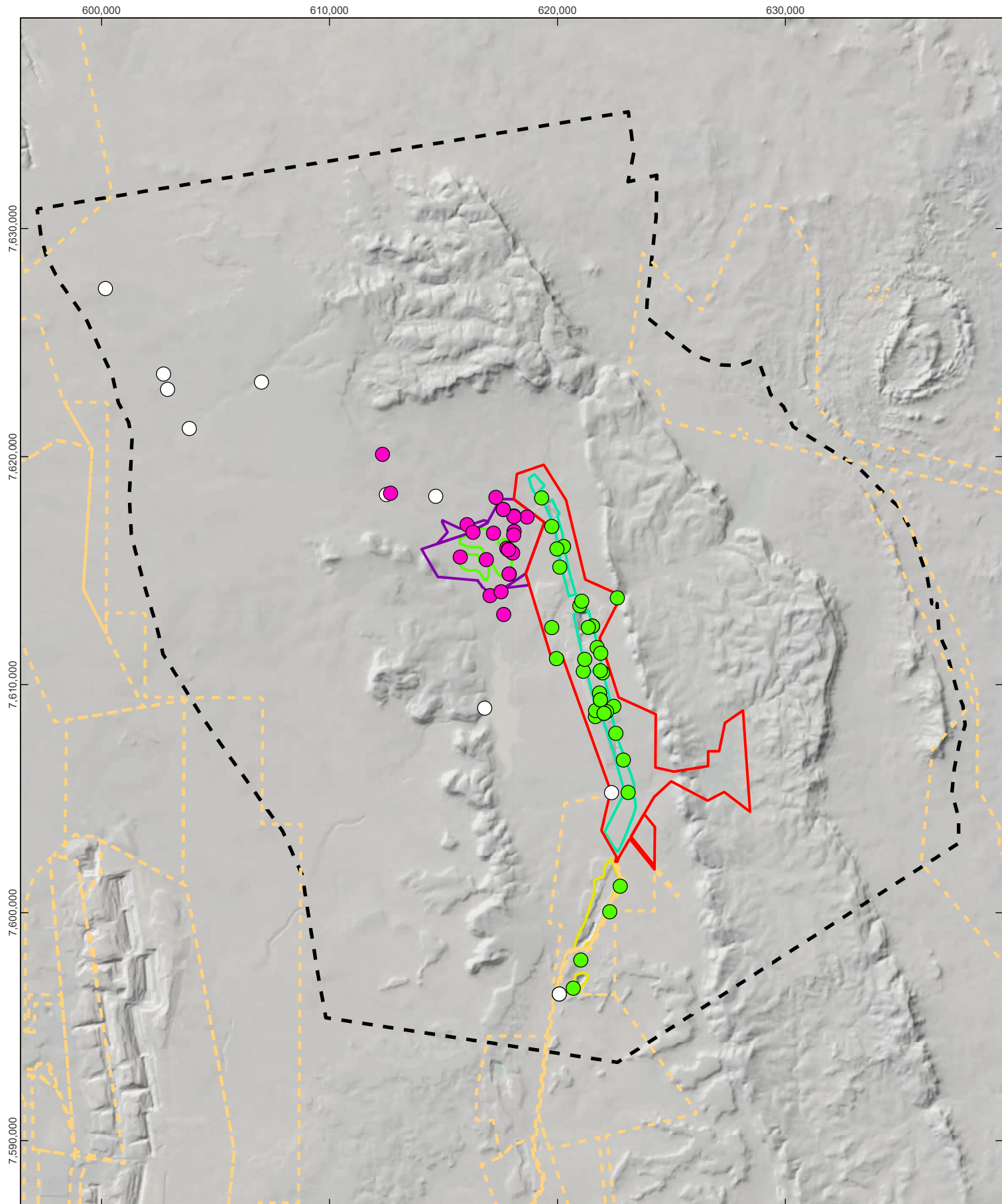
- Group 1: The initial water level observation of every bore included in the calibration; and
- Group 2: Subsequent deviations (increase and or decrease) in water levels from the initial observation at each bore, measured over time.

The justifications for these groupings are:

- For the first group, PESTPP-IES should be guided to replicate the water level elevations observed at the targets.
- For the second group, PESTPP-IES should be guided to replicate the magnitude in response, i.e. deviations, to stressors as seen in the hydrographs.

The calibration data set also included 66 zero-flux baseflow targets (average baseflow rate in each stress period) for the section of Isaac River within 3 km of the mine pits, with the purpose of guiding PESTPP-IES toward the absence of baseflow as conceptualised.





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 25-Jul-2024
 Drawn by: RB

LEGEND

Calibration Data Point

 Burton

 New Lenton

 Other

 Model Domain

 Surrounding Mine

 Burton Mining Lease

 New Lenton Mining Lease

 Burton Pit Extent

 New Lenton Pit Extent

 Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

CALIBRATION DATA POINTS



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FIGURE 2-7

For each bore, the observations in Group 1 were given an equal weight to the overall weight of observations in Group 2 to help PESTPP-IES calibrate to both the absolute water levels and the dynamic responses to stresses in the model.

After an initial run of the PESTPP-IES calibration, it was evident that the calibration had focused on matching observed data in a few bores that had significant contribution towards the objective function (Φ). Therefore, PEST (Doherty, 2018) weight adjustment utility (PWTADJ1) was used to refine observation weights such that the contribution by each bore to the overall objective function (Φ) is balanced. The baseflow targets were also assigned a weight by PWTADJ1 such that the contribution by simulated baseflow to the objective function was relatively equal to the contribution of each bore.

Details on each of the observation points and their residuals are presented in **Appendix C**.

2.2.2 Parameterisation

The hydraulic properties (i.e., horizontal, vertical conductivity, specific yield, and specific storage) for each hydraulic parameter zone were adjusted during the calibration to provide best match between the measurements and the model simulated levels. Recharge rates, riverbed vertical conductivity and evapotranspiration depths and rates were also refined during calibration. The range of parameters assessed during calibration have been included as **Appendix B**.

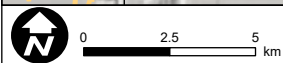
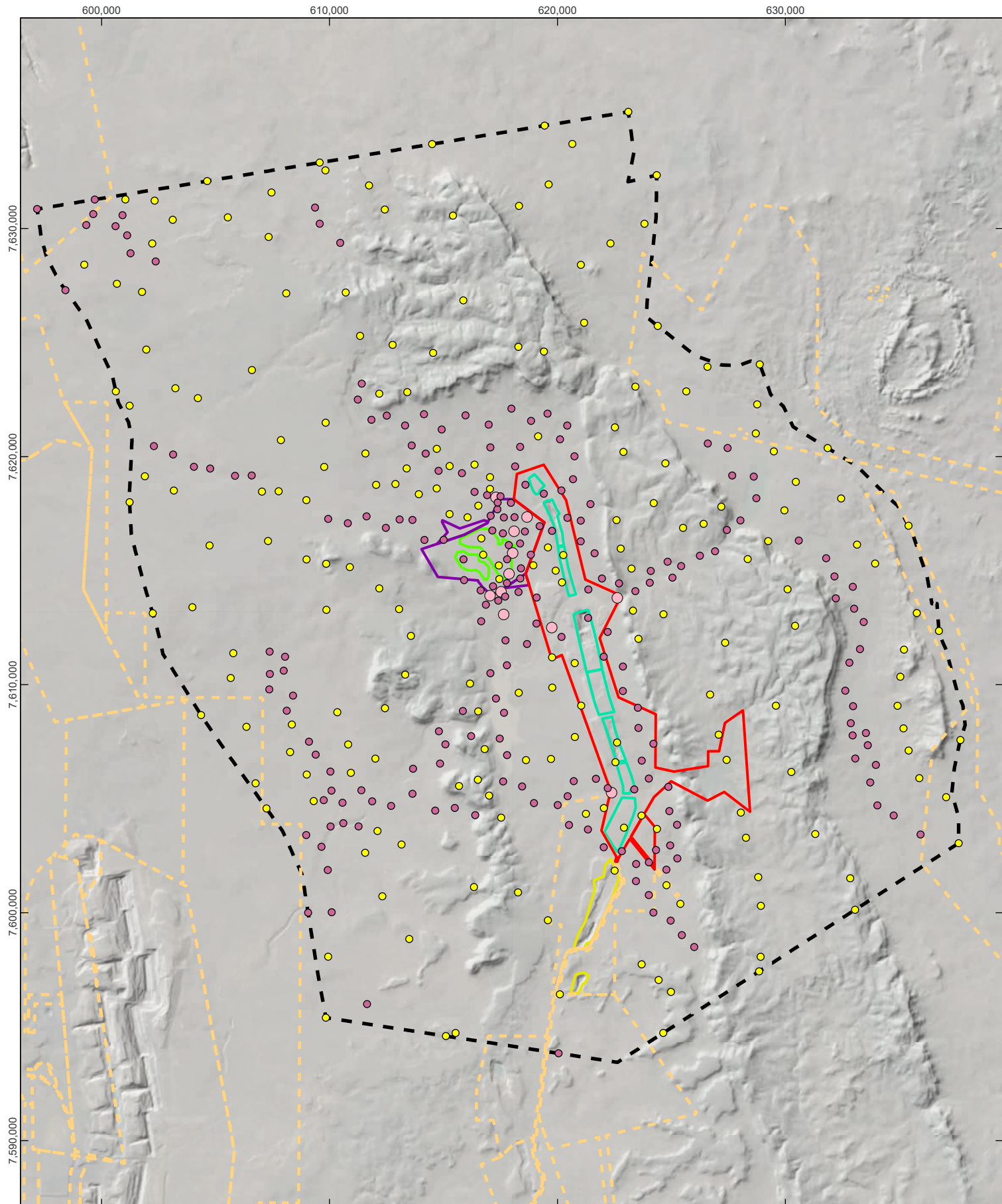
As a part of the calibration, pilot points were introduced in Layer 1 of the model to capture spatial variability in the hydraulic properties of the alluvium.

The location of the pilot points is shown in **Figure 2-8**. Pilot points were set within both the alluvium and regolith in Layer 1, with point locations generated by performing Delauney triangulation between calibration target locations in the alluvium and placing pilot points at the centre of the generated triangles derived using triangulation. This method allows PESTPP-IES to control the parameters between targets as it is these parameters that can influence the gradient between bores. Additional pilot points were manually placed between some targets, around the edges of the model domain, and at the target locations. This was done due to the heterogeneity of the alluvium in the model potentially being difficult to capture with the number of pilot points generated by triangulation alone and to assist the kriging process.

The PEST PLPROC utility (Doherty, 2018) was used to interpolate between the pilot point values and create a surface across the model domain for a targeted model parameter. This surface of model parameter values is then interrogated for values at the model cell centres to provide a value at each model cell. A total of 415 pilot points were used to assign the hydraulic parameters to Layer 1, 212 within the alluvium and 203 in the regolith. Due to the minimal thickness (1 m) and absence of observation points in the regolith of Layer 1, the pilot points in the regolith were assigned with lower spatial resolution.

PEST pilot point covariance utility (PPCOV) (Doherty and Hunt, 2010) was used to generate covariance matrix files for the pilot points based on spatially uniform variograms. An exponential variogram was used for all pilot point parameters. The variogram requires specification of a 'range variable', that is approximately equal to a third of the range for an exponential variogram. A range variable of 3000 was applied (roughly 2.5 times the average distance (m) between pilot points). The anisotropy ratio was set to 1 for the application of an isotropic variogram model. The covariance matrix files created using PPCOV were then used for regularisation during the calibration process.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 25-Jul-2024

Drawn by: RB

LEGEND

- Calibration Bores - Alluvium
- Regolith
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Surrounding Mine
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PILOT POINTS IN MODEL LAYER 1



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FIGURE 2-8

2.2.3 Calibration Statistics

An industry-standard approach for assessing the calibration of a model is to analyse statistics related to the calibration. One way of doing this is by comparing the simulated differential (i.e. error) between the simulated and observed (measured) water levels, which is often expressed as the root mean square (RMS). The RMS value is calculated by taking the square root of the mean of the squared differences between the simulated and observed water levels. In accordance with Barnett et al. (2012), the root mean square (RMS) is one of the available options for calculating goodness of fit.

Another option for measuring the accuracy of fit is the scaled root mean squared error (SRMS). SRMS is computed by dividing the RMS by the range of measured heads and expressing it as a percentage. When the goal is to fit historical measurements of water levels, SRMS provides a valuable indicator of the accuracy of fit (Barnett et al., 2012). This is primarily due to its ability to compare errors in the model against the total changes in the system. If the errors are small relative to the total change, they can be considered negligible.

The PESTPP-IES ensemble calibration process resulted in 250 calibrated realisations. The calibration statistics presented in the section of the report are for the best calibrated realisation.

RMS error calculated for the best calibrated model is 13.8 m. The total measured water level change across the model domain is 128.7 m; therefore, the ratio of RMS to the total measured water level change (SRMS) is 10.7%. While there is no universally recommended SRMS error guidelines, the Australian Groundwater Modelling Guidelines suggests that setting SRMS targets as 5 or 10% may be appropriate in some circumstances (Barnett et al, 2012).

Figure 2-9 presents the observed and simulated groundwater levels graphically as a scattergram for the transient calibration (1998 to 2023). The overall transient calibration statistics from the best calibrated realisation are presented in **Table 2-4**.

Figure 2-10, Figure 2-11 and Figure 2-12 show the distribution of calibration residuals for all the bores included in the calibration, the New Lenton bores only and the Burton bores only, respectively. **Figure 2-10** indicates that in general the model tends to over predict groundwater levels, with residuals in the shallow layers of lower magnitude (± 10 m) and those exceeding ± 15 m over or underprediction confined to the RCM coal seam and interburden units (Layers 12 to 16).

Figure 2-11 indicates that the distribution of calibration residuals for the New Lenton observations is significantly narrower (± 15 m) than the overall distribution shown in **Figure 2-10**. The residuals for the alluvium bores at New Lenton are less than ± 1 m, indicating the model achieves a close match to observed water levels in the alluvium near the site. **Figure 2-11** indicates that overprediction up to 15 m in the New Lenton bores occurs primarily in the Permian units.

Figure 2-12 shows a relatively balanced distribution of calibration residuals across the Burton observations, with slight overprediction overall. The larger residuals occur primarily in the RCM coal seams and interburden units and can be attributed to bores in close proximity to the mine pits where limited information regarding historical mining was available. The simulated water levels in these bores are discussed in more detail in **Section 2.2.4**.



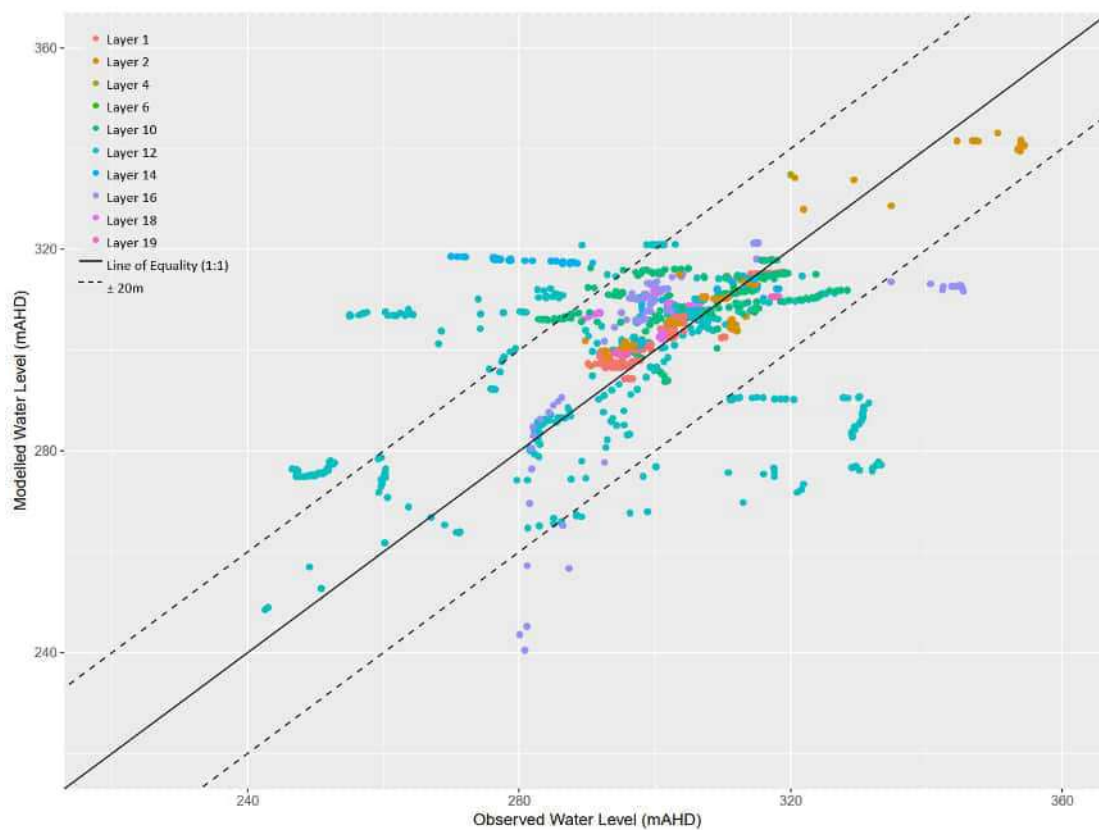


Figure 2-9 Calibration Scattergram – Modelled vs Observed Groundwater Levels

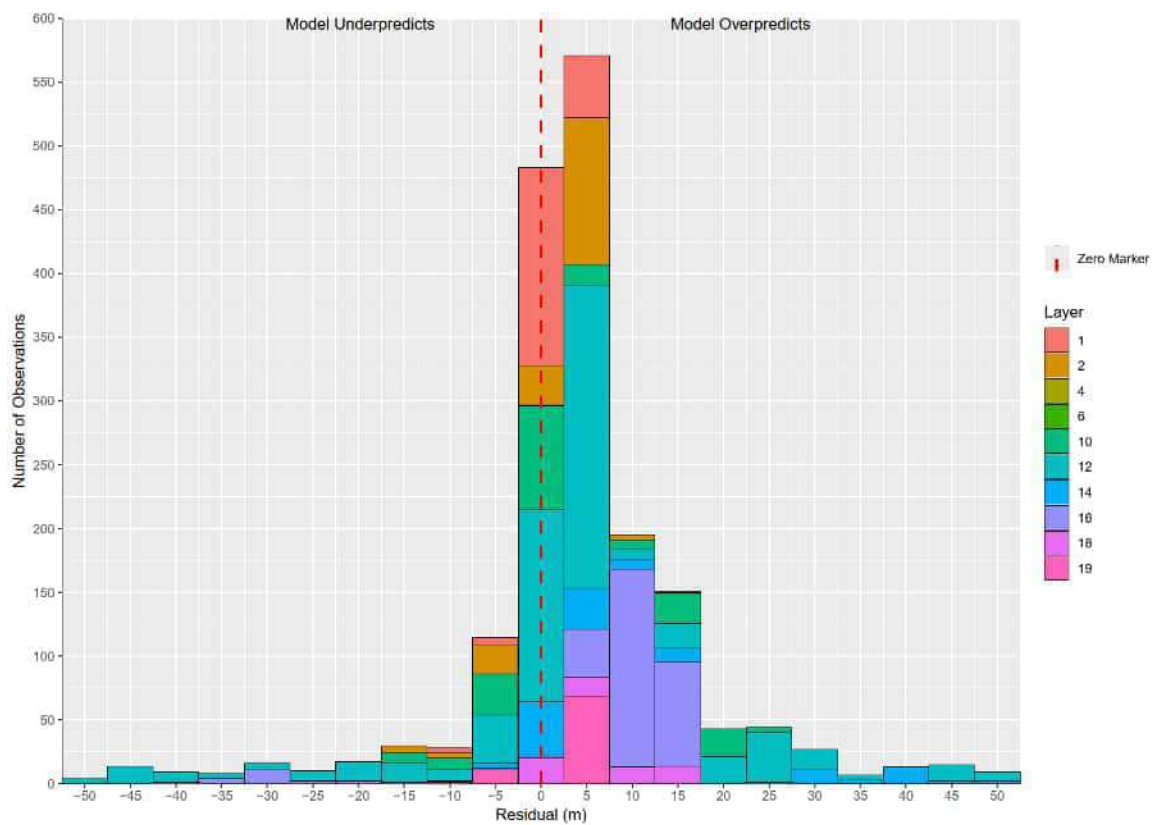


Figure 2-10 Calibration Residual Histogram (All Observations)



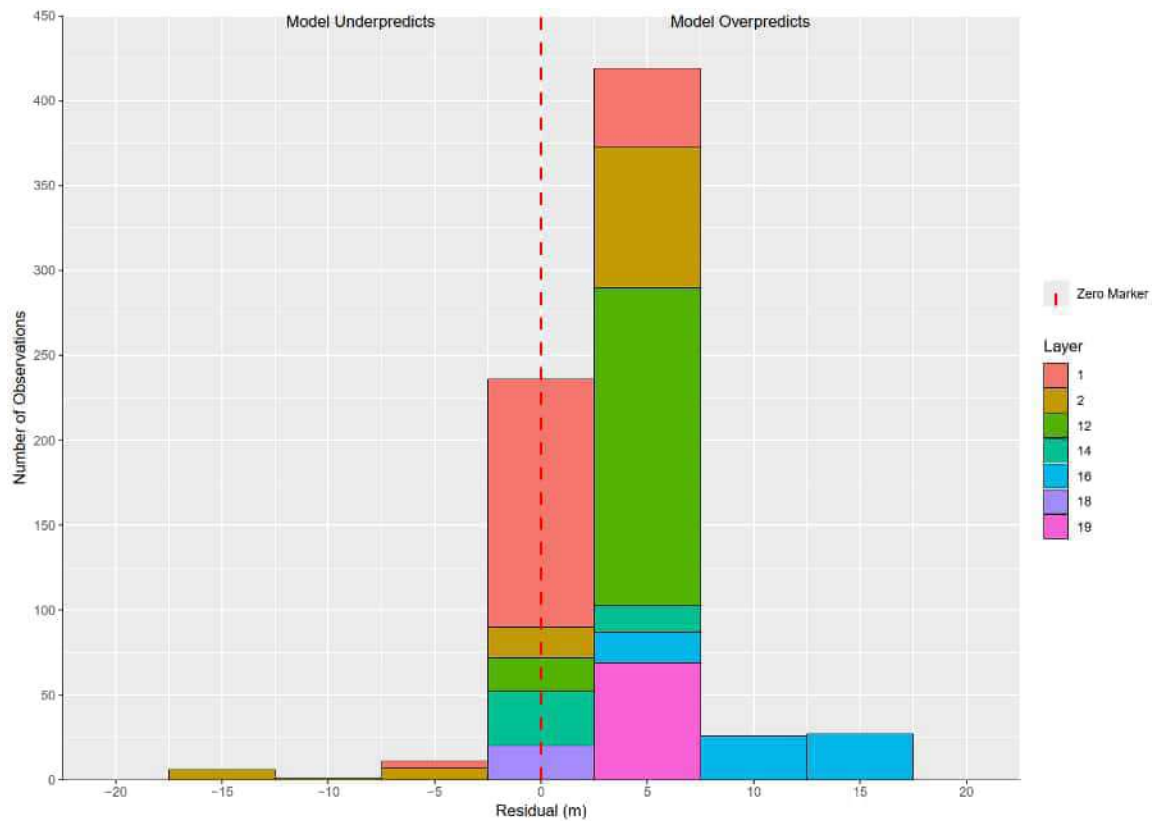


Figure 2-11 Calibration Residual Histogram (New Lenton Observations)

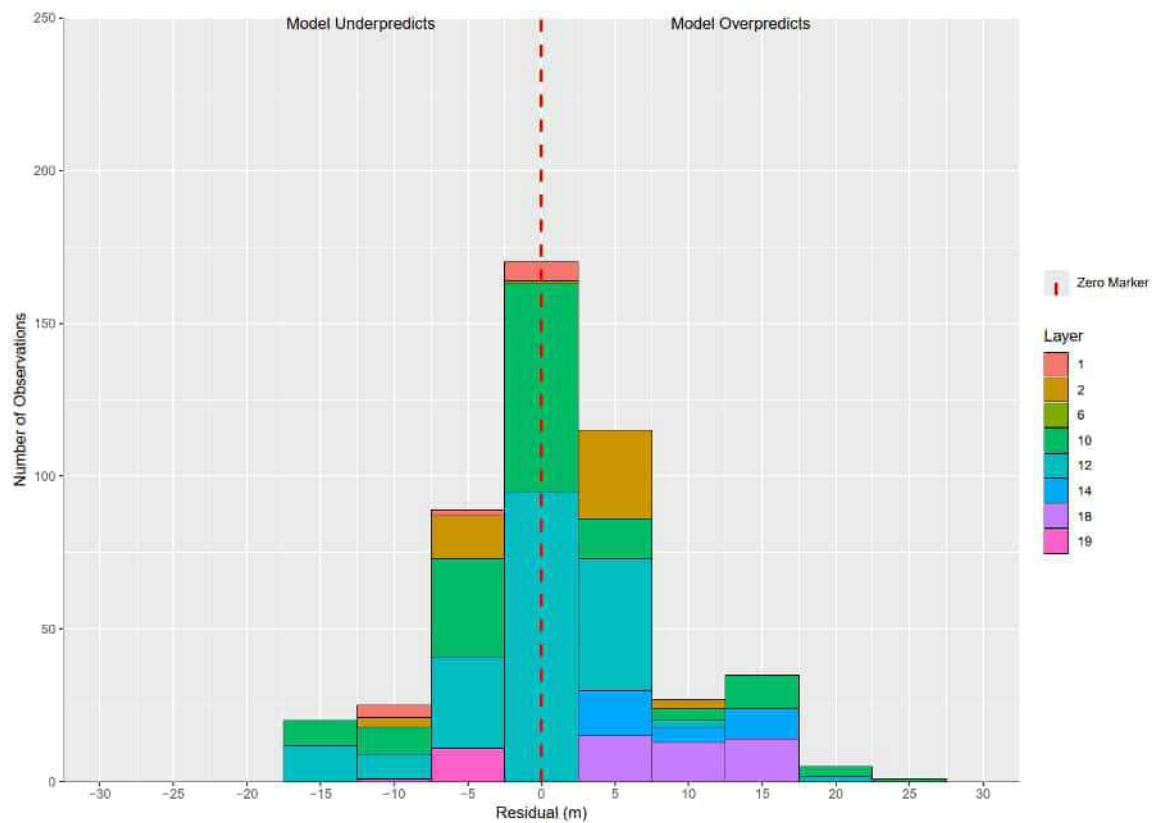


Figure 2-12 Calibration Residual Histogram (Burton Observations)



Table 2-4 Transient Calibration Statistics

Statistic	Value
Sum of Squares (SSQ) (m ²)	345731.2
Mean of Squares (m ²)	190.2
Total Number of Observations	1818
Square Root of Mean of Squares (RMS) (m)	13.8
Scaled Root Mean Square (SRMS) (%)	10.7
Range in Observations	128.7
Sum of Residuals (m)	7340.9
Mean Residual (m)	4.0
Targets within ± 2 m	381
Targets within ± 5 m	952
Targets within ± 20	1596

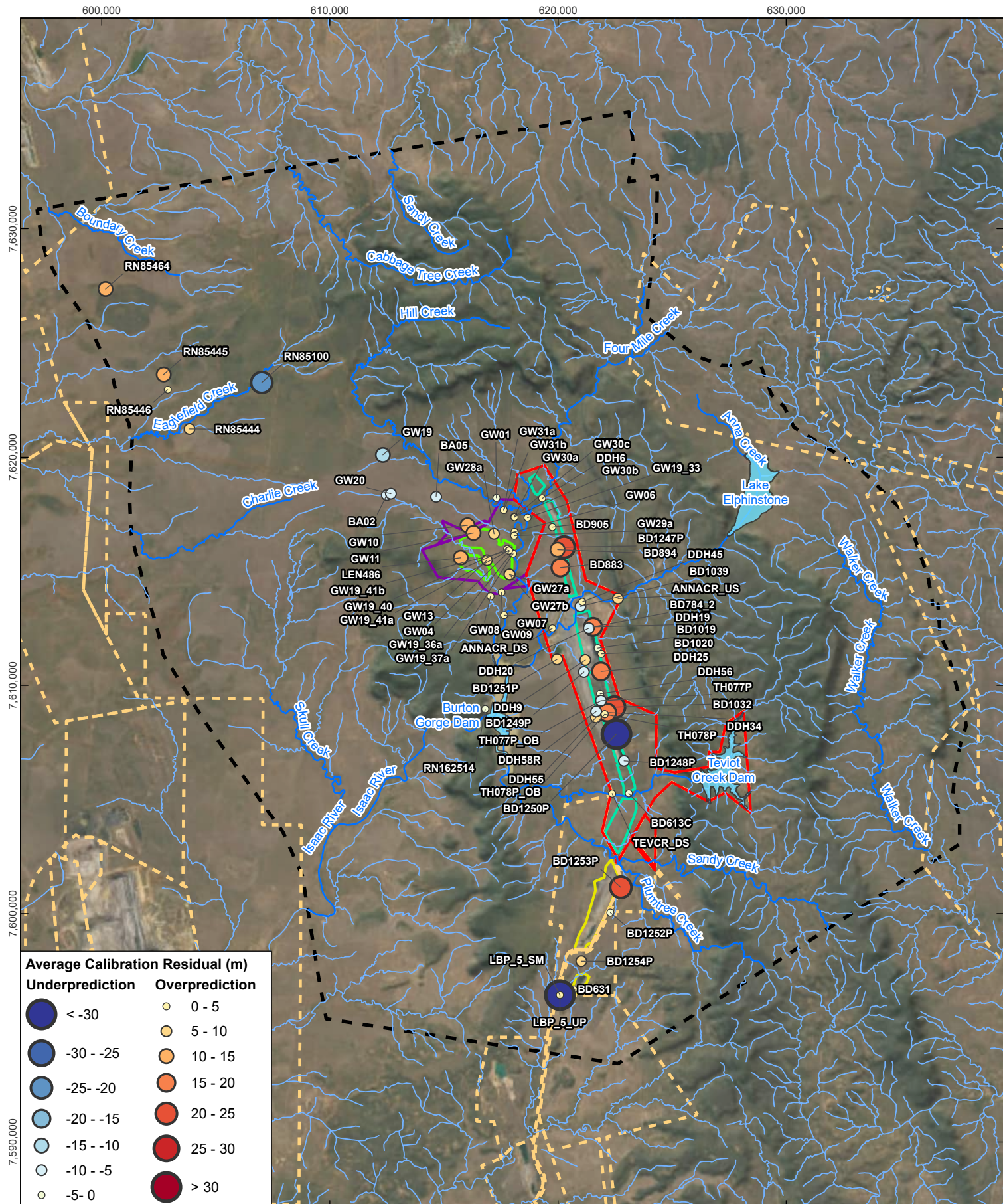
Table 2-5 shows the average calibration residual and absolute average residual for each model layer. A negative residual represents an under estimation of water levels, while a positive residual represents an overestimate. The spatial distribution of average residuals for each bore from the transient calibration is shown in **Figure 2-13** and **Appendix C**. The size of the bore symbol in **Figure 2-13** is proportional to the residual (i.e., larger residual has a larger symbol size). **Figure 2-13** shows regionally there is a good match between the observed and simulated groundwater levels. **Figure 2-14** and **Figure 2-15** show the spatial distribution of average residuals for the New Lenton and Burton observations, respectively.

Table 2-5 shows a general overestimation of water levels in most model layers across the model domain. Layers not included in **Table 2-5** indicate there were no measurements for the layer. The table shows Layer 14 (interburden between Burton/Rider Seam and Leichhardt/Vermont Seam) has the largest average residual and Layer 4 (uppermost Rewan layer) has the highest absolute average residual.

Table 2-5 Average Residual by Model Layer

Model Layer	Formation	Average Residual (m)	Average Absolute Residual (m)	Number of Observation Targets	Number of Bores
1	Alluvium & Shallow Regolith	0.98	1.90	214	11
2	Regolith & Basalt	1.53	4.38	184	16
4	Rewan (top)	-3.27	18.10	2	2
6	Rewan (middle)	0.86	0.86	1	1
10	Overburden (RCM)	3.60	7.30	202	8
12	Burton Rider Seam (RCM)	2.31	11.37	645	17
14	Interburden (RCM)	12.11	12.53	128	5
16	Leichhardt/Vermont Seams (RCM)	7.83	12.19	299	8
18	Underburden (RCM)	7.79	7.79	62	3
19	Coal Measures (FCCM)	3.26	5.33	81	2





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 25-Jul-2024
 Drawn by: RB

LEGEND

-  River
-  Watercourse and Drainage
-  SW Lake/Dam
-  Model Domain
-  Surrounding Mine
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

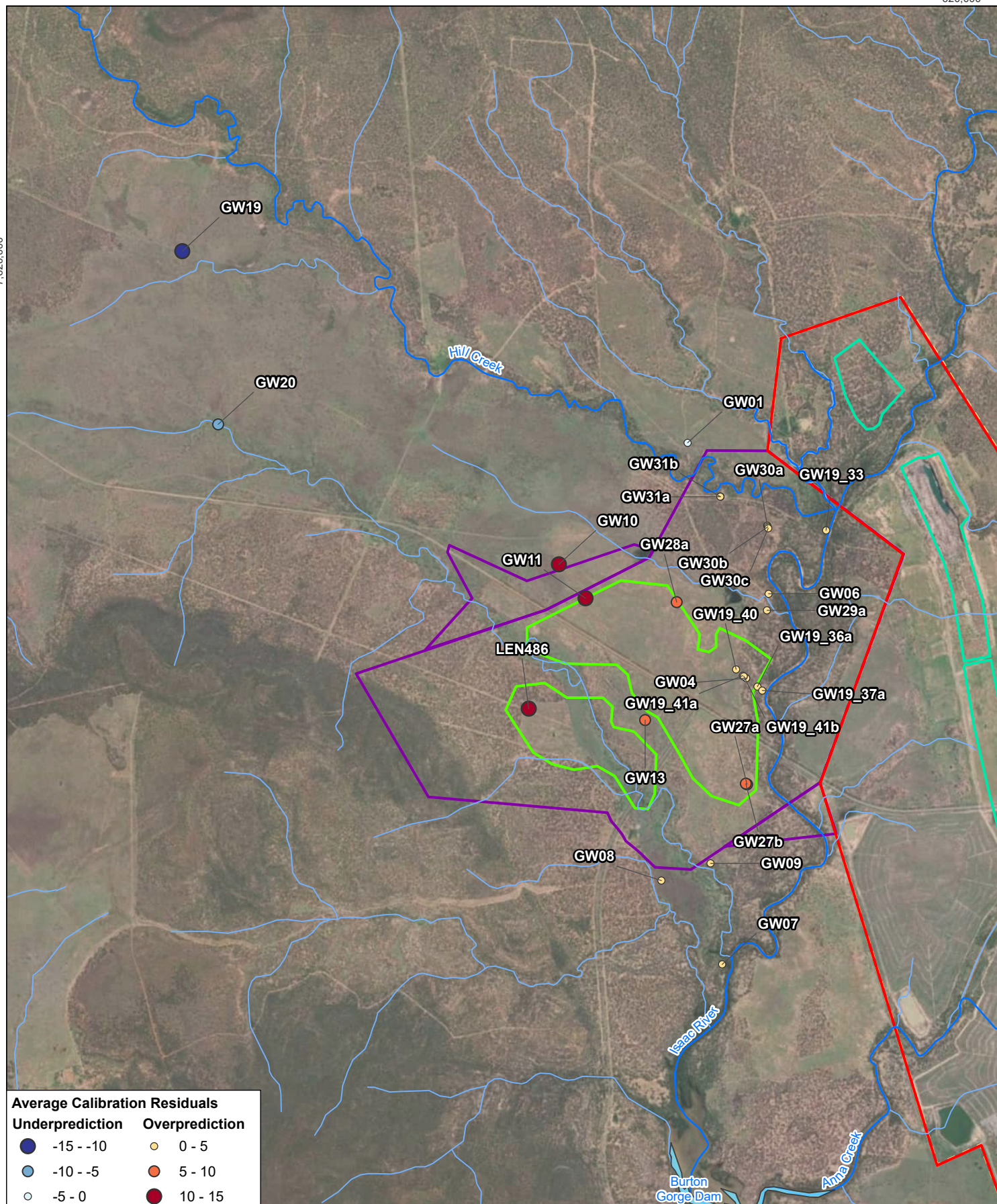
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AVERAGE CALIBRATION RESIDUALS (ALL OBSERVATIONS)



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FIGURE 2-13



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:50,000 at A4

Project Number: 620.31208.00000

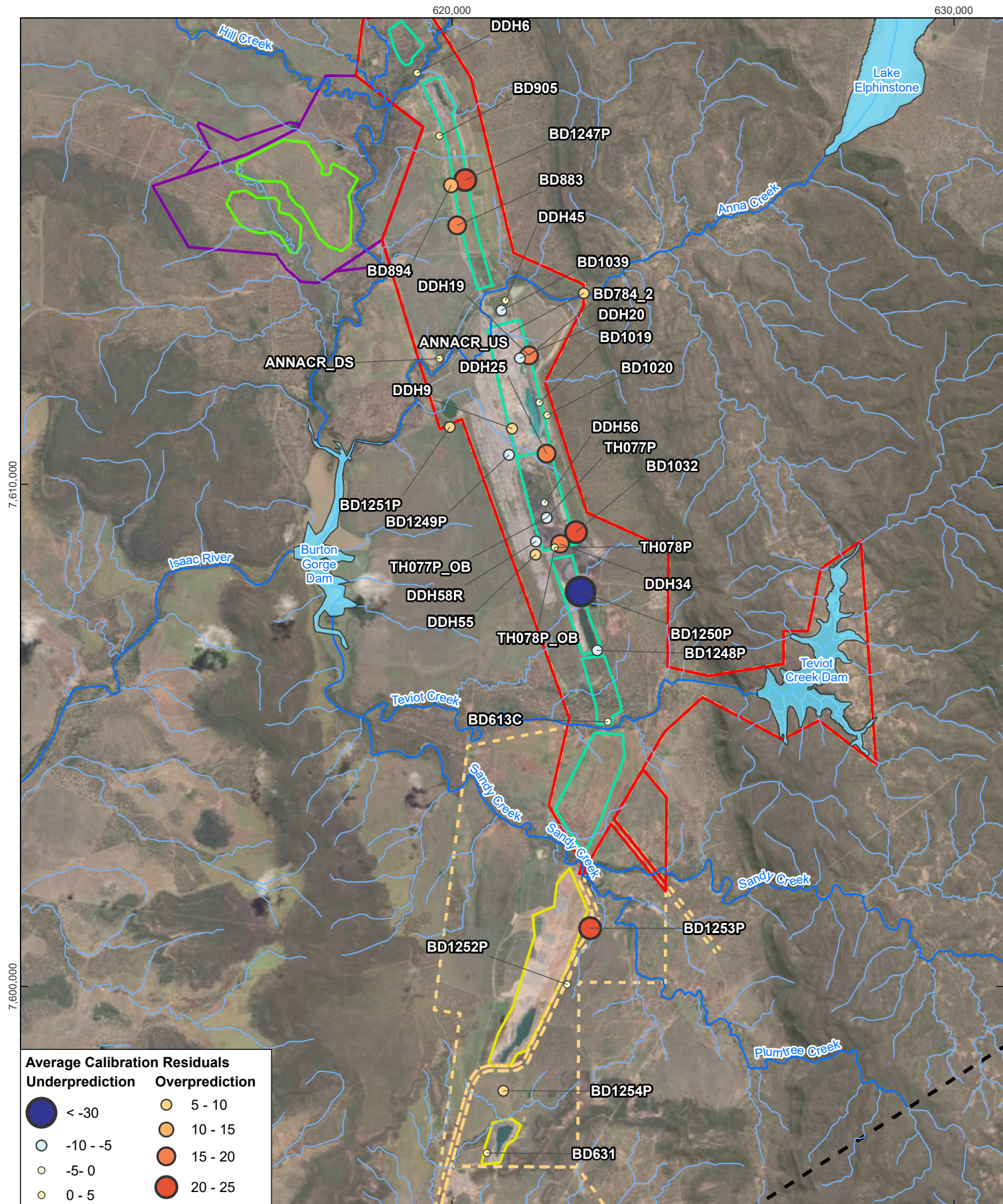
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Drawn by: AS



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FIGURE 2-14



Coordinate System: GDA2020 MGA Zone 55
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AVERAGE CALIBRATION RESIDUALS (BURTON OBSERVATIONS)



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FIGURE 2-15

As indicated in **Table 2-6**, there is an average overestimation of water levels in both the New Lenton bores and Burton bores. **Appendix C** shows the average calibration residual and absolute average residual for each calibration point.

Table 2-7 shows a summary of the residuals for the bores included in the calibration process that have the highest contribution to the error statistics for the calibrated model. The 11 bores detailed in the table contribute to 85% of the error in calibration (SSQ) listed in **Table 2-4**. A review of these bores indicated that the bore responded to historical stresses that could not be replicated in the model due to lack of information. The hydrographs for the bores listed in **Table 2-7** are discussed in more detail in **Section 2.2.4**.

Table 2-6 Average Residual by Site

Site	Average Residual (m)	Average Absolute Residual (m)	Number of Observation Targets	Number of Bores
New Lenton	4.88	5.27	887	27
Burton	3.74	12.54	813	31
Other	-0.27	11.48	118	15

Table 2-7 High Residual Bore Summary

Layer	Observation Bore	Average Residual (m)	Average Absolute Residual (m)	Number of Observation Targets
10	DDH25	17.40	17.40	40
12	BD1247P	20.78	21.46	54
	BD1248P	-7.95	10.06	63
	BD1250P	-35.90	35.90	53
	DDH16	37.60	37.60	39
	DDH19	17.42	17.42	27
14	BD1032	23.92	24.99	50
16	BD1252P	-3.07	13.38	27
	GW11	10.96	10.96	81
	LBP_5_SM	-30.74	30.74	14
	LEN486	13.24	13.24	80

2.2.4 Isaac River Baseflow

Figure 2-16 shows the simulated baseflow during the calibration period for the Isaac River, within 3 km of the mine pits. As shown in the figure, the peaks in baseflow correspond to variation in the base recharge rate output from LUMPREM2 as described in **Section 2.1.5.2**. The average baseflow for the calibration period is 0.02 ML/d. However, no baseflow is simulated in the Isaac River near the mine sites before 2010 and after the calibration period as the long-term average recharge is applied to the model.



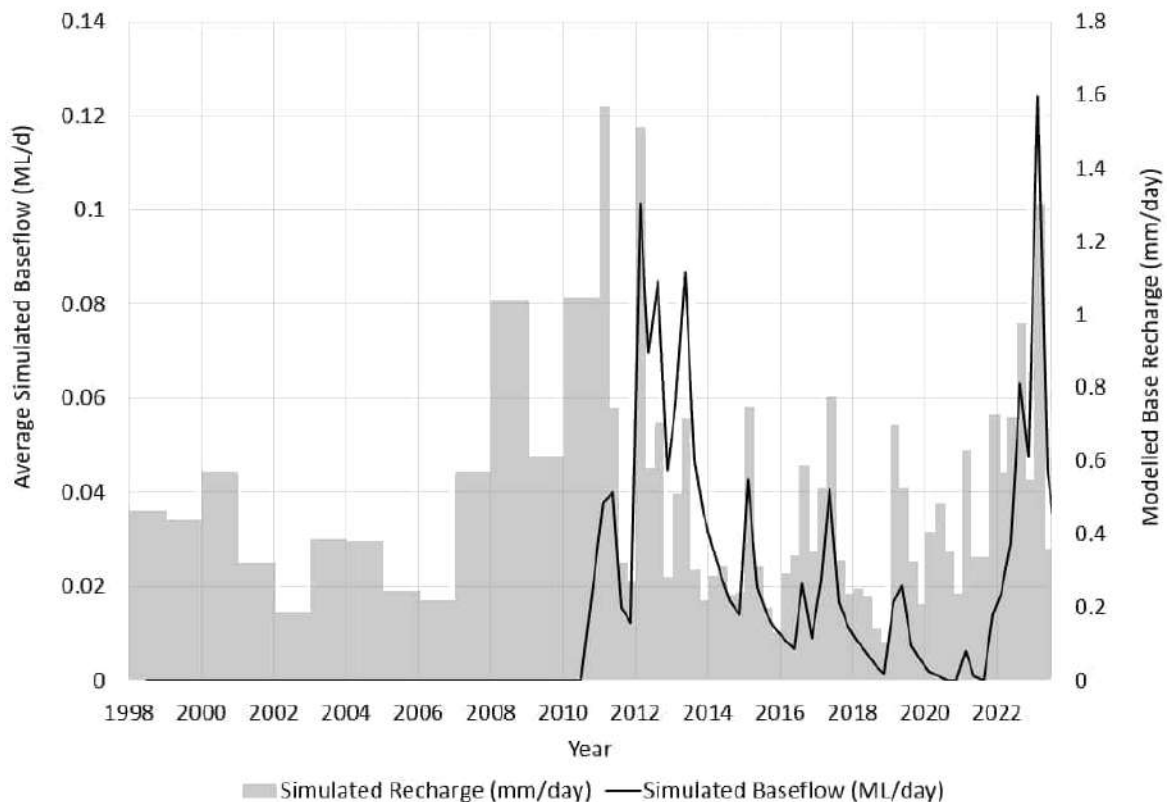


Figure 2-16 Calibration Simulated Baseflow to the Isaac River

2.2.5 Calibration Fit

This section provides discussion on the modelled and observed groundwater level trends (calibration hydrographs) for key bores across the New Lenton and Burton sites. Calibration hydrographs for the full calibration dataset are presented in **Appendix D**.

The hydrographs and calibration statistics (**Table 2-5**) show increasing error in the deeper layers where there is more severe drawdown and higher gradients around Burton mine pits. Since all models are simplifications of the actual hydrogeologic environment, potential sources of error when comparing simulated and observed water levels are:

- Imperfect simulation of mining operations whereby the representation of the historical mine plan in the model is different to the actual progression of the mine.
- Structural simplifications in the model (i.e. the vertical and horizontal discretisation of the model): the model cell sizes being too large to represent steep hydraulic gradients. For example, strong vertical gradients may mean that a model, which predicts average water levels for a cell, will struggle to replicate an observed water level if that water level is from the upper or lower portion of that layer. For a layer that is 50 m thick and where the gradient is 1 in 10, this leads to errors of ± 2.5 m.
- Temporal smoothing errors: these errors may also occur because of the discretisation of time in the model. In this case, stress period lengths are quarterly. Behaviour within this time period may significantly influence the observed water level, and the model may either not simulate the relevant stress or may smooth out the response to such a stress.



- Measurement / installation record errors: bores with identified erroneous data were removed from the calibration dataset. However, given the limitations in historical Burton bore data available for the calibration, further review of the calibration data may identify more bores with erroneous data that should be removed from the calibration.

Despite these potential sources of error, the model is deemed fit for purpose as presented in **Section 4.0**

2.2.5.1 Alluvium

Figure 2-17 presents the fit between simulated and observed heads in the Isaac River alluvium to the west of existing mining at Burton and to the south and east of planned mining at New Lenton, for all calibrated model realisations. **Figure 2-19** shows the location of these bores.

Figure 2-17 shows that the model simulates some seasonality in alluvial water levels in bores GW07, GW19_33 and GW19_37a, of a lesser magnitude but consistent with the observed seasonality in these bores. GW07, GW19_33 and GW19_37a are located less than 100 m from the Isaac River and the seasonality seen in the observed levels is understood to be associated with recharge due to rainfall derived streamflow in the Isaac River, discussed in **Section 2.1.5.2**. The match between the general simulated and observed water levels in these bores shows a slight overprediction (+2 m).

The hydrograph for bore GW06, located just over 100 m from the Isaac River and to the east of New Lenton mine, is shown in **Figure 2-17**. GW06 shows minimal response to rainfall events. The simulated water levels in GW06 indicate the model achieves a very close match to the observed water levels and trends.

Alluvial bores GW01 and GW09 located further from the Isaac River show a general trend of decreasing water levels, correlating to reduced rainfall observed over the same period.

Figure 2-17 shows that the model simulates water levels within approximately 5 m of the observed levels, underpredicting at GW01 and overpredicting at GW09. The calibrated model does not simulate the decreasing trend seen in the observed water levels in GW01 and GW09 however there are some realisations in which simulated levels show similar trends.

Figure 2-18 presents the hydrographs for the two Burton alluvial bores along Anna Creek, and the Burton alluvial bore adjacent to Teviot Creek, downstream of the mine pits. The observed water levels in the hydrograph for bore ANNACR_DS (located adjacent to Anna Creek, downstream of Burton Mine pits) show some variation, with a range of approximately 1 m. The best calibrated realisation simulates a relatively steady water level in this bore however some realisations within the ensemble show responses to stresses. The observed water levels in the hydrograph for bore ANNACR_US (located adjacent to Anna Creek, upstream of Burton Mine pits) show less than 0.5 m variation. The model simulates a similar lack of variation however the calibration ensemble underpredicts water levels in this bore by between 2 and 15 m. The best calibrated realisation matches water levels in the TEVCR_DS bore reasonably well, overpredicting levels at this location by approximately 3 m. The hydrograph for TEVCR_DS shows the calibration ensemble includes a number of realisations that simulate close matches at this bore location.



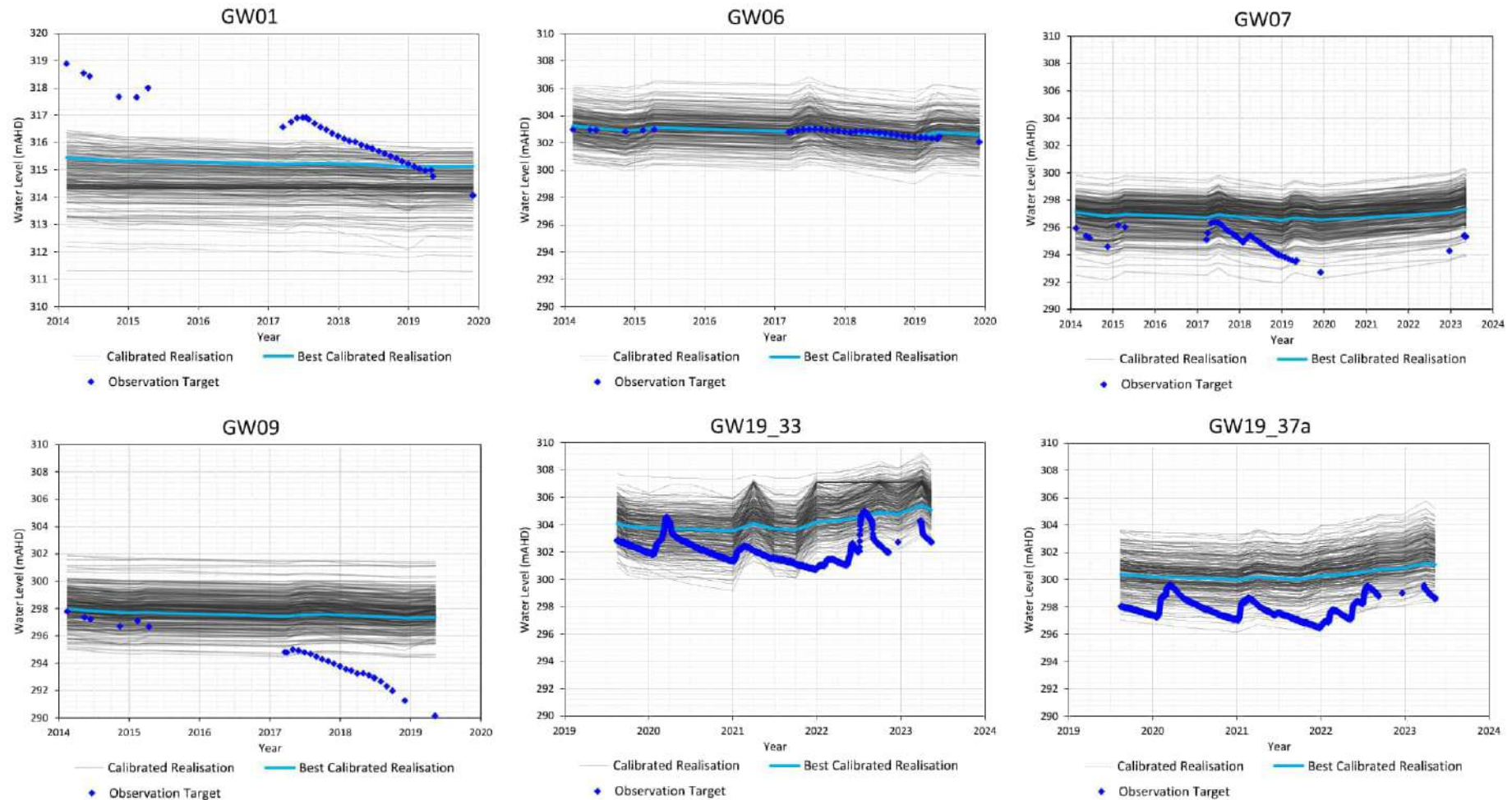


Figure 2-17 Calibration Hydrographs – Isaac River Alluvium



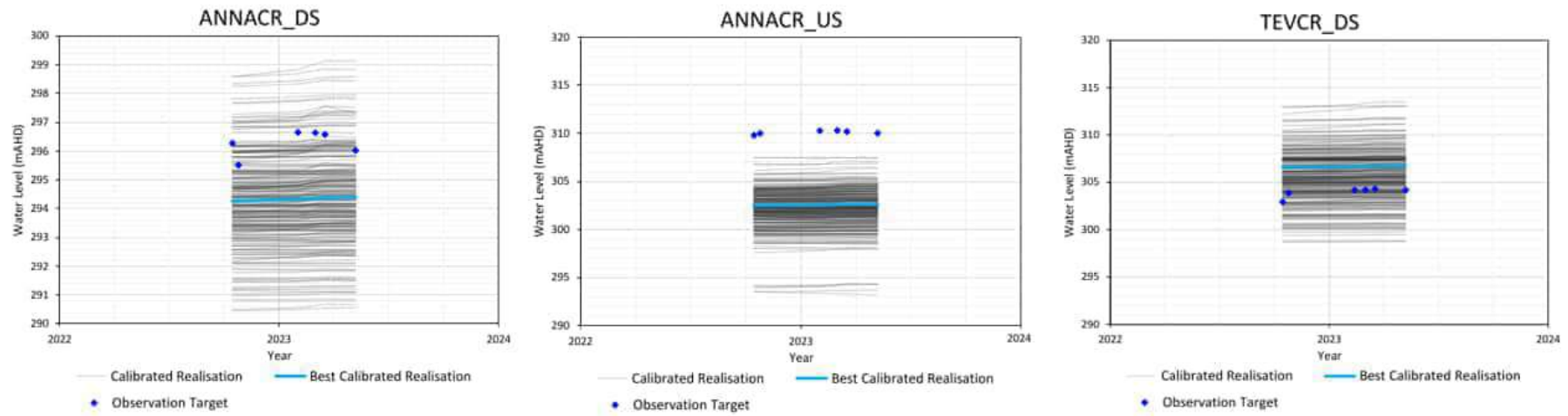
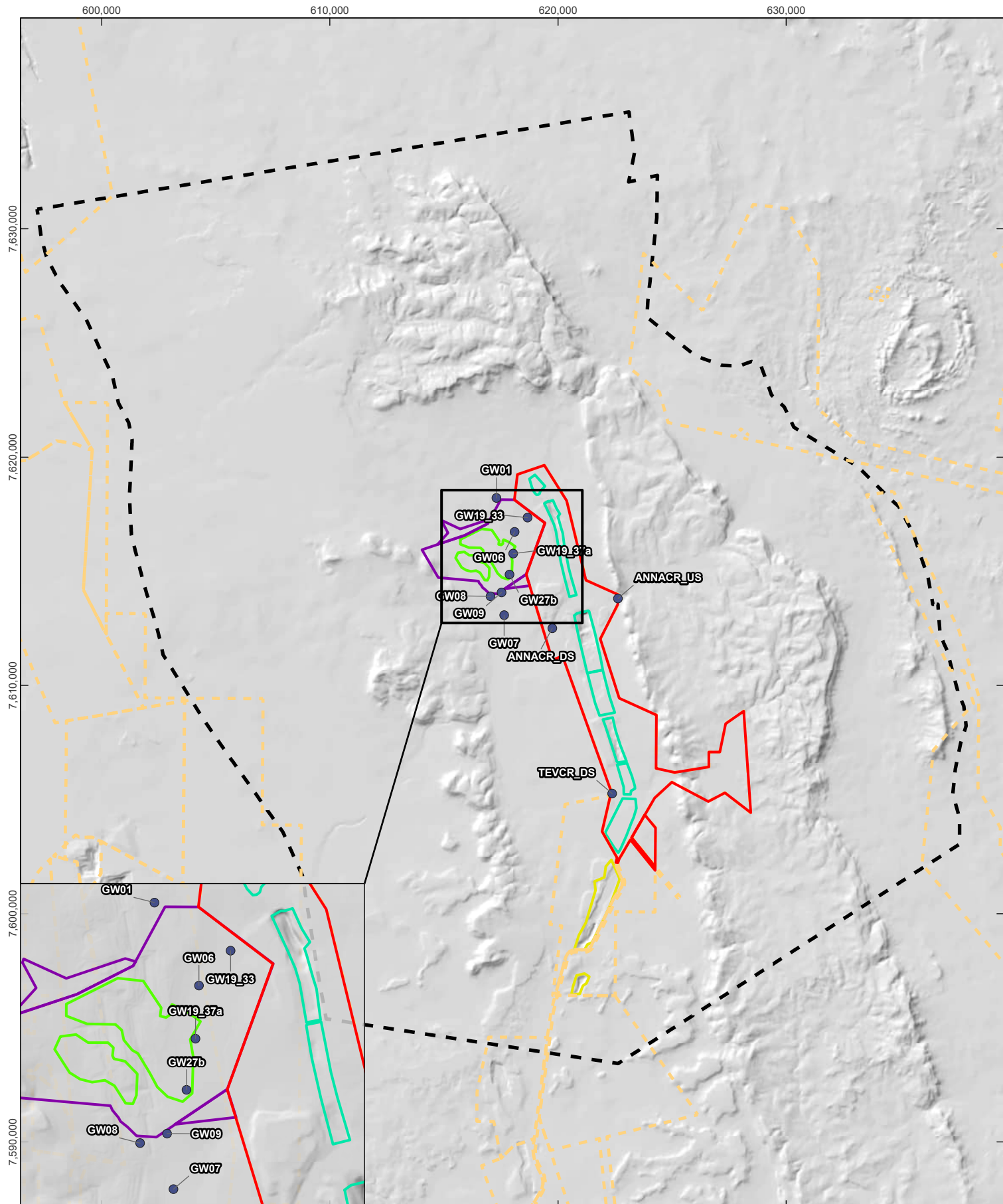


Figure 2-18 Calibration Hydrographs – Alluvium (Burton Mine)






 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
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 Drawn by: RB

LEGEND

- Burton & New Lenton Alluvium Bore
- Model Domain
- Surrounding Mine
- Burton Mining Lease

- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

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CALIBRATION BORE LOCATIONS (ALLUVIUM)



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FIGURE 2-19

2.2.5.2 Permian Coal Measures (New Lenton Observations)

The hydrographs for New Lenton Permian bores GW04, GW10, GW29a, GW19_40, GW19_41a and GW28a are shown in **Figure 2-20**. The hydrographs indicate that in general, the model overpredicts water levels in the Permian units at New Lenton by 2 to 15 m. **Figure 2-21** shows the location of the New Lenton Permian bores.

The hydrographs for the Permian bores in **Figure 2-20** show groundwater levels are relatively stable with minimal response to rainfall events, suggesting low rates of rainfall recharge to the Permian units.

Figure 2-20 shows the model simulates a reasonable match to the observed water levels in GW04 and GW29a, overpredicting by about 2 m. The observed water levels in the bores show slight response to stressors and there is similar variability shown in the simulated levels.

GW28a and GW10 show very little observed response to system stresses and the model simulates a similar stability in water levels in these bores. As shown in **Figure 2-20**, overprediction in GW28a and GW10 is greater than in other Permian bores at New Lenton, with simulated levels up to 6 and 15 m in these bores, respectively.

The hydrographs in **Figure 2-20** show an overprediction in bores GW19_40 and GW19_41a of up to 5 m. There is one calibrated realisation that simulates a match to the initial observed water levels at GW19_41a and GW19_40, with all other realisations overpredicting initial water levels at these bores, indicating the range of simulated levels from the calibration ensemble does not adequately encompass the target water level elevations. Given that the calibration ensemble was able to replicate well water level elevations and or responses at many locations throughout the model, it is assumed that where the ensemble envelope cannot encompass the target observations, there is likely to be some observational uncertainty/error not captured within the model calibration and or introduction of additional uncertainty/predictive error associated with model structural limitations.



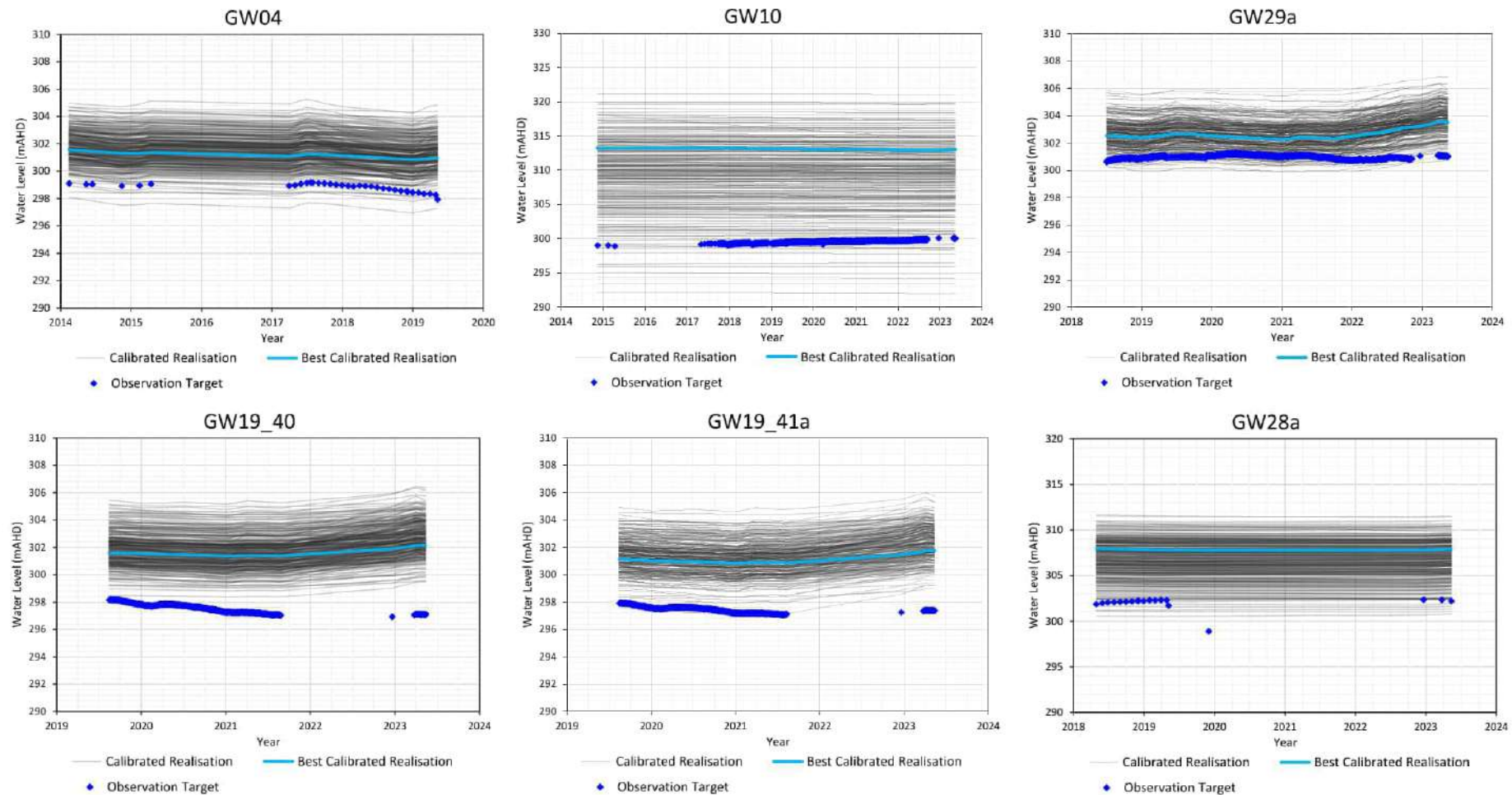
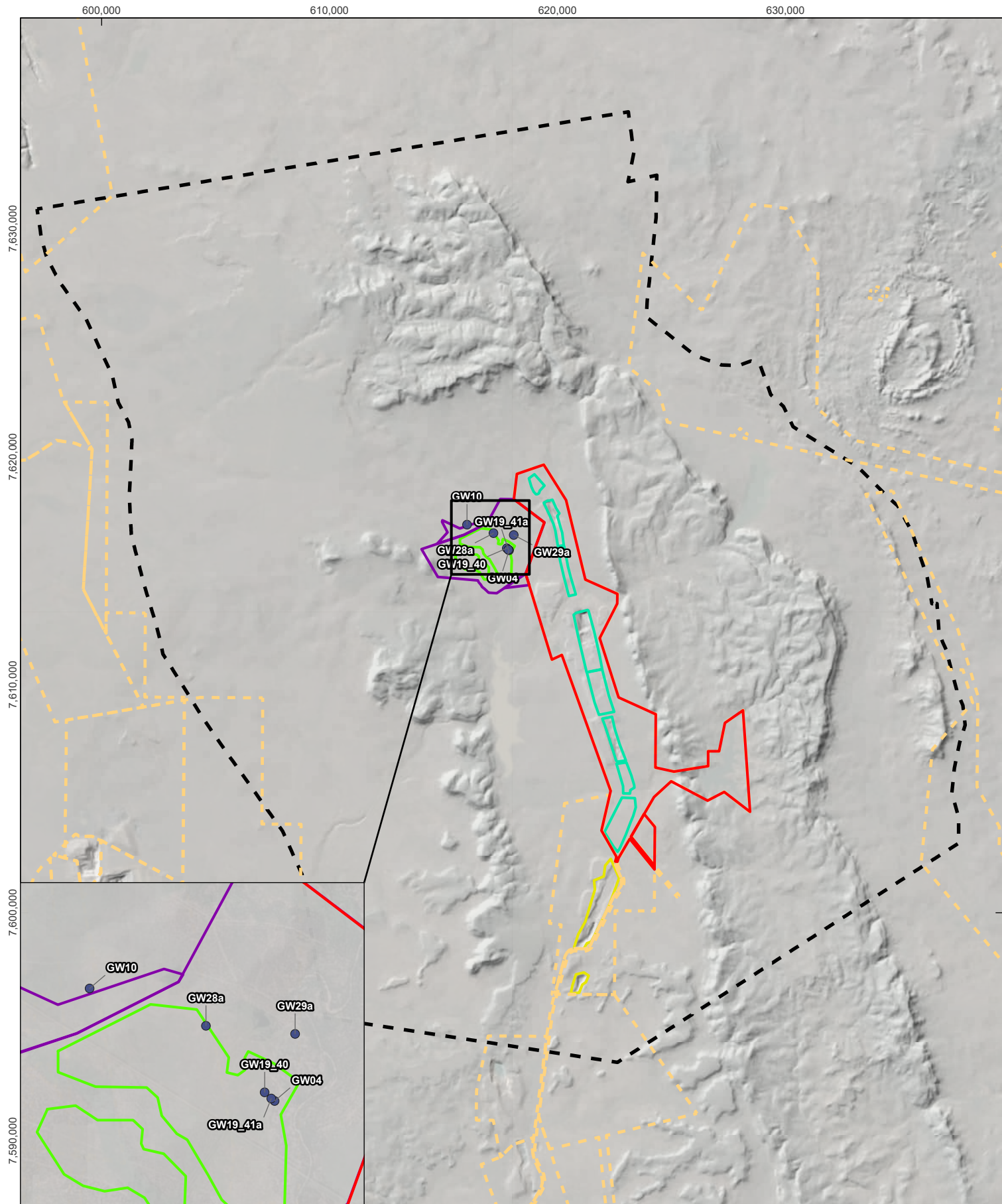


Figure 2-20 Permian Calibration Hydrographs (New Lenton Observations)





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

- New Lenton Permian Bore
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Surrounding Mine
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

CALIBRATION BORE LOCATIONS (NEW LENTON PERMIAN BORES)



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FIGURE 2-21

2.2.5.3 Permian Coal Measures (Burton Observations)

The hydrographs for Permian bores BD1019, BD613C, BD784_2, TH077P, DDH45 and DDH6 at Burton mine are shown in **Figure 2-22**.

The hydrographs indicate that in general, the model achieves a reasonable match to water levels in the Permian coal measures at Burton. **Figure 2-23** shows the location of the Burton bores in the Permian units.

The hydrographs for the Permian bores in **Figure 2-22** show groundwater levels are more responsive to rainfall events than bores installed within the Permian units near New Lenton.

Figure 2-22 shows the model simulates a reasonable match to the observed drawdown in bores BD1019, BD784_2 and DDH45, located along the northern and eastern sides of the Burton Widening pit. The discrepancy between the timing and magnitude of simulated and observed drawdown in these bores is due to the mining stresses applied in the model, where limited information on historical mine progression was available.

The hydrographs for bores BD613C and DDH6, located near the southern end of Burton mine (near Teviot's Creek) and at the northern end (near Isaac River), respectively, are shown in **Figure 2-22**. Observed water levels in BD613C and DDH6 show a notable response to rainfall variation, indicating recharge to the groundwater system occurring near these bores. The model achieves a good match to the levels and trends seen in the observed levels in BD613C and DDH6. While the best calibrated realisation simulates a more subtle response to rainfall events than observed, some realisations in the calibration ensemble were able to replicate the magnitude of response.



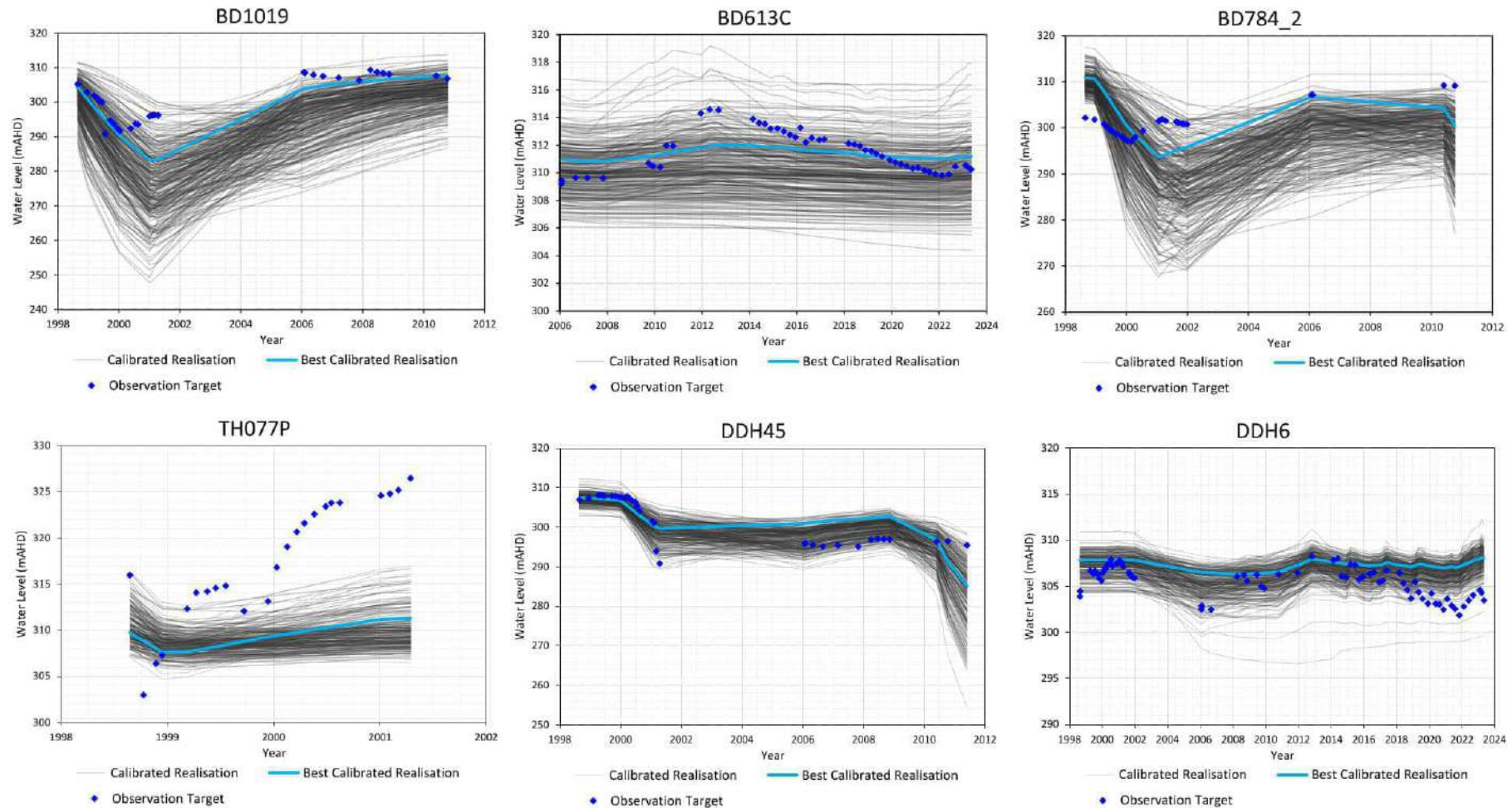
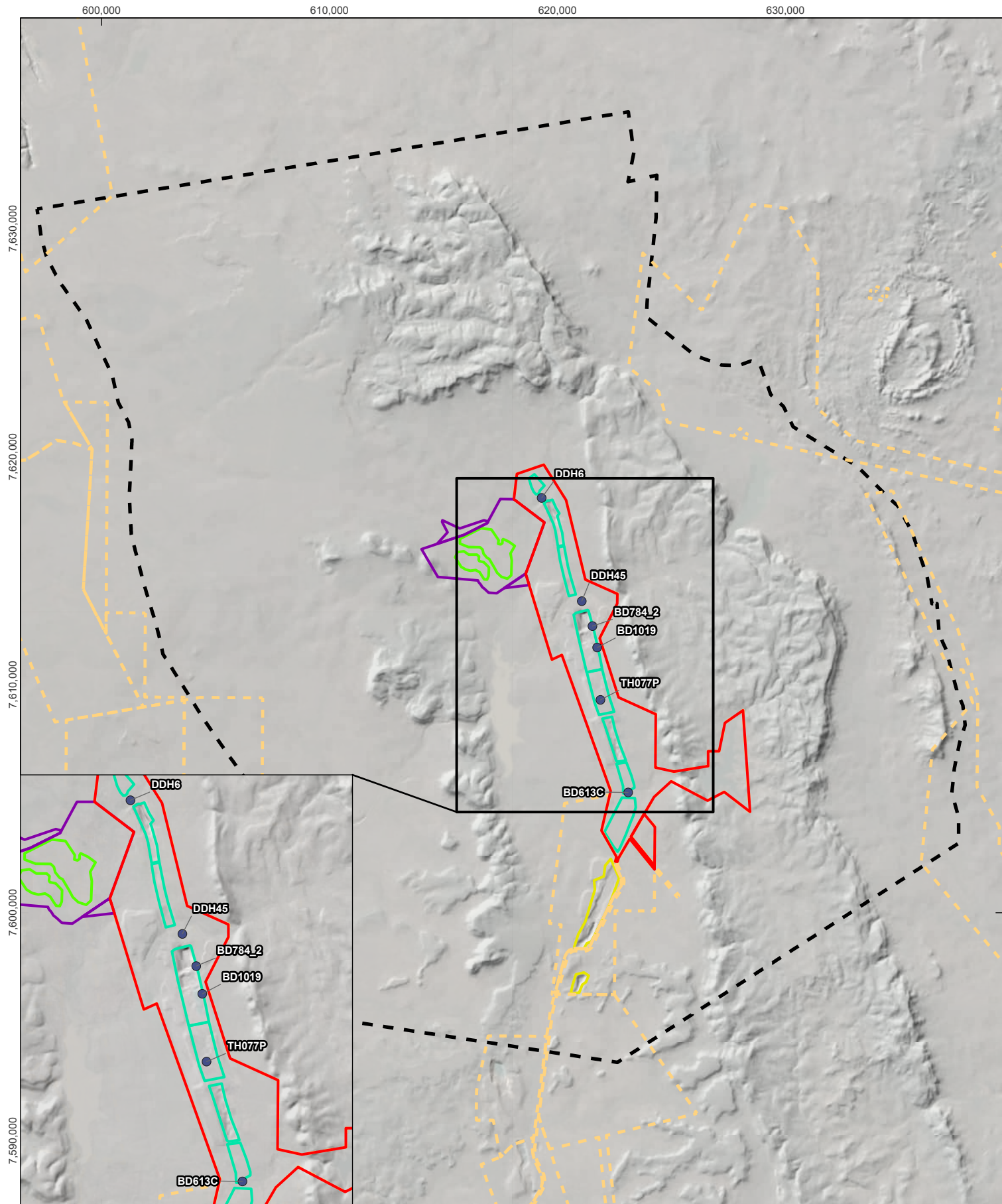


Figure 2-22 Permian Calibration Hydrographs (Burton Observations)





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

- Burton Permian Bore
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Surrounding Mine
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

CALIBRATION BORE LOCATIONS (BURTON PERMIAN BORES)



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FIGURE 2-23

2.2.5.4 Large Residual Observations

The hydrographs for bores that produced the largest residuals in the calibration are shown in **Figure 2-24**. Bores BD1032, BD1248P, BD1250P, DDH16, DDH19 and DDH25 are among the 11 bores that collectively contribute 85% of the SSQ for the calibrated model. **Figure 2-25** shows the location of bores BD1032, BD1248P, BD1250P, DDH16, DDH19 and DDH25.

As shown in **Figure 2-25**, the bores included in **Figure 2-24** are located within 300 m from the edge of mined pits at Burton. Given the proximity of these bores to pits where mining was occurring, observed levels in these bores are expected to be heavily influenced by dewatering and water storage associated with mining activity.

Figure 2-24 shows the model achieves a close match to observed groundwater levels in bore BD1248P prior to 2007 and after 2014. The significant increase and subsequent decrease in levels in BD1248P between 2007 and 2014 was not able to be replicated by the model because the stress causing this fluctuation was unknown and was not included in the model.

The hydrographs for BD1250P, DDH19 and DDH25 shown in **Figure 2-24** indicate the model achieves a reasonable match to the initial observed groundwater levels but is unable to match either the timing or magnitude of changes in level for the rest of the observation points. The hydrographs for BD1032 and DDH16 show the model is unable to match initial observed groundwater levels or trends in these bores, which may be attributed to discrepancies in simulated mine stresses or other errors in calibration data setup.

It is evident from the hydrographs in **Figure 2-24** that the calibration ensemble does not adequately simulate a range of groundwater levels in these bores that encompass the observed levels. This inability of the calibration ensemble to simulate trends and levels within a reasonable window of observed levels is likely due to historical small scale mining activities that are not captured in the groundwater model. This localised effect is unlikely to influence regional groundwater trends and predicted impacts due to future operations.



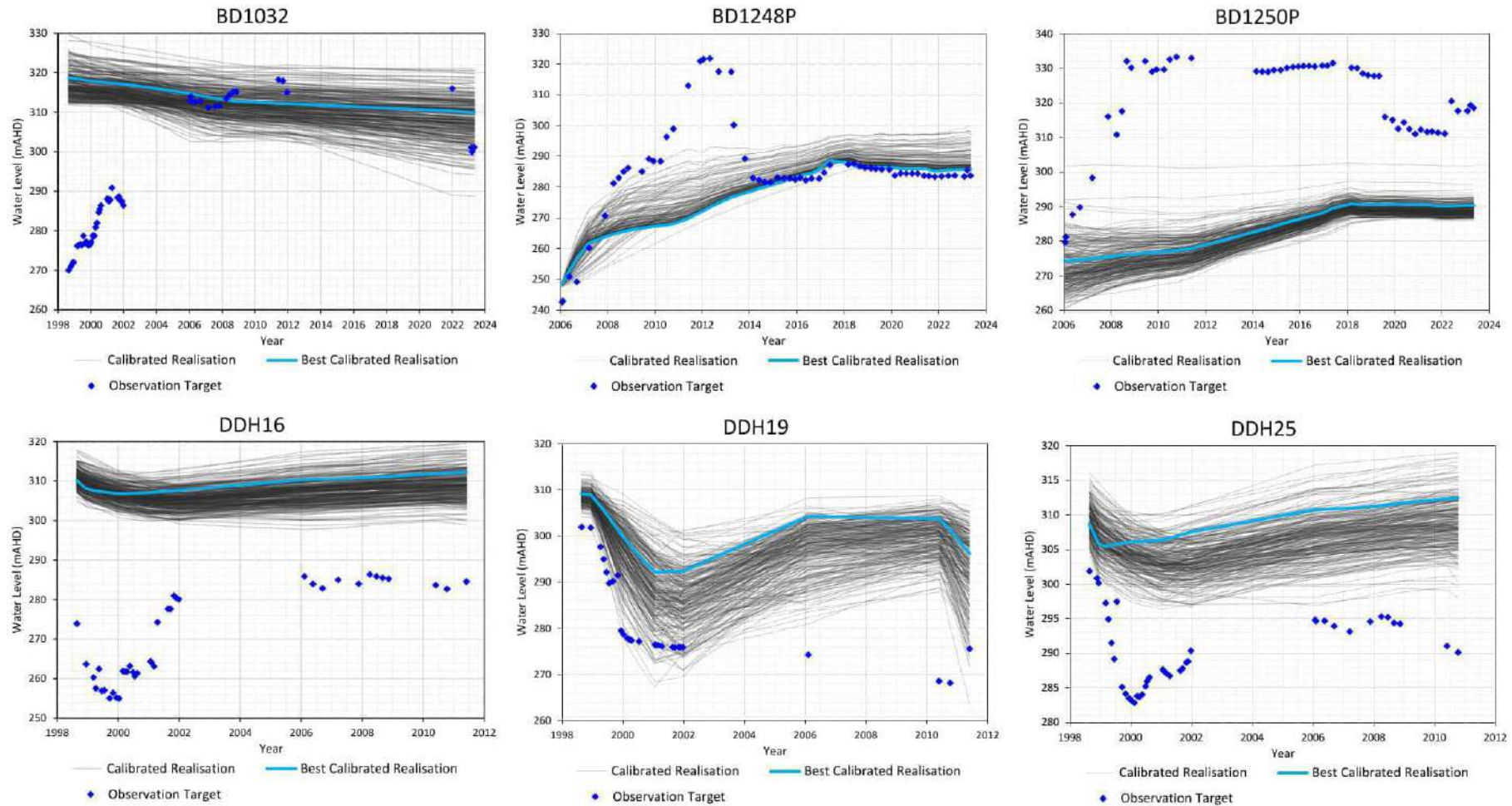
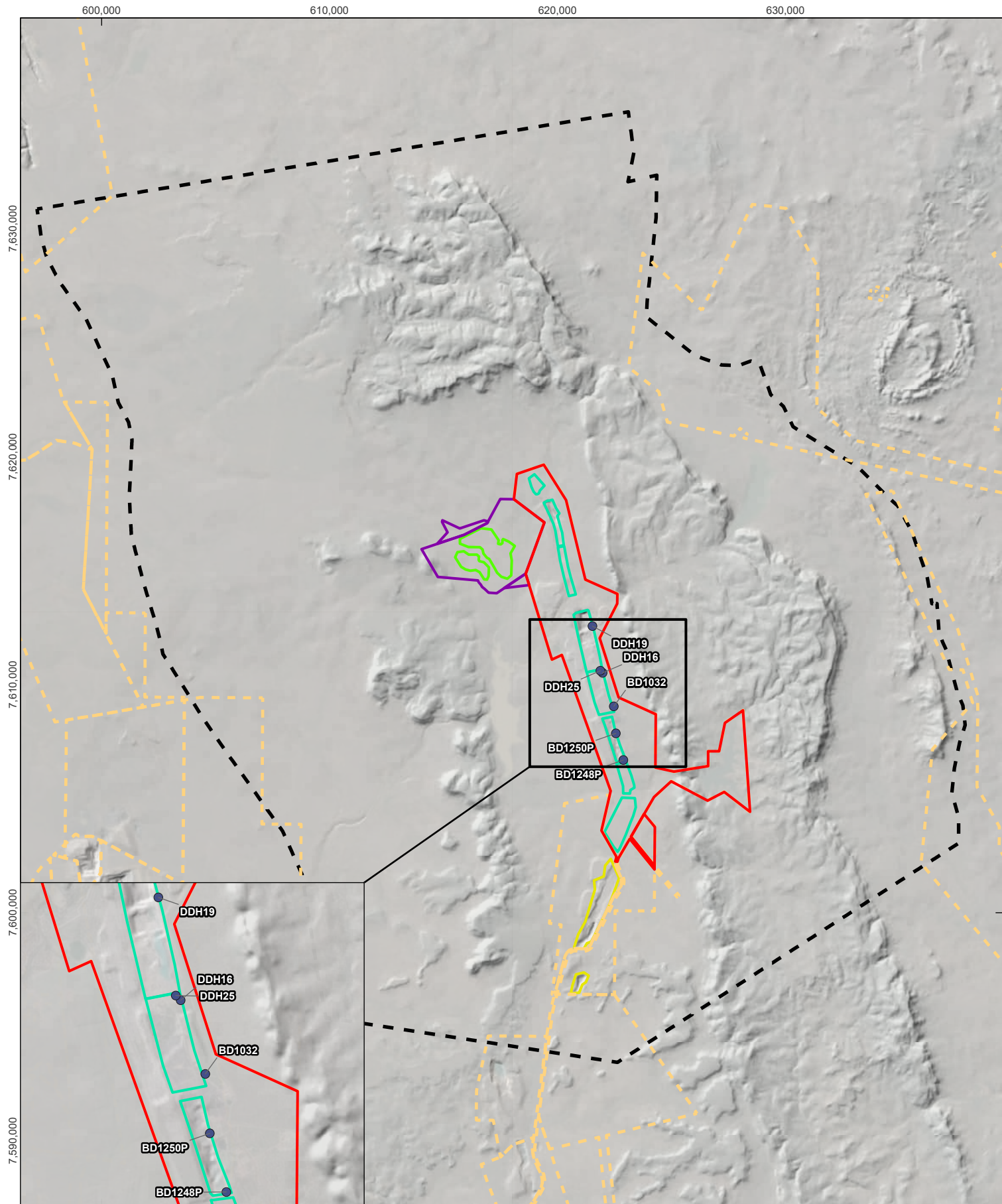


Figure 2-24 Calibration Hydrographs (Large Residual Bores)





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

- Large Residual Bore
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Surrounding Mine
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

CALIBRATION BORE LOCATIONS (LARGE RESIDUAL BORES)



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FIGURE 2-25

2.2.6 Calibrated Water Levels

The groundwater levels simulated by the best calibrated realisation are provided in **Figure 2-26** to **Figure 2-30**.

The simulated water table elevation for the steady-state model is presented in **Figure 2-26**. The figure shows the water table is a subdued reflection of topography. Highest water table elevations are in the north of the model domain and along the Kurlong Range east of Burton, and lowest water table elevations are coincident with the Isaac River downstream and immediately upstream of the Burton Gorge Dam in the southwestern and central areas of the model domain, and also coincident with Walker Creek in the southeastern corner of the model domain.

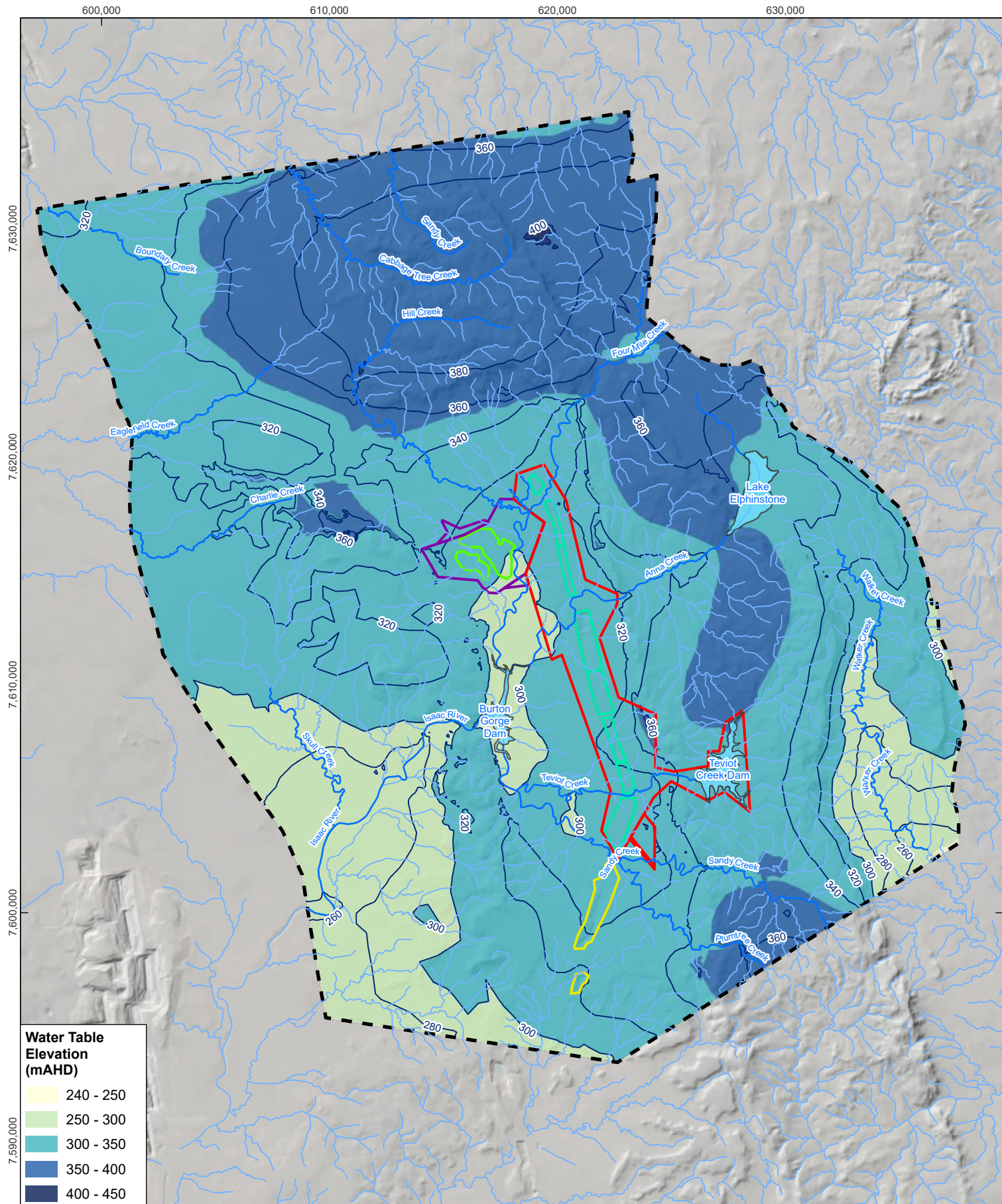
The simulated groundwater levels in the alluvium (model layer 1) and regolith (model layer 2) for the end of the calibration period (July 2023) are presented in **Figure 2-27** and **Figure 2-28**, respectively. The gaps in the simulated water levels in these figures indicate where the water level is below the base of cell and the layer is dry.

Figure 2-27 shows some saturation of the alluvium along Isaac River and tributaries where the alluvium reaches a greater depth. With the exception of a small number of river cells, the saturated groundwater levels in the alluvium shown in **Figure 2-27** are below the bed elevation of the Isaac River, consistent with the conceptualised absence of baseflow from the groundwater system to the Isaac River.

The simulated groundwater levels in the Burton/Rider Seams to the east of the BRF (model layer 12) and the Leichhardt/Vermont Seams to the east of the BRF (model layer 16) for the end of the calibration period (July 2023) are presented in **Figure 2-29** and **Figure 2-30**, respectively.

Figure 2-29 and **Figure 2-30** show groundwater within the Rangal Coal Measures has a general flow gradient associated with general topographic gradients. However, groundwater flow is currently locally influenced by depressurisation from active mining at the Burton pits.





Coordinate System: GDA2020 MGA Zone 55
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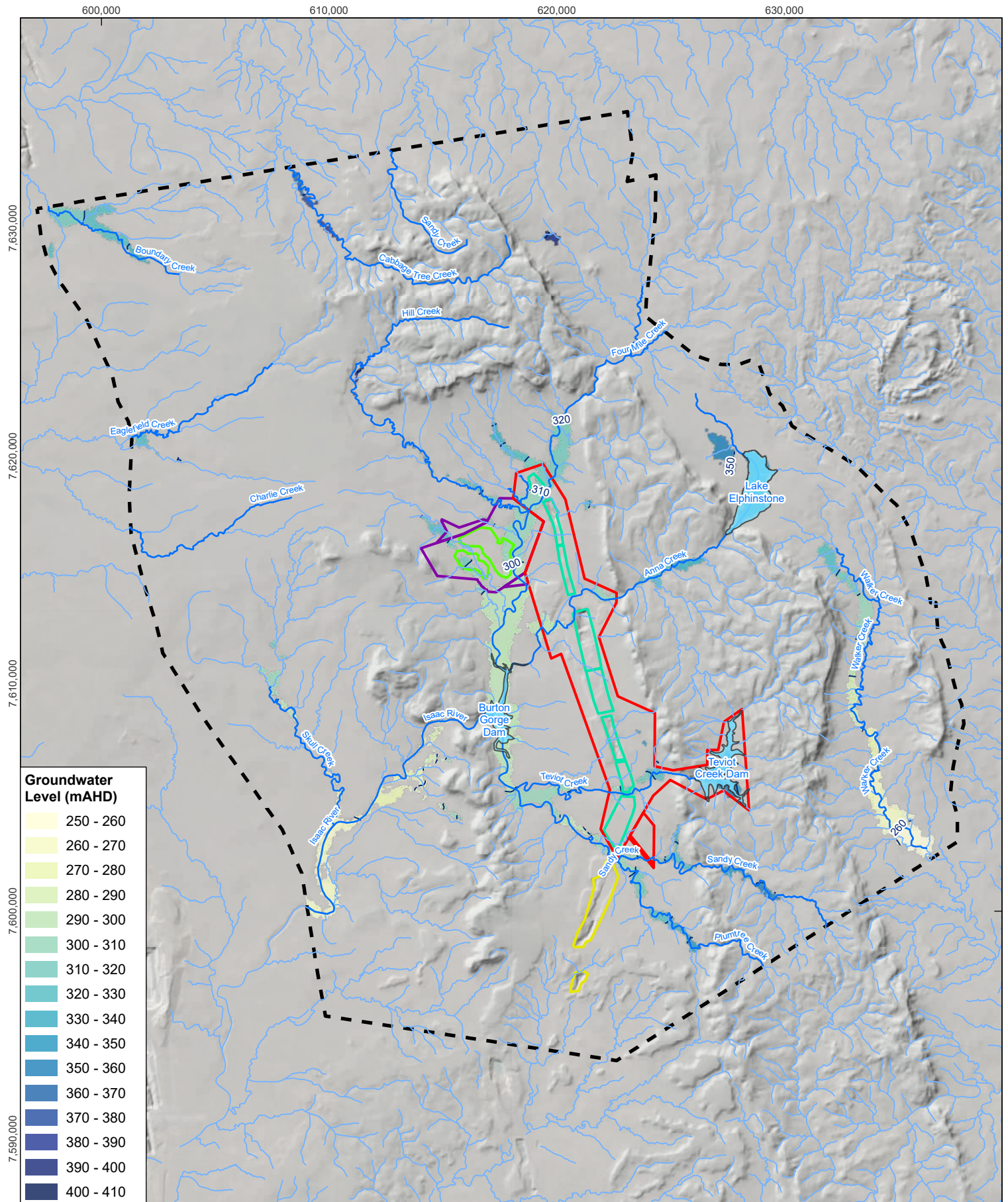
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SIMULATED STEADY-STATE WATER TABLE - BEST CALIBRATED REALISATION



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FIGURE 2-26



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHD)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

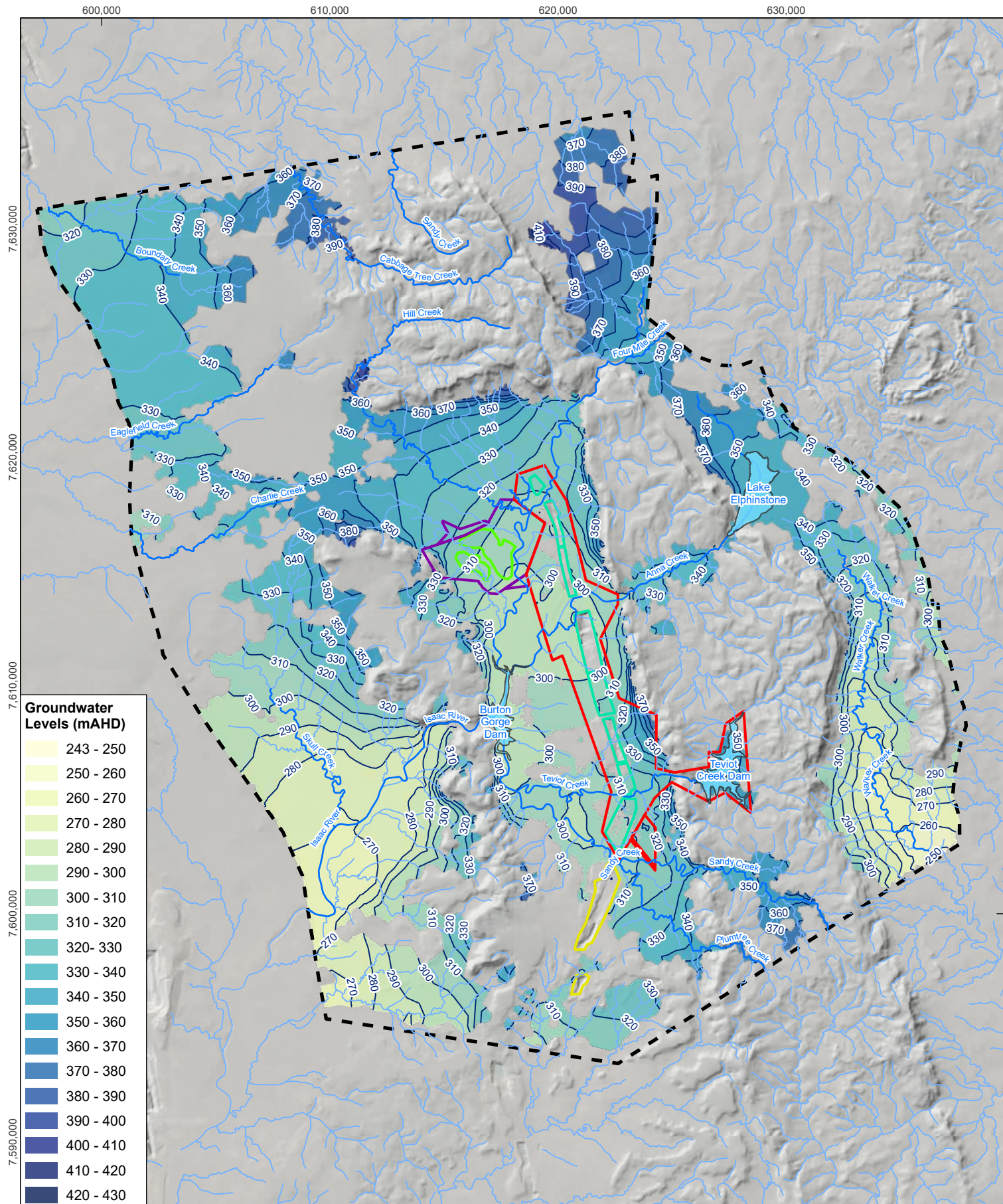
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

SIMULATED GROUNDWATER LEVELS IN ALLUVIUM – END OF CALIBRATION (JULY 2023)



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FIGURE 2-27



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

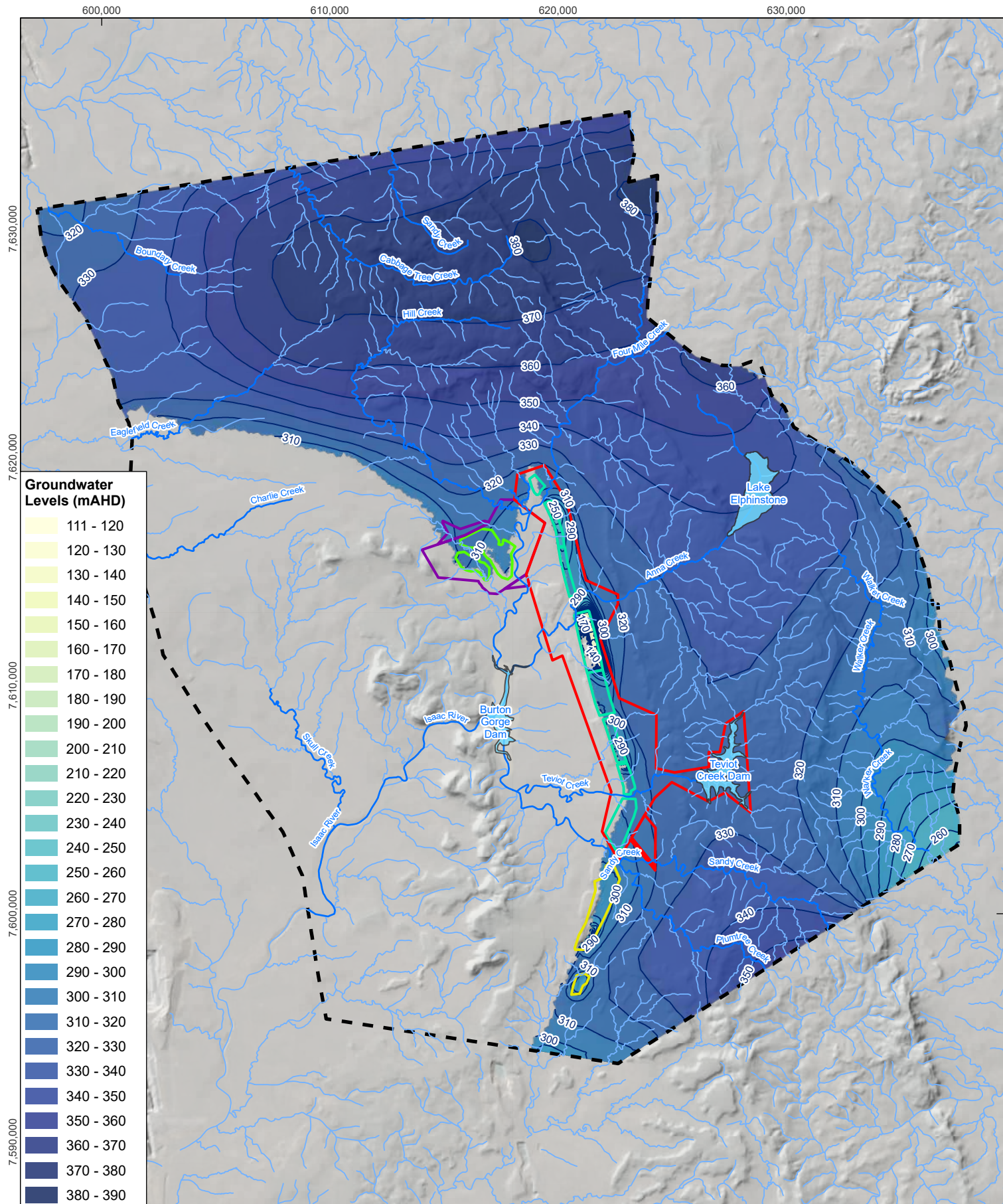
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

SIMULATED GROUNDWATER LEVELS IN REGOLITH (LAYER 2)– END OF CALIBRATION (JULY 2023)



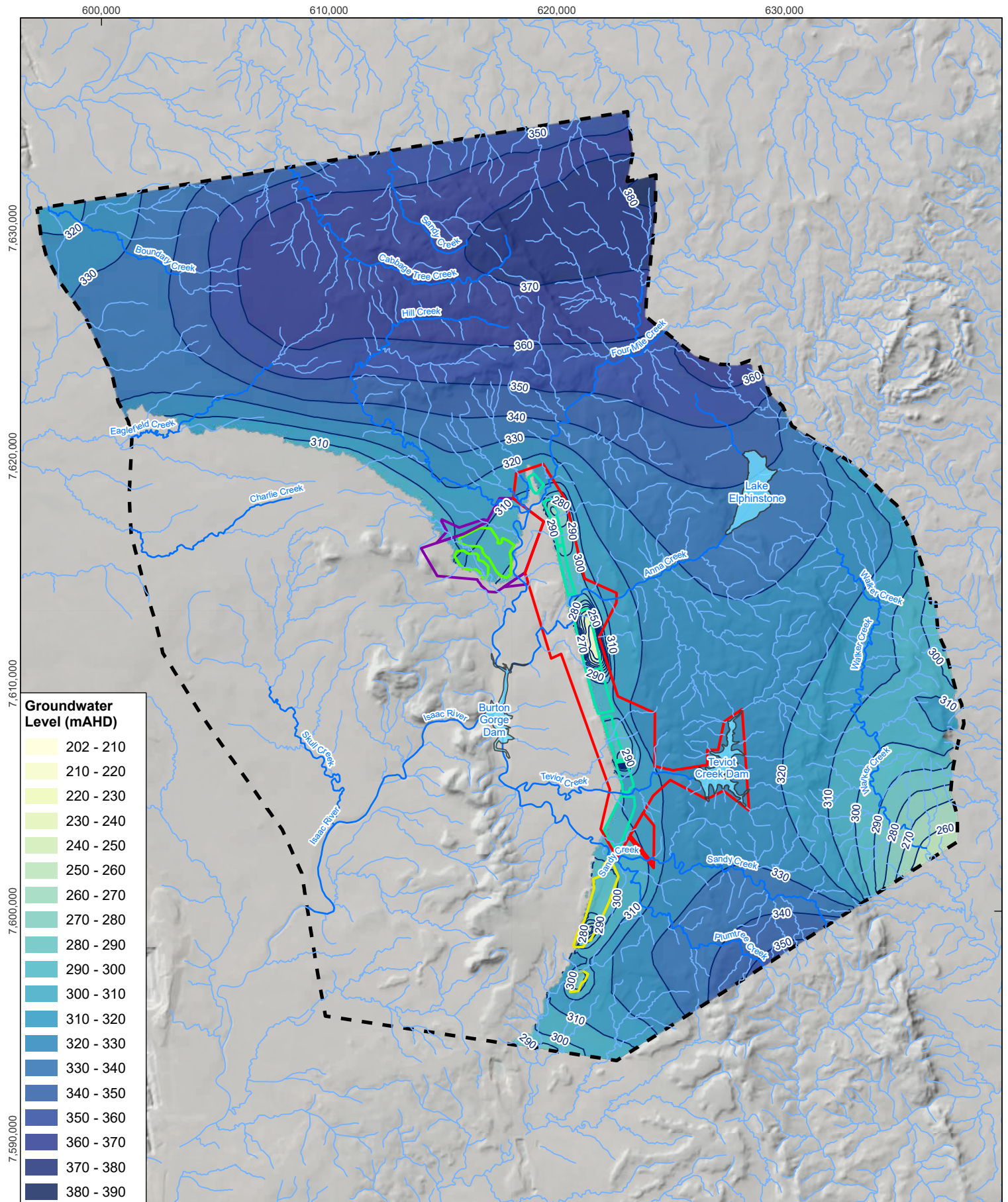
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FIGURE 2-28



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-29



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

SIMULATED GROUNDWATER LEVELS IN LEICHHARDT/VERMONT SEAM (EAST OF BR FAULT) - END OF CALIBRATION (JULY 2023)



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FIGURE 2-30

2.2.7 Water Balance

The water balance for the steady state period for the best calibrated realisation is presented in **Table 2-8**. The steady state summary indicates that recharge was the largest net inflow contributor of the model (9.07 megalitres per day [ML/d]). GHB boundary inflow and outflow are 0.30 and 1.84 ML/d respectively, indicating there is a net outflow from the model domain through regional groundwater movement. River (RIV) cell inflow and outflow are 2.17 ML/d and 2.43 ML/d respectively, indicating that some enters and leaves the model domain through this boundary condition. As Isaac River was set with a stage height of 0.0 m in the model domain, the water entering the model via RIV package is from the water dams. The model predicted 0.0 mL/day baseflow for Isaac River in steady state (**Section 2.2.4**), therefore, the volume leaving the model through the RIV package is also from the water dams.

Table 2-8 Steady-State Water Balance Summary

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	9.07	78.6	-	-
ET (from GW) (EVT)	-	-	7.26	62.9
Isaac River and Water Dams (RIV)	2.17	18.8	2.43	21.1
Regional GW Flow (GHB)	0.30	2.6	1.84	16.0
Total	11.54	100.00	11.54	100.00

The main outflow from the groundwater system is evapotranspiration (7.26 ML/d). The mass balance error for the pre-mining steady state period is 0.00%, indicating the model achieves an acceptable numerical solution under steady-state conditions.

The average water balance for the best calibrated realisation, over the transient simulation, is presented in **Table 2-9**.

Table 2-9 Transient Calibration Water Balance Summary

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	11.94	54.8	-	-
ET (from GW) (EVT)	-	-	8.18	37.6
Isaac River and Water Dams (RIV)	2.22	10.2	2.82	12.9
Regional GW Flow (GHB)	0.30	1.4	1.87	8.6
Mines (DRN)	-	-	2.39	11.0
Constant Head (CHD)	2.55	11.7	1.63	7.5
Storage	4.77	21.90	4.88	22.4
Total	21.78	100.00	21.78	100.00



The water balance indicates that recharge to the groundwater system within the model averages 11.94 ML/d. River (RIV) cell inflow and outflow are 2.22 ML/d and 2.82 ML/d respectively, indicating that there is an overall loss of groundwater from the model domain of approximately 0.6 ML/d through river cells. All the flux entering the model is from the water dams simulated within the model domain. As discussed in **Section 2.2.4**, on average 0.02 ML/day leaves the model domain through Isaac River in the calibration period. Therefore, 2.41 ML/day is removed from the model by RIV cells simulating the water dams.

Approximately 8.18 ML/d is lost to evapotranspiration in areas where the water table is within the specified extinction depth of the land surface. This likely relates to evapotranspiration along the Isaac River alluvium where the groundwater table is less than 10 m from the land surface as shown in **Figure 2-26**.

The fluxes from the GHB component (inflow and outflow) are 0.30 and 1.87 ML/d respectively, indicating there is a net outflow from the model domain through regional groundwater movement. Storage inflow and outflow are 4.77 ML/d and 4.88 ML/d respectively, indicating that some groundwater enters and leaves the model domain through storage.

The drain cells that represent dewatering associated with mining activity in the model remove on average 2.39 ML/d from the model. Average inflow and outflow for the Constant Head (CHD) used to represent mine water storage facilities are 2.55 ML/d and 1.63 ML/d, indicating an overall inflow to the model domain through this boundary condition.

The mass balance error is less than 0.02% in any individual timestep of the transient calibration period. The cumulative mass balance error at the end of the transient calibration is 0.07%. This is within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012), and indicates that the model achieves an acceptable numerical solution.

Figure 2-31 to Figure 2-41 show the time series for different components of water balance for the transient calibration period. The figures also compare the best calibration realisation to values from all the other realisations.



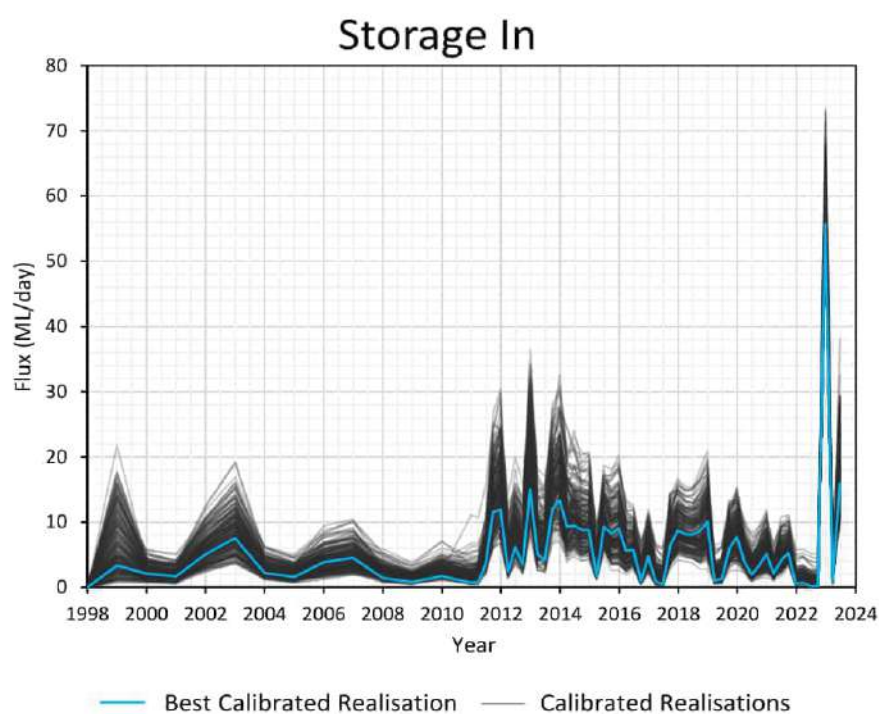


Figure 2-31 Transient Water Balance (Storage In)- Calibration Period

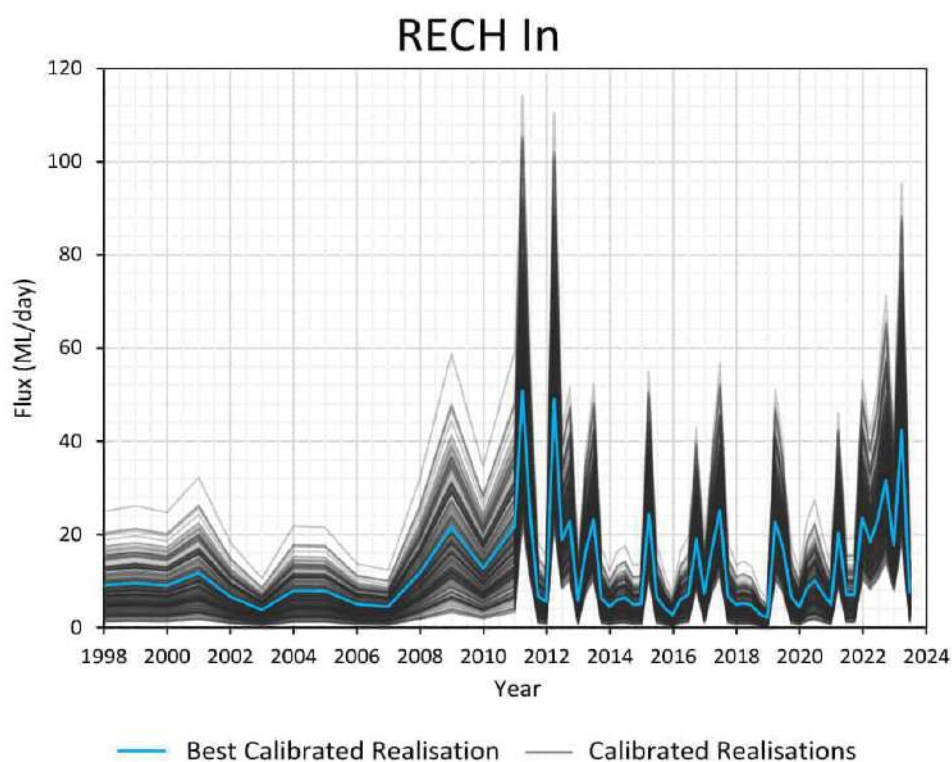


Figure 2-32 Transient Water Balance (Recharge In)- Calibration Period



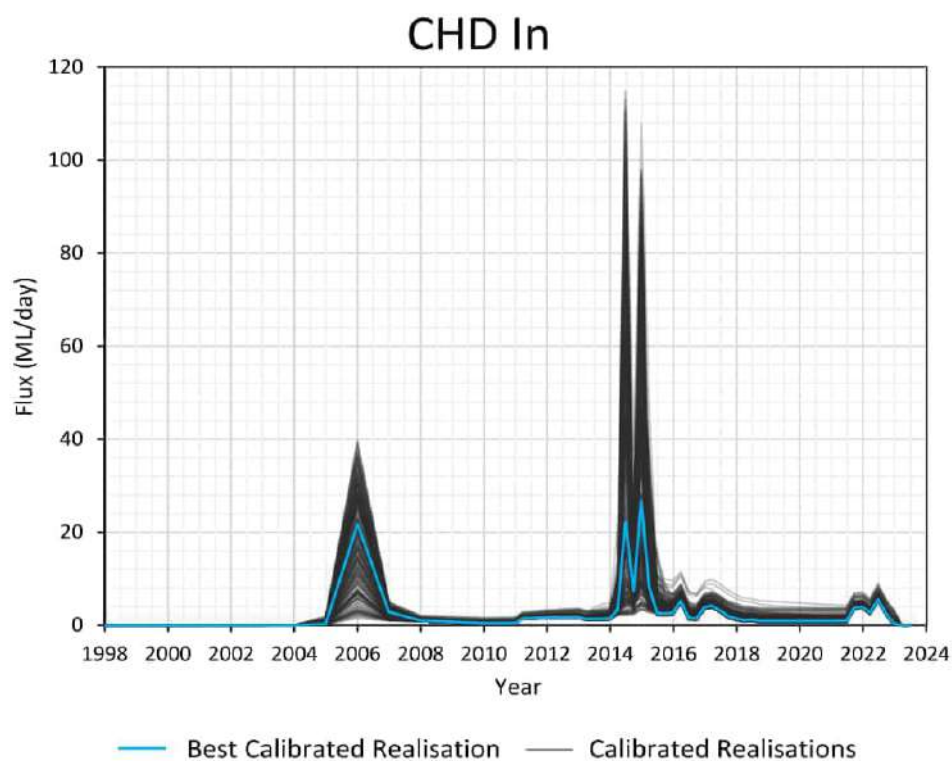


Figure 2-33 Transient Water Balance (Constant Head In)- Calibration Period

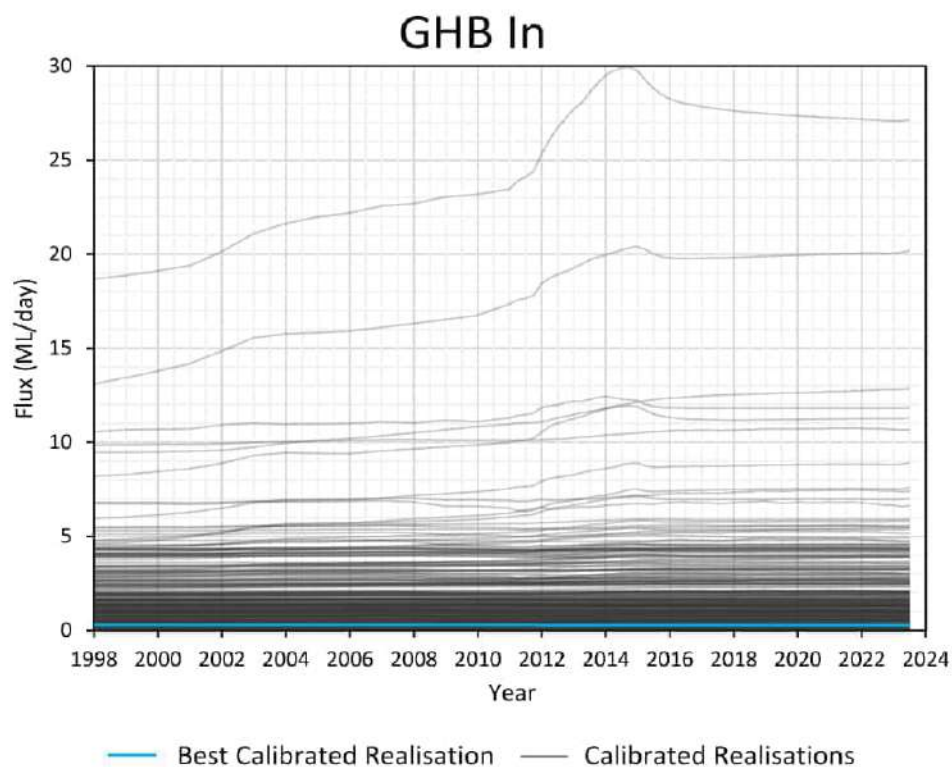


Figure 2-34 Transient Water Balance (General Head In)- Calibration Period



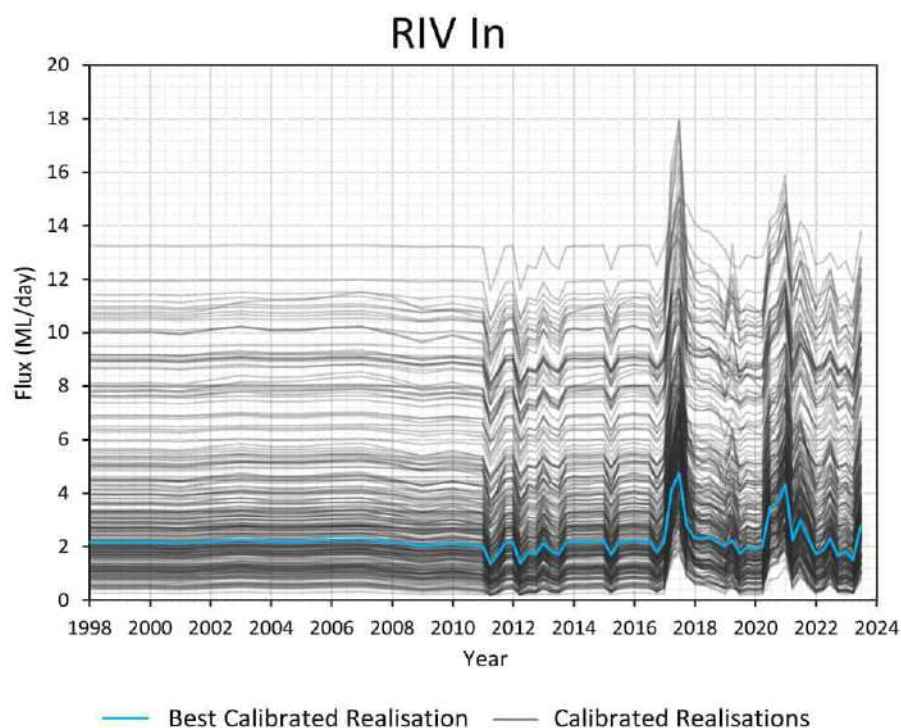


Figure 2-35 Transient Water Balance (River In)- Calibration Period

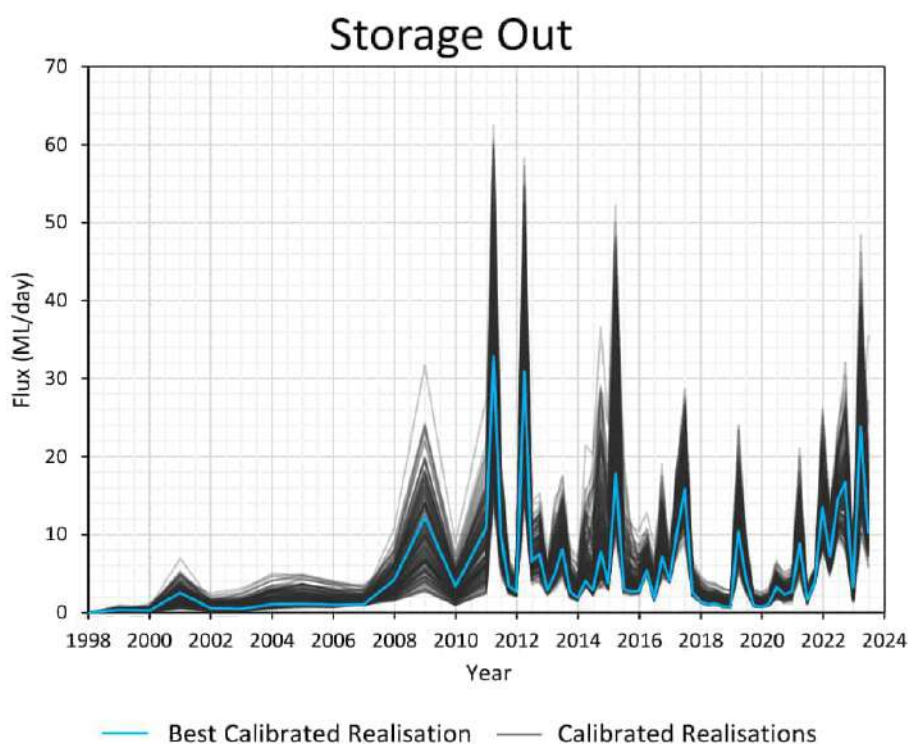


Figure 2-36 Transient Water Balance (Storage Out)- Calibration Period



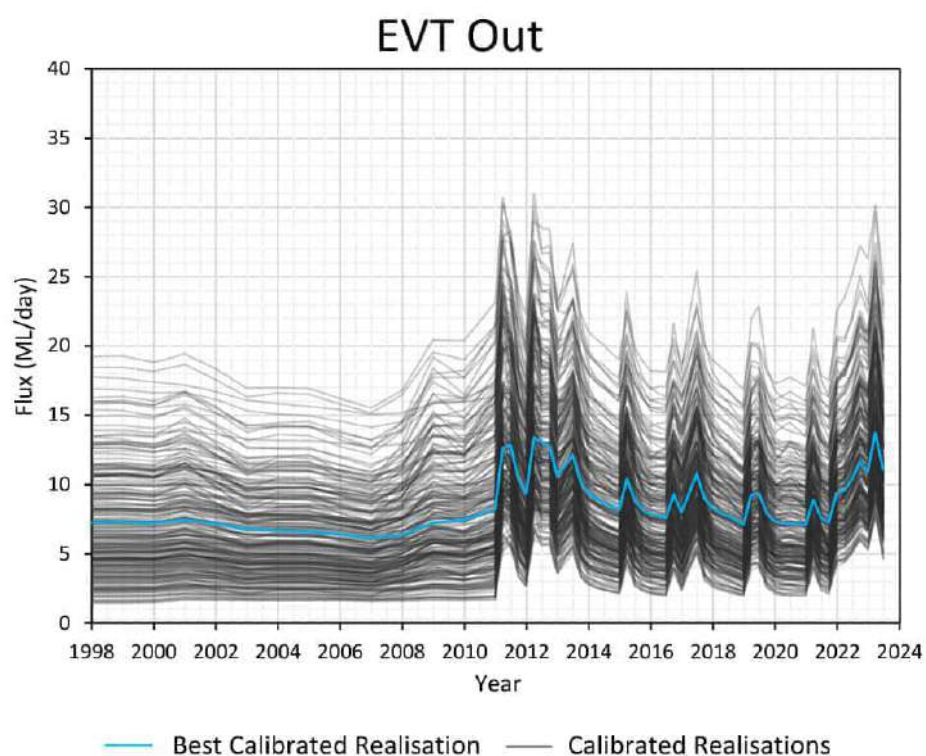


Figure 2-37 Transient Water Balance (Evapotranspiration Out)- Calibration Period

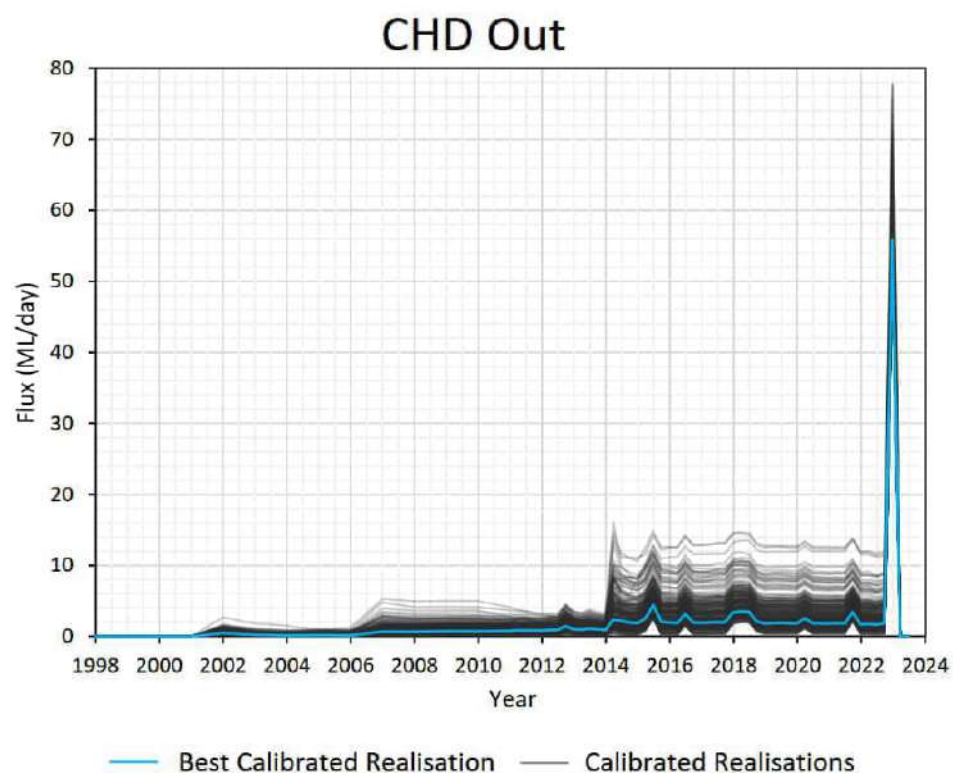


Figure 2-38 Transient Water Balance (Constant Head Out)- Calibration Period



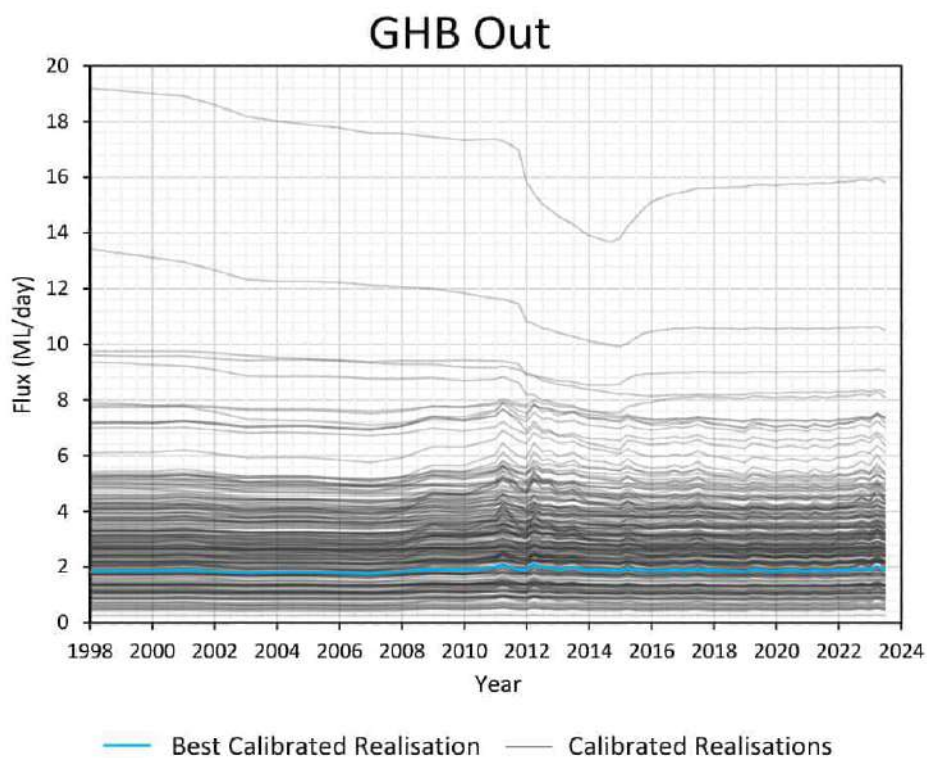


Figure 2-39 Transient Water Balance (General Head Out)- Calibration Period

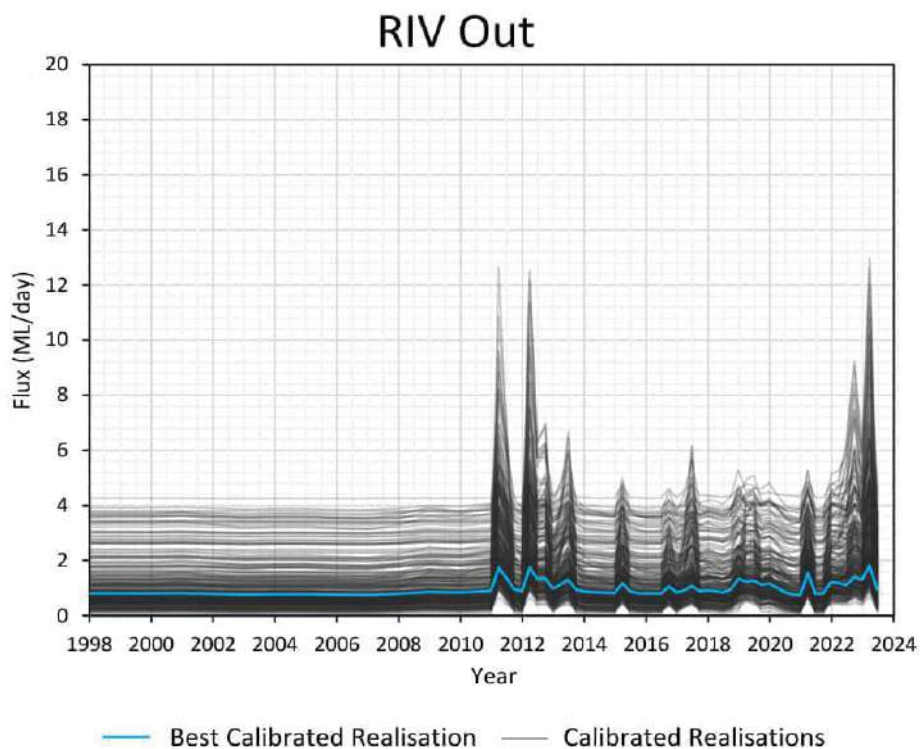


Figure 2-40 Transient Water Balance (River Out)- Calibration Period



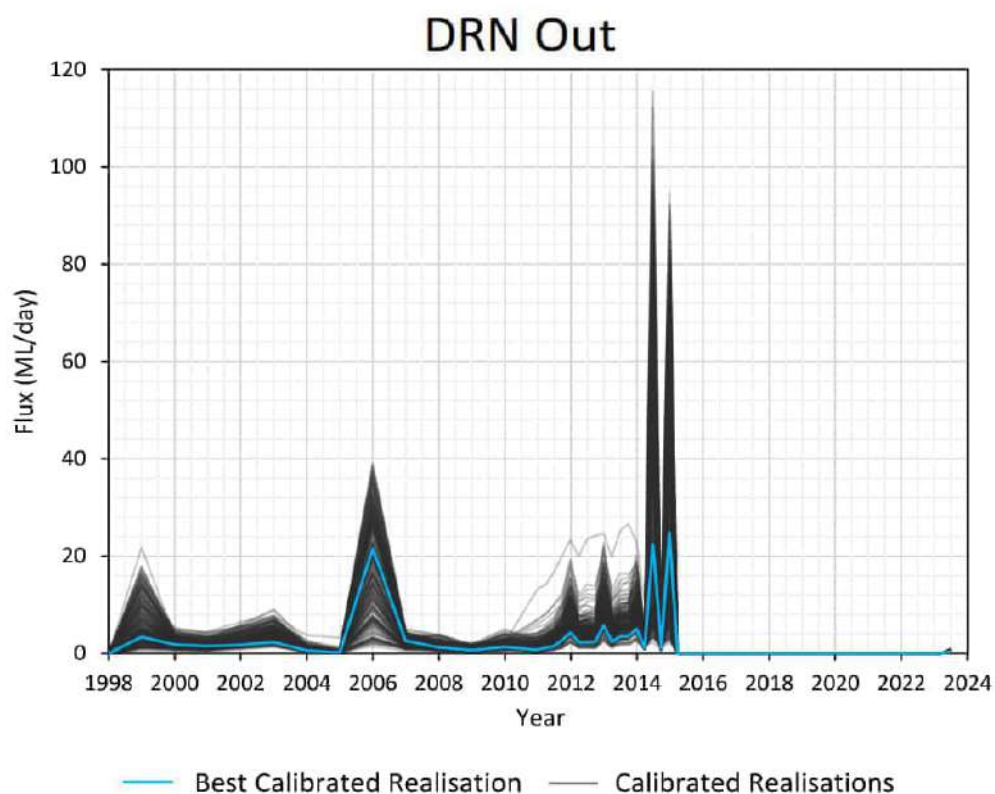


Figure 2-41 Transient Water Balance (Drain Out)- Calibration Period

2.2.8 Calibrated Hydraulic Parameters

Table 2-10 summarises the calibrated parameter values for the best calibrated realisation, including horizontal hydraulic conductivity (K_x) and vertical to horizontal hydraulic conductivity ratio (K_z/K_x), Specific Storage (S_s) and Specific Yield (S_y). The hydraulic conductivity of the Permian coal and interburden material in the model reduces with depth in order to reflect field observations.



Table 2-10 Calibrated Hydraulic Parameters – Best Calibrated Realisation

Geology Unit	Layer	Min Kx (m/d)	Max Kx (m/d)	Average Kx (m/d)	Min Kz (m/d)	Max Kz (m/d)	Average Kz (m/day)	Sy	Ss (1/m)
Alluvium	1	4.40E+00	2.90E+01	1.13E+01	1.90E+00	2.30E+01	6.34E+00	5.73E-02	7.71E-04
Regolith	1	4.50E+00	2.60E+01	1.05E+01	2.10E+00	1.60E+01	5.88E+00	5.40E-02	7.97E-04
Regolith	2	9.20E-01	9.20E-01	9.20E-01	1.20E-01	1.20E-01	1.20E-01	2.11E-02	6.69E-05
Basalt	2	2.60E-01	2.60E-01	2.60E-01	3.80E-02	3.80E-02	3.80E-02	1.25E-02	3.44E-05
Triassic (top) West of BRF	3	5.00E-04	5.00E-04	5.00E-04	1.70E-05	1.70E-05	1.70E-05	4.81E-03	3.16E-06
Triassic (top) East of BRF	4	1.70E-03	1.70E-03	1.70E-03	1.10E-04	1.10E-04	1.10E-04	3.65E-03	4.74E-06
Triassic (middle) West of BRF	5	6.60E-02	6.60E-02	6.60E-02	5.40E-03	5.40E-03	5.40E-03	6.08E-03	7.34E-07
Triassic (middle) East of BRF	6	1.80E-03	1.80E-03	1.80E-03	2.40E-04	2.40E-04	2.40E-04	5.36E-03	6.95E-07
Rewan (bottom) West of BRF	7	2.80E-01	2.80E-01	2.80E-01	1.50E-02	1.50E-02	1.50E-02	2.26E-03	1.46E-06
Rewan (bottom) East of BRF	8	5.20E-03	5.20E-03	5.20E-03	9.70E-04	9.70E-04	9.70E-04	7.89E-03	9.00E-07
Overburden (RCM) West of BRF	9	1.00E-06	1.00E-03	1.79E-04	1.00E-09	3.00E-04	1.82E-05	7.20E-03	7.00E-07
Overburden (RCM) East of BRF	10	1.00E-06	1.00E-03	2.89E-04	1.00E-09	5.00E-04	5.50E-05	6.60E-03	1.00E-06
Burton Rider Seam (RCM) West of BRF	11	1.00E-05	3.80E-02	1.75E-03	1.00E-08	6.30E-03	2.92E-04	1.10E-02	9.00E-07
Burton Rider Seam (RCM) East of BRF	12	1.00E-05	9.20E-03	6.47E-04	1.00E-08	1.70E-03	1.20E-04	1.10E-02	9.00E-07
Interburden (RCM) West of BRF	13	1.00E-06	1.00E-03	1.26E-04	1.00E-09	3.30E-04	1.55E-05	6.10E-03	1.20E-06
Interburden (RCM) East of BRF	14	1.00E-06	1.00E-03	2.24E-04	1.00E-09	5.00E-04	4.07E-05	7.70E-03	1.60E-06



Geology Unit	Layer	Min Kx (m/d)	Max Kx (m/d)	Average Kx (m/d)	Min Kz (m/d)	Max Kz (m/d)	Average Kz (m/day)	Sy	Ss (1/m)
Leichhardt/Vermont Seams (RCM) West of BRF	15	1.00E-05	2.10E-02	1.00E-03	1.00E-08	8.90E-03	4.21E-04	1.40E-02	9.00E-07
Leichhardt/Vermont Seams (RCM) East of BRF	16	1.00E-05	5.20E-02	3.63E-03	1.00E-08	2.10E-02	1.43E-03	1.20E-02	9.00E-07
Underburden (RCM) West of BRF	17	1.00E-06	1.00E-03	2.03E-04	1.00E-09	5.00E-04	4.14E-05	3.60E-03	9.30E-07
Underburden (RCM) East of BRF	18	1.00E-06	1.00E-03	5.39E-04	1.00E-09	5.00E-04	2.46E-04	4.30E-03	9.60E-07
Coal Measures (FCCM)	19	1.00E-06	1.00E-03	3.50E-04	1.00E-09	5.00E-04	7.86E-05	5.20E-03	7.00E-07



Local and regional hydraulic conductivity measurements for Permian interburden strata and coal seams show a general decline in hydraulic conductivity with depth, which is due to increasing overburden pressure reducing the aperture of secondary porosity features. To simulate the hydraulic conductivity depth dependence in the model, the following exponential equation was used to fit the hydraulic conductivity measurement data for the coal seams and interburden:

$$K_x = K_{x_0} \times e^{\text{slope} \times \text{depth}}$$

where: K_x is horizontal hydraulic conductivity which varies with depth;
 K_{x_0} is horizontal hydraulic conductivity at depth of 0 m (intercept of the curve);
slope is a term representing slope of the formula (steepness of the curve); and
depth is depth of the floor of the layer (thickness of the cover material).

The slope for the depth dependence equation was fixed at -0.02 to represent the decline in horizontal conductivity with depth seen in the measured data.

Figure 2-42 presents the horizontal conductivity against depth relationships for the coal and interburden layers estimated during the calibration. The figure also presents local data and conductivity measurements for the Permian units from surrounding mines.

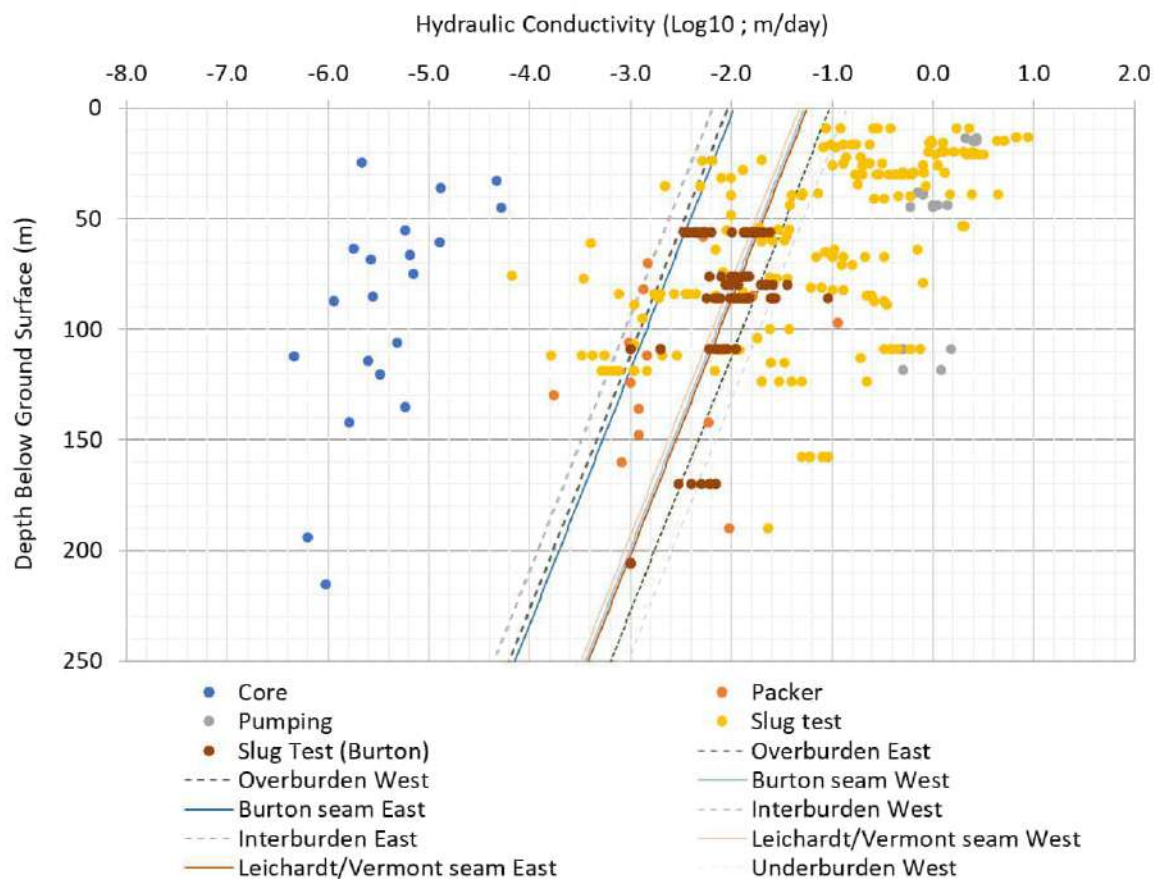


Figure 2-42 Hydraulic Conductivity against Depth in Permian Coal Measures



The properties of spoil simulated using the TVM package were adjusted during the calibration process. The spoil parameter values for the best calibrated realisation are shown in **Table 2-11**.

Table 2-11 Spoil Properties – Best Calibrated Realisation

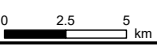
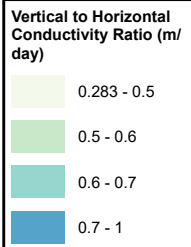
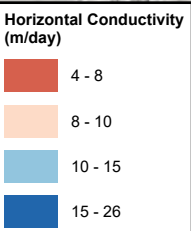
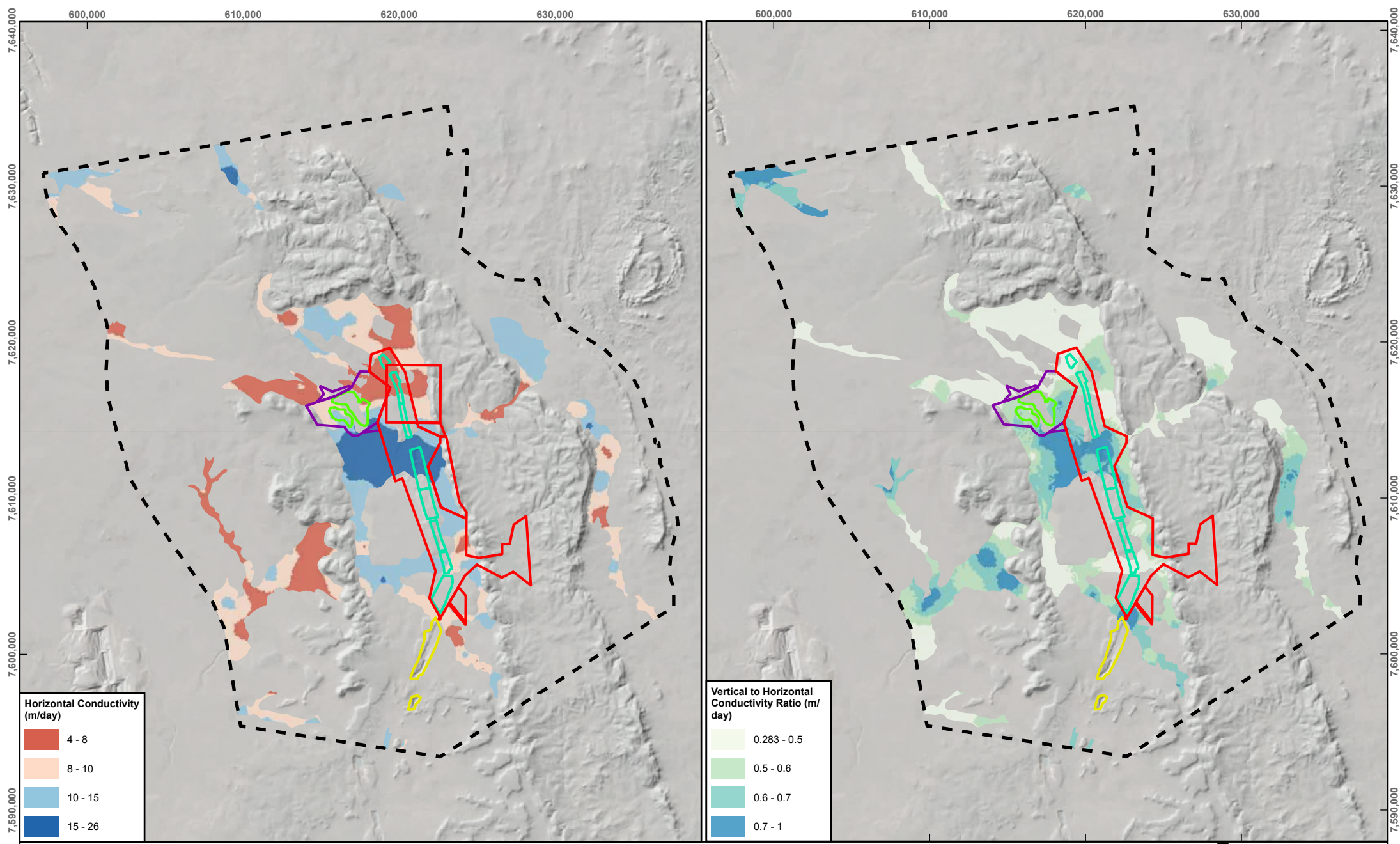
Parameter	Value
Horizontal hydraulic conductivity (m/day)	1.03
Vertical hydraulic conductivity (m/day)	0.10
Specific Yield (%)	1.30%
Specific Storage (1/m)	1.08×10^{-6}

2.2.8.1 Calibrated Pilot Point Parameter Fields

Figure 2-43 shows the horizontal hydraulic conductivity and vertical to horizontal ratio in the alluvium, for the best calibrated realisation. The inclusion of pilot points in the calibration allowed heterogeneity in hydraulic properties and resulted in higher conductivities in the alluvium near the site, where calibration targets are located. The calibrated conductivity in the regolith for the best calibrated realisation in Layer 1 is shown in **Figure 2-44**.

Figure 2-45 and **Figure 2-46** show the specific storage and specific yield in the alluvium and regolith in layer 1, respectively, for the best calibrated realisation.





Scale: 1:310,000 at A4
 Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 15-Dec-2023
 Project Number: 620.31208

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Model Domain

Burton Mining Lease

New Lenton Mining Lease

Burton Pit Extent

New Lenton Pit Extent

Former Burton Mine Pits

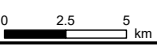
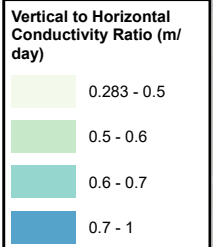
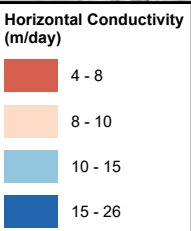
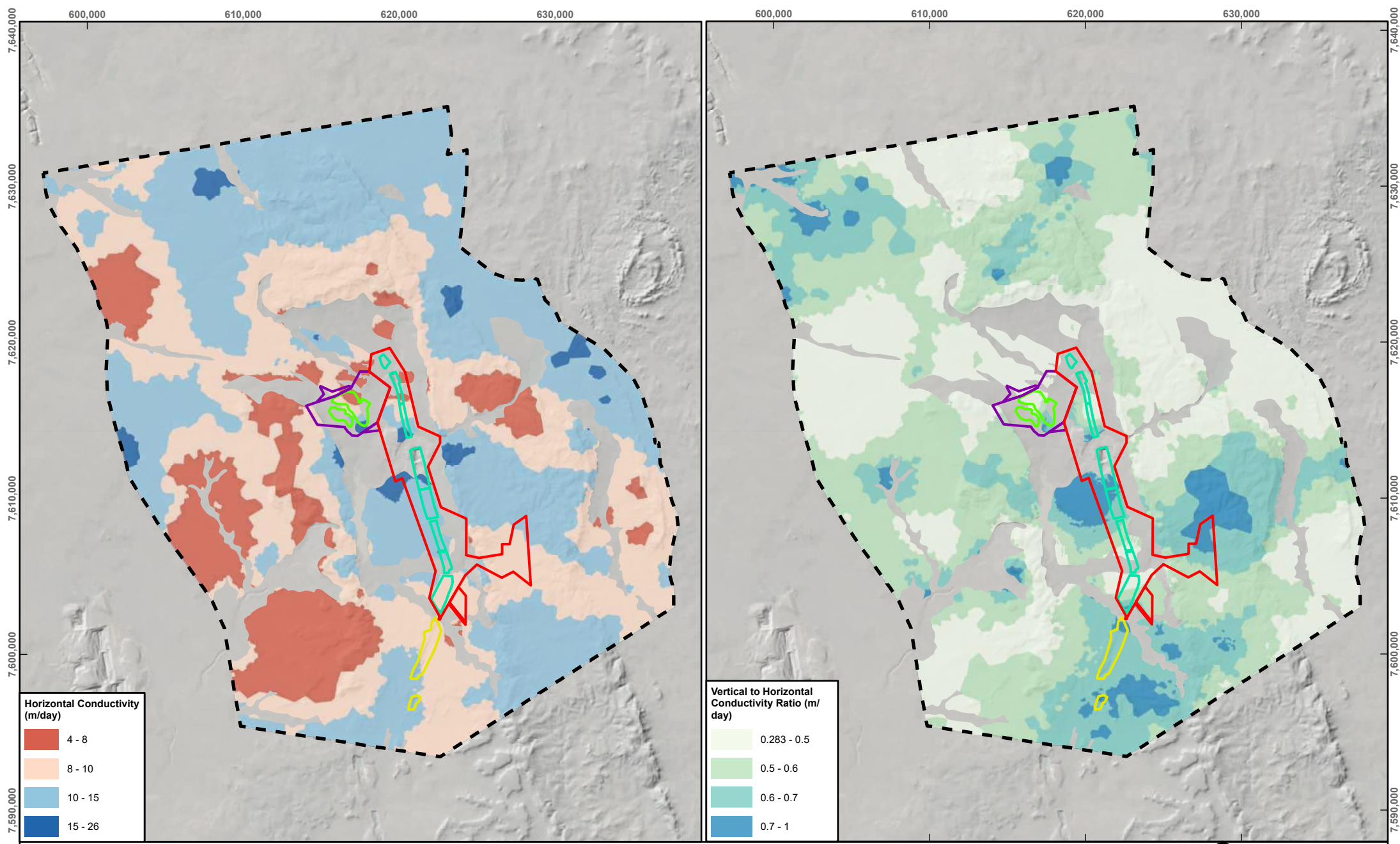
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MODELLING TECHNICAL REPORT

CALIBRATED HYDRAULIC CONDUCTIVITY

IN THE ALLUVIUM – LAYER 1

FIGURE 2-43



Scale: 1:310,000 at A4
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 Project Number: 620.31208



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Model Domain

Burton Mining Lease

New Lenton Mining Lease

Burton Pit Extent

New Lenton Pit Extent

Former Burton Mine Pits

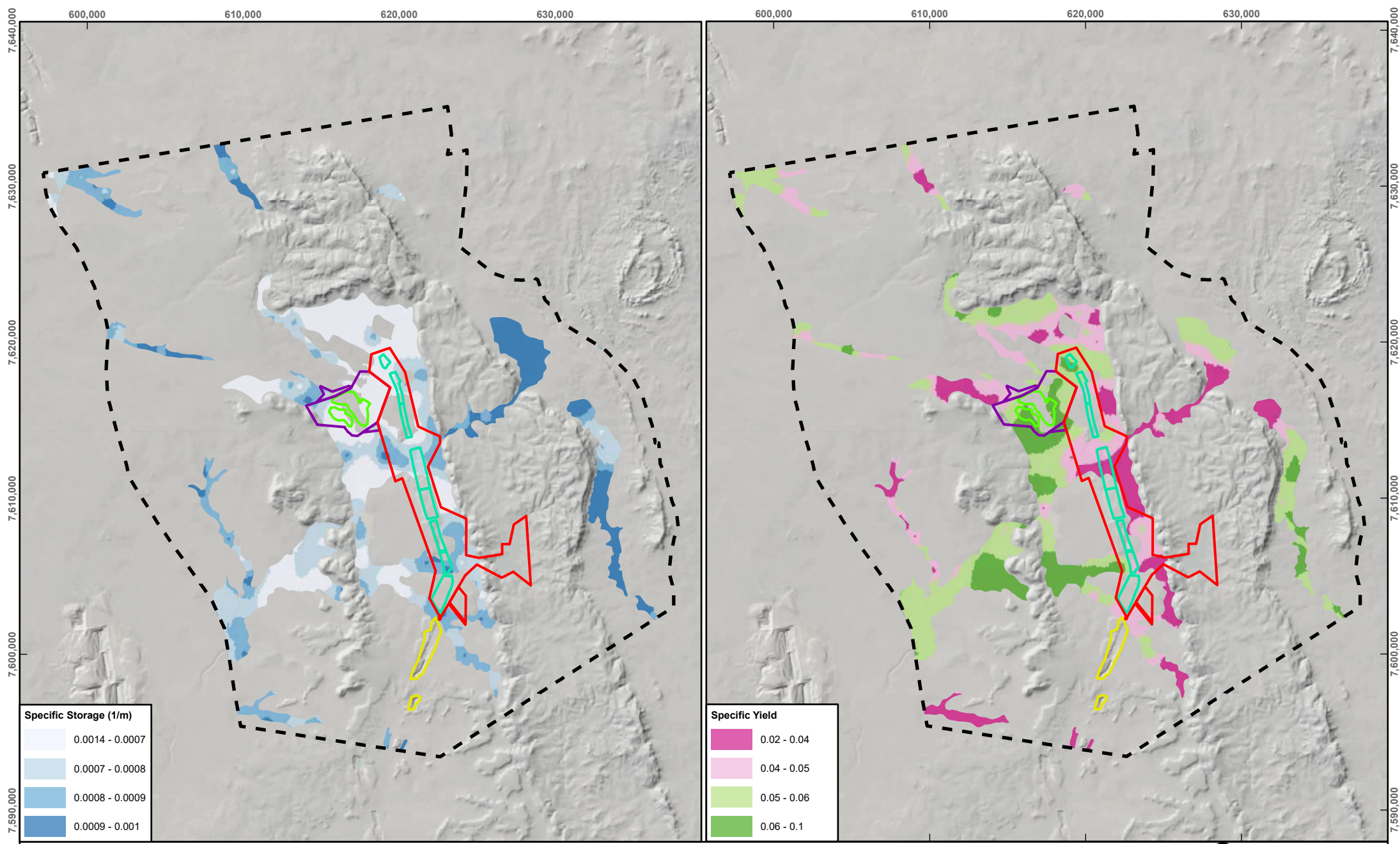
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CALIBRATED HYDRAULIC CONDUCTIVITY

IN THE REGOLITH- LAYER 1

FIGURE 2-44



Scale: 1:310,000 at A4
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CALIBRATED STORAGE PROPERTIES
IN THE ALLUVIUM- LAYER 1

FIGURE 2-45

Model Domain

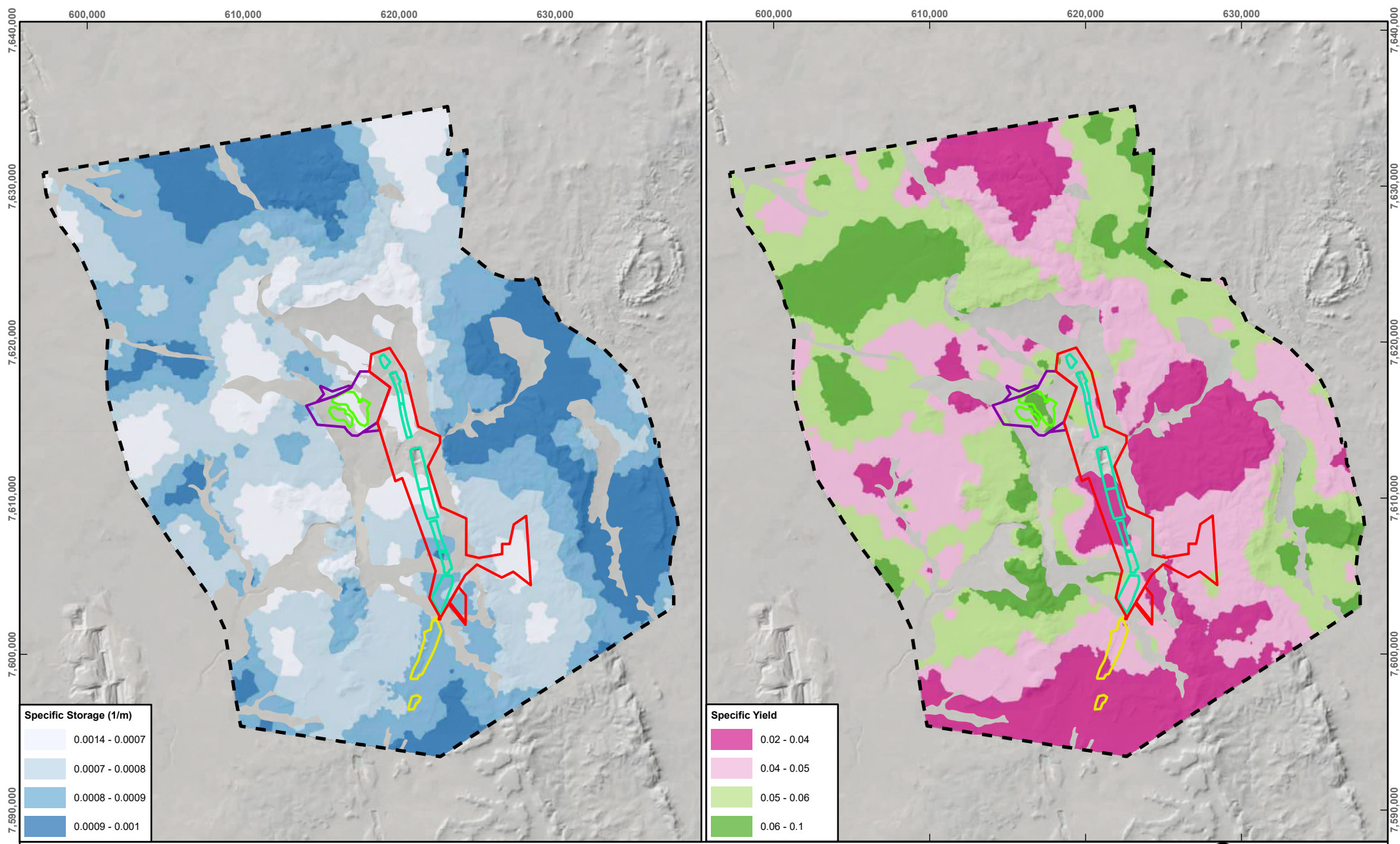
Burton Mining Lease

New Lenton Mining Lease

Burton Pit Extent

New Lenton Pit Extent

Former Burton Mine Pits



Scale: 1:310,000 at A4
 Coordinate System: GDA2020 MGA Zone 55
 Date Drawn: 16-Dec-2023
 Project Number: 620.31208



SLR

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MODELLING TECHNICAL REPORT
CALIBRATED STORAGE PROPERTIES
IN THE REGOLITH- LAYER 1

FIGURE 2-46

Model Domain

Burton Mining Lease

New Lenton Mining Lease

Burton Pit Extent

New Lenton Pit Extent

Former Burton Mine Pits

2.2.9 Calibrated Recharge and Evapotranspiration

Diffuse infiltration of rainfall through the soil profile and subsequent drainage to underlying hydrostratigraphic units is the primary method of groundwater recharge. In alluvial zones, river leakage can also provide recharge to groundwater systems, as detailed in **Section 2.1.5.2**. Model recharge zones and corresponding recharge rates for the best calibrated realisation are summarised in **Table 2-12**, including a summary of the calibrated rates for the spoil zones. Where spoil emplacement has been simulated following the removal of drain cells (as described in **Section 2.1.5.3**), enhanced recharge to spoil material has been applied in the stress period following removal of drain cells, consistent with the change in material properties simulated using the TVM package.

Table 2-12 Calibrated Recharge Rates

Unit	% of LUMPREM Net Recharge	Approximate % of Annual Rainfall	Long-term Average Rainfall Recharge (mm/yr)
Site Alluvium	2.0	0.5	3.2
Site Eluvium	16.5	4.4	26.5
Floodplain Alluvium	7.6	1.0	12.1
Permian Regolith	0.6	0.2	1.0
Triassic Regolith	1.0	0.3	1.6
Isaac River Riparian Zone	6.1	1.6	9.8
Isaac River (applied when rainfall > 30mm/d)	7.1	1.9	11.4
Spoil	10.6 – 13.3	2.8 – 3.6	16.8 – 21.4

The table includes the calibrated factor as applied to the net recharge rates output by LUMPREM2 (described in **Section 2.1.5.2**), as an approximate percentage of annual rainfall and as the corresponding long-term average rainfall recharge.

The calibrated recharge rates shown **Table 2-12** are consistent with the long-term recharge rates estimated using Chloride Mass Balance (CMB) data from site bores at New Lenton and Burton, as presented in Table 5-4 of the New Lenton Mine PER (SLR, 2023). CMB derived effective recharge estimations for the alluvium, alluvium/regolith, regolith, and Permian units indicate average recharge to be 0.3%, 8.6%, 0.2% and 0.1% of rainfall for each of the units, respectively.

Estimation of likely recharge rates through coal mine spoil was a specific topic explored by MER (2009). As documented by MER (2009), there is little information examining rainfall recharge through rehabilitated spoils. Modelling undertaken by MER (2009) suggested deep percolation rates (i.e. recharge rates) ranging from 1% to 5.5% of long-term rainfall. The recharge rates to the 13 spoil zones were calibrated to range between 2.8% and 3.6% of long-term average rainfall. Therefore, it is consistent with the published literature study of Permian coal measures spoil recharge rates (MER, 2009).

Model evapotranspiration zones and their corresponding calibrated evapotranspiration rates and extinction depths are summarised in **Table 2-13**, including for the spoil.



Table 2-13 Calibrated Evapotranspiration Rates and Depths

Unit	Factor applied to average annual EVT of 600 mm/yr	Long-term average evapotranspiration (mm/yr)	Extinction Depth (m)
Riparian Buffer	1.02	613.7	9.4
Dense Forest	1.02	611.3	3.8
Shrub and Bare	1.01	606.3	2.6
Spoil	0.99	591.9	2.1

2.2.10 Calibrated Riverbed Conductivity

Model RIV cell zones and their corresponding calibrated riverbed vertical conductivity are summarised in **Table 2-14**.

Table 2-14 Calibrated Riverbed Conductivity

Surface Water Feature in RIV Package	Riverbed vertical conductivity (m/day)
Burton Range Dam	0.013
Lake Elphinstone	0.011
Teviot Creek Dam	0.009
Isaac River	0.013



3.0 Predictive Modelling

3.1 Timing and Mining

Transient predictive modelling was used to simulate the proposed mining at New Lenton as well as planned mining at Burton mine. As discussed in **Section 2.1.3**, the predictive period comprises quarterly stress periods to January 2024, followed by annual stress periods until January 2040 and biennial stress periods thereafter. Mining cells progress annually, according to mine stage plans provided for both the New Lenton and Burton mine sites.

Figure 2-5 shows the modelled progression of open-cut mining at New Lenton and Burton mines. As discussed in **Section 2.1.5.3**, the operational window for mine cells was inferred through the annual landforms provided, after which time the drains were removed and the MODFLOW-USG Time-Variant Materials (TVM) package was used to assign spoil or void properties to the cells.

Transient predictive modelling was undertaken for three model scenarios:

- Cumulative – proposed mine plan at New Lenton plus approved mining at Burton;
- Approved – approved mine plan at Burton; and
- Null – no historic or future mining within the region.

The incremental predictions for New Lenton have been calculated as the difference between the Cumulative and Approved scenarios. The cumulative predictions have been calculated as the difference between the Cumulative and Null scenarios.

During the predictive period, the simulation of historic mined pits adjacent to Burton Mine (Plumtree and Bullock Creek, formerly part of Burton Mine) included no additional change to model properties following the historical setup. The two pits have therefore been modelled as partially backfilled pits, with residual voids consistent with the latest available LiDAR elevations, for the duration of the predictive modelling period.

3.2 Water Balance

Table 3-1, **Table 3-2** and **Table 3-3** present average flow rates for water transfer into and out of the model during the predictive period (July 2023 to January 2042), for the three predictive scenarios. The mass balance error for all three scenarios were 0.0% indicating that the model achieved an acceptable numerical solution.

Table 3-1 Transient Predictive Water Balance Summary - Cumulative

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	9.22	51.4	-	-
ET (from GW) (EVT)	-	-	7.37	41.1
Isaac River and Water Dams (RIV)	2.19	12.2	2.45	13.6
Regional GW Flow (GHB)	0.30	1.7	1.86	10.4
Mines (DRN)	-	-	2.32	12.9
Constant Head (CHD)	1.06	5.9	0.27	1.5
Storage	5.17	28.8	3.68	20.5
Total	17.94	100.00	17.94	100.00



Table 3-2 Transient Predictive Water Balance Summary - Approved

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	9.19	54.4	-	-
ET (from GW) (EVT)	-	-	7.70	45.6
Isaac River and Water Dams (RIV)	2.18	12.9	2.45	14.5
Regional GW Flow (GHB)	0.30	1.8	1.86	11.0
Mines (DRN)	-	-	1.34	8.0
Constant Head (CHD)	0.97	5.7	0.20	1.2
Storage	4.25	25.2	3.34	19.7
Total	16.89	100.0	16.90	100.0

Table 3-3 Transient Predictive Water Balance Summary - Null

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	9.07	75.9	-	-
ET (from GW) (EVT)	-	-	7.55	63.1
Isaac River and Water Dams (RIV)	2.16	18.1	2.49	20.8
Regional GW Flow (GHB)	0.30	2.5	1.87	15.7
Mines (DRN)	-	-	-	-
Constant Head (CHD)	-	-	-	-
Storage	0.42	3.5	0.05	0.4
Total	11.95	100.0	11.95	100.0

The tables show that simulated recharge increased from 9.07 ML/d in the Null scenario to 9.19 ML/day in the Approved scenario and 9.22 ML/day for the Cumulative scenario. The increase in recharge is due to the presence of open cut mining and enhanced recharge through the spoil to the groundwater system in the Approved and Cumulative scenario.

Table 3-1, Table 3-2 and Table 3-3 show an average of 0.3 ML/day entering and approximately 1.9 ML/day leaving the model through the regional groundwater flow (GHB) in all the scenarios. Evapotranspiration for the predictive models is approximately 7.5 ML/day. The loss to evapotranspiration happens where the water table is within the extinction depth of the land surface, which is mainly along the saturated extent of Isaac River alluvium.

The water balance tables show that in all the scenarios the net river exchange flux (RIV) is an outflow of approximately 0.3 ML/day. There was no baseflow predicted for Isaac River in the prediction period in any of the scenarios. Therefore, all the fluxes simulated for the RIV package are to the water dams.

Table 3-1 and Table 3-2 show that the proposed mining at New Lenton resulted in an increase in the average drain outflow from 1.34 ML/day predicted for the Approved run to 2.32 ML/day.



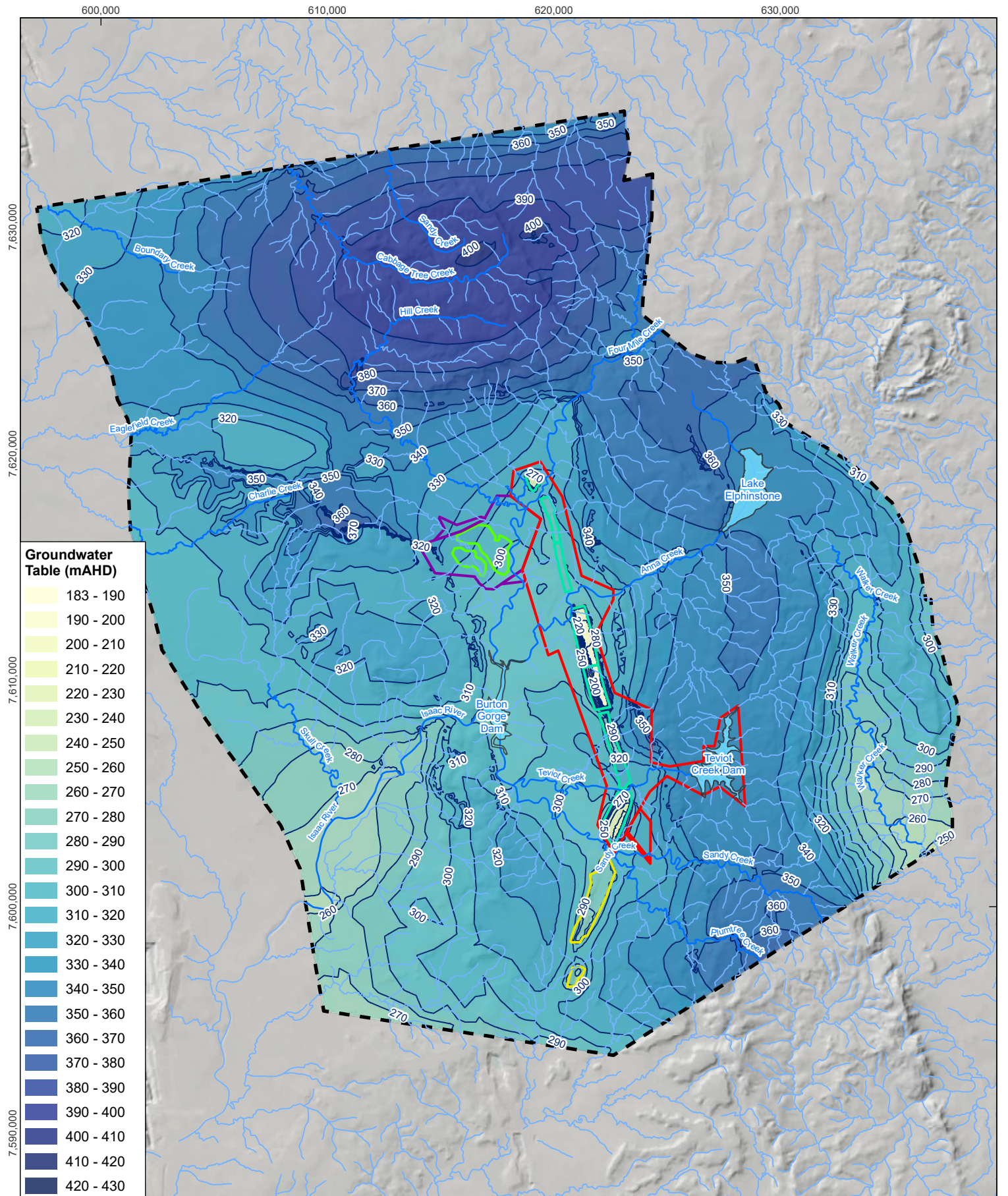
Appendix E shows the time series charts for each of the water balance components for the Null, Approved and Cumulative scenarios. **Appendix E** also compare the best calibration realisation to values from all the other realisations.

3.3 Predicted Groundwater Levels

Predicted groundwater levels at the end of mining for the Approved scenario are presented in **Figure 3-1** to **Figure 3-5**. Note that where the target seam model layers have been removed by mining, groundwater levels are not shown in that area for that layer. **Figure 3-1** shows the predicted water table at the end of mining in the Approved scenario (2040). Within the mine pit extent at the end of mining, the predicted water table elevation represents the depressurisation of the groundwater system down to the base elevation of the active pit. **Figure 3-2** to **Figure 3-5** show the predicted groundwater elevations within the unconfined (layers 1 and 2), Burton/Rider seams (layer 12), and Leichhardt/Vermont seams (layer 16), respectively.

Predicted water table and groundwater levels at the end of mining for the Cumulative scenario are presented in **Figure 3-6** to **Figure 3-10**. The gaps in the groundwater levels displayed represent unsaturated areas (i.e., where the simulated water level elevation is below the base of cell). Note again that where the Permian coal seam model layers have been removed by mining, groundwater levels are not shown in that area for that layer.





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

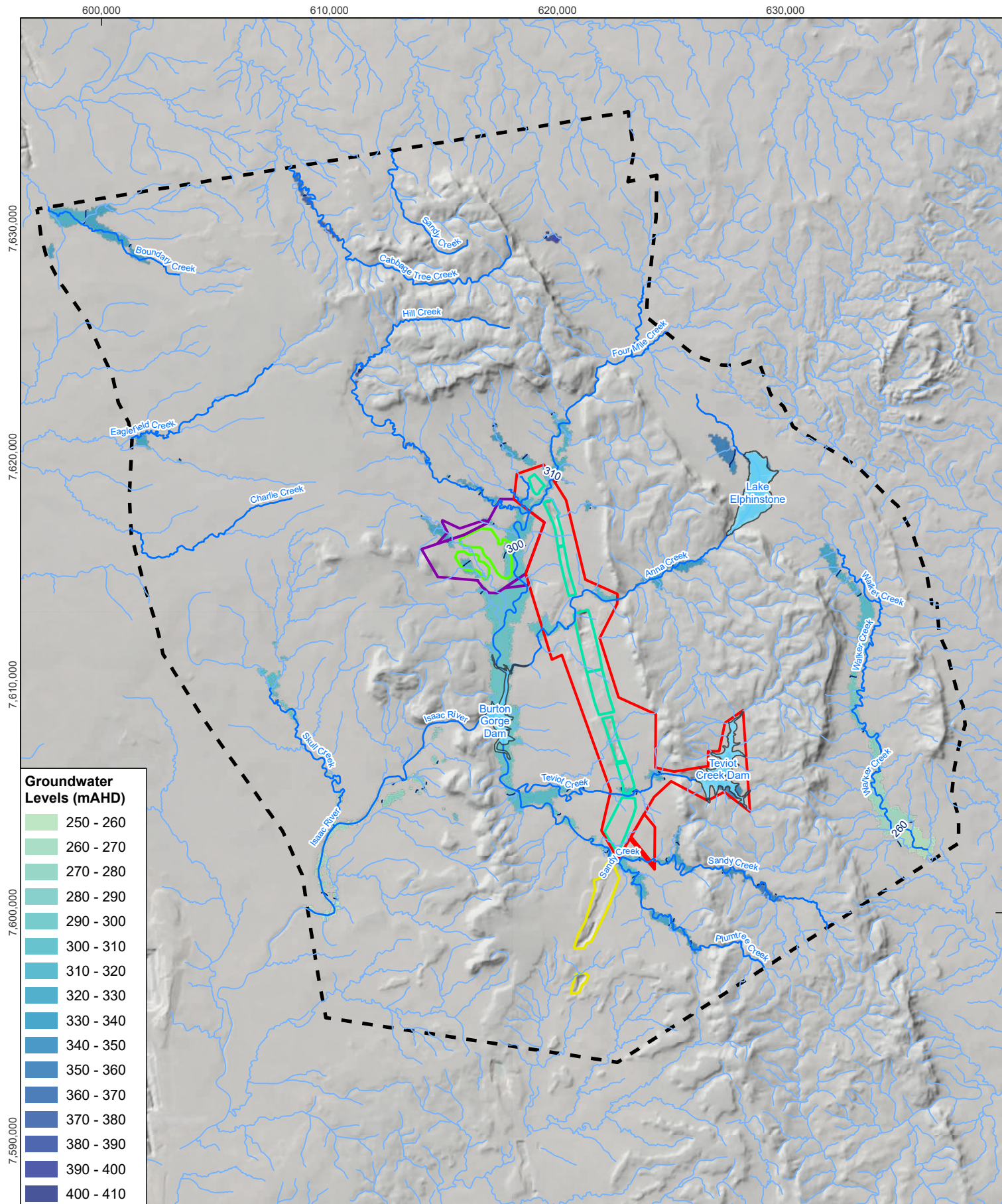
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED WATER TABLE AT END OF MINING (2040) – APPROVED SCENARIO



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FIGURE 3-1



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

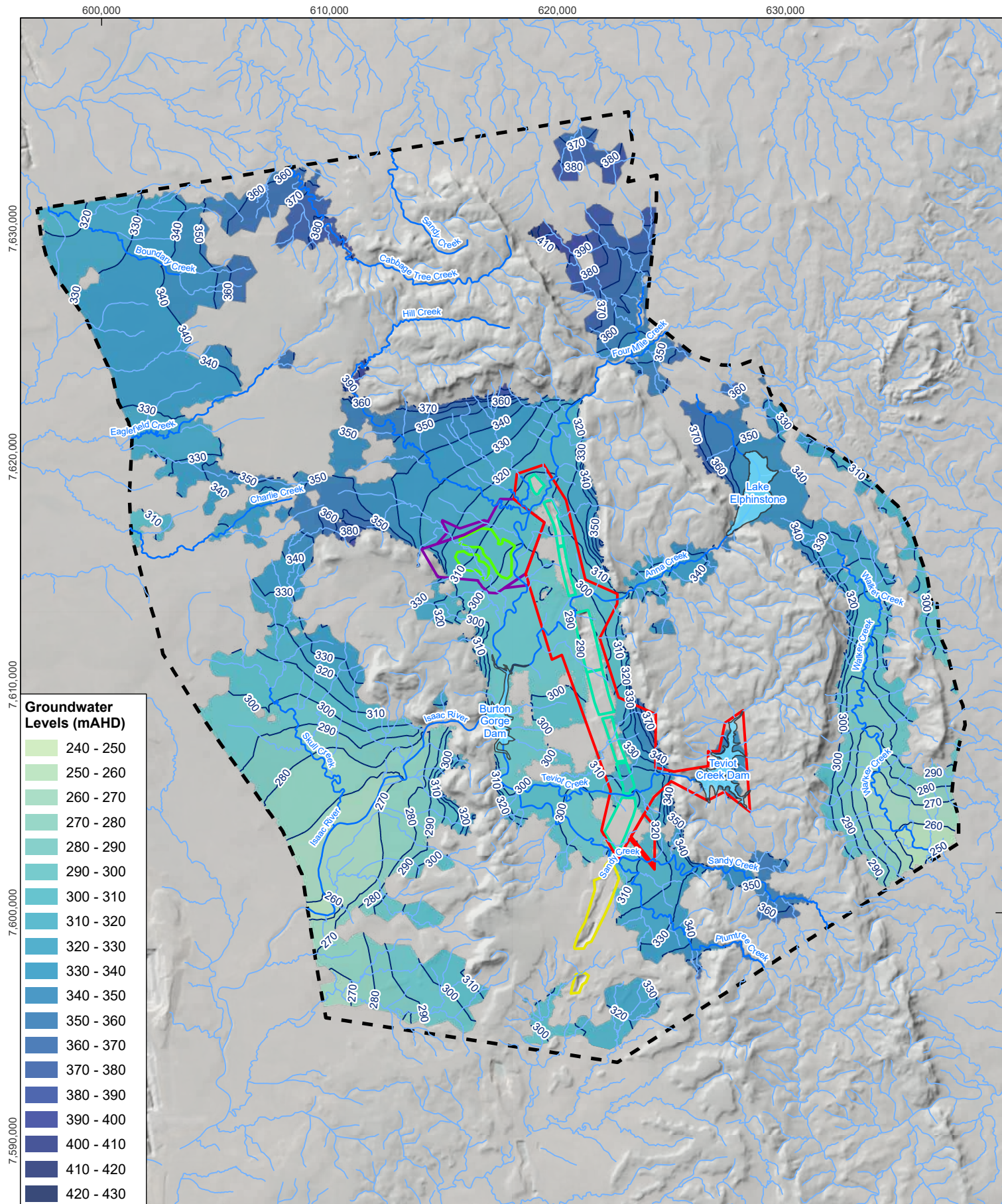
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED GROUNDWATER LEVELS IN
ALLUVIUM AT END OF MINING (2040) –
APPROVED SCENARIO**



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FIGURE 3-2



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

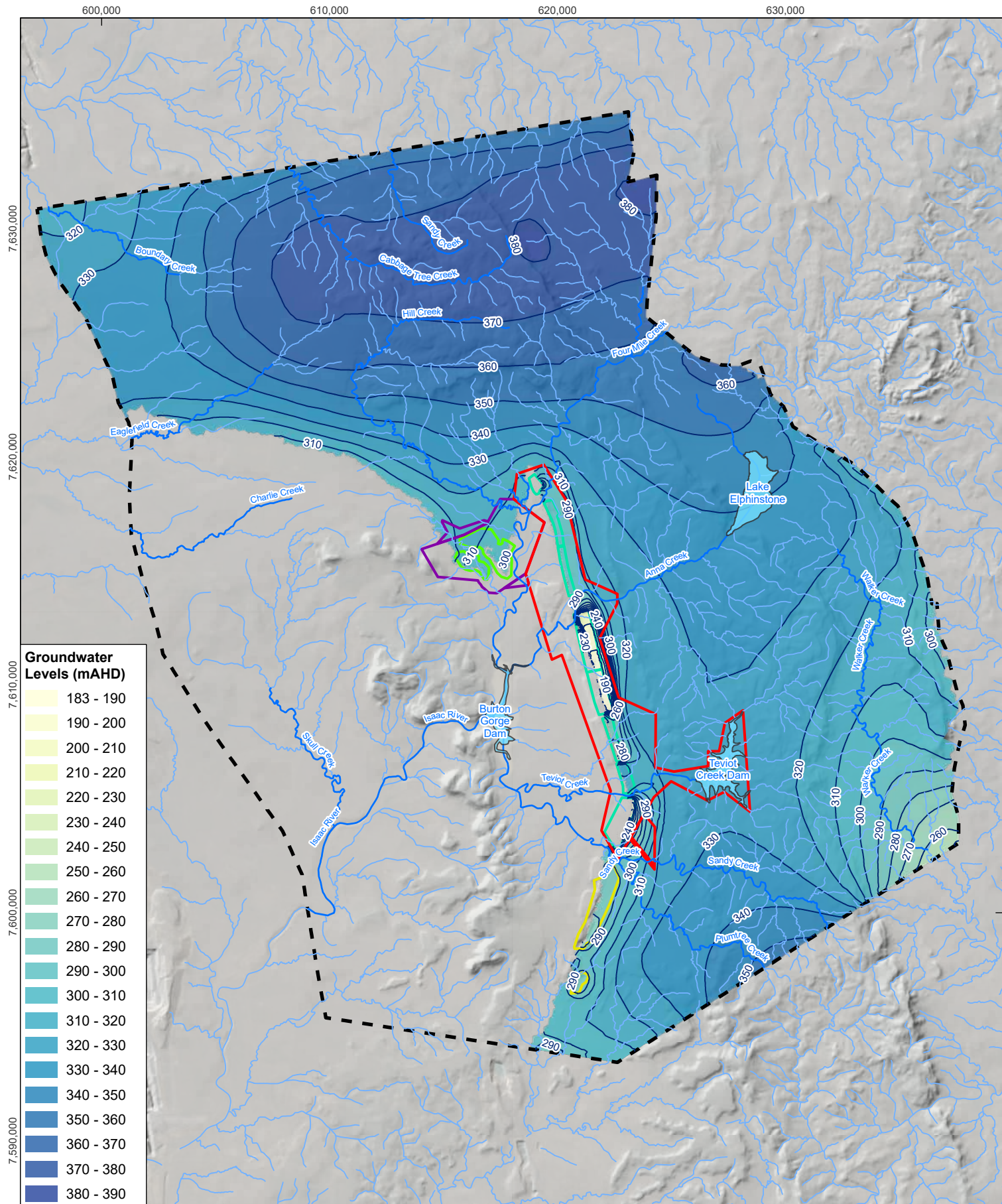
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN REGOLITH AT END OF MINING (2040) – APPROVED SCENARIO



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FIGURE 3-3

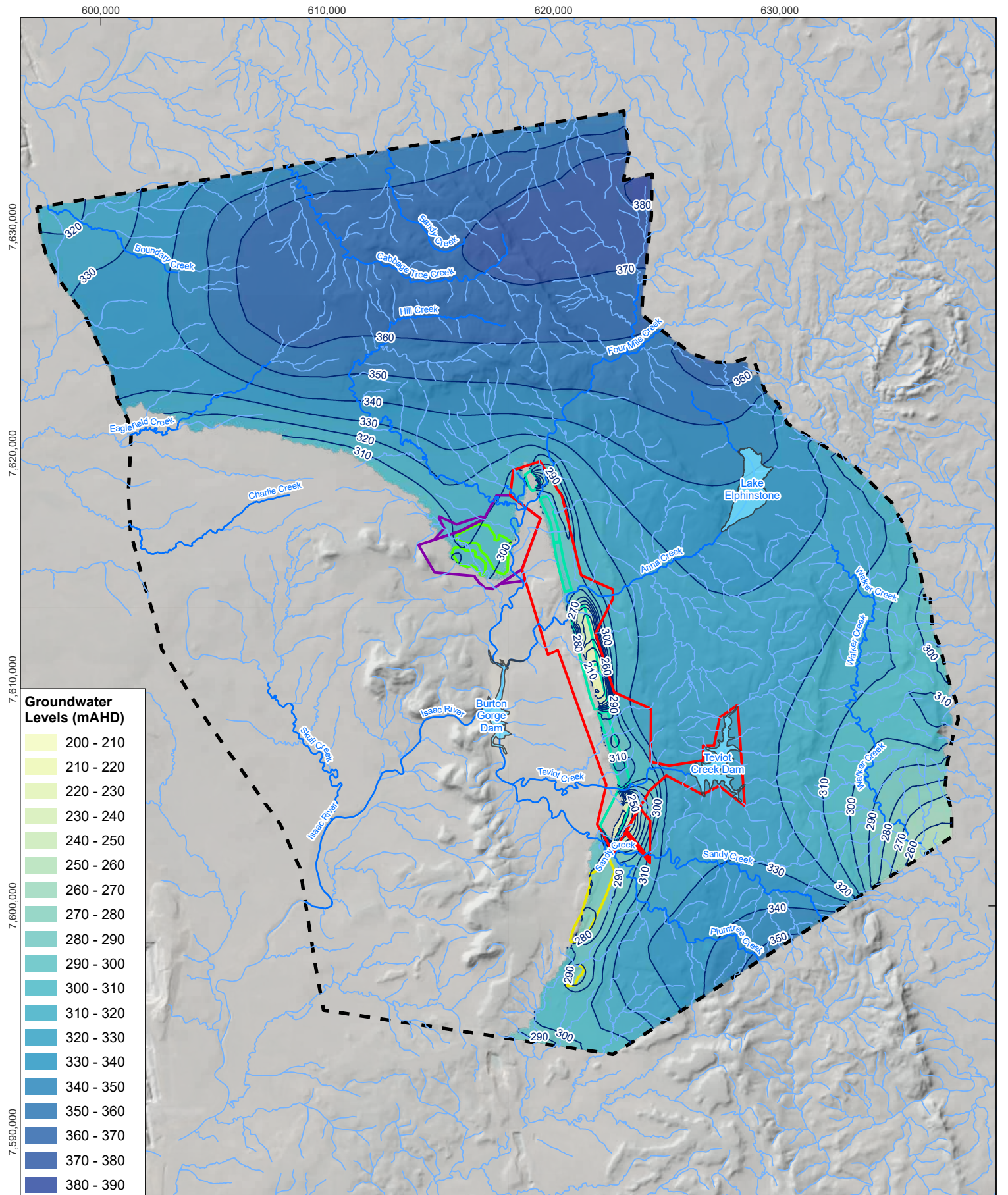


BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN BURTON/RIDER SEAM AT END OF MINING (2040) – APPROVED SCENARIO

FIGURE 3-4

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

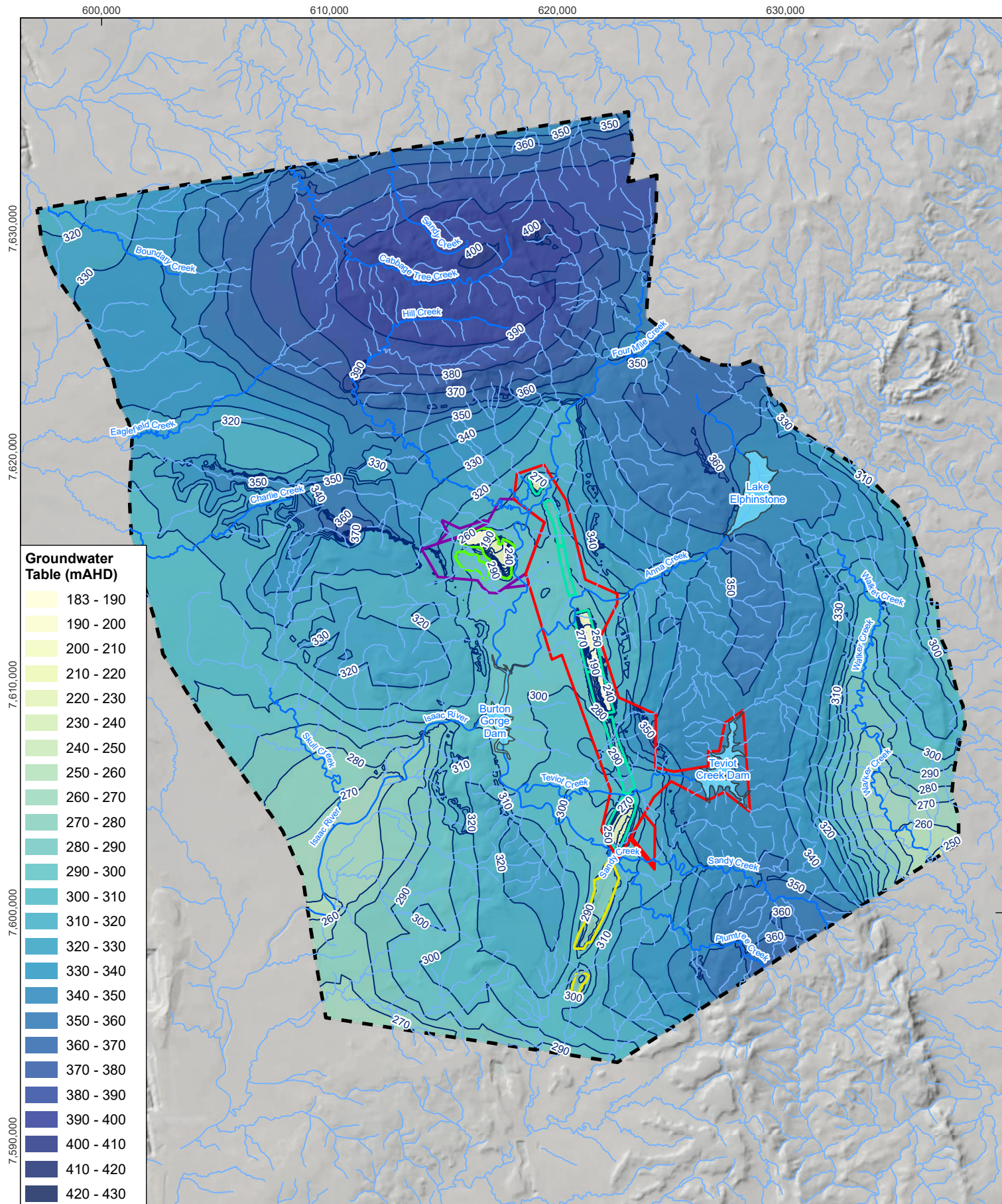
Date Drawn: 16-Dec-2023

Drawn by: AS



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FIGURE 3-5



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHD)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

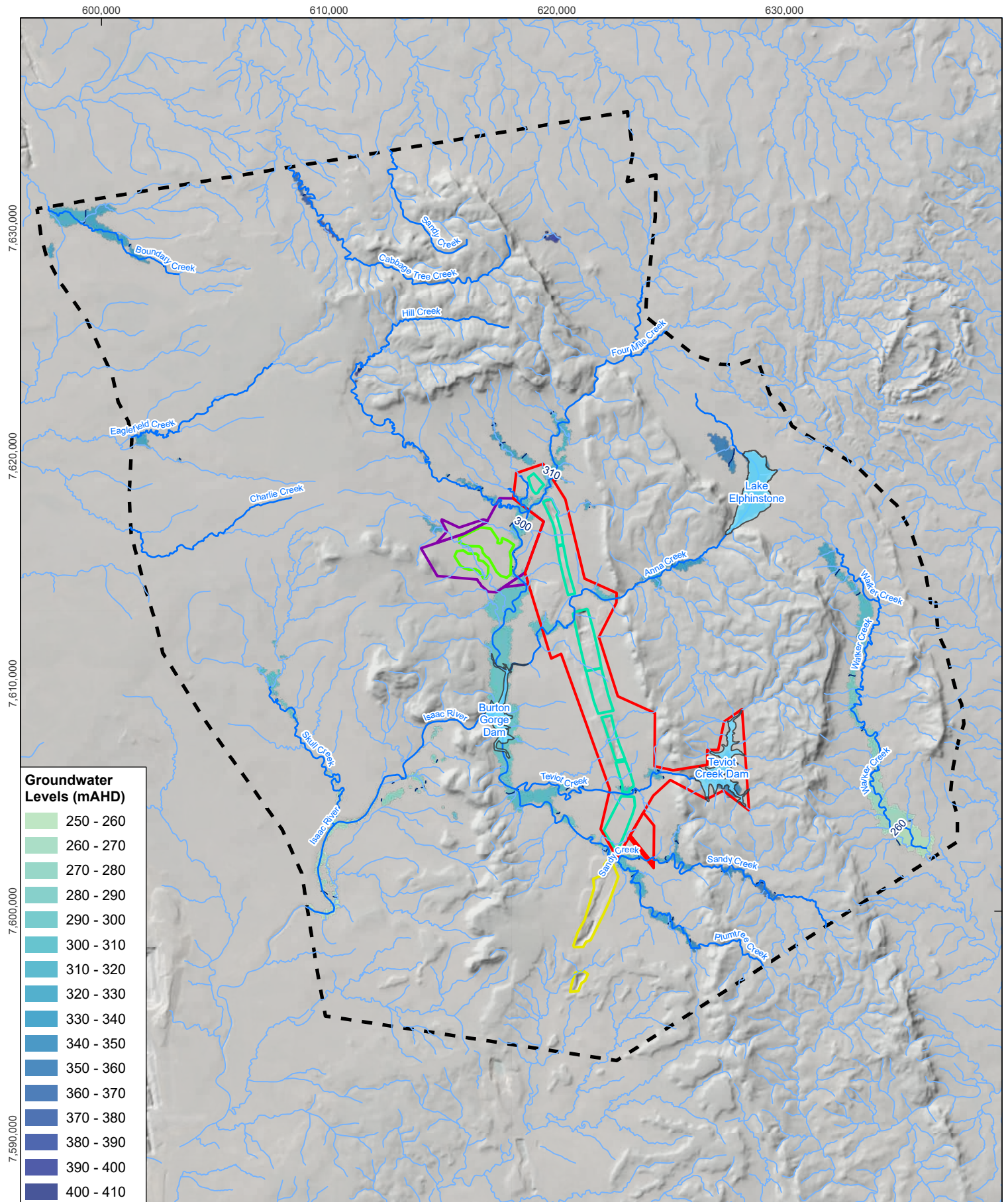
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED WATER TABLE AT END OF MINING (2040) – CUMULATIVE SCENARIO



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FIGURE 3-6



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

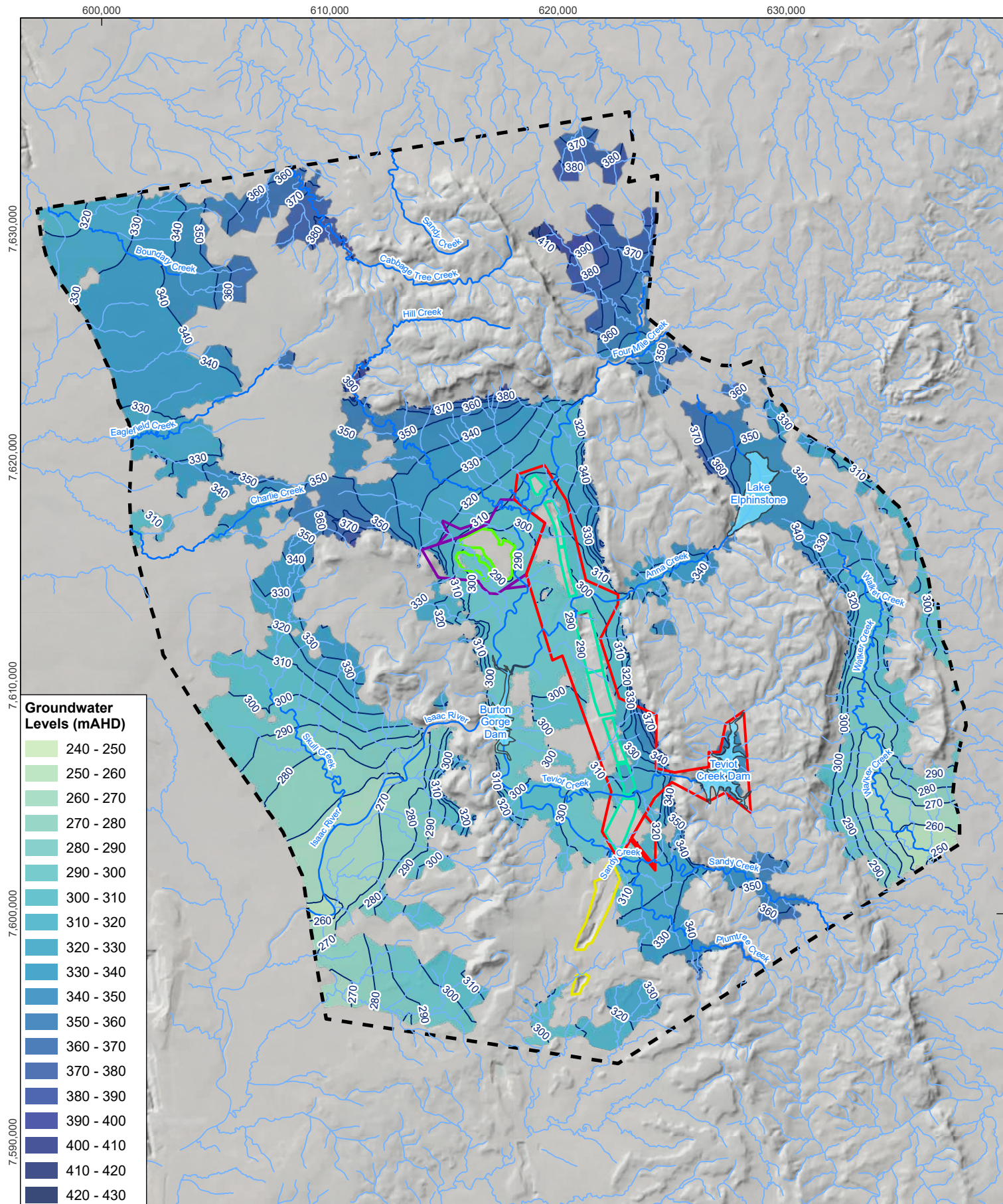
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN ALLUVIUM AT END OF MINING (2040) – CUMULATIVE SCENARIO



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FIGURE 3-7



Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

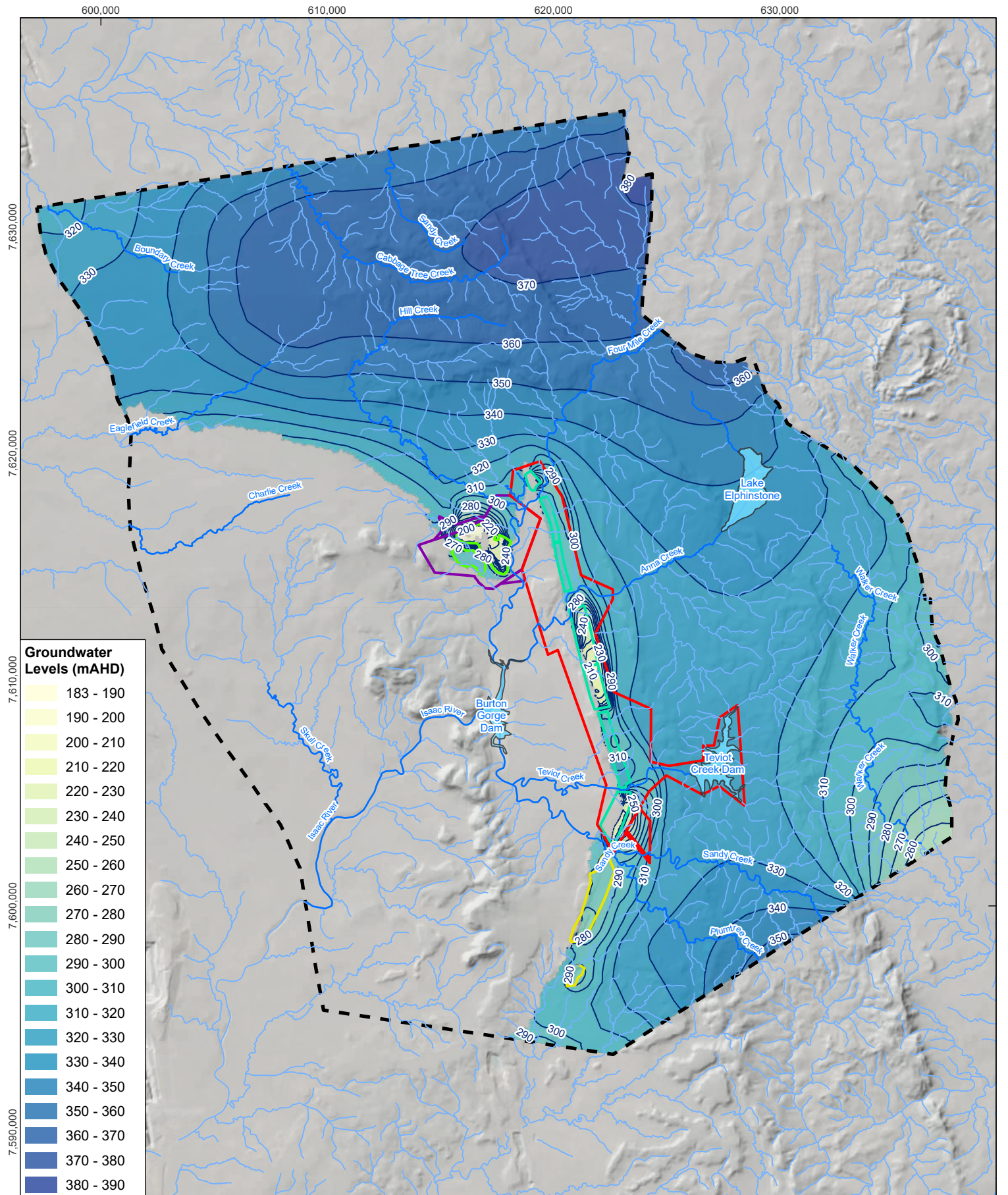


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PREDICTED GROUNDWATER LEVELS IN REGOLITH AT END OF MINING (2040) – CUMULATIVE SCENARIO

FIGURE 3-8



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHD)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN LEICHHARDT/VERMONT SEAM AT END OF MINING (2040) – CUMULATIVE SCENARIO



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FIGURE 3-10

Figure 3-1 and **Figure 3-6** indicate that away from the mine the simulated water table generally reflects the topography and surface drainage. The figures show within and immediately around the mine footprint the simulated groundwater table is influenced by depressurisation from active mining. **Figure 3-3** and **Figure 3-8** show that in both scenarios, groundwater levels in the regolith (model layer 2) are generally consistent with gradients simulated for the end of the calibration, shown in **Figure 2-28**. There is a slight decrease in the saturated extent within the regolith due to simulated mining in both scenarios.

As discussed in **Section 2.1.5.3**, progressive backfilling of the open cut mine areas with spoil was simulated in the model. During active simulated mining at Burton and New Lenton (i.e. when the MODFLOW Drain package is active), the water table in the mined out pit is simulated to remain depressed. This is assisted by replacing the host material with spoil backfill, which has a relatively high conductivity compared to the native Permian geology. Therefore, water table depression is greatest within the pit areas.

Figure 3-2 and **Figure 3-7** show in both scenarios the model predicted general flow of groundwater with the alignment of the Isaac River, towards the south-west. The trends remain consistent with those presented for the current calibrated groundwater conditions (**Figure 2-27**). Within 1 km of New Lenton, the predicted groundwater levels in the alluvium for the Cumulative scenario show a decrease in the extent of saturation comparing to the predicted groundwater levels for the Approved scenario due to de-watering of the proposed East and West pits.

Figure 3-4, **Figure 3-5**, **Figure 3-9** and **Figure 3-10** show that in both scenarios, the predicted groundwater levels within the Permian seams maintain overall flow gradients consistent with the general topography. The figures show local zones of depressurisation in groundwater levels within the Burton/Rider and Leichhardt/Vermont seams due to simulated mining. Compared to the Approved scenario, the Cumulative scenario resulted in additional drawdown to the west of Burton mine.

3.4 Predicted Drawdowns

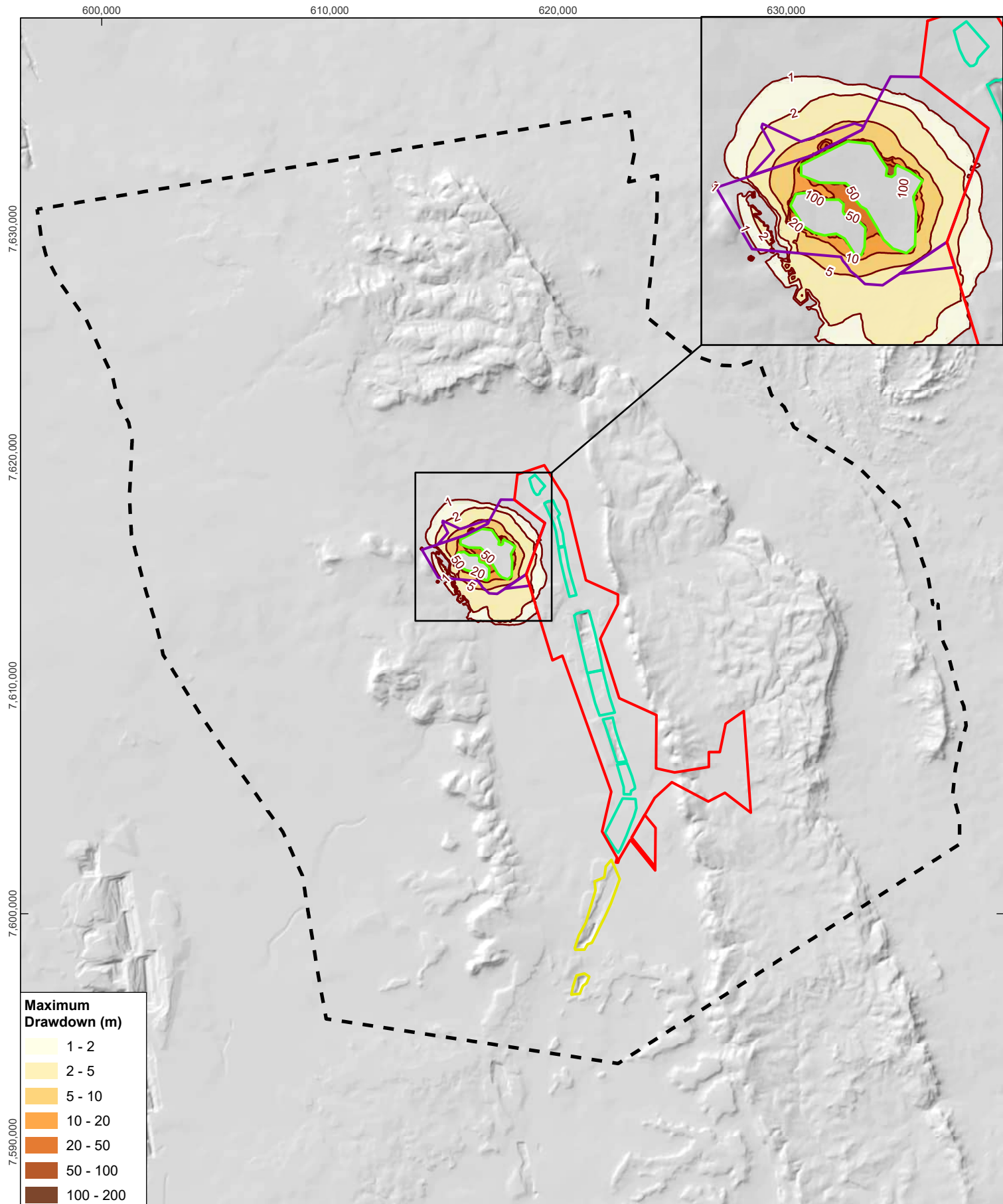
The process of mining reduces water levels in surrounding geologic units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of depressurisation in a confined aquifer and zone of drawdown within the water table. Depressurisation and drawdown are greatest at the working coal-face, and gradually reduces with distance from the mine. The predicted drawdowns due to the proposed mining at New Lenton and the Burton operations (cumulative) and due to the proposed mining at New Lenton only (incremental) are discussed in the following sections.

3.4.1 Incremental Drawdowns

Incremental drawdown due to the proposed mining at New Lenton was obtained by calculating the difference in groundwater levels for the Approved scenario and the Cumulative scenario. The maximum incremental drawdowns due to the proposed mining at New Lenton, at any point during active mining, are shown in **Figure 3-11** to **Figure 3-15**.

The maximum drawdown is a combination of the maximum drawdown values recorded at each cell at any time from the start of active mining at New Lenton (January 2025) to one year after end of the mining at New Lenton (December 2040).





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

-  Maximum Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

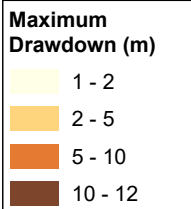
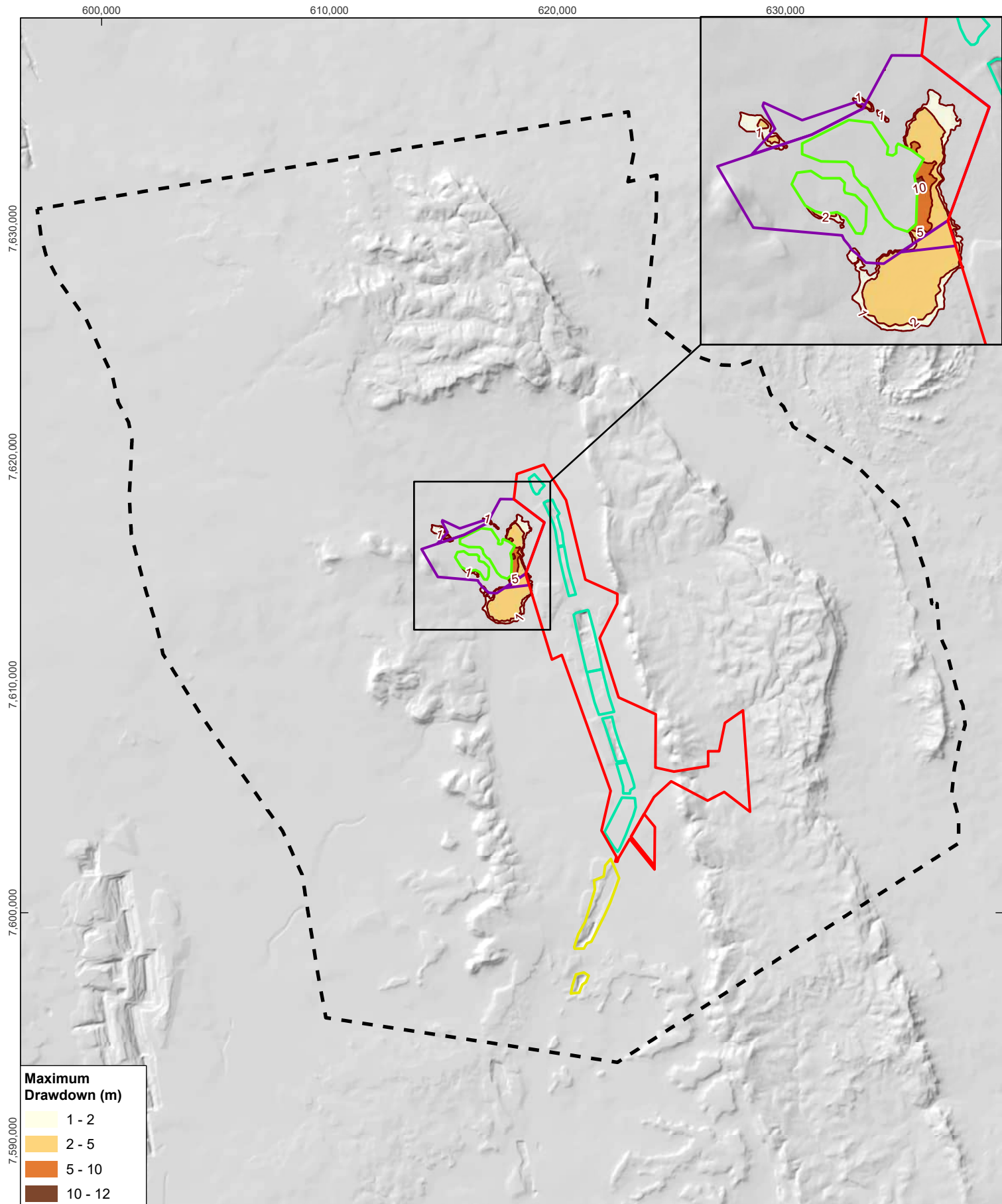
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM INCREMENTAL WATER TABLE DRAWDOWN (2025-2040)



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FIGURE 3-11



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 15-Dec-2023

Drawn by: RB

LEGEND

-  Maximum Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

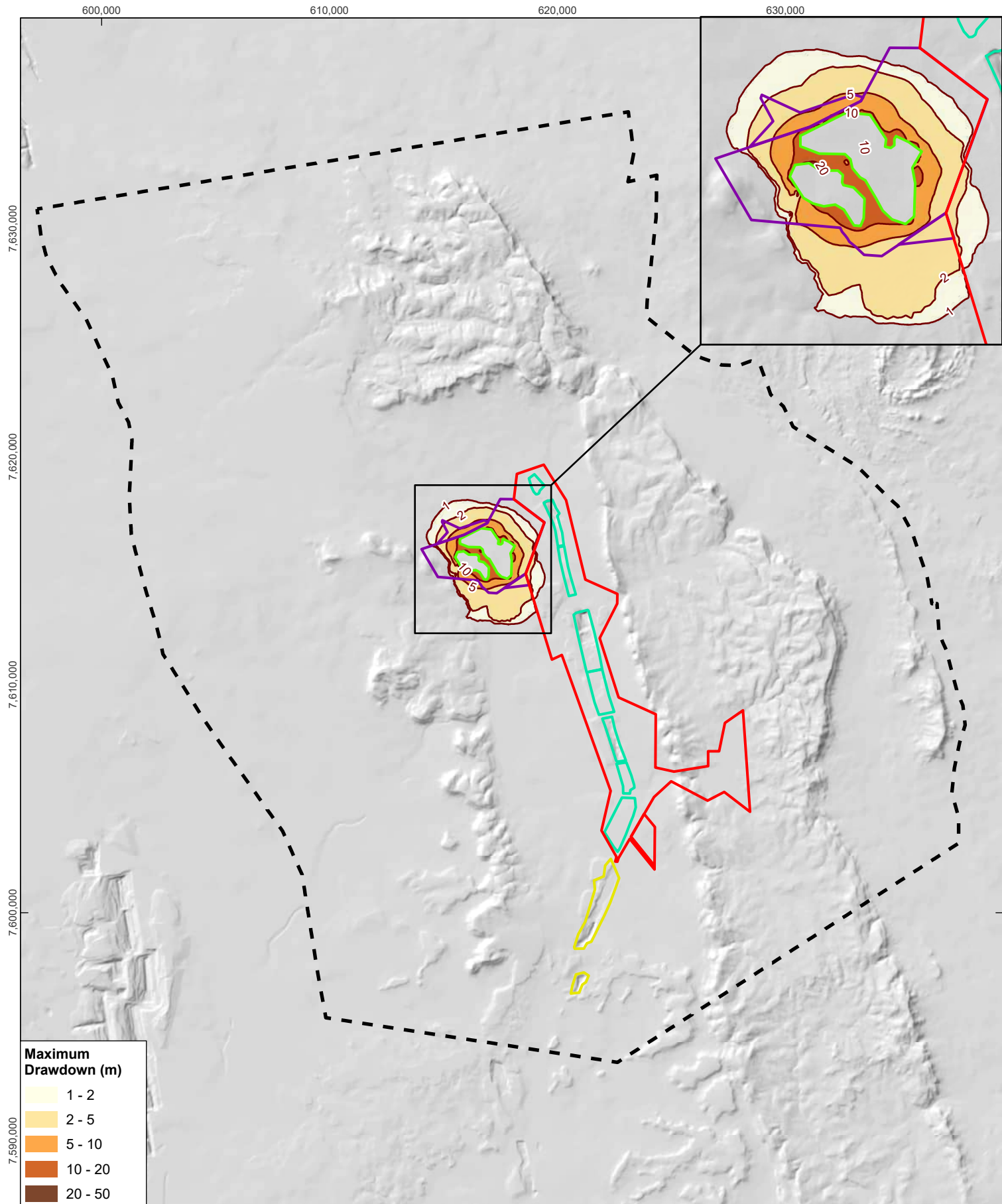
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED MAXIMUM INCREMENTAL
DRAWDOWN IN THE ALLUVIUM
(2025-2040)**



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FIGURE 3-12



Maximum Drawdown (m)

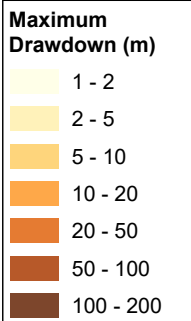
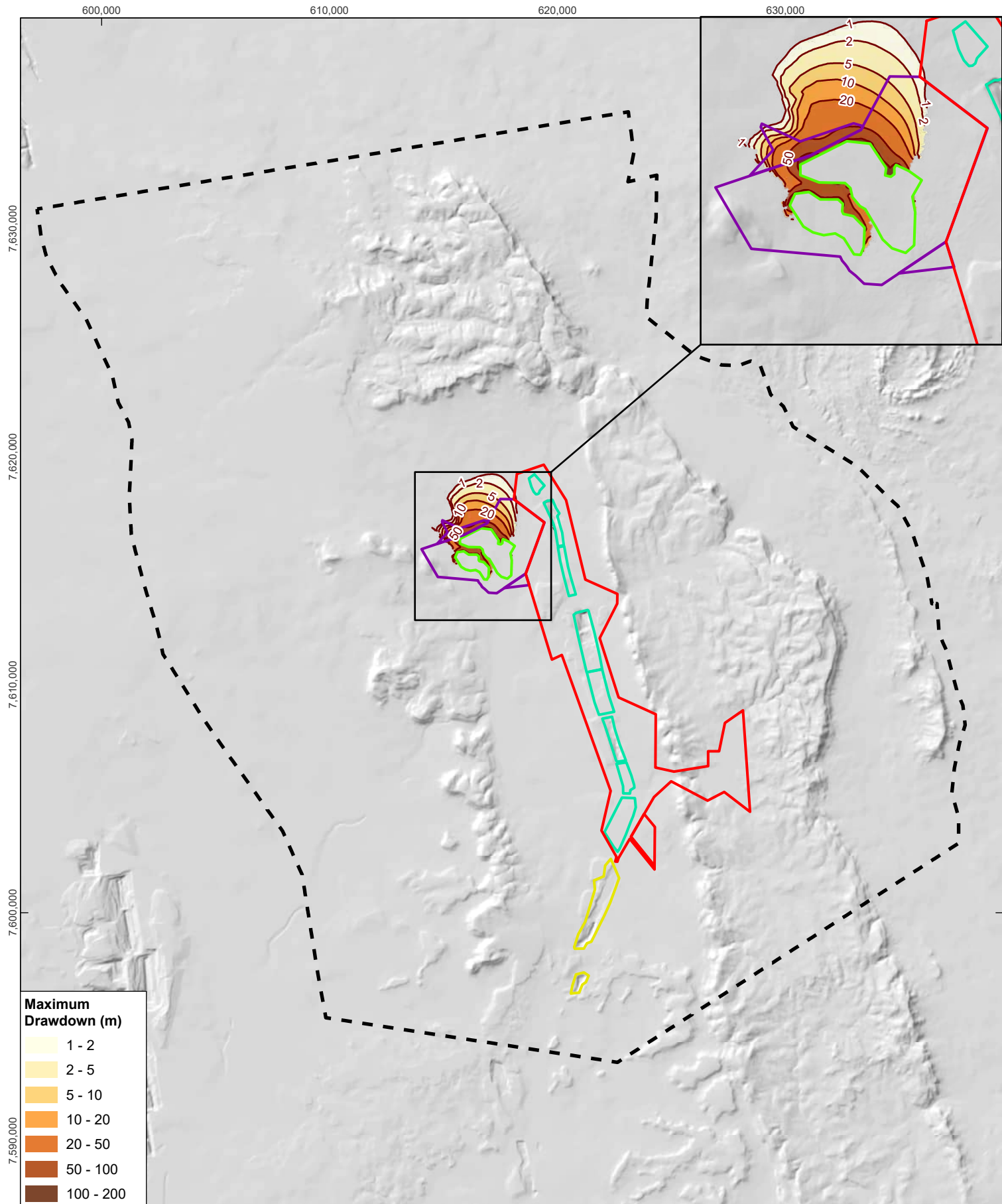
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50

 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

- LEGEND**
- Maximum Drawdown Contour (m)
 - Model Domain
 - Burton Mining Lease
 - New Lenton Mining Lease
 - Burton Pit Extent
 - New Lenton Pit Extent
 - Former Burton Mine Pits

**BURTON & NEW LENTON
 MODELLING TECHNICAL REPORT**

**PREDICTED MAXIMUM INCREMENTAL
 DRAWDOWN IN THE REGOLITH
 (2025-2040)**



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

-  Maximum Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

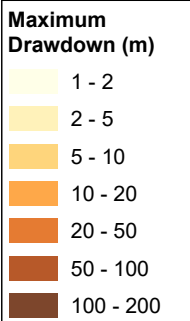
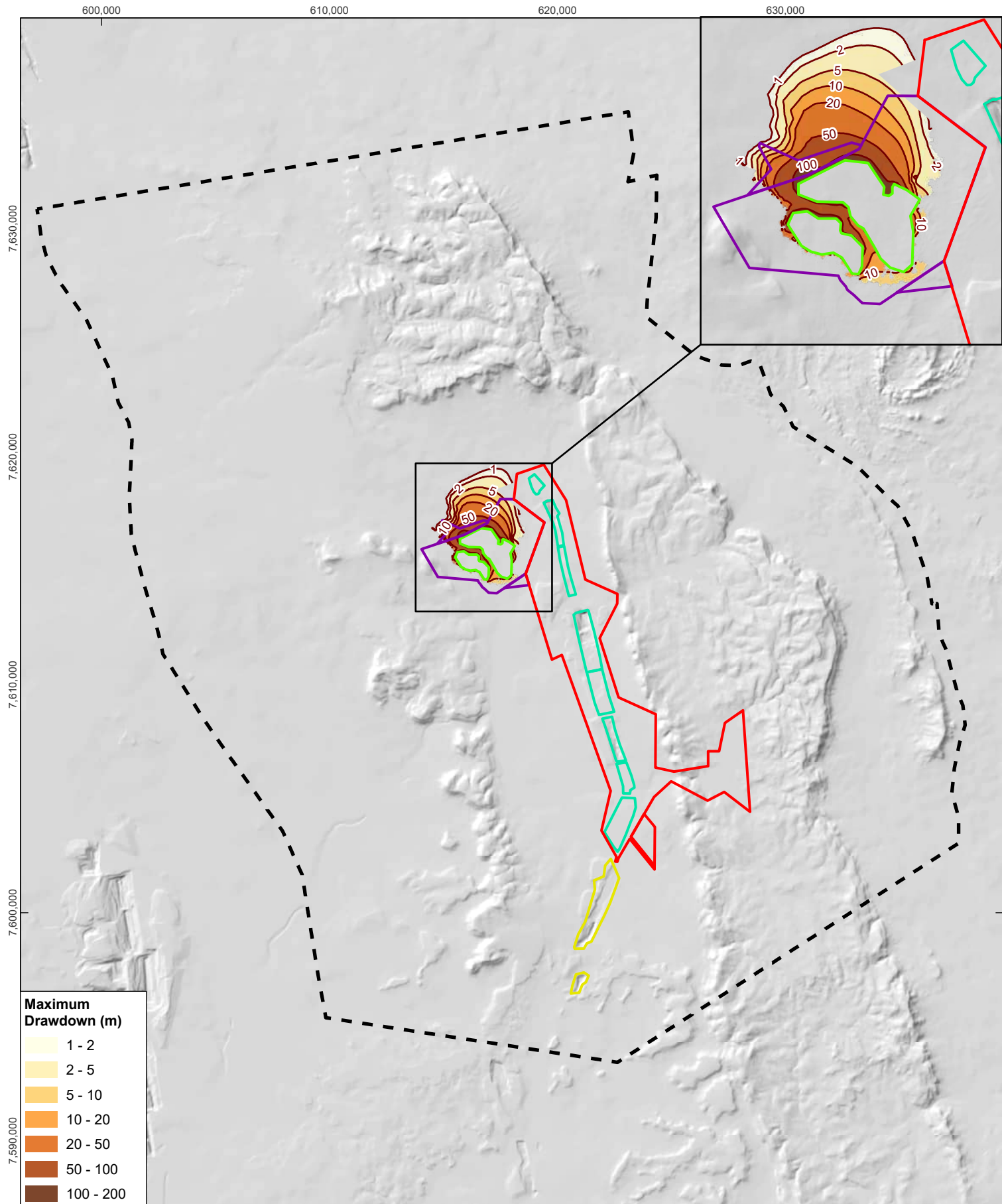
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED MAXIMUM INCREMENTAL
DRAWDOWN IN THE BURTON/RIDER SEAM
(2025-2040)**



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FIGURE 3-14



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

- Maximum Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED MAXIMUM INCREMENTAL
DRAWDOWN IN THE
LEICHHARDT/VERMONT SEAM
(2025-2040)**



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FIGURE 3-15

Figure 3-11 shows the predicted maximum incremental water table drawdown extends approximately 2 km to the north and south of the New Lenton mine pits and 1 km to the east and west.

Figure 3-12 shows the maximum incremental drawdown predicted within the Isaac River alluvium due the proposed mining at New Lenton reaches up to 10 m along the south-eastern edge of East Pit, where the Isaac River is within 150 m of the mine pit. Predicted drawdown of approximately 2 m in the alluvium extends 2 km downstream and 1 km upstream of East Pit at New Lenton. **Figure 3-13** shows the maximum incremental drawdown predicted in the regolith (model layer 2).

Figure 3-14 and **Figure 3-15** show the extent of maximum predicted depressurisation of the Permian coal seams (Burton/Rider and Leichhardt/Vermont seams, respectively). Predicted depressurisation of the Permian coal seams extends 2.5 km to the north-east, as the Permian units sub-crop to the south and west of the New Lenton pits and the model layers are not present. Note that where the coal seam model layers have been removed by mining, groundwater drawdown is not shown in that area for the layer.

Incremental drawdowns due to the proposed mining at New Lenton, at 5-year intervals (2029, 2034 and 2039) during the active mine period are provided in **Appendix F**.

3.4.2 Cumulative Drawdowns

The maximum cumulative drawdowns are obtained by the calculating the maximum difference in heads between the Cumulative and Null scenarios at each cell at any time, from the start of active mining at New Lenton (January 2025) to one year after the end of the proposed mining at New Lenton (December 2040).

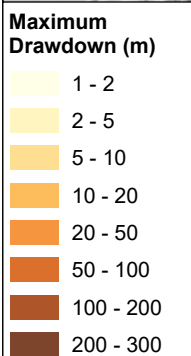
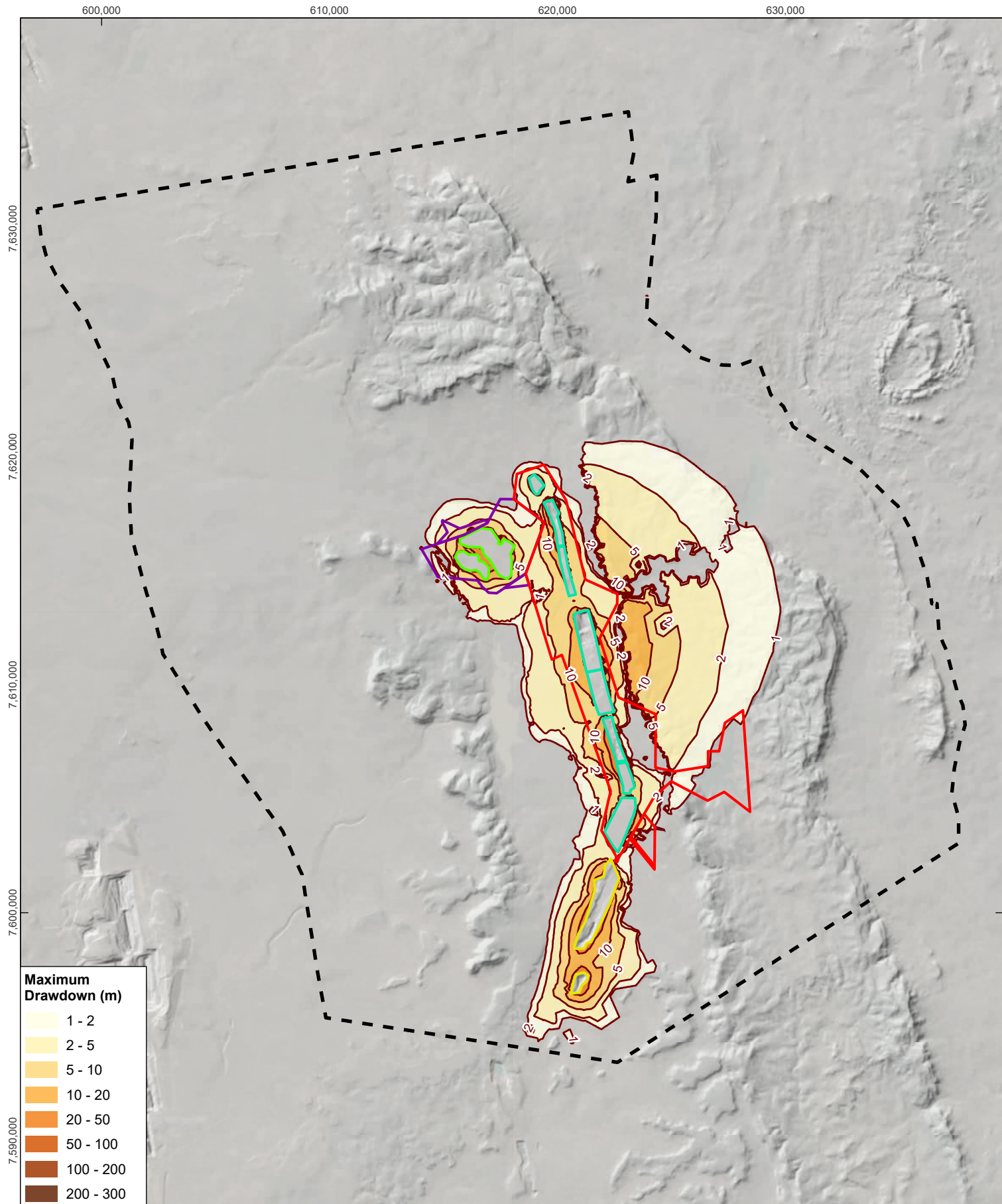
Figure 3-16 to **Figure 3-20** show the maximum predicted cumulative drawdown for the water table (all layers), as well as depressurisation within individual model layers. This includes drawdown within the alluvium and regolith, and depressurisation within the Burton/Rider and Leichhardt/Vermont seams.

Figure 3-16 shows that water table drawdown is greatest within or closely around the mining areas, and gradually reduces with distance from the mines. It should be noted that the figure presents maximum drawdown in the uppermost saturated model layer, including the Triassic units that overlie the Permian coal measures.

Figure 3-17 shows that cumulative drawdown is predicted in the alluvium where drainage lines run between the mine pits at New Lenton and Burton. The predicted maximum cumulative drawdown extent in the Isaac River alluvium due to mining at Burton and New Lenton is connected, extending a further 3 km upstream than the predicted incremental drawdown extent shown in **Figure 3-12**. **Figure 3-18** shows the maximum predicted cumulative drawdown extent in the regolith, extending up to 2.5 km to the west and 2 km to the east.

The greatest cumulative depressurisation occurs in the deeper coal seams that are mined at the mining areas. **Figure 3-19** and **Figure 3-20** show drawdowns in the Permian Burton/Rider and Leichhardt/Vermont seams around New Lenton interact with drawdowns around the northern-most Burton pits. However, the extent of depressurisation in the coal seams is limited to the west by the sub-crop of the Permian coal seams.





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

-  Maximum Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

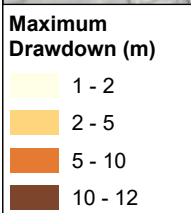
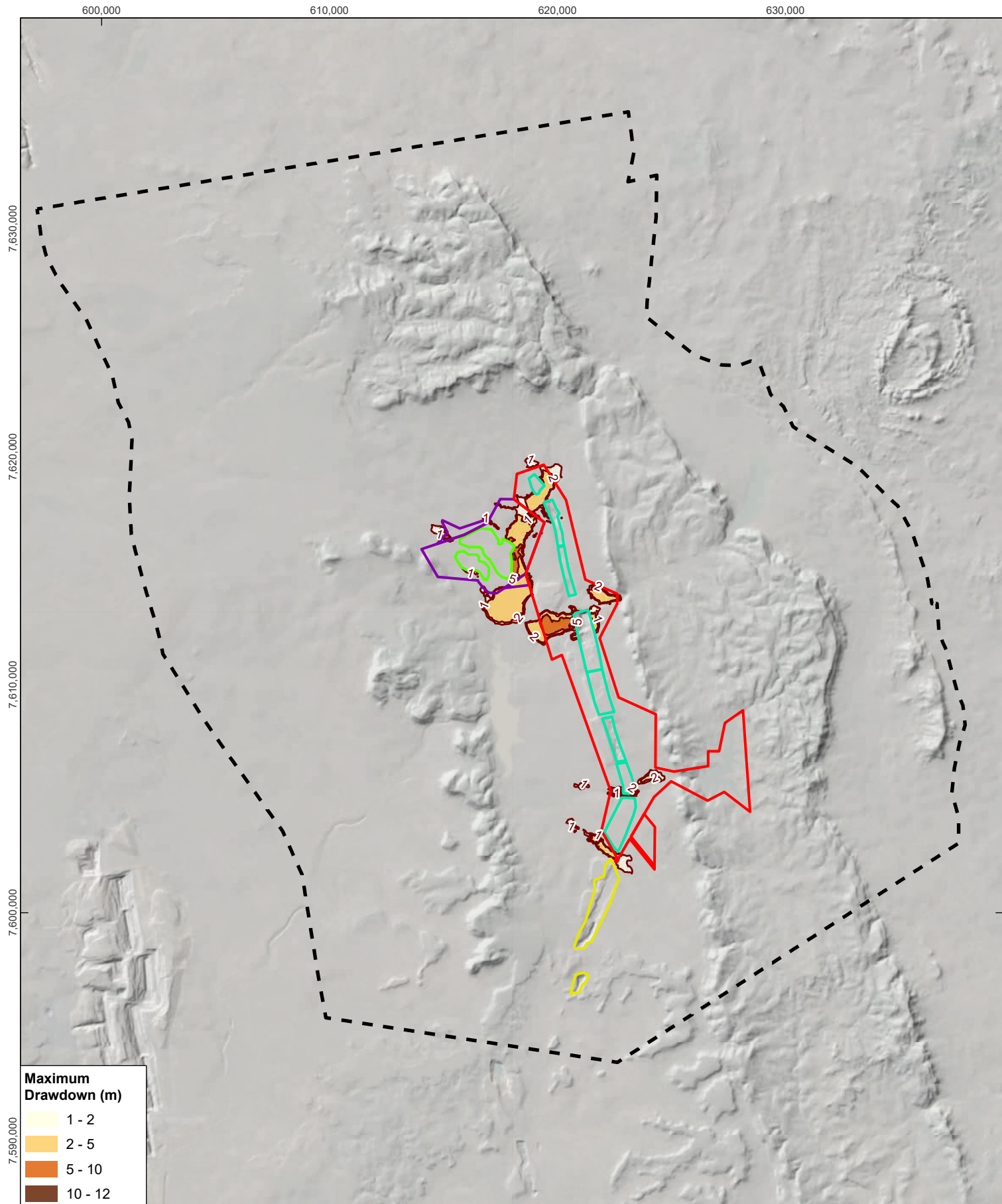
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM CUMULATIVE WATER TABLE DRAWDOWN (2025-2040)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 3-16



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

-  Maximum Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

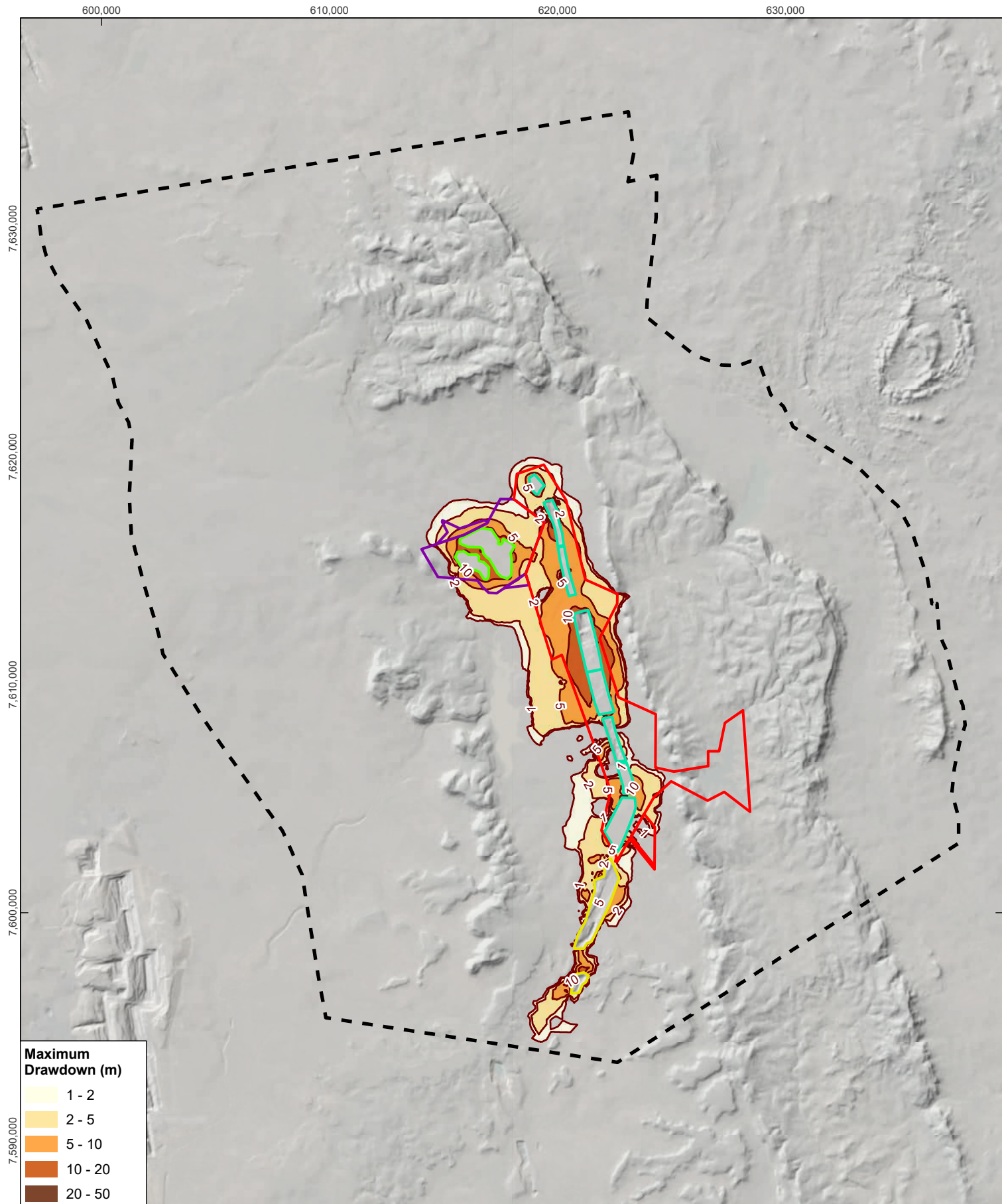
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED MAXIMUM
CUMULATIVE DRAWDOWN
IN THE ALLUVIUM (2025-2040)**



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FIGURE 3-17



Maximum Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50

 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

-  Maximum Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

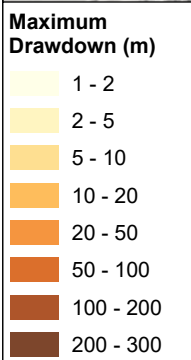
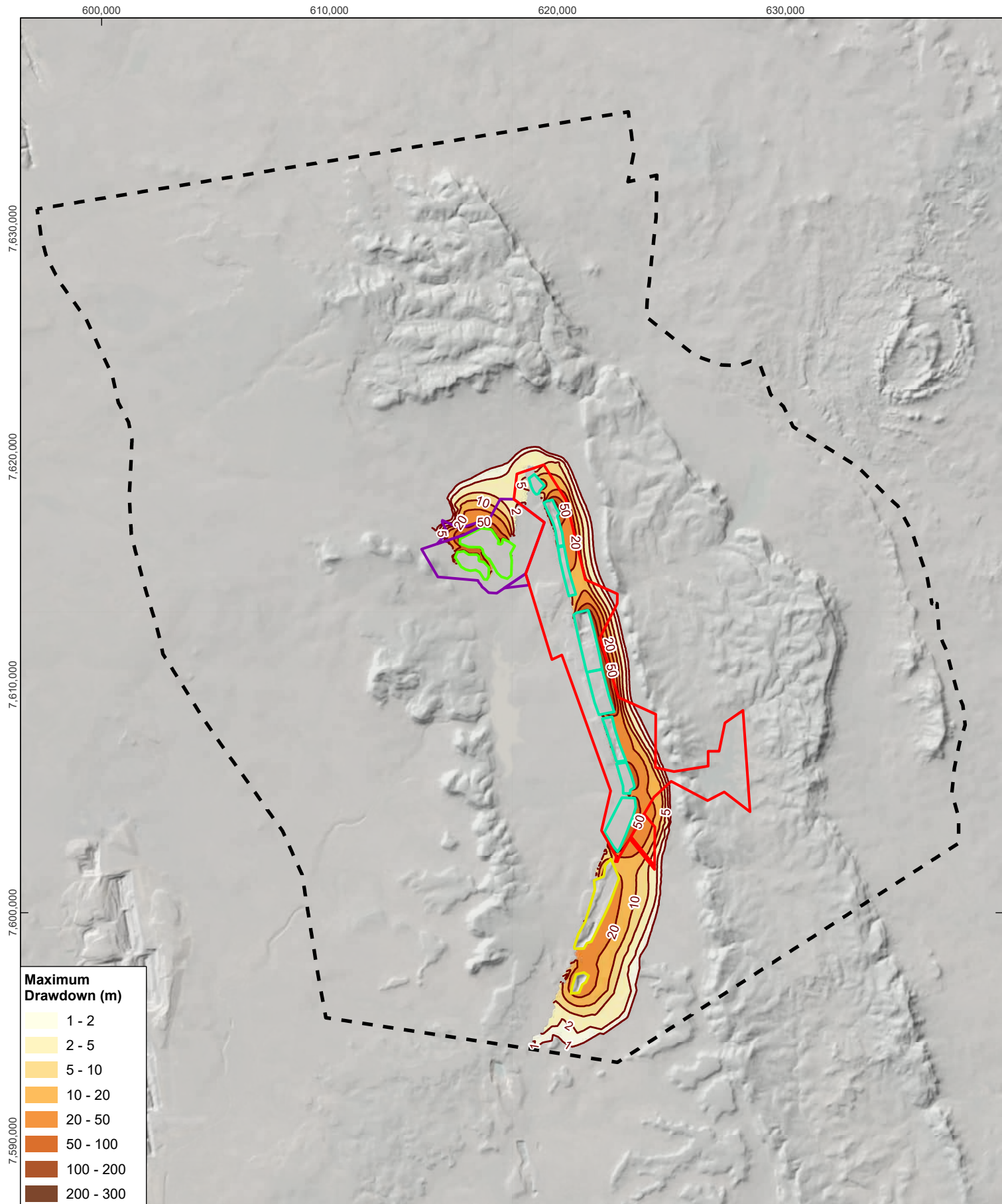
**BURTON & NEW LENTON
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**PREDICTED MAXIMUM
CUMULATIVE DRAWDOWN
IN THE REGOLITH (2025-2040)**



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FIGURE 3-18



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 16-Dec-2023

Drawn by: AS

LEGEND

-  Maximum Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

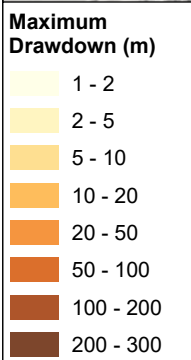
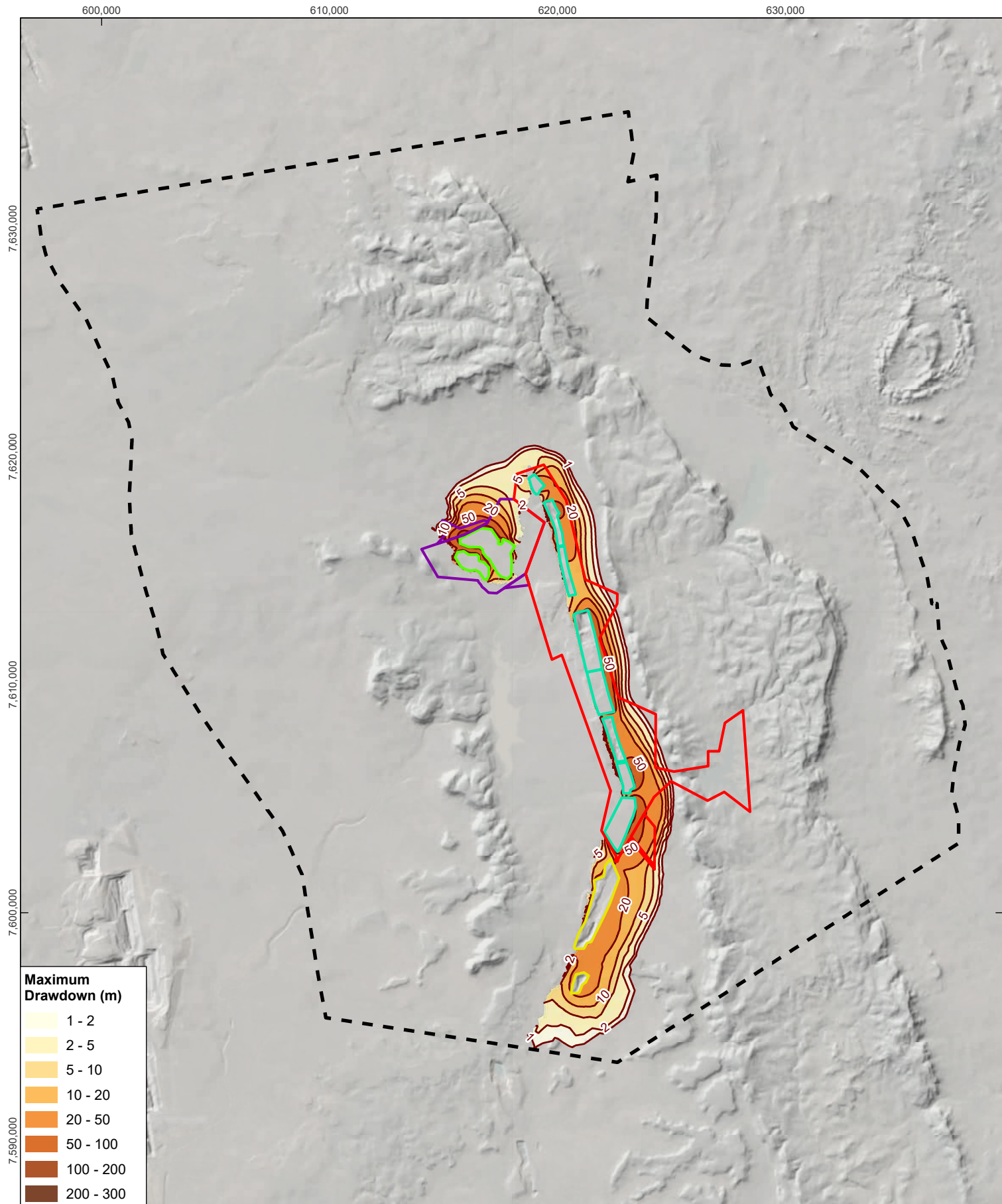
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED MAXIMUM
CUMULATIVE DRAWDOWN
IN THE BURTON/RIDER SEAM
(2025-2040)**



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FIGURE 3-19



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: AS

LEGEND

-  Maximum Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED MAXIMUM
CUMULATIVE DRAWDOWN
IN THE LEICHHARDT/VERMONT SEAM
(2025-2040)**



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FIGURE 3-20

3.5 Predicted Groundwater Interception

Predicted groundwater inflows to the proposed West and East open cut pits at New Lenton are presented in **Figure 3-21**.

The groundwater inflows to the West Pit are predicted to peak in 2027 at 524 ML/year, while for East Pit a peak of 856 ML/year is predicted in 2030. The total groundwater inflow to the New Lenton pits is predicted to reach a maximum of 1026 ML/year in 2030, coinciding with operations commencing at the second pit (East Pit) at New Lenton. The model predicts an average of 434.5 ML/year groundwater take over the duration of mining at New Lenton.

It should be noted that this total volume includes water removed in rock material with mining, as well as water evaporated from the pit surface. It is therefore an over-estimate of water that could report to the site water balance.

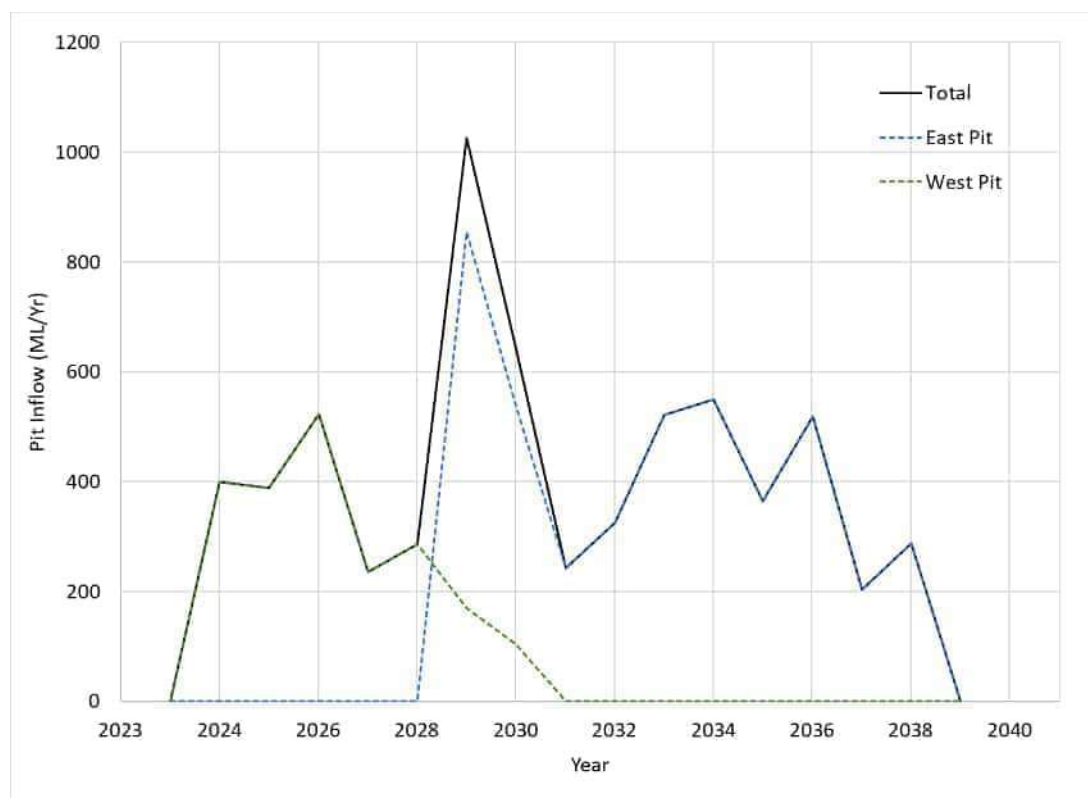


Figure 3-21 Predicted Groundwater Inflow to New Lenton During Proposed Mining

The predicted total groundwater inflows to the Burton Mine pits were extracted from the Cumulative predictive scenario for the best calibrated realisation. Future mining at Burton is considered 'approved' within the predictive modelling scenarios, as such, the objectives of this modelling work do not include the prediction of impacts due to Burton Mine during the predictive period. **Figure 3-22** presents the predicted total groundwater inflows to the Burton Mine pits during the predictive period. The inflow predictions shown in **Figure 3-22** are provided to support consideration of the model as 'fit for use' in post-mining assessments at Burton Mine only.



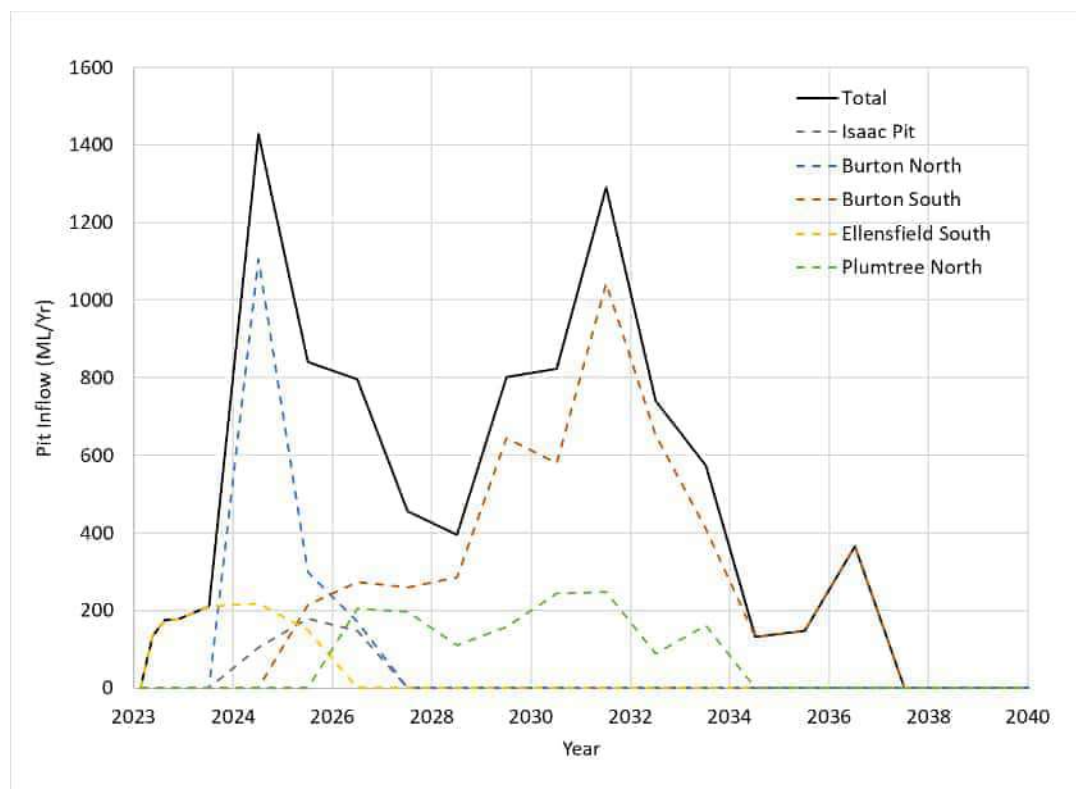


Figure 3-22 Predicted Groundwater Inflow to Burton During Approved Future Mining

3.6 Incidental Water Impacts

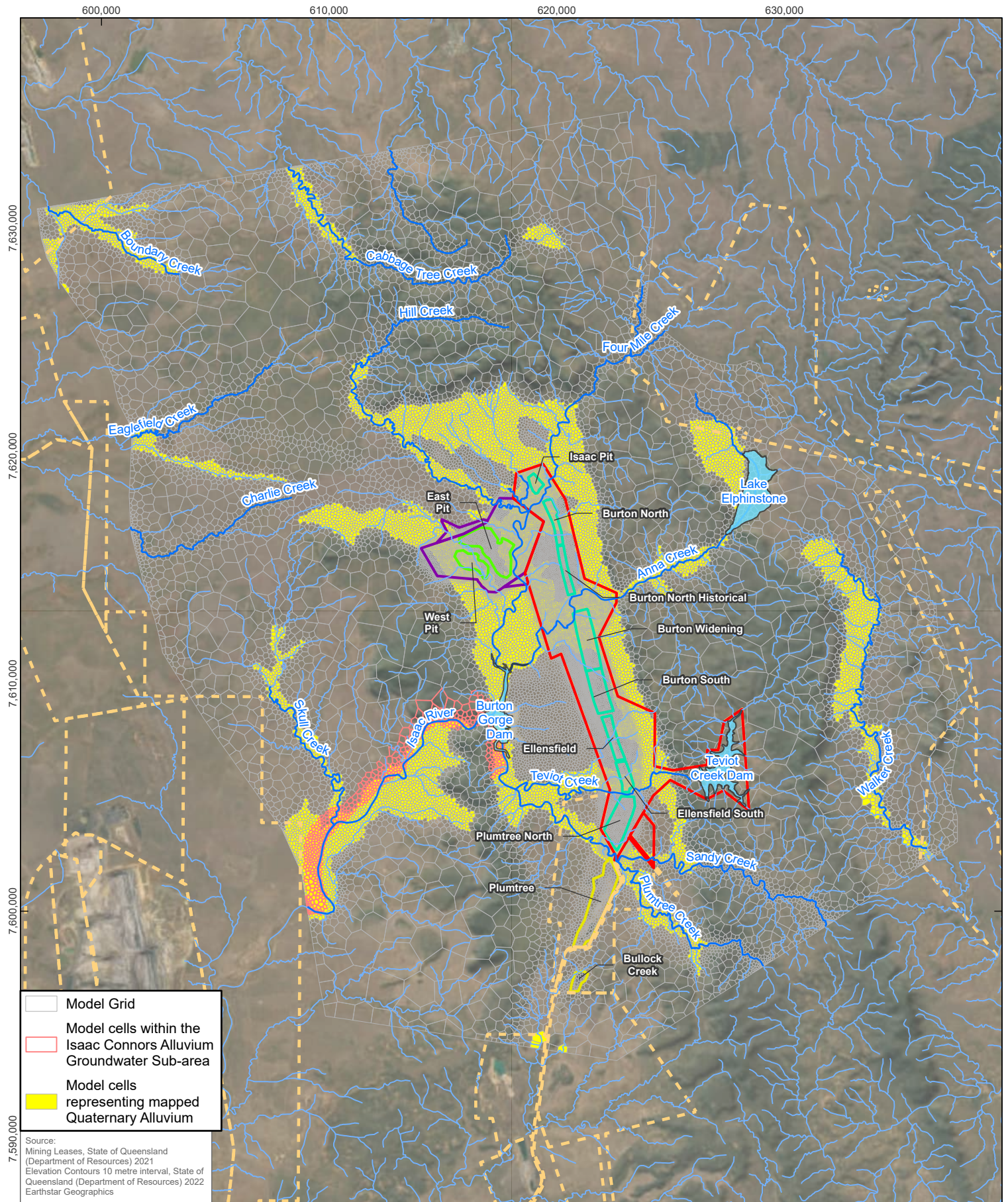
3.6.1 Influence on Alluvium

The change in alluvial water resources was calculated by comparing water budgets for alluvial zones using the Approved and Cumulative scenarios of the predictive model that included and excluded mining at New Lenton, respectively. The main alluvial resources in the area include:

- Alluvium associated with the Isaac River downstream of Burton Gorge Dam, scheduled under the Queensland *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (under the *Environmental Protection Act 1994*) as part of the Isaac Connors Alluvium Groundwater Sub-area (within the Isaac Connors Groundwater Management Area of the Fitzroy Basin water plan (WQ1310)); and
- Other mapped Quaternary alluvium localised along Isaac River upstream of Burton Gorge Dam, Hill Creek, Anna Creek and other minor drainage lines.

The budget zones representing the main alluvial resources in the model are shown in **Figure 3-23**.





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: RB

LEGEND

-  River
-  Watercourse and Drainage
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Surrounding Mine
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

MODEL BUDGET ZONES FOR ALLUVIAL RESOURCES



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 3-23

Figure 3-24 presents the incremental direct and indirect take for mapped Quaternary alluvium within the model domain, calculated as the difference between the Approved and Cumulative scenarios. The model predicts a decrease in total flux to the alluvium from surrounding hard rock, due to the proposed mining at New Lenton.

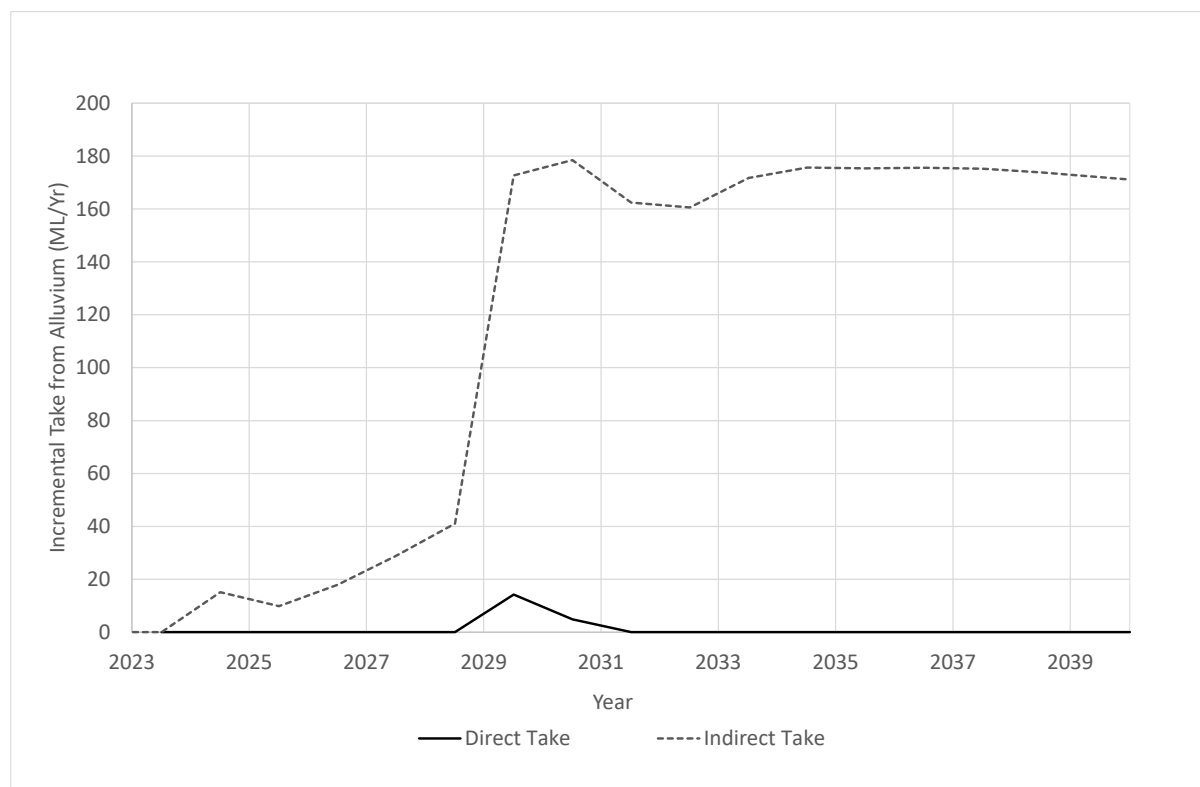


Figure 3-24 Predictive Groundwater Flux to the Alluvium for the Approved and Cumulative Scenarios

The model predicted negligible change (less than 0.5%) in the alluvial water resources scheduled as part of the Isaac Connors Alluvium Groundwater Sub-area as a result of proposed mining at New Lenton. This corresponds with the model predictions showing no incremental drawdown in the Isaac Connors Alluvium Groundwater Sub-area.

3.6.2 Influence on Surface Water Flow

The change in leakage and baseflow in the rivers due to proposed mining at New Lenton was calculated by comparing the river flow budget for the Isaac River (within 3 km of the site) for the Approved and Cumulative scenarios. The model predicted no baseflow in either the Approved or Cumulative scenario therefore no change to leakage or baseflow was identified due to simulated mining at New Lenton. Model predictions are consistent with the conceptualisation, i.e. that the alluvium associated with the Isaac River near the site is unsaturated for the majority of the year and groundwater does not supply a baseflow component to the Isaac River.



4.0 Model Confidence Level Classification

The groundwater modelling was conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al. 2012) and the released IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023).

The model confidence level (Class 1, Class 2 or Class 3 in order of increasing confidence) based on the Australian Groundwater Modelling Guidelines (Barnett et al. 2012) was previously widely used in the industry. The latest version of the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023) introduces a new concept on how model confidence can be assessed. The document also indicates that this change will follow in the next iteration of the Australian Modelling Guidelines and the new concept for assessing model confidence is hence applied for this model.

The latest version of the IESC Explanatory Note for Uncertainty Analysis defines a model fit for purpose when model results are:

- Usable -- Relevant to the decision-making process, providing information about the uncertainty in conceptualisations and modelling simulations in a way that allows decision-makers to understand the effects of uncertainty on project objectives and the effects of potential bias. The relevant Quantities of Interests (QoI) in this context are the groundwater inflows and drawdowns to assess licensing, site water management and drawdown impacts.
- Reliable -- Demonstrate that the range of model outcomes is consistent with the system knowledge and honours historical observations and provides objective evidence that uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated. The calibration performance was deemed acceptable, and a rigorous uncertainty analysis was undertaken to further improve confidence in the modelling outputs.
- Feasible -- Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the Project.

This study is an update of an earlier model, which shows that there are several model revisions therefore mitigating budget and time trade-offs. Updated technical datasets are included in the most recent revision. The model has been peer reviewed for each revision. The model builds and associated review process are therefore deemed commensurate with the Project related risk to the groundwater environment.

In order to assess these three points above in more details, the four sources of scientific uncertainty (structural, parametrisation, measurement error, predictions) have been qualitatively assessed with regards key aspects of the New Lenton and Burton groundwater model, as presented in **Table 4-1**.

The model captures depressurisation due to active mining. The model is numerically stable with no mass balance error. The model shows a good fit between observed and modelled groundwater levels (**Section 2.2**). A depth dependence function was used for hydraulic conductivity, with the calibrated values showing a good fit to observed data as presented in **Section 2.2.8**.

Overall, the model is considered fit for purpose to achieve the objectives outlined in **Section 1** based on the data provided and the Project timeframe. Updates could be conducted in future to further refine the model, but this would be dependent on the purpose of the modelling and availability of data to inform future changes.



The model sensitivity was explored for an array of parameters. This process identified the most sensitive parameters in model calibration.

The uncertainty analysis was undertaken to add a likelihood estimate to the prediction for during mining operation and in post-mining for the main two quantities of interest, the groundwater inflows and predicted drawdowns in a multitude of relevant geological formations.



Table 4-1 Groundwater Model and Data Limitations

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	The model has an unstructured Voronoi grid that includes detailed cell refinement around site, neighbouring mines and along drainage features.
	Layers	Fit for purpose	Top of layer 1 incorporates site LiDAR data
		Fit for purpose	Representation of alluvium is based site transient electromagnetic (TEM) data and CSIRO Regolith mapping (Wilford et al (2016)).
	Conceptualisation – Geological Structure	Fit for purpose, future improvements possible where new data collected	The local structure of the geology is based on detailed data at site (Burton and New Lenton Mine geology models), and regional model geometry (outside of site) interpolated based on publicly available data, such as geological mapping and the CSIRO Regolith data set. The geological units displaced by the Burton Range Fault (BRF) are represented by different layers based on their location either on the western or eastern side of the fault; i.e. the model simulates the fault via layers being offset on either side of the fault. The structure of the coal seams was checked to ensure it matches observed and mapped geology. The predictions of drawdown adjacent to mining was checked and the model generally shows a reasonable fit between modelled and observed trends.
	Conceptualisation – GDEs	Fit for purpose, future improvements possible	A GDE conceptualisation is provided in SLR, 2023.
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose,	Discussion on surface water groundwater interactions is provided in SLR, 2023.
Parameterisation	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose	Site monitoring network includes bores mapped within alluvium that was used to inform saturated extent of alluvium locally at site and for calibration targets.
	Hydraulic Conductivity – Shallow layers	Fit for purpose	The simulation of the Alluvium and Regolith in the model involves the use of pilot points in Layer 1 and Layer 2. Pilot points were used to simulate heterogeneity in the alluvium system.



Type	Part	Status	Comment
	Hydraulic Conductivity – Depth Dependence	Fit for purpose	Field testing of hydraulic conductivity (horizontal and to a lesser extent vertical) has been conducted in the region and at site. Hydraulic conductivity test results from the other sites within the model domain were also considered. The data shows a general decline in hydraulic conductivity with depth that is replicated in the model.
	Spoil Properties	Fit for purpose, future improvements possible	Limited site-specific data is available for the spoil. Spoil properties were adjusted during calibration using with the bounds for spoil parameters set using previous studies.
	Rivers	Fit for purpose	The conceptualisation concluded that Isaac River is highly ephemeral with flow in the river only occurring for a few days per year. The observed groundwater levels for the alluvium bores indicated that a baseflow to Isaac River is unlikely to exist. The infrequency and temporal nature of observed surface flow in the Isaac River reported during Project fieldwork suggests that there is no groundwater baseflow to the Isaac River, either onsite, associated with onsite tributaries (Hill Creek and Ti-Tree Creek) or from upstream sources within the catchment area. The river cells representing Isaac River were assigned a stage height of zero for each stress period in the model. To represent the shallow groundwater recharge due to rainfall derived streamflow in the model, an enhanced recharge factor was applied along Isaac River during specific stress periods. In order to be consistent with the conceptualisation, zero baseflow for Isaac River was used as a target during the calibration process.
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and calibrated recharge rates.
Measurement Error	Observation Data Quality	Fit for purpose	Comprehensive bore logs and construction details available for some site bores, with other bores subject to review by JBT (2016). Long-term site water level data available for various units.



Type	Part	Status	Comment
	Landholder Bore Data Quality	Fit for purpose, future improvements possible	Impacts on registered landholder bores are influenced by the assumptions of the bore design, target geology and use. Field census survey data has been utilised where available.
	Temporal spread	Fit for purpose	Timeseries water level data from the site as well as for the tertiary and Permian coal measures.
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose, future improvements possible	Transient (1998 to 2023) calibration model set up and a depth dependence function used and calibration to water levels conducted using automated (PESTPP-IES). Simulated mine progression and other mine-related stresses inferred and interpolated from the limited available information regarding historical mine schedule and historical mine water storage at Burton Mine. Calibration to mine-affected groundwater level data could be improved with more accurate representation of these stresses in the model, if further information were to become available.
	Predictive	Fit for purpose	Model captures approved mining at Burton and proposed open cut mining at New Lenton. Existing historic mine voids on ML 70258 and ML 70259 (south of Burton) remained as voids during predictive simulations. No other neighbouring mines with foreseeable future activity were identified within the model domain.
	Sensitivity and uncertainty	Fit for purpose	Uncertainty analysis covered the entire model simulation period (Pre-mining, during mining and post-mining). Uncertainty analysis has been conducted by stochastic modelling using an adapted Monte Carlo method with modern software packages. The Latin Hypercube Sampling (LHS) method was used to create random realisations. The uncertainty analysis quantified the variability in predictions with changes in maximum predicted drawdowns, mine inflows, impact on alluvium flow and impacts on surface water flow during mining and in post mining.



5.0 Sensitivity Analysis and Uncertainty Analysis

5.1 Calibration Identifiability

As reported by PEST Uncertainty User Guide (Doherty., 2011) “*Identifiability is defined here as the capability of model calibration to constrain parameters used by a model*” and “*Where this value is zero for a particular parameter, the calibration dataset possesses no information with respect to that parameter. Where it is 1, the parameter is completely identifiable on the basis of the current calibration dataset (though cannot be estimated without error because its estimation takes place on a dataset that contains measurement noise)*”.

The PEST utility GENLINPRED was used to provide an estimate of parameter identifiability for each of the model parameters.

The parameter identifiability was assessed separately for the water level targets and baseflow targets. The weights applied to each observation for the identifiability analysis was scaled according to the number of observations in that observation group, such that the weight of the individual observation was equal to 1 divided by the square root of the total observation count for the group. Estimated identifiability values for the calibrated parameters horizontal hydraulic conductivity, anisotropy, specific yield and recharge are summarised in **Figure 5-1** to **Figure 5-8**.

Figure 5-1 and **Figure 5-2** show the identifiability of horizontal conductivity and anisotropy for the water level targets and baseflow targets, respectively. The figures show that the modelled water levels in the calibration were highly sensitive to conductivity in the spoil (identifiability > 0.95), while the modelled baseflows were not sensitive to this parameter.

Figure 5-1 indicates that for the modelled water level targets were sensitive to horizontal conductivity. The conductivities of the weathered material and Triassic units had high identifiability values above 0.70. The conductivities of interburden units of the RCM also well had identifiability values above 0.50. The modelled water levels were not sensitive to the conductivities in the coal seams and anisotropy in the tertiary and coal seams.

Figure 5-2 indicates that for the modelled baseflow was sensitive to conductivity in the regolith and shallow Triassic units and insensitive to the conductivities in the coal measures and anisotropies.

Identifiability of storage parameters are shown in **Figure 5-3** and **Figure 5-4**, respectively.

Figure 5-3 shows that for most zones the modelled water levels were not sensitive to storage parameters. The sensitive storage properties in the model were specific yield in the regolith, Rangel overburden and spoil (identifiability >0.7). **Figure 5-4** shows for the modelled baseflow were not sensitive to most of the storage parameters, with the exception of the specific yield in the regolith which had an identifiability of 0.4.

Figure 5-5 and **Figure 5-6** show identifiability of recharge, evapotranspiration and river parameters for water level targets and baseflow targets, respectively. The figures show that both modelled water levels and baseflows were not sensitive to recharge factors of the spoil zones, EVT factors and extinction depths, and river conductance.

Figure 5-5 shows the modelled water levels were sensitive to recharge factors for most model zones (identifiability >0.5). **Figure 5-6** shows that the modelled baseflows were sensitive to recharge factors for some model zones with identifiability of the recharge factors for the Quaternary Alluvium and Isaac River flow events exceeding 0.75.



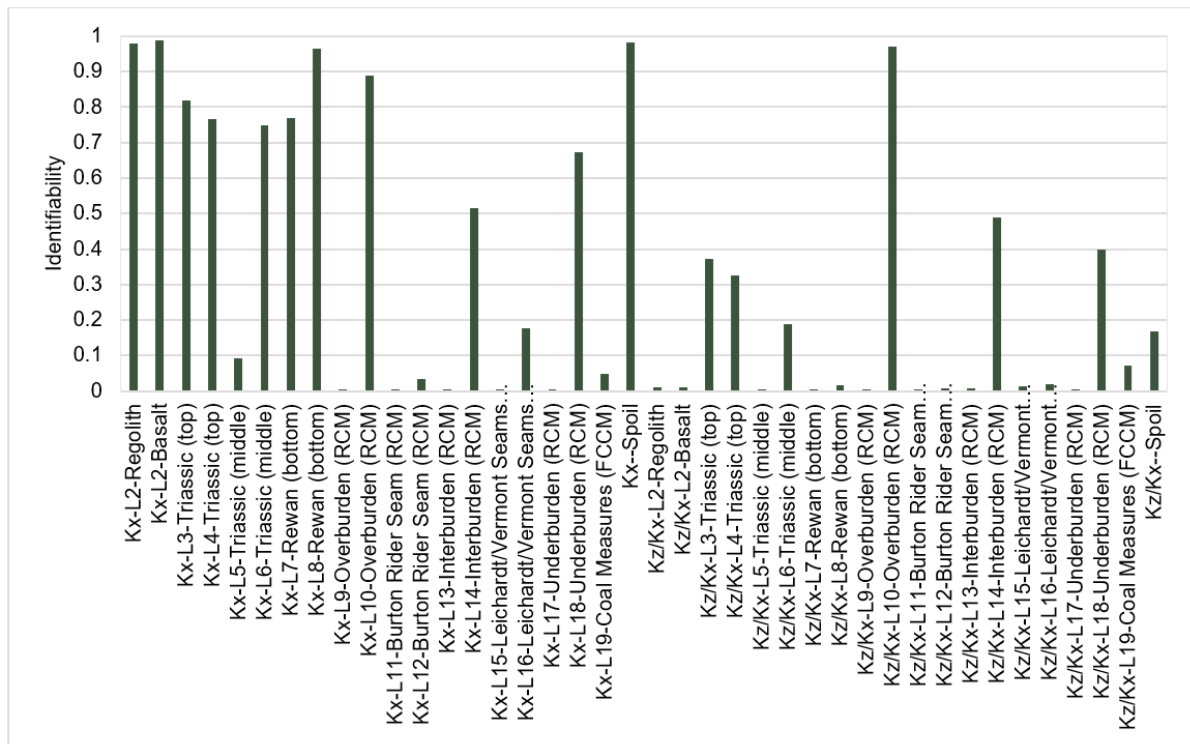


Figure 5-1 Identifiability (Water Level Targets) – Horizontal Conductivity and Anisotropy

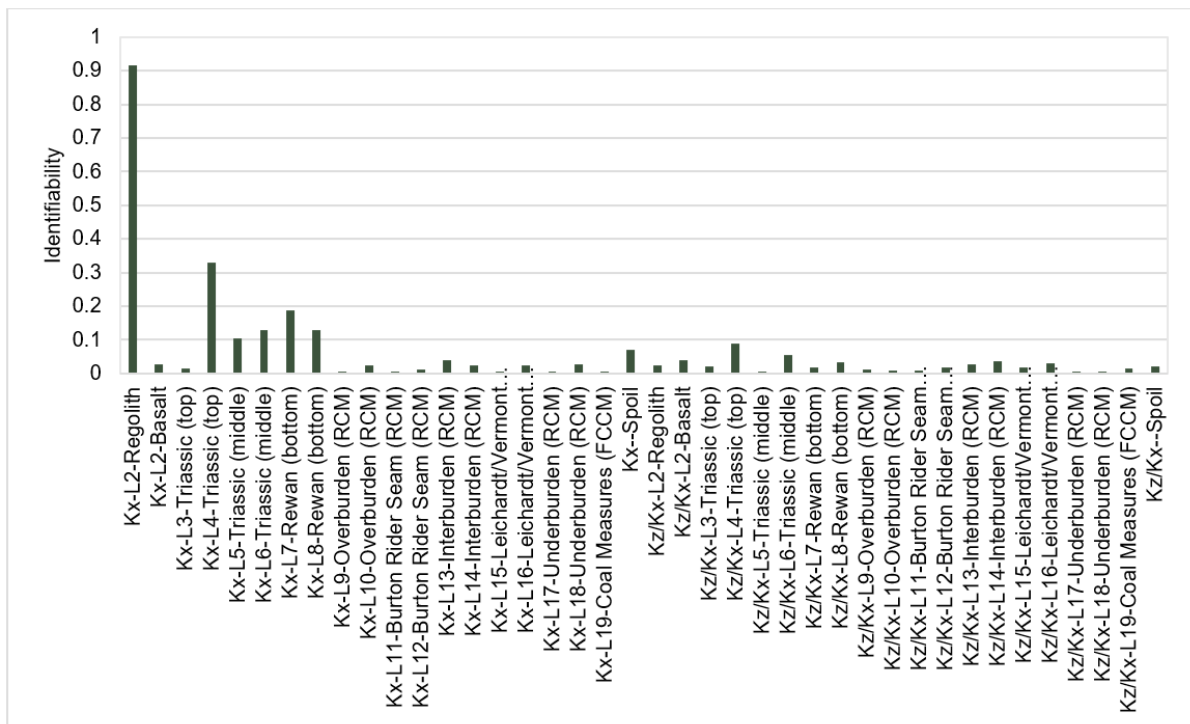


Figure 5-2 Identifiability (Baseflow Targets) – Horizontal Conductivity and Anisotropy



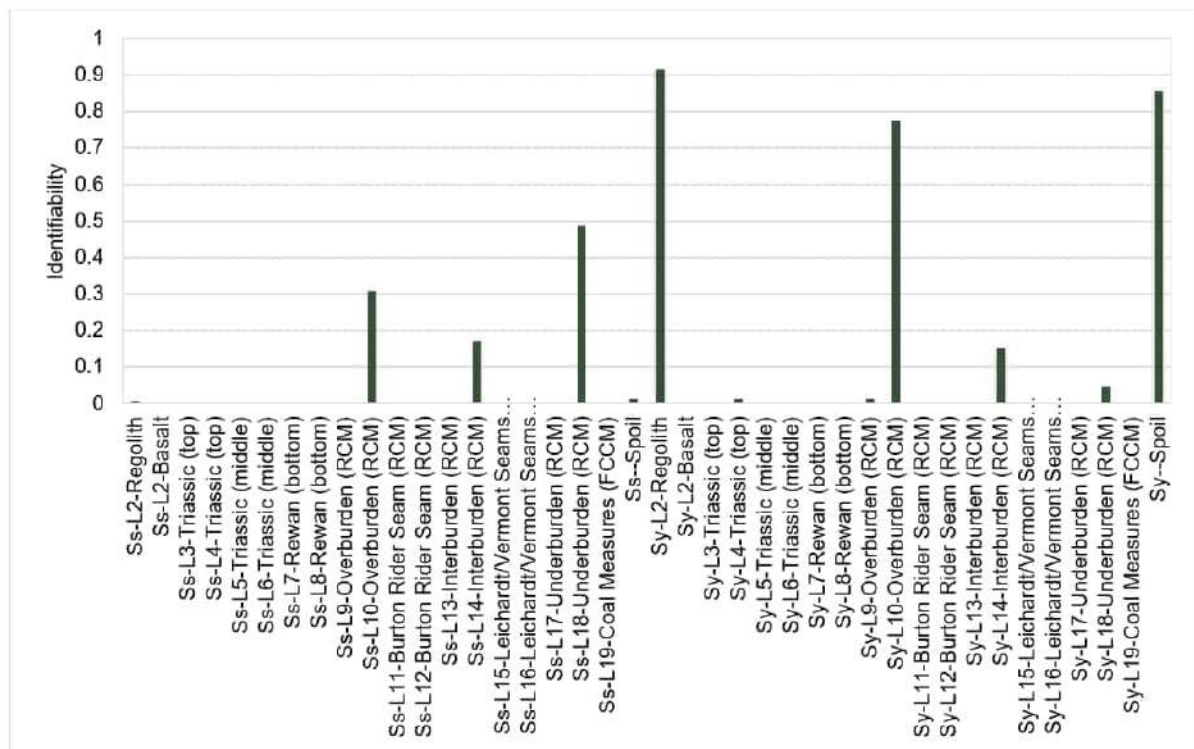


Figure 5-3 Identifiability (Water Level Targets) – Specific Storage and Specific Yield

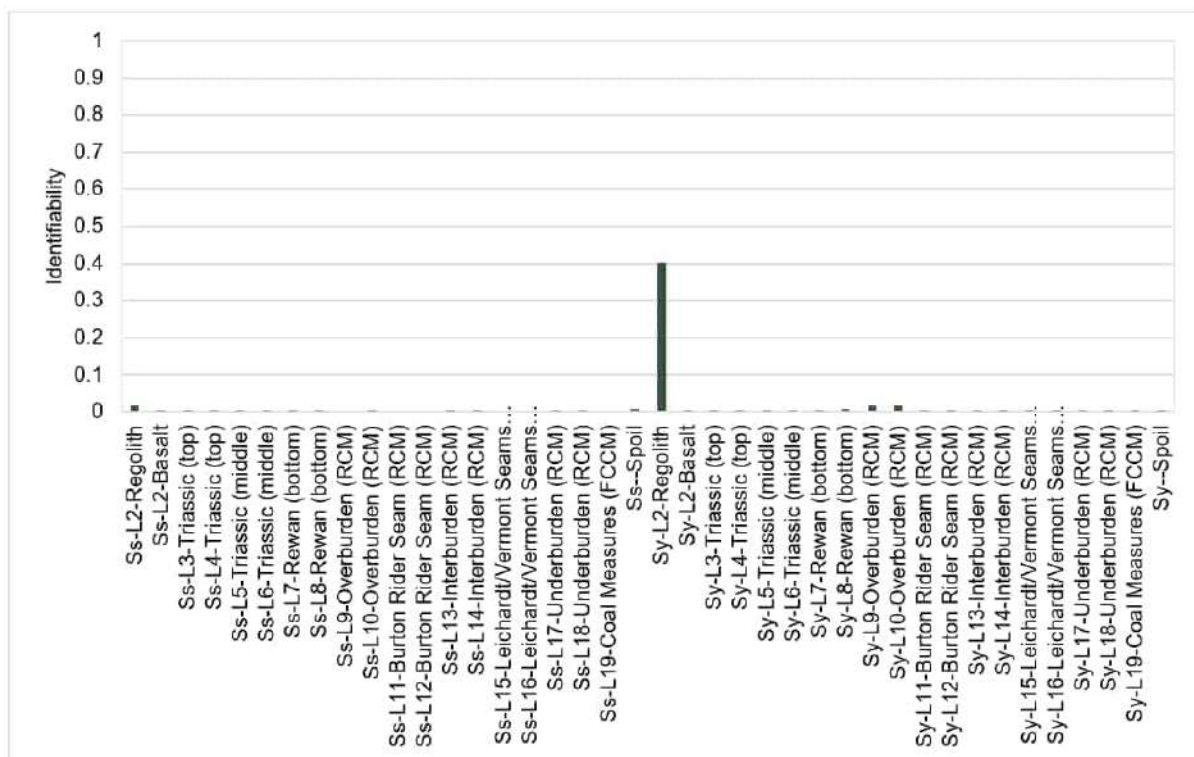


Figure 5-4 Identifiability (Baseflow Targets) – Specific Storage and Specific Yield



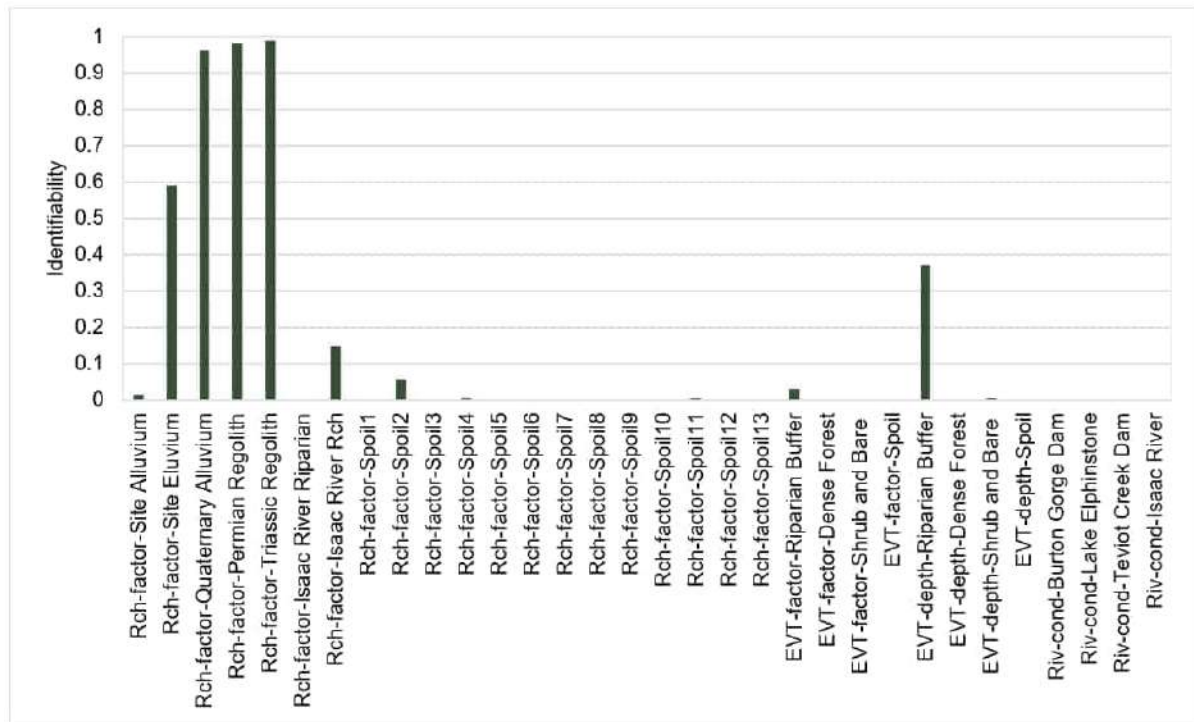


Figure 5-5 Identifiability (Water Level Targets) – RCH, EVT and RIV Parameters

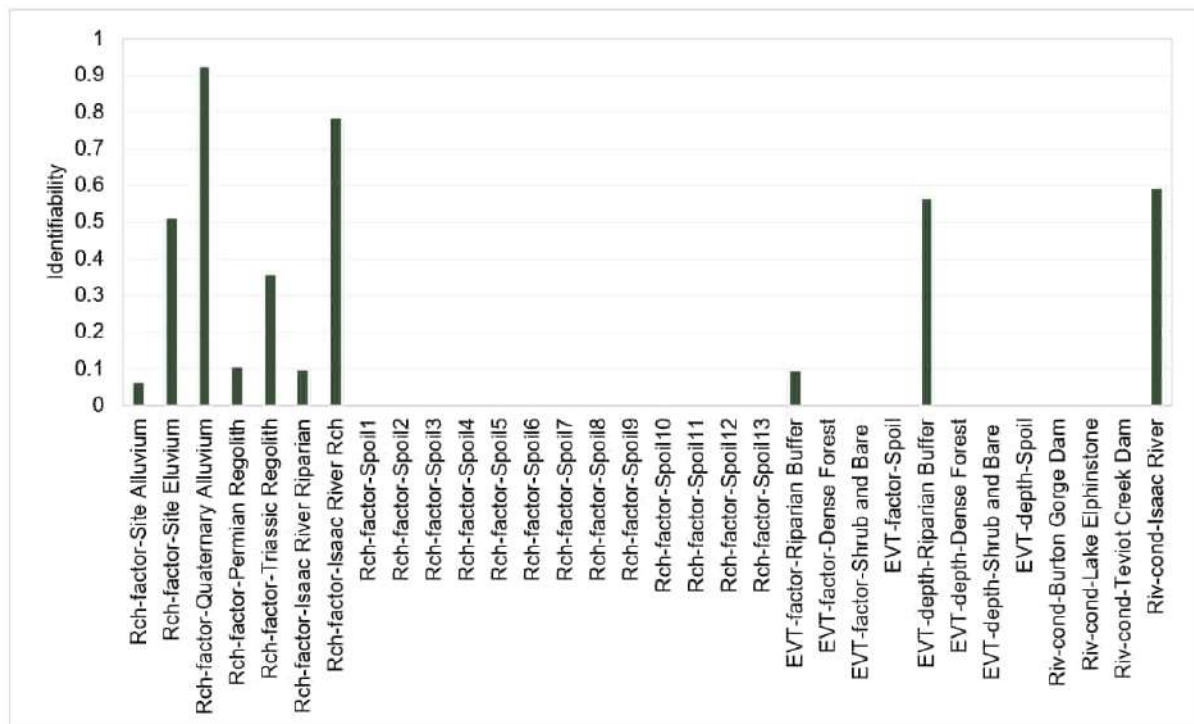


Figure 5-6 Identifiability (Baseflow Targets) – RCH, EVT and RIV Parameters



The estimated identifiability of the hydraulic parameters (horizontal conductivity, vertical conductivity, specific storage and specific yield) for the pilot points are presented spatially in **Figure 5-7** and **Figure 5-8**, for the water level targets and baseflow targets, respectively. The figures also display the location of water level targets in model layer 1.

Figure 5-7 and **Figure 5-8** show that the modelled water levels were somewhat sensitive to the horizontal conductivity for pilot points located closer to Isaac River and associated alluvial target locations (**Figure 5-7 A**). The modelled baseflows were somewhat sensitive to the horizontal conductivity and specific yield for the pilot points located in the alluvium along the Isaac River (upstream of the sites) (**Figure 5-8 A**).

Overall, most of the pilot points in the model have identifiability of more than zero meaning most model parameters are not completely insensitive. The analysis indicates that some model parameters such as recharge and anisotropy affecting the alluvium water levels and baseflows were relatively identifiable during the calibration process. This is considered a good outcome as (where saturated), the groundwater systems in the alluvium are sensitive receptors within and near the Project area.

For the deeper units such as the Permian unit, the calibration process was less successful in identifying appropriate model parameters. Given that the Permian units are not considered sensitive environmental receptors in this project, their uncertainty in parameter values is less significant.

Parameters showing high identifiability can be construed as significant controls on model performance. Identifiable parameters highlight where the numerical and conceptual models are reasonably constructed to replicate measured processes. Although identifiability can offer valuable insights into the behaviour of a calibrated model, it should not be over-interpreted as identifiability serves primarily as a qualitative indicator (Doherty, 2010).



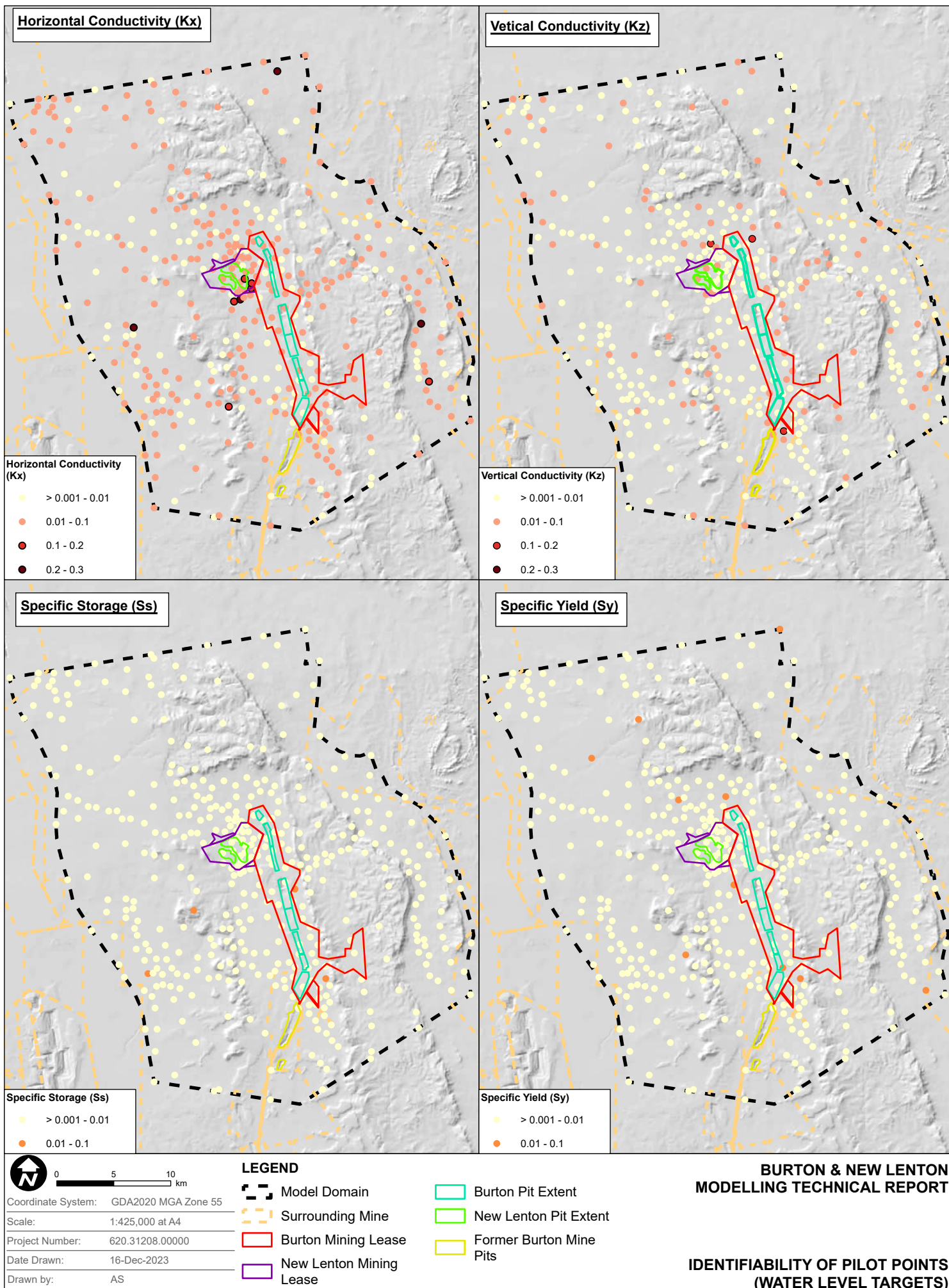


FIGURE 5-7

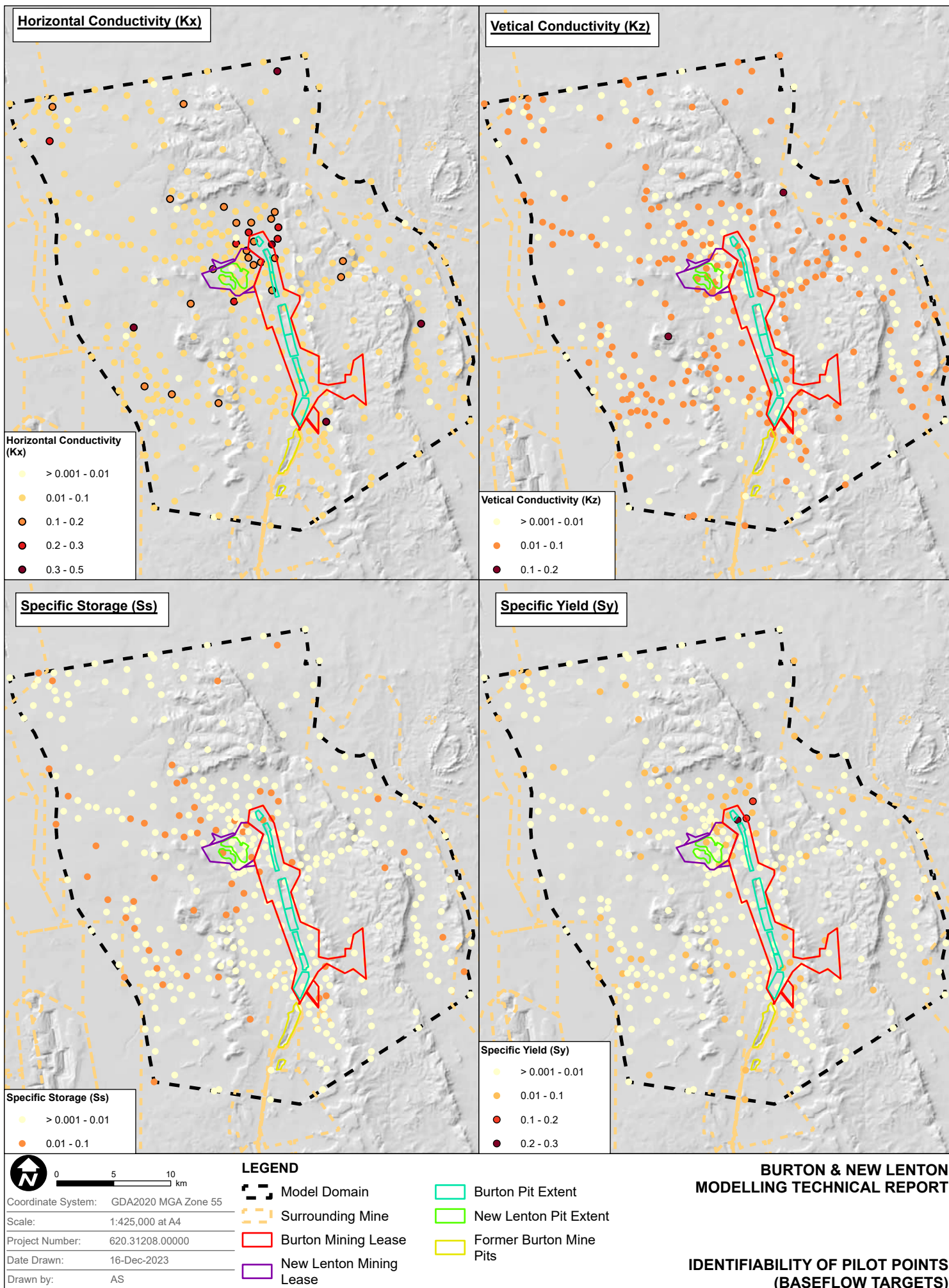


FIGURE 5-8

5.2 Predictive Uncertainty Analysis

A Type 3 Monte Carlo uncertainty analysis was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis.

The first step in Monte Carlo analysis is to define the parameter distribution and range. The parameters are assumed to be log-normally distributed around the optimum value derived from the calibration. In order to define the distributions, a mean and standard deviation for each parameter was defined, and the ranges listed in **Appendix B** were applied. The mean value was chosen as the optimum value derived from calibration. The standard deviation was chosen based upon the standard deviation for that parameter in the optimised calibration ensemble. Parameters with a standard deviation of less than 0.75 (log10) in the calibration ensemble were assigned a standard deviation of 0.5 (log10) and those with standard deviation of more than 0.75 (log10) in the calibration ensemble were assigned a standard deviation of 1 (log10). The distribution for each parameter was checked and constrained such that upper or lower ranges do not go beyond ranges in literature.

Instead of simple random sampling, the Latin Hypercube Sampling (LHS) method was used to create random realisations from parameter distribution. LHS aims to spread the sample points evenly across all possible values. In doing so, it divides parameter space into N intervals of equal probability and chooses one sample from each interval. The generated random numbers derived from LHS approach is distributed sufficiently across the parameter space even at small sample sizes. The main advantage of LHS over simple random sampling is that a lower number of realisations are needed to obtain a reasonable convergence of the uncertainty results.

1,200 model realisations were generated, each with unique parameter distributions. 200 of the realisations met calibration criteria assigned based on the statistics for the optimally calibrated realisation (SRMS < 12%, Isaac River baseflow (near site) < 70 m³/d) after running through the calibration model. 162 of the 250 realisations from the existing calibration ensemble also met the calibration criteria and were adopted for the uncertainty analysis in addition to the 200 accepted realisations from the Monte Carlo ensemble, comprising a total of 362 realisations.

The uncertainty analysis was carried out on the Approved, Cumulative, and Null scenarios. The predictions included in the uncertainty analysis were:

- Pit inflows at New Lenton;
- Incidental change in alluvial fluxes (Quaternary Alluvium and Isaac Connors Alluvium Groundwater Sub-area);
- Incremental Isaac River baseflow change; and
- Maximum incremental drawdown due to proposed mining at New Lenton.

Appendix G compares the prior Monte Carlo parameter distributions (1,200 Monte Carlo realisations) to the distribution for realisations that met the calibration criteria (362 realisations). Additionally, the graphs in **Appendix G** demonstrate how the values from the best-calibrated model, reported in **Section 2.2**, align with the overall distribution.



5.2.1 Number of Realisations

The predictive model scenarios were run using the 362 parameters sets described above. The results from the predictive modelling were used to conduct statistical analyses to assess if additional realisations were likely to provide results that would significantly change the reported predictive results. The 95% confidence intervals were calculated for the predicted mine inflows and for the maximum incremental drawdown from the 362 realisations of the Cumulative and Approved scenarios.

Figure 5-9 and **Figure 5-10** show the 95 % confidence intervals of the maximum, median and variance of the predicted mine inflow rate and maximum incremental drawdowns, as more realisations are added to the uncertainty analysis. For example, the 95% confidence interval for the simulated mine inflow is calculated by first estimating the inflow for each realisation and then calculating the 95 % confidence interval of the simulated mine inflow as each realisation is added to the dataset. As shown in **Figure 5-9** and **Figure 5-10**, additional realisations are unlikely to significantly increase or decrease the confidence intervals of predictions of simulated mine inflow and the maximum incremental drawdown.

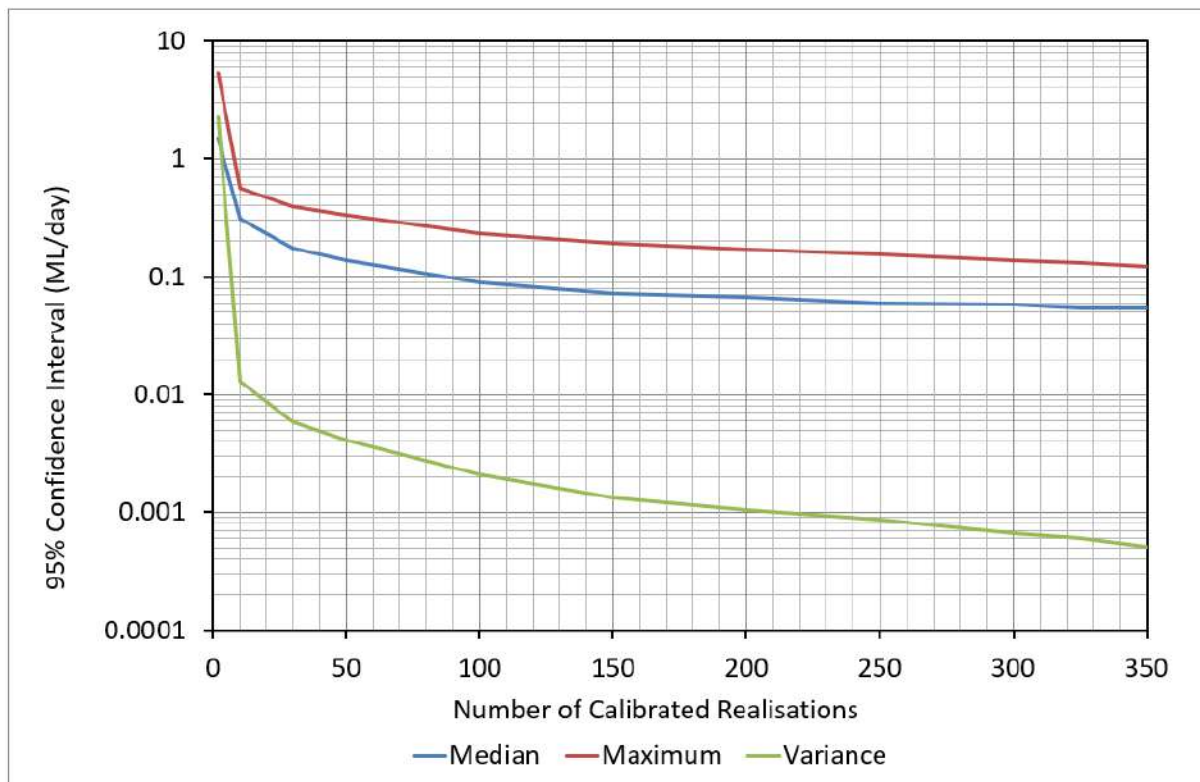


Figure 5-9 95 % Confidence Interval for Predicted Mine Inflows



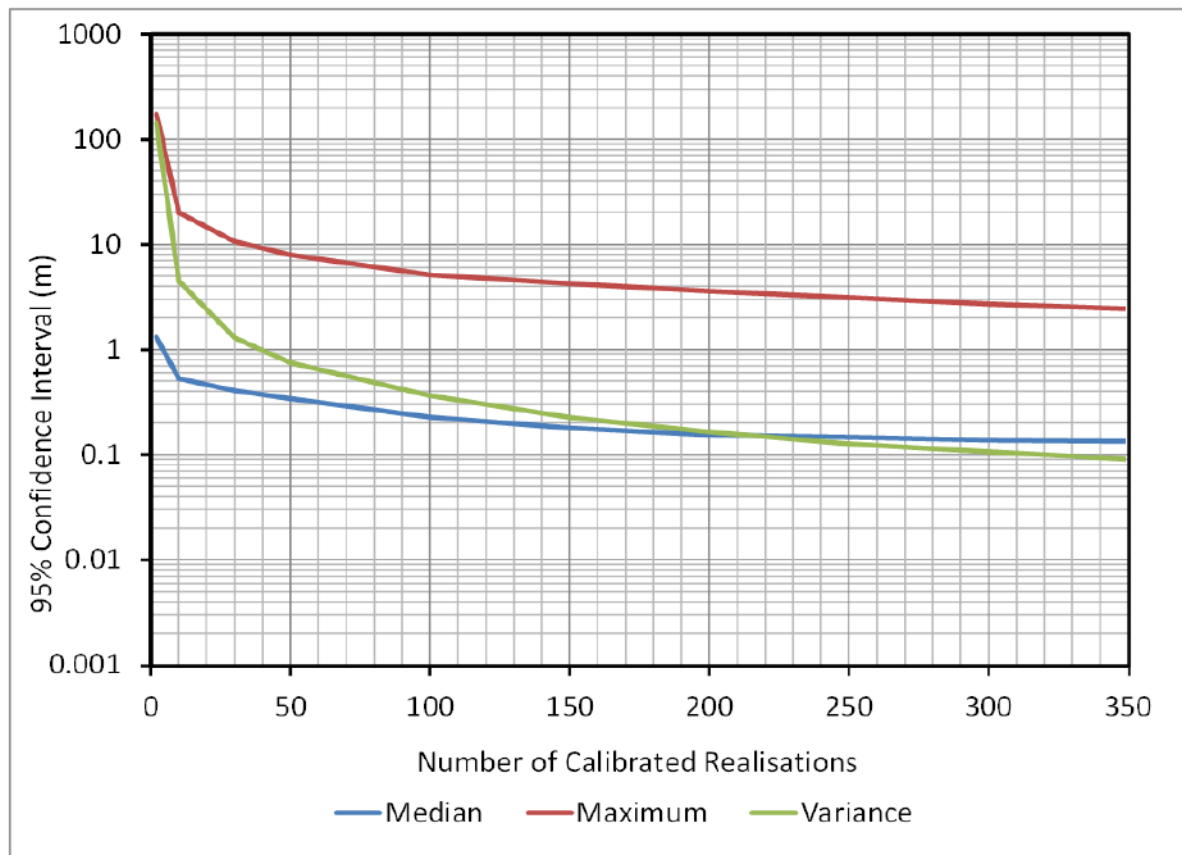


Figure 5-10 95 % Confidence Interval for Maximum Incremental Drawdown

5.2.2 Uncertainty of New Lenton Mine Inflows

Figure 5-11 presents the uncertainty of predicted total groundwater inflows to the New Lenton open cut pits that have been extracted from the Cumulative scenario. The figure shows the predicted inflows for the best calibrated realisation and different percentiles including 10th, 33rd, 67th and 90th prediction bounds. Based on Table 4 of the IESC guidelines (Peeters and Middlemis, 2023) these represent:

- 10th percentile indicates it is very likely the outcome is larger than this value.
- 10th - 33rd indicates it is likely that the outcome is larger than this value.
- 33rd - 67th indicate it is as likely as not that the outcome is larger or smaller than this value.
- 67th - 90th indicates it is unlikely that the outcome is larger than this value.
- 90th percentile indicates it is very unlikely the outcome is larger than this value.

The bounds in the figure demonstrate the uncertainty within the predicted inflow rate. The bounds show that the best calibrated realisation is roughly consistent with the 50th percentile.

As shown in **Figure 5-11**, the maximum total mine inflow in the uncertainty analysis was 2,862 ML/year (7.84 ML/day) for 2030 (very unlikely outcome is larger than this value). The 10th to 90th range in mine inflows for the year 2030 was 600 ML/year (1.64 ML/day) to 1,749 ML/year (4.79 ML/day).



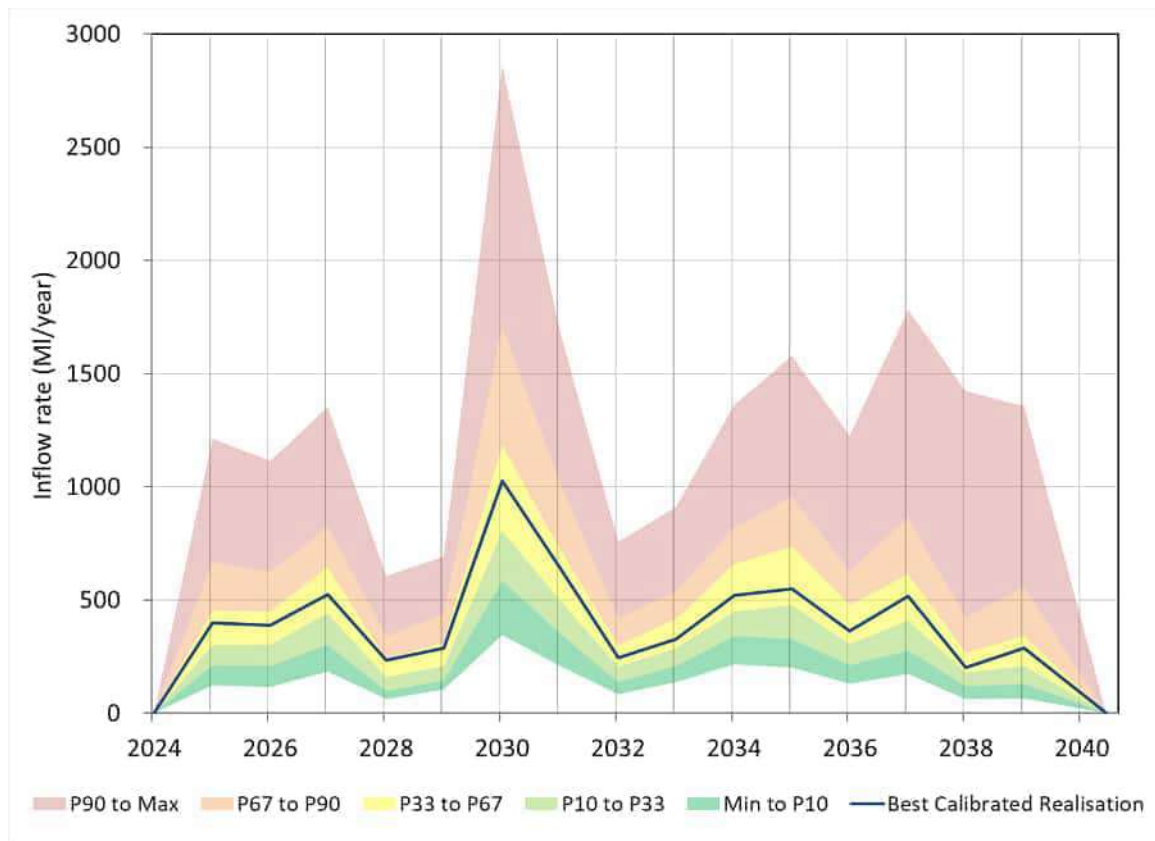


Figure 5-11 Uncertainty of New Lenton Mine Inflows

5.2.3 Uncertainty of Influence on Surface Water Flow

Table 5-1 and

Table 5-2 show the uncertainty range of predicted incremental alluvium flux change for all Quaternary Alluvium mapped within the model domain and for water resources scheduled as part of the Isaac Connors Alluvium Groundwater Sub-area, respectively. The budget zones used to assess the change in flux for these two resources are shown in **Figure 3-23**.

The uncertainty results indicate that the 90th percentile decrease in leakage from the Triassic and Permian units to the Quaternary Alluvium is up to 1.85ML/day (676 ML/year). The 90th percentile decrease in leakage from the Triassic and Permian units to the Isaac Connors Alluvium Groundwater Sub-area within the model domain occurs from 2033 onward and is predicted to be 0.01 ML/day (3.65 ML/year).

As shown in **Table 5-1** and

Table 5-2, the 50th percentile change in flux to the Quaternary Alluvium does not exceed 354.3 ML/year (1 ML/day) in any year, and for the Isaac Connors Alluvium Groundwater Sub-area is negligible (< 0.01 ML/day), consistent with the predictions reported in **Section 3.6.1**.



Table 5-1 Uncertainty of Decrease in Flux to Quaternary Alluvium (ML/Year)

Year	10 th Percentile	50 th Percentile	Best Calibrated Realisation	90 th Percentile
2023	0.0	0.0	0.0	0.0
2024	0.0	0.0	0.0	0.0
2025	0.0	14.6	51.1	84.0
2026	0.0	21.9	32.9	95.0
2027	3.7	25.6	47.5	95.0
2028	7.3	36.5	69.4	113.2
2029	11.0	54.8	91.3	149.8
2030	146.1	354.3	518.7	675.7
2031	120.5	277.6	387.2	482.1
2032	98.6	222.8	277.6	383.5
2033	98.6	208.2	259.3	357.9
2034	91.3	193.6	255.7	343.3
2035	98.6	197.2	255.7	350.6
2036	98.6	197.2	255.7	339.7
2037	98.6	197.2	255.7	339.7
2038	98.6	197.2	255.7	343.3
2039	102.3	197.2	252.0	343.3
2040	95.0	197.2	248.4	332.4



Table 5-2 Uncertainty of Decrease in Flux Isaac Connors Alluvium Groundwater Sub-area (ML/year)

Year	10 th Percentile	50 th Percentile	Best Calibrated Realisation	90 th Percentile
2023	0.00	0.00	0.00	0.00
2024	0.00	0.00	0.00	0.00
2025	0.00	0.00	0.00	0.00
2026	0.00	0.00	0.00	0.00
2027	0.00	0.00	0.00	0.00
2028	0.00	0.00	0.00	0.00
2029	0.00	0.00	0.00	0.00
2030	0.00	0.00	0.00	0.00
2031	0.00	0.00	0.00	0.00
2032	0.00	0.00	0.00	<1.00
2033	0.00	0.00	0.00	<1.00
2034	0.00	0.00	0.00	<1.00
2035	0.00	0.00	0.00	<1.00
2036	0.00	0.00	0.00	<1.00
2037	0.00	0.00	0.00	<1.00
2038	0.00	0.00	0.00	<1.00
2039	0.00	0.00	0.00	<1.00
2040	0.00	0.00	0.00	<1.00

5.2.4 Uncertainty of Groundwater Drawdowns

To illustrate the level of uncertainty in the extent of predicted incremental drawdown due to the proposed mining at New Lenton, the maximum extent of the 1 m predicted drawdown for the 10th, 50th and 90th percentiles was compared to the maximum extent of the 1m drawdown from the best calibrated realisation. This comparison was produced for the alluvium (**Figure 5-12**), regolith (**Figure 5-13**), Burton/Rider and Leichhardt/Vermont seams (**Figure 5-14** and **Figure 5-15** , respectively).

The 90th percentiles shown in **Figure 5-12** to **Figure 5-15** indicate the predicted maximum incremental drawdown extent exceeded by 10% of tested realisations. Therefore, drawdown extent greater than the 90th percentile area is an unlikely outcome. The 10th percentile lines in the figures show the predicted maximum incremental drawdown extent exceeded by 90% of tested realisations. Therefore, it is highly likely that the actual extent will be greater than that shown for the 10th percentile. The 50th percentile lines show the predicted maximum incremental drawdown extent exceeded 50% of tested realisations. Therefore, these predictions are considered as likely outcomes.

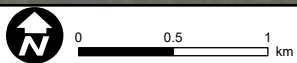
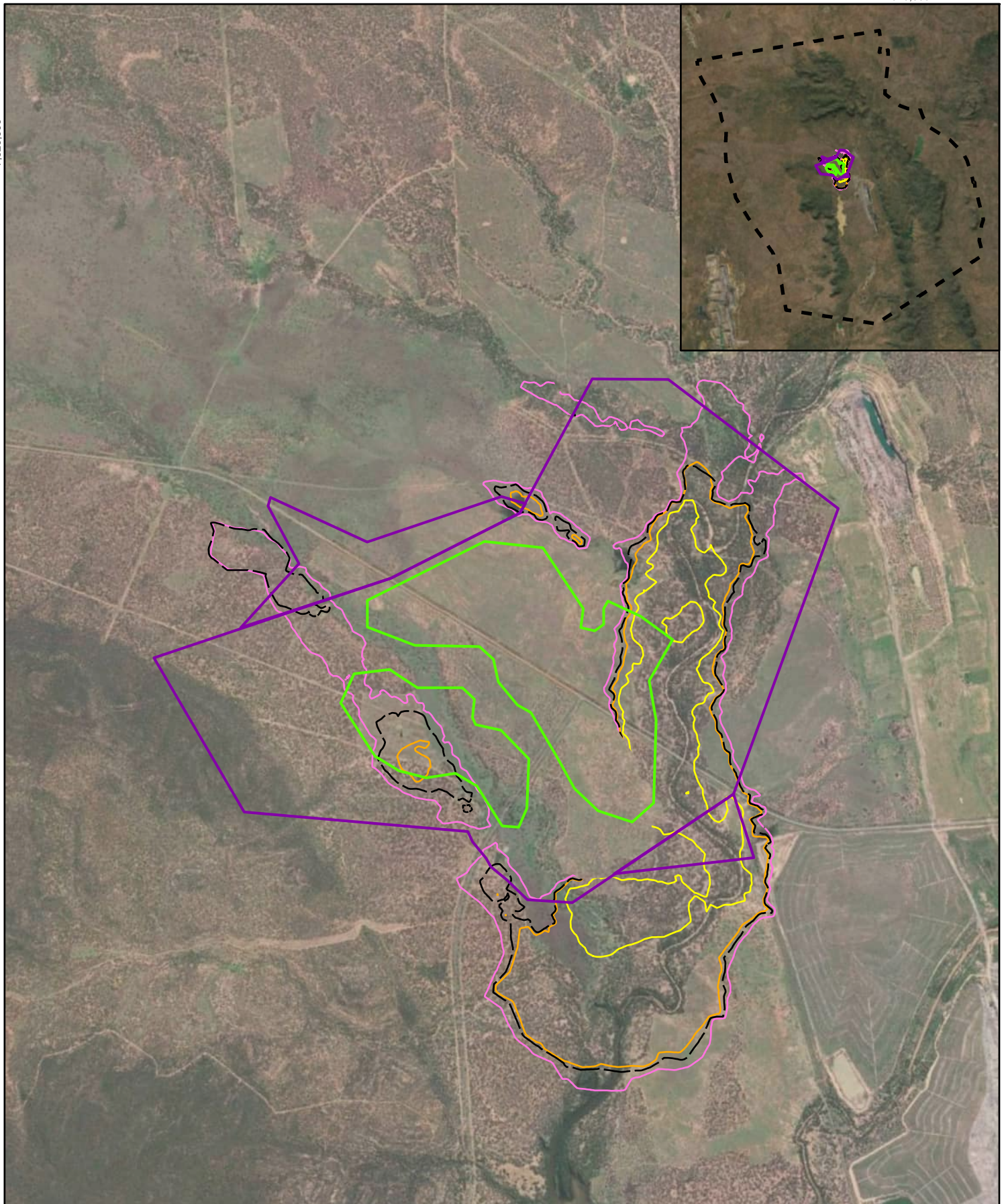
Figure 5-12 shows the uncertainty analysis for the predicted incremental drawdown impacts greater than 1 m for the alluvium as a result of the proposed mining at New Lenton. The 50th and 90th percentiles in the figure indicate 1 m incremental drawdown extending approximately 2 km to the northeast and southwest of the New Lenton pits.



Figure 5-13 shows the uncertainty in the extent of predicted maximum incremental drawdown impacts greater than 1 m in the regolith. The 90th percentile in the figure indicates the model predicts it is very unlikely incremental drawdown exceeding 1 m will extend more than approximately 2 km from the pits. The 50th percentile shown in **Figure 5-13** shows predicted incremental maximum drawdown consistent with the extent of incremental drawdown predicted by the best calibrated realisation.

Figure 5-14 and **Figure 5-15** show the uncertainty in the extent of predicted 1 m maximum incremental drawdown in the Burton/Rider and Leichhardt/Vermont seams, respectively. The figures show that the 90th percentile drawdown in the coal seams extends primarily to the north, reaching approximately 4 km from the New Lenton pits. **Figure 5-14** and **Figure 5-15** show consistency between the best calibrated realisation and the 50th percentile predicted incremental drawdown.





Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 13-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

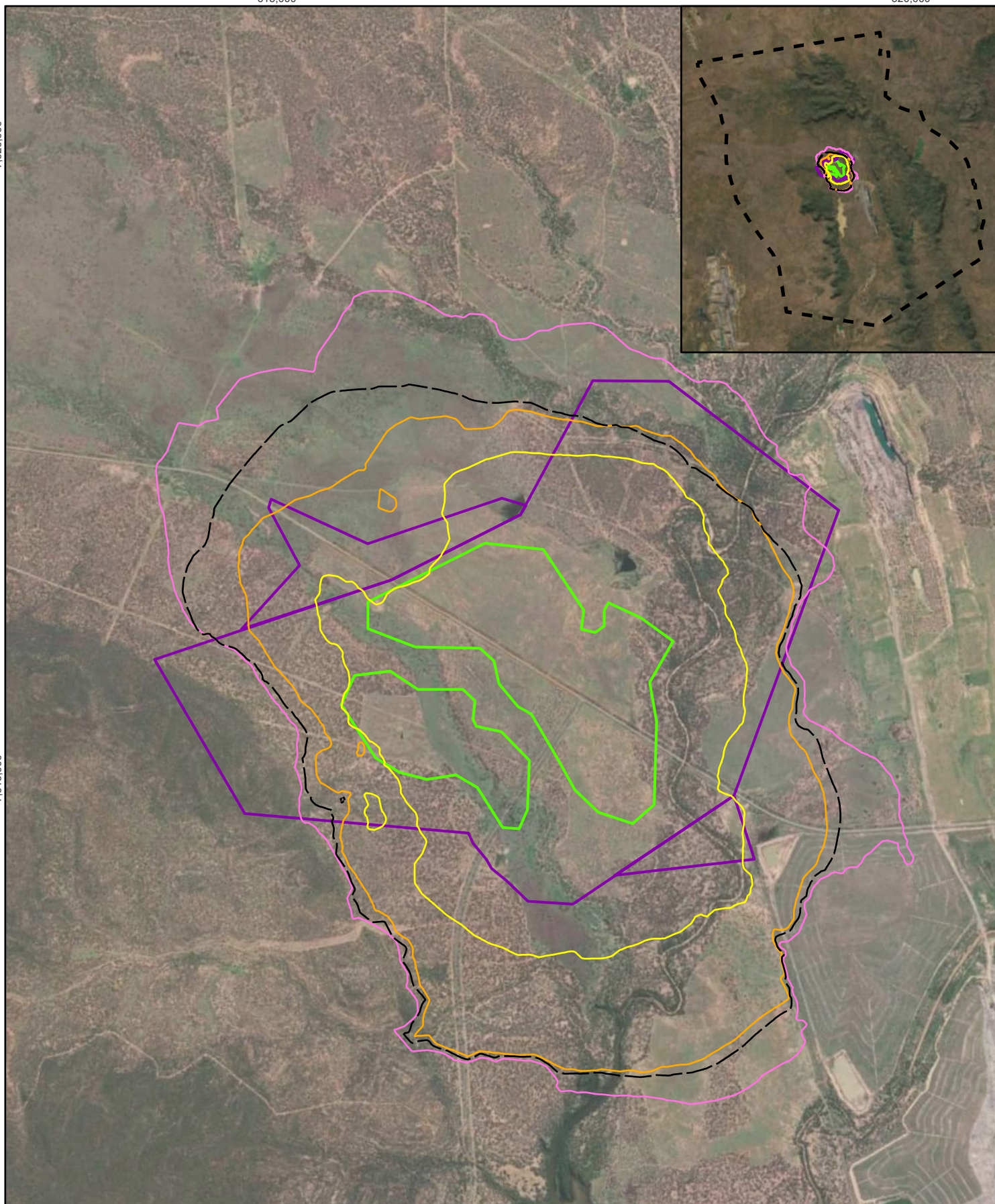
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M MAXIMUM INCREMENTAL DRAWDOWN EXTENT IN ALLUVIUM (LAYER 1)



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FIGURE 5-12



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 13-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

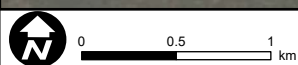
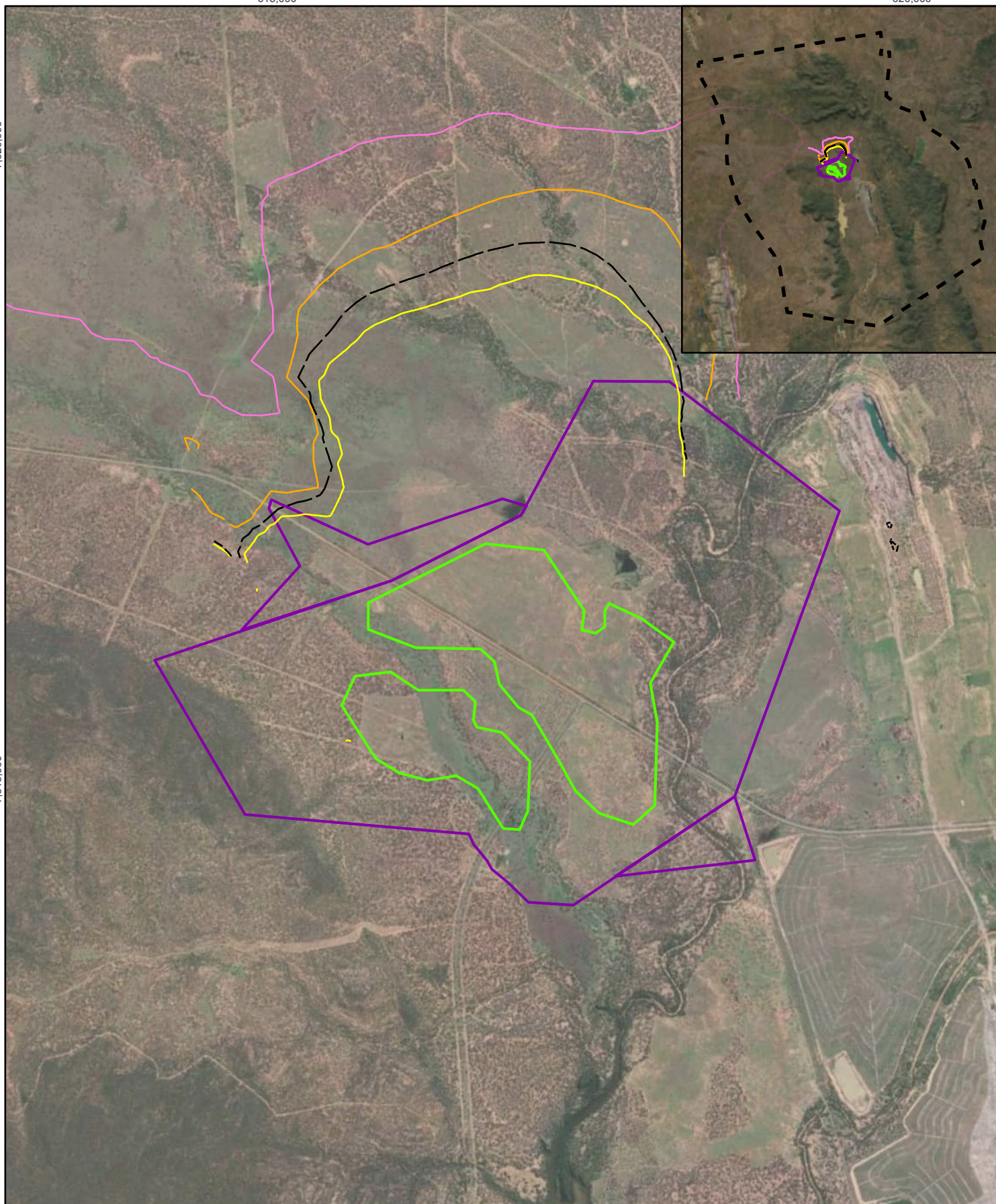
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M MAXIMUM INCREMENTAL DRAWDOWN EXTENT IN REGOLITH (LAYER 2)



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FIGURE 5-13



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 13-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

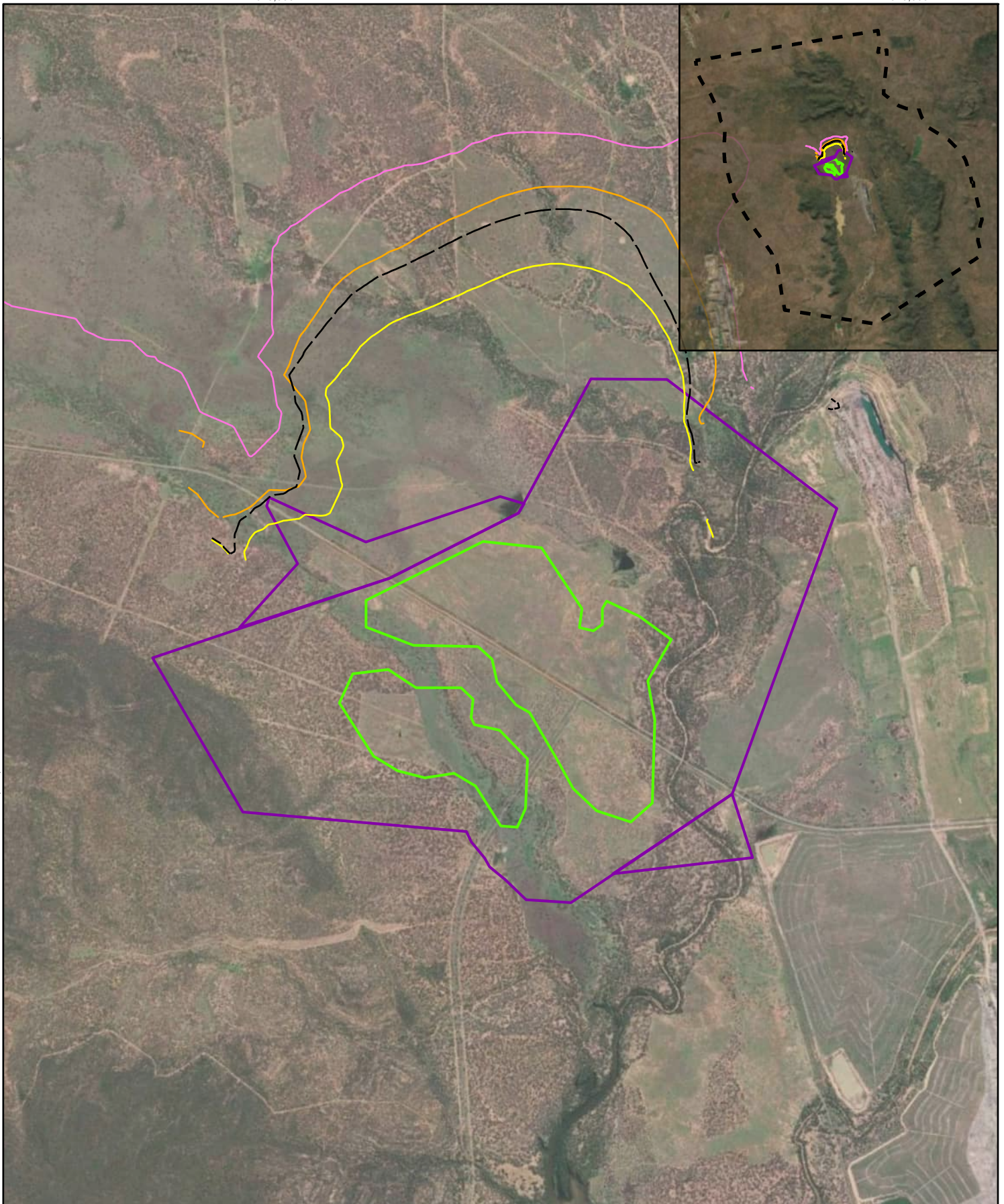
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M MAXIMUM INCREMENTAL DRAWDOWN EXTENT IN BURTON/RIDER SEAM (LAYER 12)



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FIGURE 5-14



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 16-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

**UNCERTAINTY IN PREDICTED 1M
MAXIMUM INCREMENTAL DRAWDOWN
EXTENT IN LEICHHARDT/VERMONT SEAM
(LAYER 16)**



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FIGURE 5-15

6.0 Predictive Post Mining Recovery Modelling

This section describes the post mining groundwater recovery modelling and the potential long term post mining groundwater levels in the vicinity of the New Lenton and Burton mines.

6.1 Groundwater Model Setup

Transient predictive modelling was used to simulate groundwater responses following the cessation of all mining operations in the model domain, encompassing both the New Lenton and Burton mines, rather than focusing solely on either of the mines alone.

The post-mining recovery period starts at the end of mining at the New Lenton Mine (2040) and continues for approximately 730 years (2040-2770). Mining at Burton Mine is expected to finish by 2036. The recovery period consists of biennial stress periods for the first 20 years post-mining, followed by stress periods of increasing length of up to 100-years.

Three transient predictive recovery scenarios have been developed, to allow the assessment of incremental and cumulative impacts on the groundwater system:

- Cumulative – Post-mining at the New Lenton Mine plus at the Burton Mine;
- Approved – Post-mining at the Burton Mine, no mining at New Lenton Mine anytime in the past or future; and
- Null run – No mining within the region anytime in the past or future.

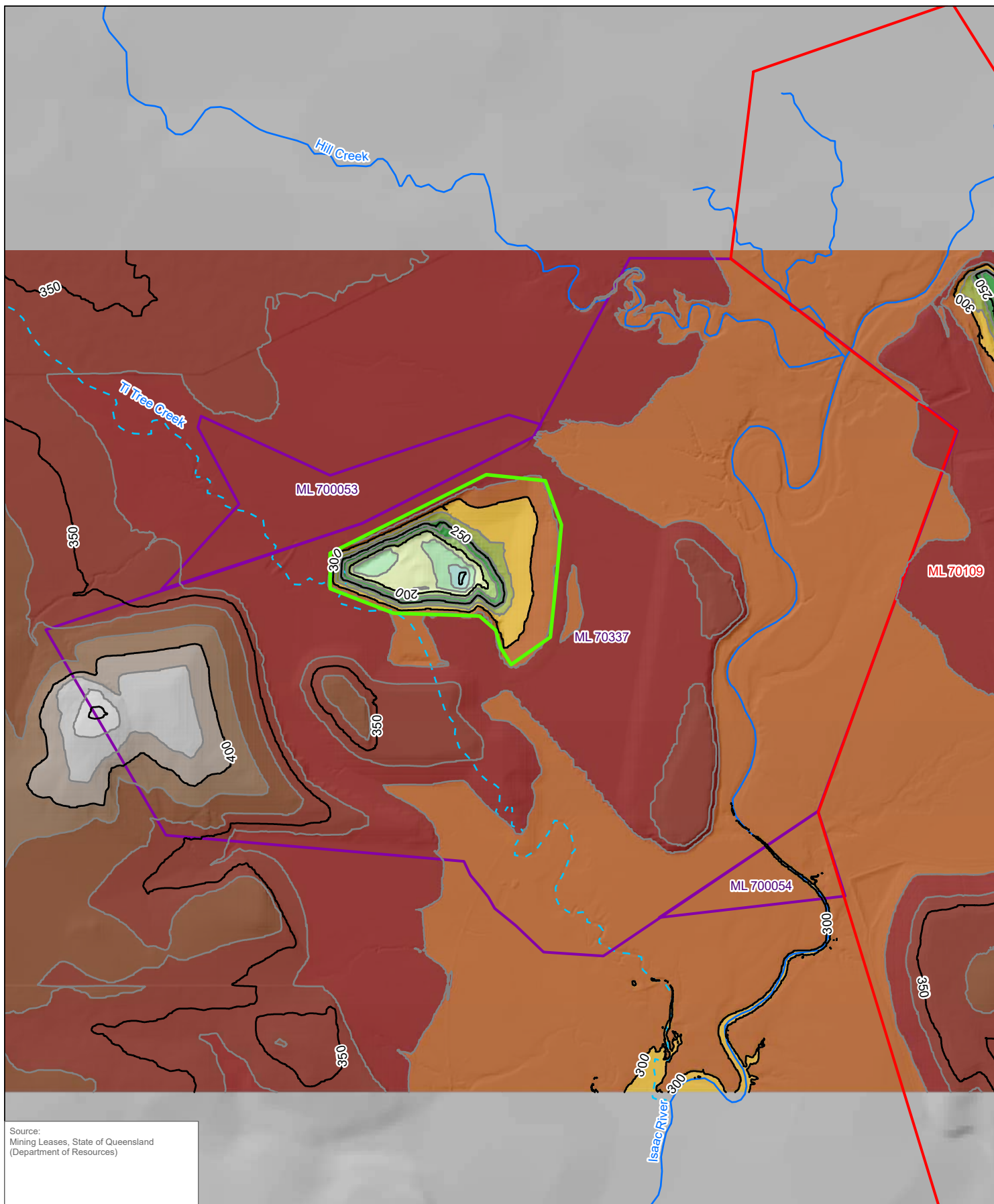
The proposed final landforms for New Lenton and Burton mines were provided by LJV and are replicated in the model, including areas of spoil emplacement within mined out pits and the residual voids. **Figure 6-1** and **Figure 6-2** show the extent of the residual voids within the final landforms for New Lenton Mine and Burton Mine, respectively. These areas represent the maximum possible extent of a lake forming within these voids up to the crest/spill level.

During the recovery period, the simulation of historic mined pits adjacent to Burton Mine (Plumtree and Bullock Creek, formerly part of Burton Mine) included no additional change to model properties following the historical and predictive setup. The two pits have therefore been modelled as partially backfilled pits, with residual voids consistent with the latest available LiDAR elevations, for the duration of the recovery modelling period.

At the end of mining all drain cells (representing pit dewatering in areas of active mining) are removed from the groundwater model. Using the TVM package, the properties of the residual void cells are assigned high horizontal and vertical hydraulic conductivities (1,000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, specific storage of 5.0×10^{-6} m⁻¹), to simulate free water movement within the residual void. The properties of cells within areas of proposed spoil emplacement were assigned the calibrated spoil parameters presented in **Table 2-11**. Similarly, the EVT factor, extinction depth and zone-specific recharge factor for the spoil, from the best calibrated realisation, were applied to the spoil during the post-mining recovery simulation.

Climate related boundary conditions (i.e., recharge and evapotranspiration) outside of void lakes in the recovery model were set at constant rates (i.e, long term averages from SILO grid point observations for the site) for the duration of the post-mining simulation, consistent with the values used in the predictive modelling (**Section 3.0**). Climate related boundary conditions on residual voids themselves (where lakes form) are discussed in **Section 6.2** below.





 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:30,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: RB

LEGEND

- Non-designated Watercourse
- River
- Topographic Contour (20 m)
- Topographic Contour (50 m)
- Final Void Extent
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease

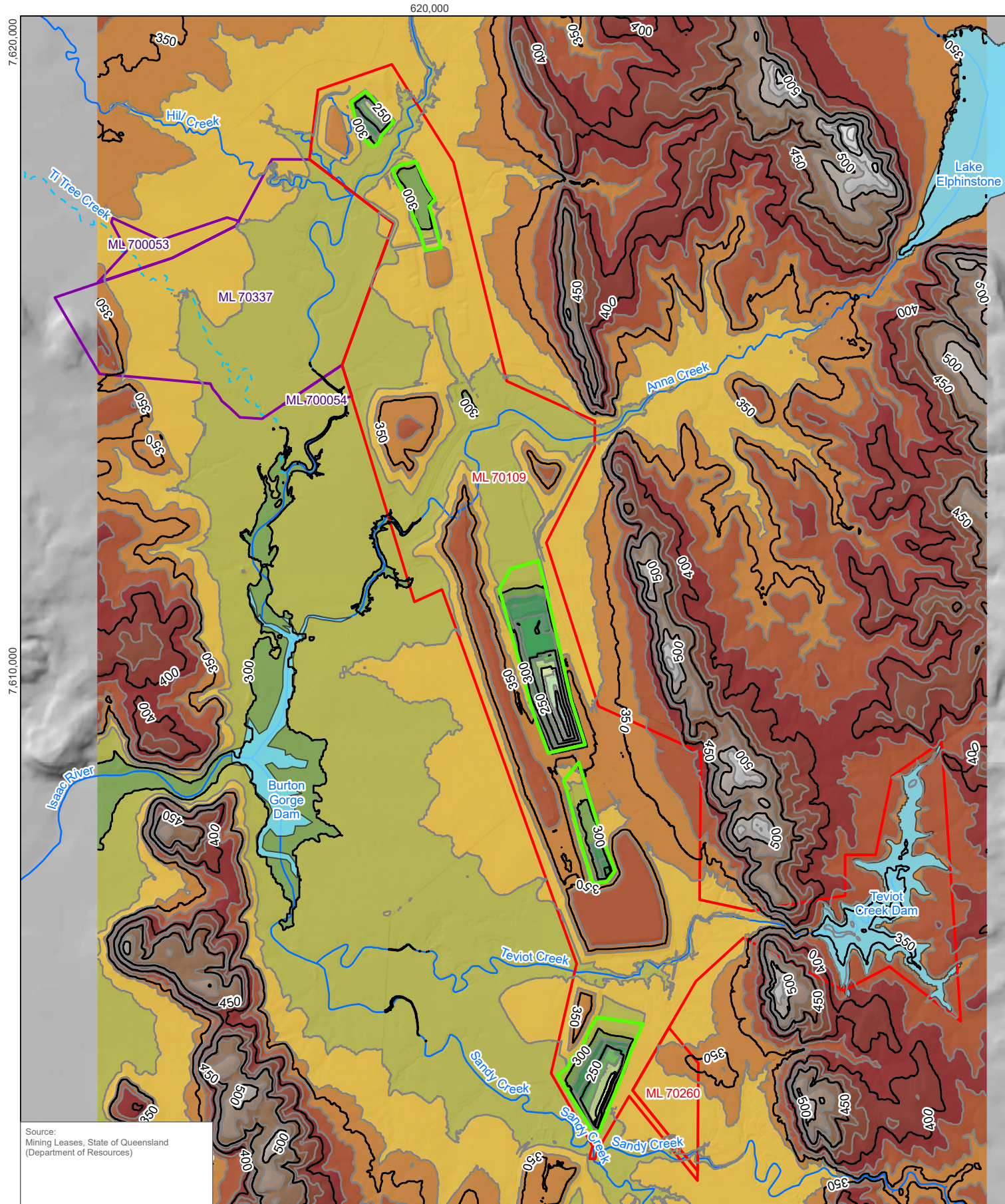
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RESIDUAL VOID EXTENT (NEW LENTON MINE)



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FIGURE 6-1



0 0.5 1
km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:80,000 at A4

Project Number: 620.31208.00000

Date Drawn: 16-Dec-2023

Drawn by: RB

LEGEND

- Non-designated Watercourse
- River
- Topographic Contour (50 m)
- Topographic Contour (20 m)
- Final Void Extent
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

RESIDUAL VOID EXTENT (BURTON MINE)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-2

6.2 Integration with Residual Void Water Balance Model

Figure 6-3 presents a conceptual diagram of the post-mining modelling setup adopted for the model. As shown in **Figure 6-3**, the residual voids will accumulate water over time due to direct rainfall, surface water runoff and groundwater inflow from both spoil and natural rock as groundwater levels recover. Whilst the numerical groundwater model can reliably account for the groundwater inflow component, the surface components of direct rainfall, surface water runoff, as well as evaporative loss from the void lake, are considered to be better accounted for within a surface water balance model.

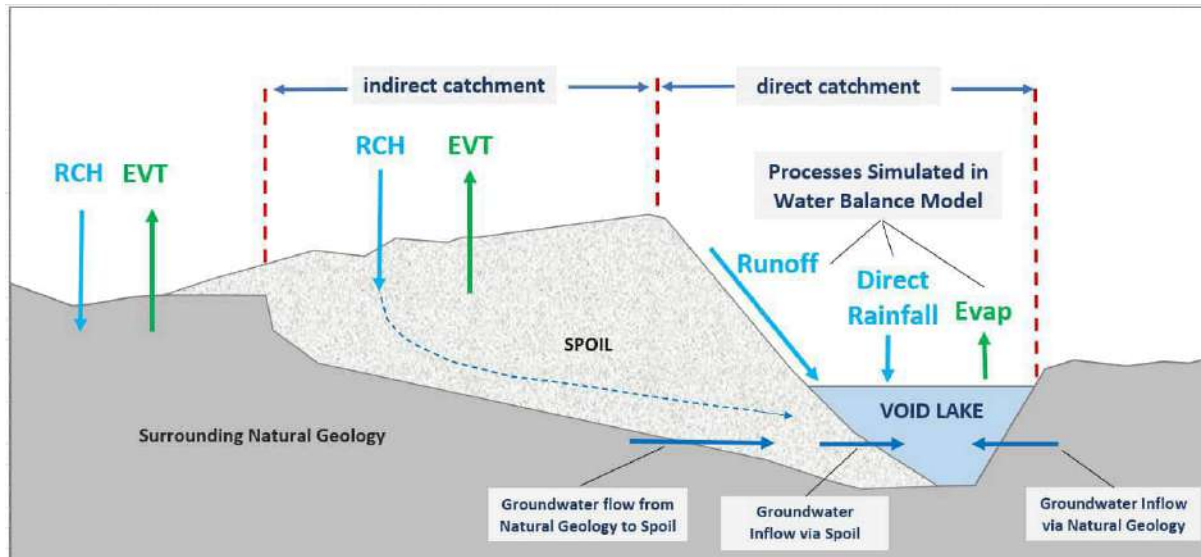


Figure 6-3 Final Void Recovery Model Conceptual Diagram

The groundwater model was therefore used to predict the following fluxes to the residual voids:

- Groundwater inflow to the pit shell from the surrounding geology, including inflow from the natural geology to the spoil backfill and inflow from the natural geology directly to the residual void; and
- Groundwater inflow originating from the indirect catchment (i.e. areas of spoil backfill that receive rainfall recharge that then flows through the spoil into the residual void).

A surface water balance model developed by WRM Water & Environment (WRM, 2023a; WRM, 2023b) estimated the void lake levels using the groundwater model predictions for groundwater inflow described above, as well as direct rainfall and rainfall runoff from the surrounding landform catchment against the evaporation loss from the void lake. Recharge and ET are not applied to the residual voids in the groundwater model as the residual void water balance model used iteratively with the groundwater model (WRM, 2023a; WRM, 2023b) accounts for these parameters. The final lake levels are estimated through iterative process between groundwater model and surface water model as described below:

- Step 1: Initial predicted groundwater inflows to the residual voids vs time were extracted from the groundwater model and were incorporated in the initial void water balance model prepared by WRM (2023a; 2023b).
- Step 2: The pit lake recovery levels vs time were then simulated by the WRM (2023a; 2023b) surface water model, which incorporated both groundwater (from Step 1) and surface water fluxes and processes.



- Step 3: To refine the groundwater model prediction of groundwater inflow during recovery, the residual void water elevations derived from the WRM (2023a; 2023b) surface water balance modelling (Step 2) were then replicated within the numerical groundwater model using a time variant CHD condition applied to the residual void.
- Step 4: The refined predicted groundwater inflows to the voids vs time from the numerical groundwater model (Step 3) were then incorporated into an update of the Step 2 water balance model. After three such iterations between the groundwater model and the surface model (Step 2 to Step 4 loop), the groundwater model predictions for fluxes to the residual voids over time were in agreement with what was used as input to the water balance modelling. At this point it was agreed between SLR and WRM that further iterations between the two models were not required and therefore the groundwater model results from the 3rd iteration were adopted for reporting.

6.3 Residual Void Lake Levels

6.3.1 New Lenton Mine

Figure 6-4 provides a graphical representation of the final simulated recovery of water levels in the residual void at East Pit, based on the iterative groundwater and surface water balance modelling described above. Note that, as discussed above, the void lake levels simulated in the groundwater model are a simplified (time averaged) version of the WRM (2023a) reported lake levels because of the inherent difference in time step setup between the two types of model.

Figure 6-4 shows that the residual void water level recovery is a slow process with the recovery rate declining as the lakes reach equilibrium conditions. The equilibrium conditions were reached after approximately 250 years. The predicted equilibrated water level in the residual void at 500 years post-mining is included in **Table 6-1** and approximates 271 mAHD in the time-averaged level adopted in the groundwater model, noting that WRM (2023a) report that the equilibrium lake level fluctuates between 270 and 278 mAHD. This difference is not considered significant enough to invalidate the convergence between the two types of model, or affect the groundwater model predictions described later in this report.



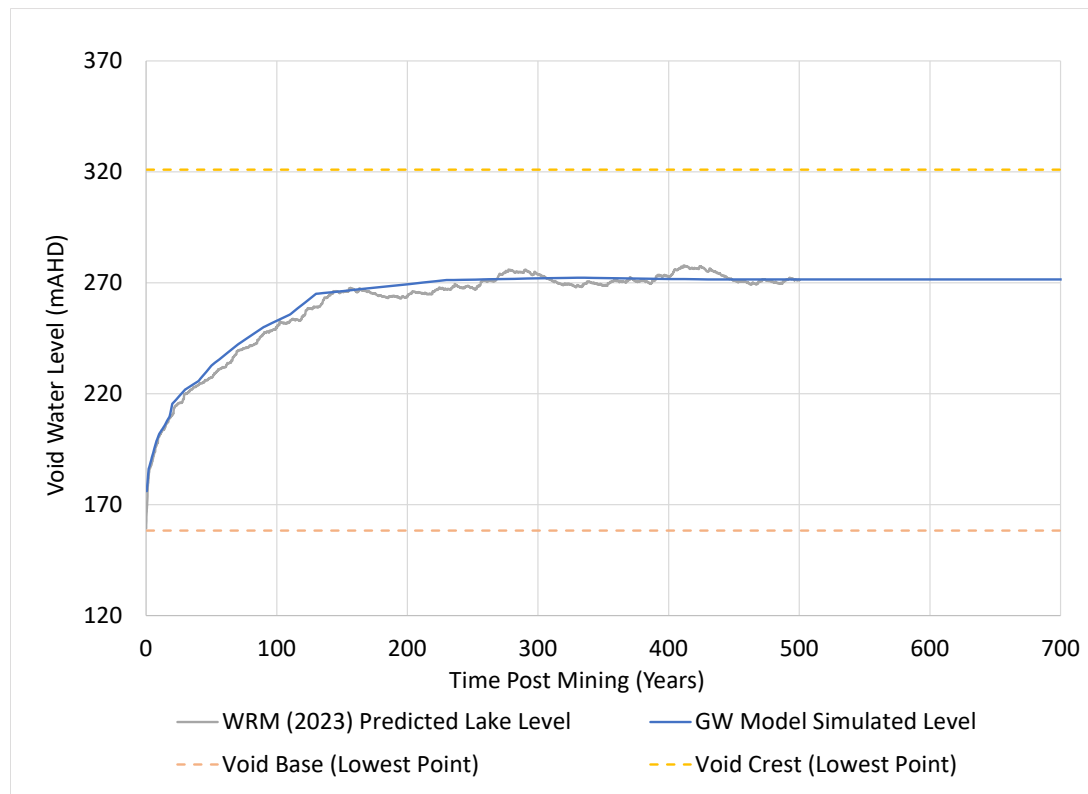


Figure 6-4 Simulated Void Water Level Recovery Post-mining – East Pit (New Lenton)

The freeboard for the residual void is calculated as the difference in elevation between the equilibrium void lake levels and the maximum void storage elevation. The freeboard for the residual void at New Lenton is shown in **Table 6-1**.

Table 6-1 Approximate Equilibrium Conditions for Residual Void at New Lenton

Residual Void	Spill Elevation (mAHD)	Approximate Time to Equilibrium (years)	Equilibrium Water Level (mAHD)	Freeboard (m)
East Pit	320	250	271.5	48.5

6.3.2 Burton Mine

Figure 6-5 to Figure 6-9 provide a graphical representation of the final simulated recovery of water levels in the residual voids at Burton Mine, based on the iterative groundwater and surface water balance modelling described in **Section 6.2**. Note that, as discussed above, the void lake levels simulated in the groundwater model are a simplified (time averaged) version of the WRM (2023b) reported lake levels because of the inherent difference in time step setup between the two types of model.

Figure 6-5 to Figure 6-9 show that the equilibrium conditions were reached between approximately 200 - 400 years for all voids at Burton Mine.



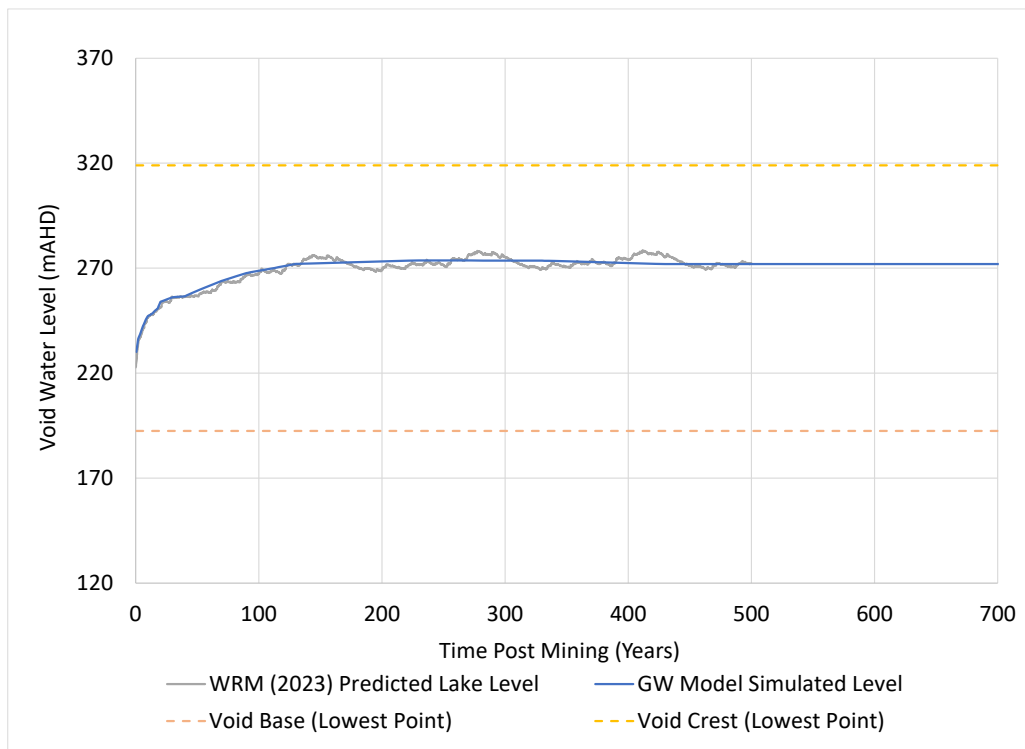


Figure 6-5 Simulated Void Water Level Recovery Post-mining – Isaac Pit (Burton)

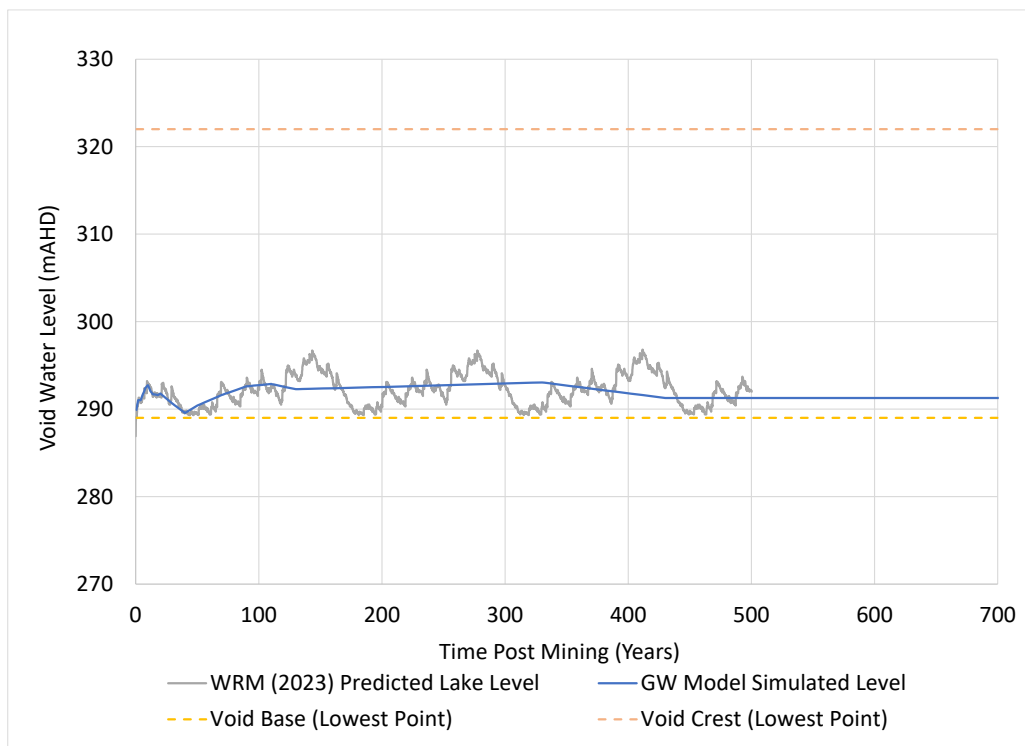


Figure 6-6 Simulated Void Water Level Recovery Post-mining – Burton North (Burton)



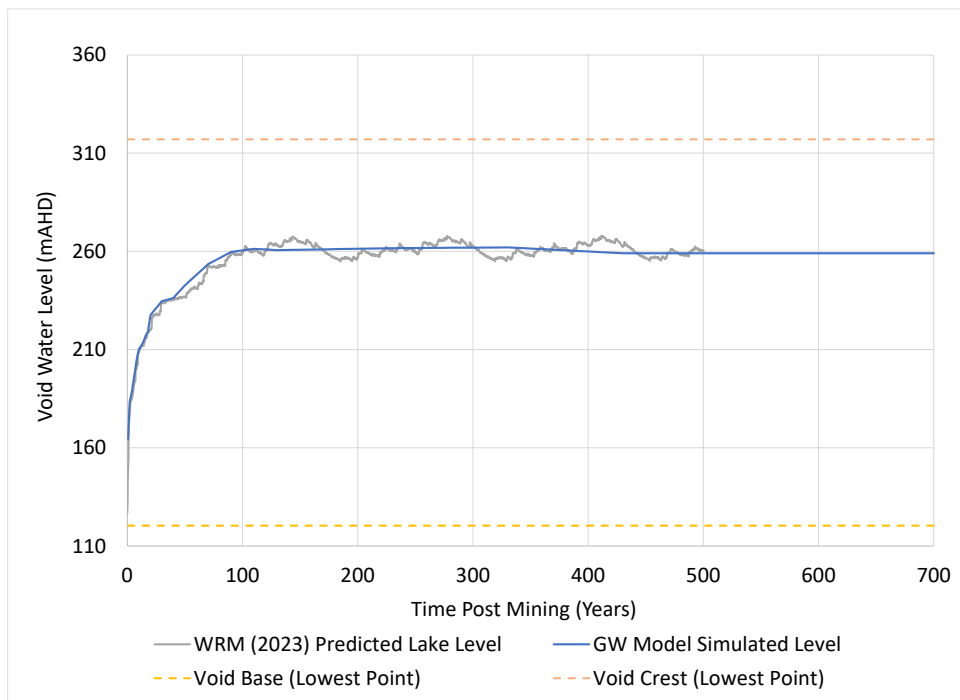


Figure 6-7 Simulated Void Water Level Recovery Post-mining – Burton South (Burton)

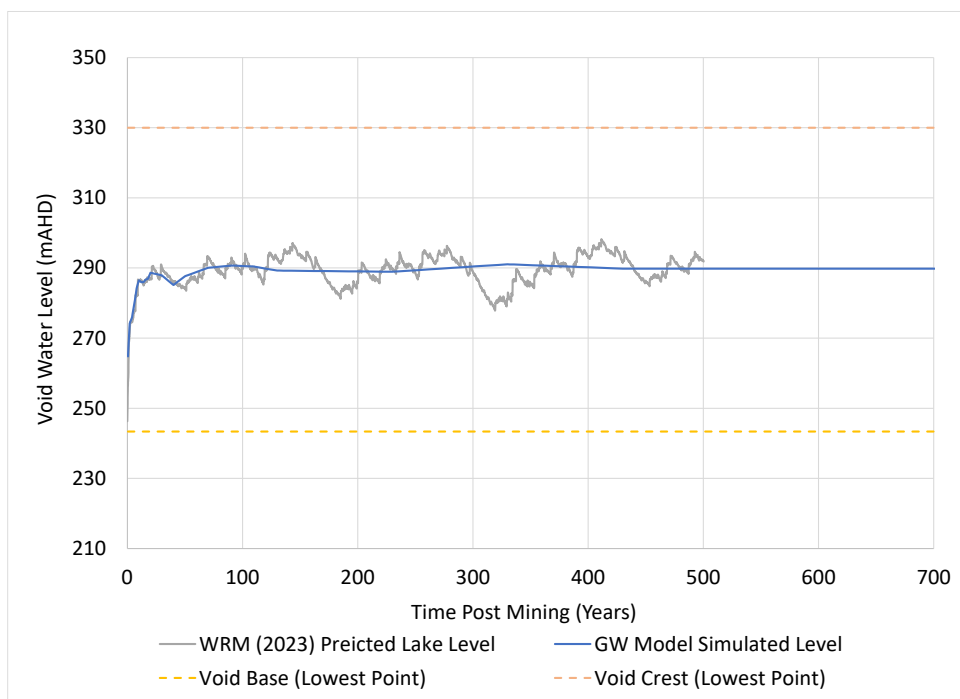


Figure 6-8 Simulated Void Water Level Recovery Post-mining – Ellensfield (Burton)



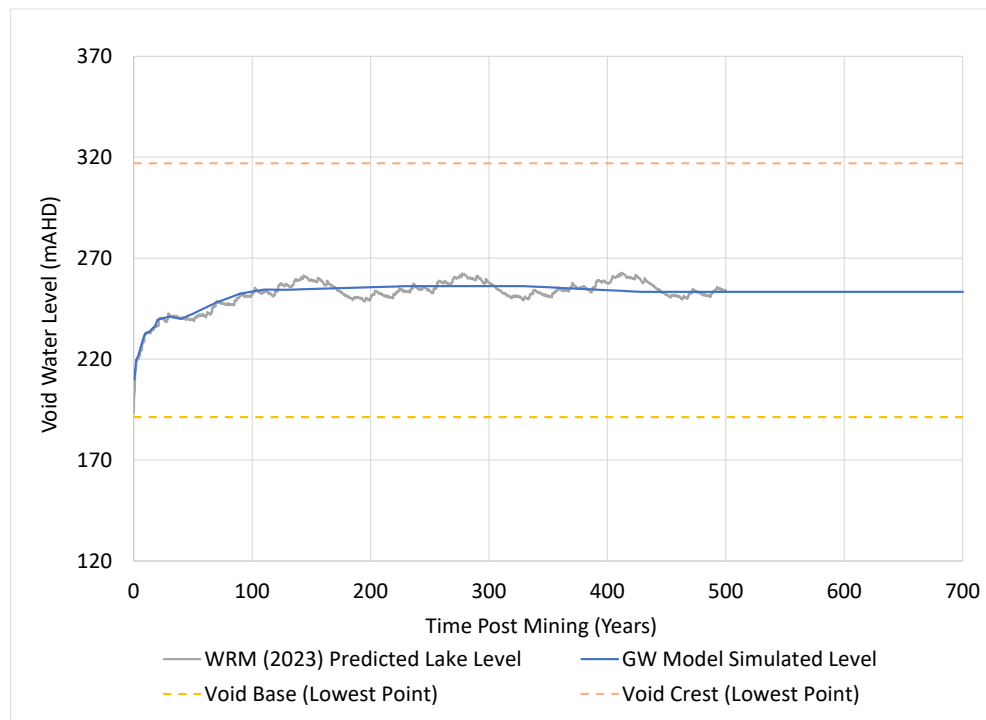


Figure 6-9 Simulated Void Water Level Recovery Post-mining – Plumtree North (Burton)

The predicted time to equilibrium and equilibrated post-mining water levels in the residual voids are shown in **Table 6-2**, along with the approximate pre-mining groundwater level at each void. The freeboard values for the residual voids at Burton are also shown in **Table 6-2**. It should be noted that the predicted residual void lake levels remain significantly below the base of the shallow geologic formations for each of the residual voids. This is discussed in more details in **Section 6.5.1** and **Appendix H**.

Table 6-2 Approximate Equilibrium Conditions for Residual Void at Burton Mine

Residual Void	Spill Elevation (mAHD)	Approximate Time to Equilibrium (years)	Equilibrium Water Level (mAHD)	Freeboard (m)
Isaac Pit	319	400	271.9	47.1
Burton North	322	400	291.3	30.7
Burton South	317	400	259.0	58.0
Ellensfield	330	200	289.8	40.2
Plumtree North	317	400	253.3	63.7



6.4 Residual Void Groundwater Inflow

6.4.1 New Lenton Mine

The groundwater inflows to the East Pit void predicted by the groundwater model are shown in **Figure 6-10**. The inflows are partitioned between flow into the residual void through spoil, and that which flows into the residual void through only surrounding natural geological formations (i.e. where the natural geology remains exposed to the void shell).

Figure 6-10 shows there are periods of variable groundwater inflows predicted by the groundwater model in the first 50 to 100 years post-mining when groundwater levels remain suppressed. The figures also show relatively large variability in the predicted inflow magnitudes over the first 50 years post-mining. During this transition period, groundwater fluxes to the voids are largely controlled by variable levels predicted by the WRM (2023a) surface water balance model.

The groundwater inflow to the void is predicted to stabilise between 200 to 500 years post closure consistent with the stabilisation of void lake levels.

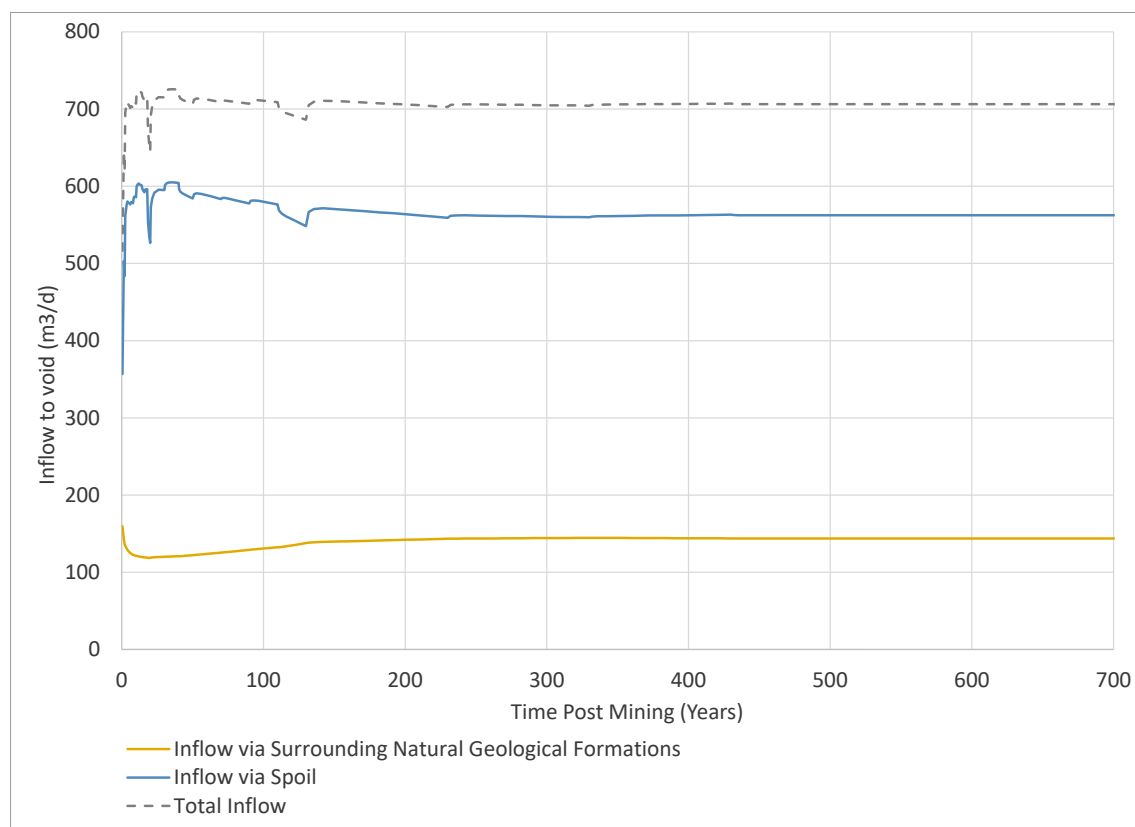


Figure 6-10 Simulated Residual Void Groundwater Inflows – East Pit Void (New Lenton)

The post-mining equilibrium flux to the New Lenton East pit shell is summarised in **Table 6-3**. This flux is indicative of the total longterm average take from the groundwater system, and includes the component of flow directly to the void from natural geologic formations presented in **Table 6-4**.



Table 6-4 shows the predicted post-mining equilibrium groundwater inflows to East Pit final void. The table indicates that for the East Pit void, 80% of the long-term groundwater inflow to the voids comes via the spoil, which is a composition of both direct rainfall recharge to spoil areas and groundwater inflows from natural geologic formations.

Table 6-3 Equilibrium Groundwater Inflows to the Pit Shell from Natural Geological Formations - New Lenton

Residual Void	Equilibrium Inflow Rate – Natural Geological Formations (m ³ /day)
East Pit Void	635.5

Table 6-4 Equilibrium Groundwater Inflows to the Residual Voids - New Lenton

Residual Void	From Spoil (m ³ /day)	From Natural Geological Formations (m ³ /day)	Total (m ³ /day)
East Pit Void	562.3	143.8	706.1

6.4.2 Burton Mine

The final iteration of predicted groundwater inflows to the residual voids at Burton Mine are shown in **Figure 6-11** to **Figure 6-15**, with inflows partitioned between that which flows into the residual voids through spoil, and that which flows into the residual voids directly from surrounding natural geological formations.

In the first 100 years post-mining, groundwater levels remain suppressed. During this time, groundwater fluxes to the voids are largely controlled by the predicted WRM (2023b) residual void lake levels that rise and fall periodically (refer **Section 6.3.2**) according to:

- the day-on-day climatic simulation within the WRM (2023b) water balance model, and
- how the daily timestep water balance results are translated to the groundwater model's more simplified stress period setup.

Accordingly, there are periods of variable groundwater inflow and outflow predicted by the groundwater model in the first 50 years post-mining, and some variability in the predicted inflow magnitudes over the first 100 years post-mining.

Figure 6-11, **Figure 6-13**, **Figure 6-14** and **Figure 6-15** show that for most of the voids at Burton Mine, inflow conditions prevail when mining activity ceases, with the magnitude of inflow decreasing significantly within the first 20 to 50 years. This prevailing inflow condition is maintained for the duration of the recovery simulation and the variability in magnitude decreases after approximately 100 years.

Figure 6-11 shows that there are no predicted fluxes through spoil to the Isaac Void. This absence of flux is attributed to the fact that the Isaac Void lacks any spoil and is entirely surrounded by bedrock.

Figure 6-12 shows that there is an initial outflow of rainfall derived surface water captured in the Burton North void to the surrounding spoil. The direction of flow out of the Burton North void lake is reversed after approximately 6 months and long-term groundwater inflow to the lake is established, with only inflow conditions prevailing thereafter.



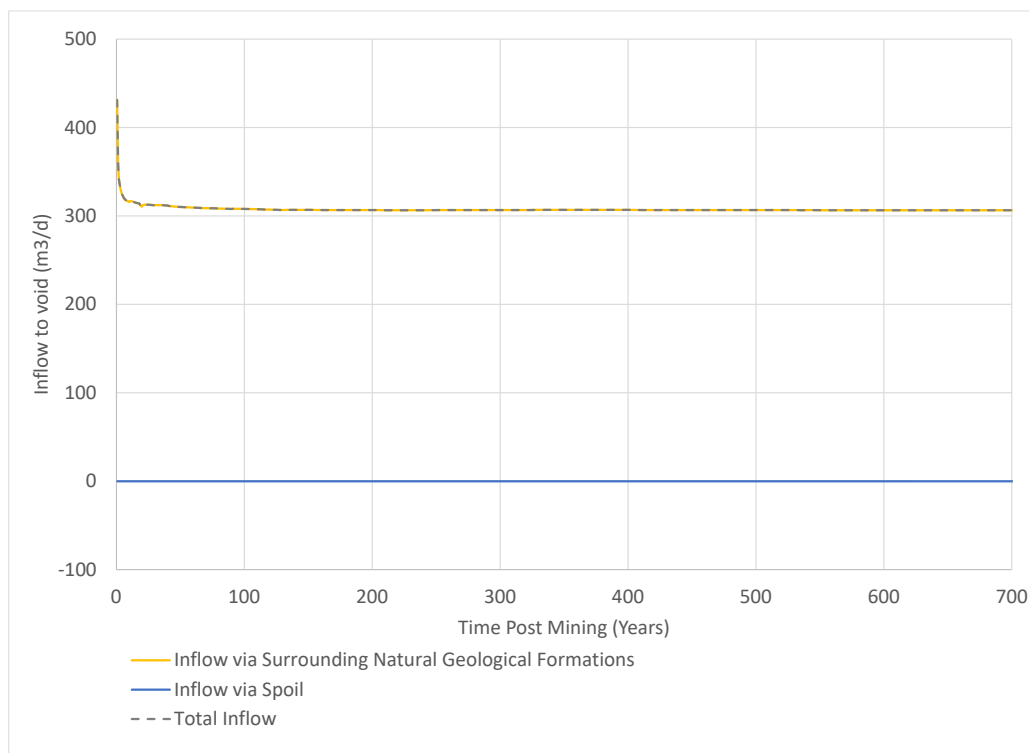


Figure 6-11 Simulated Residual Void Groundwater Inflows – Isaac Pit Void (Burton)

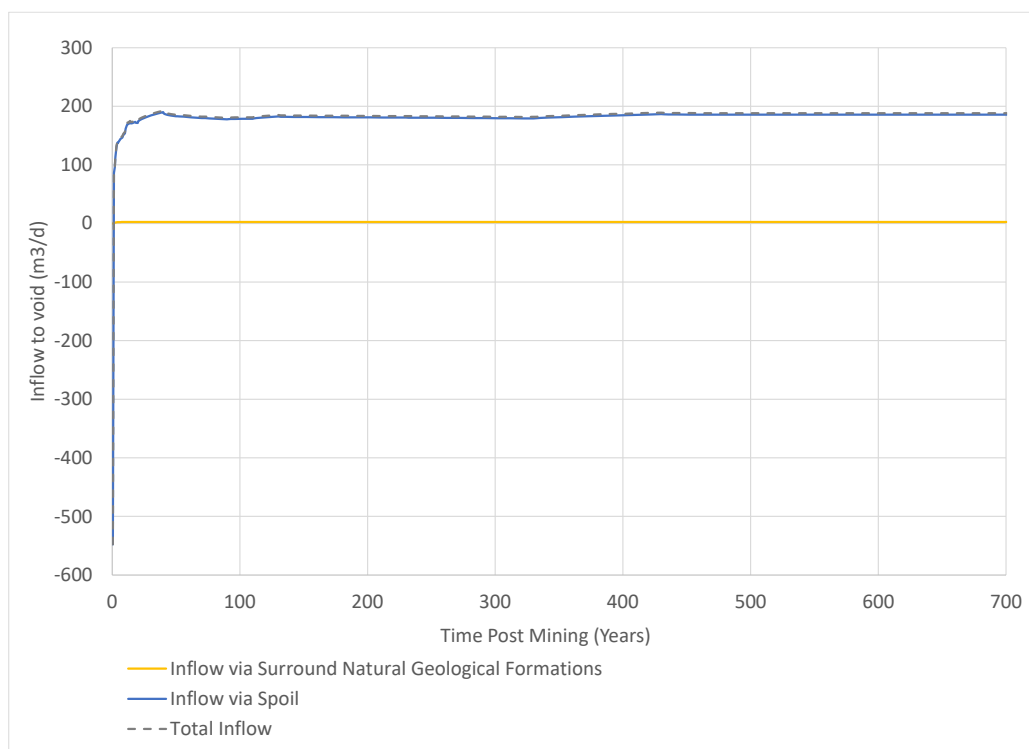


Figure 6-12 Simulated Residual Void Groundwater Inflows – Burton North Void (Burton)



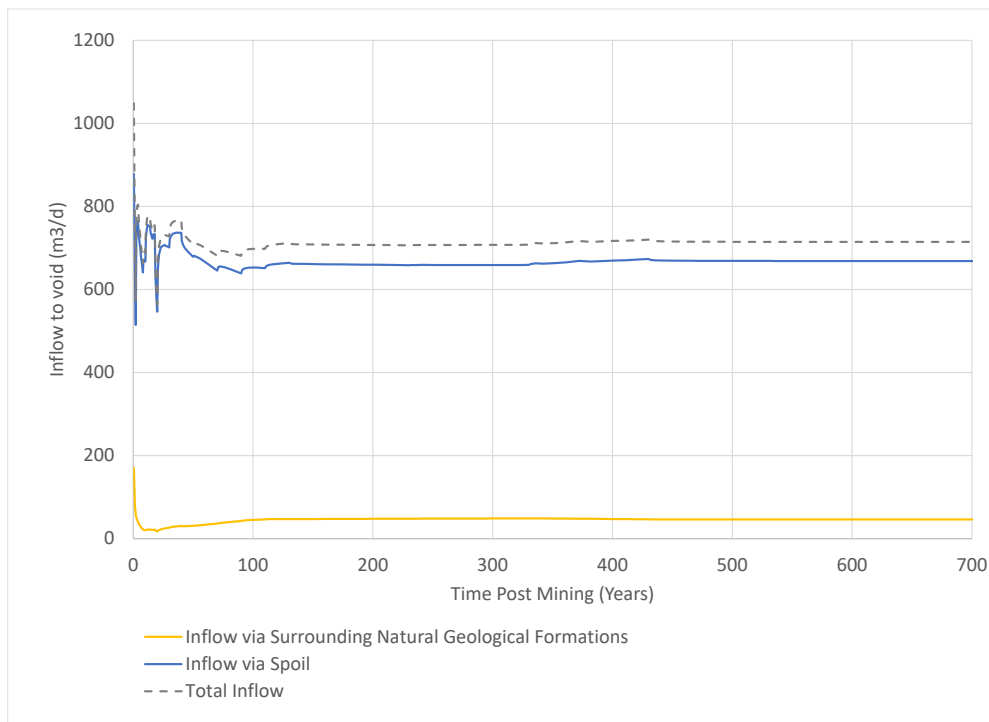


Figure 6-13 Simulated Residual Void Groundwater Inflows – Burton South Void (Burton)

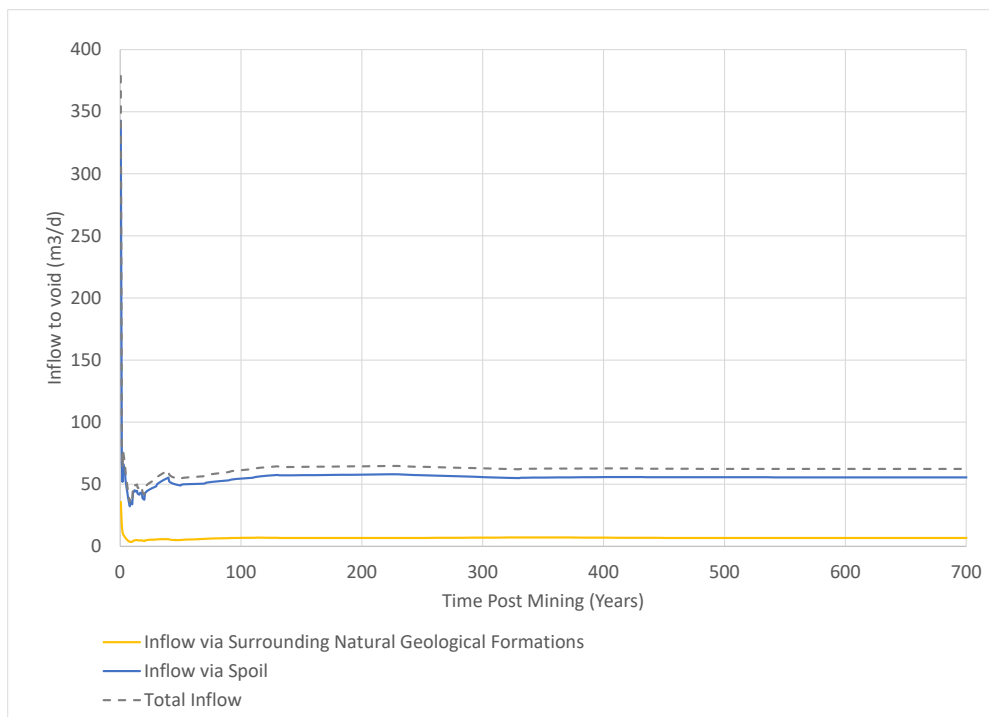


Figure 6-14 Simulated Residual Void Groundwater Inflows – Ellensfield Void (Burton)



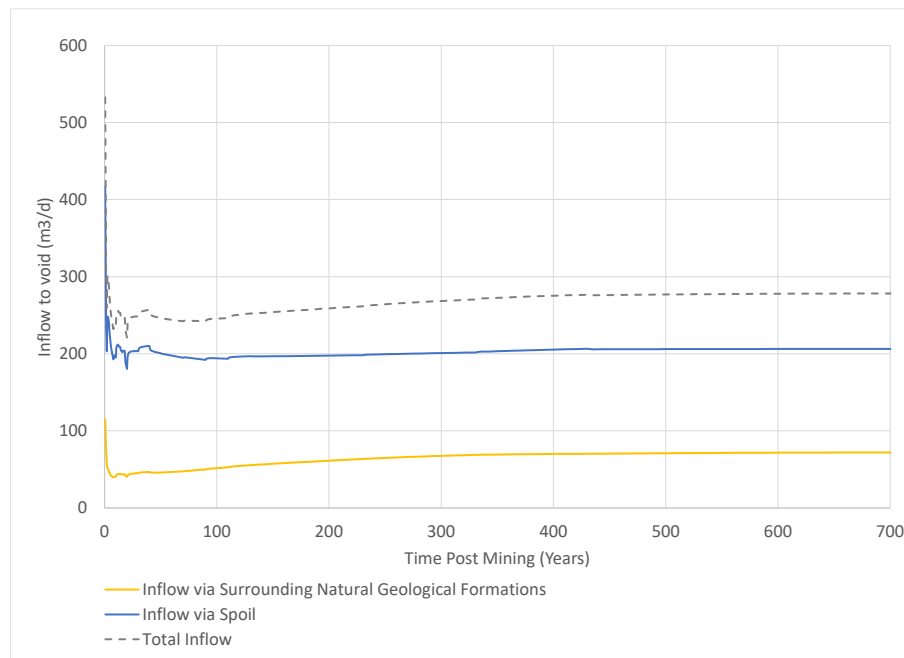


Figure 6-15 Simulated Residual Void Groundwater Inflows – Plumtree North Void (Burton)

Predicted post-mining equilibrium groundwater inflows from the surrounding bedrock to each of the Burton pit shells are summarised in **Table 6-5**. This flux is indicative of the total longterm average take from the groundwater system, and includes the component of flow directly to the void from natural geologic formations presented in **Table 6-6**.

Table 6-6 shows the predicted post-mining equilibrium groundwater inflows to each of the voids. Additionally, the table outlines the contributions of flow from both the spoil and the bedrock to each void. Model results indicate that, with the exception of Isaac Void, between 75% and 98% of the total inflow to the voids is coming from the spoil. The Isaac Pit void has no backfilled spoil within the mined pit, therefore the inflow to the void comes solely from surrounding natural geological formations directly into the residual void.

Table 6-5 Equilibrium Groundwater Inflows to the Pit Shell from Natural Geological Formations - Burton

Residual Void	Equilibrium Inflow Rate – Natural Geological Formations (m³/day)
Isaac	306.6
Burton North	146.3
Burton South	661.8
Ellensfield	48.2
Plumtree North	258.9



Table 6-6 Equilibrium Groundwater Inflows to the Residual Voids - Burton

Residual Void	From Spoil (m ³ /day)	From Natural Geological Formations (m ³ /day)	Total (m ³ /day)
Isaac	-	306.6	306.6
Burton North	185.6	2.5	188.1
Burton South	668.5	46.0	714.5
Ellensfield	55.6	6.8	62.4
Plumtree North	206.4	72.0	278.4

6.5 Post Mining Equilibrium Groundwater Levels

The predicted equilibrium groundwater table is shown in **Figure 6-16**. Predicted equilibrium groundwater levels for the Alluvium, Regolith, Burton/Rider and Leichhardt/Vermont seams are shown in **Figure 6-17** to **Figure 6-20**.

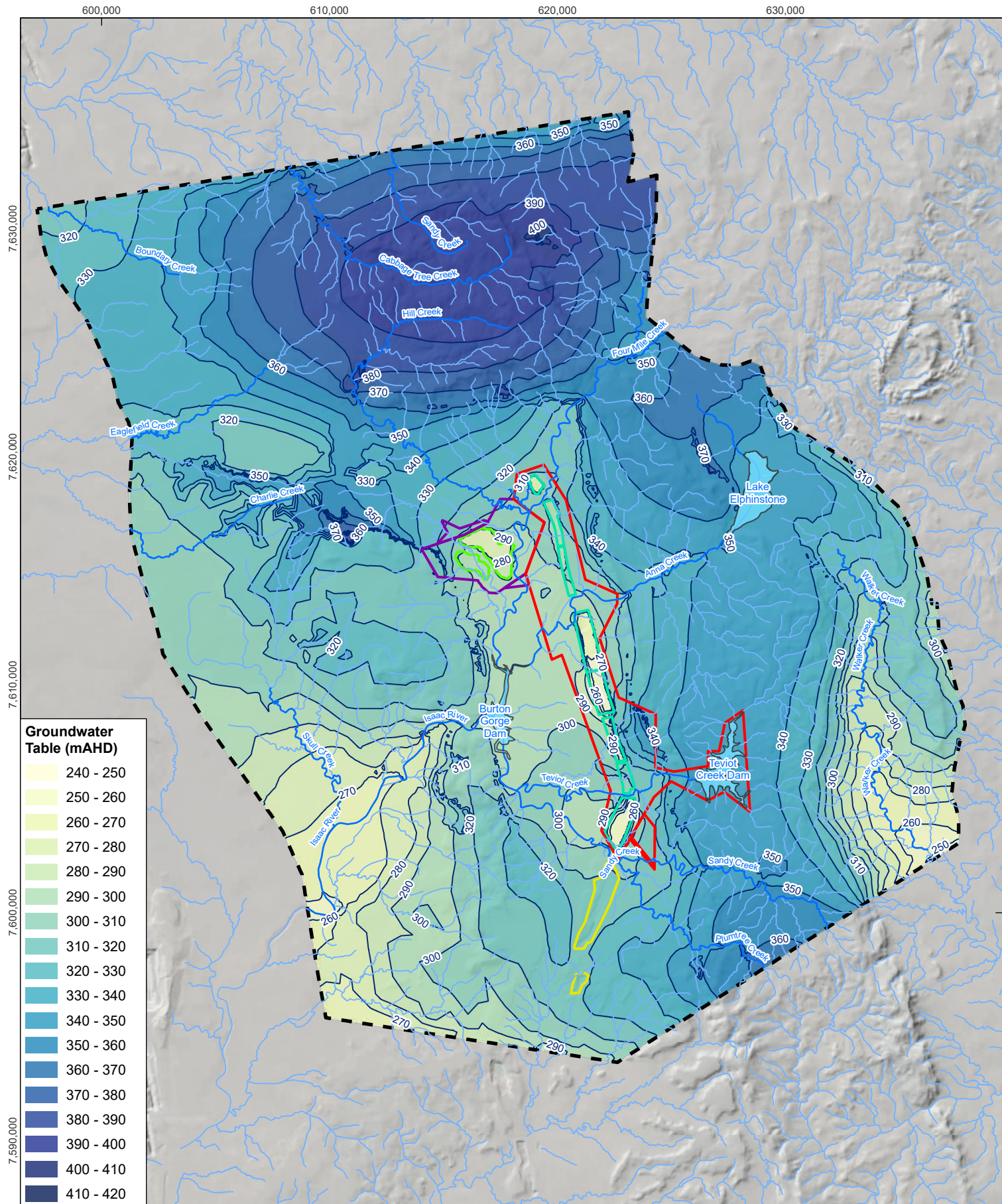
Figure 6-16 indicates that away from the mines, the simulated post-mining groundwater table generally reflects topography and surface drainage. The figures show within and immediately around the mine footprints, the simulated groundwater table is permanently influenced by mining activities with the residual voids acting as sinks to the groundwater system. The local water table in proximity to the residual voids is predicted to remain depressed in the long term driven by the ongoing groundwater discharge to the final voids, governed by the void lake elevations.

Figure 6-17 shows groundwater levels in alluvium in post-mining. The model predicts the general flow of alluvial groundwater consistent with the alignment of the Isaac River, towards the southwest discharging through the GHB condition at the western boundary of the model.

Figure 6-18 shows the predicted groundwater levels in the regolith at post-mining equilibrium, largely consistent with the gradients observed in the predicted water table shown in **Figure 6-16**.

Predicted groundwater levels for the coal seams are presented in **Figure 6-19** and **Figure 6-20**. The figures indicate that groundwater levels in the Permian coal seams are predicted to remain depressed in the long term, driven by the ongoing evaporation-driven groundwater discharge to the residual void lakes and governed by the residual void lake elevations.





Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
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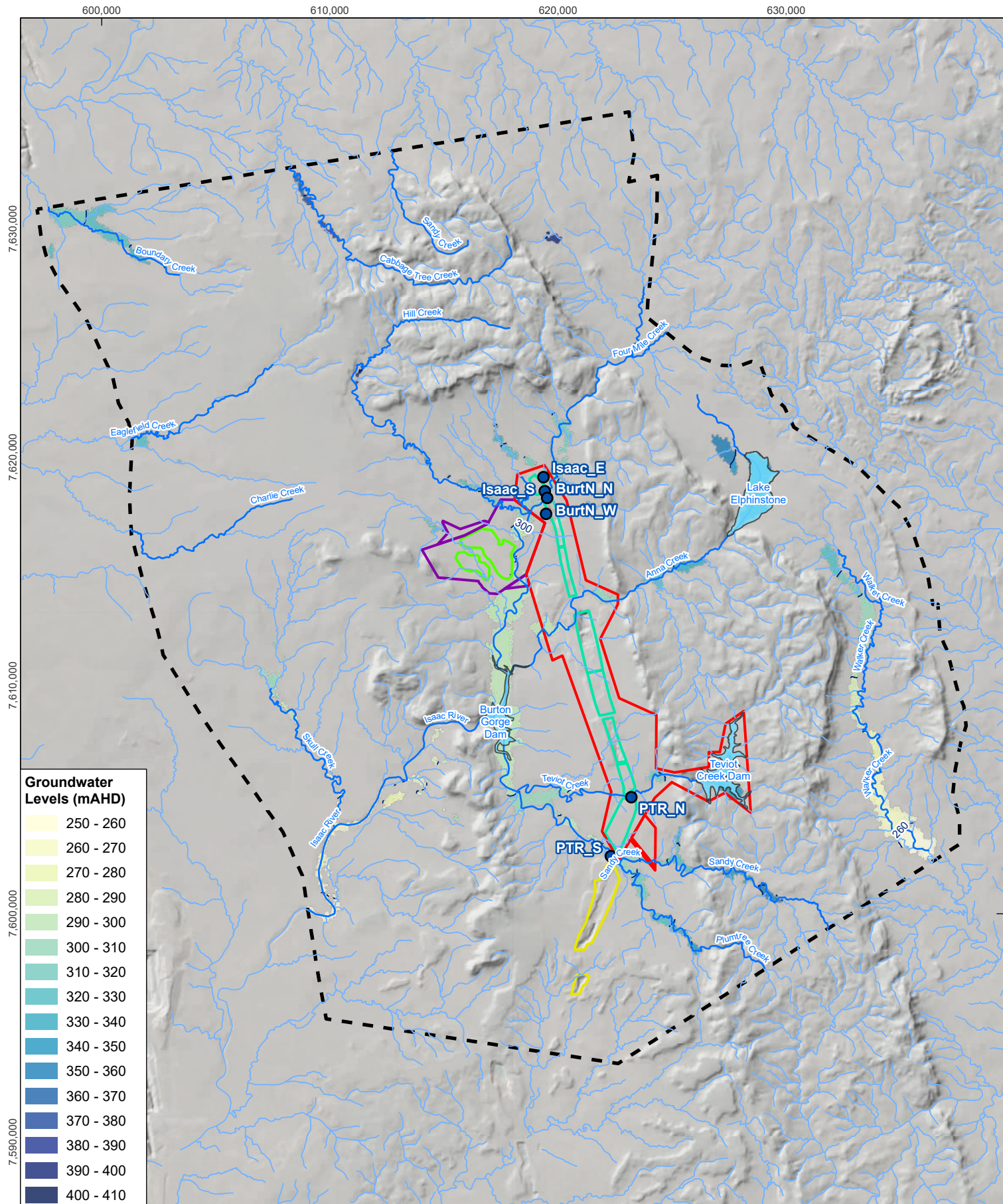


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BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED WATER TABLE – POST-MINING EQUILIBRIUM (CUMULATIVE SCENARIO)

FIGURE 6-16



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: RB

LEGEND

-  Bore location
-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

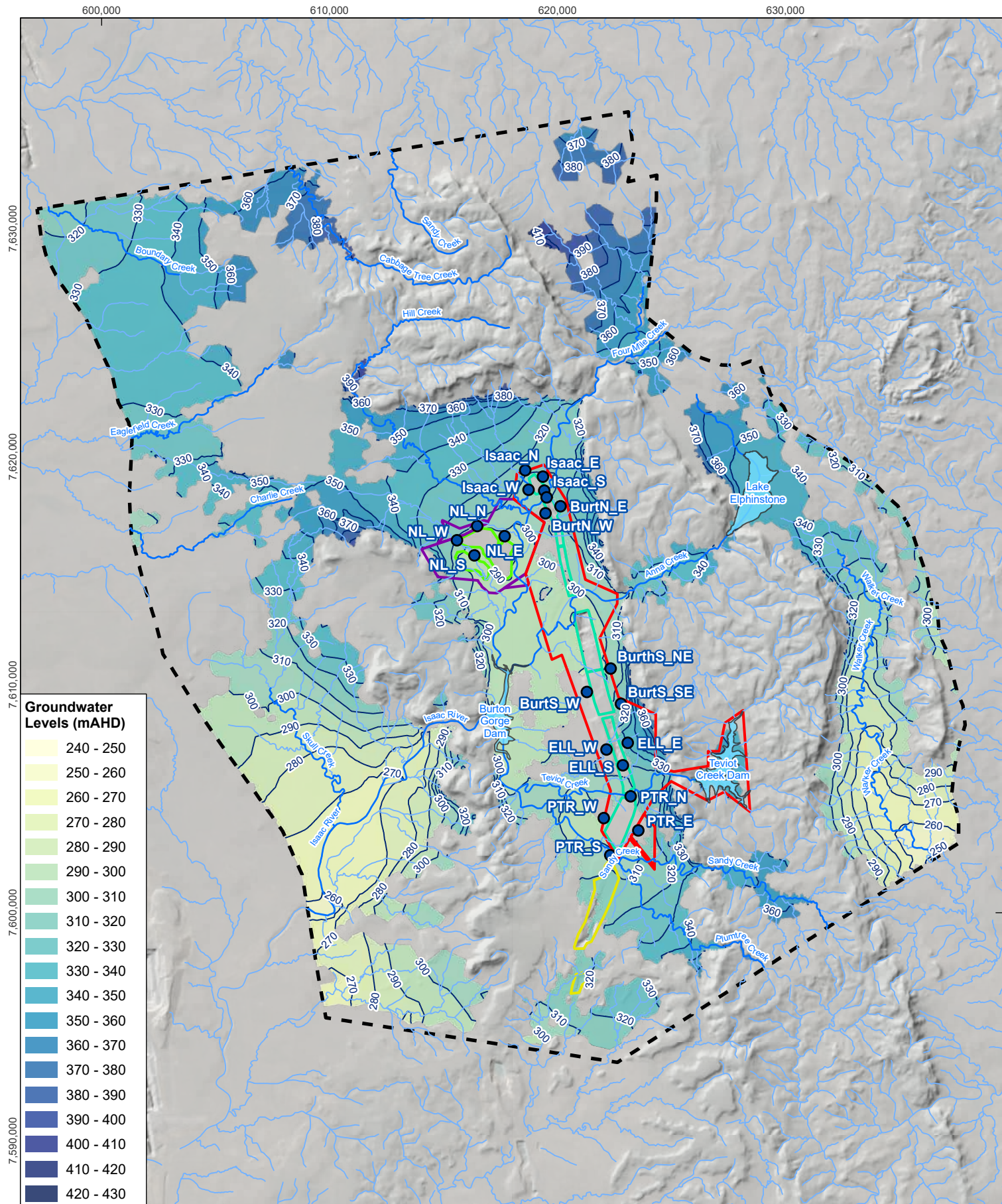
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN ALLUVIUM (LAYER 1) – POST-MINING EQUILIBRIUM (CUMULATIVE SCENARIO)



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FIGURE 6-17



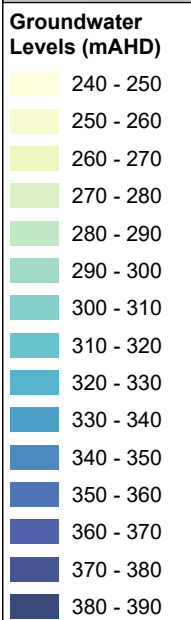
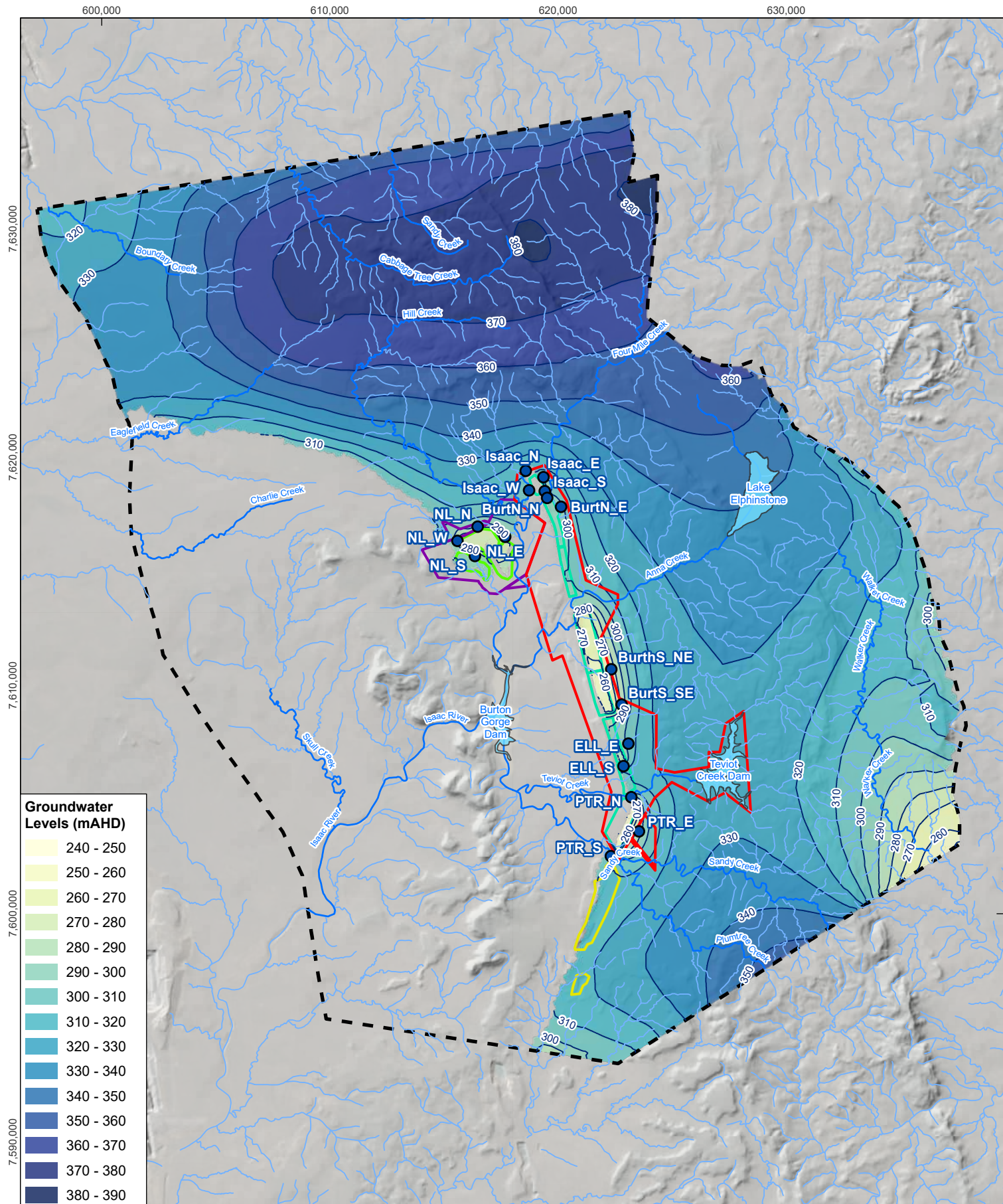
Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 16-Dec-2023

Drawn by: RB



0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: RB

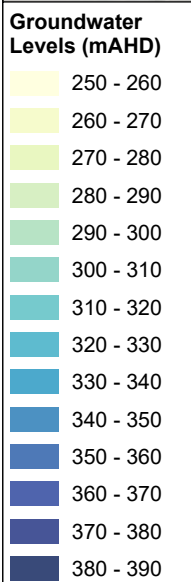
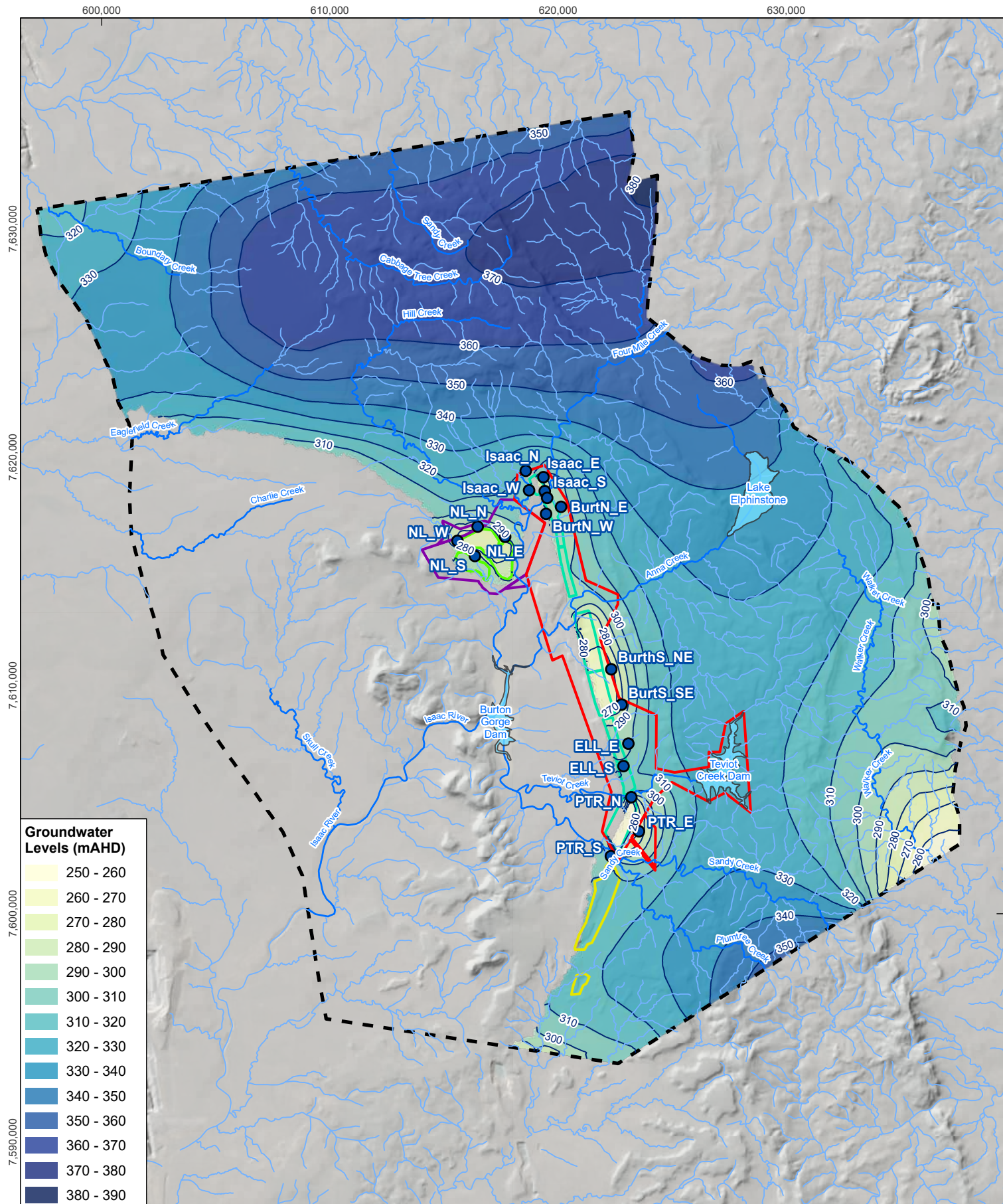
LEGEND

- Bore Location
- River
- Watercourse and Drainage
- Groundwater Contour (mAHd)
- SW Lake/Dam
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN BURTON/RIDER SEAM (LAYER 12) – POST-MINING EQUILIBRIUM (CUMULATIVE SCENARIO)

FIGURE 6-19



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: RB

LEGEND

-  Bore location
-  River
-  Watercourse and Drainage
-  Groundwater Contour (mASL)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS IN LEICHHARDT/VERMONT SEAM (LAYER 16) – POST-MINING EQUILIBRIUM (CUMULATIVE SCENARIO)

FIGURE 6-20

6.5.1 Post-Mining Hydrographs

Predictive hydrographs showing the change in groundwater levels over time for the alluvium, regolith, Burton/Rider and Leichhardt/Vermont seams just outside the East Pit residual void at New Lenton, and also just outside each of the Burton residual voids, are provided as **Appendix H**, with the hydrograph locations shown in **Figure 6-17** through to **Figure 6-20**.

The hydrographs demonstrate that the groundwater levels in all geological units surrounding the residual void lakes are higher than the void lake levels, indicating that there is no potential for the movement of water from the void lakes into the surrounding geological formations. The predicted levels shown in the hydrographs show that the voids are predicted to act as sinks to the groundwater system.

6.6 Post-Mining Equilibrium Residual Drawdown

This section presents the residual drawdown at post-mining equilibrium due to the planned mining and final landforms provided for the New Lenton and Burton mines. The residual cumulative drawdown considers drawdown of groundwater levels due to both the New Lenton and Burton mines, while the residual incremental drawdown considers the residual drawdown impact attributable to New Lenton only.

6.6.1 Post-Mining Residual Cumulative Drawdown

Residual cumulative drawdown refers to the remaining groundwater level drawdown after post-mining recovery to equilibrium compared to pre-mining groundwater levels and is obtained by subtracting the predicted equilibrium post-closure groundwater levels in the Cumulative scenario from the Null model scenario. The residual drawdown is therefore a comparison of groundwater levels between a 'mining and closure' situation, and a 'no mining' situation.

Figure 6-21 shows the predicted residual groundwater table drawdown (greater than 1m) at post-mining equilibrium. **Figure 6-21** shows that at post-mining equilibrium, there is predicted water table drawdown of up to 50 m within or closely around the mining pits, gradually reducing with distance from the mines. It should be noted that the figure presents maximum drawdown in the uppermost saturated model layer, including the Triassic units that overlie the Permian coal measures.

Figure 6-22 to **Figure 6-25** show the predicted residual cumulative drawdown in the alluvium, regolith, Burton/Rider and Leichhardt/Vermont seams at post-mining equilibrium.

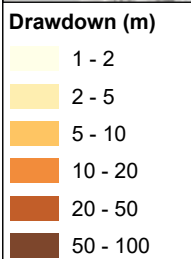
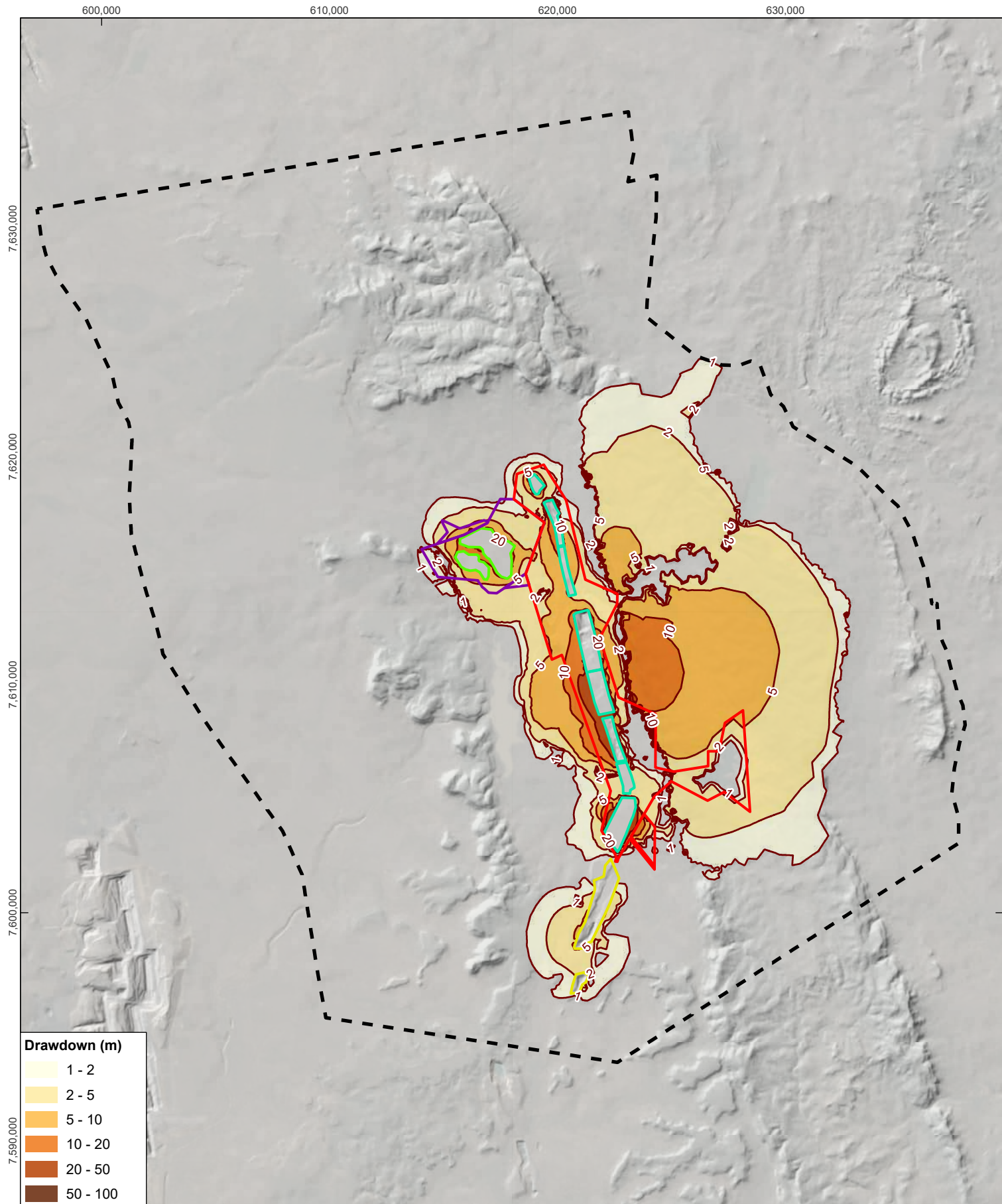
Figure 6-22 shows the cumulative residual drawdown is predicted in the alluvium, particularly in the area between the mine pits at New Lenton and Burton. The extent of predicted cumulative residual drawdown in the Isaac River alluvium is consistent with the cumulative drawdown observed during mining. **Figure 6-22** illustrates the maximum predicted cumulative drawdown extent in the alluvium, reaching up to 1.5 km to the southwest and 1 km to the east.

Figure 6-23 shows the maximum predicted cumulative drawdown extent in the regolith, extending up to 2.5 km to the west and 2 km to the east.

Figure 6-24 and **Figure 6-25** shows the model predicts that the residual cumulative drawdown in the coal seam around the mine pits will remain, and greater than the drawdowns at the end of mining (see **Figure 3-19** and **Figure 3-20**) due to:

- the slow outward propagation of drawdown in response to mining, which continues to propagate towards east and north of the pits (before stabilising) once mining has ceased, and
- the continued drawdown effect of the low residual void lake levels.





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 16-Dec-2023
 Drawn by: RB

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

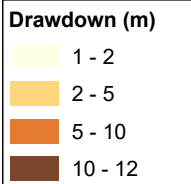
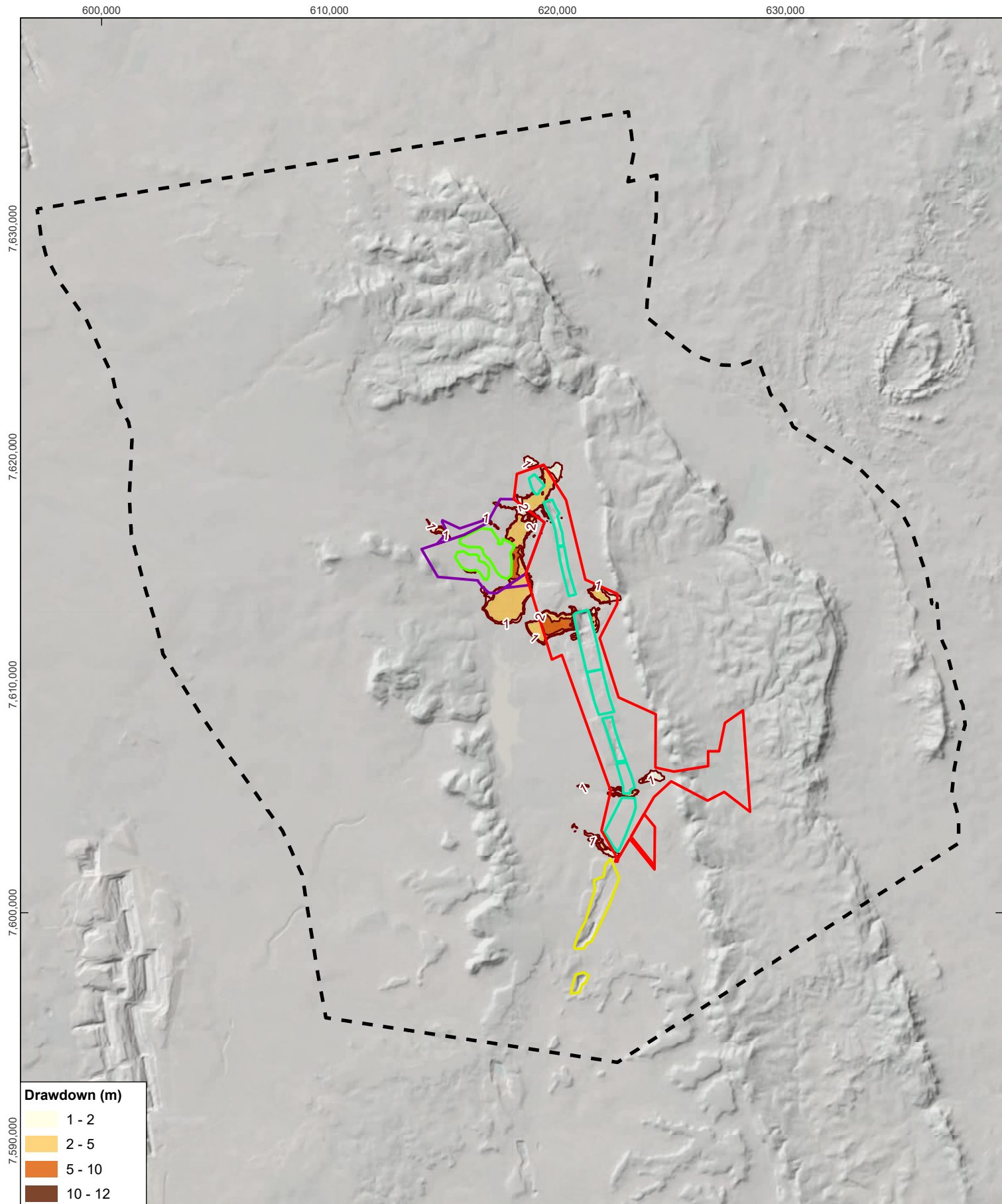
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PREDICTED CUMULATIVE WATER TABLE DRAWDOWN – POST-MINING EQUILIBRIUM



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FIGURE 6-21



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: RB

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

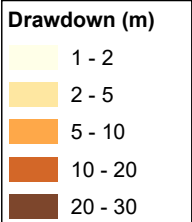
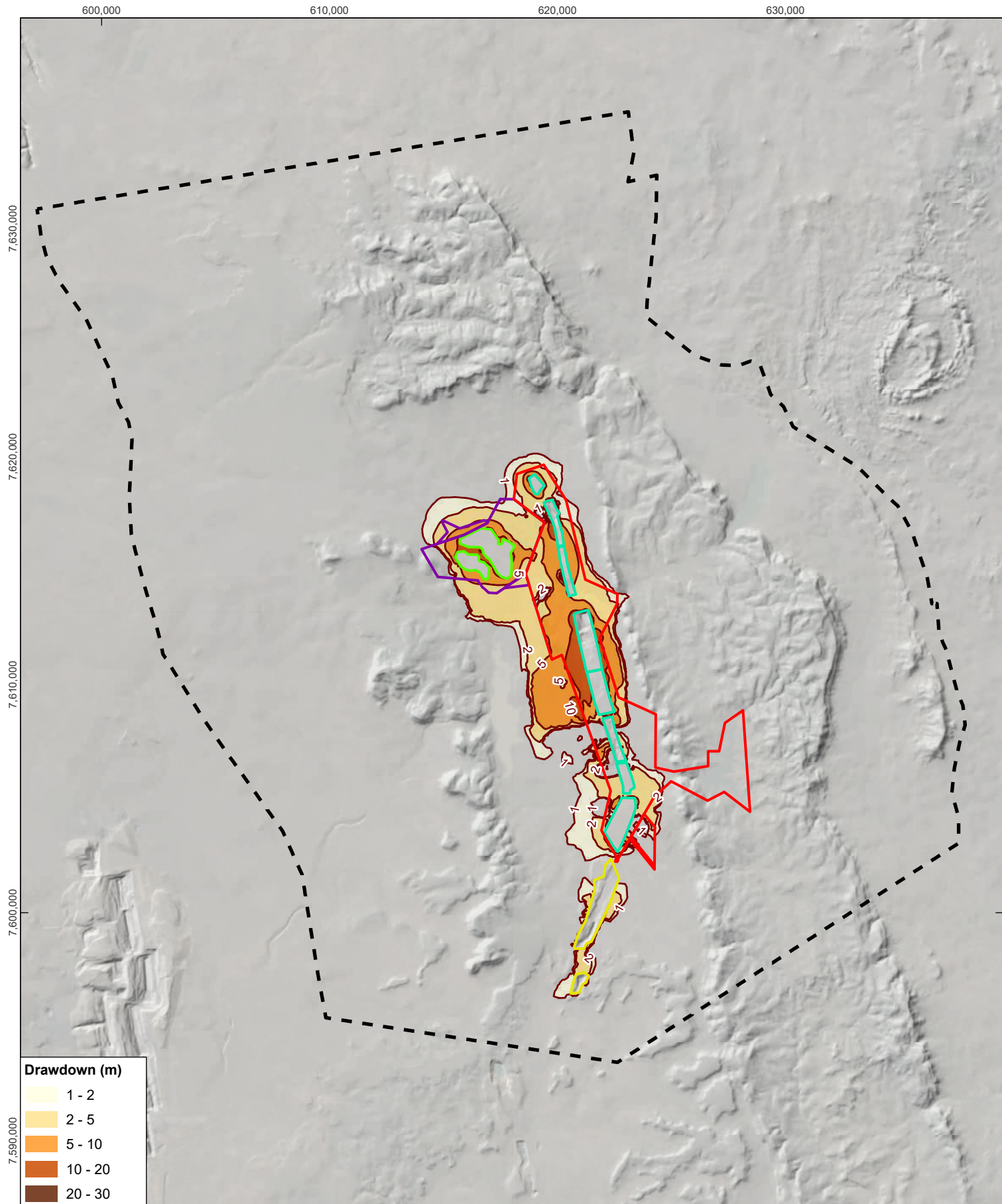
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE ALLUVIUM AND REGOLITH
(LAYER 1) – POST-MINING EQUILIBRIUM**



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FIGURE 6-22



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: RB

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

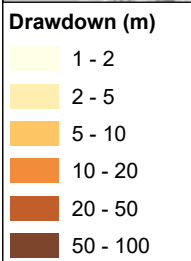
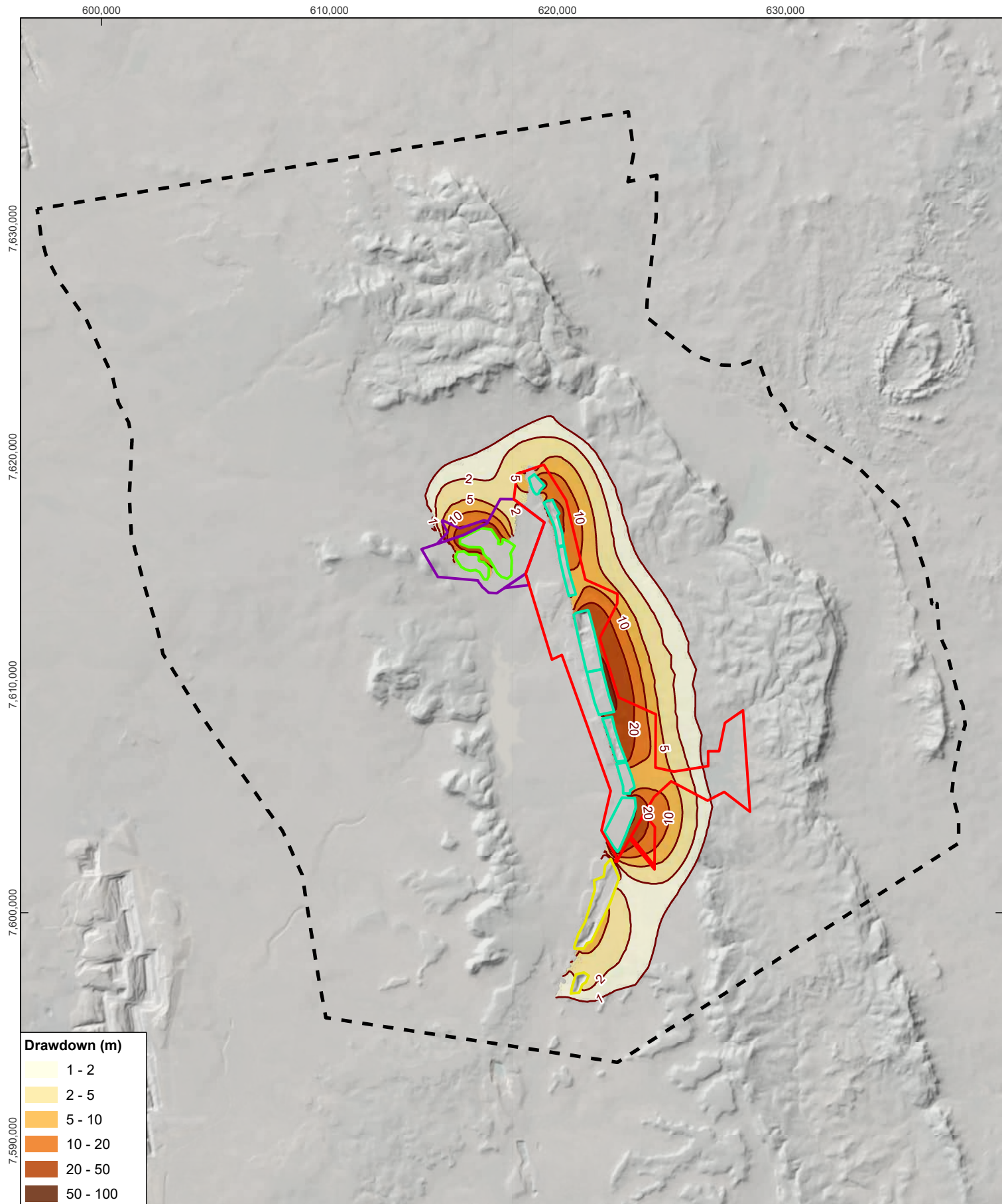
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**PREDICTED CUMULATIVE DRAWDOWN
IN THE REGOLITH (LAYER 2) –
POST-MINING EQUILIBRIUM**



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FIGURE 6-23



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: RB

LEGEND

-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

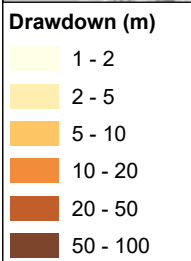
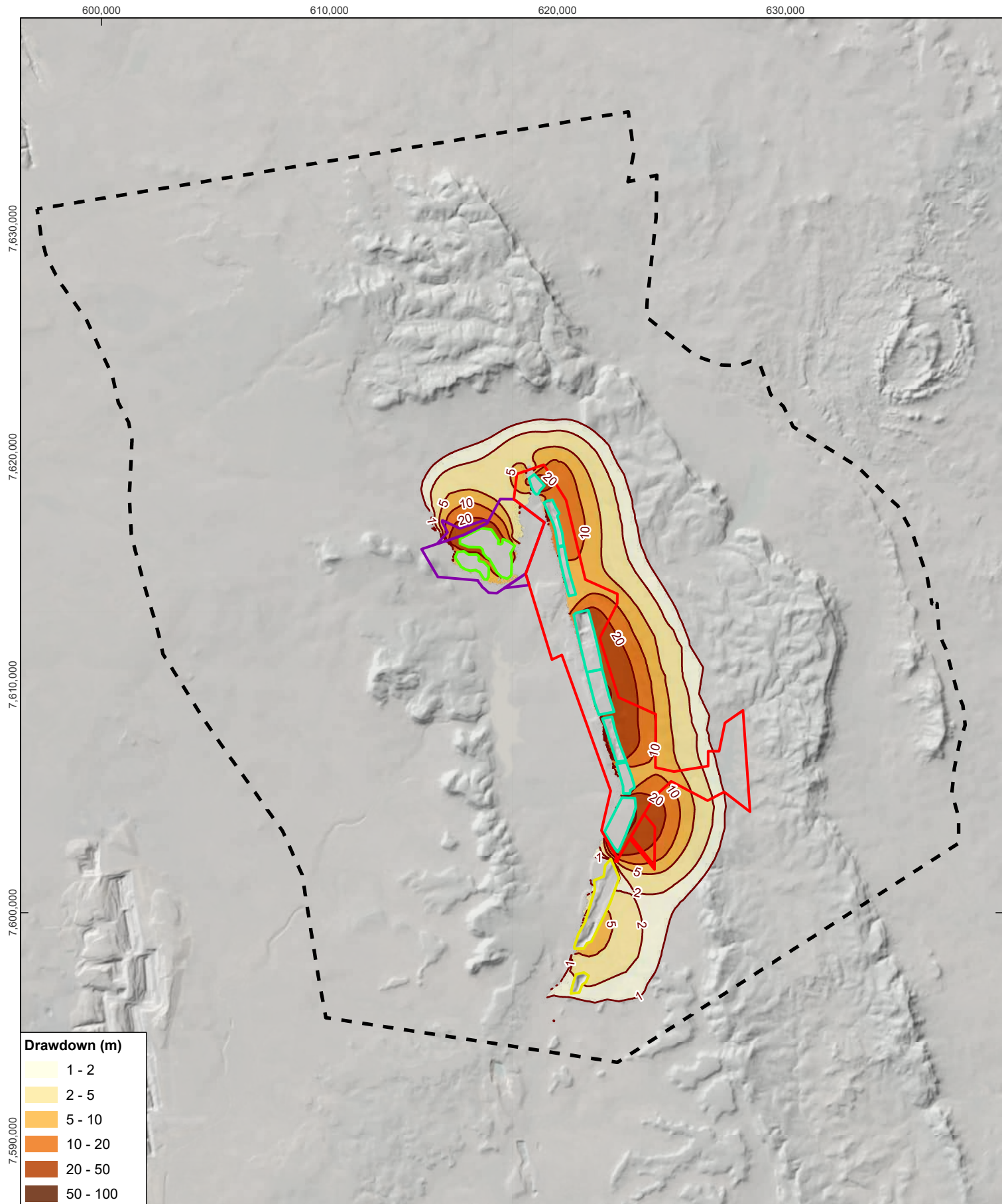
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MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN IN
BURTON/RIDER SEAM (LAYER 12) –
POST-MINING EQUILIBRIUM**



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FIGURE 6-24



	0 2.5 5 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:220,000 at A4
Project Number:	620.31208.00000
Date Drawn:	17-Dec-2023
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

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PREDICTED CUMULATIVE DRAWDOWN IN LEICHHARDT/VERMONT SEAM (LAYER 16) – POST-MINING EQUILIBRIUM



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FIGURE 6-25

6.6.2 Post-Mining Residual Incremental Drawdown - New Lenton Mine

The residual incremental drawdown at post-mining equilibrium due to the proposed mining and final landform at New Lenton has been obtained by subtracting the predicted equilibrium post-closure groundwater levels in the Cumulative scenario from the Approved model scenario. The residual drawdown is therefore a comparison of groundwater levels between a 'mining and closure' situation including New Lenton Mine, and a 'mining and closure' situation excluding New Lenton Mine.

Figure 6-26 shows the predicted residual incremental groundwater table drawdown (greater than 1m) due to the New Lenton Mine at post-mining equilibrium. **Figure 6-26** shows that at post-mining equilibrium, the incremental water table drawdown extends up to approximately 2.0 km in all directions from the pits.

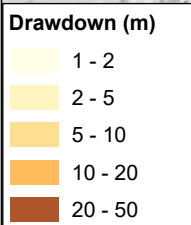
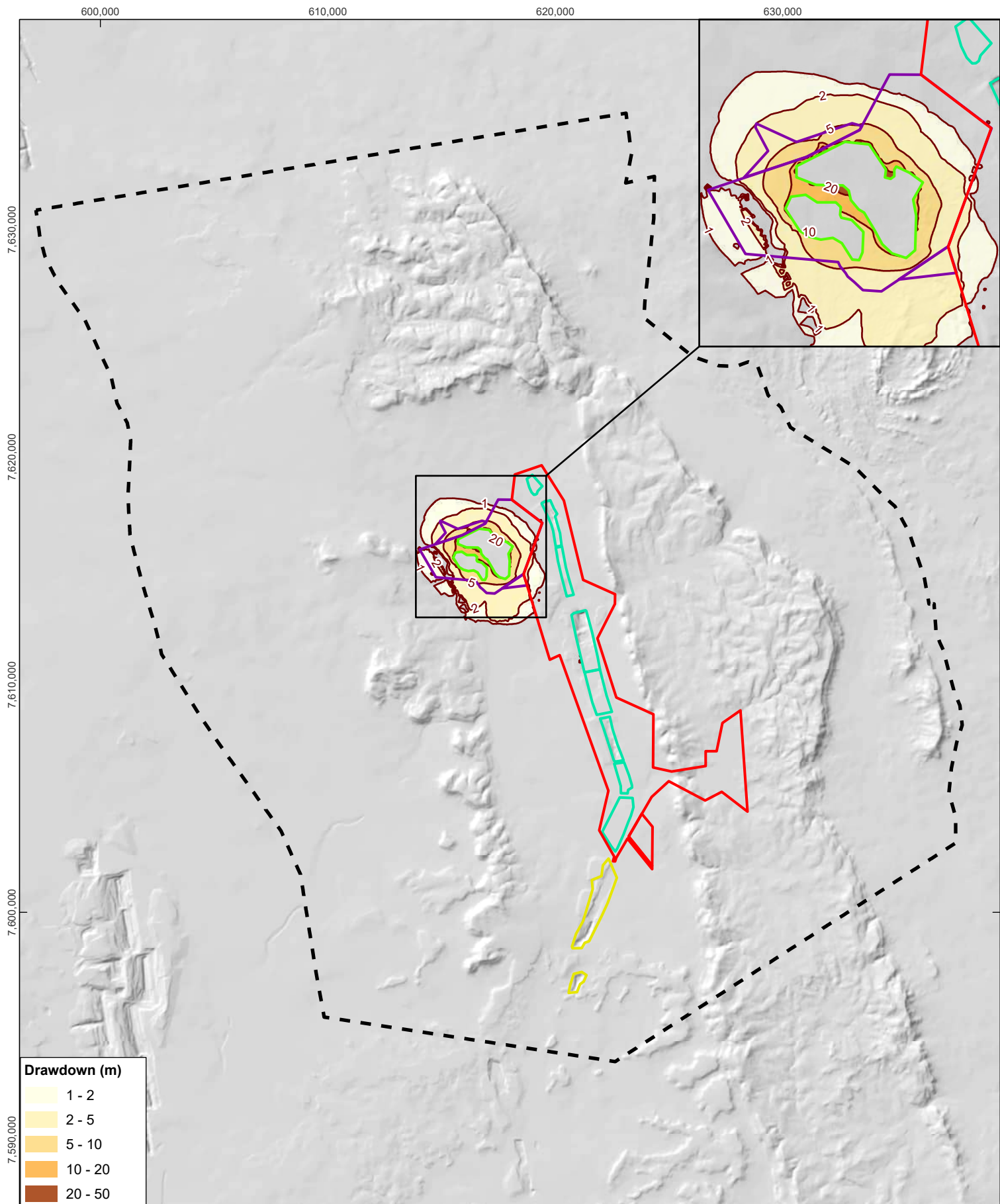
Figure 6-27 to **Figure 6-30** show the predicted residual incremental groundwater table drawdown (greater than 1m) due to the New Lenton Mine at post-mining equilibrium, in the alluvium, regolith, Burton/Rider and Leichhardt/Vermont seams.

Figure 6-27 shows the model predicts post-mining incremental drawdown in the alluvium, mirroring the extent of drawdown during mining. The post-mining incremental drawdown extends up to 2 km downstream and 1 km upstream of the East Pit at New Lenton.

Figure 6-28 shows the predicted post-mining incremental drawdown extent in the regolith, extending up to 2.5 km to the west and 2 km to the east for the New Lenton pits.

Figure 6-29 to **Figure 6-30** show the extent of post-mining incremental drawdown in the Permian coal seams (Burton/Rider and Leichhardt/Vermont seams, respectively). These figures illustrate that the predicted post-mining incremental drawdown is more extensive than the drawdown observed during mining and extends 3.0 km to the north of the New Lenton pits for the reasons discussed in **Section 6.6.1**.





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: RB

LEGEND

-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

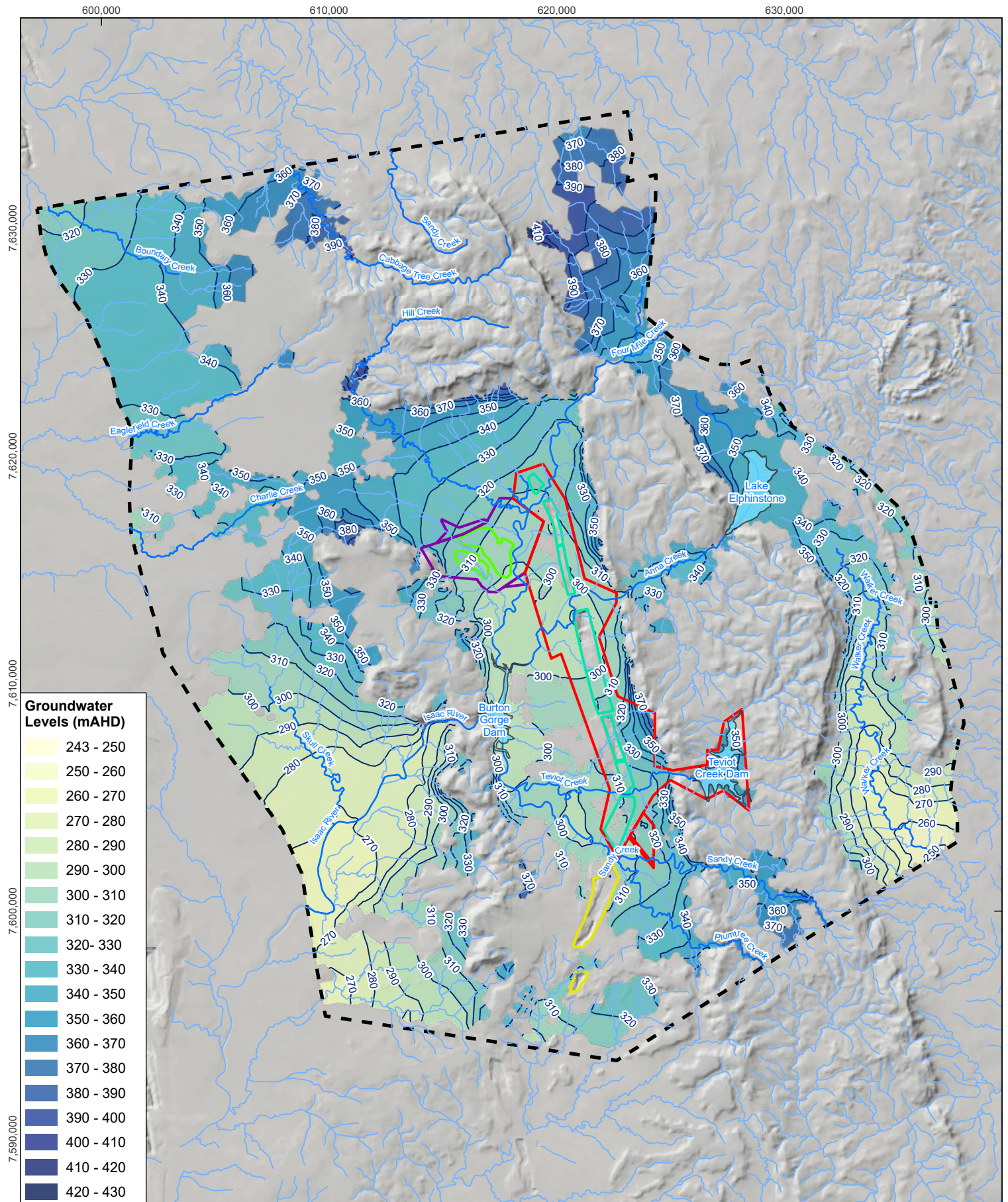
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PREDICTED RESIDUAL INCREMENTAL WATER TABLE DRAWDOWN – NEW LENTON (POST-MINING EQUILIBRIUM)



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FIGURE 6-26



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  SW Lake/Dam
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

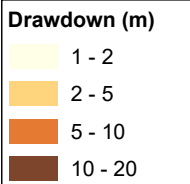
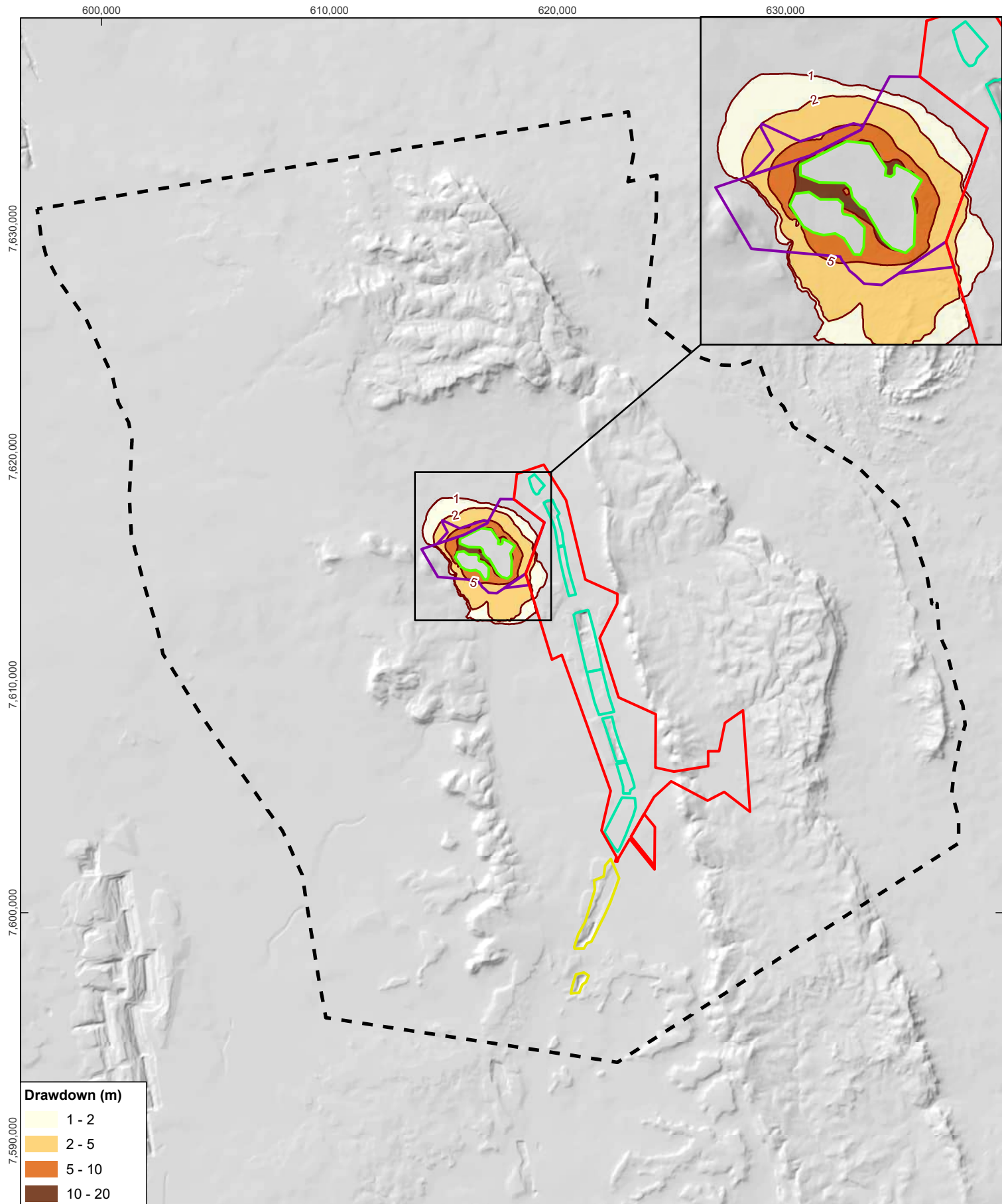
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SIMULATED GROUNDWATER LEVELS IN REGOLITH (LAYER 2)– END OF CALIBRATION (JULY 2023)



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FIGURE 2-27



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: RB

LEGEND

-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

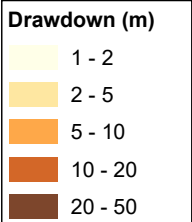
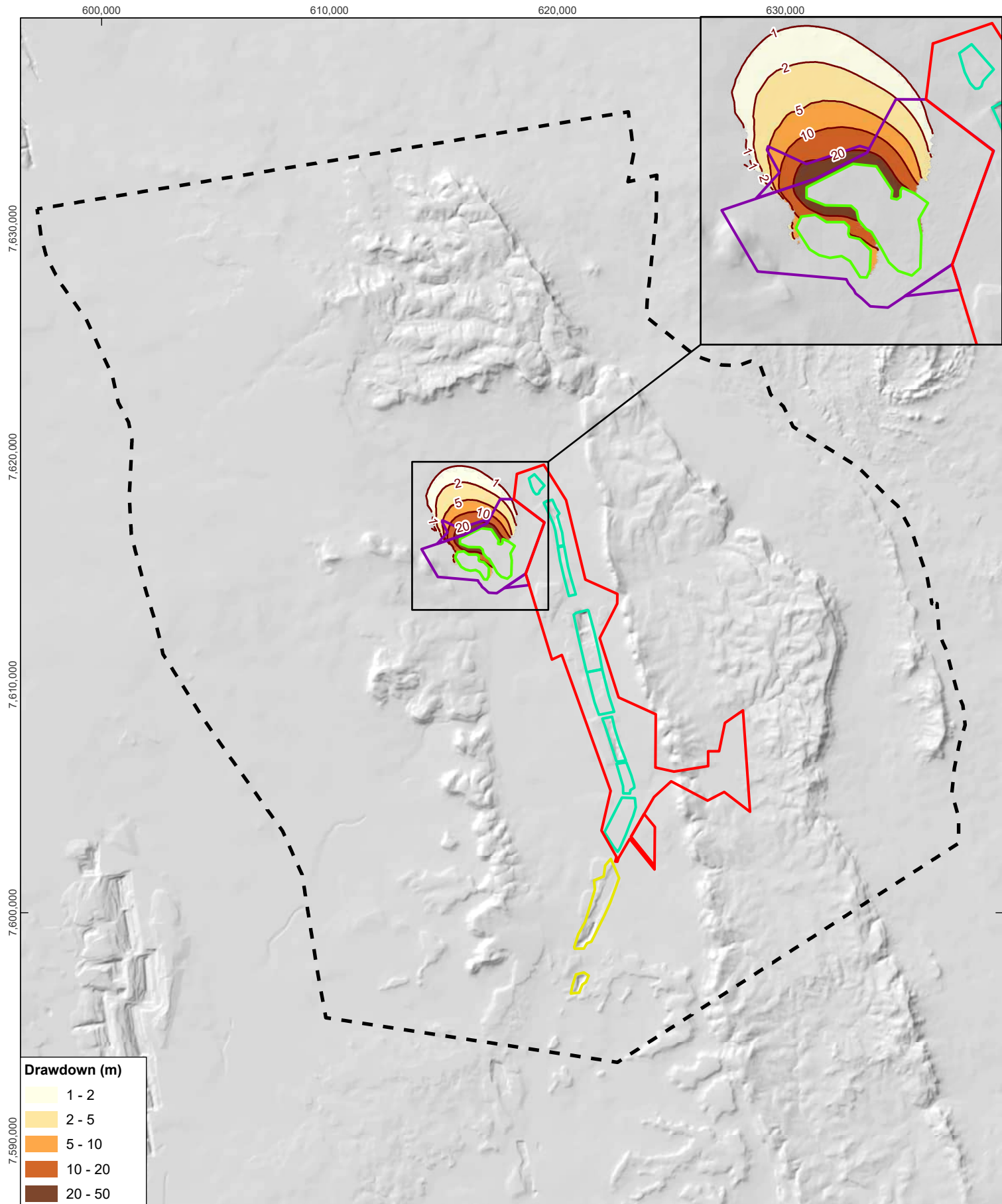
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PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN REGOLITH (LAYER 2) – NEW LENTON (POST-MINING EQUILIBRIUM)



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FIGURE 6-28



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 17-Dec-2023
 Drawn by: RB

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

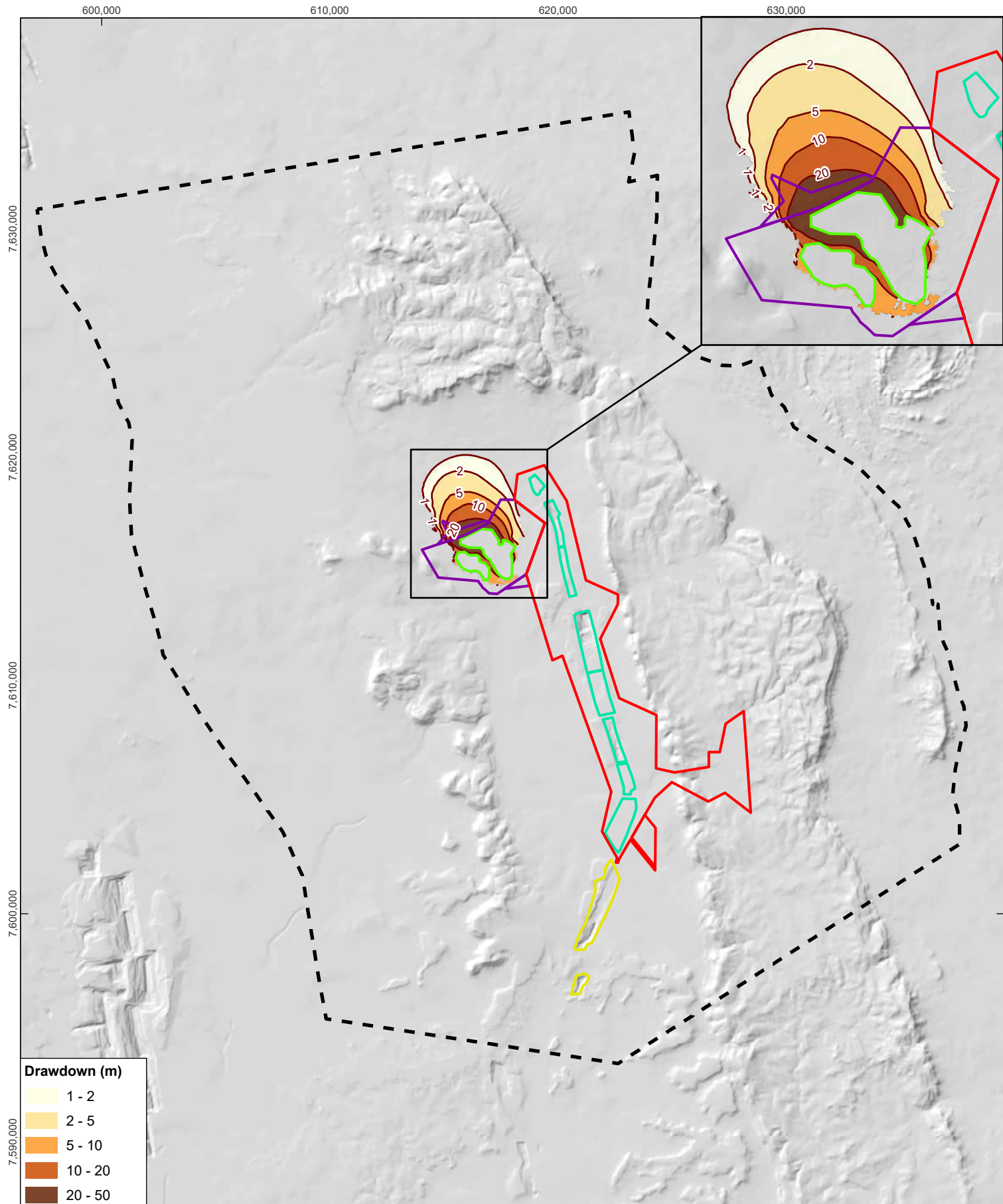
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED RESIDUAL INCREMENTAL
DRAWDOWN IN BURTON/RIDER (LAYER 12) –
NEW LENTON (POST-MINING EQUILIBRIUM)**



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FIGURE 6-29



Drawdown (m)

1 - 2
2 - 5
5 - 10
10 - 20
20 - 50



0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 17-Dec-2023

Drawn by: RB

LEGEND

— Drawdown Contour (m)	□ Burton Pit Extent
- - - Model Domain	□ New Lenton Pit Extent
— Burton Mining Lease	□ Former Burton Mine Pits
— New Lenton Mining Lease	

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN LEICHHARDT/VERMONT SEAM (LAYER 16) – NEW LENTON (POST-MINING EQUILIBRIUM)



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FIGURE 6-30

6.7 Influence on Alluvium

The main alluvial resources in the area include:

- Alluvium associated with the Isaac River downstream of the Burton Gorge Dam, scheduled under the Queensland *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (under the *Environmental Protection Act 1994*) as part of the Isaac Connors Alluvium Groundwater Sub-area (within the Isaac Connors Groundwater Management Area of the Fitzroy Basin water plan (WQ1310)); and
- Other mapped Quaternary alluvium localised along Isaac River upstream of the Burton Gorge Dam, Hill Creek, Anna Creek and other minor drainage lines.

The cumulative change in alluvial water resources during post-mining recovery was calculated by comparing water budgets for alluvial zones using the Cumulative and Null scenarios of the model that included and excluded mining activity, respectively.

Figure 6-31 shows the predicted cumulative decrease in fluxes to the alluvium during the post-mining period. The change in flux shown in **Figure 6-31** shows higher variability in the first 100 years post-mining, stabilising after approximately 400 years of recovery where the system reached an equilibrium condition.

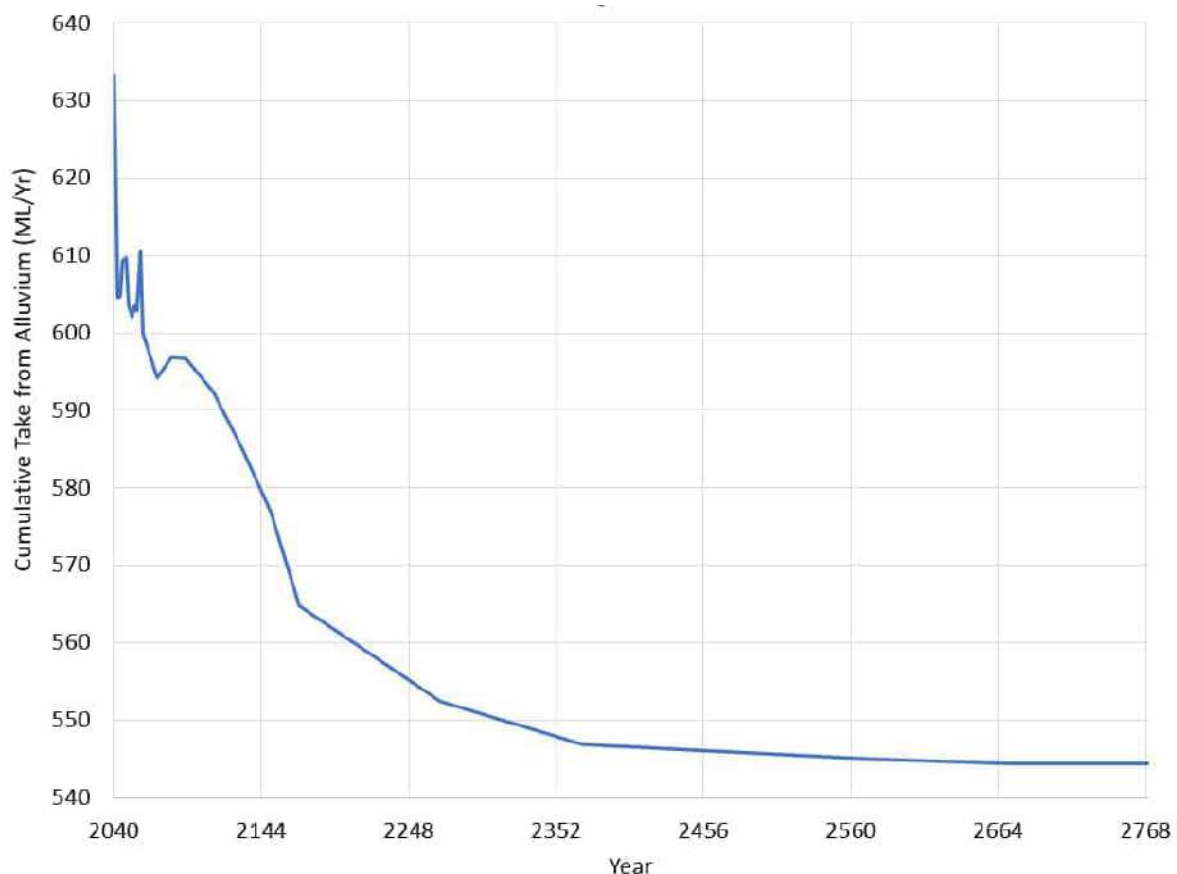


Figure 6-31 Predicted Cumulative Change in Flux from Alluvium to Permian (ML/year)



Figure 6-32 shows the predicted incremental decrease in total flux to the alluvium in due to post-mining recovery at New Lenton. The incremental flux was calculated by comparing the water budgets for the Approved and Cumulative scenarios, excluding and including the mining at New Lenton, respectively. The figure shows that the post-mining landform at New Lenton results in a long-term equilibrated decrease in flux to the Quaternary Alluvium of 157.8 ML/year, reaching equilibrium after approximately 400 years. The predicted alluvium flux change at equilibrium is lower than predicted change in flux at the end of mining.

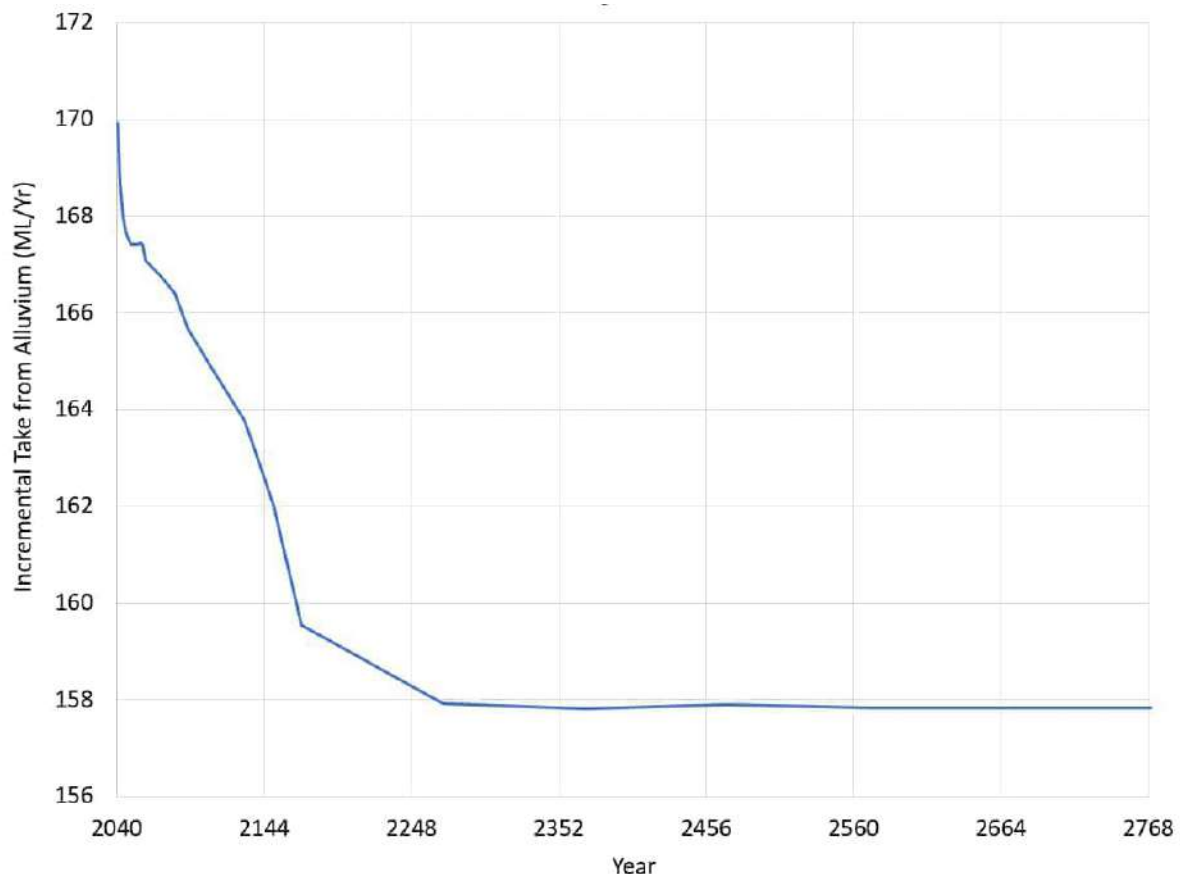


Figure 6-32 Predicted Incremental Change in Flux from Alluvium to Permian (ML/year) – New Lenton Mine

The model predicted negligible cumulative or incremental change (less than 1%) in the alluvial water resources downstream of Burton Gorge Dam scheduled as part of the Isaac Connors Alluvium Groundwater Sub-area as a result of mining at New Lenton and Burton.

6.8 Influence on Surface Water Flow

The model predicts no baseflow along Isaac River within 3km of the site, for any of the scenarios. This is consistent with the conceptualisation, i.e. that the alluvium associated with the Isaac River near the site is unsaturated for the majority of the year and groundwater does not supply a baseflow component to the Isaac River. During the recovery simulation, the application of long-term average recharge reflects this general condition.



6.9 Flow Path Simulation (Particle Tracking)

Particle tracking was undertaken to illustrate the simulated post-mining groundwater flow field (advection) in the vicinity of the mined pits using mod-PATH3DU (MP3DU) (S.S. Papadopoulos & Associates, Inc., 2018). Particle tracking can be considered as the advection component contributing to solute transport, and thus can also assist with identifying potential contaminant flow paths.

Particles were placed around and within the final voids and across the in-pit spoil emplacements in the recovery groundwater model. MP3DU simulates the movement of these particles through the groundwater flow field from the end of mining, during recovery through to the end of the recovery simulation (730 years). MP3DU used the transient head outputs from the groundwater flow model to simulate the particle flow paths. The particles were released at the start of the post-mining simulation, with the movement of the particles then recorded during the post-mining simulation.

The particles were placed at the ground surface of the model around the pit shells, final voids and across areas of spoil backfill and out of pit spoil dumps. It should be noted that the MP3DU code automatically moves the particle from the model surface to the shallowest saturated layer at the commencement of the simulation. For many of the particles this represents the Permian layers as the shallow layers (Quaternary Alluvium and regolith) are partly unsaturated across the New Lenton and Burton areas at the commencement of the post-mining simulation (including areas of spoil backfill).

6.9.1 New Lenton Mine

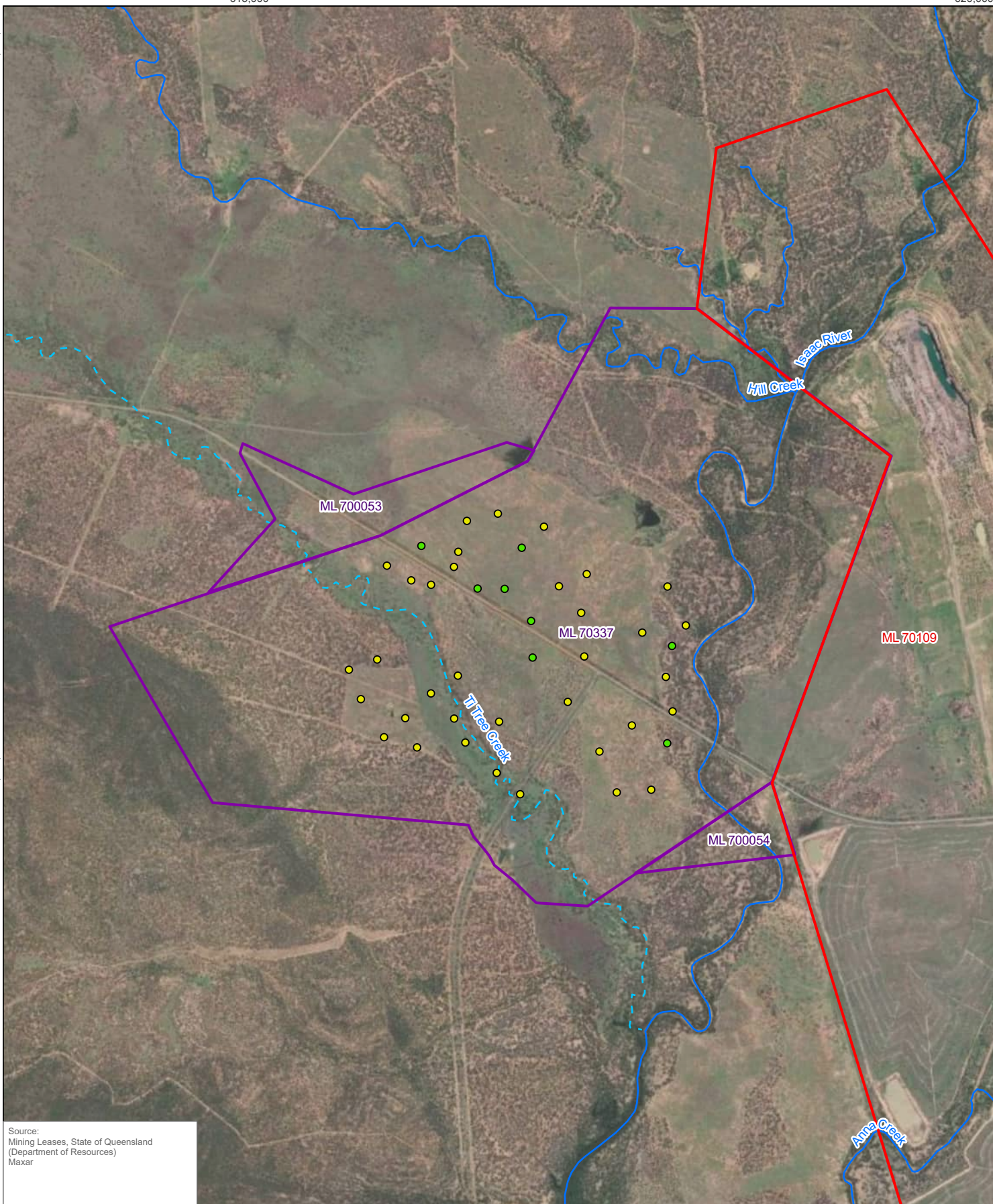
Figure 6-33 shows the initial location and starting layer of particles on the final landform for the New Lenton Mine area.

Figure 6-34 shows the predicted movement of water particles at New Lenton in the 730-year recovery simulation. The colours along the predicted particle flow paths indicates the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallow to deep model layers. The flow path analysis indicated generally the particles move toward the residual void lake, with particles that enter void lake remaining there once they have entered the lake.

Particles commencing in the residual voids remain in the residual voids for the duration of the simulation, indicating no potential for water discharge to the surrounding groundwater environment. Locations where the model predicts saturation in the shallow groundwater system (i.e., along Isaac River Alluvium) at the end of mining, were predicted not to be affected by post-mining recovery at the New Lenton and Burton mines.

Note that the void lake extents shown in **Figure 6-34** are at end of recovery steady state equilibrium (maximum level/extent). Head contours shown on the map are also at steady state equilibrium and do not represent the transient head changes that occur over the duration of the post-mining recovery period, therefore particle movement pre-equilibrium results in some particle tracks that are counter to head gradients or other particle tracks on the map.





0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:35,000 at A4

Project Number: 620.31208.00000

Date Drawn: 20-Dec-2023

Drawn by: RB

LEGEND

Starting Model Layer

● 16

● 18

--- Non-designated
Watercourse

— River

■ Burton Mining Lease

■ New Lenton Mining Lease

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

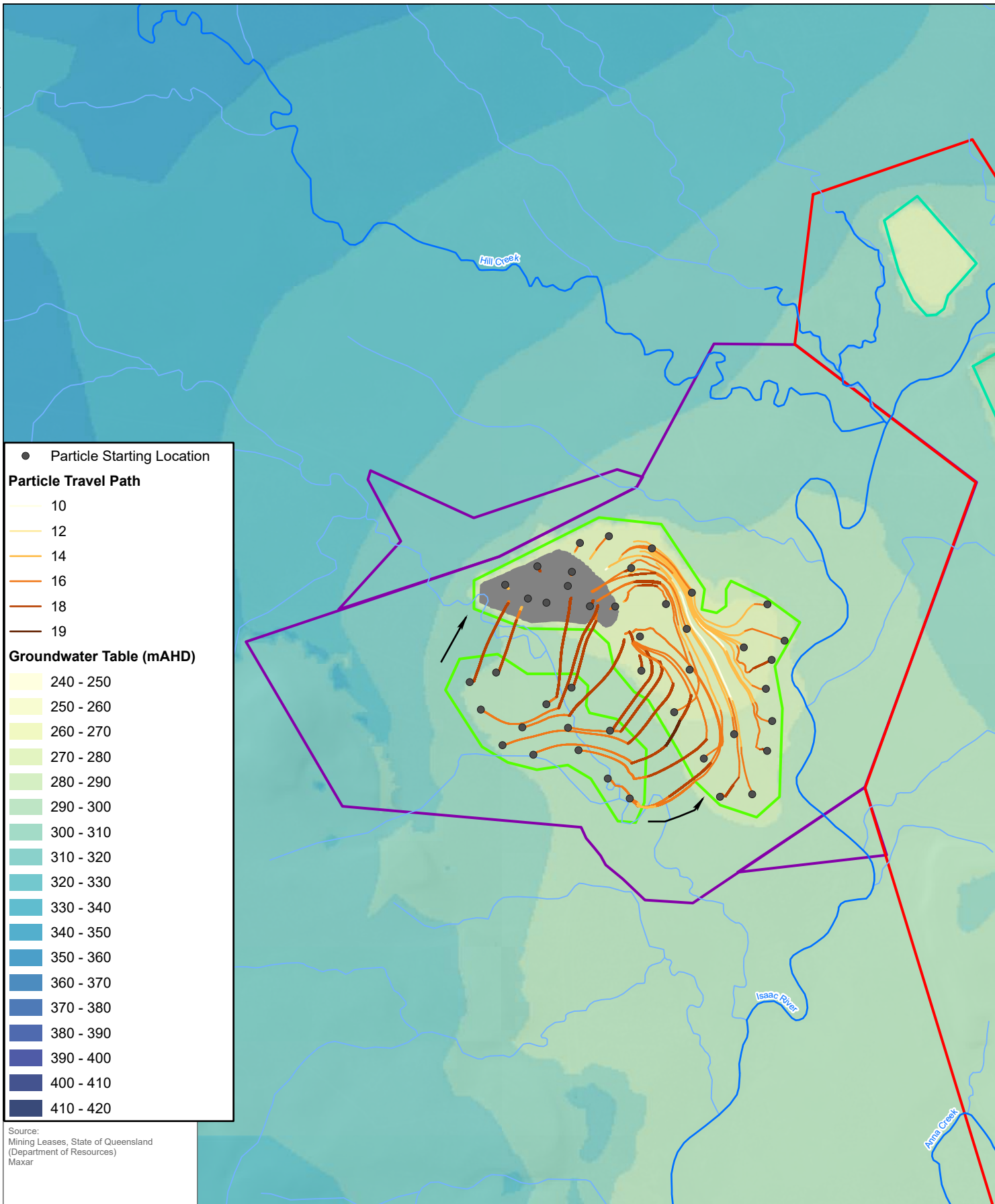
PARTICLE STARTING LOCATIONS (NEW LENTON MINE)



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FIGURE 6-33

7,620,000



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:37,500 at A4

Project Number: 620.31208.00000

Date Drawn: 17-Dec-2023

Drawn by: RB

LEGEND

- River
- Watercourse and Drainage
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits
- Model Domain
- Void Lake

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PARTICLE STARTING LOCATIONS (NEW LENTON MINE)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 6-34

6.9.2 Burton Mine

Figure 6-35 shows the release location and initial model layer of particles on the final landform for Burton Mine area.

Figure 6-36 shows the predicted movement of water particles at Burton from the end of mining to the end of the recovery simulation. The colours along the predicted particle flow paths indicates the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallow to deep model layers.

The movement of particles shown in **Figure 6-36**. **Figure 6-36** indicate that there is no potential for the migration of water beyond the Isaac, Burton North, Burton South, Ellensfield or Plumtree North pit-shells to the surrounding groundwater environment. The flow path analysis for these pits indicated generally the particles placed in spoil emplacements move toward residual void lakes, with both the particles that start in the void lakes and that enter void lakes showing no subsequent movement out of the lakes.

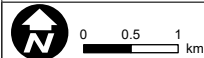
The flow pathways for particles in the backfilled Ellensfield South pit show a groundwater flow divide between the northern and southern ends of the pit. Particles that start at the northern end of the backfilled pit move toward the north while those further south travel toward Plumtree North pit, crossing beneath the Teviot Creek drainage line.

Note that the void lake extents shown in **Figure 6-36** are at post-mining steady state equilibrium (maximum level/extent). Head contours shown on the map are also at steady state equilibrium and do not represent the transient head changes that occur over the duration of the post-mining recovery period, therefore particle movement pre-equilibrium results in some particle tracks that are counter to head gradients or other particle tracks on the map.





Source:
Mining Leases, State of Queensland
(Department of Resources)
Earthstar Geographics



Coordinate System: GDA2020 MGA Zone 55
Scale: 1:80,000 at A4
Project Number: 620.31208.00000
Date Drawn: 20-Dec-2023
Drawn by: RB

LEGEND

Starting Model Layer

- 8
- 10
- 12
- 14
- 16
- 18

- - - Non-designated Watercourse
- River
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease

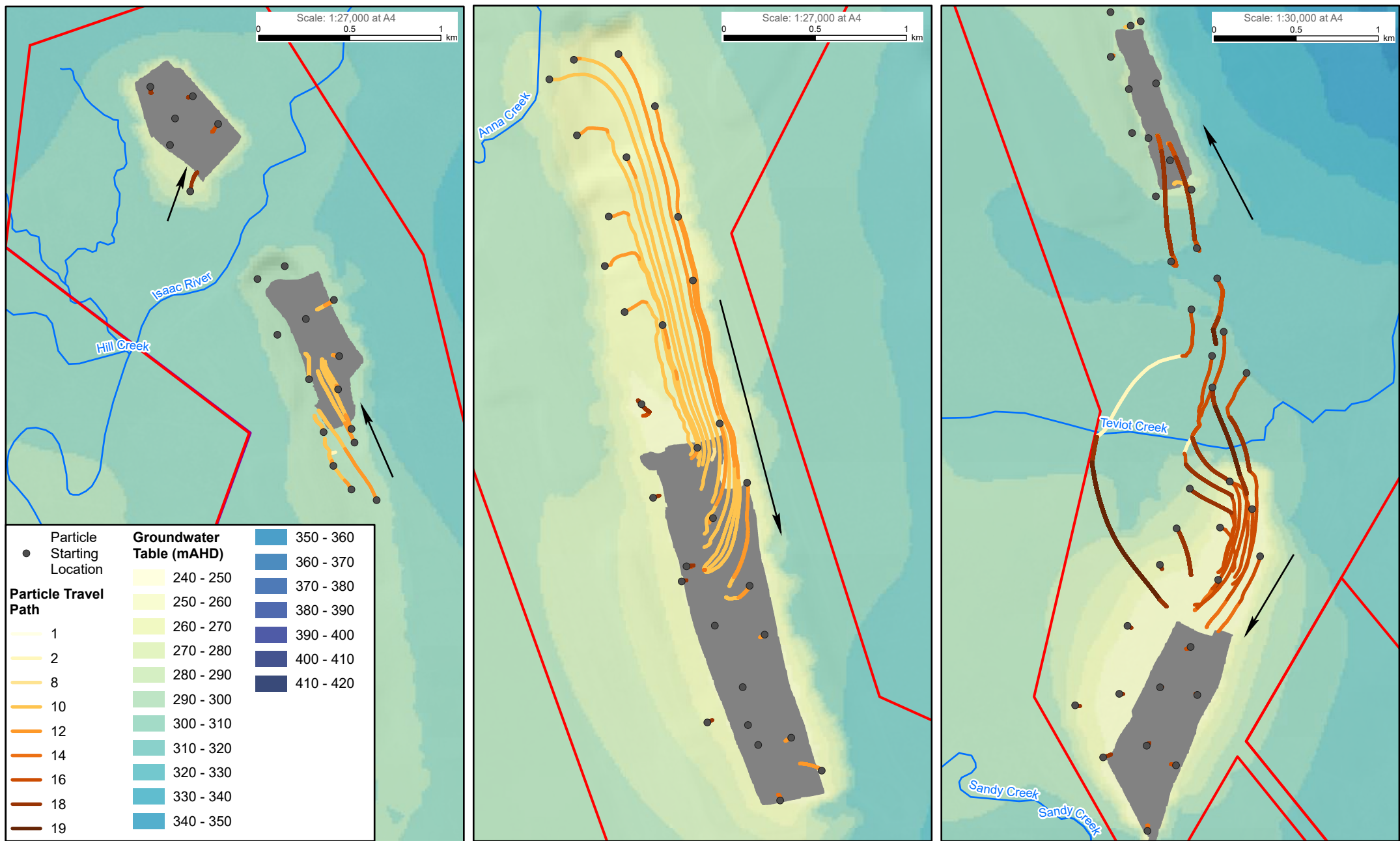
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PARTICLE STARTING LOCATIONS (BURTON MINE)



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FIGURE 6-35



6.10 Recovery Uncertainty Analysis

To estimate the uncertainty associated with model predictions during the post-mining recovery period, uncertainty analysis was undertaken. The existing Monte Carlo ensemble described in **Section 5.2**, comprising 362 calibrated realisations, was used for the recovery uncertainty analysis. The prior and posterior parameter distributions from the derivation of the Monte Carlo ensemble are included in **Appendix G**.

The uncertainty analysis was carried out on the Approved, Cumulative, and Null recovery scenarios listed in **Section 6.1**. The recovery predictions included in the uncertainty analysis were:

- Void inflows at New Lenton and Burton mines;
- Incidental change in alluvial fluxes (Quaternary Alluvium and Isaac Connors Alluvium Groundwater Sub-area); and
- Maximum incremental drawdown due to proposed mining at New Lenton.

6.10.1 Uncertainty of Residual Void Inflows

The 10th, 50th and 90th percentiles have been calculated for the residual void inflow predictions for the Monte Carlo ensemble of 362 realisations. Based on Table 4 of the IESC guidelines (Peeters and Middlemis, 2023) the 10th percentile indicates it is very likely the outcome is larger than this value, and the 90th percentile indicates it is very unlikely the outcome is larger than this value.

6.10.1.1 New Lenton Mine

Figure 6-37 presents the uncertainty of predicted total groundwater inflow to the New Lenton residual void at East Pit, that has been extracted from the Cumulative scenario over the post-mining recovery period. The figure shows the predicted void inflows for the best calibrated realisation and percentiles including 10th, 50th and 90th prediction bounds.

The bounds in the figure demonstrate the uncertainty within the predicted void inflow rate. The bounds show that the void inflow predictions from the best calibrated realisation sit just above the 50th percentile (approximately 590 m³/day inflow at post-mining equilibrium).

As shown in **Figure 6-37**, the 90th percentile for the total void inflow predicted an equilibrium flux of approximately 1,100 m³/d (very unlikely outcome is larger than this value). The 10th percentile for the total void inflow predicted an equilibrium flux of approximately 276 m³/d (very likely the outcome is larger than this value).



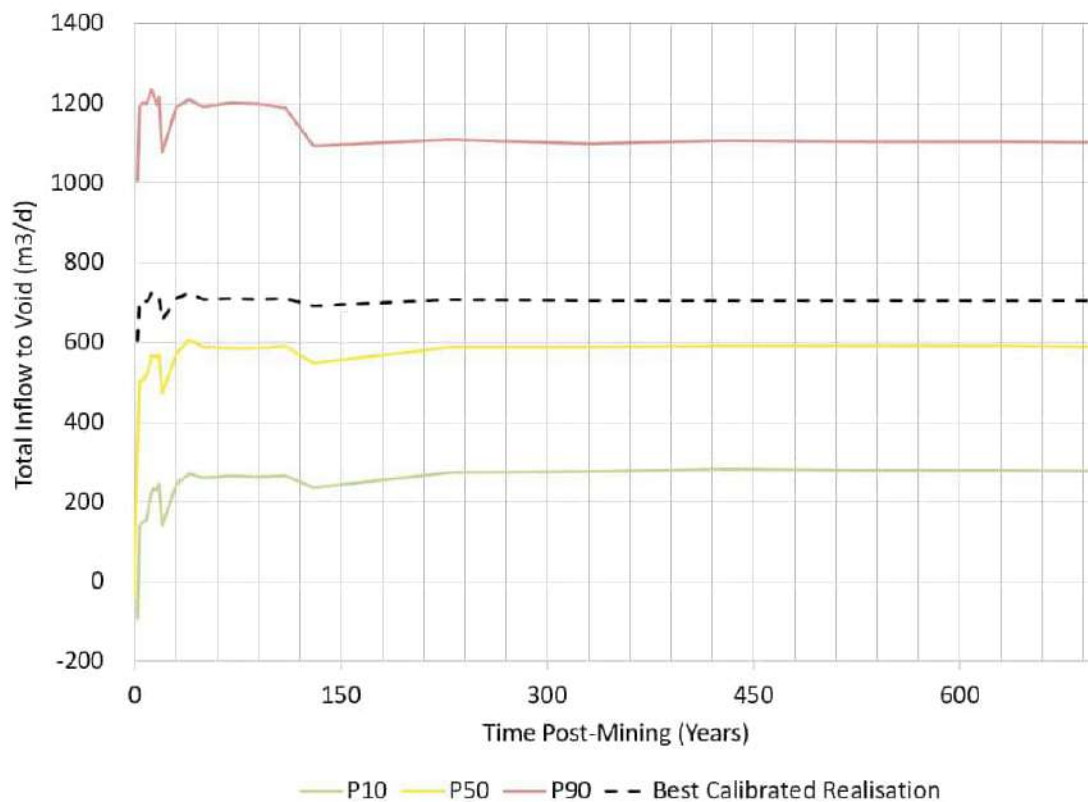


Figure 6-37 **Uncertainty in Predicted Void Inflow – East Pit (New Lenton)**

The uncertainty associated with the total post-mining equilibrium flux to the New Lenton East Pit shell was assessed through calculation of the 10th, 50th and 90th percentiles and is summarised in **Table 6-7**. This includes the inflow from natural geological formations to the void and to the backfilled pit shell as described in **Section 6.4.1**.

Table 6-8 shows the uncertainty in predicted post-mining equilibrium groundwater inflows to East Pit final void. The 10th, 50th and 90th percentiles are provided for each component of the total inflow to the void.

Table 6-7 **Uncertainty in Equilibrium Groundwater Inflows to the Pit Shell from Natural Geological Formations - New Lenton**

Residual Void	Equilibrium Inflow Rate – Natural Geological Formations (m3/day)			
	10 th Percentile	50 th Percentile	Best Calibrated Realisation	90 th Percentile
East Pit	208.9	494.5	635.5	1006.9



Table 6-8 Uncertainty in Equilibrium Groundwater Inflows to the Residual Voids - New Lenton

Residual Void	Percentile*	From Spoil (m ³ /day)	From Natural Geological Formations (m ³ /day)	Total (m ³ /day)
East Pit Void	10 th	219.2	19.7	276.8
	50 th	460.4	94.4	589.5
	Best Calibrated Realisation	562.3	143.8	706.1
	90 th	858.1	263.5	1102.6

*The percentiles presented for spoil, natural geological formations and total inflow to the residual voids have been calculated independently for each flux prediction. Discrepancy between the sum of the components and the total inflow for each percentile indicate differences in the parameter combinations in the uncertainty ensemble that result in differing distributions for each individual inflow component.

6.10.1.2 Burton Mine

Figure 6-38 to **Figure 6-42** present the uncertainty of predicted total groundwater inflow to the residual voids (Isaac Pit, Burton North, Burton South, Ellensfield and Plumtree North, respectively) at Burton Mine, over the post-mining recovery period. The total inflows to the voids have been extracted from the Cumulative scenario. The figure shows the predicted void inflows for the best calibrated realisation and the 10th, 50th and 90th percentile predictions.

Figure 6-38 shows that the inflow predictions for the Isaac Pit void from the best calibrated realisation are between the 50th and 90th percentiles. The predicted total inflow to the Burton North and Ellensfield voids, shown in **Figure 6-39** and **Figure 6-41**, indicate that the best calibrated realisation prediction also sits between the 50th and 90th percentiles for these voids.

Figure 6-40 and **Figure 6-42** show the inflow predictions during post-mining recovery for the Burton South and Plumtree North voids, for the best calibrated realisation and 10th, 50th and 90th percentiles. The figures indicate that for the Burton South and Plumtree North voids, the predicted total inflow to the voids for the best calibrated realisation are slightly lower than the 50th percentile.



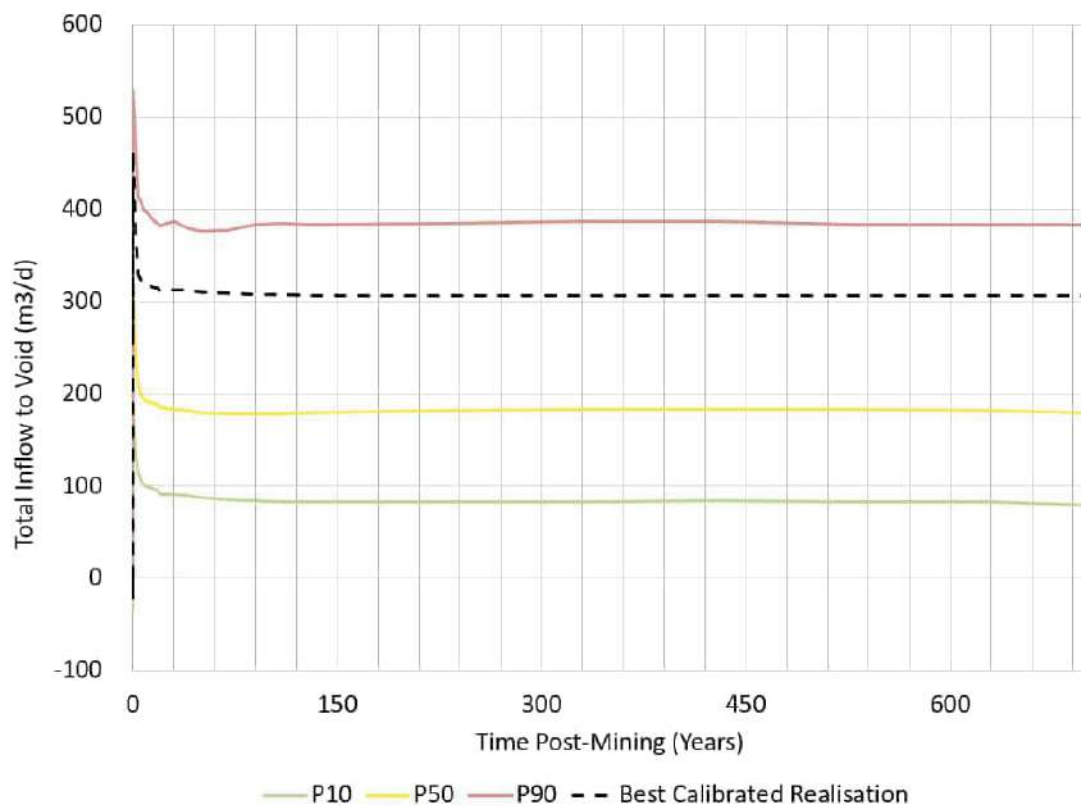


Figure 6-38 **Uncertainty in Predicted Void Inflow – Isaac Pit (Burton)**

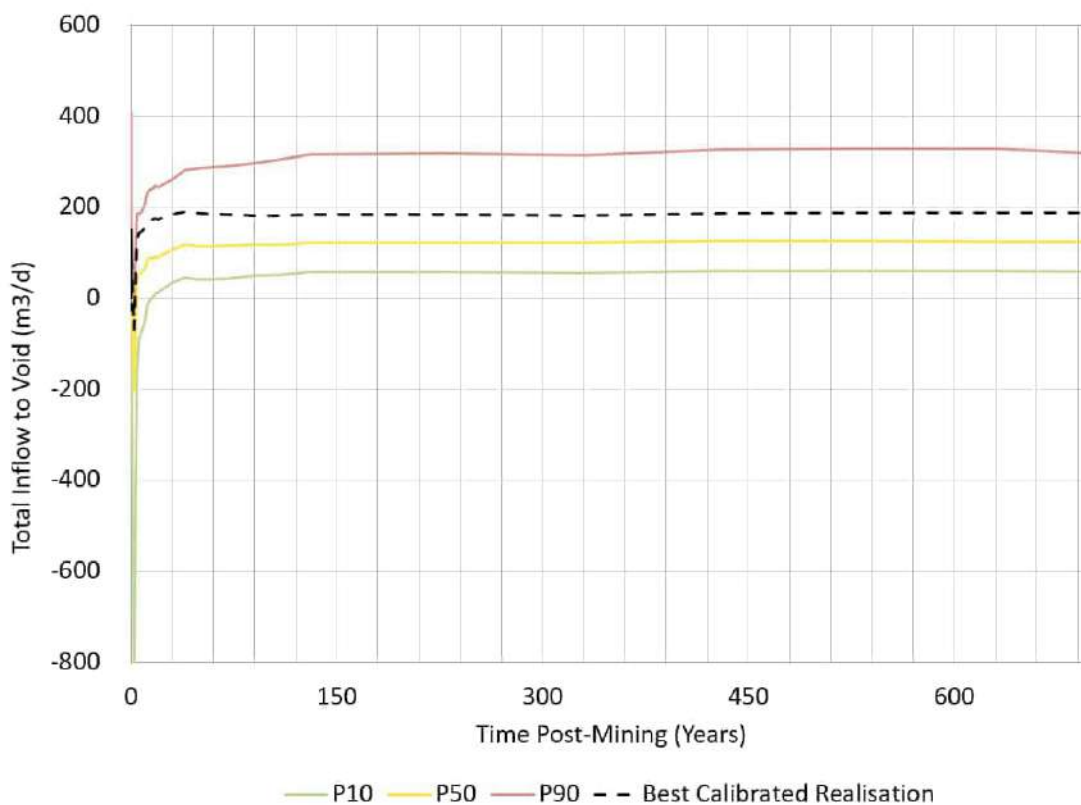


Figure 6-39 **Uncertainty in Predicted Void Inflow – Burton North (Burton)**



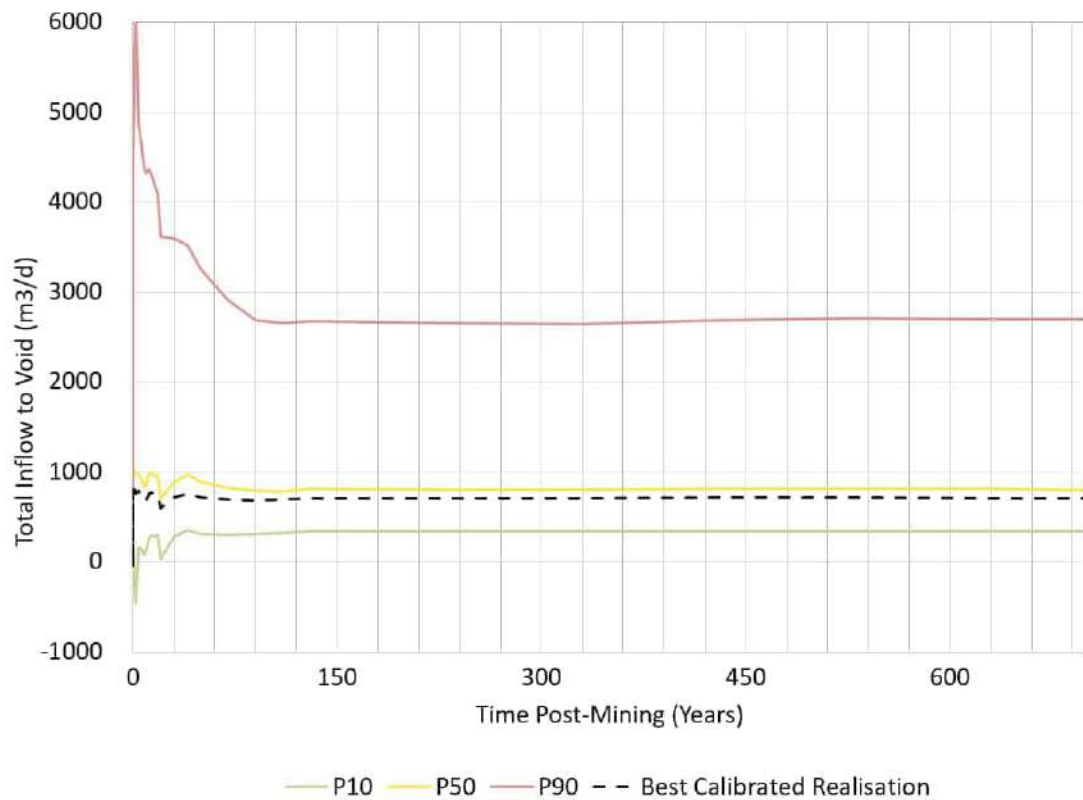


Figure 6-40 **Uncertainty in Predicted Void Inflow – Burton South (Burton)**

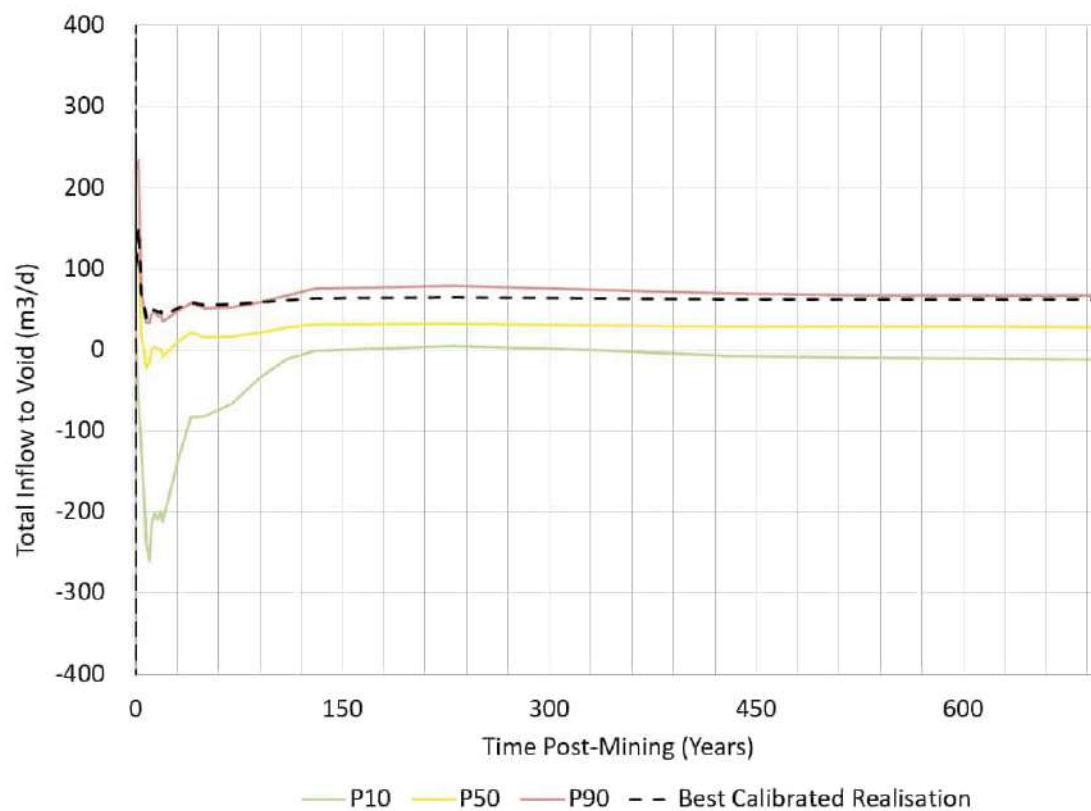


Figure 6-41 **Uncertainty in Predicted Void Inflow – Ellensfield (Burton)**



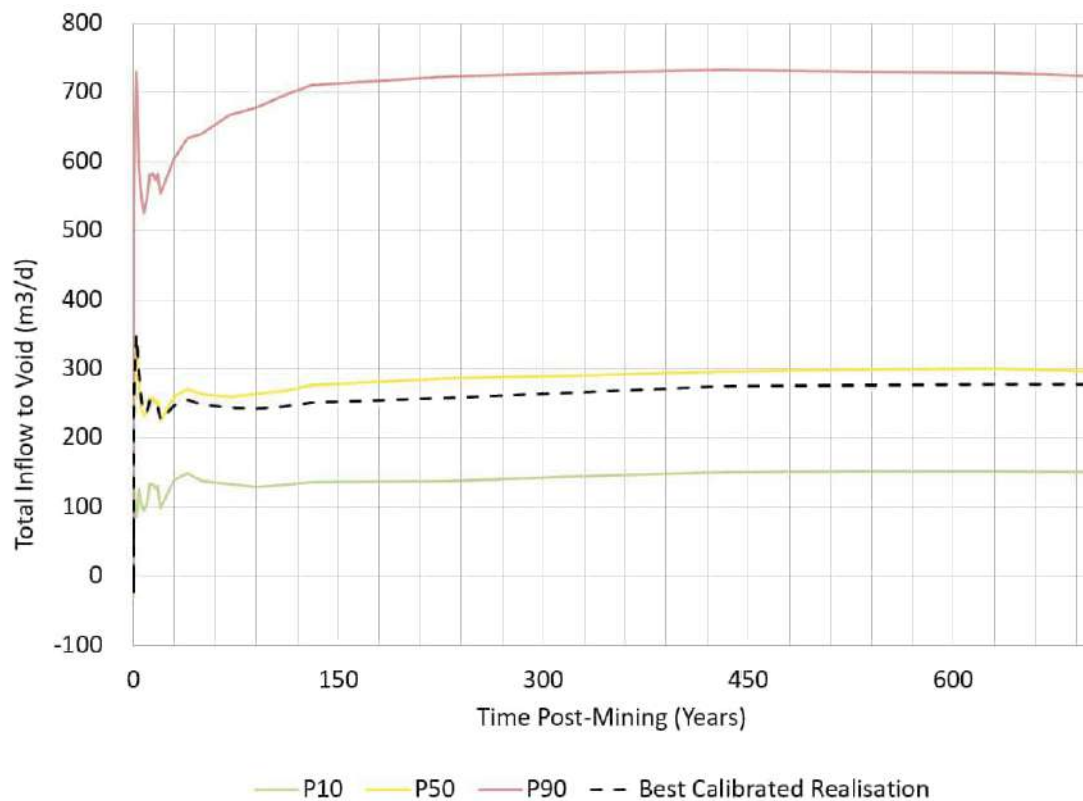


Figure 6-42 Uncertainty in Predicted Void Inflow – Plumtree North (Burton)

The uncertainty associated with the total post-mining equilibrium fluxes to the Isaac, Burton North, Burton South, Ellensfield and Plumtree North pit shells at Burton was assessed through calculation of the 10th, 50th and 90th percentiles and is summarised in **Table 6-9**. This includes the inflow from natural geological formations to the void and to the backfilled pit shell as described in **Section 6.4.2**.

Table 6-10 shows the uncertainty in predicted post-mining equilibrium groundwater inflows to final voids at Burton. The 10th, 50th and 90th percentiles are provided for each component of the total inflow to each void.

Table 6-9 Uncertainty in Equilibrium Groundwater Inflows to the Pit Shell from Natural Geological Formations - Burton

Residual Void	Equilibrium Inflow Rate – Natural Geological Formations (m3/day)			
	10 th Percentile	50 th Percentile	Best Calibrated Realisation	90 th Percentile
Isaac Pit	78.6	178.1	306.6	383.1
Burton North	49.1	116.5	146.3	334.0
Burton South	227.7	670.7	661.8	2399.7
Ellensfield	-17.2	21.4	48.2	54.1
Plumtree North	90.3	172.2	258.9	358.7



Table 6-10 Uncertainty in Equilibrium Groundwater Inflows to the Residual Voids - Burton

Residual Void	Percentile*	From Spoil (m³/day)	From Natural Geological Formations (m³/day)	Total (m³/day)
Isaac Pit	10 th	-	78.6	78.6
	50 th	-	178.1	178.1
	Best Calibrated Realisation	-	306.6	306.6
	90 th	-	383.1	383.1
Burton North	10 th	53.9	0.2	58.4
	50 th	117.8	3.4	124.3
	Best Calibrated Realisation	185.6	2.5	188.1
	90 th	290.3	26.8	313.5
Burton South	10 th	300.1	10.8	343.4
	50 th	751.8	42.1	796.8
	Best Calibrated Realisation	668.5	46.0	714.5
	90 th	2481.0	166.5	2701.4
Ellensfield	10 th	-17.4	2.1	-11.6
	50 th	19.8	7.2	27.0
	Best Calibrated Realisation	55.6	6.8	62.4
	90 th	50.7	20.7	66.9
Plumtree North	10 th	110.4	28.9	150.7
	50 th	189.8	94.7	294.9
	Best Calibrated Realisation	206.3	72.0	278.3
	90 th	384.0	326.3	721.0

*The percentiles presented for spoil, natural geological formations and total inflow to the residual voids have been calculated independently for each flux prediction. Discrepancy between the sum of the components and the total inflow for each percentile indicate differences in the parameter combinations in the uncertainty ensemble that result in differing distributions for each individual inflow component.



6.10.2 Uncertainty of Influence on Post-Mining Surface Water Flow

The uncertainty ranges of predicted cumulative and incremental (due to mining at New Lenton only) alluvial flux change during the post-mining recovery period are summarised in **Table 6-11** and **Table 6-12** respectively. The tables present the 10th, 50th and 90th percentile predictions for the decrease in flux to Quaternary Alluvium mapped within the model domain.

The change in flux due to the cumulative mining has been obtained by subtracting the predicted flux to the Quaternary Alluvium in the Cumulative scenario from that in the Null model scenario. The decrease in flux is therefore a comparison of between a 'mining and closure' situation, and a 'no mining' situation. Similarly, the incremental flux decrease due to mining at New Lenton has been obtained by subtracting the predicted flux to the Quaternary Alluvium in the Cumulative scenario from that in the Approved scenario.

The cumulative post-mining uncertainty results shown in **Table 6-11** indicate that the 90th percentile change in the Quaternary Alluvium increases gradually from the start of the post-mining period and reaches a maximum of approximately 957.0 ML/year (2.64 ML/day), 17 to 20 years post-mining. The cumulative decrease in flux predicted by the best calibrated realisation is close to the 50th percentile for the prediction.

Table 6-11 Post-Mining Uncertainty of Cumulative Decrease in Flux to Quaternary Alluvium (ML/Year)

Years	10 th Percentile	50 th Percentile	Best Calibrated Realisation	90 th Percentile
2040 to 2041	219.2	482.1	631.9	927.7
2041 to 2044	219.2	478.5	606.3	946.0
2044 to 2045	226.5	482.1	606.3	949.7
2045 to 2048	230.1	482.1	610.0	953.3
2048 to 2049	230.1	485.8	610.0	953.3
2049 to 2052	230.1	474.8	602.7	953.3
2052 to 2053	219.2	467.5	602.7	953.3
2053 to 2056	222.8	471.2	602.7	957.0
2056 to 2057	226.5	471.2	602.7	957.0
2057 to 2060	233.8	493.1	610.0	964.3
2060 to 2069	226.5	482.1	599.0	949.7
2069 to 2080	219.2	471.2	595.4	938.7
2080 to 2089	219.2	471.2	599.0	942.3
2089 to 2110	222.8	474.8	595.4	935.0
2110 to 2130	215.5	474.8	591.7	924.1
2130 to 2150	211.8	467.5	584.4	902.2
2150 to 2170	204.5	456.6	577.1	887.6
2170 to 2270	197.2	438.3	566.1	869.3



The incremental post-mining uncertainty results shown in **Table 6-12** indicate that the 90th percentile change in flux to the Quaternary Alluvium due to mining at New Lenton is at a maximum of approximately 248.4 ML/year (0.68 ML/day) at the beginning of the post-mining simulation and decreases thereafter. The incremental decrease in flux predicted by the best calibrated realisation is slightly higher than the 50th percentile for the prediction.

Table 6-12 Post-Mining Uncertainty of Incremental (New Lenton) Decrease in Flux to Quaternary Alluvium (ML/Year)

Years	10 th Percentile	50 th Percentile	Calibrated Prediction Model	90 th Percentile
2040 to 2041	65.7	138.8	171.7	248.4
2041 to 2044	65.7	138.8	168.0	244.7
2044 to 2045	65.7	135.1	168.0	244.7
2045 to 2048	65.7	135.1	168.0	241.1
2048 to 2049	65.7	135.1	168.0	241.1
2049 to 2052	65.7	135.1	168.0	241.1
2052 to 2053	65.7	135.1	168.0	241.1
2053 to 2056	65.7	135.1	168.0	241.1
2056 to 2057	65.7	135.1	168.0	241.1
2057 to 2060	65.7	135.1	168.0	241.1
2060 to 2069	62.1	135.1	168.0	241.1
2069 to 2080	62.1	131.5	168.0	241.1
2080 to 2089	58.4	131.5	168.0	237.4
2089 to 2110	58.4	131.5	164.4	237.4
2110 to 2130	54.8	127.8	164.4	233.8
2130 to 2150	54.8	124.2	164.4	233.8
2150 to 2170	51.1	120.5	160.7	230.1
2170 to 2270	43.8	116.9	160.7	222.8

6.10.3 Uncertainty of Post-Mining Residual Groundwater Drawdowns

To illustrate the uncertainty in the extent of predicted post-mining residual drawdown, the maximum extent of the 1 m predicted incremental drawdown for the 10th, 50th and 90th percentiles was compared to the maximum extent of the 1 m incremental drawdown from the best calibrated realisation.

The 90th percentiles shown in the following section indicates the predicted residual drawdown extent exceeded by 10% of tested realisations. Therefore, drawdown extent greater than the 90th percentile area is an unlikely outcome. The 10th percentile lines in the figures show the predicted residual drawdown extent exceeded by 90% of tested realisations, therefore it is highly likely that the actual extent will be greater than that shown for the 10th percentile. The 50th percentile lines show the predicted residual drawdown extent exceeded 50% of tested realisations. These predictions are considered as likely outcomes.

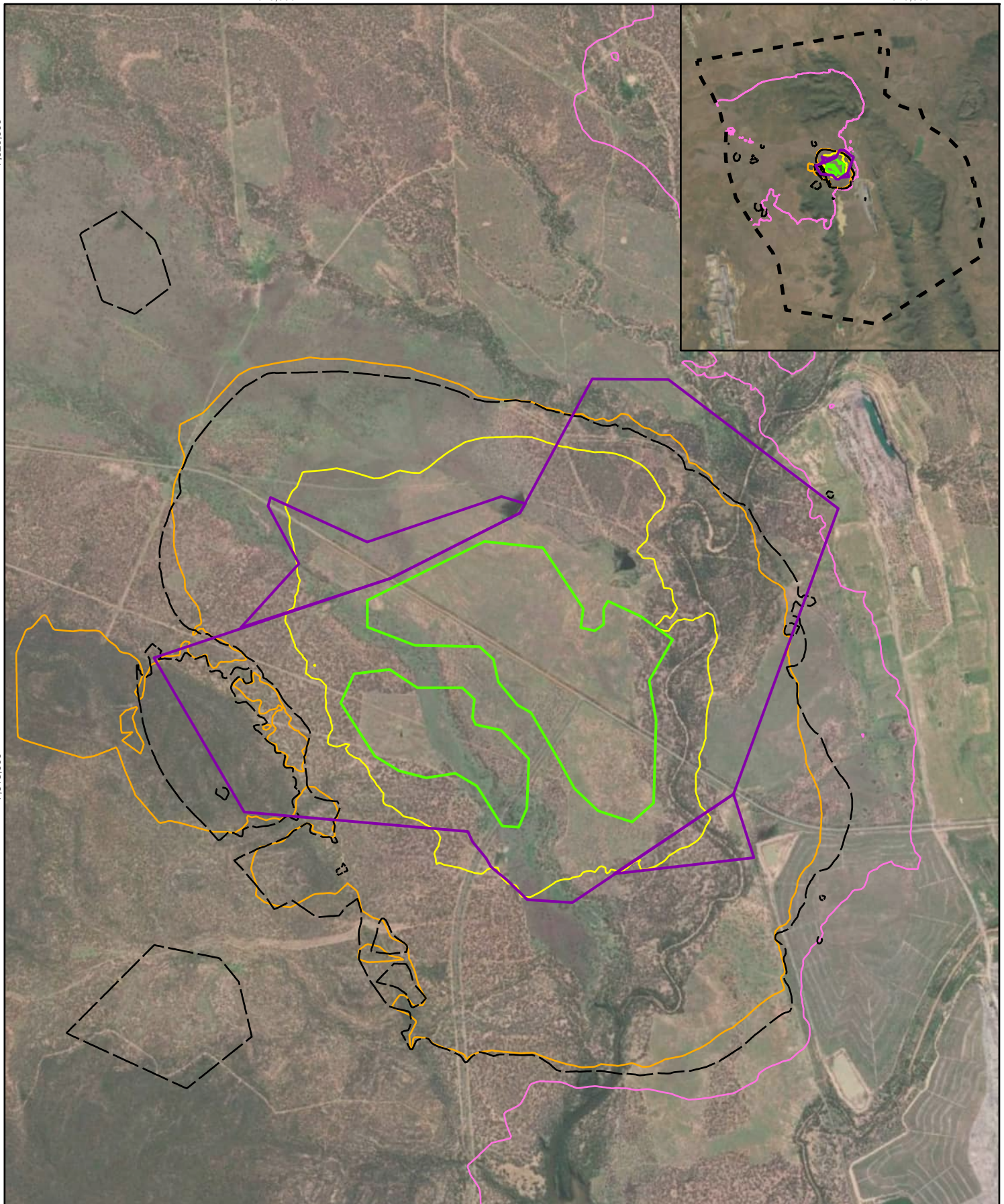


Incremental residual drawdown at the end of the recovery simulation, due to the proposed mining at New Lenton, was obtained by calculating the difference in groundwater levels for the Approved scenario and the Cumulative scenario.

The extent of the predicted incremental drawdown of the water table at post-mining equilibrium, due to mining at New Lenton, is shown in **Figure 6-43**. The incremental drawdown extent predicted by the best calibrated realisation and the 10th, 50th and 90th percentiles for the alluvium, regolith and Burton/Rider and Leichhardt/Vermont seams are shown in **Figure 6-44** to **Figure 6-47**, respectively. The figures show that in general, the extent of the residual incremental drawdown predicted by the best calibrated realisation is in line with the 50th percentile predictions.

The 90th percentile residual incremental drawdown in the coal seams, presented in **Figure 6-46** (Burton/Rider seam) and **Figure 6-47** (Leichhardt/Vermont seam) indicate significant extent of this predicted impact for the 90th percentile beyond that of the 50th percentile, stretching approximately 16 km to the north-west of New Lenton, along the Burton Range fault, reaching the western model boundary. The extent of this prediction is likely attributable to a combination of structural limitations of the model and extreme parameter combinations in a small number of the realisations derived during the Monte Carlo analysis. While lateral connectivity has been applied to model cells on either side of the fault, realisations in which both the horizontal and vertical conductivity for the adjacent layers (i.e. Burton/Rider, Leichhardt/Vermont seams in lateral connection to the 2 lower Rewan layers) differ by between 4 to 7 orders of magnitude on either side of the fault have resulted in residual drawdown extent predictions such as those shown for the 90th percentile. As such, the extent of the 90th percentile predictions shown in **Figure 6-46** and **Figure 6-47** should be considered an unlikely outcome resulting from the structural representation of the fault in the model and some extreme parameter combinations included in the uncertainty ensemble.





0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

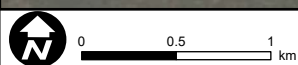
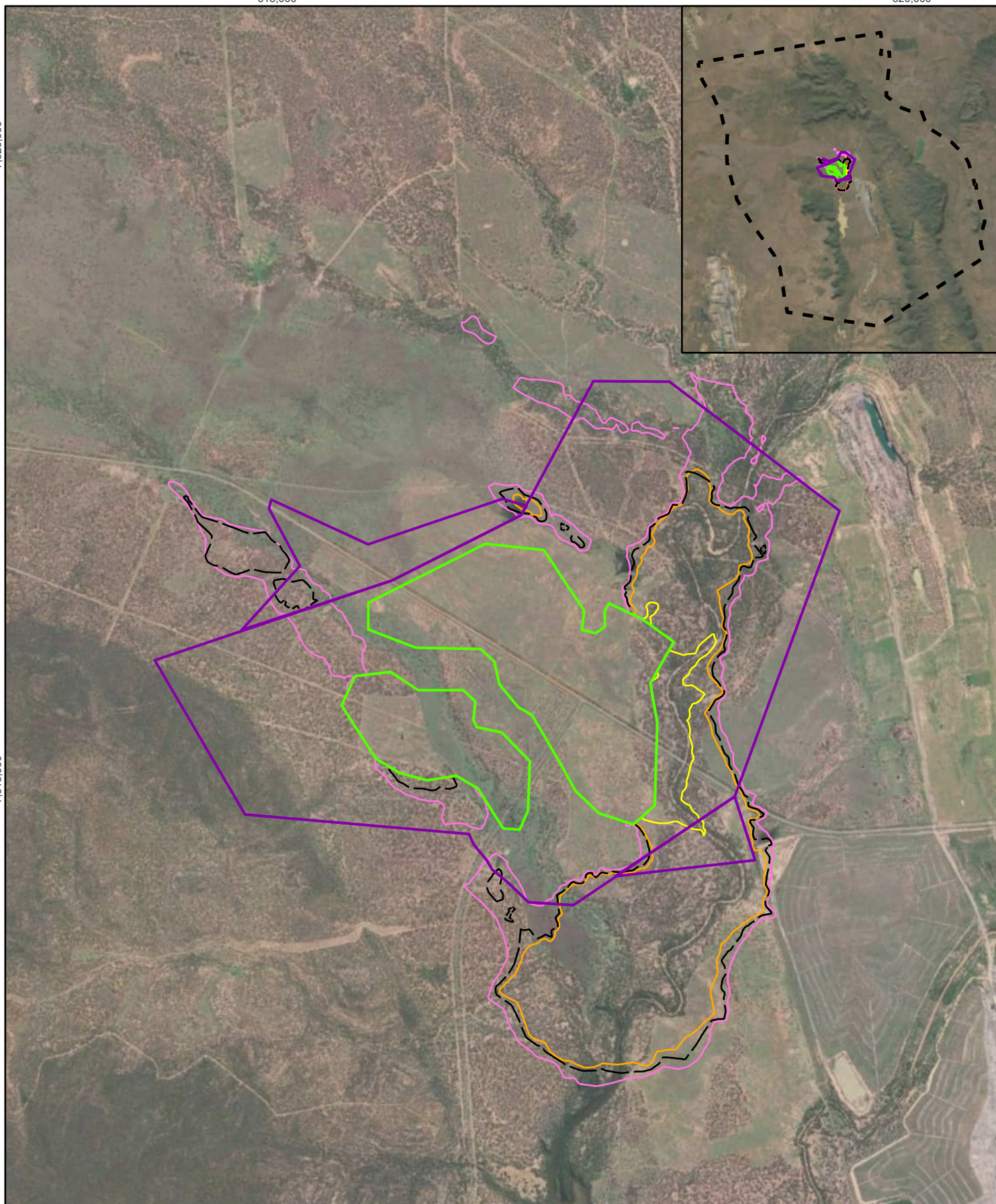
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UNCERTAINTY IN PREDICTED RESIDUAL INCREMENTAL GROUNDWATER TABLE DRAWDOWN – NEW LENTON (POST-MINING EQUILIBRIUM)



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FIGURE 6-43



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

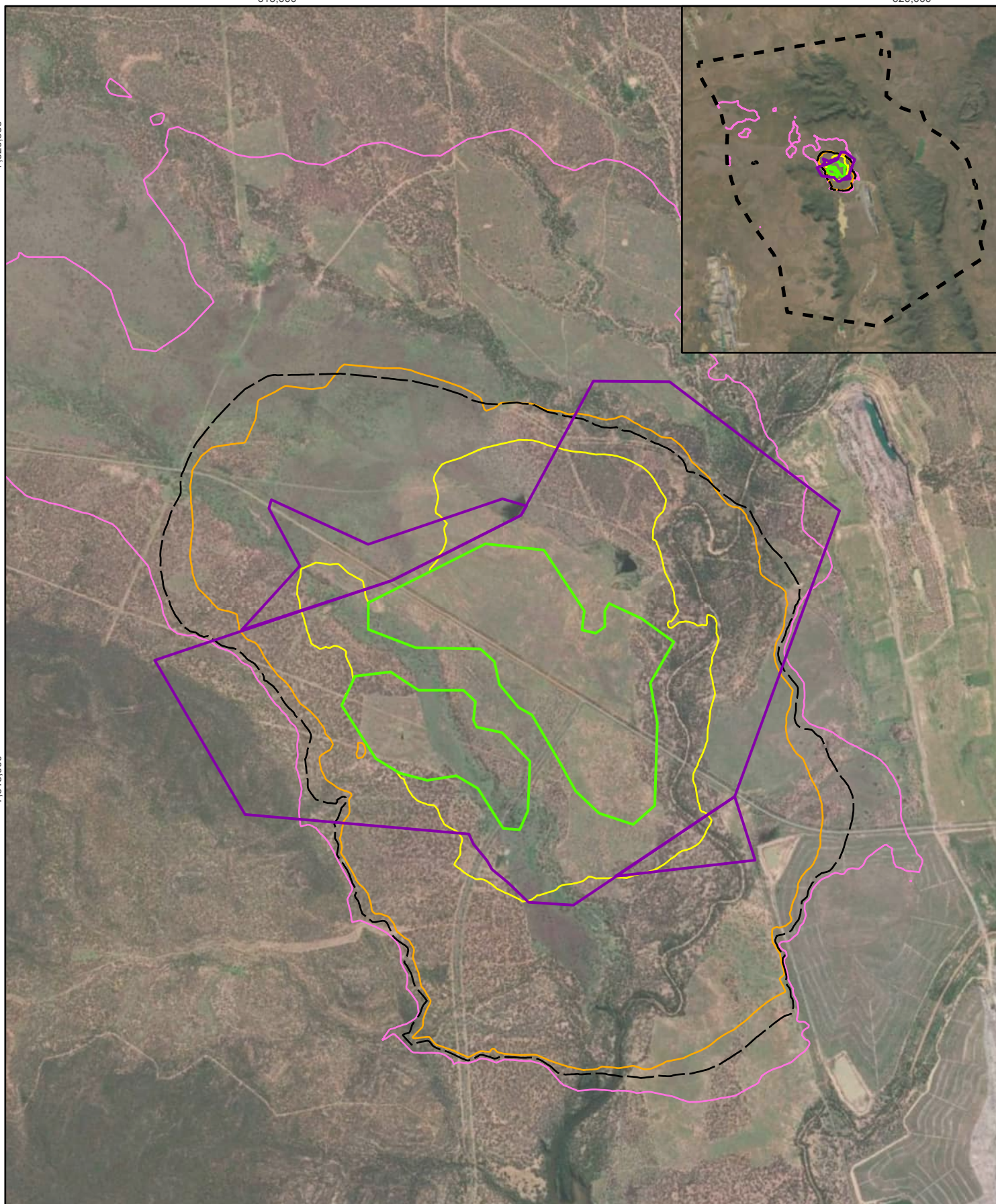
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN ALLUVIUM (LAYER 1) – NEW LENTON (POST-MINING EQUILIBRIUM)



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FIGURE 6-44



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN REGOLITH (LAYER 2) – NEW LENTON (POST-MINING EQUILIBRIUM)



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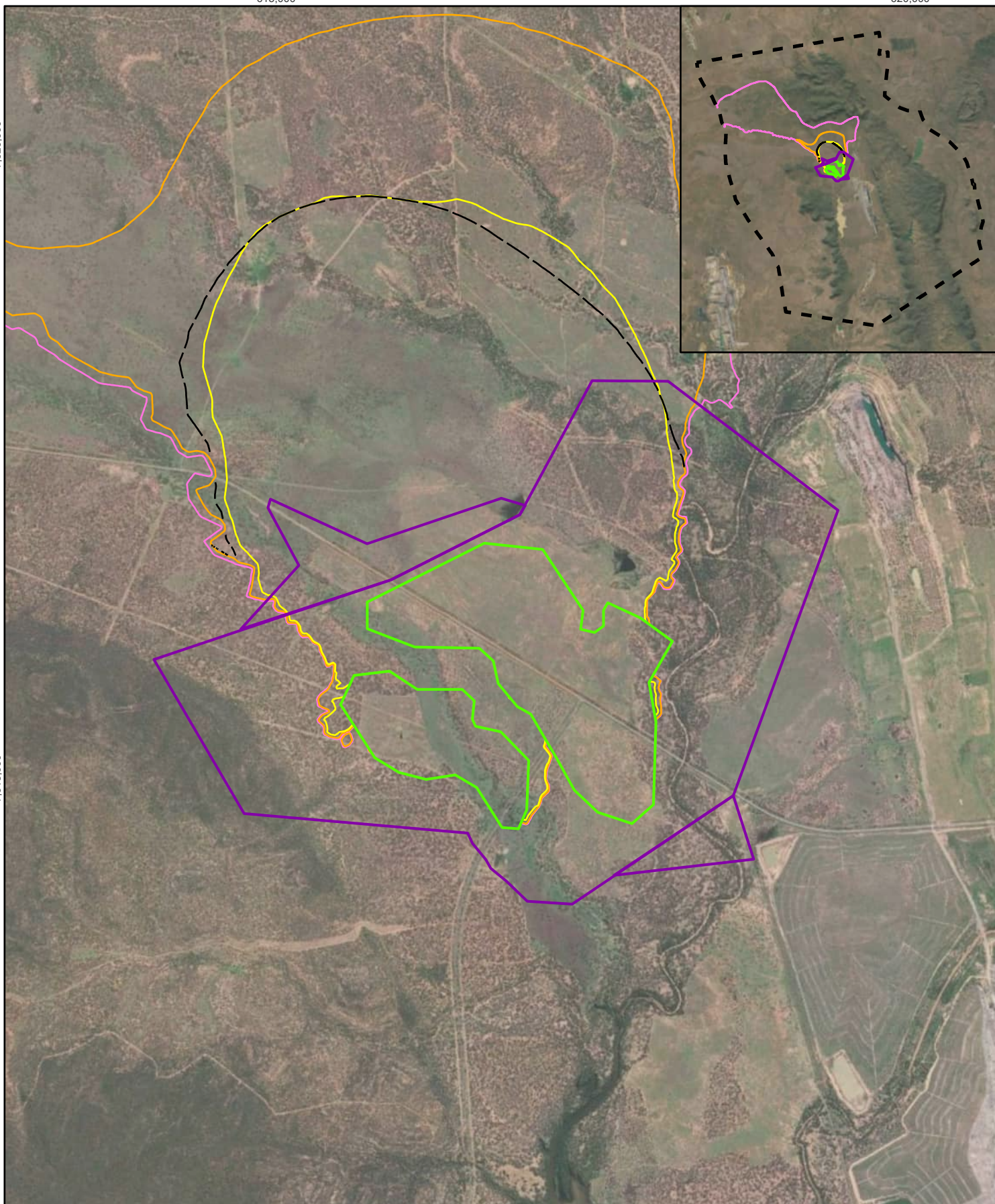
FIGURE 6-45

615,000

620,000

7,620,000

7,615,000



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**
**UNCERTAINTY IN PREDICTED RESIDUAL
INCREMENTAL DRAWDOWN IN
BURTON/RIDER SEAM (LAYER 12) –
NEW LENTON
(POST-MINING EQUILIBRIUM)**


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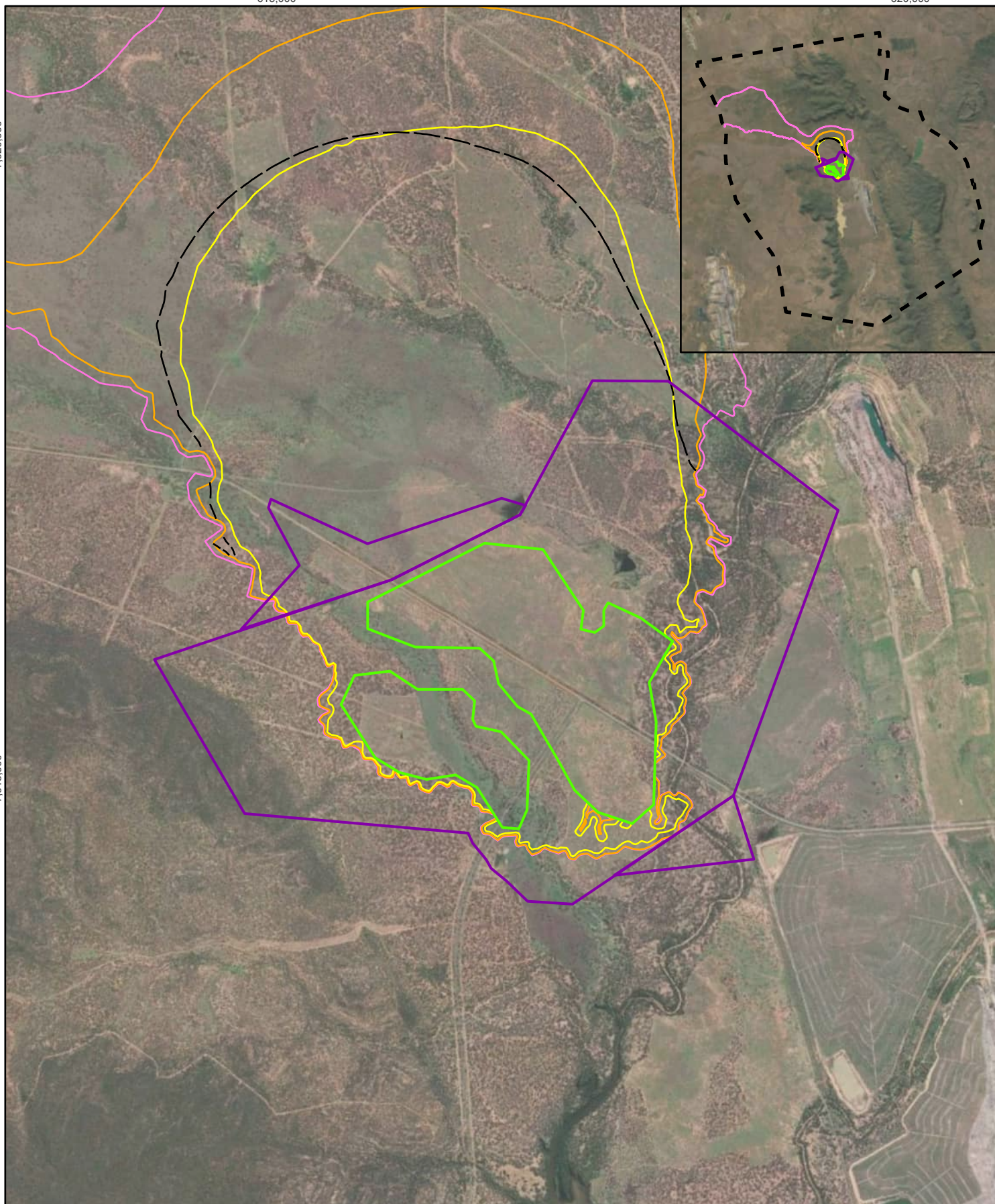
FIGURE 6-46

615,000

620,000

7,620,000

7,615,000



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31208.00000

Date Drawn: 14-Dec-2023

Drawn by: RB

LEGEND

Model Domain

New Lenton Mining Lease

New Lenton Pit Extent

1m Drawdown Contour

Best Calibrated Realisation

10th Percentile

50th Percentile

90th Percentile

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**
**UNCERTAINTY IN PREDICTED RESIDUAL
INCREMENTAL DRAWDOWN IN
LEICHHARDT/VERMONT SEAM
(LAYER 16) – NEW LENTON
(POST-MINING EQUILIBRIUM)**


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FIGURE 6-47

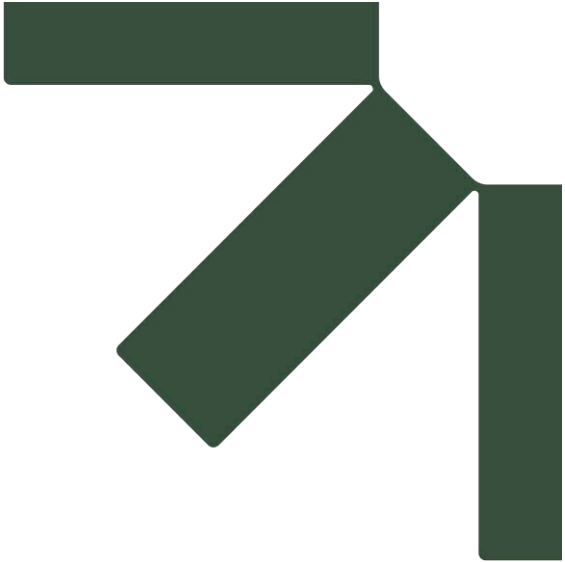
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Appendix A Modelled Hydraulic Property Zones

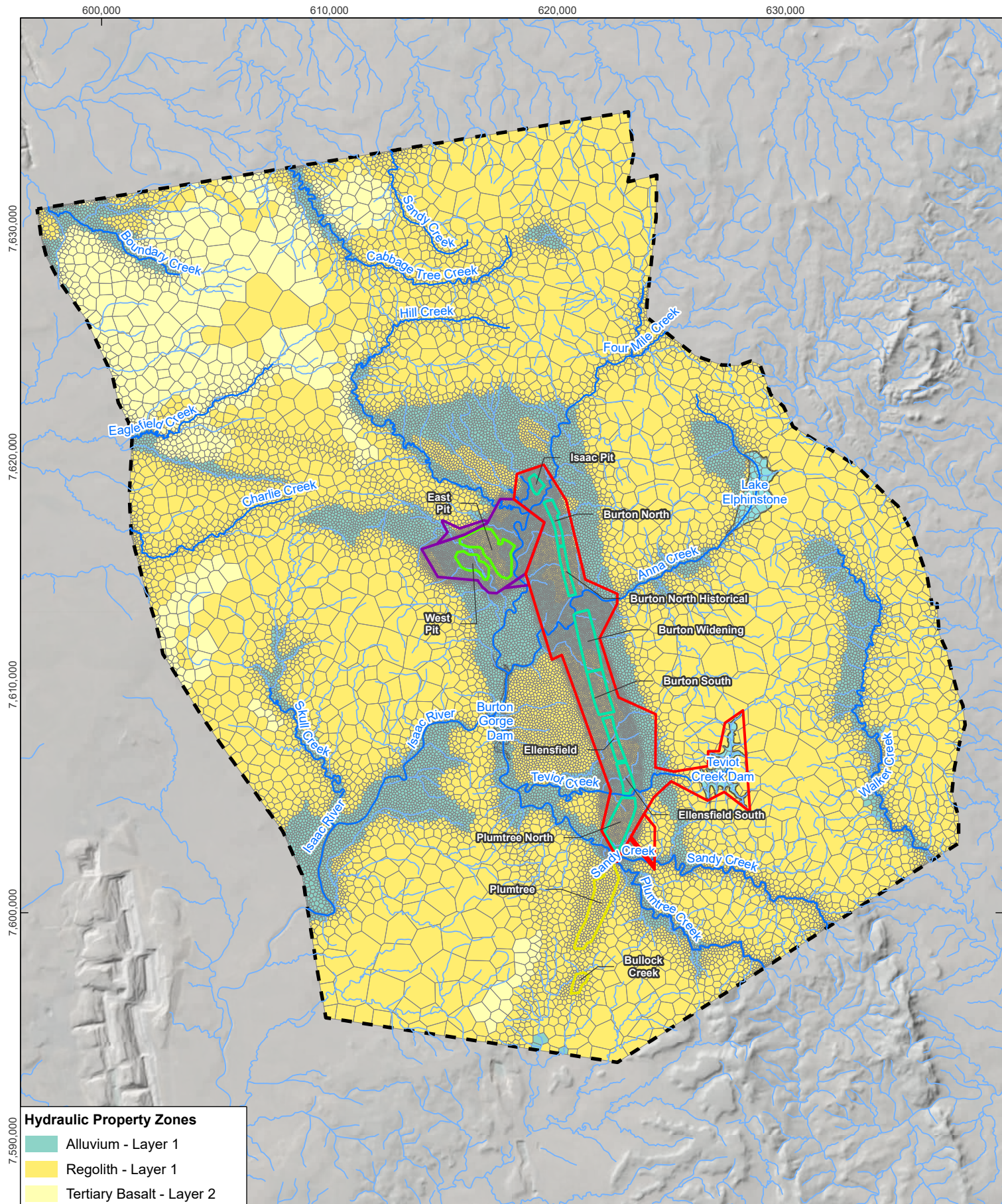
New Lenton & Burton

2023 Groundwater Modelling Technical Report

Lenton Joint Venture

SLR Project No.: 620.31367.00000

11 September 2024



Hydraulic Property Zones

- Alluvium - Layer 1
- Regolith - Layer 1
- Tertiary Basalt - Layer 2

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

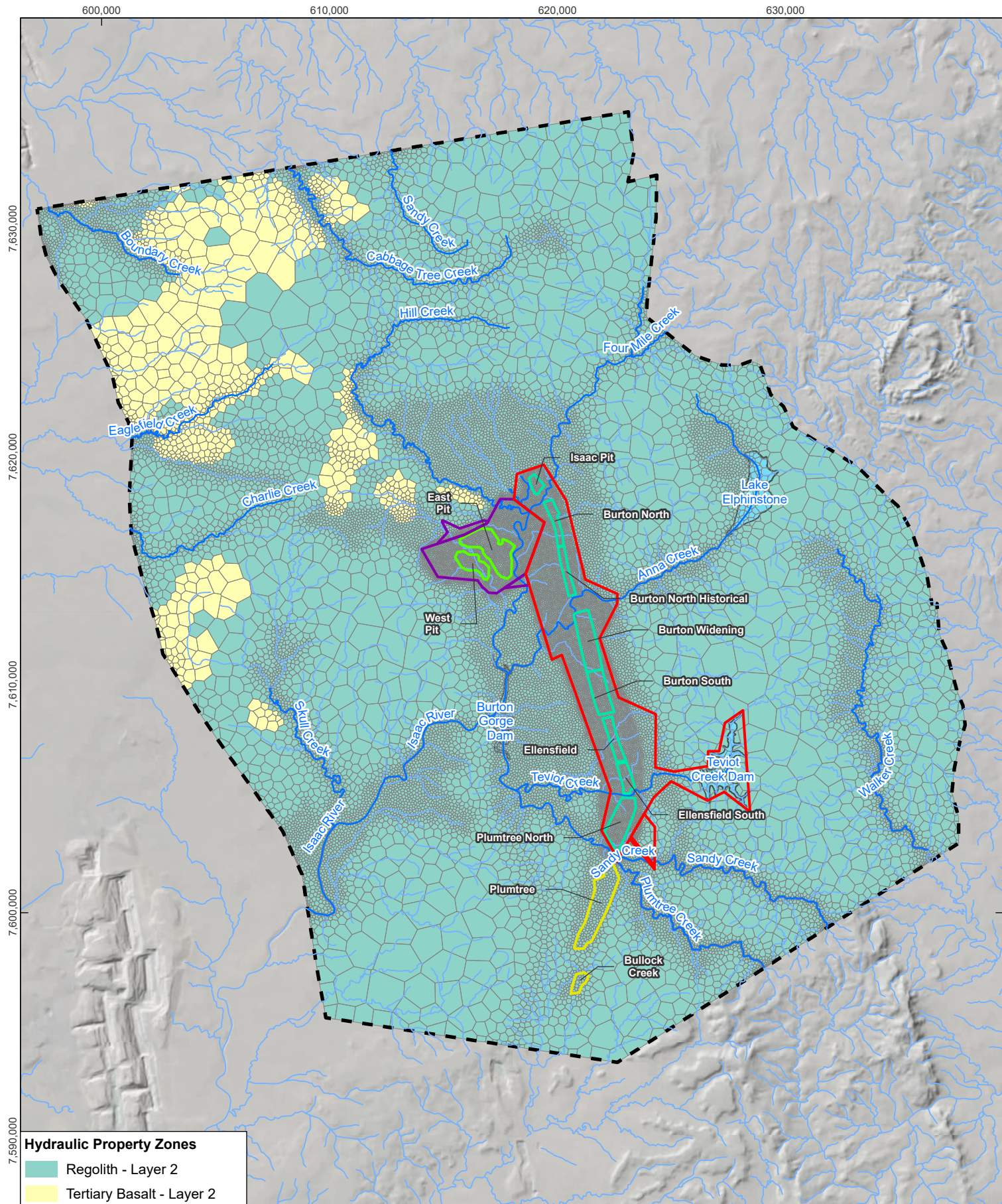
- River
- Watercourse and Drainage
- Model Domain
- Model Grid
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 1)**



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Hydraulic Property Zones

- Regolith - Layer 2
- Tertiary Basalt - Layer 2

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

- River
- Watercourse and Drainage
- Model Domain
- Model Grid
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

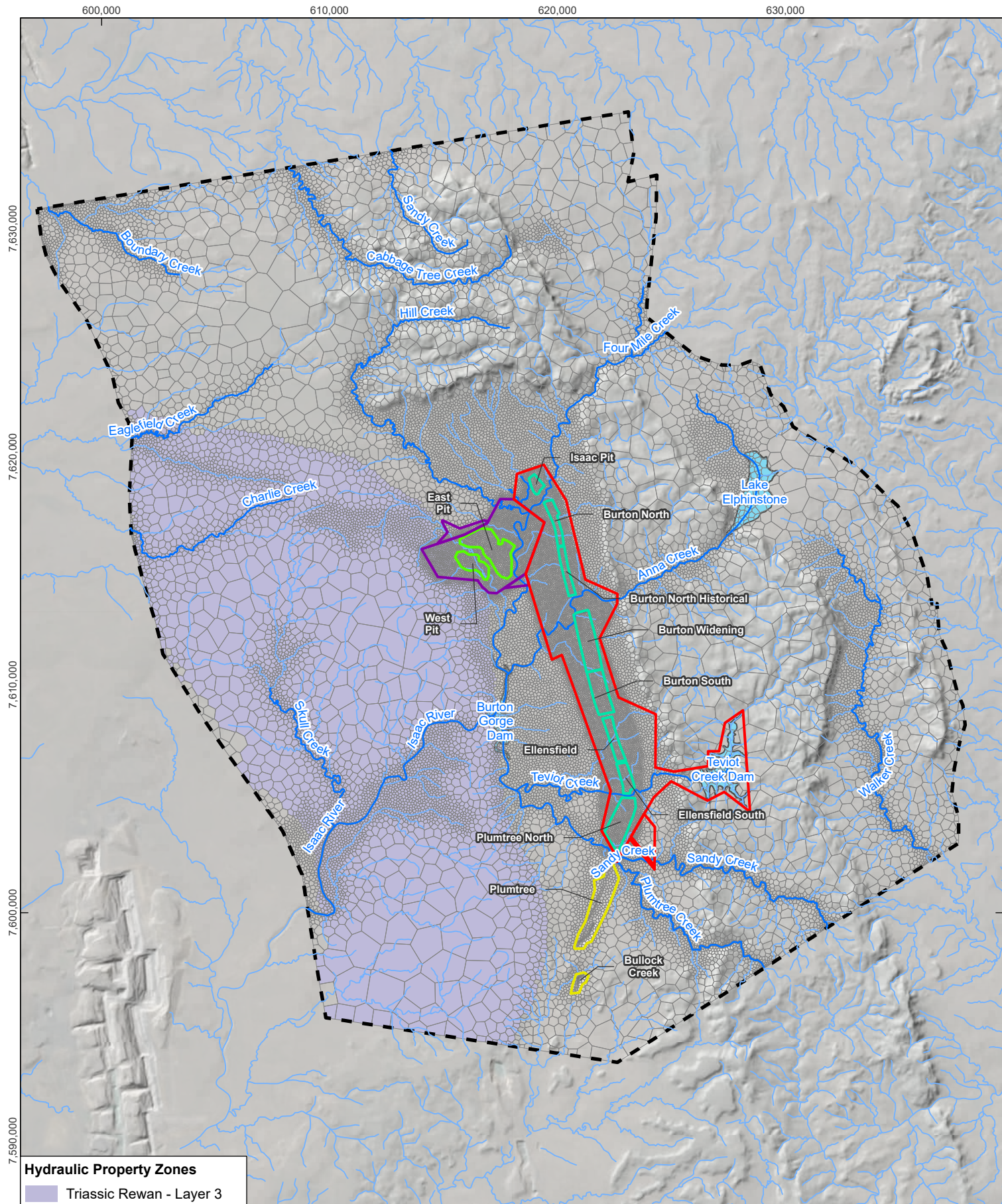
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MODELLLED HYDRAULIC PROPERTY ZONES (LAYER 2)



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APPENDIX A



Hydraulic Property Zones
Triassic Rewan - Layer 3

 0 2.5 5 km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:220,000 at A4
Project Number: 620.31208.00000
Date Drawn: 18-Dec-2023
Drawn by: AS

LEGEND

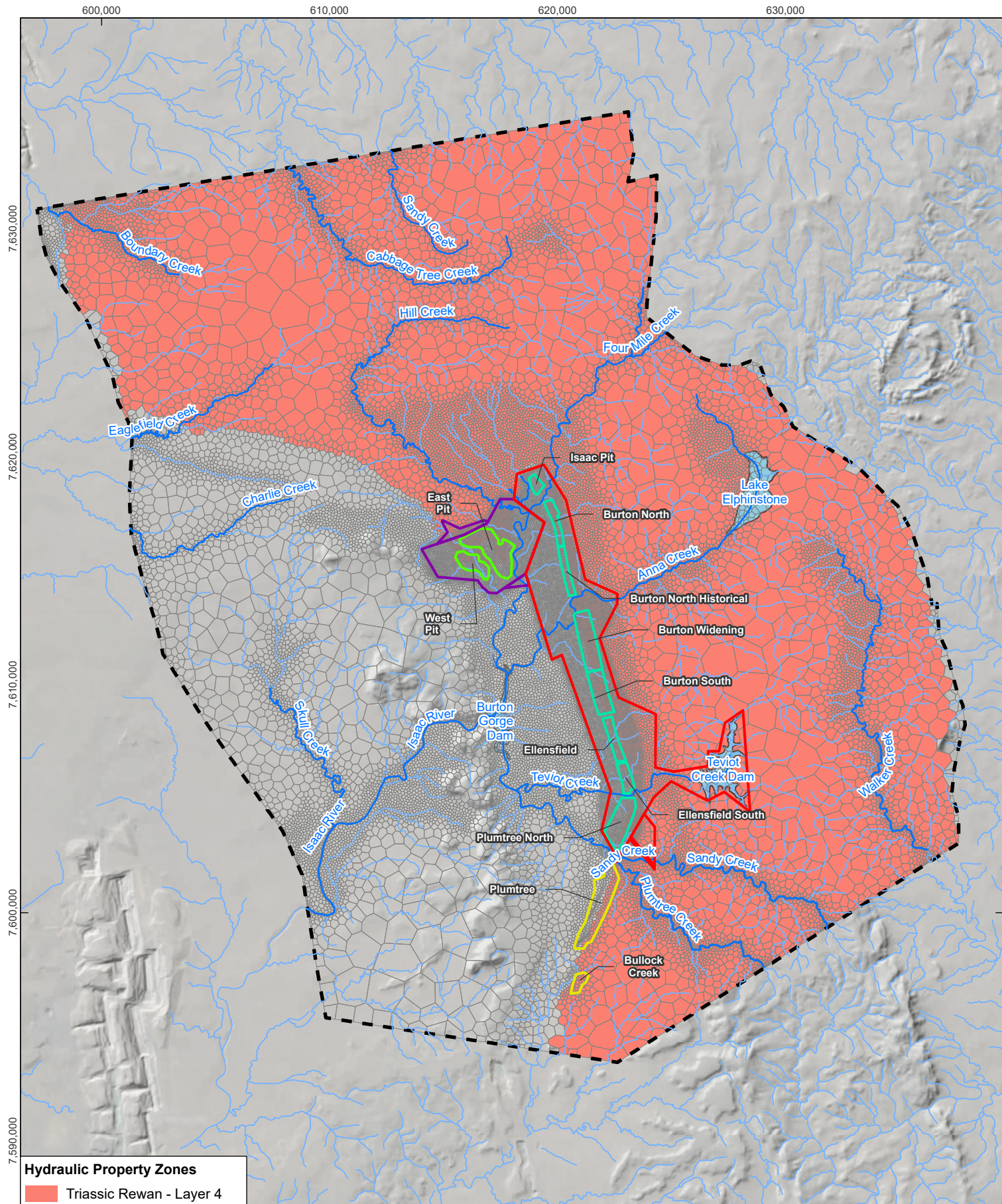
-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 3)**



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Hydraulic Property Zones
Triassic Rewan - Layer 4

 0 2.5 5 km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:220,000 at A4
Project Number: 620.31208.00000
Date Drawn: 18-Dec-2023
Drawn by: AS

LEGEND

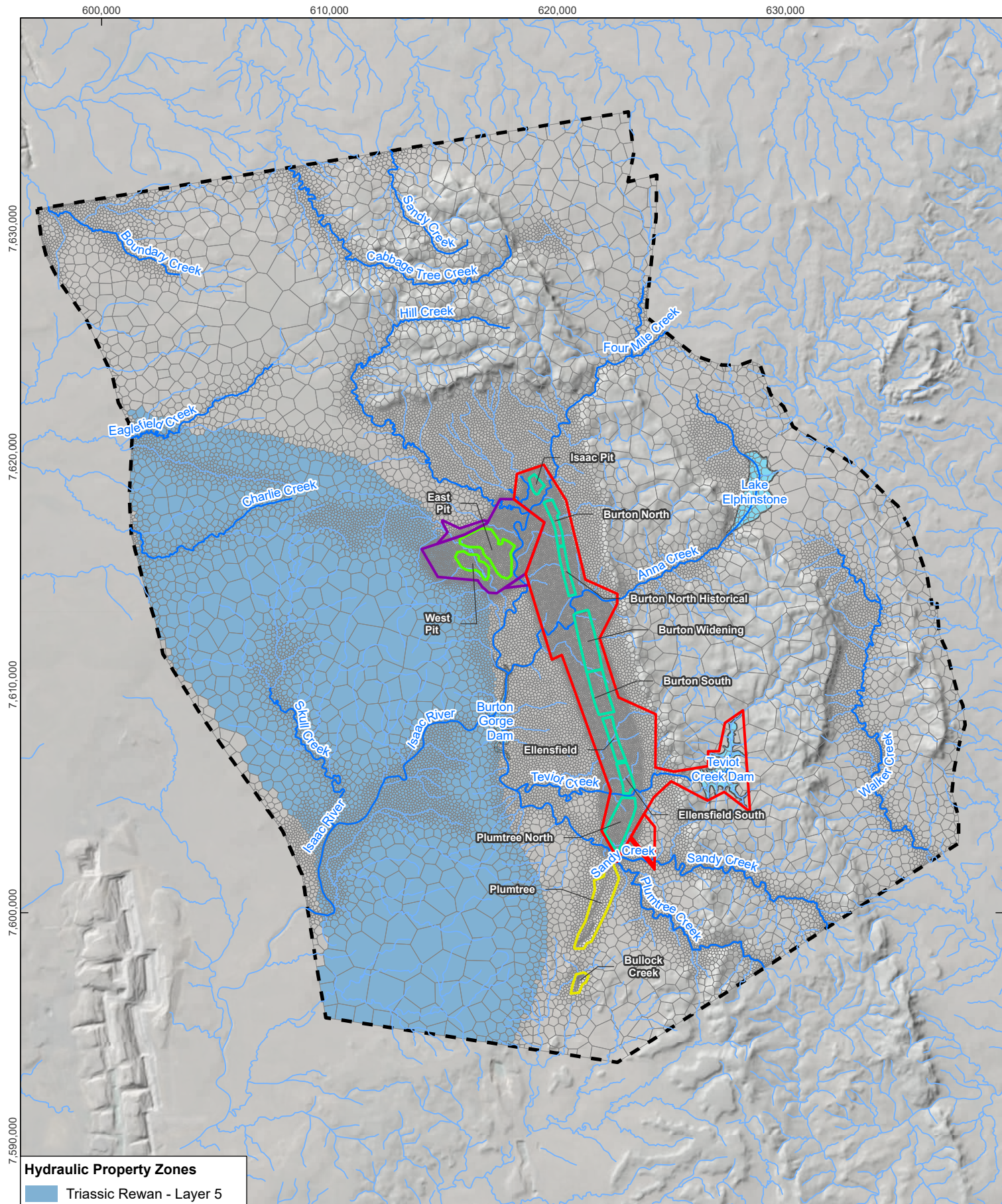
-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 4)**



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Hydraulic Property Zones
Triassic Rewan - Layer 5

 0 2.5 5 km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:220,000 at A4
Project Number: 620.31208.00000
Date Drawn: 18-Dec-2023
Drawn by: AS

LEGEND

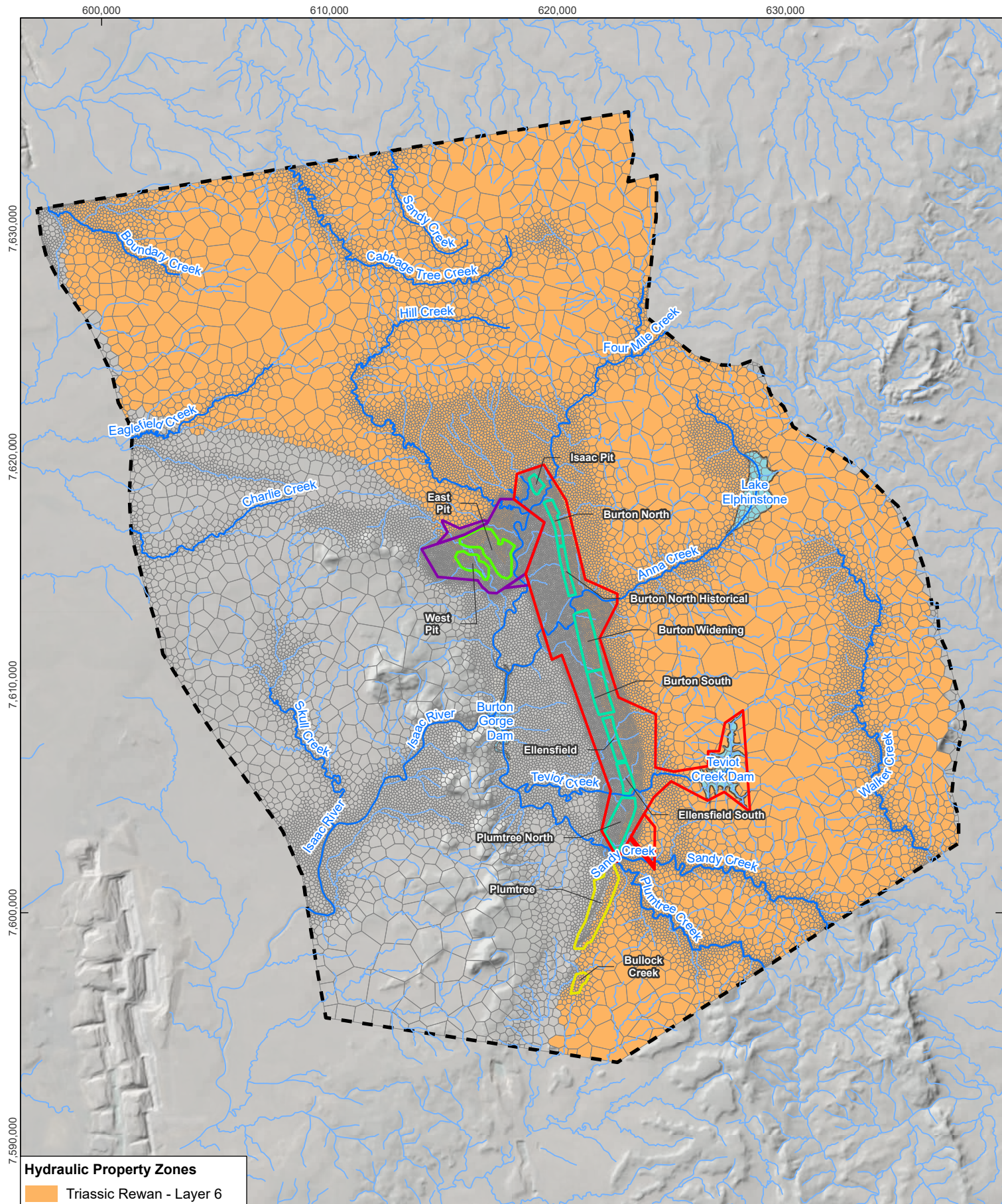
-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 5)**



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Hydraulic Property Zones
Triassic Rewan - Layer 6

 0 2.5 5 km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:220,000 at A4
Project Number: 620.31208.00000
Date Drawn: 18-Dec-2023
Drawn by: AS

LEGEND

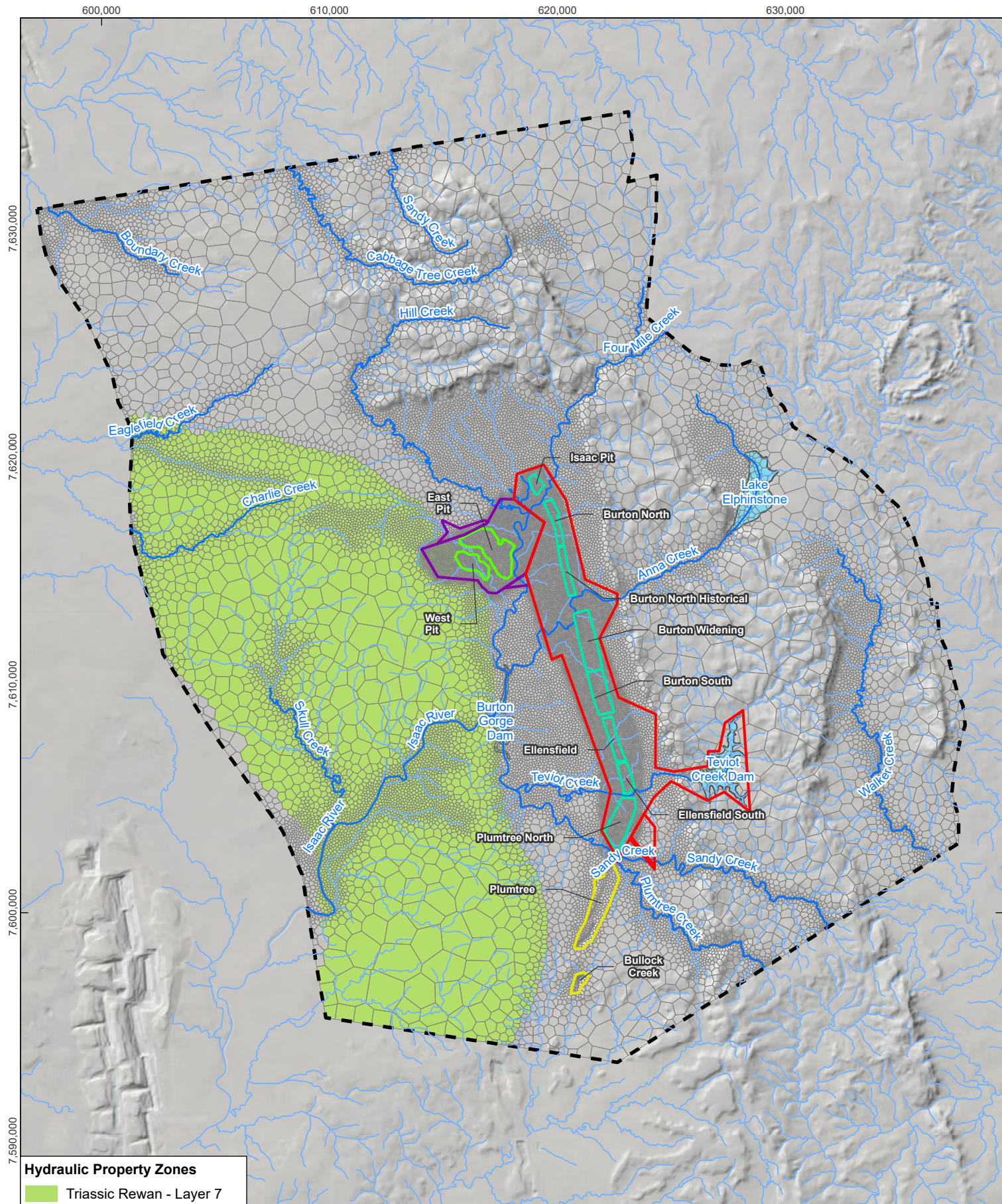
-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 6)**



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Hydraulic Property Zones

Triassic Rewan - Layer 7

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

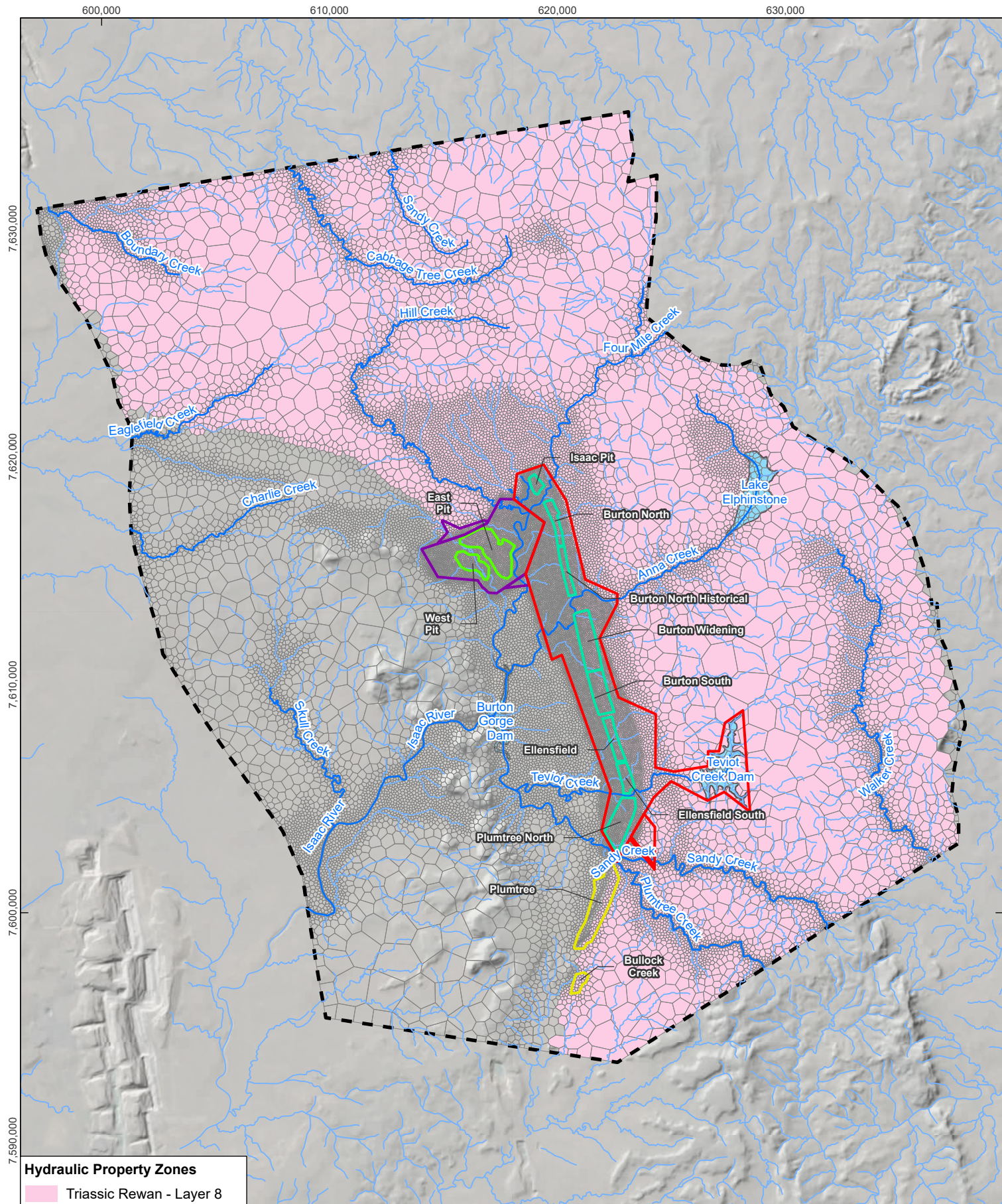
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**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 7)**



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APPENDIX A



Hydraulic Property Zones
Triassic Rewan - Layer 8

 0 2.5 5 km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:220,000 at A4
Project Number: 620.31208.00000
Date Drawn: 18-Dec-2023
Drawn by: AS

LEGEND

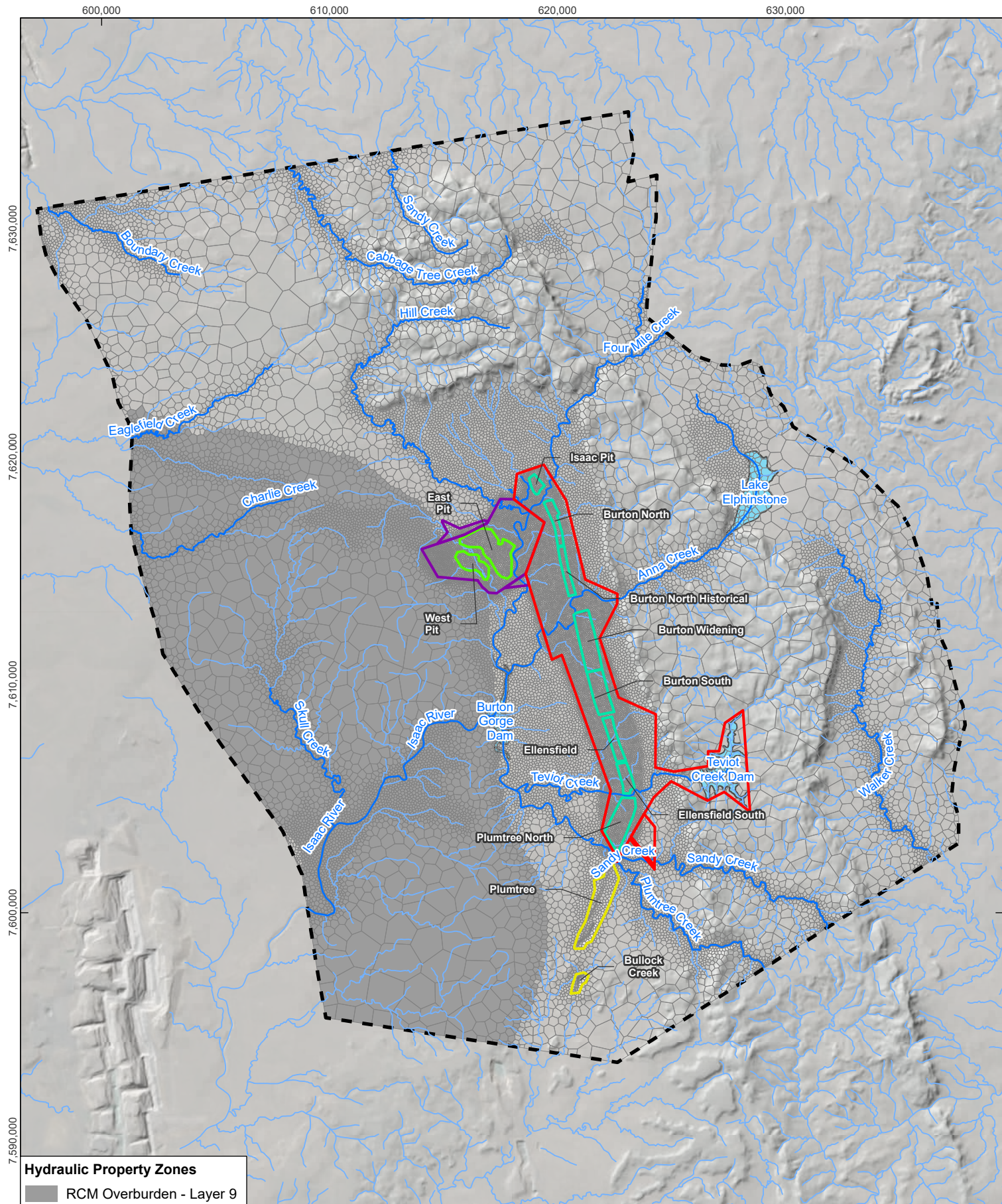
-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

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MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 8)**



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Hydraulic Property Zones

RCM Overburden - Layer 9

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

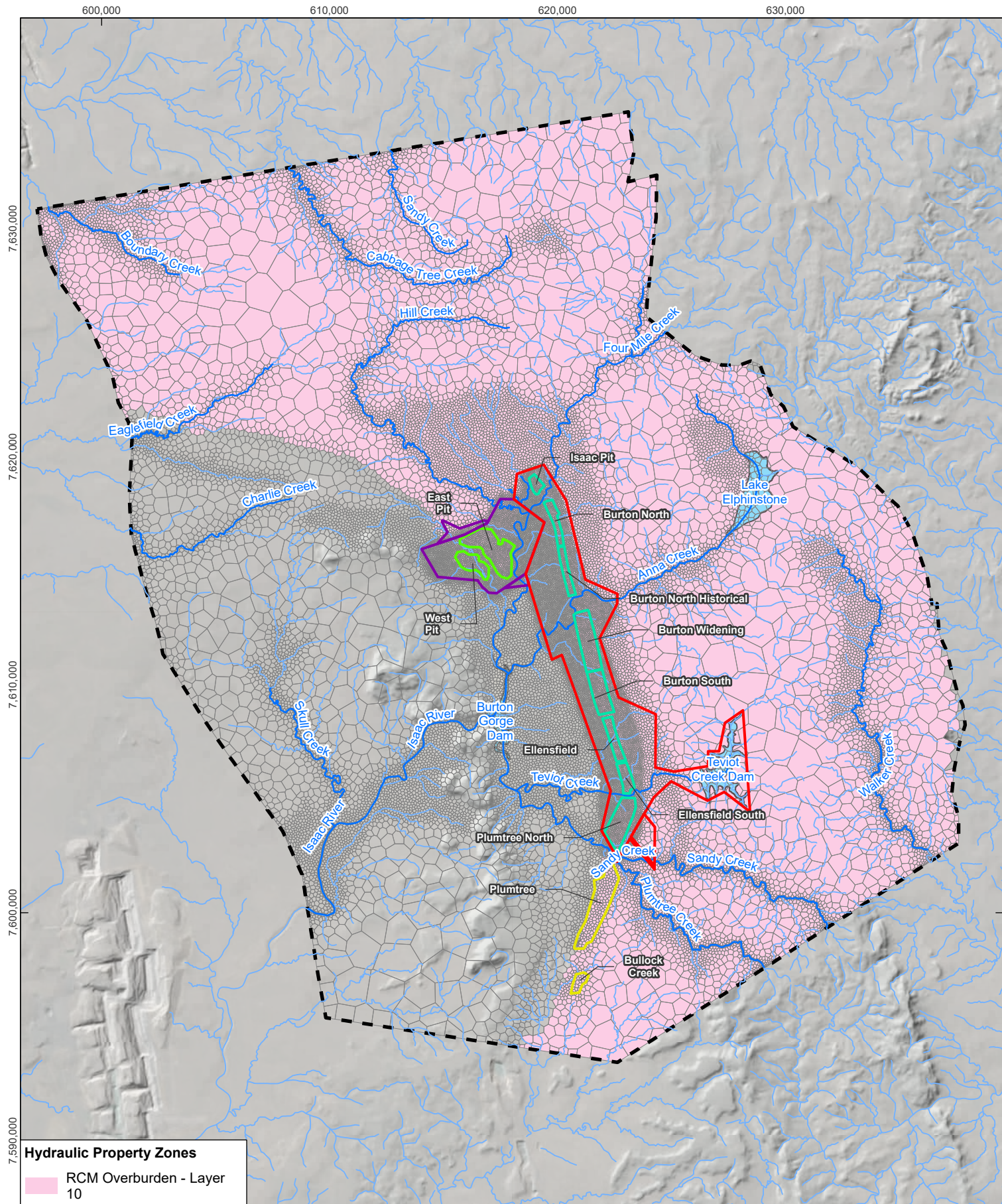
-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 9)**



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Hydraulic Property Zones

RCM Overburden - Layer 10

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:220,000 at A4
Project Number: 620.31208.00000
Date Drawn: 18-Dec-2023
Drawn by: AS

LEGEND

- River
- Watercourse and Drainage
- Model Domain
- Model Grid
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

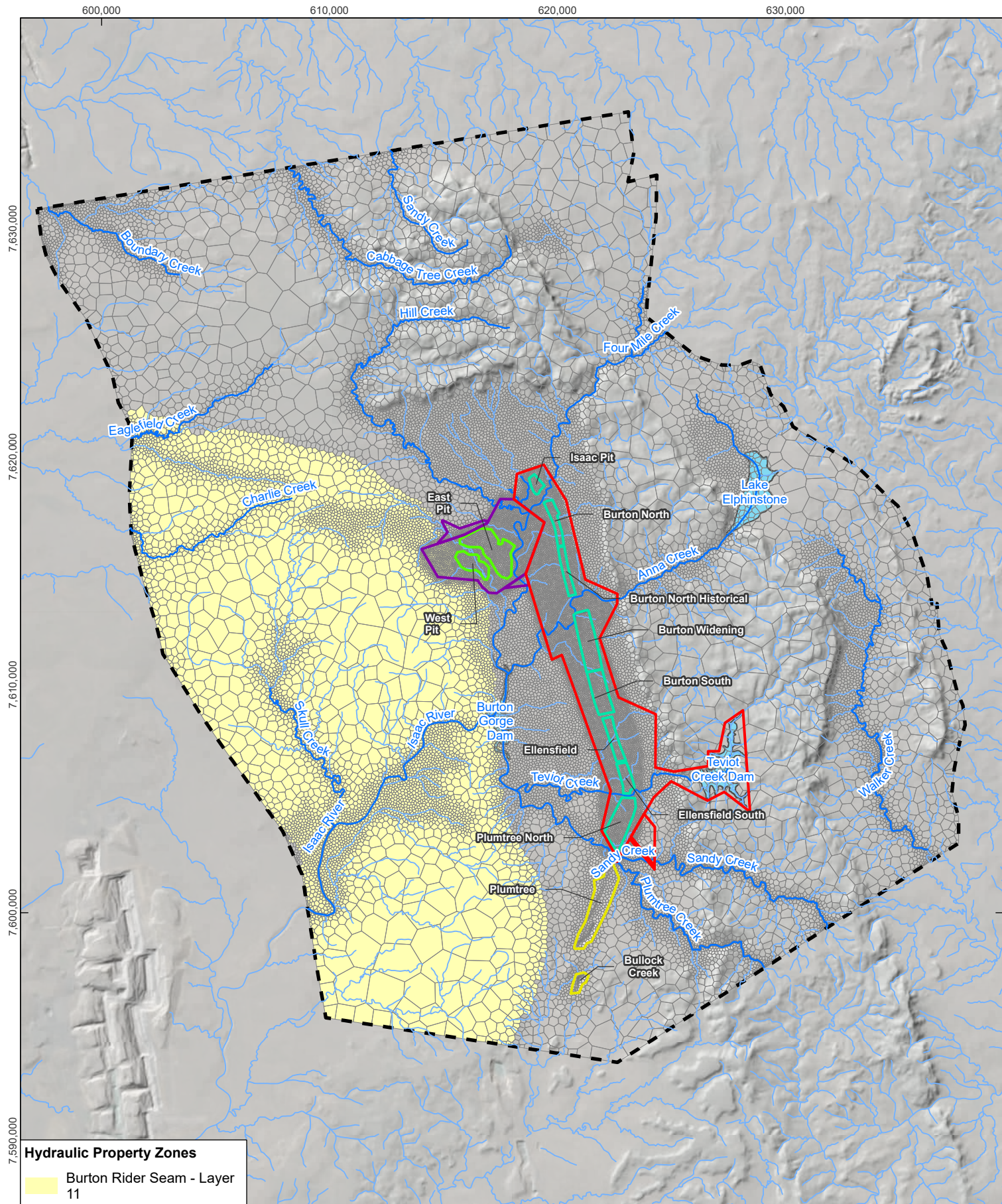
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MODELLLED HYDRAULIC PROPERTY ZONES (LAYER 10)



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APPENDIX A



Hydraulic Property Zones

■ Burton Rider Seam - Layer 11

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

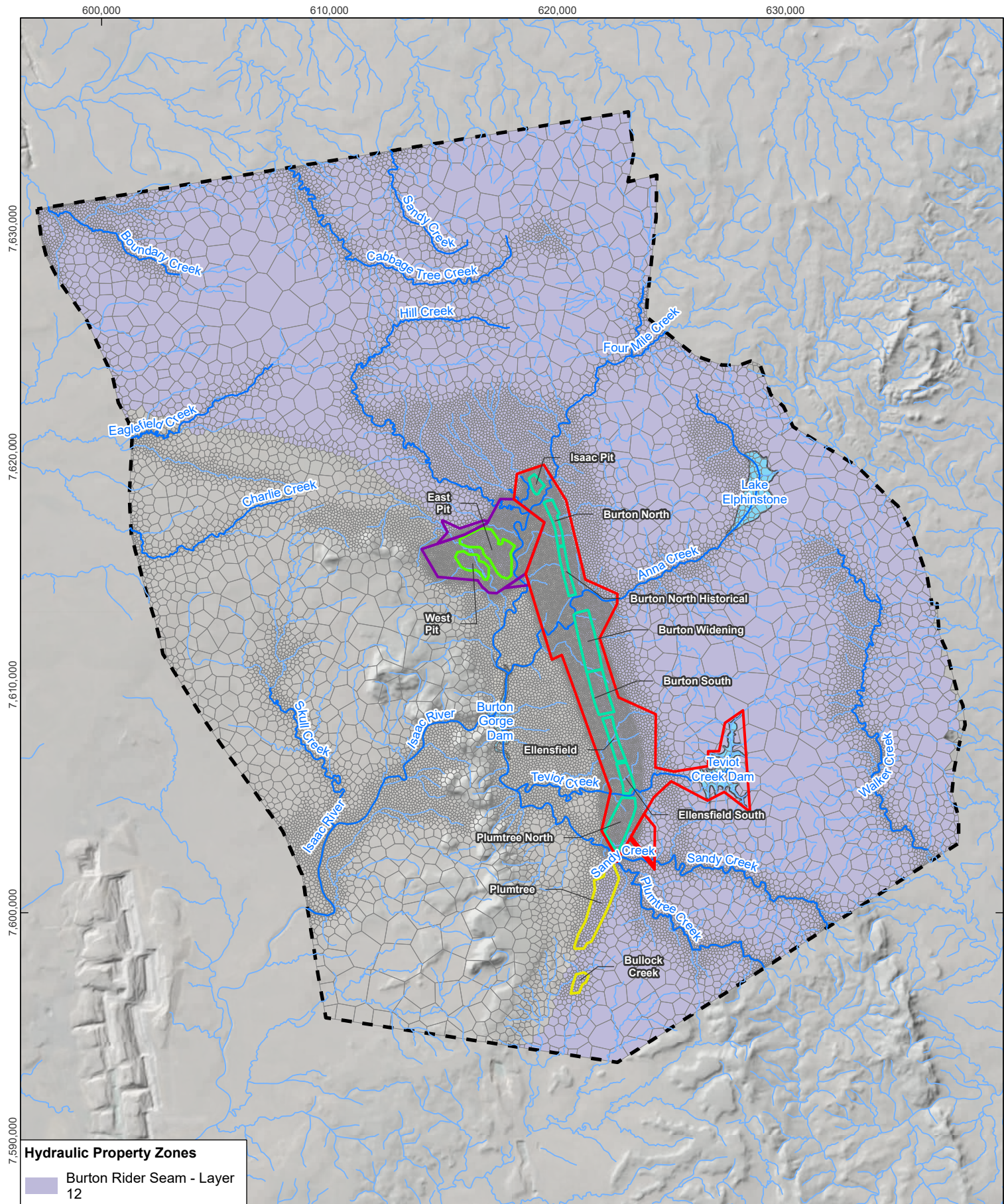
- River
- Watercourse and Drainage
- Model Domain
- Model Grid
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 11)**



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Hydraulic Property Zones

Burton Rider Seam - Layer 12

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:220,000 at A4
Project Number: 620.31208.00000
Date Drawn: 18-Dec-2023
Drawn by: AS

LEGEND

- River
- Watercourse and Drainage
- Model Domain
- Model Grid
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

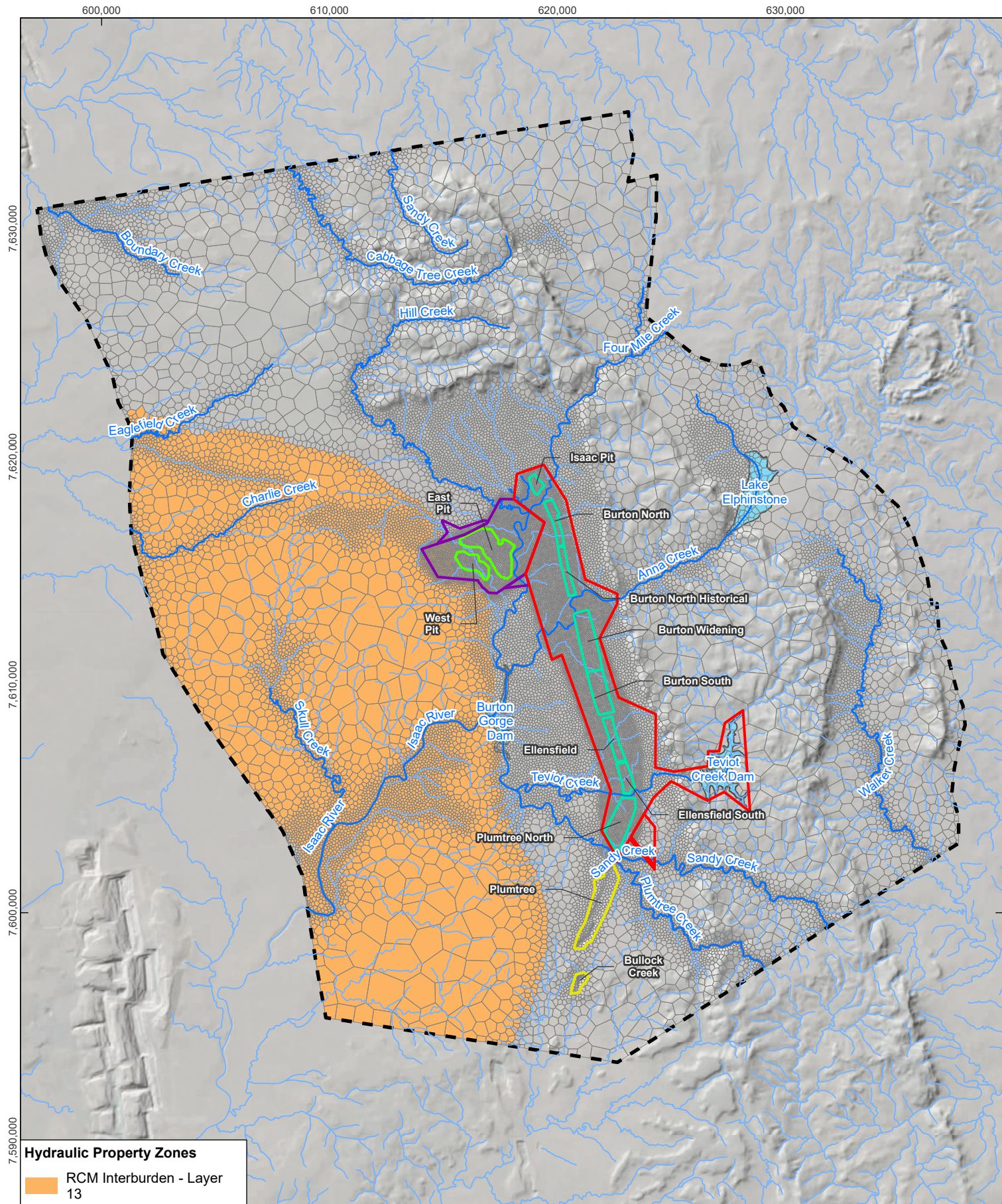
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MODELLLED HYDRAULIC PROPERTY ZONES (LAYER 12)



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APPENDIX A



Hydraulic Property Zones

 RCM Interburden - Layer 13

	0 2.5 5 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:220,000 at A4
Project Number:	620.31208.00000
Date Drawn:	18-Dec-2023
Drawn by:	AS

LEGEND

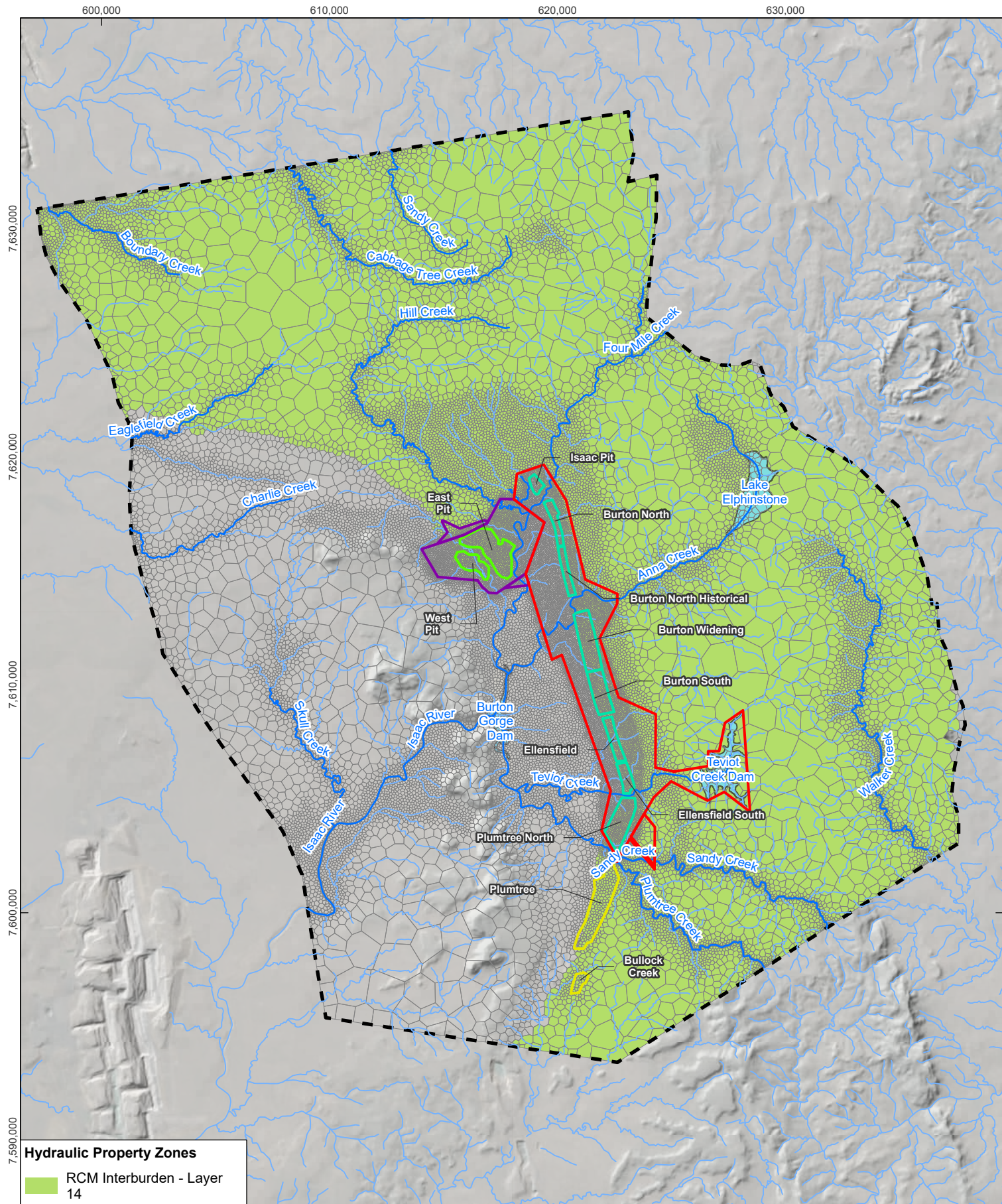
- | | | | |
|---|--------------------------|---|-------------------------|
|  | River |  | Burton Mining Lease |
|  | Watercourse and Drainage |  | New Lenton Mining Lease |
|  | Model Domain |  | Burton Pit Extent |
|  | Model Grid |  | New Lenton Pit Extent |
|  | SW Lake/Dam |  | Former Burton Mine Pits |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 13)**



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Hydraulic Property Zones

RCM Interburden - Layer 14

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

- River
- Watercourse and Drainage
- Model Domain
- Model Grid
- SW Lake/Dam

- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

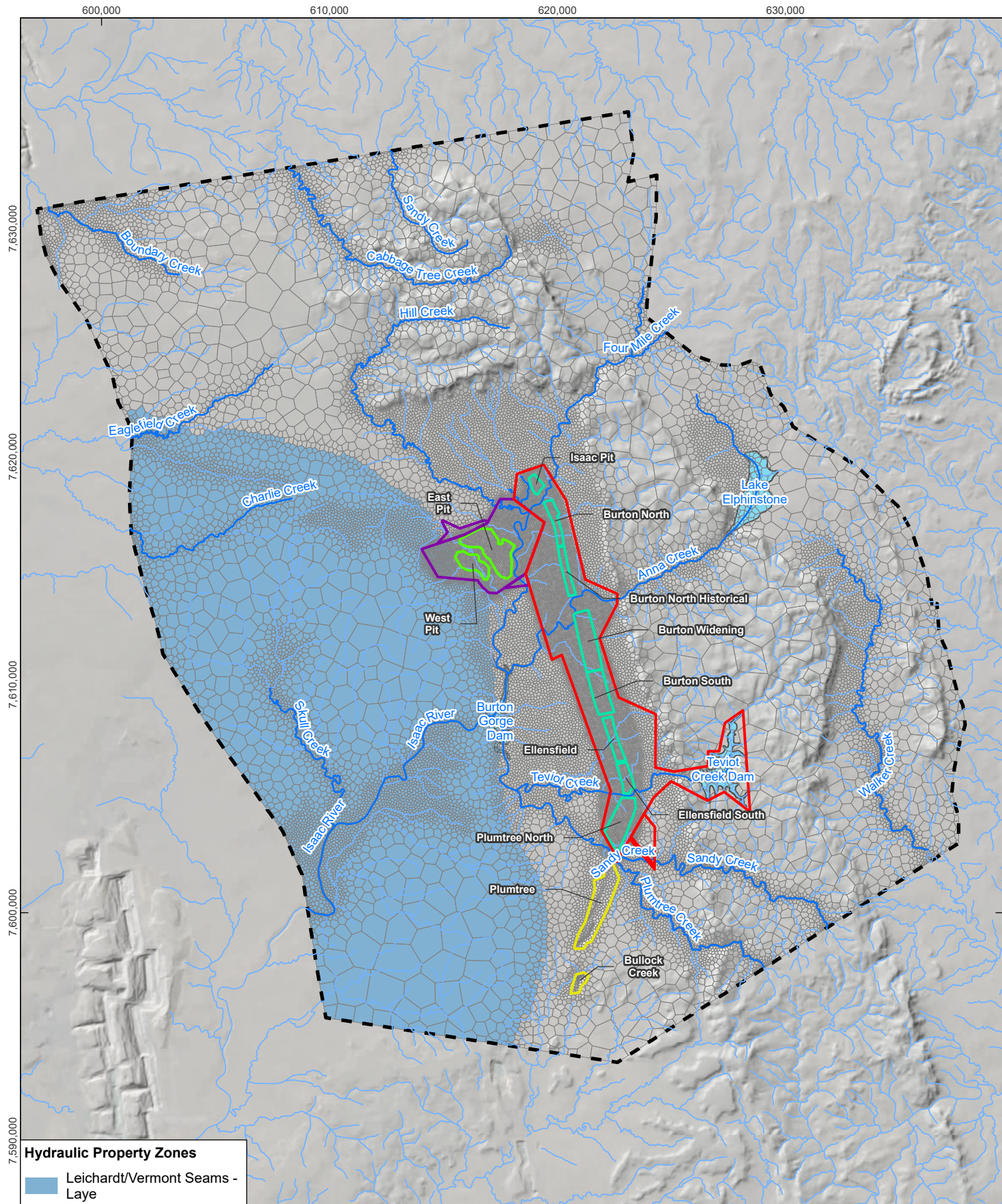
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MODELLLED HYDRAULIC PROPERTY ZONES (LAYER 14)



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APPENDIX A



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

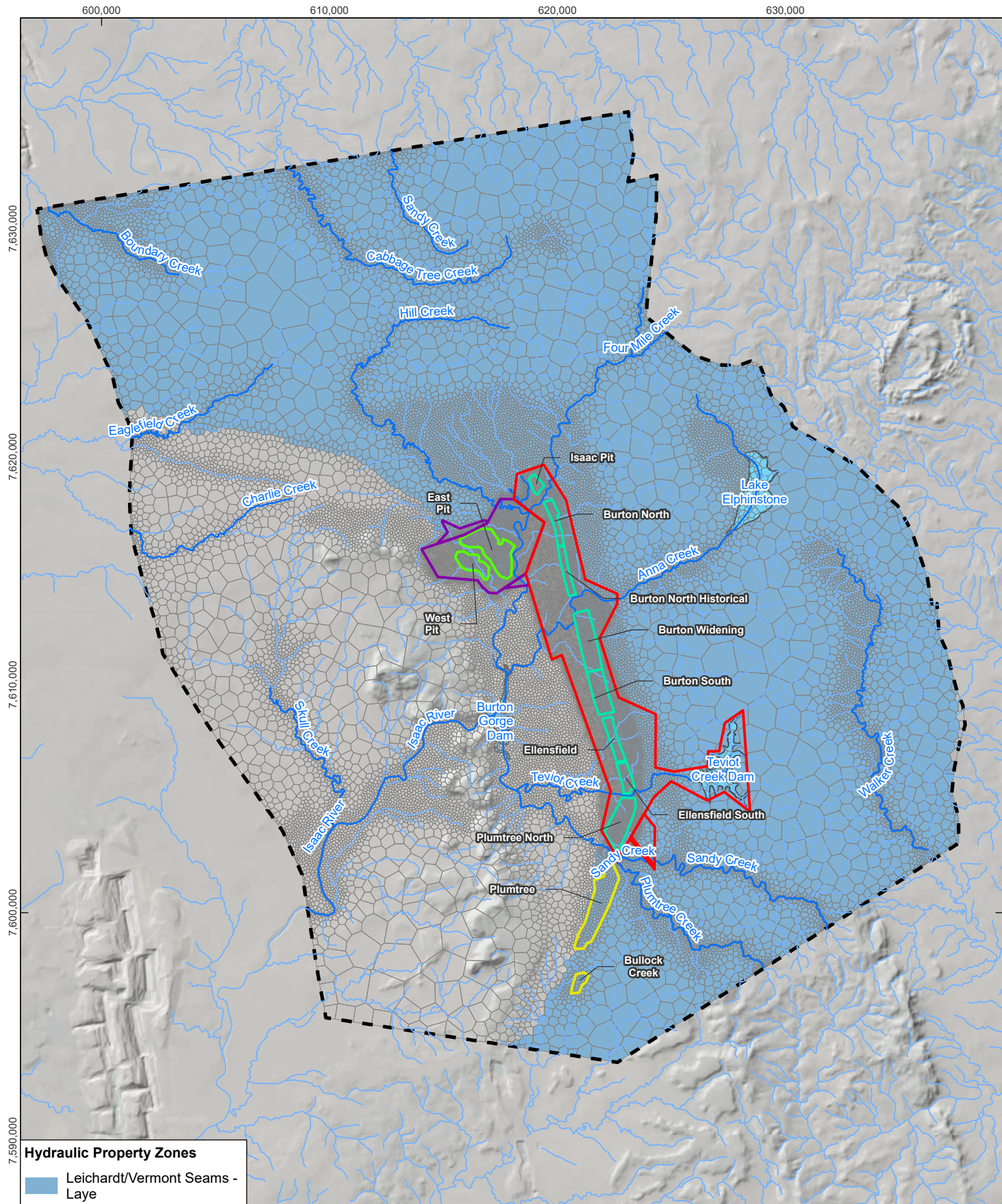
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MODELLLED HYDRAULIC PROPERTY ZONES (LAYER 15)



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APPENDIX A



Hydraulic Property Zones

Leichardt/Vermont Seams - Laye

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

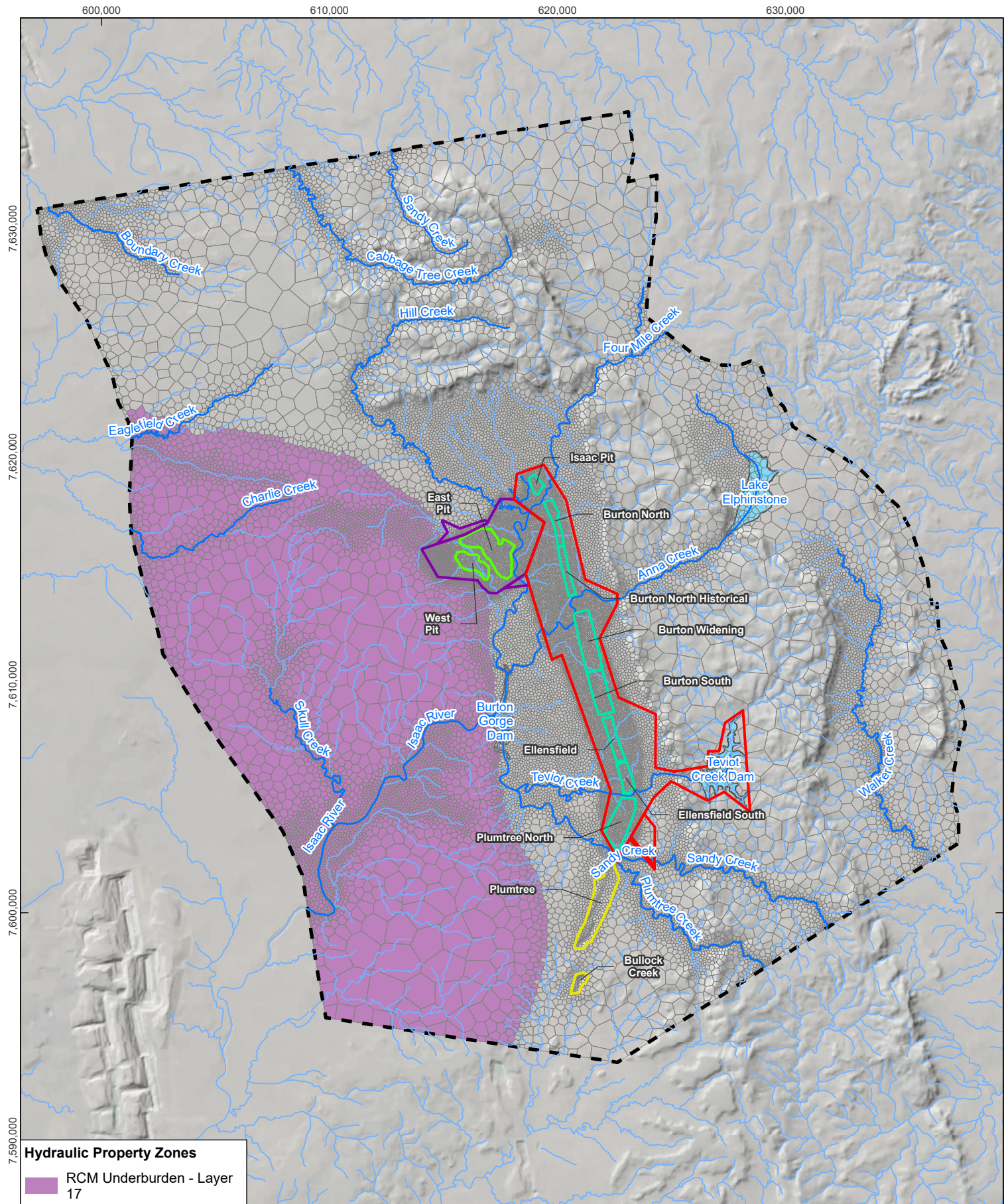
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 16)**



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APPENDIX A



Hydraulic Property Zones

RCM Underburden - Layer 17

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

-  River
-  Watercourse and Drainage
-  Model Domain
-  Model Grid
-  SW Lake/Dam
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

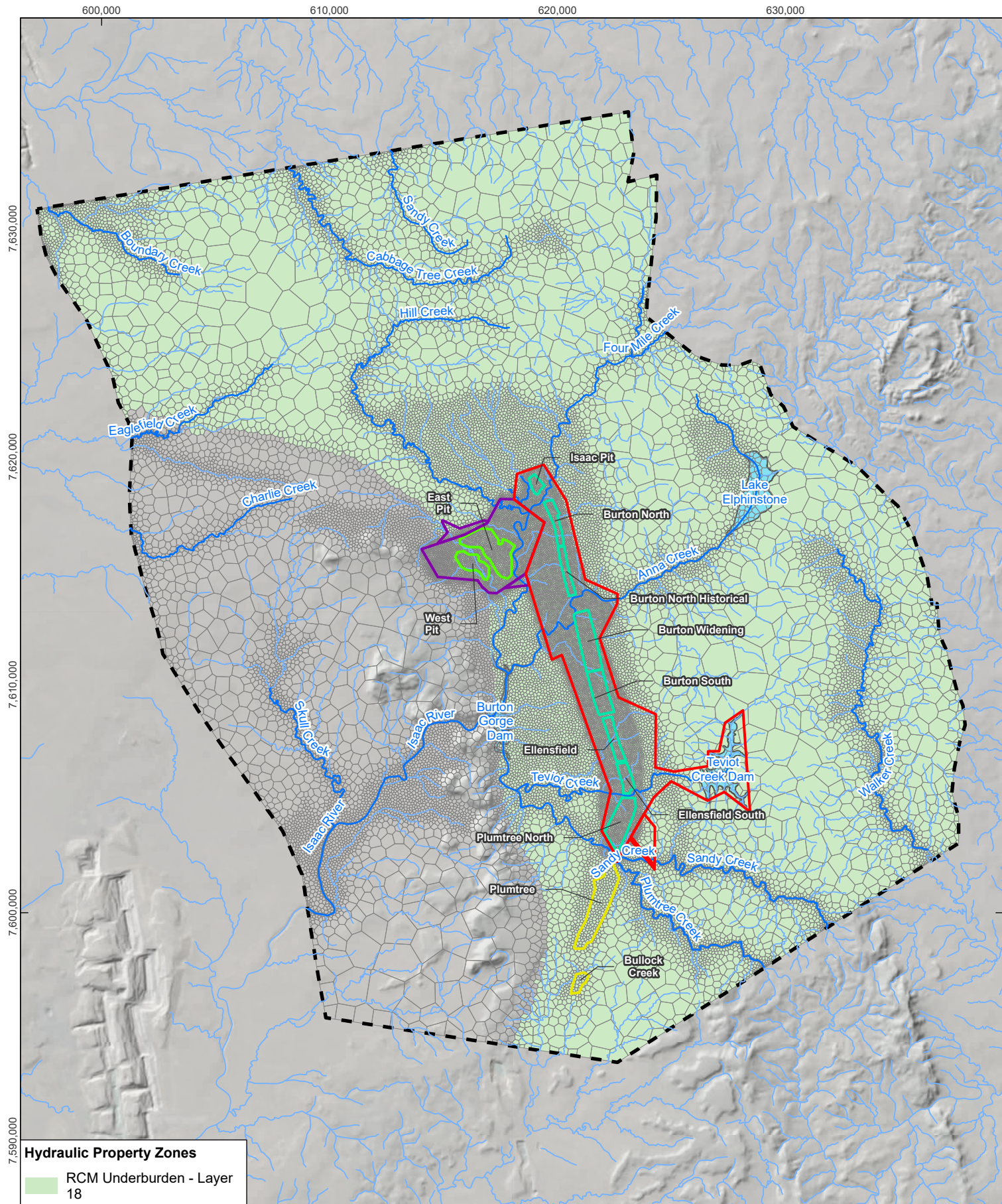
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

MODELLLED HYDRAULIC PROPERTY ZONES (LAYER 17)



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APPENDIX A



Hydraulic Property Zones

RCM Underburden - Layer 18

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:220,000 at A4
Project Number: 620.31208.00000
Date Drawn: 18-Dec-2023
Drawn by: AS

LEGEND

- River
- Watercourse and Drainage
- Model Domain
- Model Grid
- SW Lake/Dam
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**MODELLLED HYDRAULIC
PROPERTY ZONES
(LAYER 18)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

Appendix B Calibration Parameter Ranges

New Lenton & Burton

2023 Groundwater Modelling Technical Report

Lenton Joint Venture

SLR Project No.: 620.31367.00000

11 September 2024

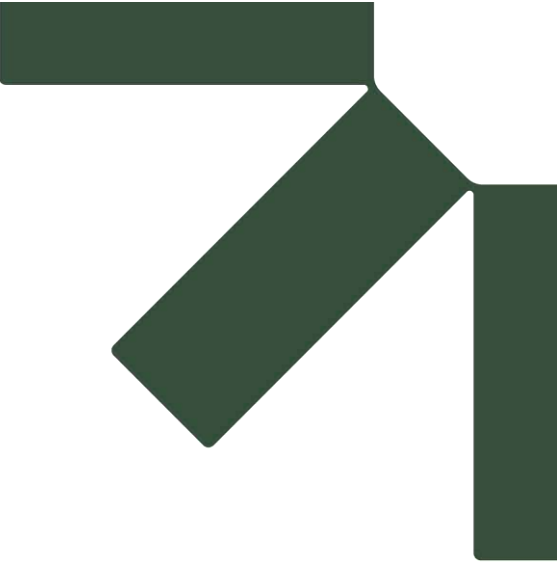


Parameter Zone	Parameter	Lower Bound	Upper Bound
Alluvium (pilot points)	Horizontal K (m/day)	1.00E-03	1.00E+02
	Vertical K/Horizontal K ratio	1.00E-03	1.00E+00
	Specific Yield	1.00E-03	2.00E-01
	Specific Storage (m ⁻¹)	5.00E-06	1.00E-03
Regolith	Horizontal K (m/day)	1.00E-03	1.00E+01
	Vertical K/Horizontal K ratio	1.00E-03	1.00E+00
	Specific Yield	1.00E-03	5.00E-02
	Specific Storage (m ⁻¹)	5.00E-06	1.00E-03
Basalt	Horizontal K (m/day)	1.00E-05	1.00E+01
	Vertical K/Horizontal K ratio	1.00E-03	1.00E+00
	Specific Yield	1.00E-03	5.00E-02
	Specific Storage (m ⁻¹)	5.00E-06	1.00E-03
Rewan	Horizontal K (m/day)	1.00E-05	1.00E+00
	Vertical K/Horizontal K ratio	1.00E-03	1.00E+00
	Specific Yield	1.00E-03	5.00E-02
	Specific Storage (m ⁻¹)	5.00E-07	1.00E-04
RCM Interburden	Horizontal K (m/day)	1.00E-06	1.00E-03
	Vertical K/Horizontal K ratio	1.00E-03	1.00E+00
	Specific Yield	1.00E-04	3.00E-02
	Specific Storage (m ⁻¹)	5.00E-07	1.00E-04
RCM Coal Seams (Burton/Rider and Leichhardt/Vermont)	Horizontal K (m/day)	1.00E-05	1.00E-01
	Vertical K/Horizontal K ratio	1.00E-03	1.00E+00
	Specific Yield	1.00E-03	5.00E-02
	Specific Storage (m ⁻¹)	5.00E-07	1.00E-04
FCCM (Basement)	Horizontal K (m/day)	1.00E-06	1.00E-03
	Vertical K/Horizontal K ratio	1.00E-03	1.00E+00
	Specific Yield	1.00E-03	5.00E-02
	Specific Storage (m ⁻¹)	5.00E-07	1.00E-04
Spoil	Horizontal K (m/day)	1.00E-03	1.00E+01
	Vertical K/Horizontal K ratio	1.00E-03	1.00E+00
	Specific Yield	1.00E-02	2.50E-01
	Specific Storage (m ⁻¹)	1.00E-07	1.00E-03
	Recharge (% long-term average rainfall)	1.00E+00	1.00E+01
	EVT Rate (mm/year)	4.50E+02	7.50E+02
	Extinction Depth (m)	2.00E+00	5.00E+00



Parameter Zone	Parameter	Lower Bound	Upper Bound
Site Alluvium	Recharge (% long-term average rainfall)	1.00E-02	1.00E+01
Site Eluvium	Recharge (% long-term average rainfall)	1.00E-02	1.00E+01
Floodplain Alluvium	Recharge (% long-term average rainfall)	1.00E-02	1.00E+01
Permian Regolith	Recharge (% long-term average rainfall)	1.00E-05	1.00E+00
Triassic Regolith	Recharge (% long-term average rainfall)	1.00E-05	1.00E+00
Isaac River Riparian Zone	Recharge (% long-term average rainfall)	1.00E-01	2.00E+01
Isaac River (applied when rainfall > 30mm/d)	Recharge (% long-term average rainfall)	2.50E+01	2.00E+02
Riparian Buffer	EVT Rate (mm/year)	4.50E+02	7.50E+02
	Extinction Depth (m)	1.00E+00	1.00E+01
Dense Forest	EVT Rate (mm/year)	4.50E+02	7.50E+02
	Extinction Depth (m)	2.00E+00	5.00E+00
Shrub and Bare	EVT Rate (mm/year)	4.50E+02	7.50E+02
	Extinction Depth (m)	2.00E+00	5.00E+00
Burton Range Dam	Riverbed K_v (m/d)	5.00E-03	1.00E-01
Lake Elphinstone	Riverbed K_v (m/d)	5.00E-03	1.00E-01
Teviot Creek Dam	Riverbed K_v (m/d)	5.00E-03	1.00E-01
Isaac River	Riverbed K_v (m/d)	5.00E-03	1.00E-01





Appendix C Calibration Residuals

New Lenton & Burton

2023 Groundwater Modelling Technical Report

Lenton Joint Venture

SLR Project No.: 620.31367.00000

11 September 2024

Bore ID	Easting (GDA2020 Z55)	Northing (GDA2020 Z55)	Model Layer	Average Residual (m)
ANNACR_DS	619750.75	7612502.44	1	1.94
ANNACR_US	622625.75	7613804.44	1	7.51
BA02	612494.75	7618334.44	2	-7.38
BA05	614658.75	7618259.44	2	-6.15
BD1019	621740.937	7611628.938	12	-3.85
BD1020	621897.4994	7611376.938	6	0.86
BD1032	622471.6241	7609046.438	14	23.92
BD1039	620983.75	7613461.44	12	-5.22
BD1247P	620265.5	7616057.938	12	20.78
BD1248P	622891.4988	7606692.938	12	-7.95
BD1249P	621134.4368	7610584.938	2	-6.57
BD1250P	622561.499	7607862.938	12	-35.9
BD1251P	619956.4994	7611138.938	2	6.14
BD1252P	622294.75	7600040.44	16	-3.07
BD1253P	622752.4981	7601159.938	12	21.37
BD1254P	621022.75	7597921.44	16	8.39
BD613C	623102.4987	7605270.938	10	-0.14
BD631	620691.4975	7596684.938	10	1
BD784_2	621535.0621	7612566.438	10	-0.42
BD883	620102.4999	7615154.938	18	15.79
BD894	619978.5	7615950.938	14	12.23
BD905	619749.5001	7616934.938	14	2.92
DDH16	621979.95	7610516.44	12	37.6
DDH19	621535.0621	7612566.438	12	17.42
DDH20	621353.2496	7612508.938	12	-5.27
DDH25	621882.4993	7610609.938	10	17.4
DDH34	622154.05	7608813.14	10	16.37
DDH45	621066.4997	7613658.938	12	1.11
DDH55	621664.4991	7608598.938	18	8.16
DDH56	621845.4992	7609631.938	10	-1.03
DDH58R	621671.4991	7608860.938	19	-6.97
DDH6	619305.5003	7618187.939	12	1.91
DDH9	621196.4994	7611107.938	2	5.35
GW01	617300.05	7618211.34	1	-0.97
GW04	617877.15	7615893.94	14	2.3

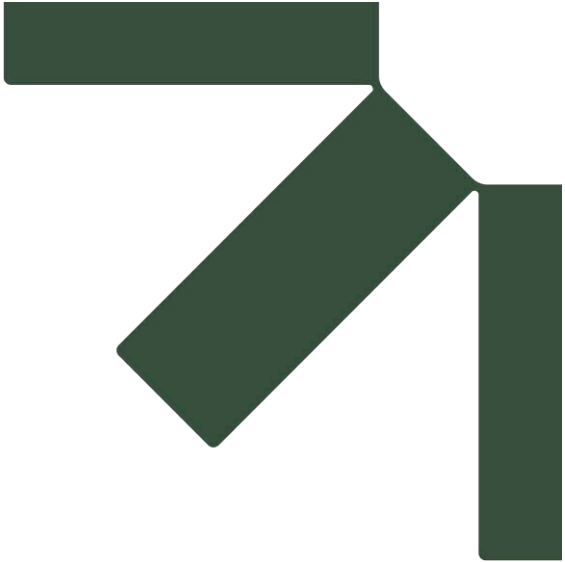


Bore ID	Easting (GDA2020 Z55)	Northing (GDA2020 Z55)	Model Layer	Average Residual (m)
GW06	618097.55	7616724.54	1	0.07
GW07	617640.25	7613076.54	1	1.89
GW08	617041.85	7613901.74	1	2.91
GW09	617525.55	7614071.14	1	3.28
GW10	616032.45	7617015.24	16	13.63
GW11	616294.65	7616680.94	16	10.96
GW13	616881.65	7615481.64	16	8.32
GW19	612323.35	7620098.64	2	-13.47
GW19_33	618664.35	7617349.74	1	1.83
GW19_36a	617987.65	7615811.34	2	2.68
GW19_37a	618034.75	7615772.34	1	2.35
GW19_40	617777.55	7615980.04	12	4.13
GW19_41a	617843.75	7615918.64	14	3.68
GW19_41b	617853.55	7615912.14	2	4.96
GW20	612676.55	7618393.04	2	-5.21
GW27a	617886.25	7614848.74	19	5.04
GW27b	617873.75	7614855.94	1	6.94
GW28a	617192.35	7616642.94	16	6.04
GW29a	618081.45	7616562.34	18	1.67
GW30a	618084.55	7617396.14	12	3.42
GW30b	618089.25	7617383.54	12	3.49
GW30c	618094.35	7617369.94	2	3.07
GW31a	617624.55	7617681.54	12	3.95
GW31b	617622.15	7617681.74	2	2.66
LBP_5_SM	620080.75	7596431.44	16	-30.74
LBP_5_UP	620080.75	7596431.44	2	1.16
LEN486	615735.45	7615594.24	16	13.24
RN162514	616807	7608967	2	-0.22
RN85100	607014	7623268	4	-21.37
RN85444	603849	7621232	2	6.02
RN85445	602717	7623622	2	13.58
RN85446	602894	7622949	2	4.5
RN85464	600169	7627369	4	14.82
TEVCR_DS	622372.75	7605261.44	1	2.73
TH077P	621885.05	7609331.24	12	-7.97



Bore ID	Easting (GDA2020 Z55)	Northing (GDA2020 Z55)	Model Layer	Average Residual (m)
TH077P_OB	621885.05	7609331.24	10	-8.62
TH078P	622045.55	7608741.14	12	1.87
TH078P_OB	622045.55	7608741.14	10	0.12





Appendix D Calibration Hydrographs

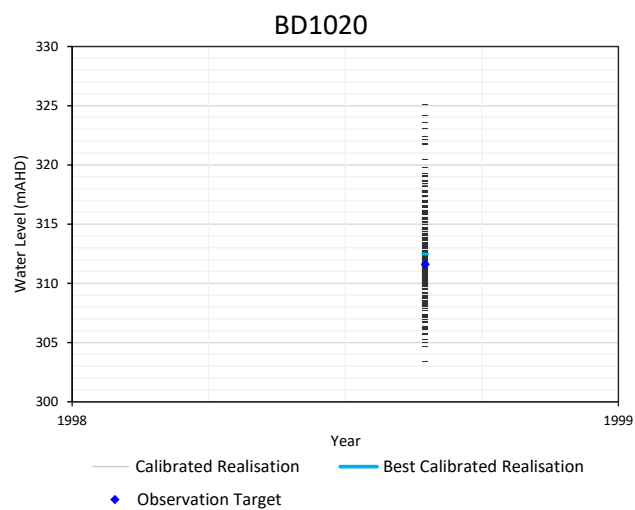
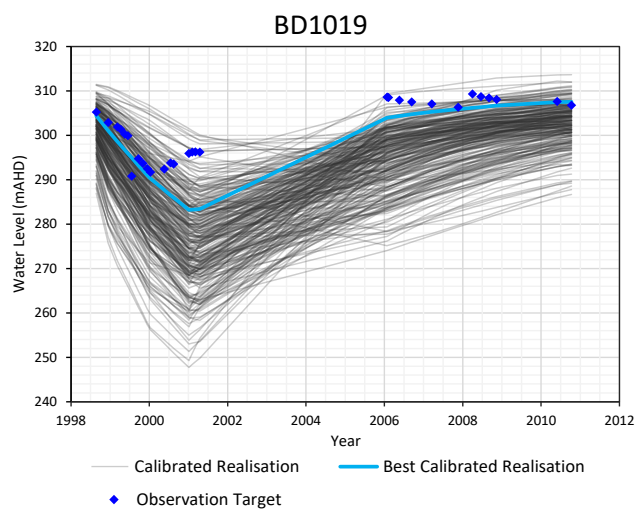
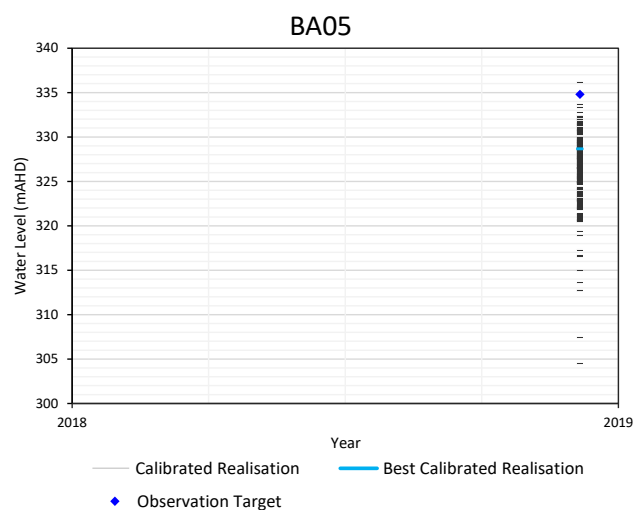
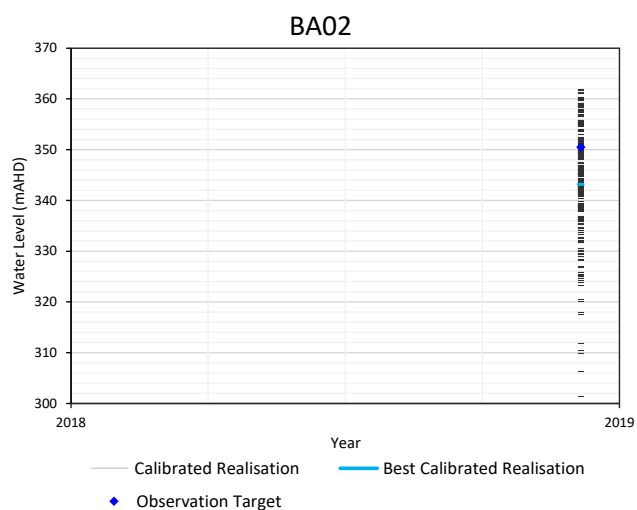
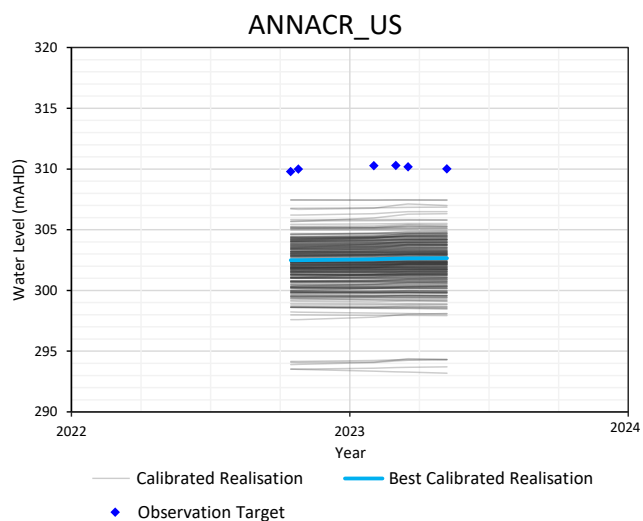
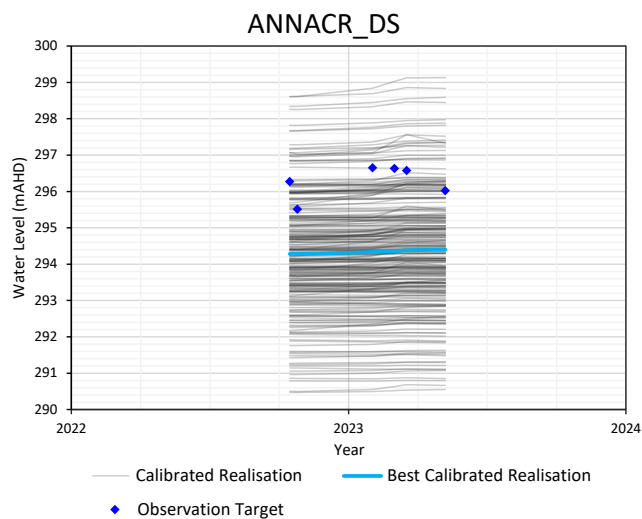
New Lenton & Burton

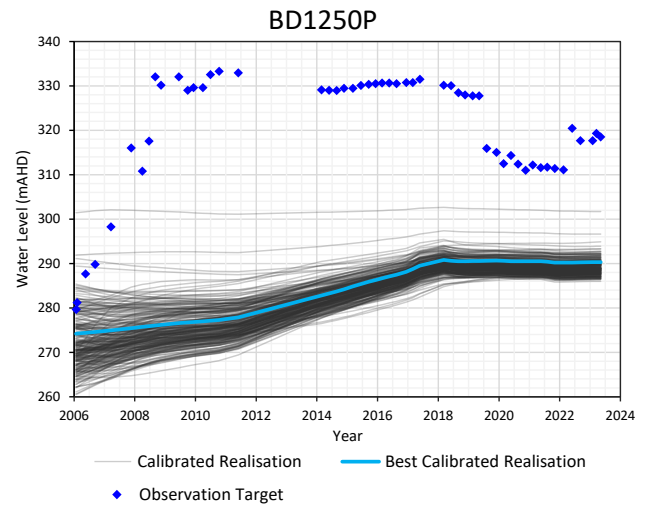
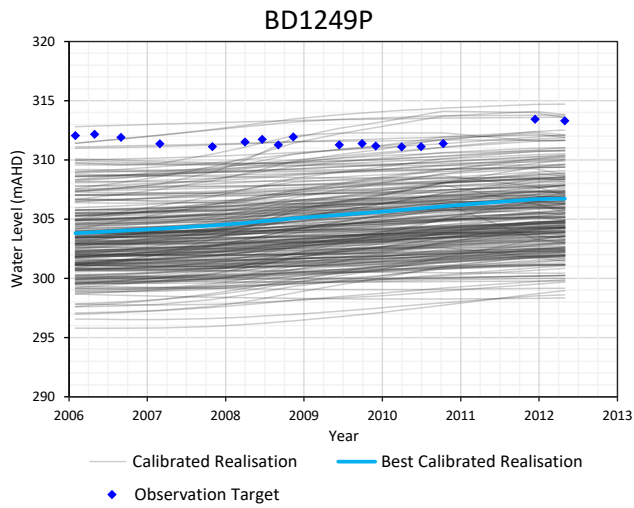
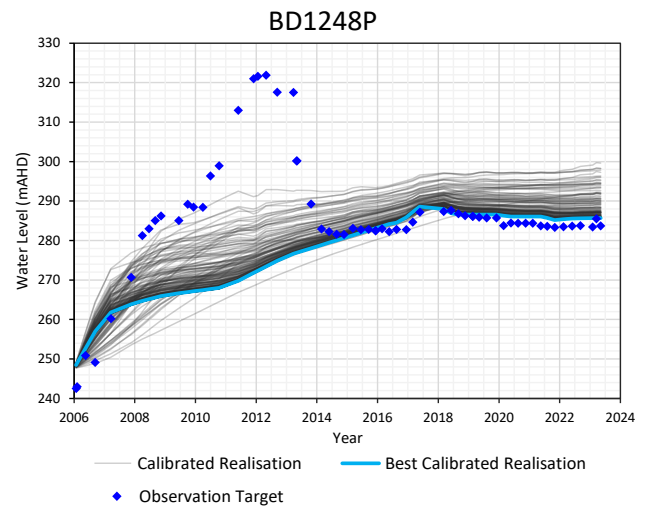
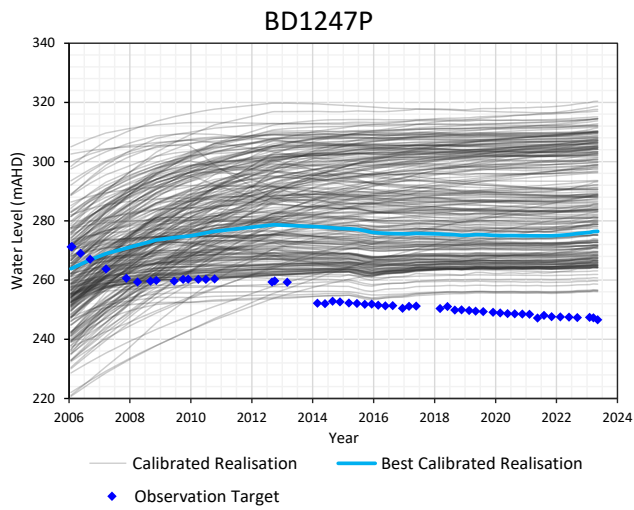
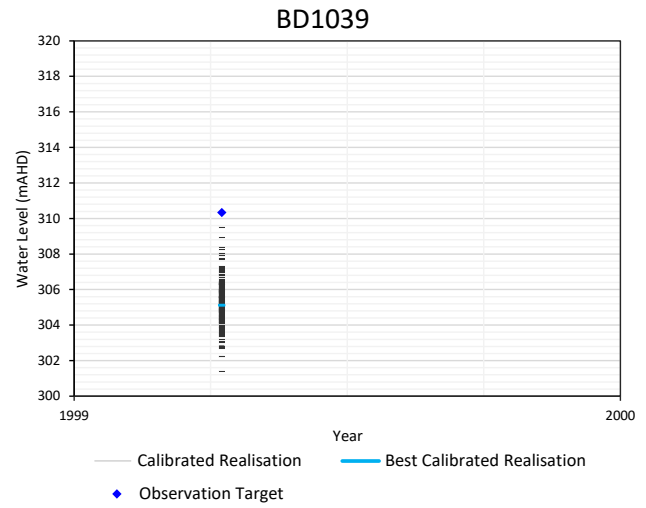
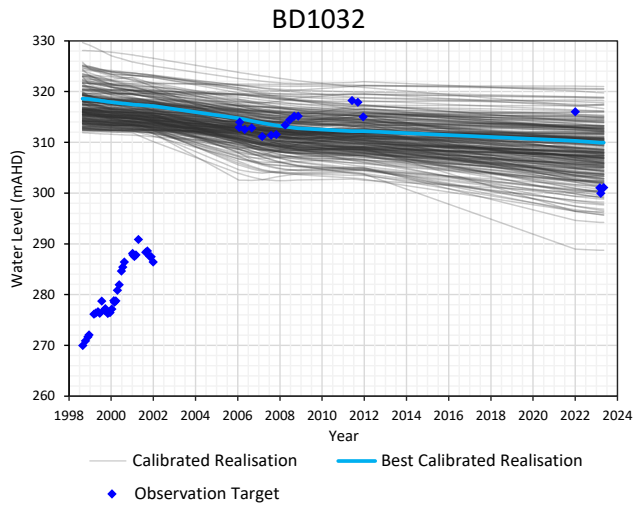
2023 Groundwater Modelling Technical Report

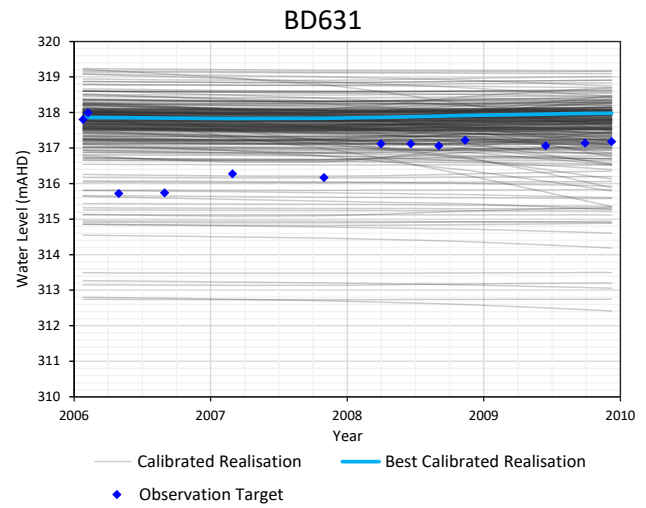
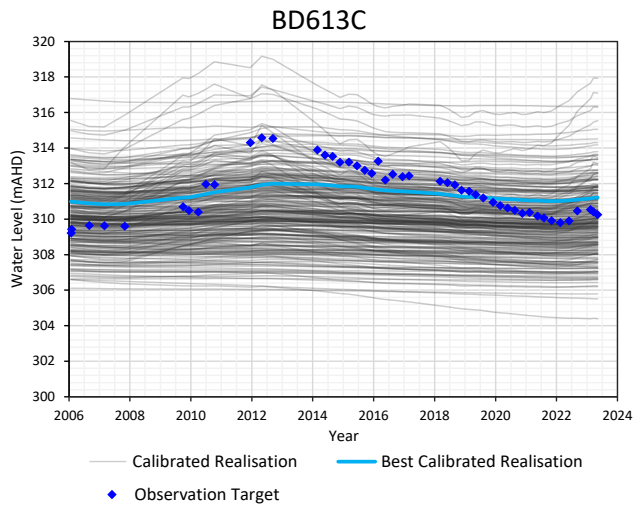
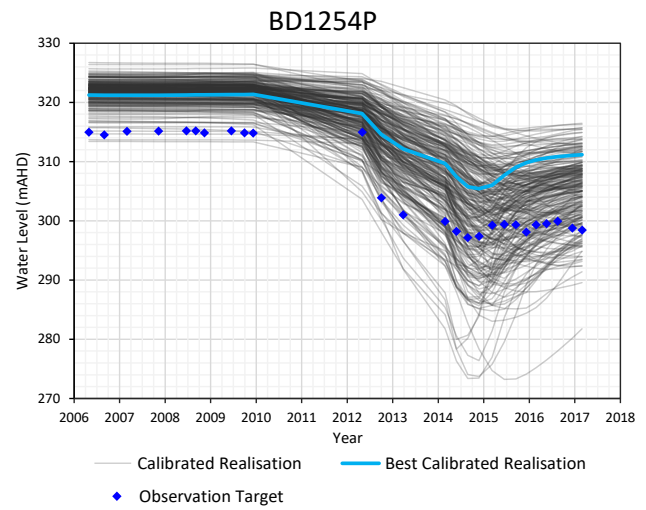
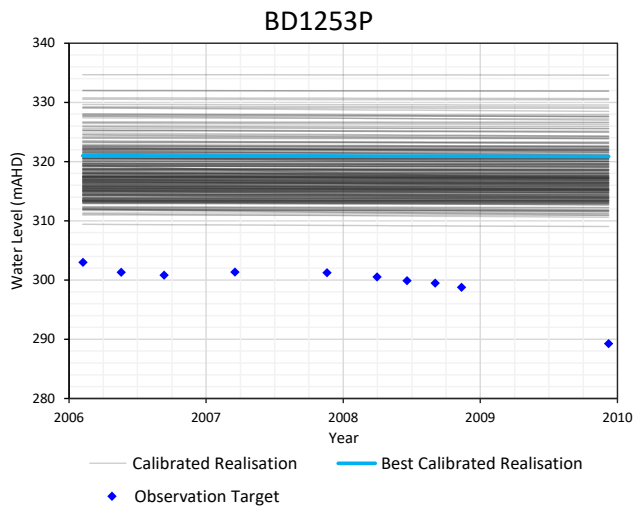
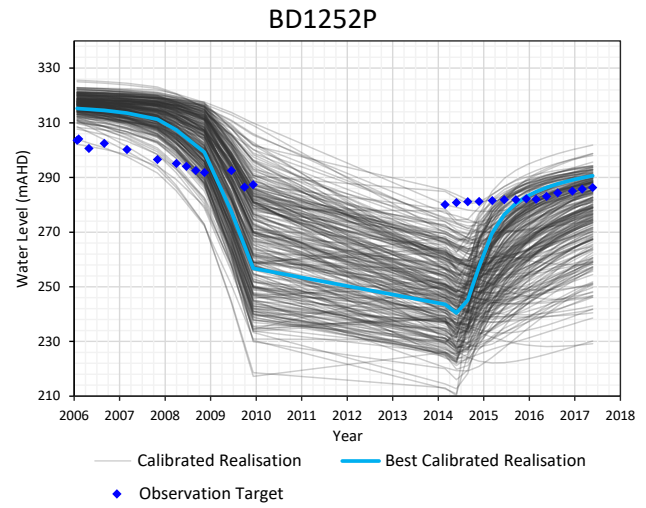
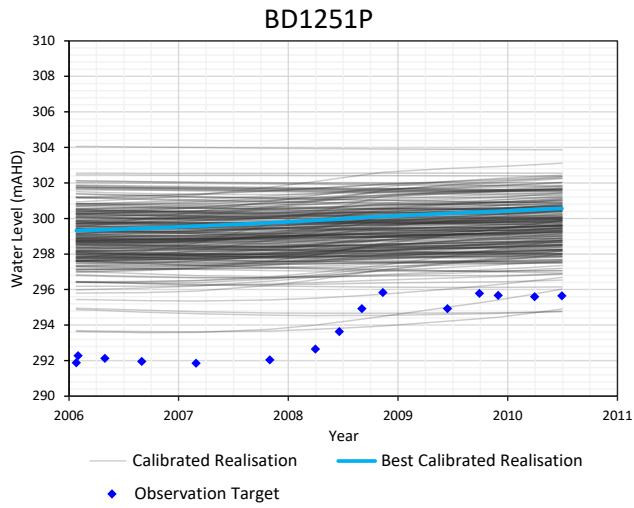
Lenton Joint Venture

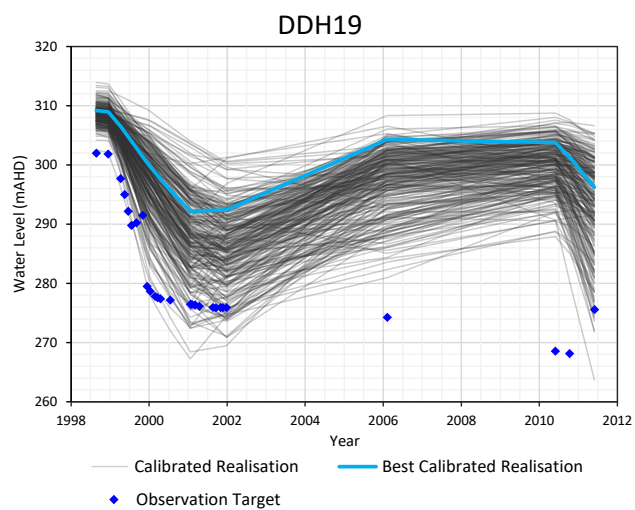
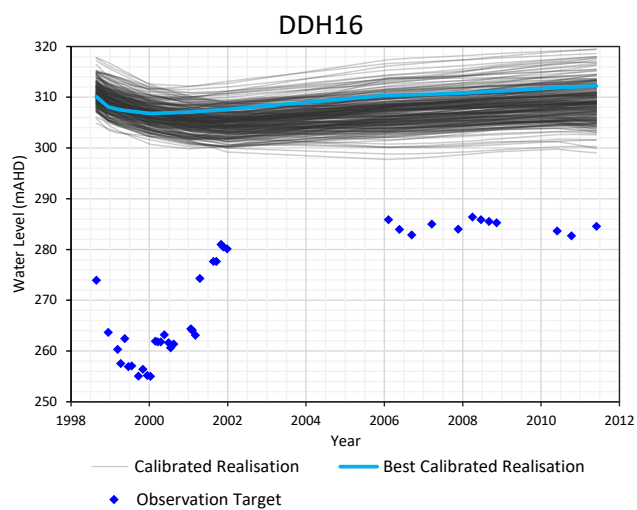
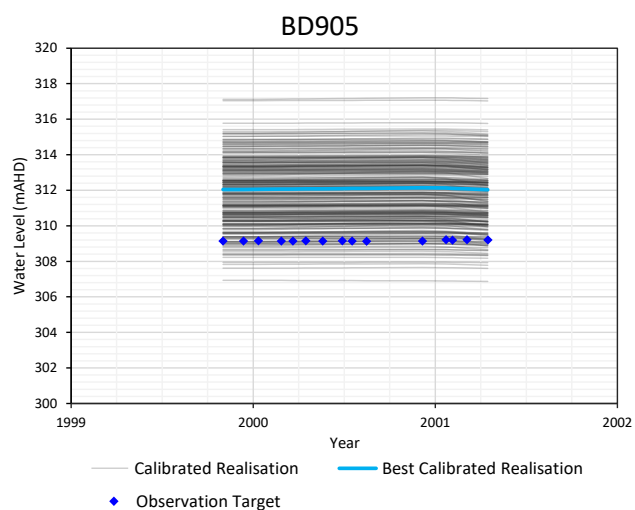
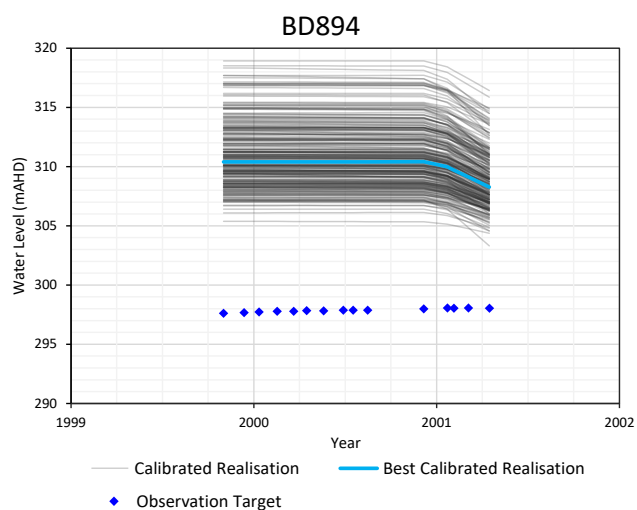
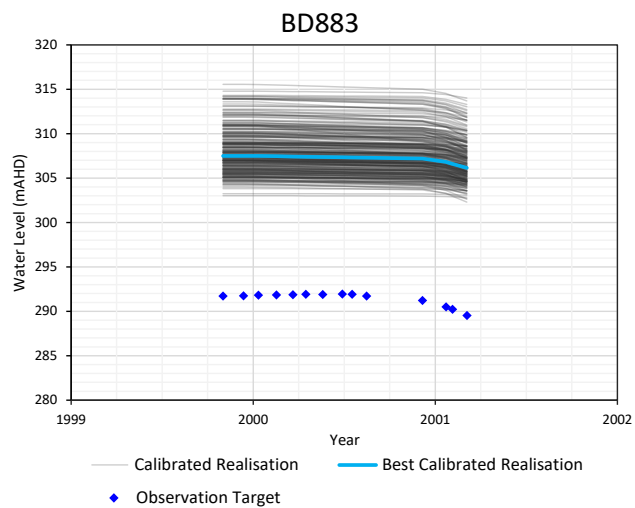
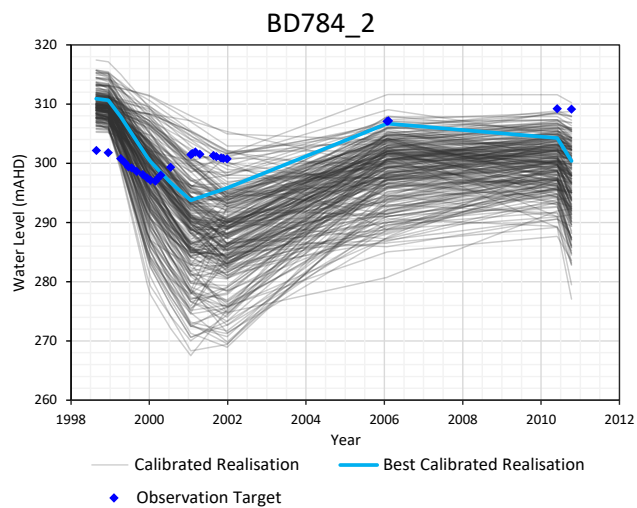
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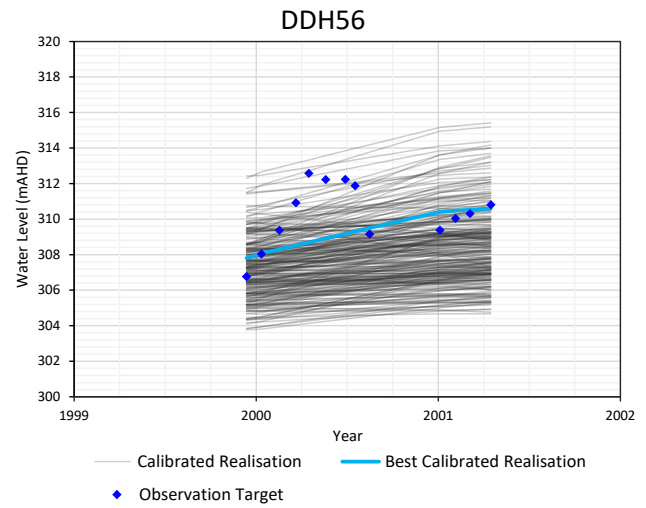
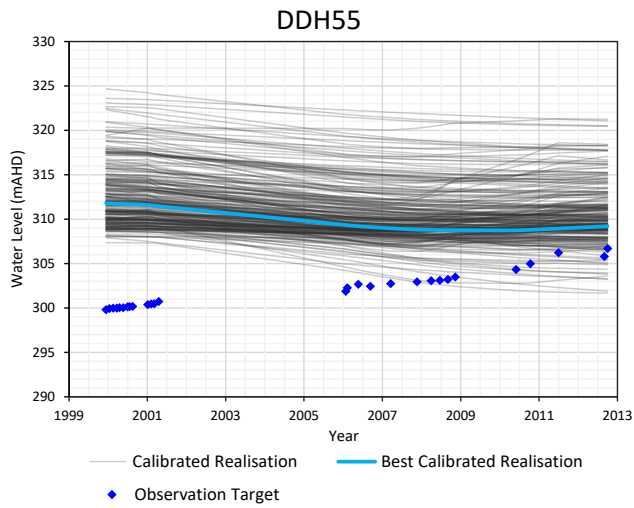
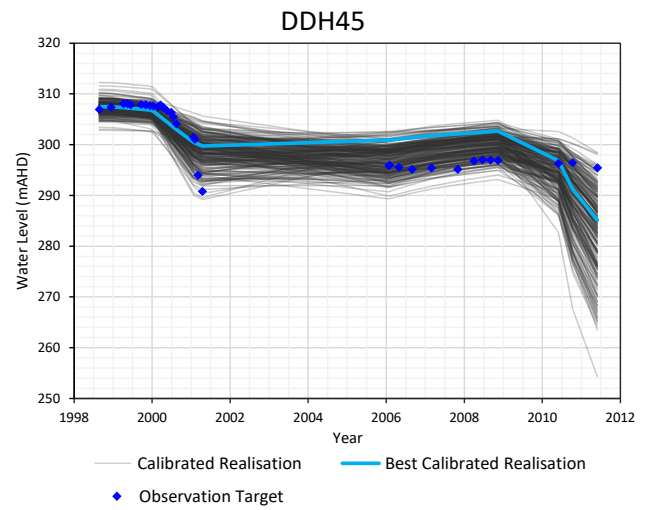
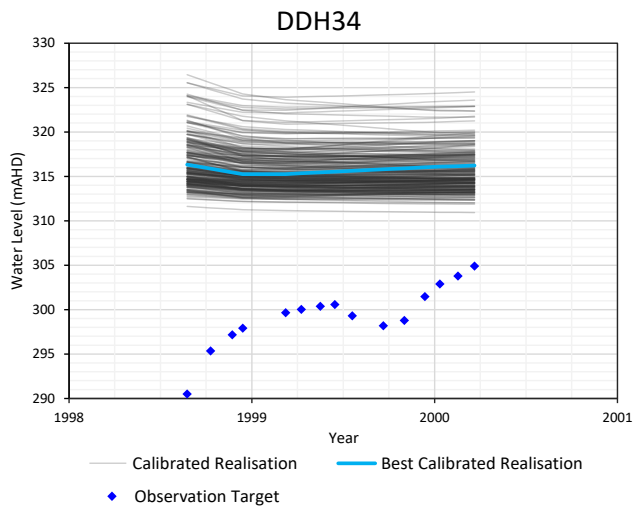
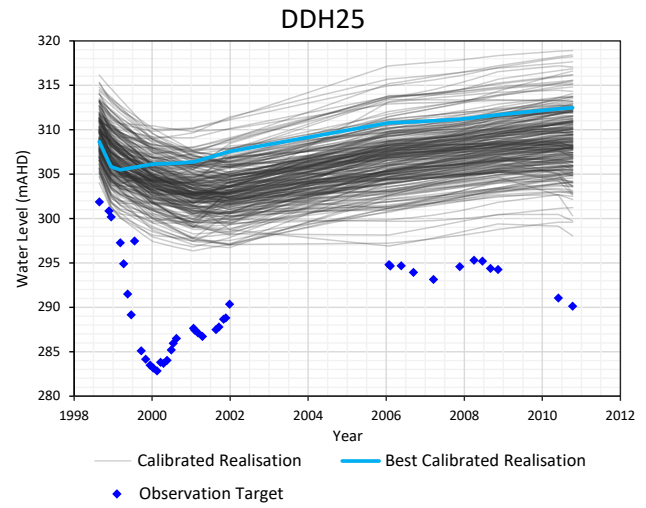
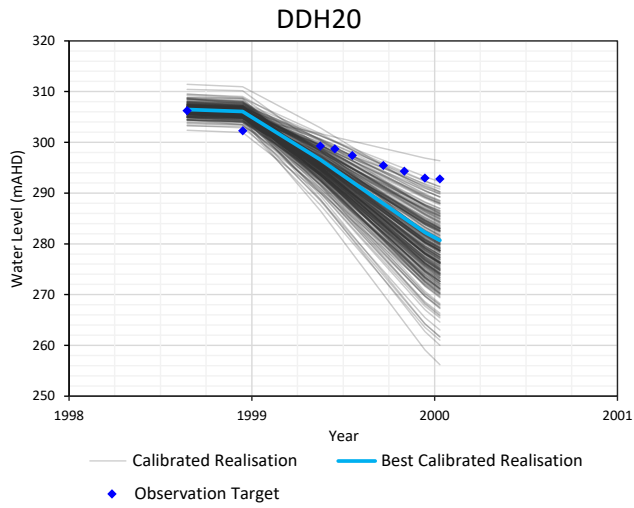
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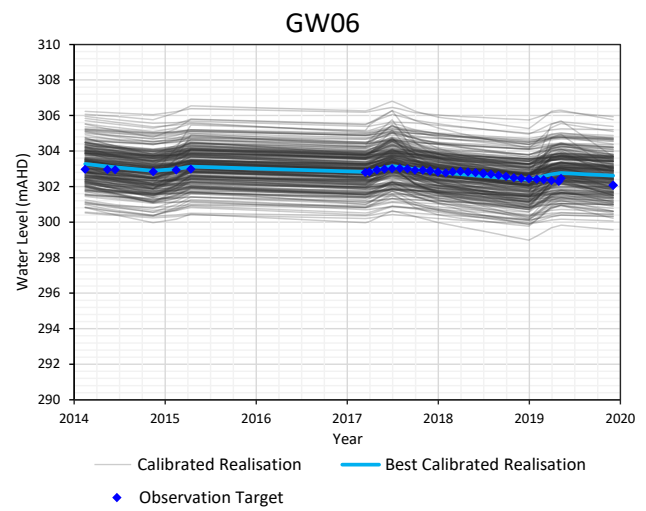
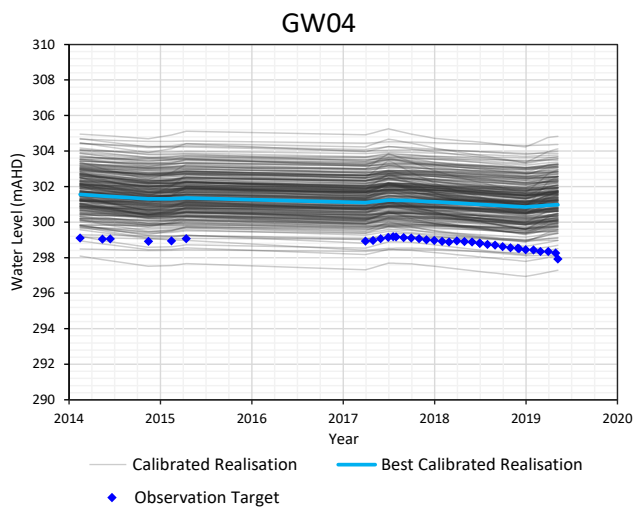
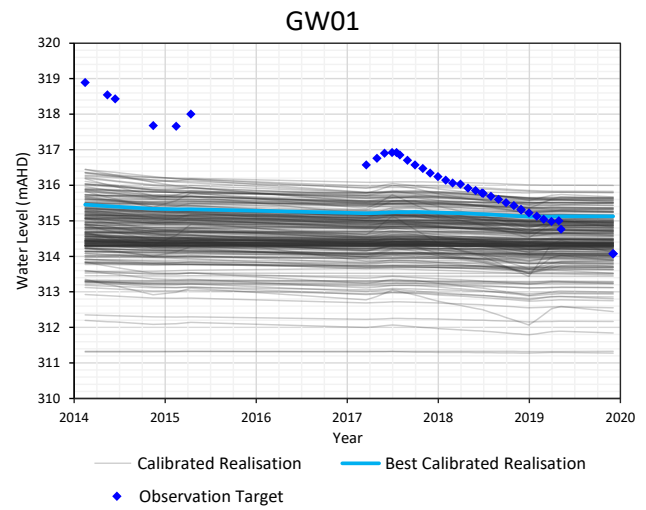
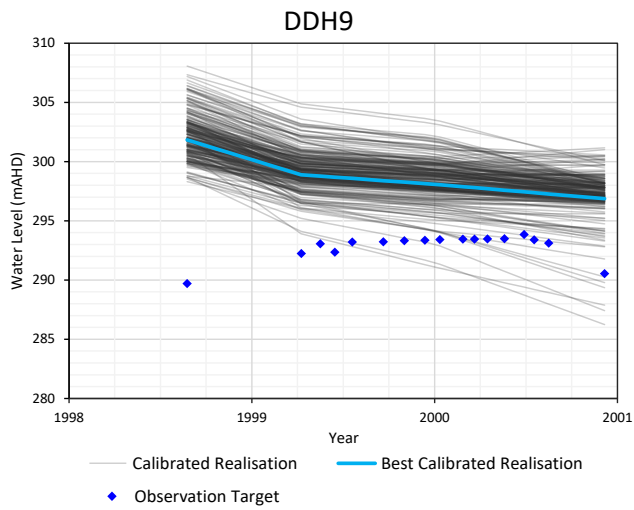
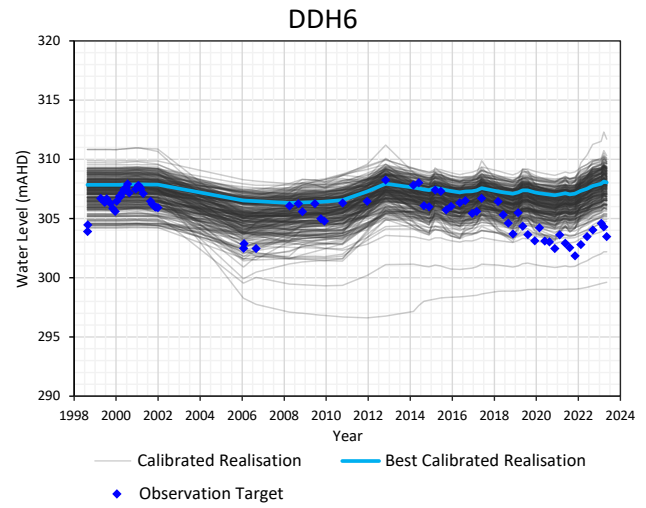
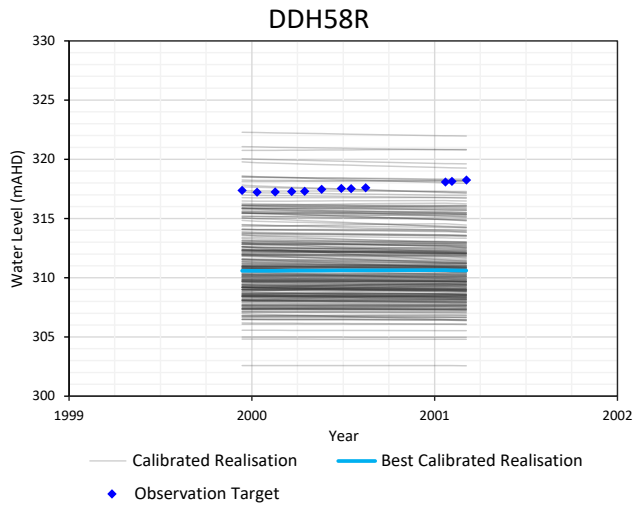


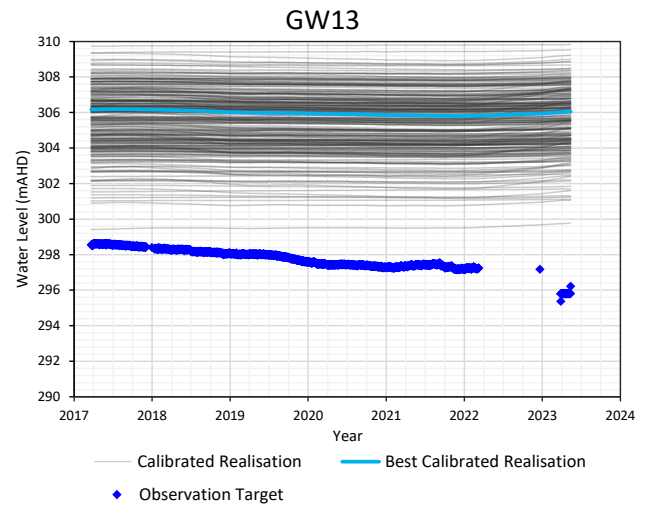
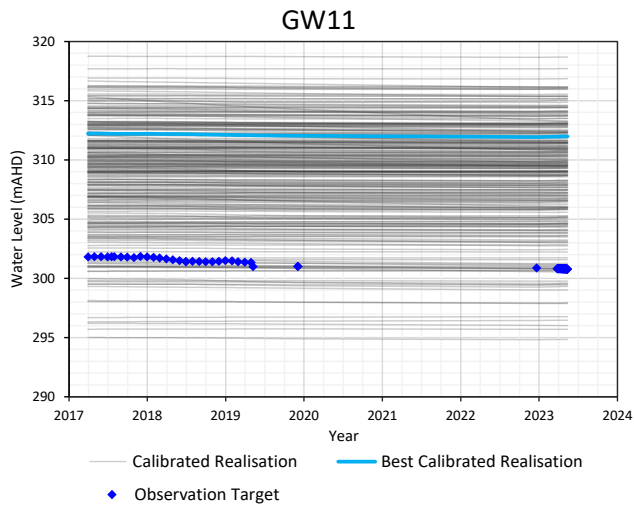
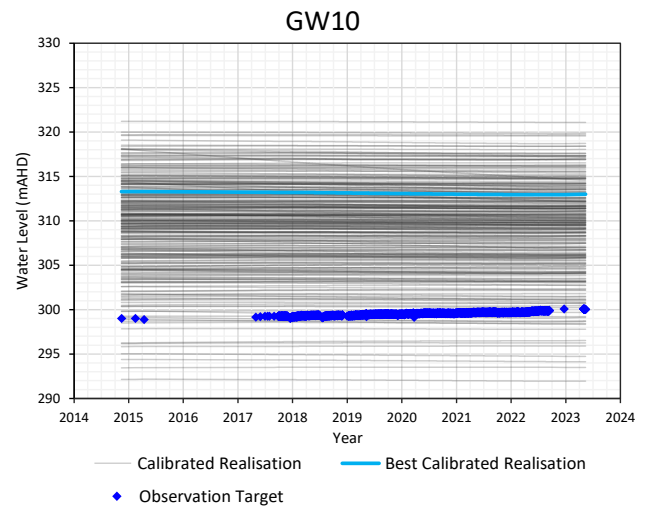
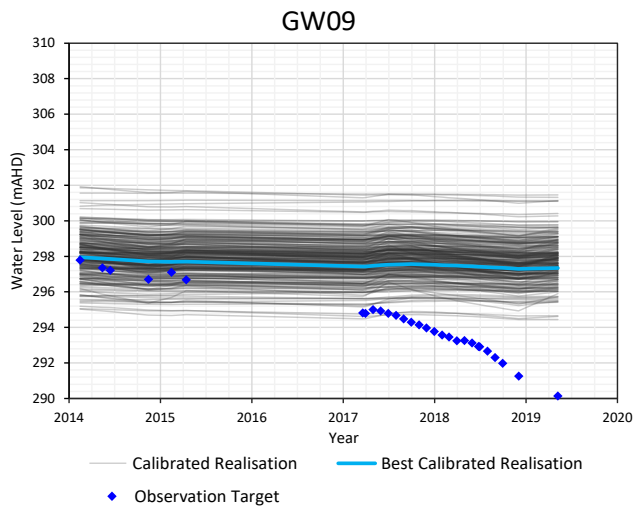
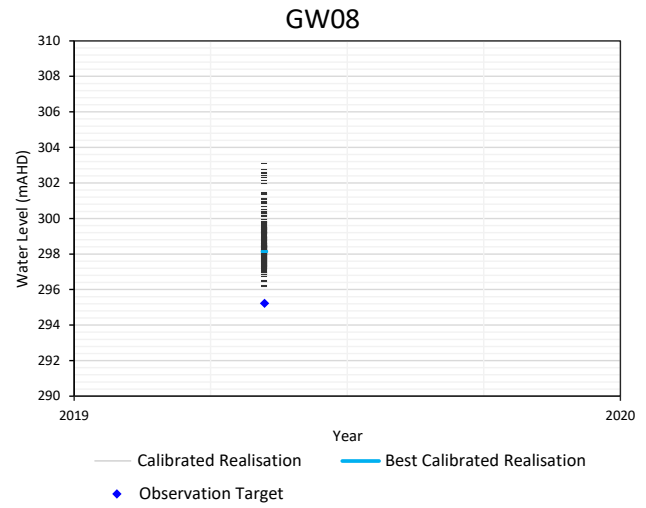
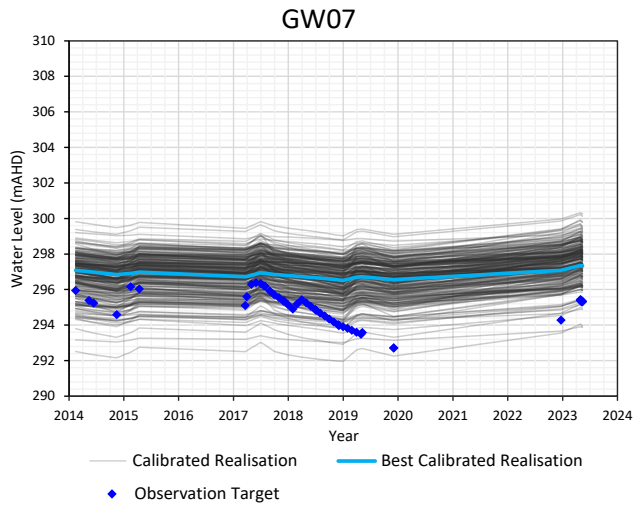


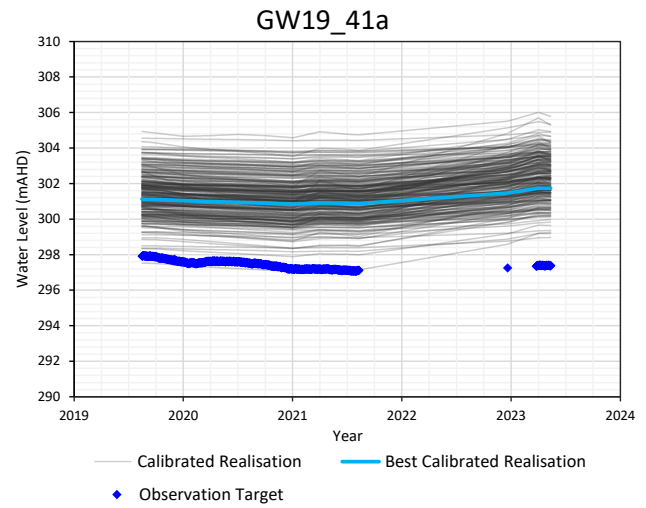
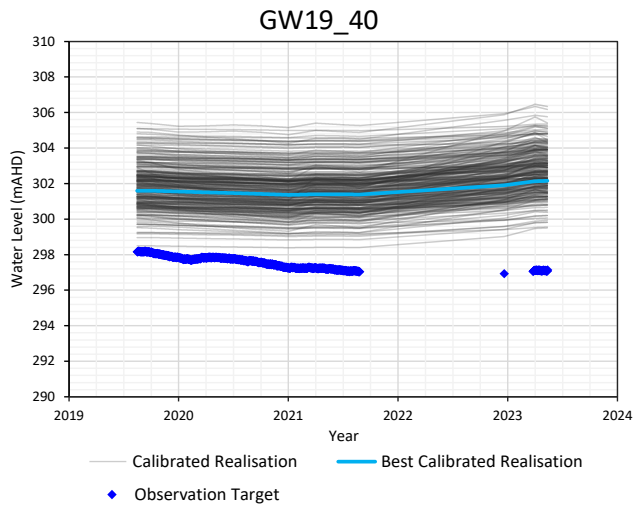
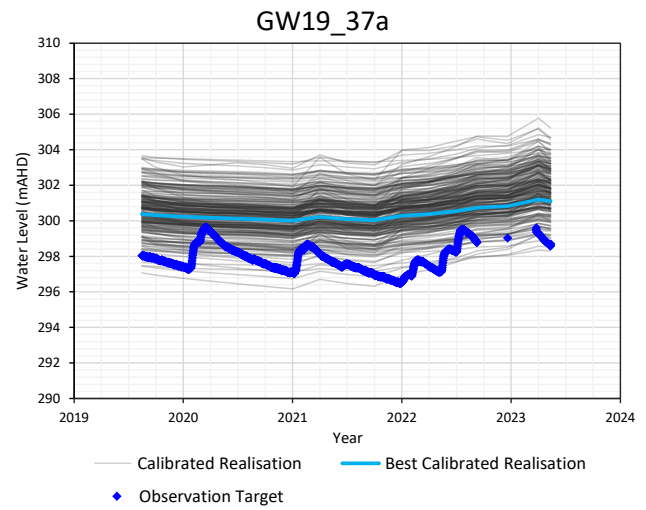
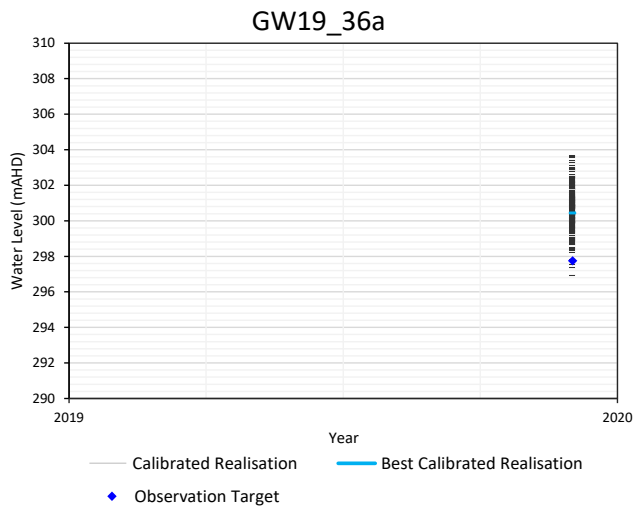
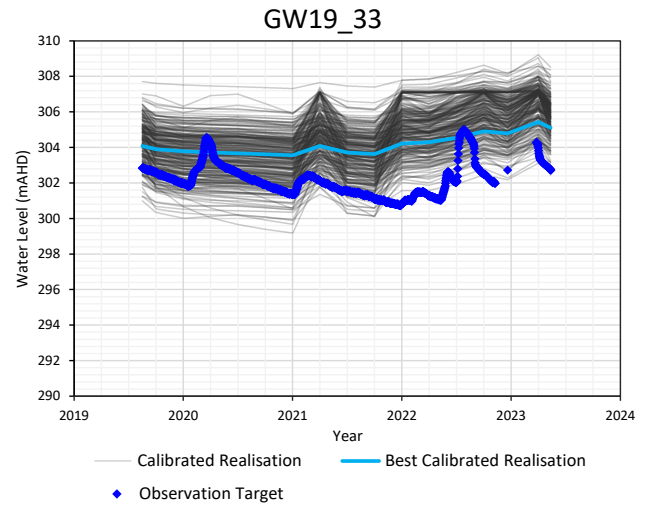
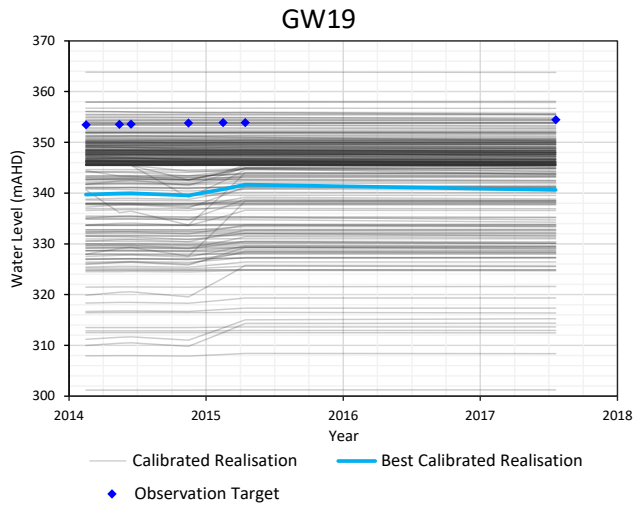


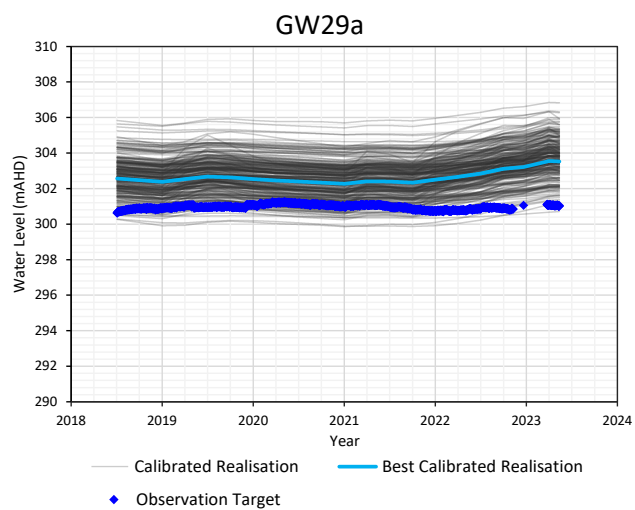
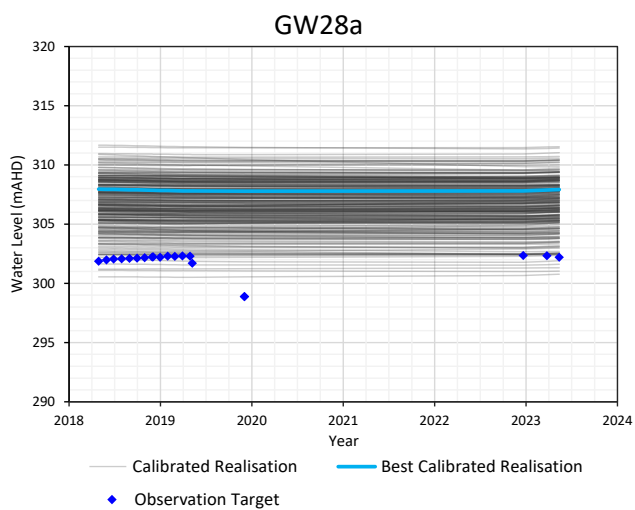
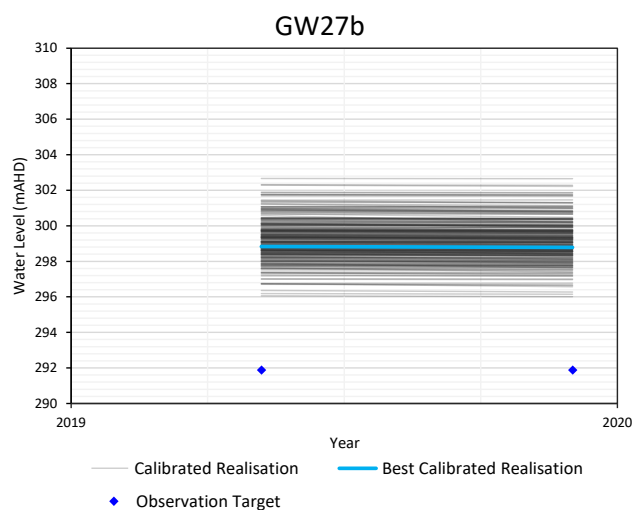
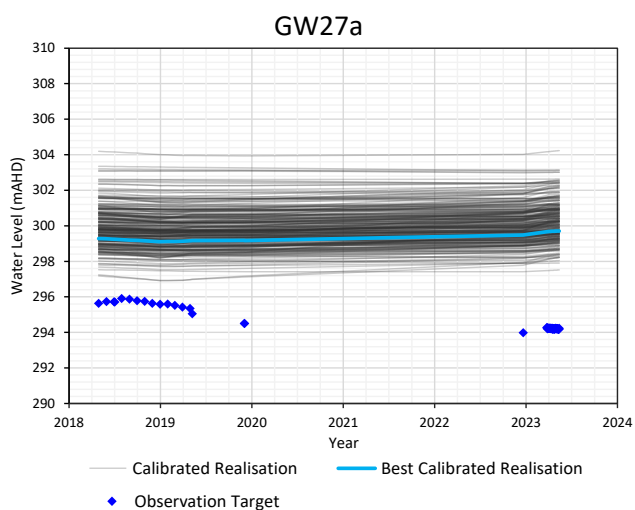
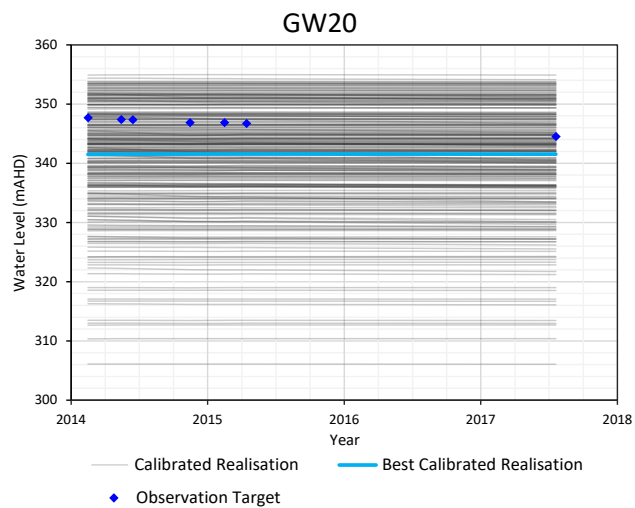
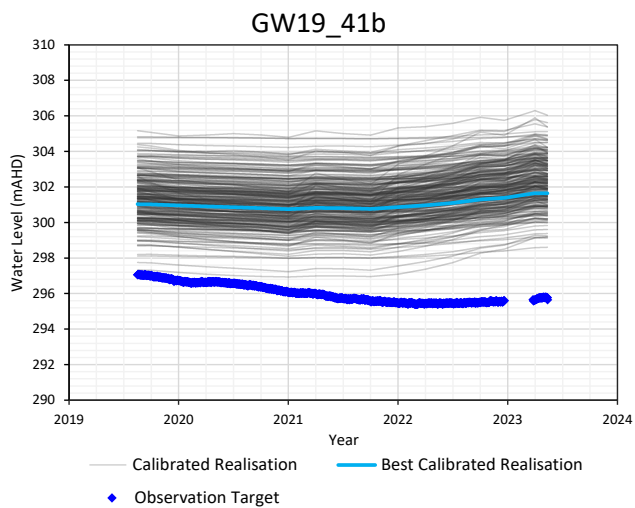


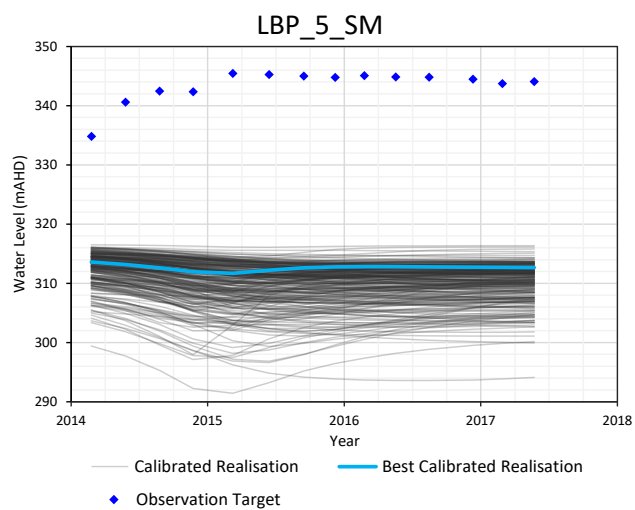
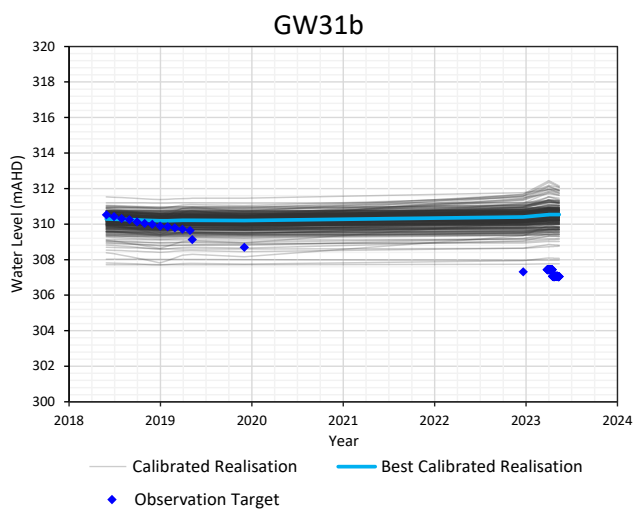
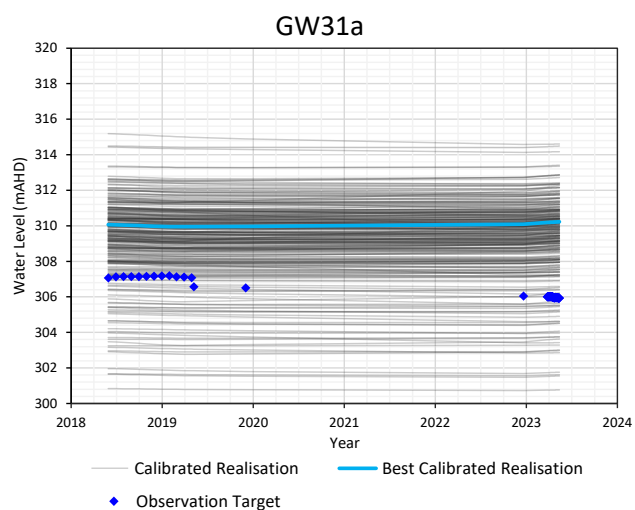
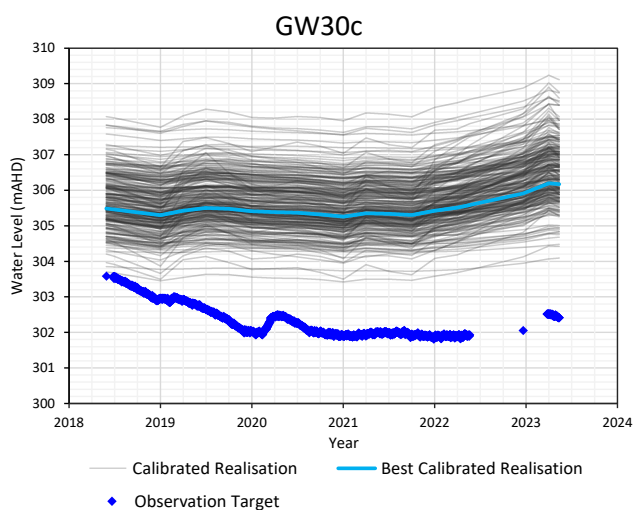
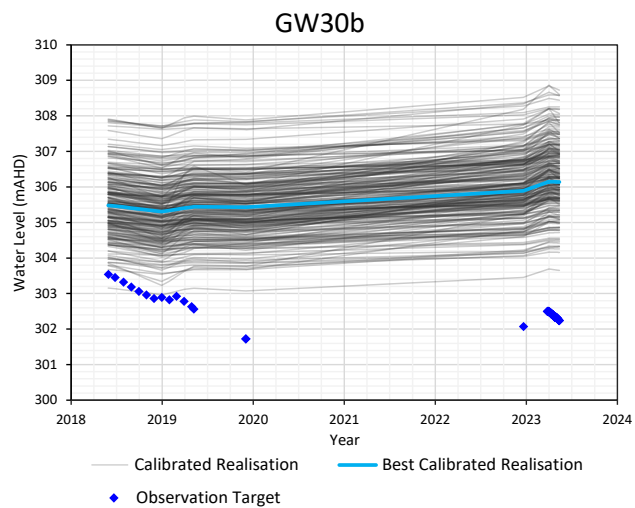
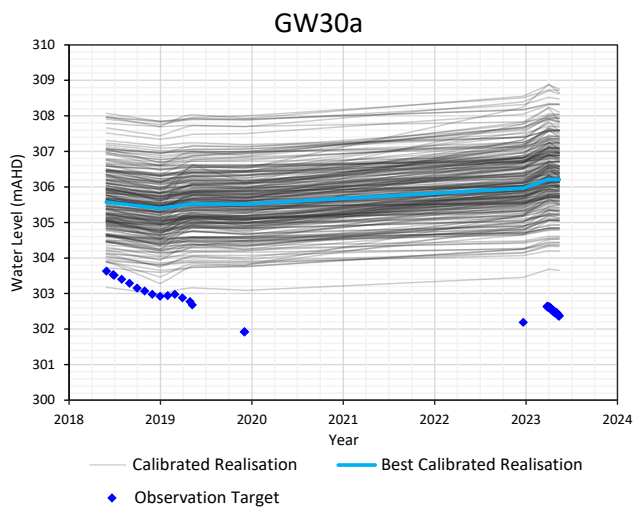


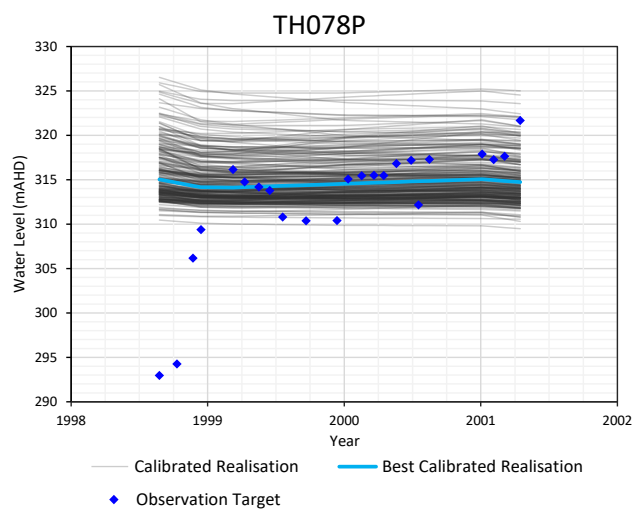
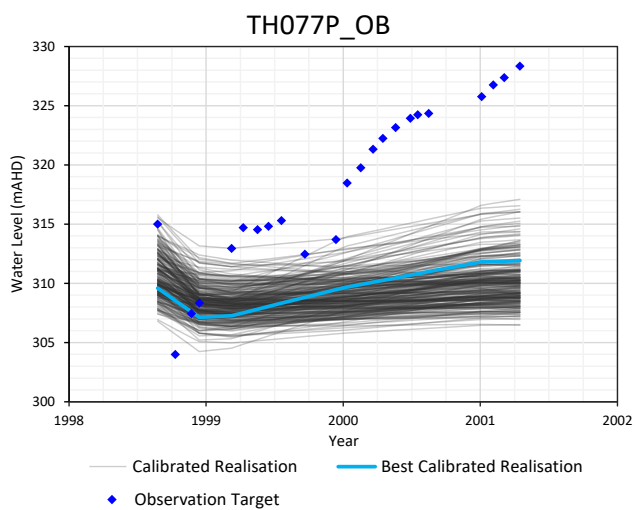
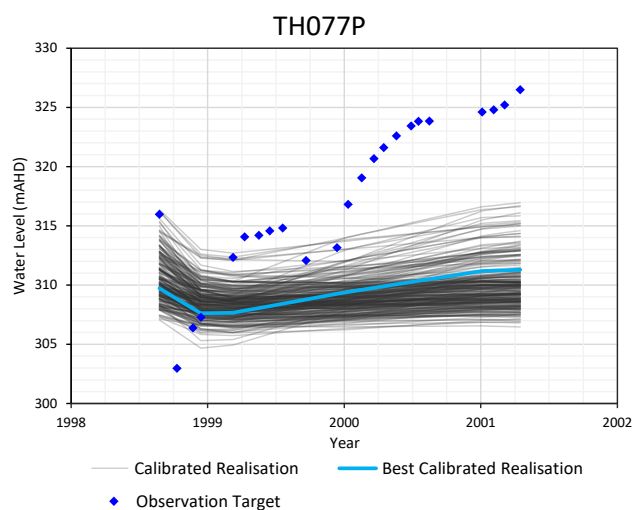
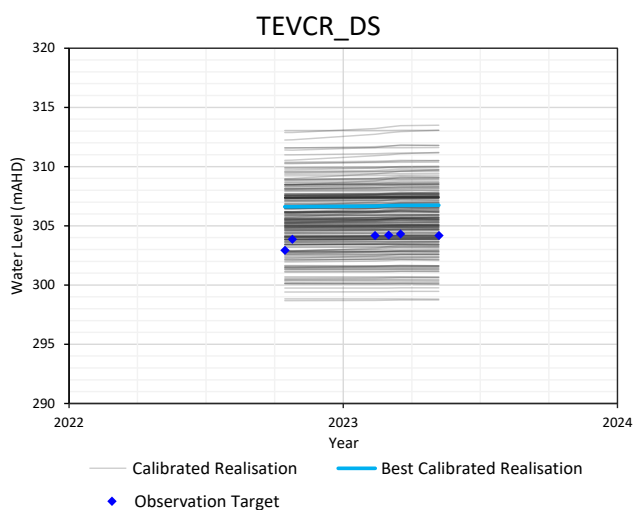
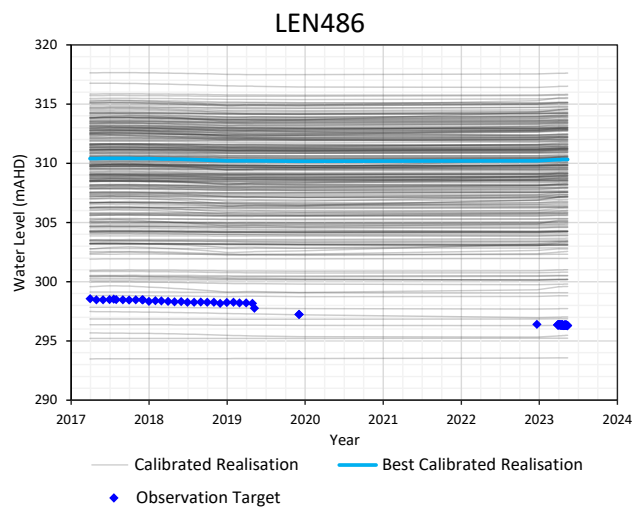
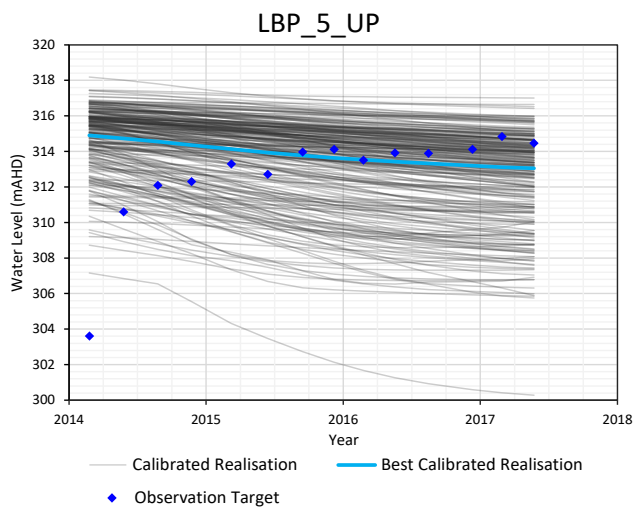


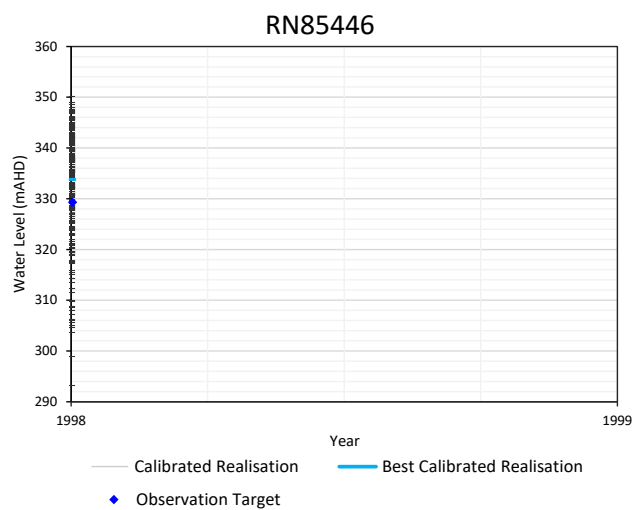
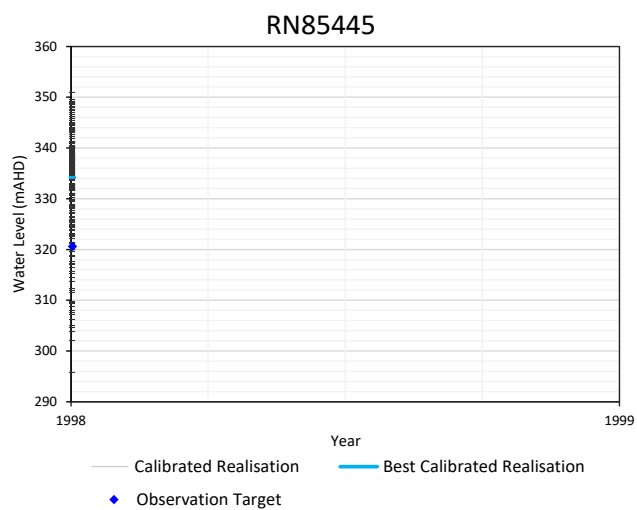
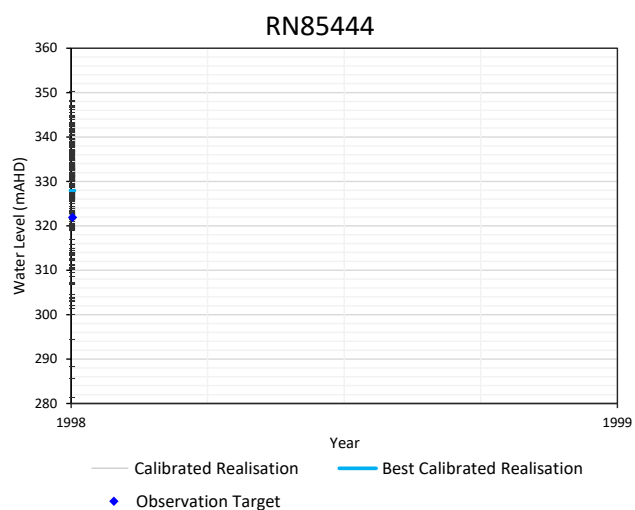
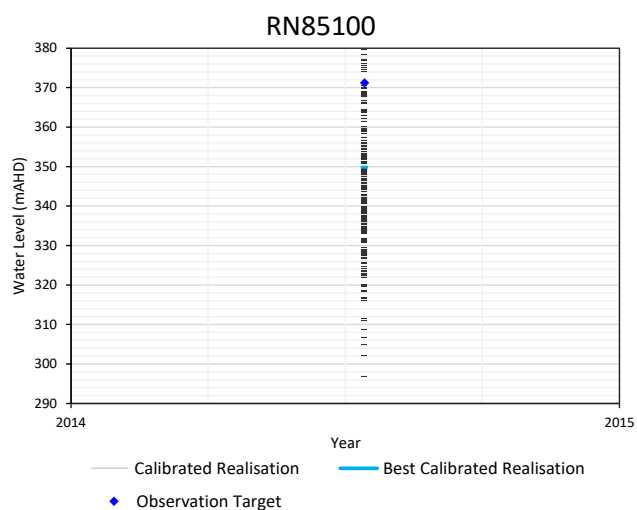
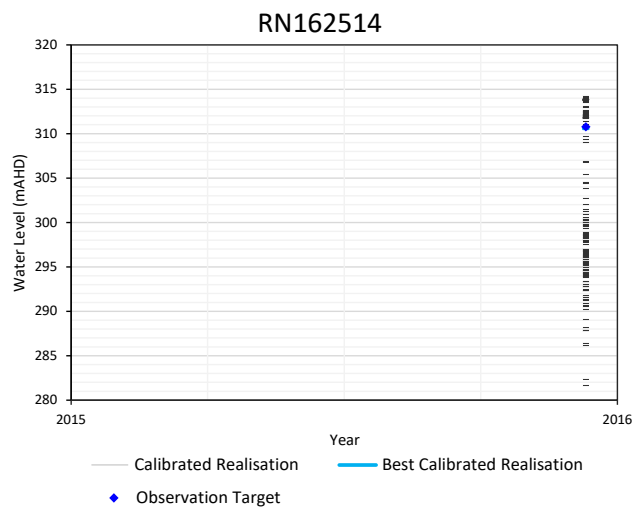
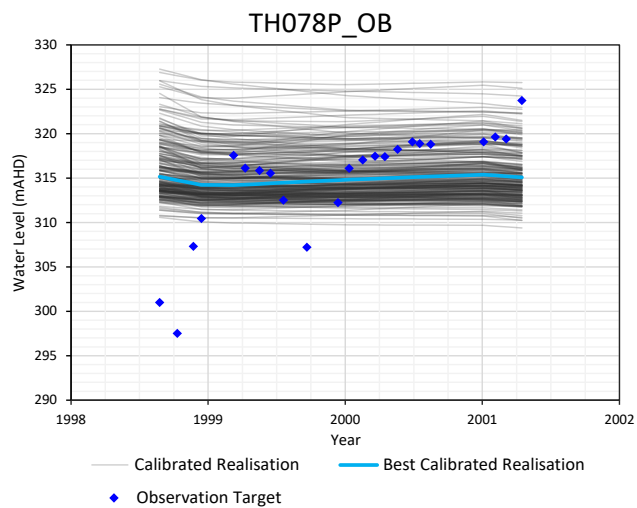




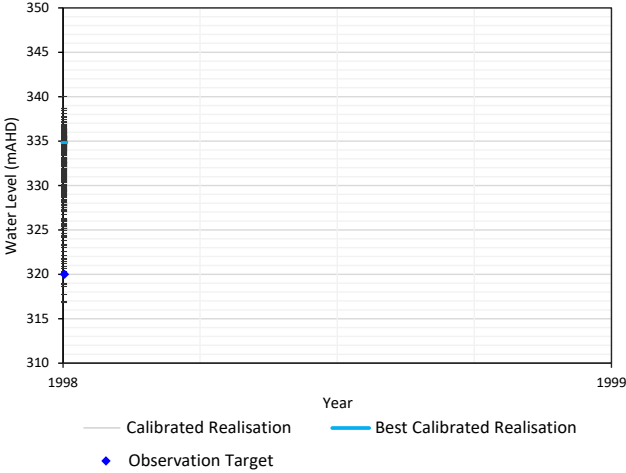


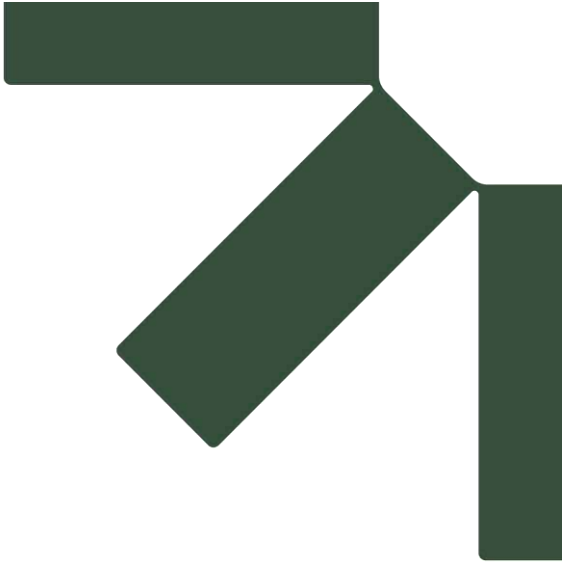






RN85464





Appendix E Predictive Water Balance Time Series

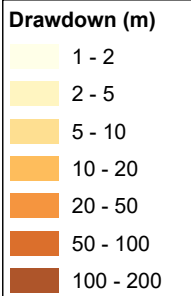
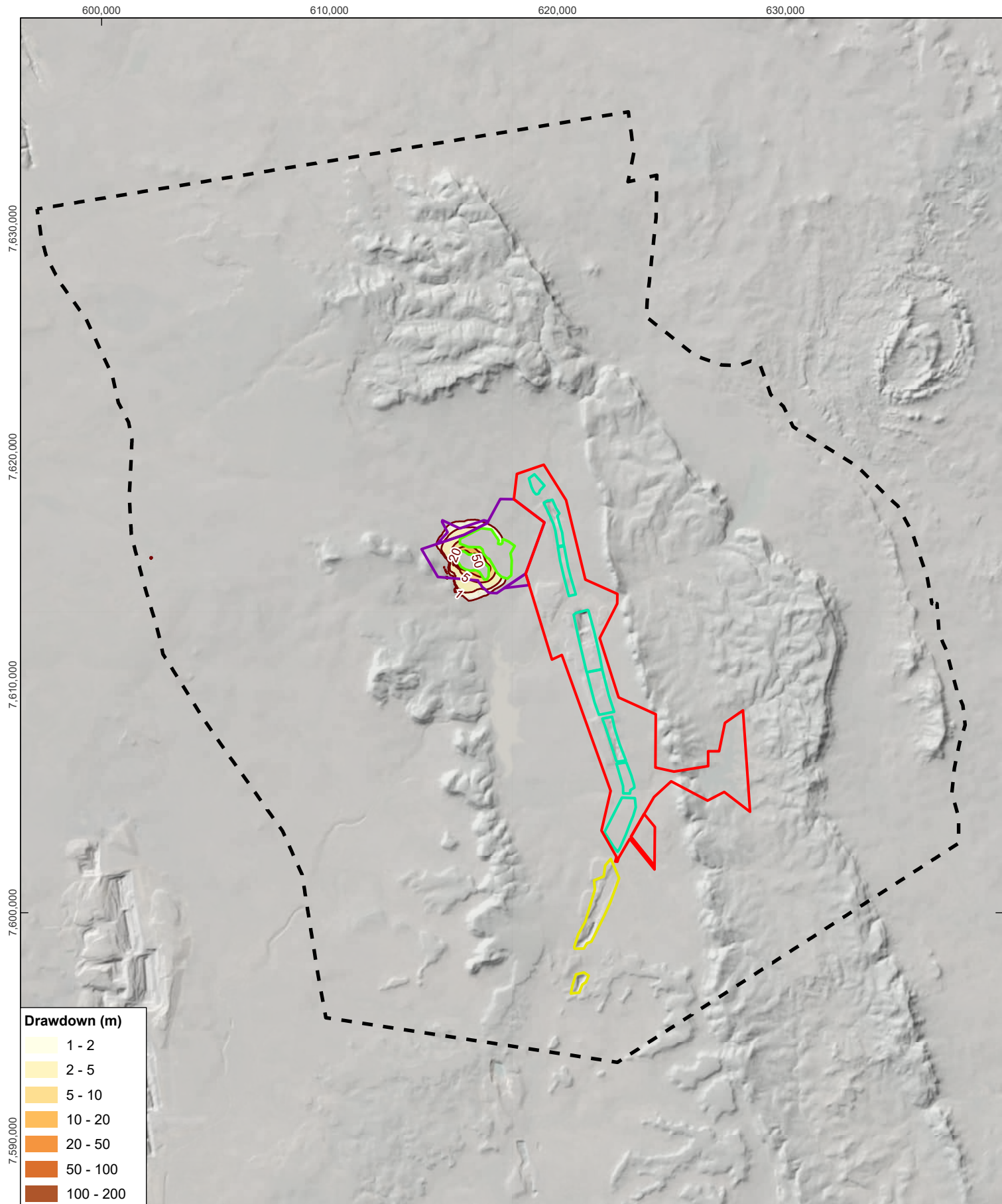
New Lenton & Burton

2023 Groundwater Modelling Technical Report

Lenton Joint Venture

SLR Project No.: 620.31367.00000

11 September 2024



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

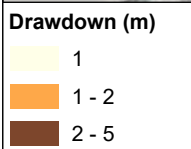
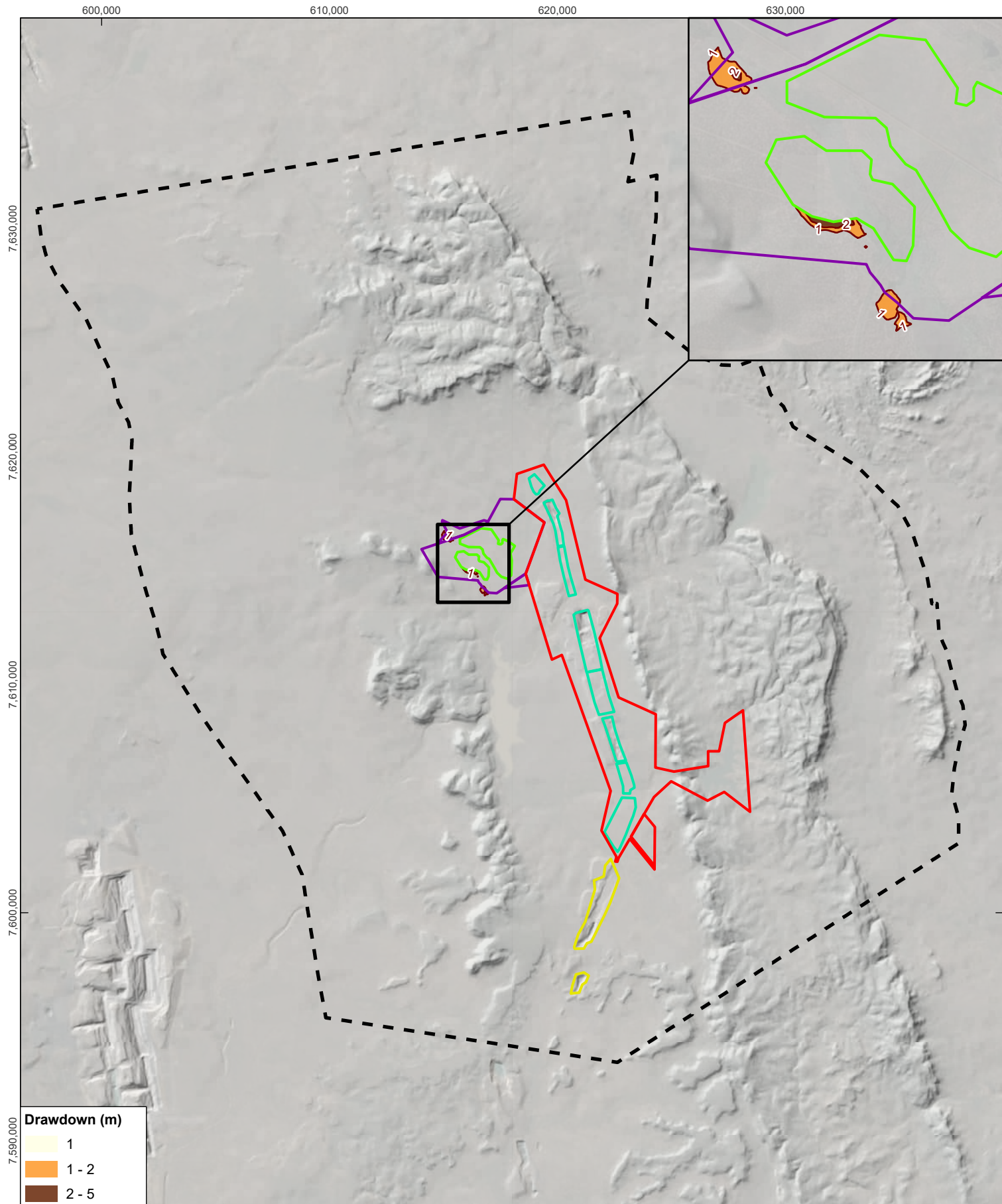
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|---|---|
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|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
WATER TABLE DRAWDOWN (2029)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

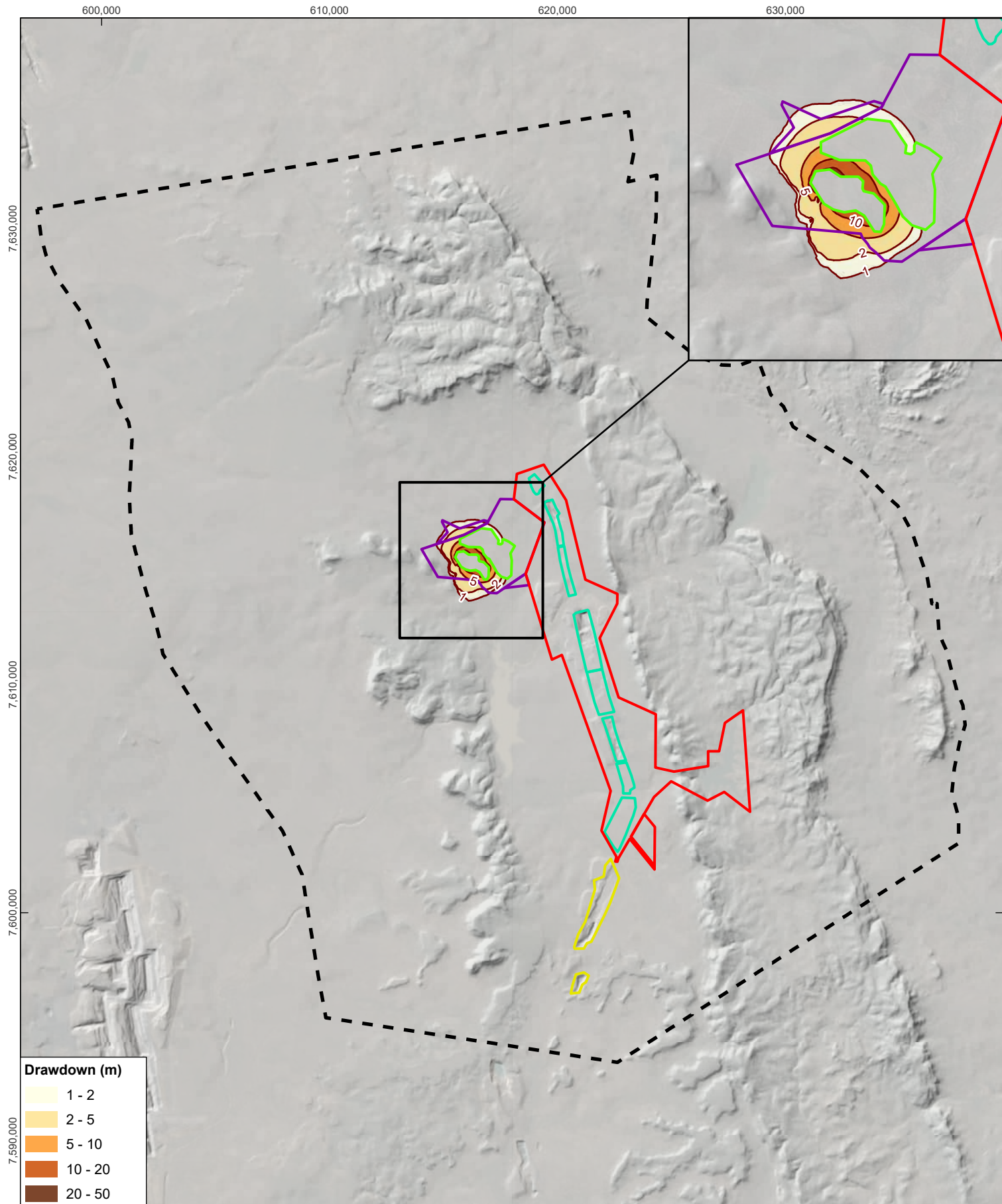
-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

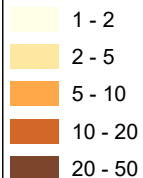
PREDICTED INCREMENTAL DRAWDOWN IN THE ALLUVIUM (2029)



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Drawdown (m)



0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

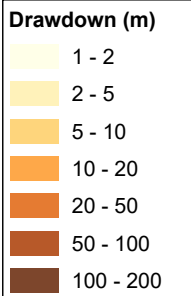
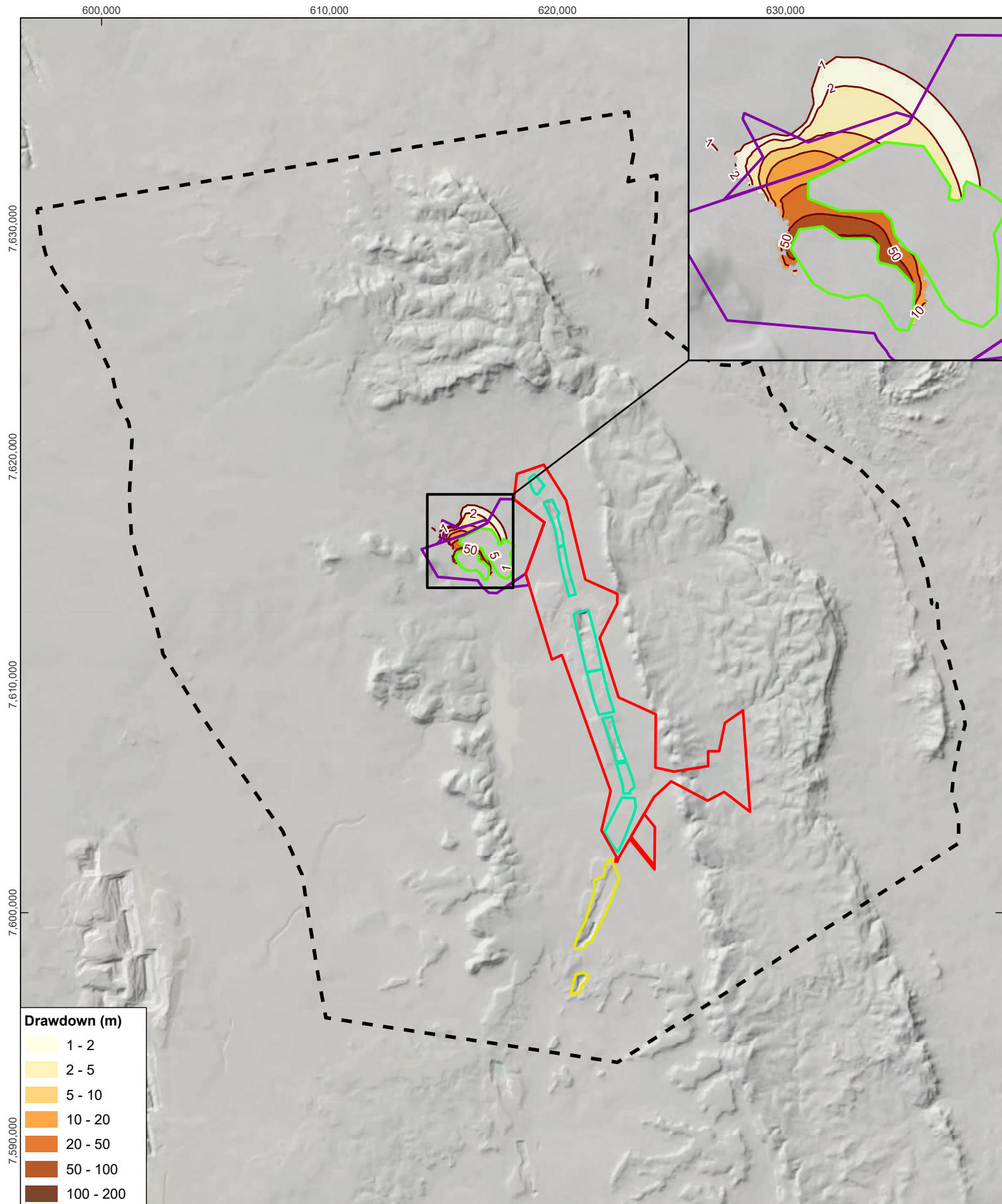
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- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE REGOLITH (2029)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

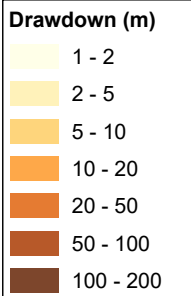
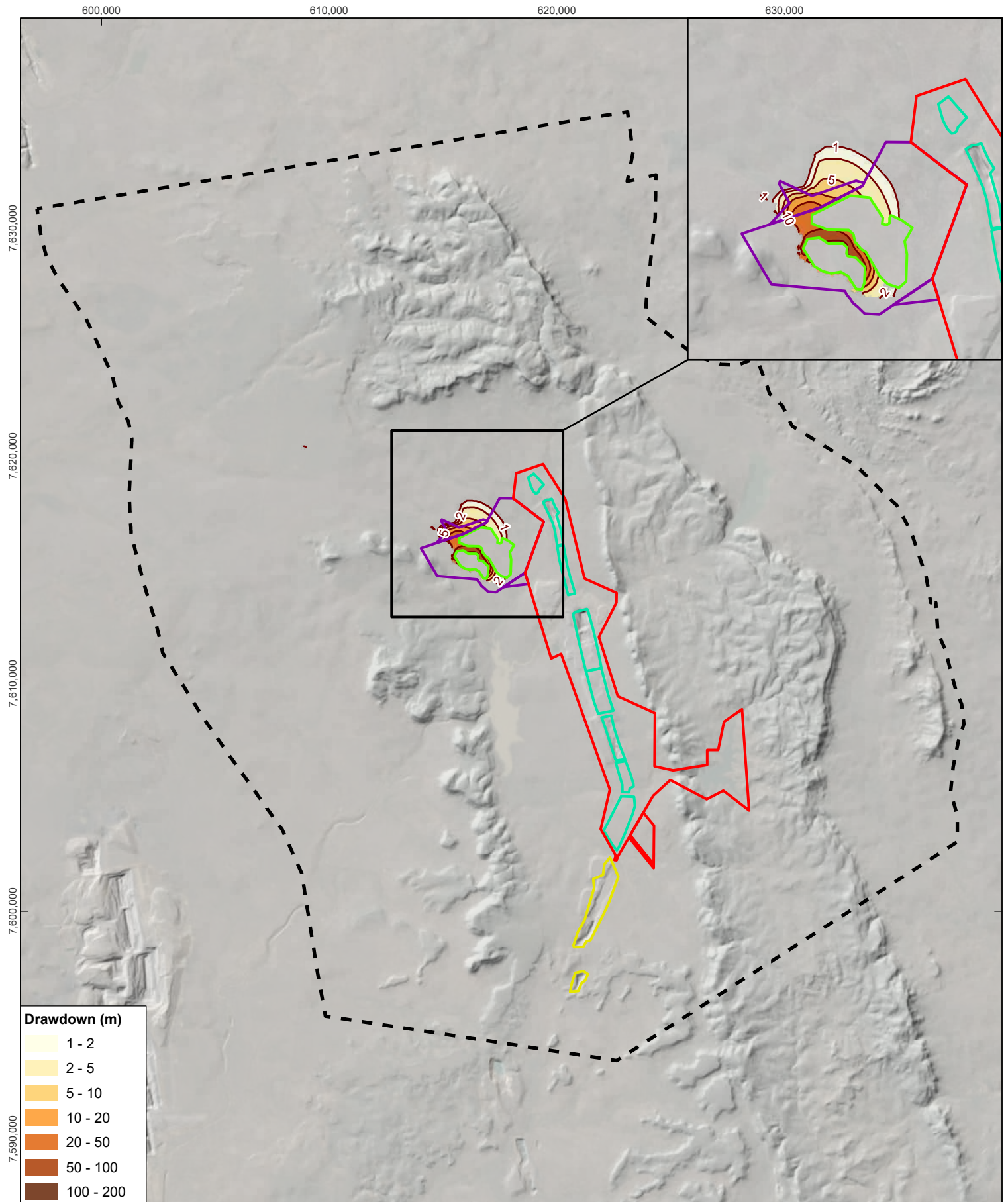
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE BURTON/RIDER SEAM (2029)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

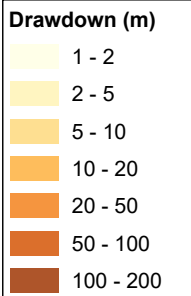
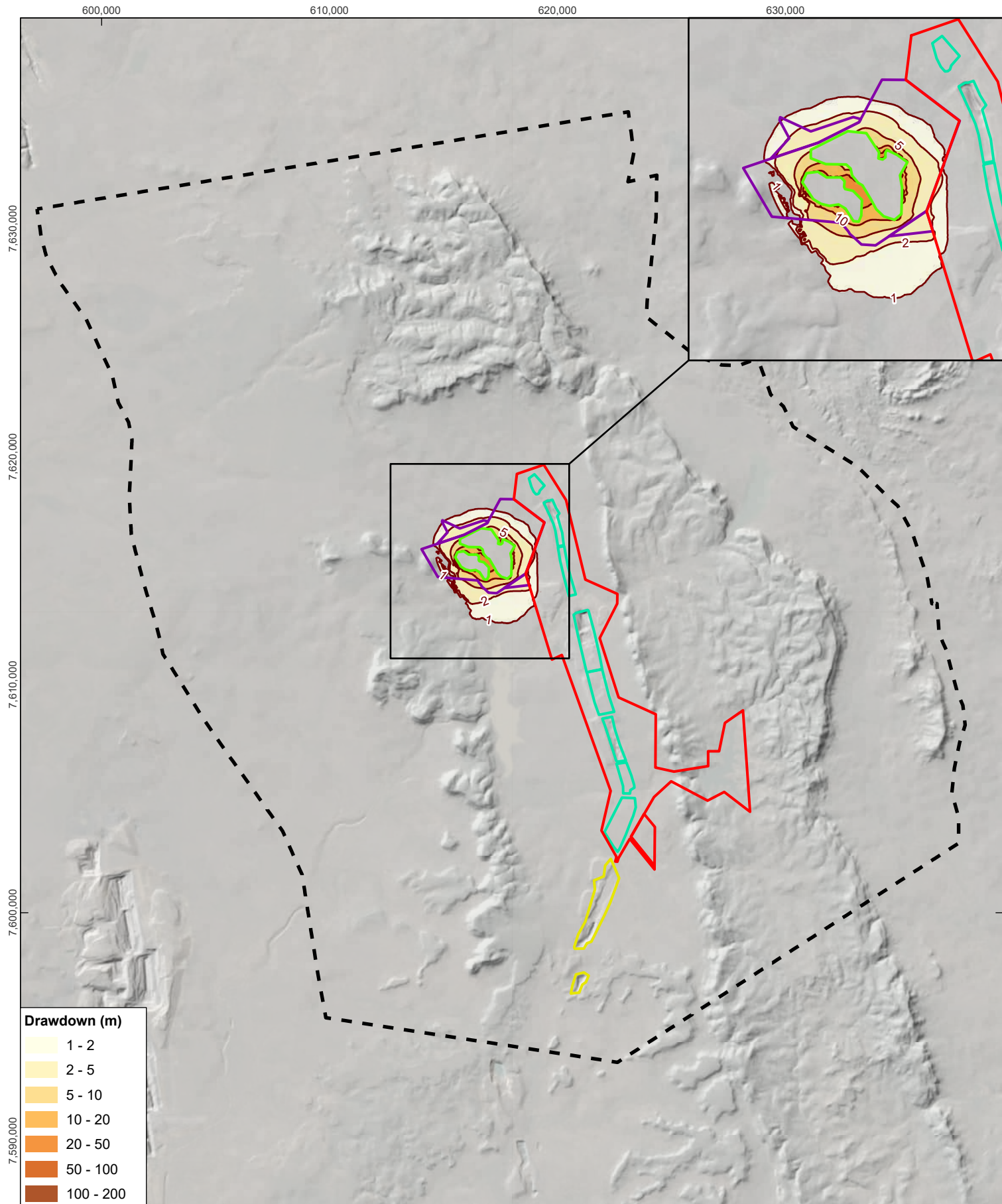
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|---|---|
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|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE LEICHHARDT/VERMONT SEAM (2029)



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 0 2.5 5 km
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 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

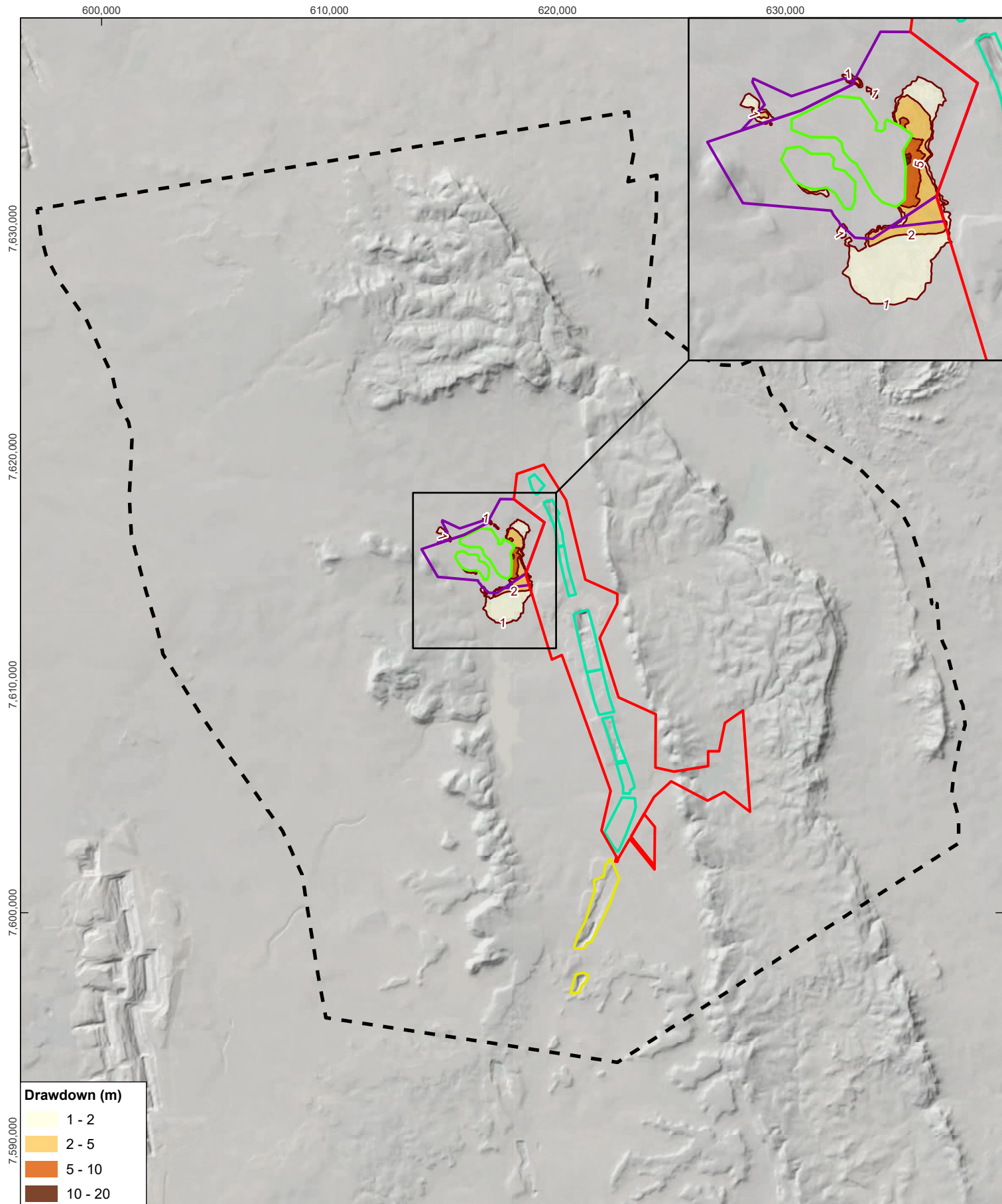
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
WATER TABLE DRAWDOWN (2034)**



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Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20

0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 15-Dec-2023

Drawn by: AS

LEGEND

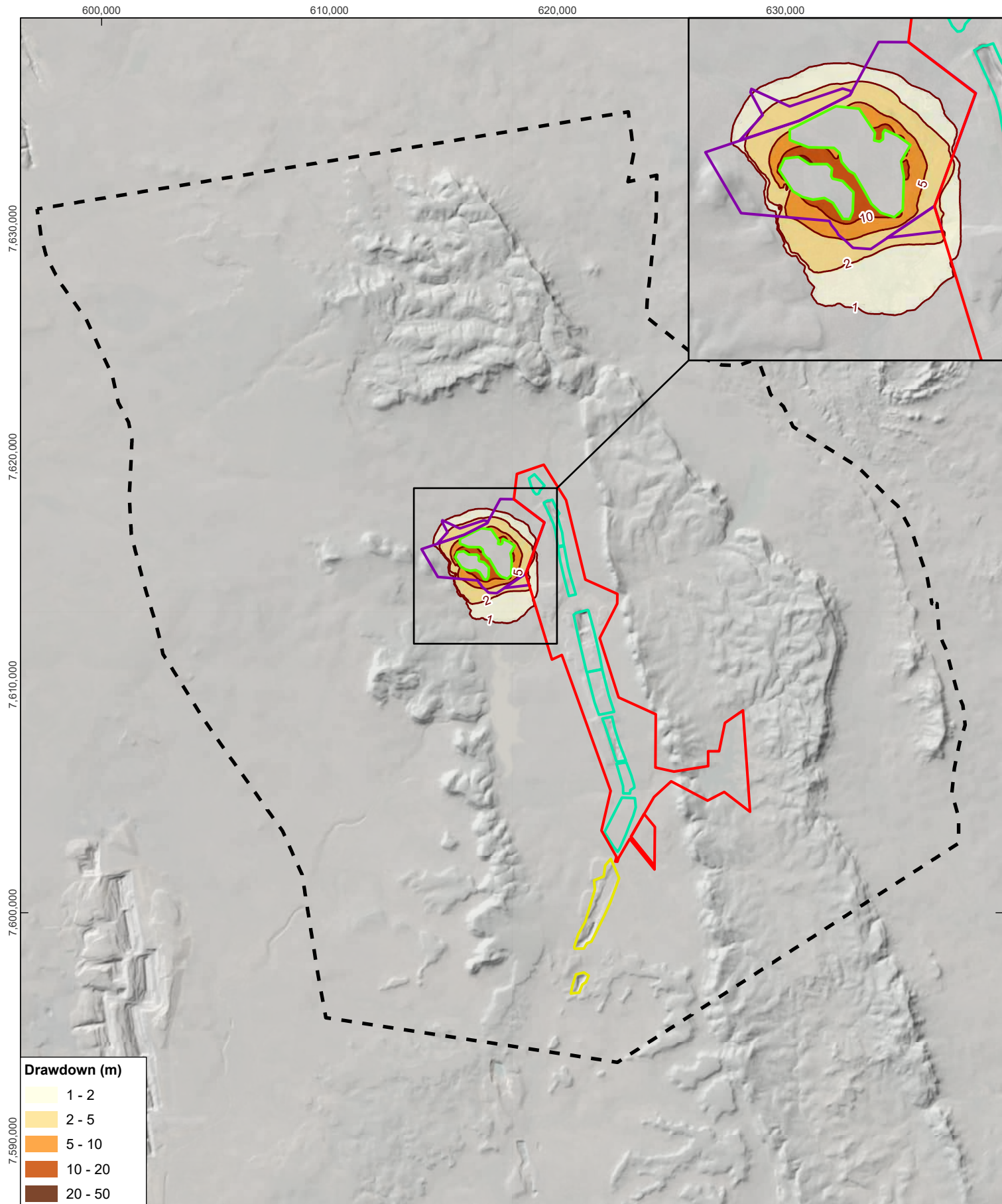
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- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE ALLUVIUM (2034)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

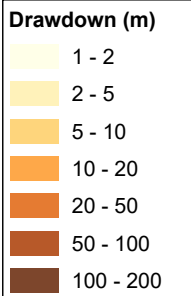
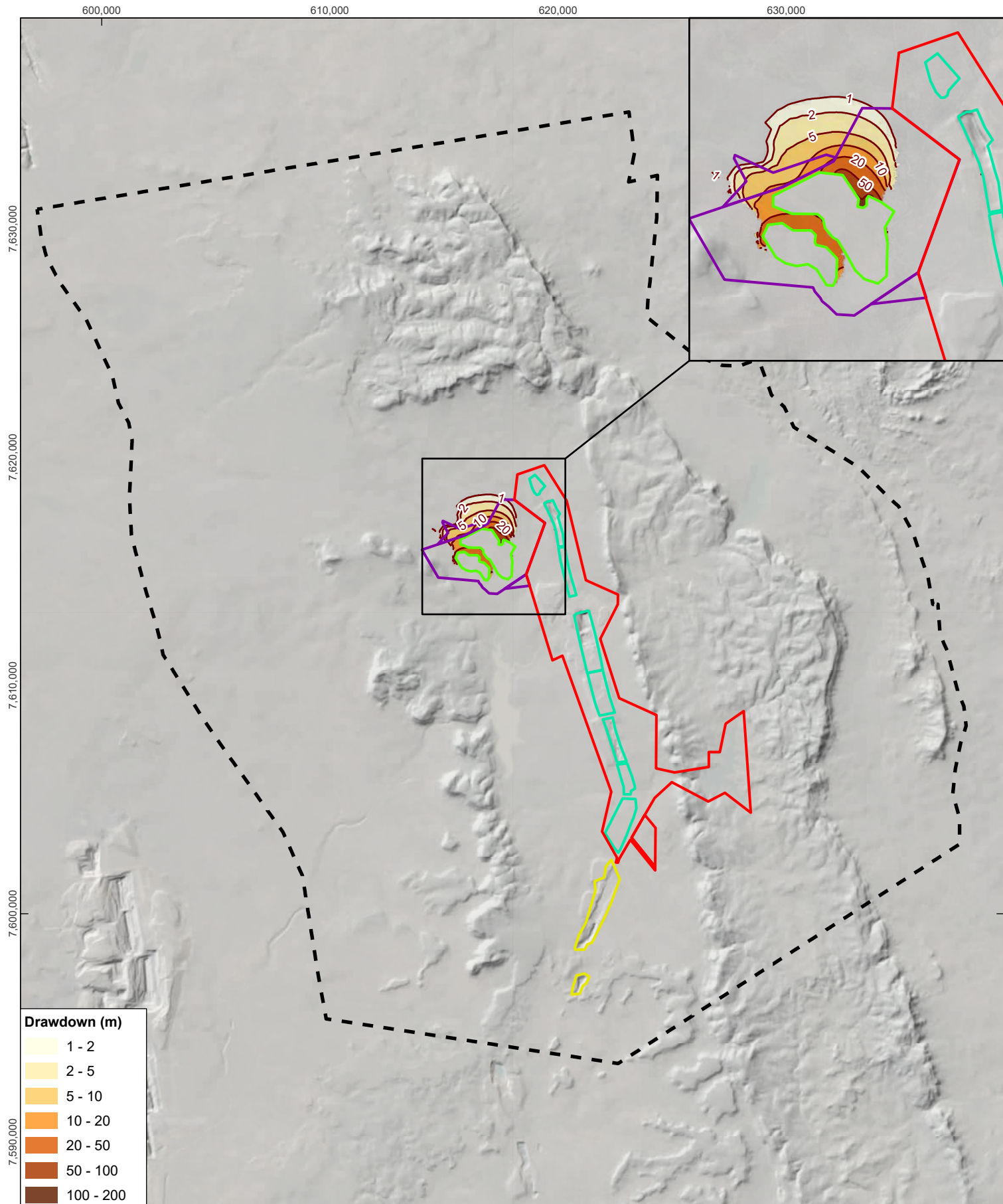
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|---------------------------|---------------------------|
| — Drawdown Contour (m) | □ Burton Pit Extent |
| --- Model Domain | □ New Lenton Pit Extent |
| ▭ Burton Mining Lease | □ Former Burton Mine Pits |
| ▭ New Lenton Mining Lease | |

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE REGOLITH (2034)



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	0 2.5 5 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:220,000 at A4
Project Number:	620.31208.00000
Date Drawn:	18-Dec-2023
Drawn by:	AS

LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

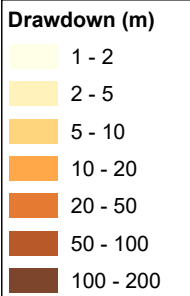
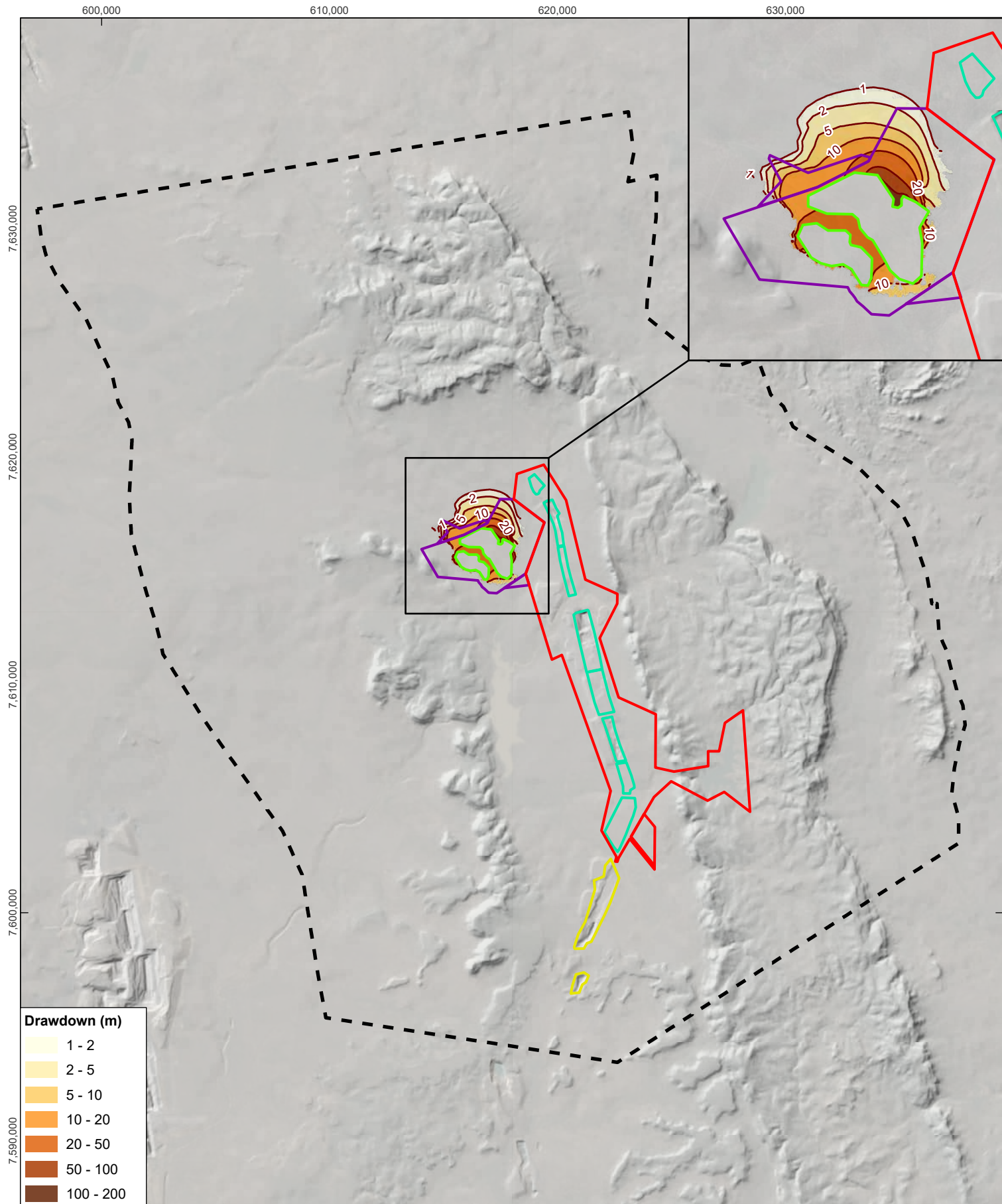
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE BURTON/RIDER SEAM (2034)



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APPENDIX F-9



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

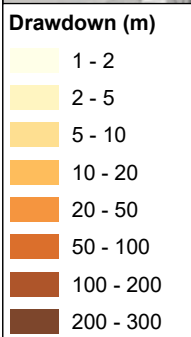
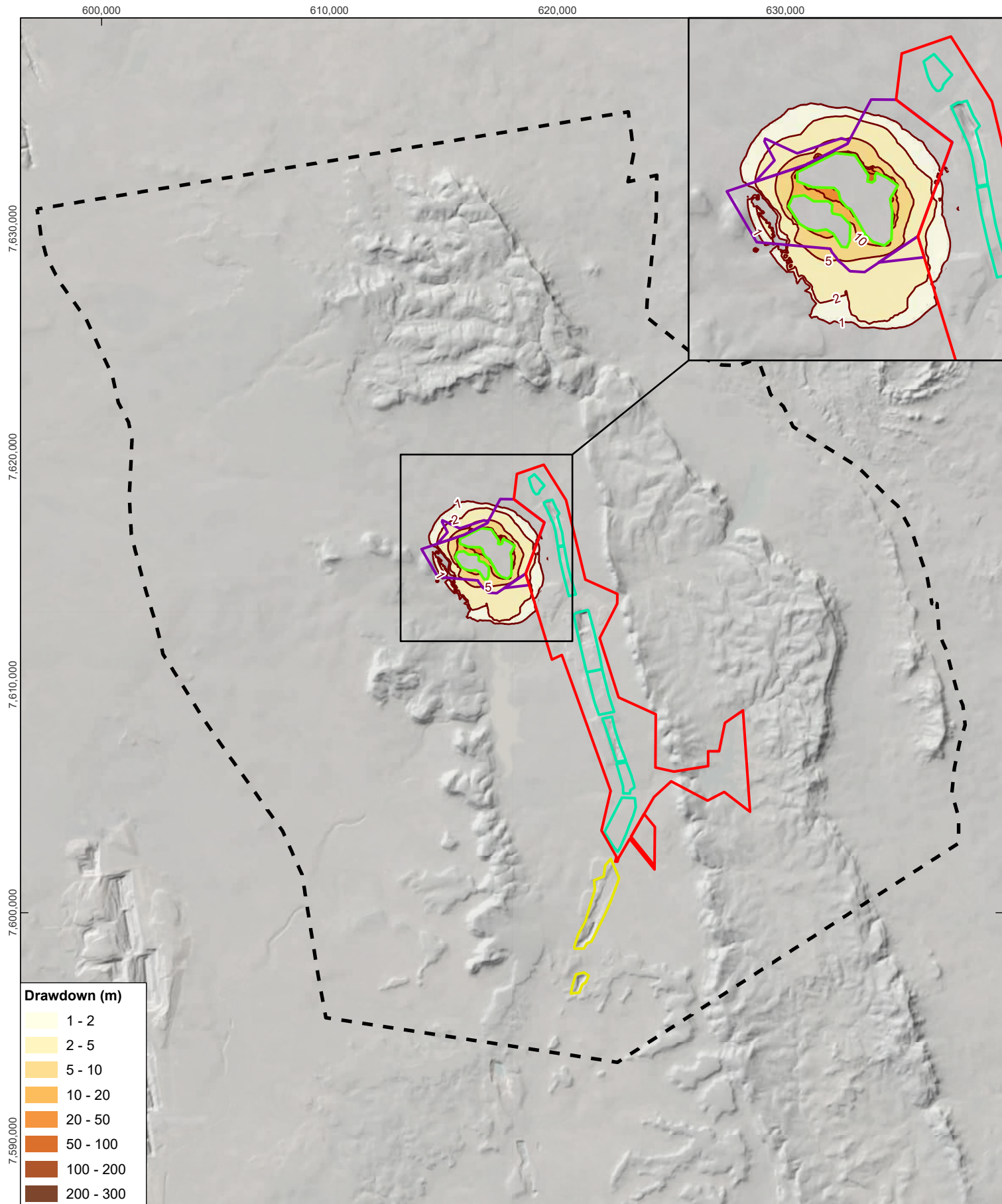
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
DRAWDOWN IN THE
LEICHHARDT/VERMONT SEAM (2034)**



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APPENDIX F-10



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

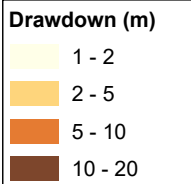
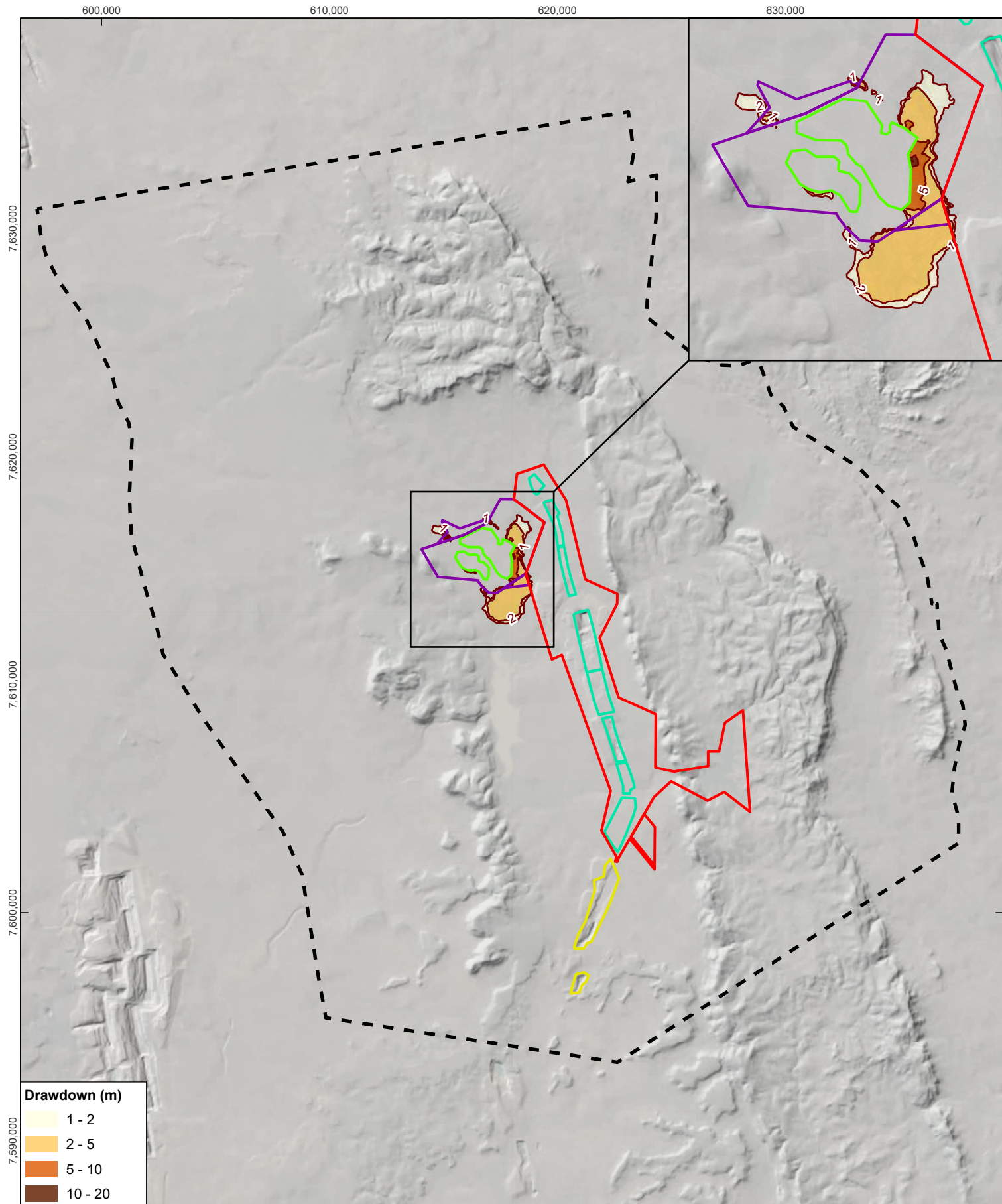
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
WATER TABLE DRAWDOWN (2039)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

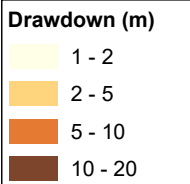
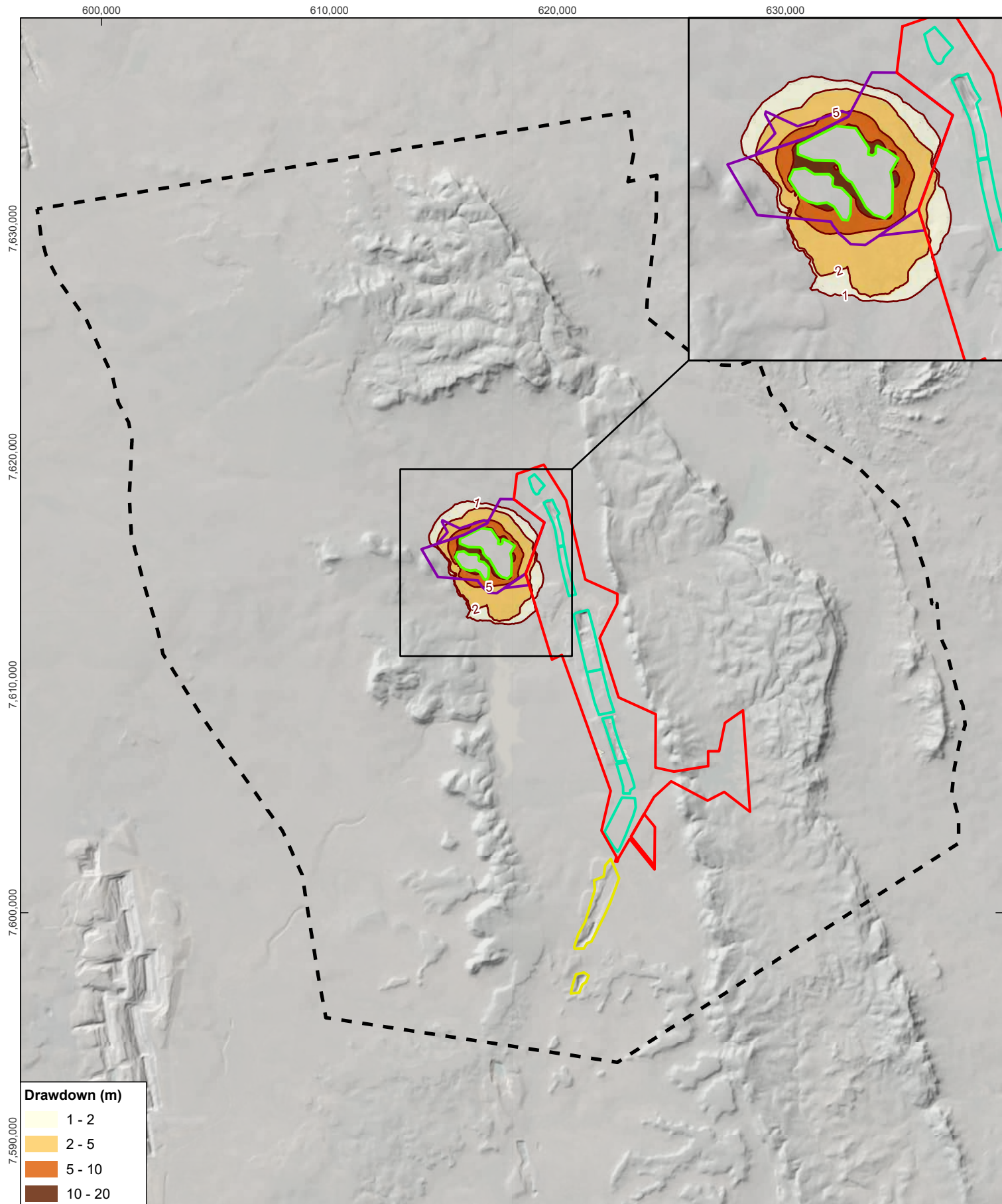
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE ALLUVIUM (2039)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

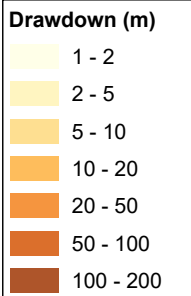
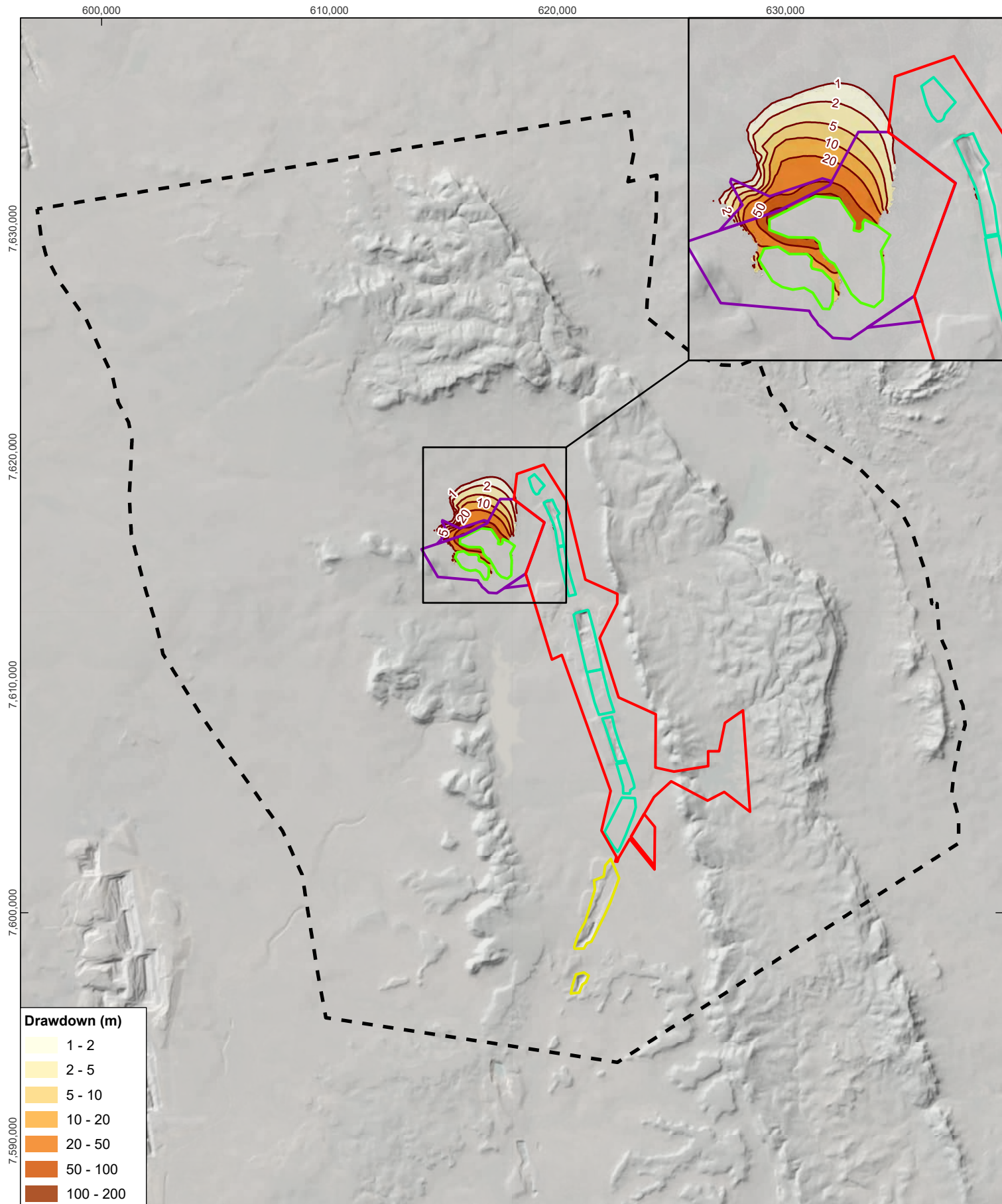
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE REGOLITH (2039)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

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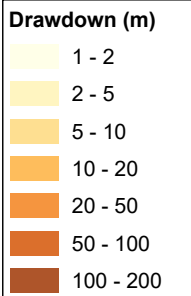
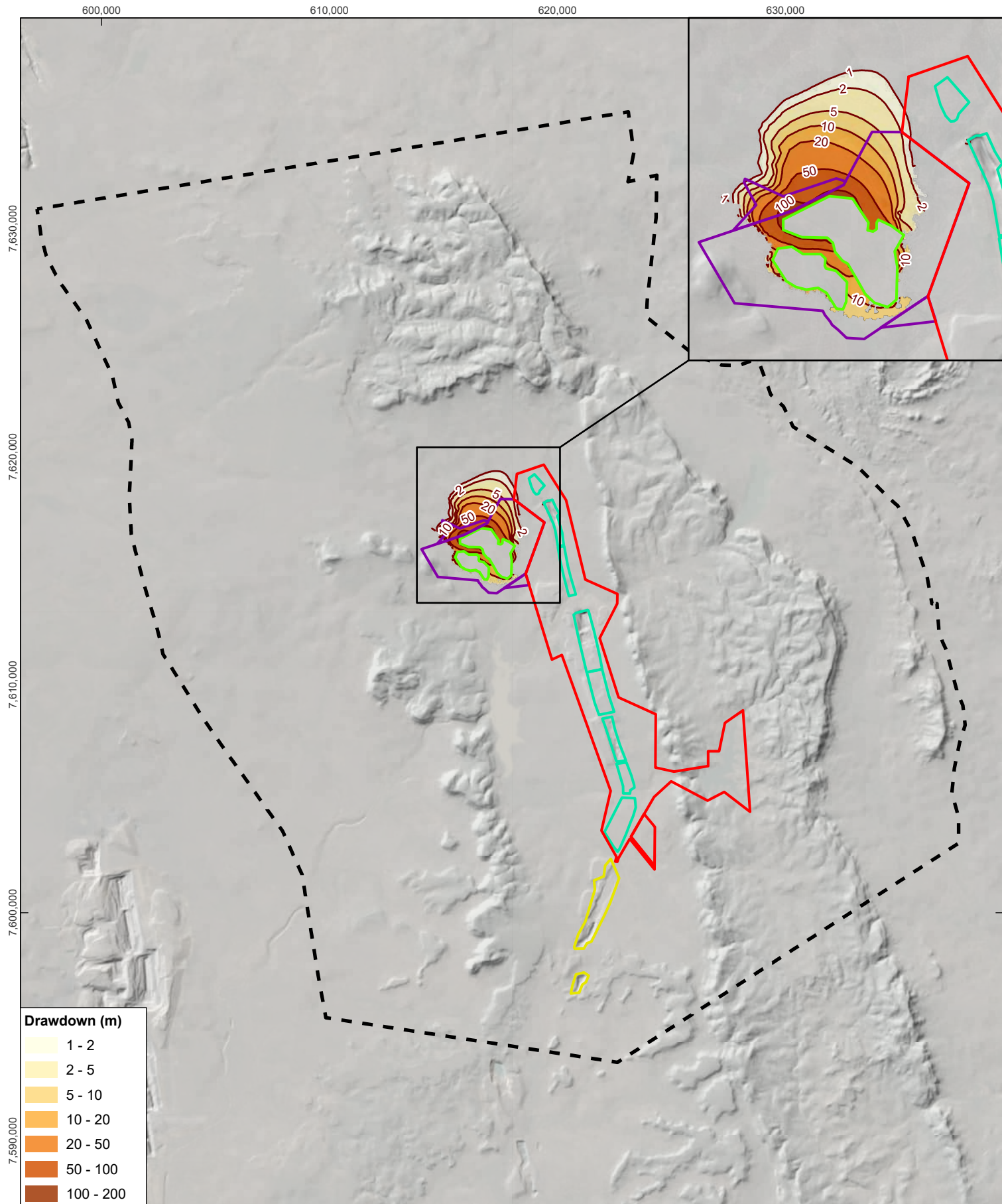
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-  Model Domain
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-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE BURTON/RIDER SEAM (2039)



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 0 2.5 5 km
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 Project Number: 620.31208.00000
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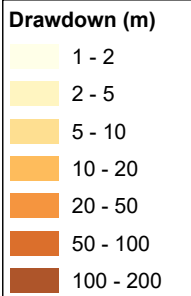
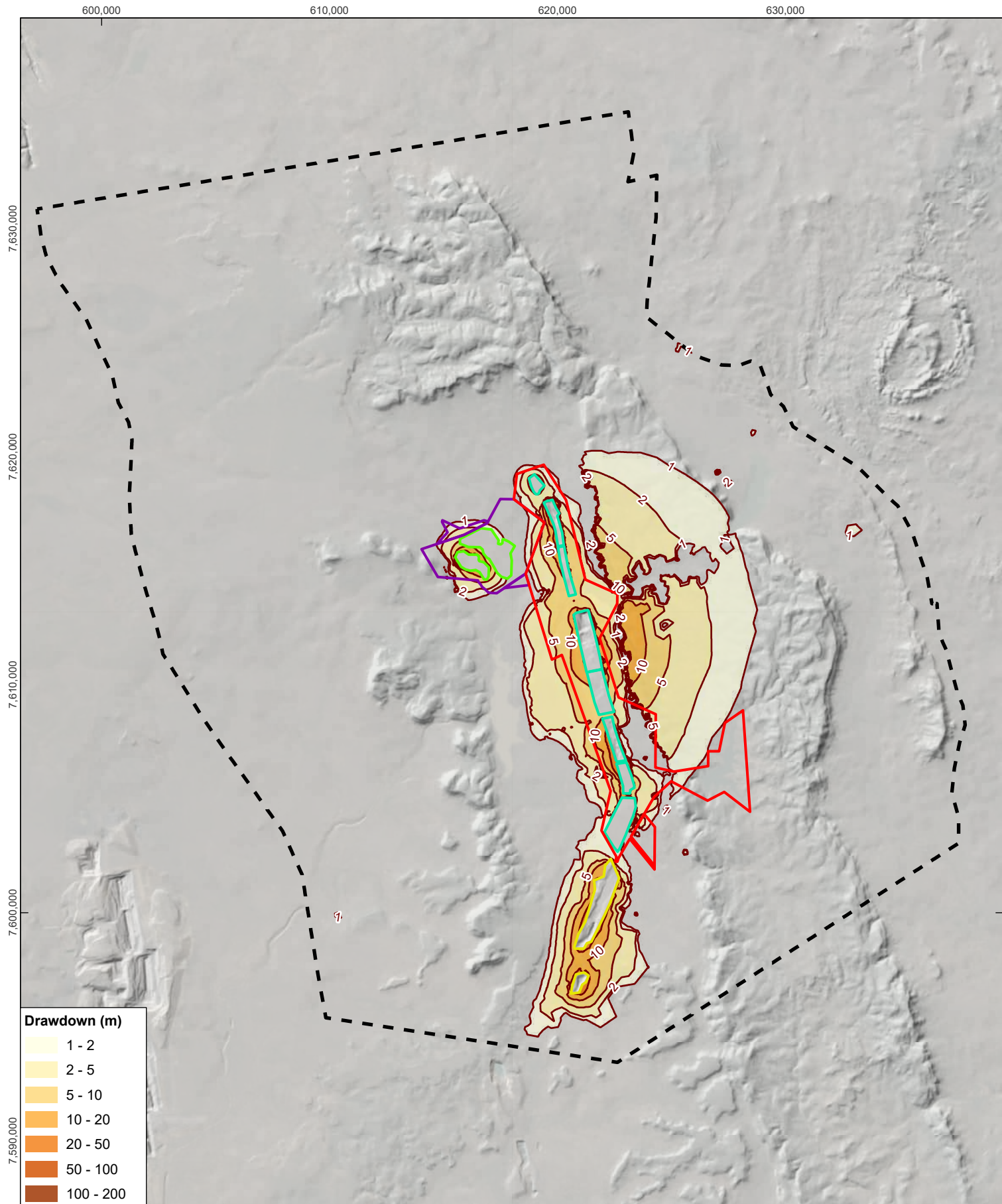
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
DRAWDOWN IN THE
LEICHHARDT/VERMONT SEAM (2039)**



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 0 2.5 5 km
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 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

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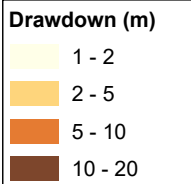
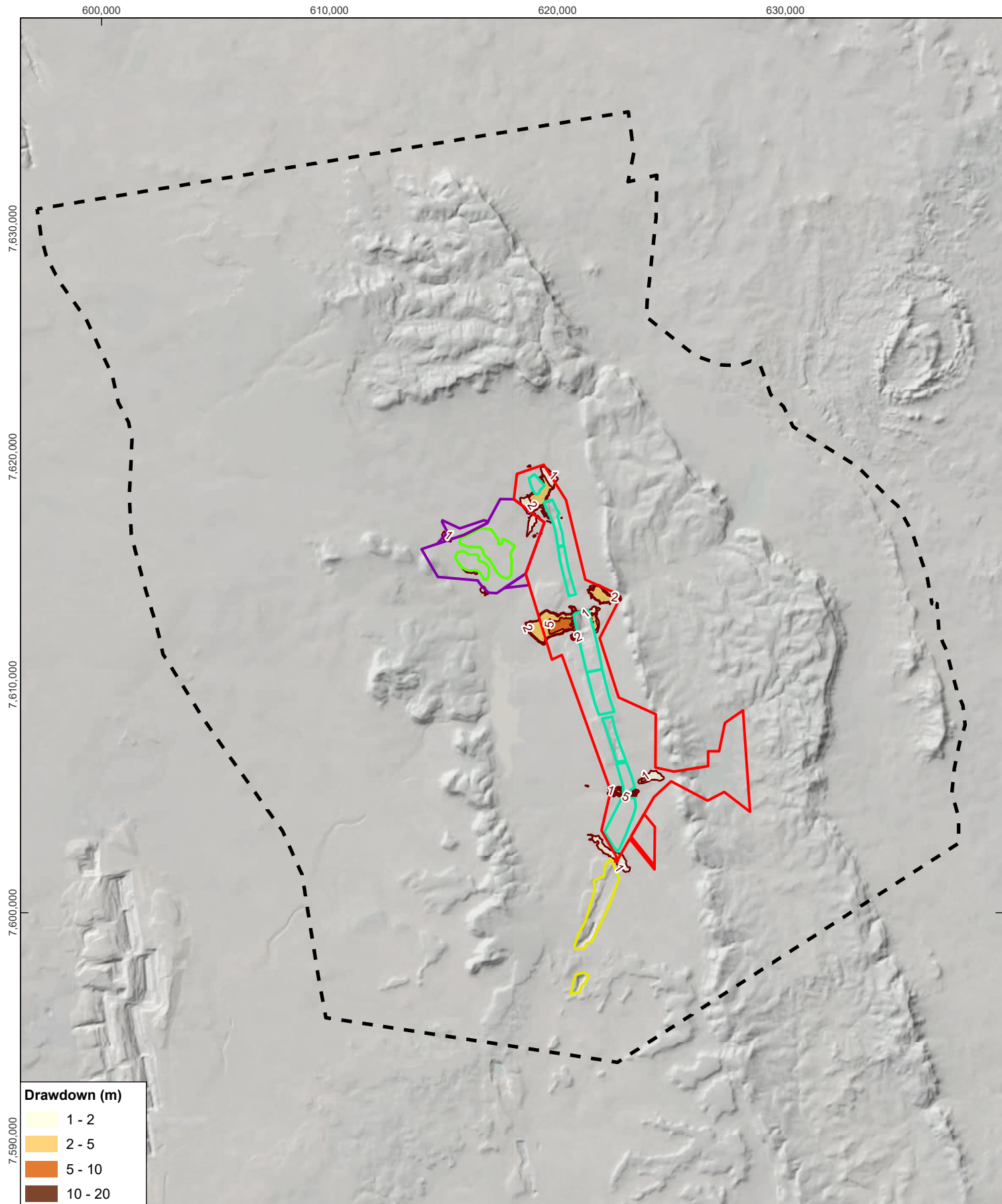
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED CUMULATIVE WATER TABLE DRAWDOWN (2029)



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 15-Dec-2023

Drawn by: AS

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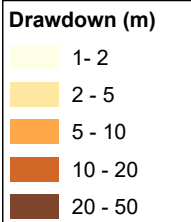
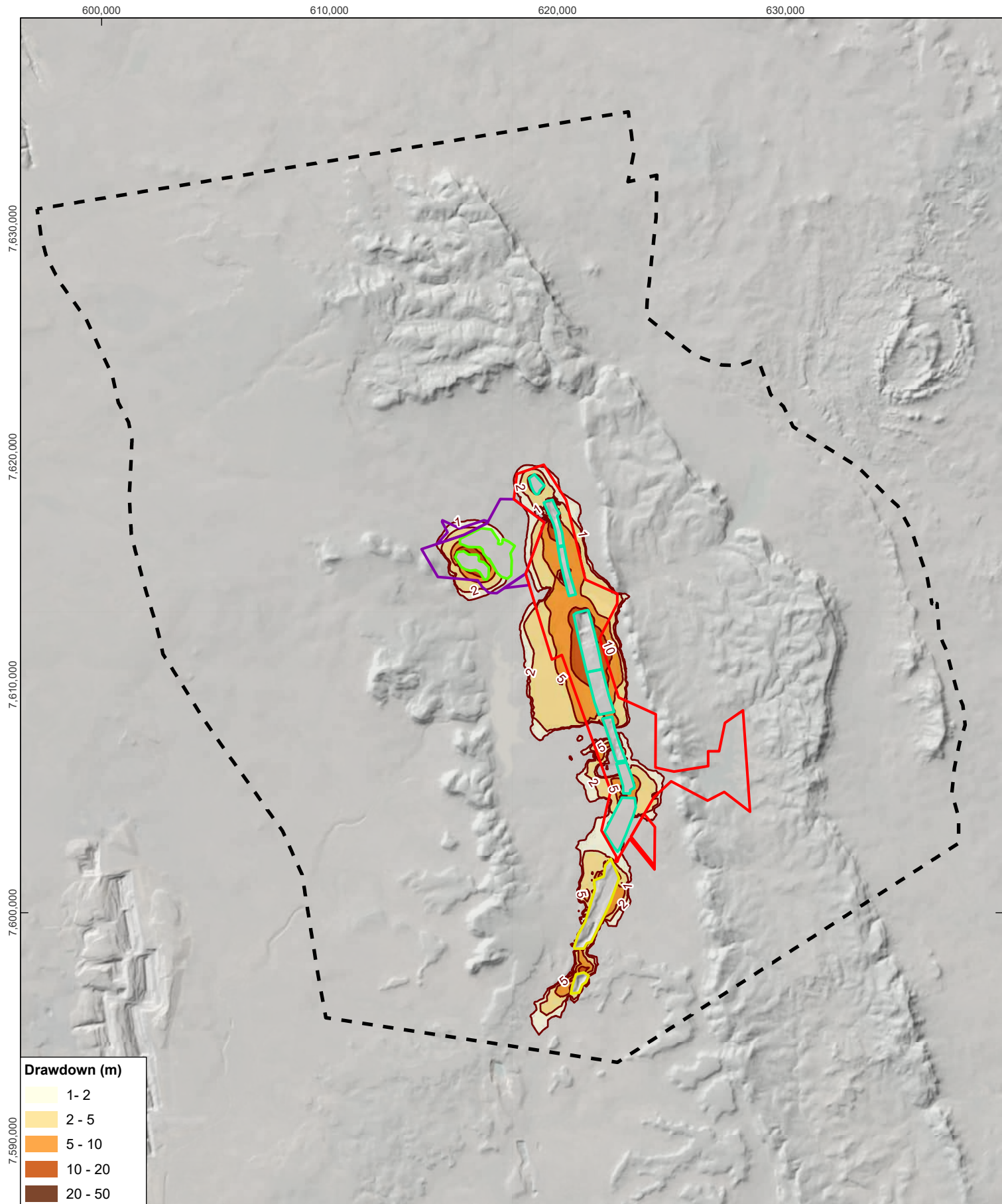
- Drawdown Contour (m)
- - - Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE ALLUVIUM (2029)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

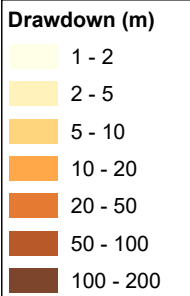
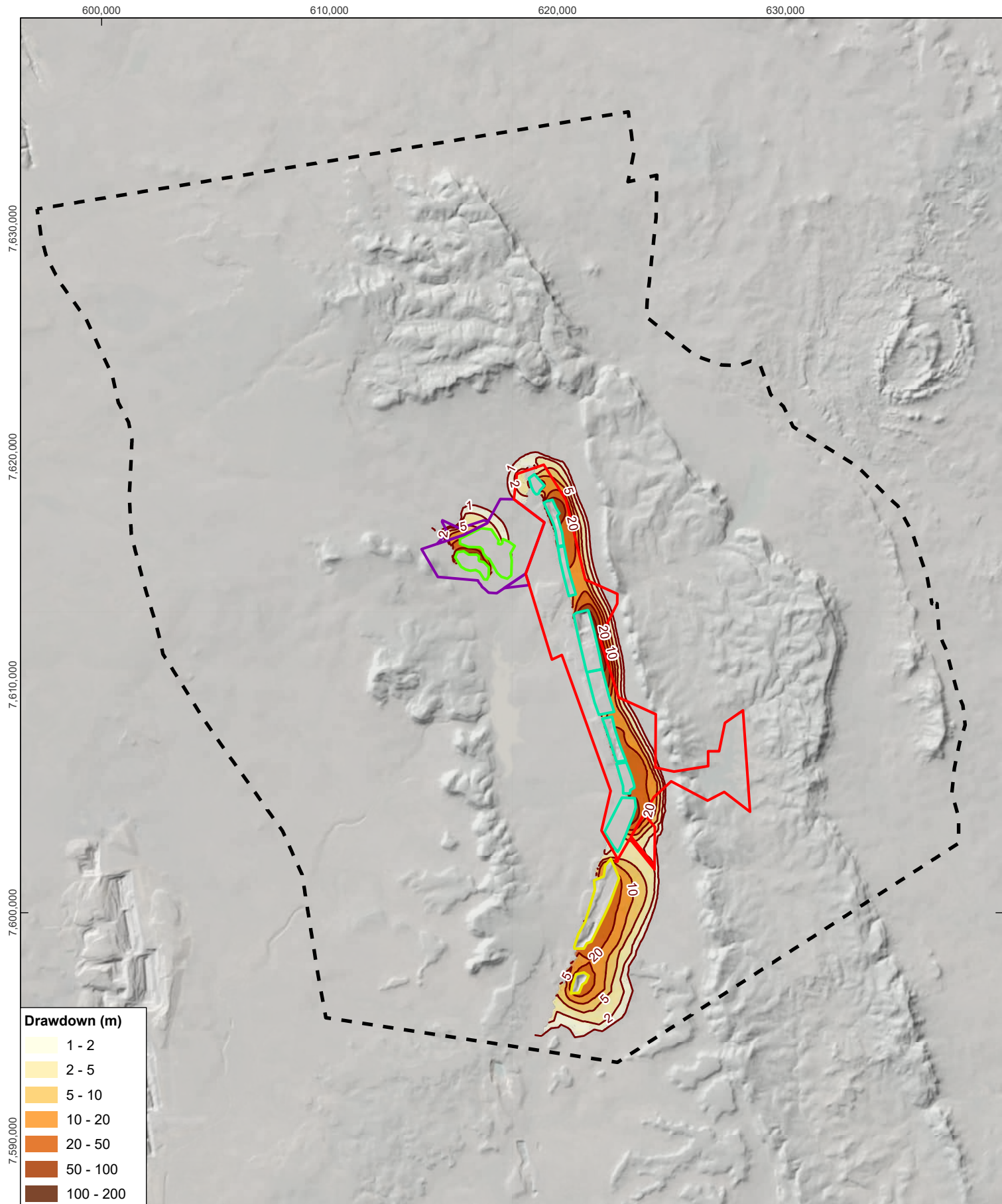
-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE REGOLITH (2029)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

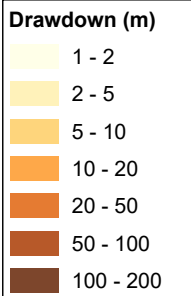
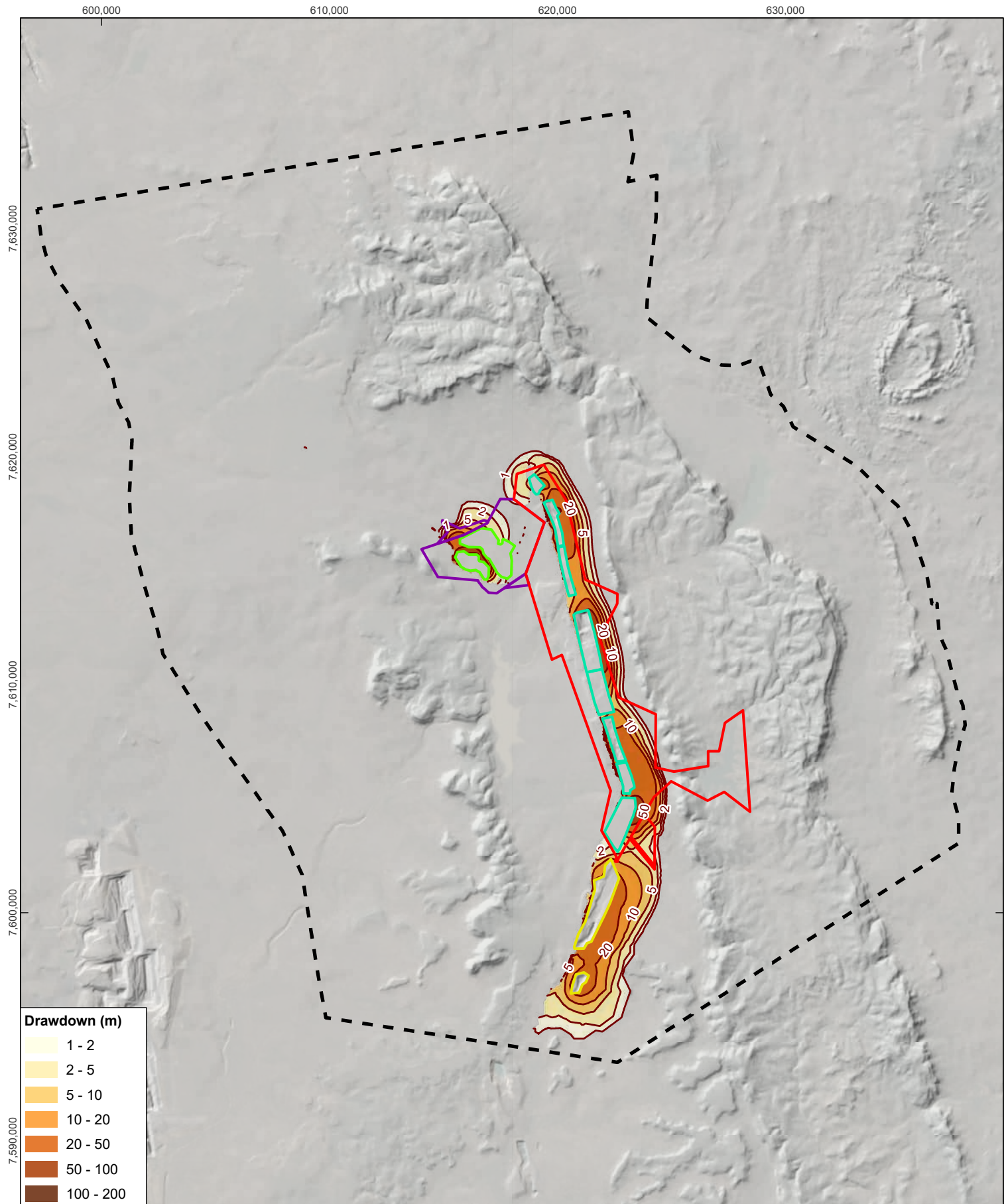
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|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE BURTON/RIDER SEAM (2029)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

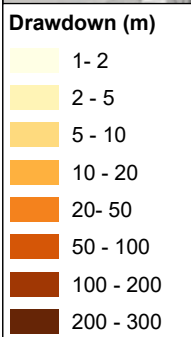
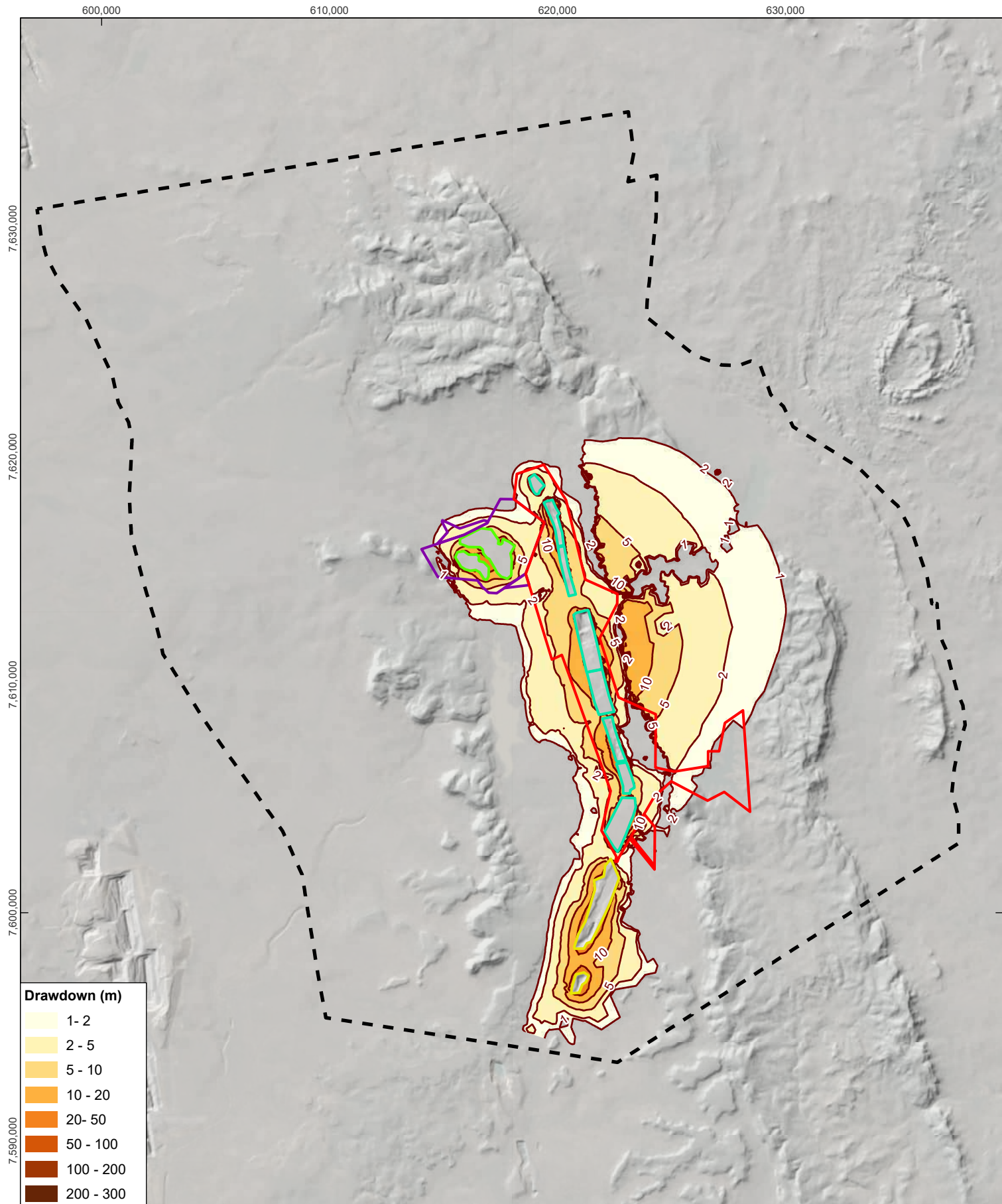
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE LEICHHARDT/VERMONT SEAM (2029)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

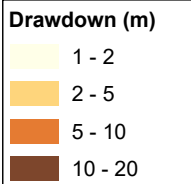
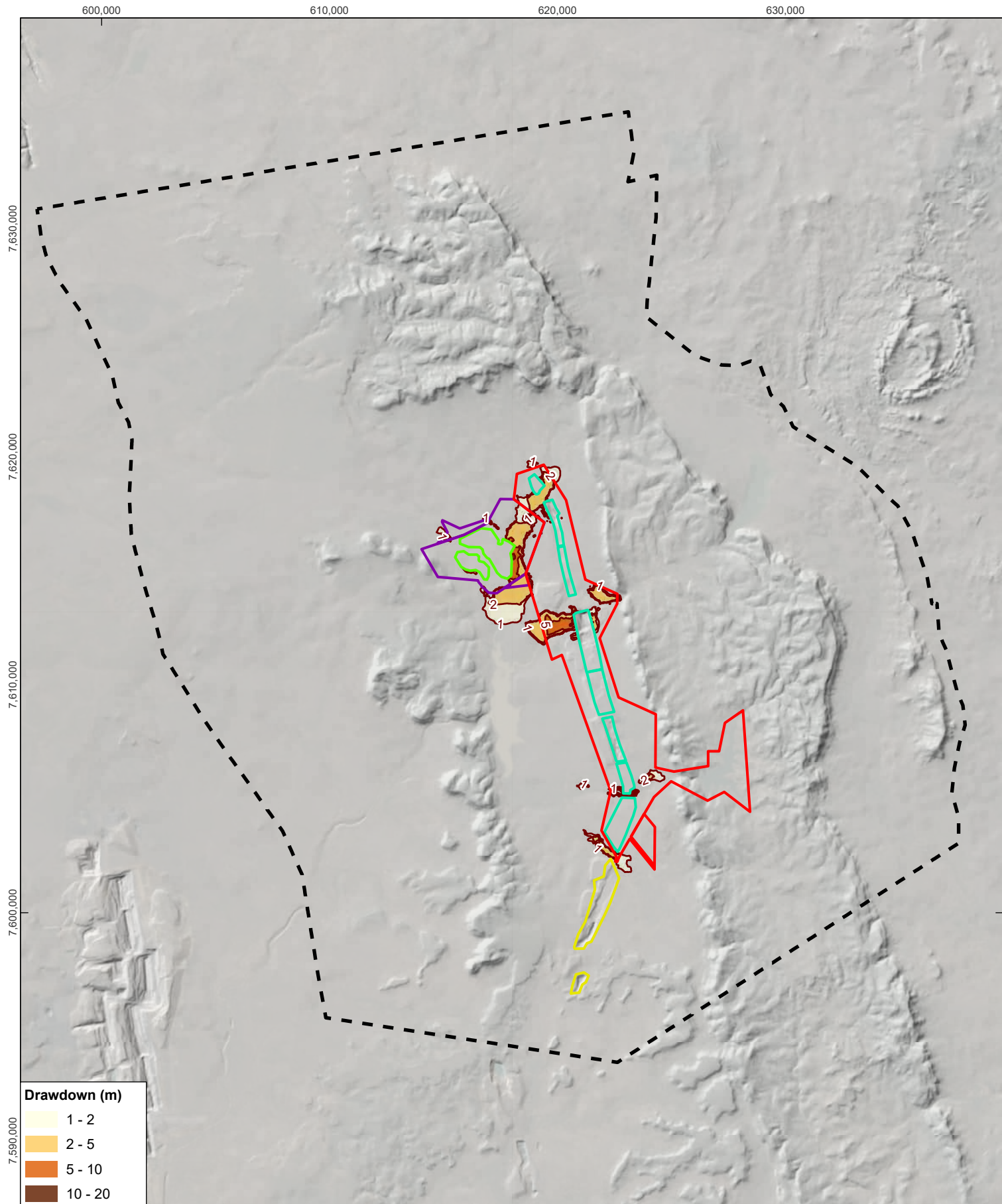
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE
WATER TABLE DRAWDOWN (2034)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 15-Dec-2023

Drawn by: AS

LEGEND

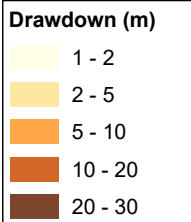
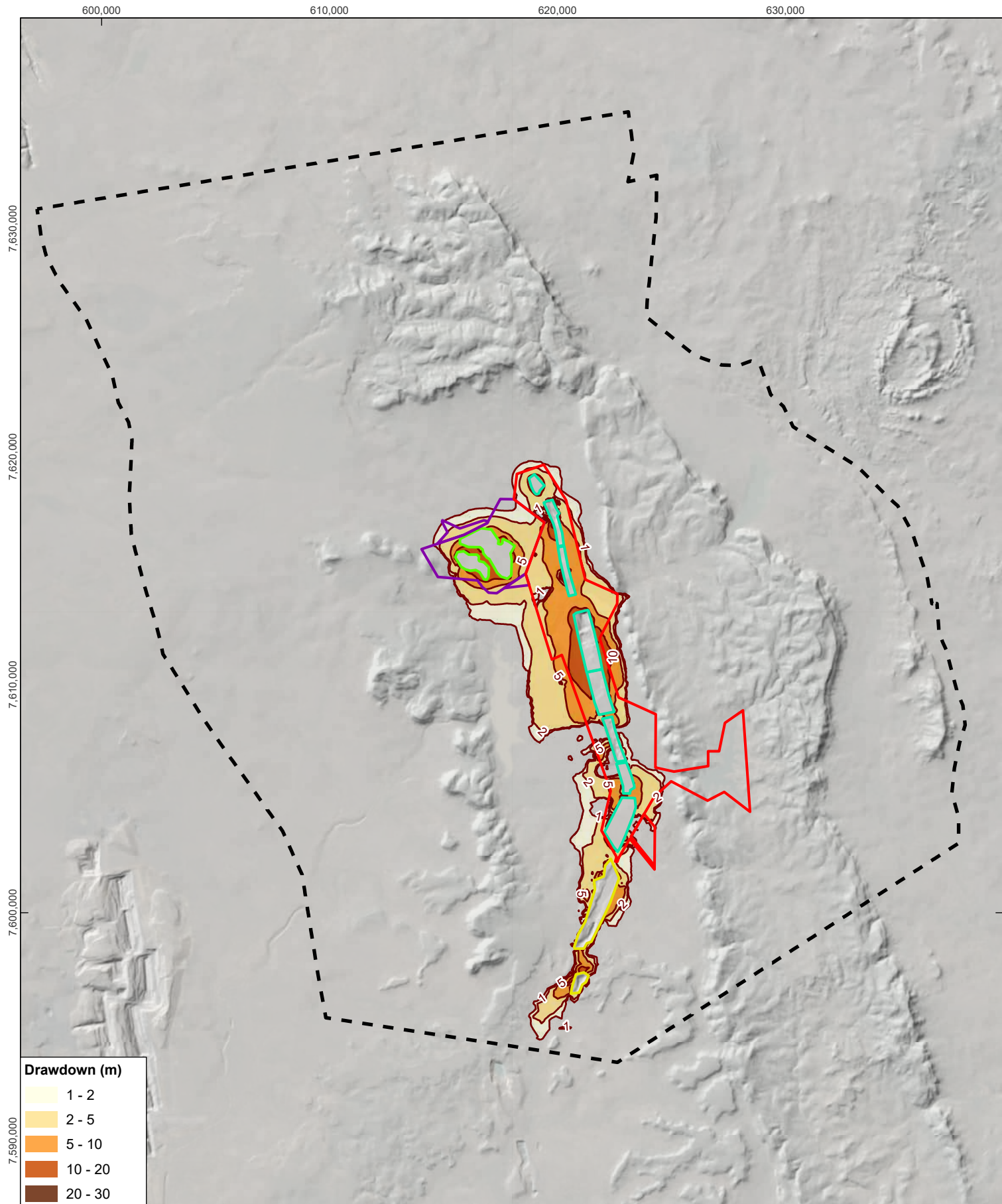
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE ALLUVIUM (2034)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

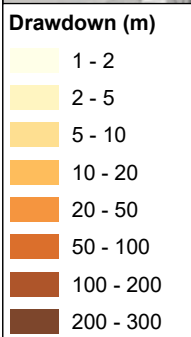
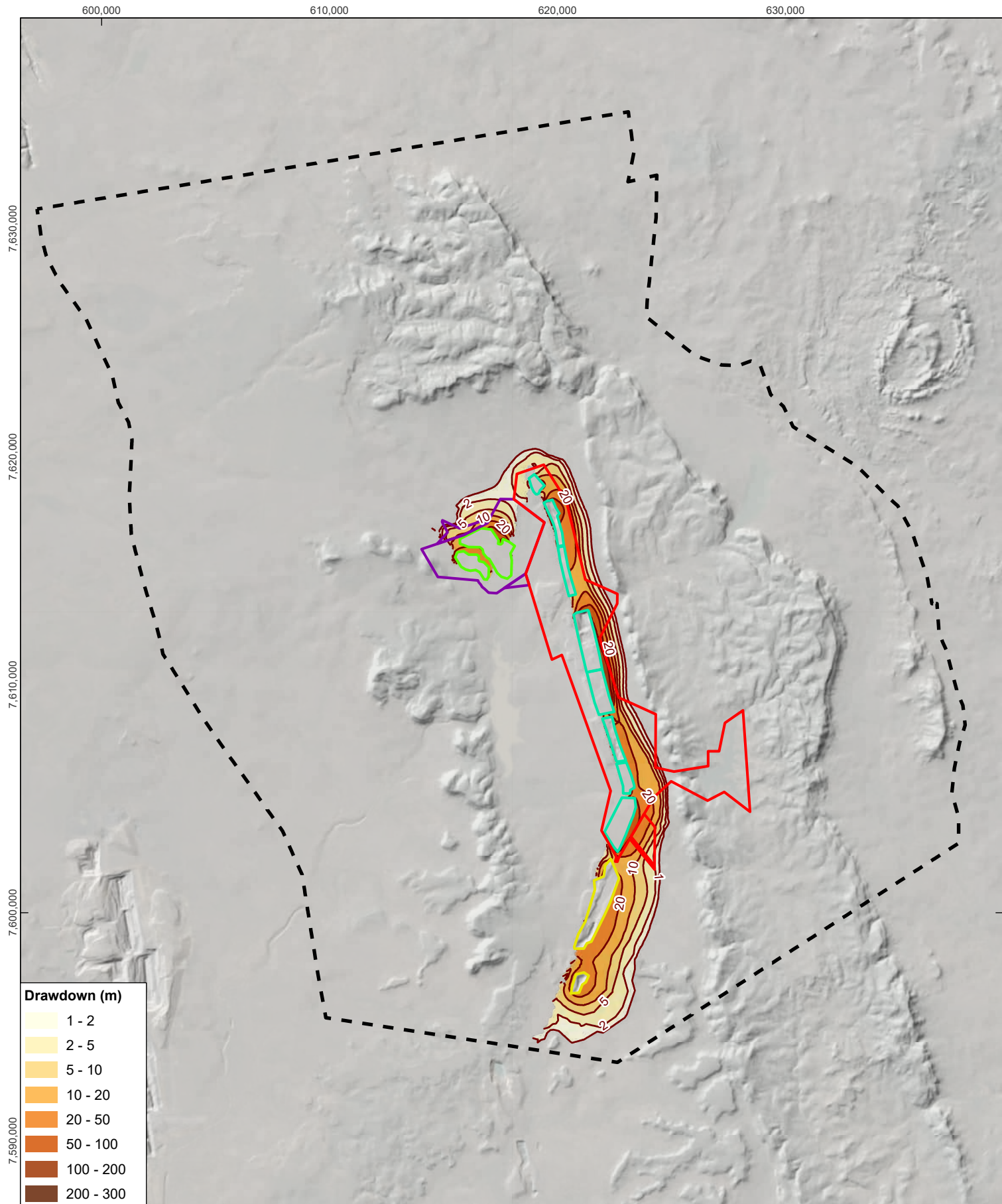
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE REGOLITH (2034)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

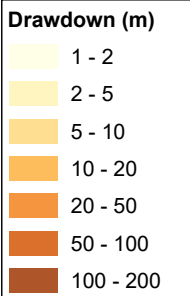
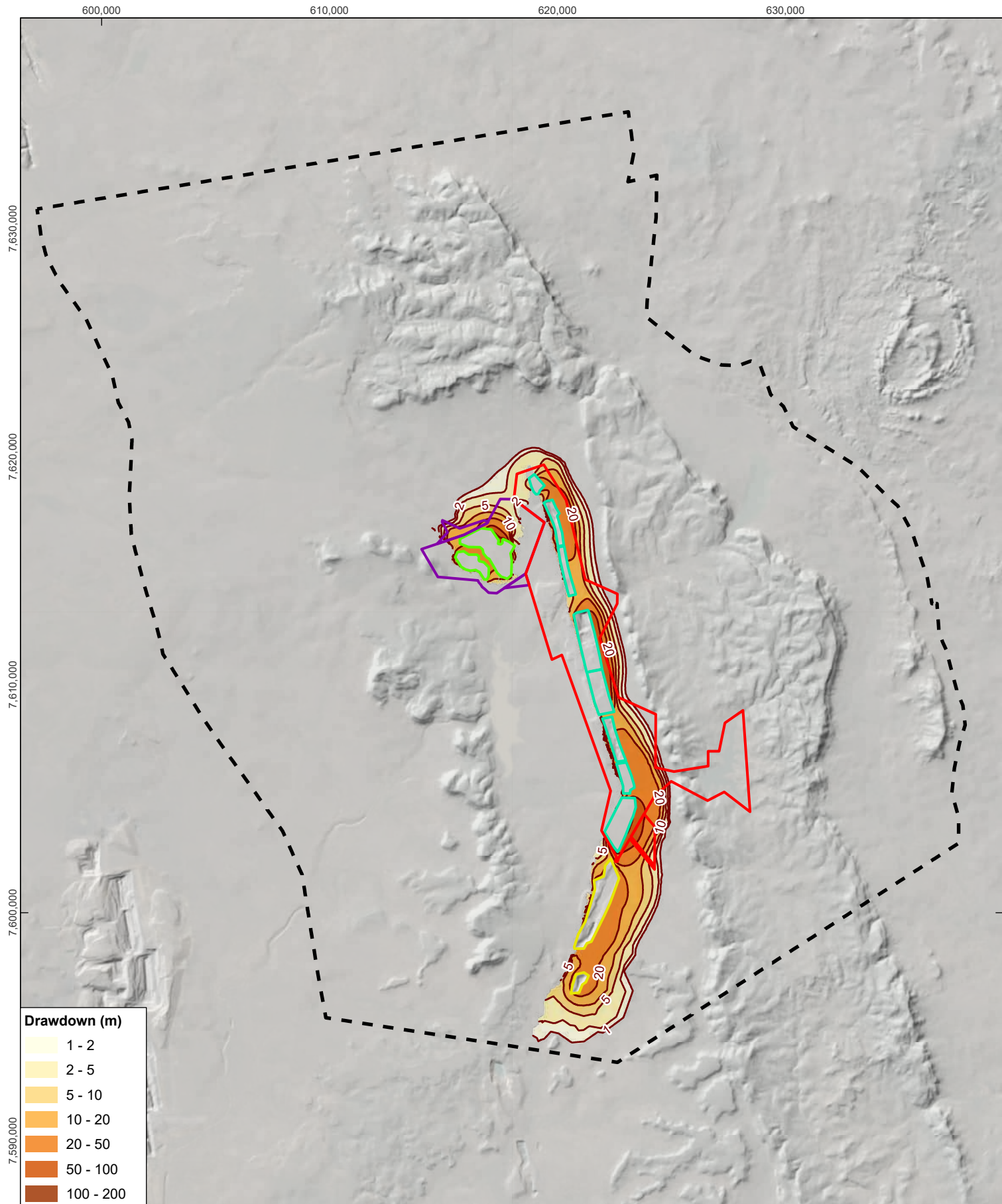
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE BURTON/RIDER SEAM (2034)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

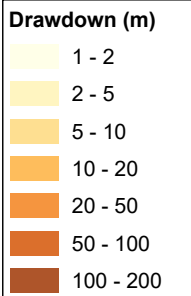
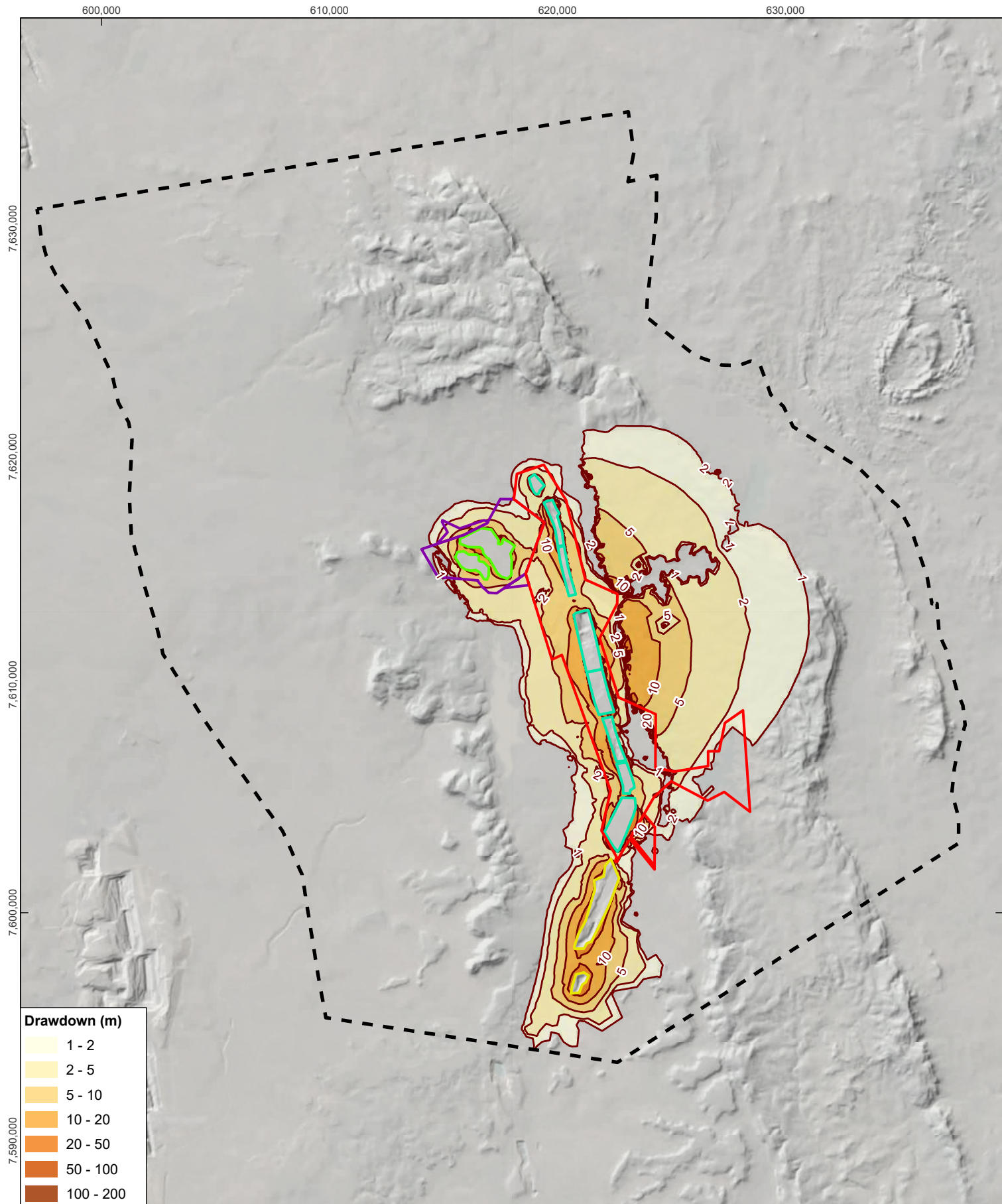
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE LEICHHARDT/VERMONT SEAM (2034)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

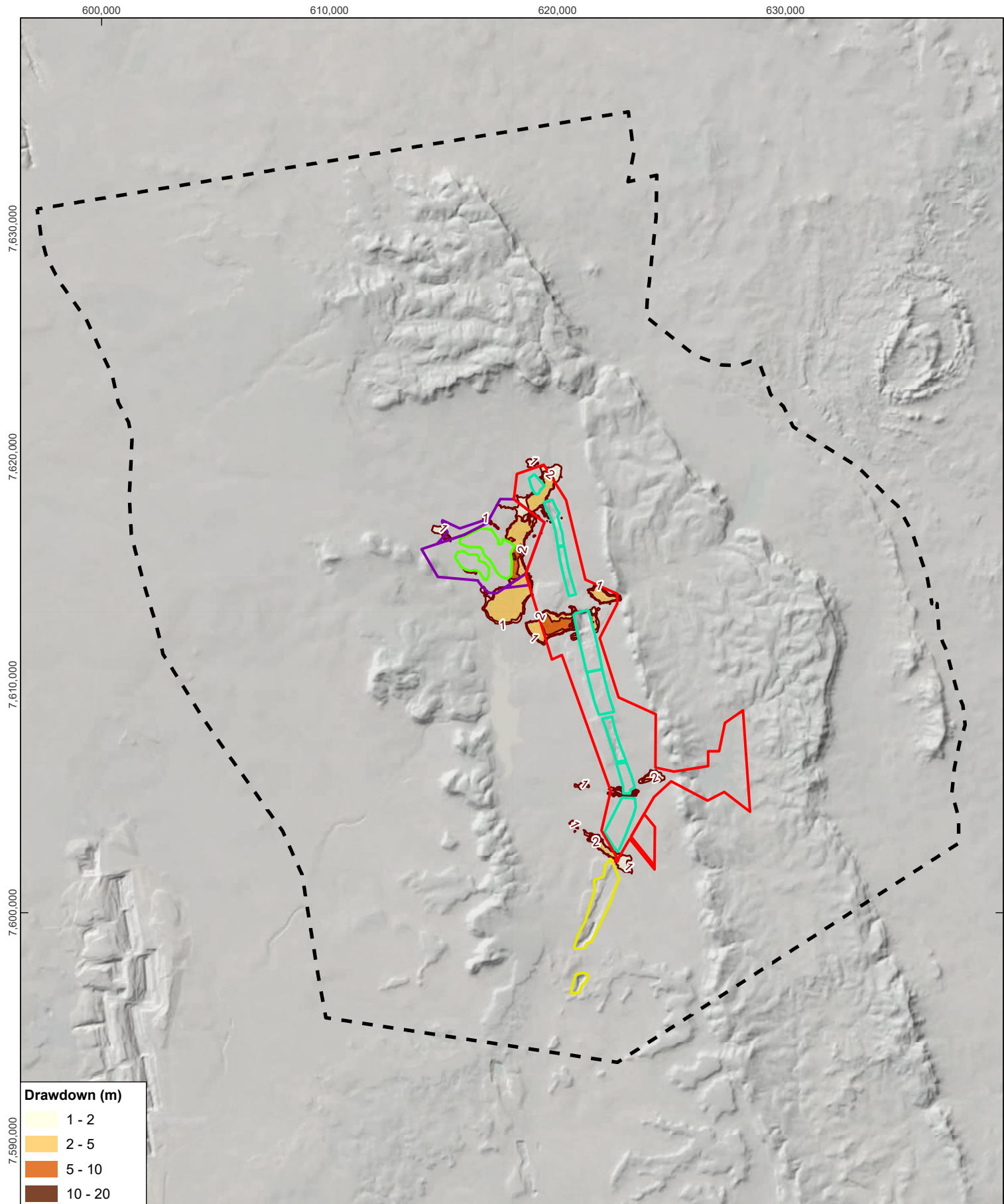
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE
WATER TABLE DRAWDOWN (2039)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 15-Dec-2023

Drawn by: AS

LEGEND

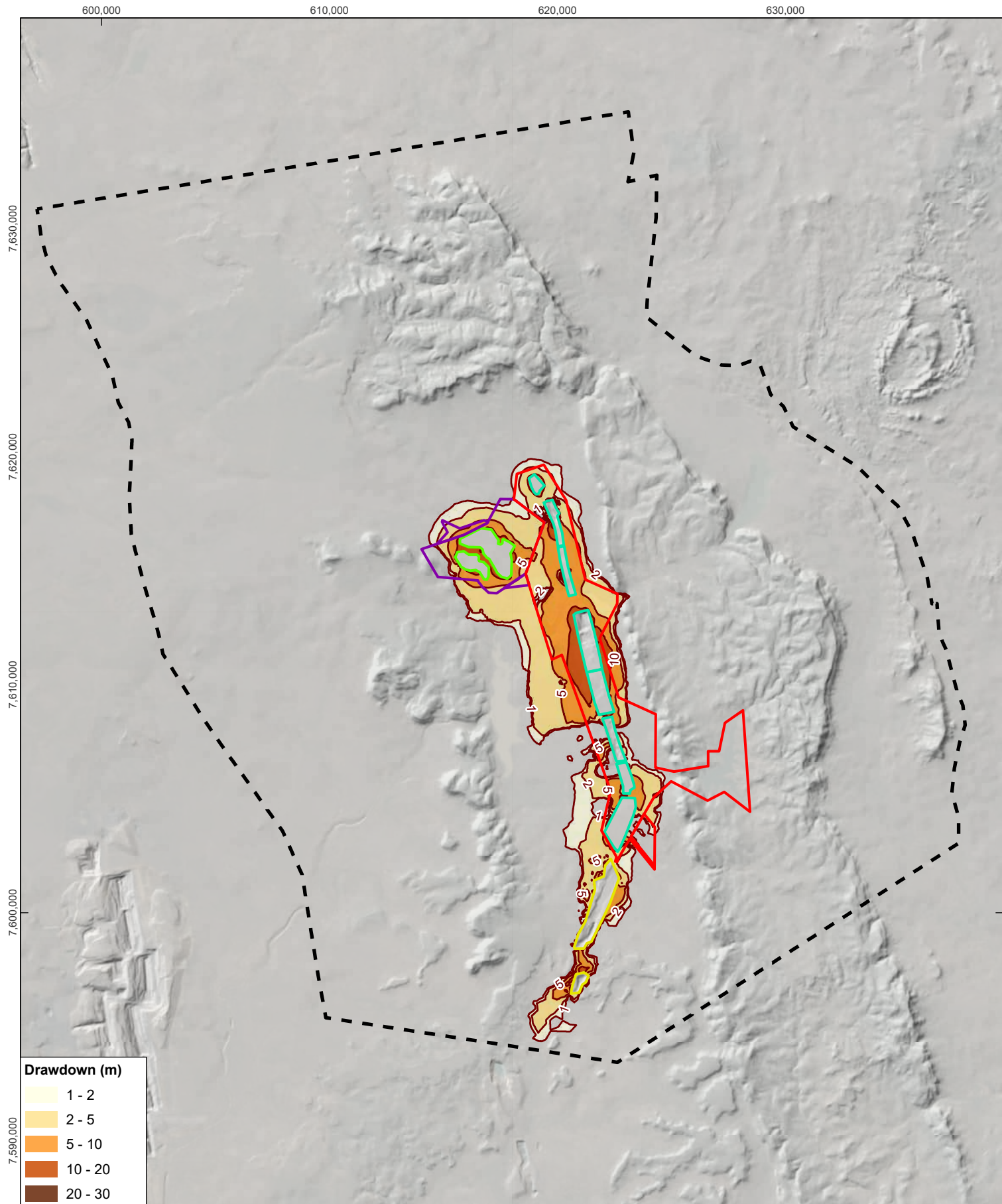
- Drawdown Contour (m)
- - - Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

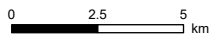
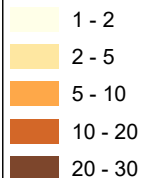
PREDICTED CUMULATIVE DRAWDOWN IN THE ALLUVIUM (2039)



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Drawdown (m)



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

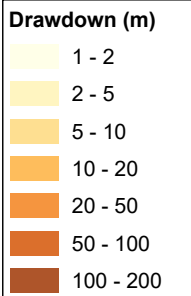
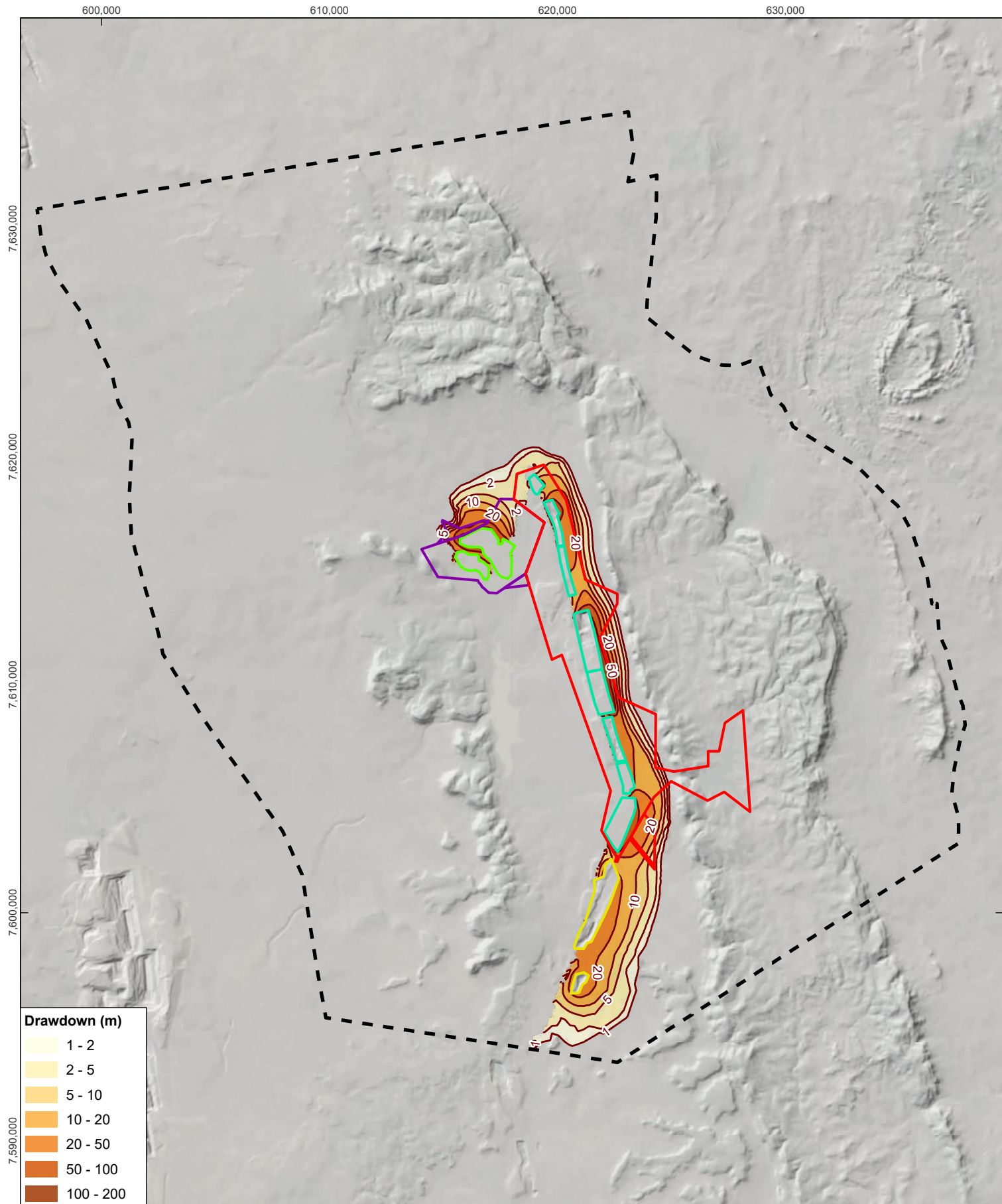
- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED CUMULATIVE DRAWDOWN IN THE REGOLITH (2039)



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

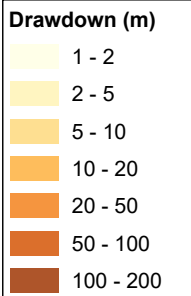
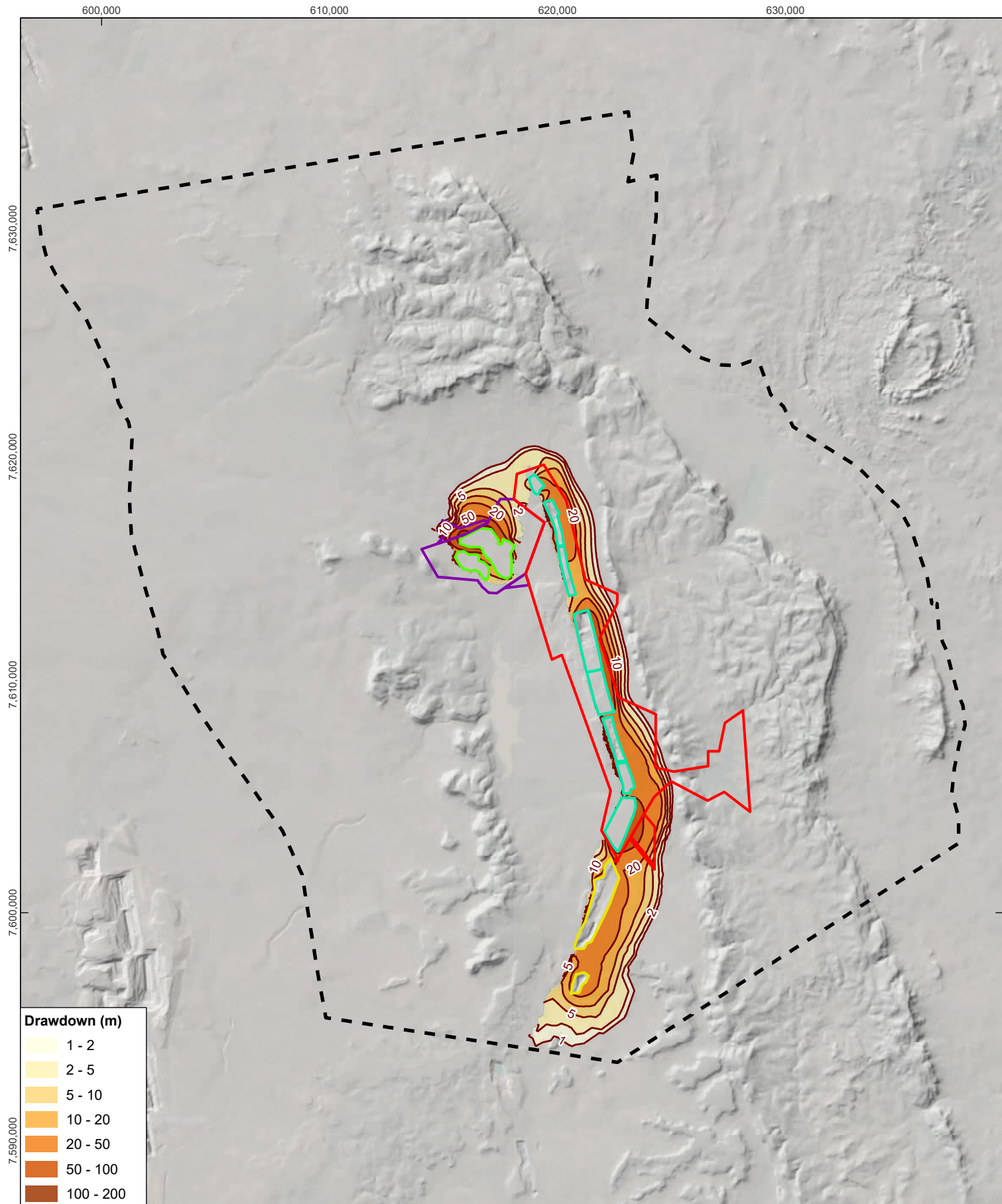
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE BURTON/RIDER SEAM (2039)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

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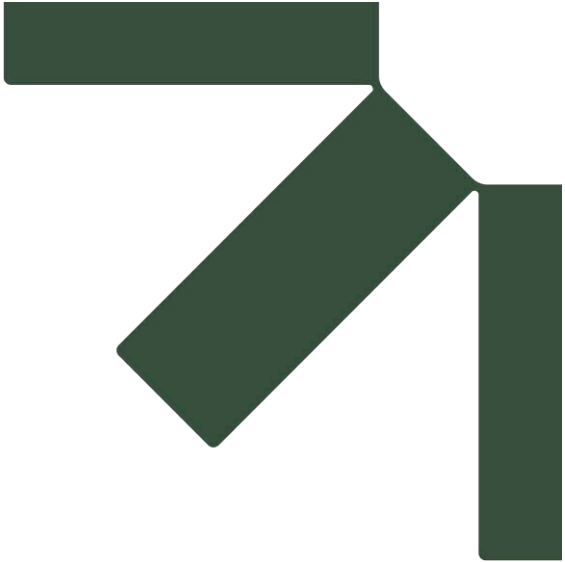
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE LEICHHARDT/VERMONT SEAM (2039)**



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Appendix F Predicted Drawdowns

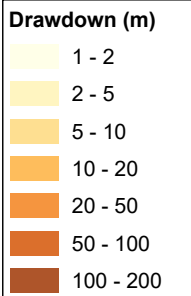
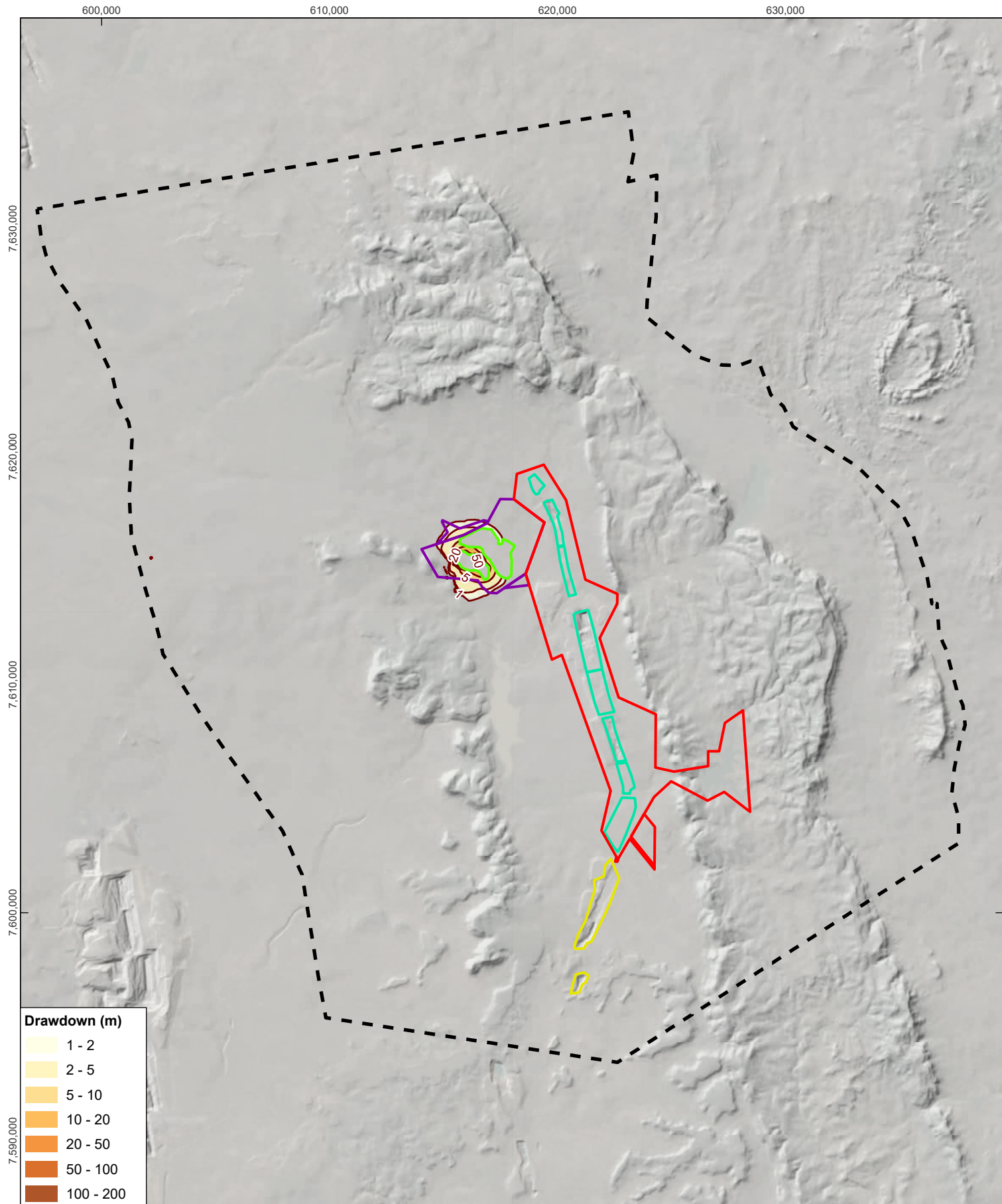
New Lenton & Burton

2023 Groundwater Modelling Technical Report

Lenton Joint Venture

SLR Project No.: 620.31367.00000

11 September 2024



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

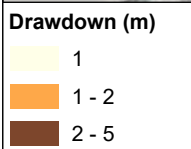
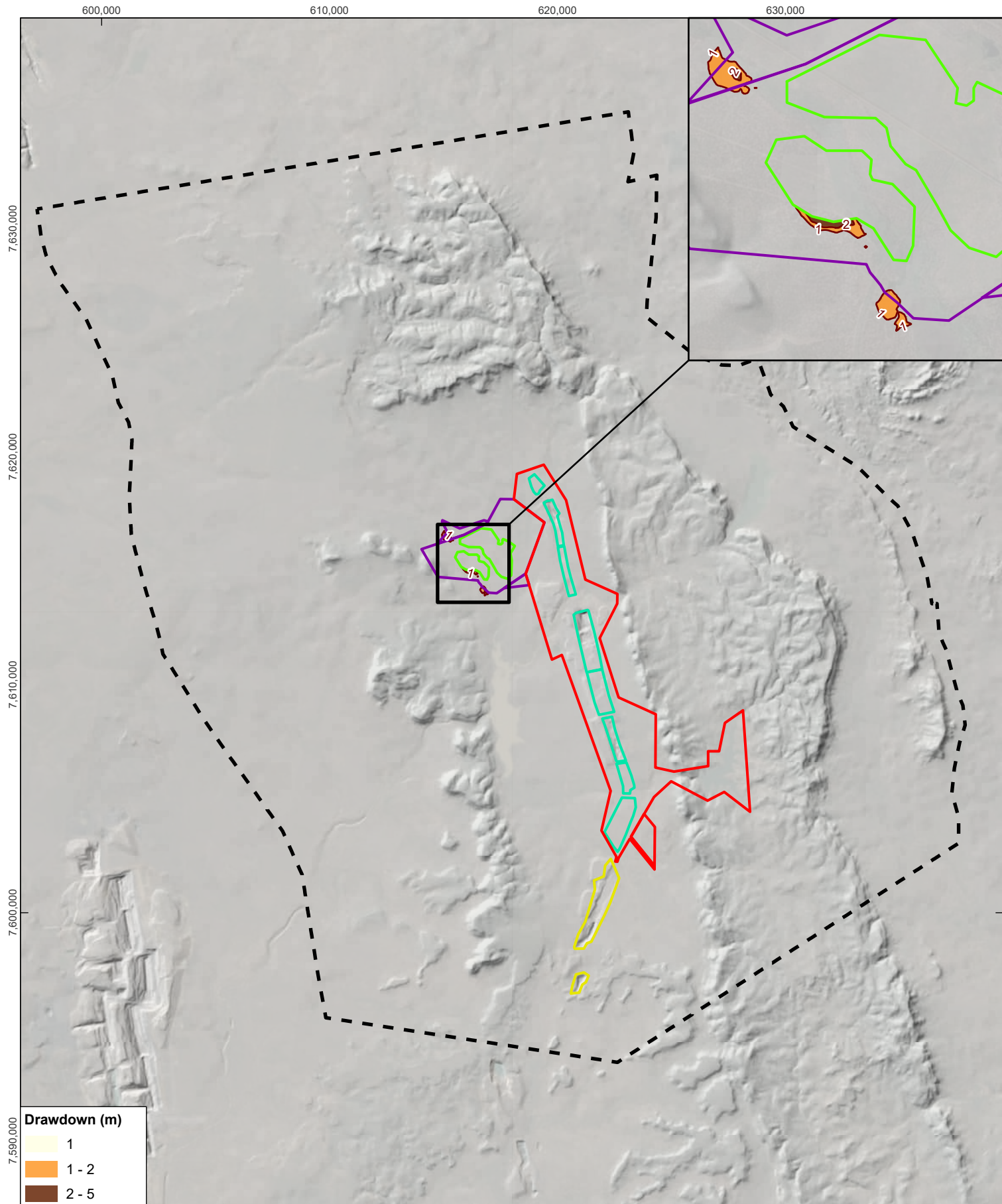
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
WATER TABLE DRAWDOWN (2029)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

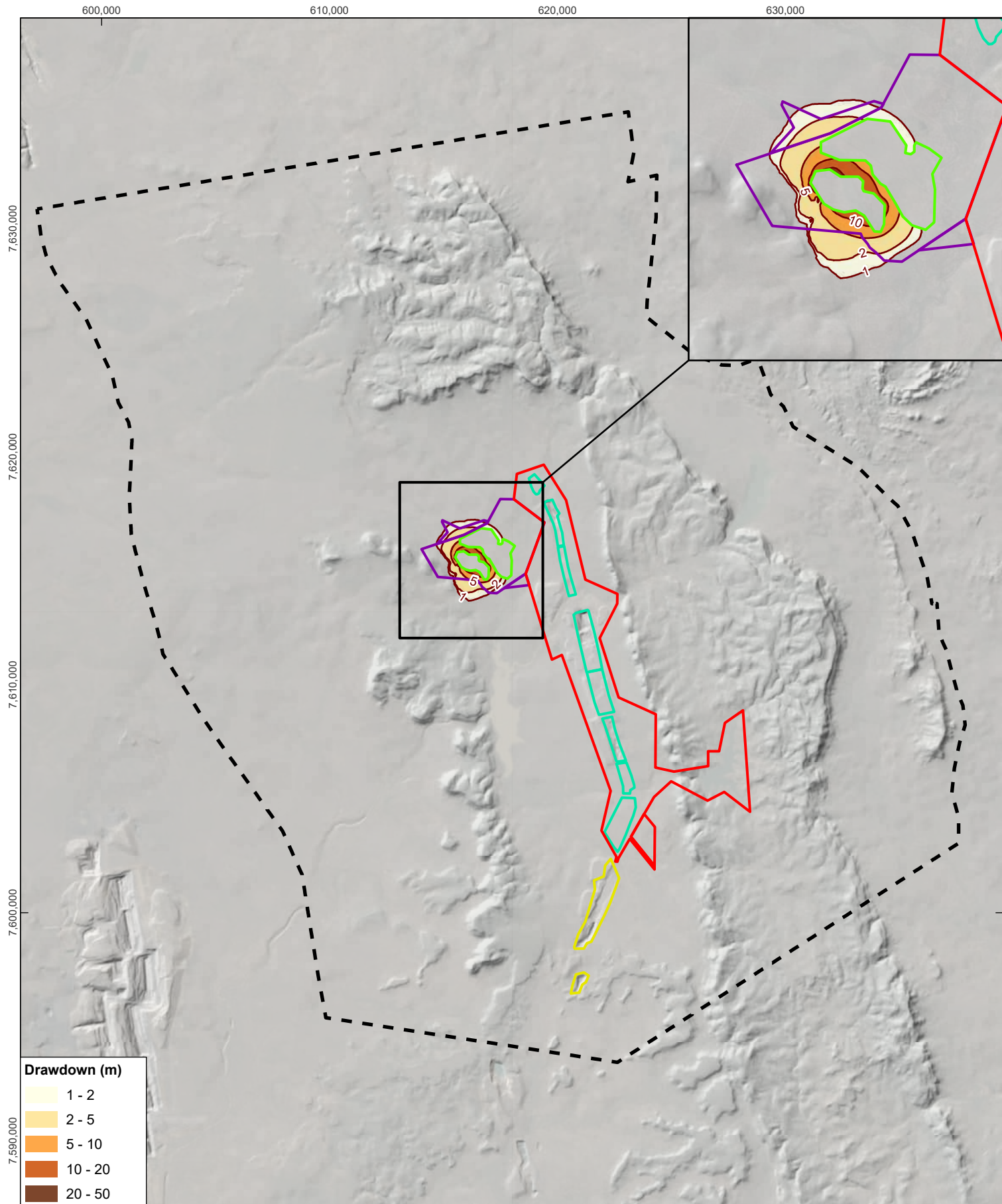
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

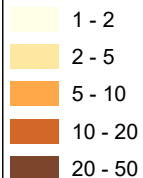
PREDICTED INCREMENTAL DRAWDOWN IN THE ALLUVIUM (2029)



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Drawdown (m)



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

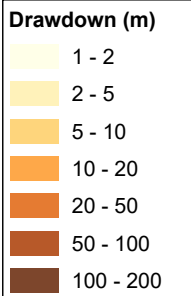
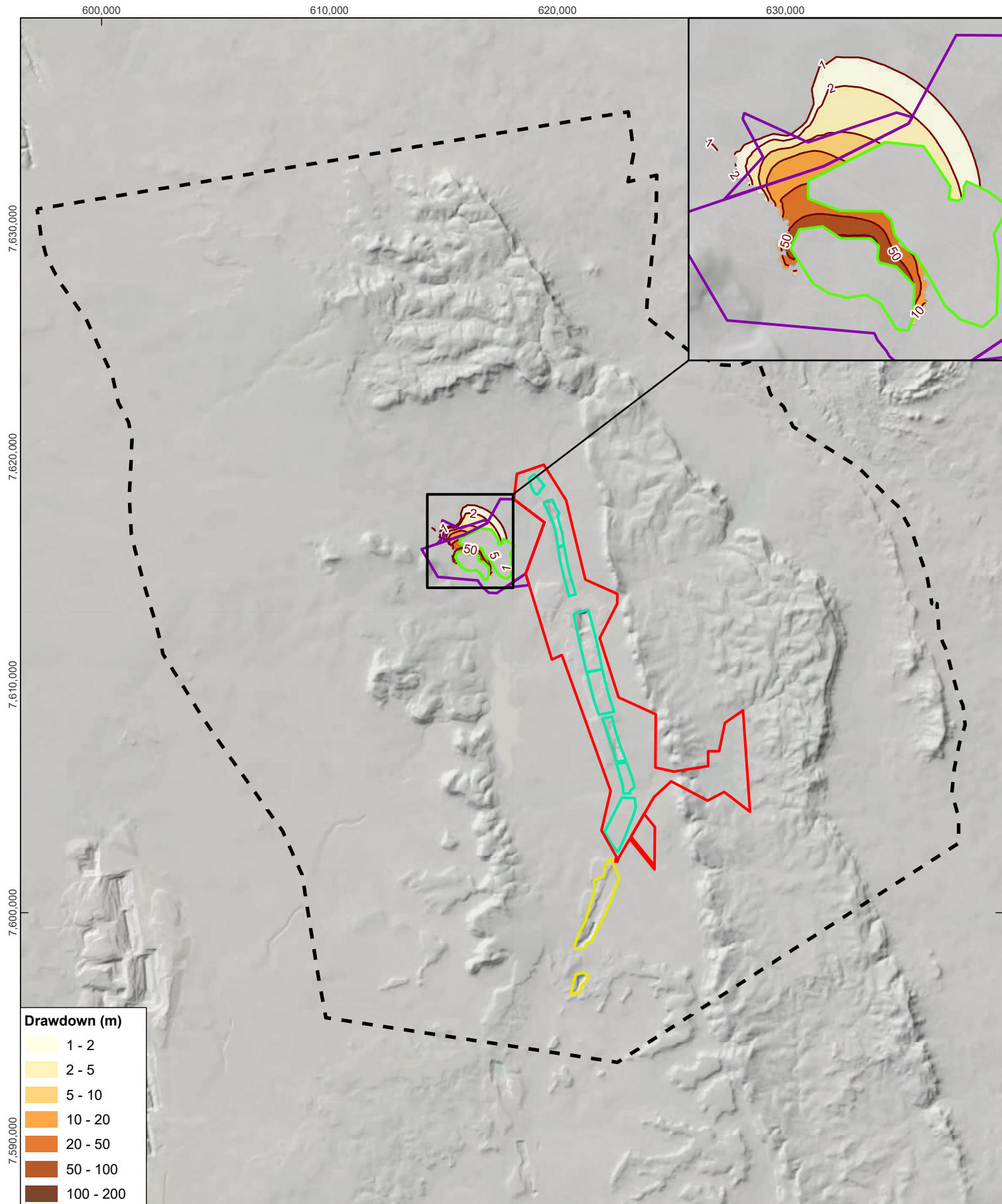
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL DRAWDOWN
IN THE REGOLITH (2029)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
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 Date Drawn: 18-Dec-2023
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LEGEND

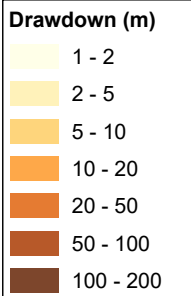
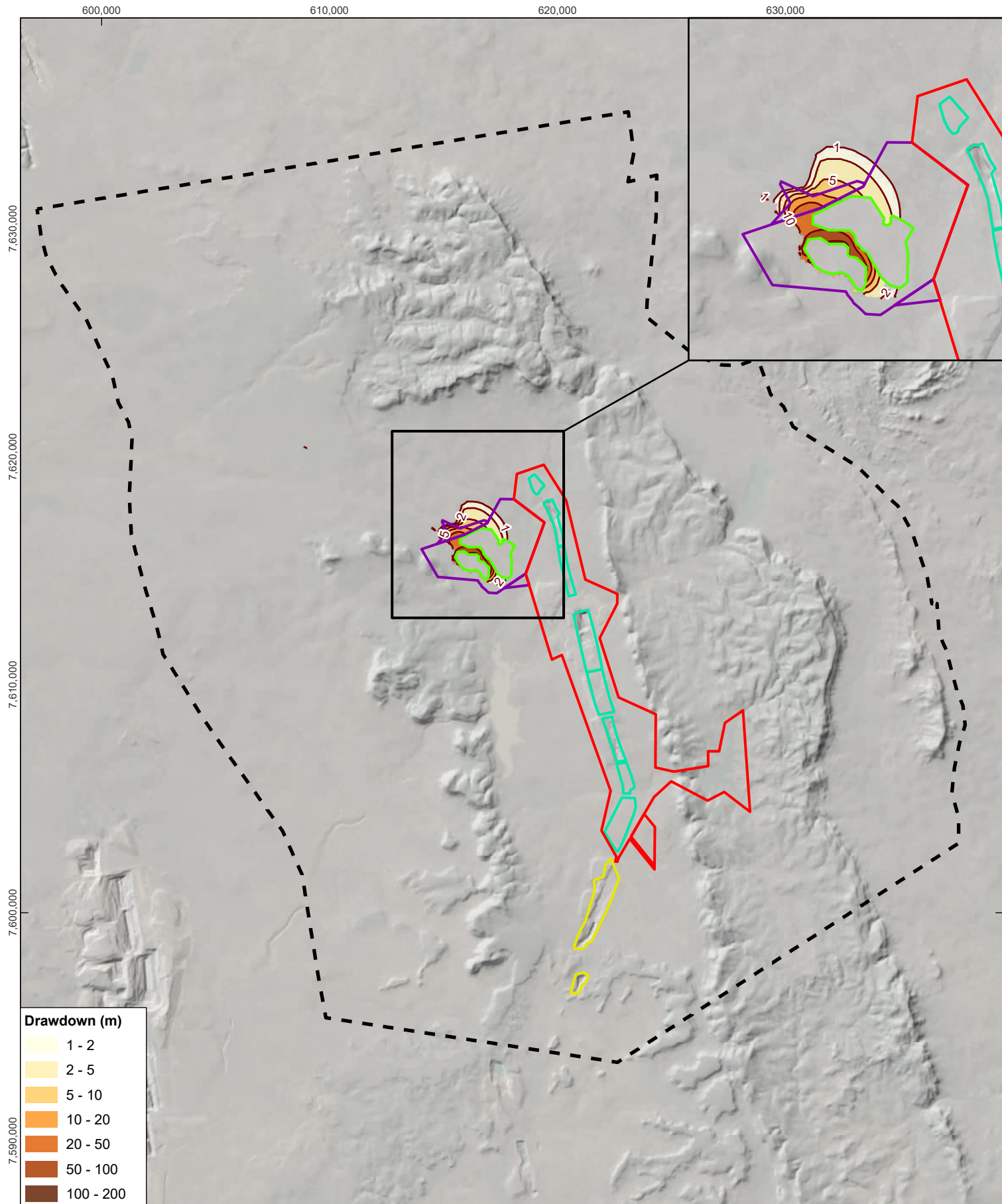
- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL DRAWDOWN
IN THE BURTON/RIDER SEAM (2029)**



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 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
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LEGEND

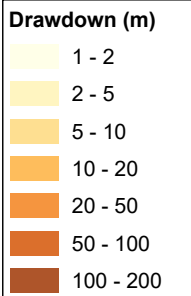
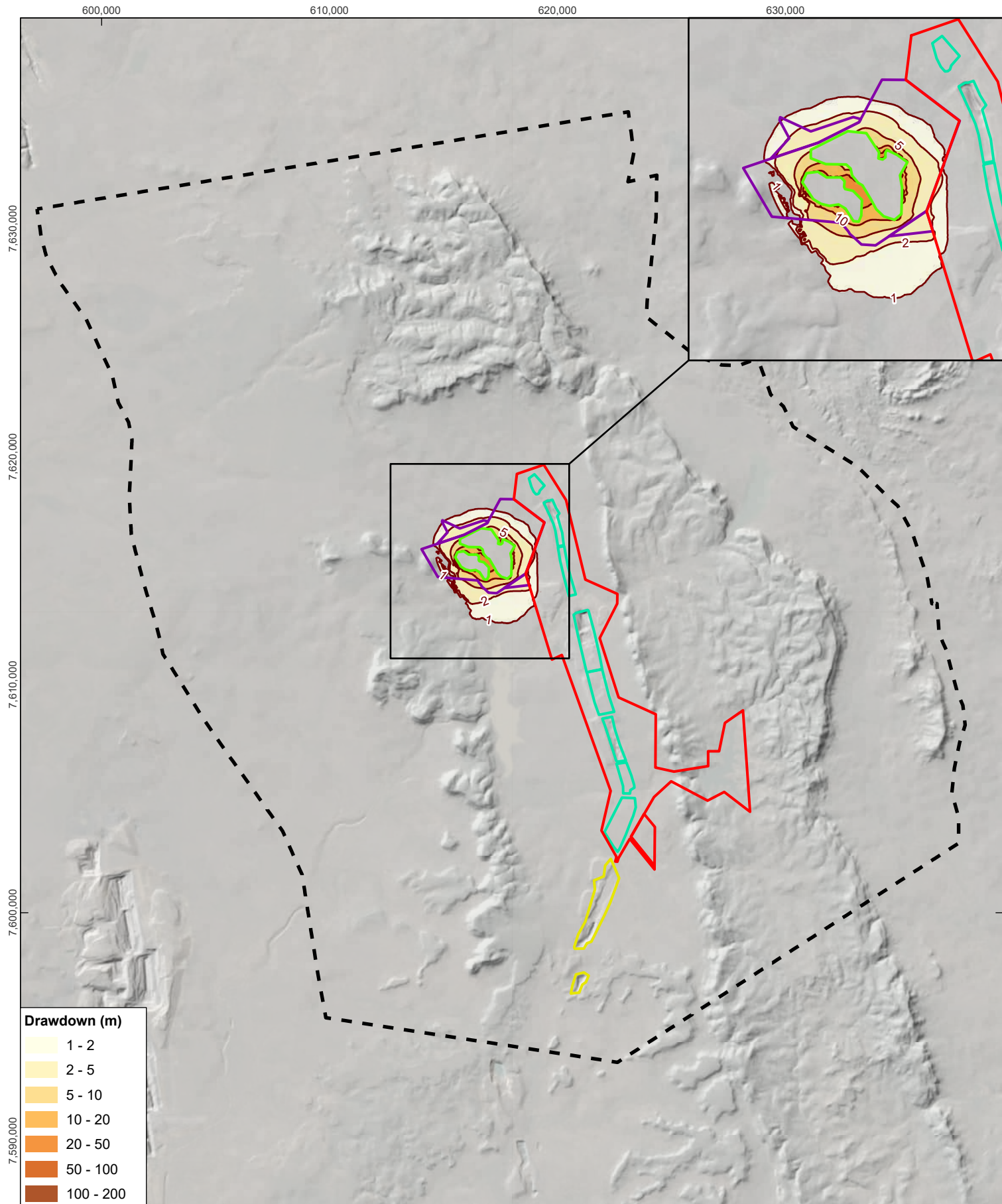
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE LEICHHARDT/VERMONT SEAM (2029)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

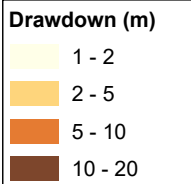
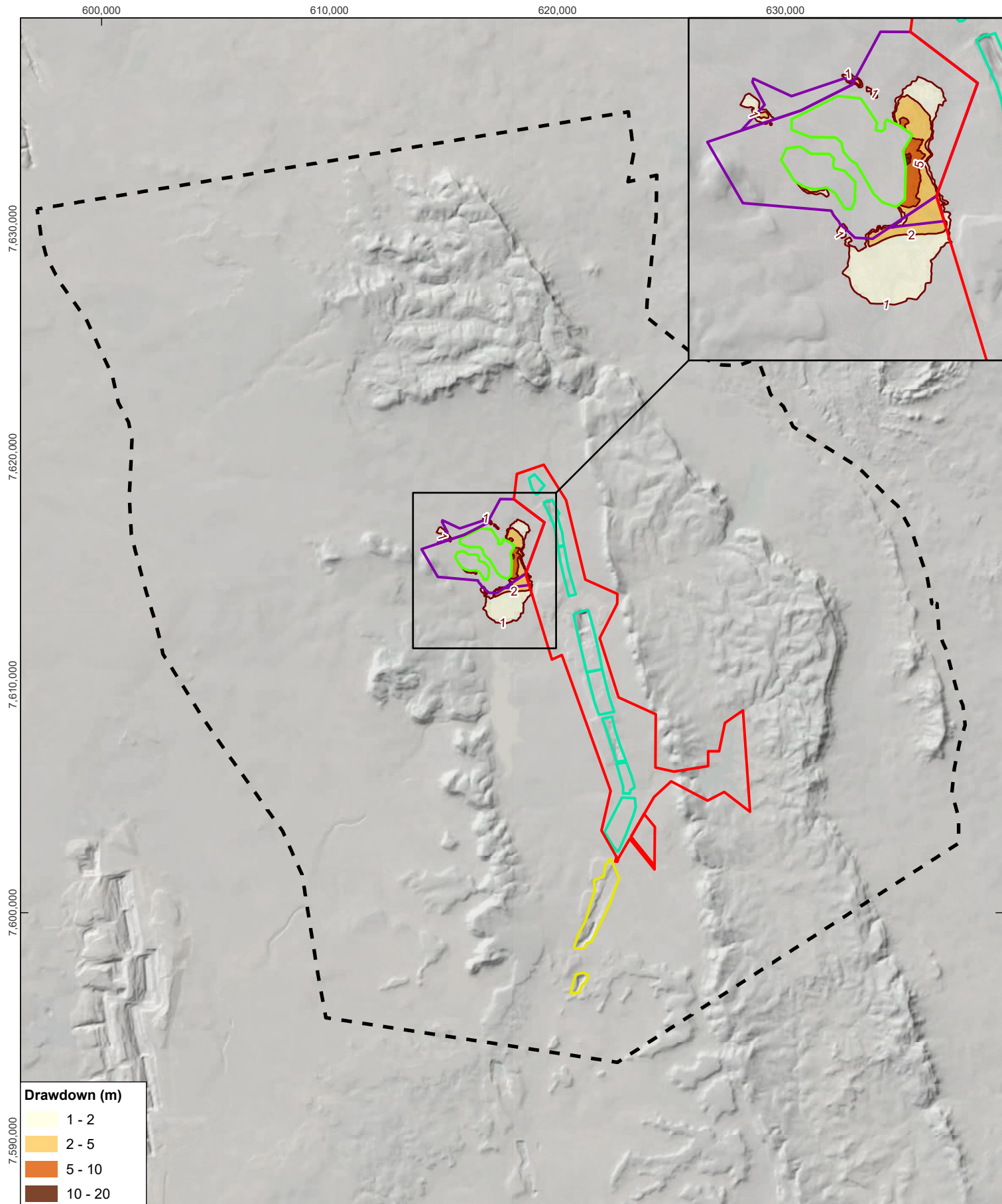
-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL WATER TABLE DRAWDOWN (2034)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

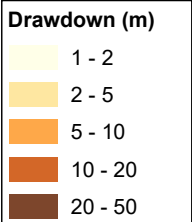
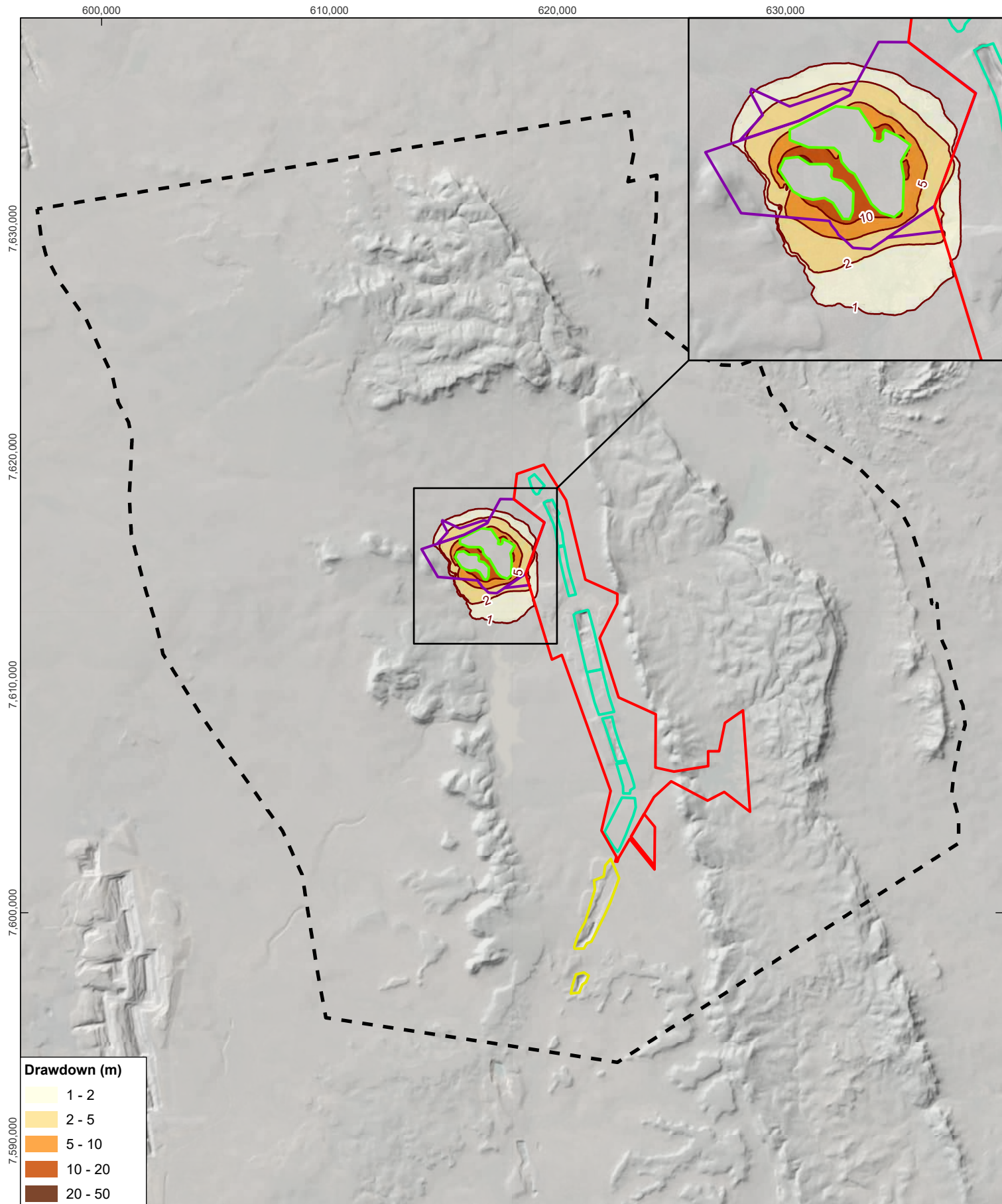
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
DRAWDOWN IN THE ALLUVIUM (2034)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

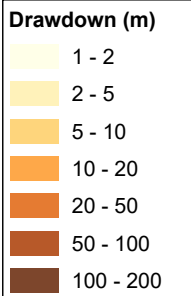
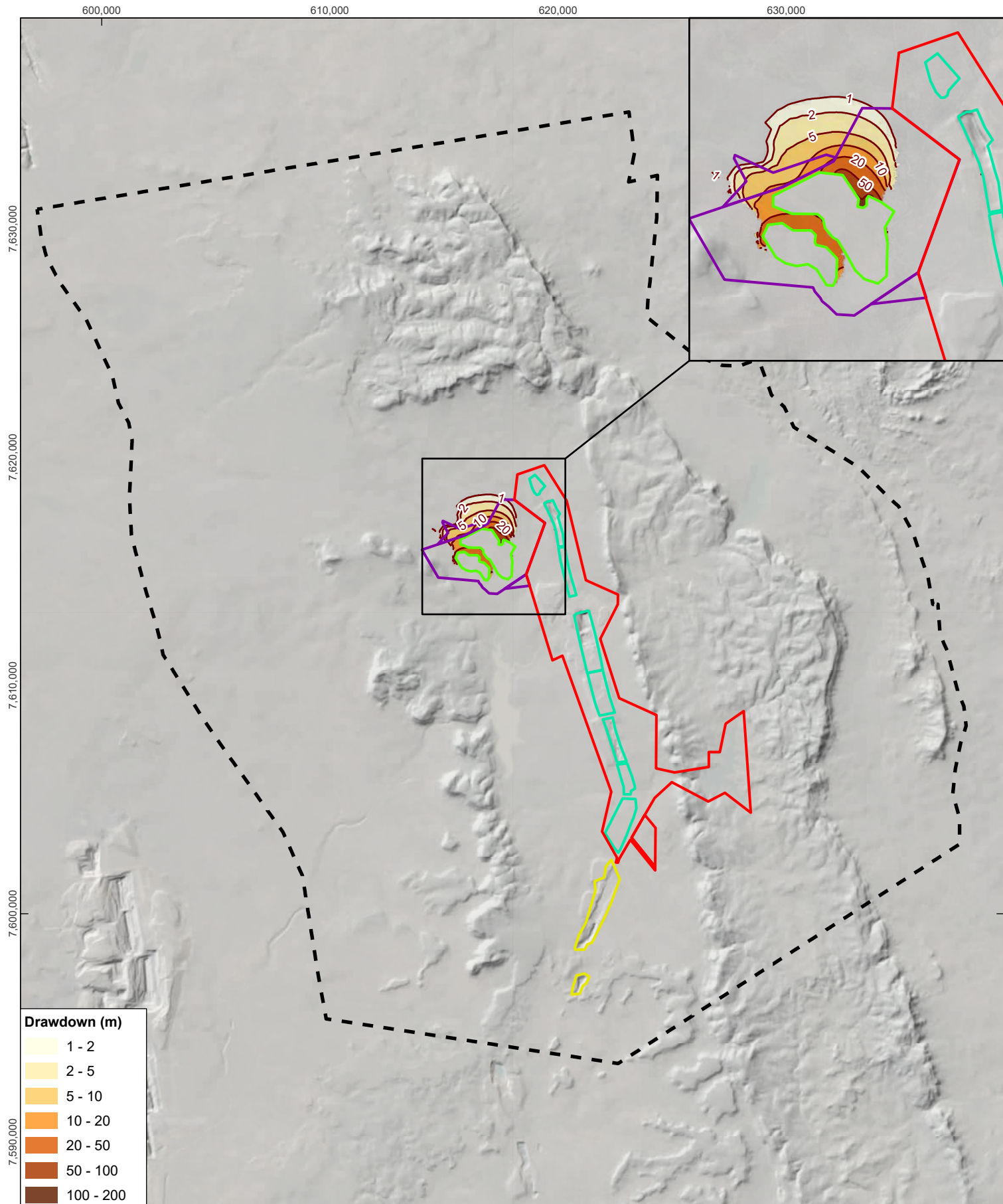
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
DRAWDOWN IN THE REGOLITH (2034)**



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	0 2.5 5 km
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:220,000 at A4
Project Number:	620.31208.00000
Date Drawn:	18-Dec-2023
Drawn by:	AS

LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

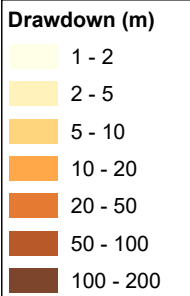
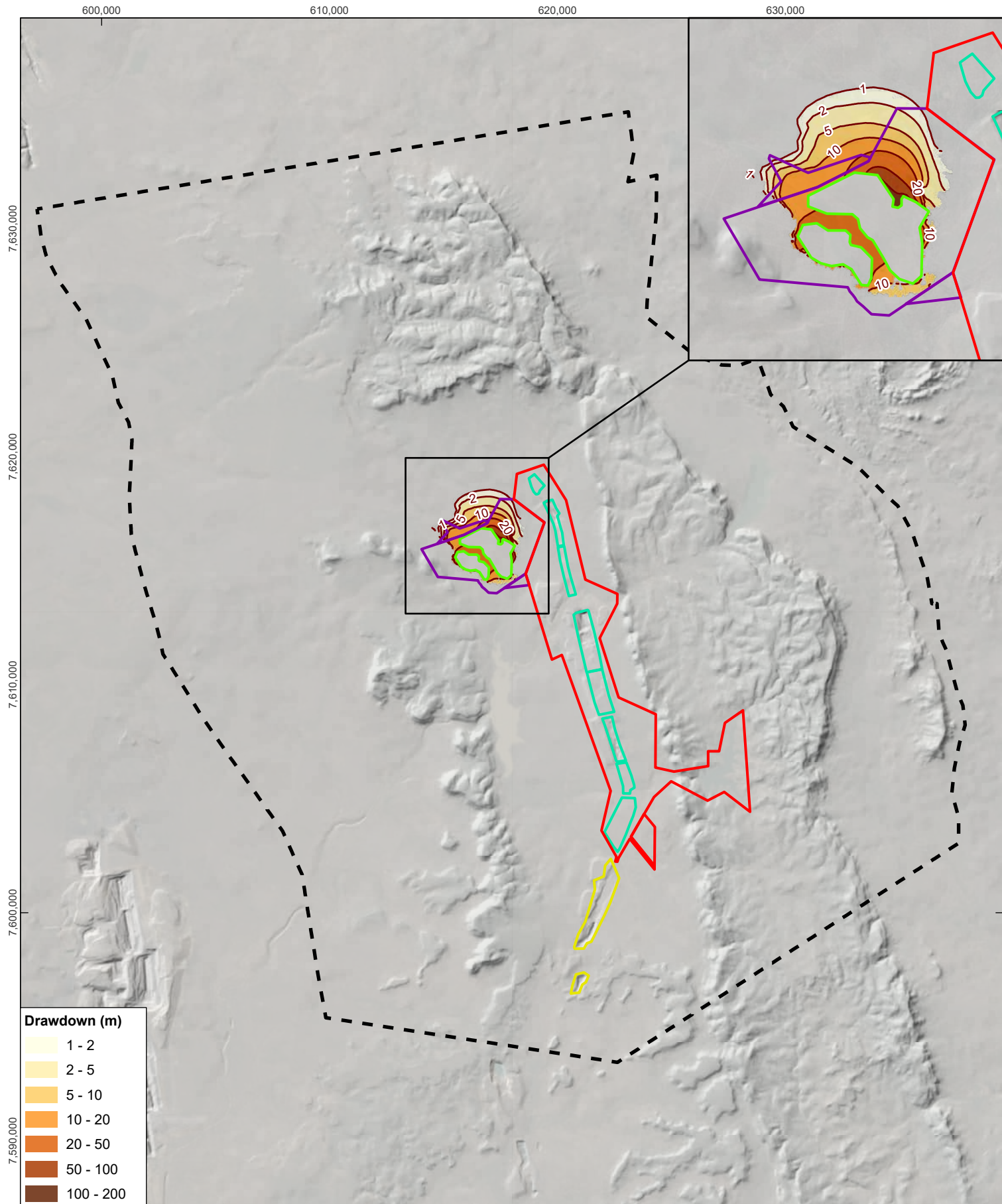
BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE BURTON/RIDER SEAM (2034)



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APPENDIX F-9



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

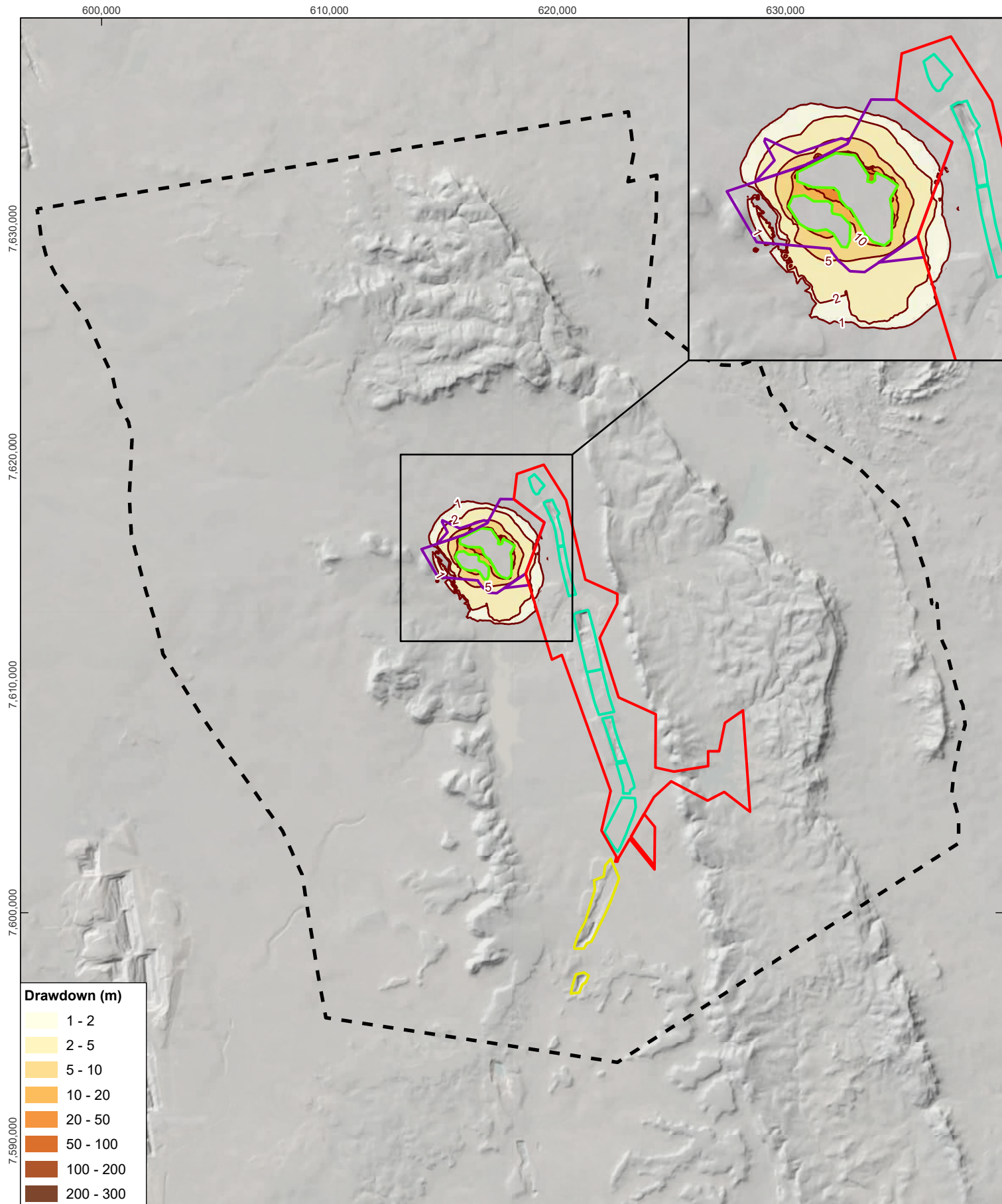
**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
DRAWDOWN IN THE
LEICHHARDT/VERMONT SEAM (2034)**



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APPENDIX F-10



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

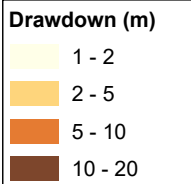
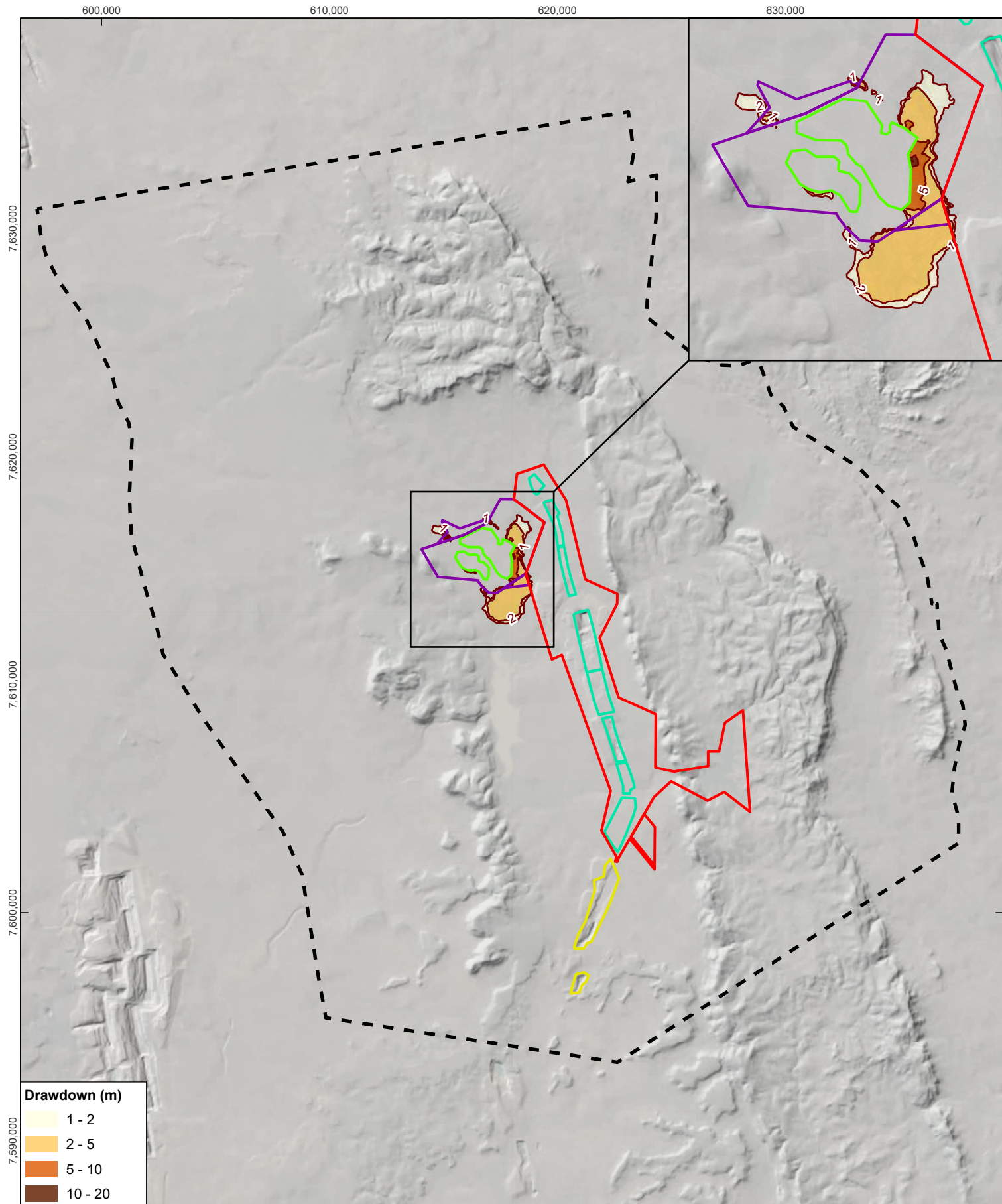
-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL WATER TABLE DRAWDOWN (2039)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

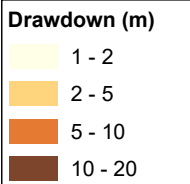
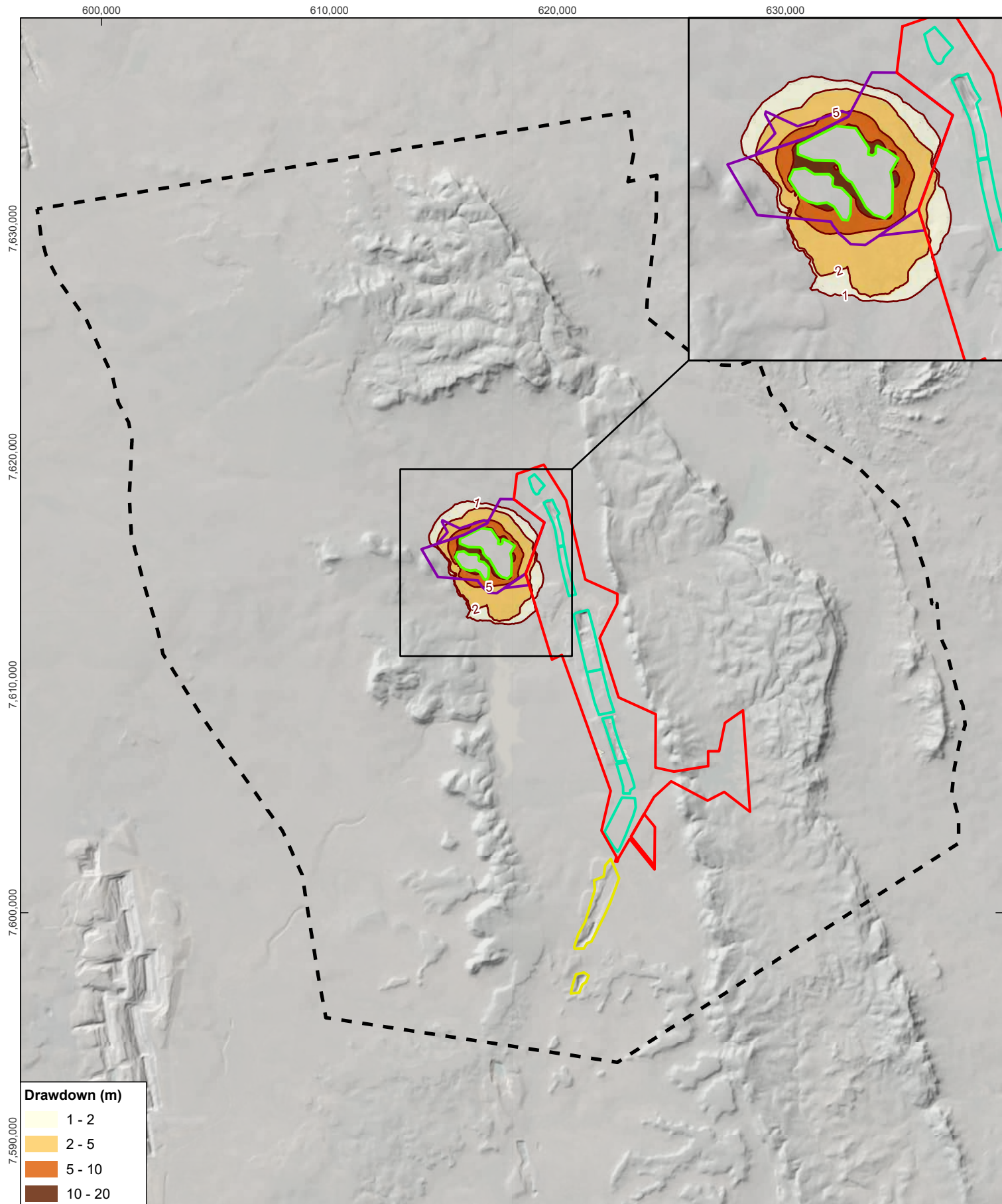
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
DRAWDOWN IN THE ALLUVIUM (2039)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

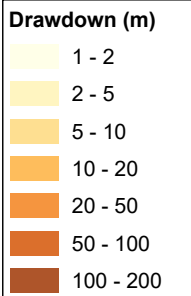
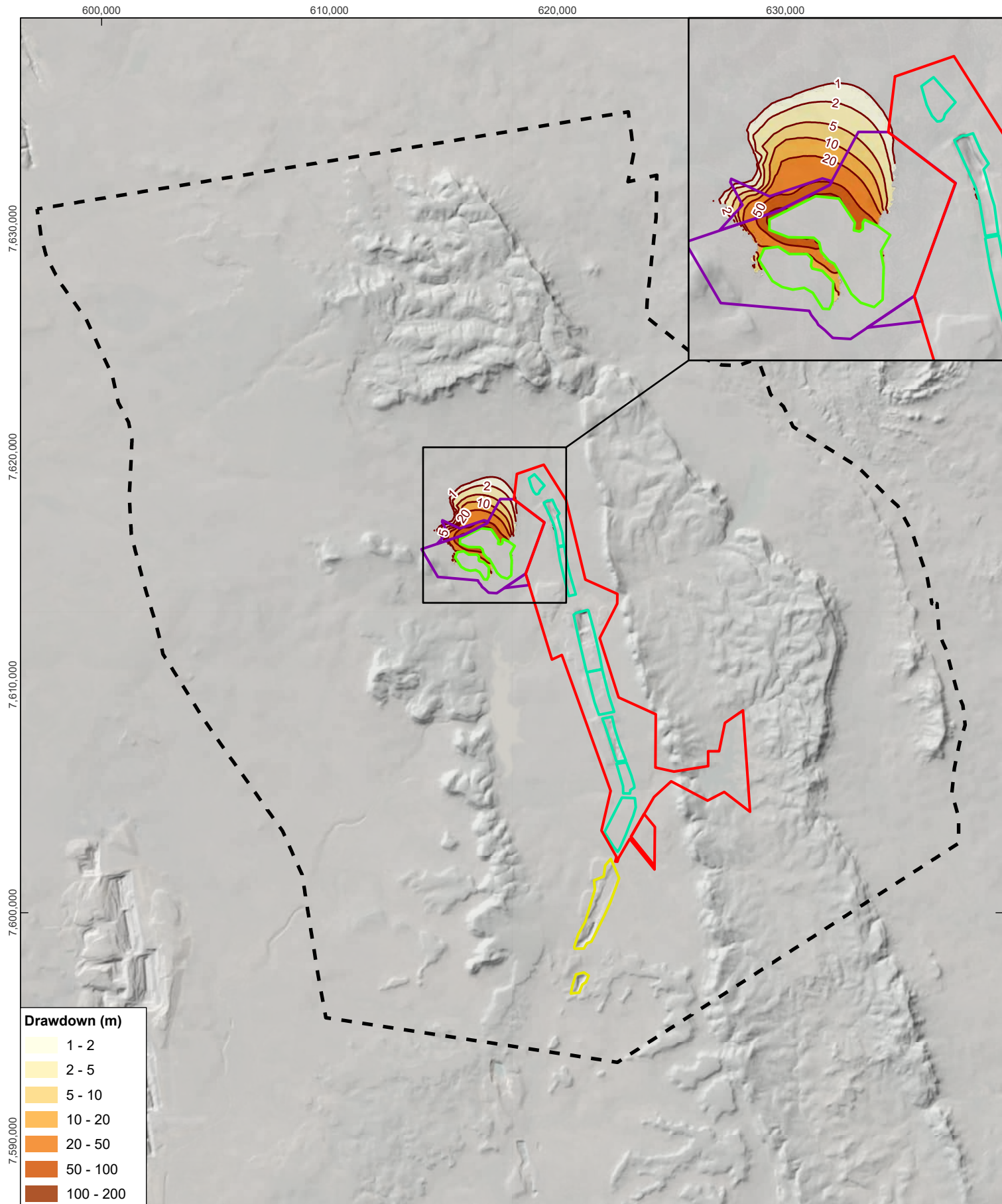
-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED INCREMENTAL DRAWDOWN IN THE REGOLITH (2039)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

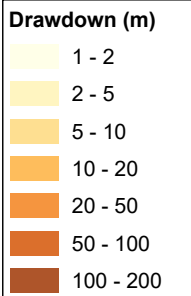
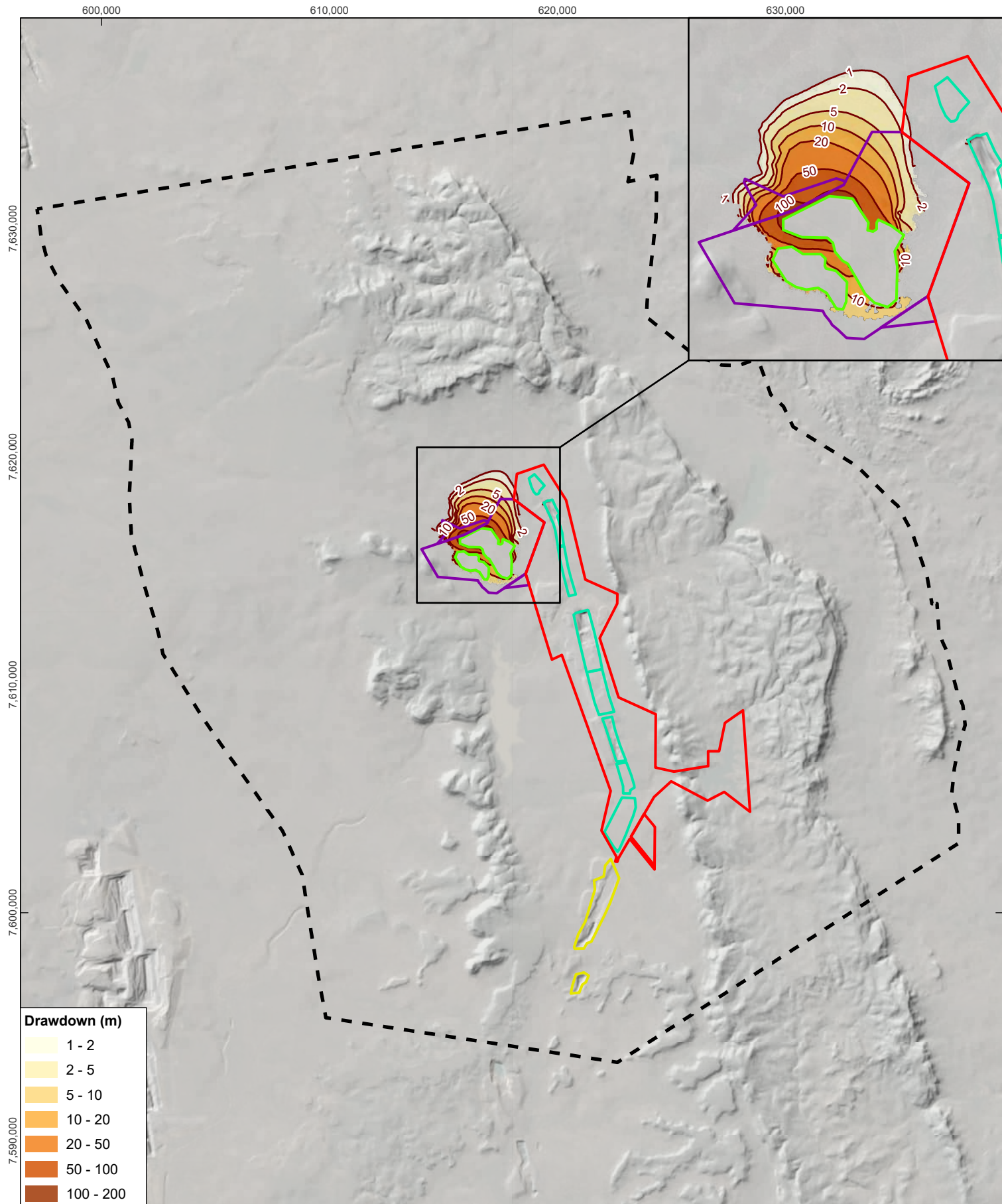
-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
DRAWDOWN IN THE
BURTON/RIDER SEAM (2039)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
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LEGEND

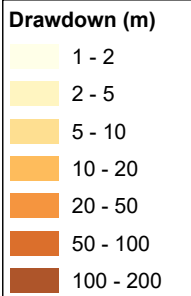
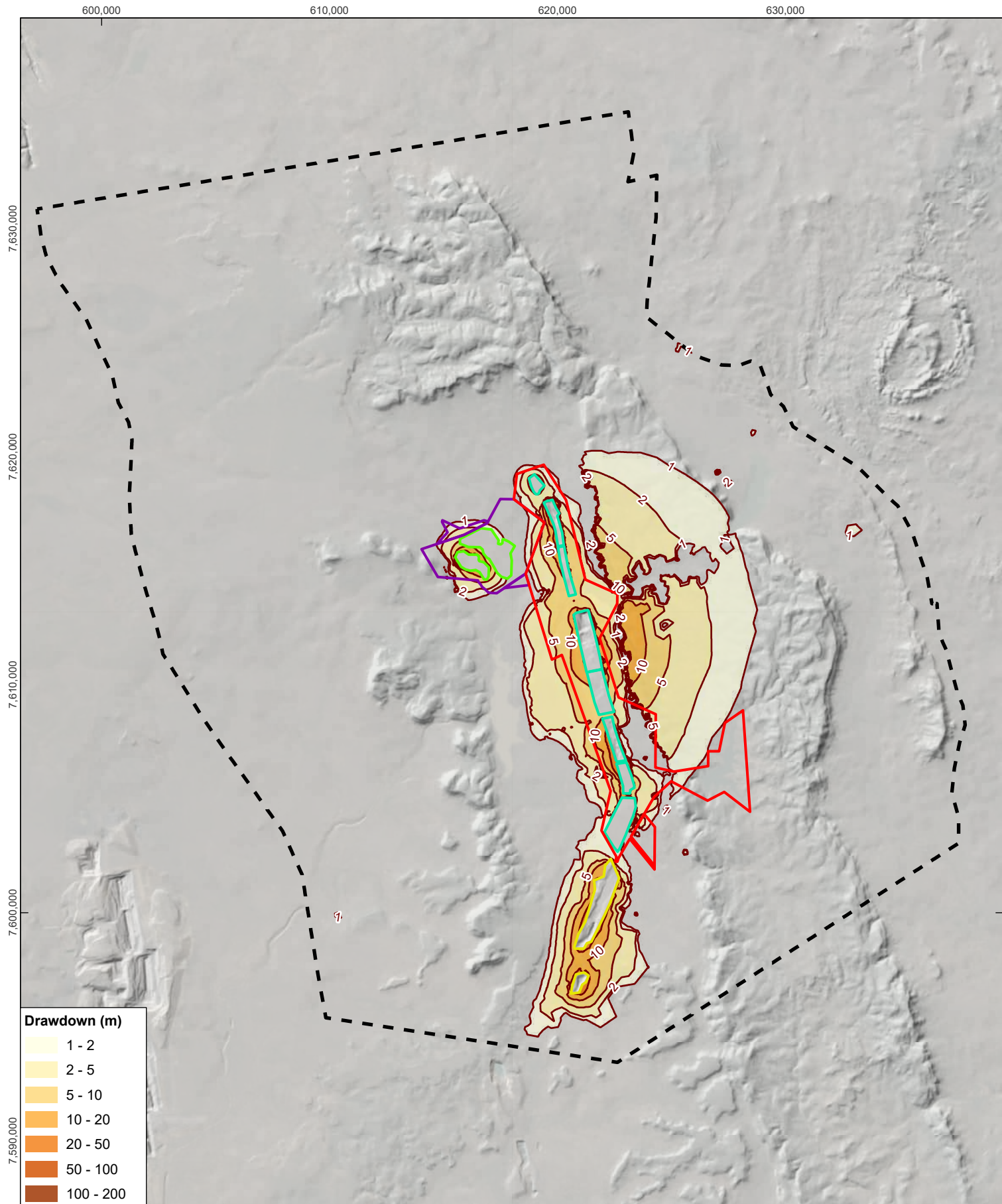
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED INCREMENTAL
DRAWDOWN IN THE
LEICHHARDT/VERMONT SEAM (2039)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

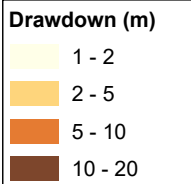
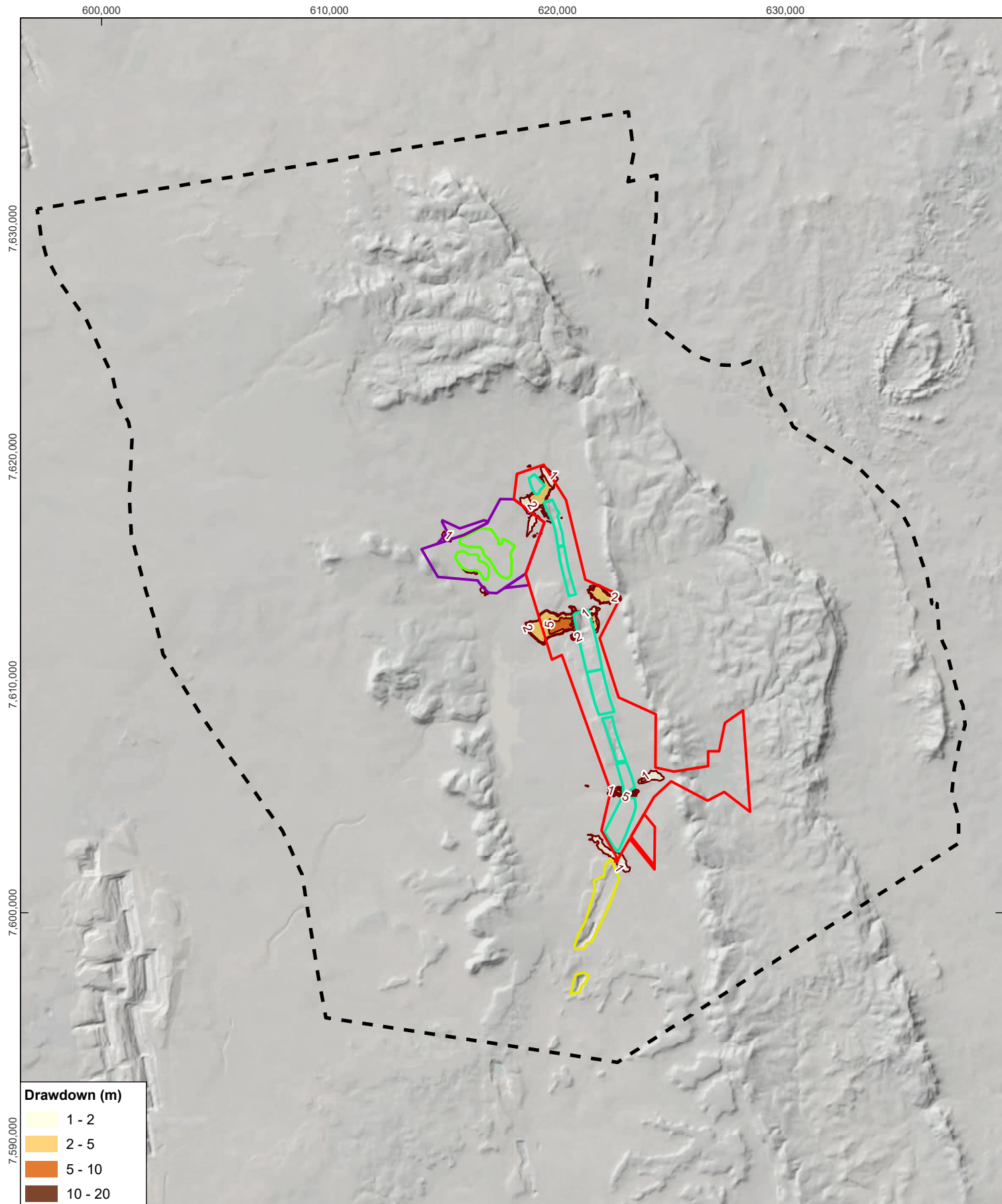
-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED CUMULATIVE WATER TABLE DRAWDOWN (2029)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

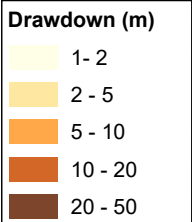
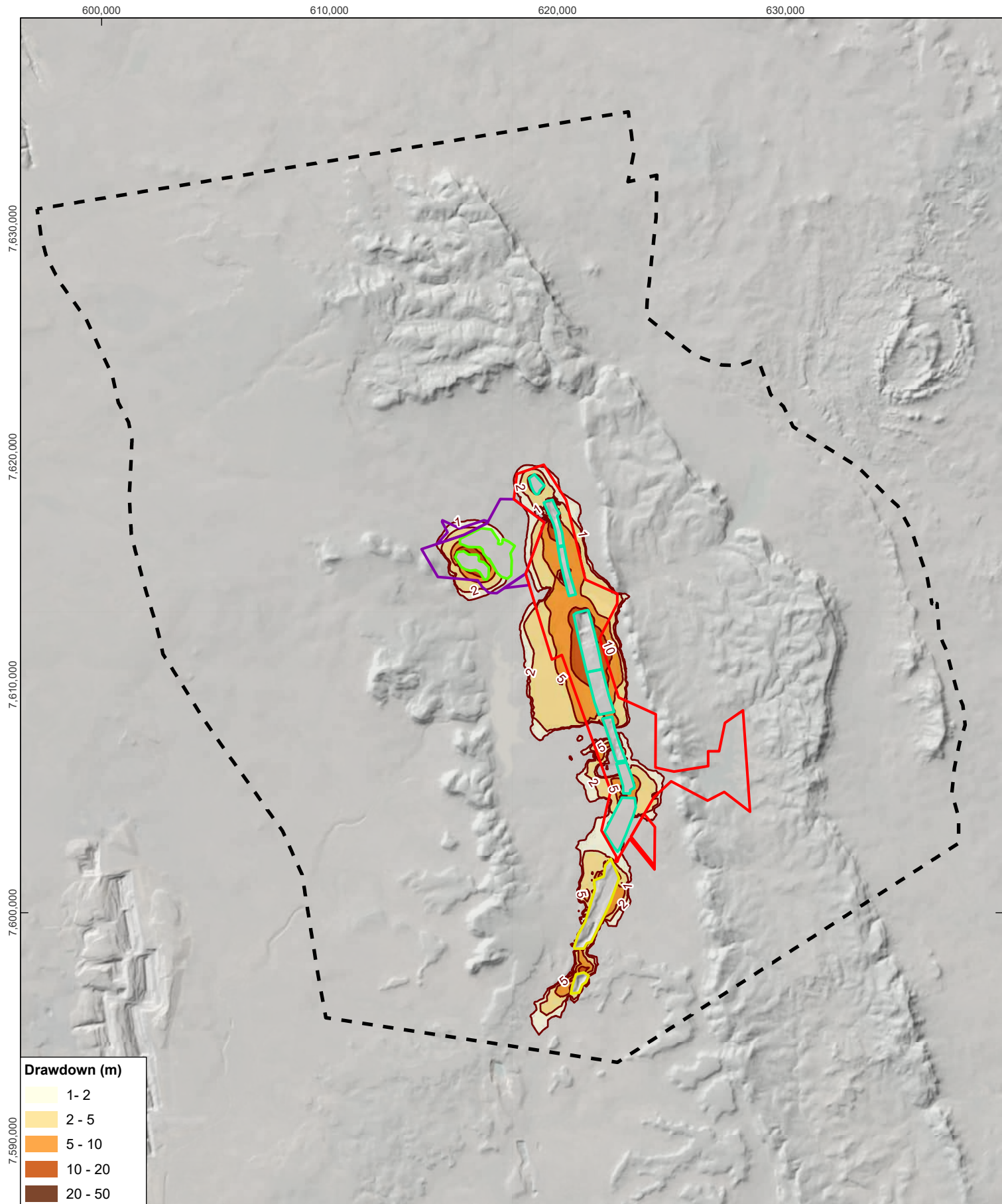
-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE ALLUVIUM (2029)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

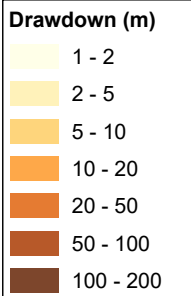
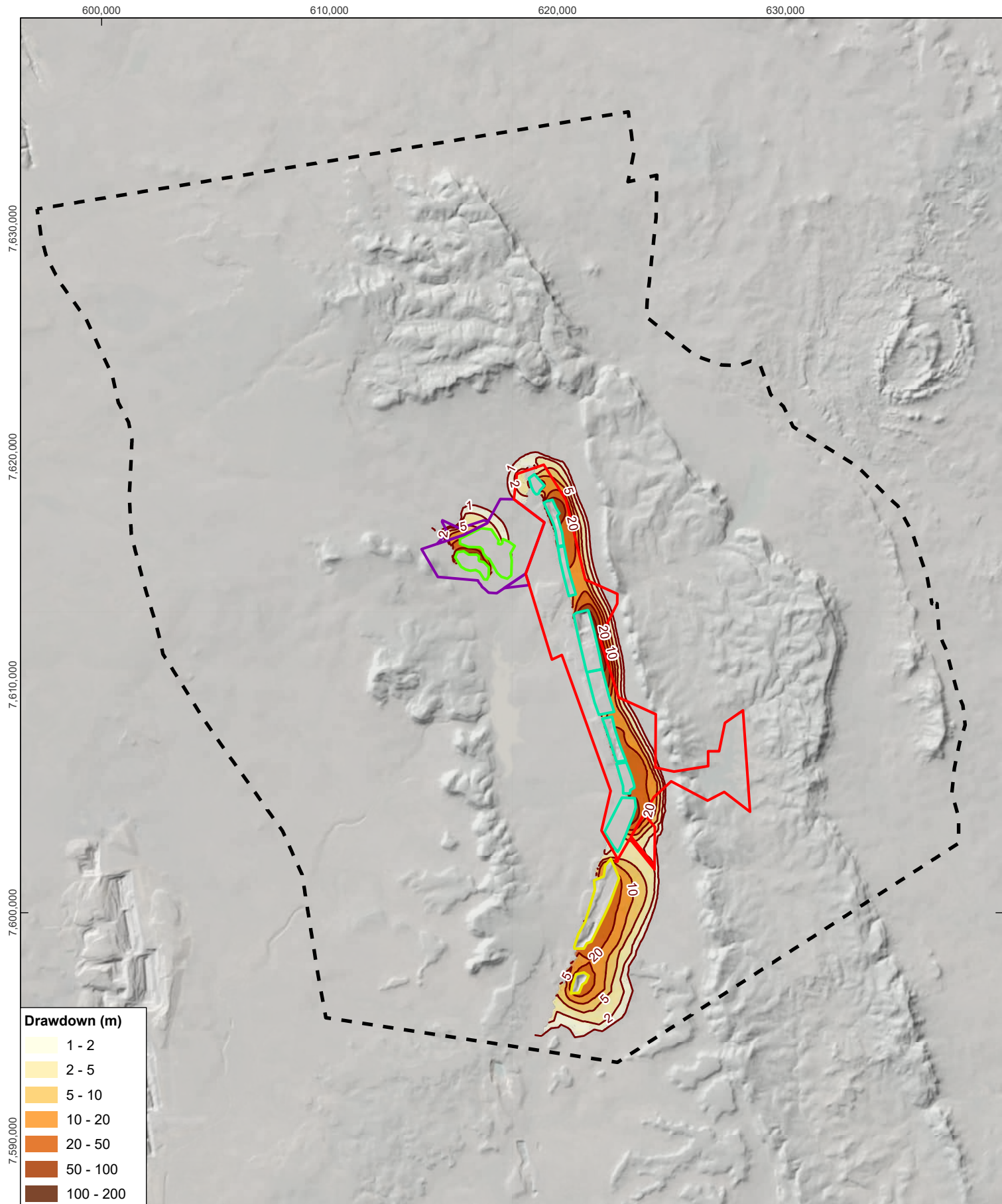
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE REGOLITH (2029)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

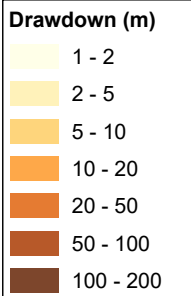
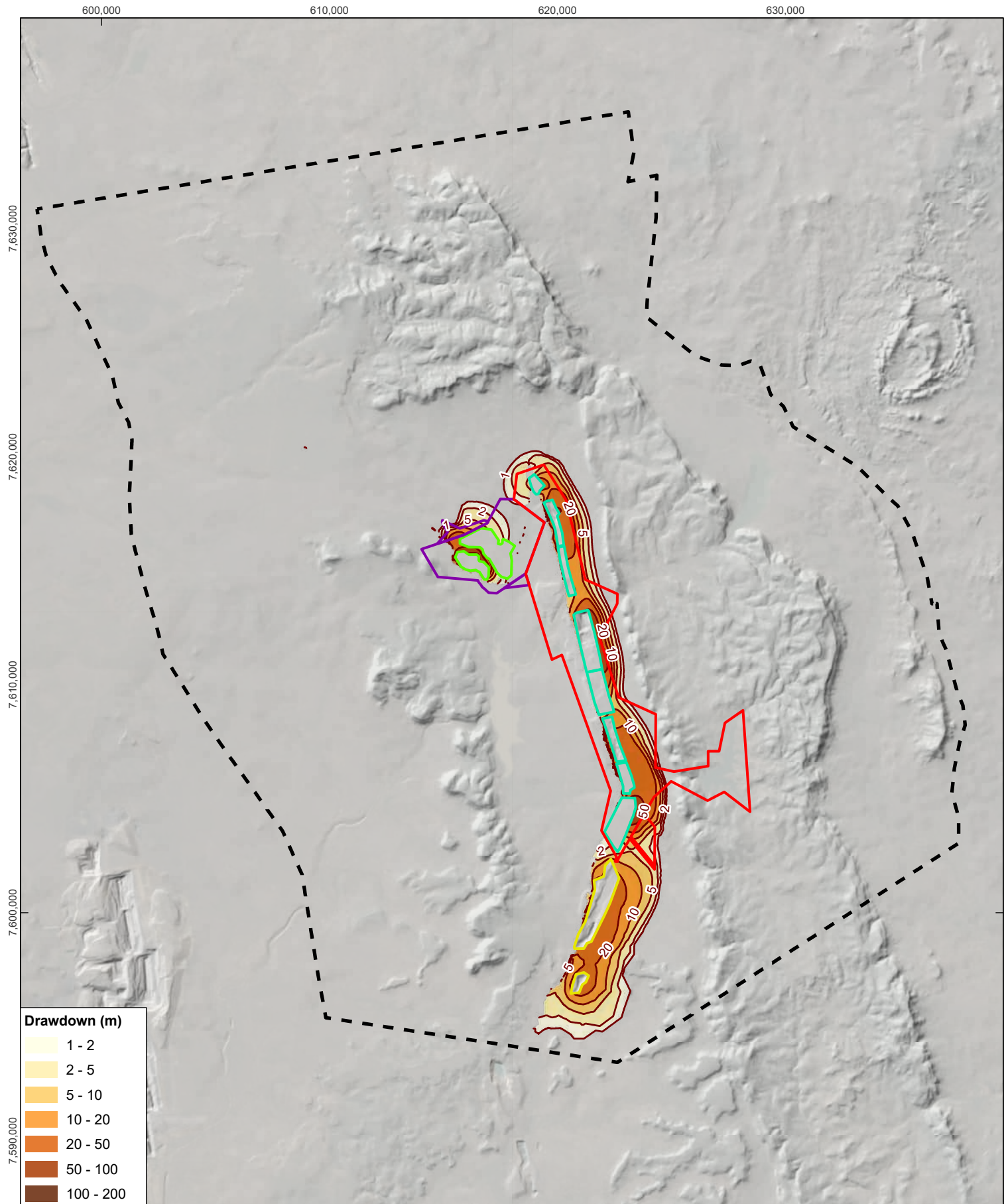
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE BURTON/RIDER SEAM (2029)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
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LEGEND

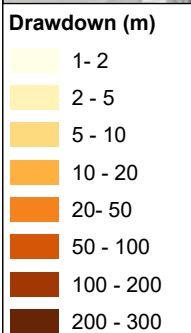
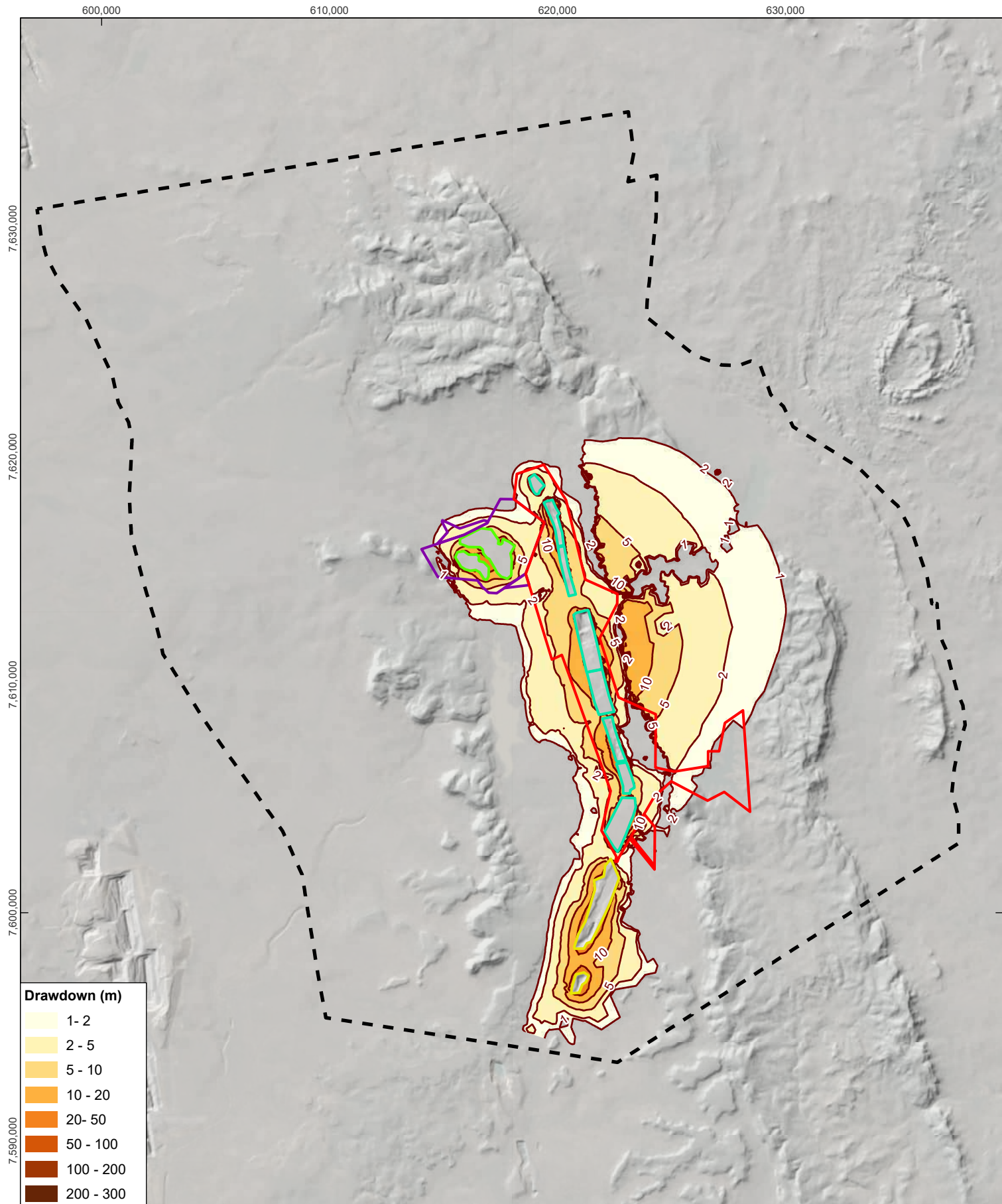
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED CUMULATIVE DRAWDOWN IN THE LEICHHARDT/VERMONT SEAM (2029)



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

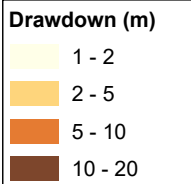
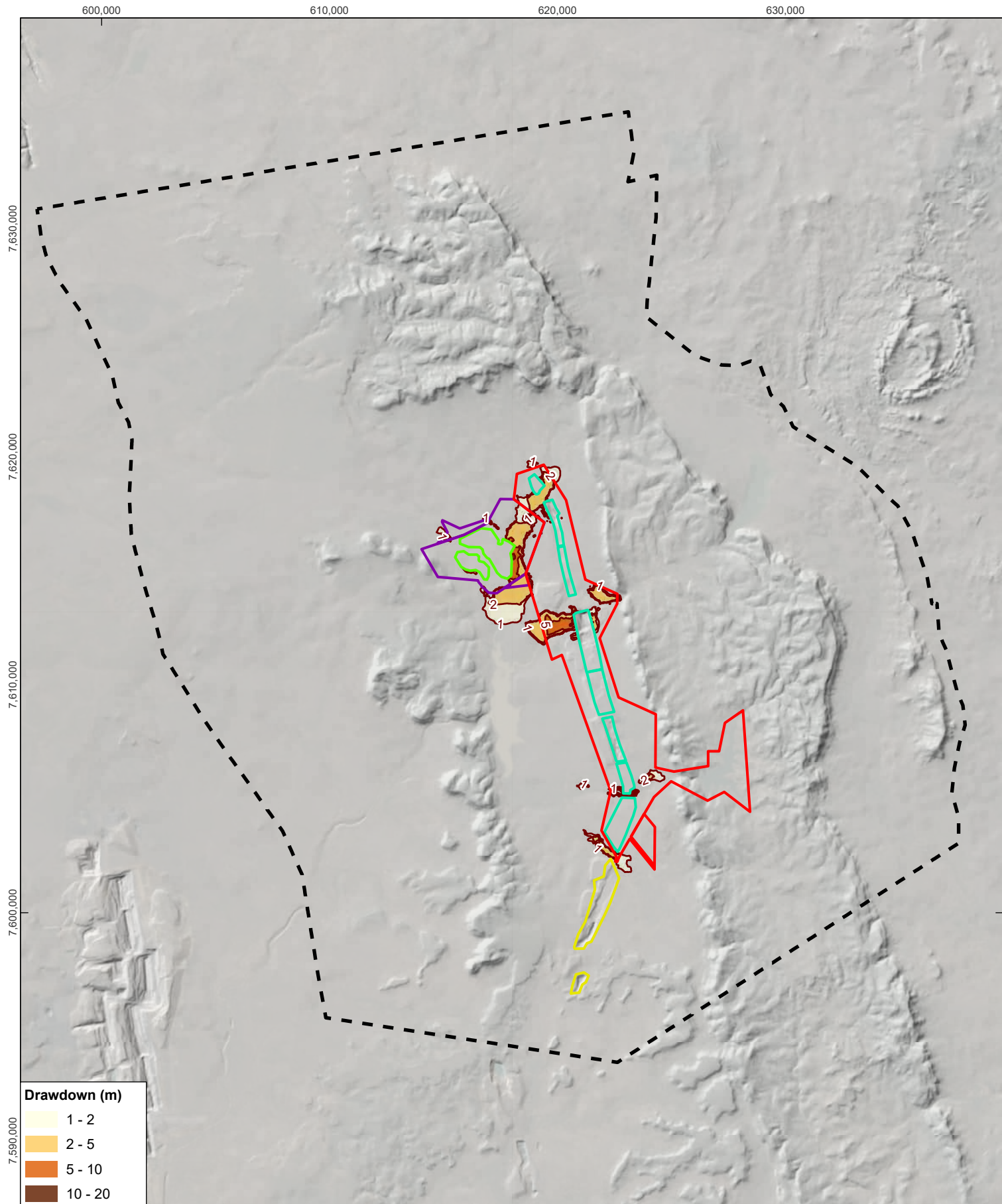
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE
WATER TABLE DRAWDOWN (2034)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 15-Dec-2023
 Drawn by: AS

LEGEND

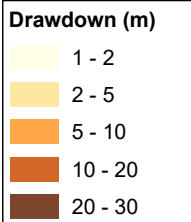
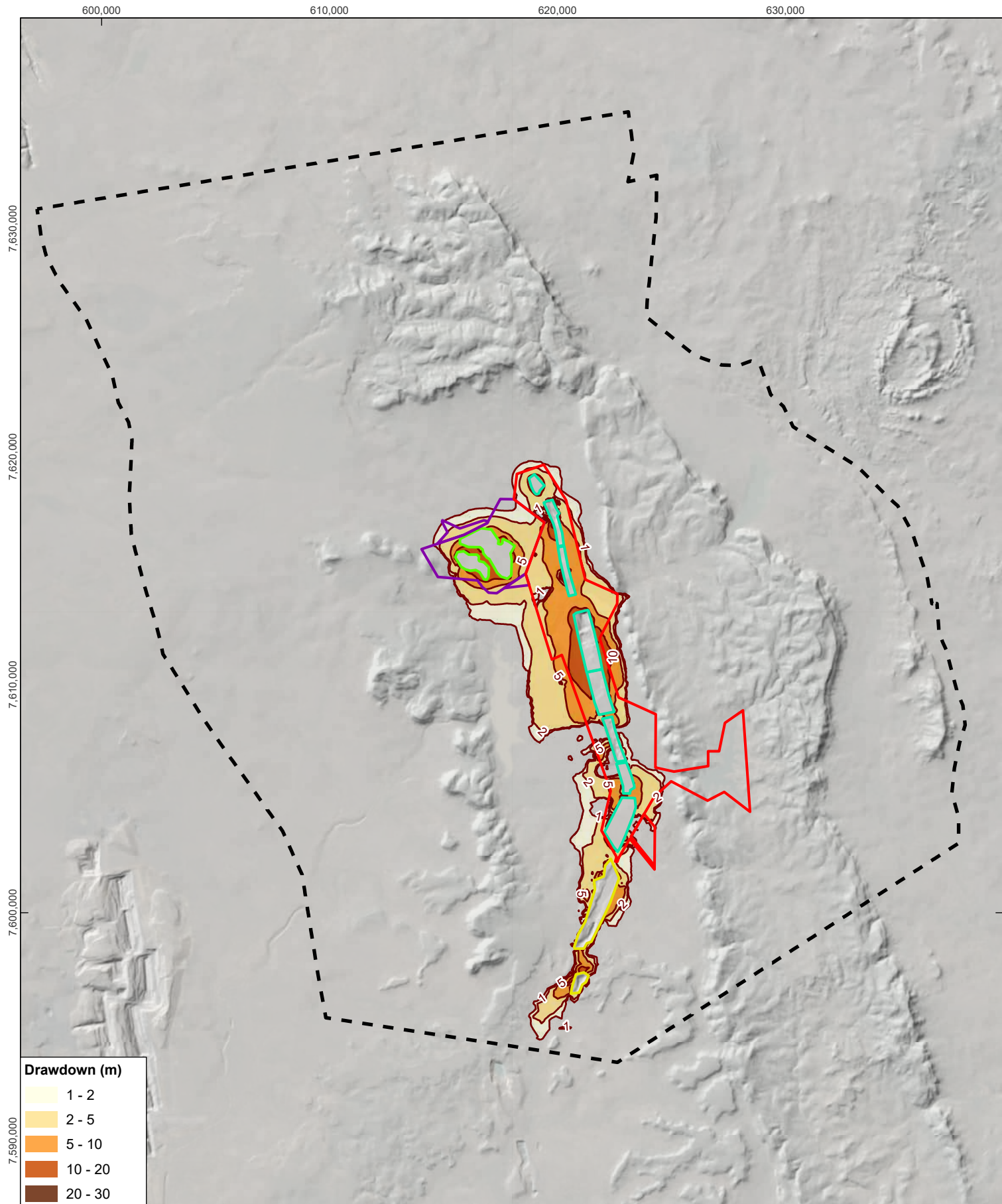
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-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED CUMULATIVE DRAWDOWN IN THE ALLUVIUM (2034)



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

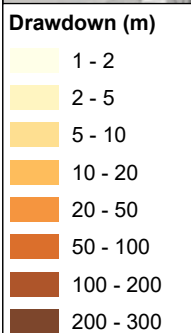
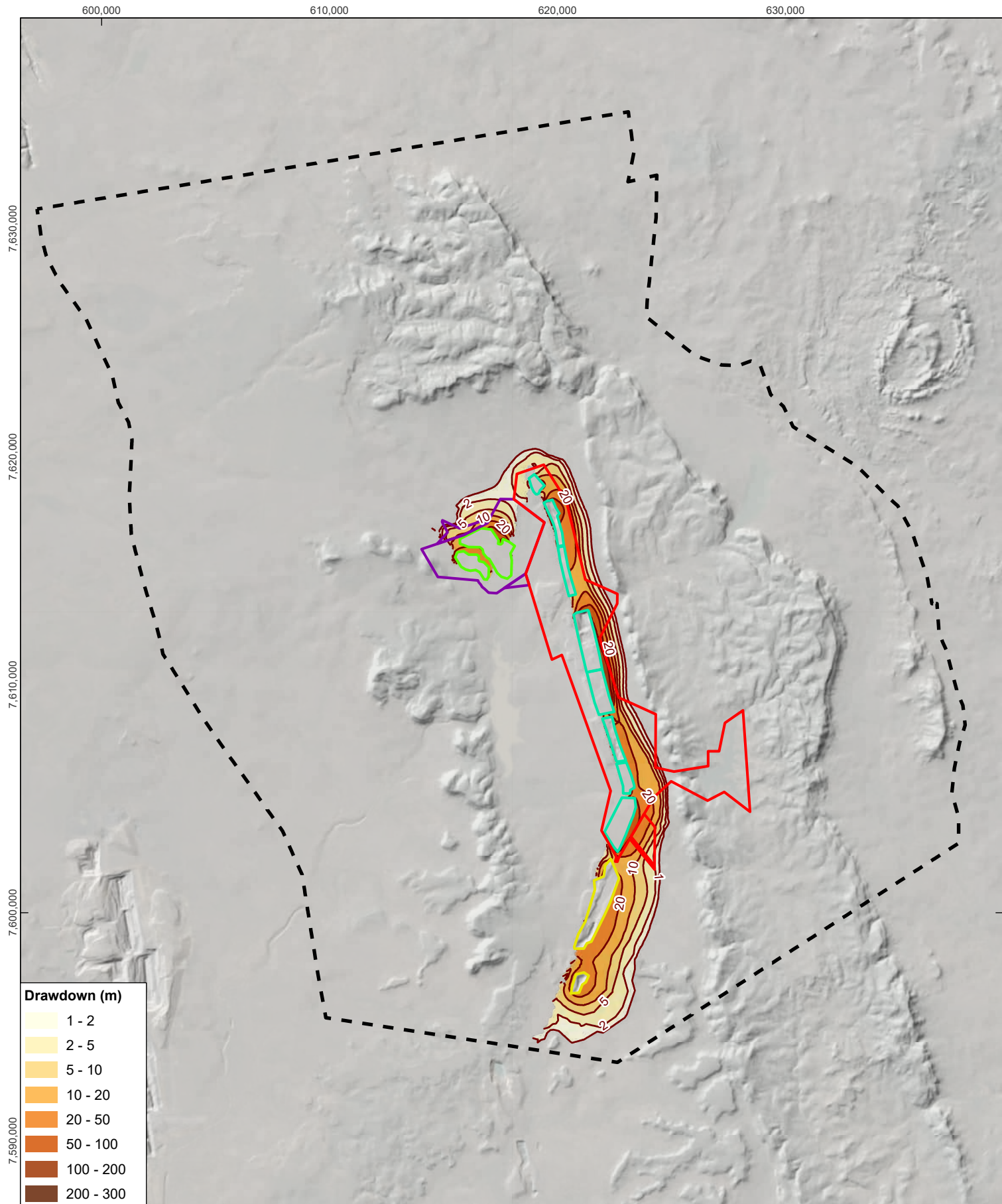
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE REGOLITH (2034)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

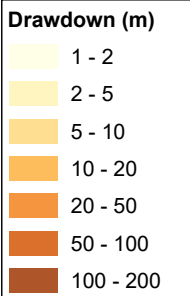
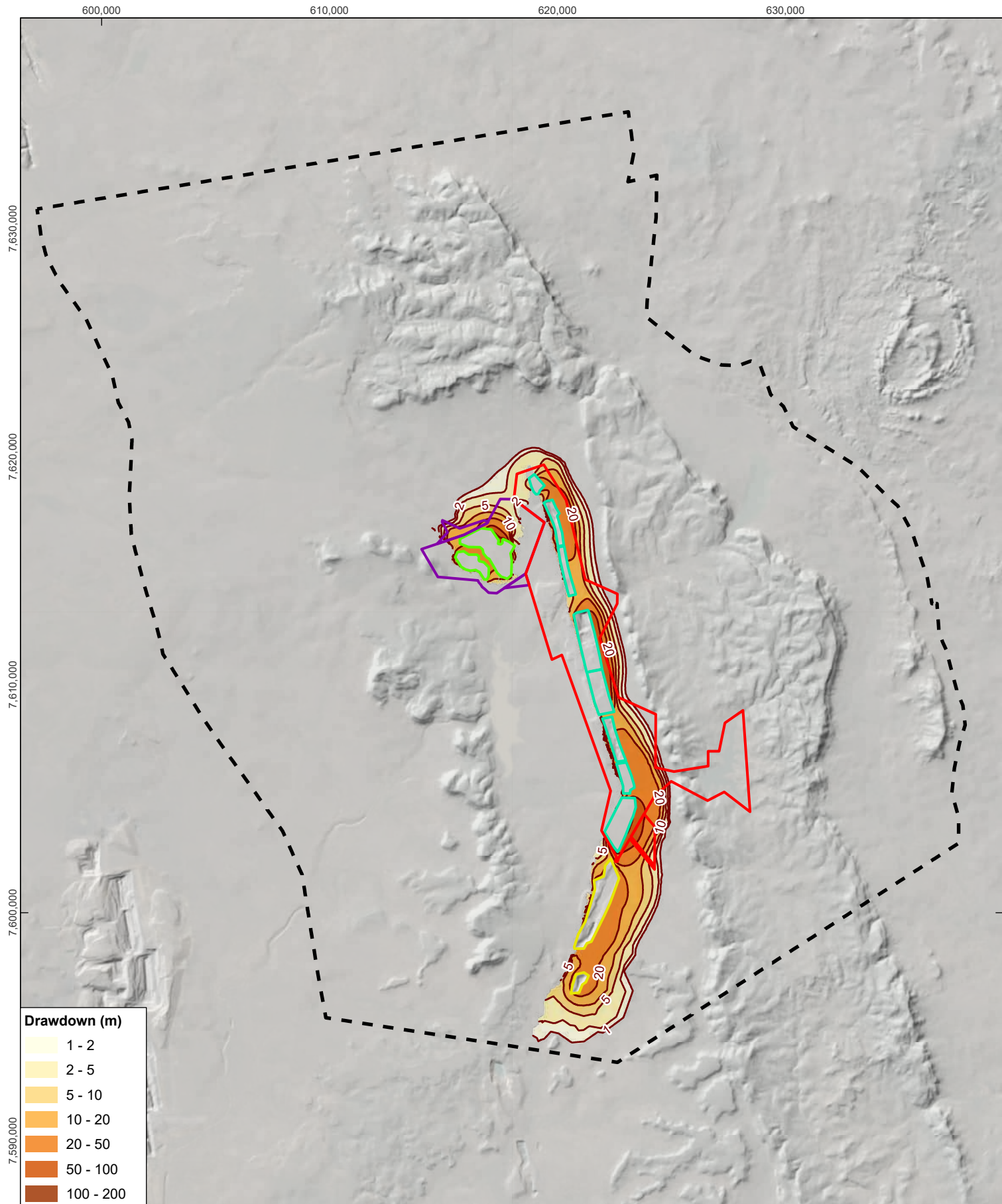
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE BURTON/RIDER SEAM (2034)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

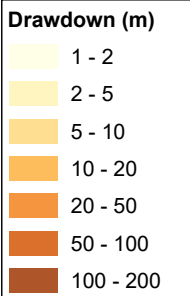
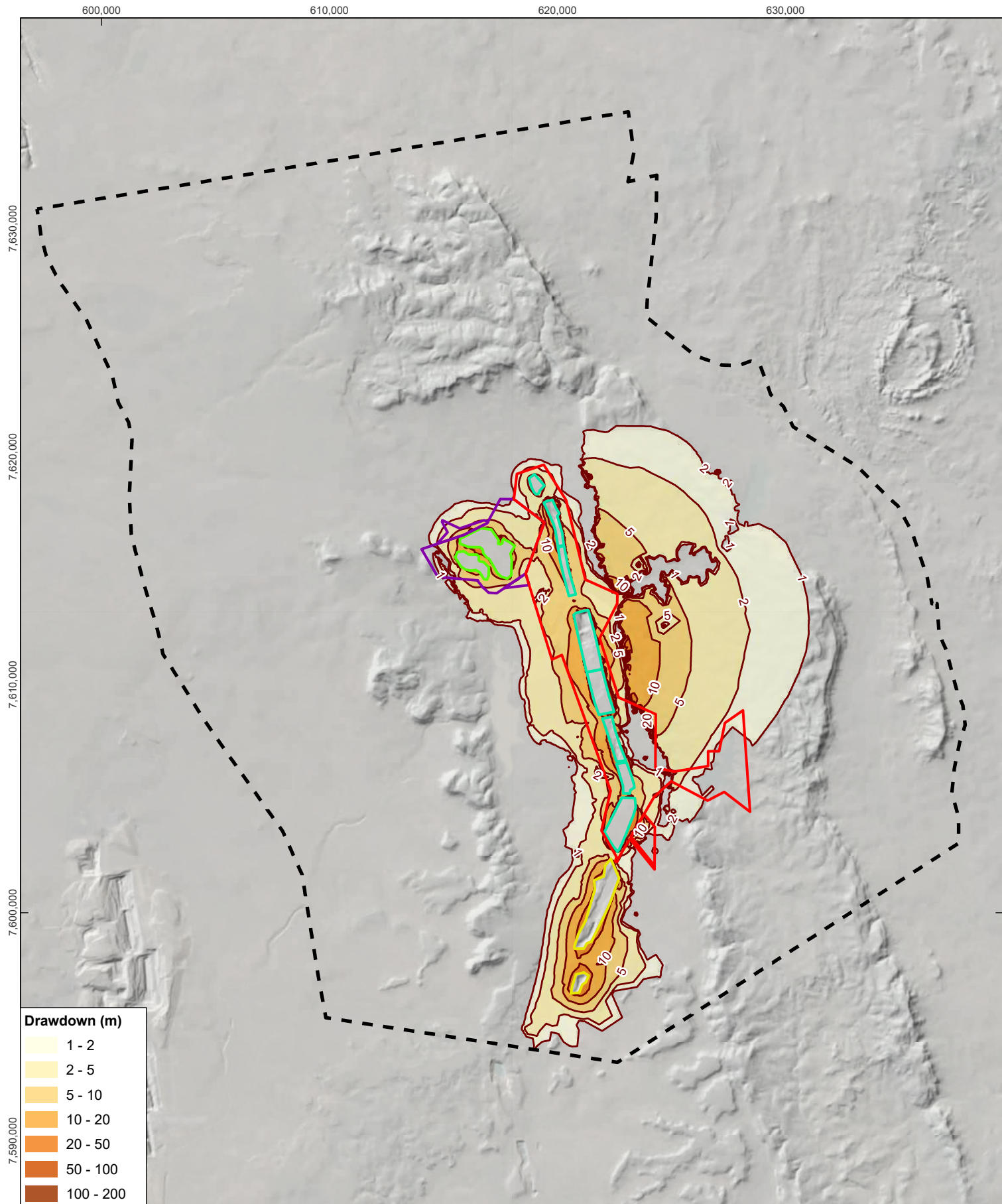
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE LEICHHARDT/VERMONT SEAM (2034)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31208.00000
 Date Drawn: 18-Dec-2023
 Drawn by: AS

LEGEND

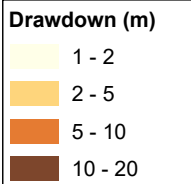
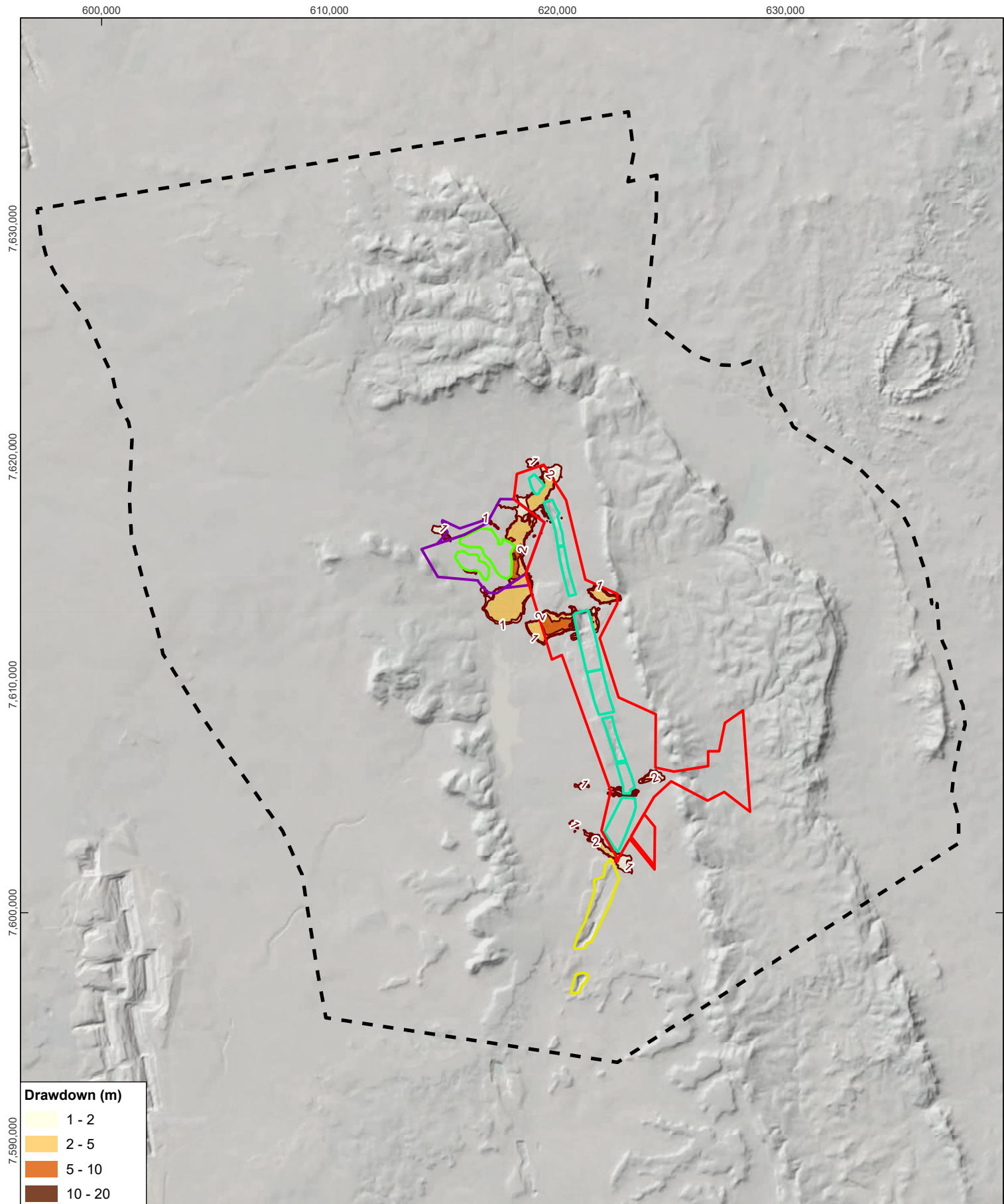
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE
WATER TABLE DRAWDOWN (2039)**



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 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 15-Dec-2023

Drawn by: AS

LEGEND

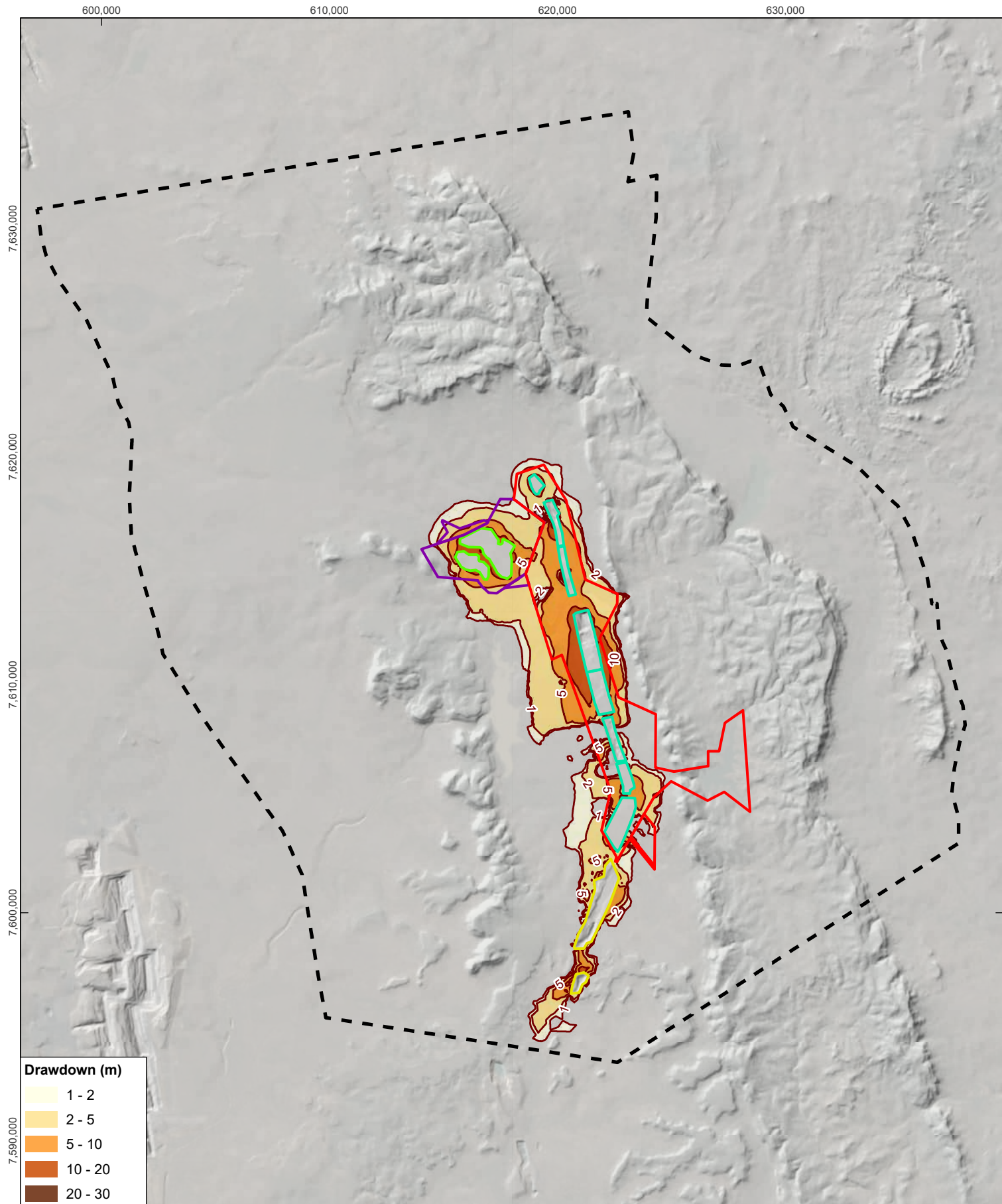
- Drawdown Contour (m)
- - - Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

BURTON & NEW LENTON MODELLING TECHNICAL REPORT

PREDICTED CUMULATIVE DRAWDOWN IN THE ALLUVIUM (2039)



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Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 30

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

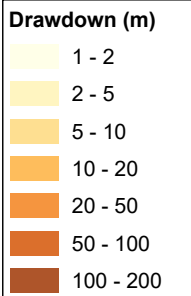
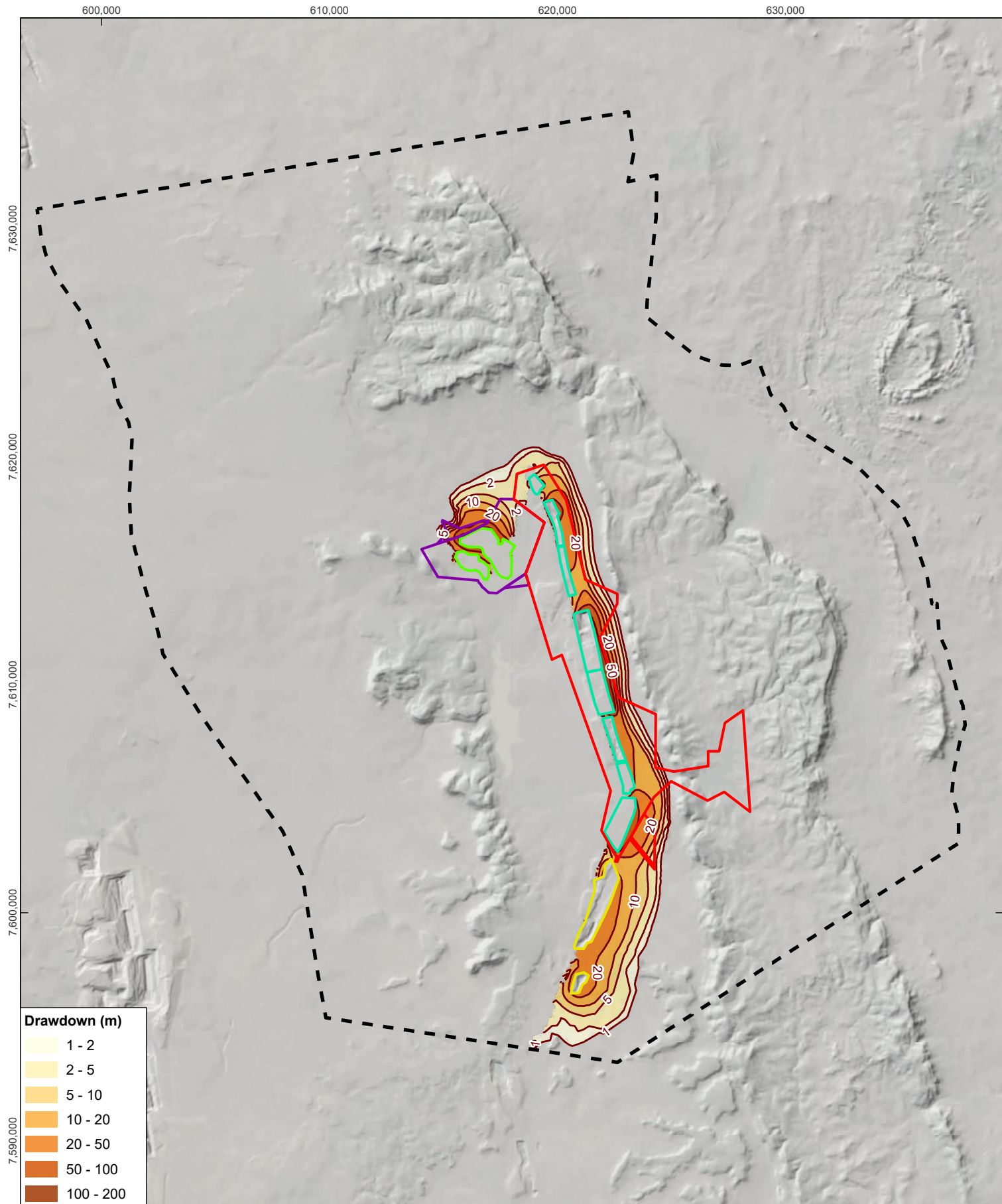
- Drawdown Contour (m)
- - - Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE REGOLITH (2039)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.



 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31208.00000

Date Drawn: 18-Dec-2023

Drawn by: AS

LEGEND

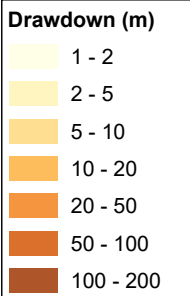
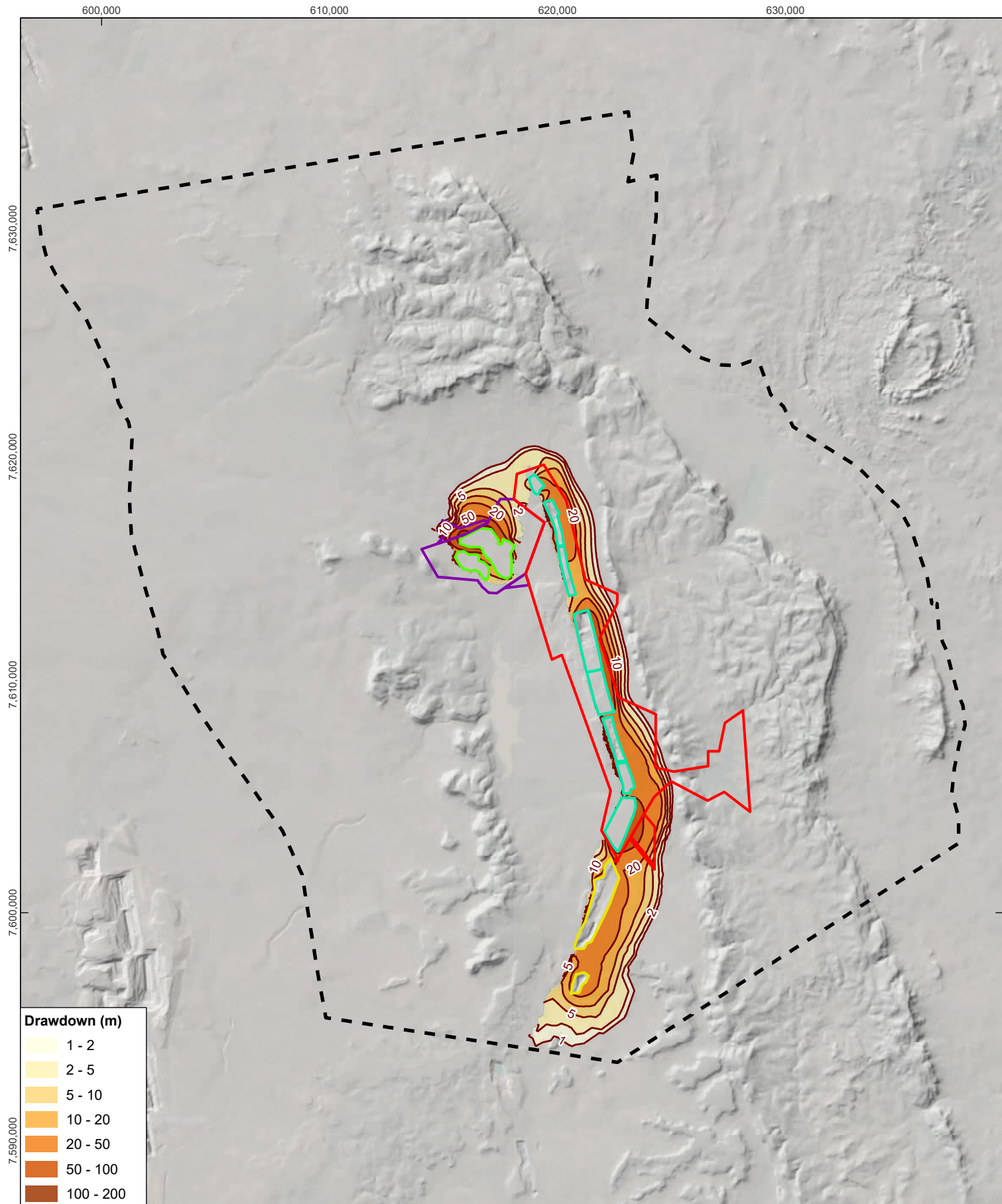
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|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE BURTON/RIDER SEAM (2039)**



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 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
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LEGEND

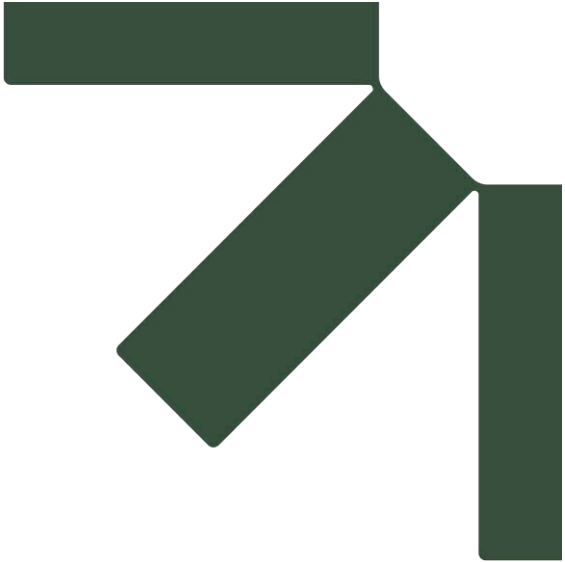
- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**BURTON & NEW LENTON
MODELLING TECHNICAL REPORT**

**PREDICTED CUMULATIVE DRAWDOWN
IN THE LEICHHARDT/VERMONT SEAM (2039)**



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Appendix G Uncertainty Analysis - Parameter Distributions

New Lenton & Burton

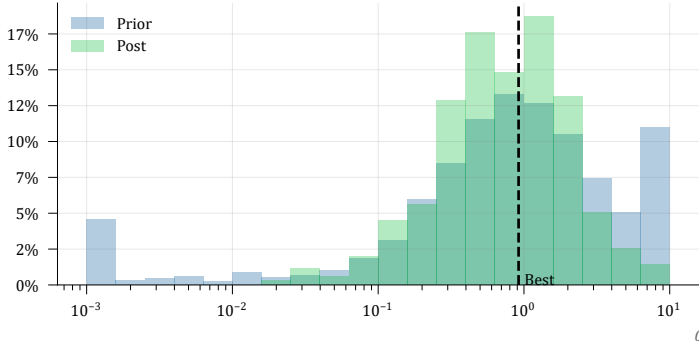
2023 Groundwater Modelling Technical Report

Lenton Joint Venture

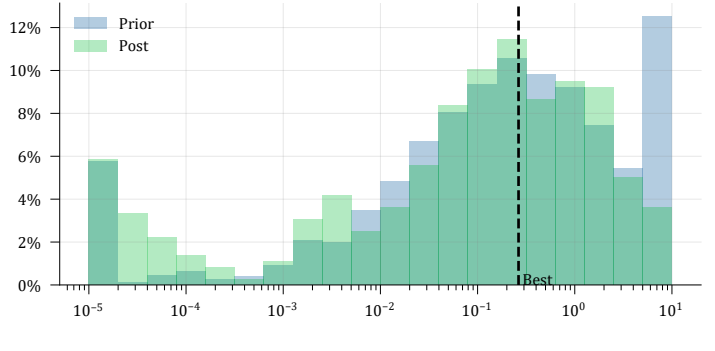
SLR Project No.: 620.31367.00000

11 September 2024

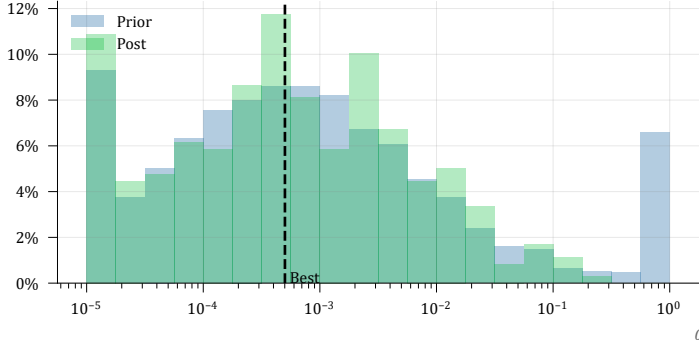
kx_z03(RegolithL2)



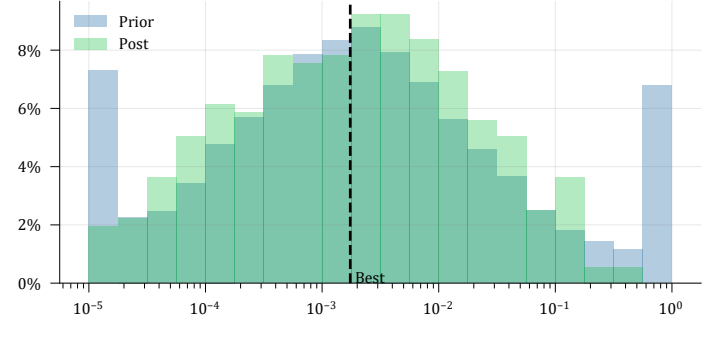
kx_z04(BasaltL2)



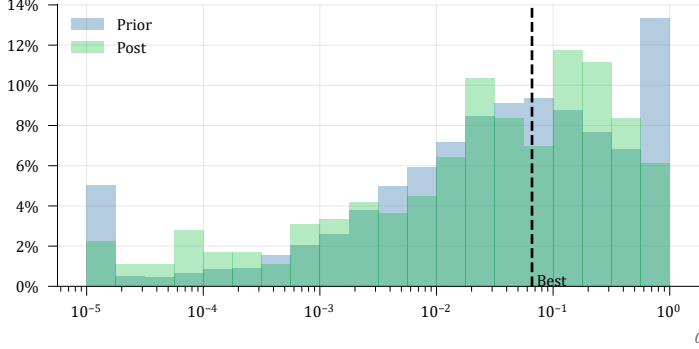
kx_z05(Triassic_(top)_West_of_BRF)



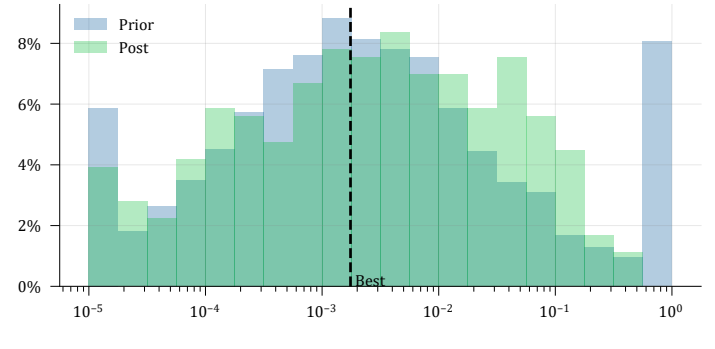
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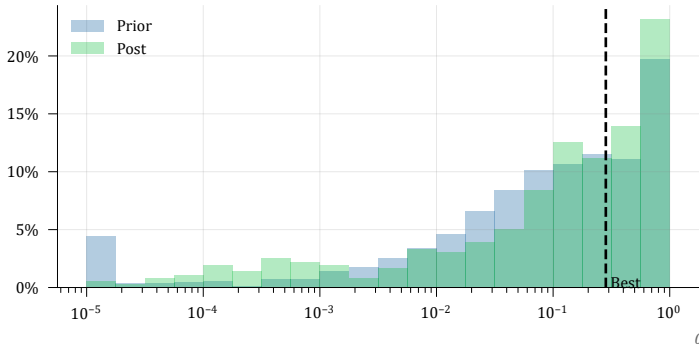
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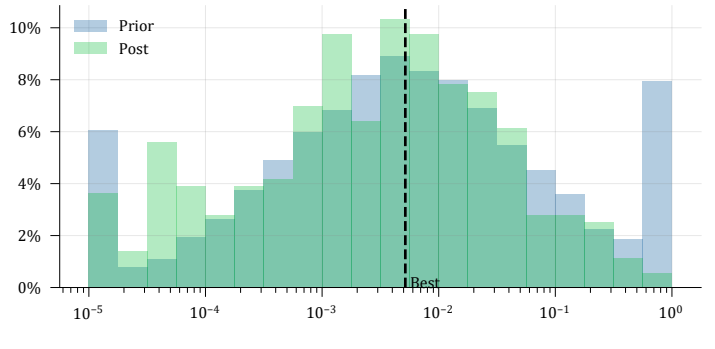
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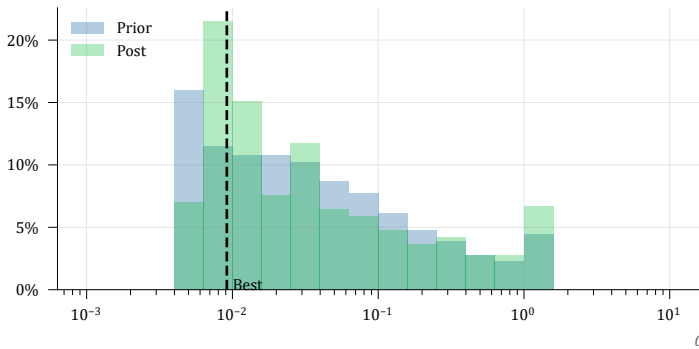
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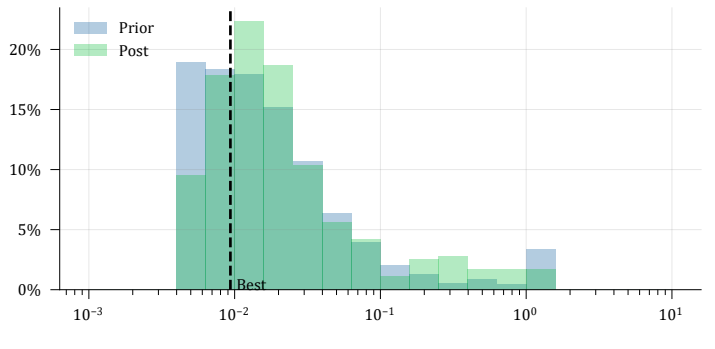
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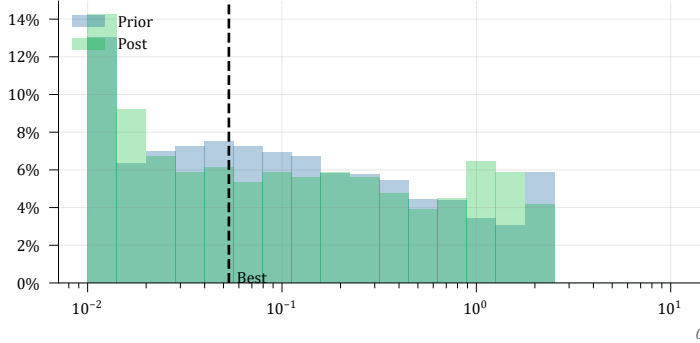
kx_z11(Overburden_(RCM)_West_of_BRF)



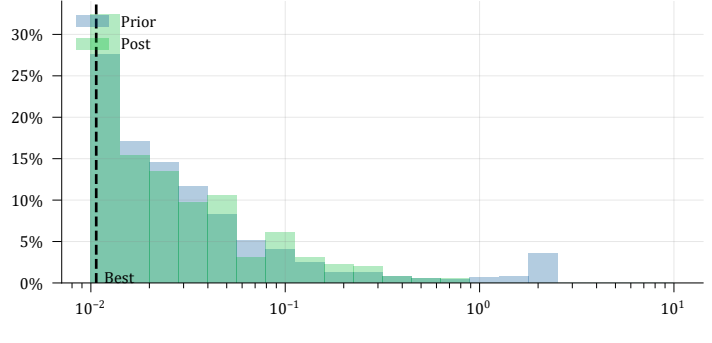
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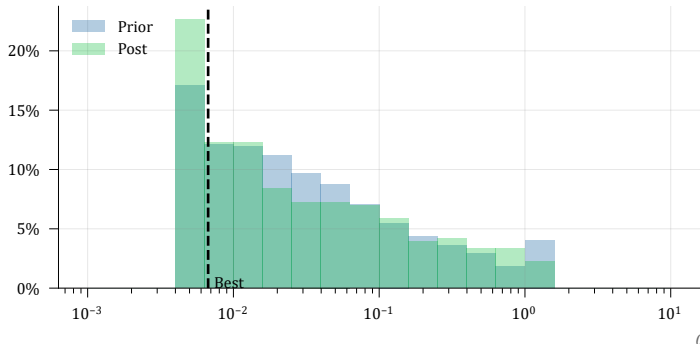
kx_z13(Burton_Rider_Seam_(RCM)_West_of_BRF)



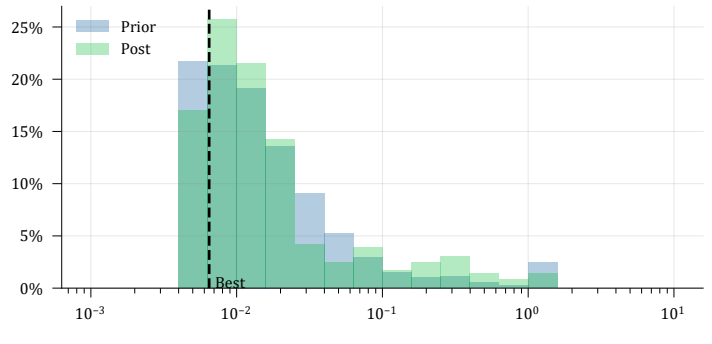
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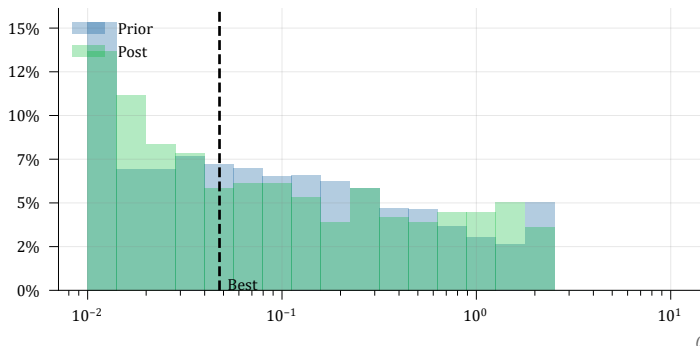
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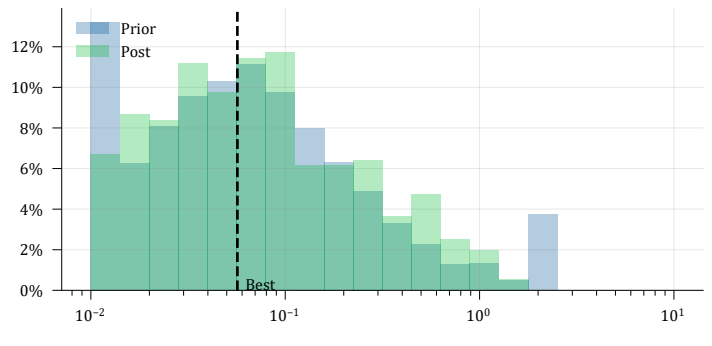
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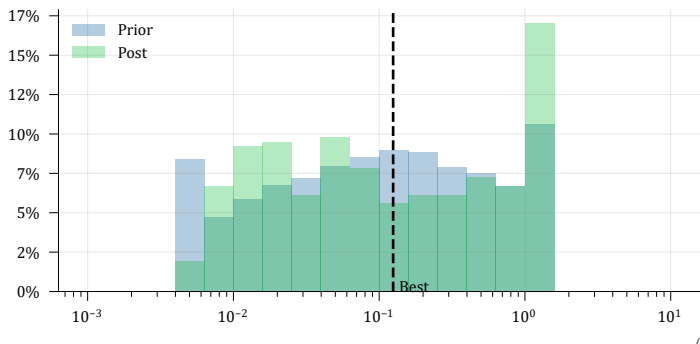
kx_z17(Leichardt/Vermont_Seams_(RCM)_West_of_BRF)



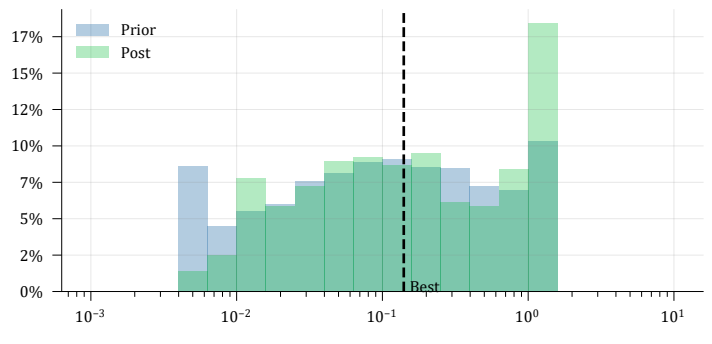
kx_z18(Leichardt/Vermont_Seams_(RCM)_East_of_BRF)



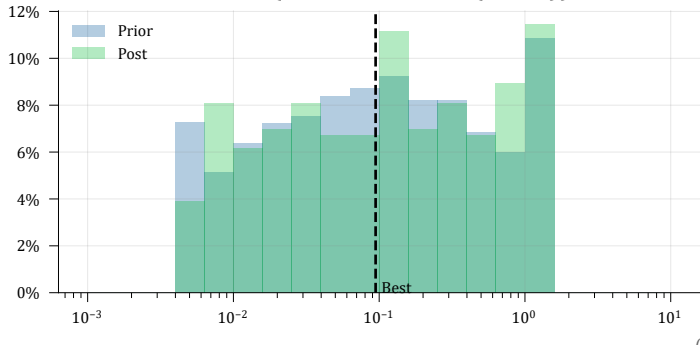
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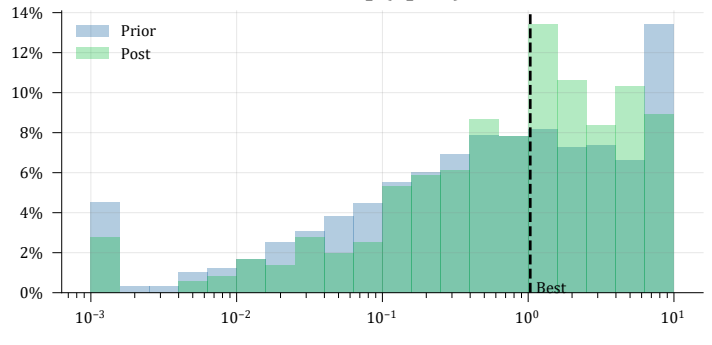
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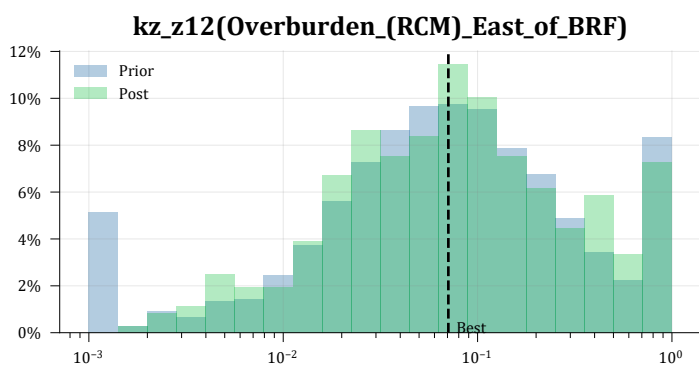
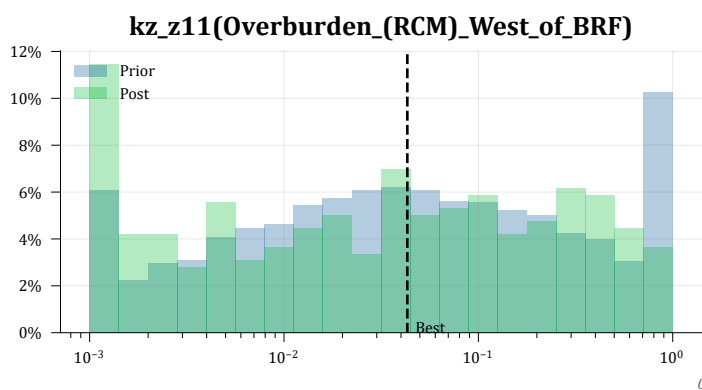
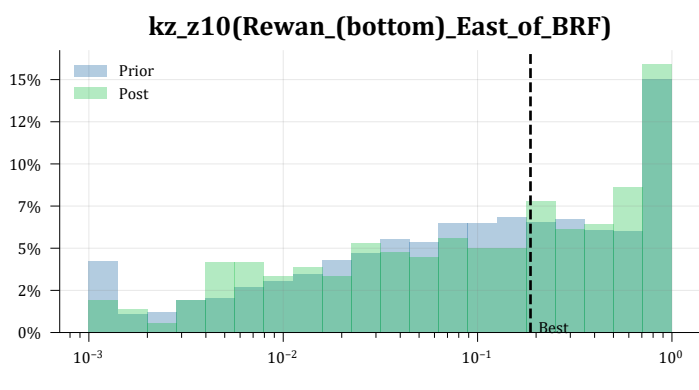
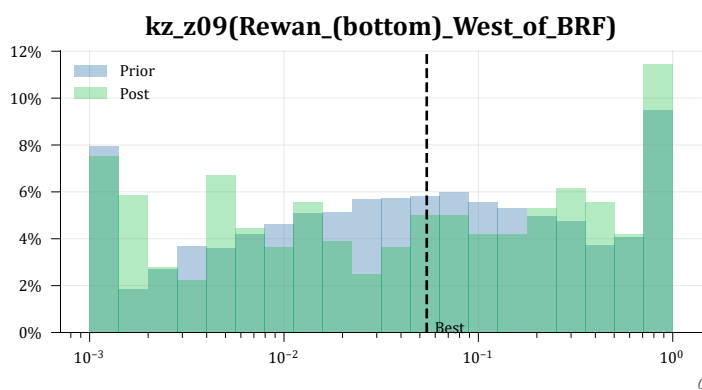
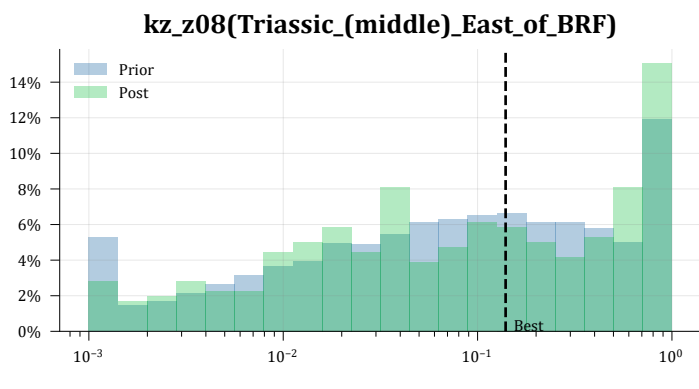
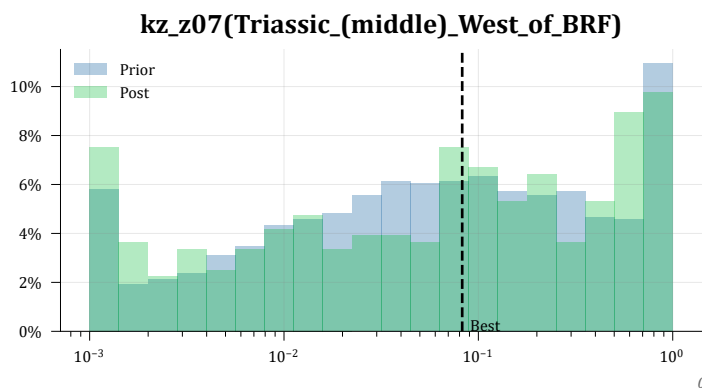
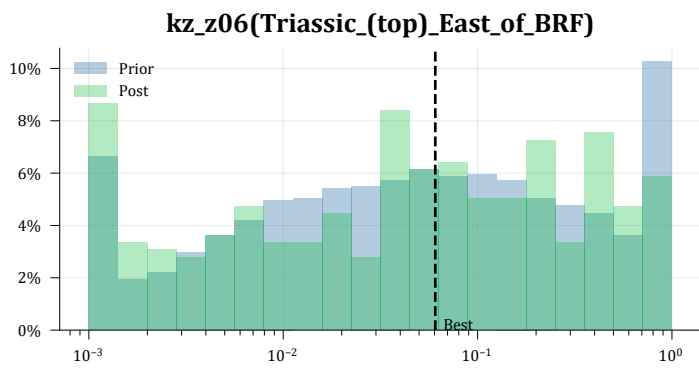
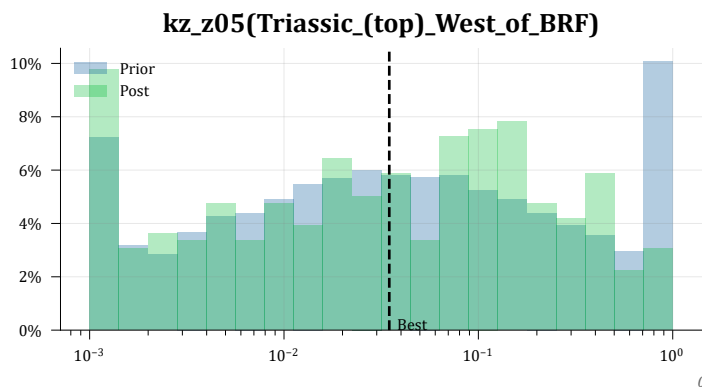
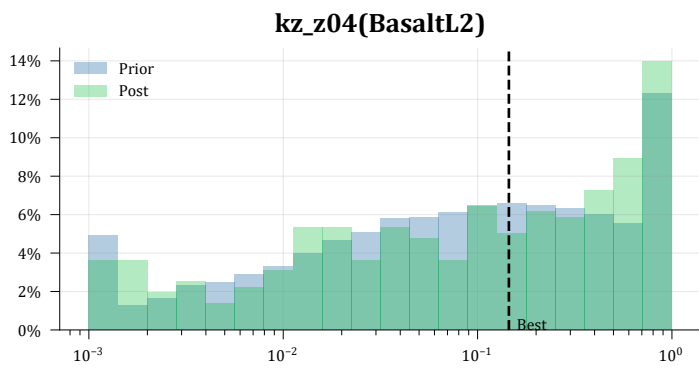
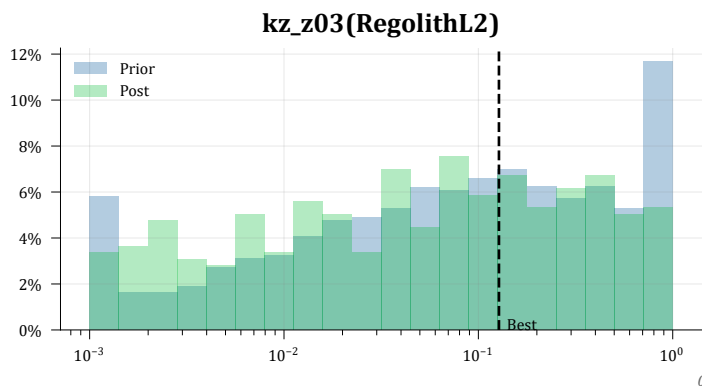


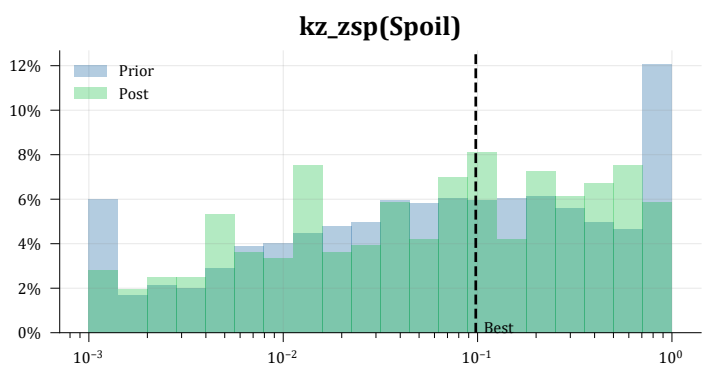
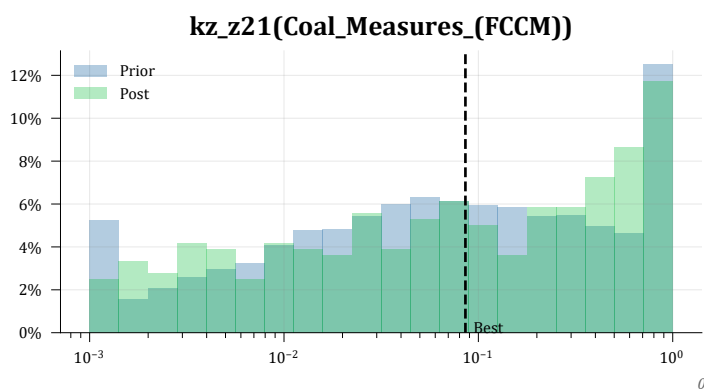
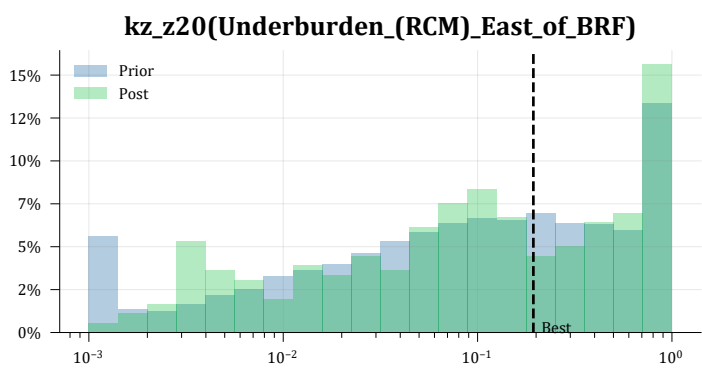
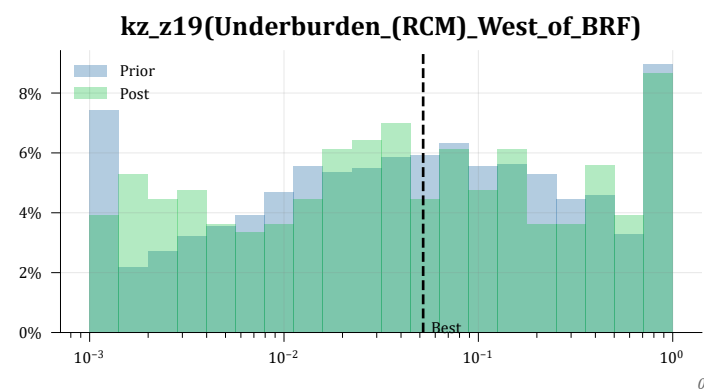
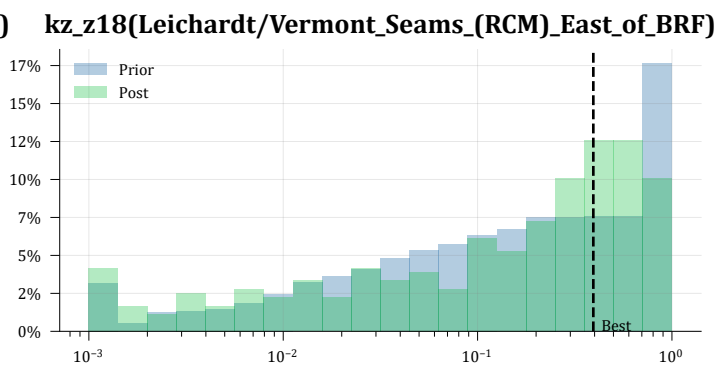
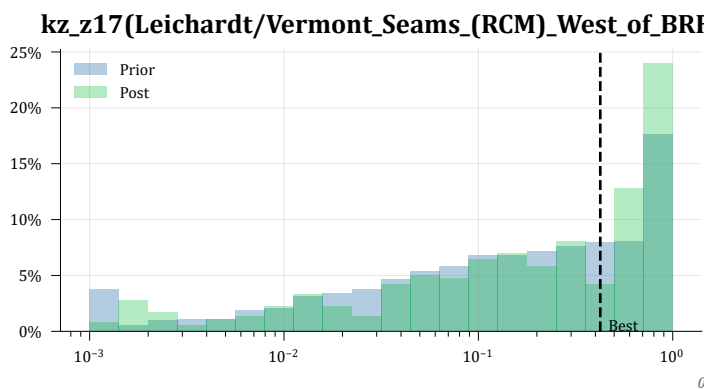
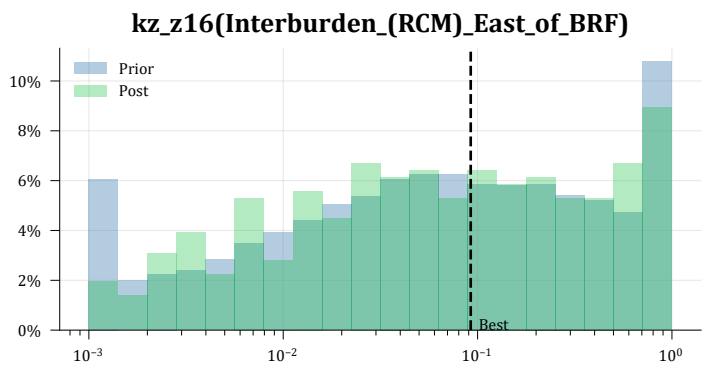
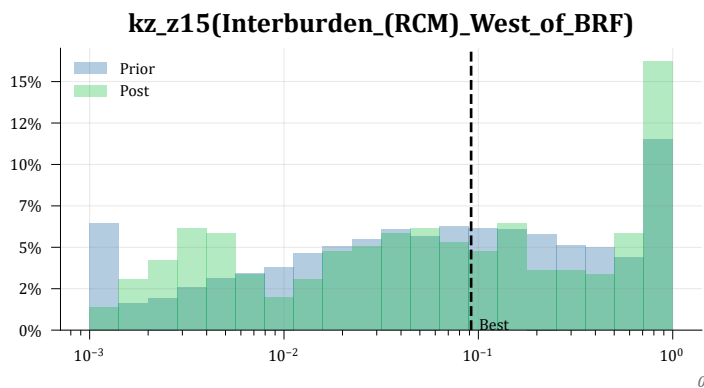
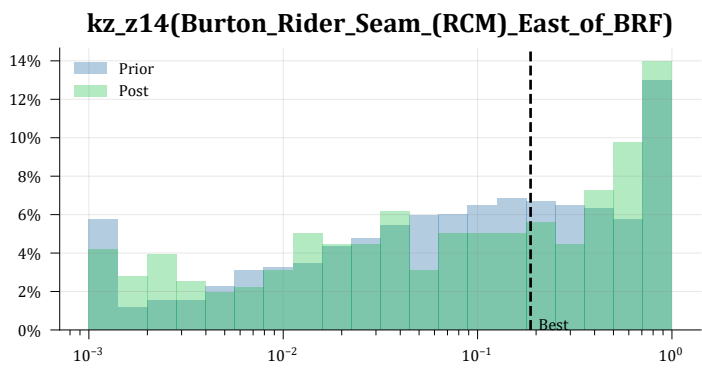
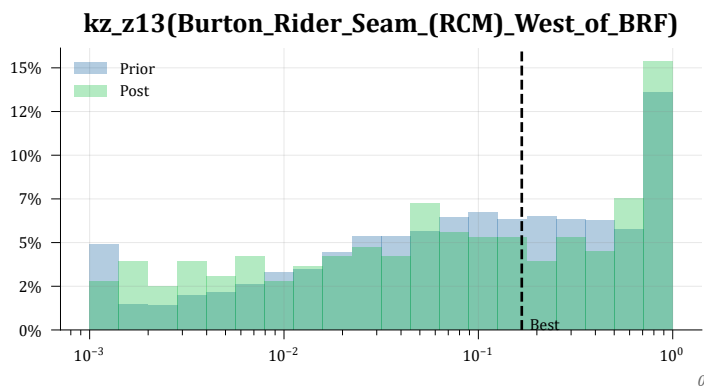
kx_z21(Coal_Measures_(FCCM))

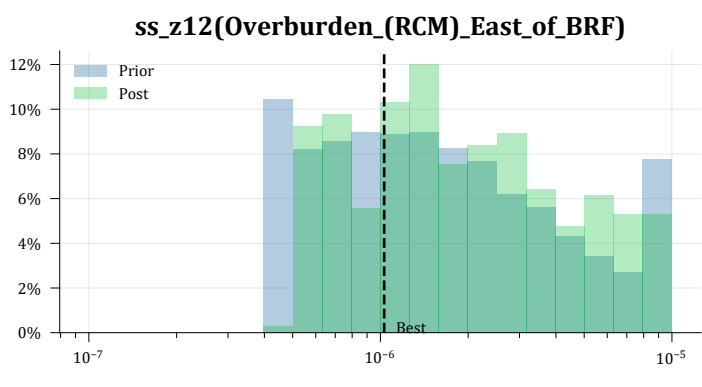
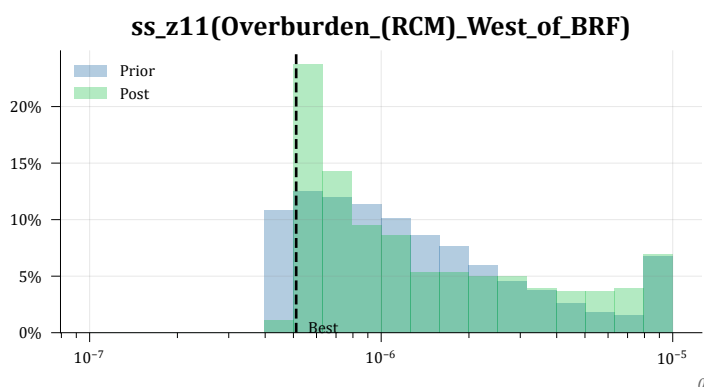
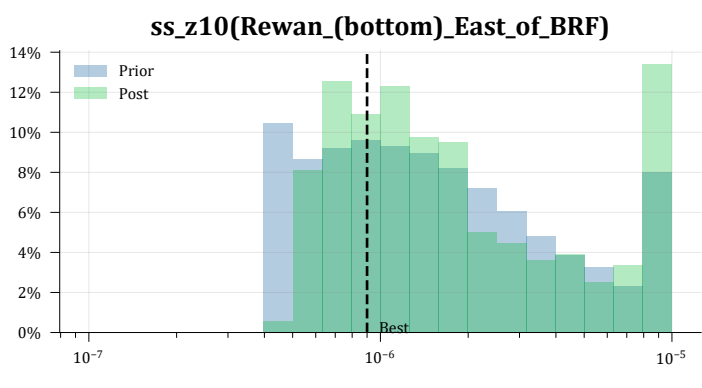
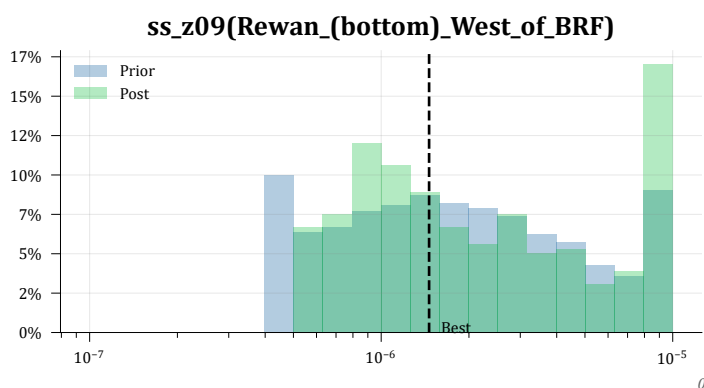
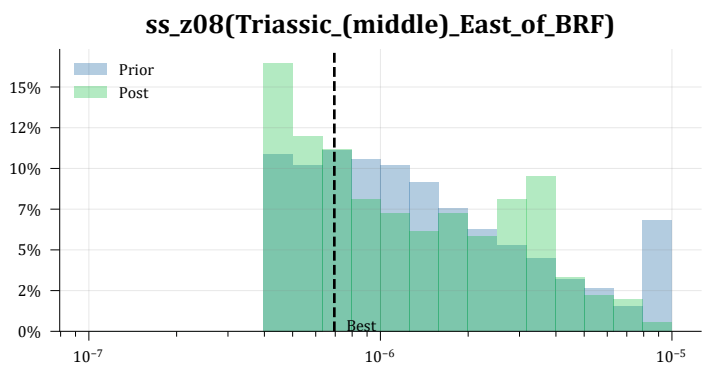
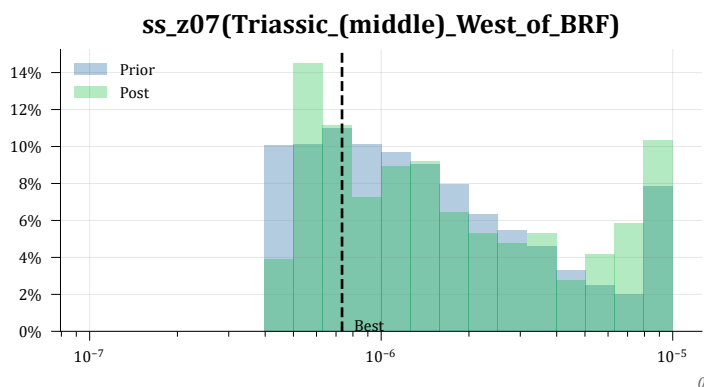
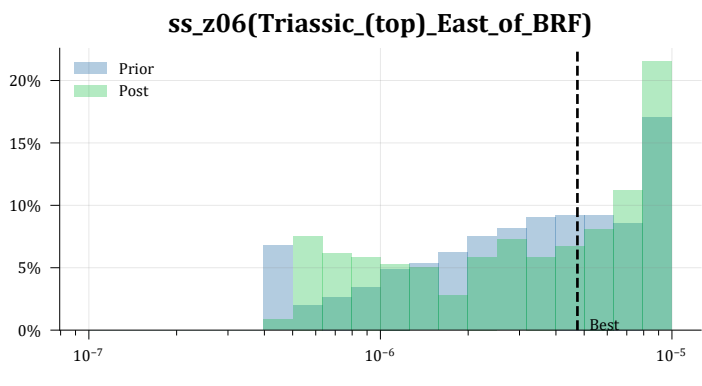
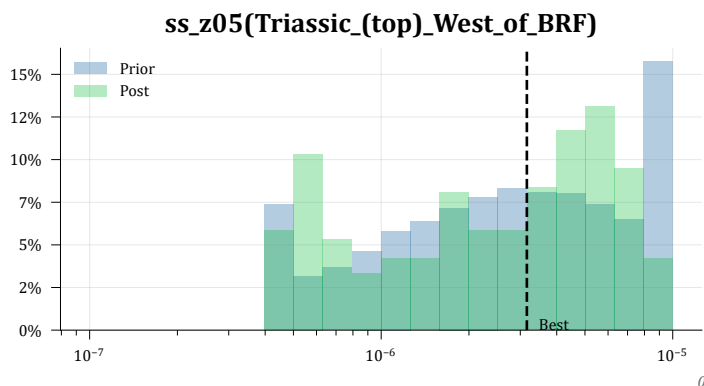
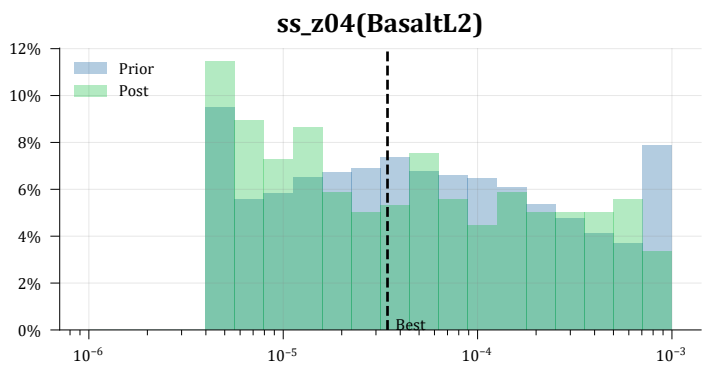
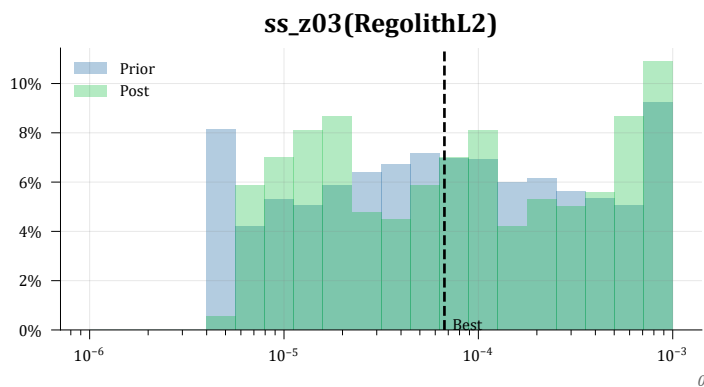


kx_zsp(Spoil)

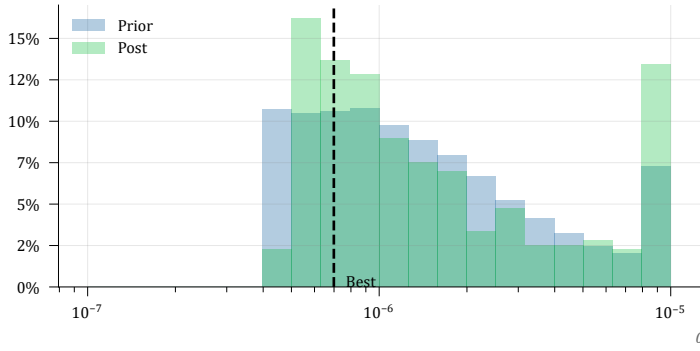




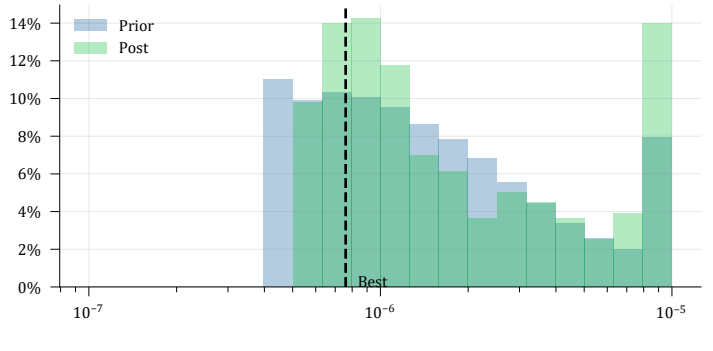




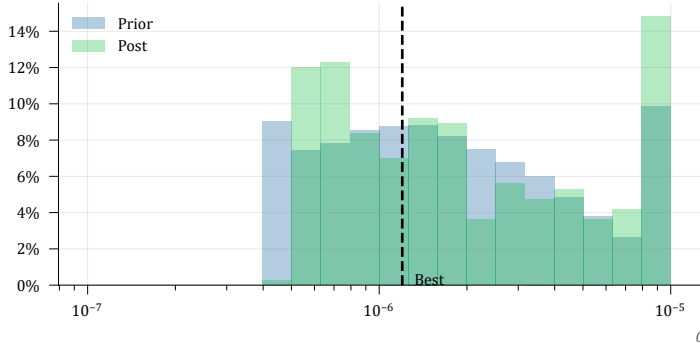
ss_z13(Burton_Rider_Seam_(RCM)_West_of_BRF)



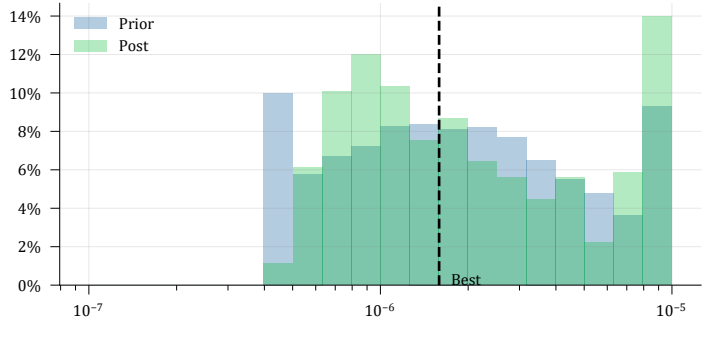
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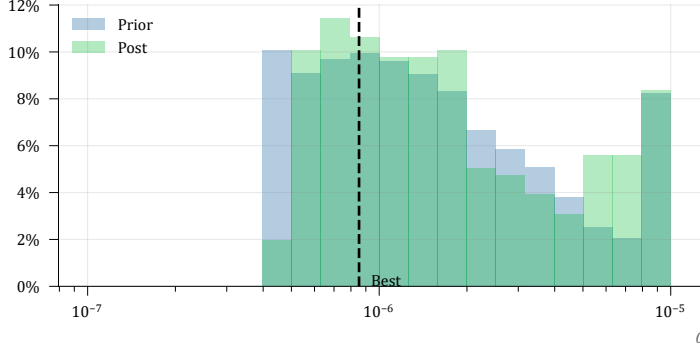
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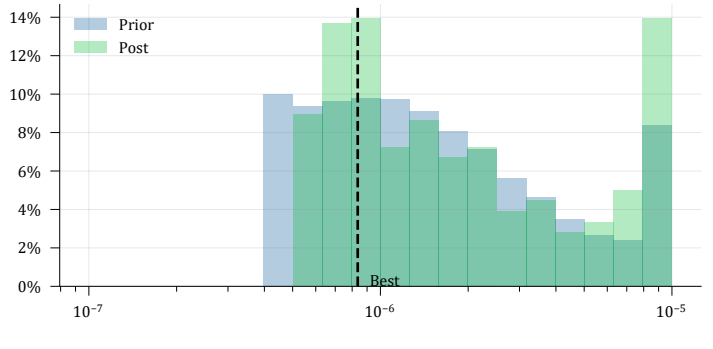
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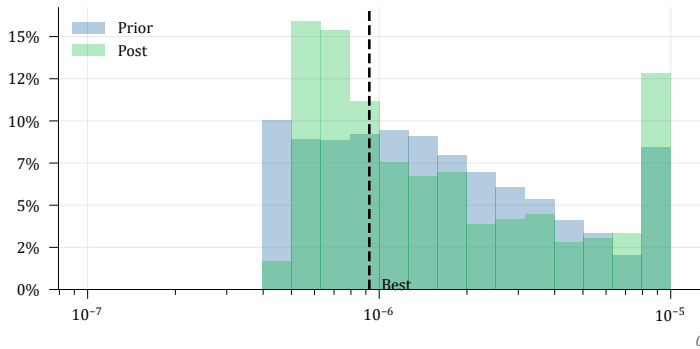
ss_z17(Leichardt/Vermont_Seams_(RCM)_West_of_BRF)



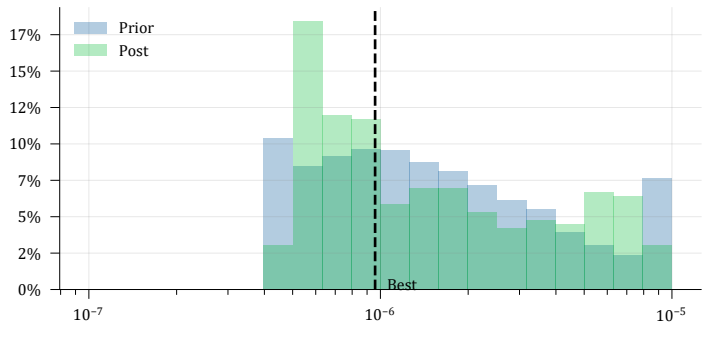
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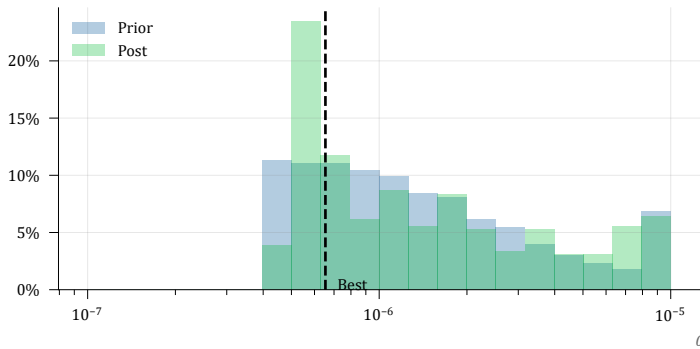
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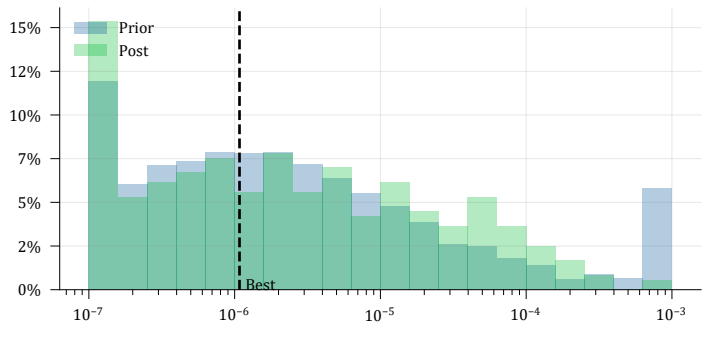
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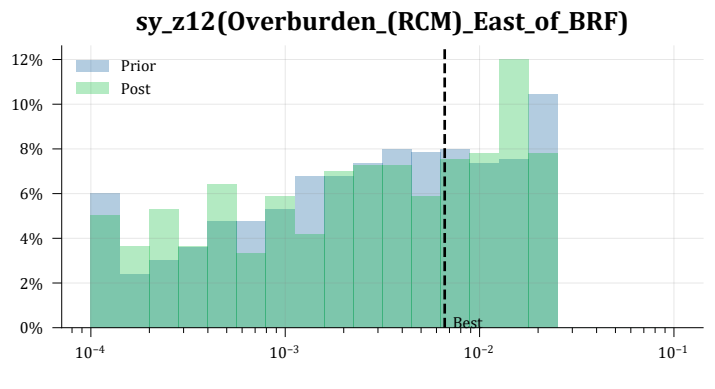
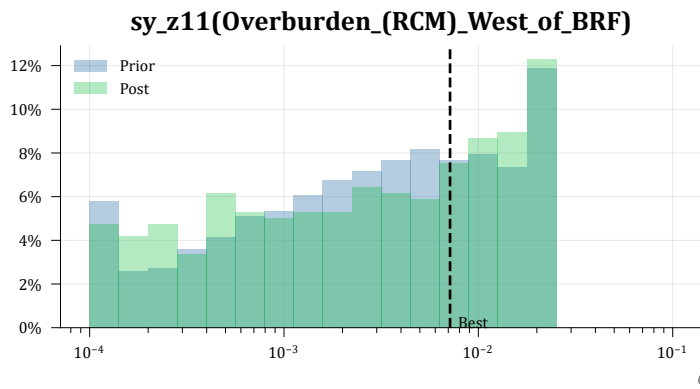
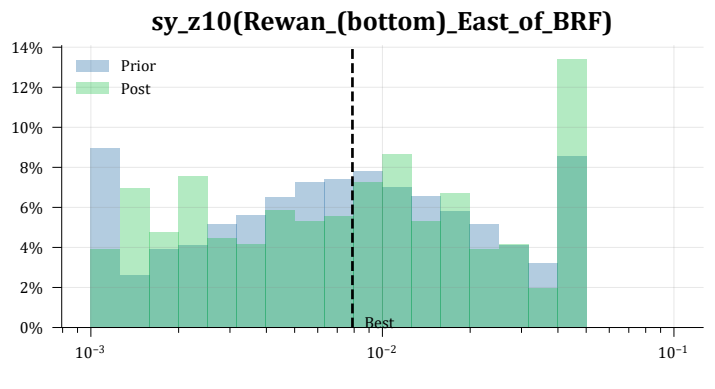
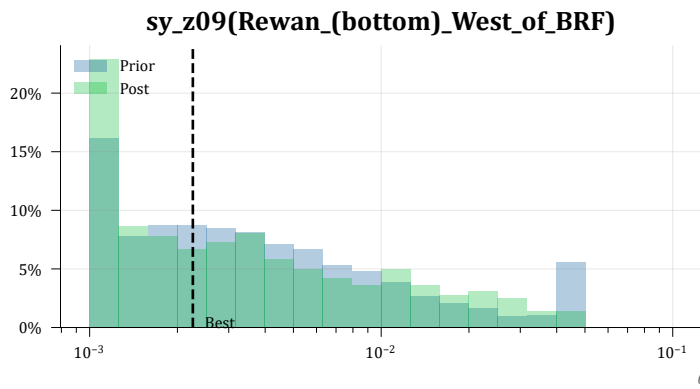
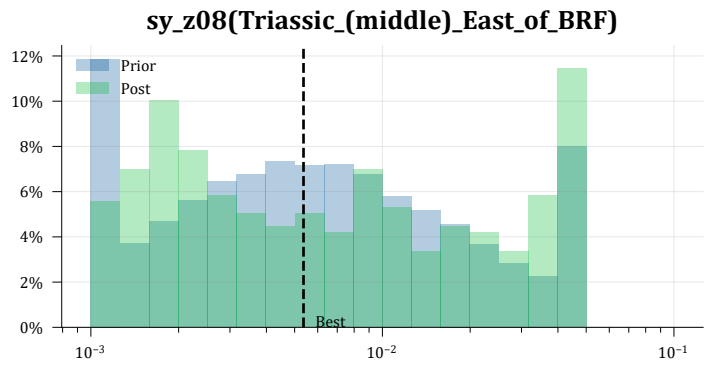
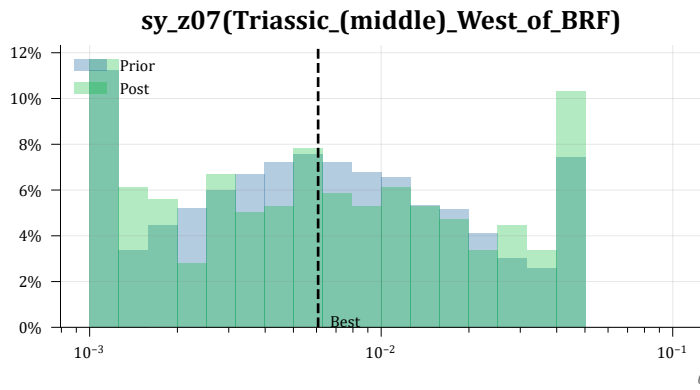
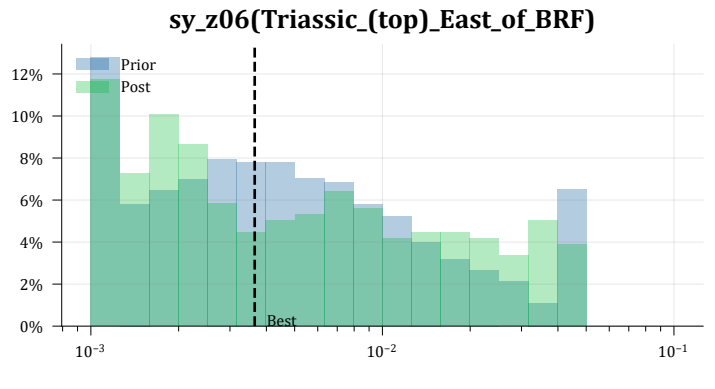
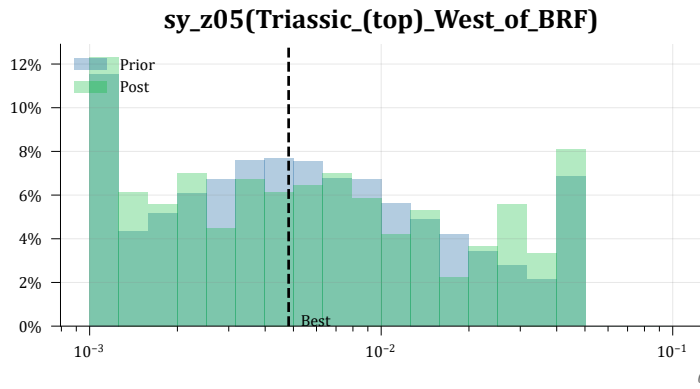
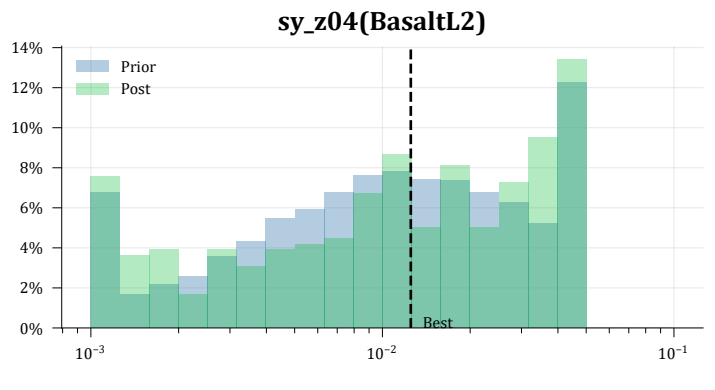
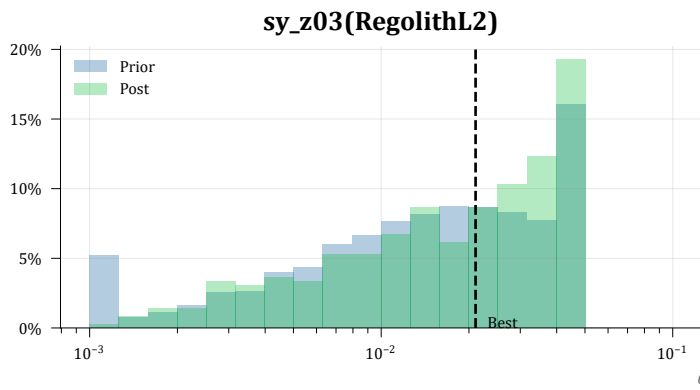


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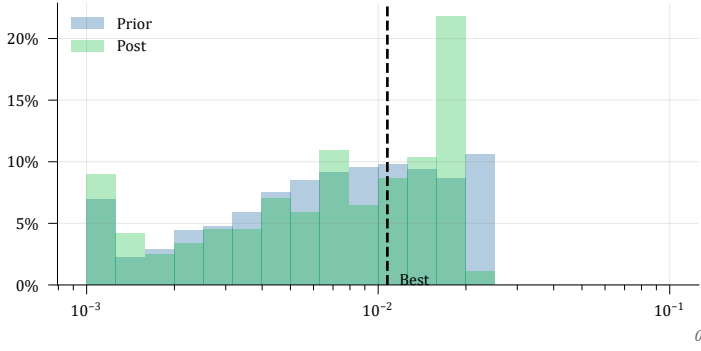


ss_zsp(Spoil)

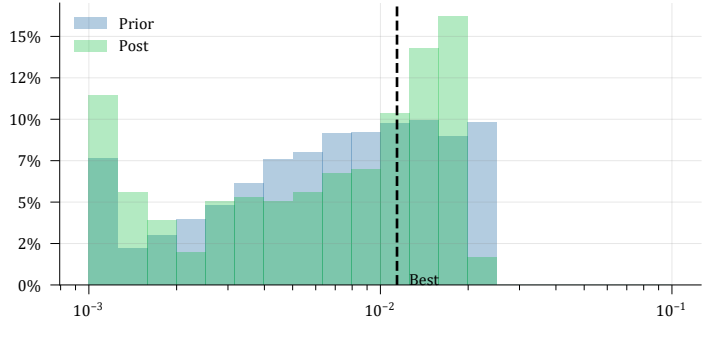




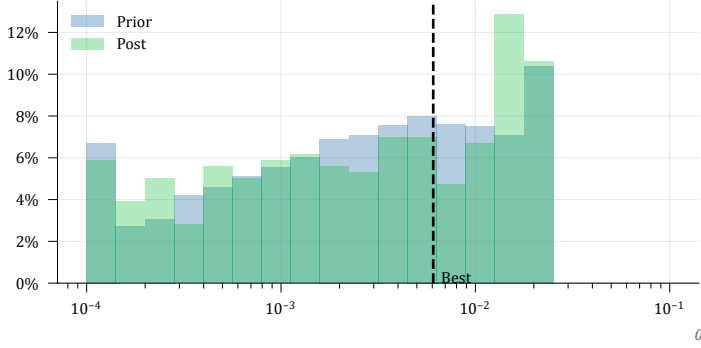
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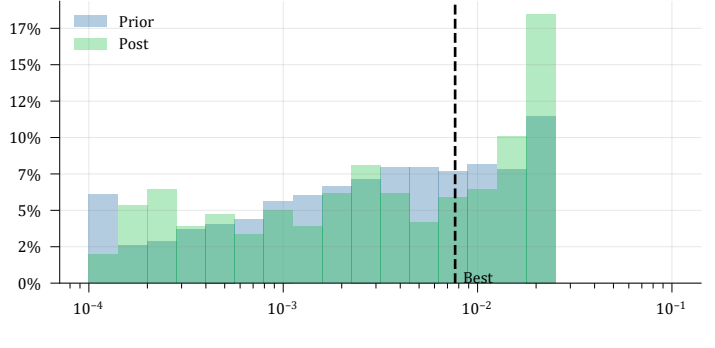
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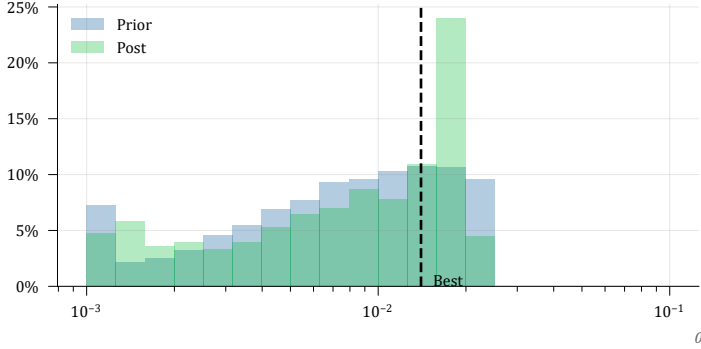
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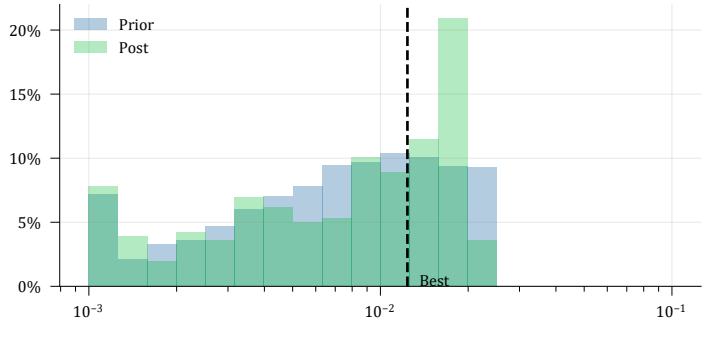
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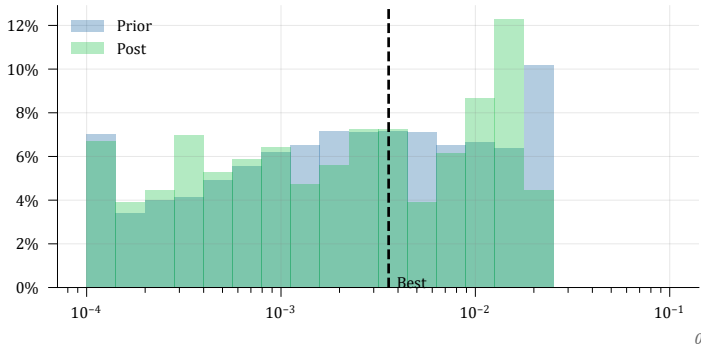
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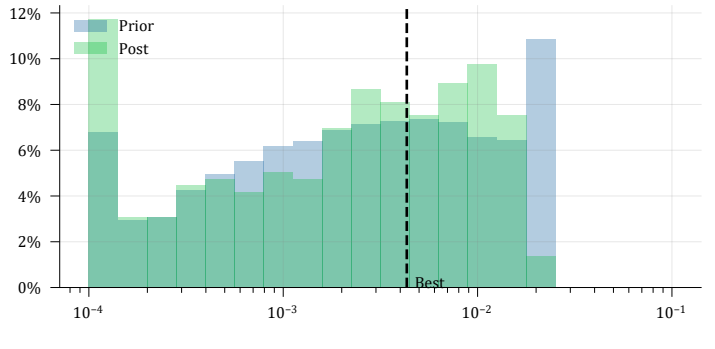
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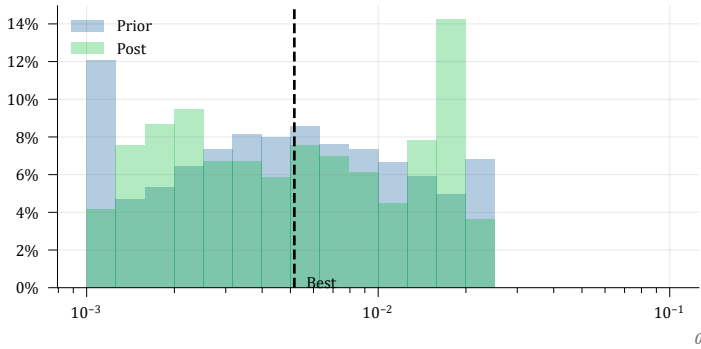
sy_z19(Underburden_(RCM)_West_of_BRF)



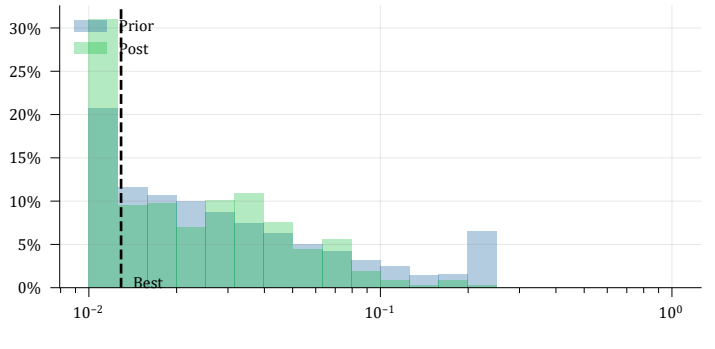
sy_z20(Underburden_(RCM)_East_of_BRF)

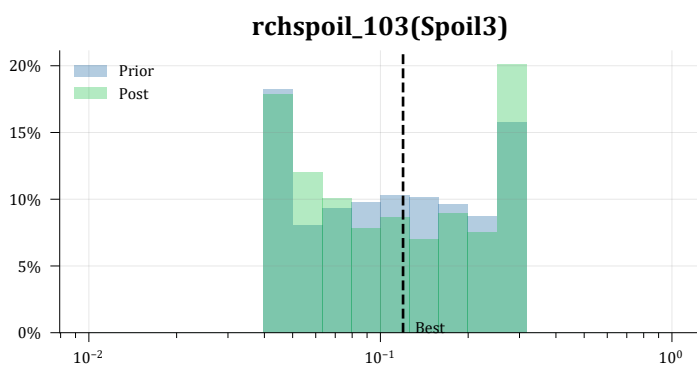
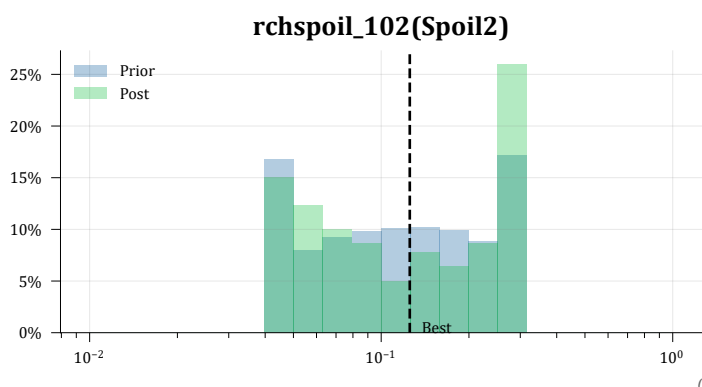
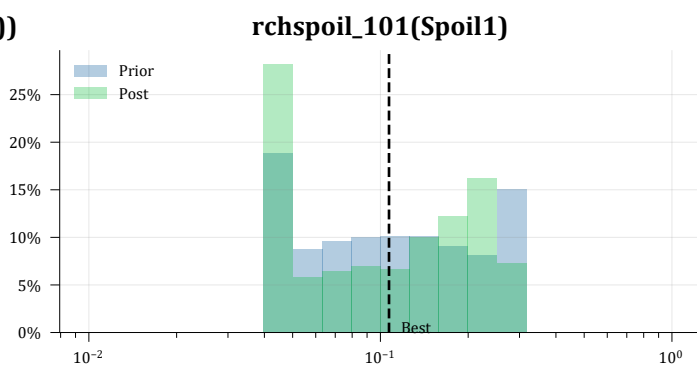
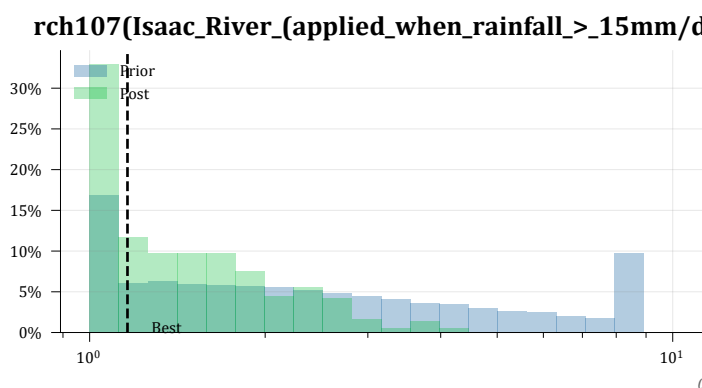
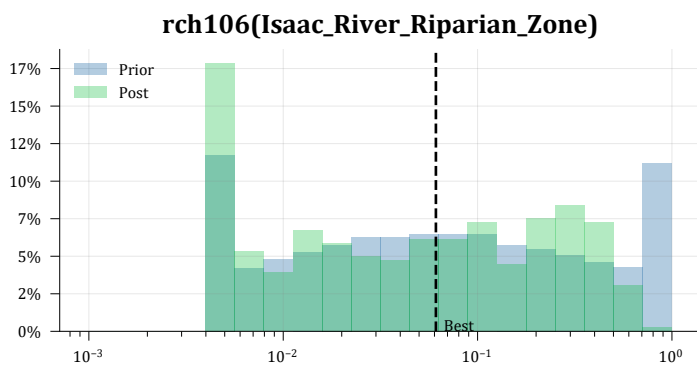
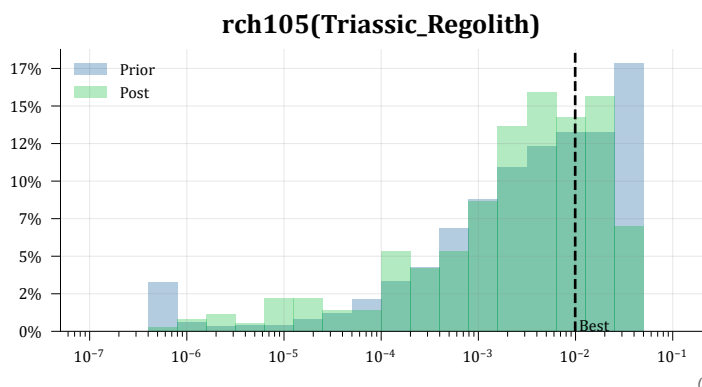
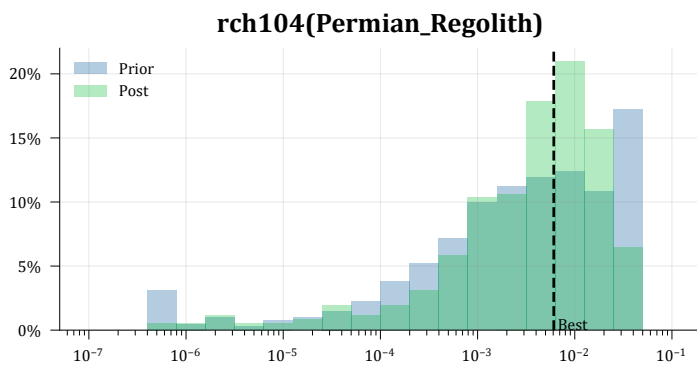
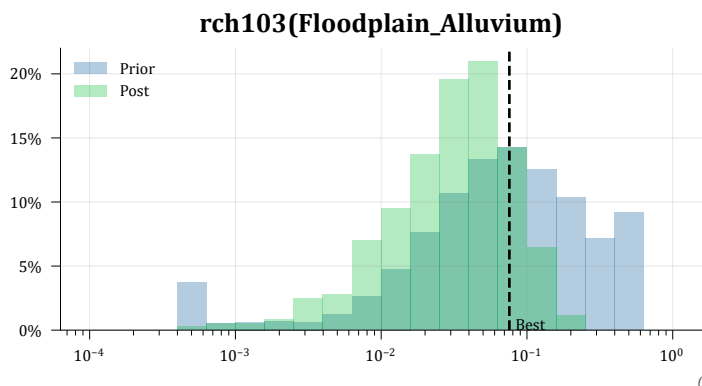
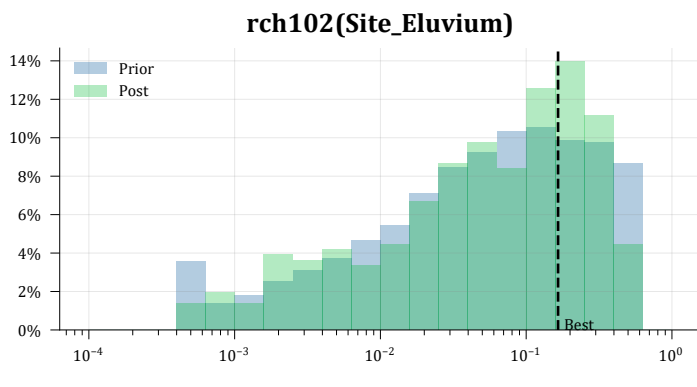
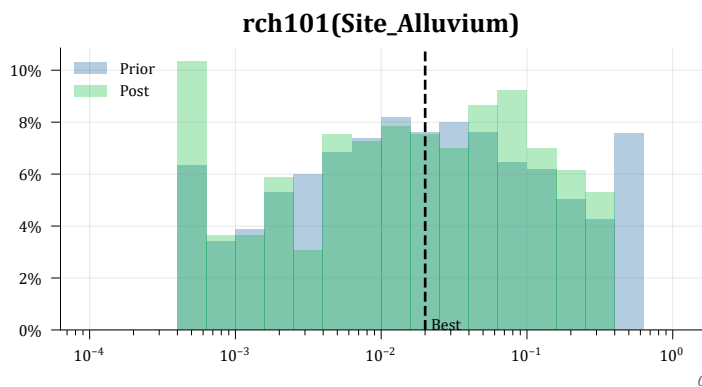


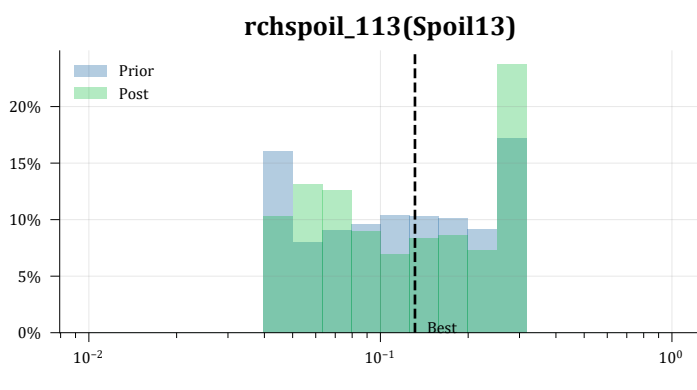
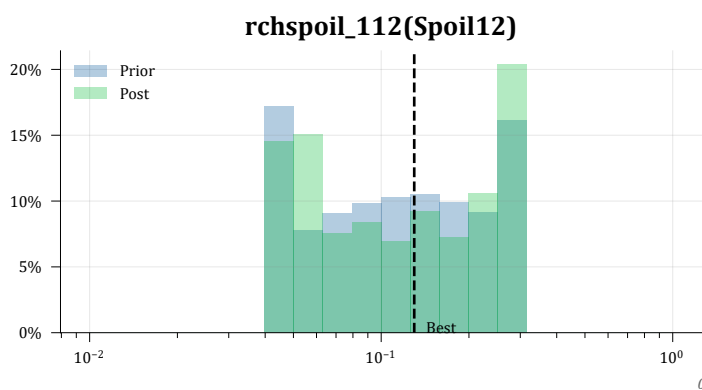
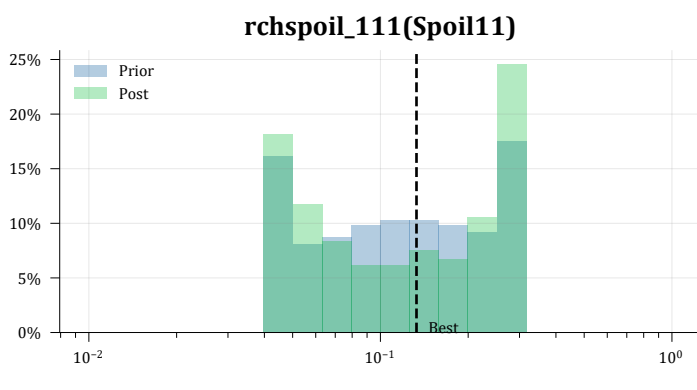
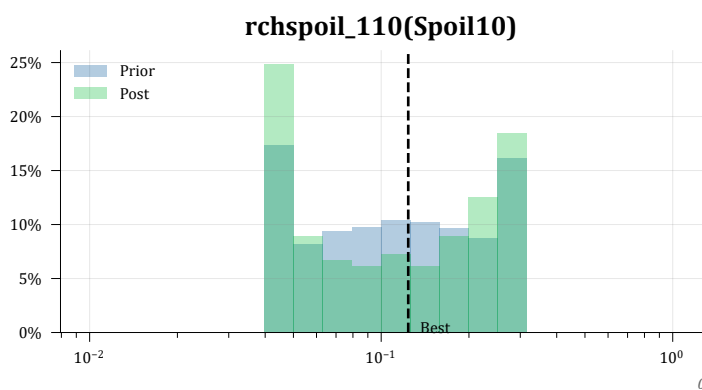
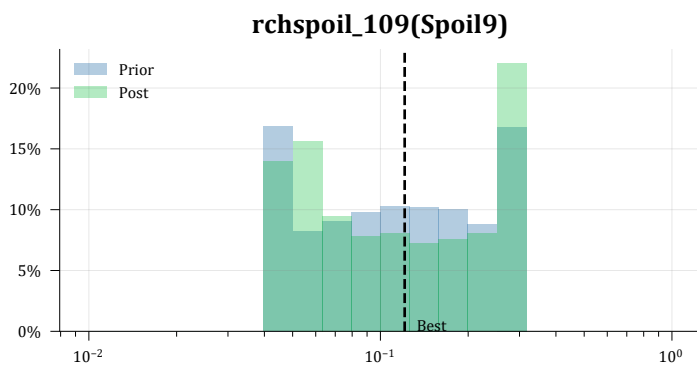
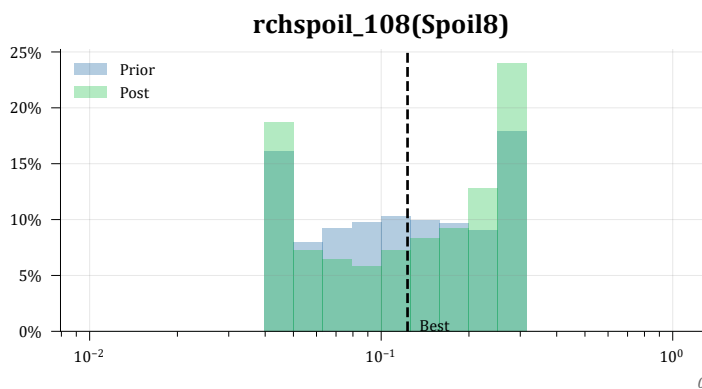
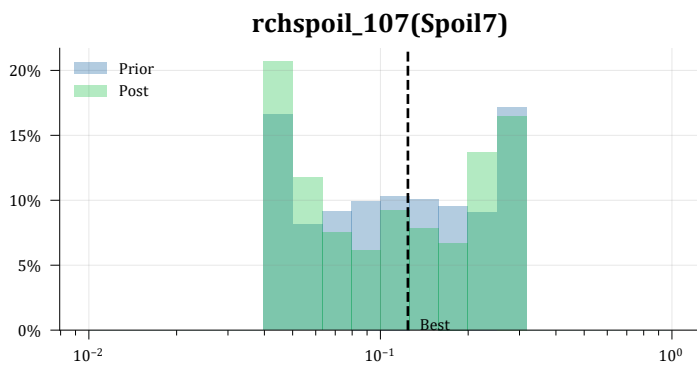
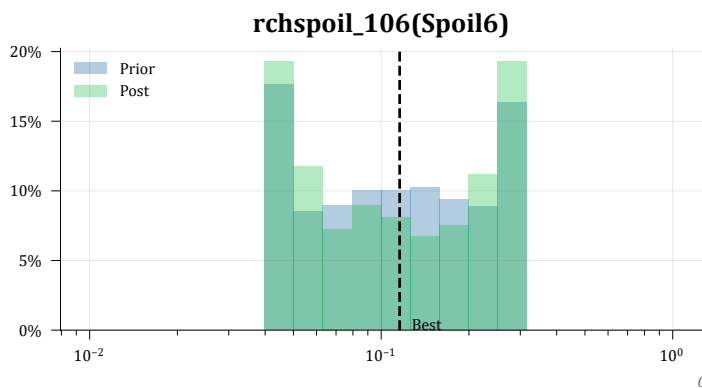
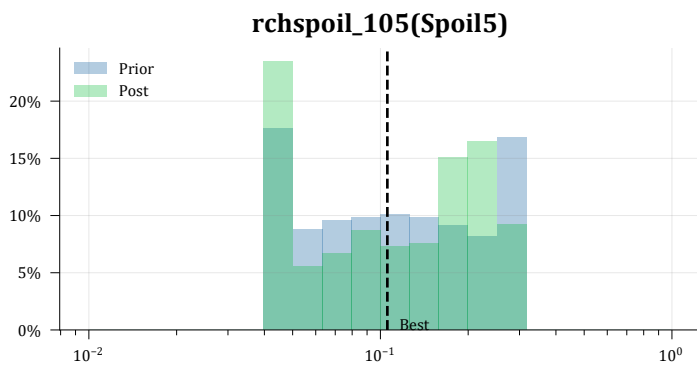
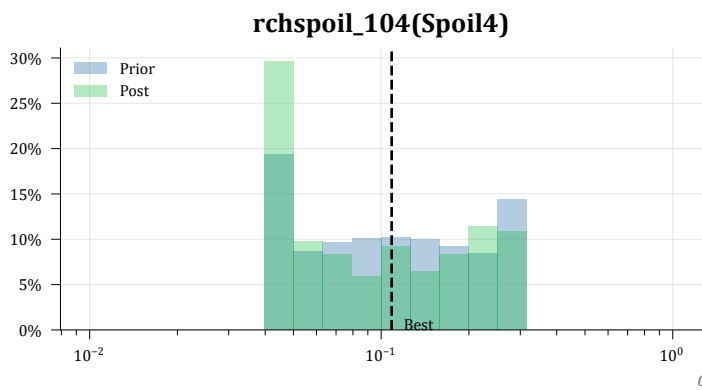
sy_z21(Coal_Measures_(FCCM))



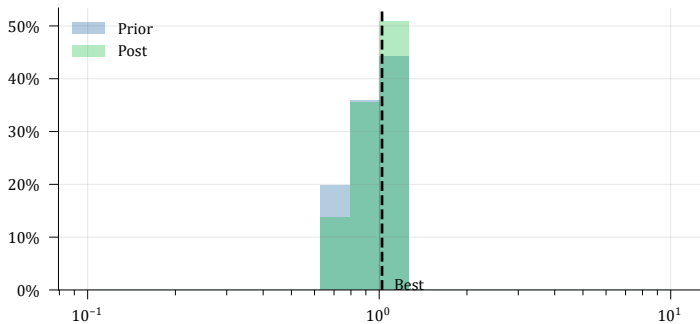
sy_zsp(Spoil)



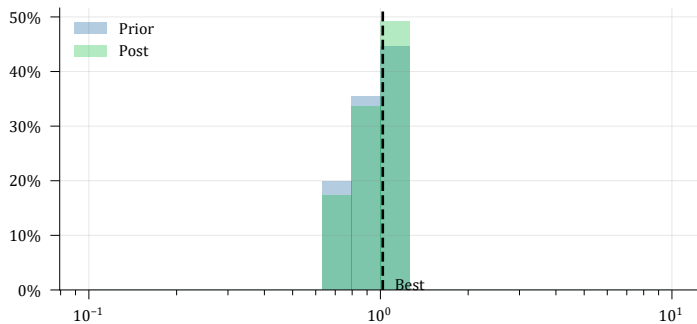




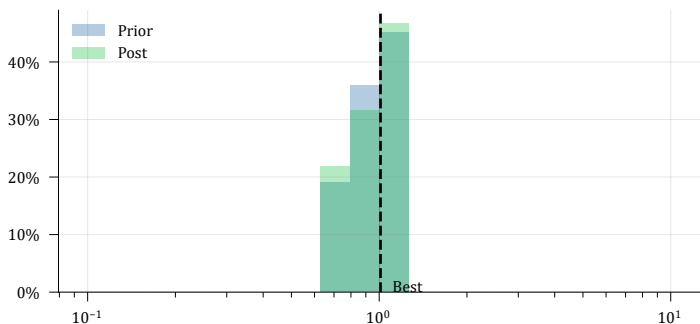
evt101(Riparian_Buffer)



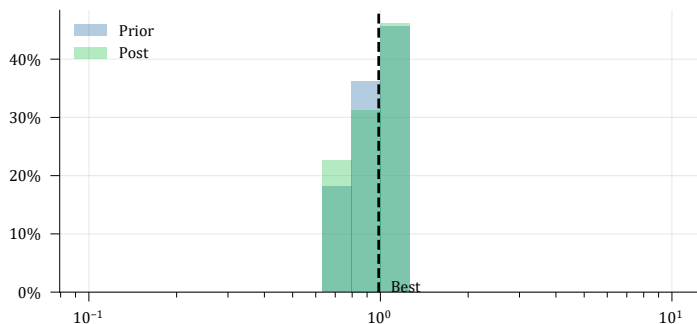
evt102(Dense_Forest)



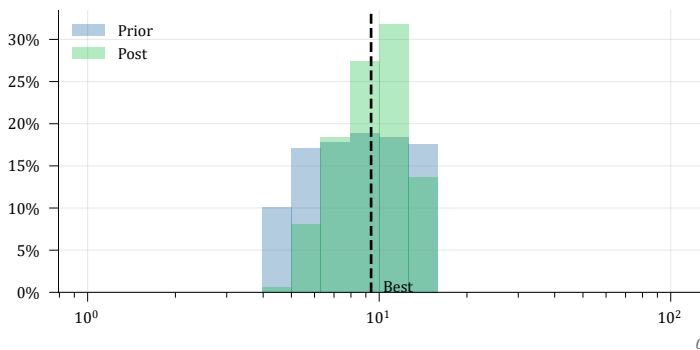
evt103(Shrub_and_Bare)



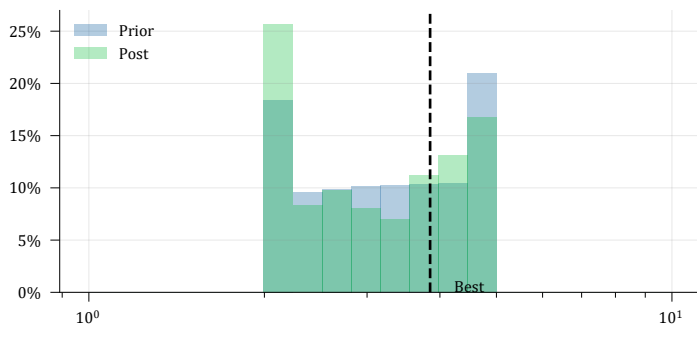
evt1_sp(Spoil)



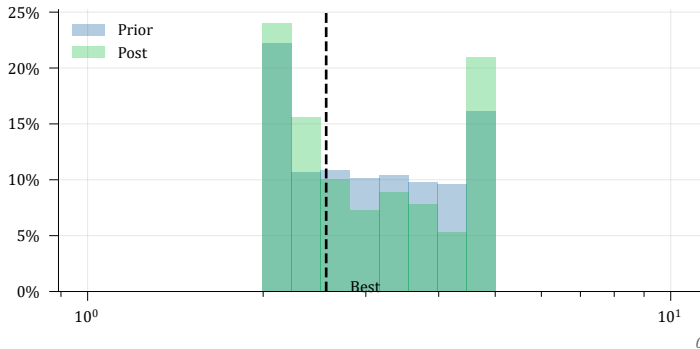
evt201(Riparian_Buffer)



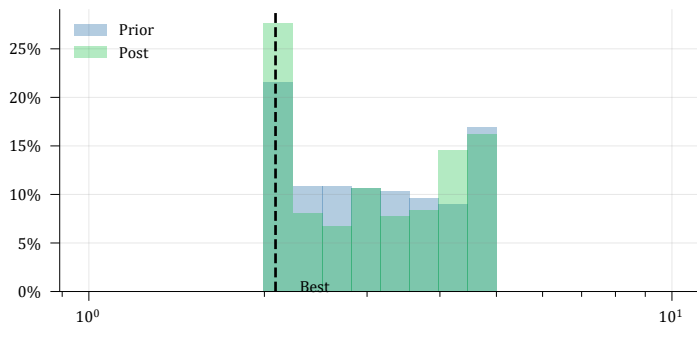
evt202(Dense_Forest)



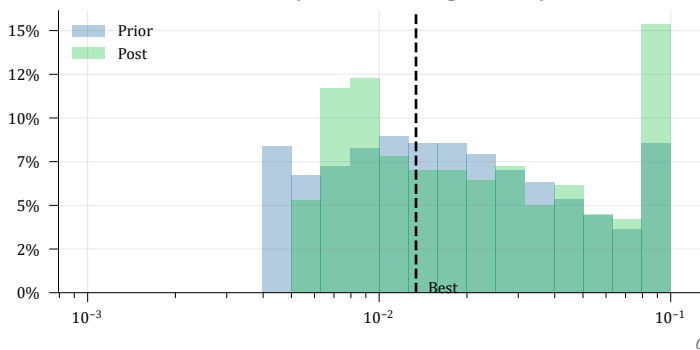
evt203(Shrub_and_Bare)



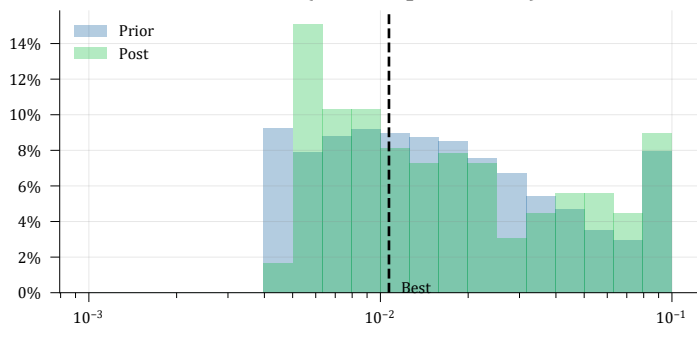
evt2_sp(Spoil)



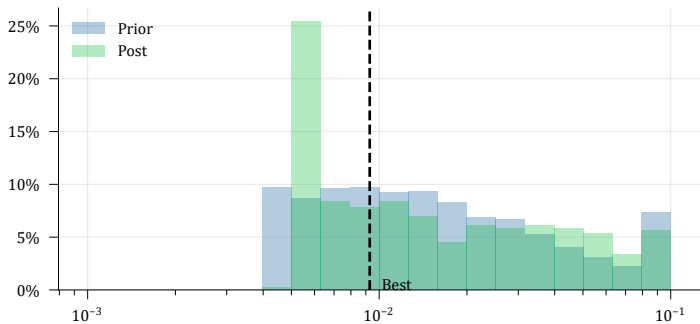
riv101(Burton_Range_Dam)



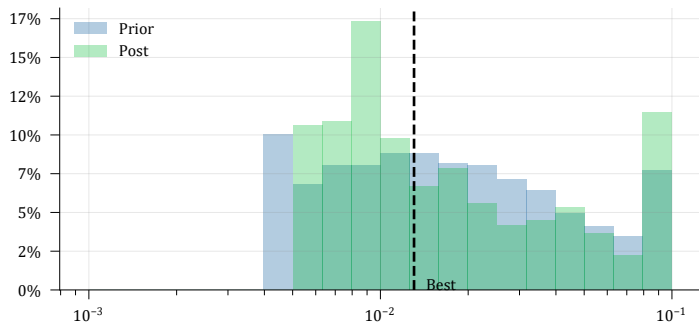
riv102(Lake_Elphinstone)



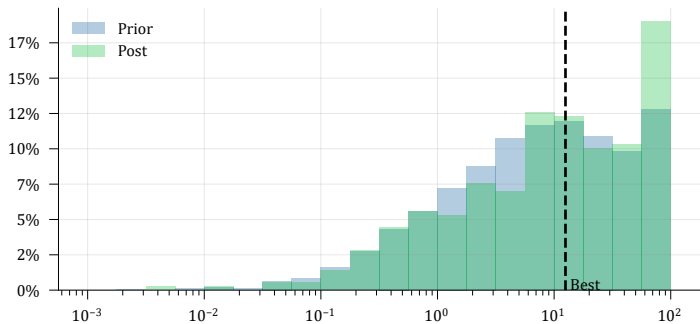
riv103(Teviot_Creek_Dam)



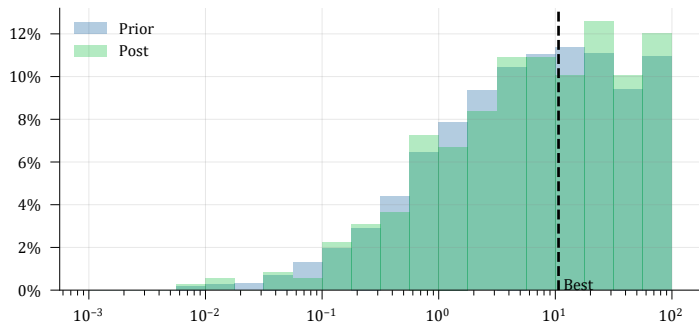
riv104(Isaac_River)



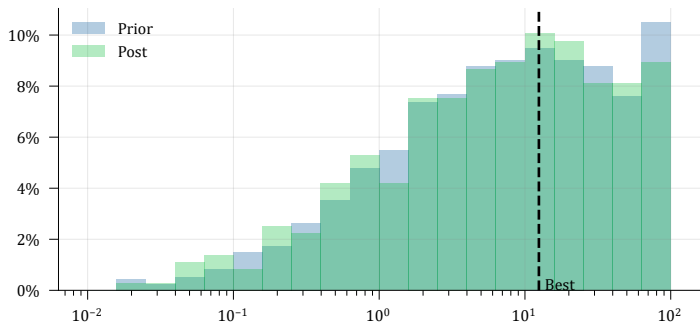
kx_p1(Pilot_Point_L1)



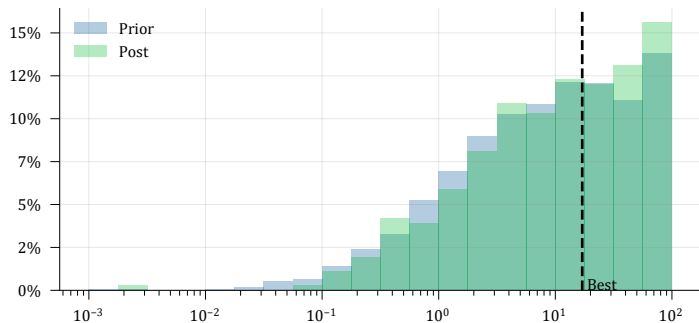
kx_p2(Pilot_Point_L1)



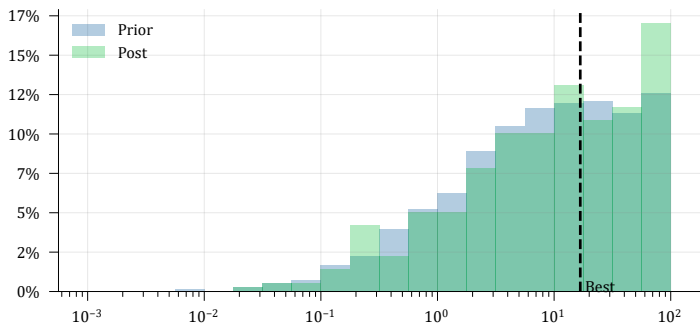
kx_p3(Pilot_Point_L1)



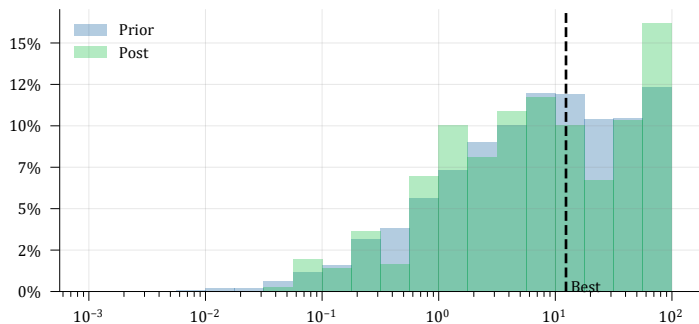
kx_p4(Pilot_Point_L1)



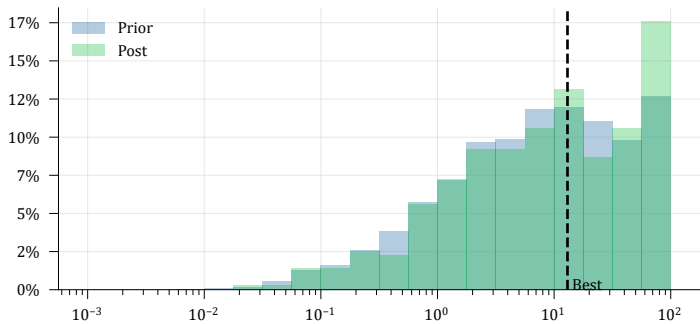
kx_p5(Pilot_Point_L1)



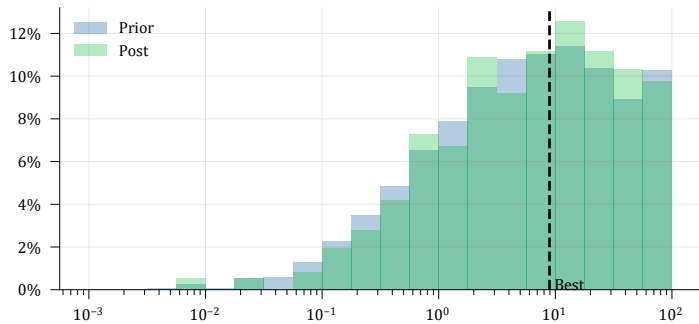
kx_p6(Pilot_Point_L1)

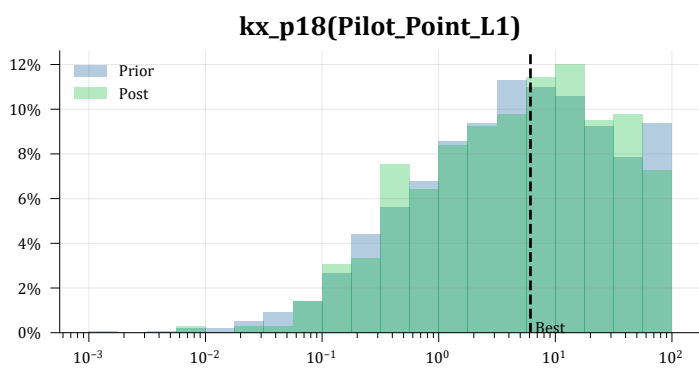
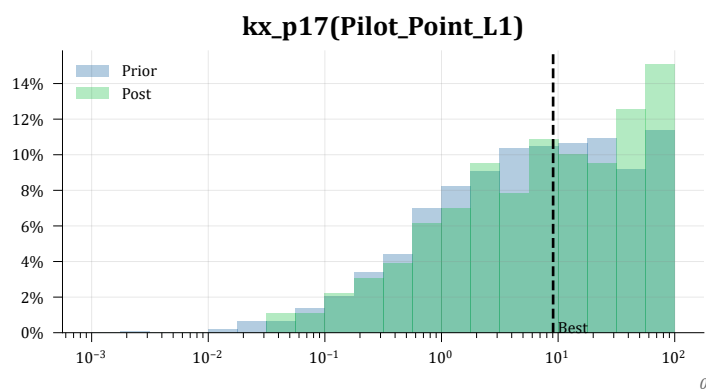
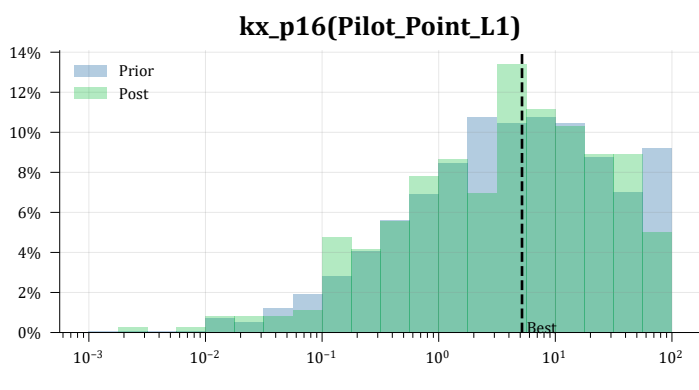
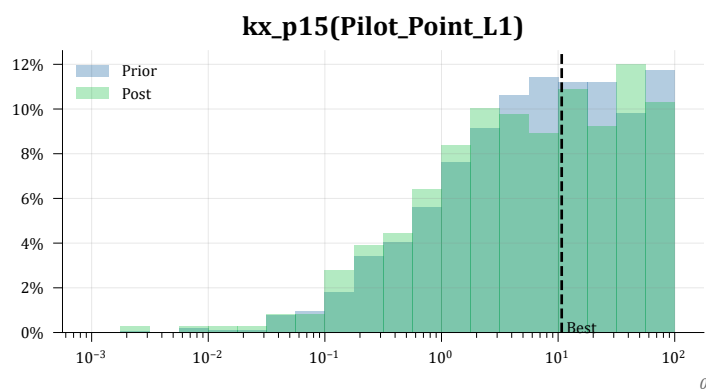
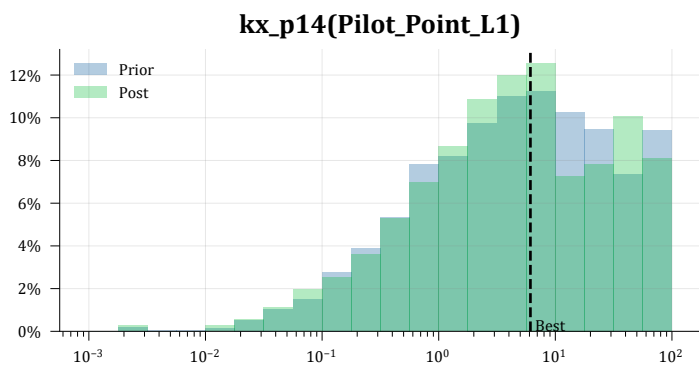
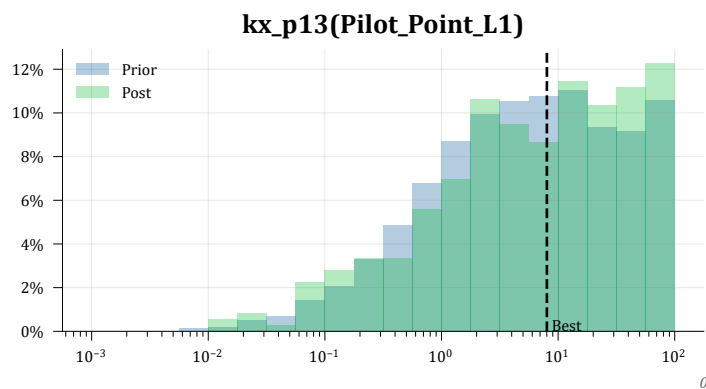
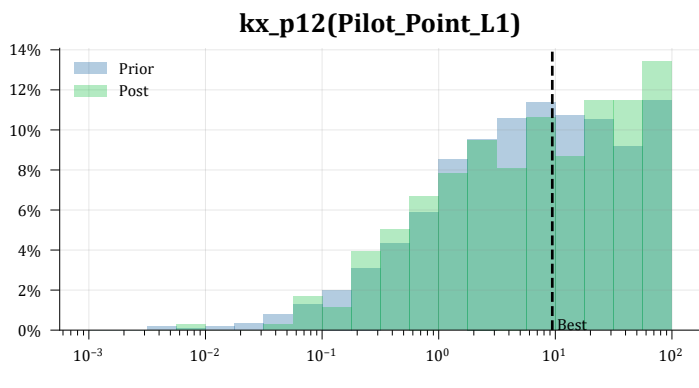
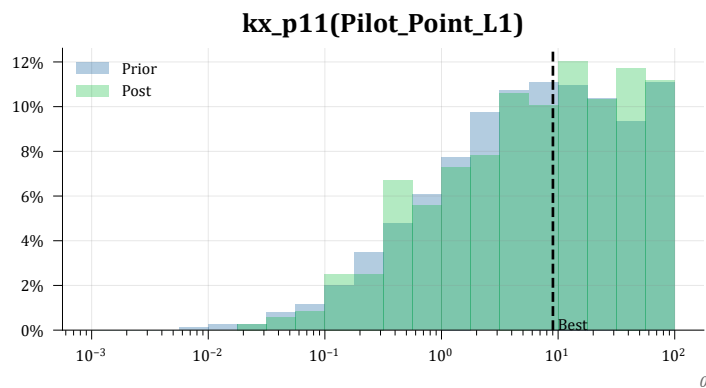
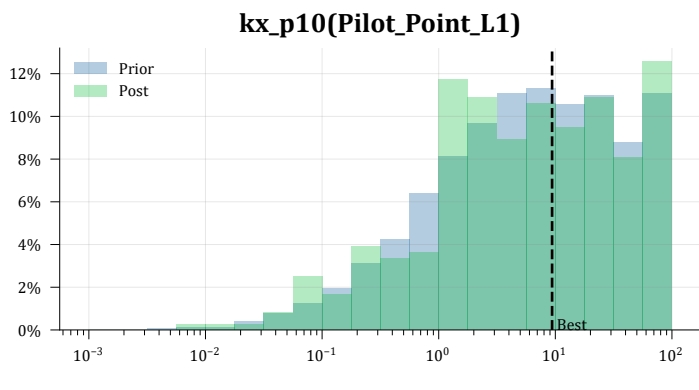
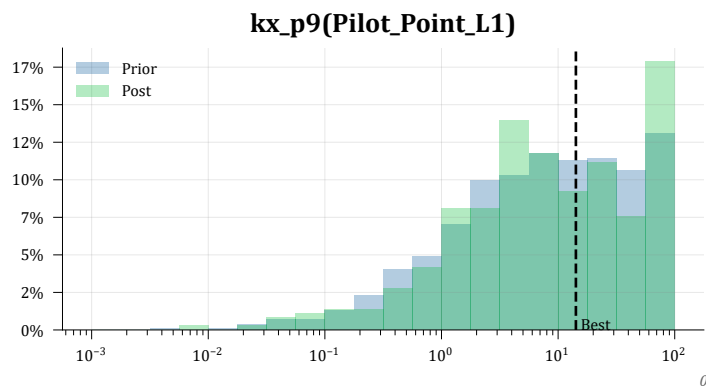


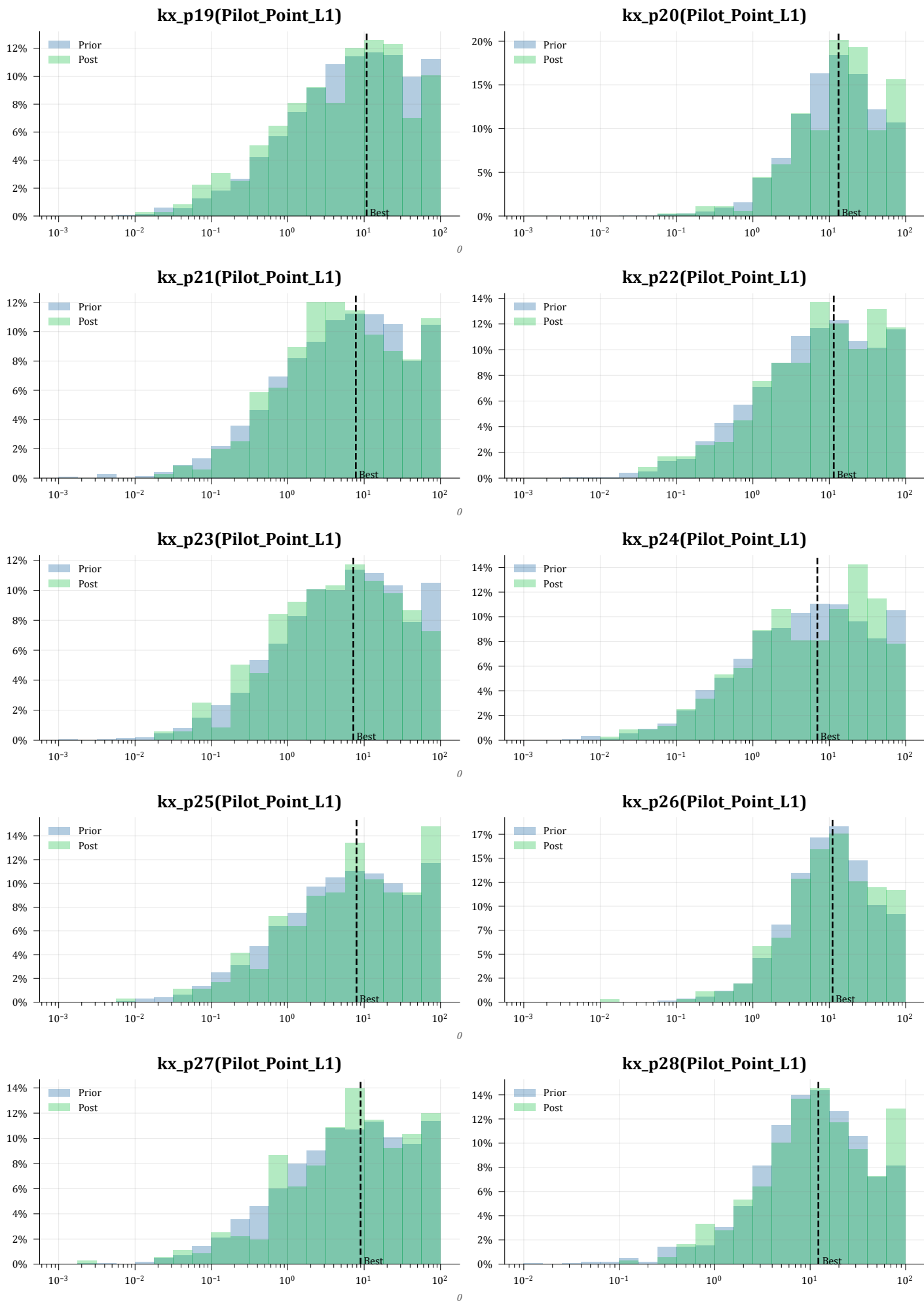
kx_p7(Pilot_Point_L1)



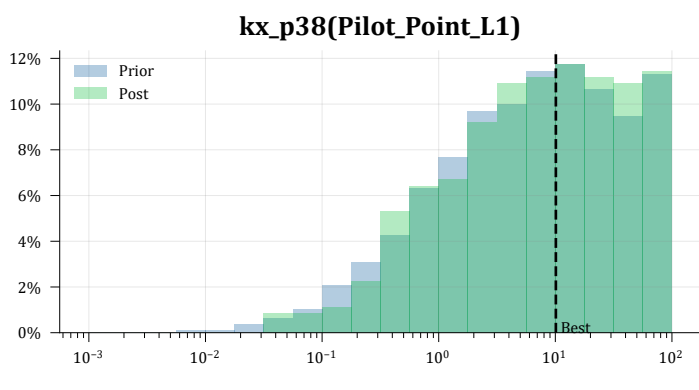
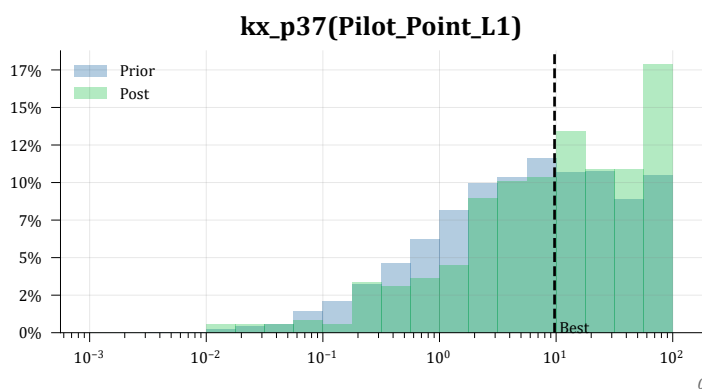
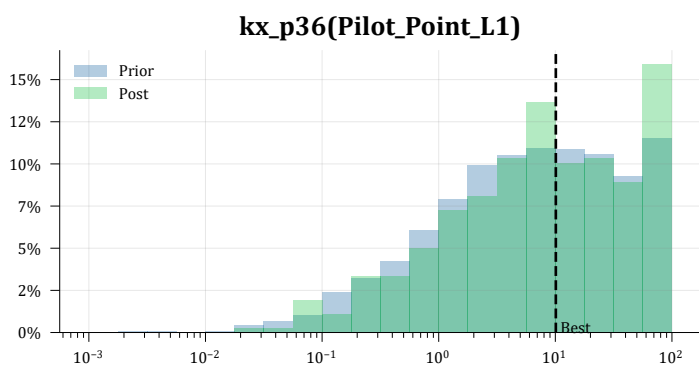
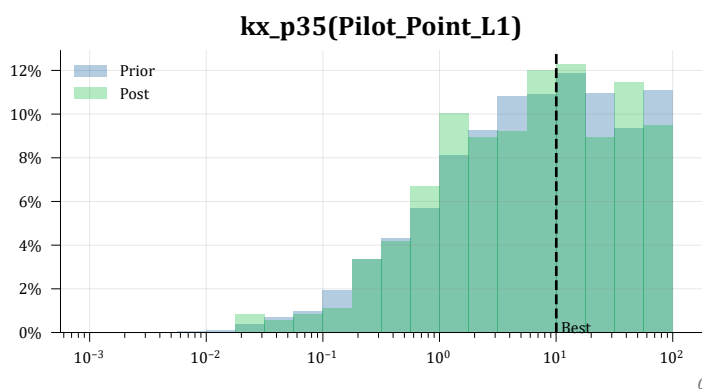
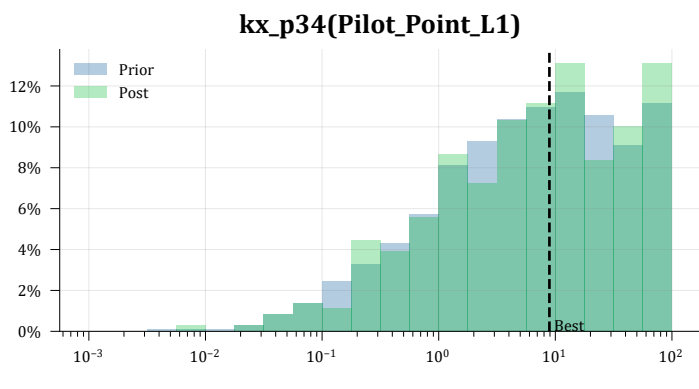
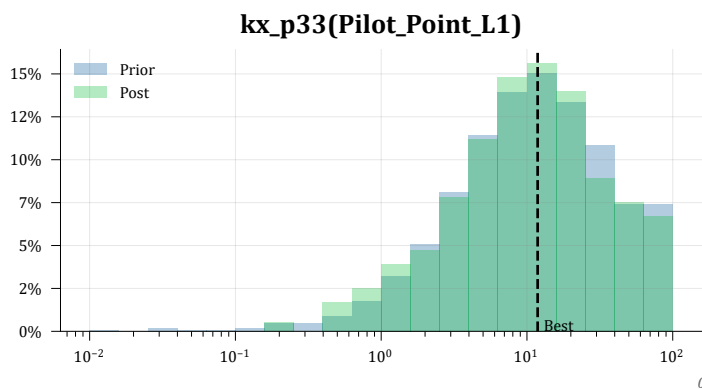
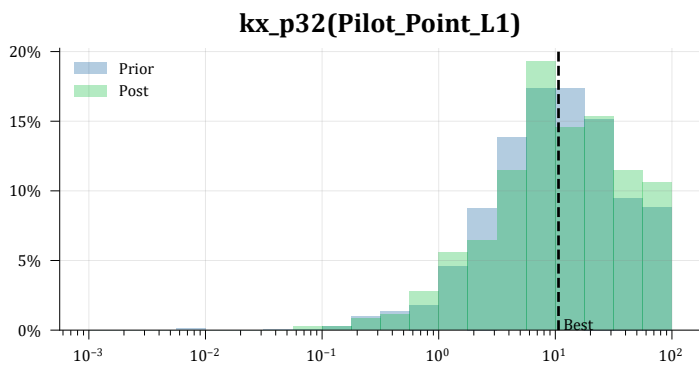
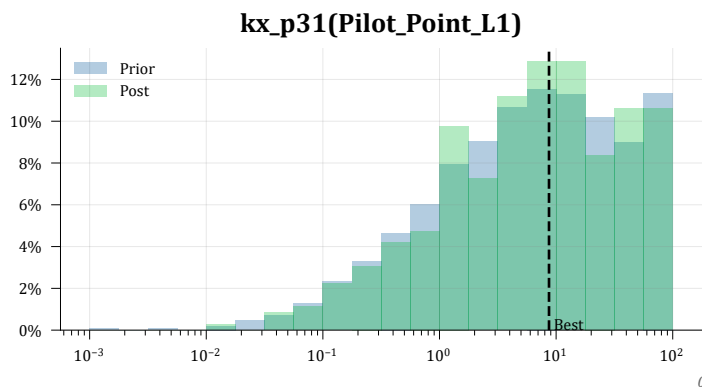
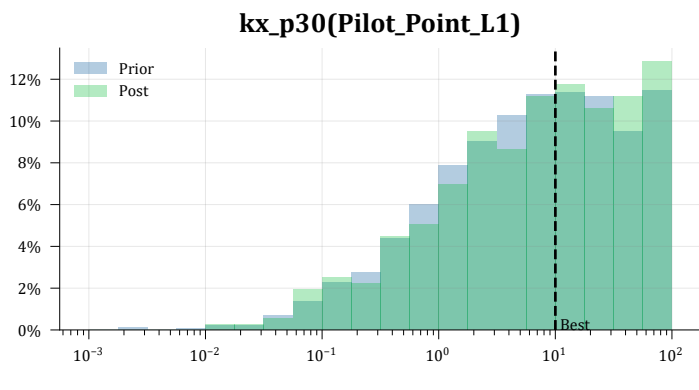
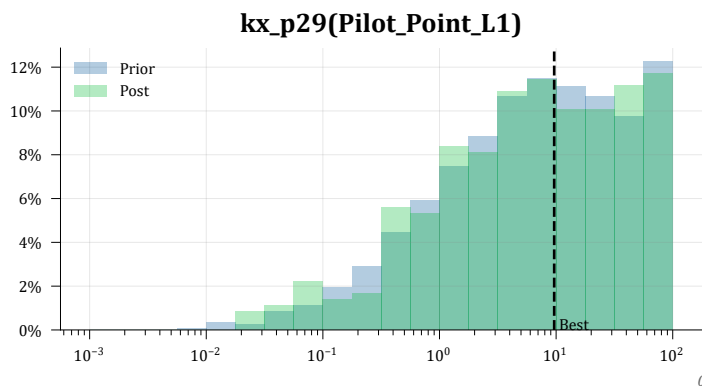
kx_p8(Pilot_Point_L1)

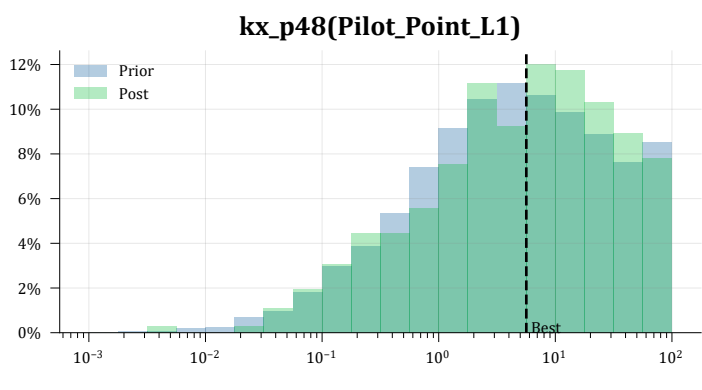
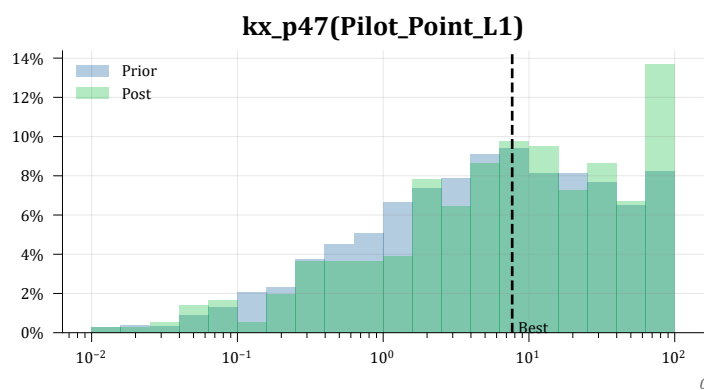
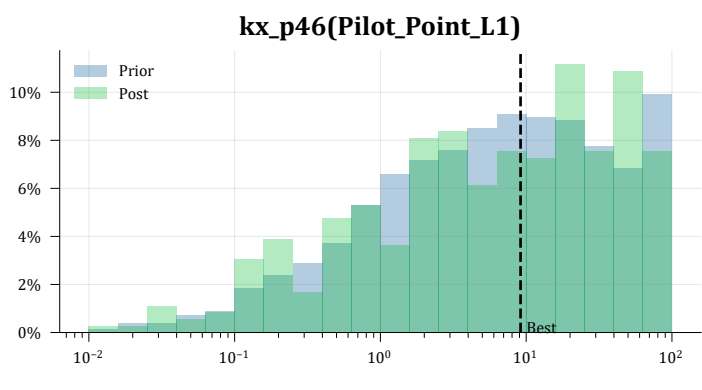
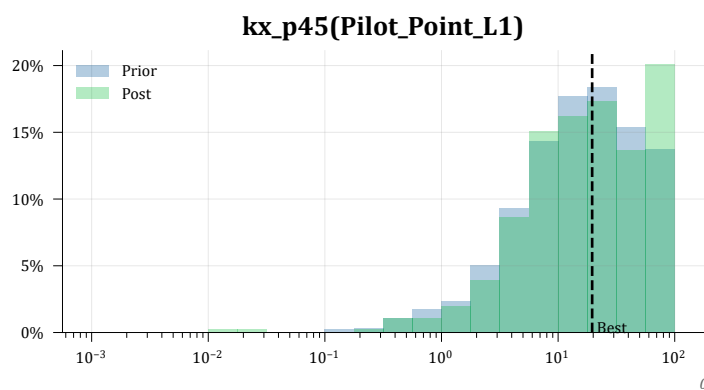
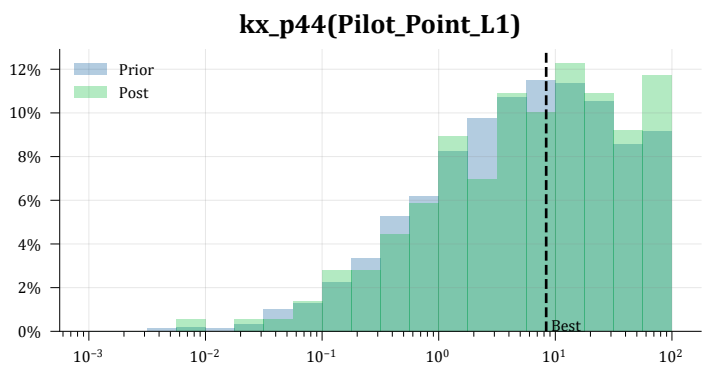
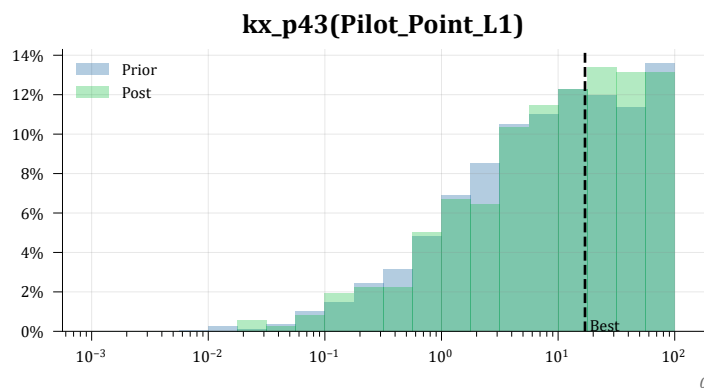
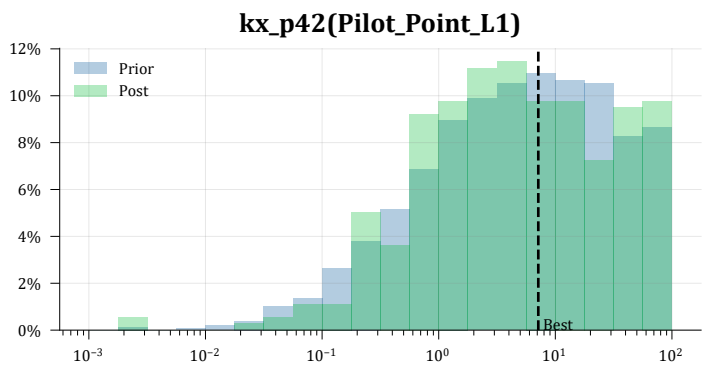
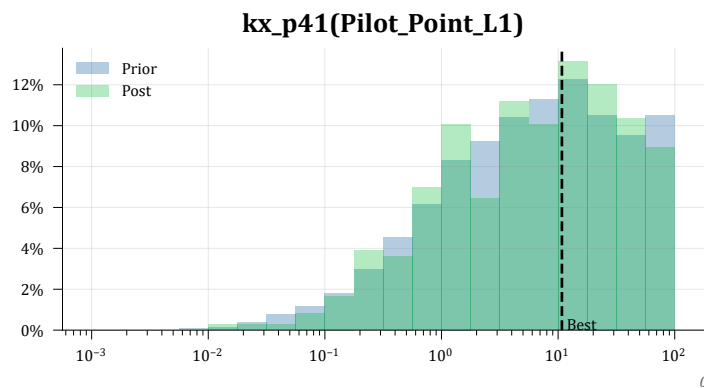
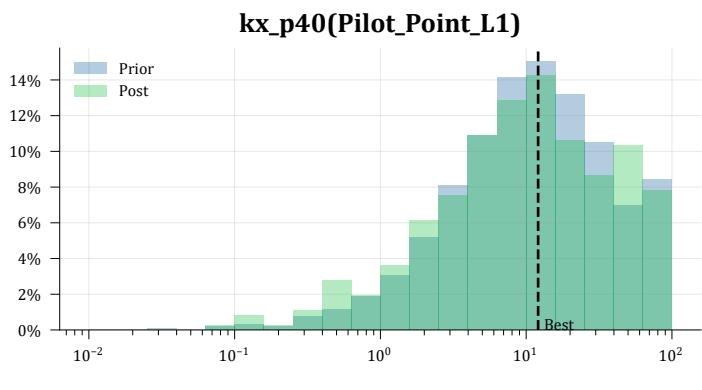
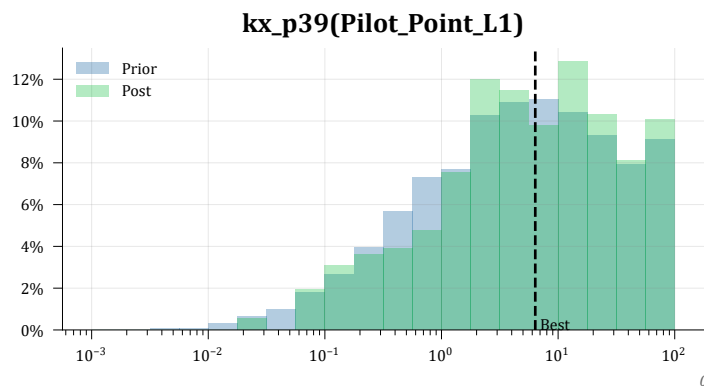


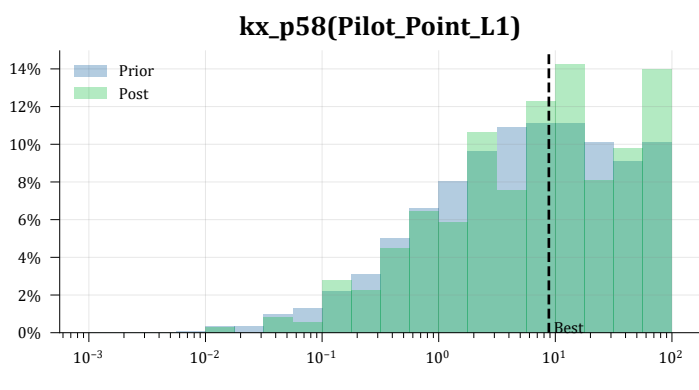
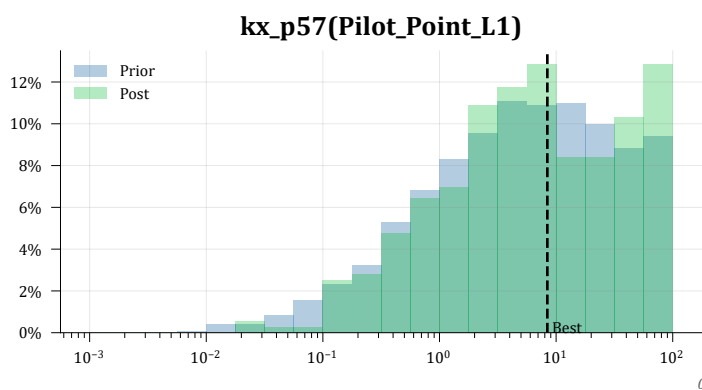
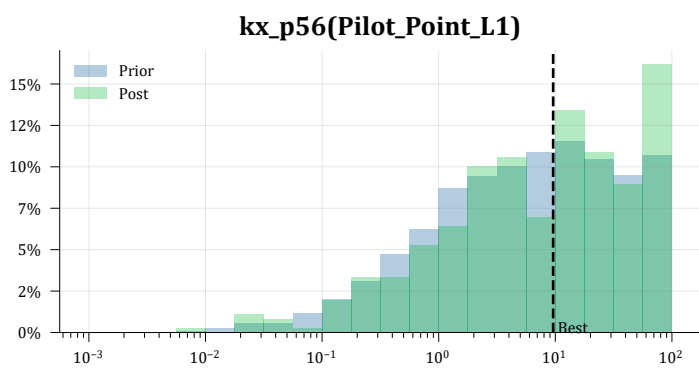
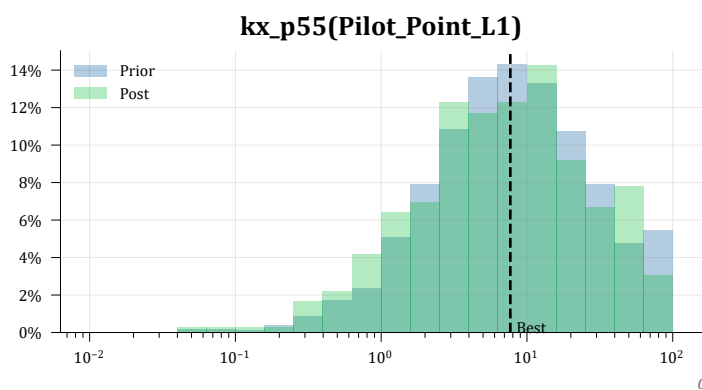
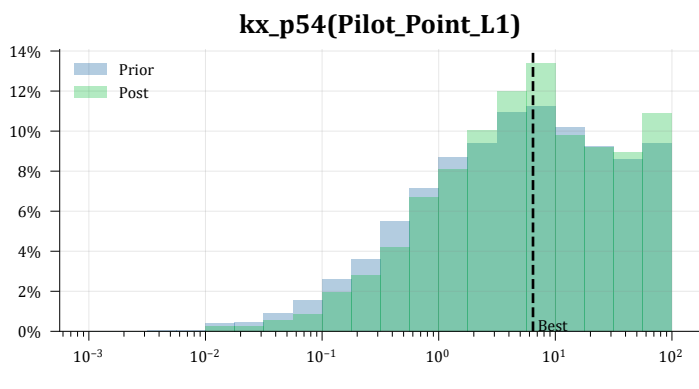
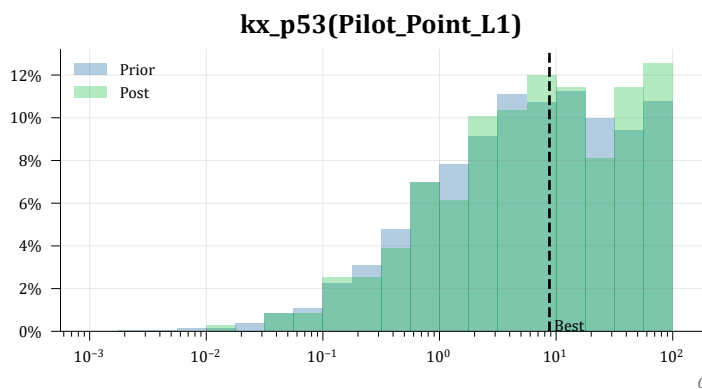
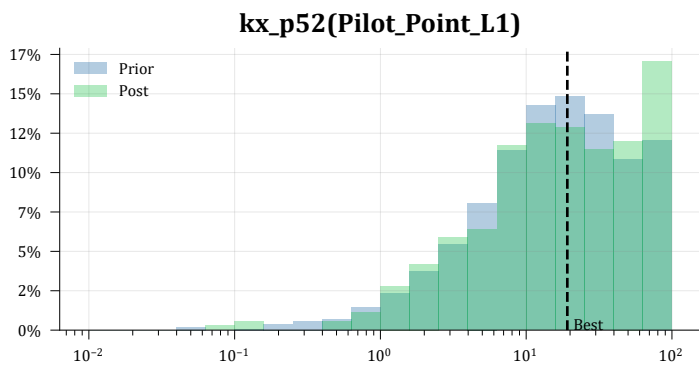
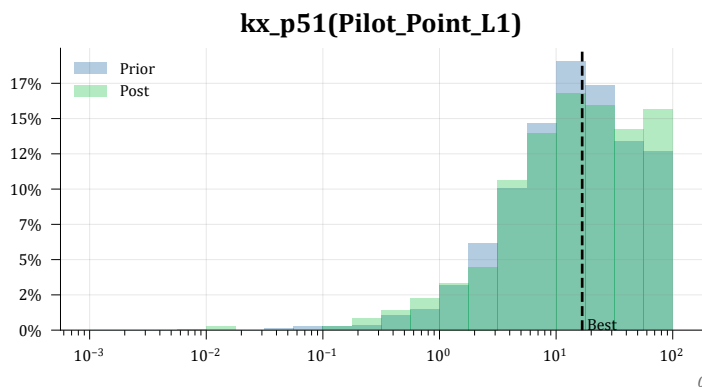
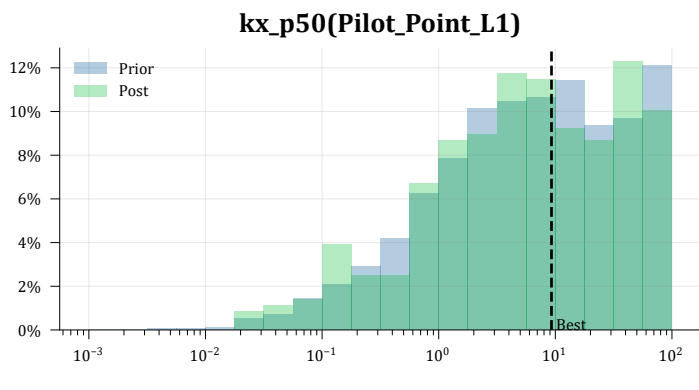
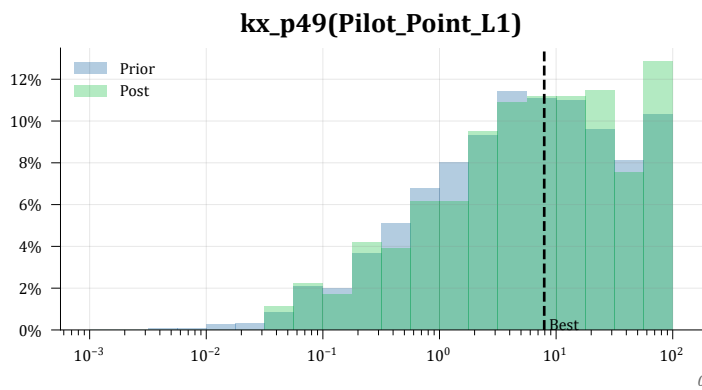


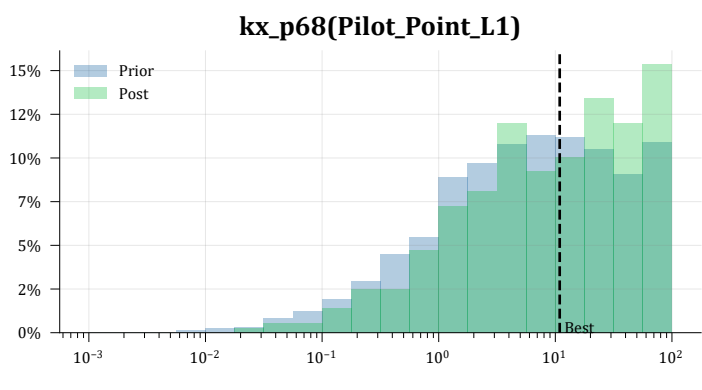
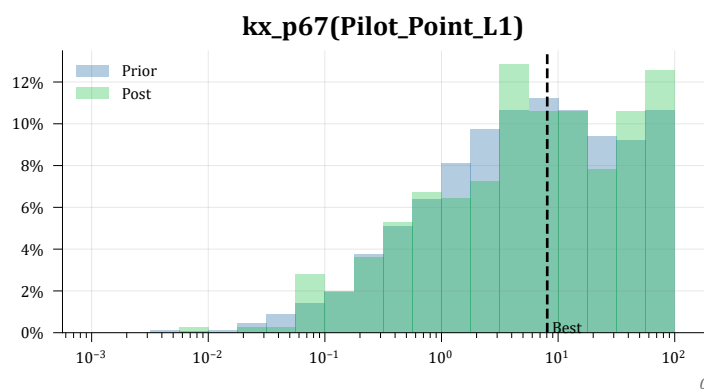
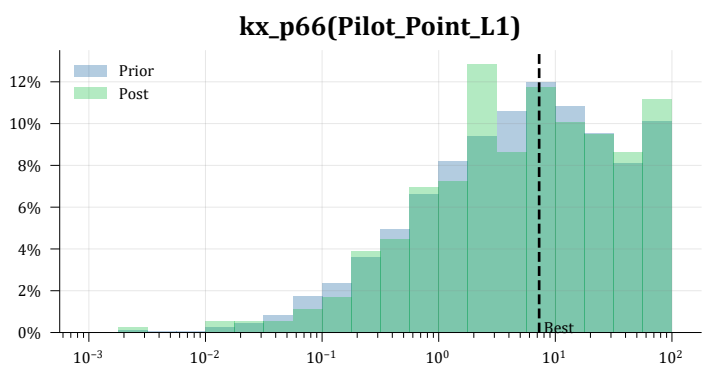
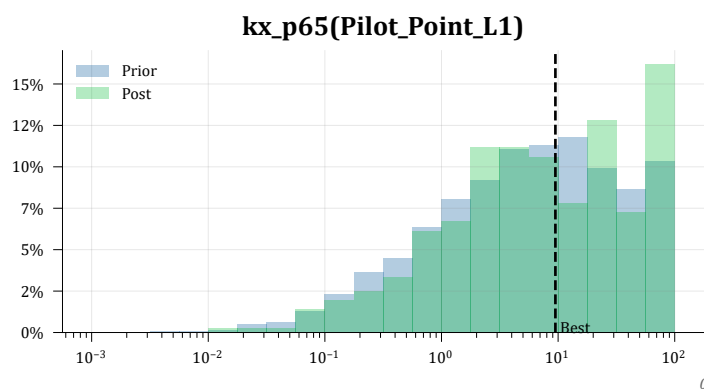
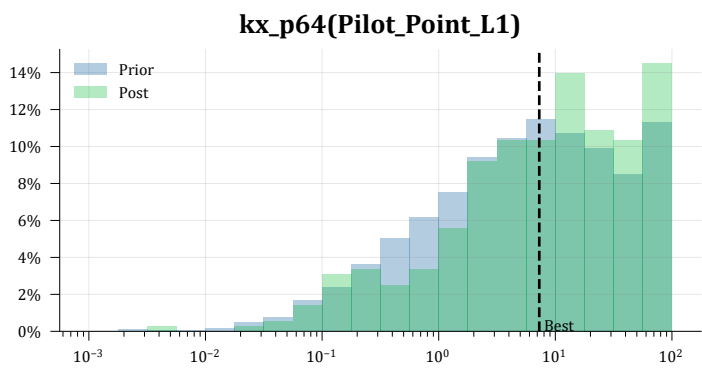
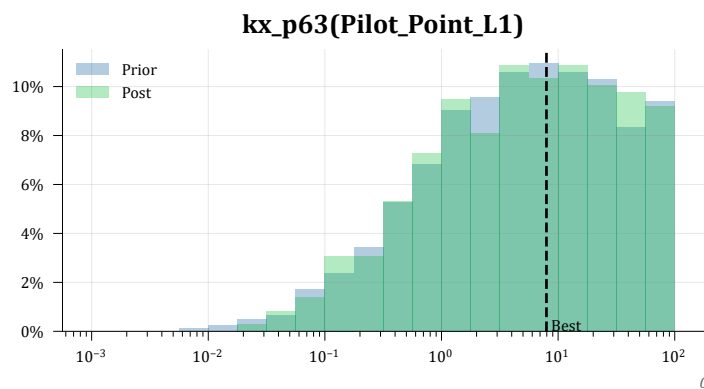
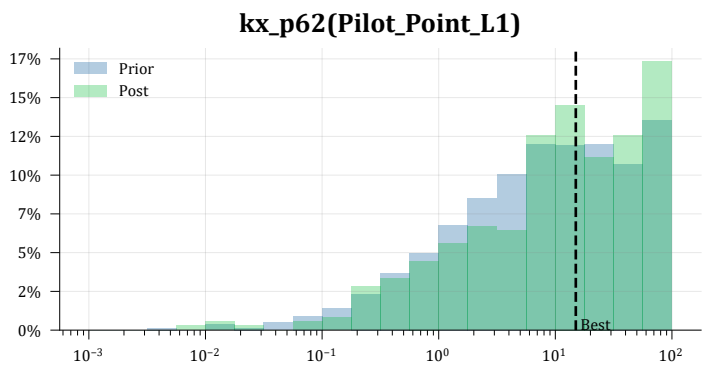
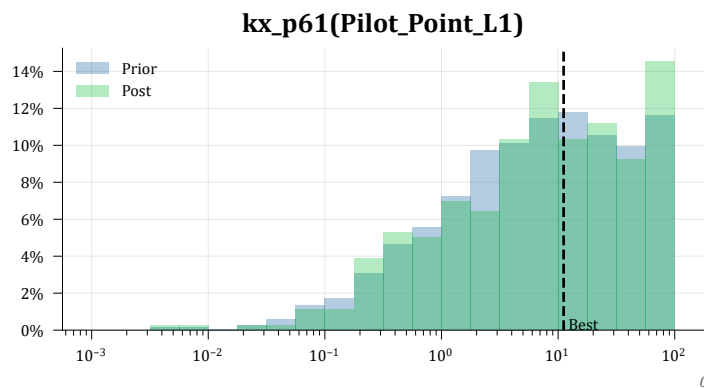
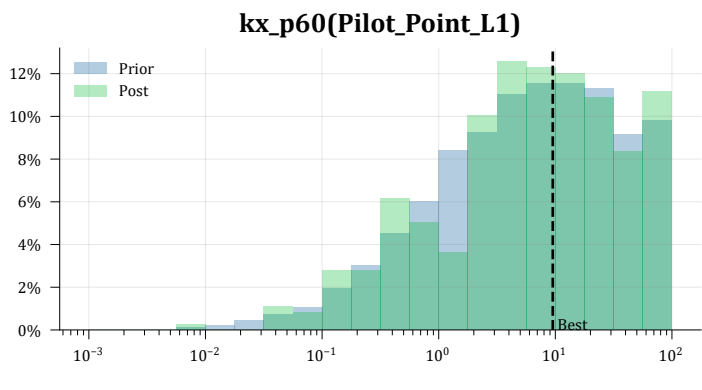
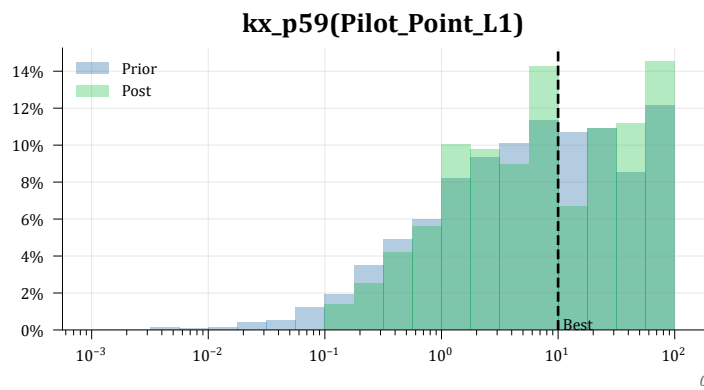


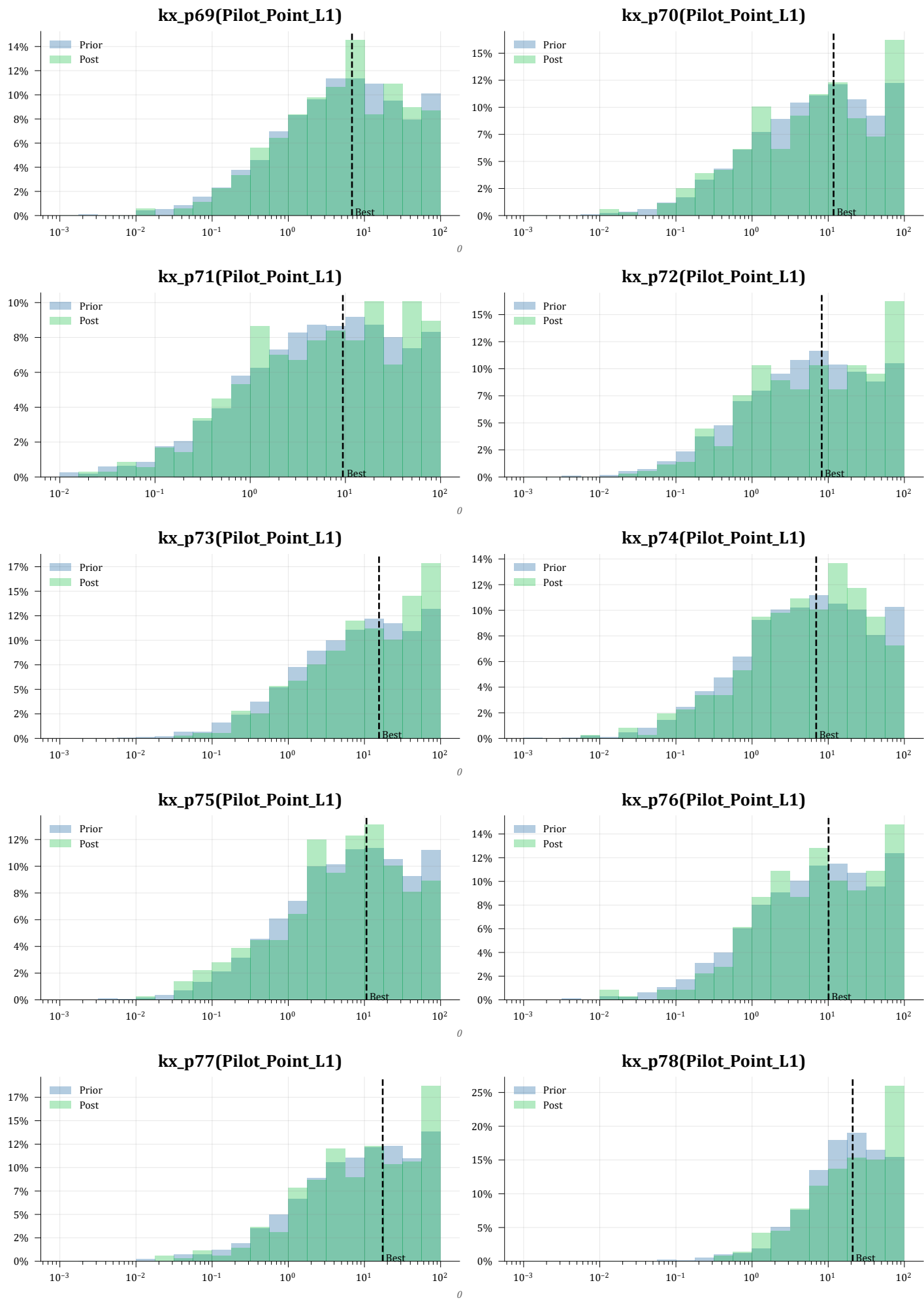
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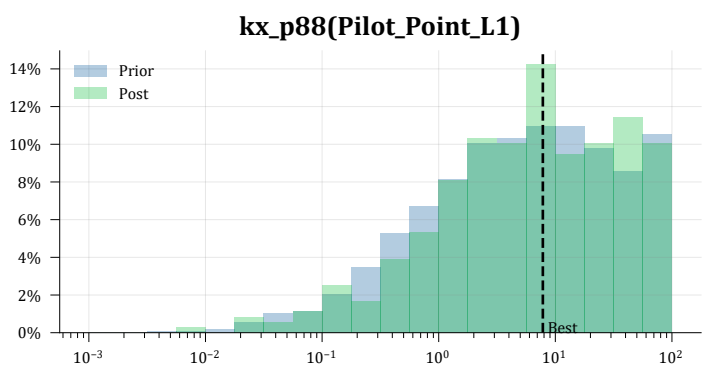
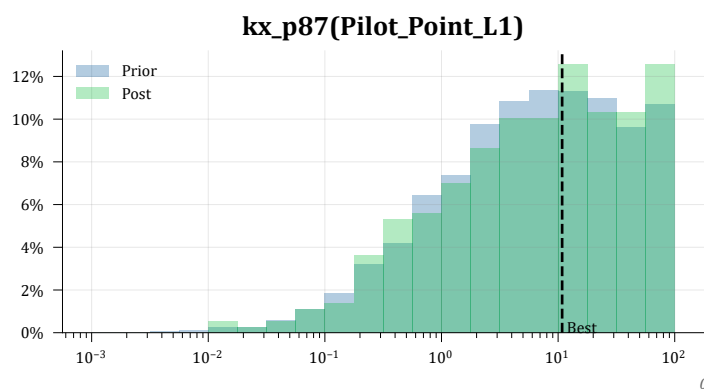
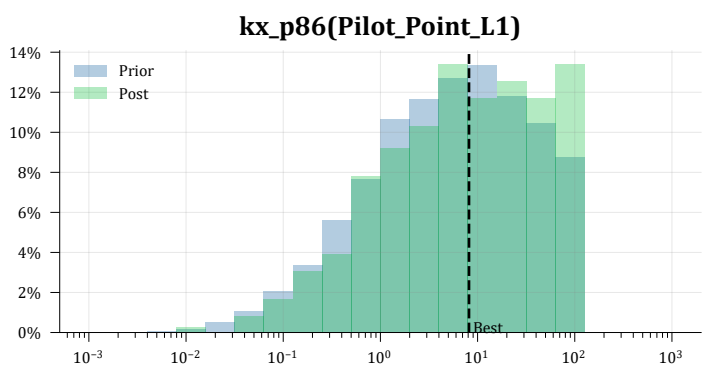
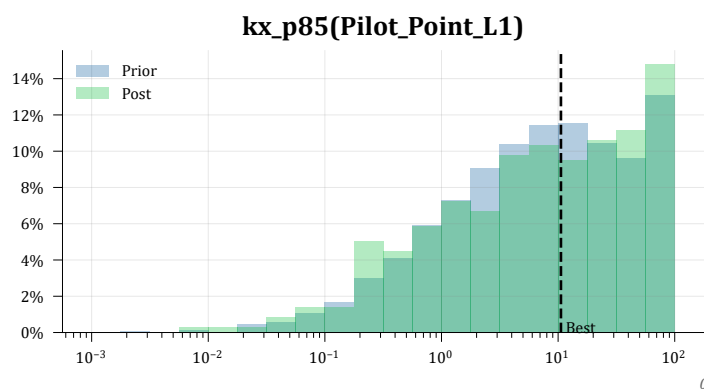
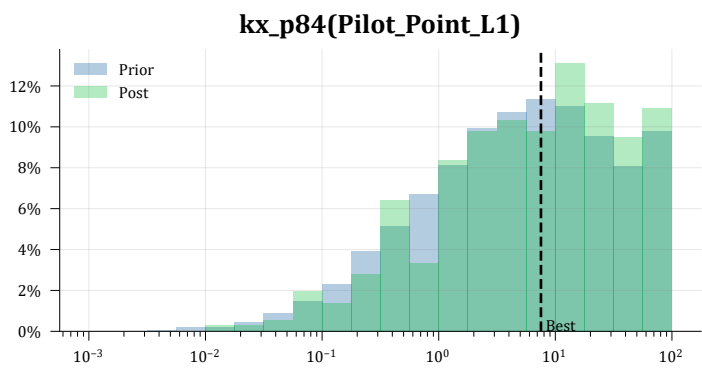
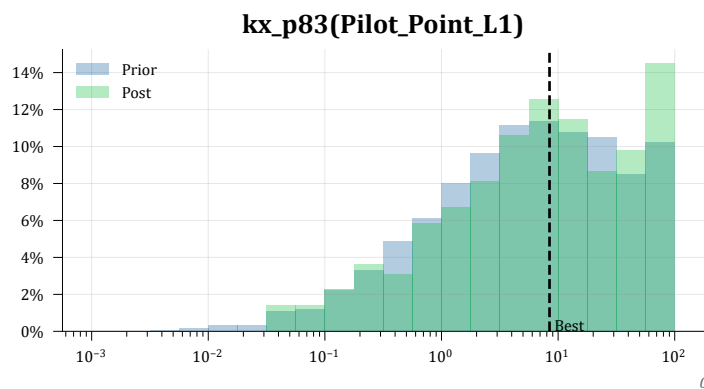
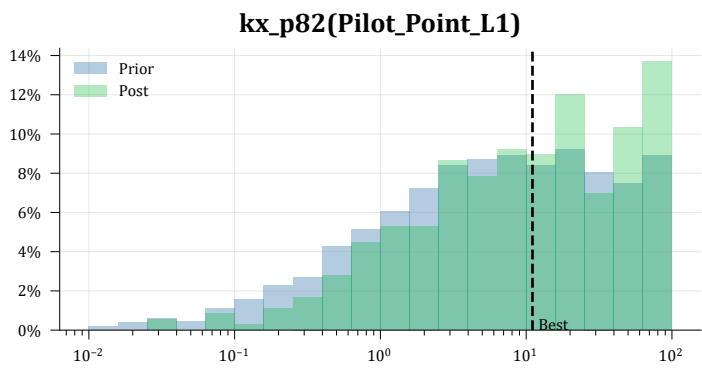
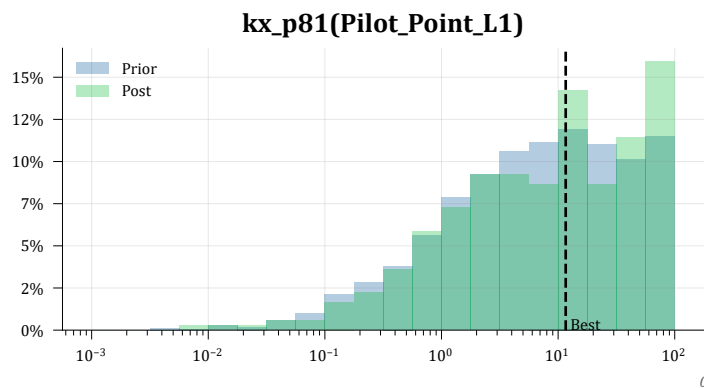
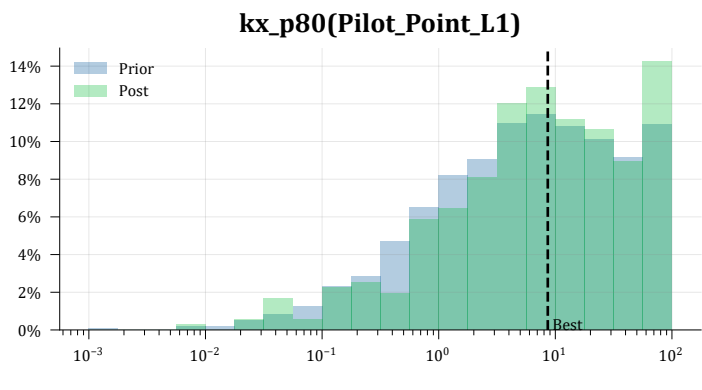
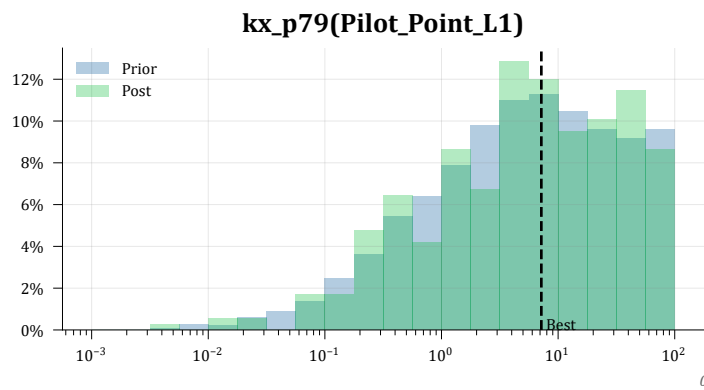


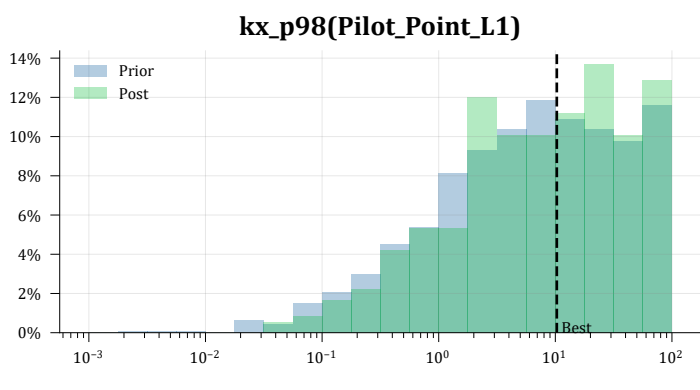
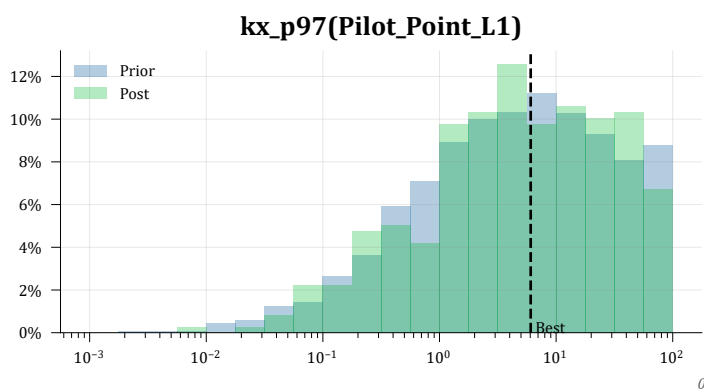
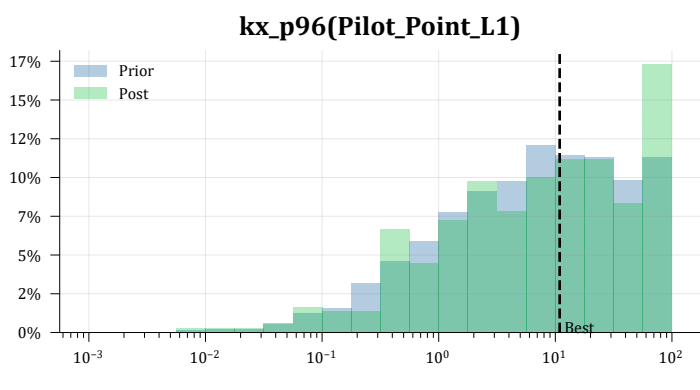
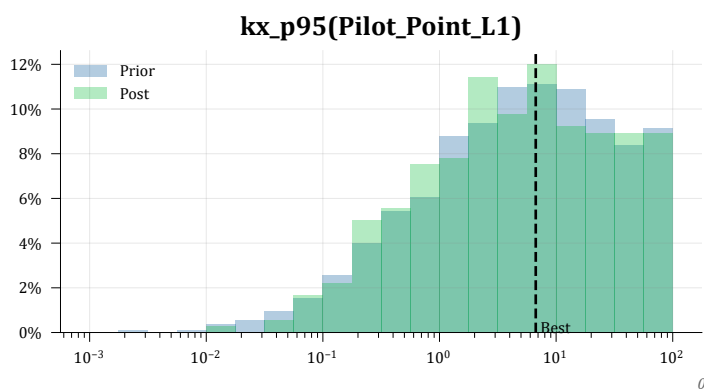
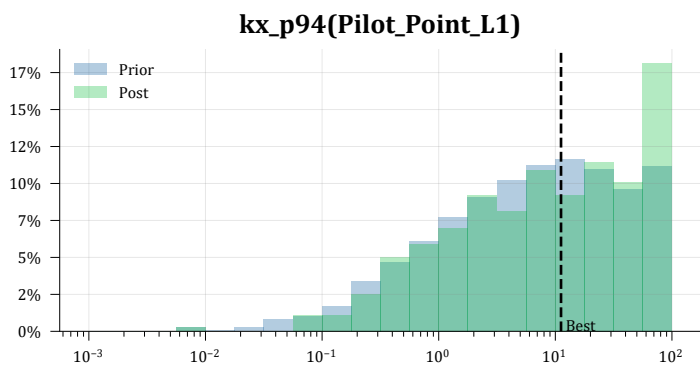
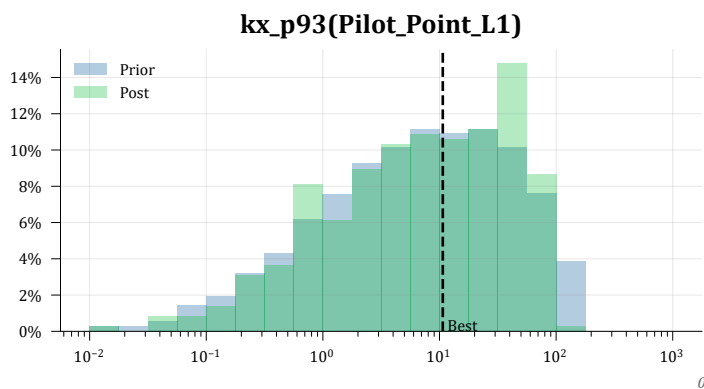
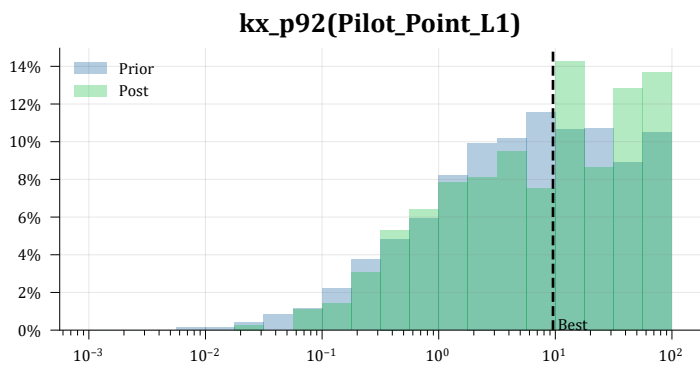
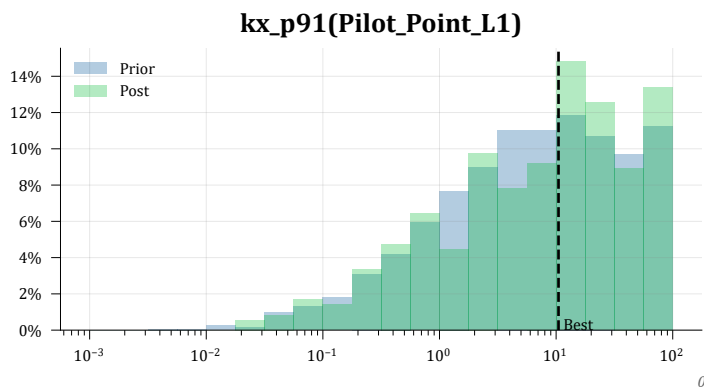
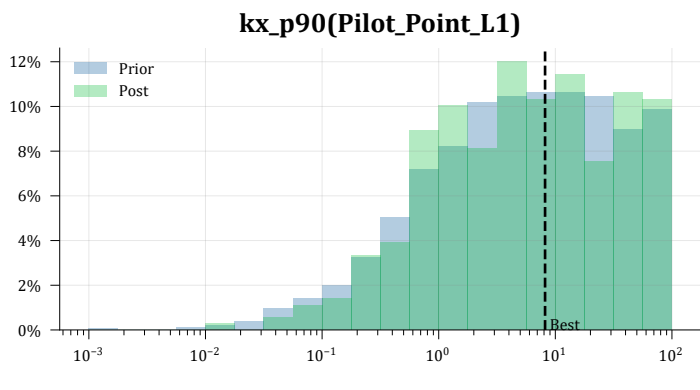
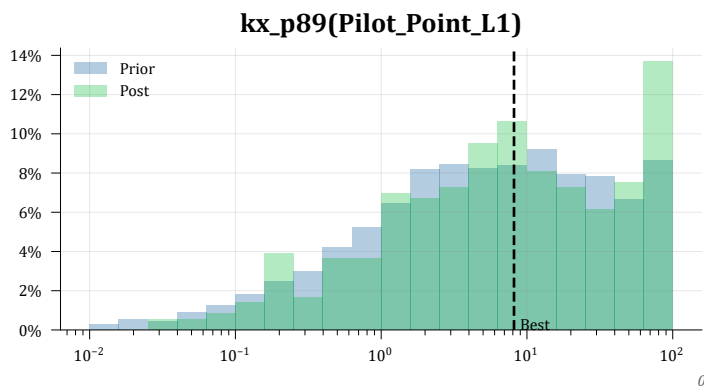


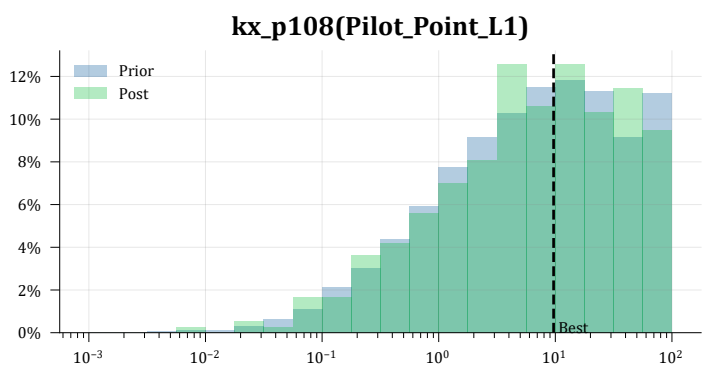
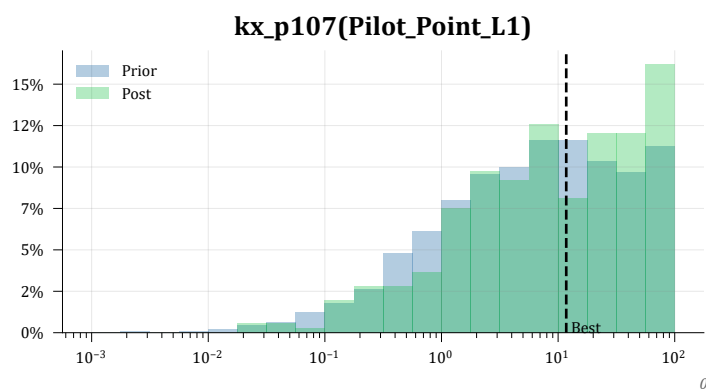
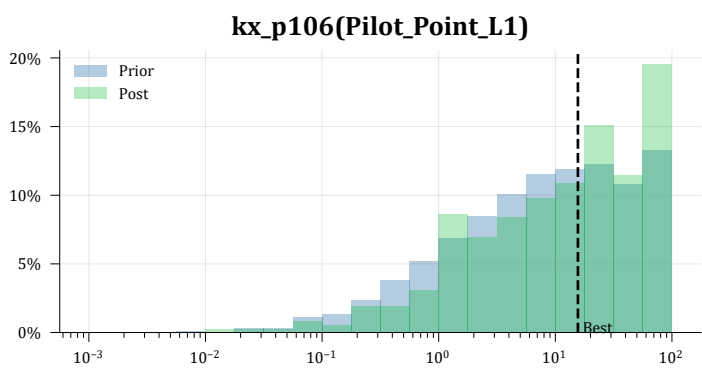
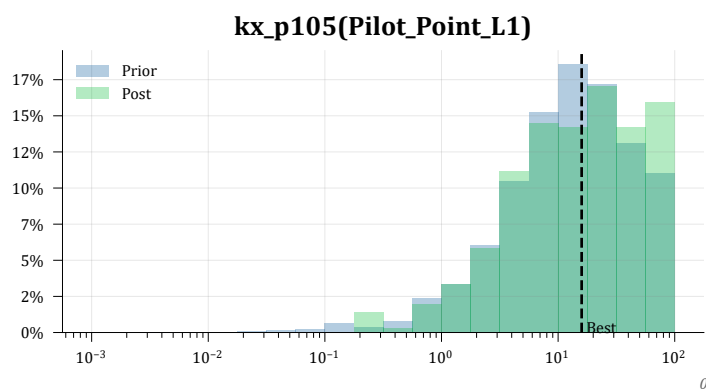
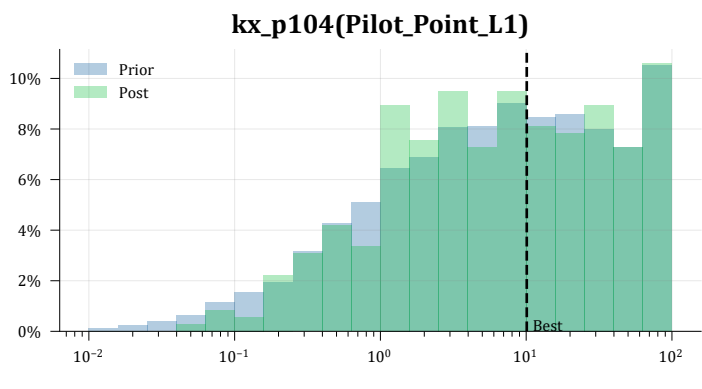
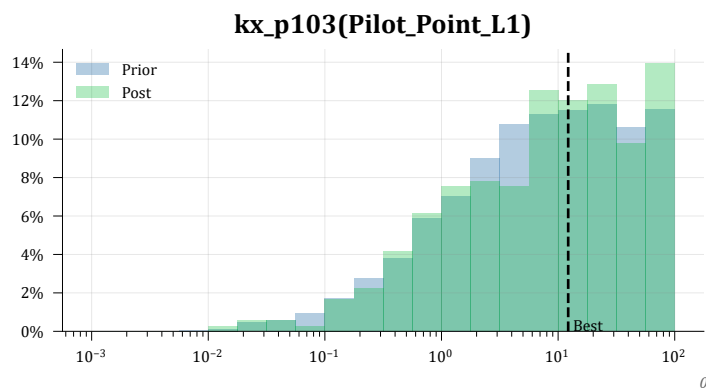
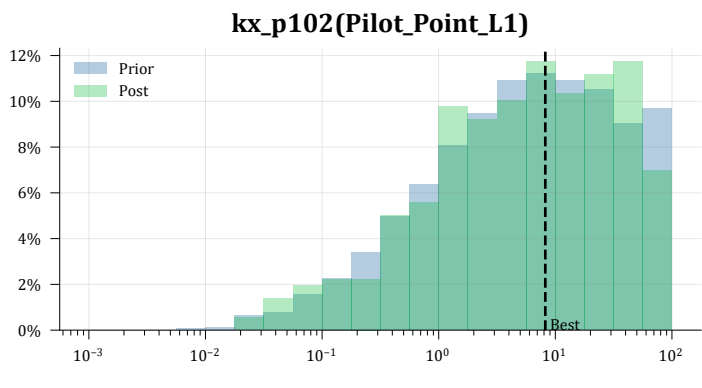
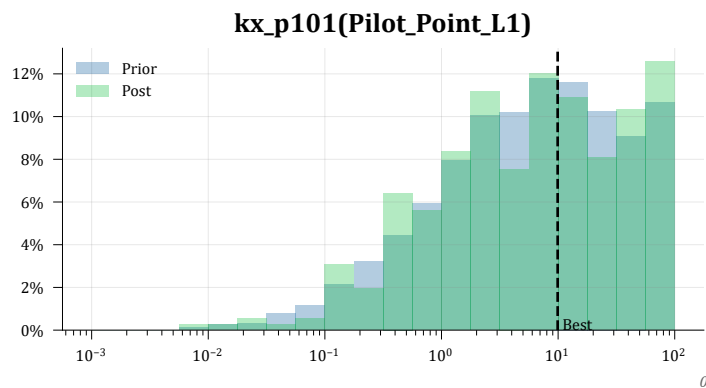
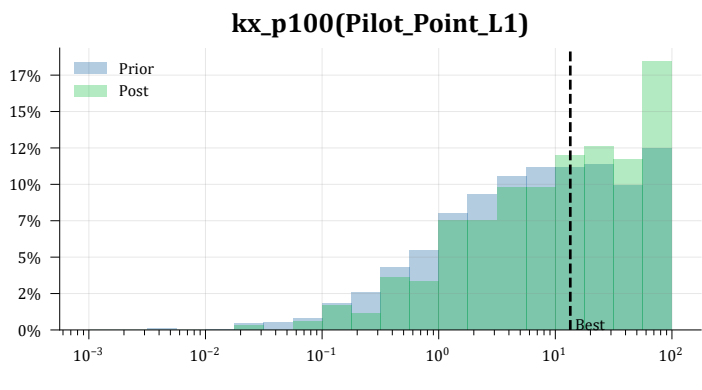
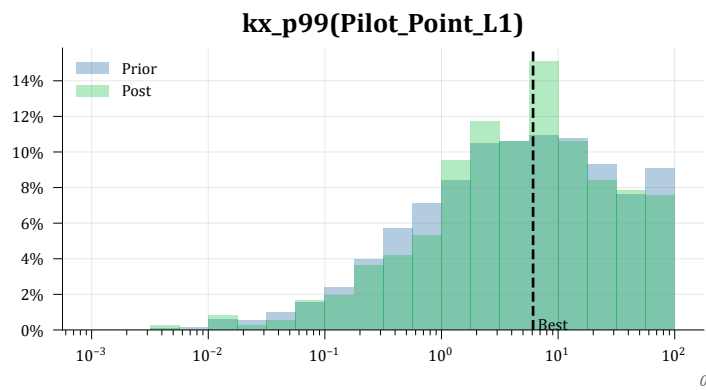




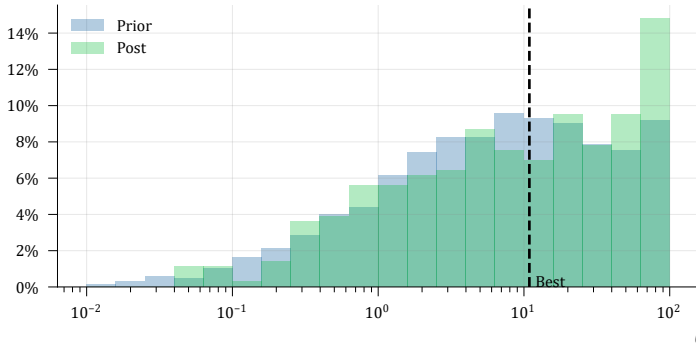
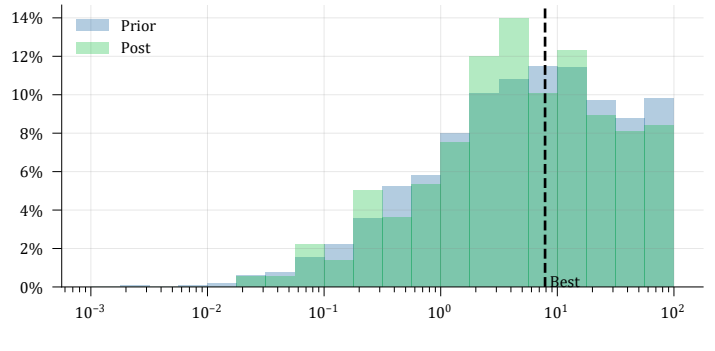
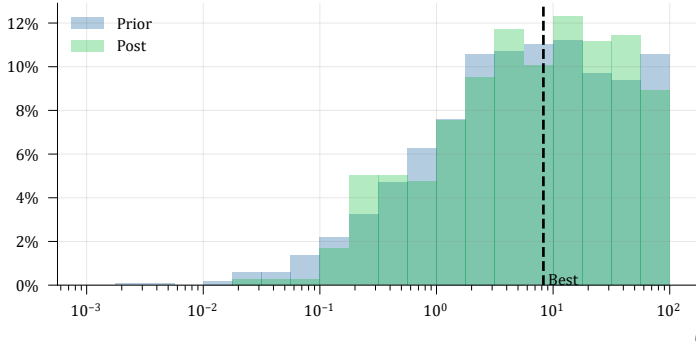
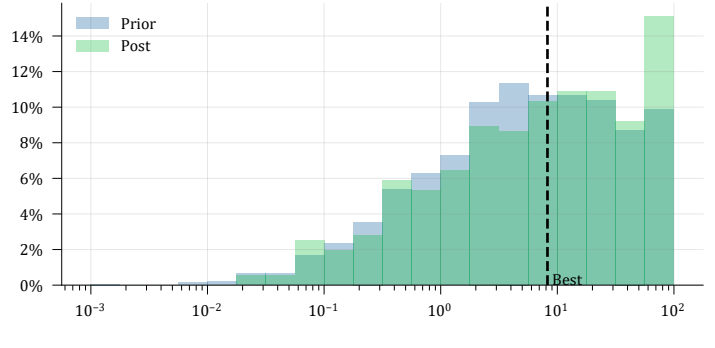
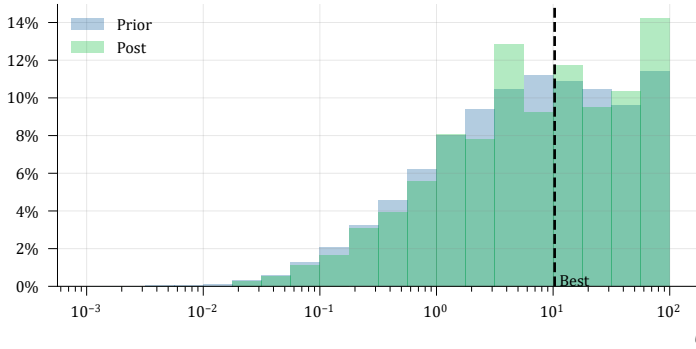
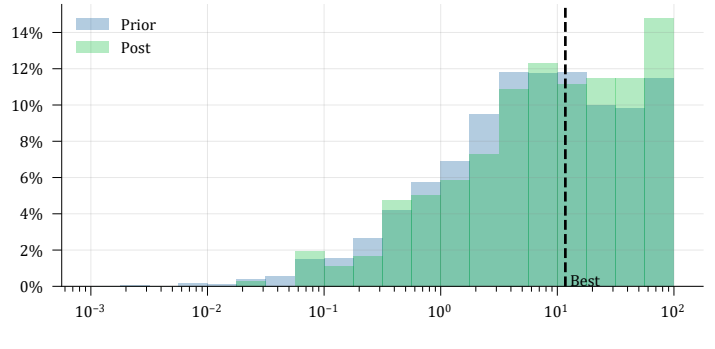
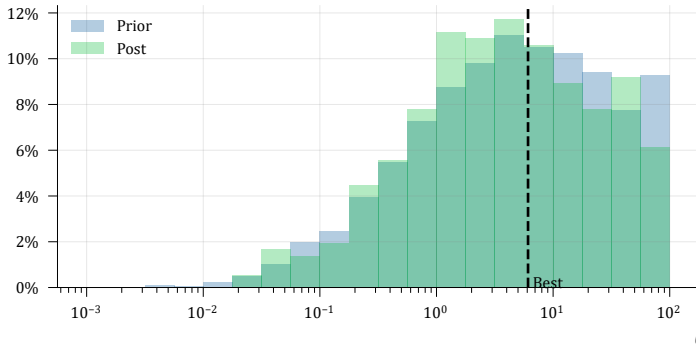
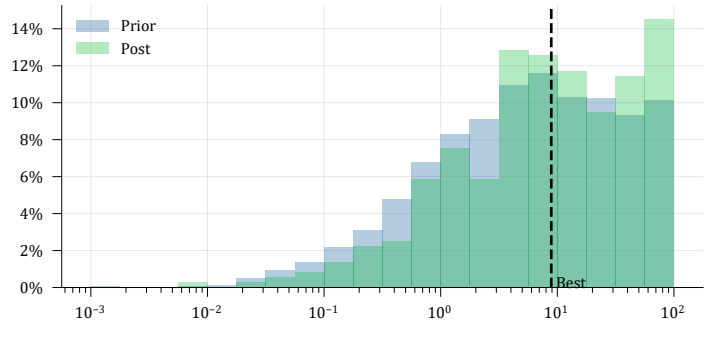
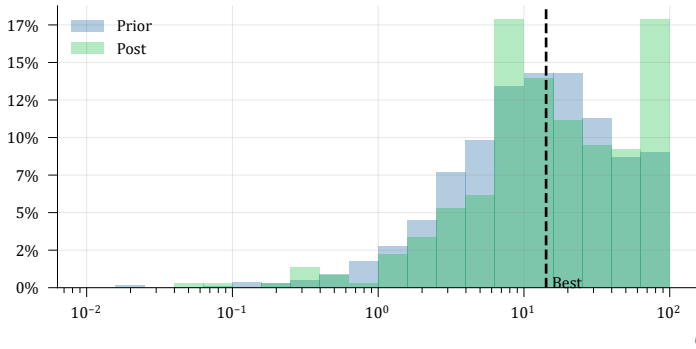
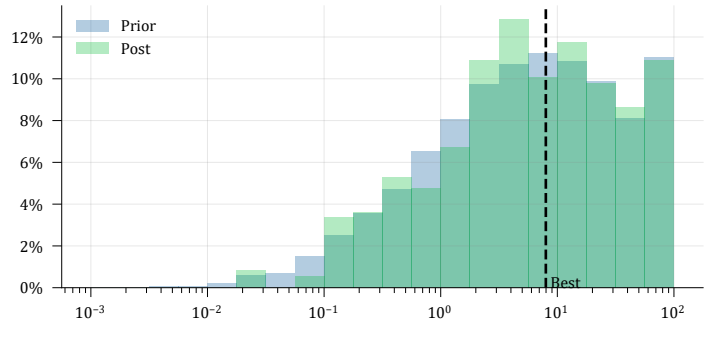


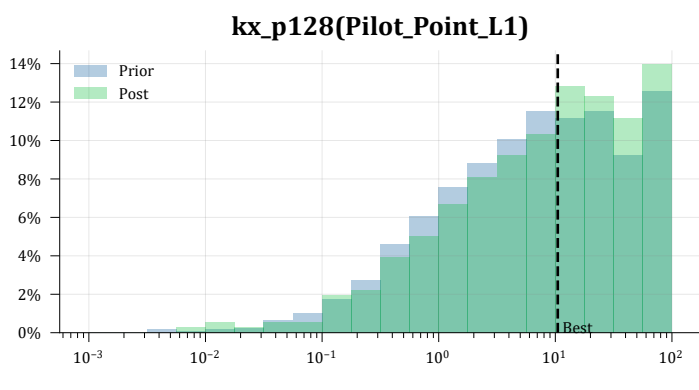
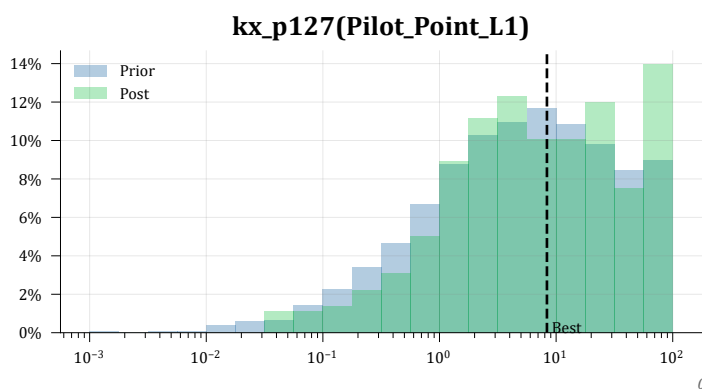
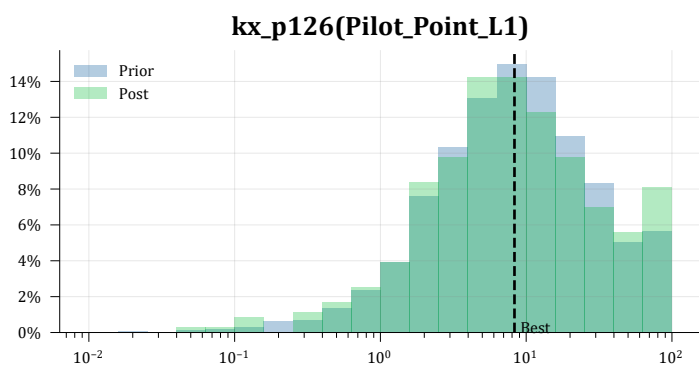
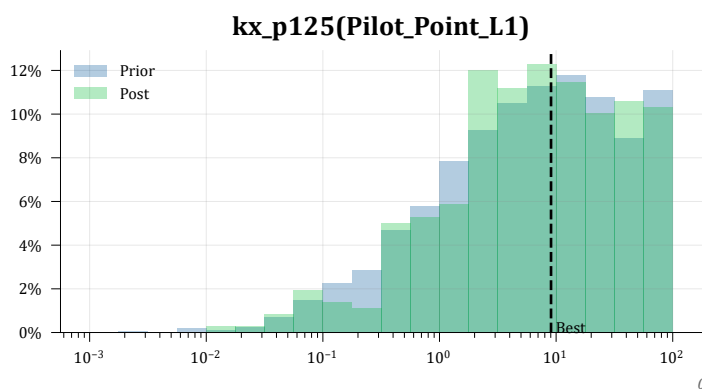
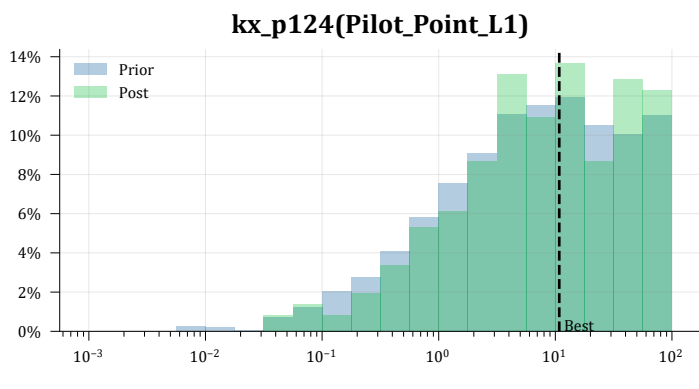
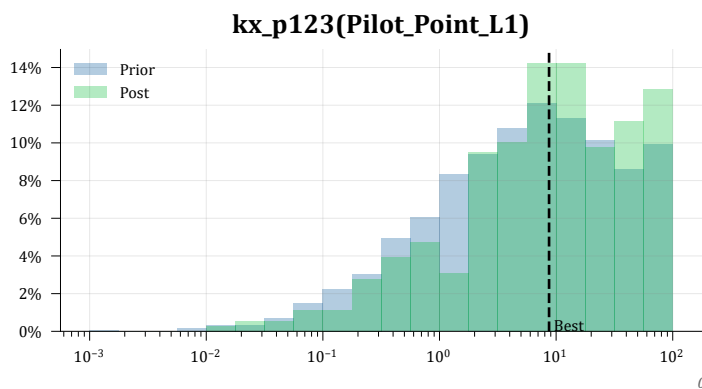
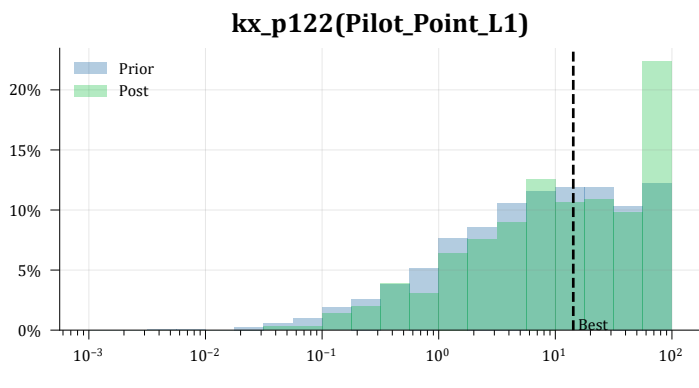
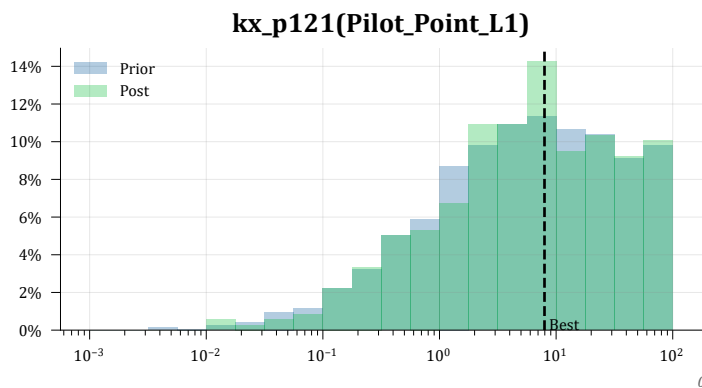
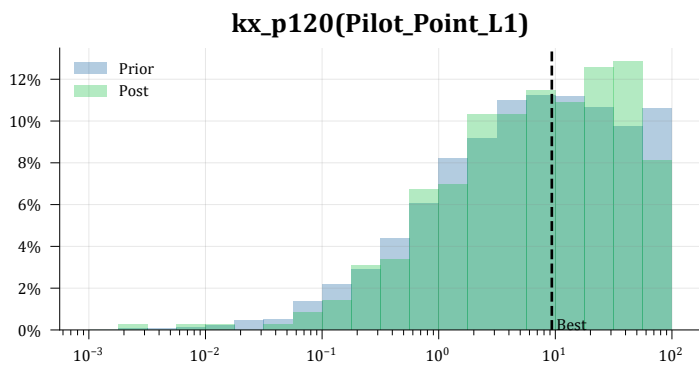
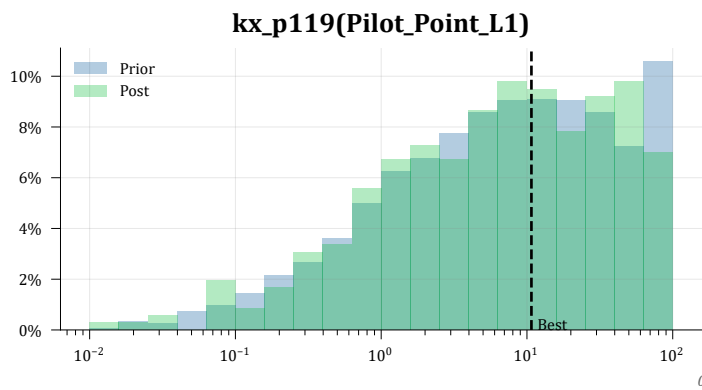


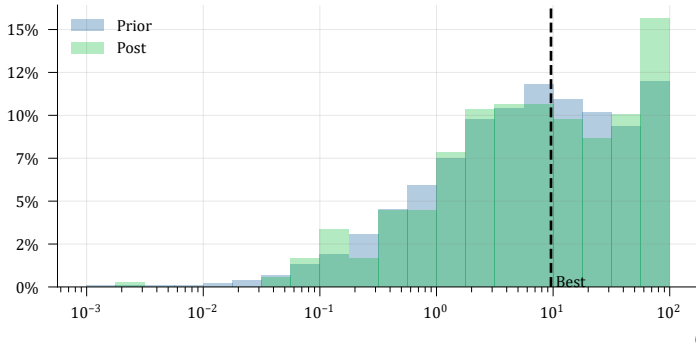
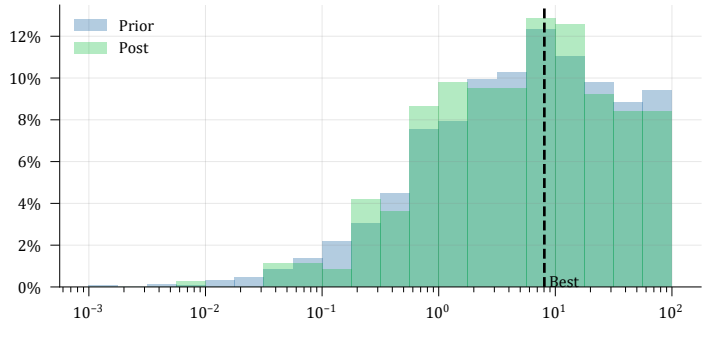
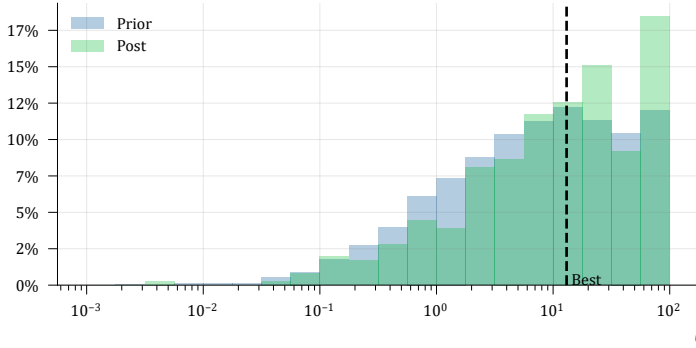
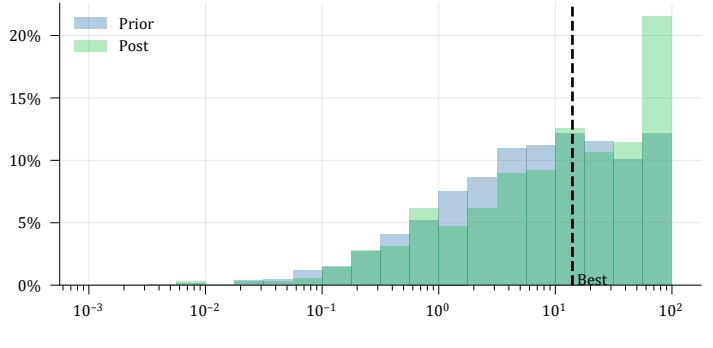
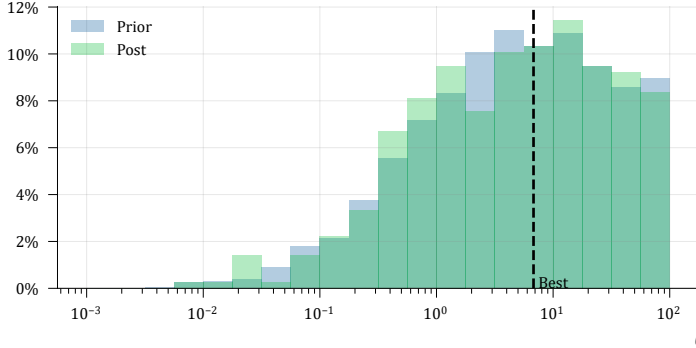
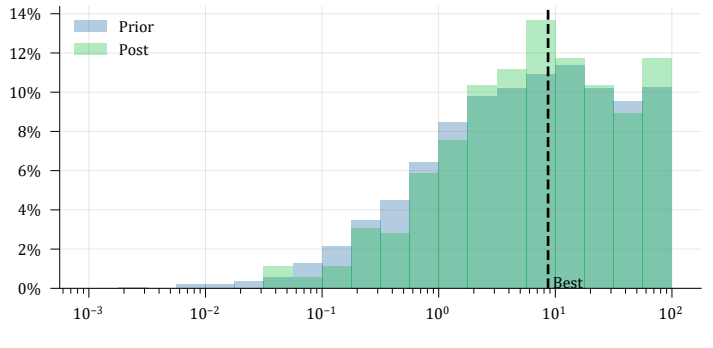
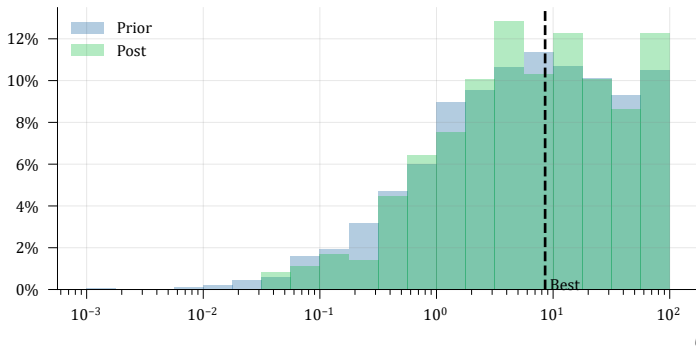
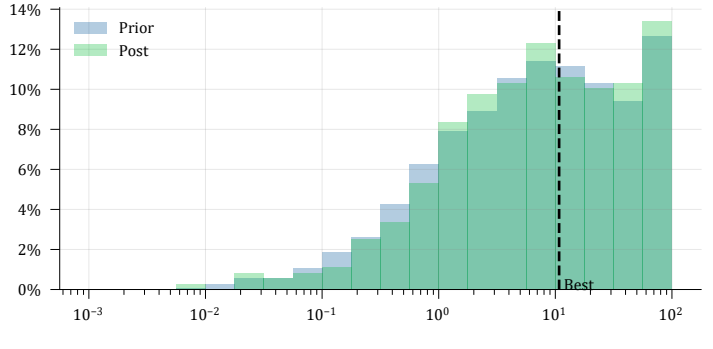
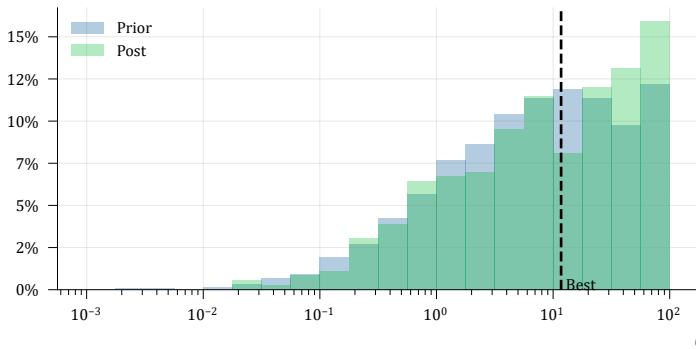
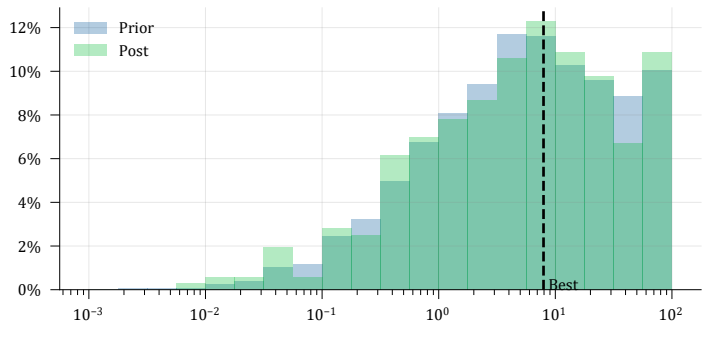


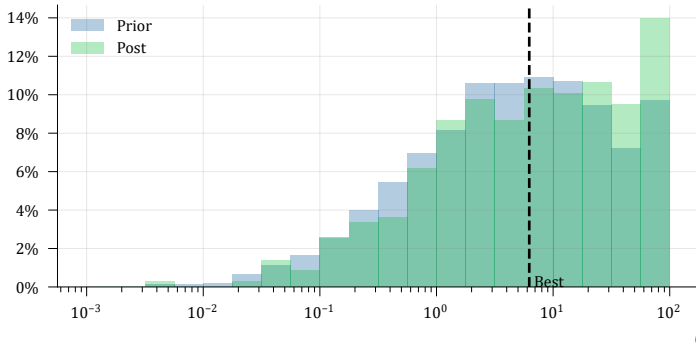
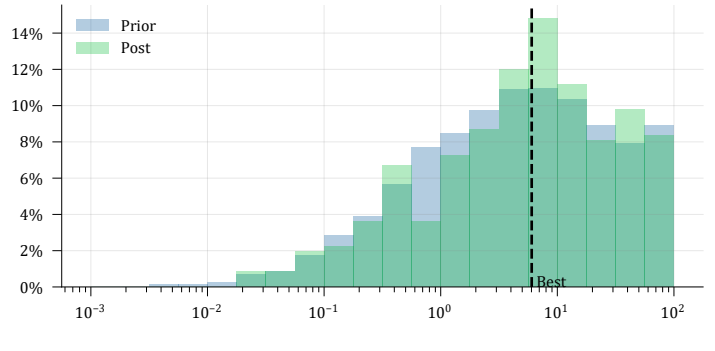
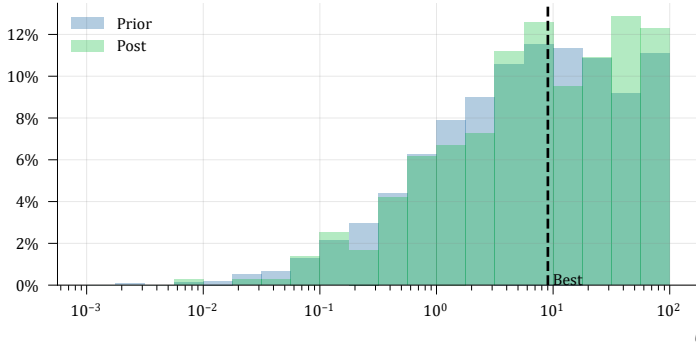
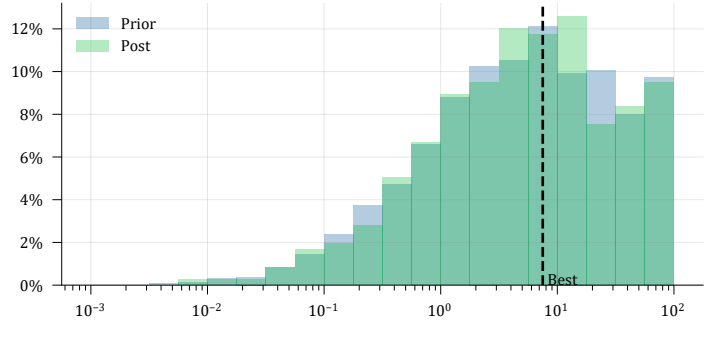
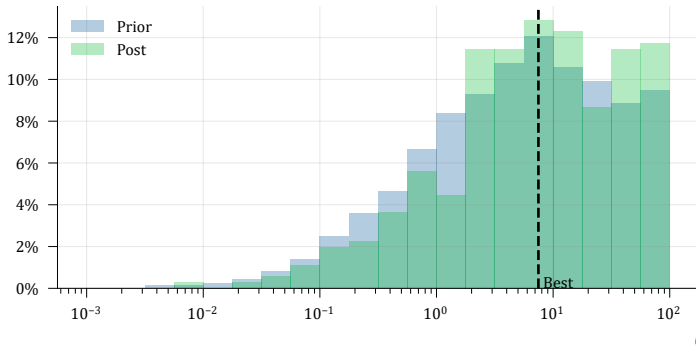
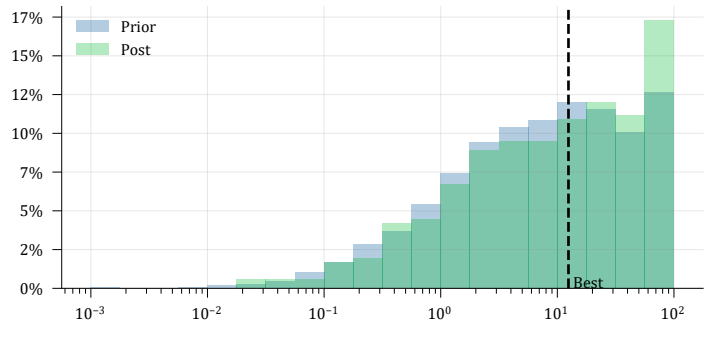
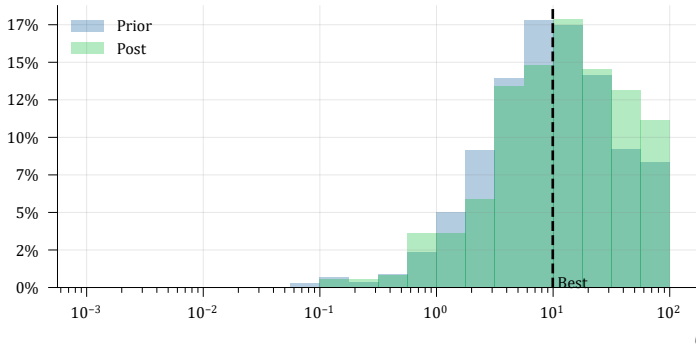
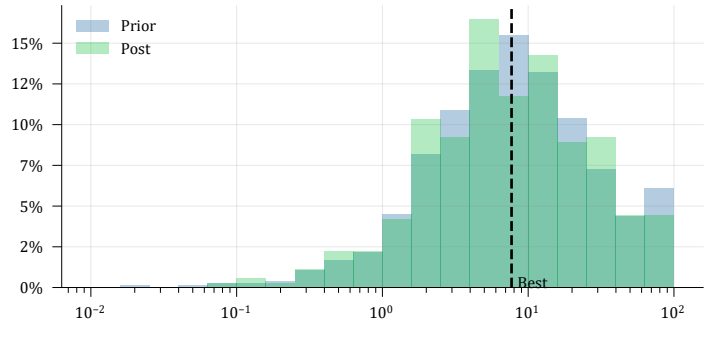
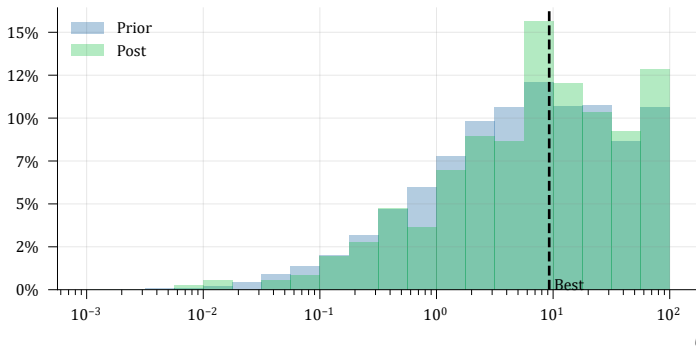
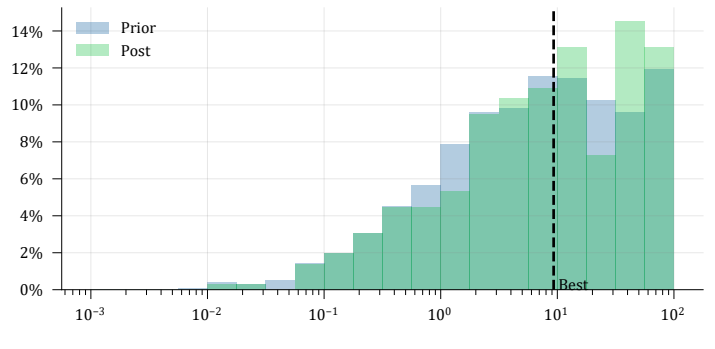


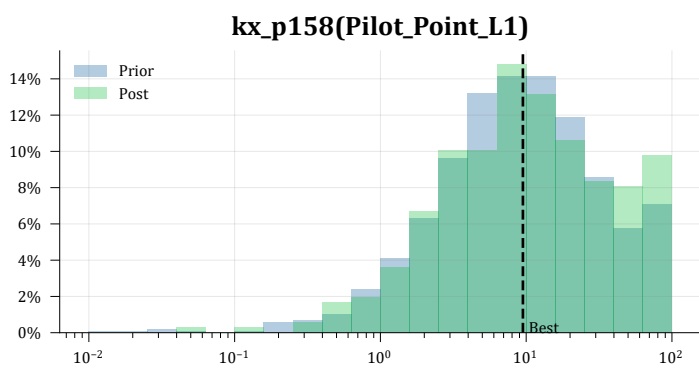
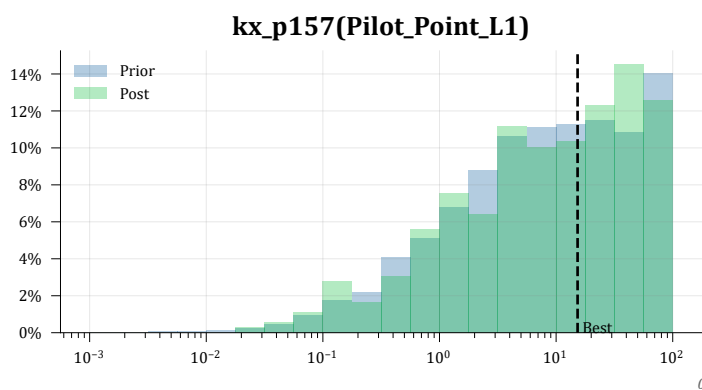
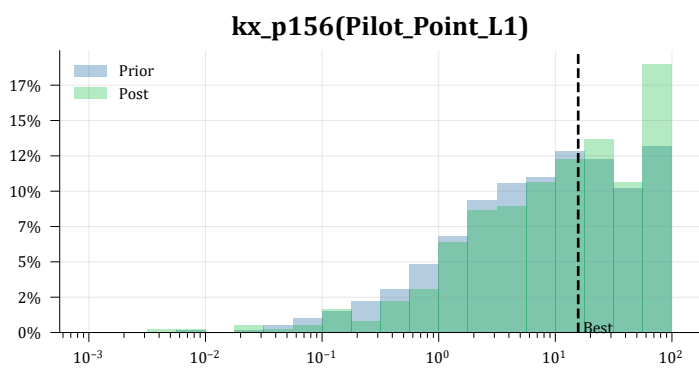
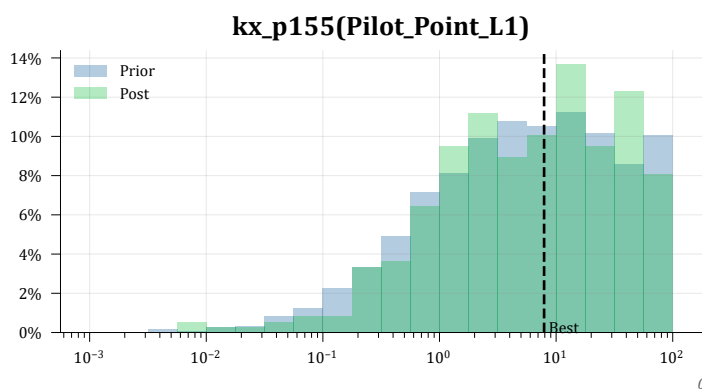
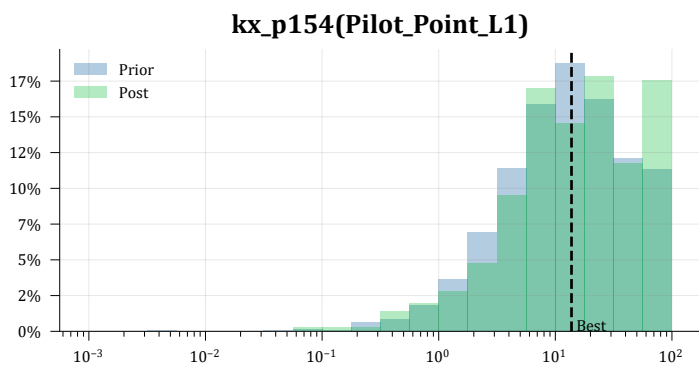
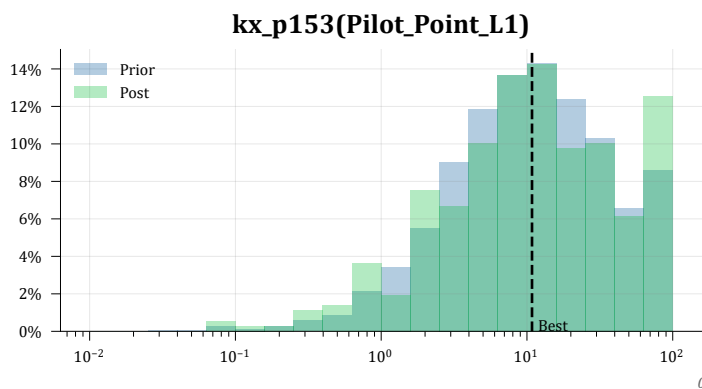
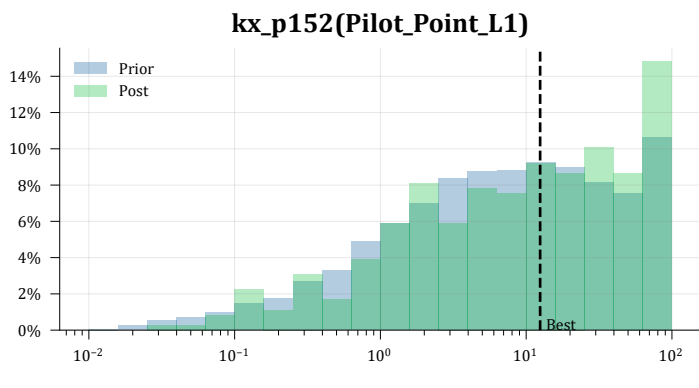
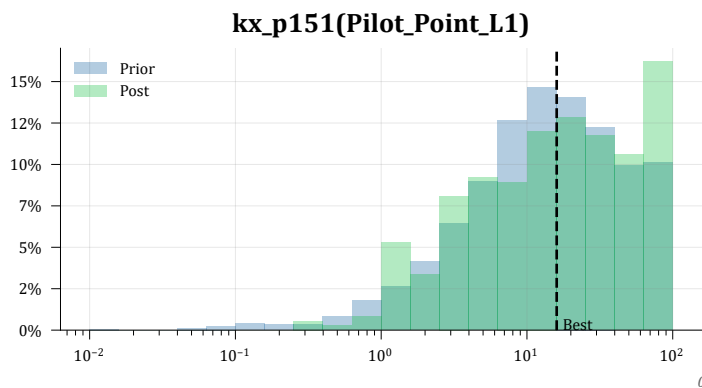
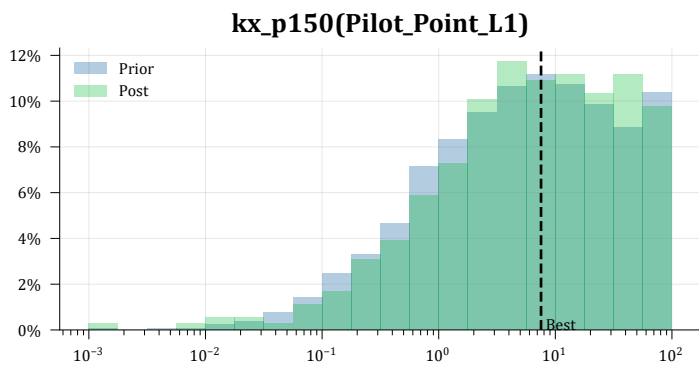
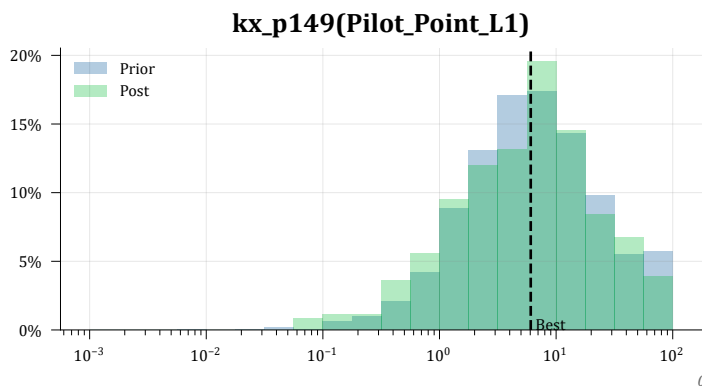
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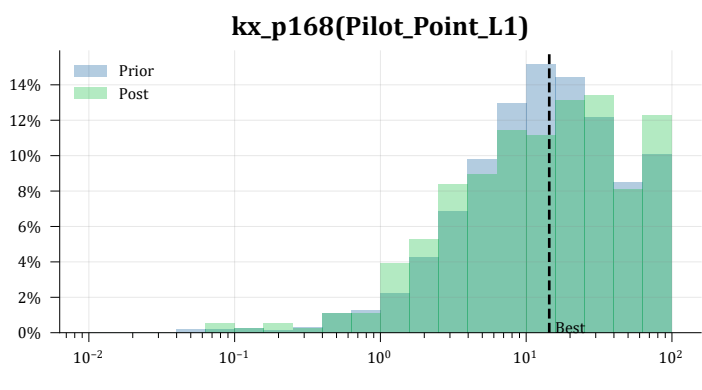
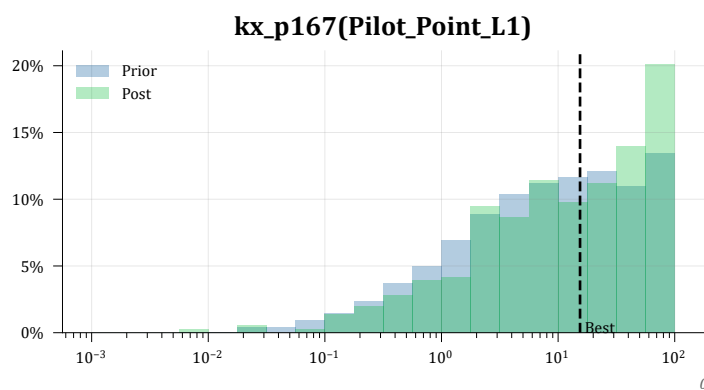
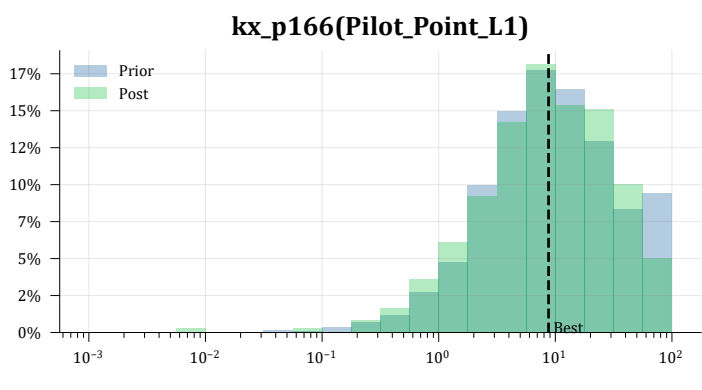
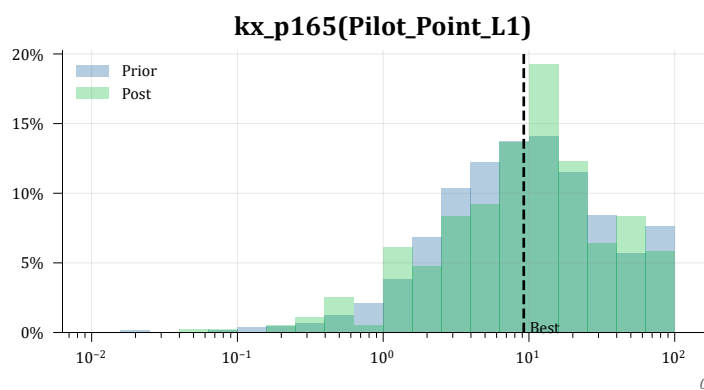
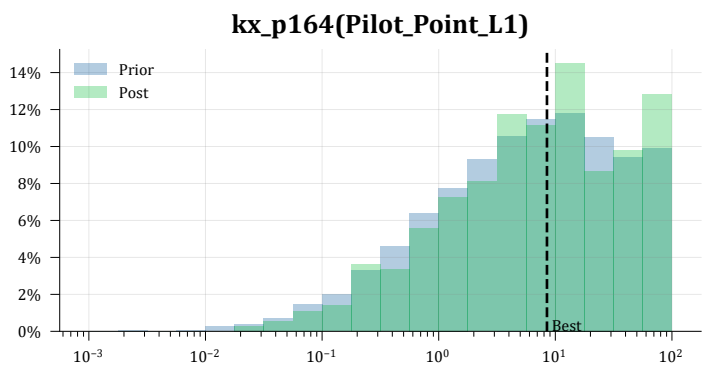
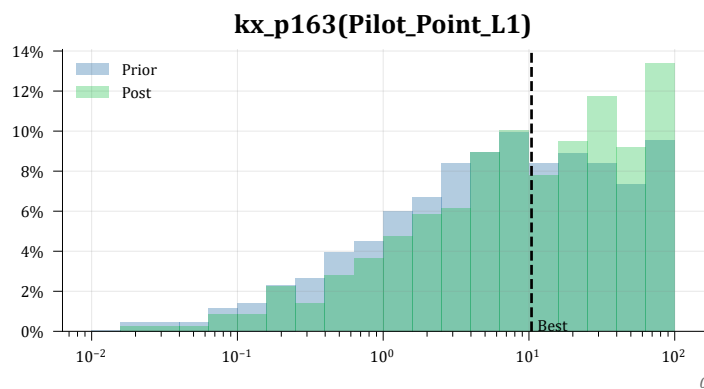
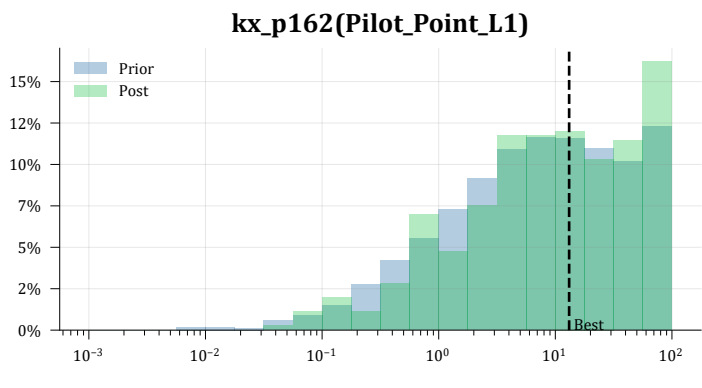
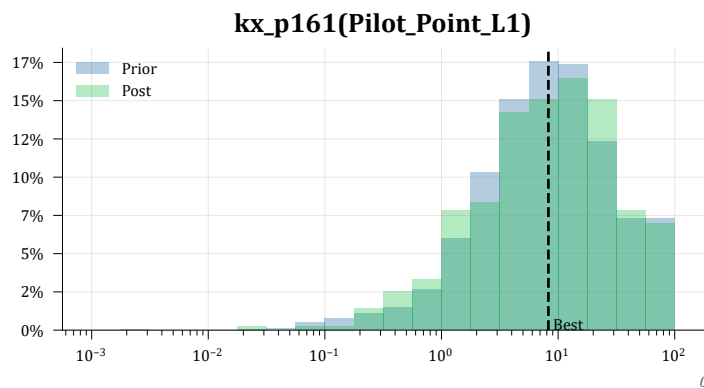
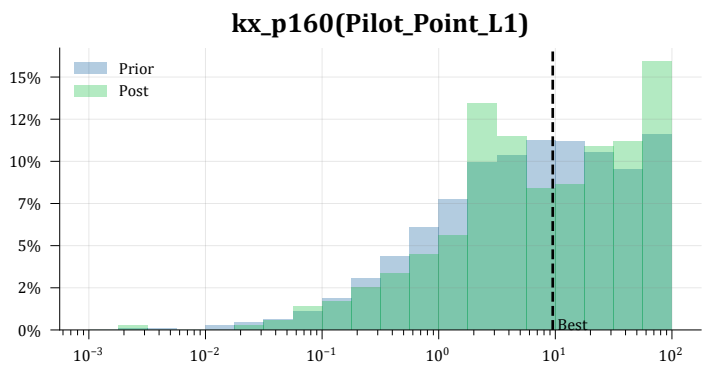
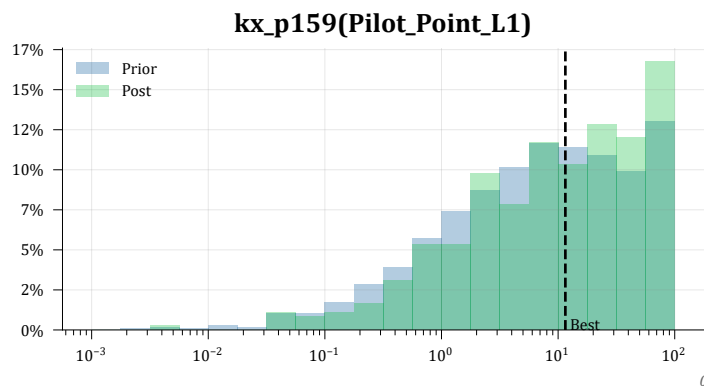
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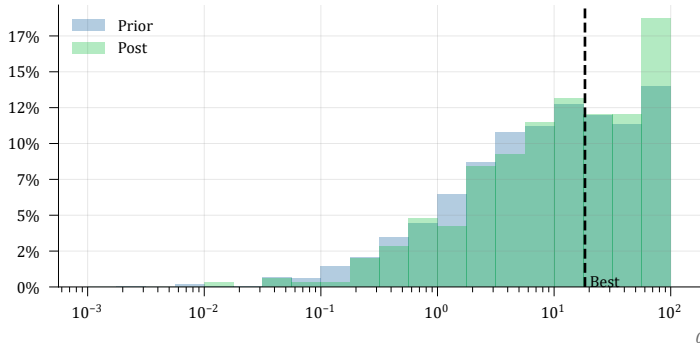
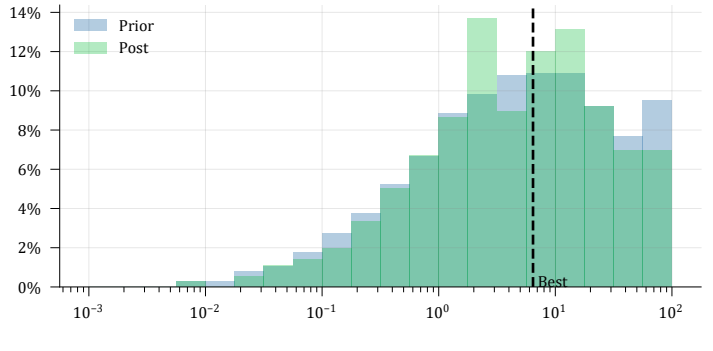
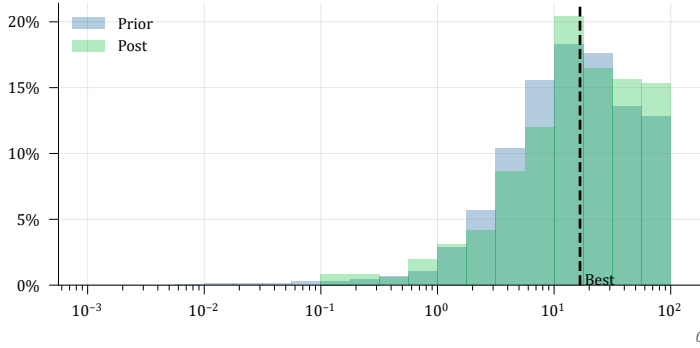
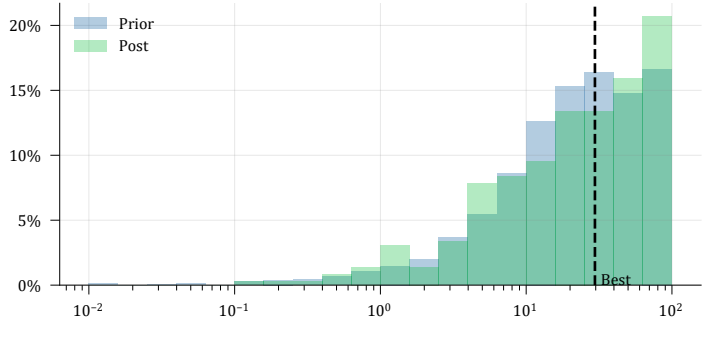
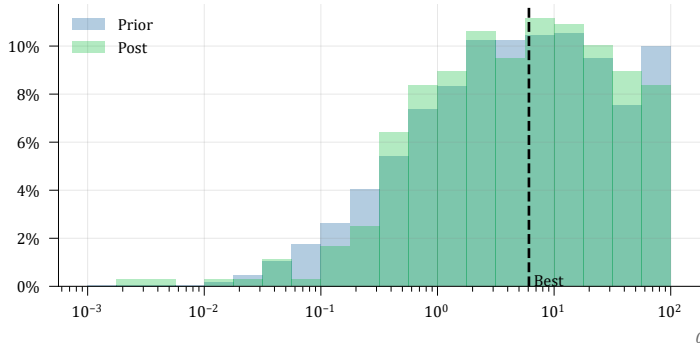
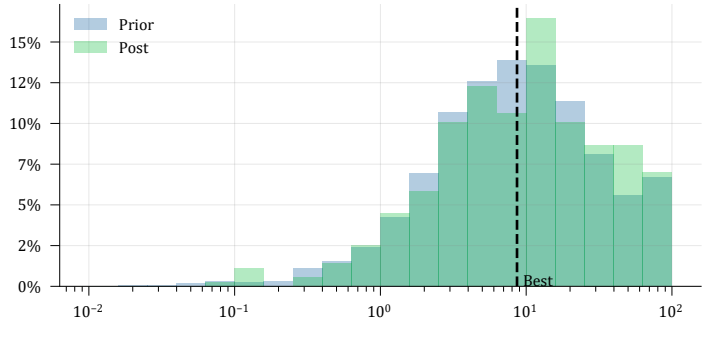
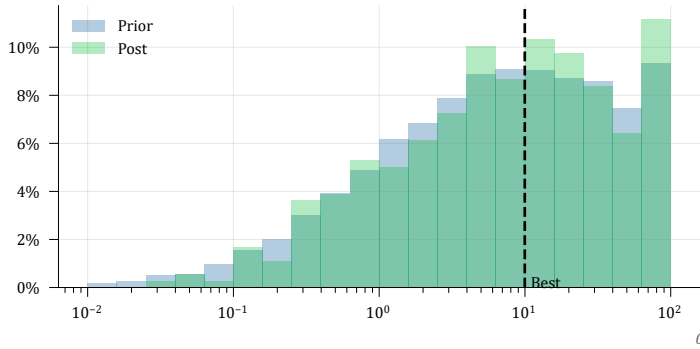
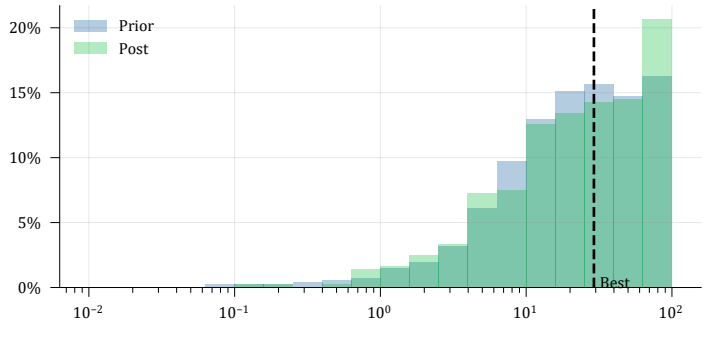
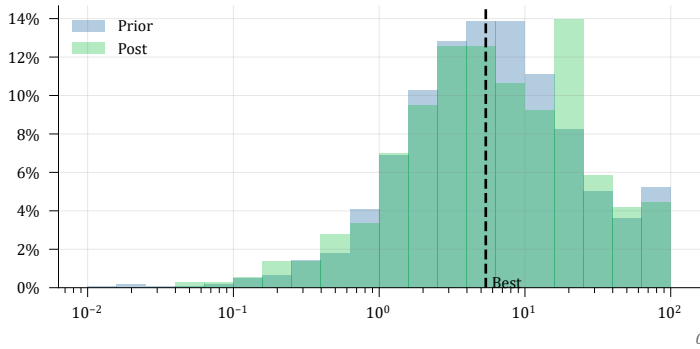
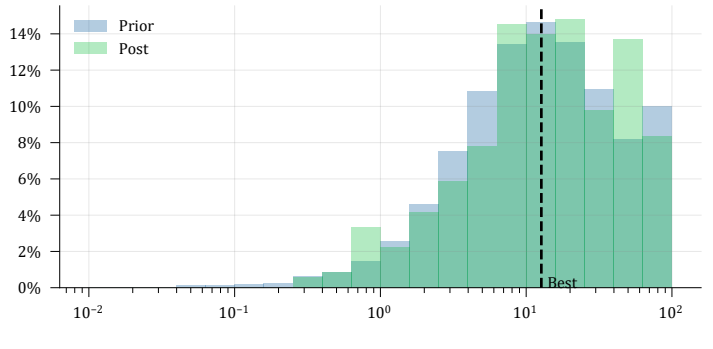


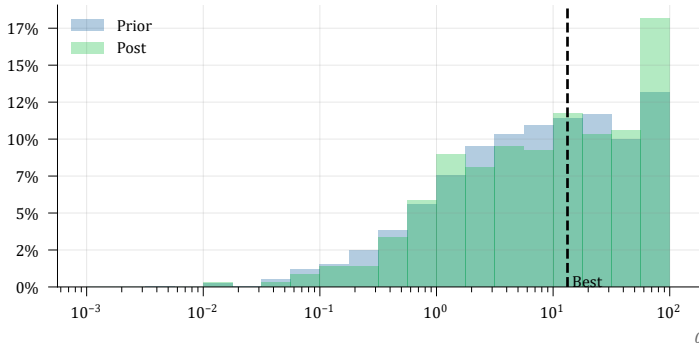
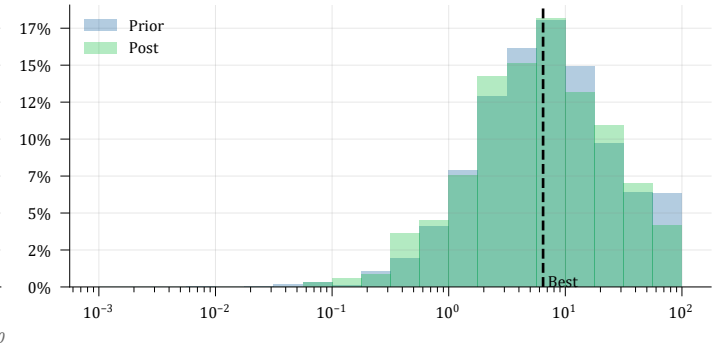
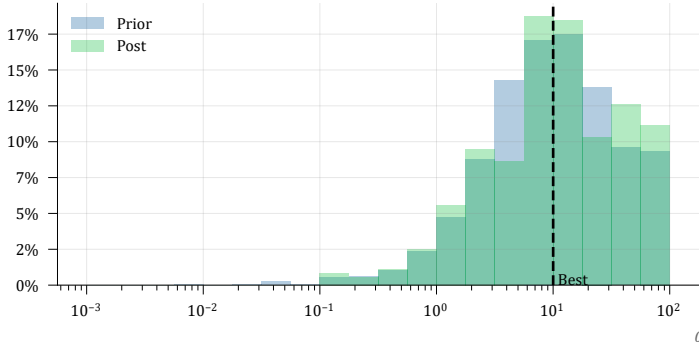
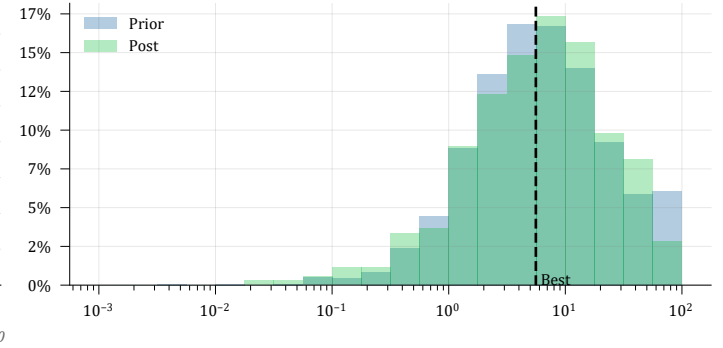
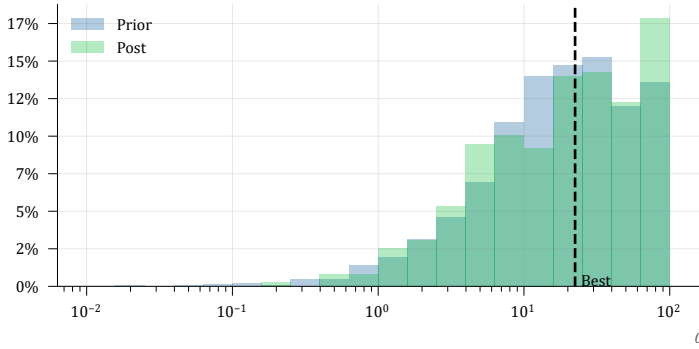
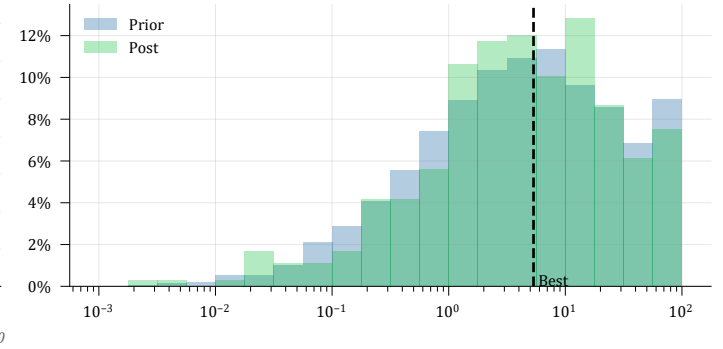
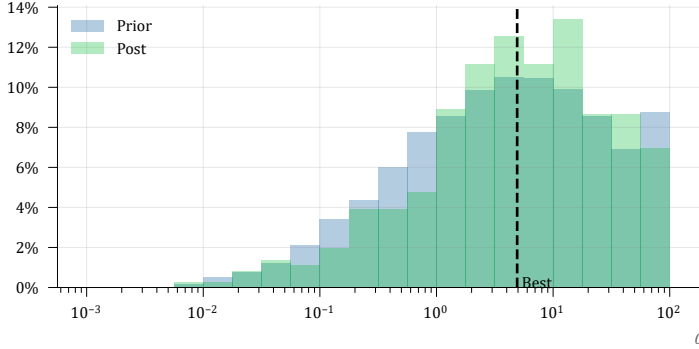
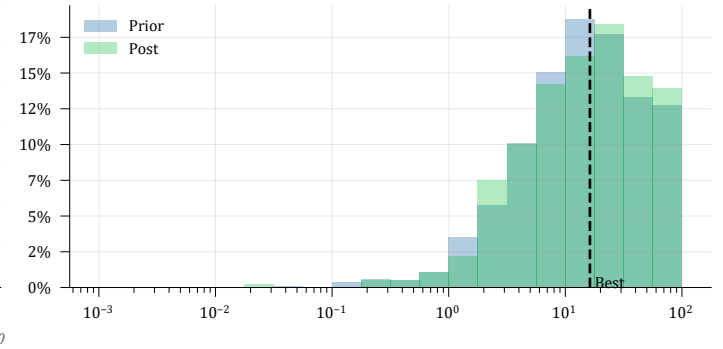
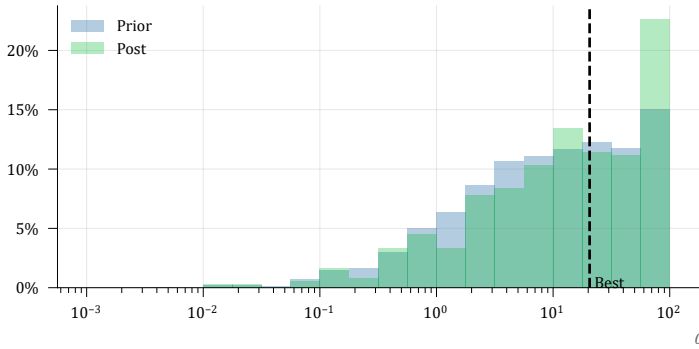
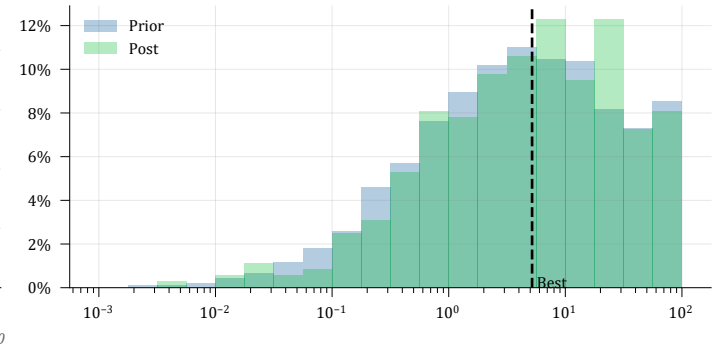
kx_p129(Pilot_Point_L1)**kx_p130(Pilot_Point_L1)****kx_p131(Pilot_Point_L1)****kx_p132(Pilot_Point_L1)****kx_p133(Pilot_Point_L1)****kx_p134(Pilot_Point_L1)****kx_p135(Pilot_Point_L1)****kx_p136(Pilot_Point_L1)****kx_p137(Pilot_Point_L1)****kx_p138(Pilot_Point_L1)**

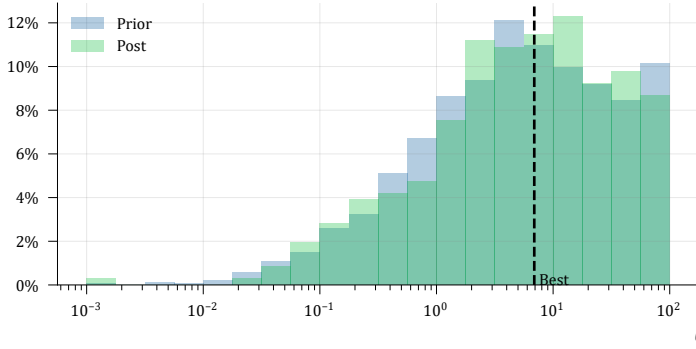
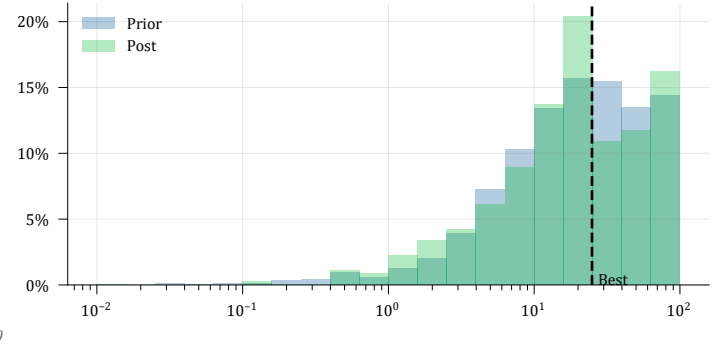
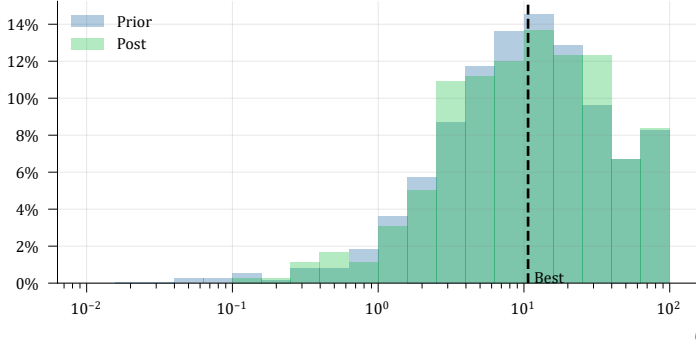
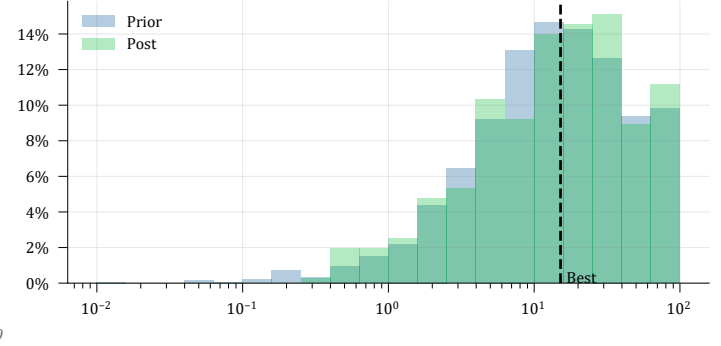
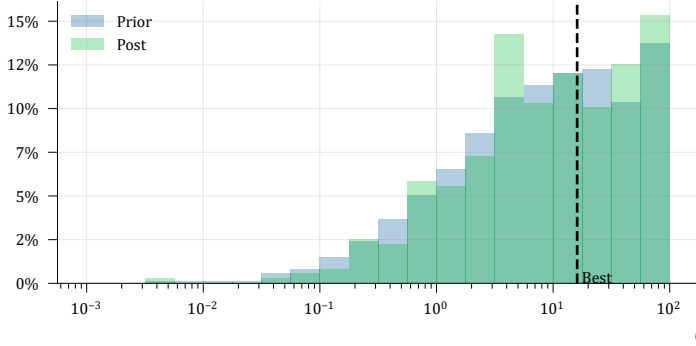
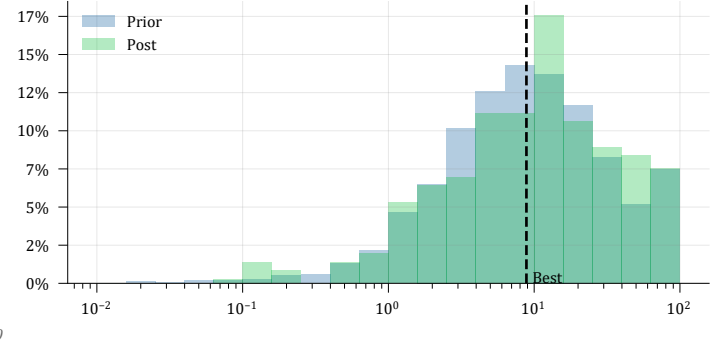
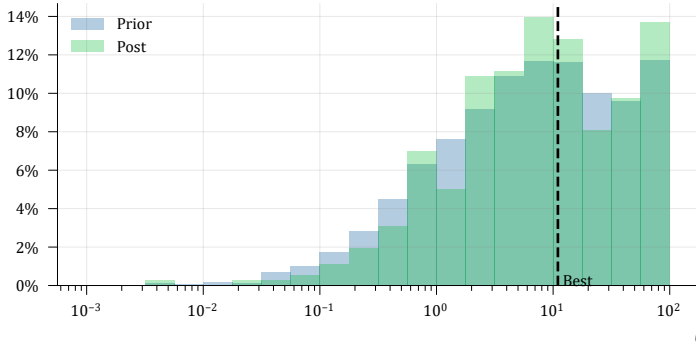
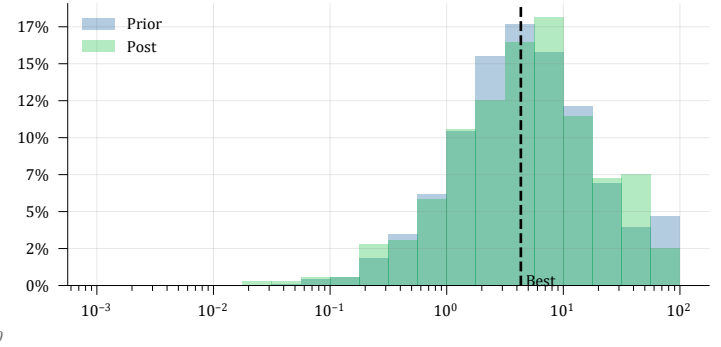
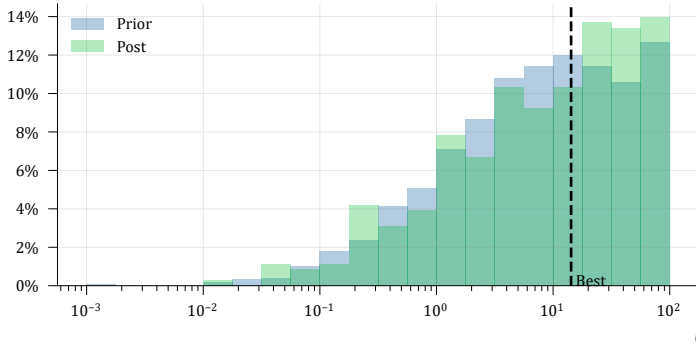
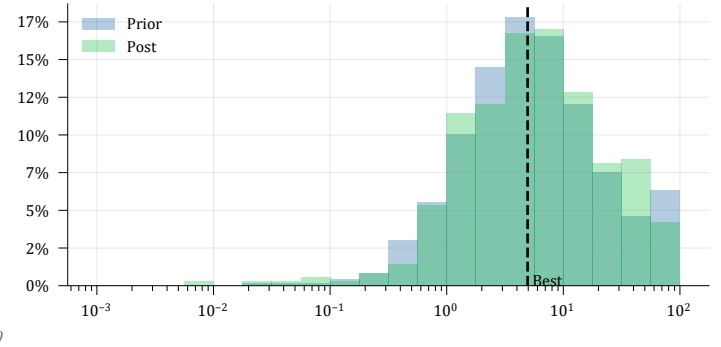
kx_p139(Pilot_Point_L1)**kx_p140(Pilot_Point_L1)****kx_p141(Pilot_Point_L1)****kx_p142(Pilot_Point_L1)****kx_p143(Pilot_Point_L1)****kx_p144(Pilot_Point_L1)****kx_p145(Pilot_Point_L1)****kx_p146(Pilot_Point_L1)****kx_p147(Pilot_Point_L1)****kx_p148(Pilot_Point_L1)**

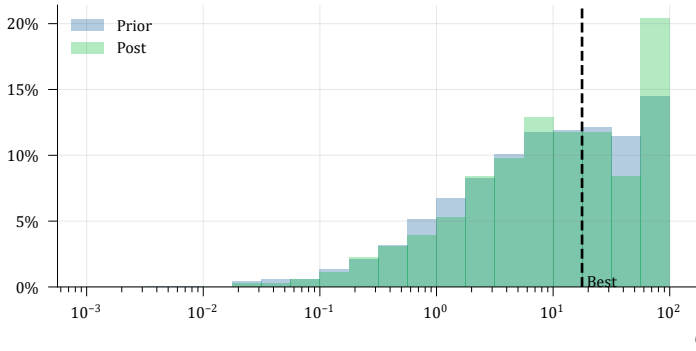
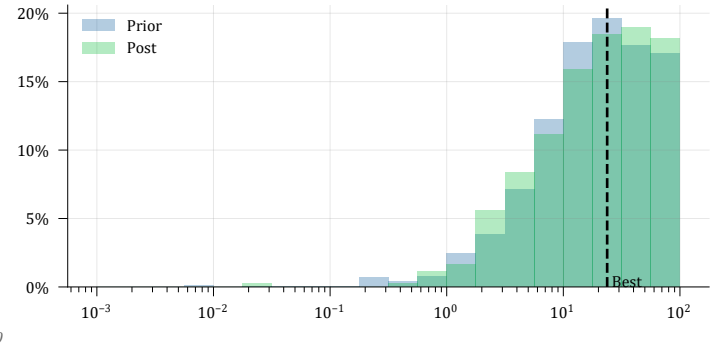
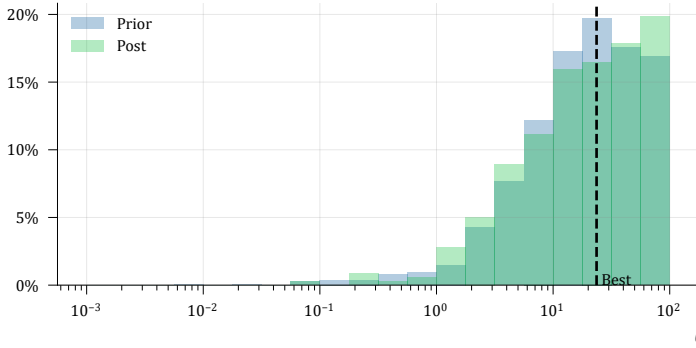
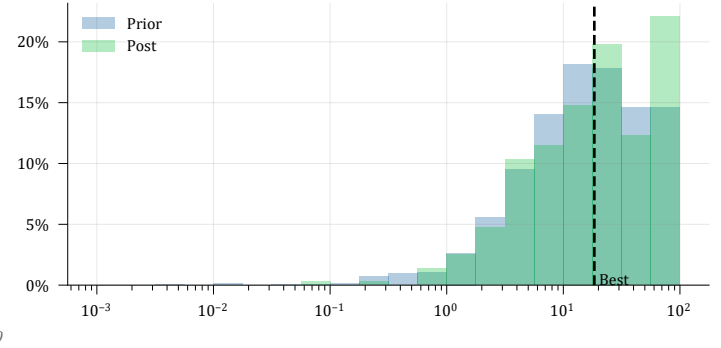
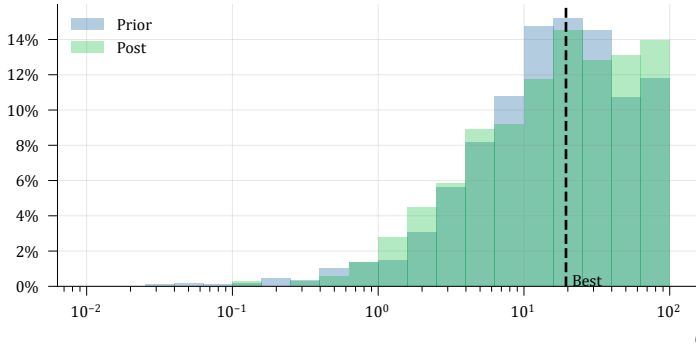
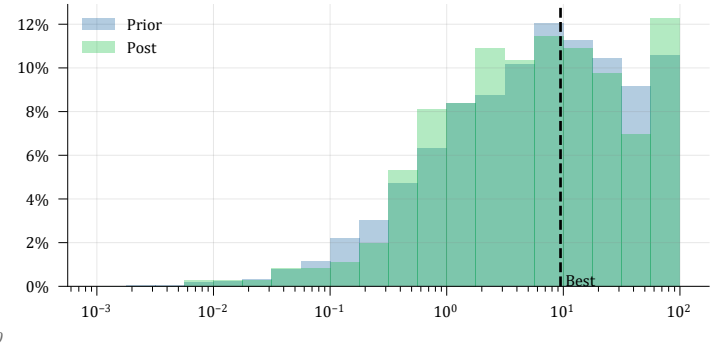
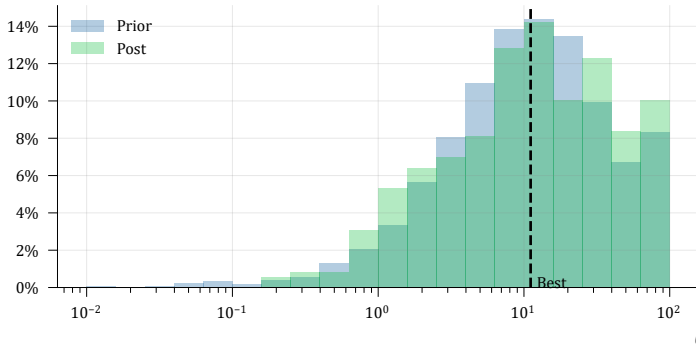
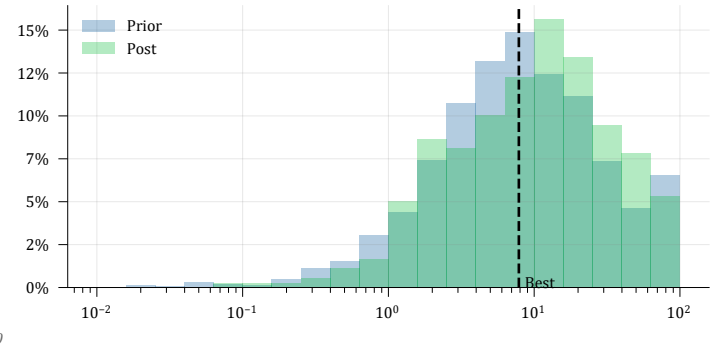
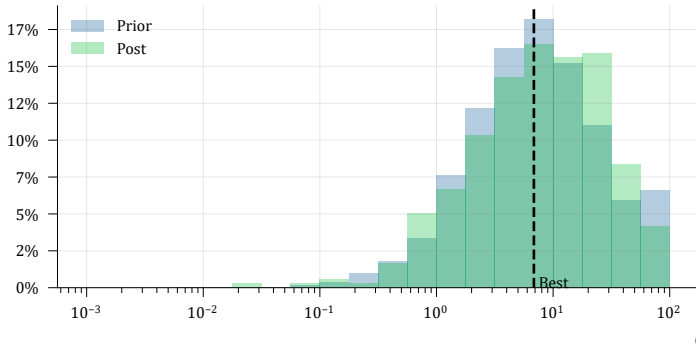
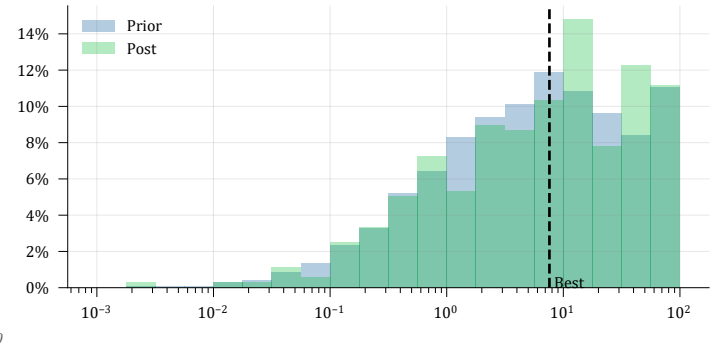


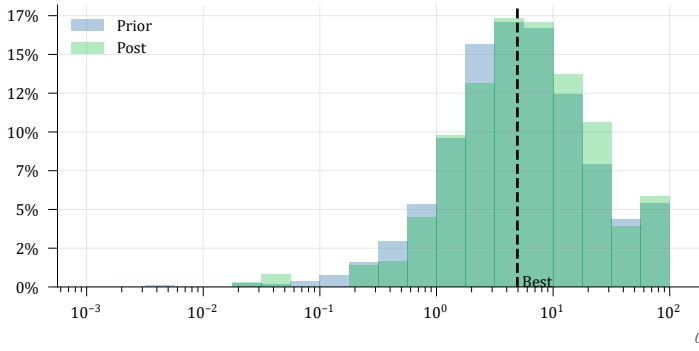
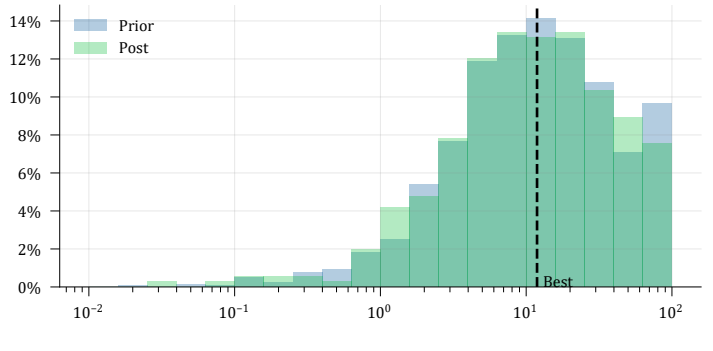
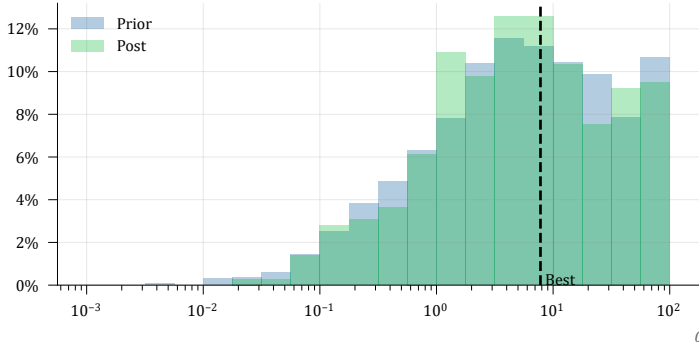
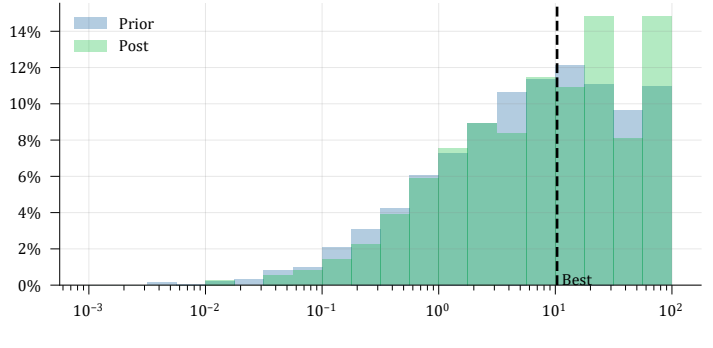
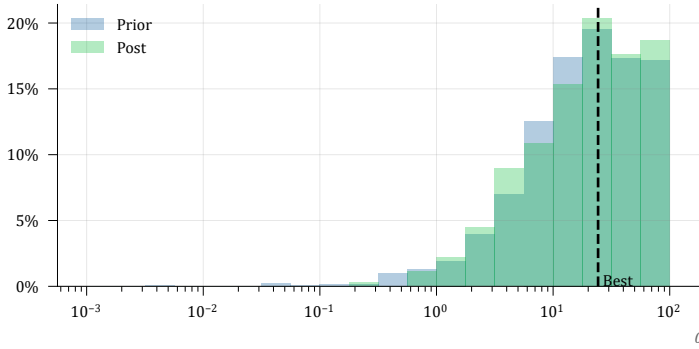
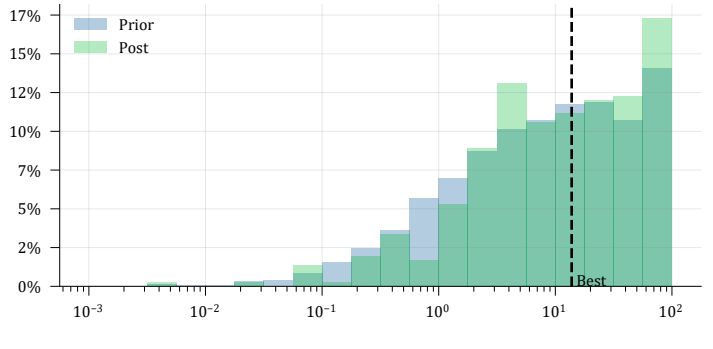
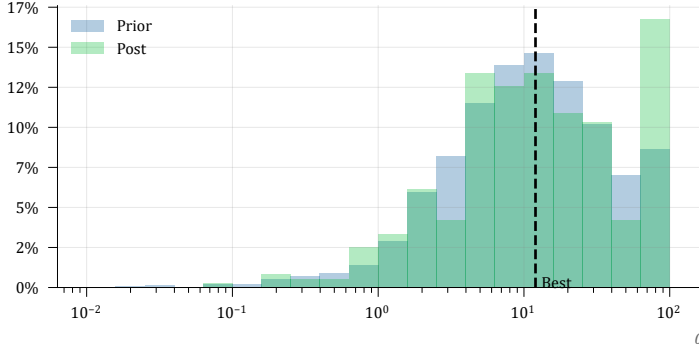
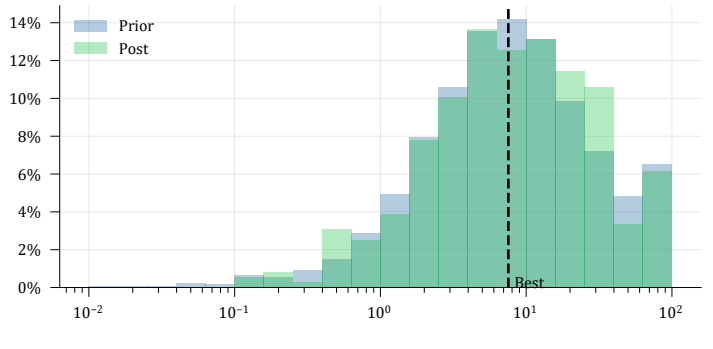
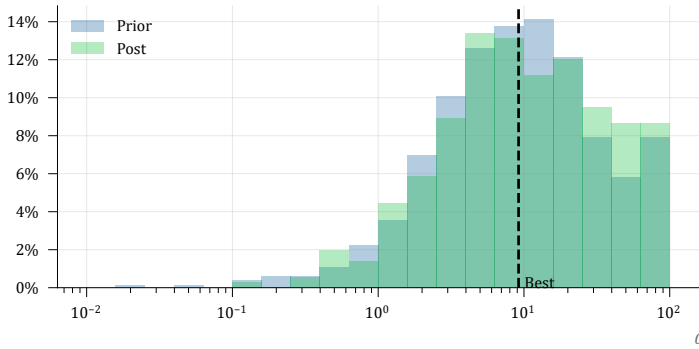
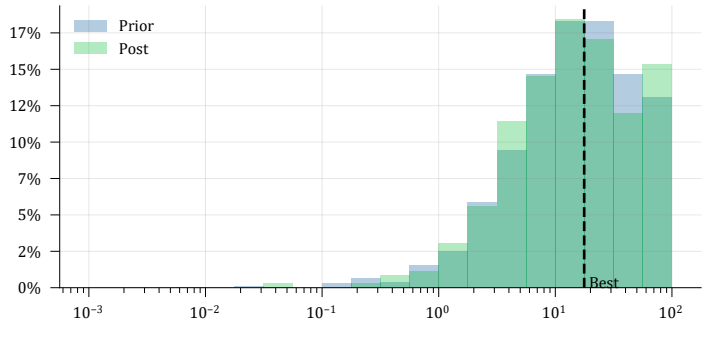


kx_p169(Pilot_Point_L1)**kx_p170(Pilot_Point_L1)****kx_p171(Pilot_Point_L1)****kx_p172(Pilot_Point_L1)****kx_p173(Pilot_Point_L1)****kx_p174(Pilot_Point_L1)****kx_p175(Pilot_Point_L1)****kx_p176(Pilot_Point_L1)****kx_p177(Pilot_Point_L1)****kx_p178(Pilot_Point_L1)**

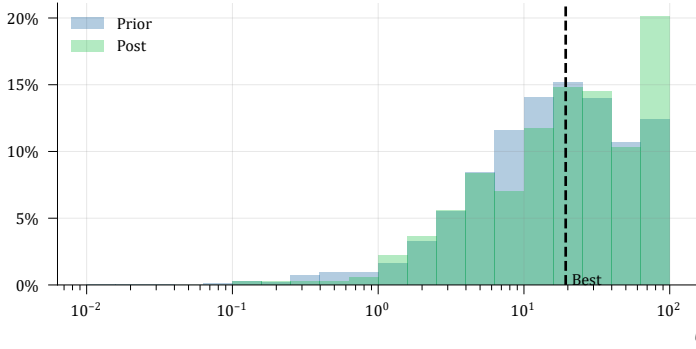
kx_p179(Pilot_Point_L1)**kx_p180(Pilot_Point_L1)****kx_p181(Pilot_Point_L1)****kx_p182(Pilot_Point_L1)****kx_p183(Pilot_Point_L1)****kx_p184(Pilot_Point_L1)****kx_p185(Pilot_Point_L1)****kx_p186(Pilot_Point_L1)****kx_p187(Pilot_Point_L1)****kx_p188(Pilot_Point_L1)**

kx_p189(Pilot_Point_L1)**kx_p190(Pilot_Point_L1)****kx_p191(Pilot_Point_L1)****kx_p192(Pilot_Point_L1)****kx_p193(Pilot_Point_L1)****kx_p194(Pilot_Point_L1)****kx_p195(Pilot_Point_L1)****kx_p196(Pilot_Point_L1)****kx_p197(Pilot_Point_L1)****kx_p198(Pilot_Point_L1)**

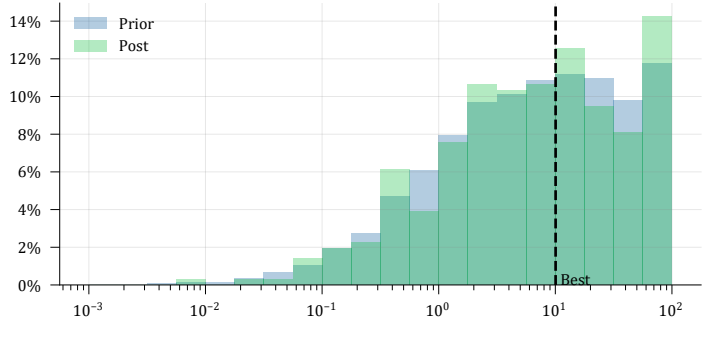
kx_p199(Pilot_Point_L1)**kx_p200(Pilot_Point_L1)****kx_p201(Pilot_Point_L1)****kx_p202(Pilot_Point_L1)****kx_p203(Pilot_Point_L1)****kx_p204(Pilot_Point_L1)****kx_p205(Pilot_Point_L1)****kx_p206(Pilot_Point_L1)****kx_p207(Pilot_Point_L1)****kx_p208(Pilot_Point_L1)**

kx_p209(Pilot_Point_L1)**kx_p210(Pilot_Point_L1)****kx_p211(Pilot_Point_L1)****kx_p212(Pilot_Point_L1)****kx_p213(Pilot_Point_L1)****kx_p214(Pilot_Point_L1)****kx_p215(Pilot_Point_L1)****kx_p216(Pilot_Point_L1)****kx_p217(Pilot_Point_L1)****kx_p218(Pilot_Point_L1)**

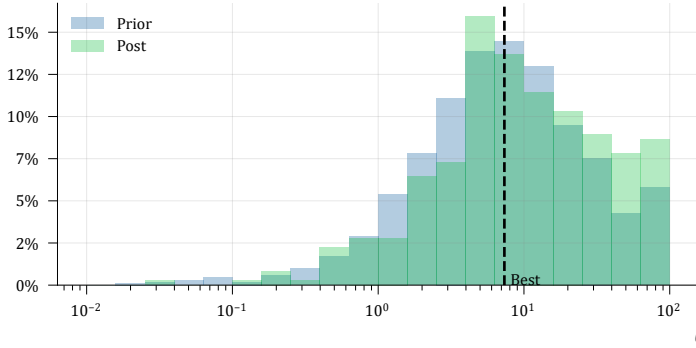
kx_p219(Pilot_Point_L1)



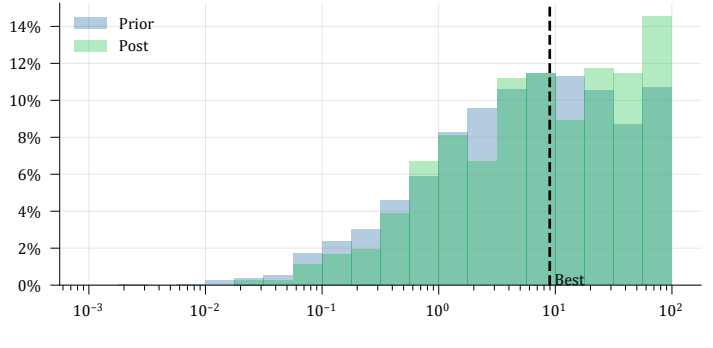
kx_p220(Pilot_Point_L1)



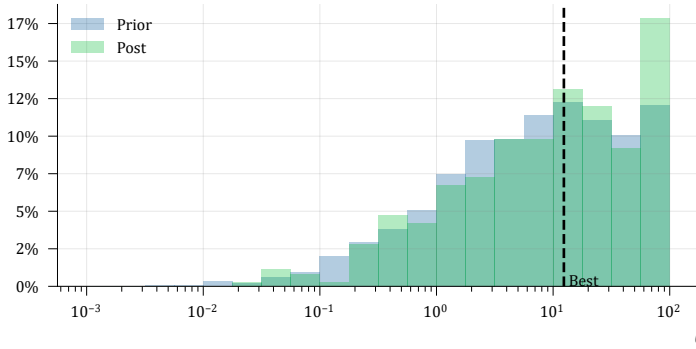
kx_p221(Pilot_Point_L1)



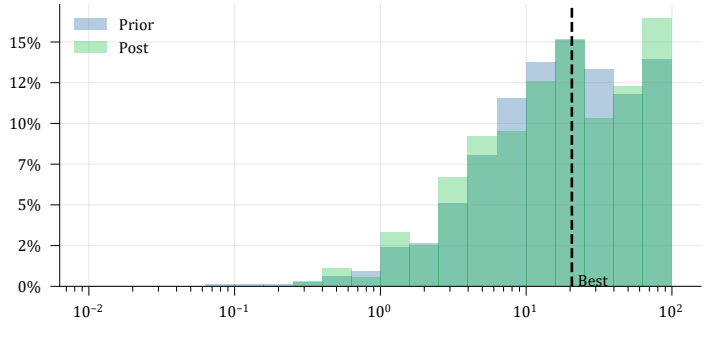
kx_p222(Pilot_Point_L1)



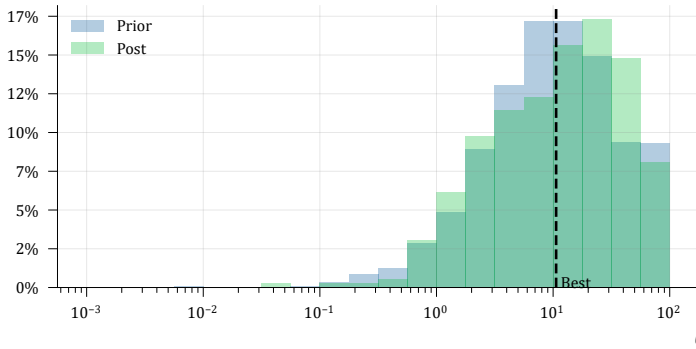
kx_p223(Pilot_Point_L1)



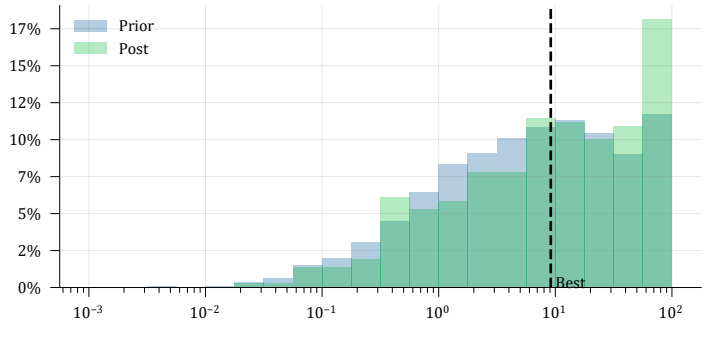
kx_p224(Pilot_Point_L1)



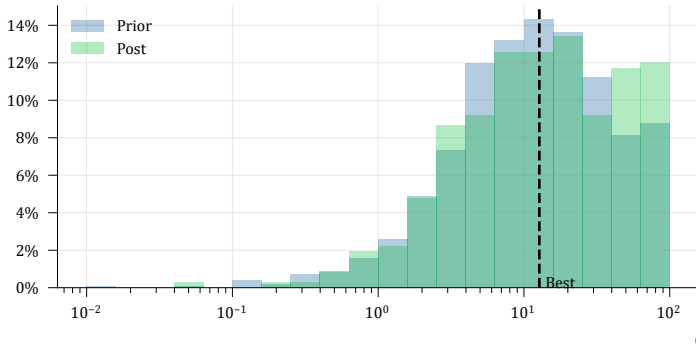
kx_p225(Pilot_Point_L1)



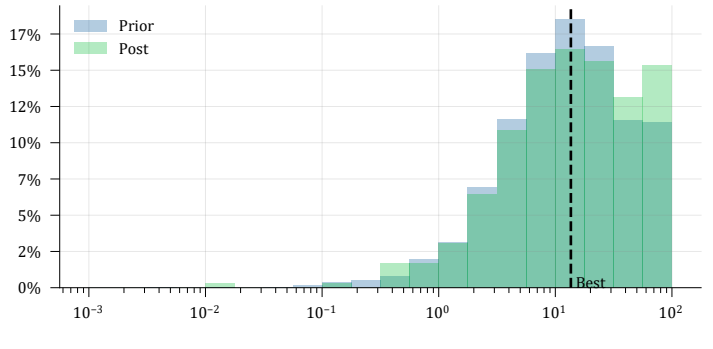
kx_p226(Pilot_Point_L1)



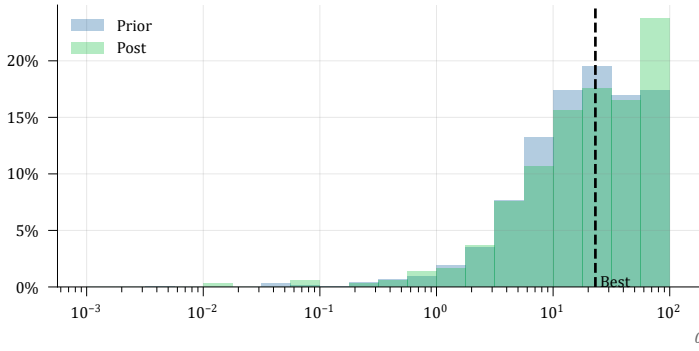
kx_p227(Pilot_Point_L1)



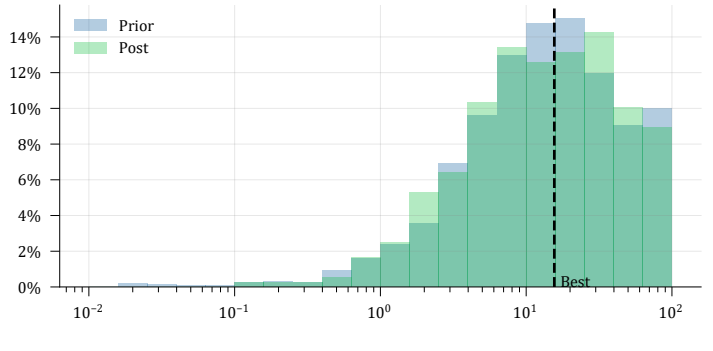
kx_p228(Pilot_Point_L1)



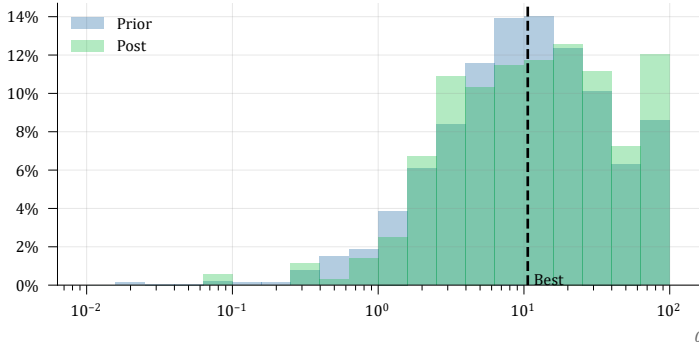
kx_p229(Pilot_Point_L1)



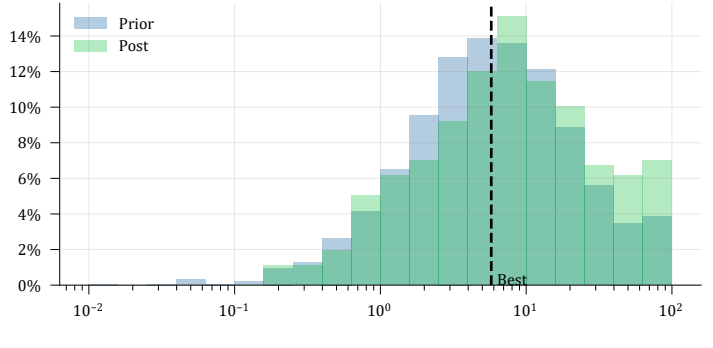
kx_p230(Pilot_Point_L1)



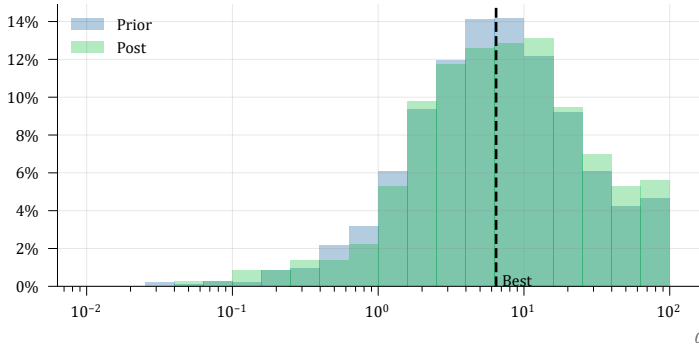
kx_p231(Pilot_Point_L1)



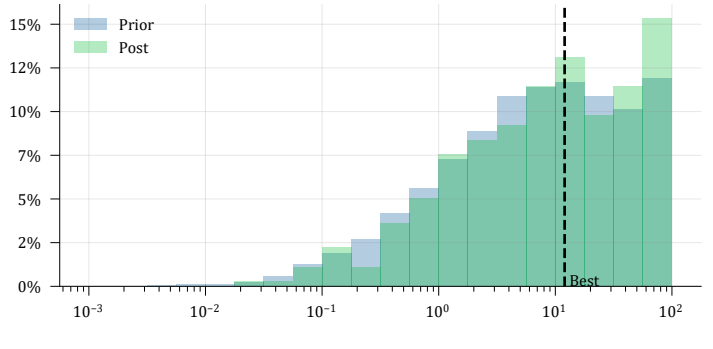
kx_p232(Pilot_Point_L1)



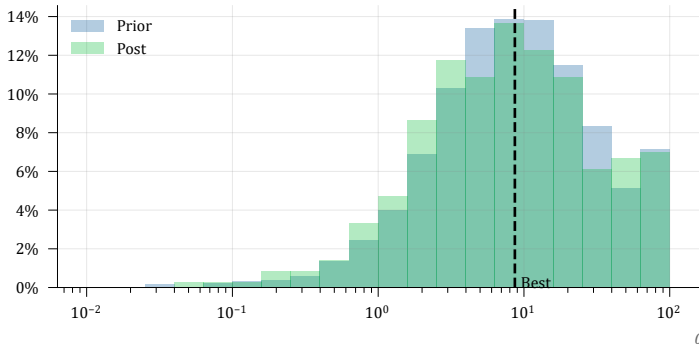
kx_p233(Pilot_Point_L1)



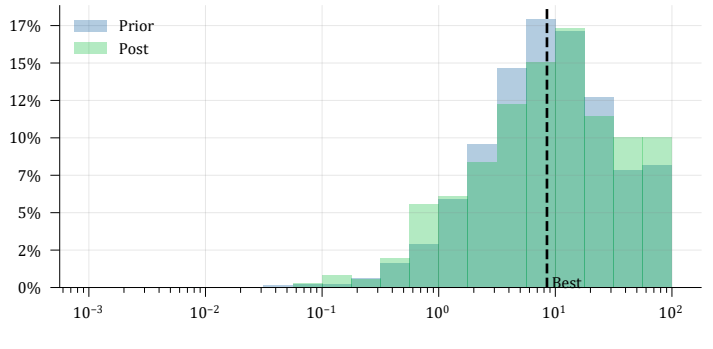
kx_p234(Pilot_Point_L1)



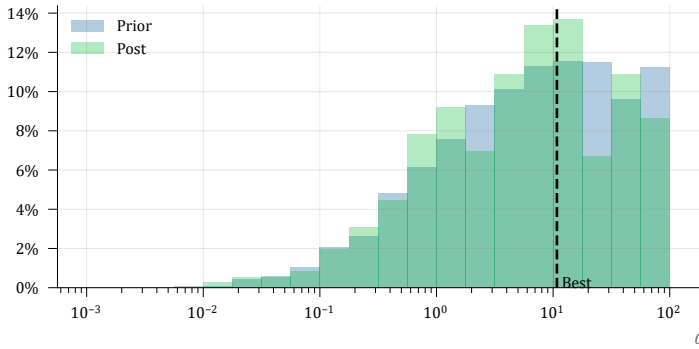
kx_p235(Pilot_Point_L1)



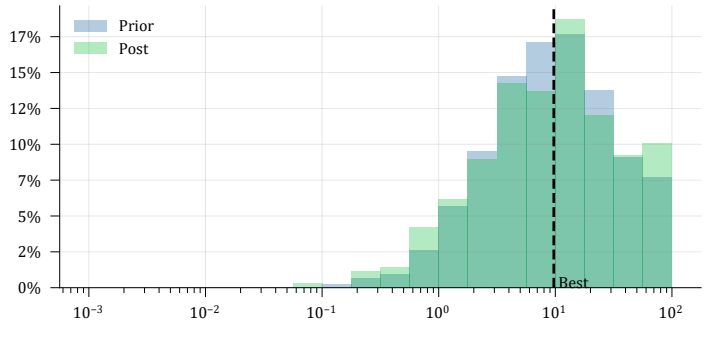
kx_p236(Pilot_Point_L1)

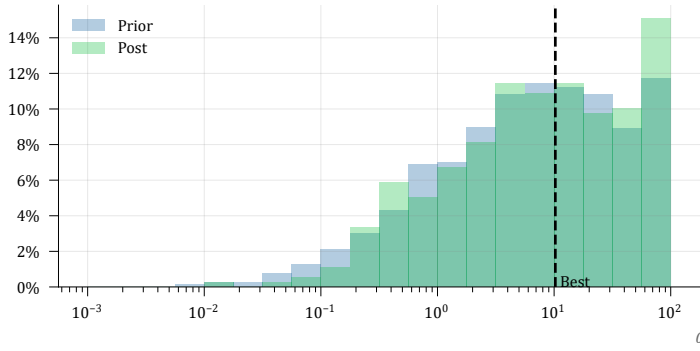
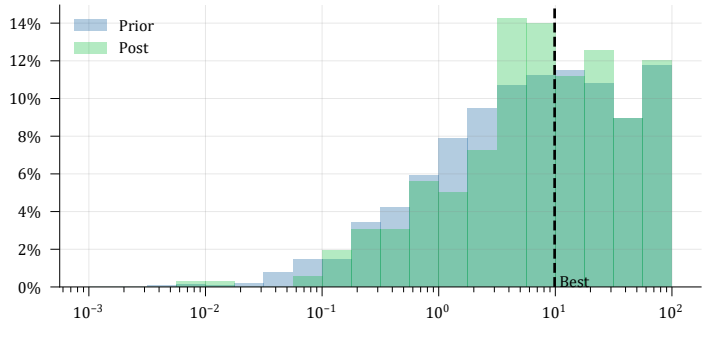
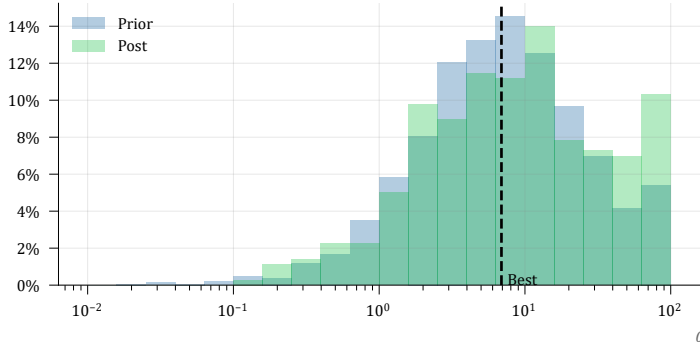
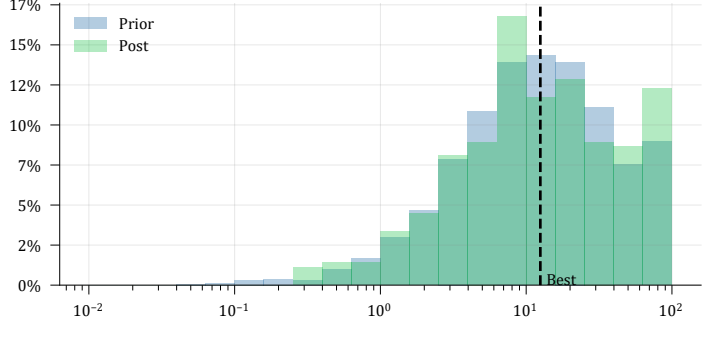
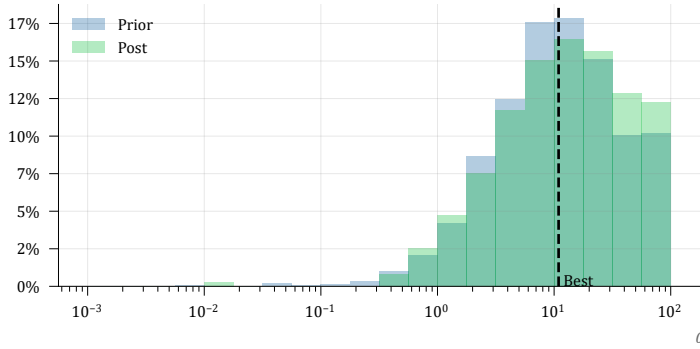
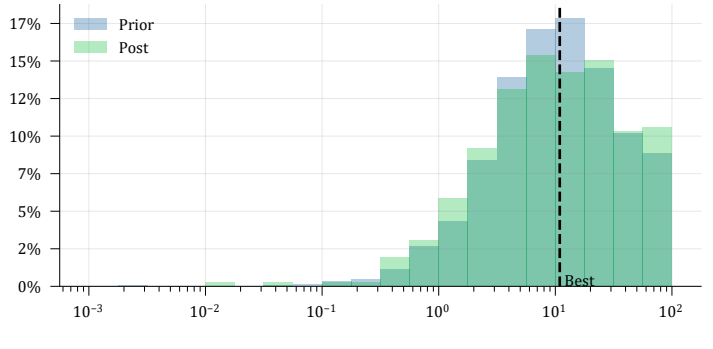
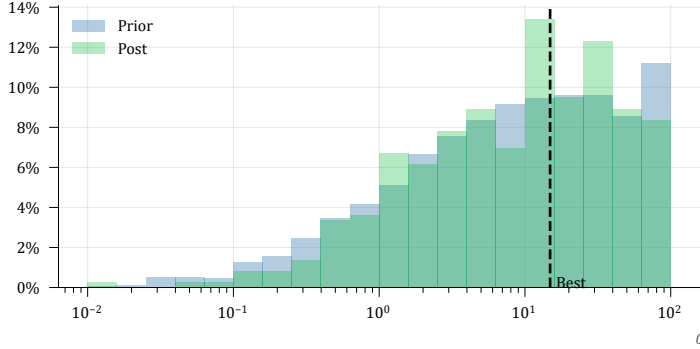
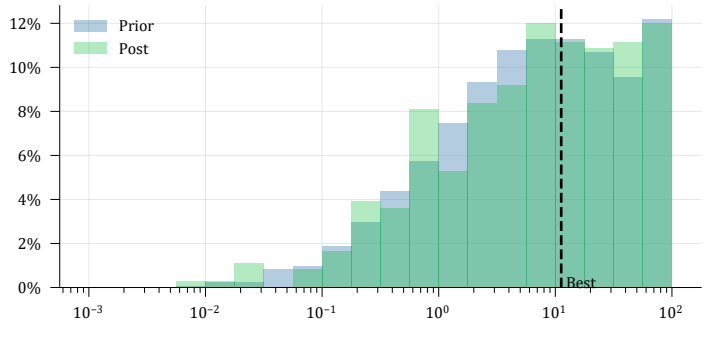
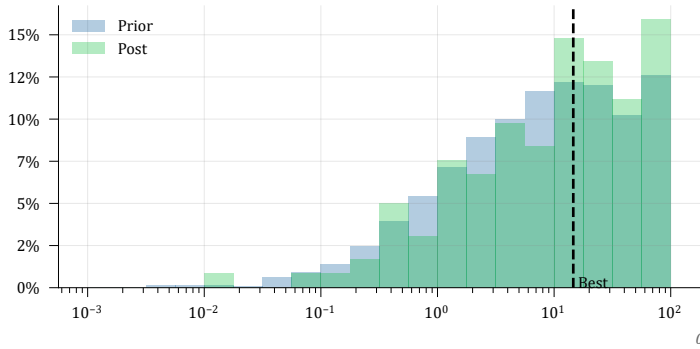
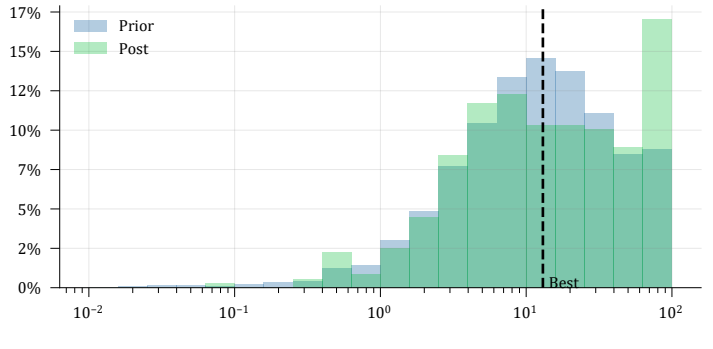


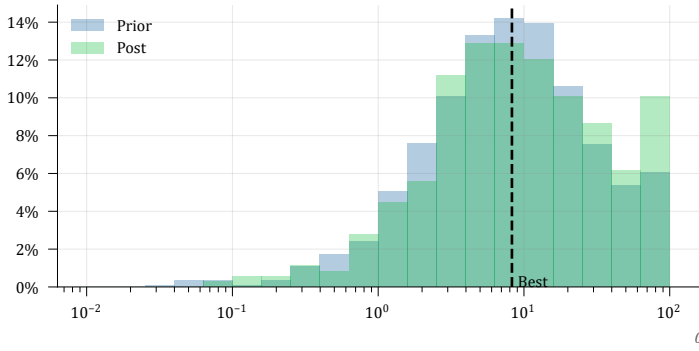
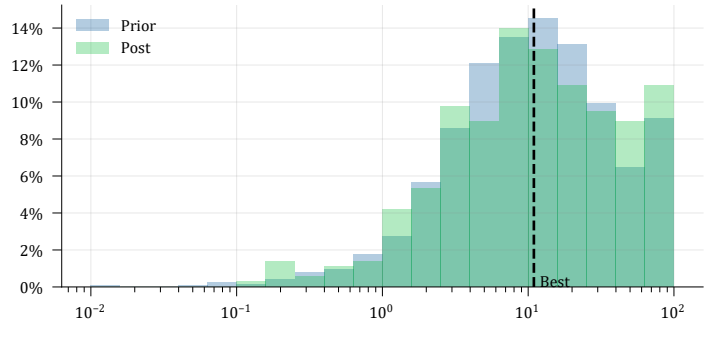
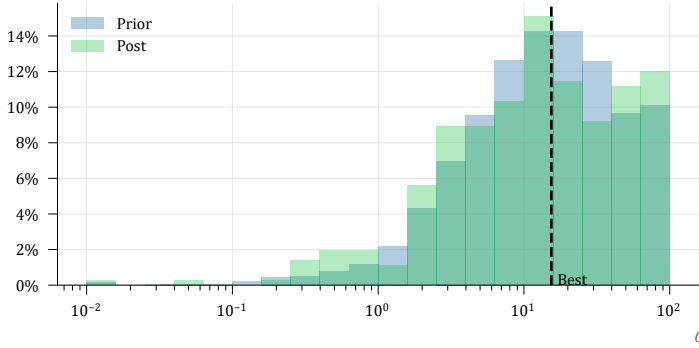
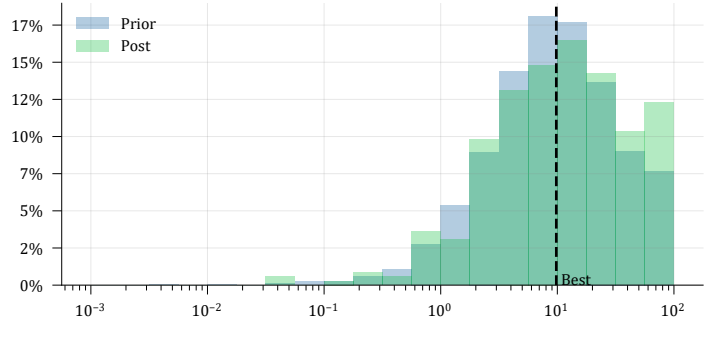
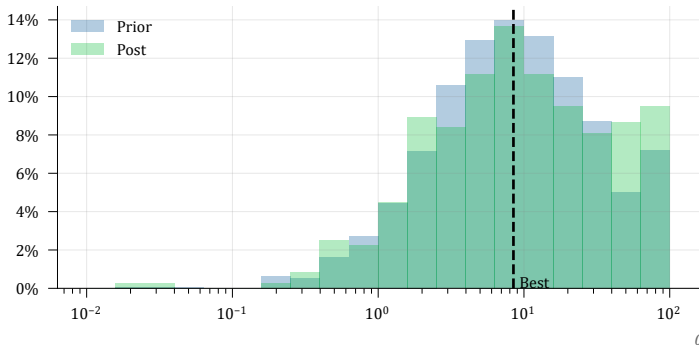
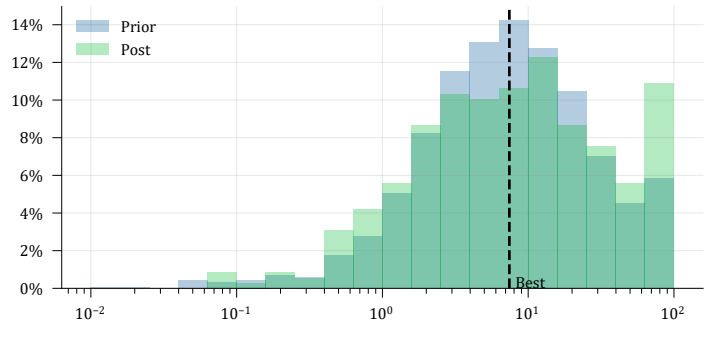
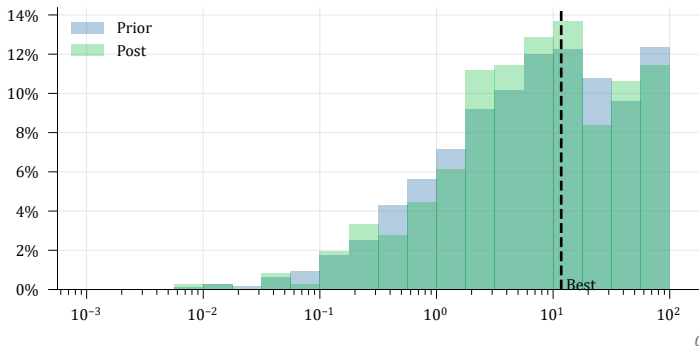
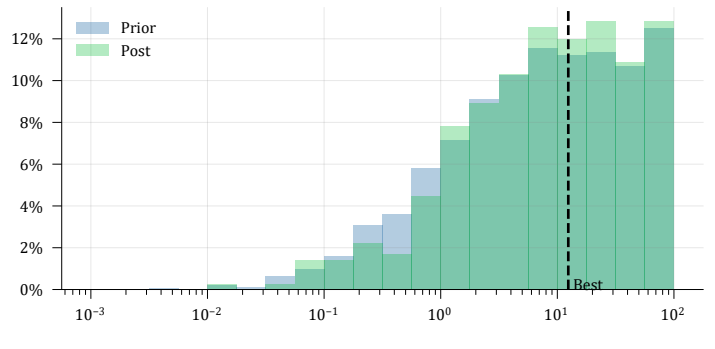
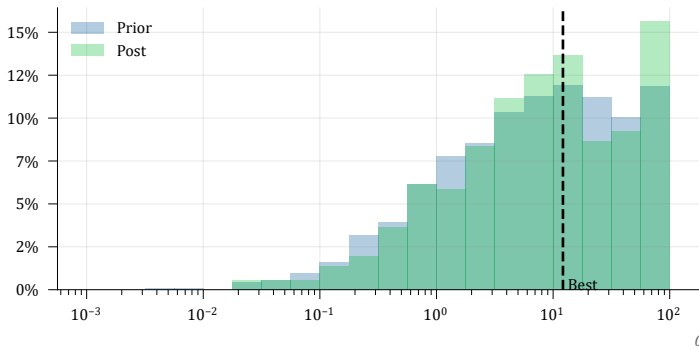
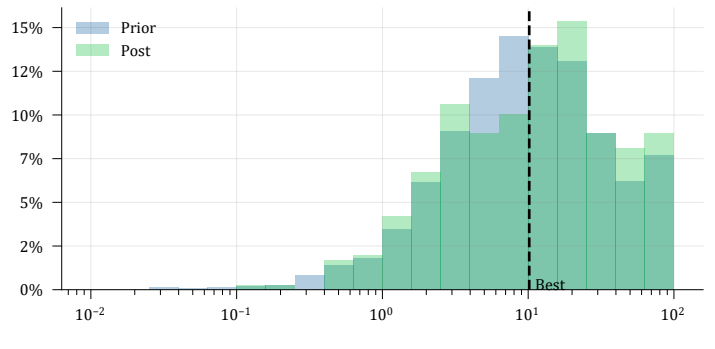
kx_p237(Pilot_Point_L1)

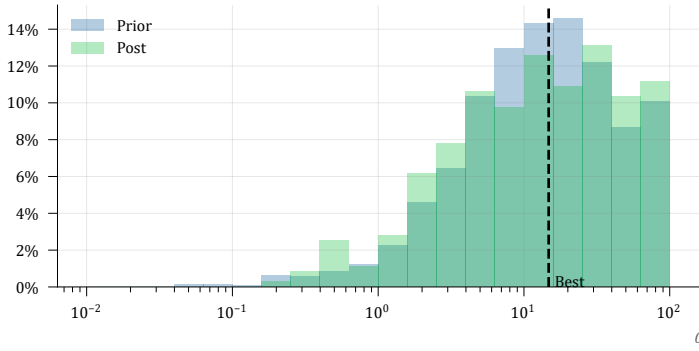
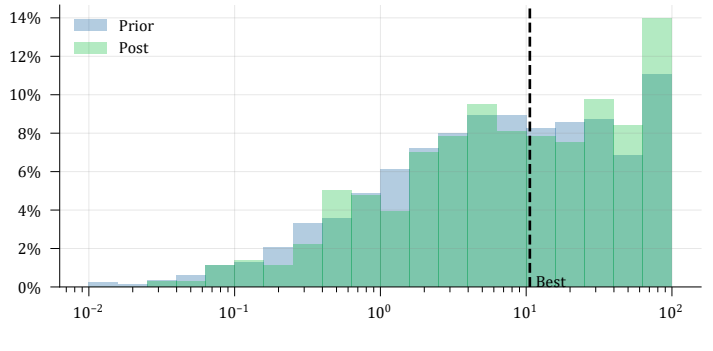
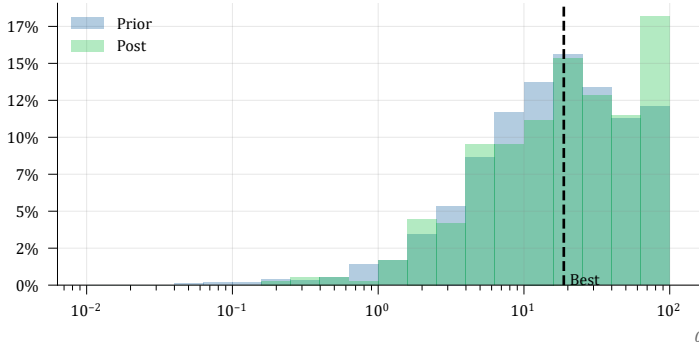
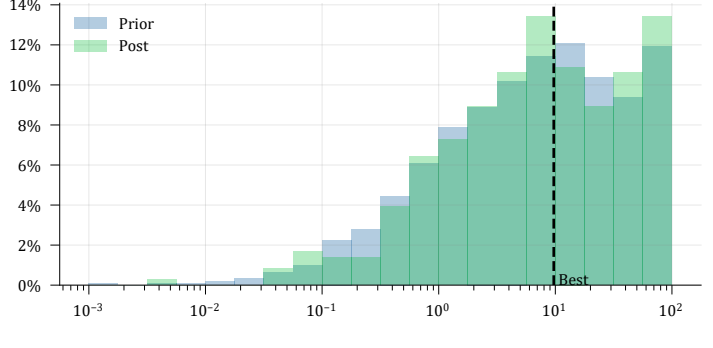
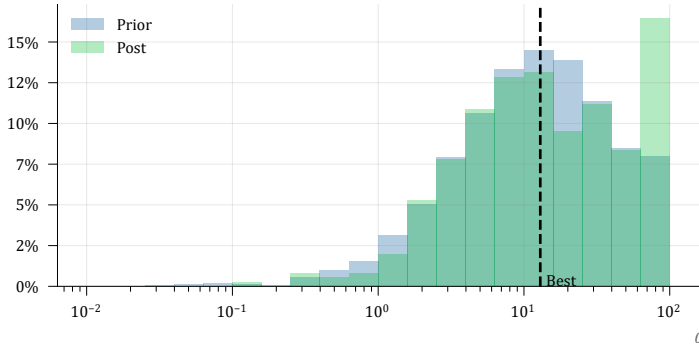
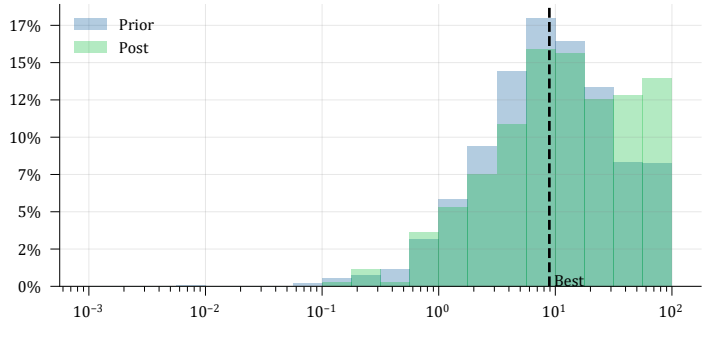
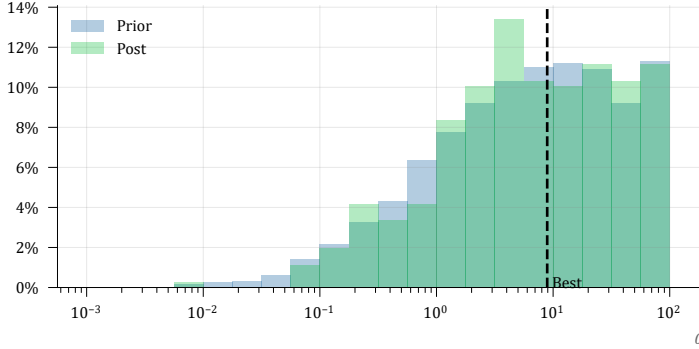
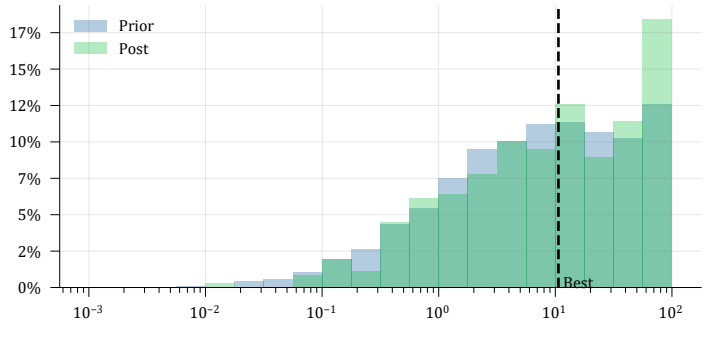
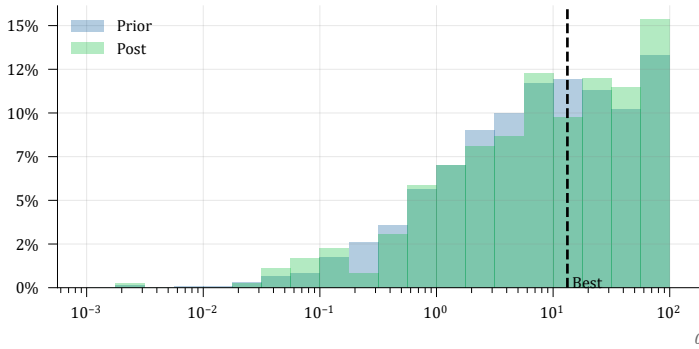
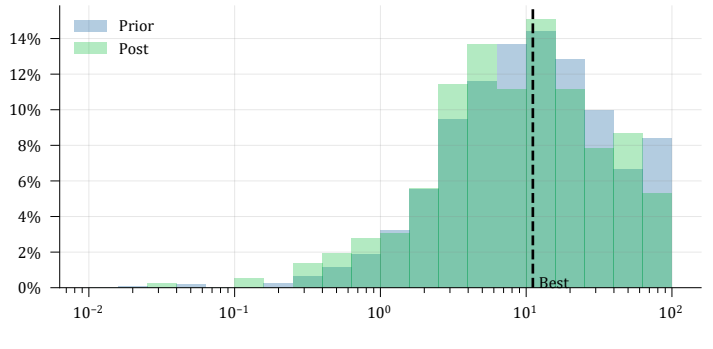


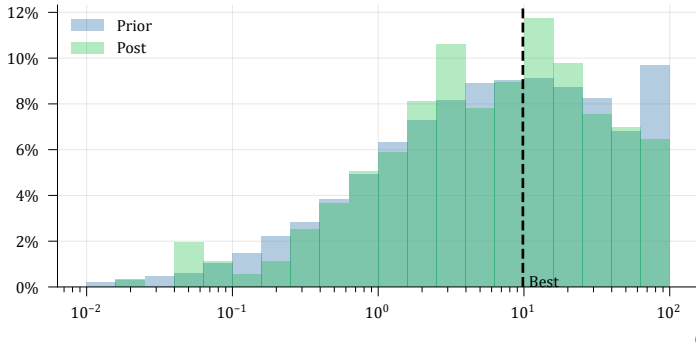
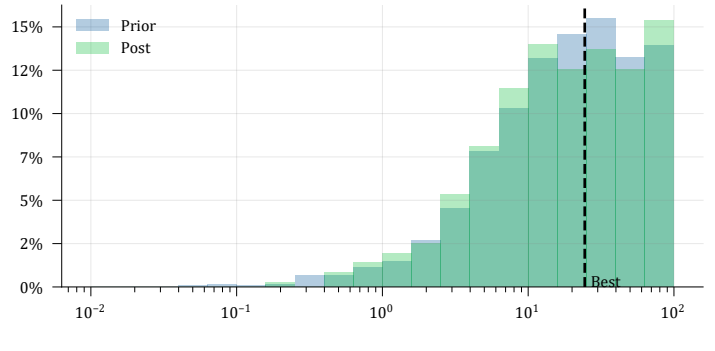
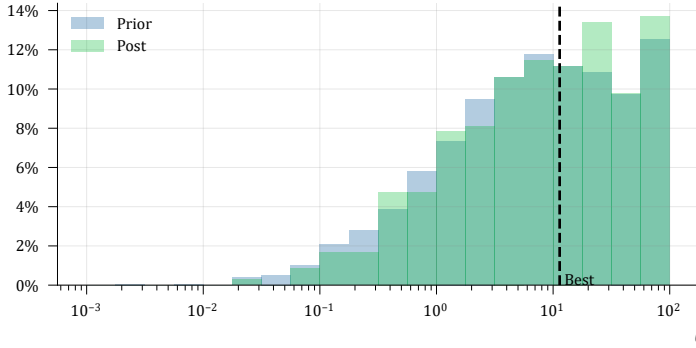
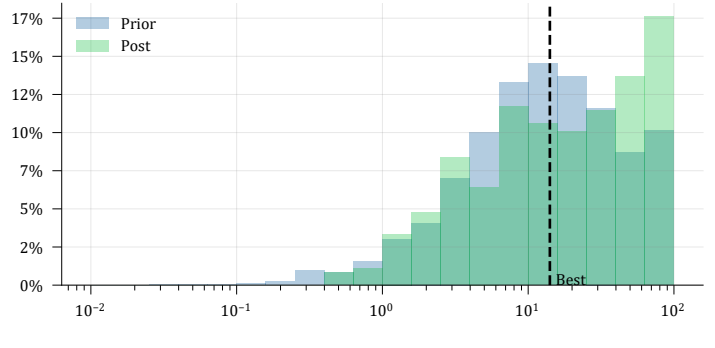
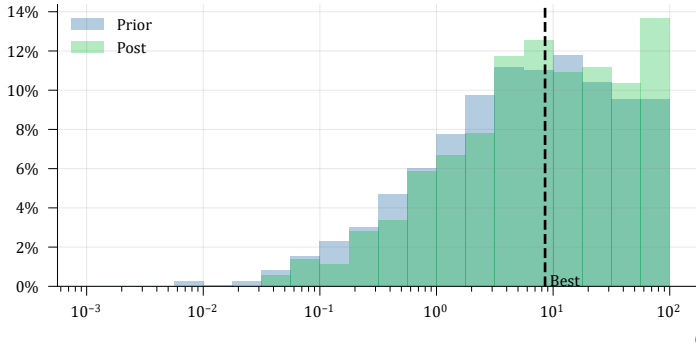
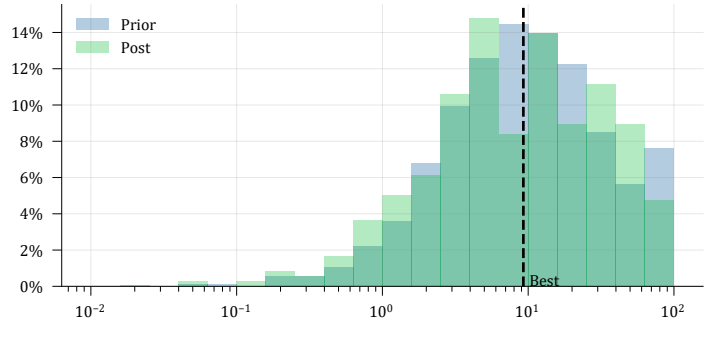
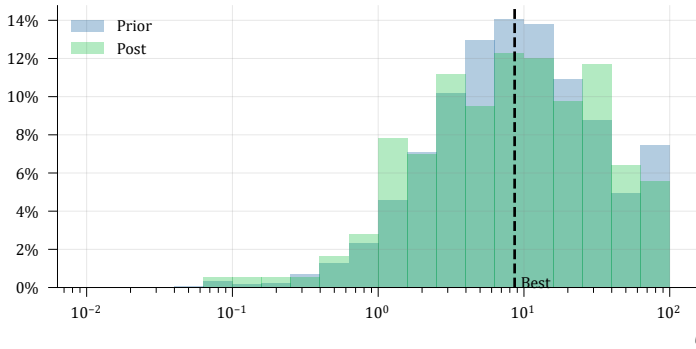
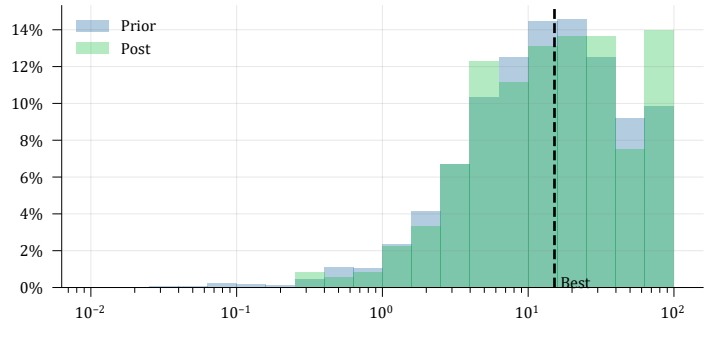
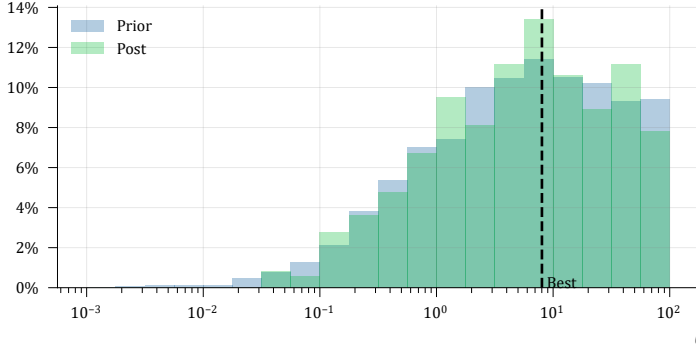
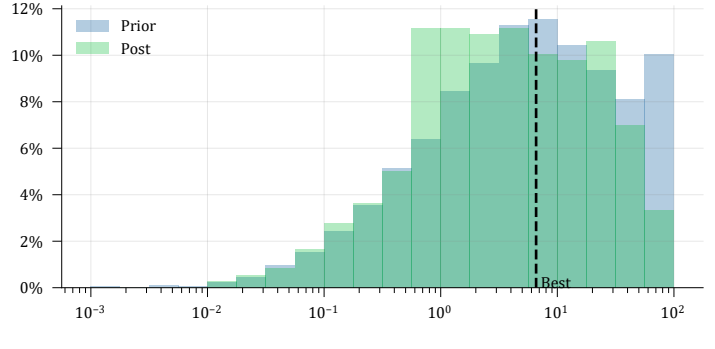
kx_p238(Pilot_Point_L1)



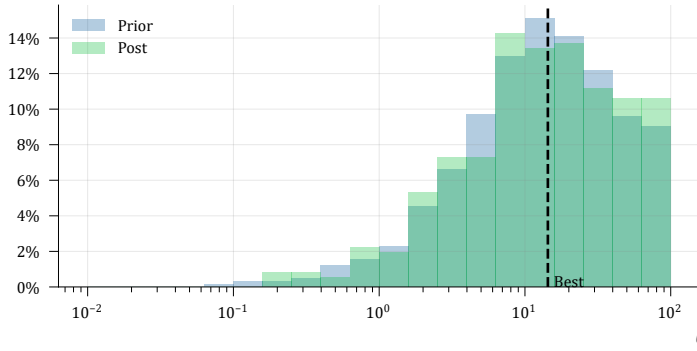
kx_p239(Pilot_Point_L1)**kx_p240(Pilot_Point_L1)****kx_p241(Pilot_Point_L1)****kx_p242(Pilot_Point_L1)****kx_p243(Pilot_Point_L1)****kx_p244(Pilot_Point_L1)****kx_p245(Pilot_Point_L1)****kx_p246(Pilot_Point_L1)****kx_p247(Pilot_Point_L1)****kx_p248(Pilot_Point_L1)**

kx_p249(Pilot_Point_L1)**kx_p250(Pilot_Point_L1)****kx_p251(Pilot_Point_L1)****kx_p252(Pilot_Point_L1)****kx_p253(Pilot_Point_L1)****kx_p254(Pilot_Point_L1)****kx_p255(Pilot_Point_L1)****kx_p256(Pilot_Point_L1)****kx_p257(Pilot_Point_L1)****kx_p258(Pilot_Point_L1)**

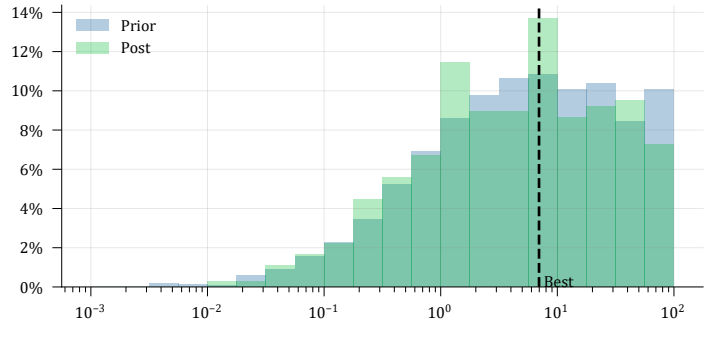
kx_p259(Pilot_Point_L1)**kx_p260(Pilot_Point_L1)****kx_p261(Pilot_Point_L1)****kx_p262(Pilot_Point_L1)****kx_p263(Pilot_Point_L1)****kx_p264(Pilot_Point_L1)****kx_p265(Pilot_Point_L1)****kx_p266(Pilot_Point_L1)****kx_p267(Pilot_Point_L1)****kx_p268(Pilot_Point_L1)**

kx_p269(Pilot_Point_L1)**kx_p270(Pilot_Point_L1)****kx_p271(Pilot_Point_L1)****kx_p272(Pilot_Point_L1)****kx_p273(Pilot_Point_L1)****kx_p274(Pilot_Point_L1)****kx_p275(Pilot_Point_L1)****kx_p276(Pilot_Point_L1)****kx_p277(Pilot_Point_L1)****kx_p278(Pilot_Point_L1)**

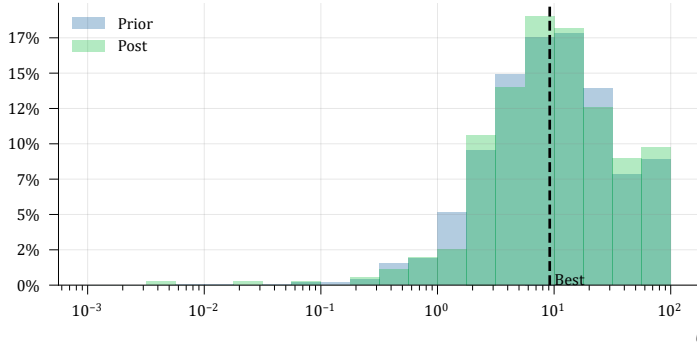
kx_p279(Pilot_Point_L1)



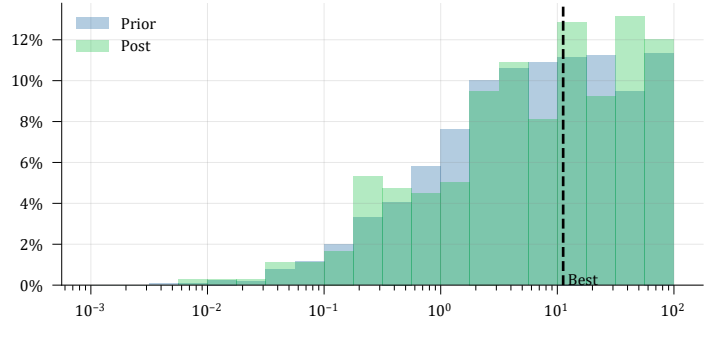
kx_p280(Pilot_Point_L1)



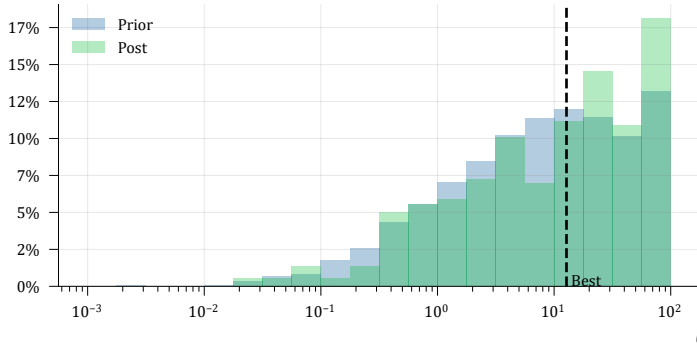
kx_p281(Pilot_Point_L1)



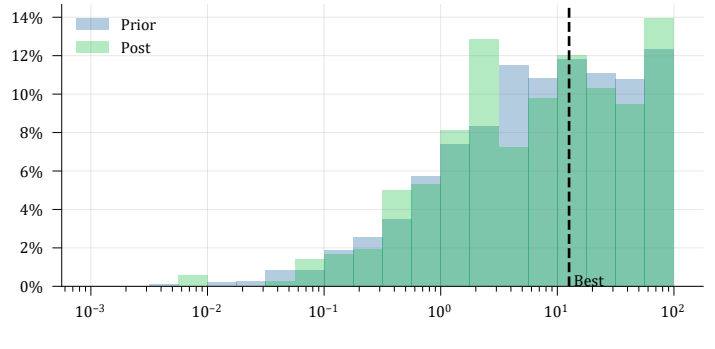
kx_p282(Pilot_Point_L1)



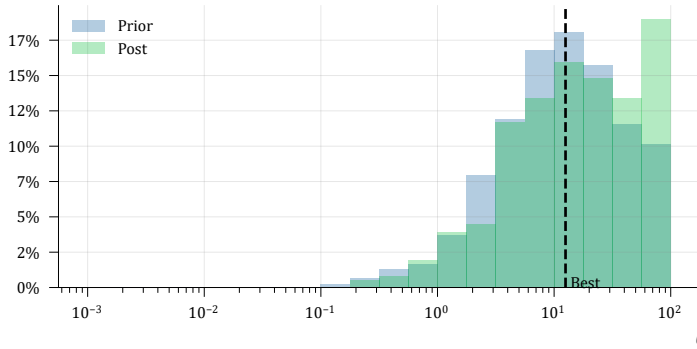
kx_p283(Pilot_Point_L1)



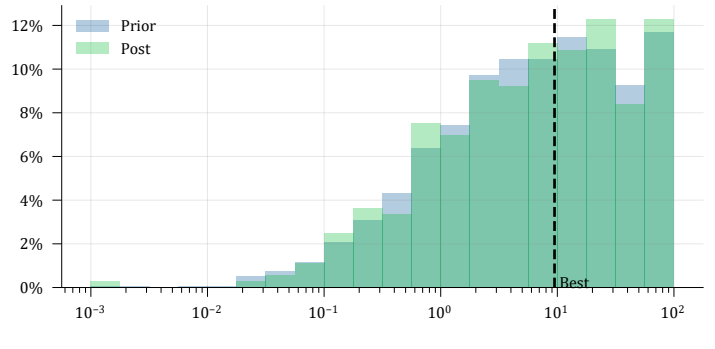
kx_p284(Pilot_Point_L1)



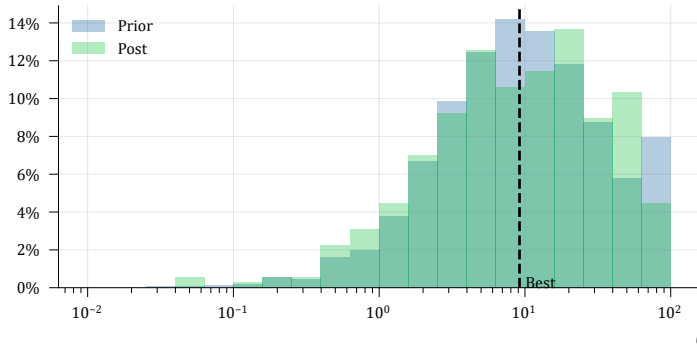
kx_p285(Pilot_Point_L1)



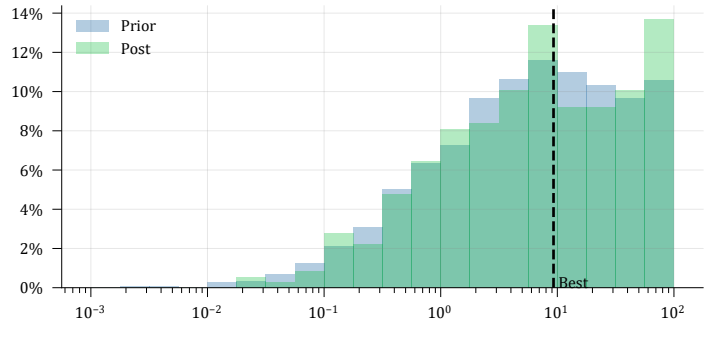
kx_p286(Pilot_Point_L1)

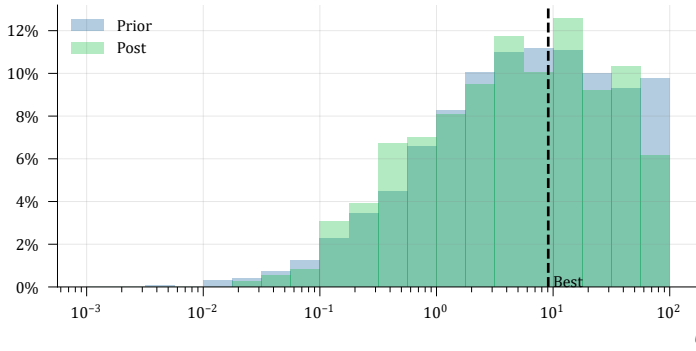
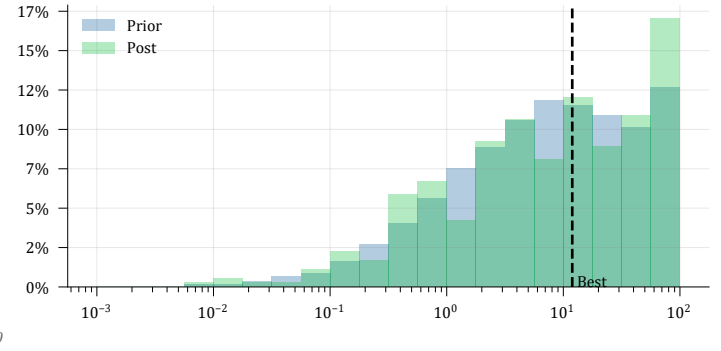
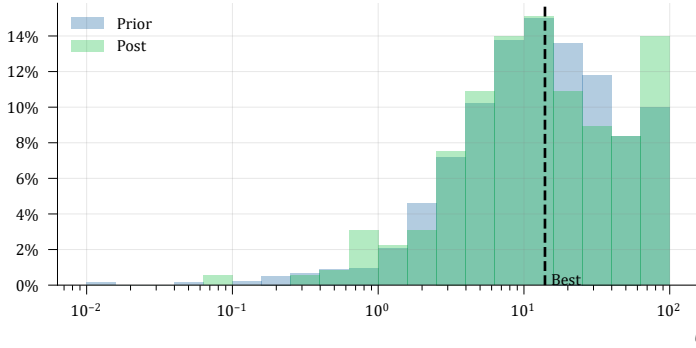
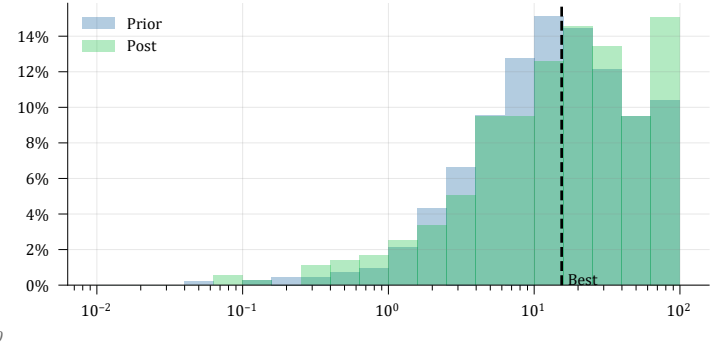
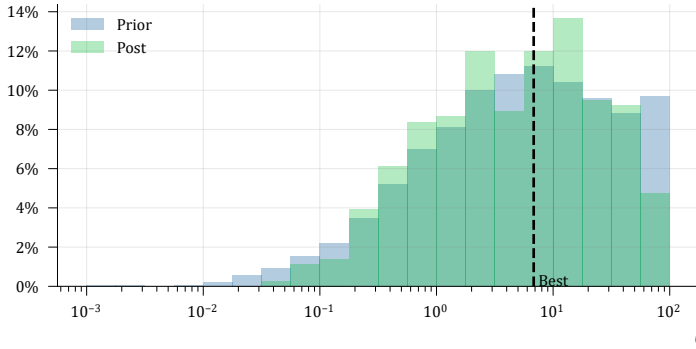
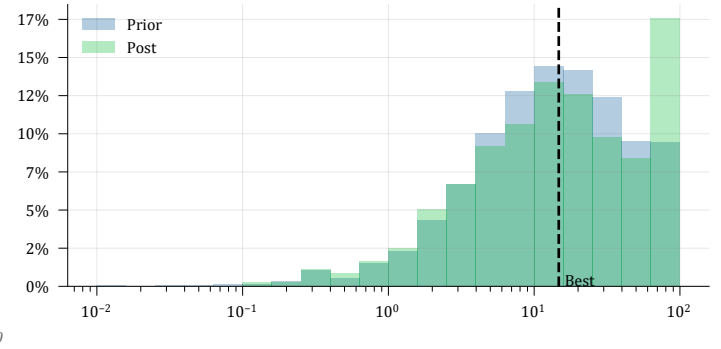
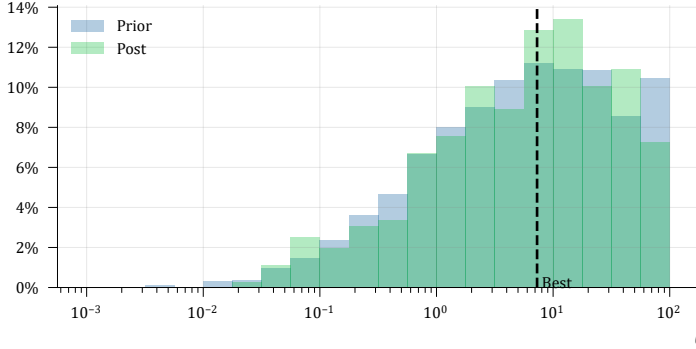
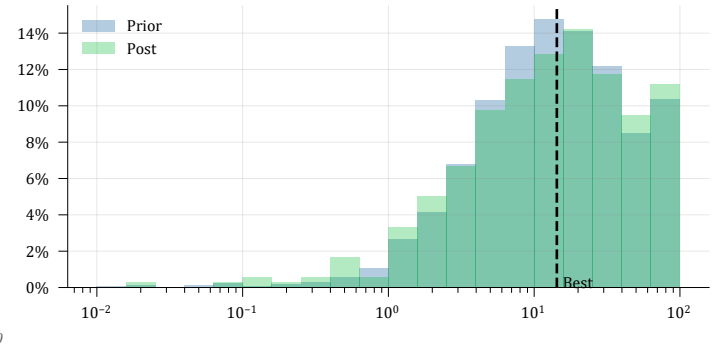
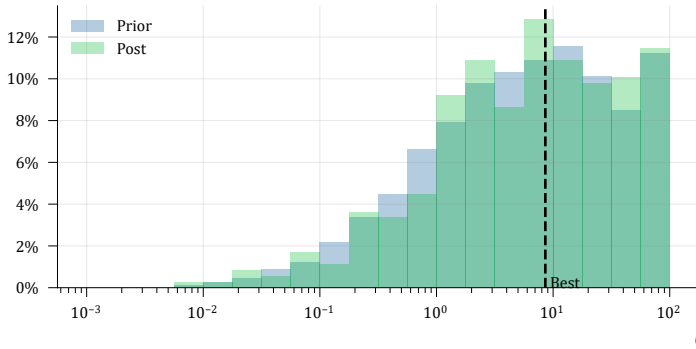
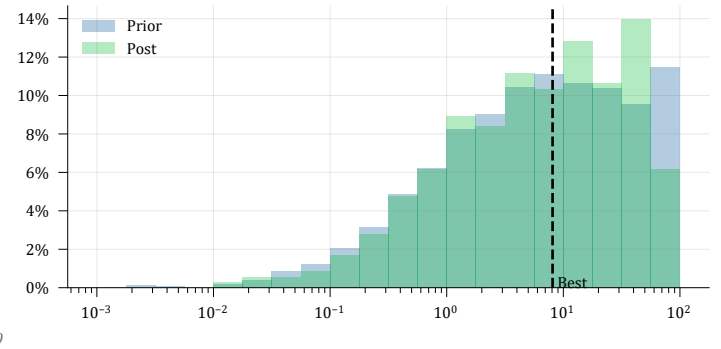


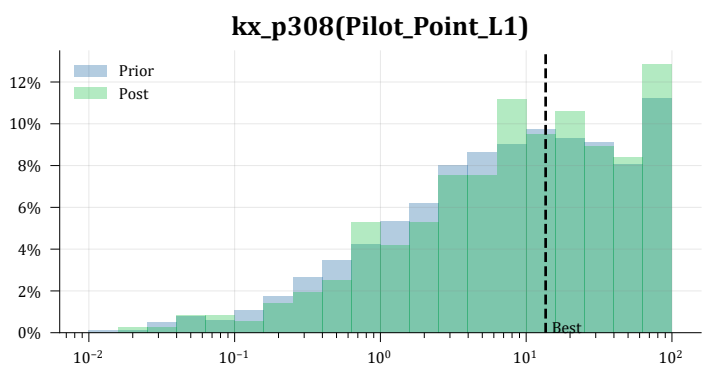
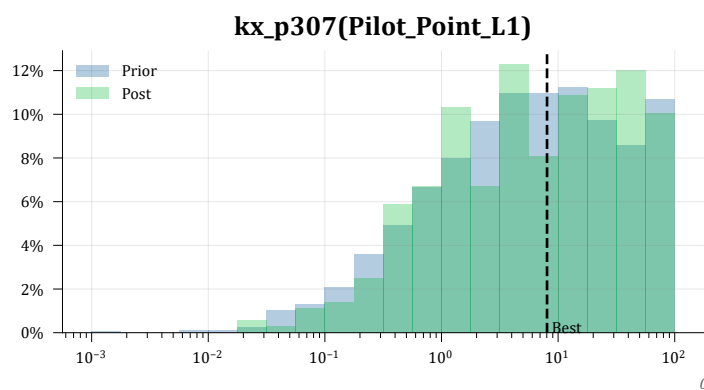
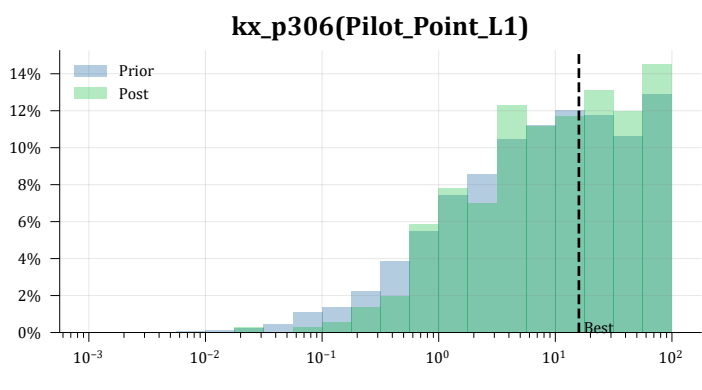
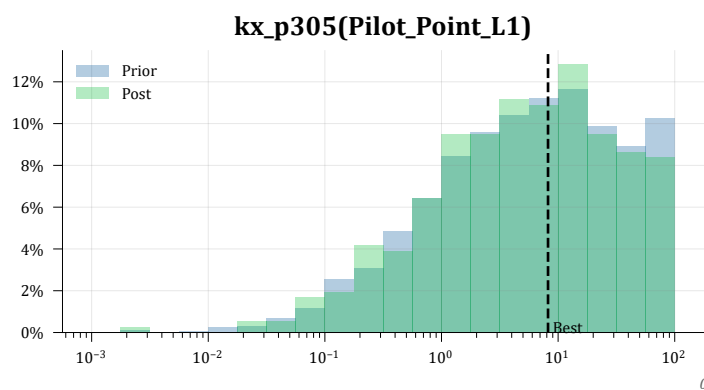
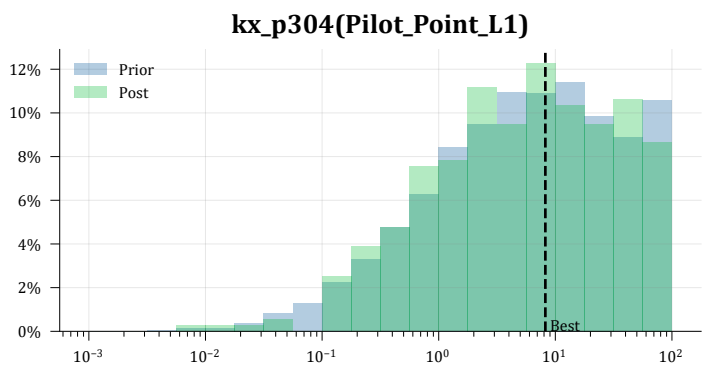
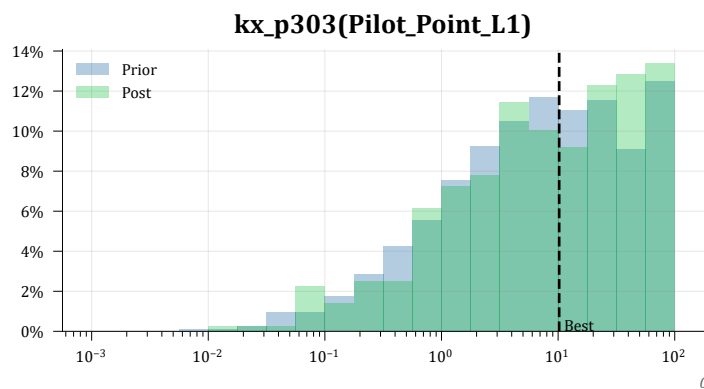
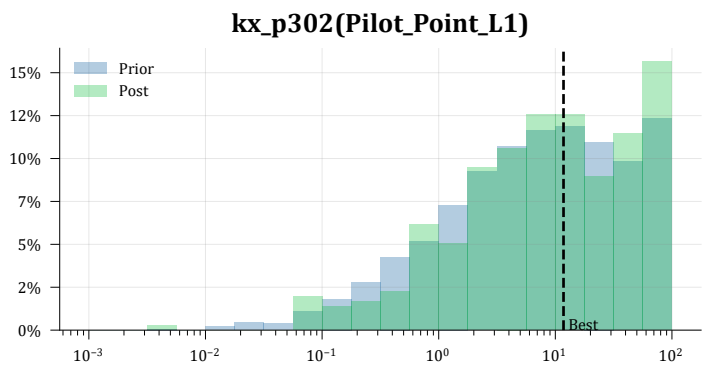
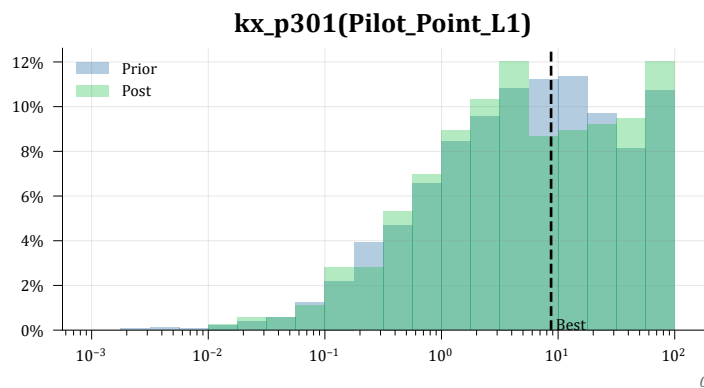
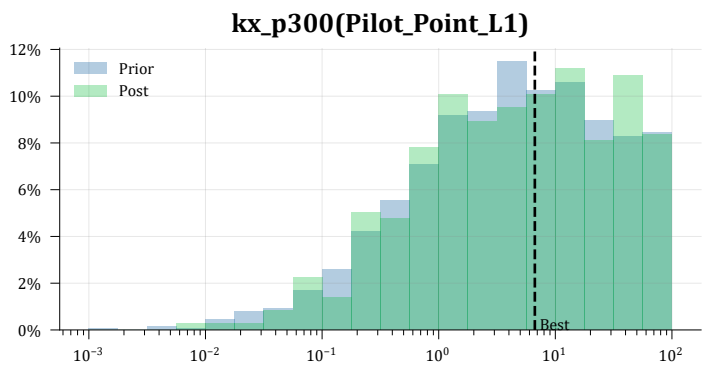
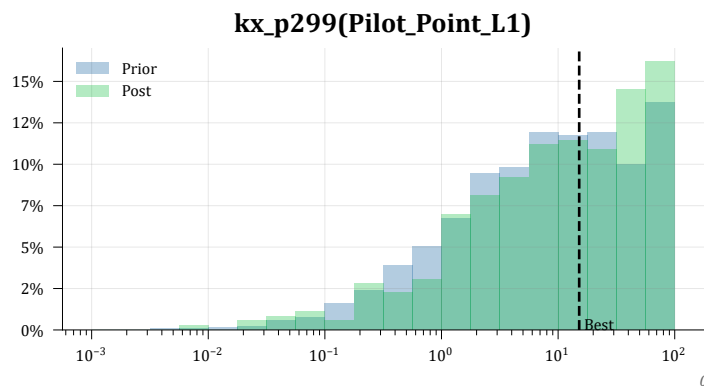
kx_p287(Pilot_Point_L1)



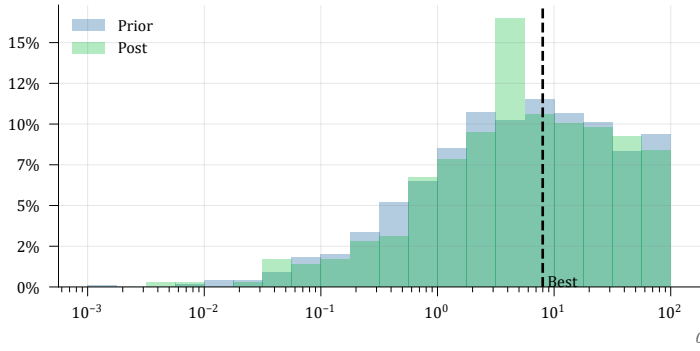
kx_p288(Pilot_Point_L1)



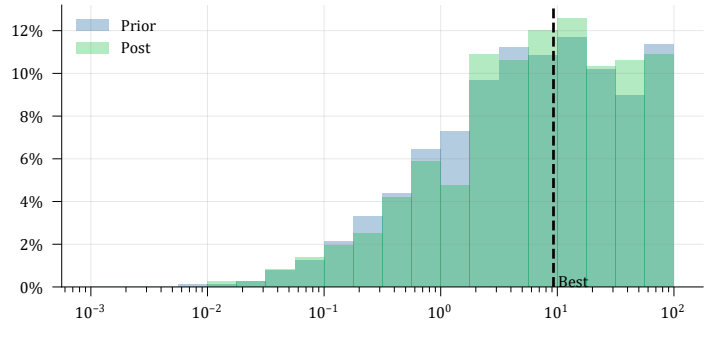
kx_p289(Pilot_Point_L1)**kx_p290(Pilot_Point_L1)****kx_p291(Pilot_Point_L1)****kx_p292(Pilot_Point_L1)****kx_p293(Pilot_Point_L1)****kx_p294(Pilot_Point_L1)****kx_p295(Pilot_Point_L1)****kx_p296(Pilot_Point_L1)****kx_p297(Pilot_Point_L1)****kx_p298(Pilot_Point_L1)**



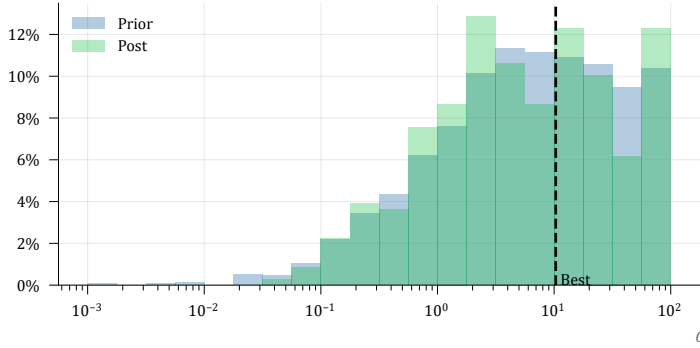
kx_p309(Pilot_Point_L1)



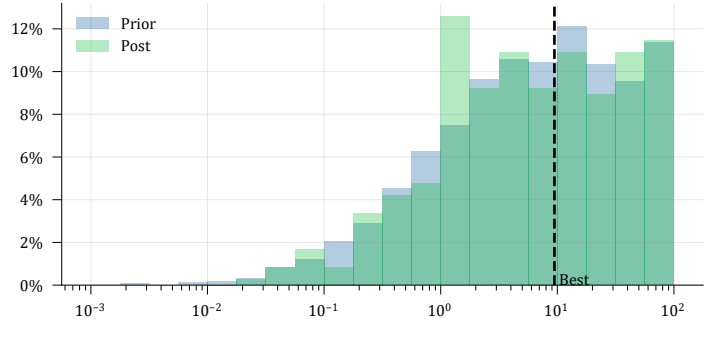
kx_p310(Pilot_Point_L1)



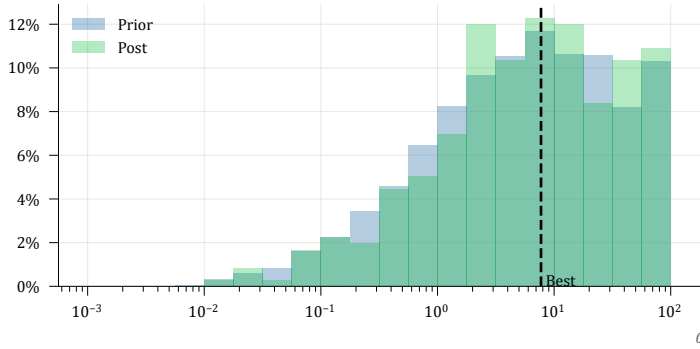
kx_p311(Pilot_Point_L1)



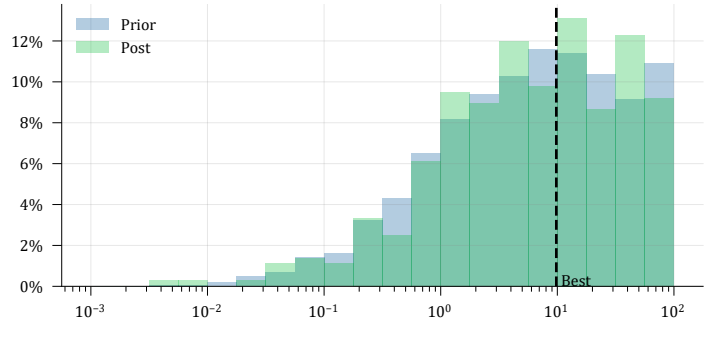
kx_p312(Pilot_Point_L1)



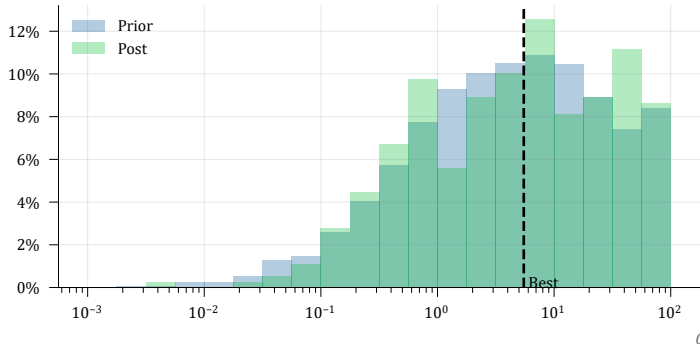
kx_p313(Pilot_Point_L1)



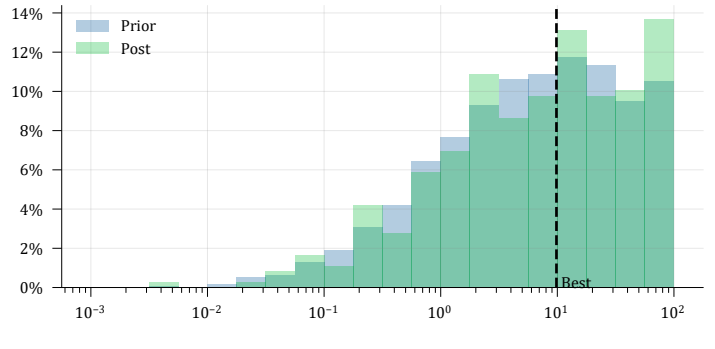
kx_p314(Pilot_Point_L1)



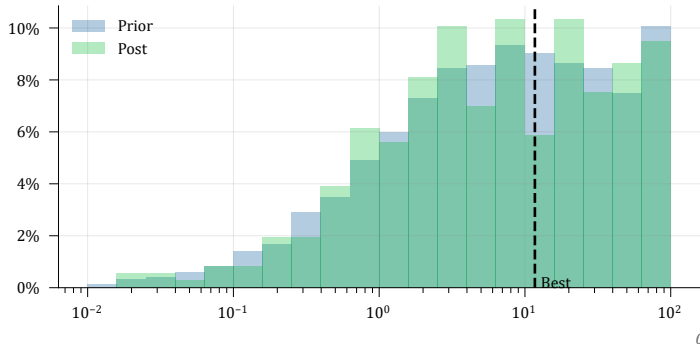
kx_p315(Pilot_Point_L1)



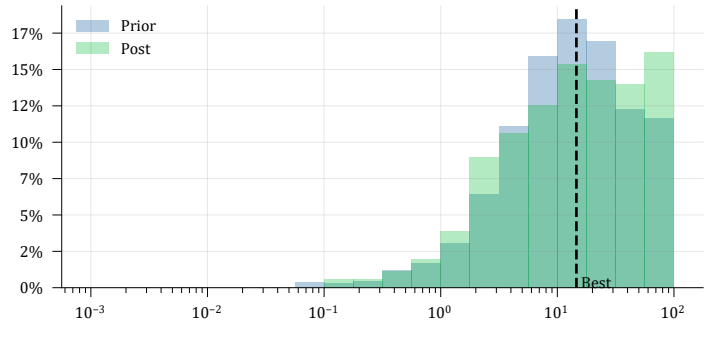
kx_p316(Pilot_Point_L1)

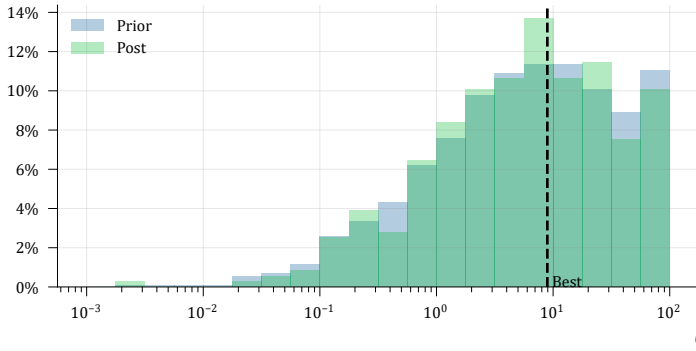
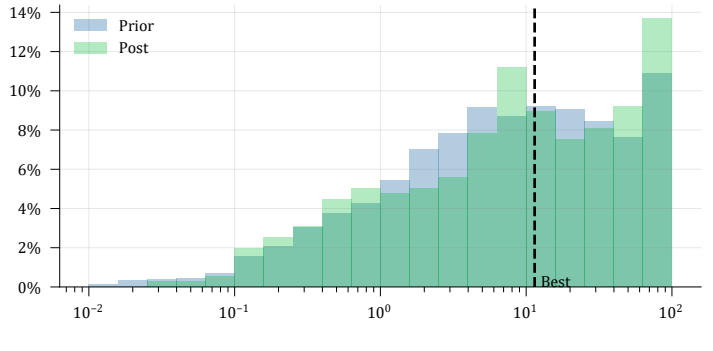
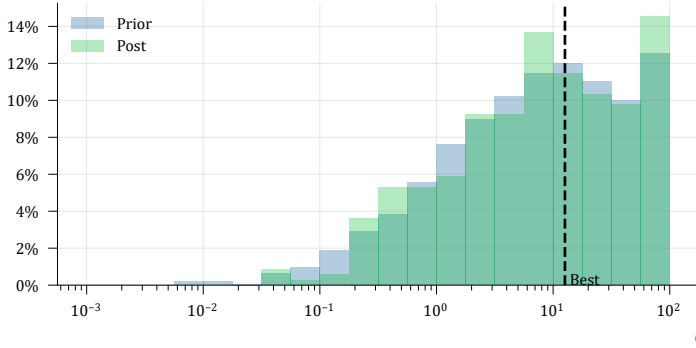
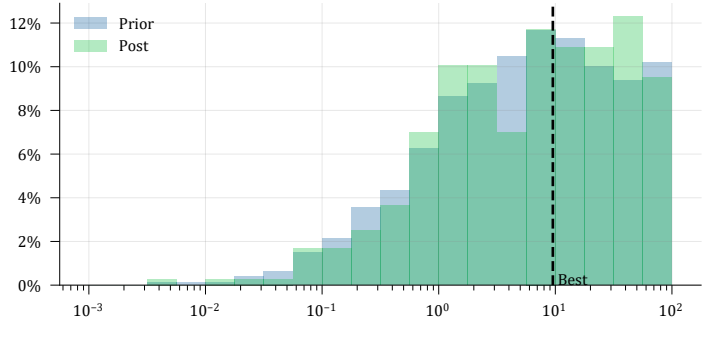
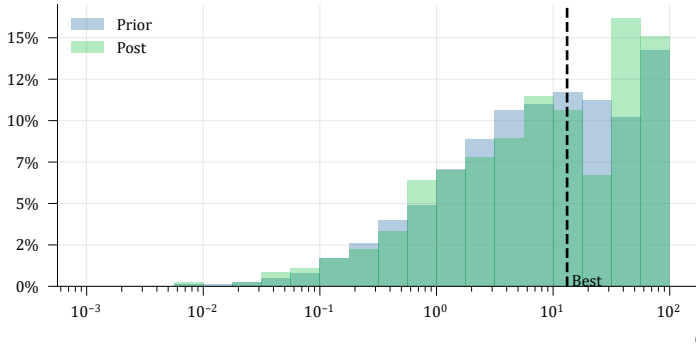
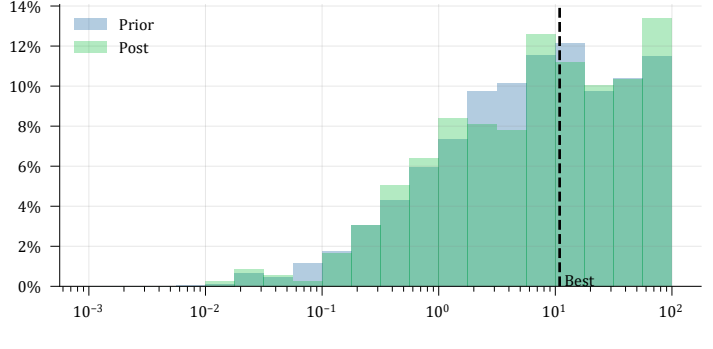
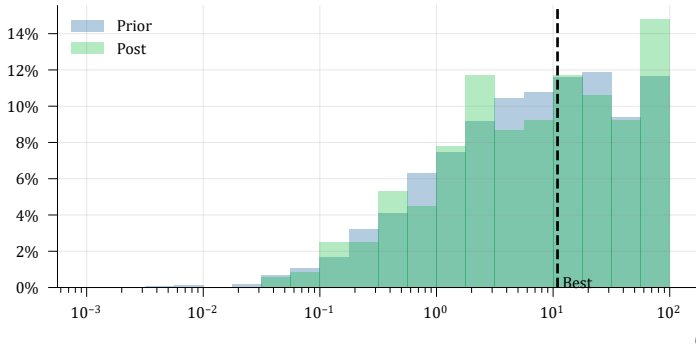
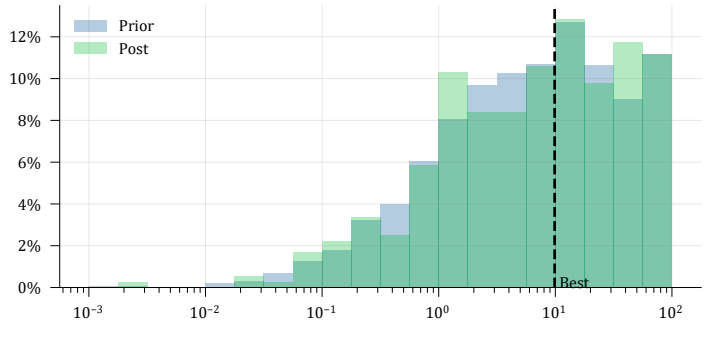
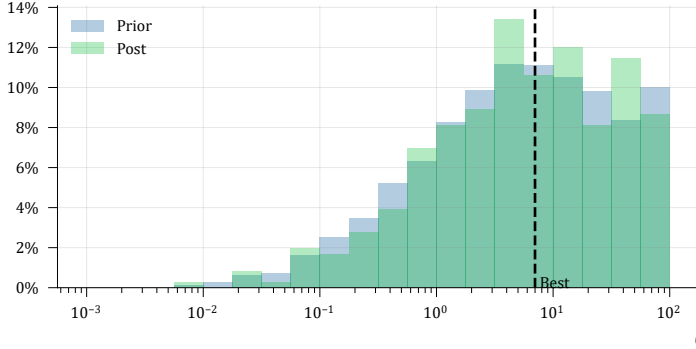
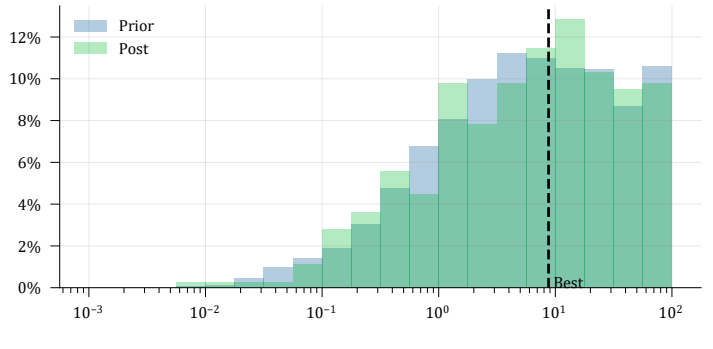


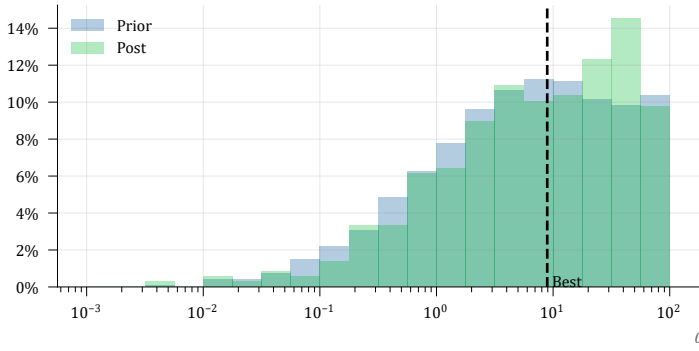
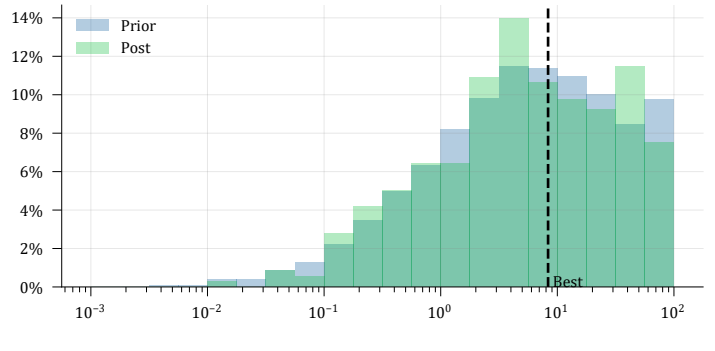
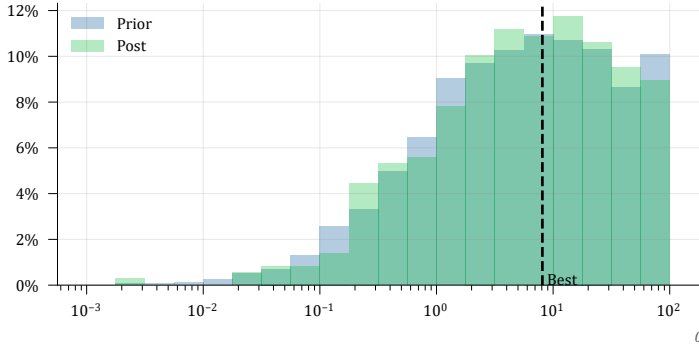
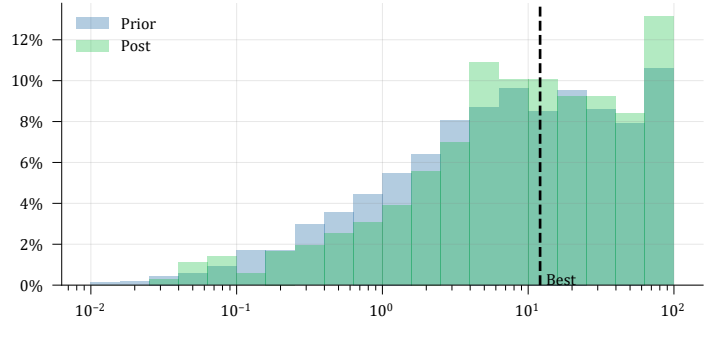
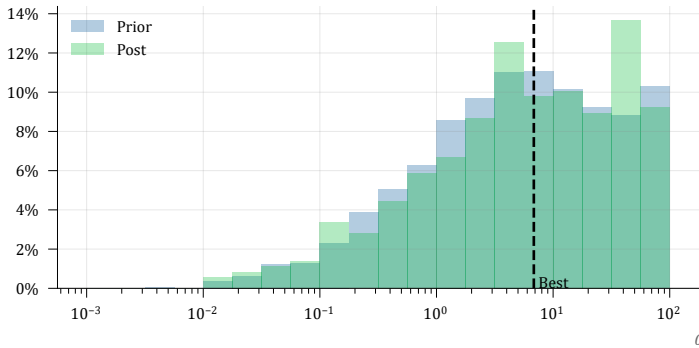
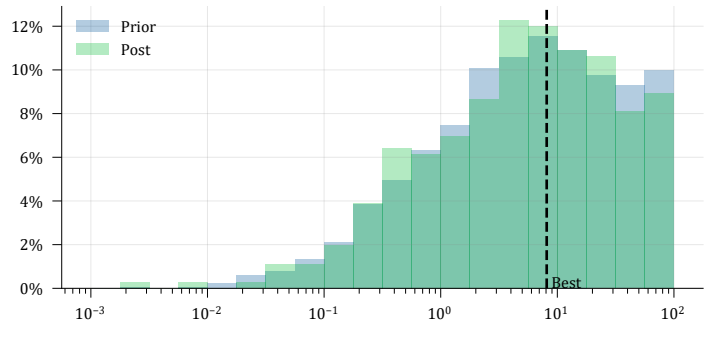
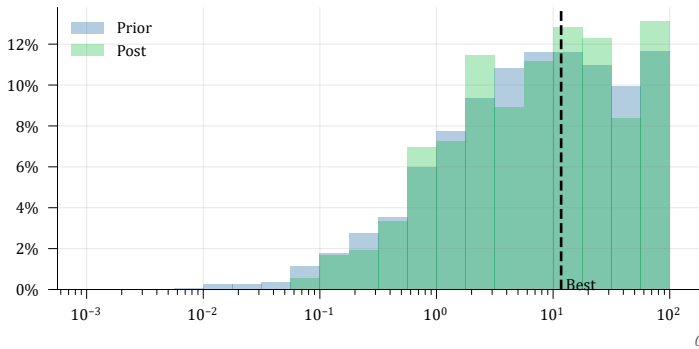
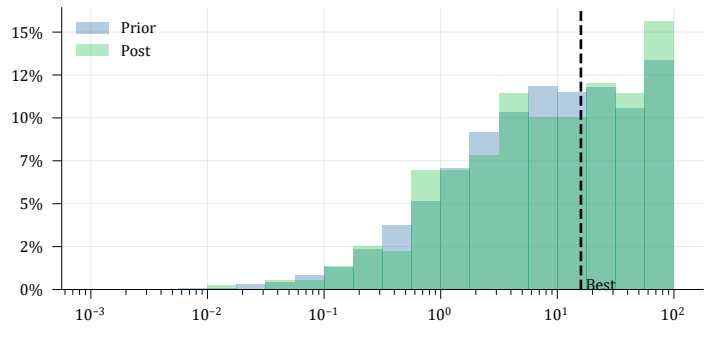
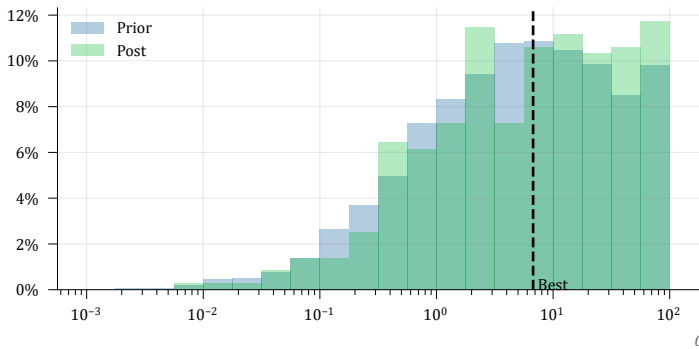
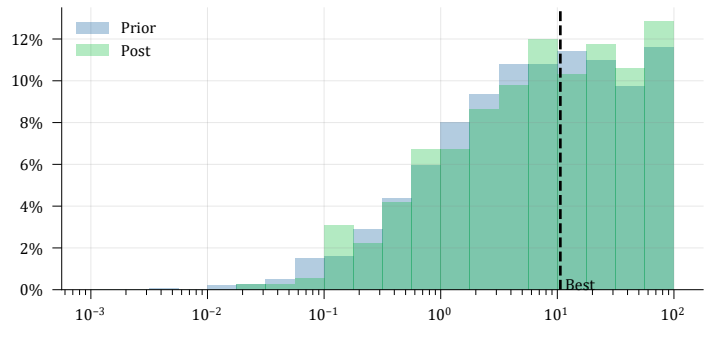
kx_p317(Pilot_Point_L1)

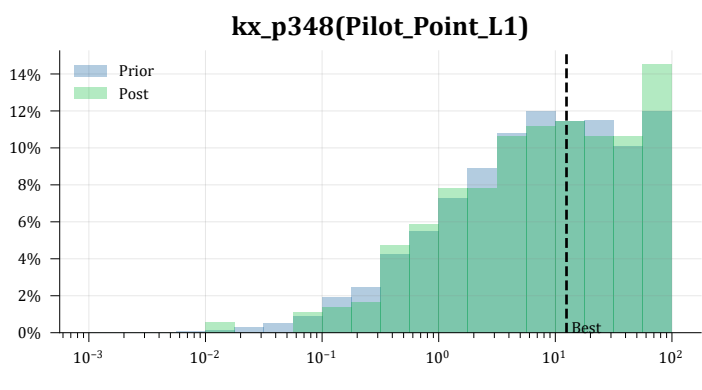
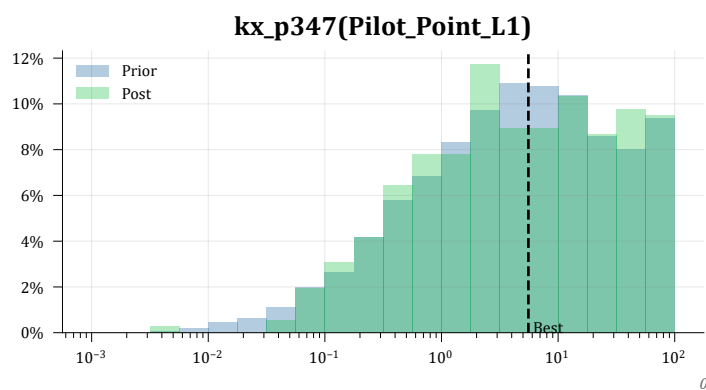
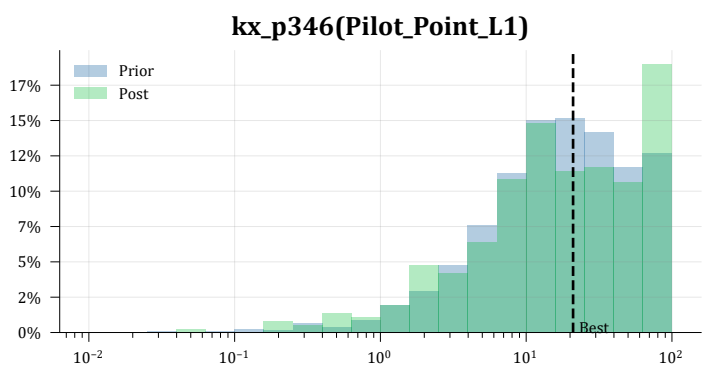
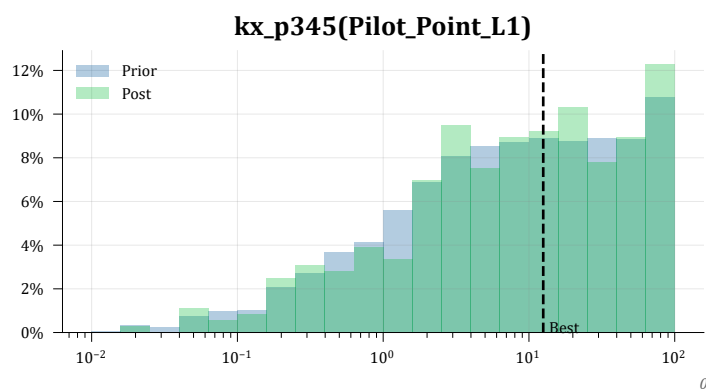
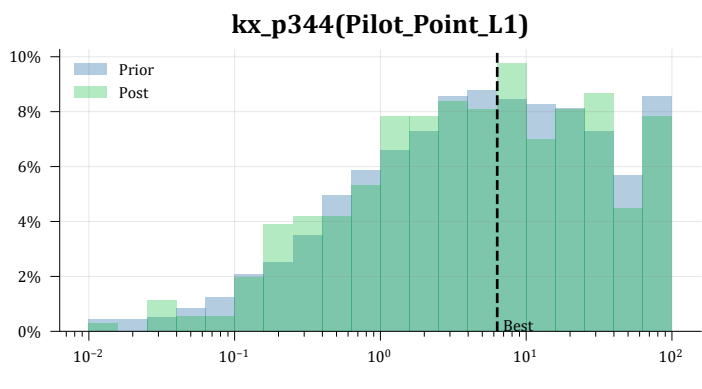
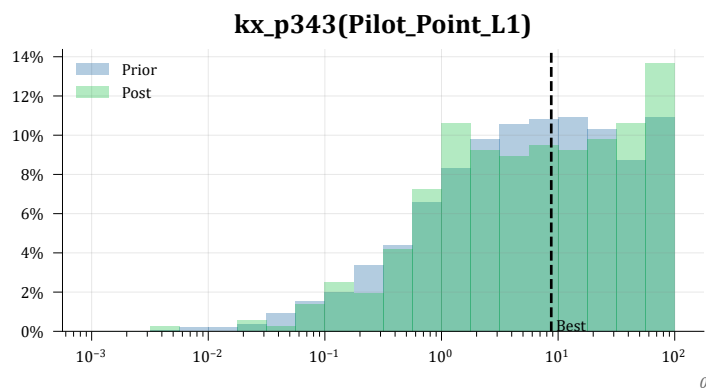
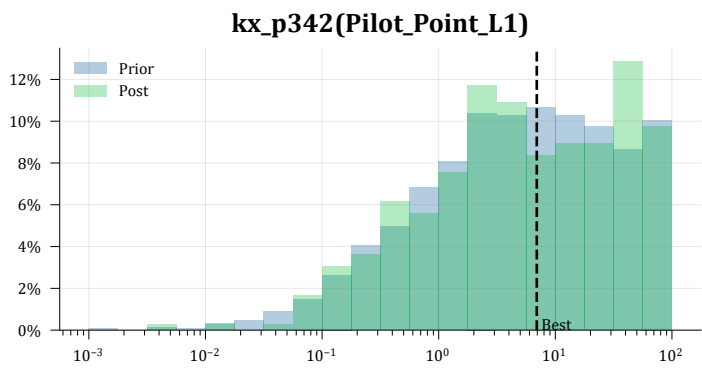
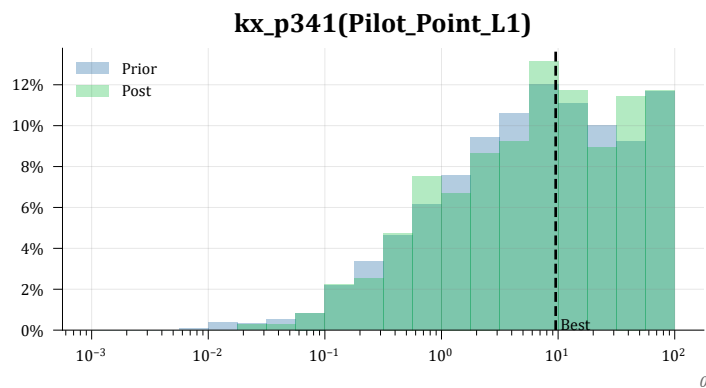
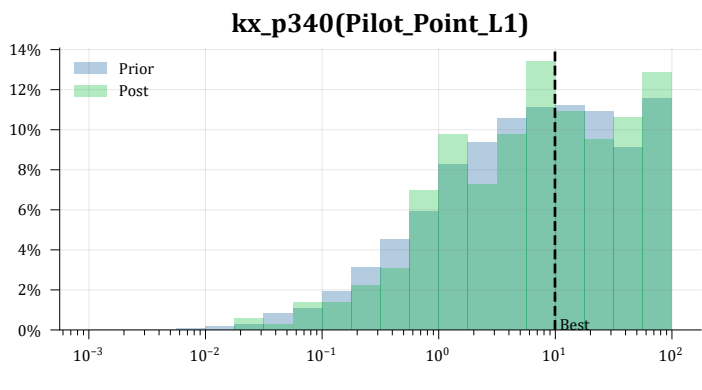
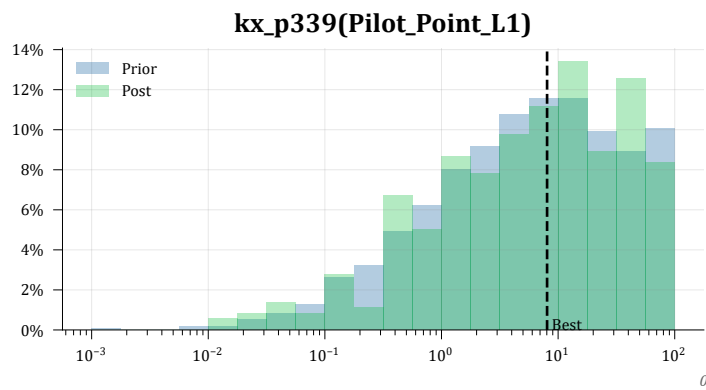


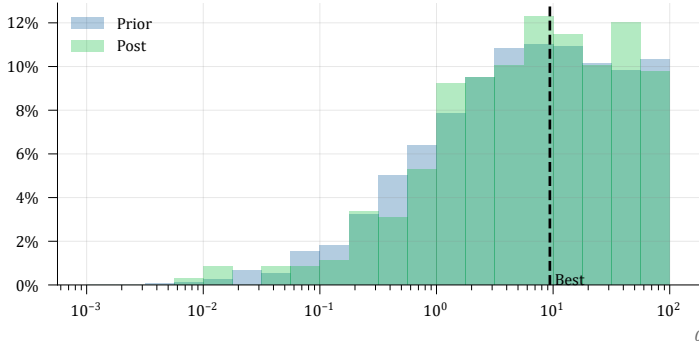
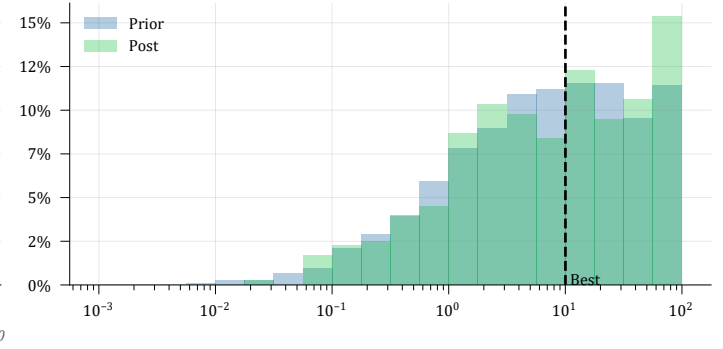
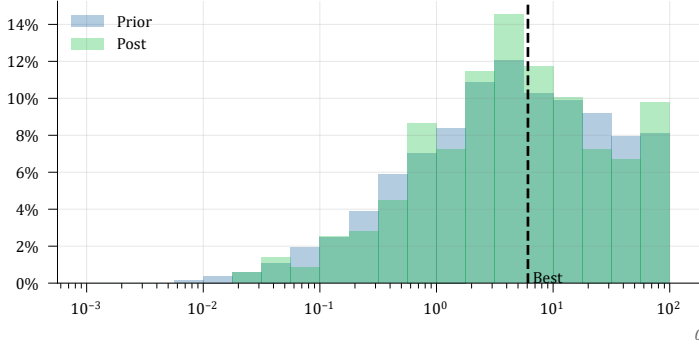
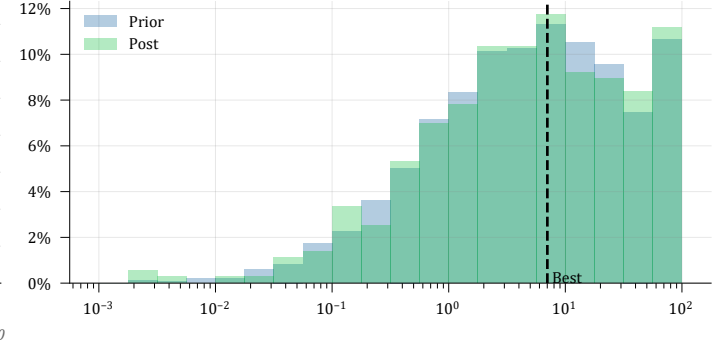
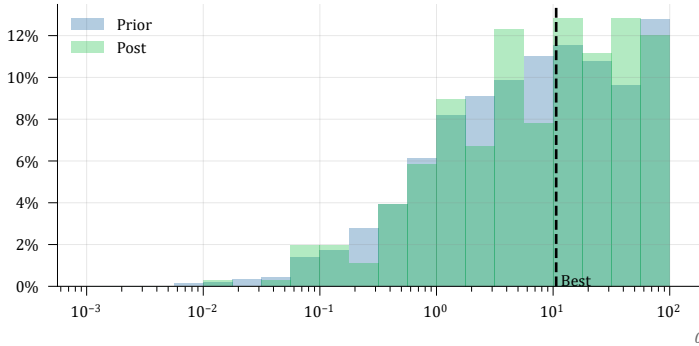
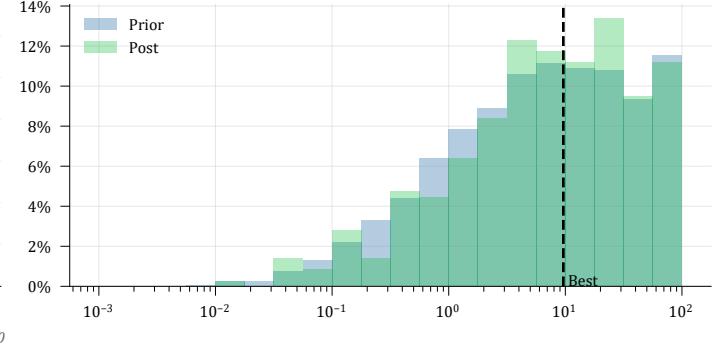
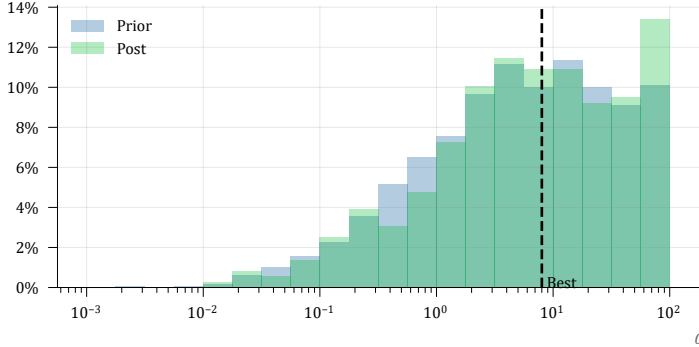
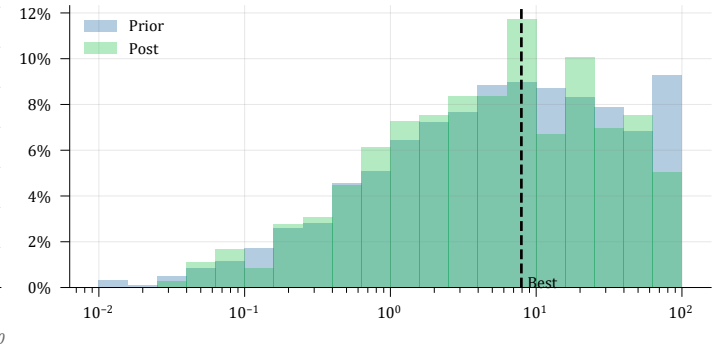
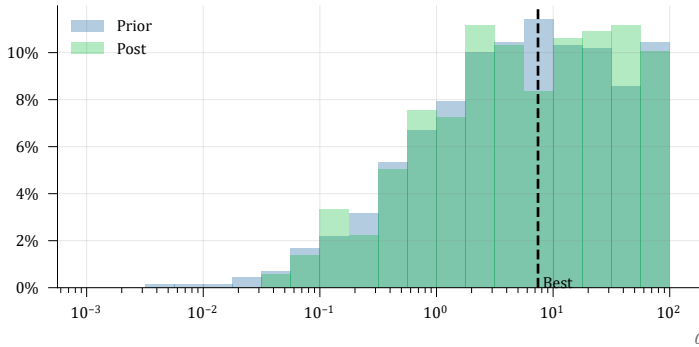
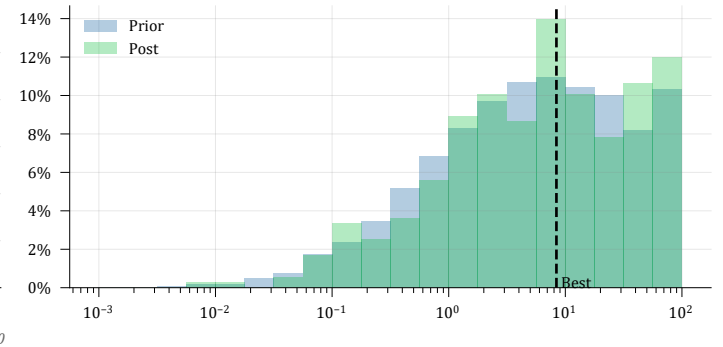
kx_p318(Pilot_Point_L1)

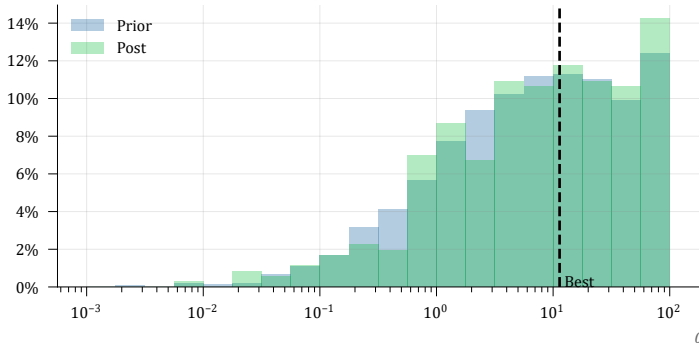
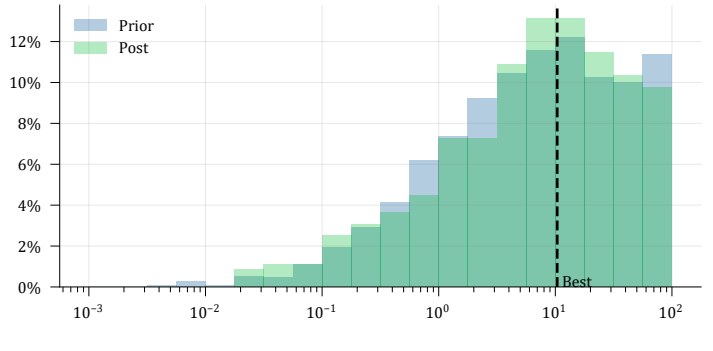
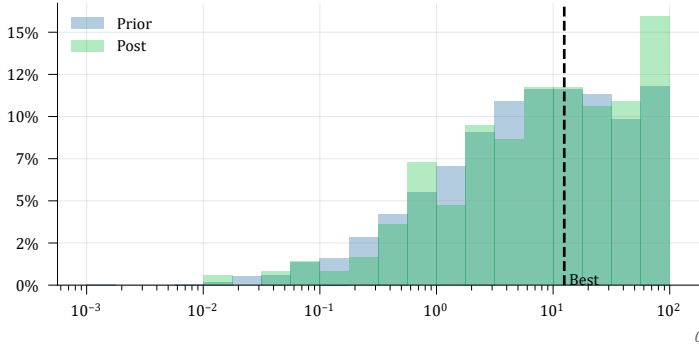
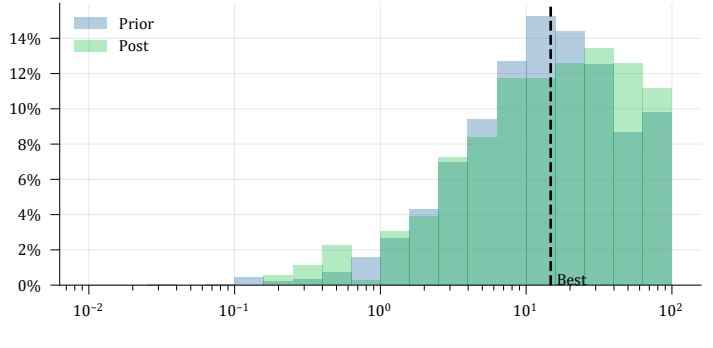
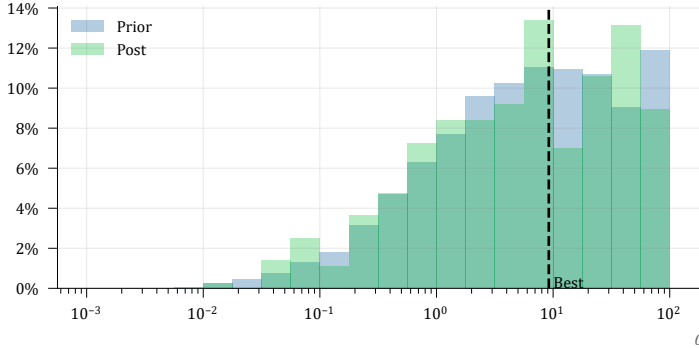
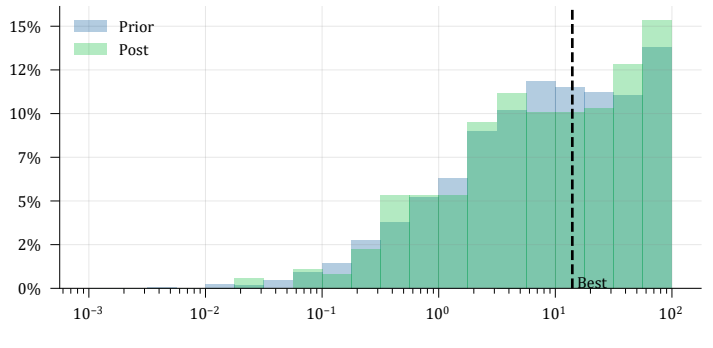
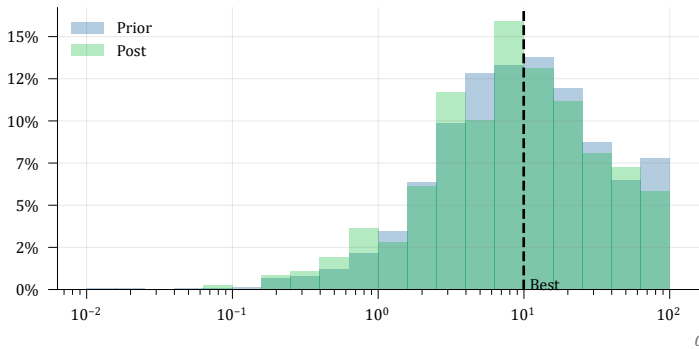
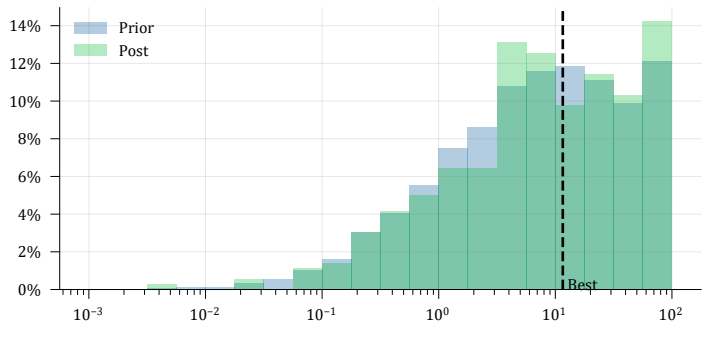
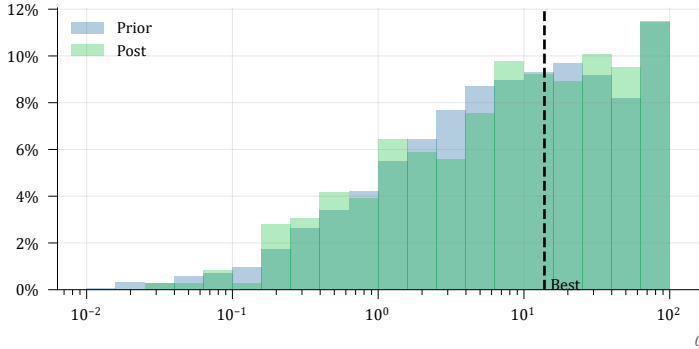
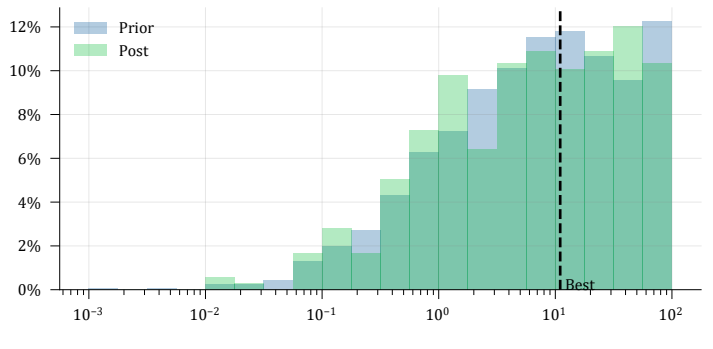


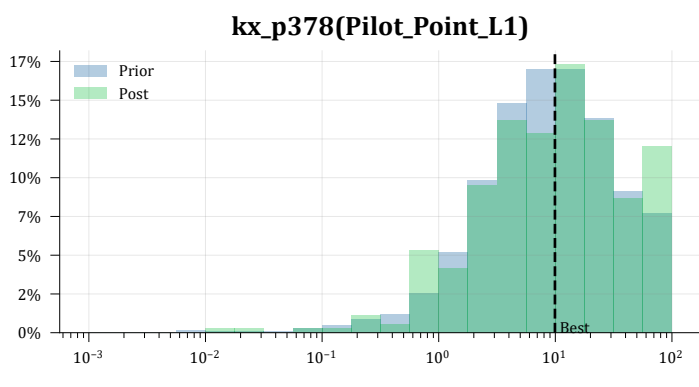
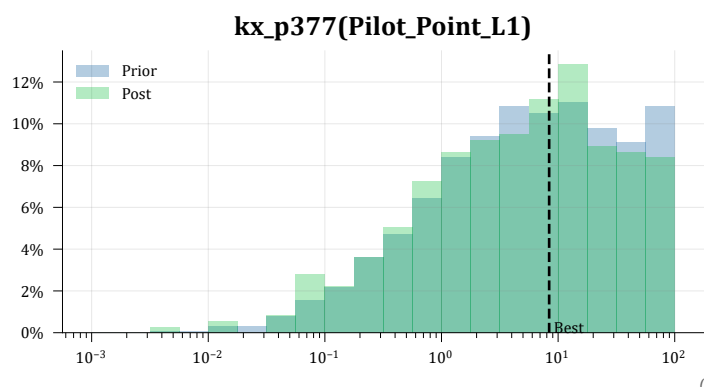
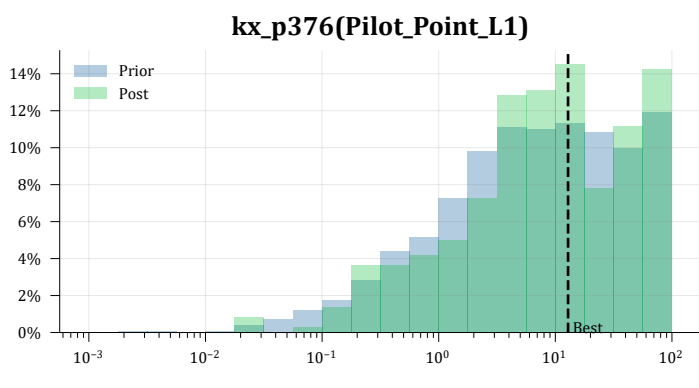
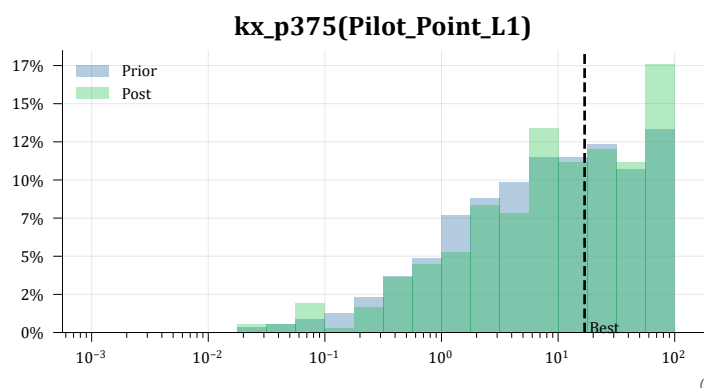
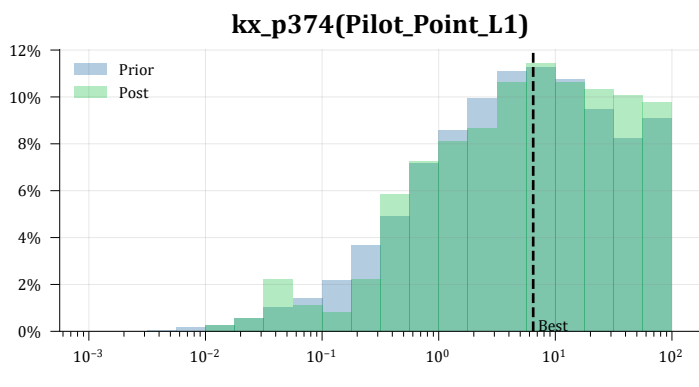
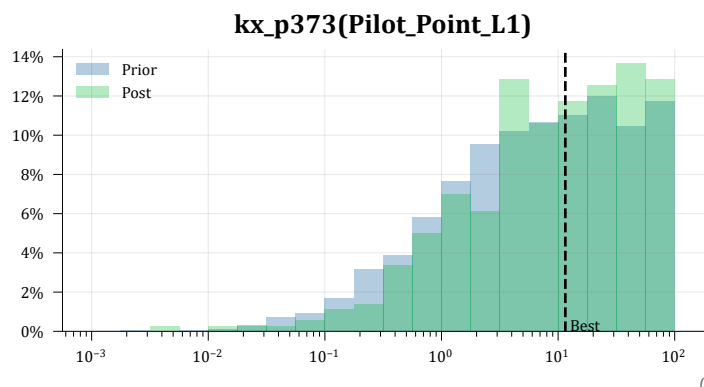
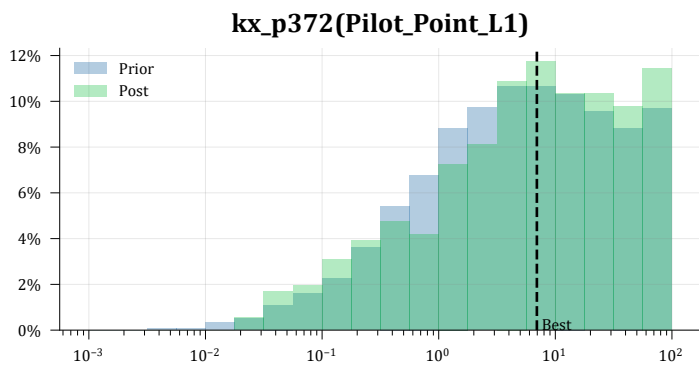
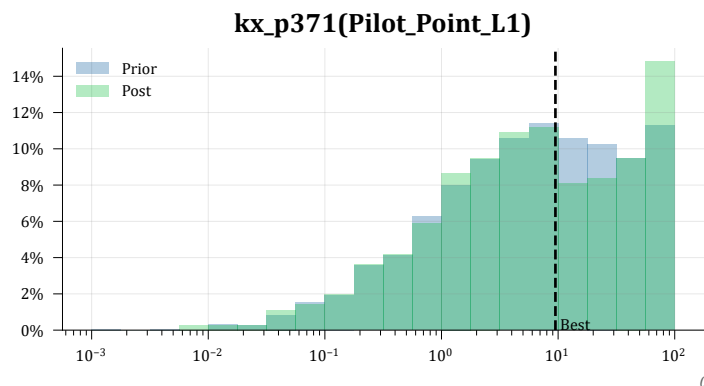
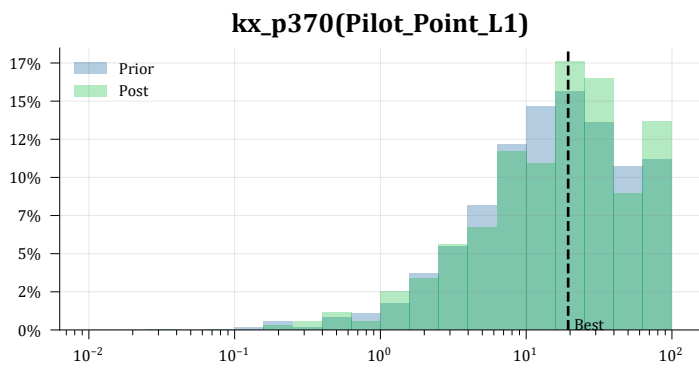
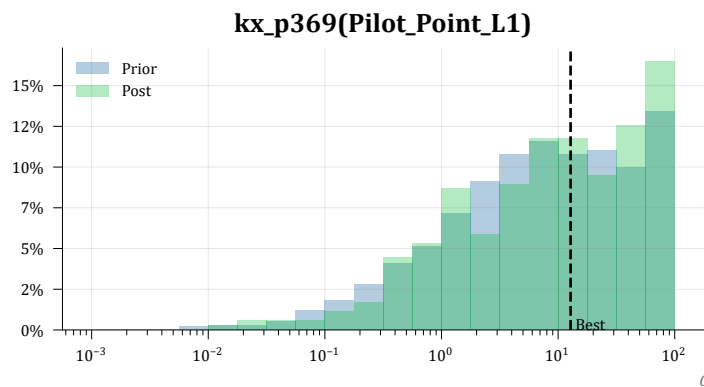
kx_p319(Pilot_Point_L1)**kx_p320(Pilot_Point_L1)****kx_p321(Pilot_Point_L1)****kx_p322(Pilot_Point_L1)****kx_p323(Pilot_Point_L1)****kx_p324(Pilot_Point_L1)****kx_p325(Pilot_Point_L1)****kx_p326(Pilot_Point_L1)****kx_p327(Pilot_Point_L1)****kx_p328(Pilot_Point_L1)**

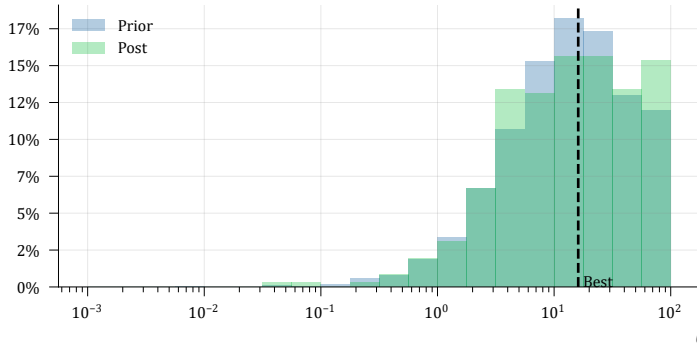
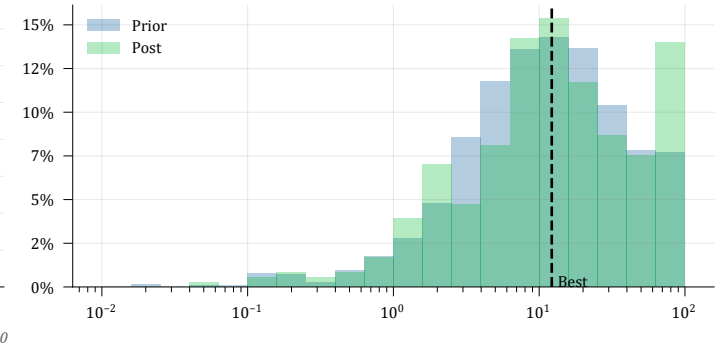
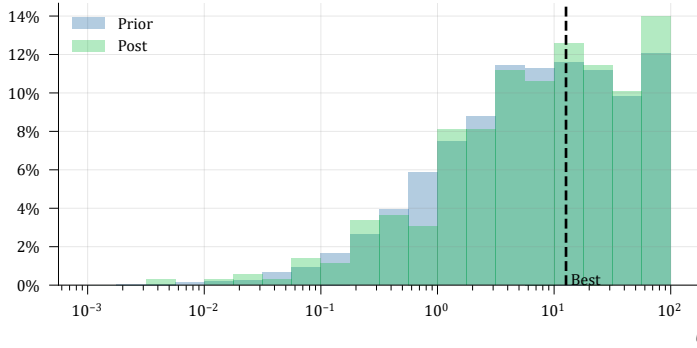
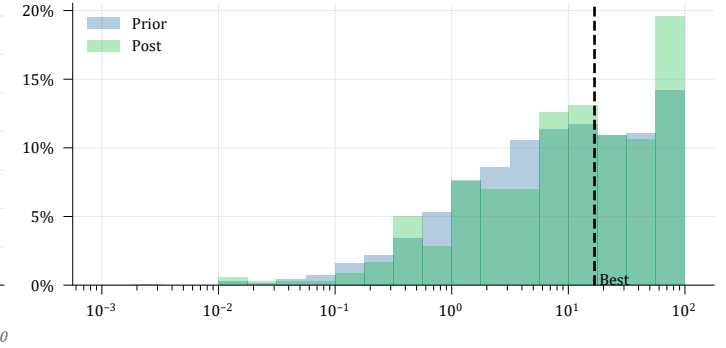
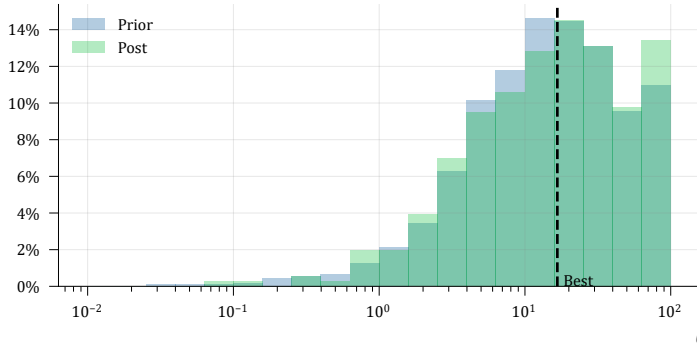
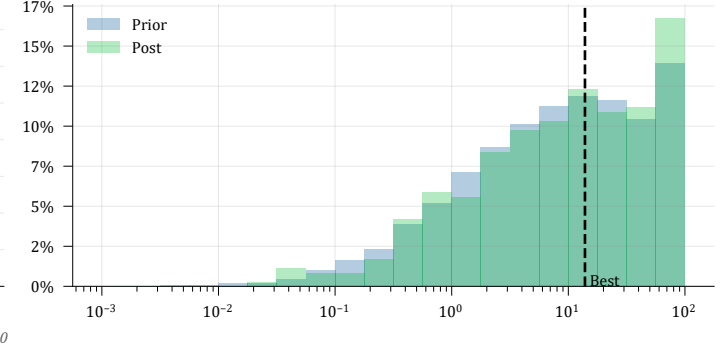
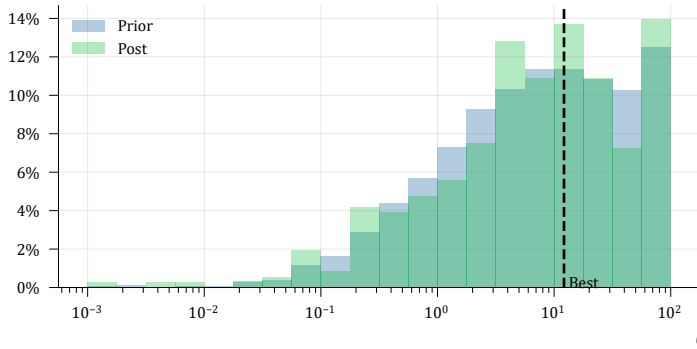
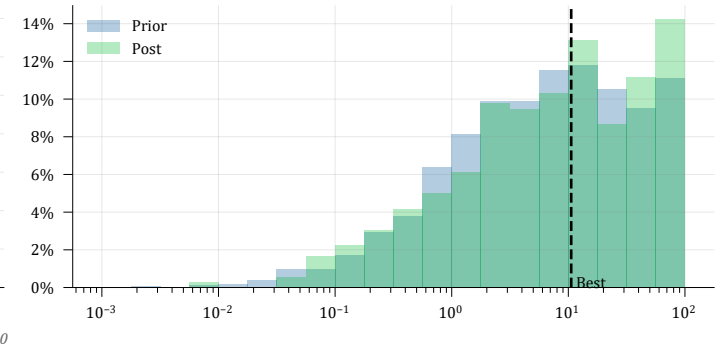
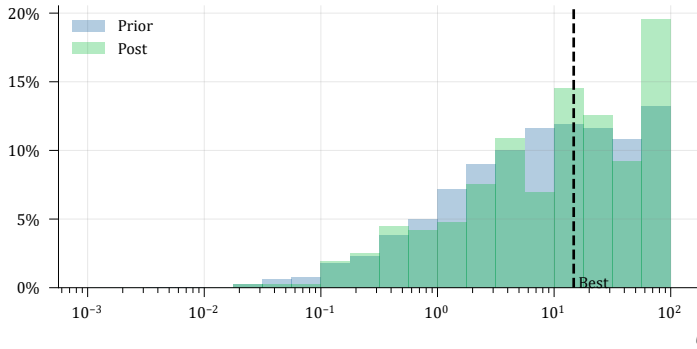
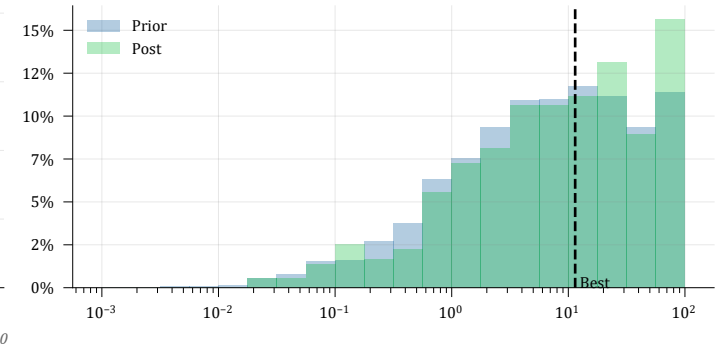
kx_p329(Pilot_Point_L1)**kx_p330(Pilot_Point_L1)****kx_p331(Pilot_Point_L1)****kx_p332(Pilot_Point_L1)****kx_p333(Pilot_Point_L1)****kx_p334(Pilot_Point_L1)****kx_p335(Pilot_Point_L1)****kx_p336(Pilot_Point_L1)****kx_p337(Pilot_Point_L1)****kx_p338(Pilot_Point_L1)**



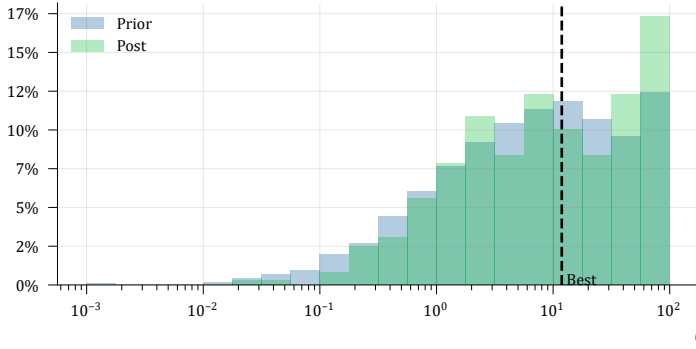
kx_p349(Pilot_Point_L1)**kx_p350(Pilot_Point_L1)****kx_p351(Pilot_Point_L1)****kx_p352(Pilot_Point_L1)****kx_p353(Pilot_Point_L1)****kx_p354(Pilot_Point_L1)****kx_p355(Pilot_Point_L1)****kx_p356(Pilot_Point_L1)****kx_p357(Pilot_Point_L1)****kx_p358(Pilot_Point_L1)**

kx_p359(Pilot_Point_L1)**kx_p360(Pilot_Point_L1)****kx_p361(Pilot_Point_L1)****kx_p362(Pilot_Point_L1)****kx_p363(Pilot_Point_L1)****kx_p364(Pilot_Point_L1)****kx_p365(Pilot_Point_L1)****kx_p366(Pilot_Point_L1)****kx_p367(Pilot_Point_L1)****kx_p368(Pilot_Point_L1)**

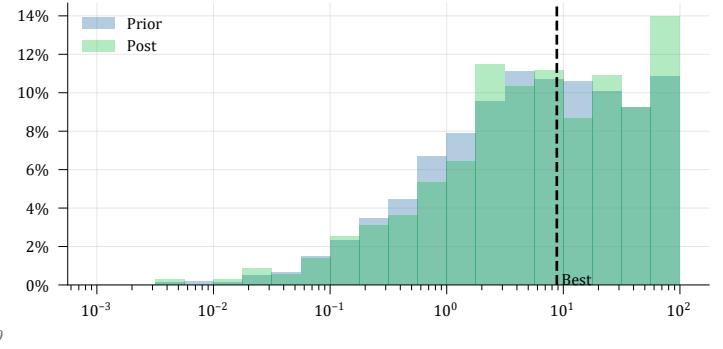


kx_p379(Pilot_Point_L1)**kx_p380(Pilot_Point_L1)****kx_p381(Pilot_Point_L1)****kx_p382(Pilot_Point_L1)****kx_p383(Pilot_Point_L1)****kx_p384(Pilot_Point_L1)****kx_p385(Pilot_Point_L1)****kx_p386(Pilot_Point_L1)****kx_p387(Pilot_Point_L1)****kx_p388(Pilot_Point_L1)**

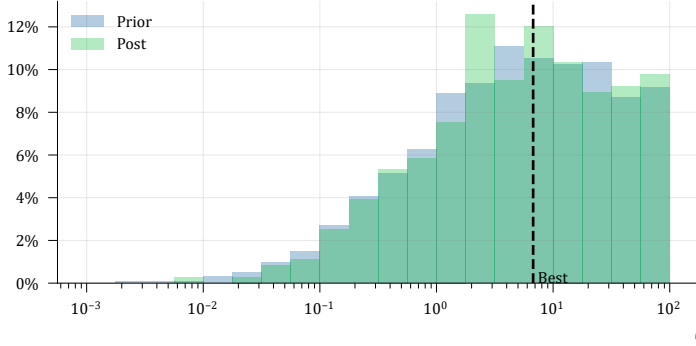
kx_p389(Pilot_Point_L1)



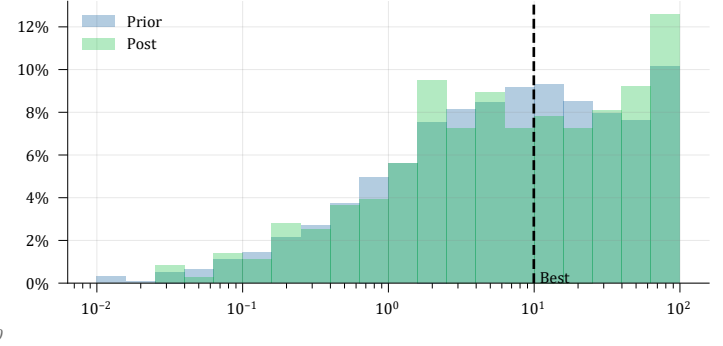
kx_p390(Pilot_Point_L1)



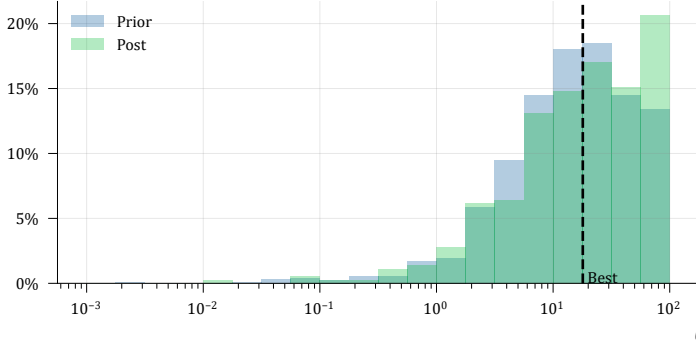
kx_p391(Pilot_Point_L1)



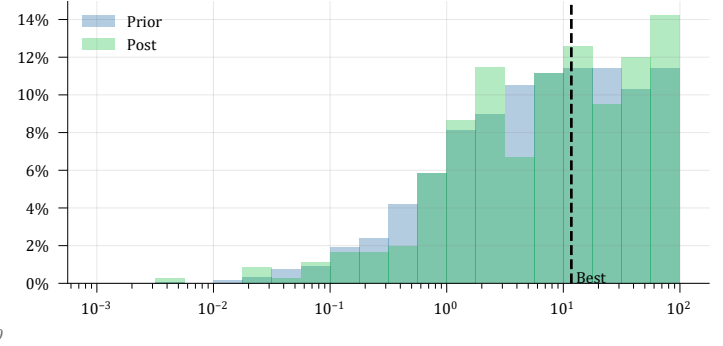
kx_p392(Pilot_Point_L1)



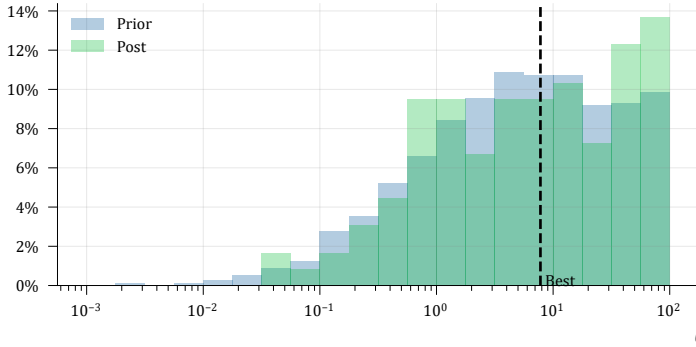
kx_p393(Pilot_Point_L1)



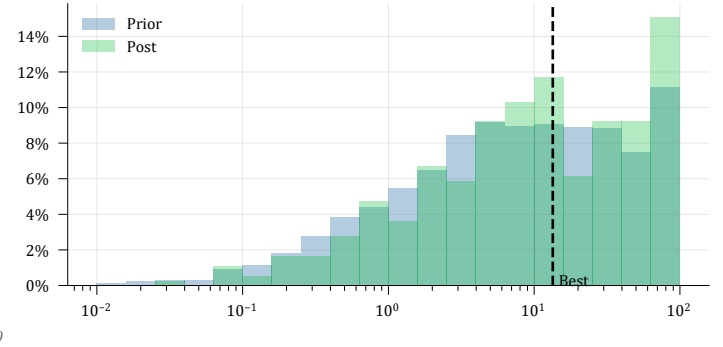
kx_p394(Pilot_Point_L1)



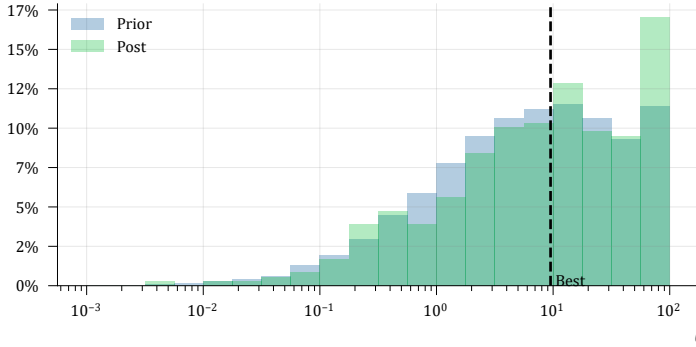
kx_p395(Pilot_Point_L1)



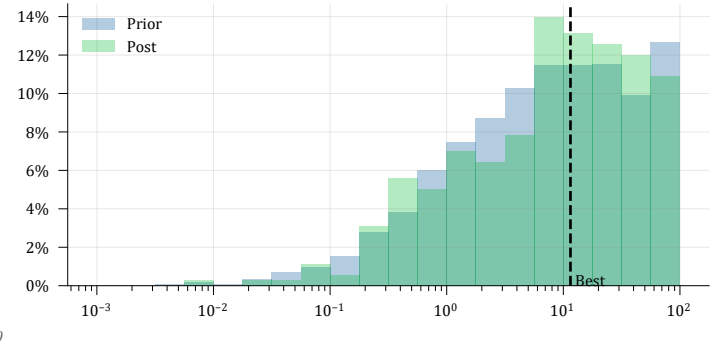
kx_p396(Pilot_Point_L1)

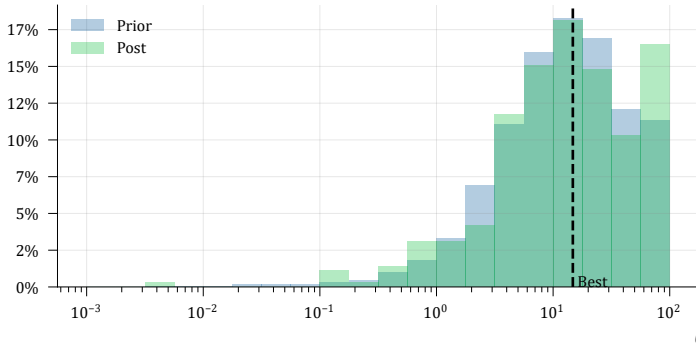
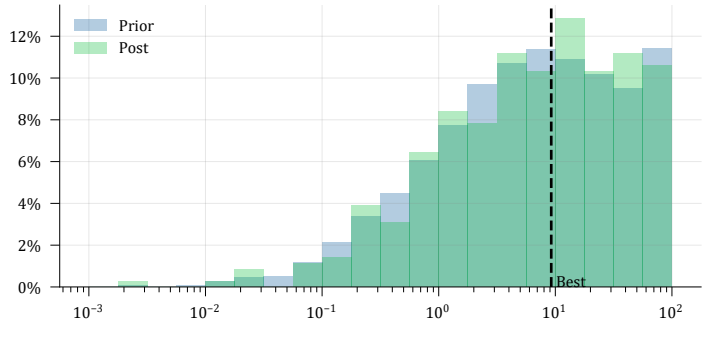
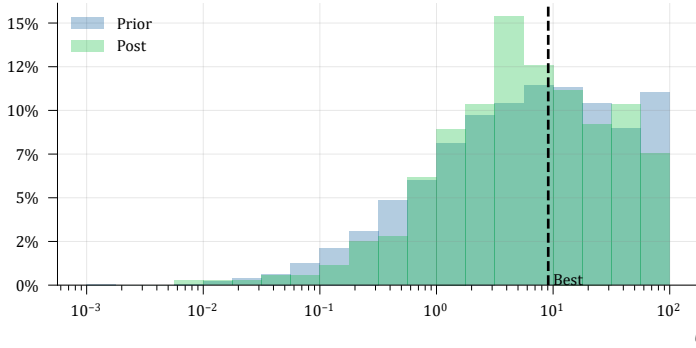
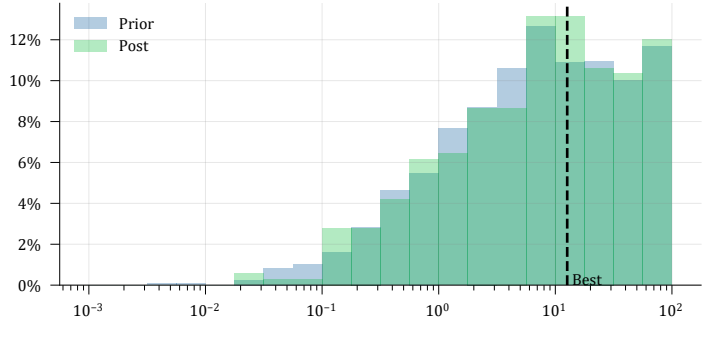
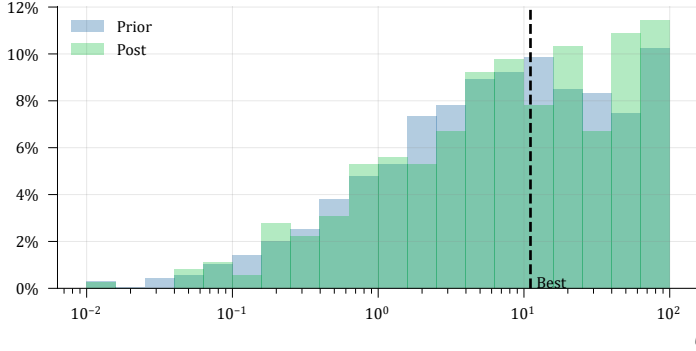
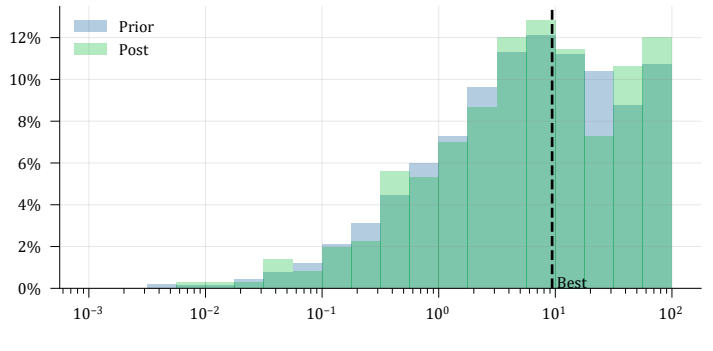
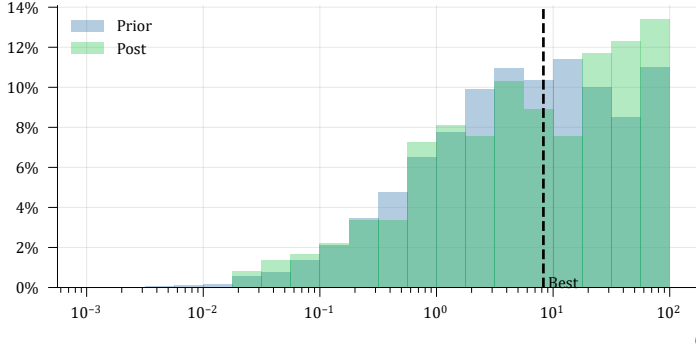
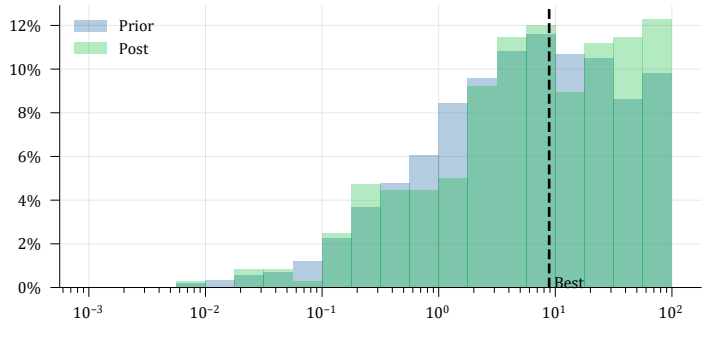
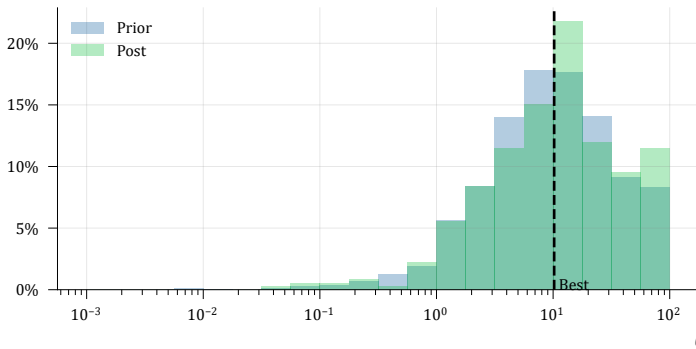
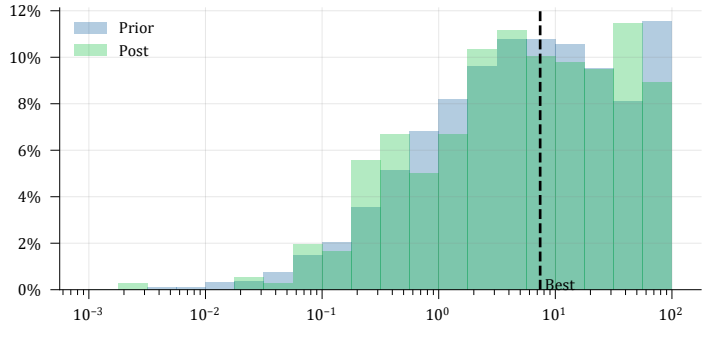


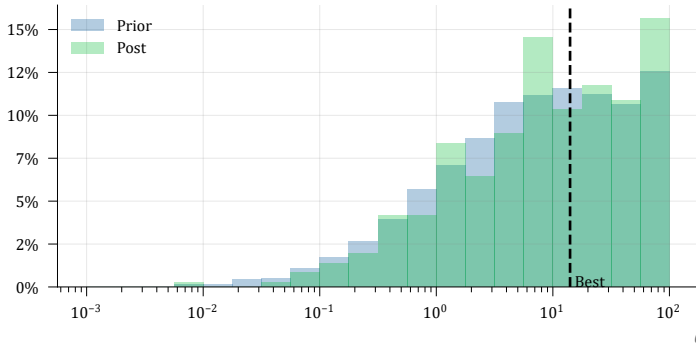
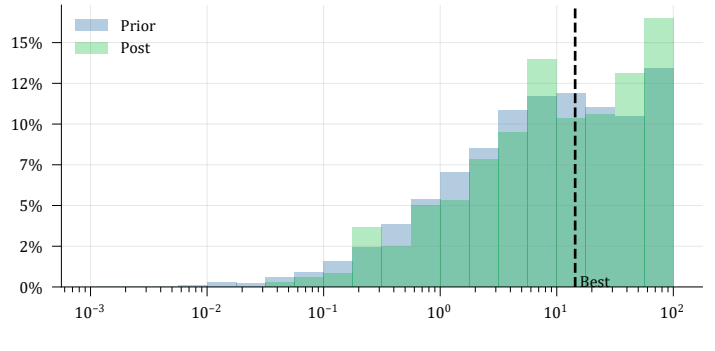
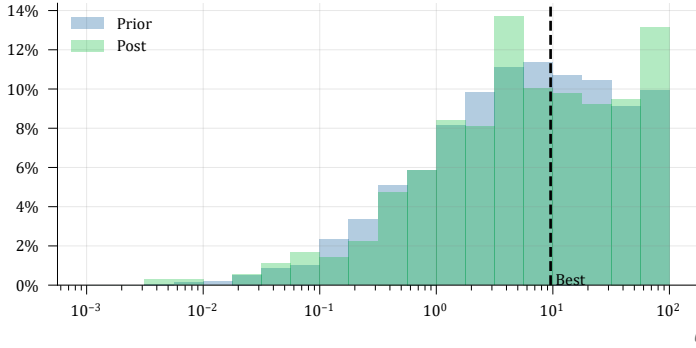
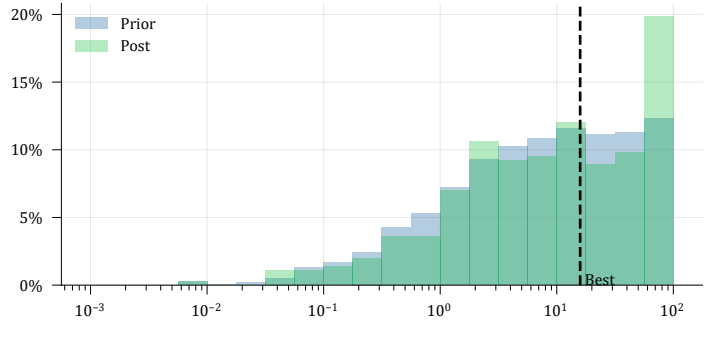
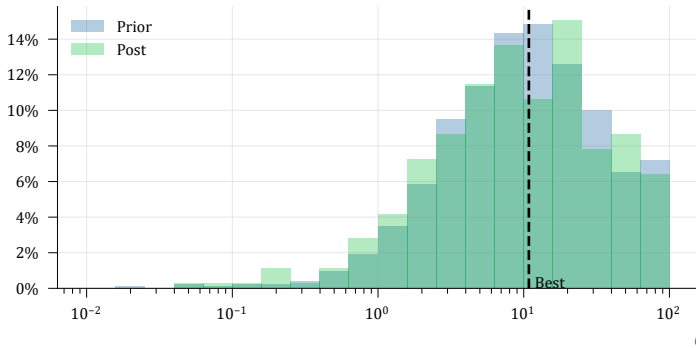
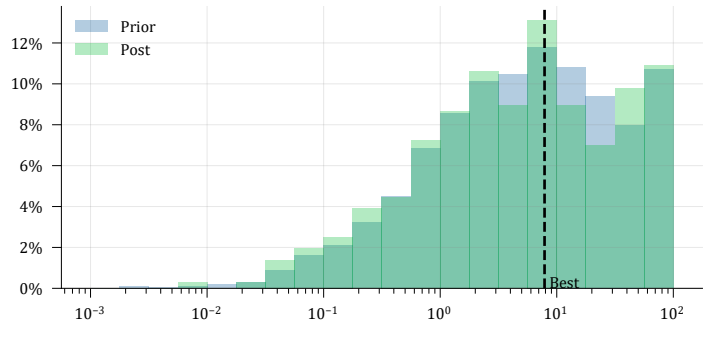
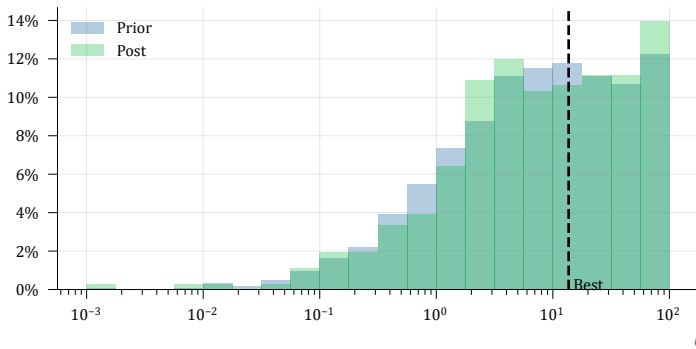
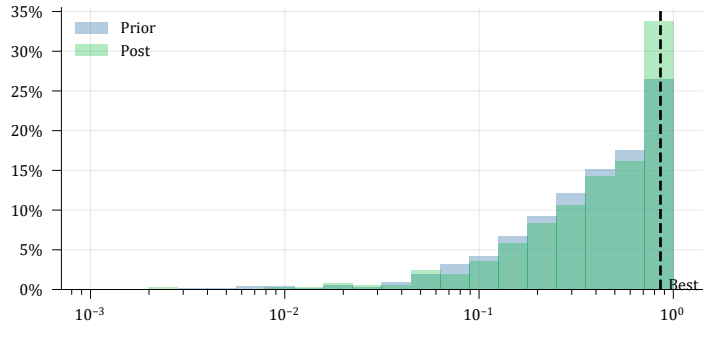
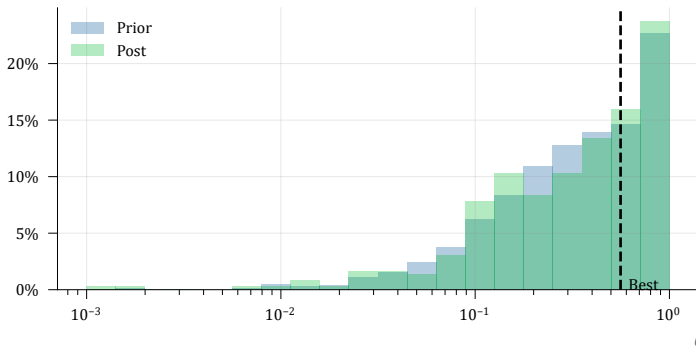
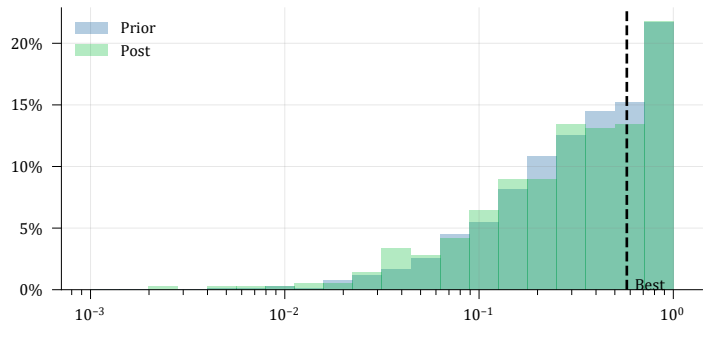
kx_p397(Pilot_Point_L1)

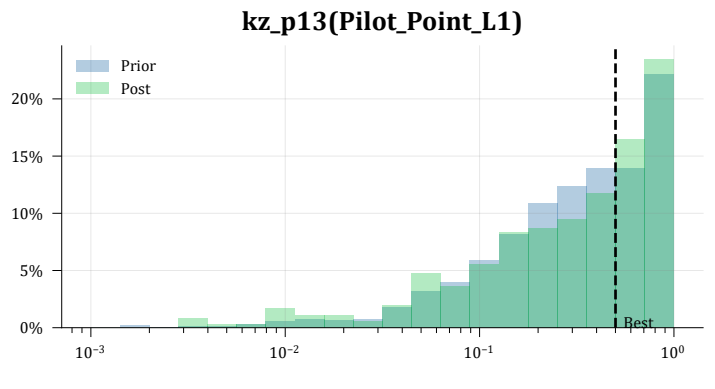
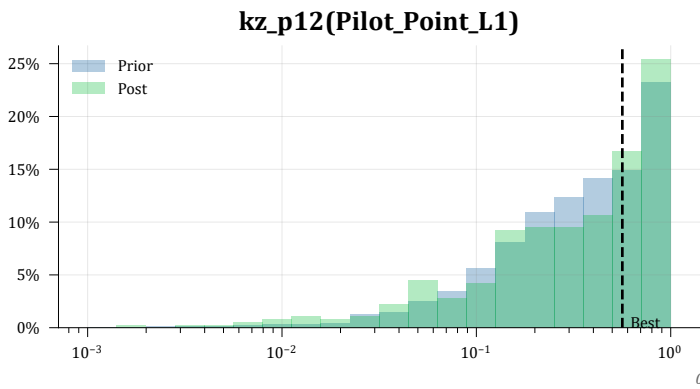
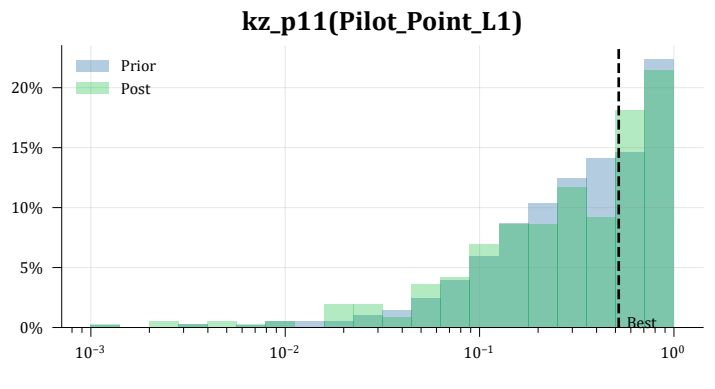
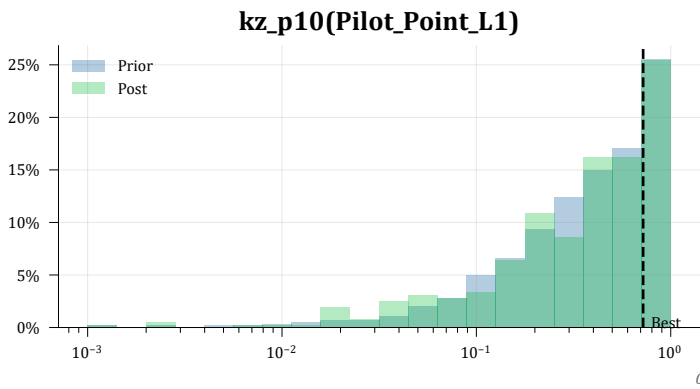
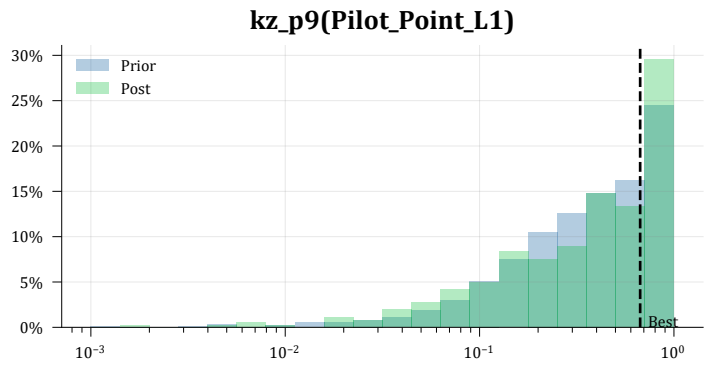
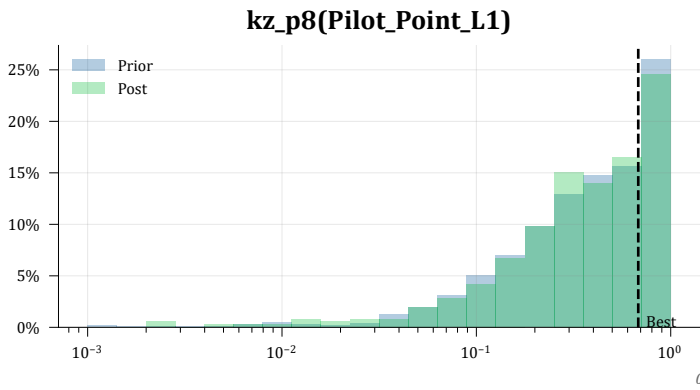
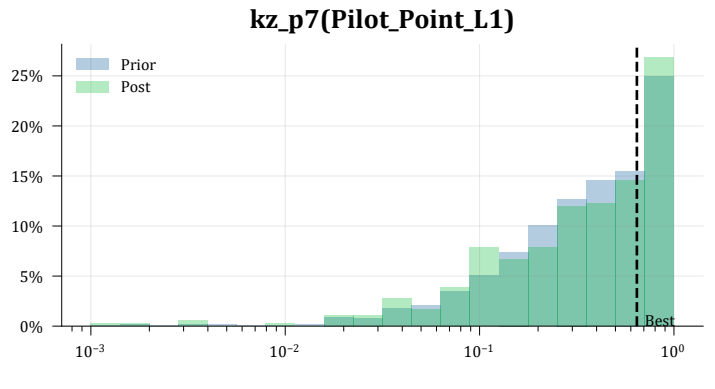
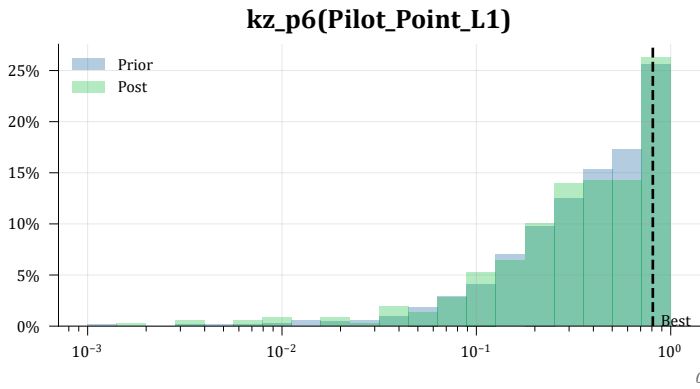
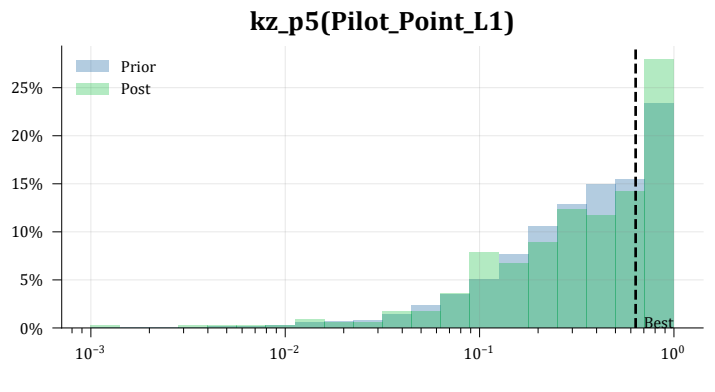
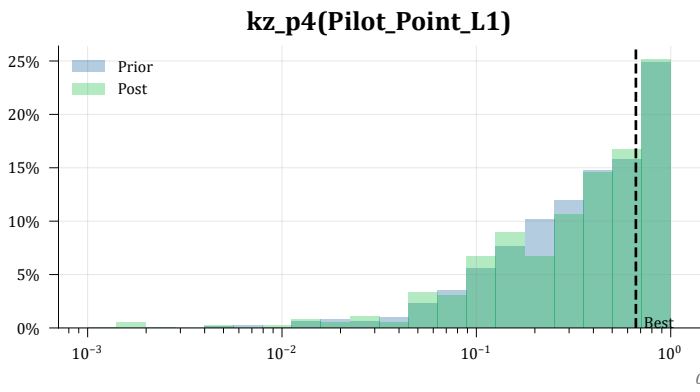


kx_p398(Pilot_Point_L1)

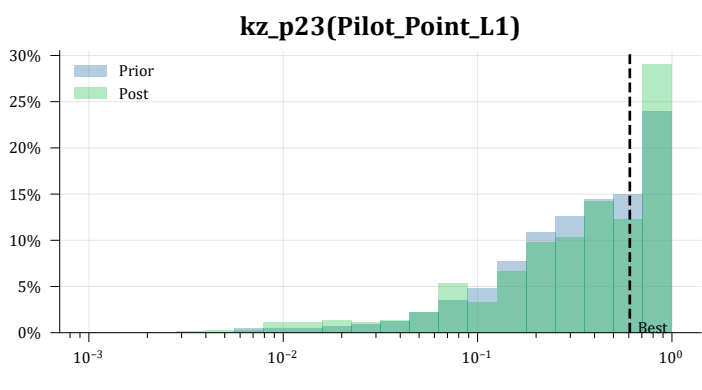
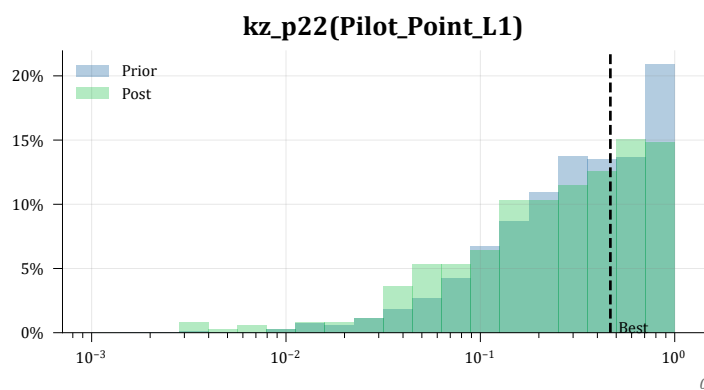
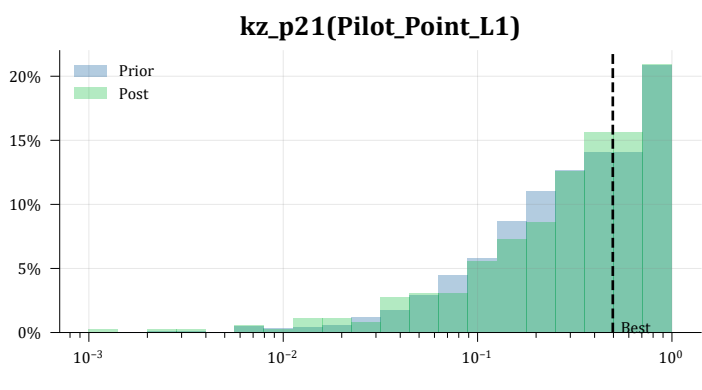
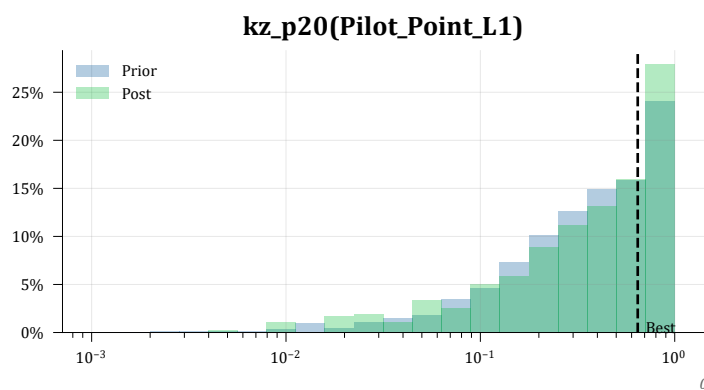
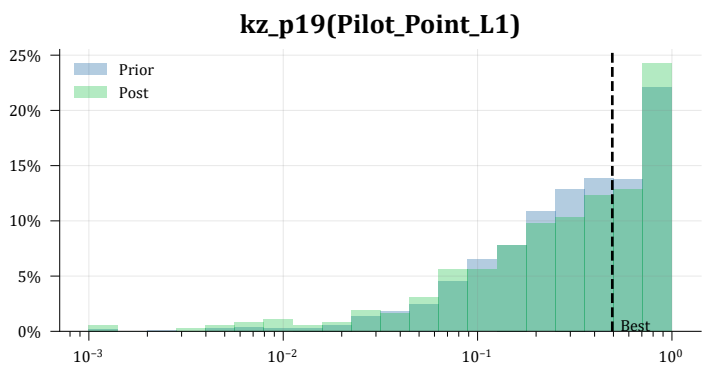
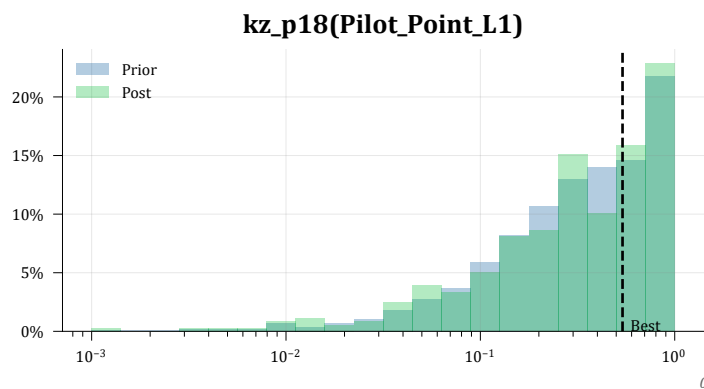
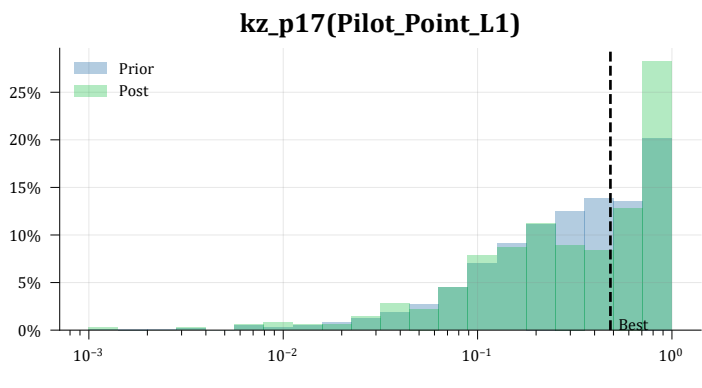
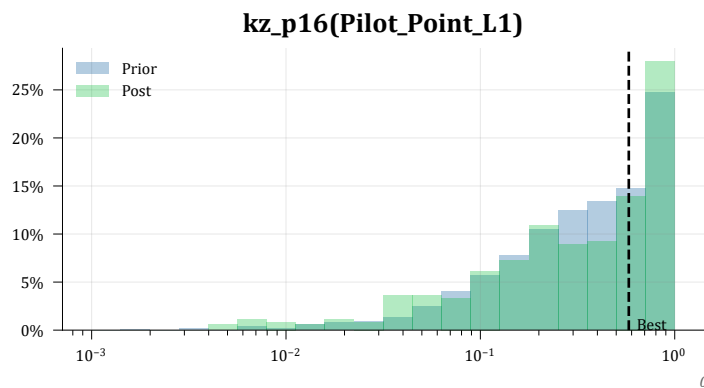
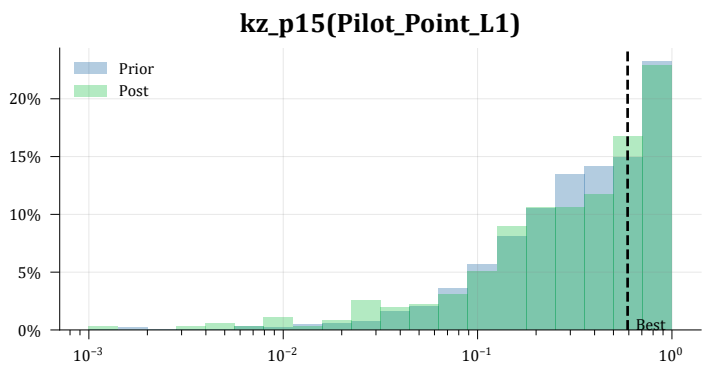
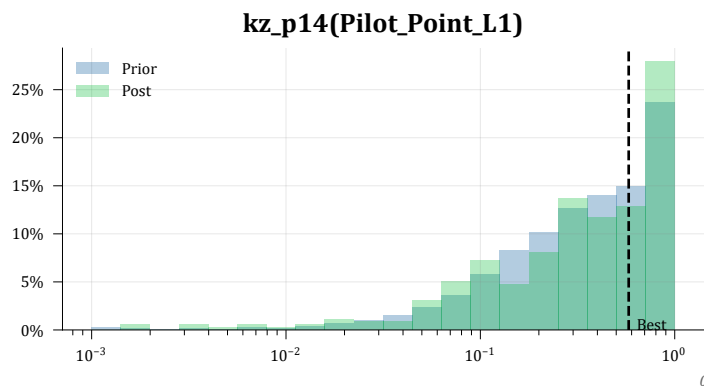


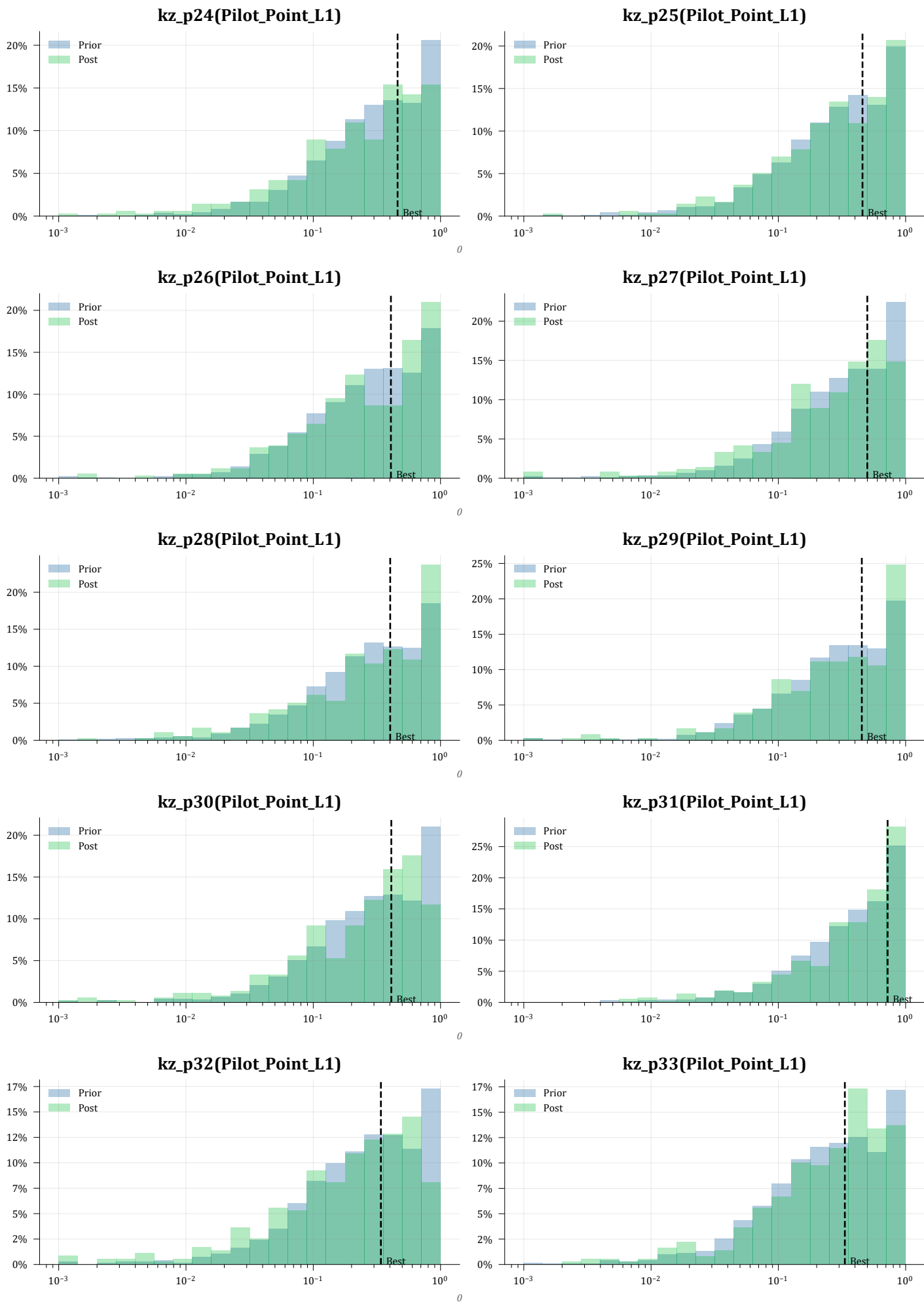
kx_p399(Pilot_Point_L1)**kx_p400(Pilot_Point_L1)****kx_p401(Pilot_Point_L1)****kx_p402(Pilot_Point_L1)****kx_p403(Pilot_Point_L1)****kx_p404(Pilot_Point_L1)****kx_p405(Pilot_Point_L1)****kx_p406(Pilot_Point_L1)****kx_p407(Pilot_Point_L1)****kx_p408(Pilot_Point_L1)**

kx_p409(Pilot_Point_L1)**kx_p410(Pilot_Point_L1)****kx_p411(Pilot_Point_L1)****kx_p412(Pilot_Point_L1)****kx_p413(Pilot_Point_L1)****kx_p414(Pilot_Point_L1)****kx_p415(Pilot_Point_L1)****kz_p1(Pilot_Point_L1)****kz_p2(Pilot_Point_L1)****kz_p3(Pilot_Point_L1)***Parameters*

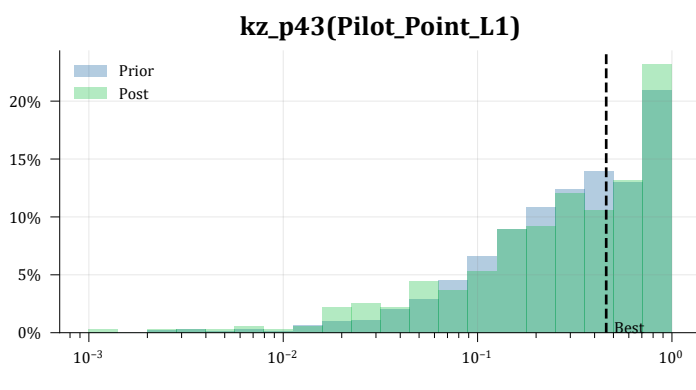
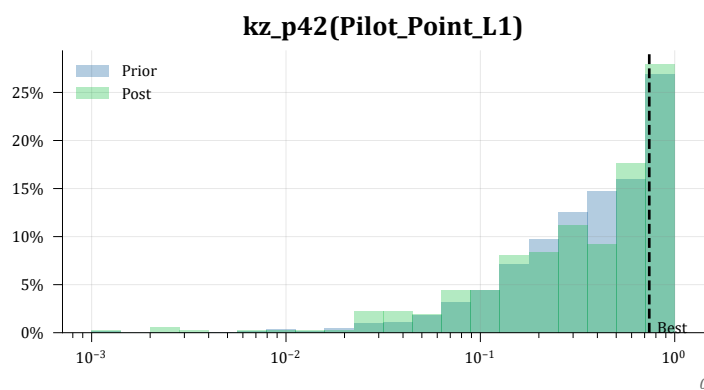
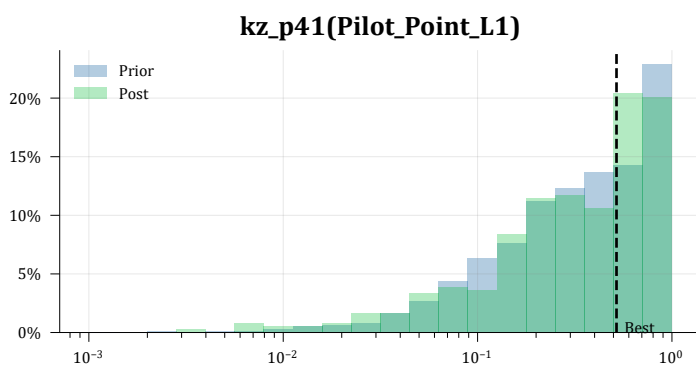
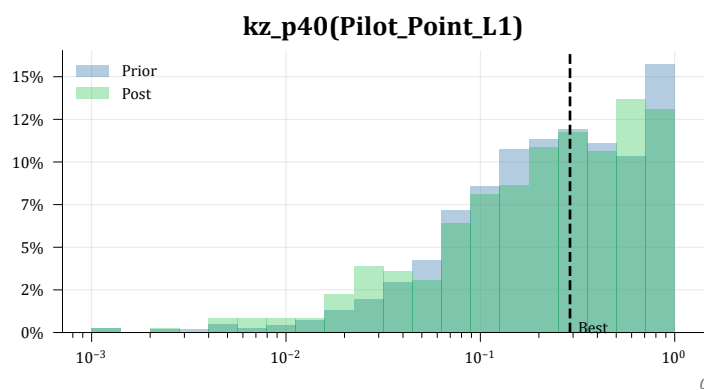
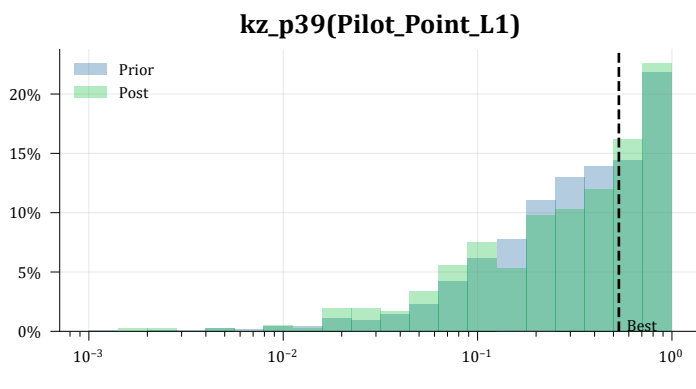
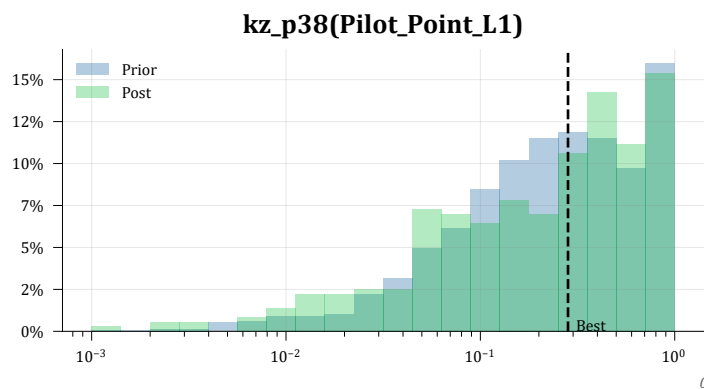
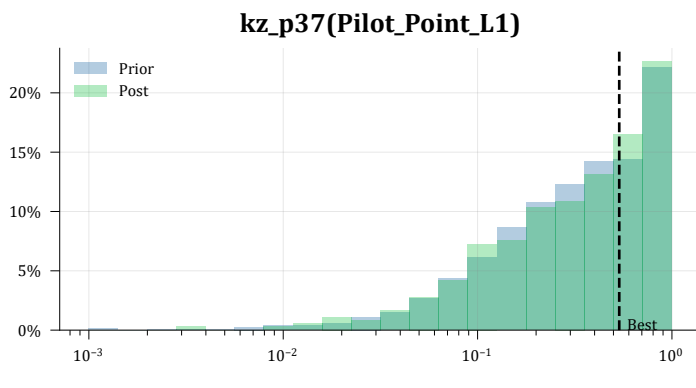
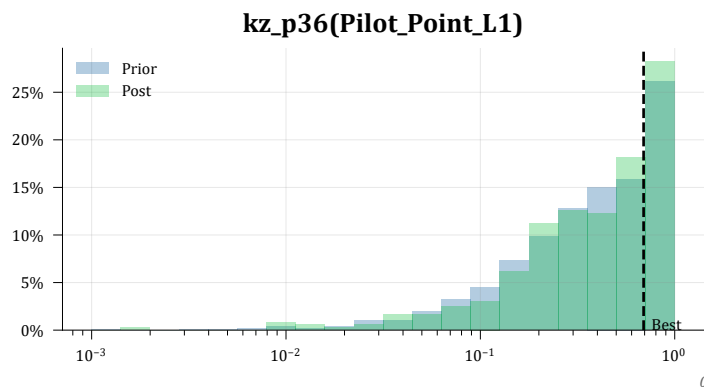
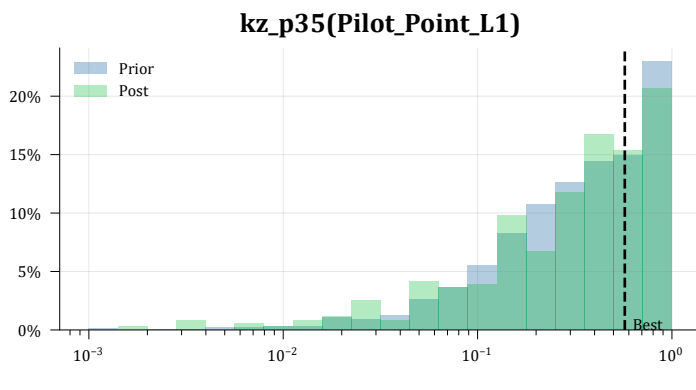
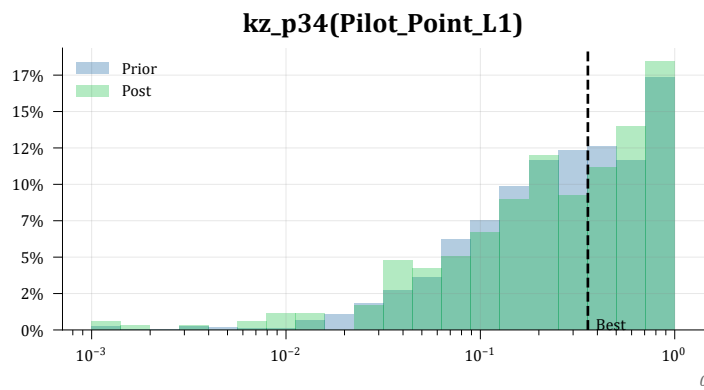


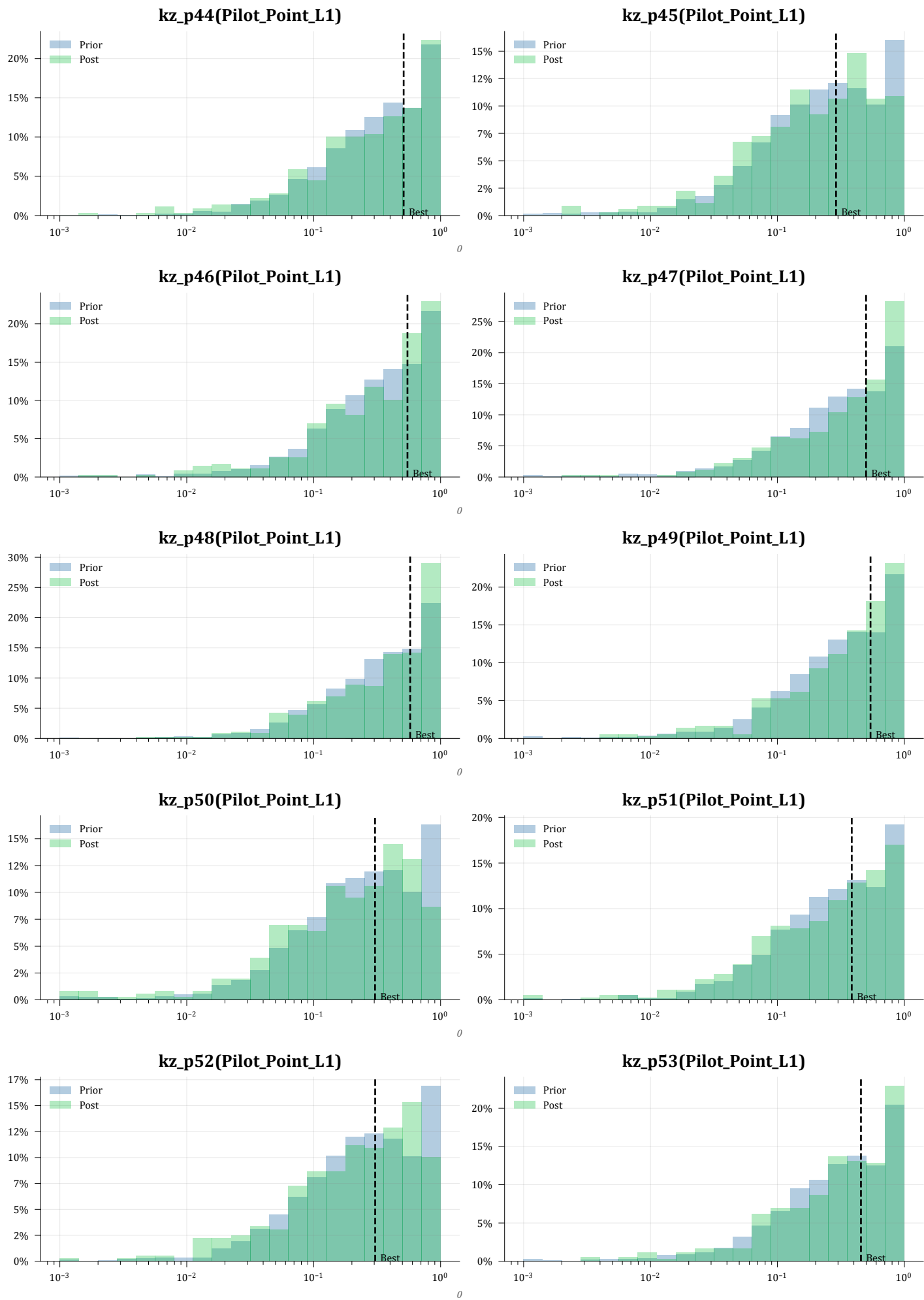
Parameters

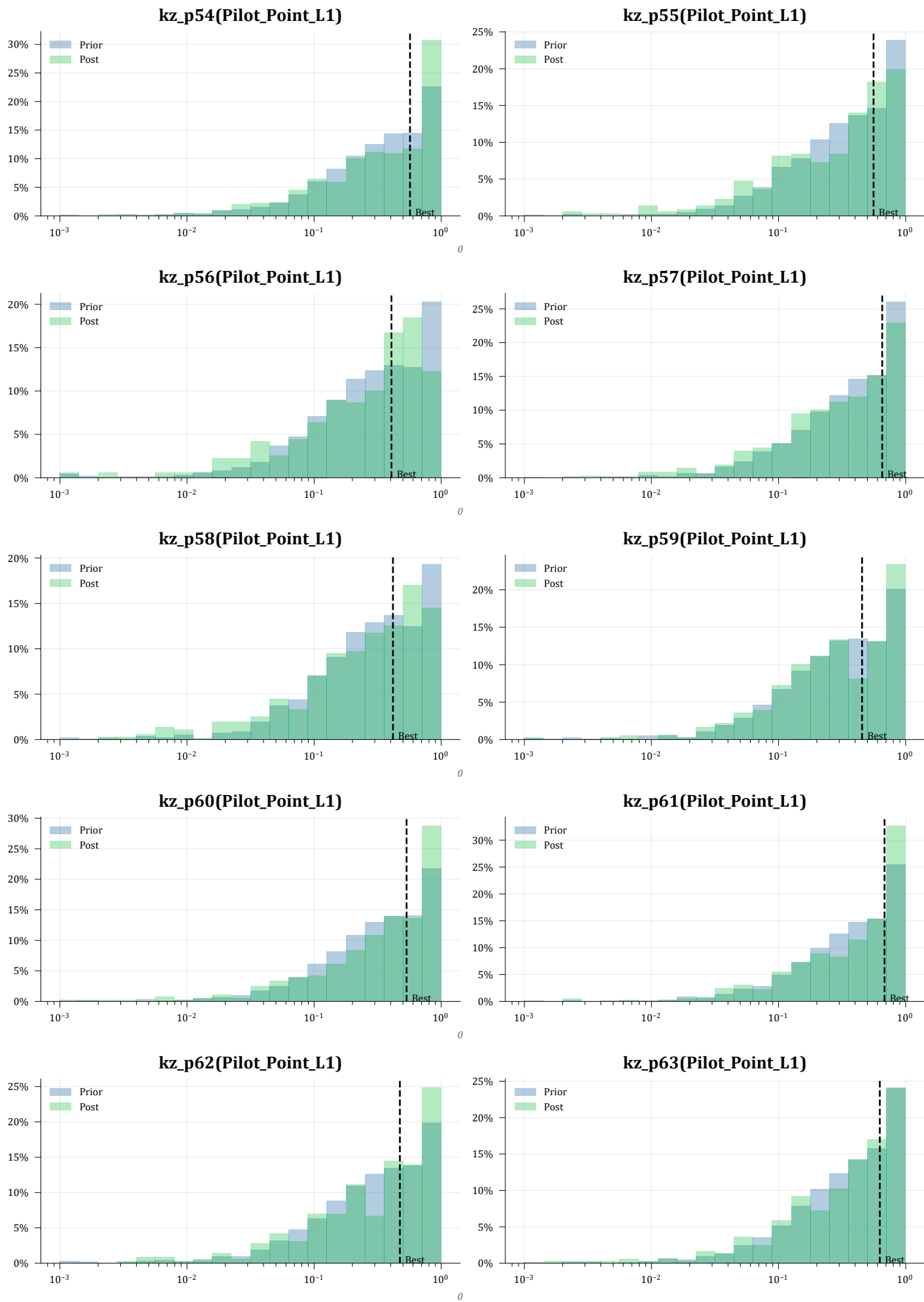




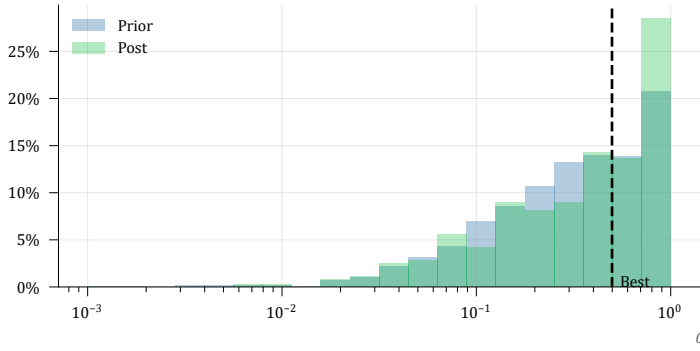
Parameters



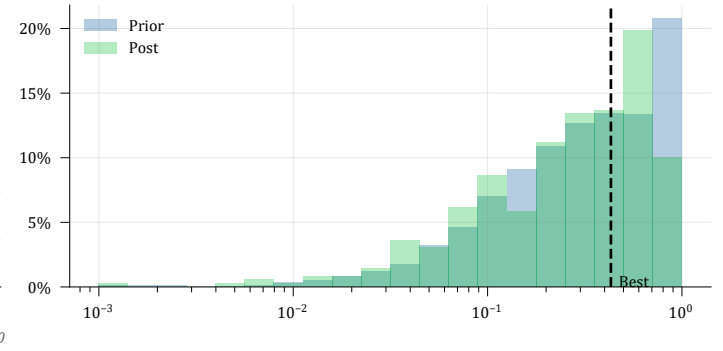




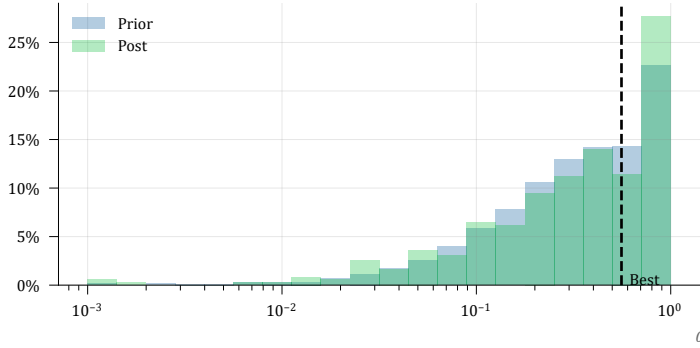
kz_p64(Pilot_Point_L1)



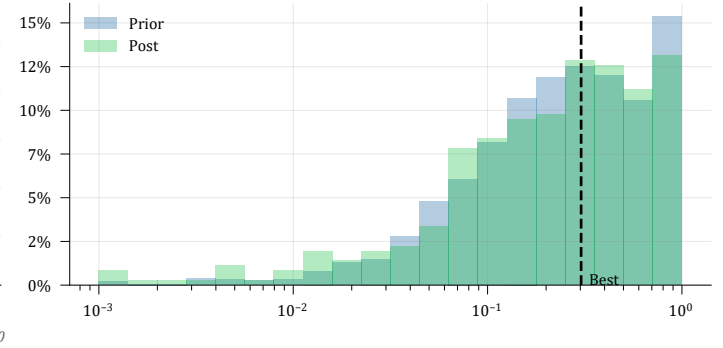
kz_p65(Pilot_Point_L1)



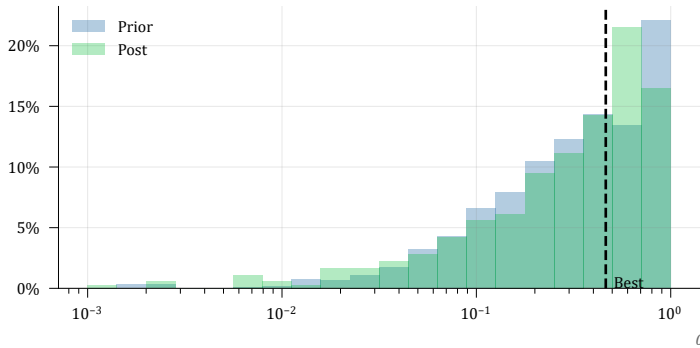
kz_p66(Pilot_Point_L1)



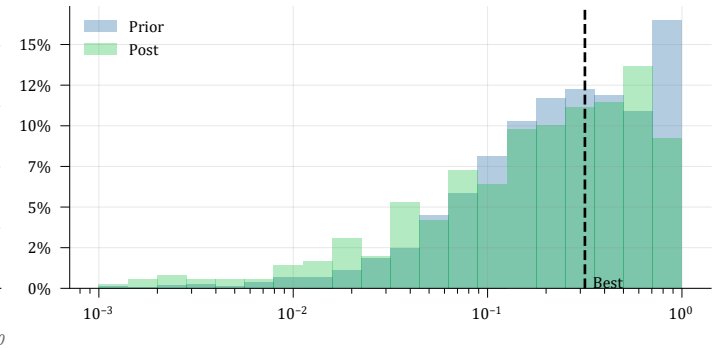
kz_p67(Pilot_Point_L1)



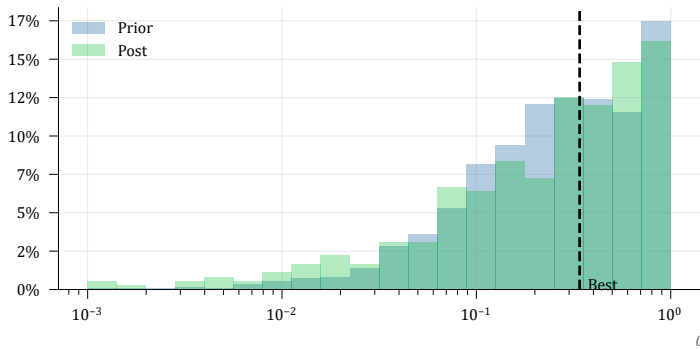
kz_p68(Pilot_Point_L1)



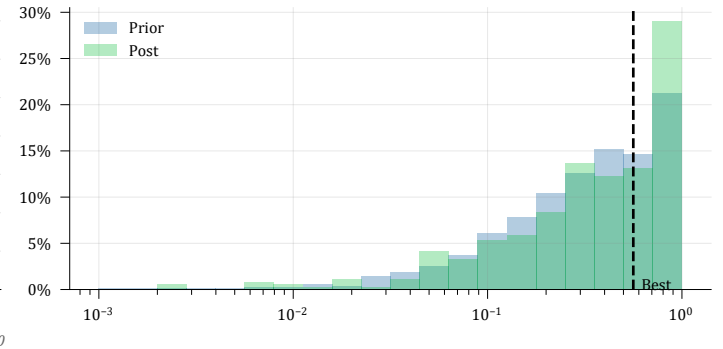
kz_p69(Pilot_Point_L1)



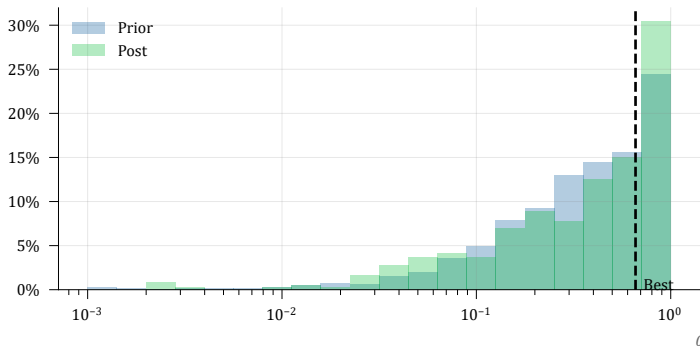
kz_p70(Pilot_Point_L1)



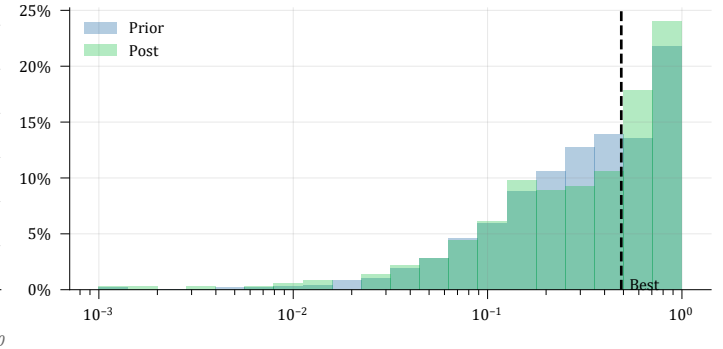
kz_p71(Pilot_Point_L1)

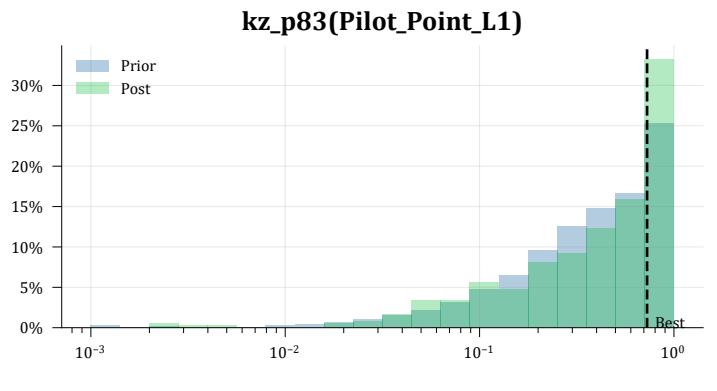
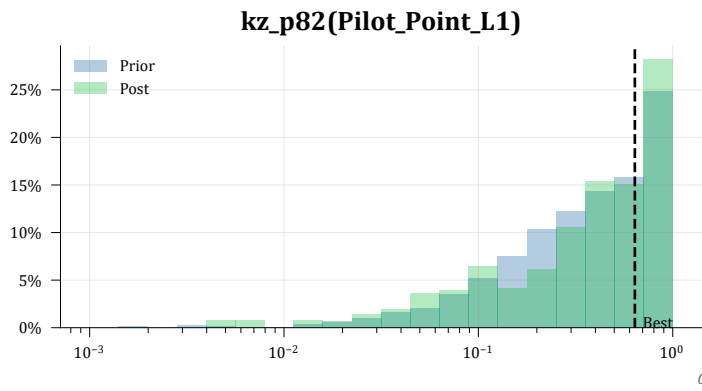
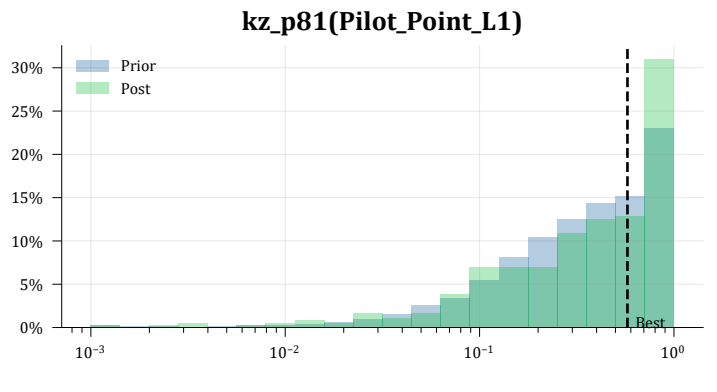
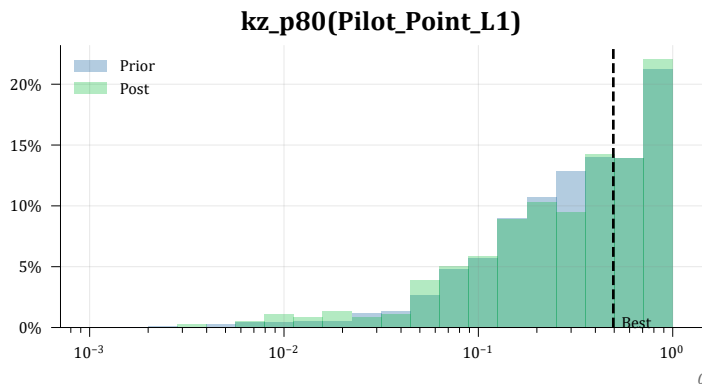
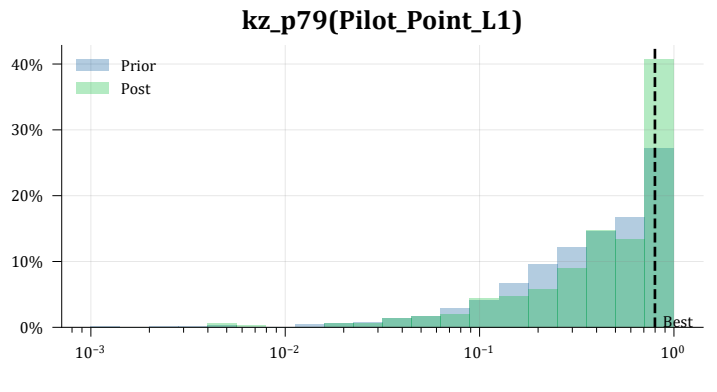
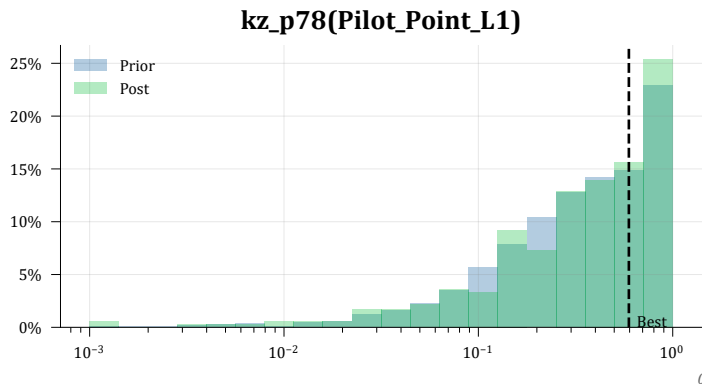
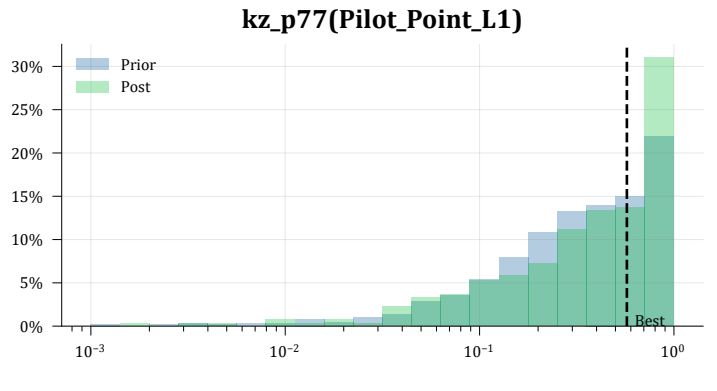
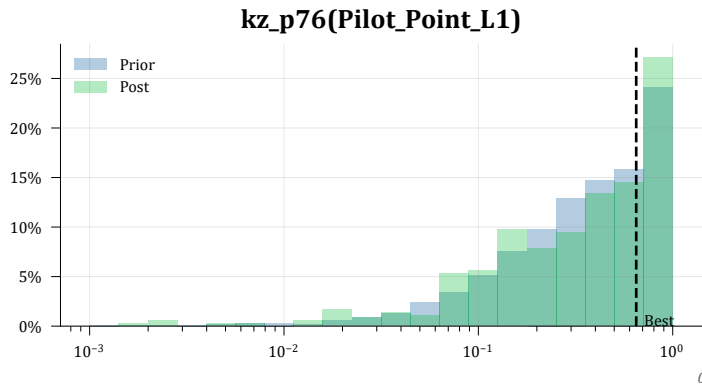
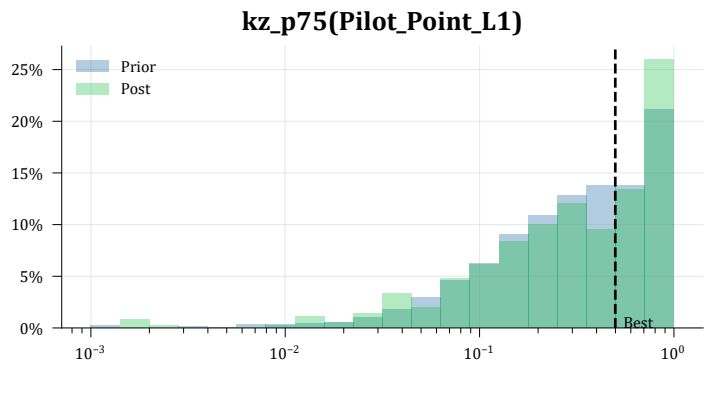
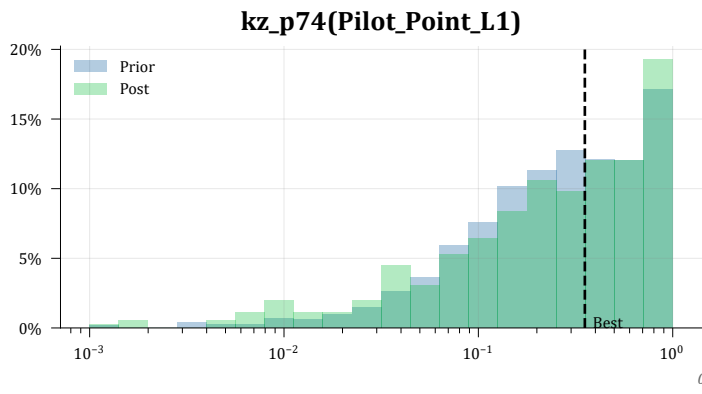


kz_p72(Pilot_Point_L1)

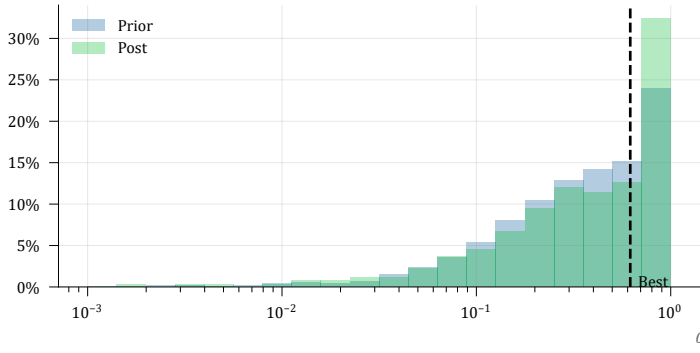


kz_p73(Pilot_Point_L1)

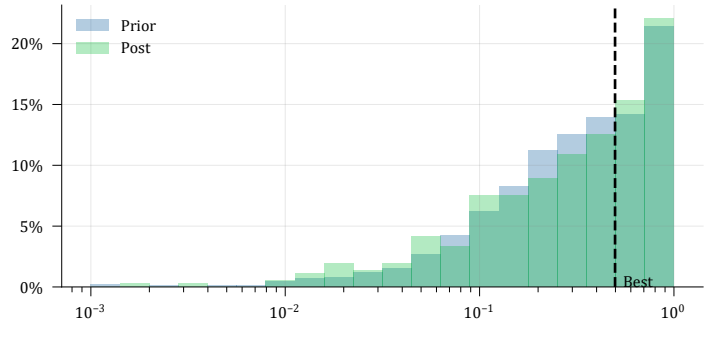




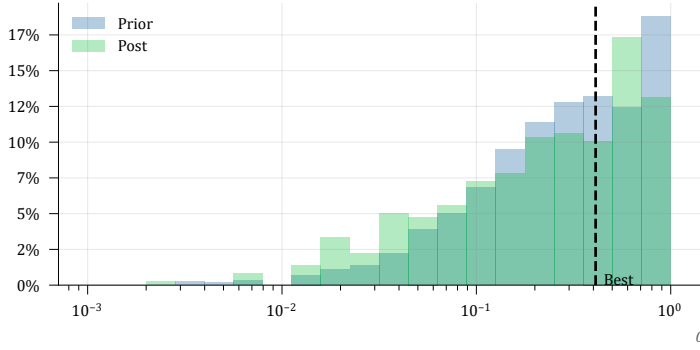
kz_p84(Pilot_Point_L1)



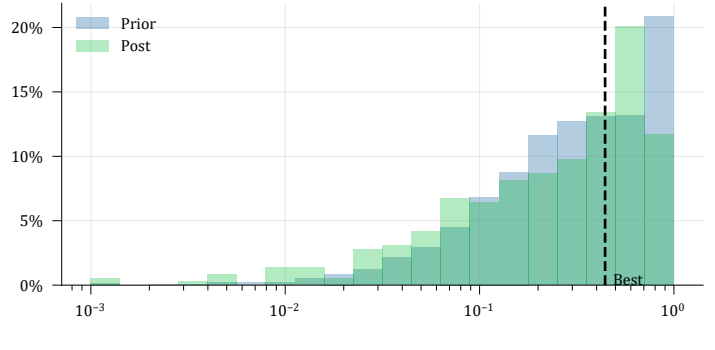
kz_p85(Pilot_Point_L1)



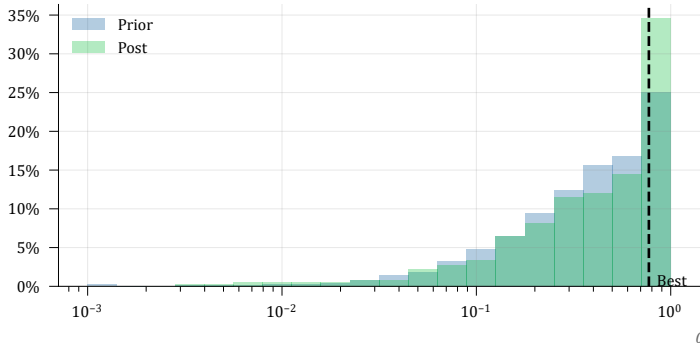
kz_p86(Pilot_Point_L1)



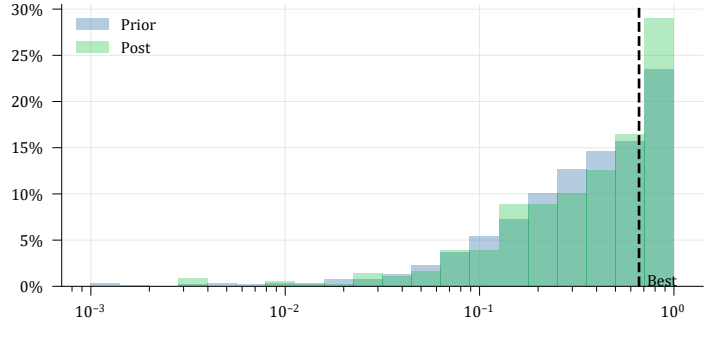
kz_p87(Pilot_Point_L1)



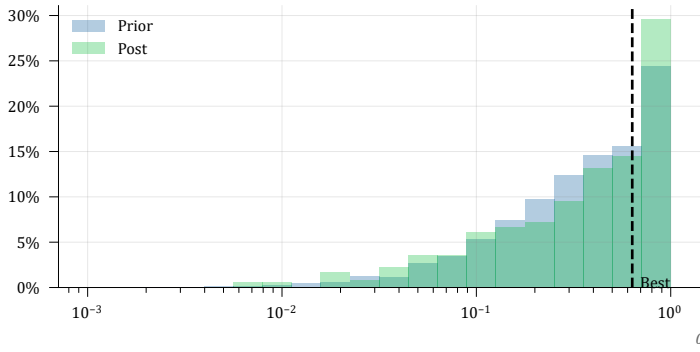
kz_p88(Pilot_Point_L1)



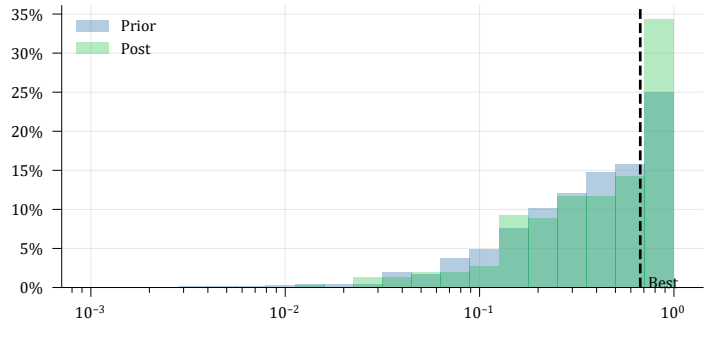
kz_p89(Pilot_Point_L1)



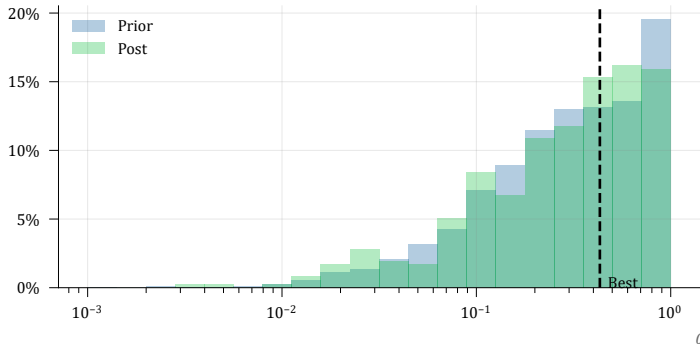
kz_p90(Pilot_Point_L1)



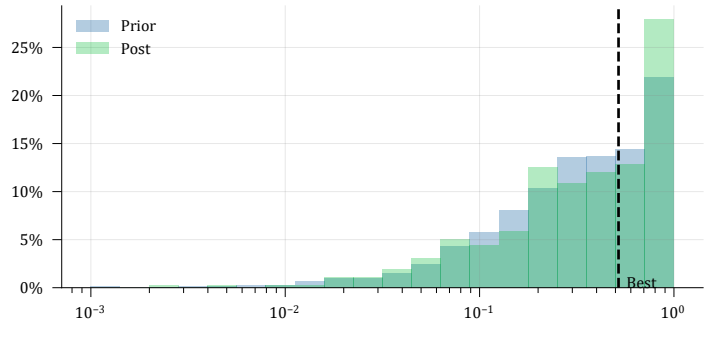
kz_p91(Pilot_Point_L1)

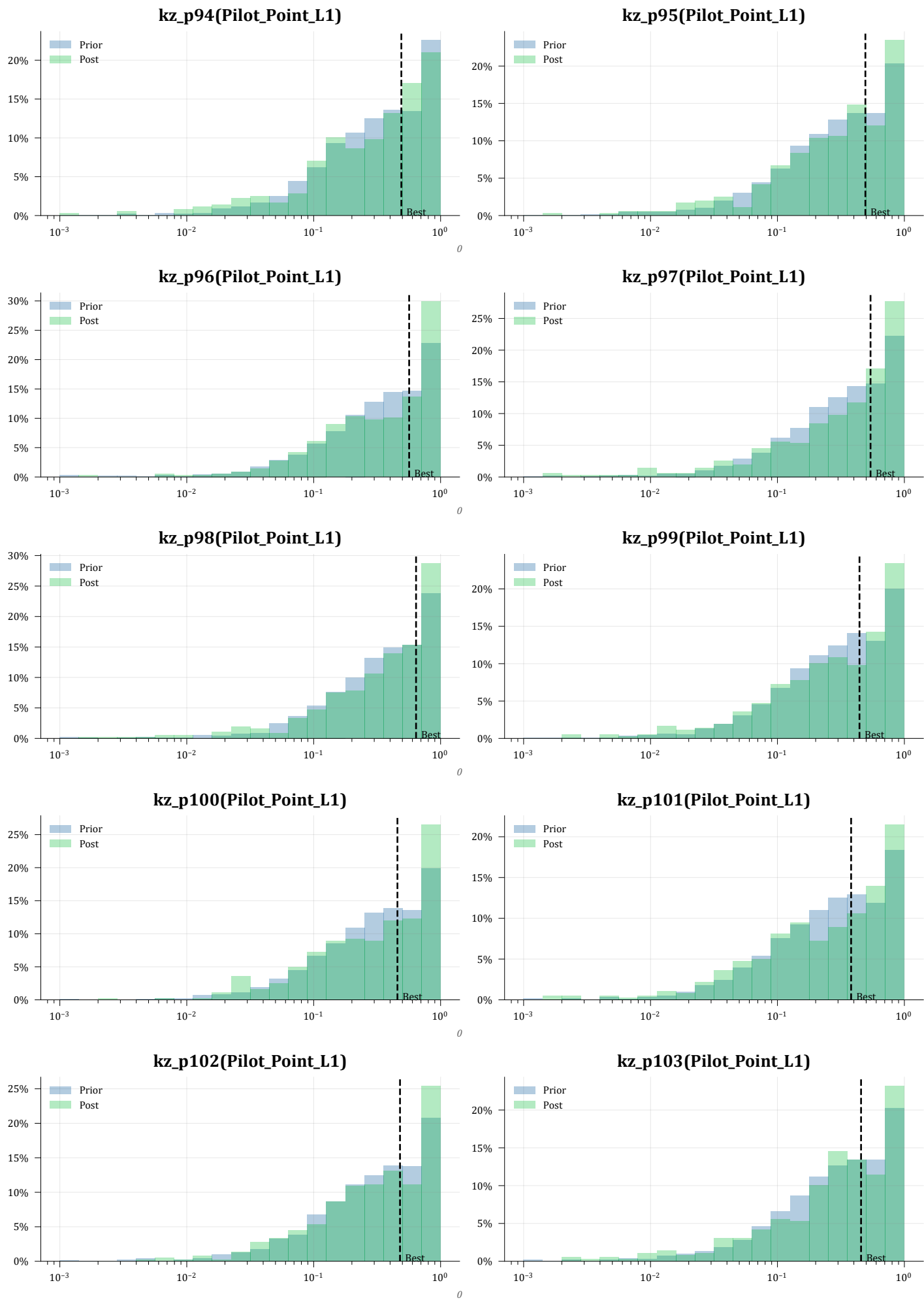


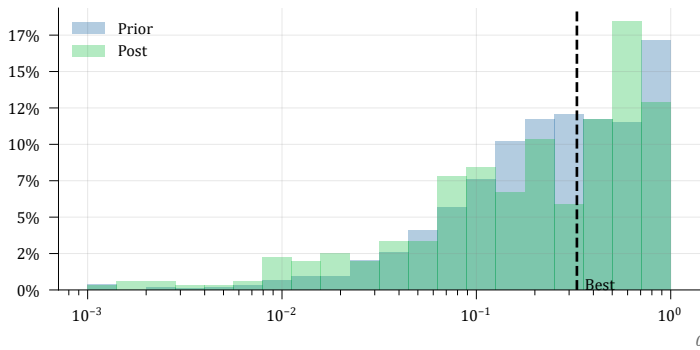
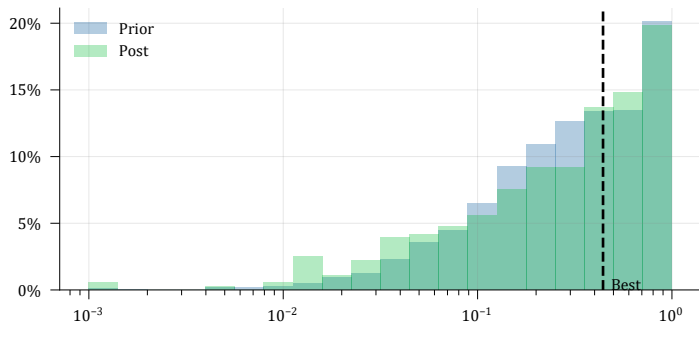
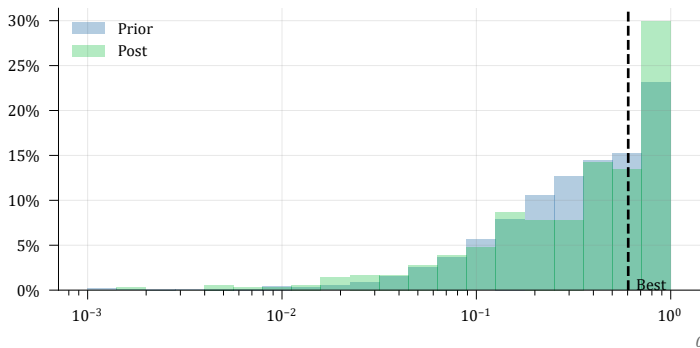
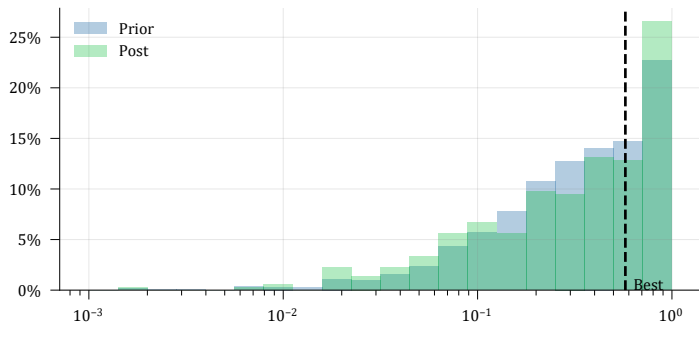
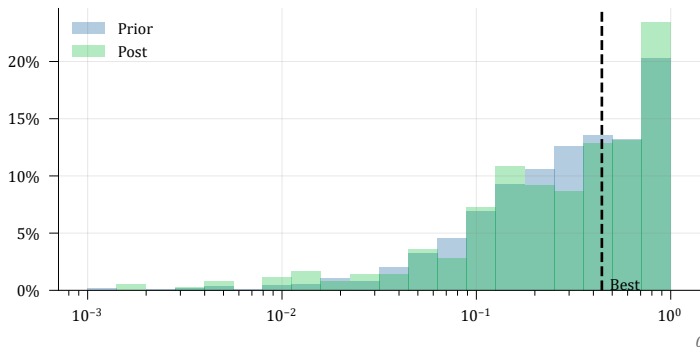
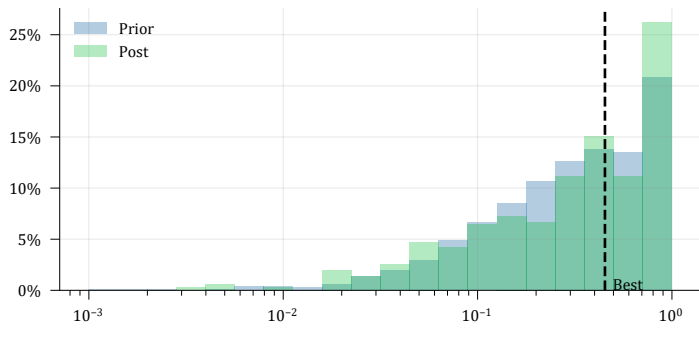
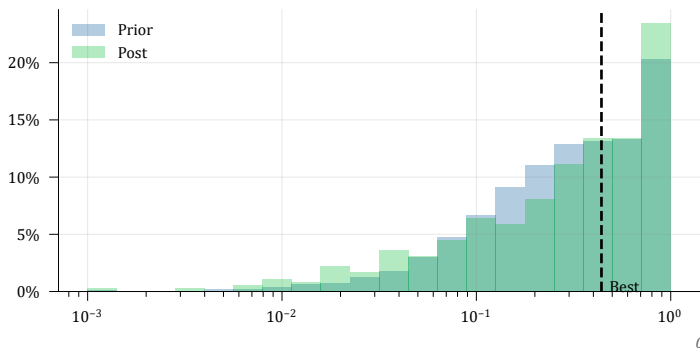
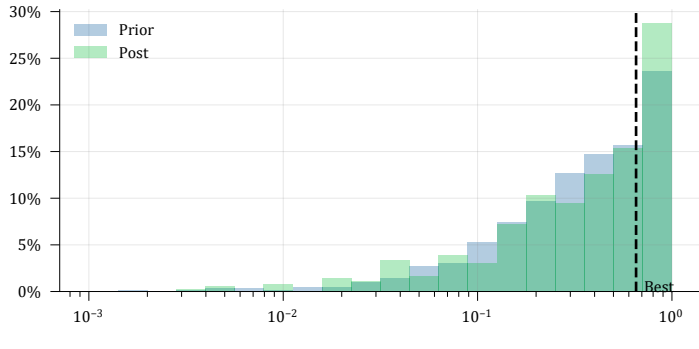
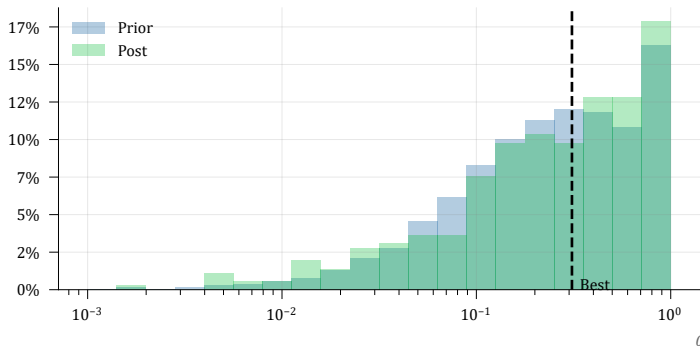
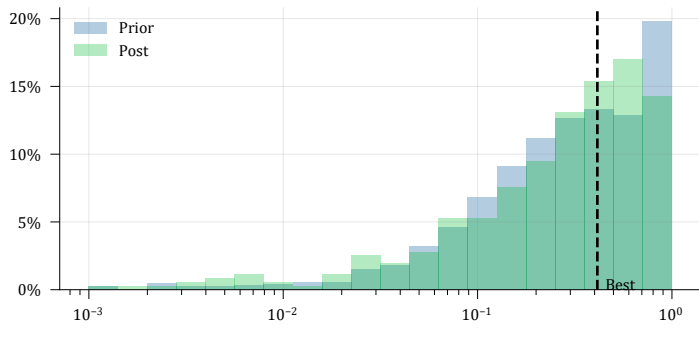
kz_p92(Pilot_Point_L1)

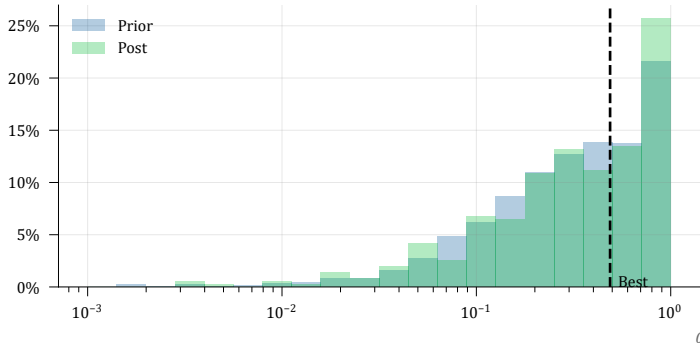
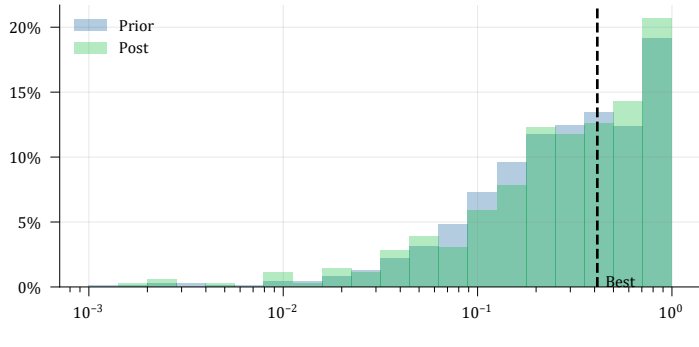
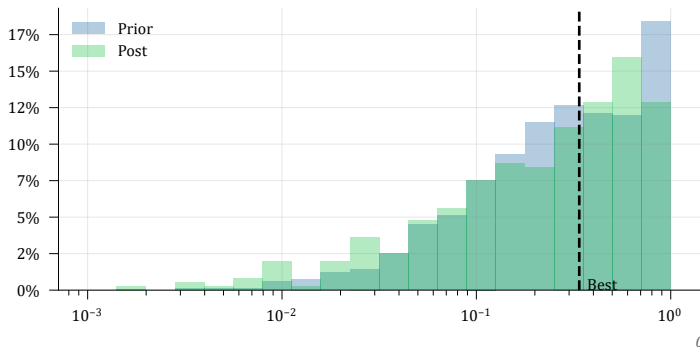
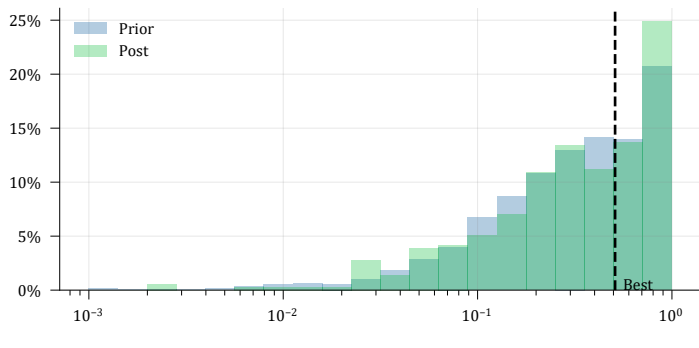
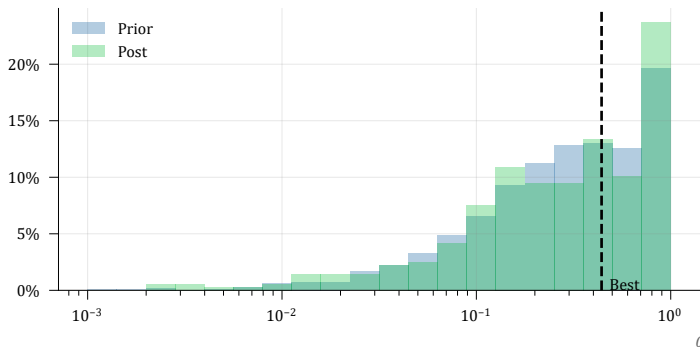
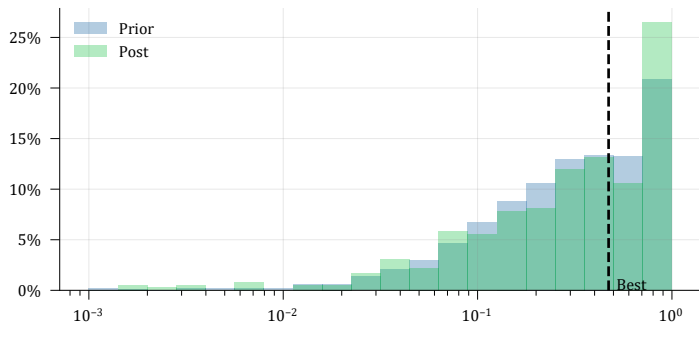
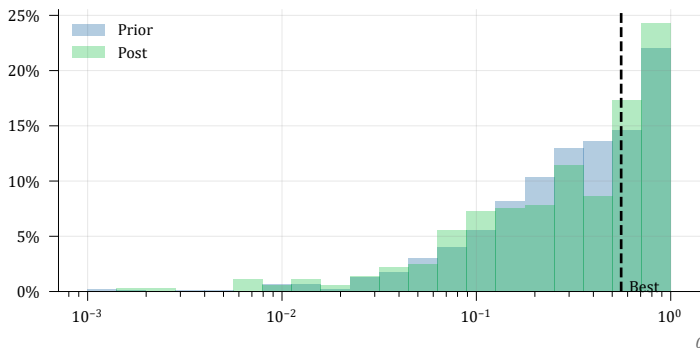
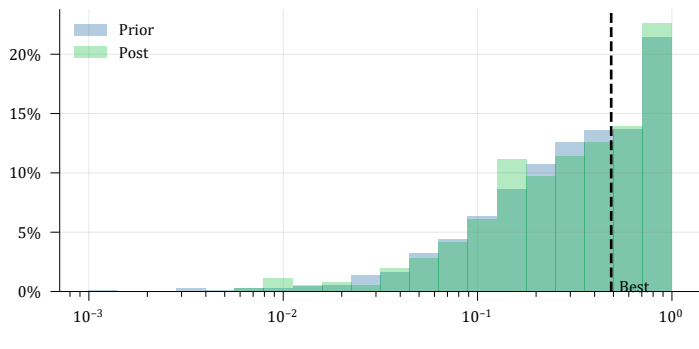
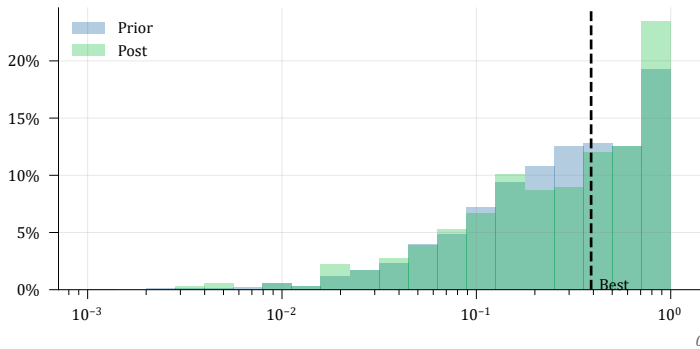
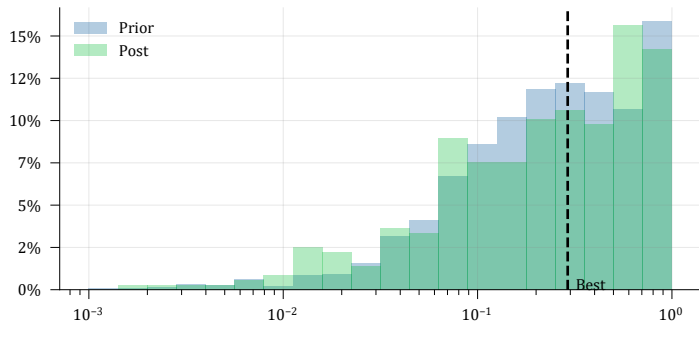


kz_p93(Pilot_Point_L1)

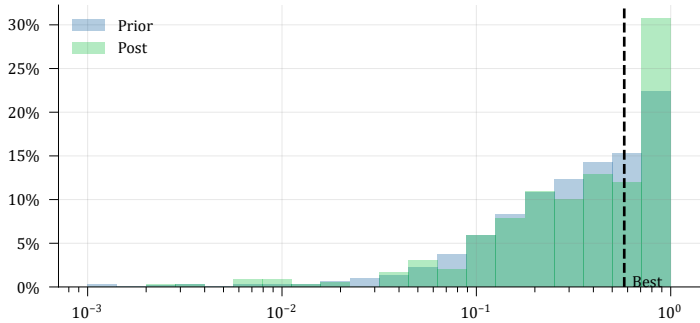




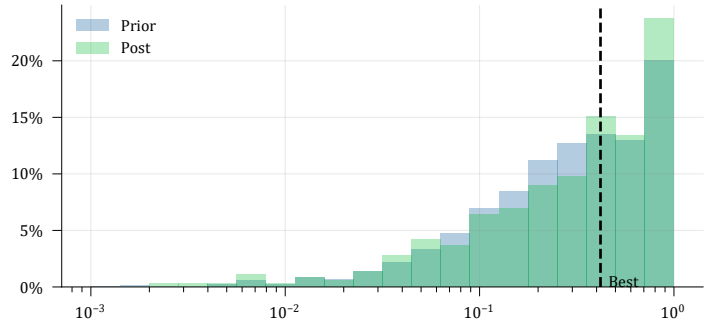
kz_p104(Pilot_Point_L1)**kz_p105(Pilot_Point_L1)****kz_p106(Pilot_Point_L1)****kz_p107(Pilot_Point_L1)****kz_p108(Pilot_Point_L1)****kz_p109(Pilot_Point_L1)****kz_p110(Pilot_Point_L1)****kz_p111(Pilot_Point_L1)****kz_p112(Pilot_Point_L1)****kz_p113(Pilot_Point_L1)**

kz_p114(Pilot_Point_L1)**kz_p115(Pilot_Point_L1)****kz_p116(Pilot_Point_L1)****kz_p117(Pilot_Point_L1)****kz_p118(Pilot_Point_L1)****kz_p119(Pilot_Point_L1)****kz_p120(Pilot_Point_L1)****kz_p121(Pilot_Point_L1)****kz_p122(Pilot_Point_L1)****kz_p123(Pilot_Point_L1)**

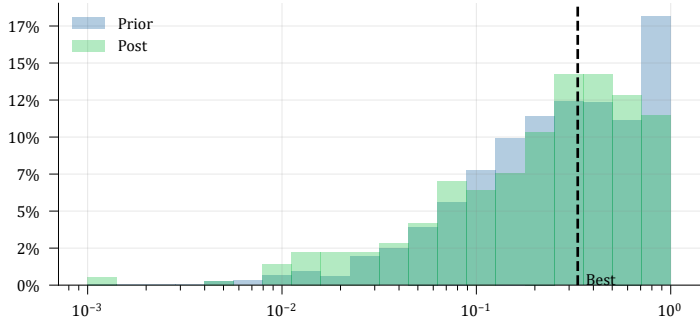
kz_p124(Pilot_Point_L1)



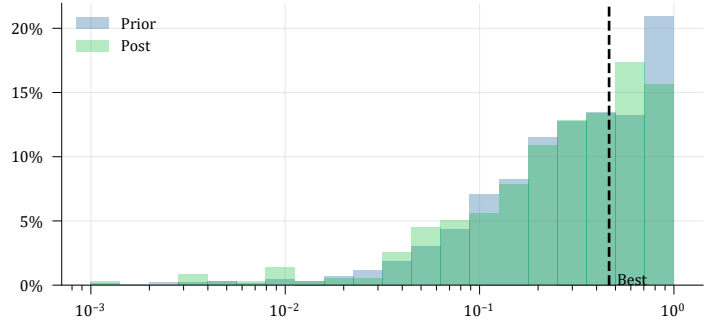
kz_p125(Pilot_Point_L1)



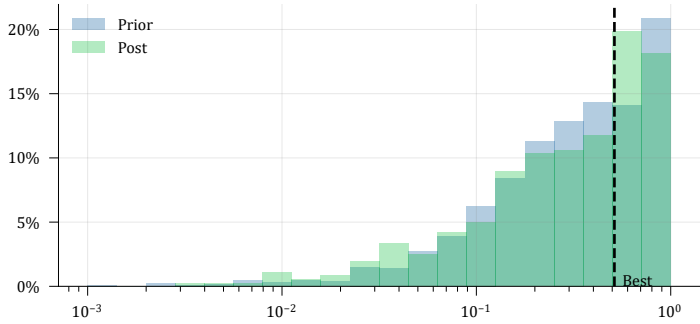
kz_p126(Pilot_Point_L1)



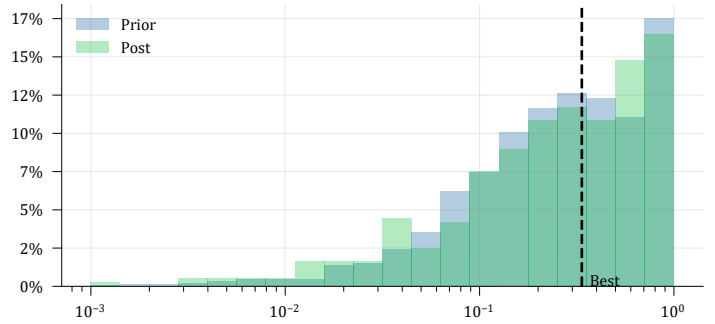
kz_p127(Pilot_Point_L1)



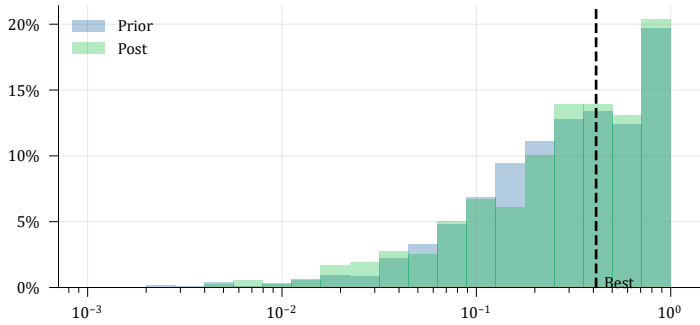
kz_p128(Pilot_Point_L1)



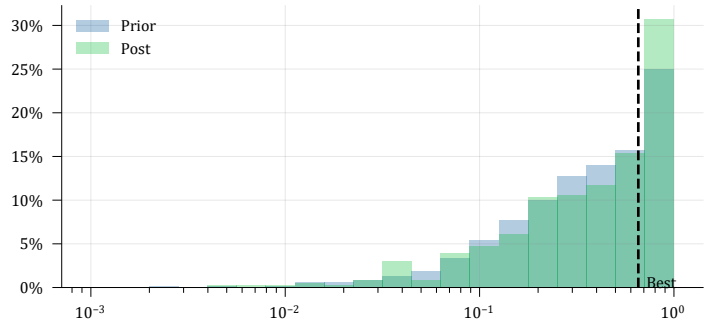
kz_p129(Pilot_Point_L1)



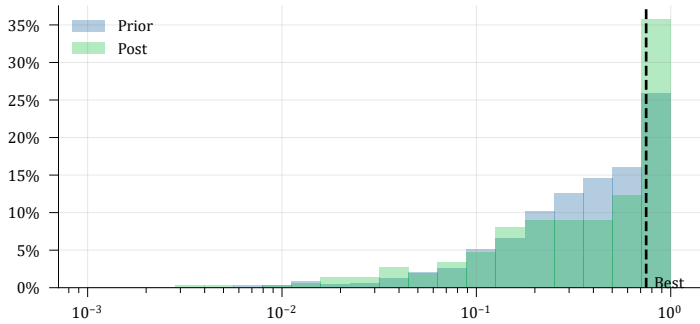
kz_p130(Pilot_Point_L1)



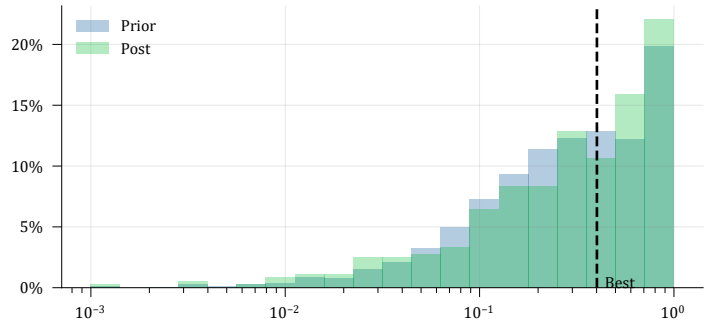
kz_p131(Pilot_Point_L1)

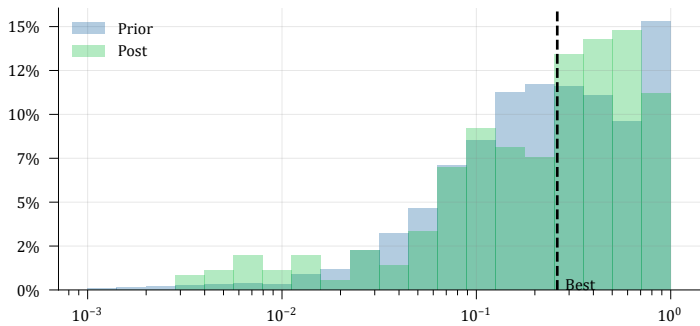
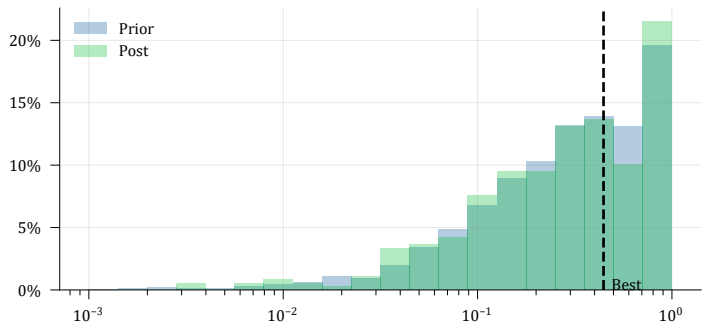
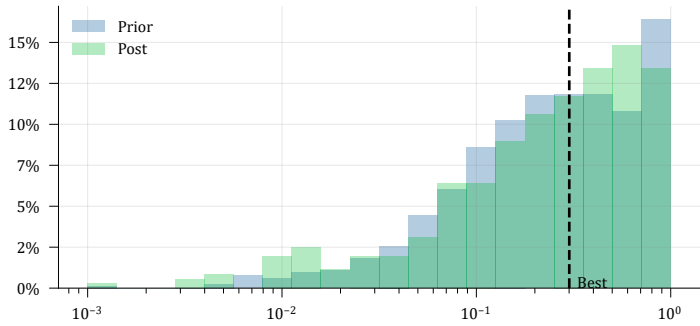
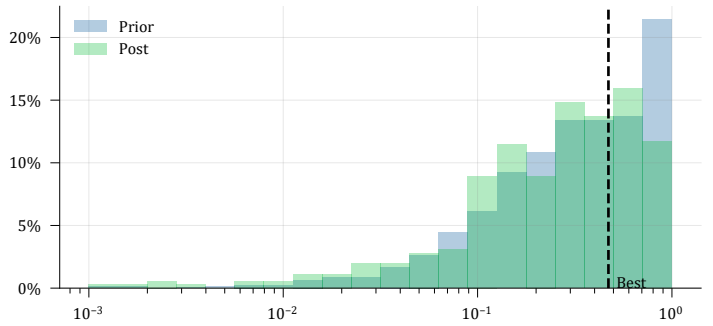
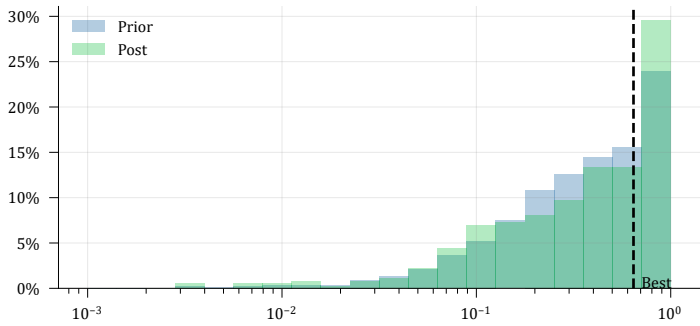
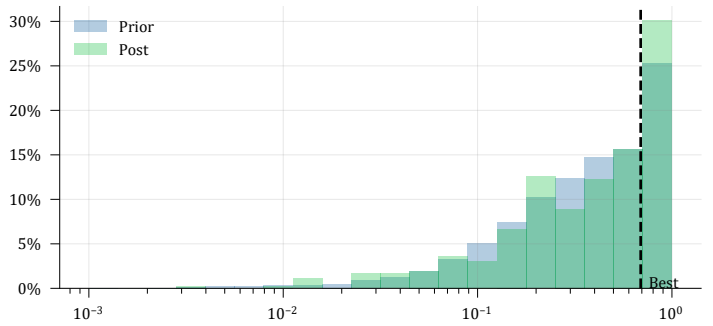
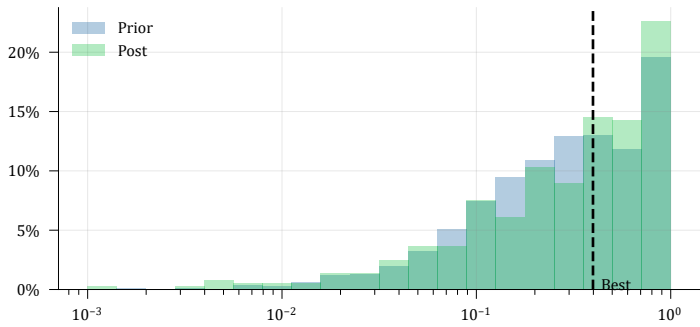
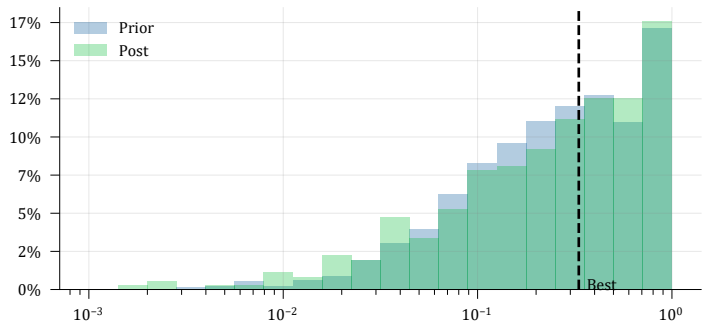
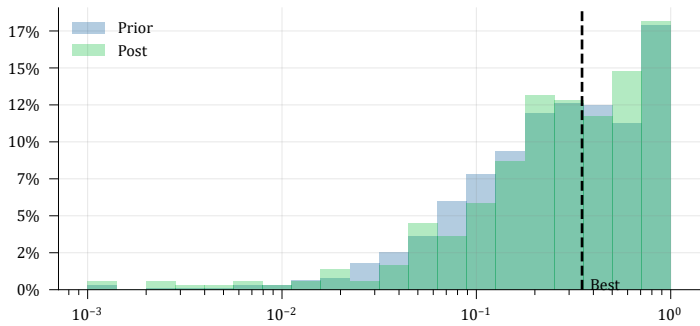
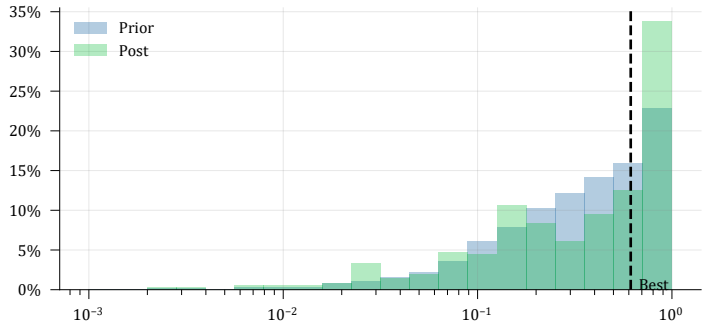


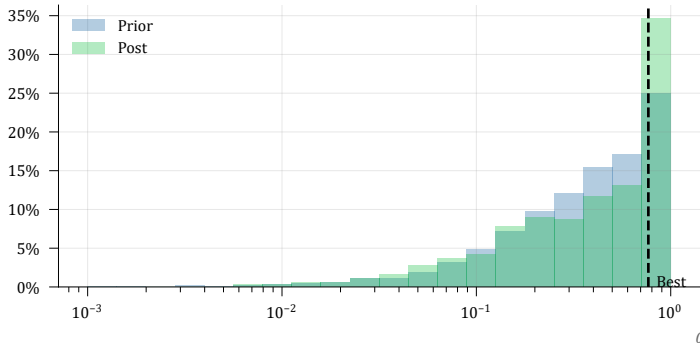
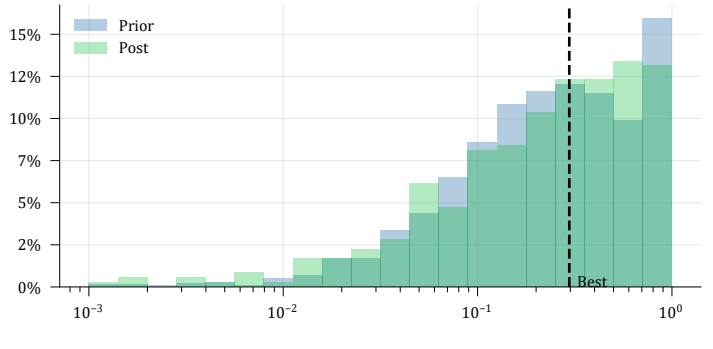
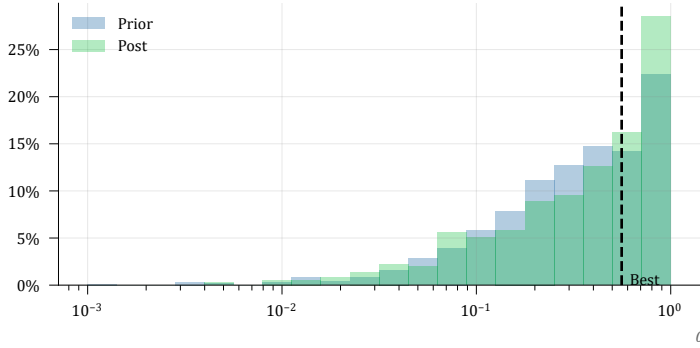
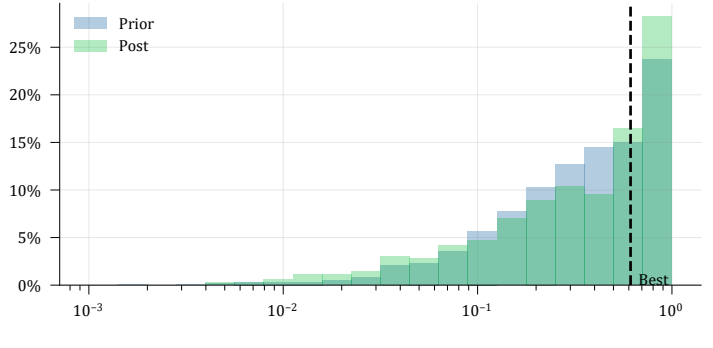
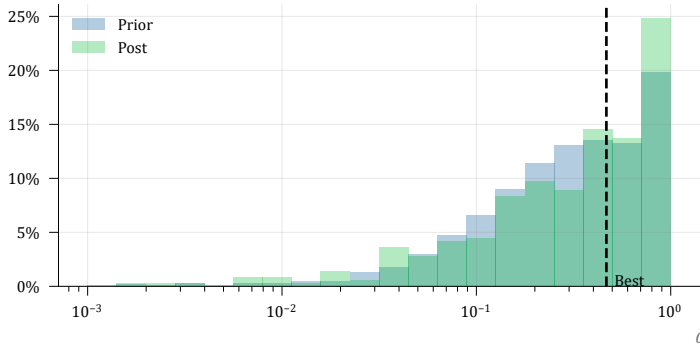
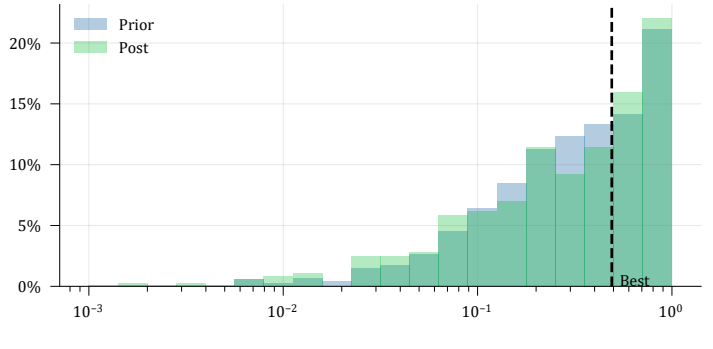
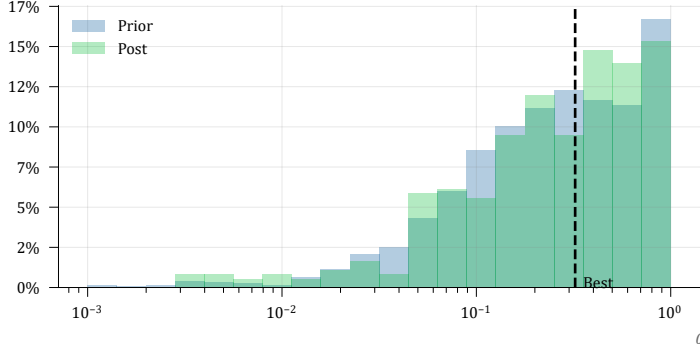
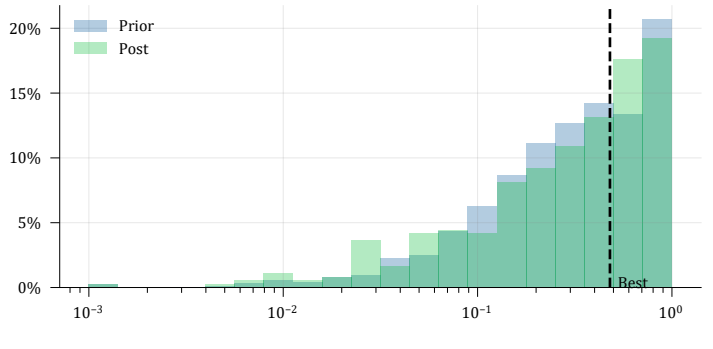
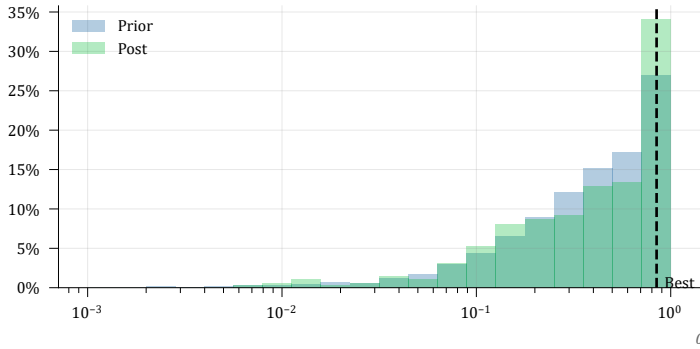
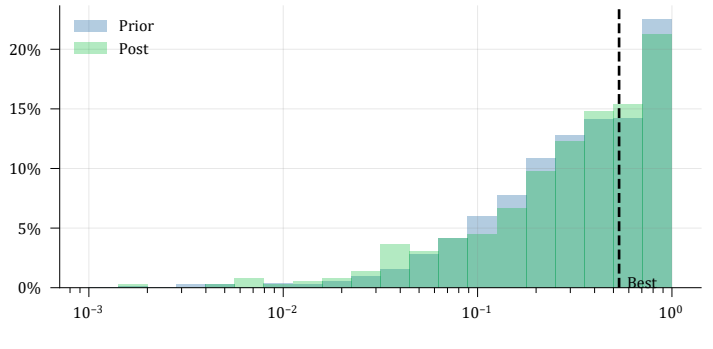
kz_p132(Pilot_Point_L1)



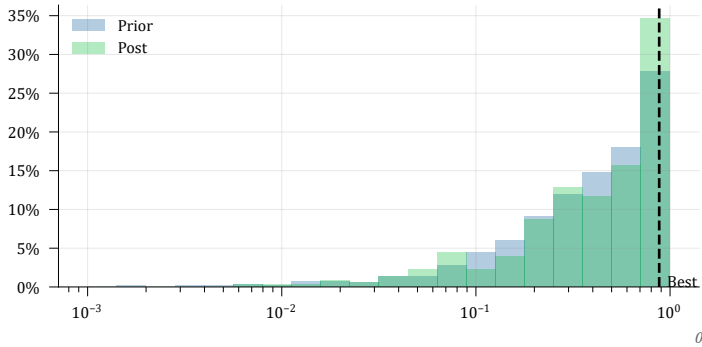
kz_p133(Pilot_Point_L1)



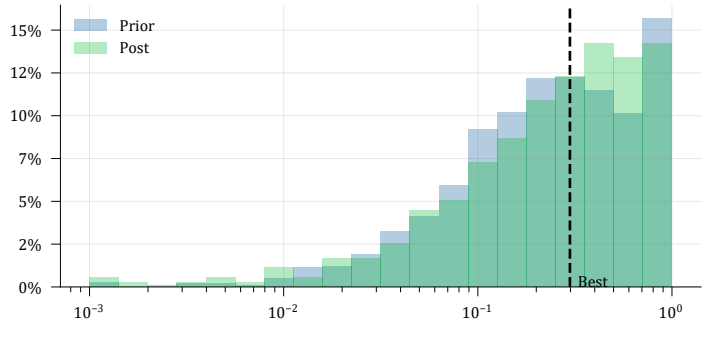
kz_p134(Pilot_Point_L1)**kz_p135(Pilot_Point_L1)****kz_p136(Pilot_Point_L1)****kz_p137(Pilot_Point_L1)****kz_p138(Pilot_Point_L1)****kz_p139(Pilot_Point_L1)****kz_p140(Pilot_Point_L1)****kz_p141(Pilot_Point_L1)****kz_p142(Pilot_Point_L1)****kz_p143(Pilot_Point_L1)**

kz_p144(Pilot_Point_L1)**kz_p145(Pilot_Point_L1)****kz_p146(Pilot_Point_L1)****kz_p147(Pilot_Point_L1)****kz_p148(Pilot_Point_L1)****kz_p149(Pilot_Point_L1)****kz_p150(Pilot_Point_L1)****kz_p151(Pilot_Point_L1)****kz_p152(Pilot_Point_L1)****kz_p153(Pilot_Point_L1)**

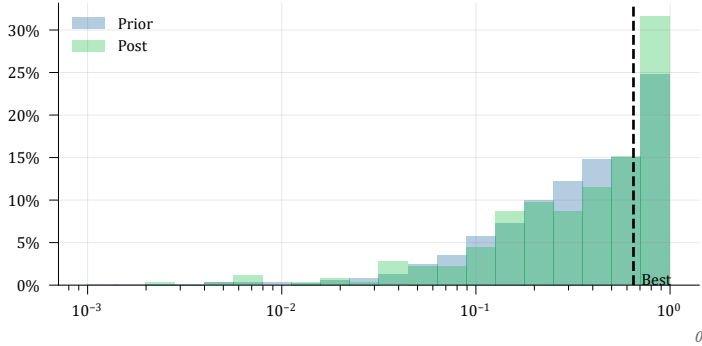
kz_p154(Pilot_Point_L1)



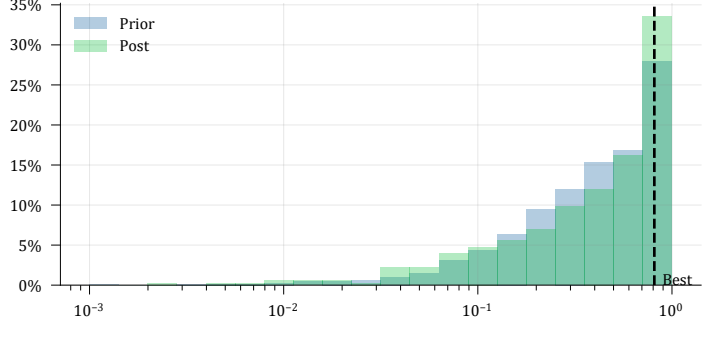
kz_p155(Pilot_Point_L1)



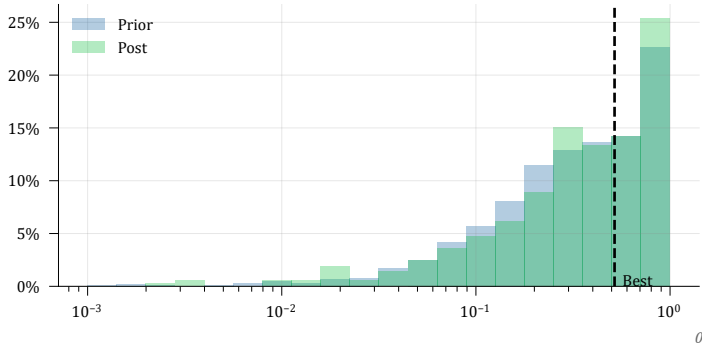
kz_p156(Pilot_Point_L1)



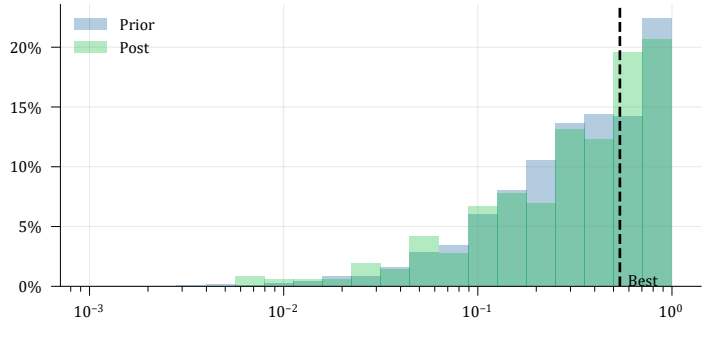
kz_p157(Pilot_Point_L1)



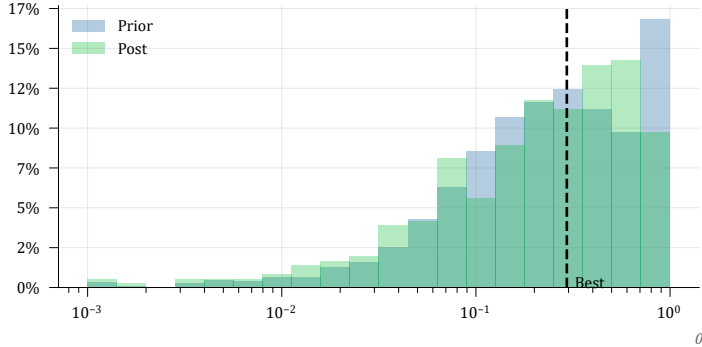
kz_p158(Pilot_Point_L1)



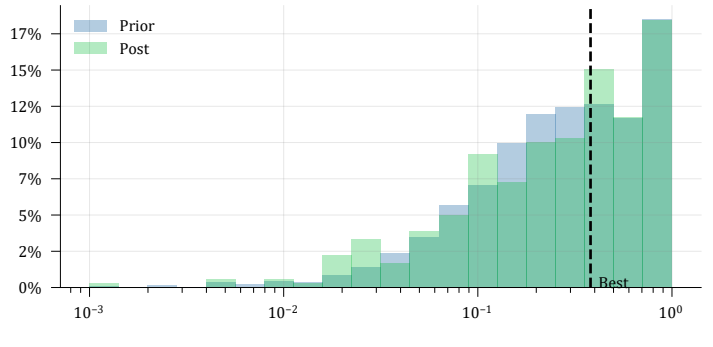
kz_p159(Pilot_Point_L1)



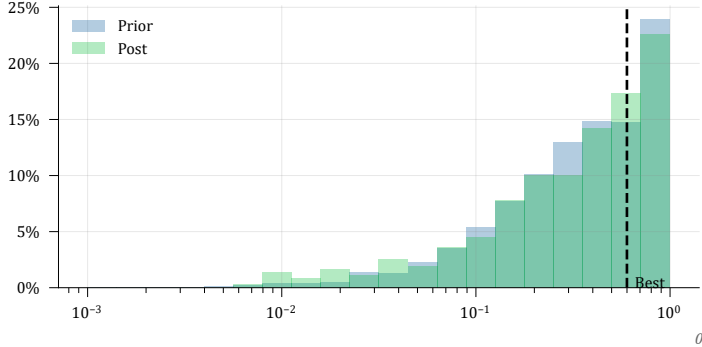
kz_p160(Pilot_Point_L1)



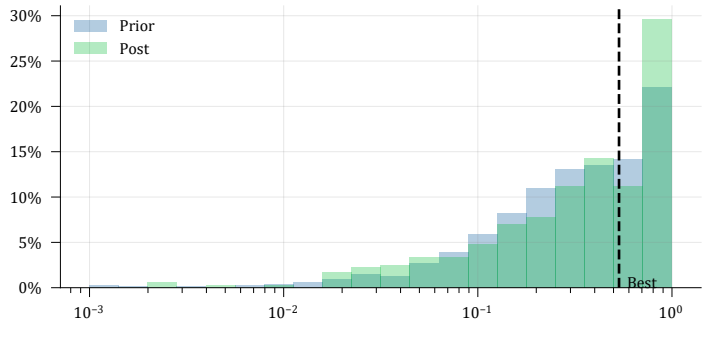
kz_p161(Pilot_Point_L1)

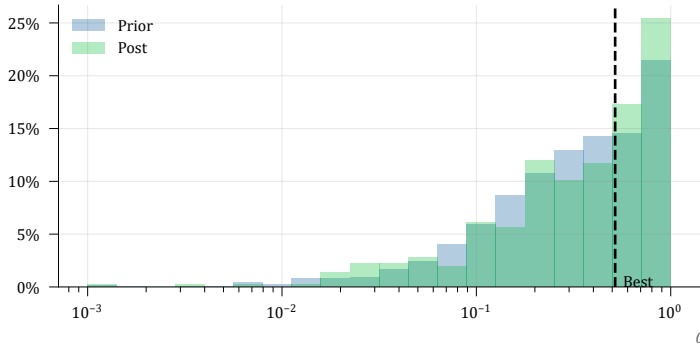
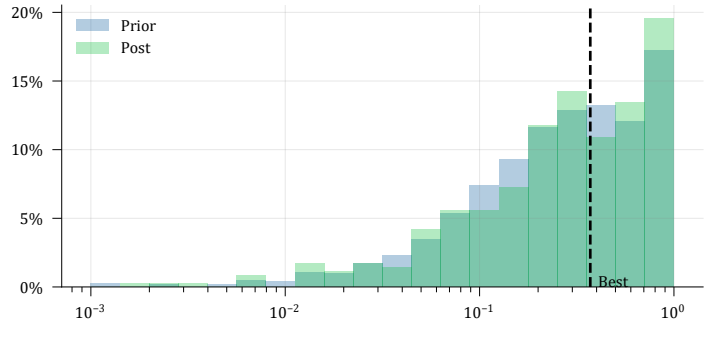
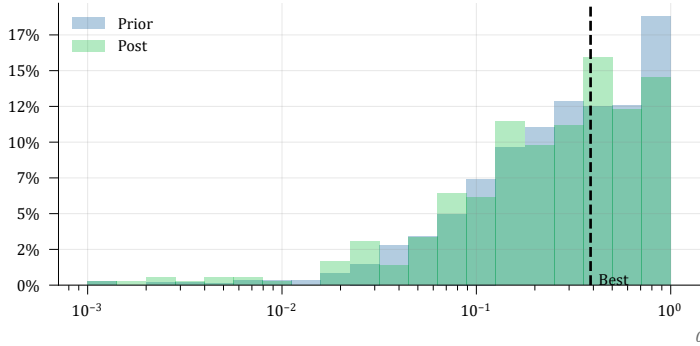
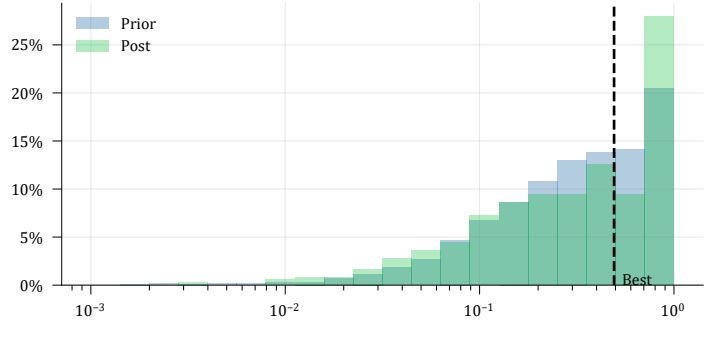
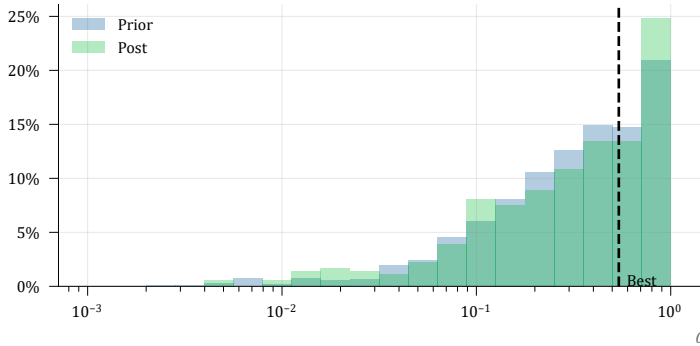
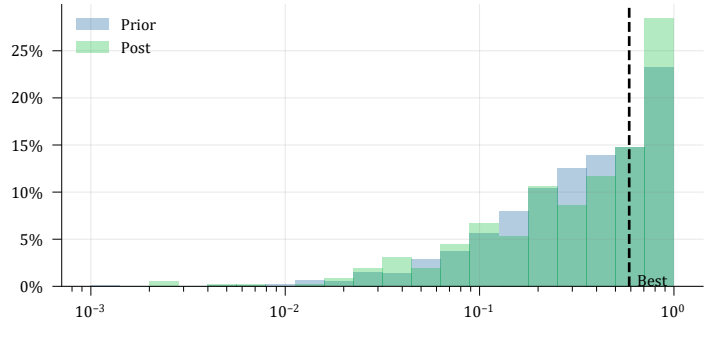
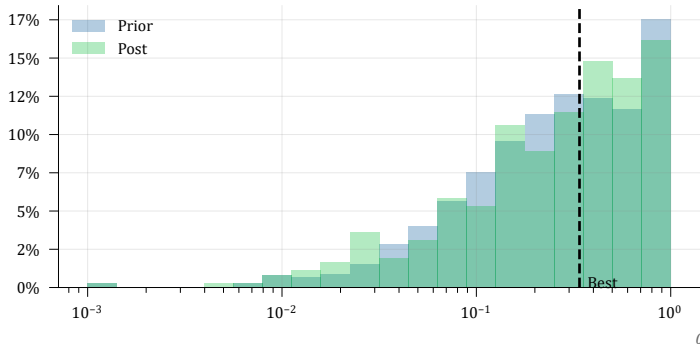
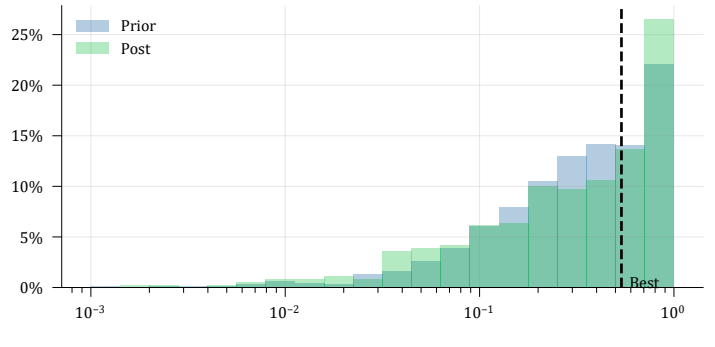
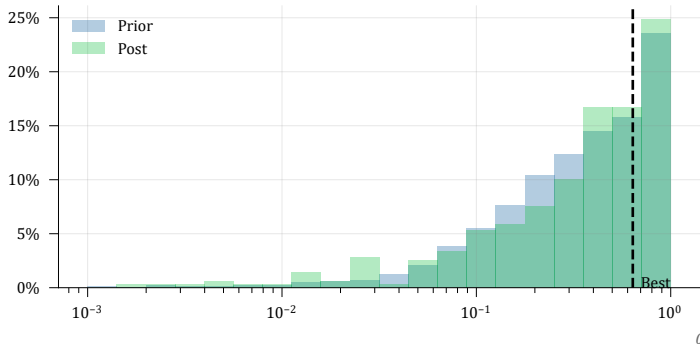
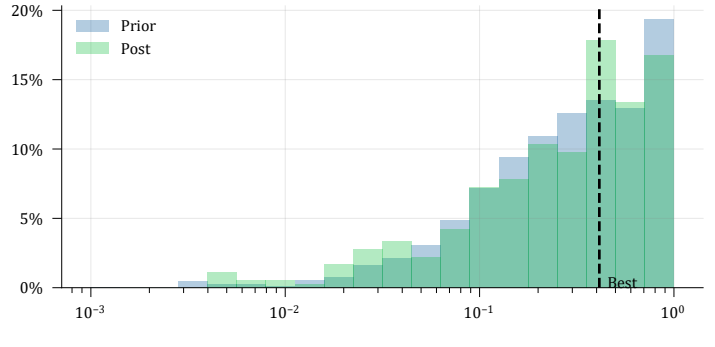


kz_p162(Pilot_Point_L1)

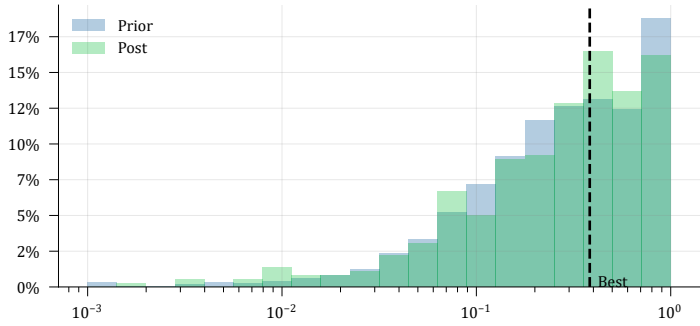


kz_p163(Pilot_Point_L1)

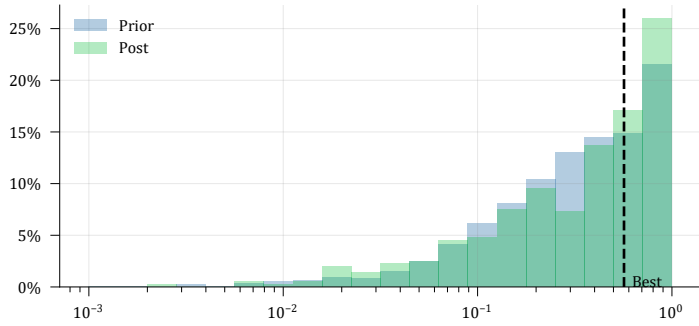


kz_p164(Pilot_Point_L1)**kz_p165(Pilot_Point_L1)****kz_p166(Pilot_Point_L1)****kz_p167(Pilot_Point_L1)****kz_p168(Pilot_Point_L1)****kz_p169(Pilot_Point_L1)****kz_p170(Pilot_Point_L1)****kz_p171(Pilot_Point_L1)****kz_p172(Pilot_Point_L1)****kz_p173(Pilot_Point_L1)**

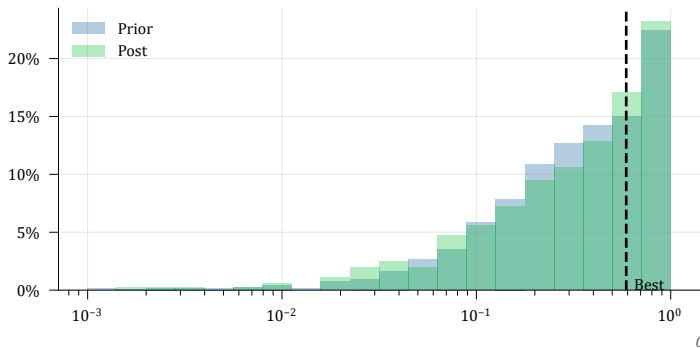
kz_p174(Pilot_Point_L1)



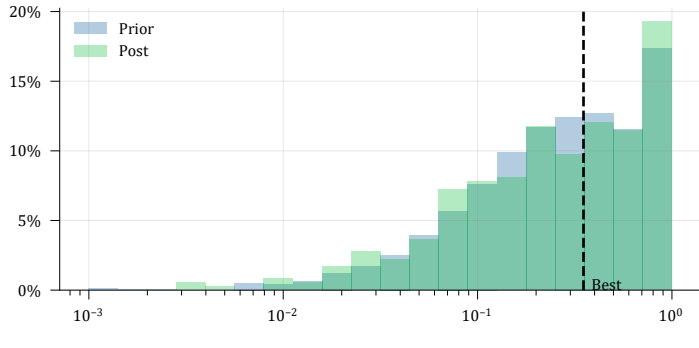
kz_p175(Pilot_Point_L1)



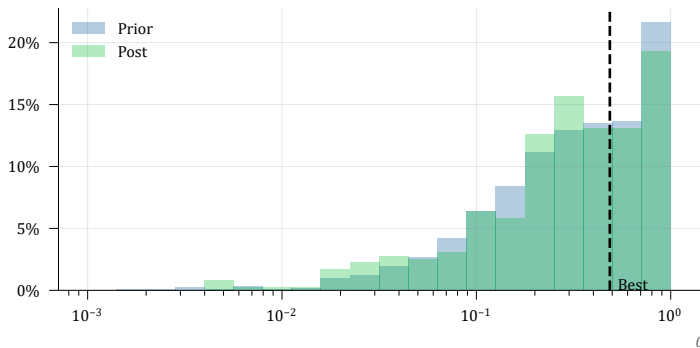
kz_p176(Pilot_Point_L1)



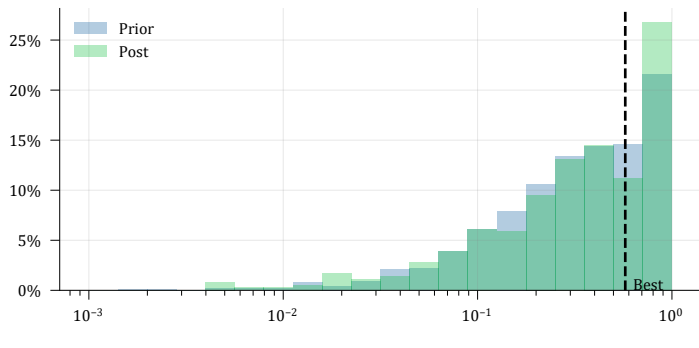
kz_p177(Pilot_Point_L1)



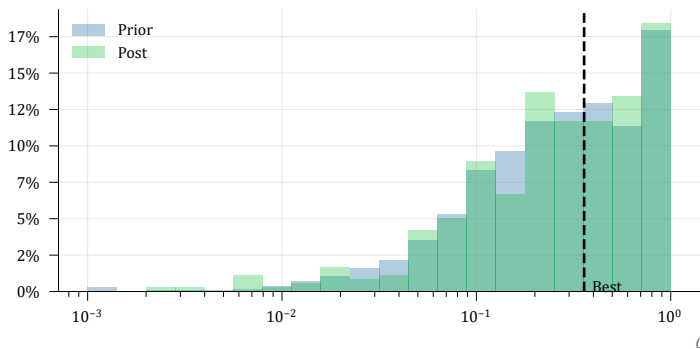
kz_p178(Pilot_Point_L1)



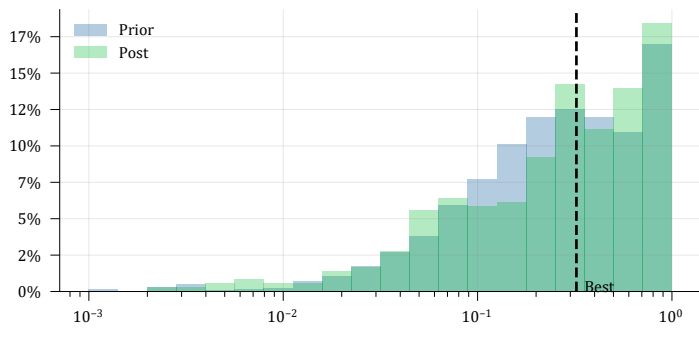
kz_p179(Pilot_Point_L1)



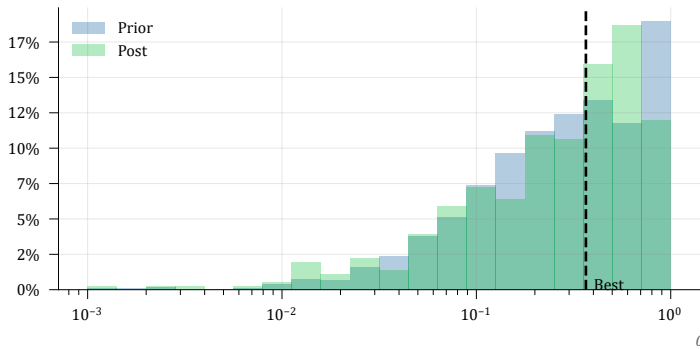
kz_p180(Pilot_Point_L1)



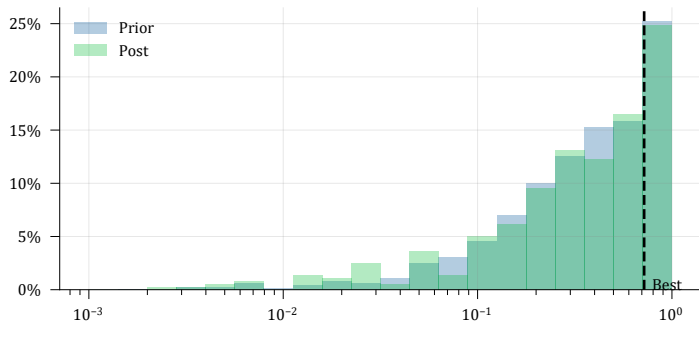
kz_p181(Pilot_Point_L1)



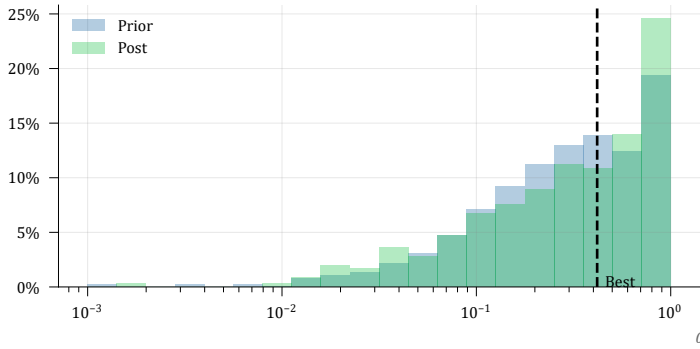
kz_p182(Pilot_Point_L1)



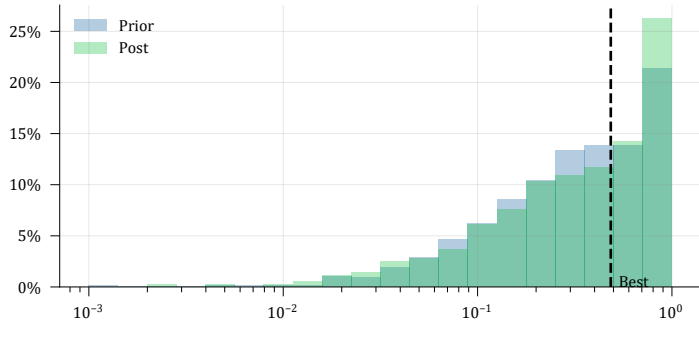
kz_p183(Pilot_Point_L1)



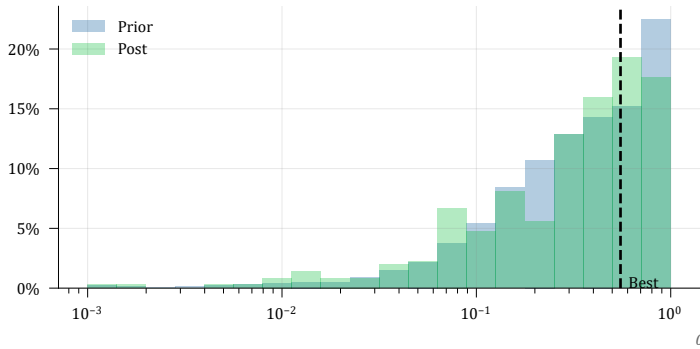
kz_p184(Pilot_Point_L1)



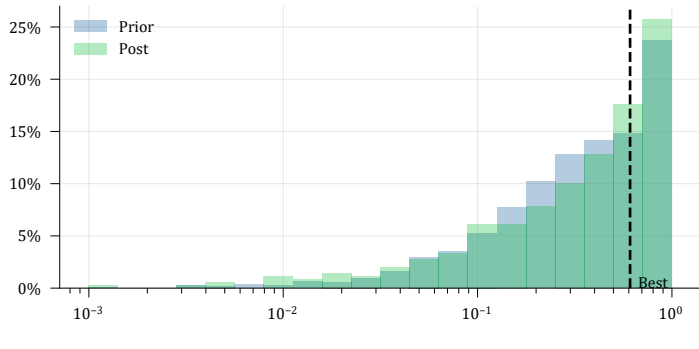
kz_p185(Pilot_Point_L1)



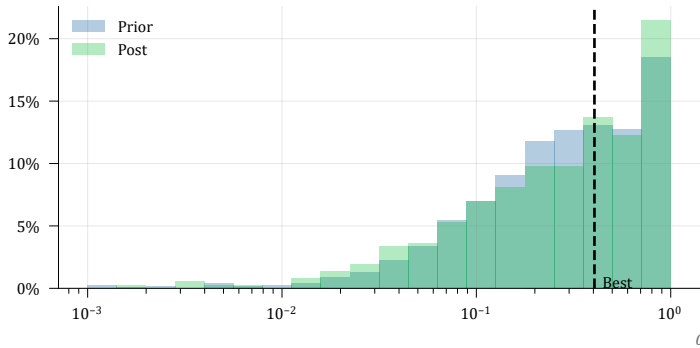
kz_p186(Pilot_Point_L1)



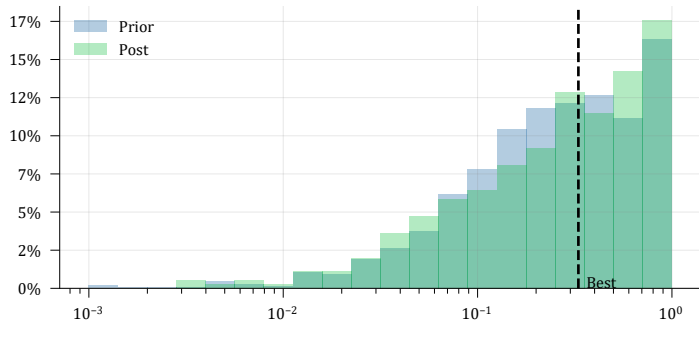
kz_p187(Pilot_Point_L1)



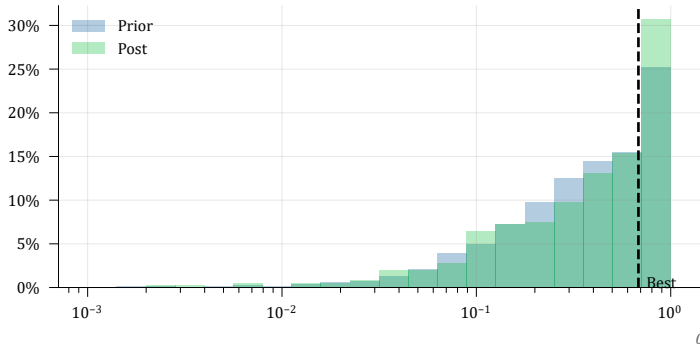
kz_p188(Pilot_Point_L1)



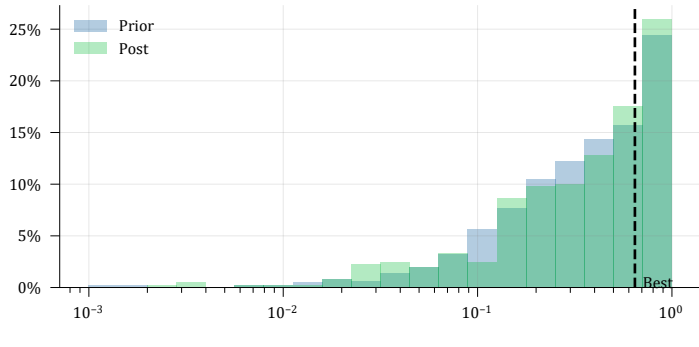
kz_p189(Pilot_Point_L1)



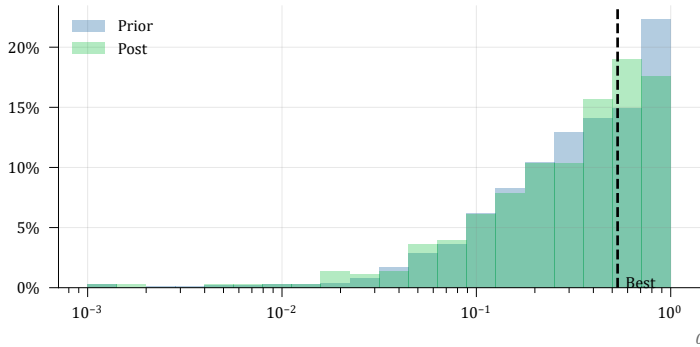
kz_p190(Pilot_Point_L1)



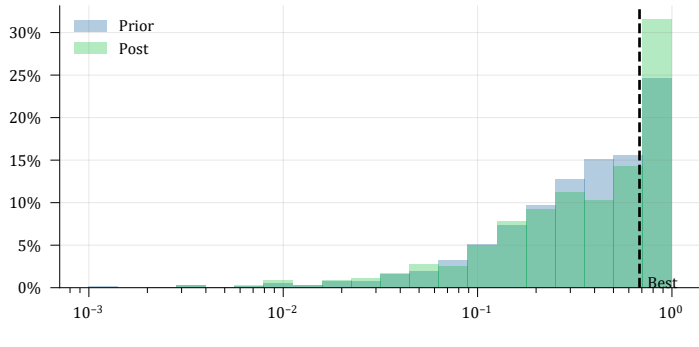
kz_p191(Pilot_Point_L1)



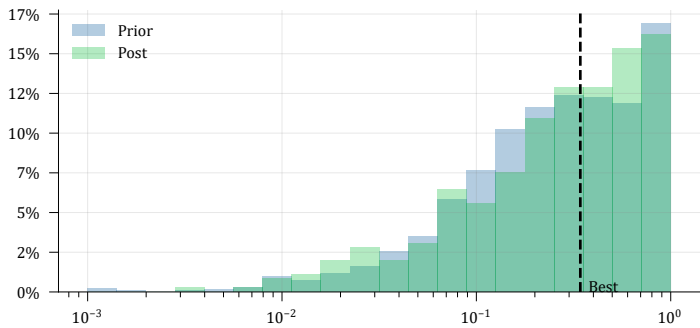
kz_p192(Pilot_Point_L1)



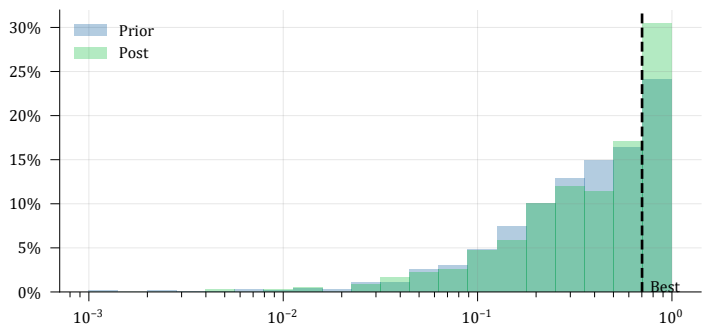
kz_p193(Pilot_Point_L1)



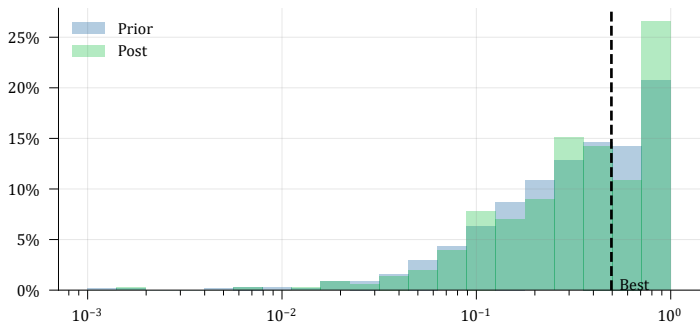
kz_p194(Pilot_Point_L1)



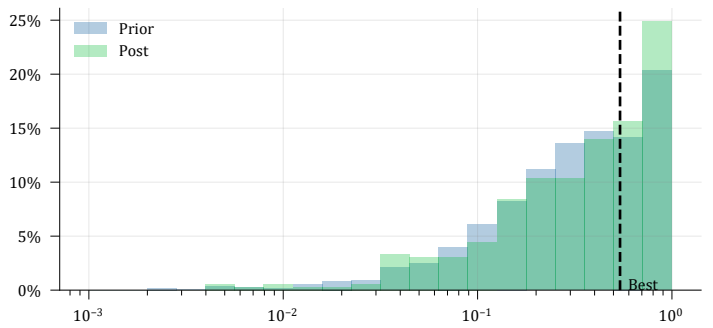
kz_p195(Pilot_Point_L1)



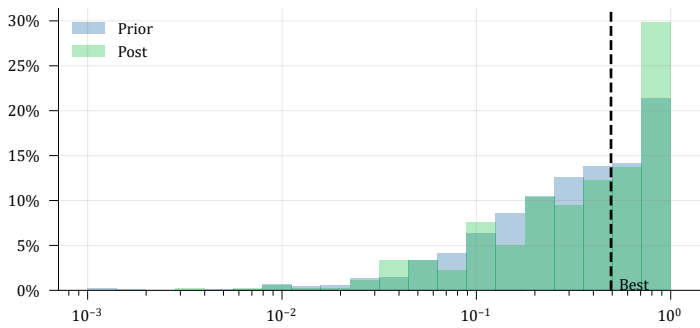
kz_p196(Pilot_Point_L1)



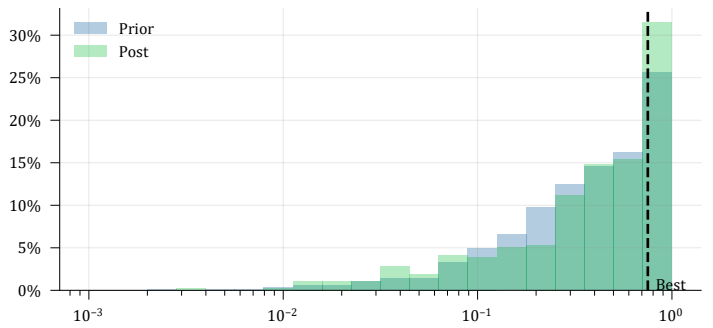
kz_p197(Pilot_Point_L1)



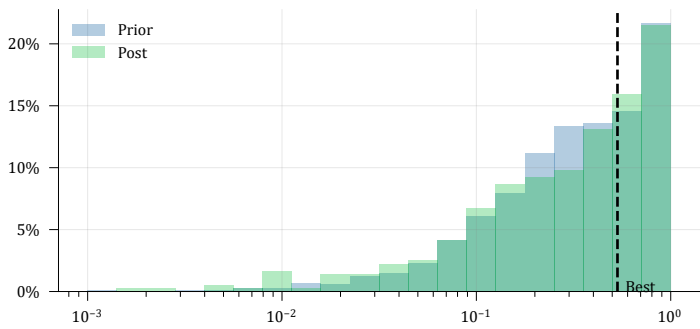
kz_p198(Pilot_Point_L1)



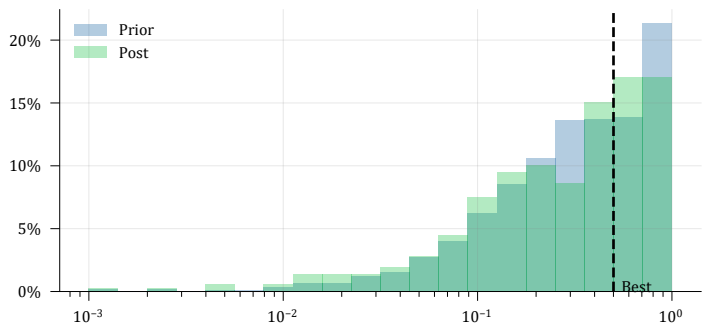
kz_p199(Pilot_Point_L1)



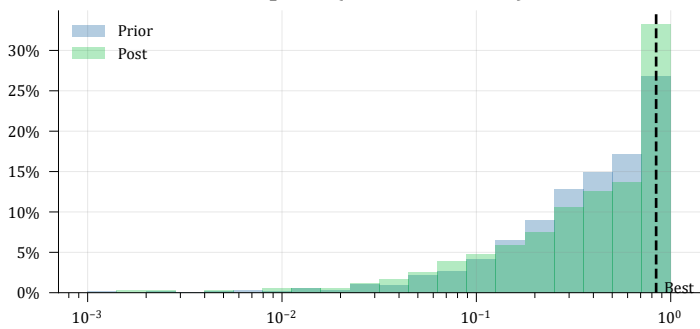
kz_p200(Pilot_Point_L1)



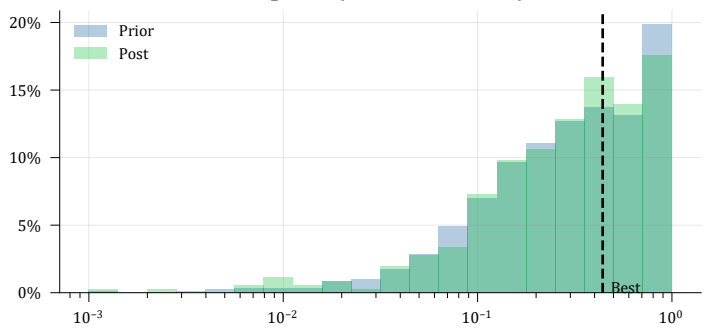
kz_p201(Pilot_Point_L1)



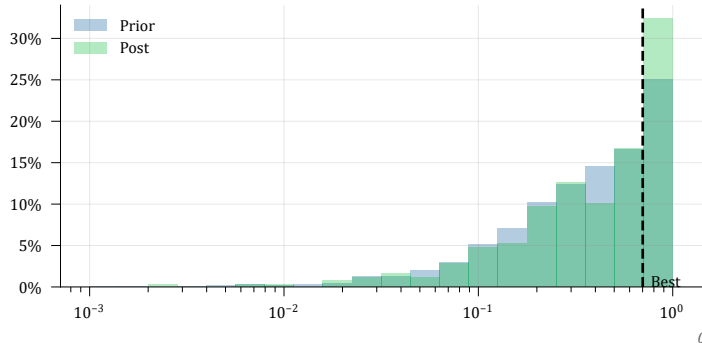
kz_p202(Pilot_Point_L1)



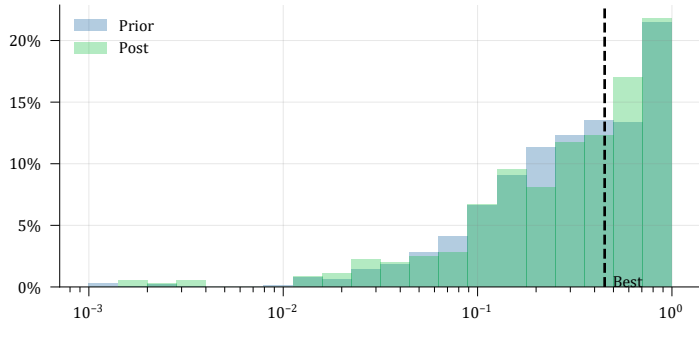
kz_p203(Pilot_Point_L1)



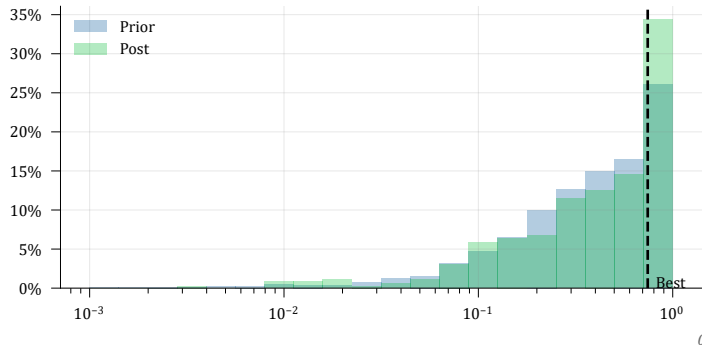
kz_p204(Pilot_Point_L1)



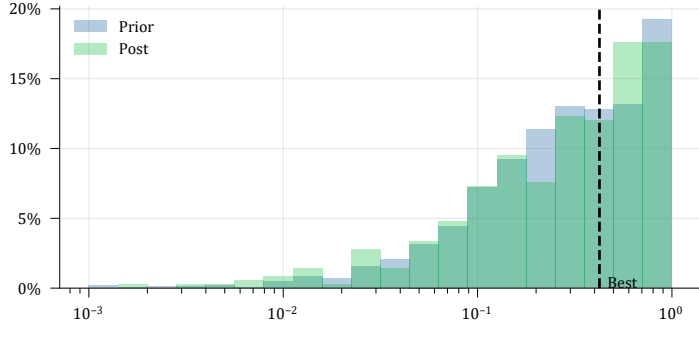
kz_p205(Pilot_Point_L1)



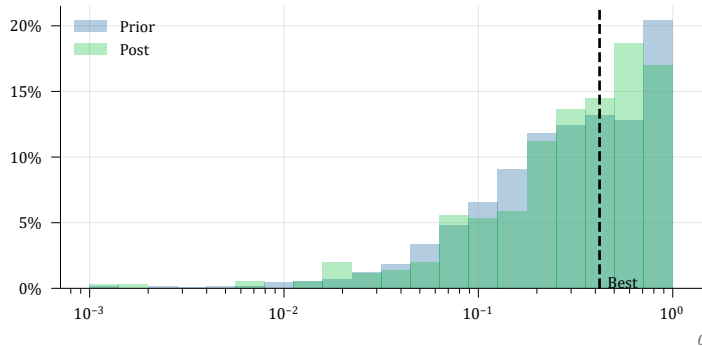
kz_p206(Pilot_Point_L1)



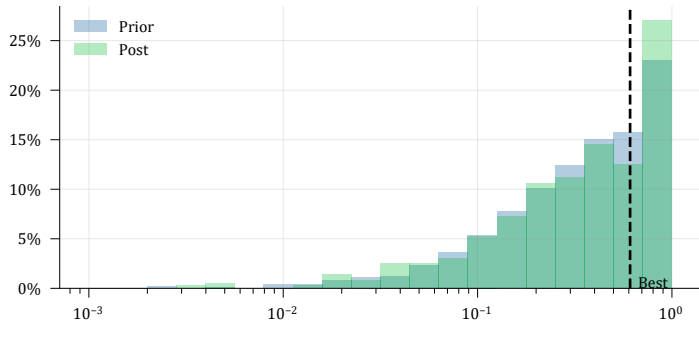
kz_p207(Pilot_Point_L1)



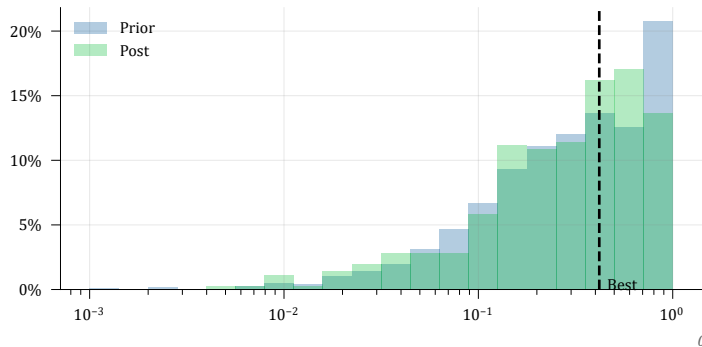
kz_p208(Pilot_Point_L1)



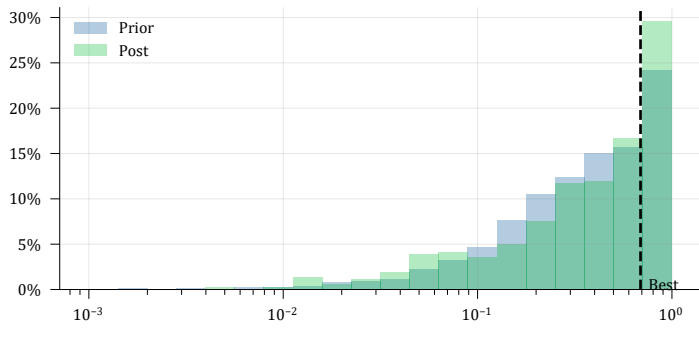
kz_p209(Pilot_Point_L1)



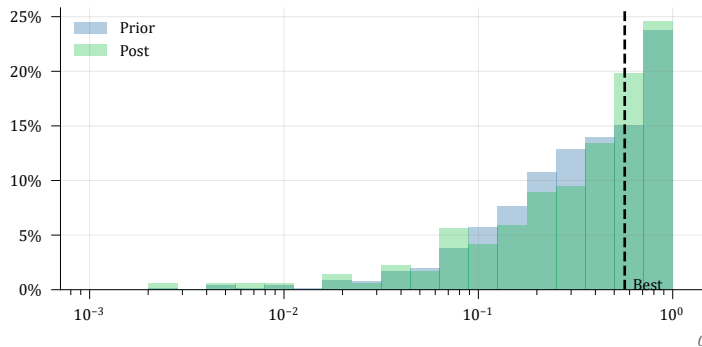
kz_p210(Pilot_Point_L1)



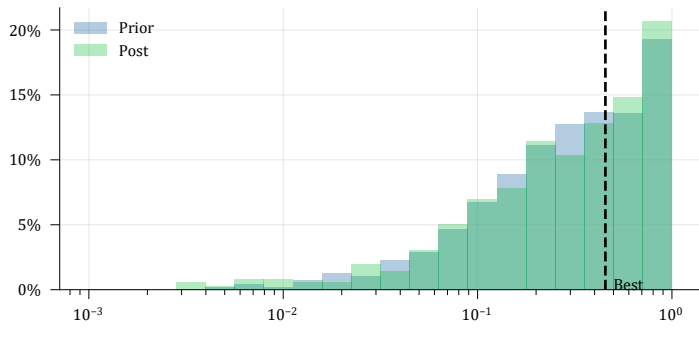
kz_p211(Pilot_Point_L1)

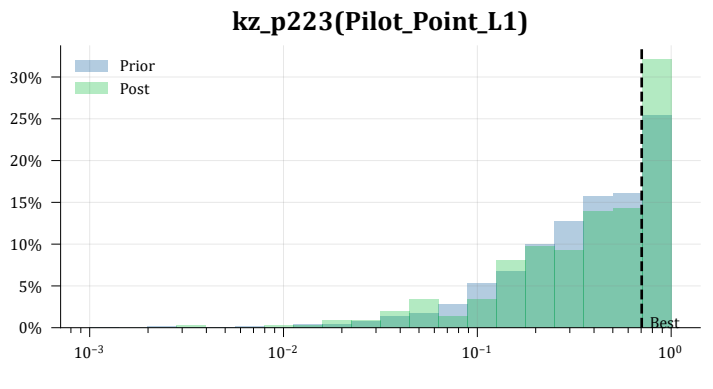
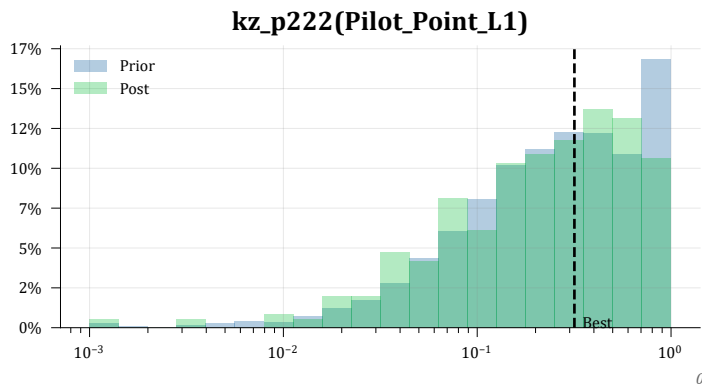
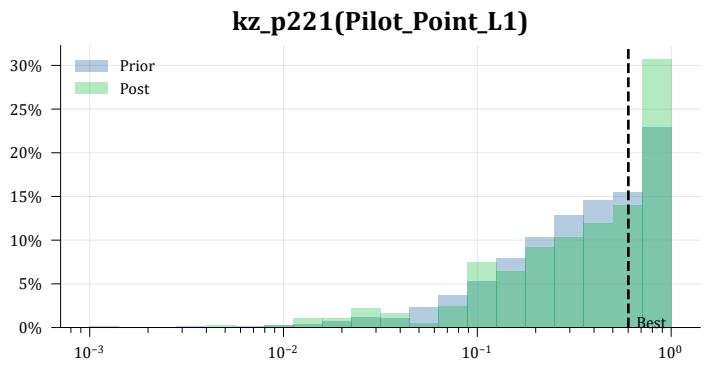
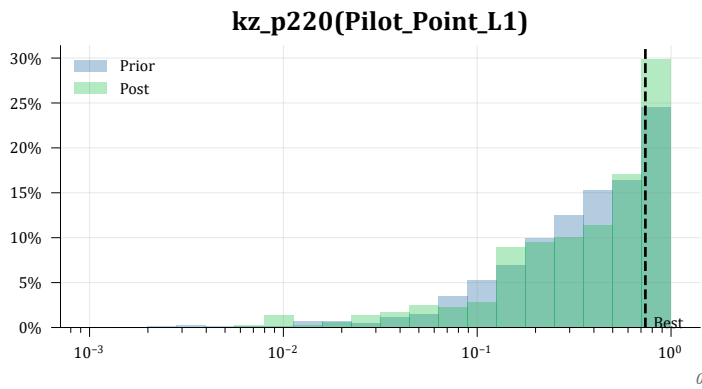
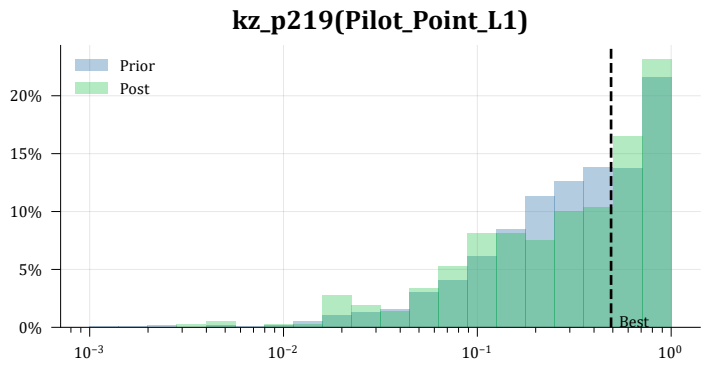
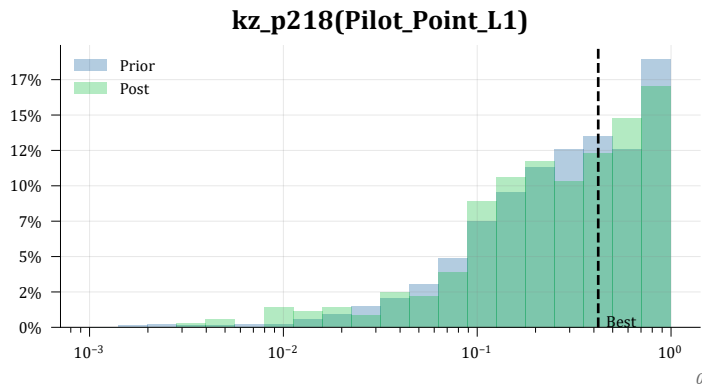
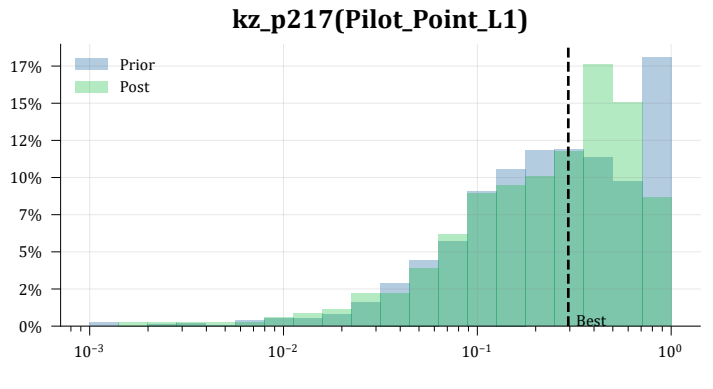
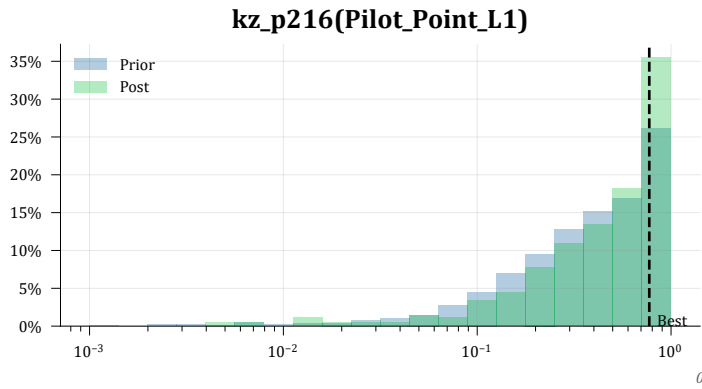
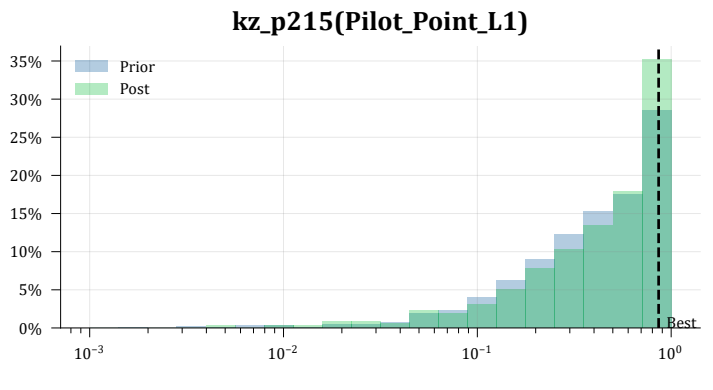
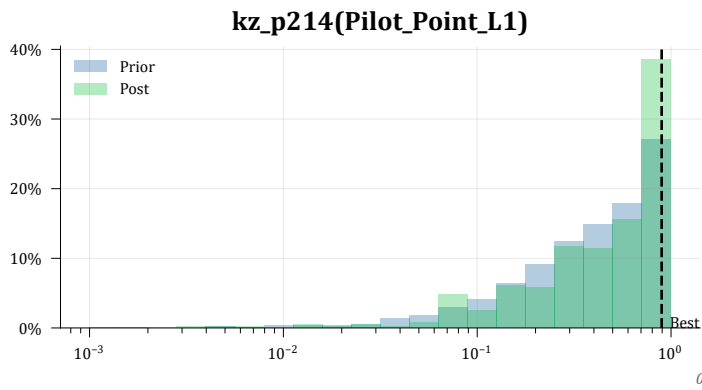


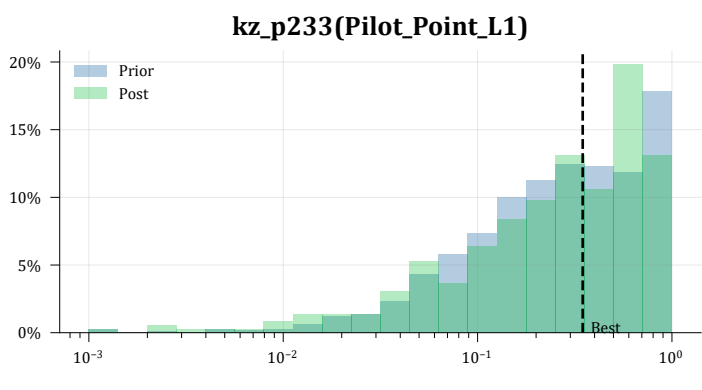
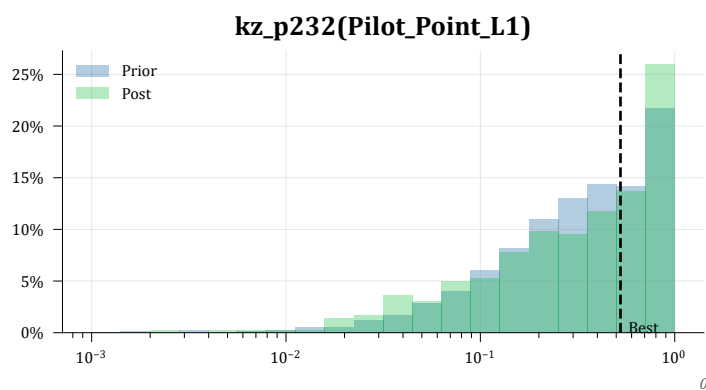
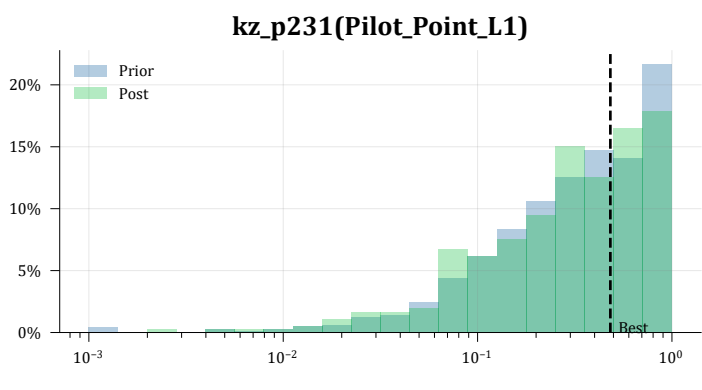
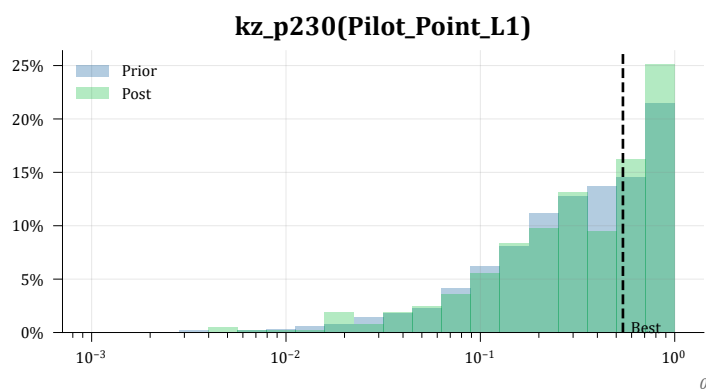
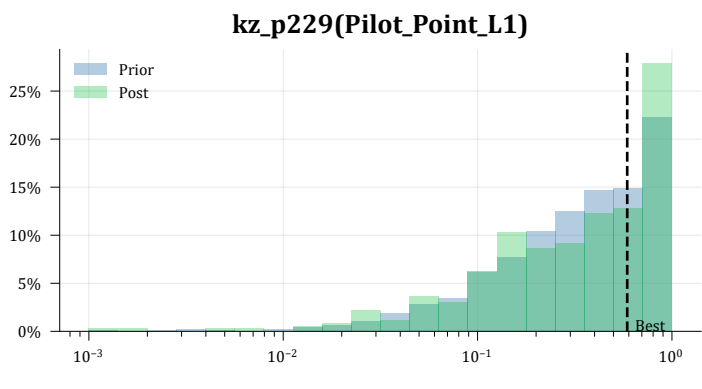
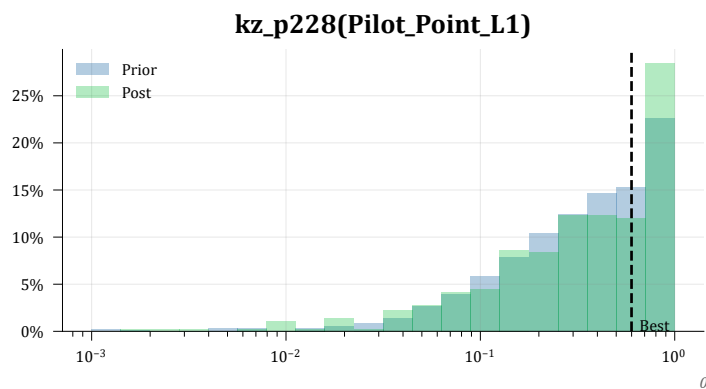
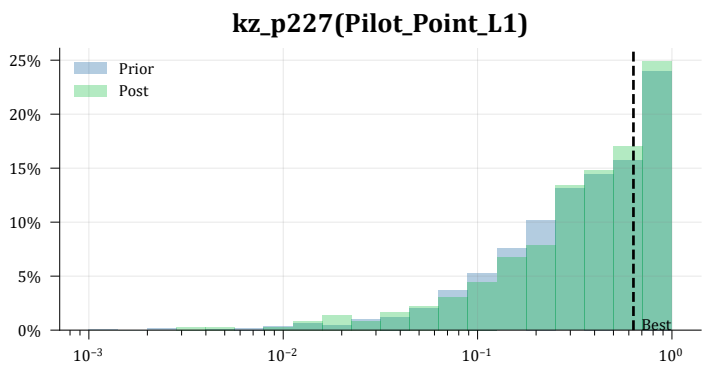
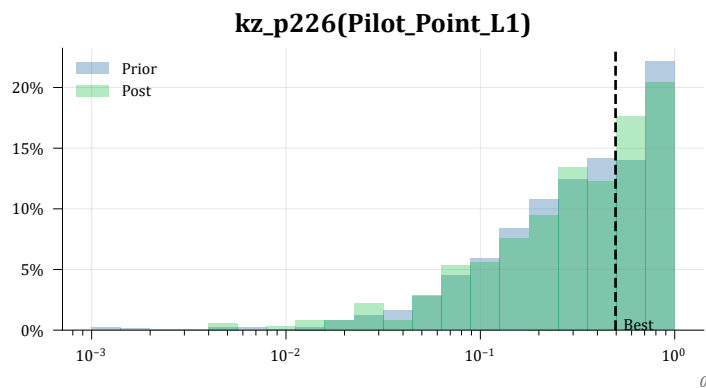
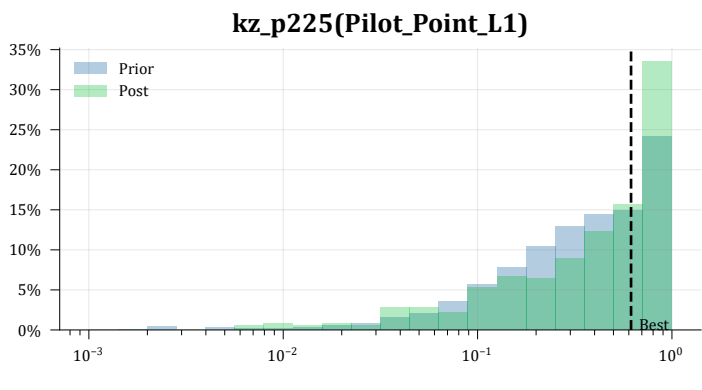
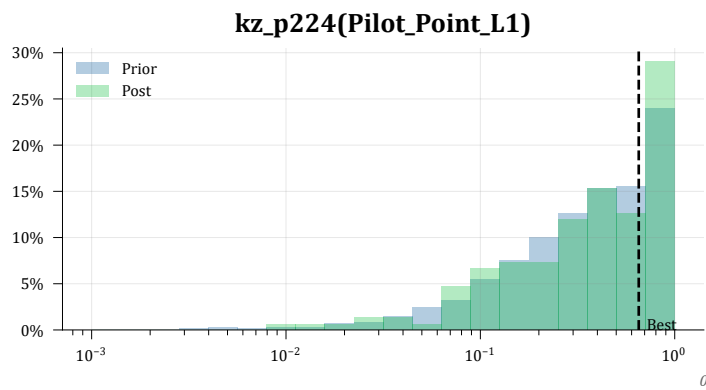
kz_p212(Pilot_Point_L1)



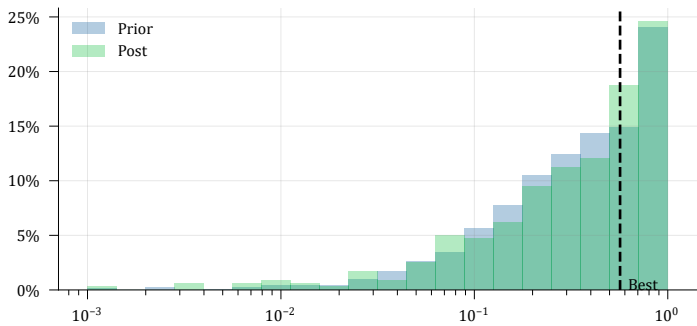
kz_p213(Pilot_Point_L1)



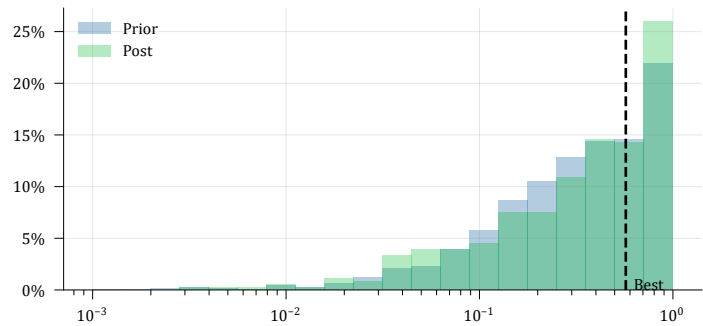




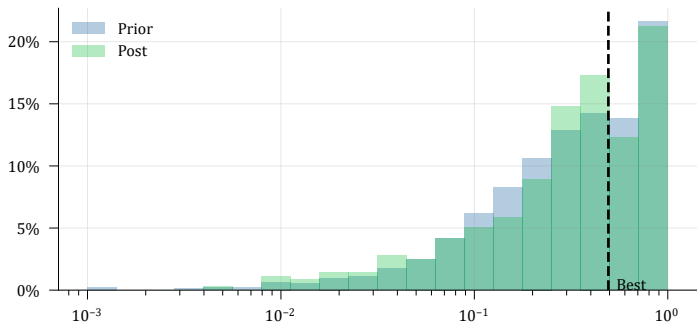
kz_p234(Pilot_Point_L1)



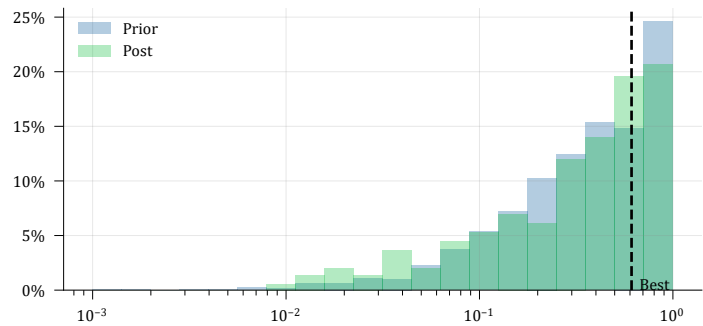
kz_p235(Pilot_Point_L1)



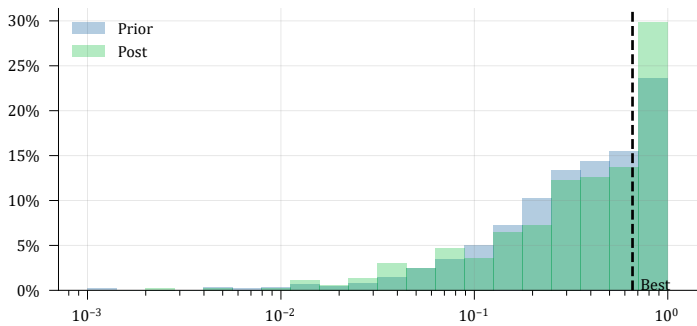
kz_p236(Pilot_Point_L1)



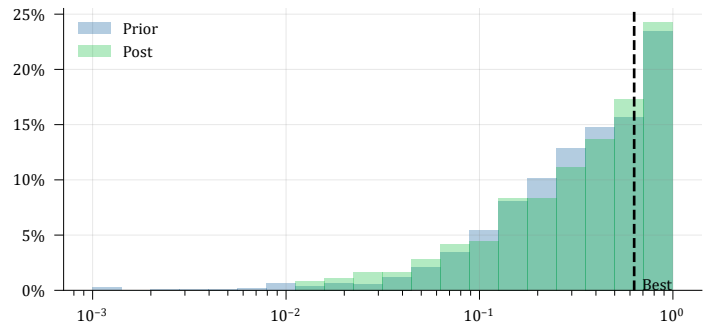
kz_p237(Pilot_Point_L1)



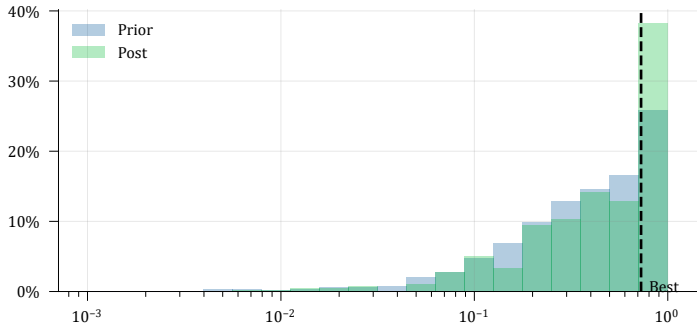
kz_p238(Pilot_Point_L1)



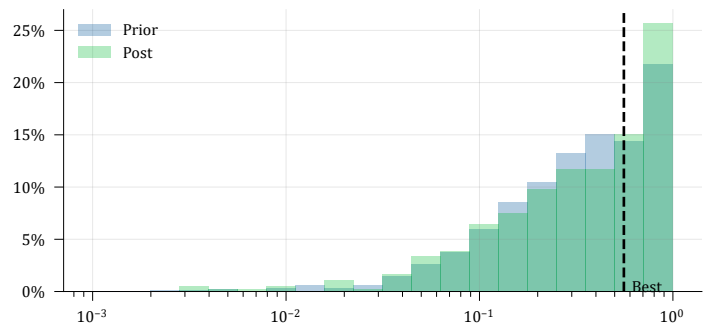
kz_p239(Pilot_Point_L1)



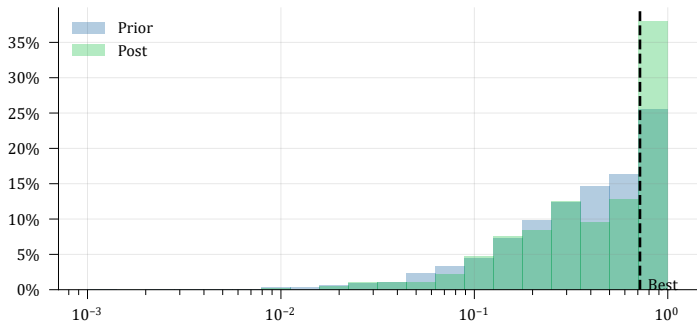
kz_p240(Pilot_Point_L1)



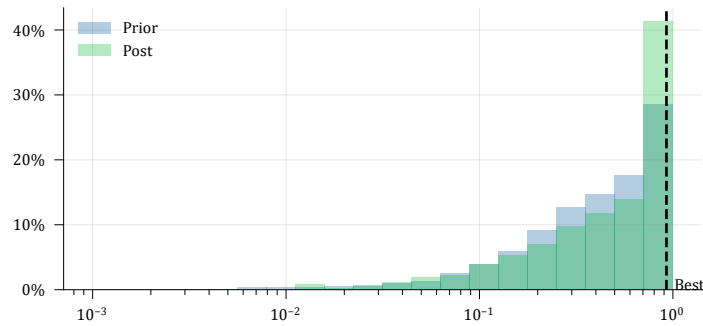
kz_p241(Pilot_Point_L1)



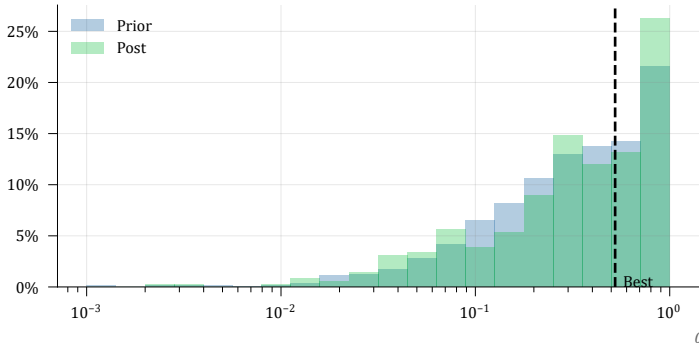
kz_p242(Pilot_Point_L1)



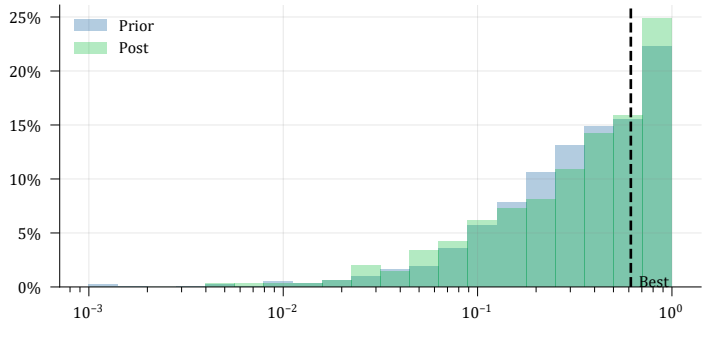
kz_p243(Pilot_Point_L1)



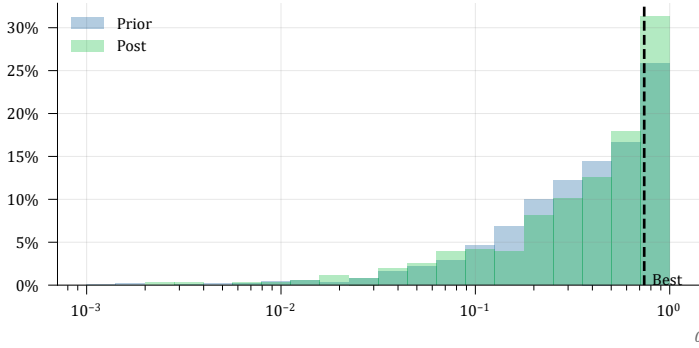
kz_p244(Pilot_Point_L1)



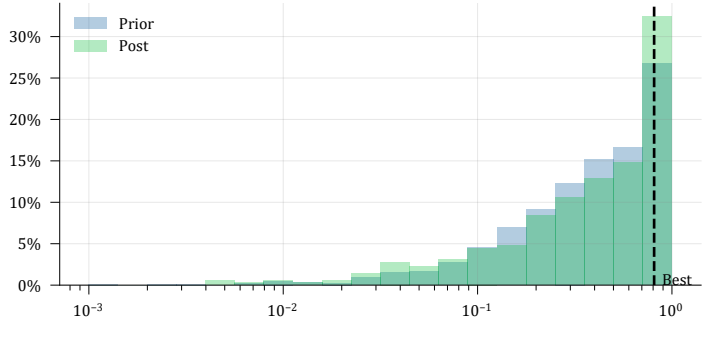
kz_p245(Pilot_Point_L1)



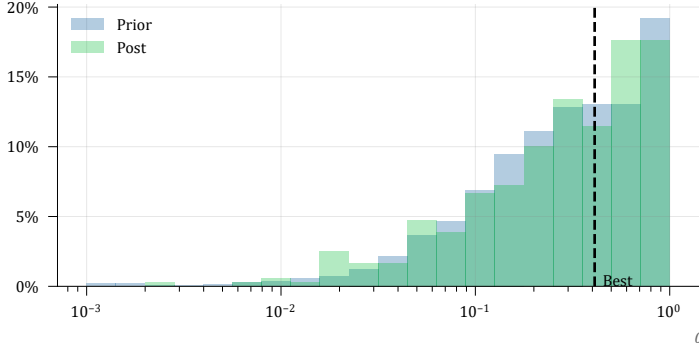
kz_p246(Pilot_Point_L1)



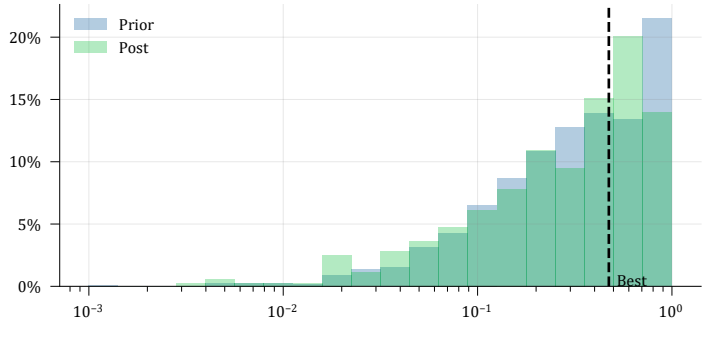
kz_p247(Pilot_Point_L1)



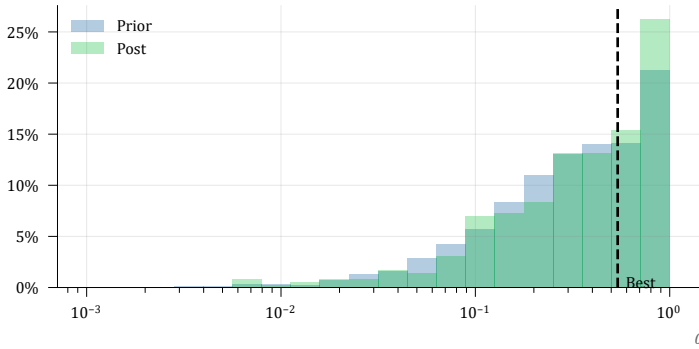
kz_p248(Pilot_Point_L1)



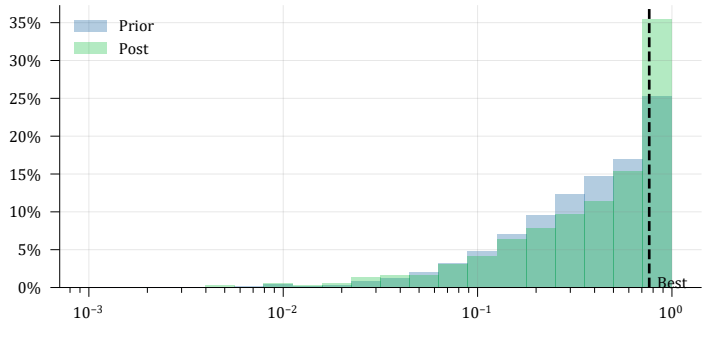
kz_p249(Pilot_Point_L1)



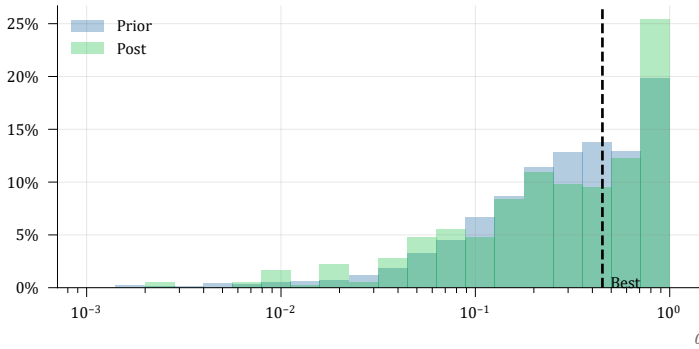
kz_p250(Pilot_Point_L1)



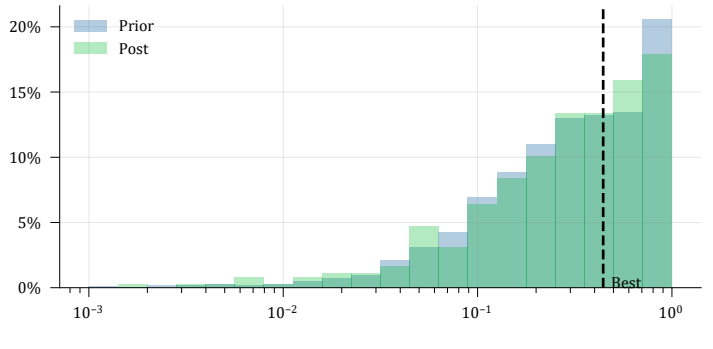
kz_p251(Pilot_Point_L1)



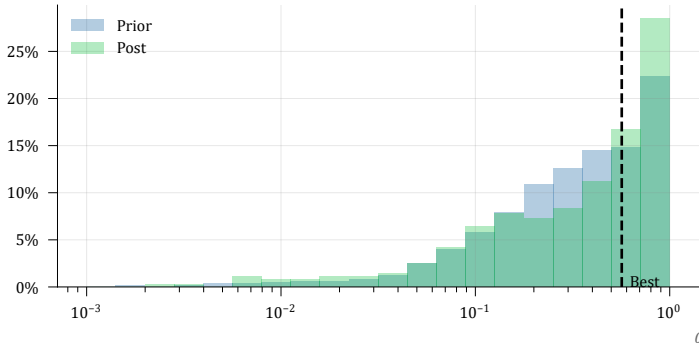
kz_p252(Pilot_Point_L1)



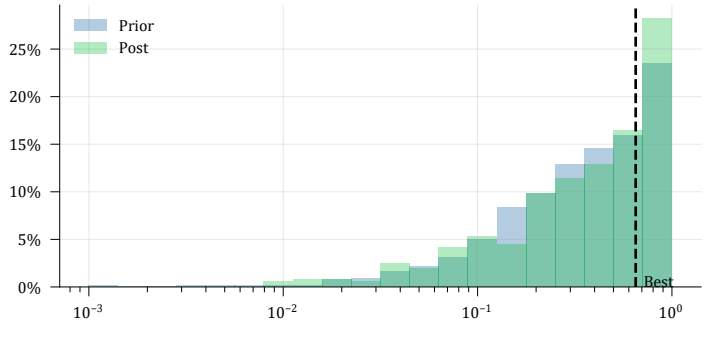
kz_p253(Pilot_Point_L1)



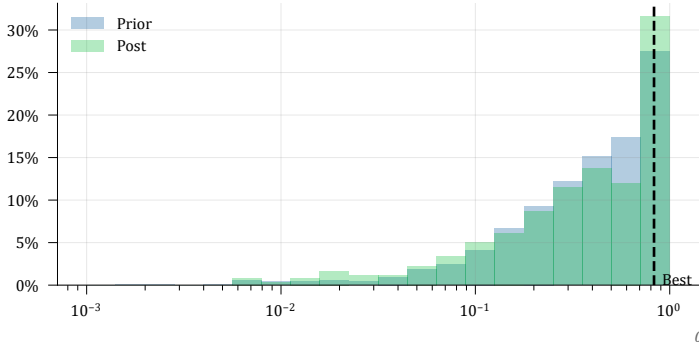
kz_p254(Pilot_Point_L1)



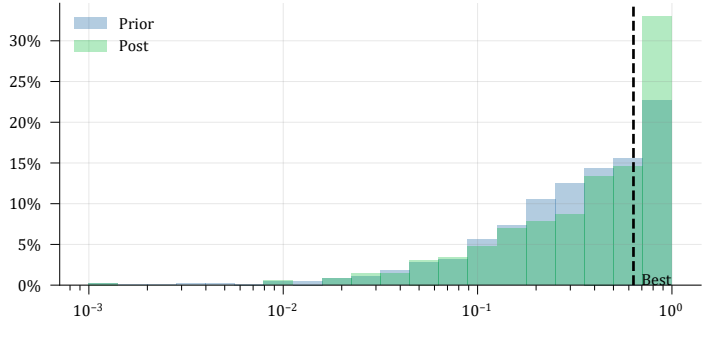
kz_p255(Pilot_Point_L1)



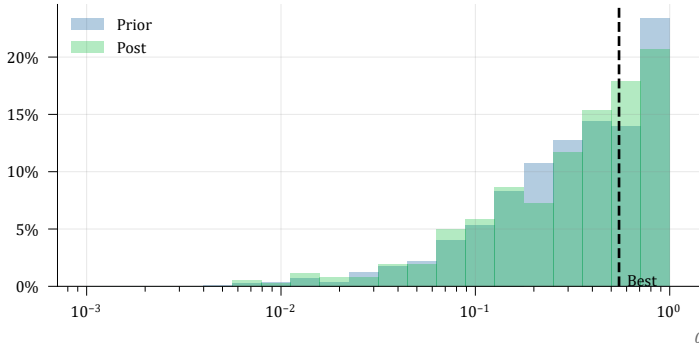
kz_p256(Pilot_Point_L1)



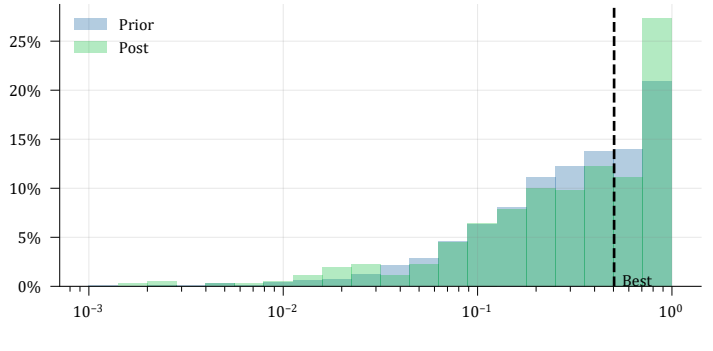
kz_p257(Pilot_Point_L1)



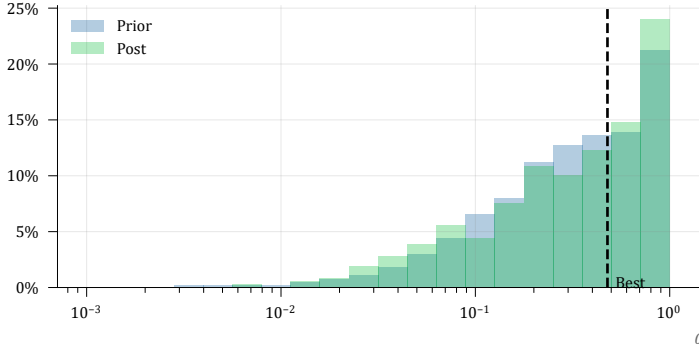
kz_p258(Pilot_Point_L1)



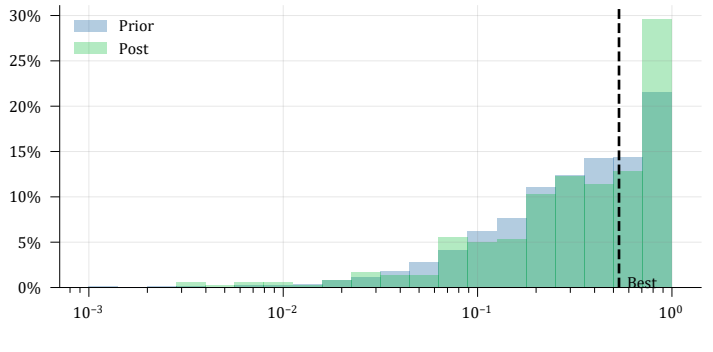
kz_p259(Pilot_Point_L1)



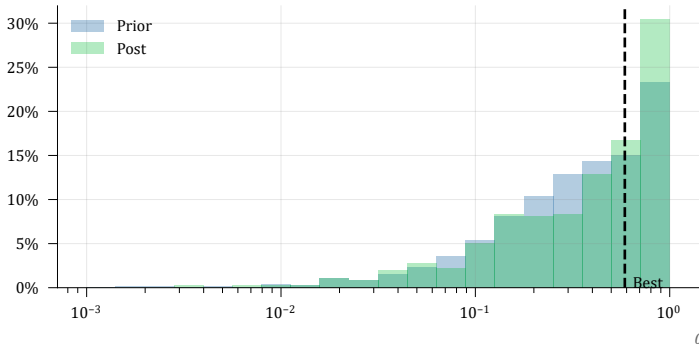
kz_p260(Pilot_Point_L1)



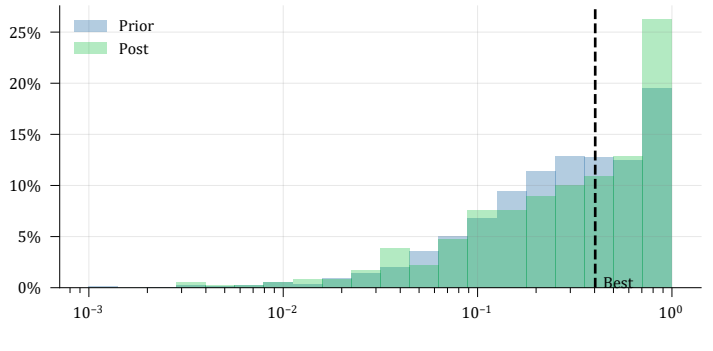
kz_p261(Pilot_Point_L1)



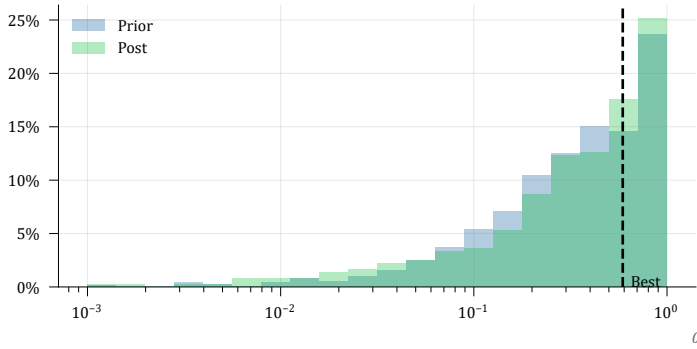
kz_p262(Pilot_Point_L1)



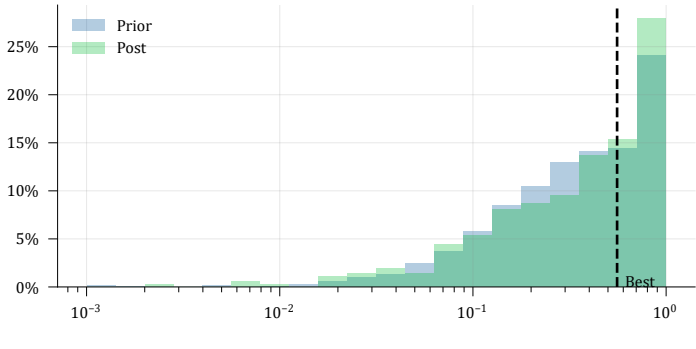
kz_p263(Pilot_Point_L1)



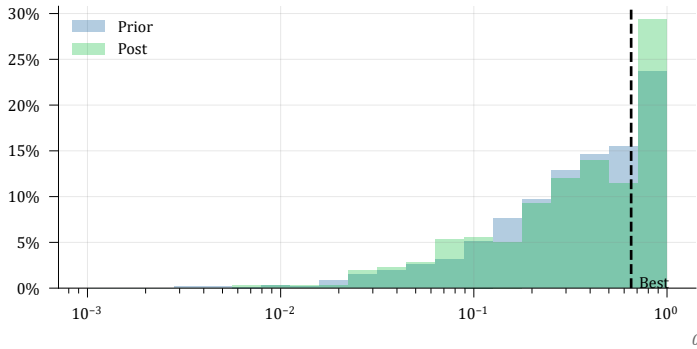
kz_p264(Pilot_Point_L1)



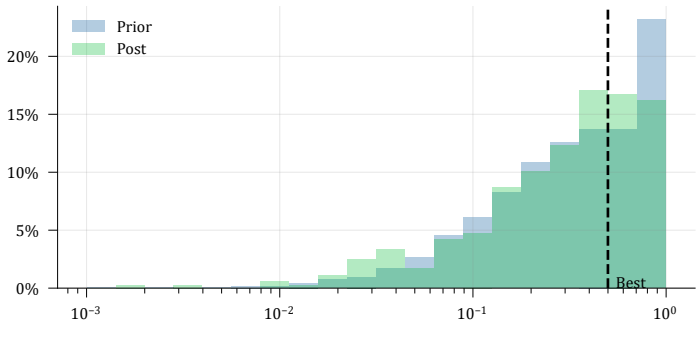
kz_p265(Pilot_Point_L1)



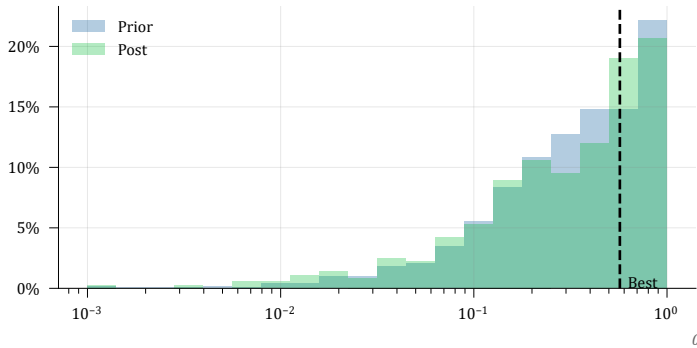
kz_p266(Pilot_Point_L1)



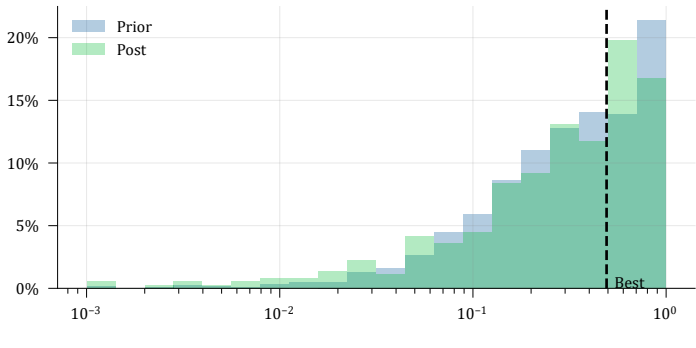
kz_p267(Pilot_Point_L1)



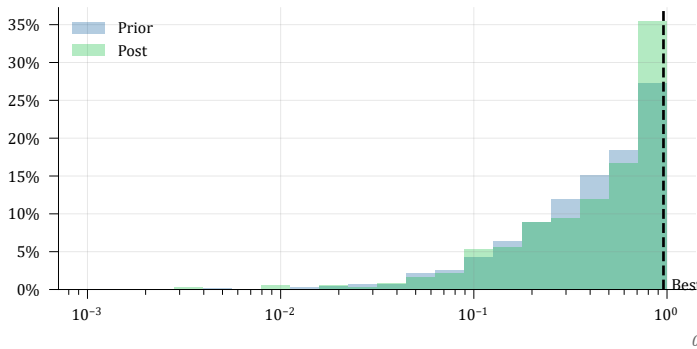
kz_p268(Pilot_Point_L1)



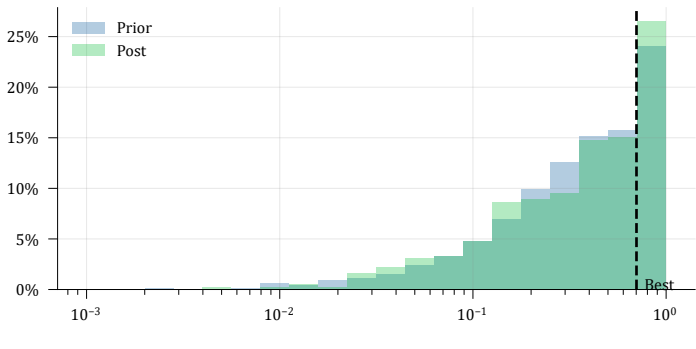
kz_p269(Pilot_Point_L1)



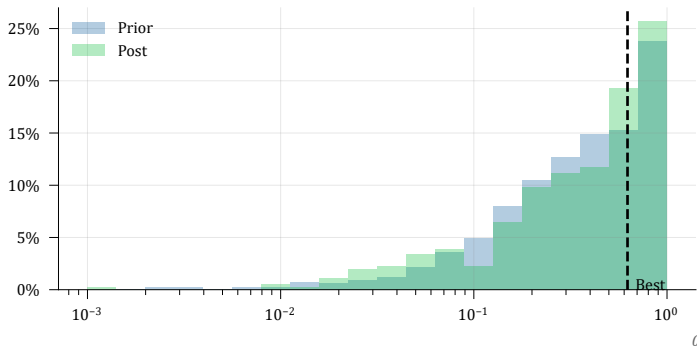
kz_p270(Pilot_Point_L1)



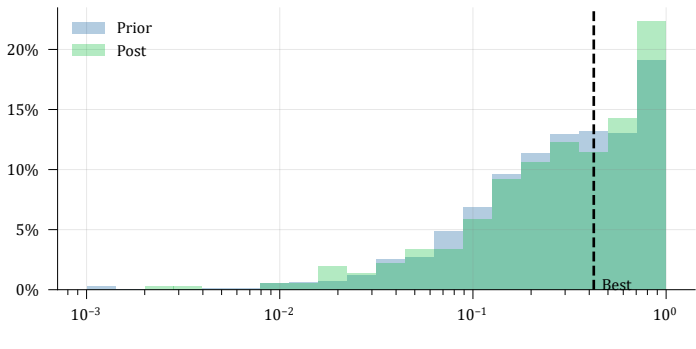
kz_p271(Pilot_Point_L1)

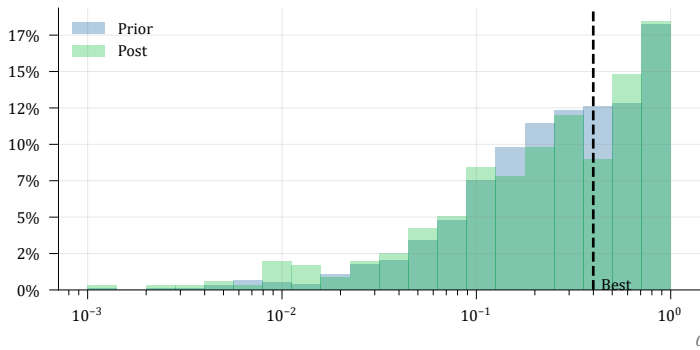
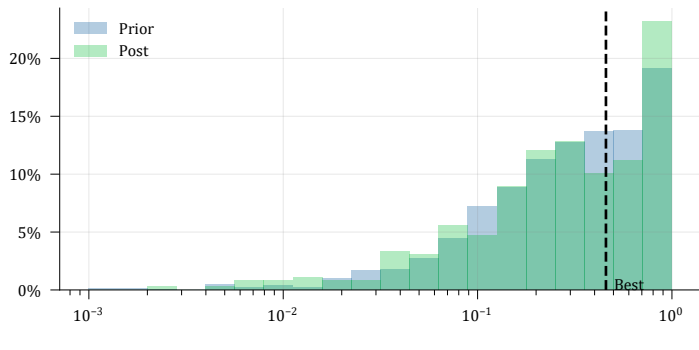
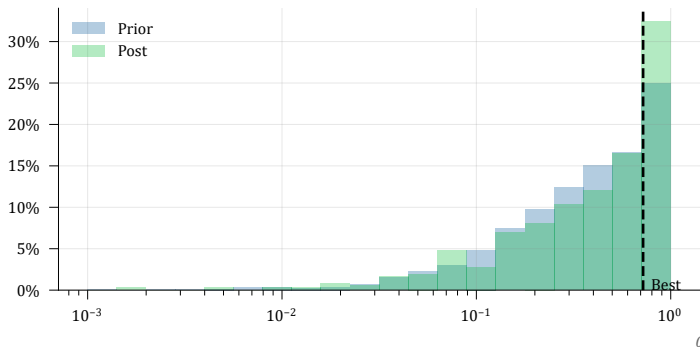
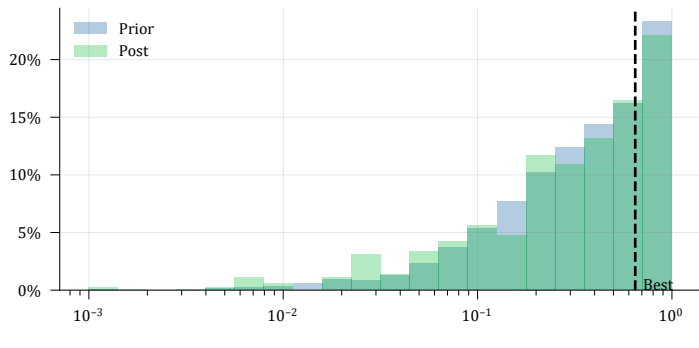
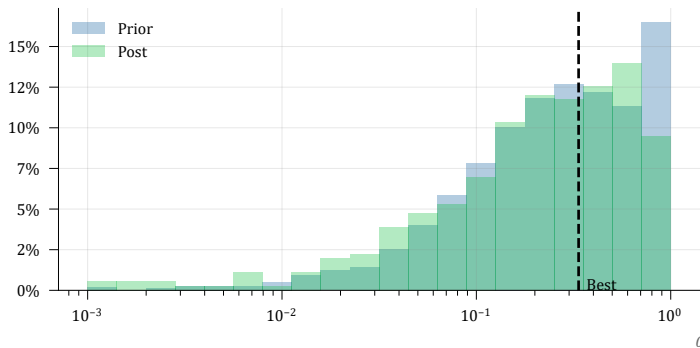
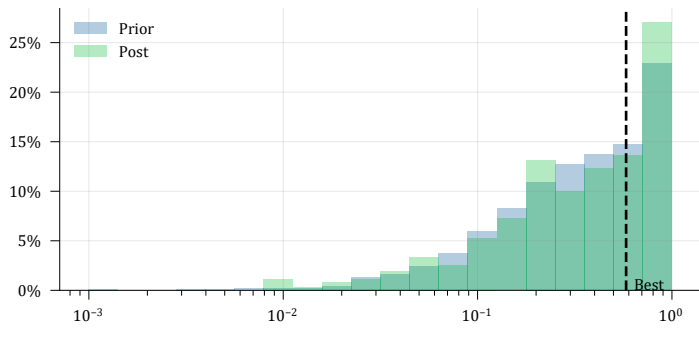
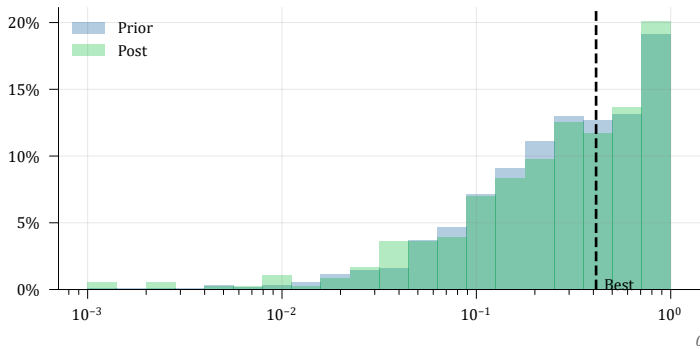
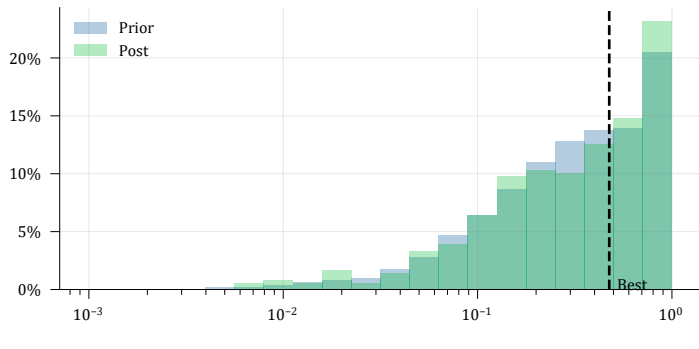
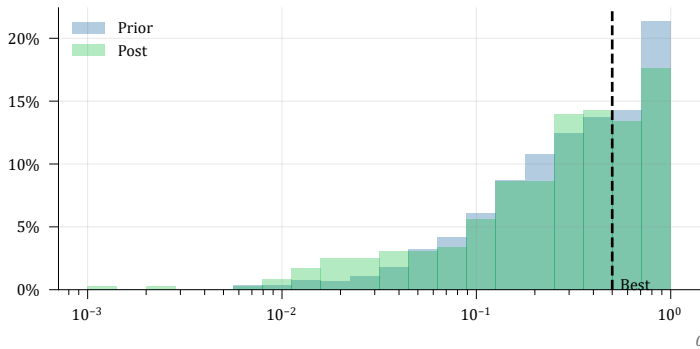
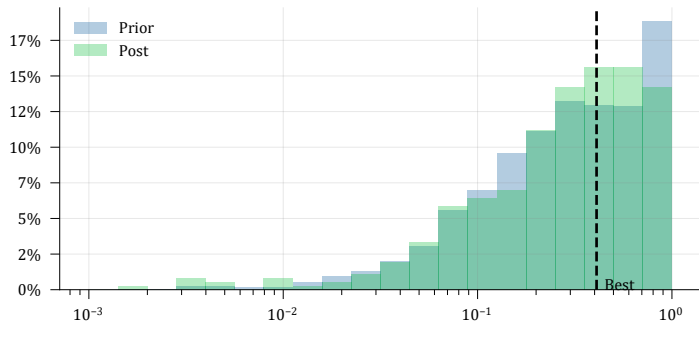


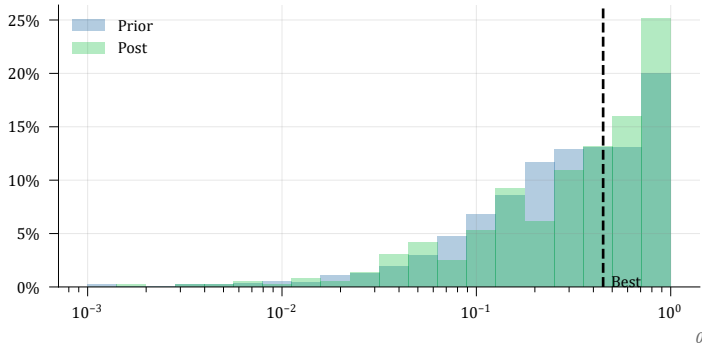
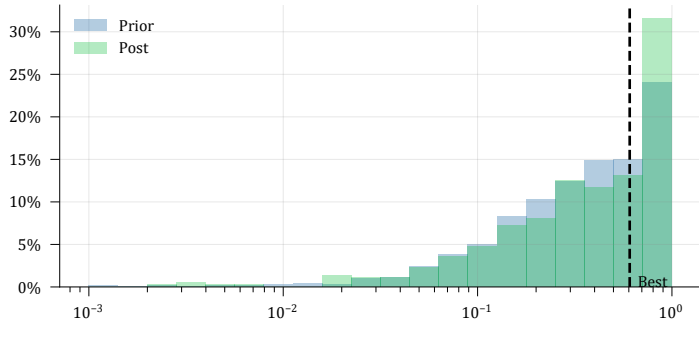
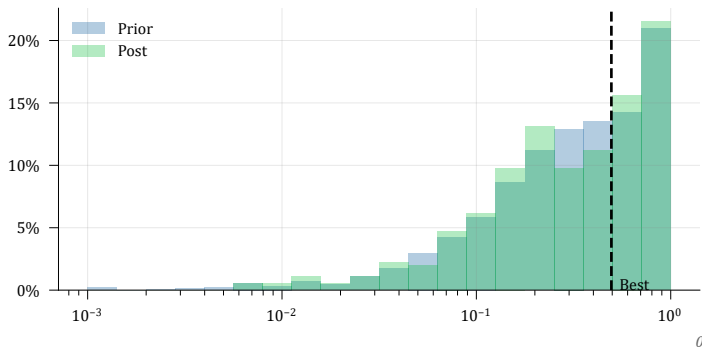
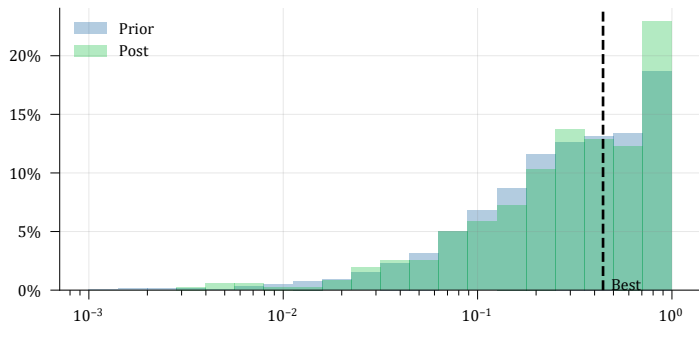
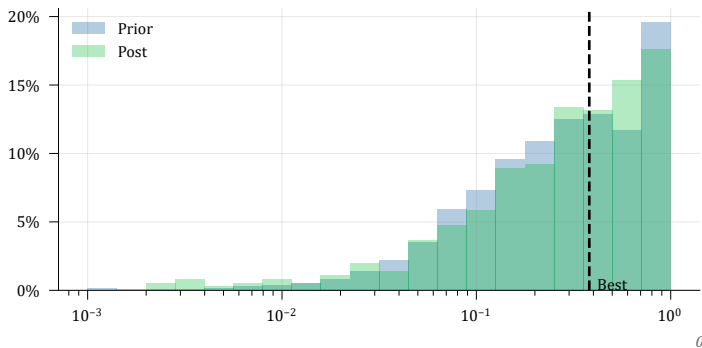
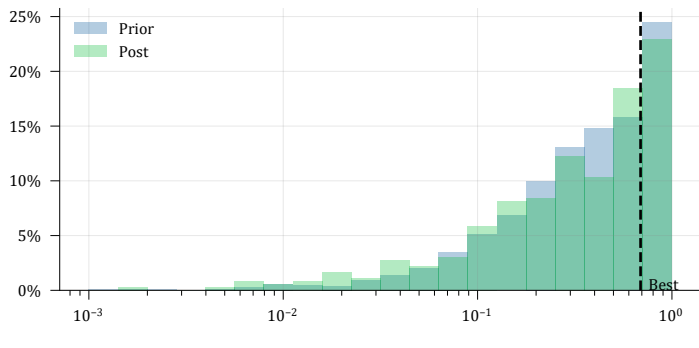
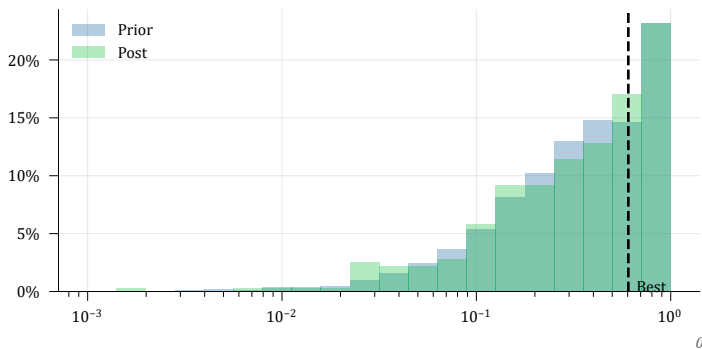
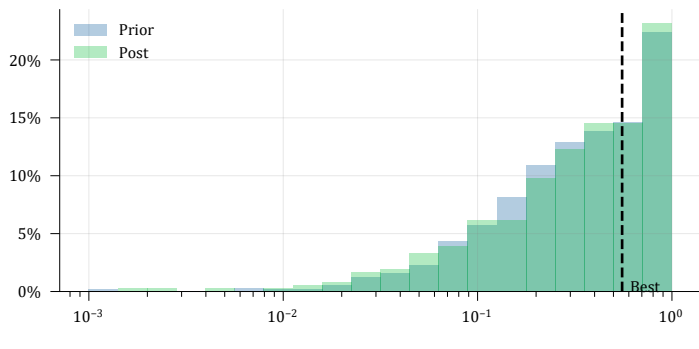
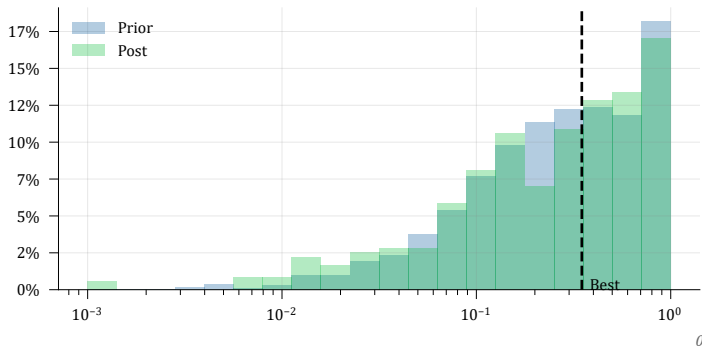
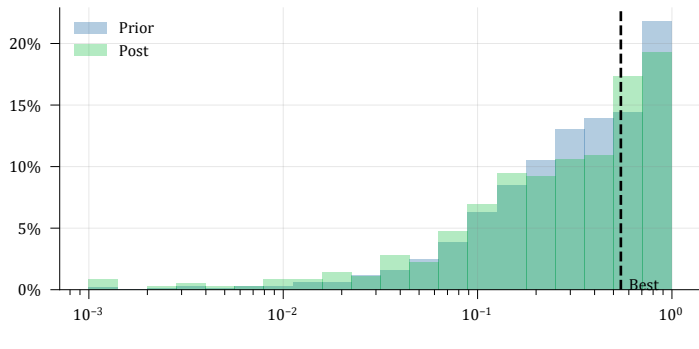
kz_p272(Pilot_Point_L1)



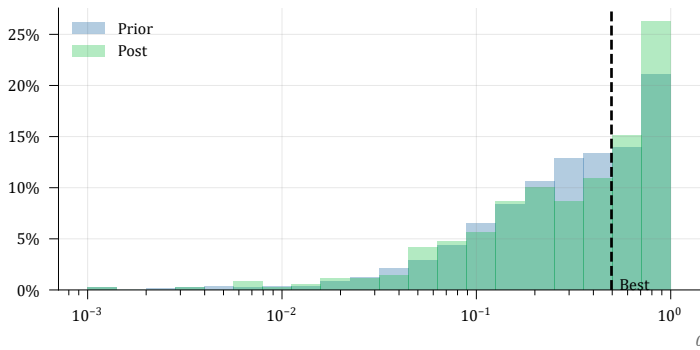
kz_p273(Pilot_Point_L1)



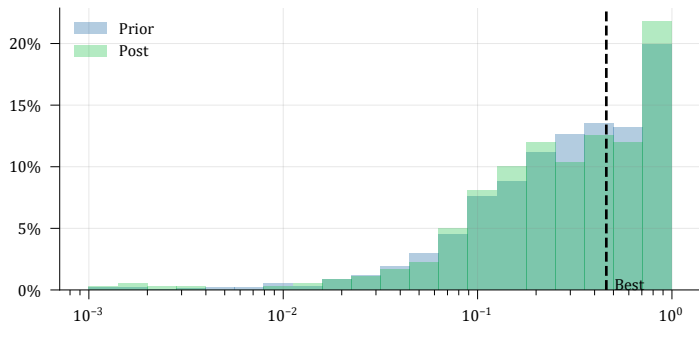
kz_p274(Pilot_Point_L1)**kz_p275(Pilot_Point_L1)****kz_p276(Pilot_Point_L1)****kz_p277(Pilot_Point_L1)****kz_p278(Pilot_Point_L1)****kz_p279(Pilot_Point_L1)****kz_p280(Pilot_Point_L1)****kz_p281(Pilot_Point_L1)****kz_p282(Pilot_Point_L1)****kz_p283(Pilot_Point_L1)**

kz_p284(Pilot_Point_L1)**kz_p285(Pilot_Point_L1)****kz_p286(Pilot_Point_L1)****kz_p287(Pilot_Point_L1)****kz_p288(Pilot_Point_L1)****kz_p289(Pilot_Point_L1)****kz_p290(Pilot_Point_L1)****kz_p291(Pilot_Point_L1)****kz_p292(Pilot_Point_L1)****kz_p293(Pilot_Point_L1)**

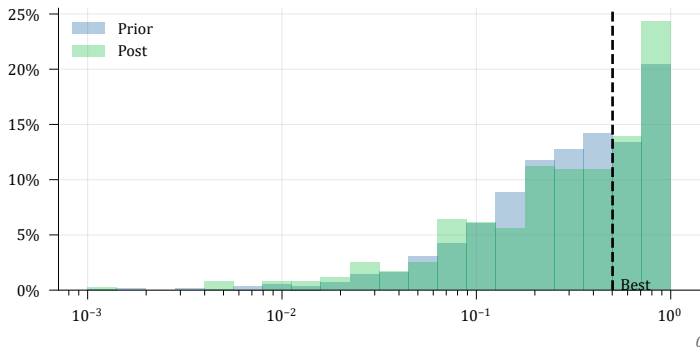
kz_p294(Pilot_Point_L1)



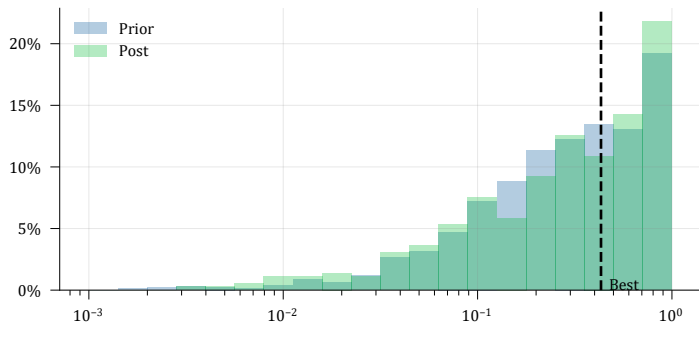
kz_p295(Pilot_Point_L1)



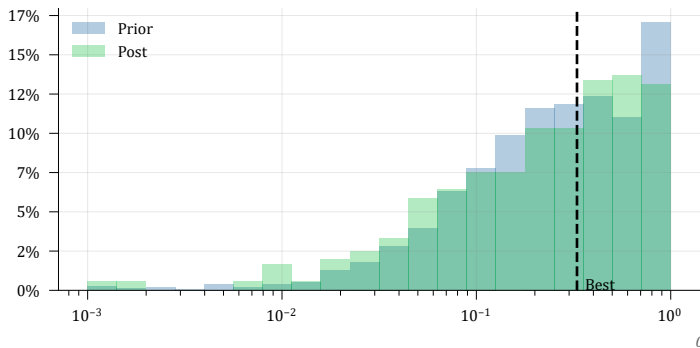
kz_p296(Pilot_Point_L1)



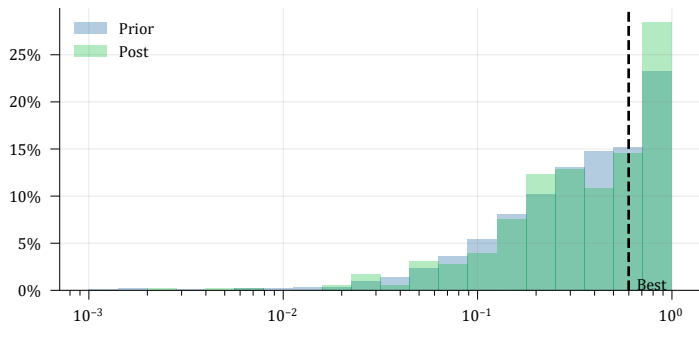
kz_p297(Pilot_Point_L1)



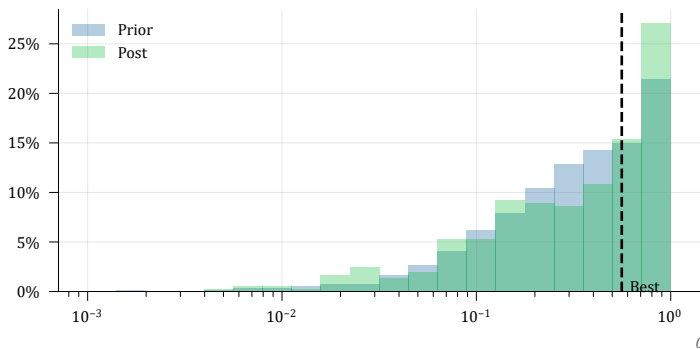
kz_p298(Pilot_Point_L1)



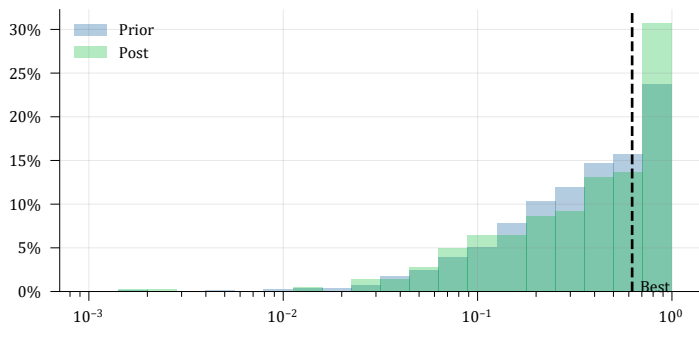
kz_p299(Pilot_Point_L1)



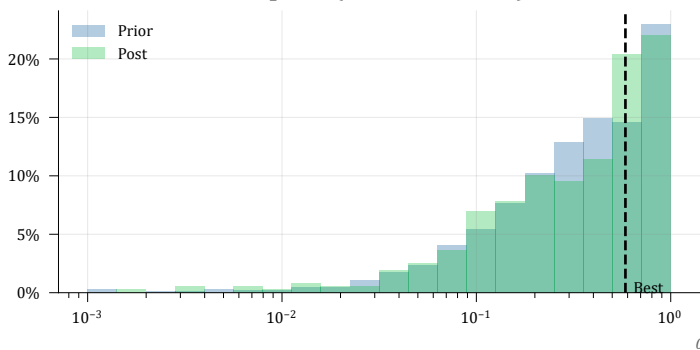
kz_p300(Pilot_Point_L1)



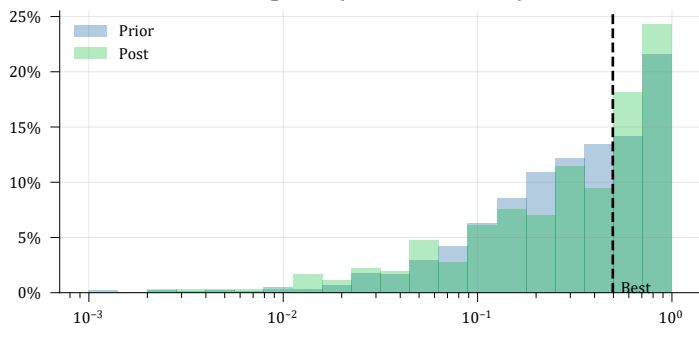
kz_p301(Pilot_Point_L1)

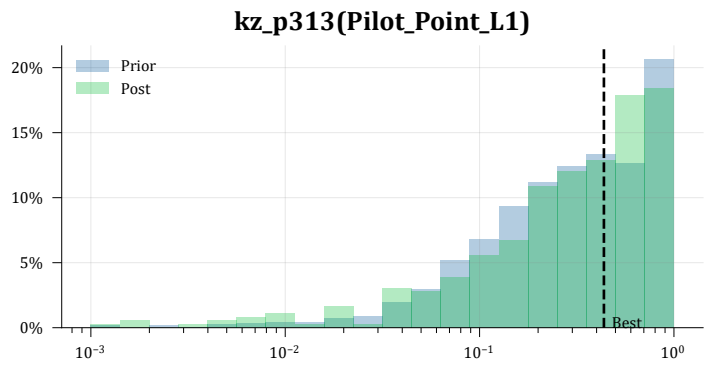
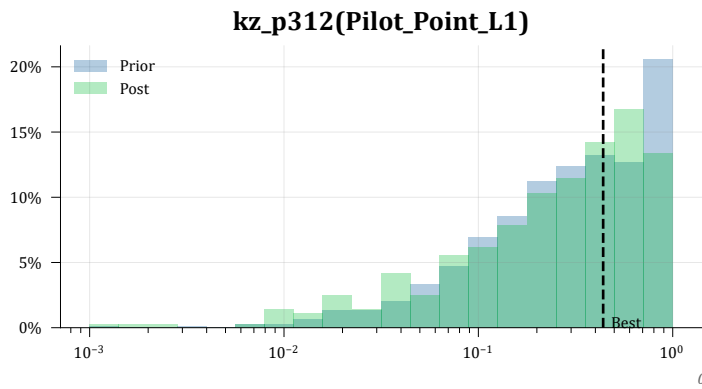
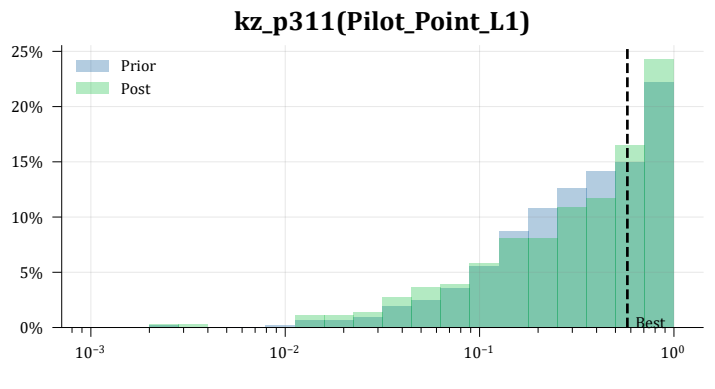
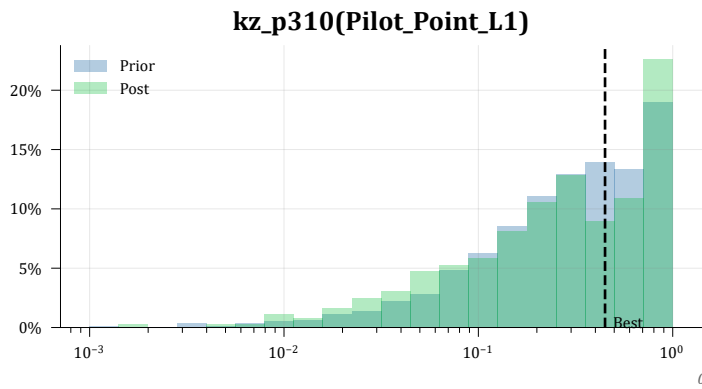
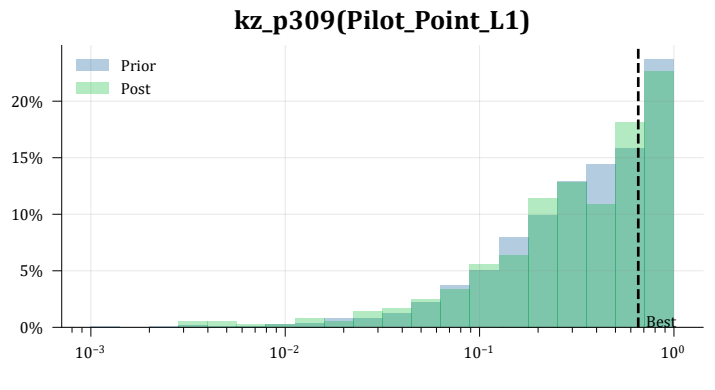
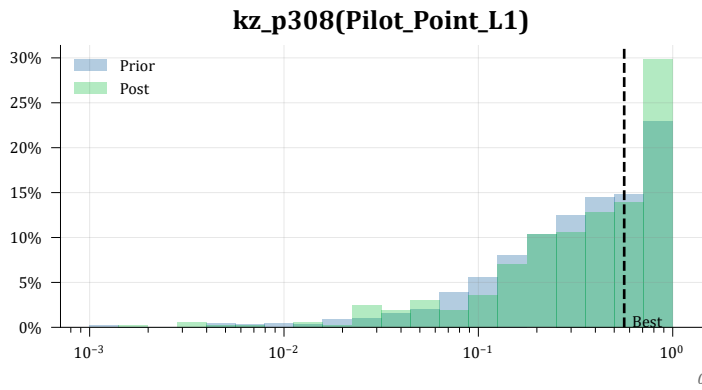
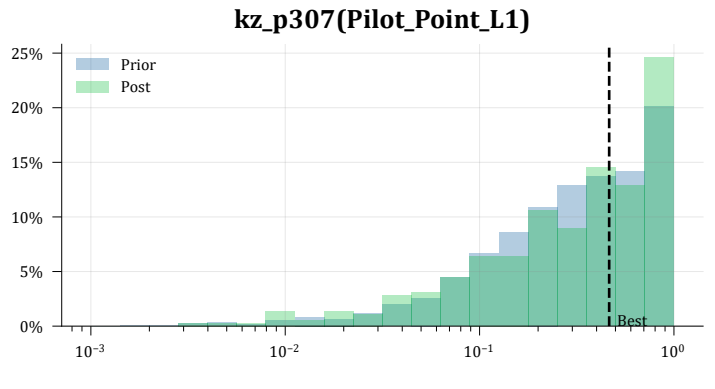
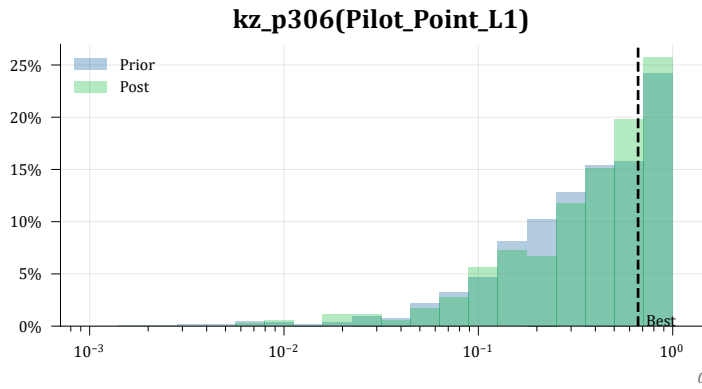
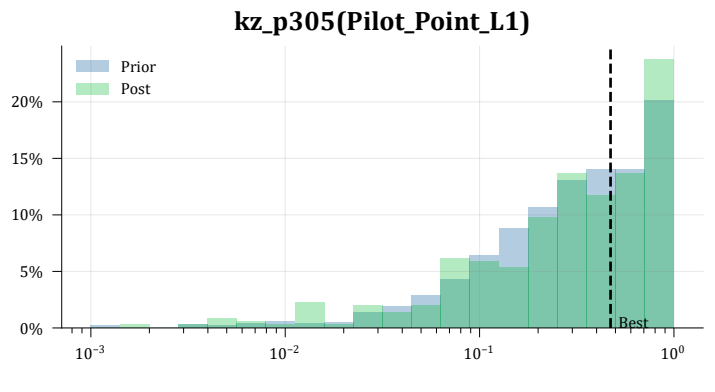
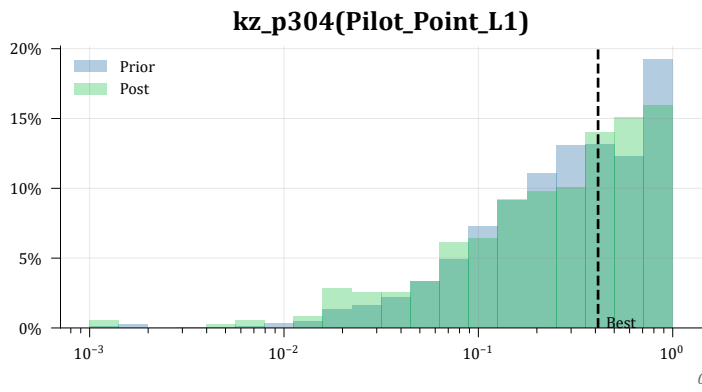


kz_p302(Pilot_Point_L1)

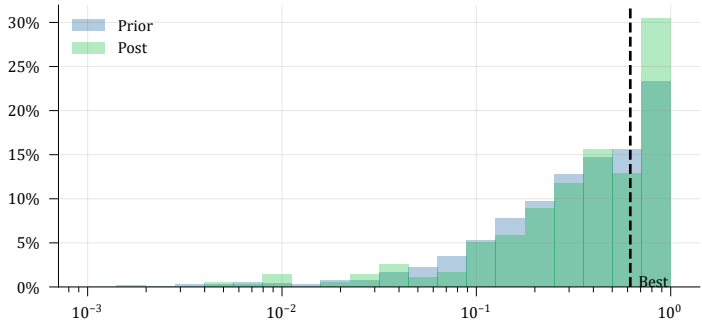


kz_p303(Pilot_Point_L1)

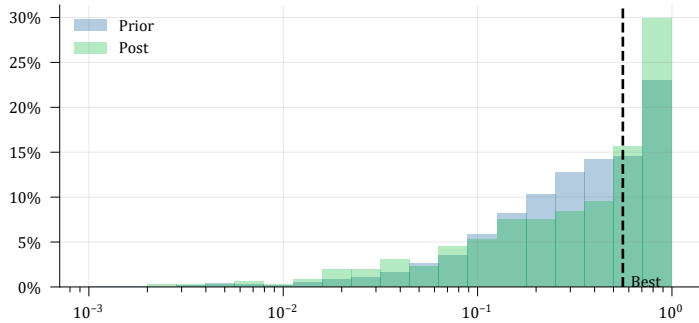




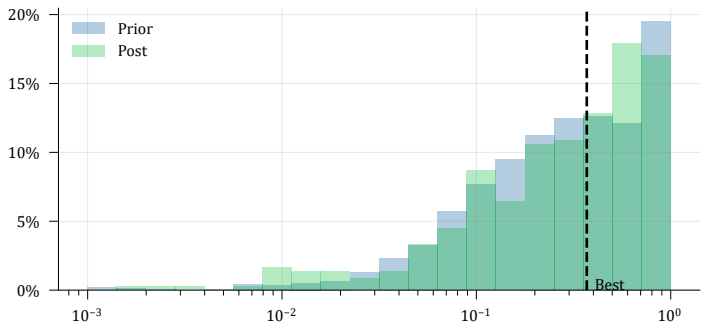
kz_p314(Pilot_Point_L1)



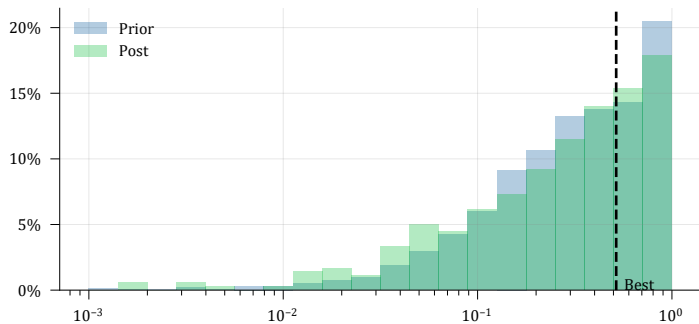
kz_p315(Pilot_Point_L1)



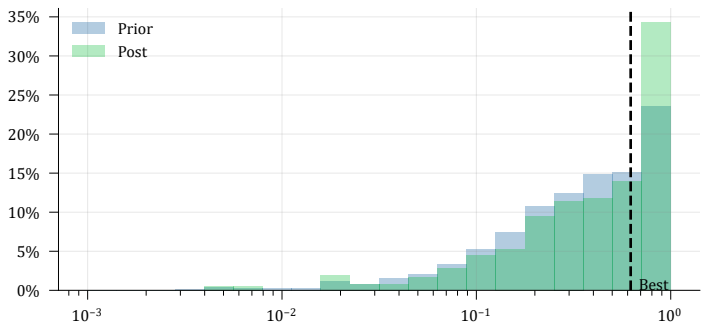
kz_p316(Pilot_Point_L1)



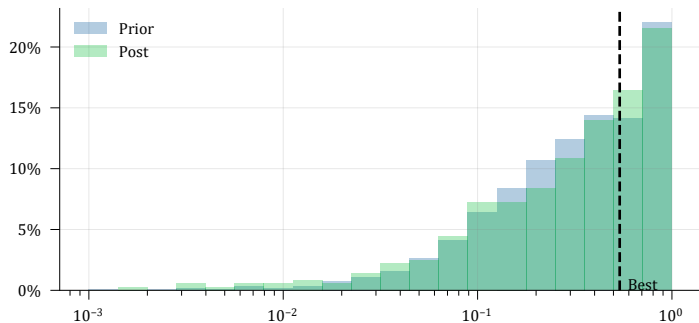
kz_p317(Pilot_Point_L1)



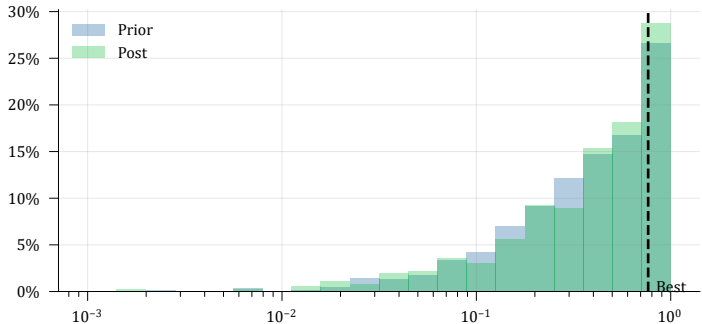
kz_p318(Pilot_Point_L1)



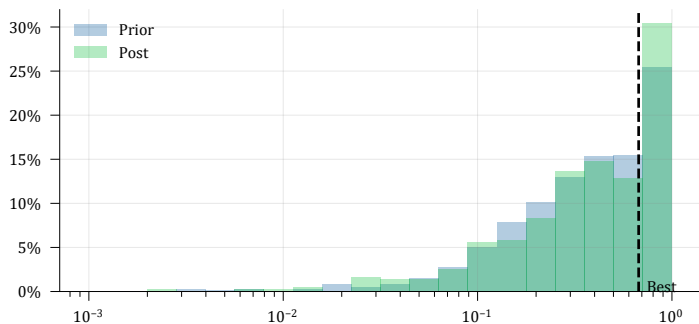
kz_p319(Pilot_Point_L1)



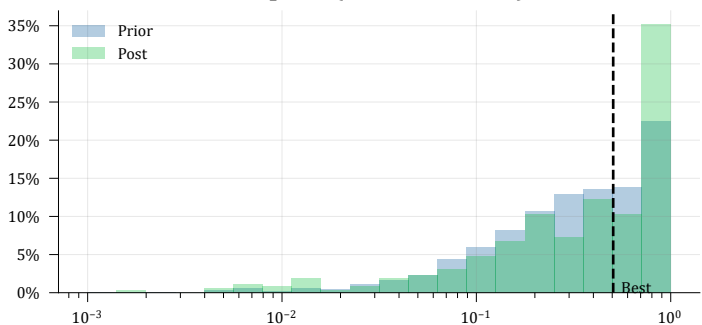
kz_p320(Pilot_Point_L1)



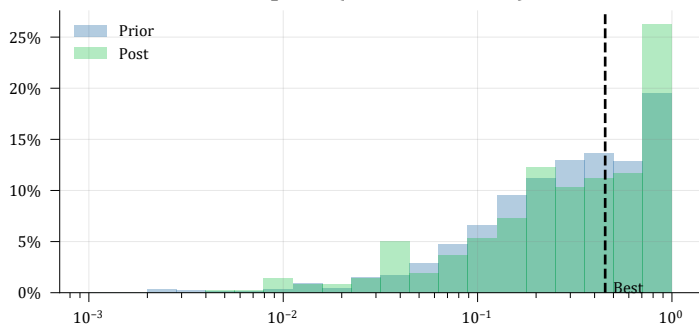
kz_p321(Pilot_Point_L1)



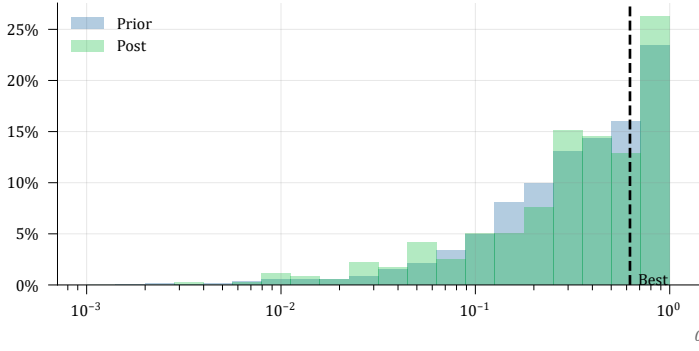
kz_p322(Pilot_Point_L1)



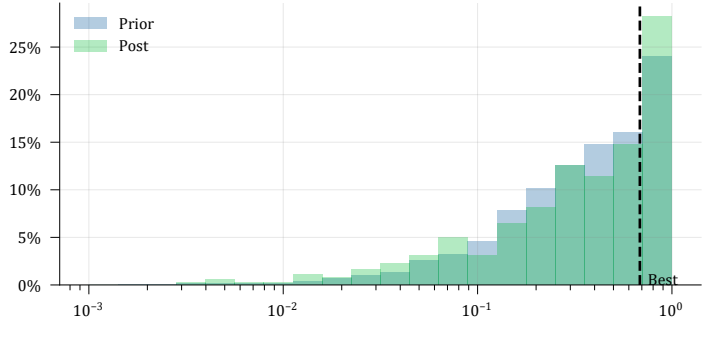
kz_p323(Pilot_Point_L1)



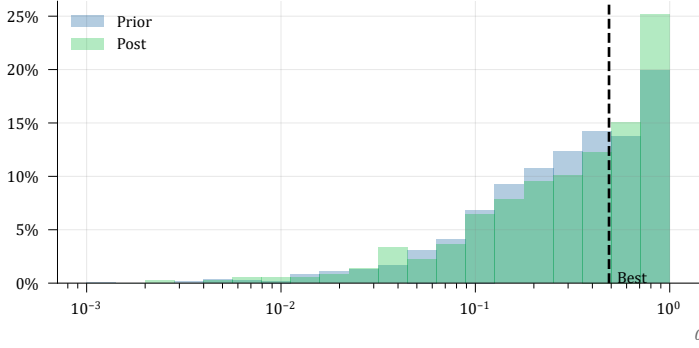
kz_p324(Pilot_Point_L1)



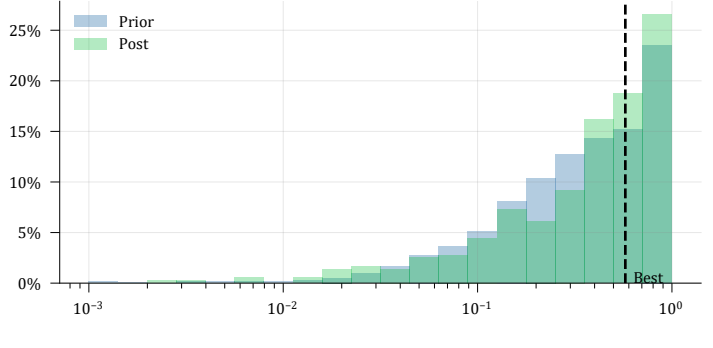
kz_p325(Pilot_Point_L1)



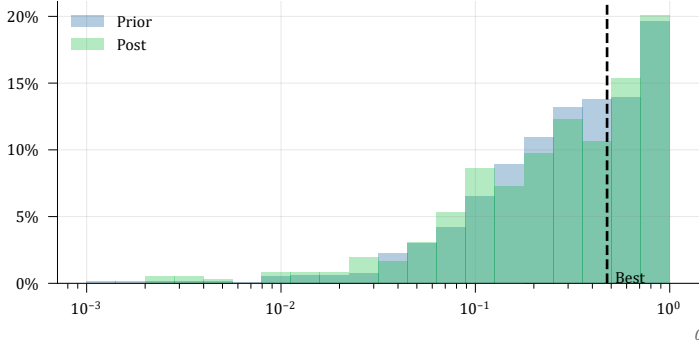
kz_p326(Pilot_Point_L1)



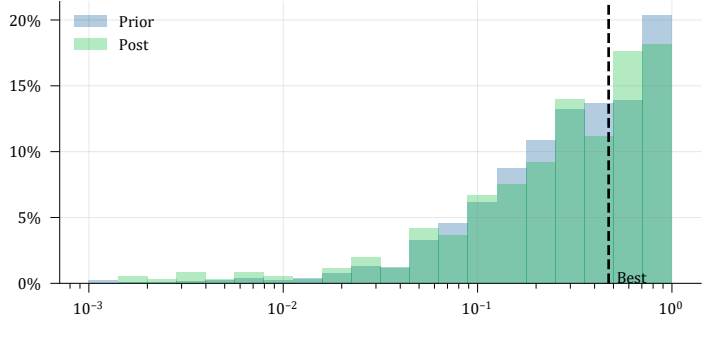
kz_p327(Pilot_Point_L1)



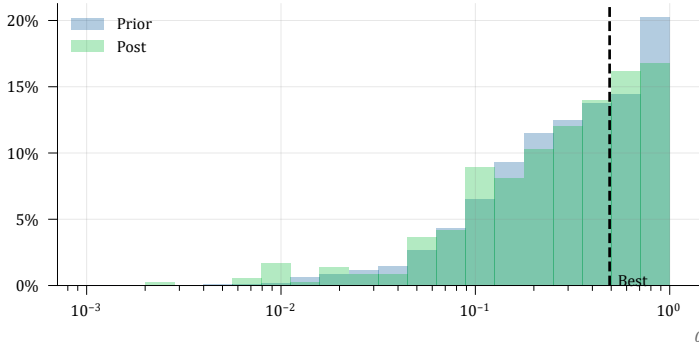
kz_p328(Pilot_Point_L1)



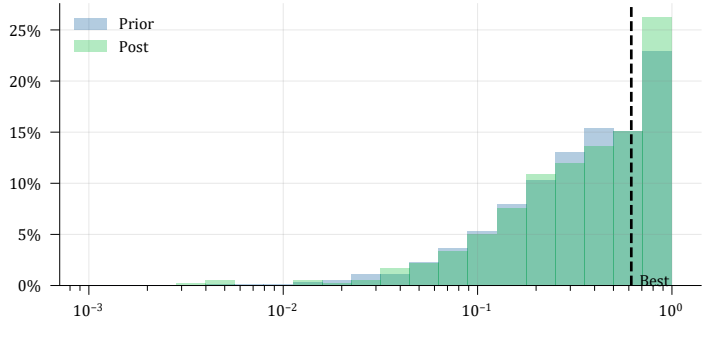
kz_p329(Pilot_Point_L1)



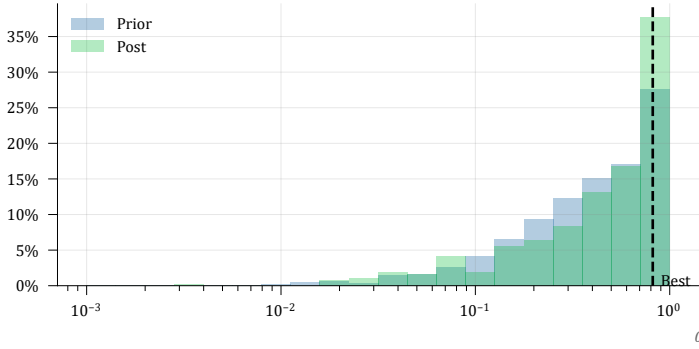
kz_p330(Pilot_Point_L1)



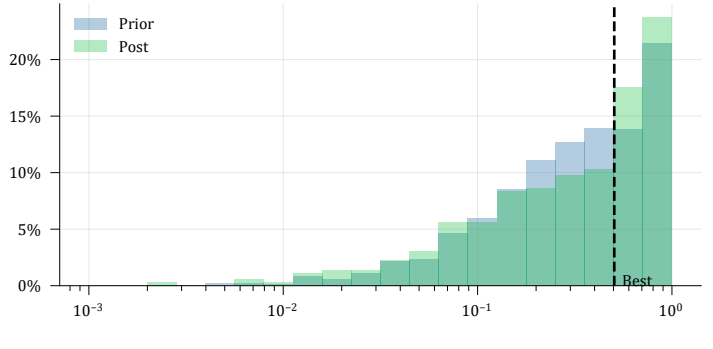
kz_p331(Pilot_Point_L1)



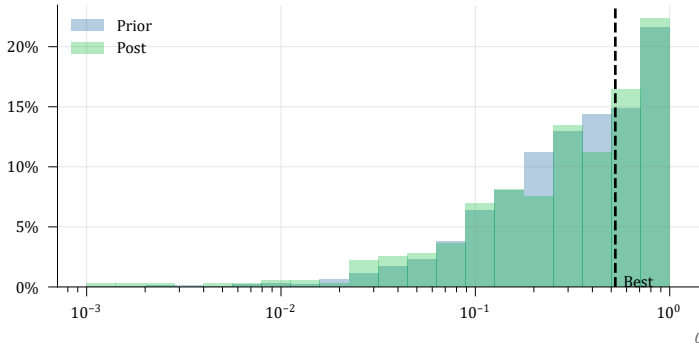
kz_p332(Pilot_Point_L1)



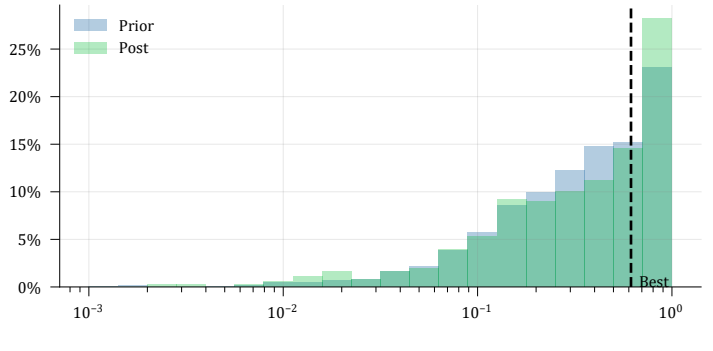
kz_p333(Pilot_Point_L1)



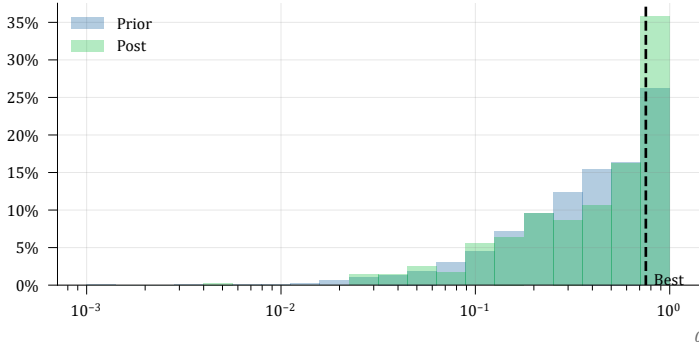
kz_p334(Pilot_Point_L1)



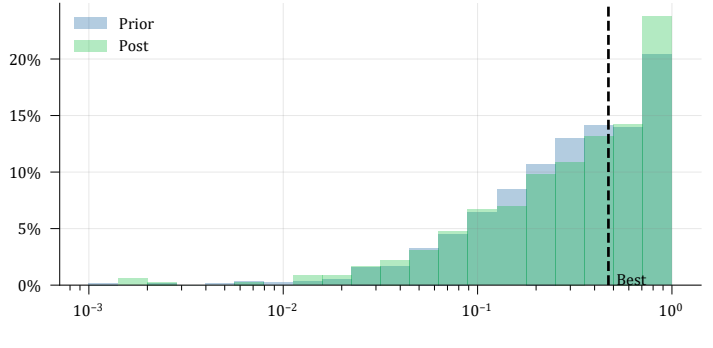
kz_p335(Pilot_Point_L1)



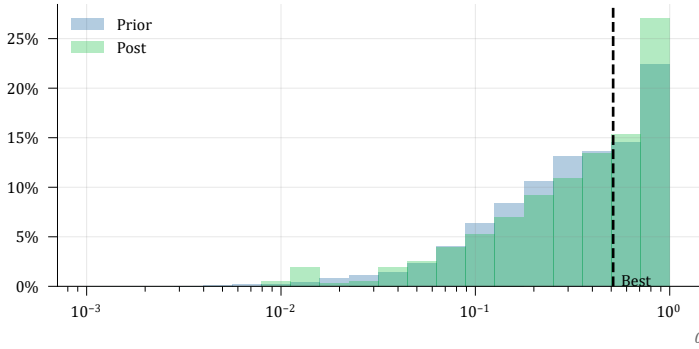
kz_p336(Pilot_Point_L1)



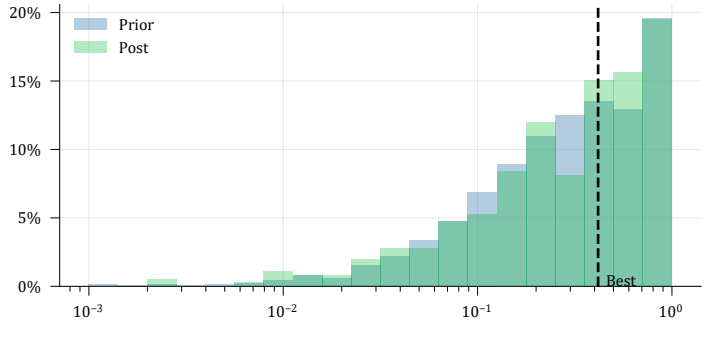
kz_p337(Pilot_Point_L1)



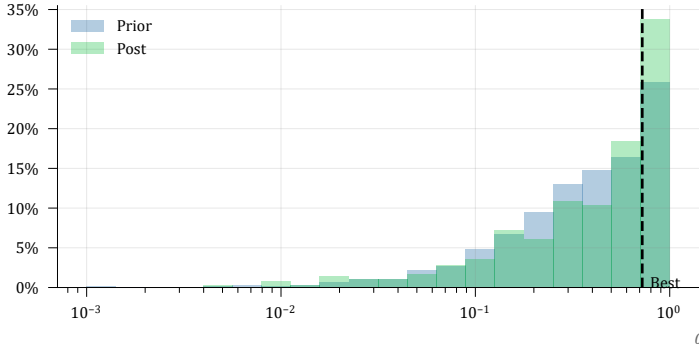
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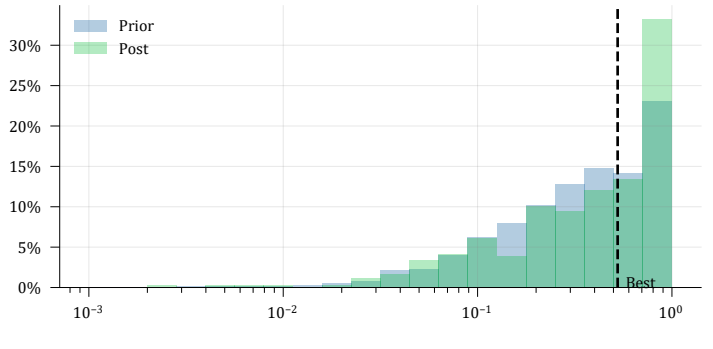
kz_p339(Pilot_Point_L1)



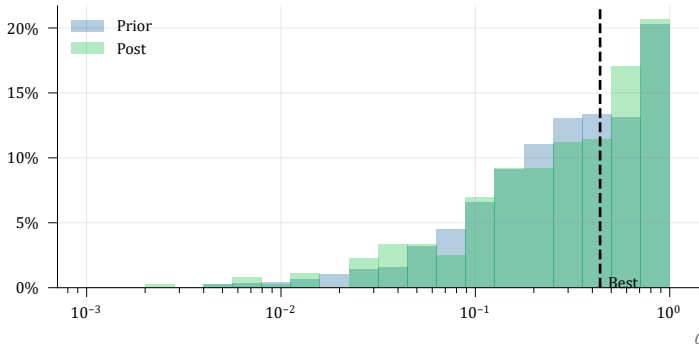
kz_p340(Pilot_Point_L1)



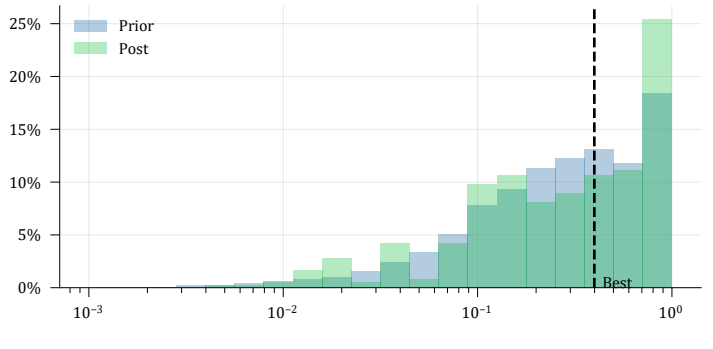
kz_p341(Pilot_Point_L1)



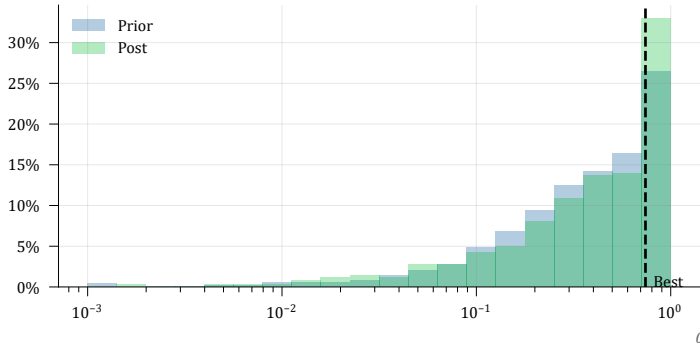
kz_p342(Pilot_Point_L1)



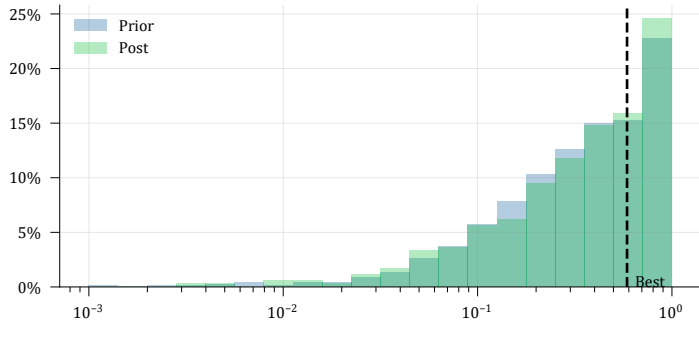
kz_p343(Pilot_Point_L1)



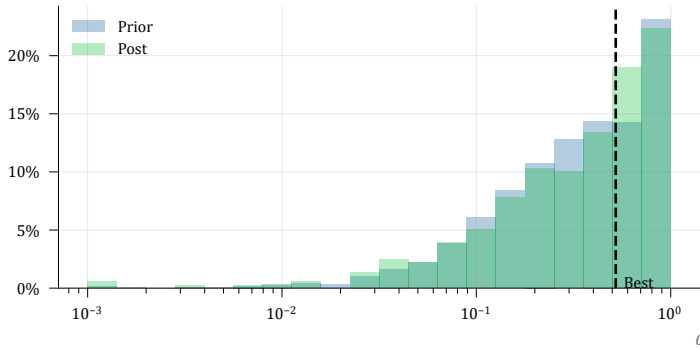
kz_p344(Pilot_Point_L1)



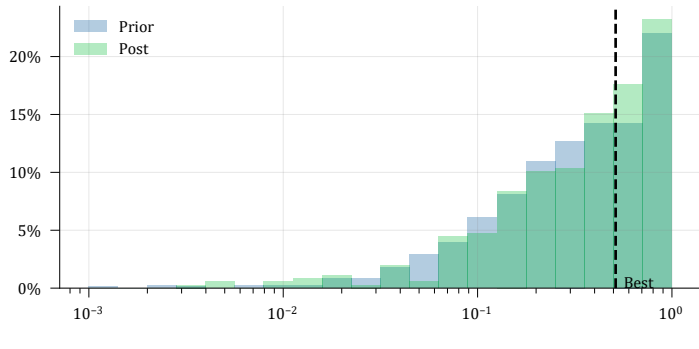
kz_p345(Pilot_Point_L1)



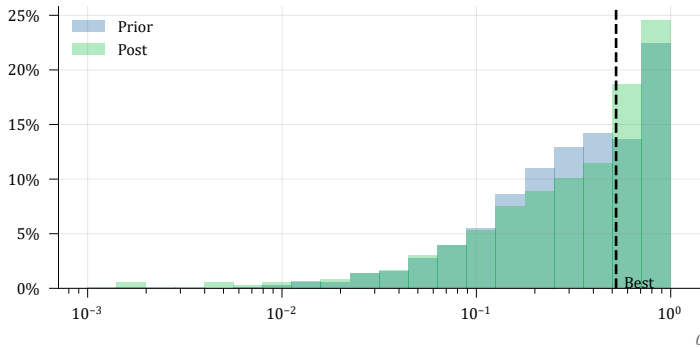
kz_p346(Pilot_Point_L1)



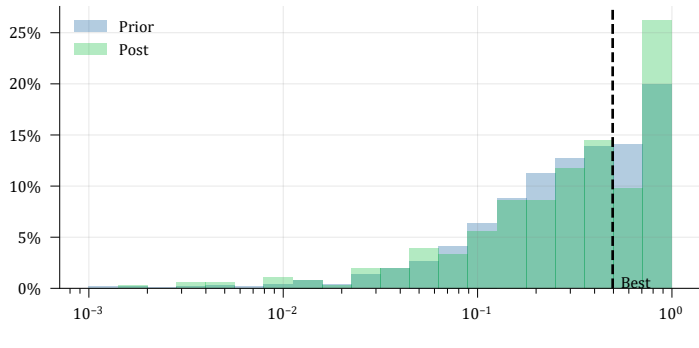
kz_p347(Pilot_Point_L1)



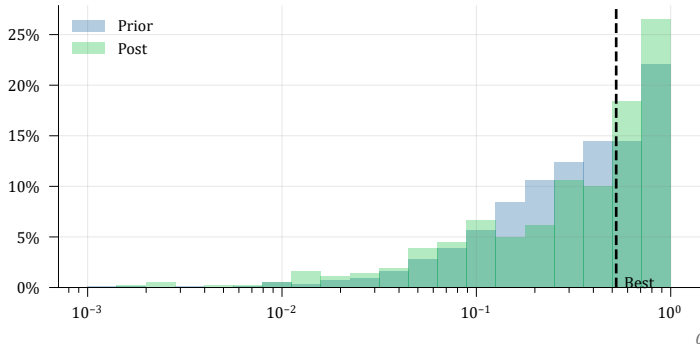
kz_p348(Pilot_Point_L1)



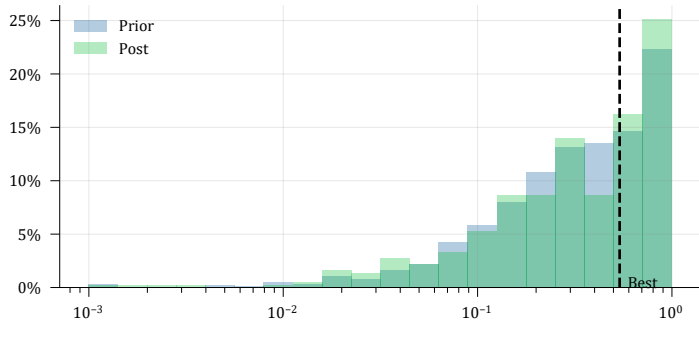
kz_p349(Pilot_Point_L1)



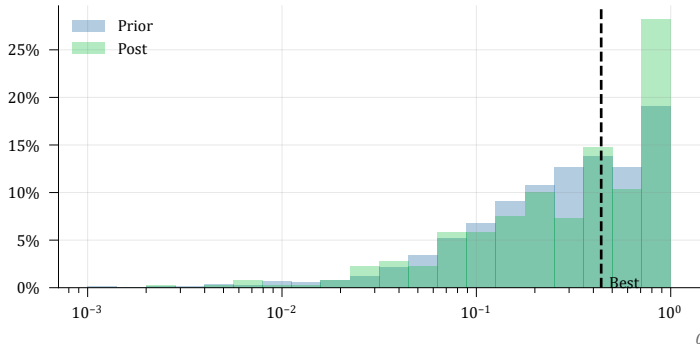
kz_p350(Pilot_Point_L1)



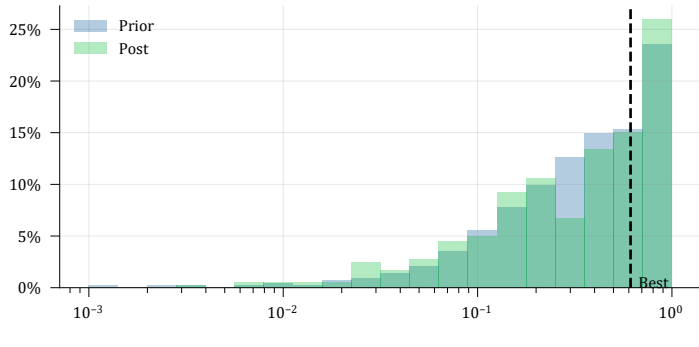
kz_p351(Pilot_Point_L1)



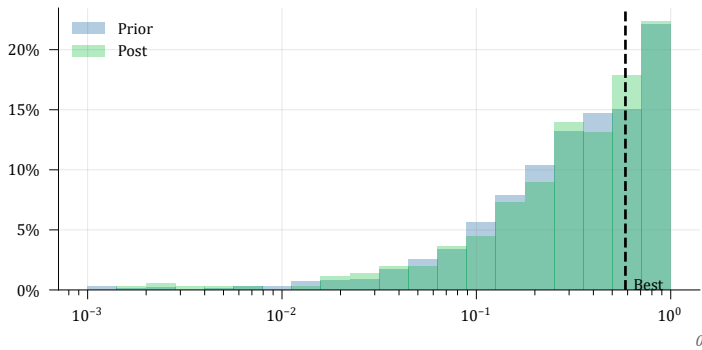
kz_p352(Pilot_Point_L1)



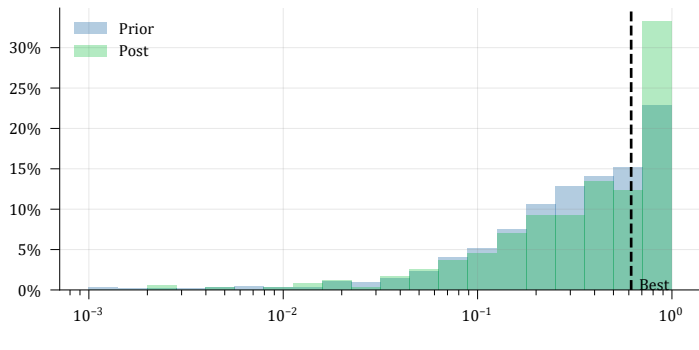
kz_p353(Pilot_Point_L1)



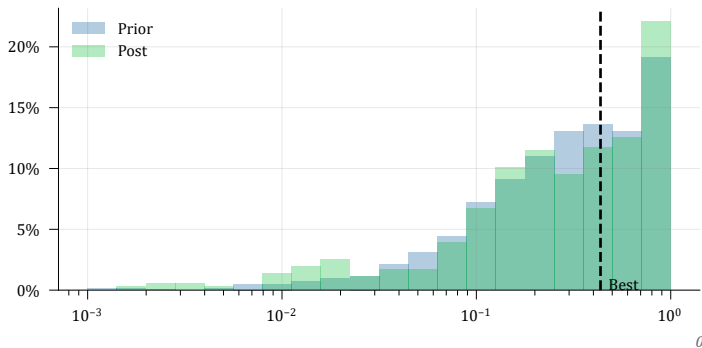
kz_p354(Pilot_Point_L1)



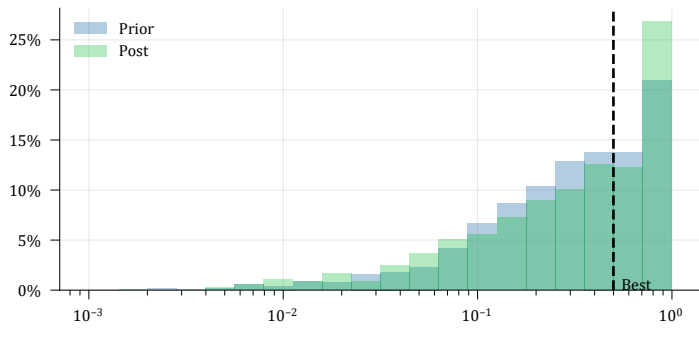
kz_p355(Pilot_Point_L1)



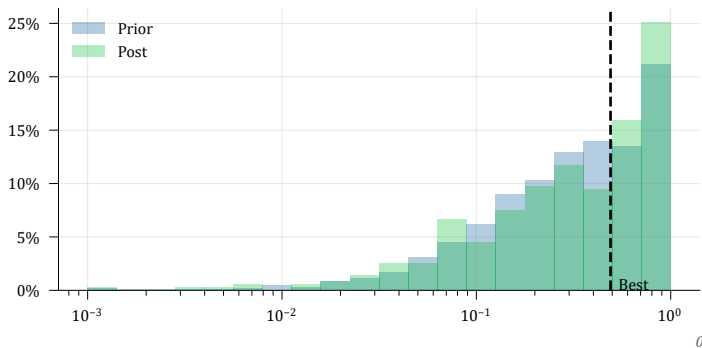
kz_p356(Pilot_Point_L1)



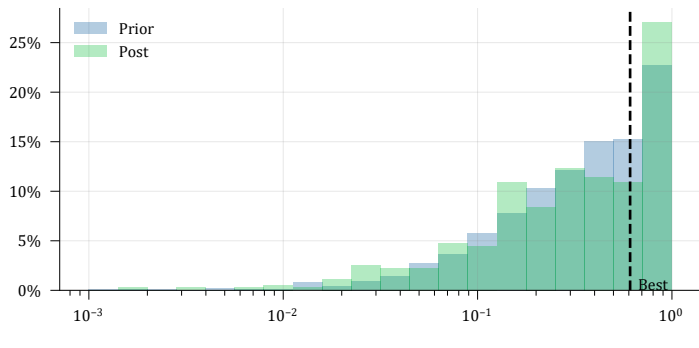
kz_p357(Pilot_Point_L1)



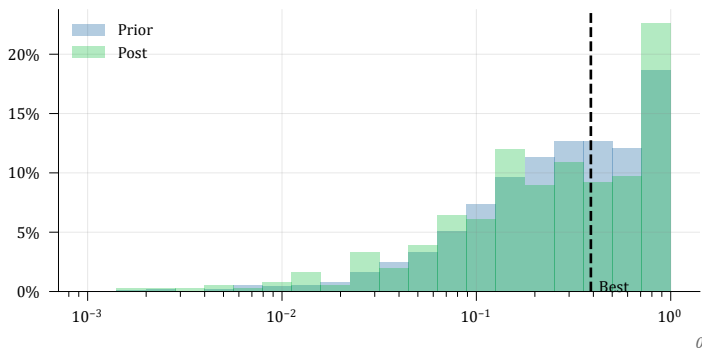
kz_p358(Pilot_Point_L1)



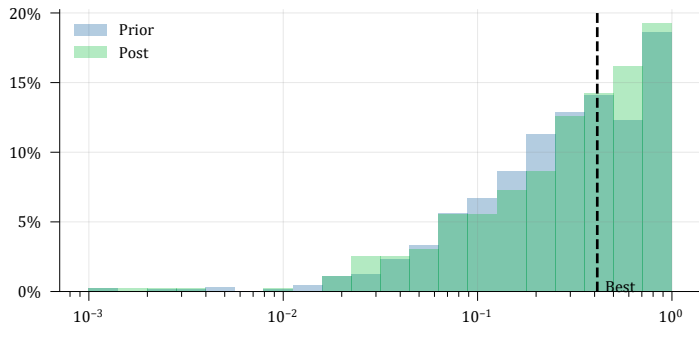
kz_p359(Pilot_Point_L1)



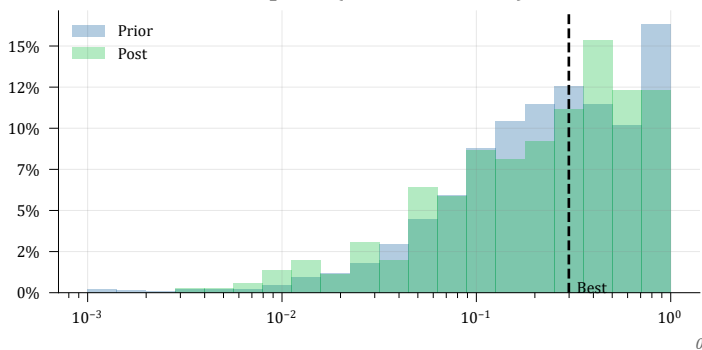
kz_p360(Pilot_Point_L1)



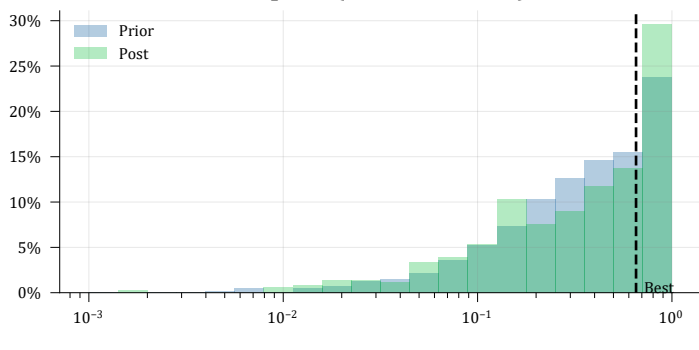
kz_p361(Pilot_Point_L1)



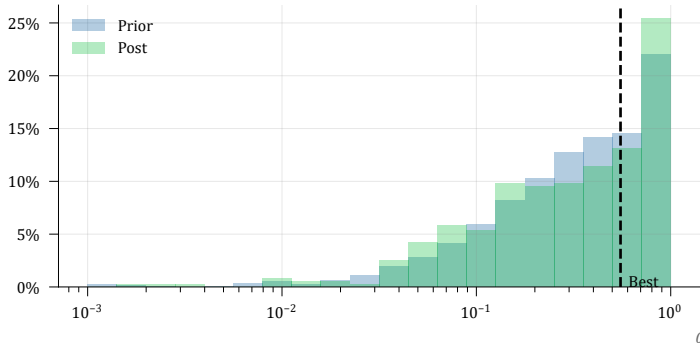
kz_p362(Pilot_Point_L1)



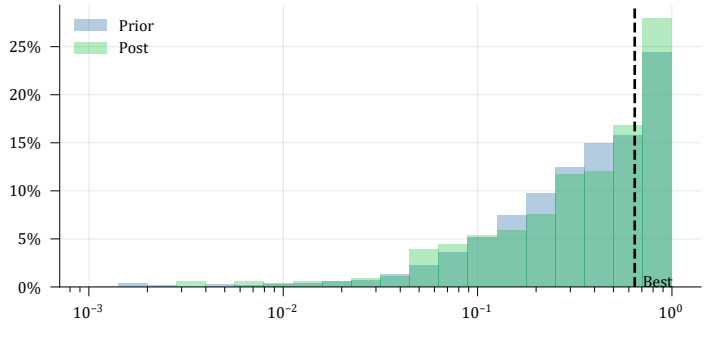
kz_p363(Pilot_Point_L1)



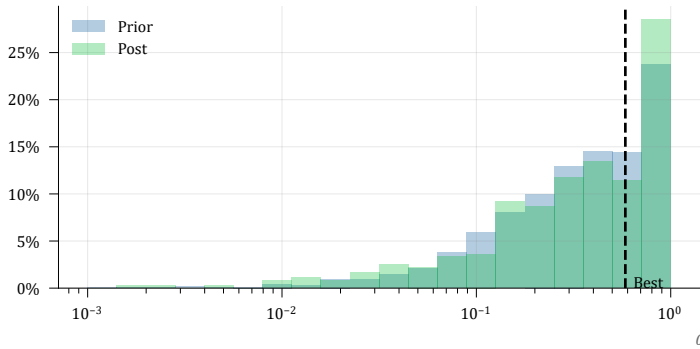
kz_p364(Pilot_Point_L1)



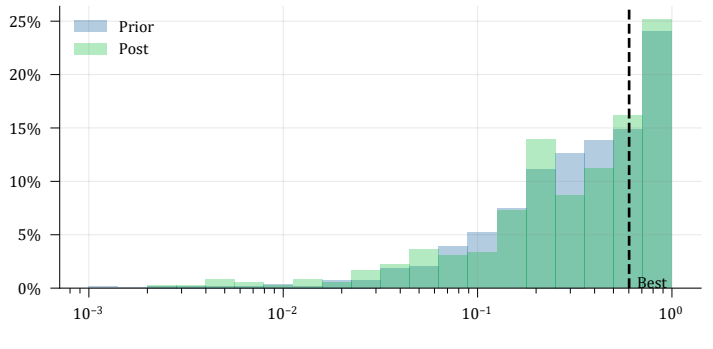
kz_p365(Pilot_Point_L1)



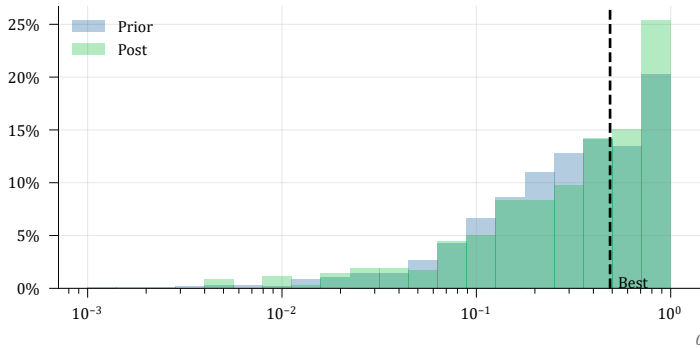
kz_p366(Pilot_Point_L1)



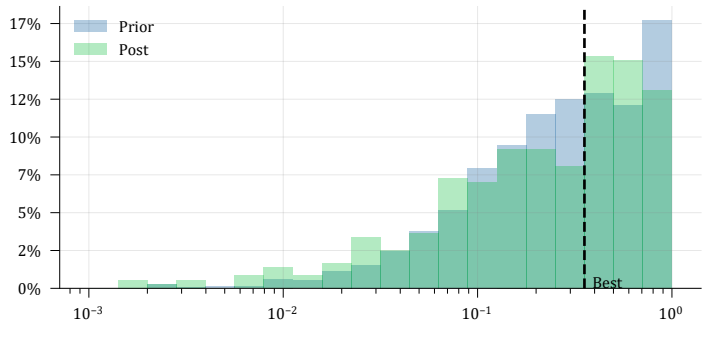
kz_p367(Pilot_Point_L1)



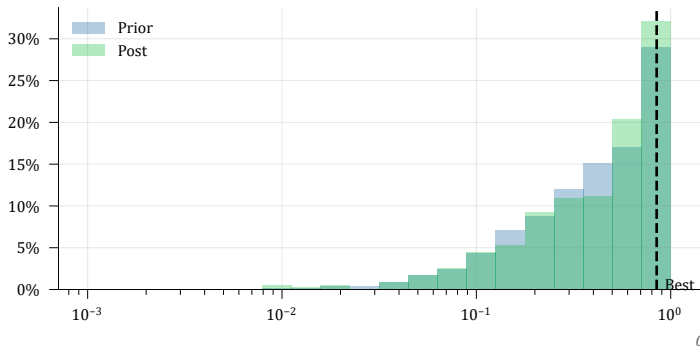
kz_p368(Pilot_Point_L1)



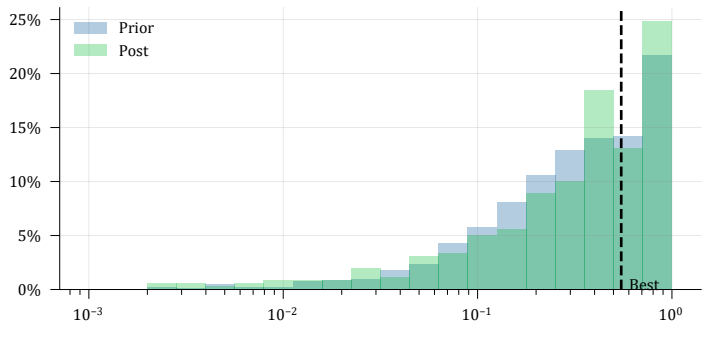
kz_p369(Pilot_Point_L1)



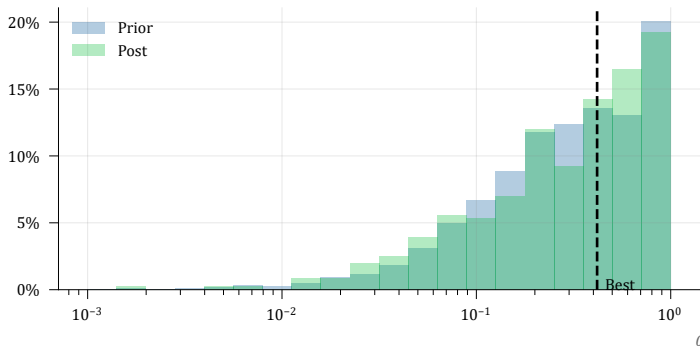
kz_p370(Pilot_Point_L1)



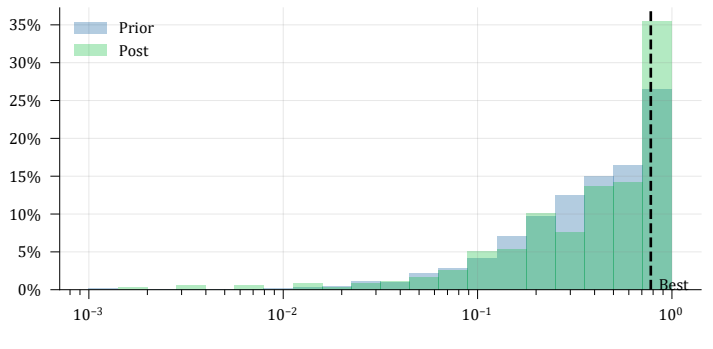
kz_p371(Pilot_Point_L1)



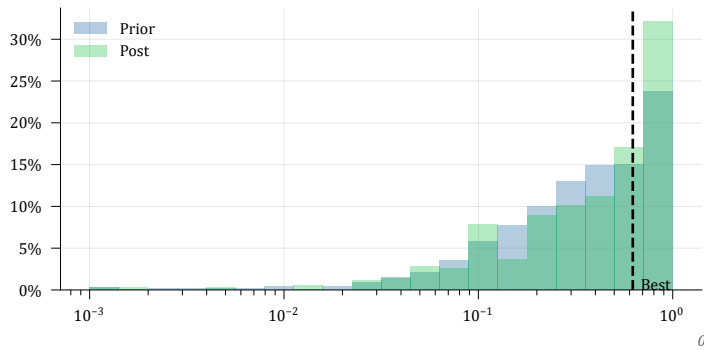
kz_p372(Pilot_Point_L1)



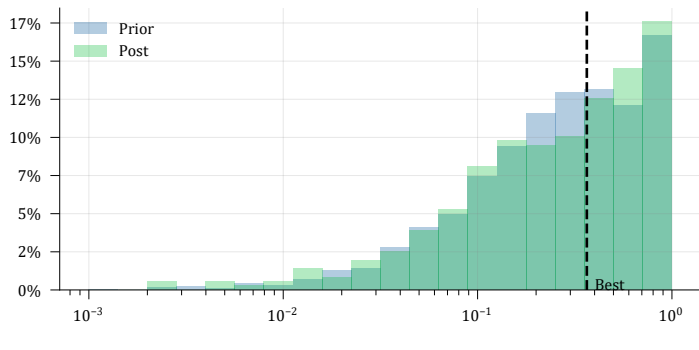
kz_p373(Pilot_Point_L1)



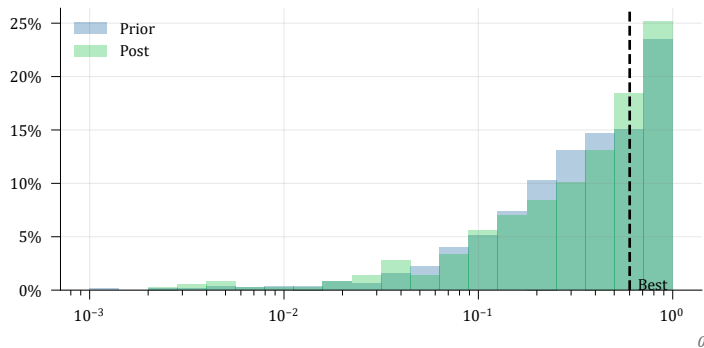
kz_p374(Pilot_Point_L1)



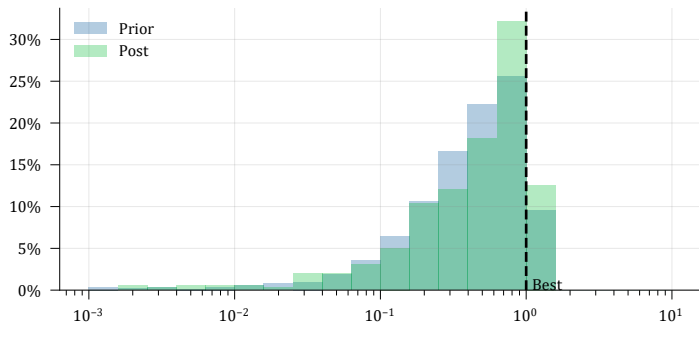
kz_p375(Pilot_Point_L1)



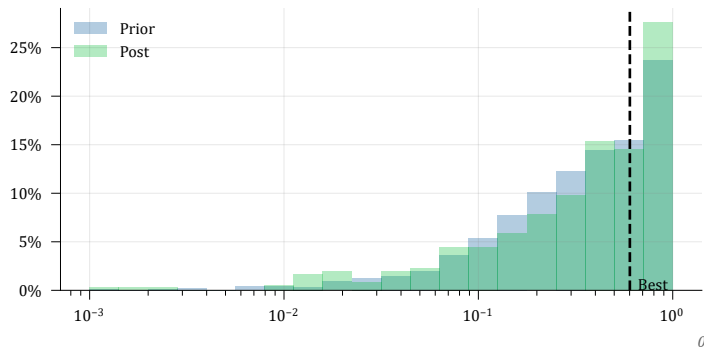
kz_p376(Pilot_Point_L1)



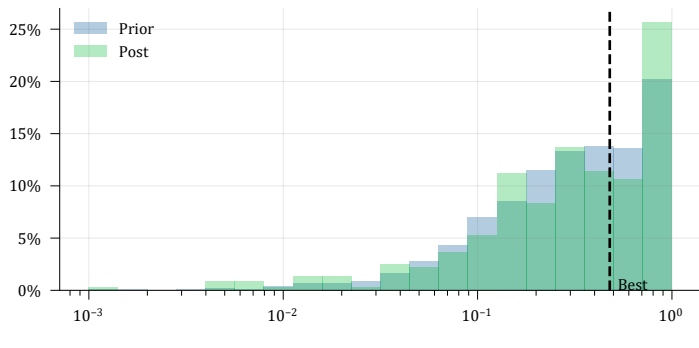
kz_p378(Pilot_Point_L1)



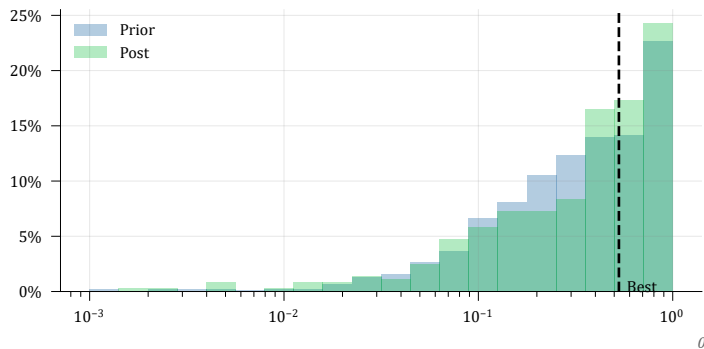
kz_p379(Pilot_Point_L1)



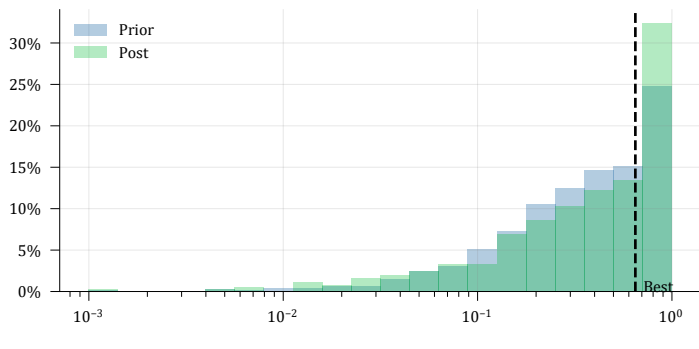
kz_p380(Pilot_Point_L1)



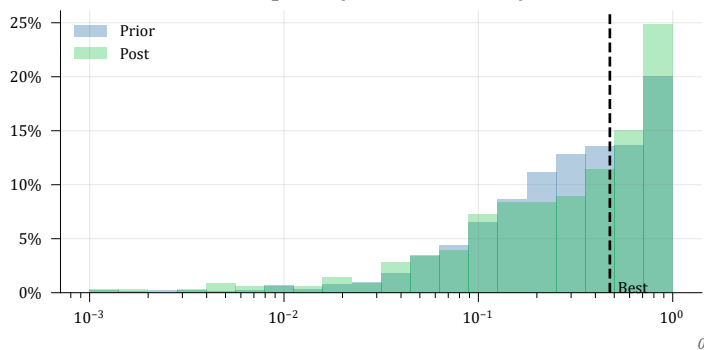
kz_p381(Pilot_Point_L1)



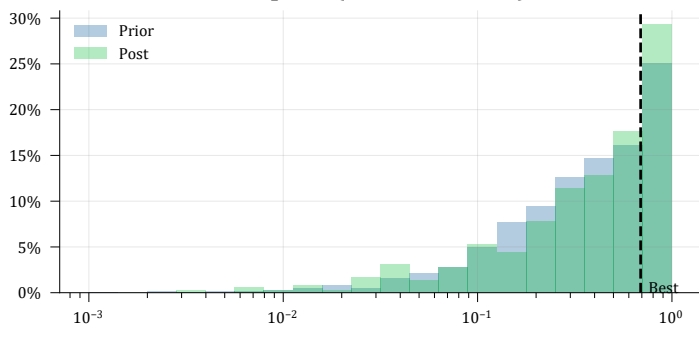
kz_p382(Pilot_Point_L1)

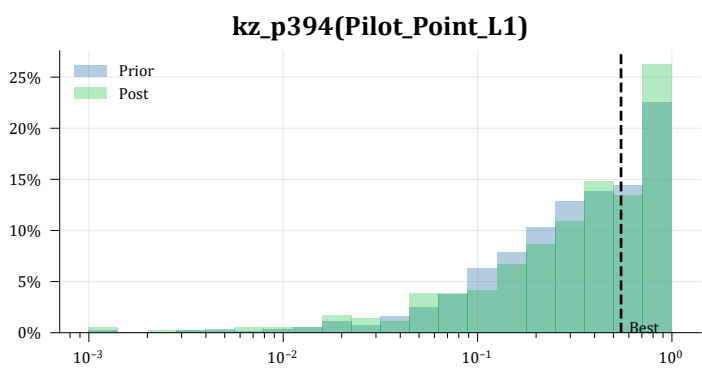
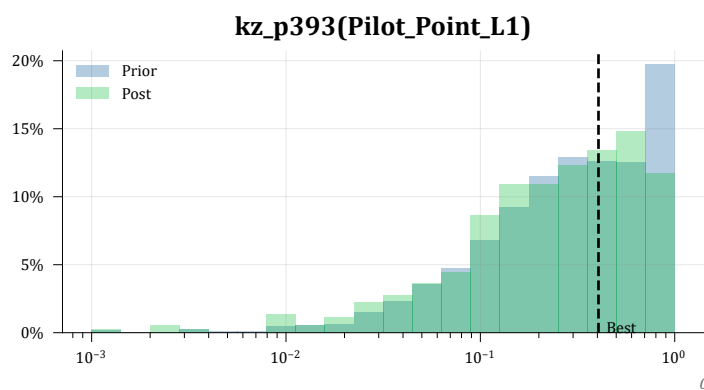
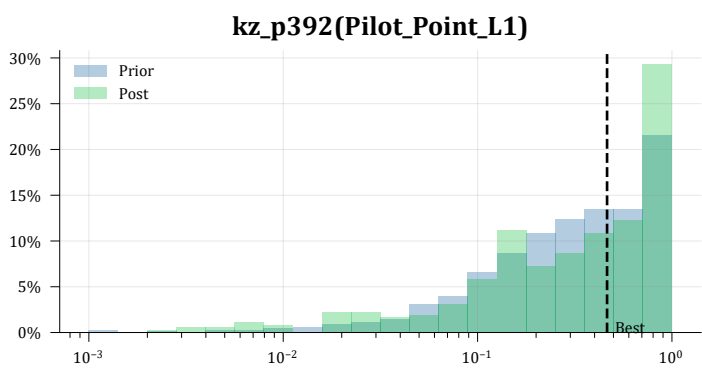
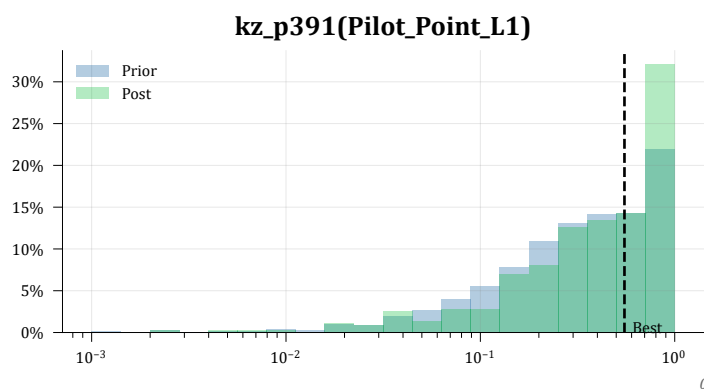
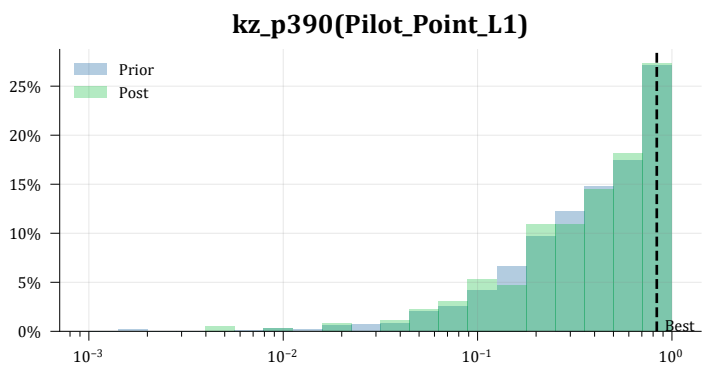
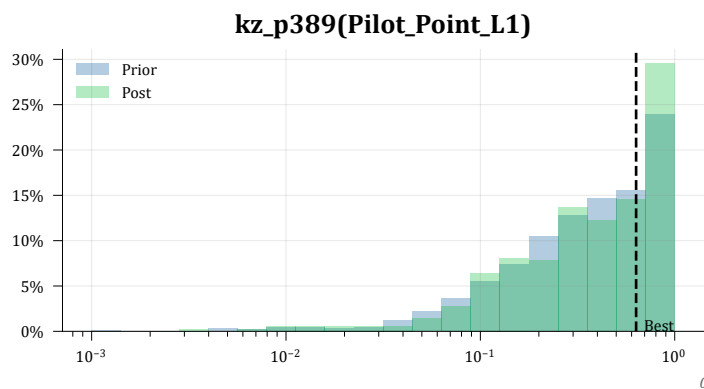
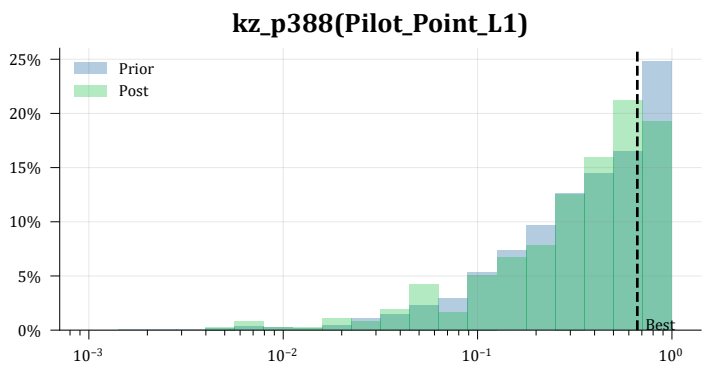
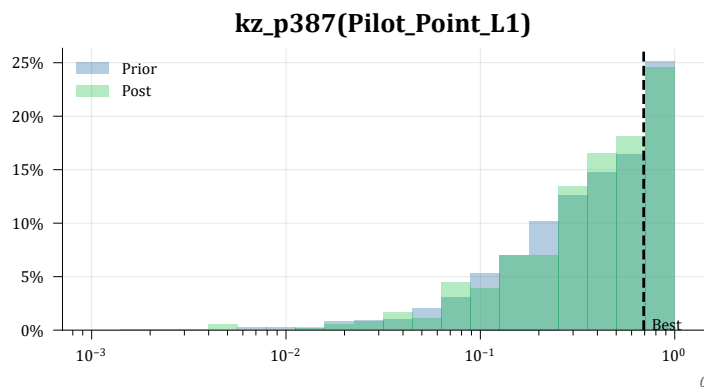
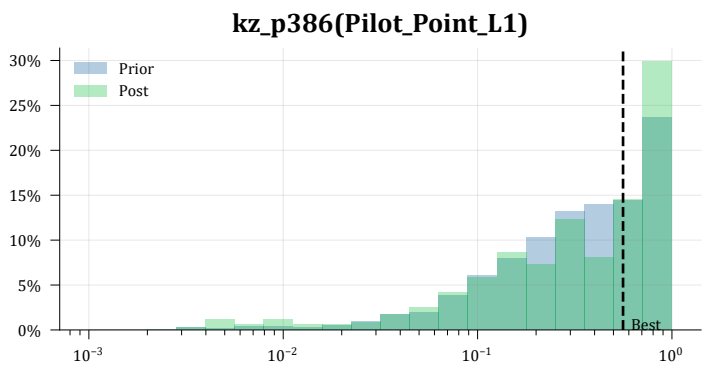
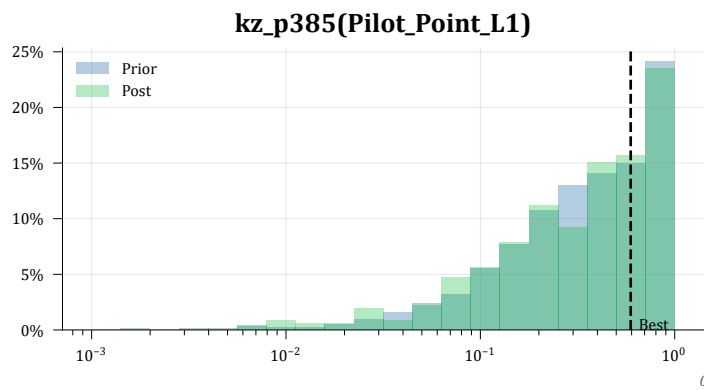


kz_p383(Pilot_Point_L1)

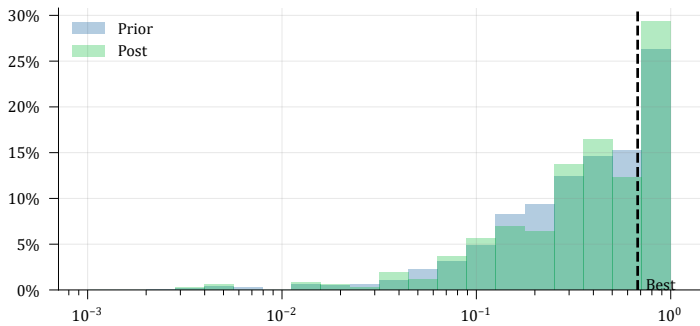


kz_p384(Pilot_Point_L1)

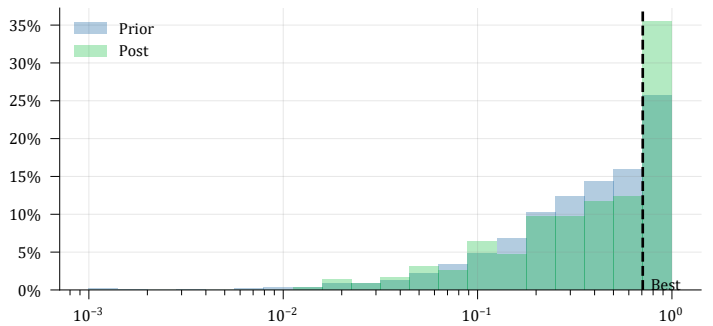




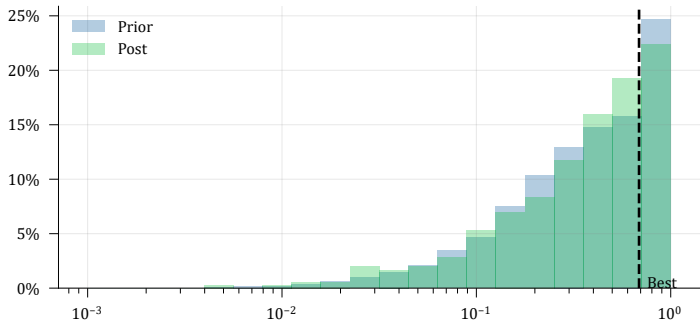
kz_p395(Pilot_Point_L1)



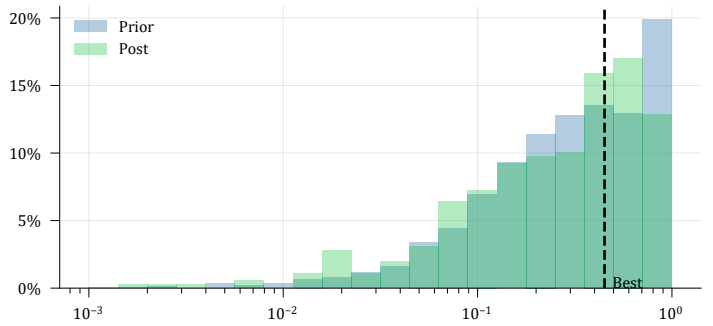
kz_p396(Pilot_Point_L1)



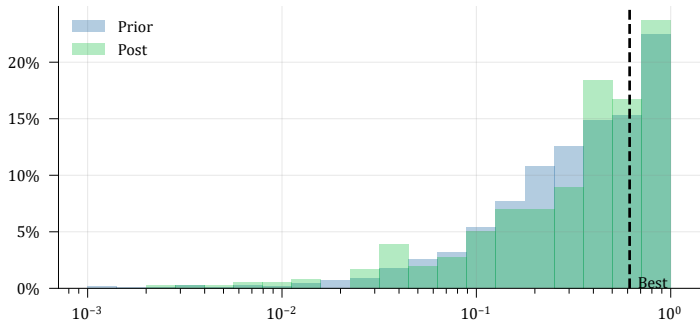
kz_p397(Pilot_Point_L1)



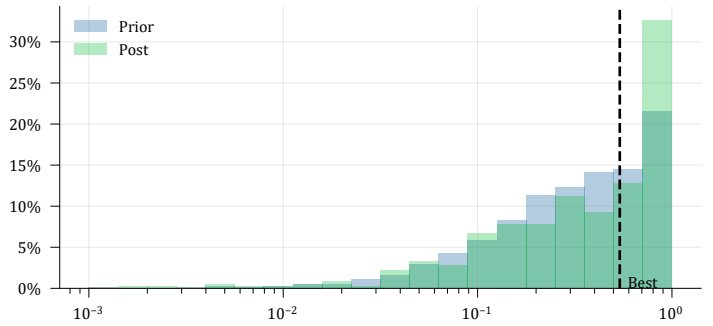
kz_p398(Pilot_Point_L1)



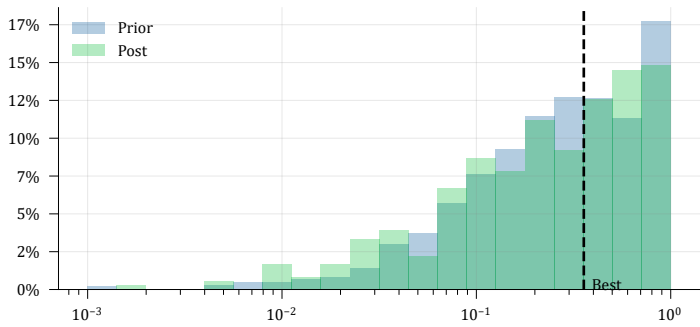
kz_p399(Pilot_Point_L1)



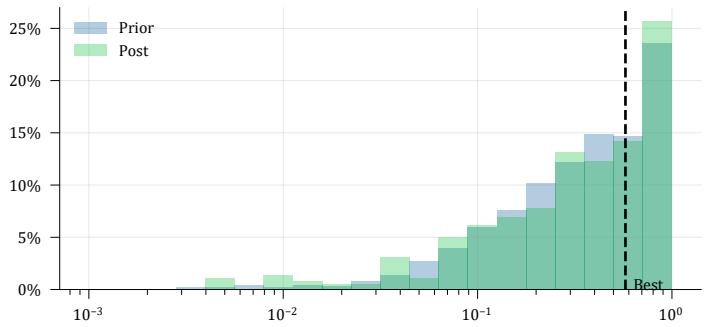
kz_p400(Pilot_Point_L1)



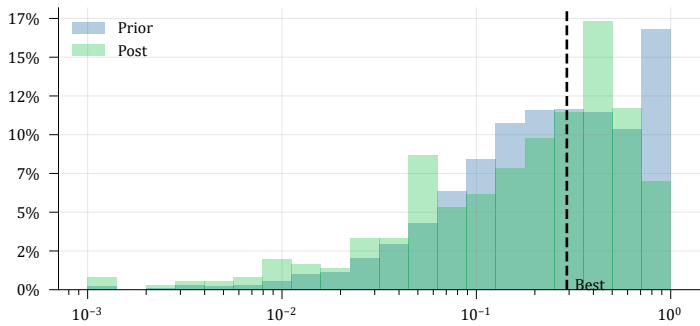
kz_p401(Pilot_Point_L1)



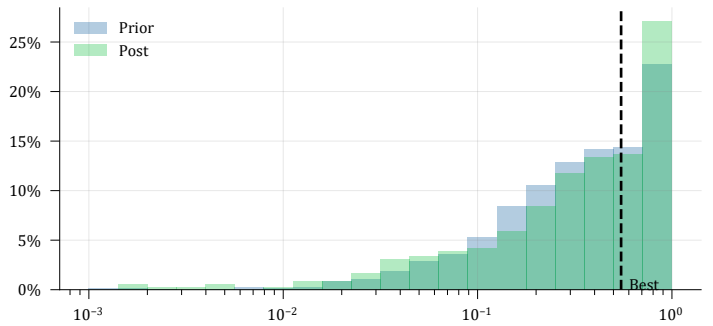
kz_p402(Pilot_Point_L1)

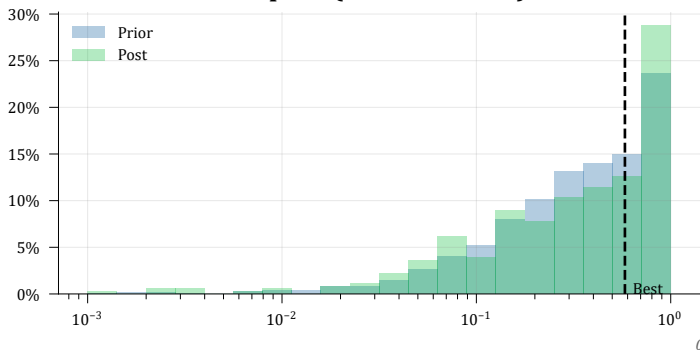
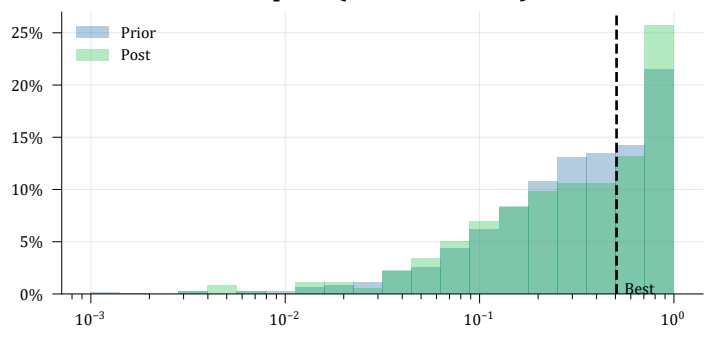
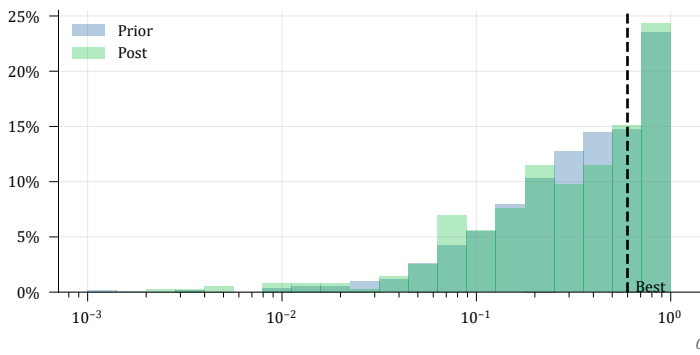
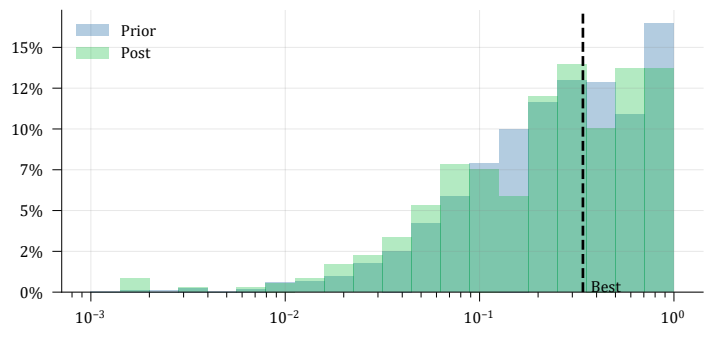
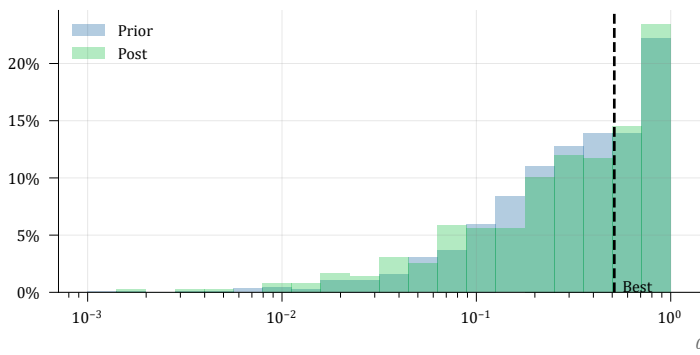
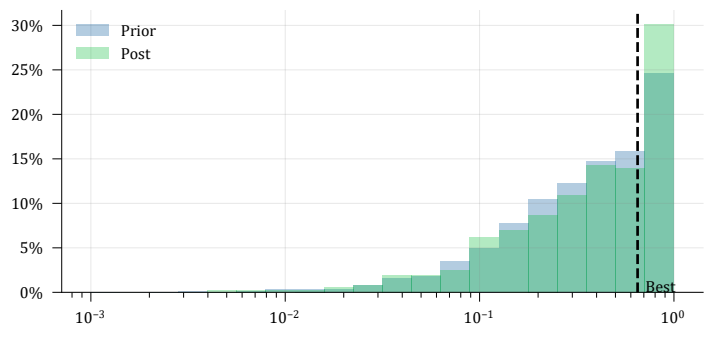
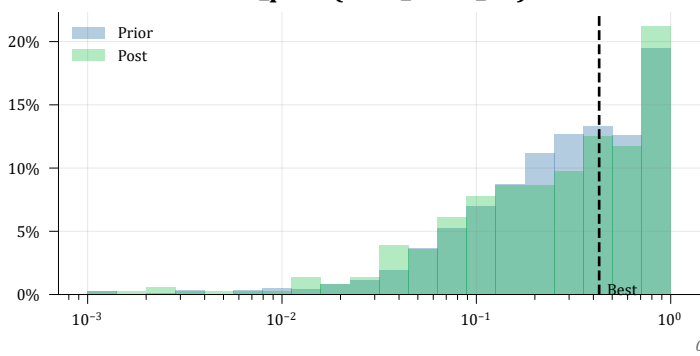
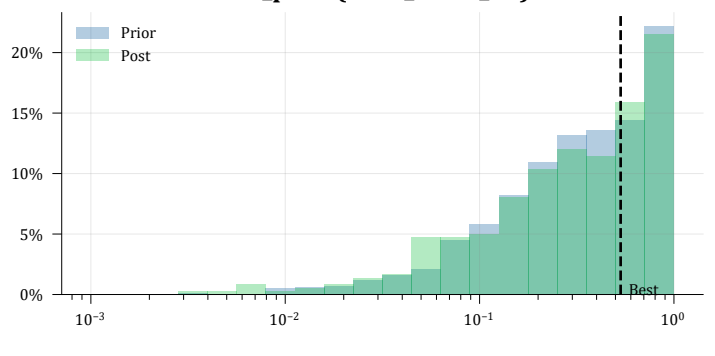
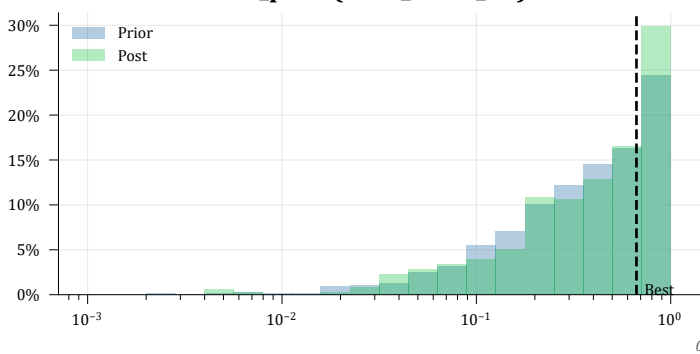
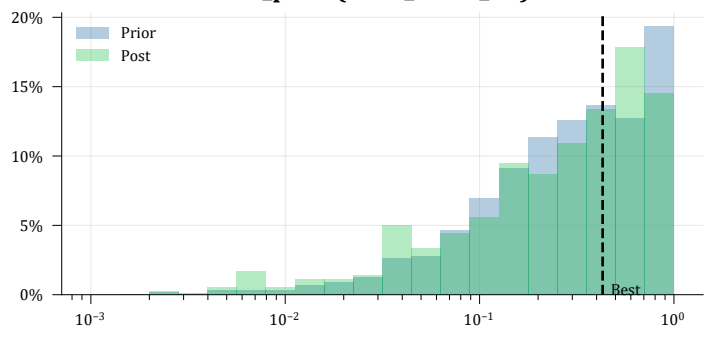


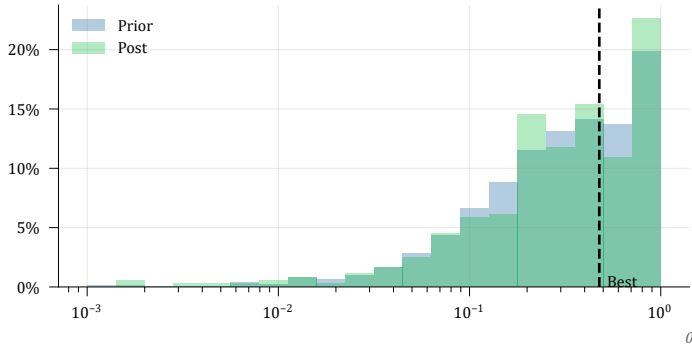
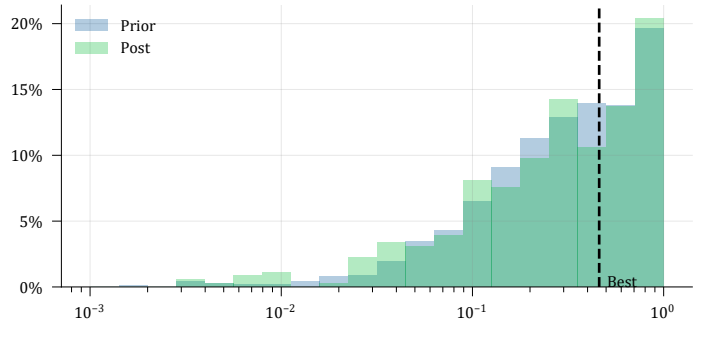
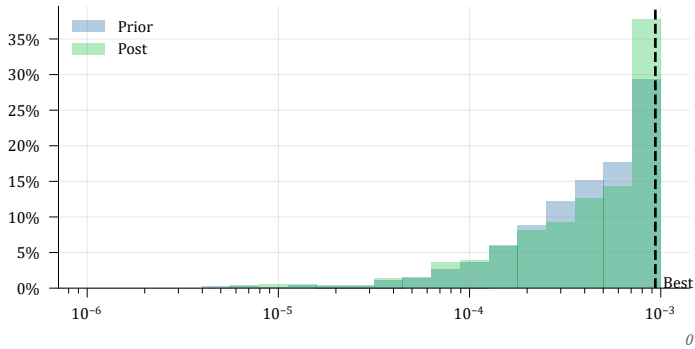
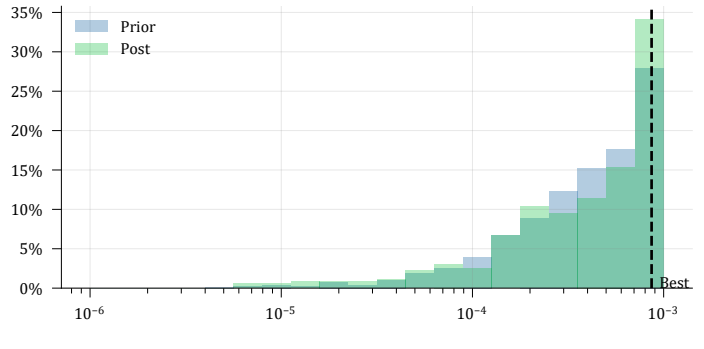
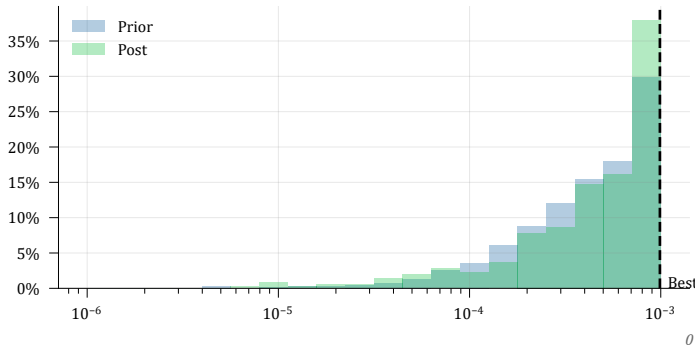
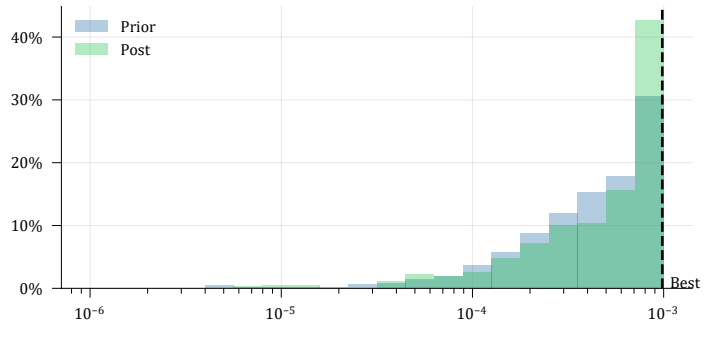
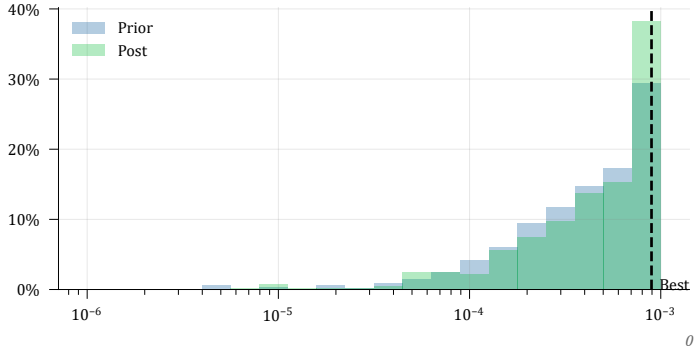
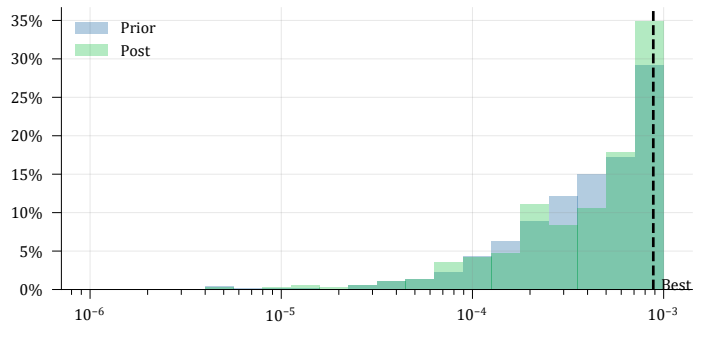
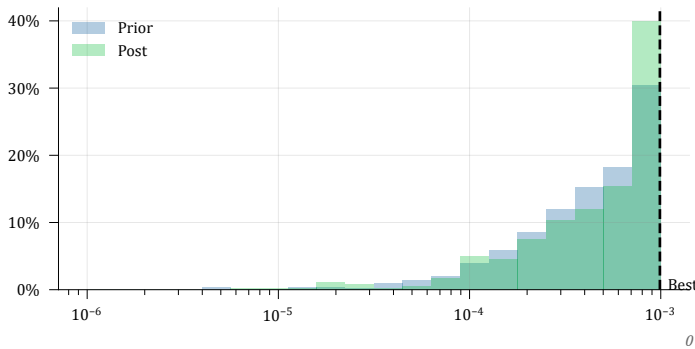
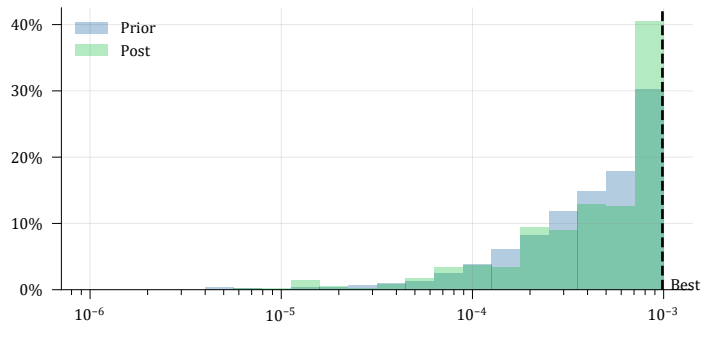
kz_p403(Pilot_Point_L1)



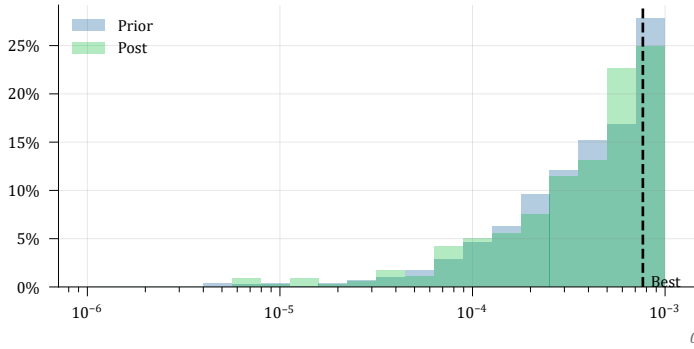
kz_p404(Pilot_Point_L1)



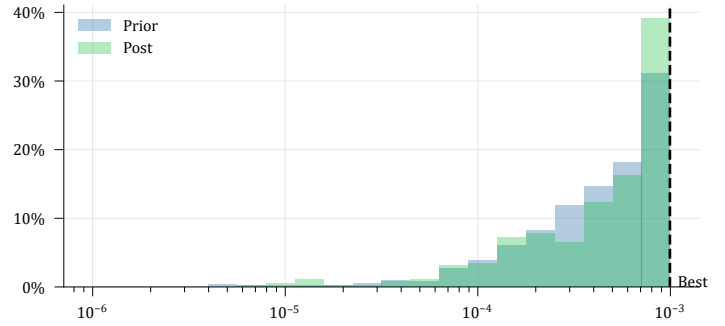
kz_p405(Pilot_Point_L1)**kz_p406(Pilot_Point_L1)****kz_p407(Pilot_Point_L1)****kz_p408(Pilot_Point_L1)****kz_p409(Pilot_Point_L1)****kz_p410(Pilot_Point_L1)****kz_p411(Pilot_Point_L1)****kz_p412(Pilot_Point_L1)****kz_p413(Pilot_Point_L1)****kz_p414(Pilot_Point_L1)**

kz_p415(Pilot_Point_L1)**ss_p1(Pilot_Point_L1)****ss_p2(Pilot_Point_L1)****ss_p3(Pilot_Point_L1)****ss_p4(Pilot_Point_L1)****ss_p5(Pilot_Point_L1)****ss_p6(Pilot_Point_L1)****ss_p7(Pilot_Point_L1)****ss_p8(Pilot_Point_L1)****ss_p9(Pilot_Point_L1)**

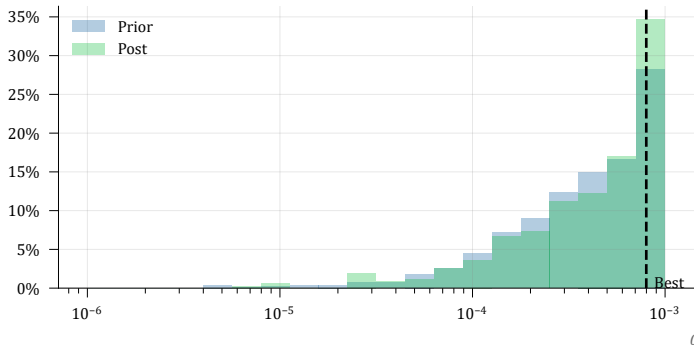
ss_p10(Pilot_Point_L1)



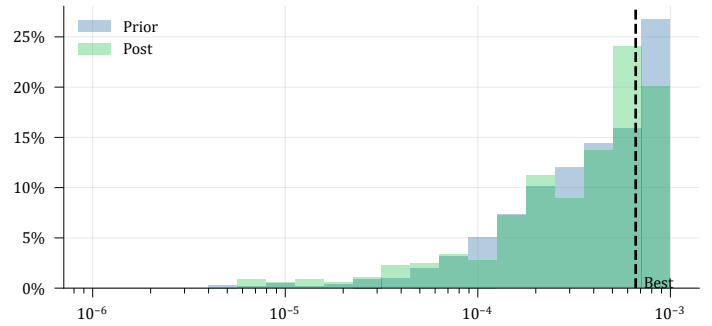
ss_p11(Pilot_Point_L1)



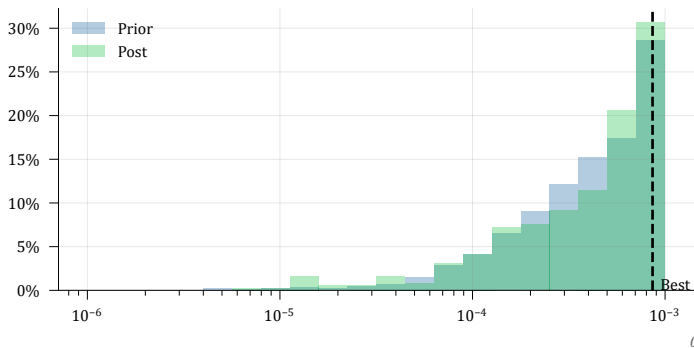
ss_p12(Pilot_Point_L1)



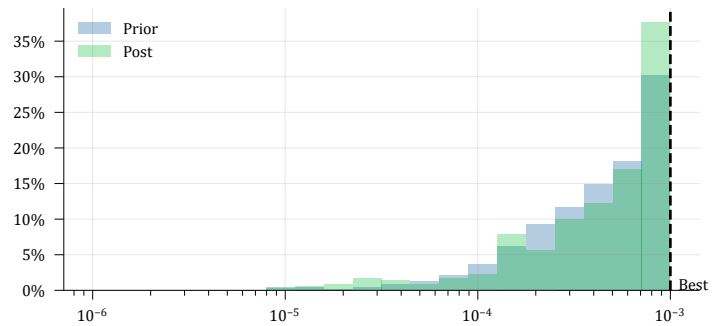
ss_p13(Pilot_Point_L1)



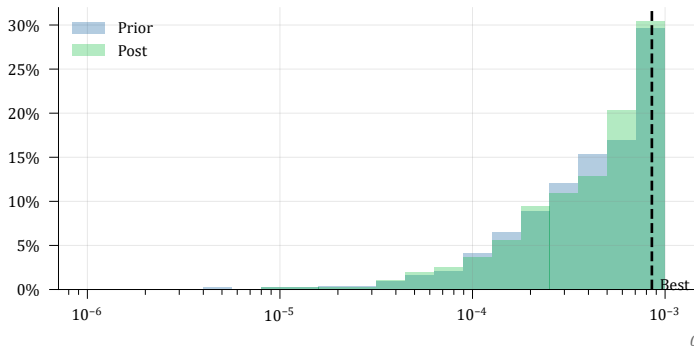
ss_p14(Pilot_Point_L1)



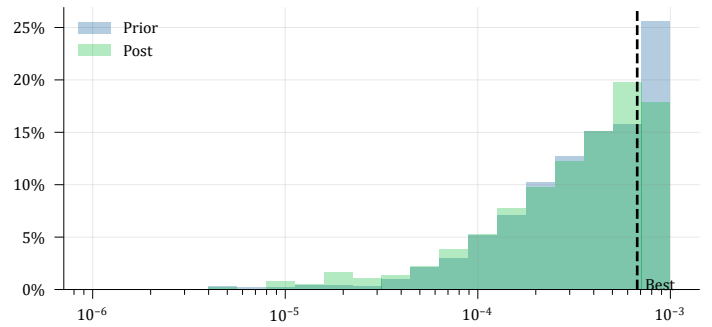
ss_p15(Pilot_Point_L1)



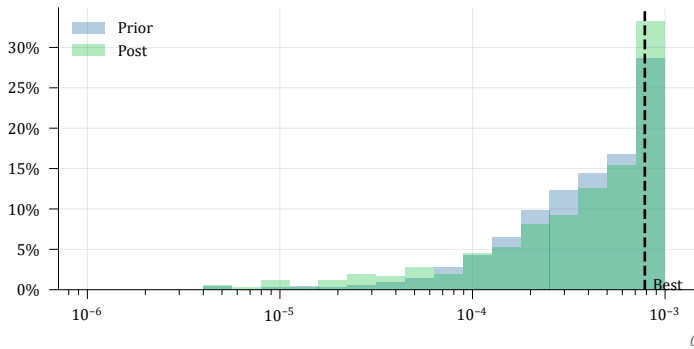
ss_p16(Pilot_Point_L1)



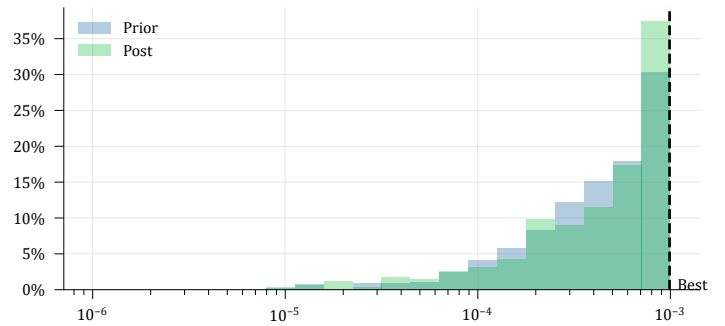
ss_p17(Pilot_Point_L1)



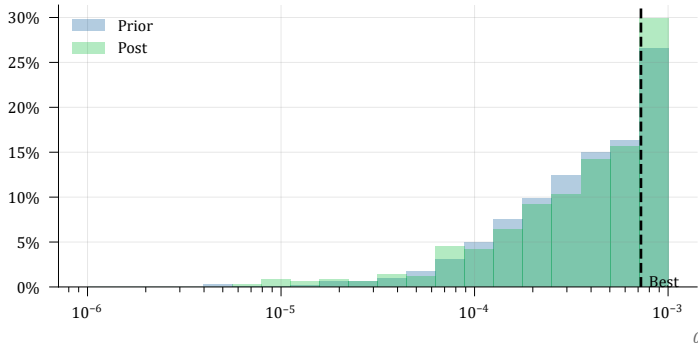
ss_p18(Pilot_Point_L1)



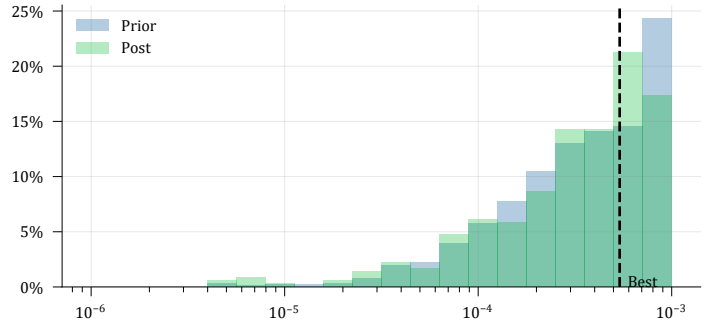
ss_p19(Pilot_Point_L1)



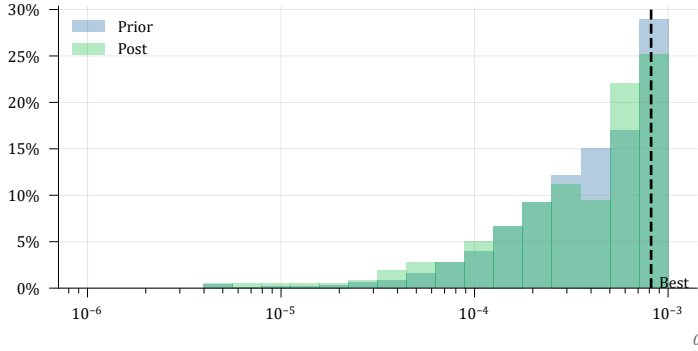
ss_p20(Pilot_Point_L1)



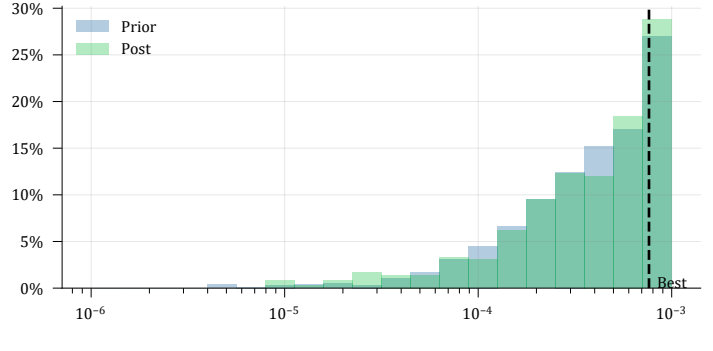
ss_p21(Pilot_Point_L1)



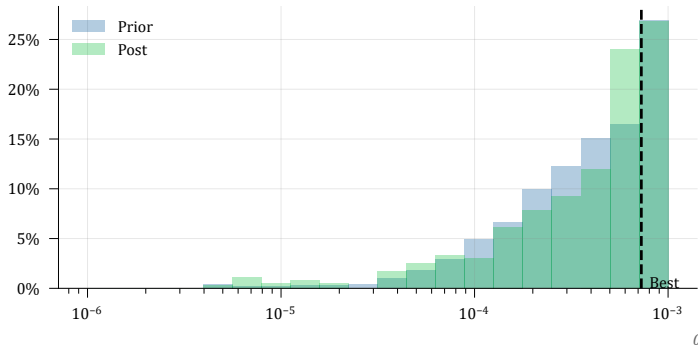
ss_p22(Pilot_Point_L1)



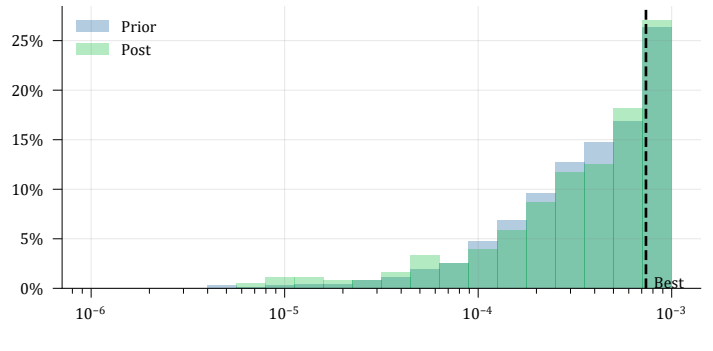
ss_p23(Pilot_Point_L1)



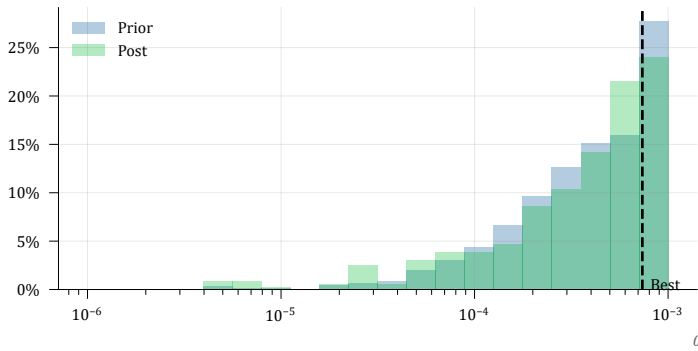
ss_p24(Pilot_Point_L1)



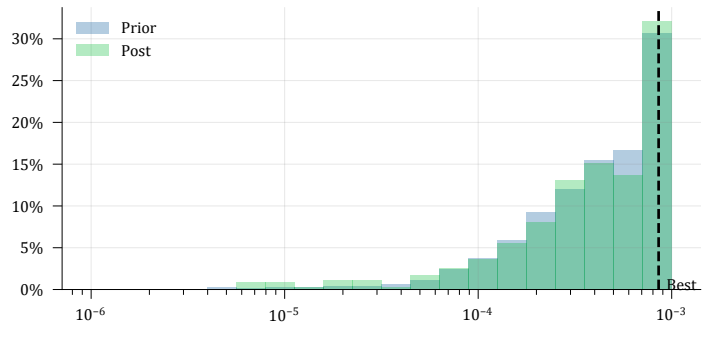
ss_p25(Pilot_Point_L1)



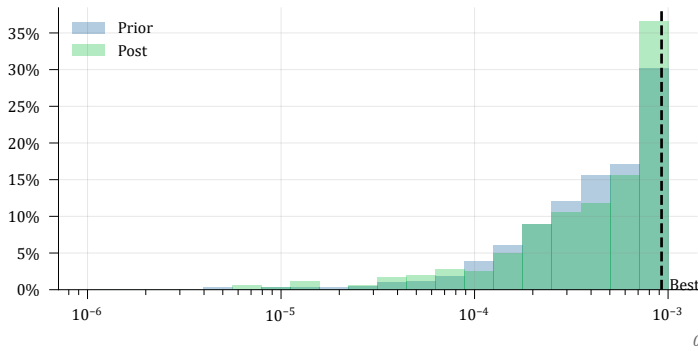
ss_p26(Pilot_Point_L1)



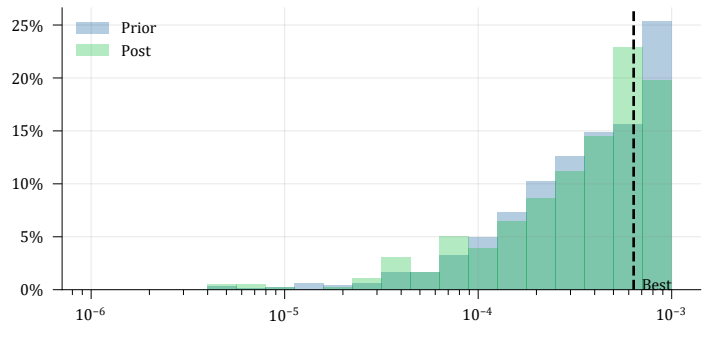
ss_p27(Pilot_Point_L1)



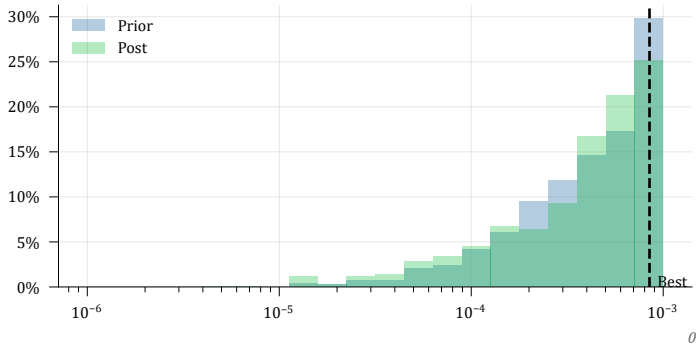
ss_p28(Pilot_Point_L1)



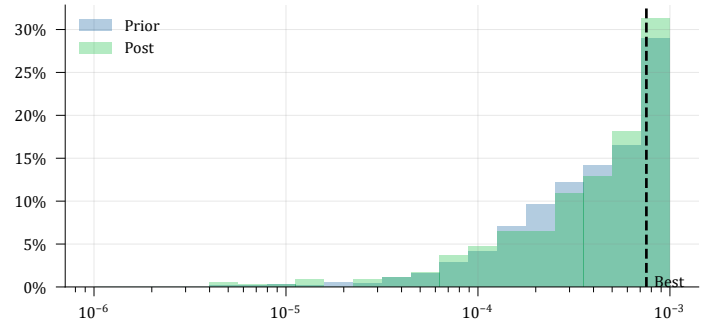
ss_p29(Pilot_Point_L1)



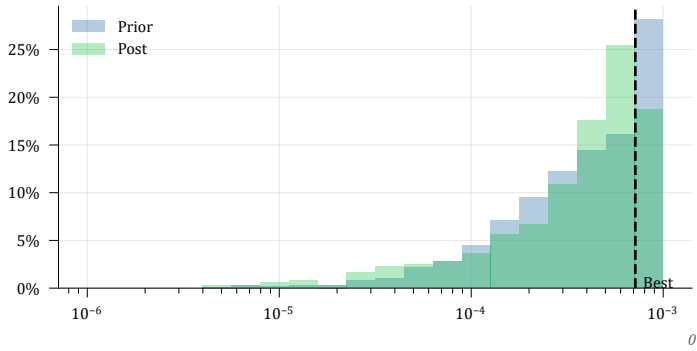
ss_p30(Pilot_Point_L1)



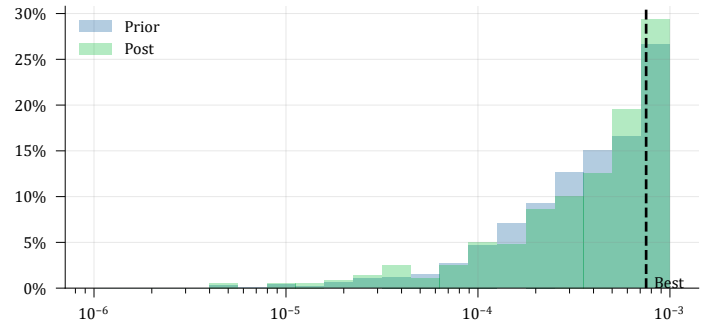
ss_p31(Pilot_Point_L1)



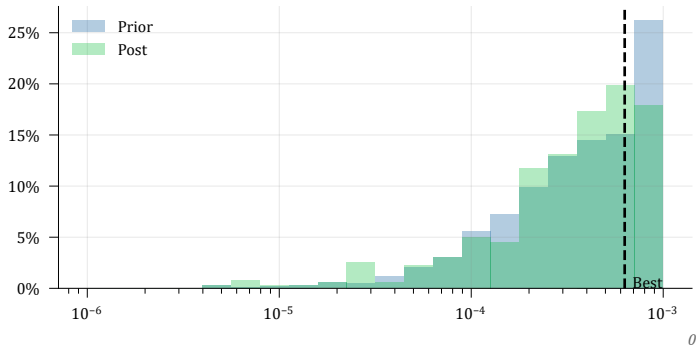
ss_p32(Pilot_Point_L1)



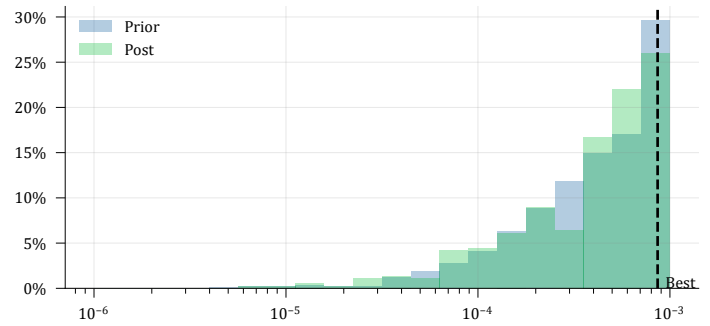
ss_p33(Pilot_Point_L1)



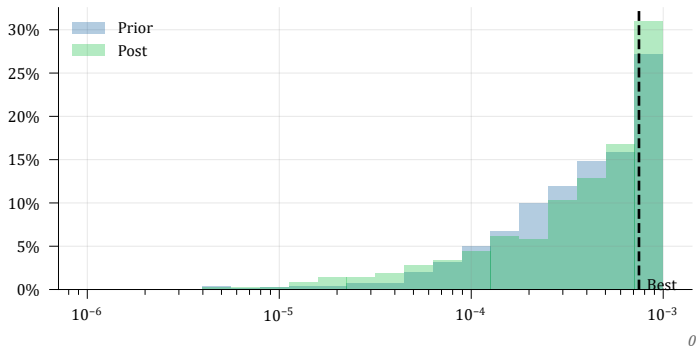
ss_p34(Pilot_Point_L1)



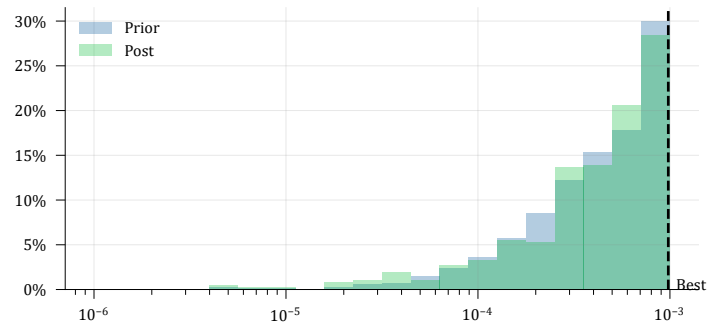
ss_p35(Pilot_Point_L1)



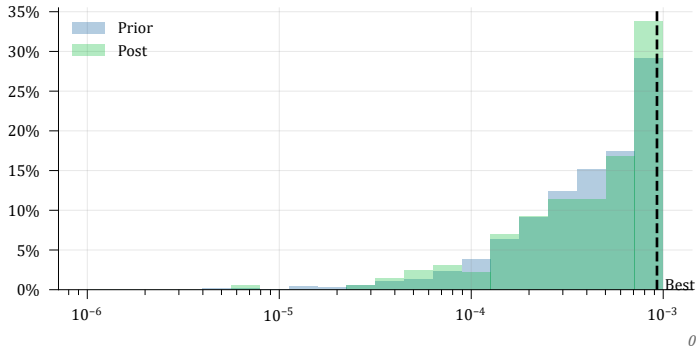
ss_p36(Pilot_Point_L1)



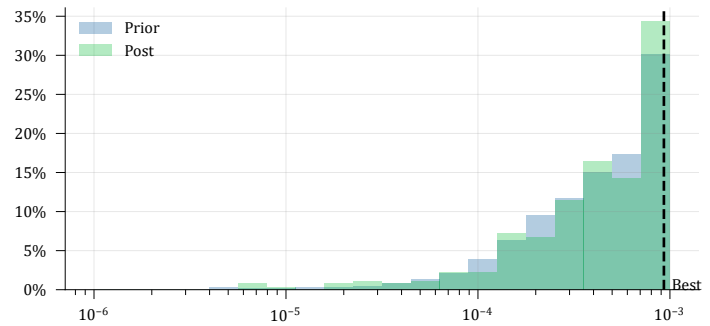
ss_p37(Pilot_Point_L1)

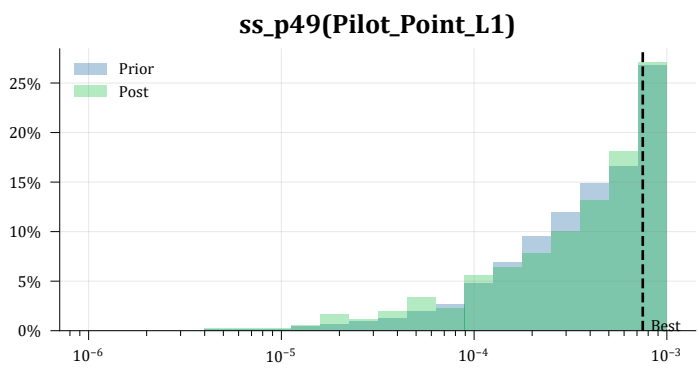
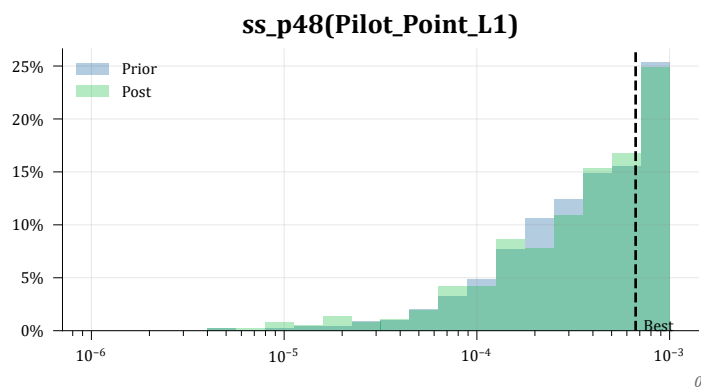
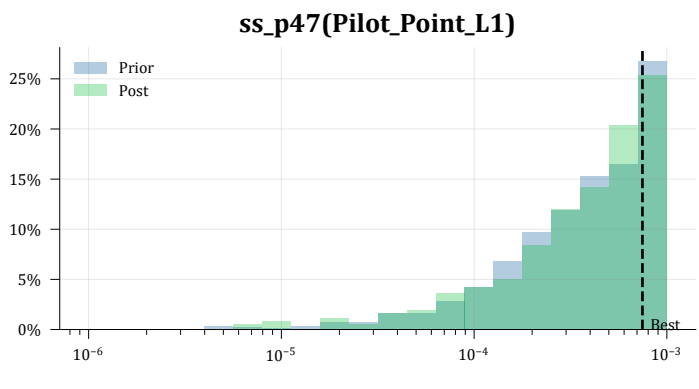
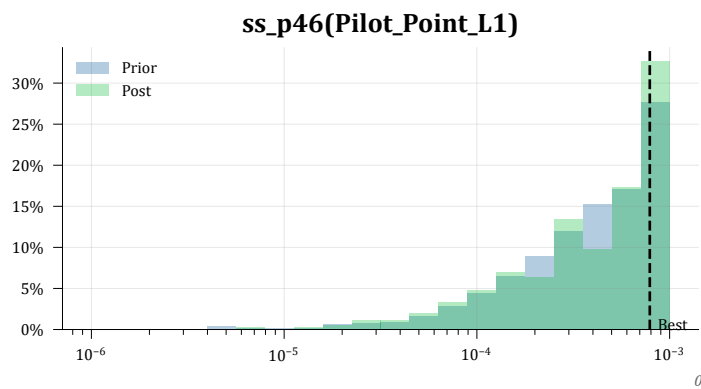
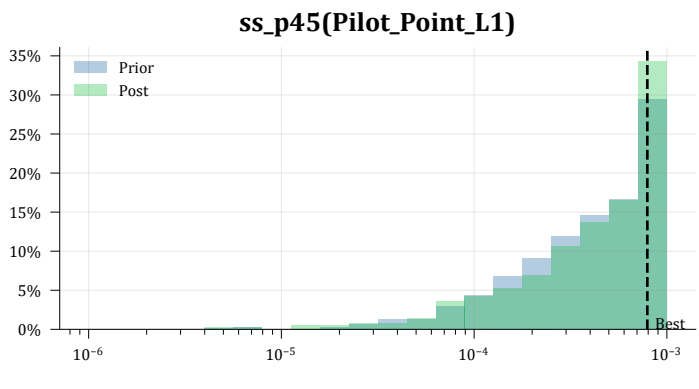
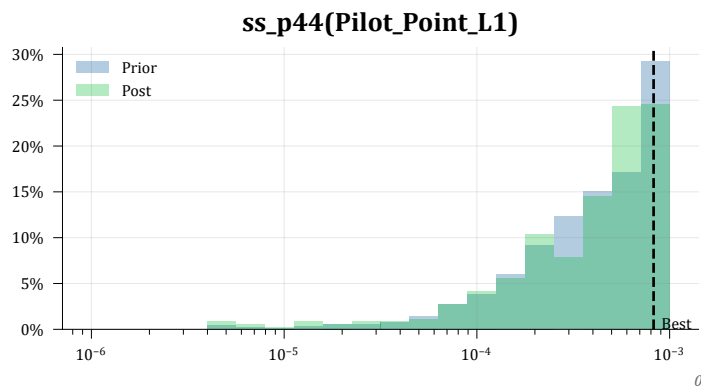
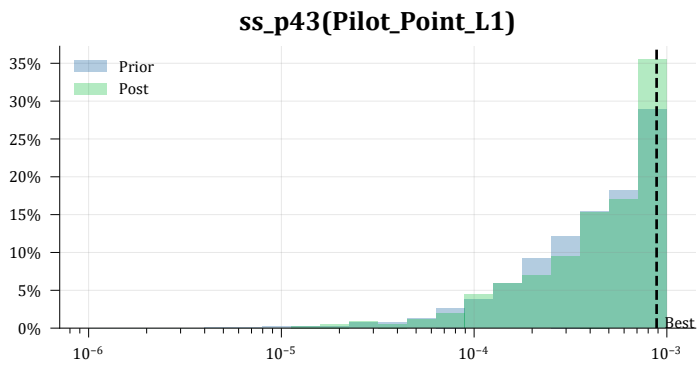
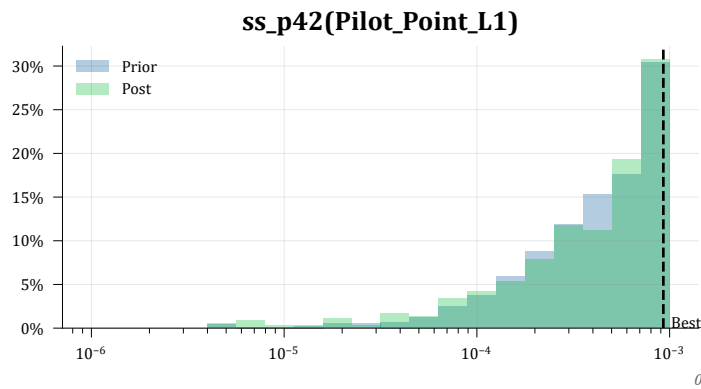
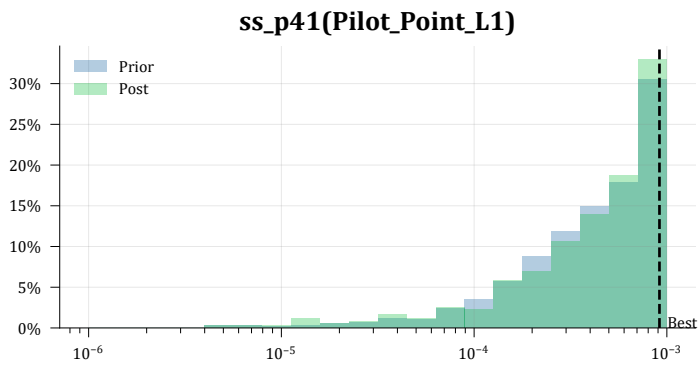
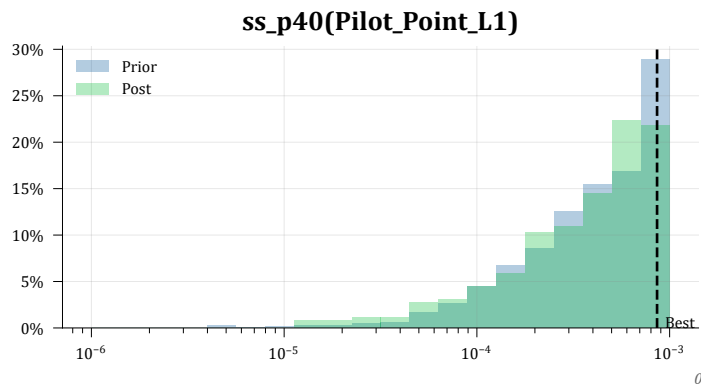


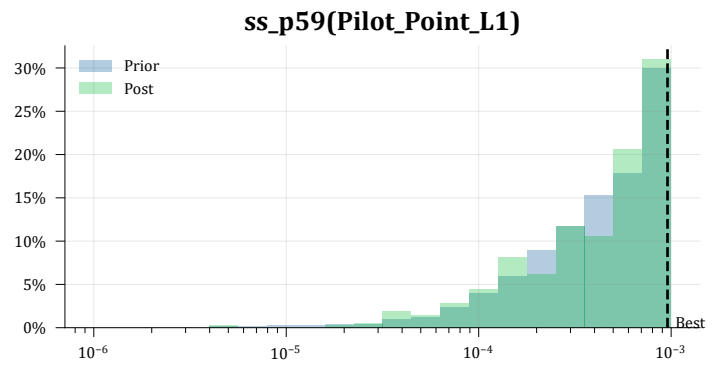
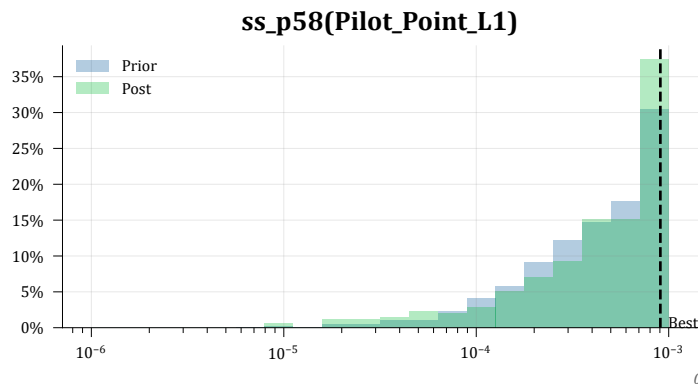
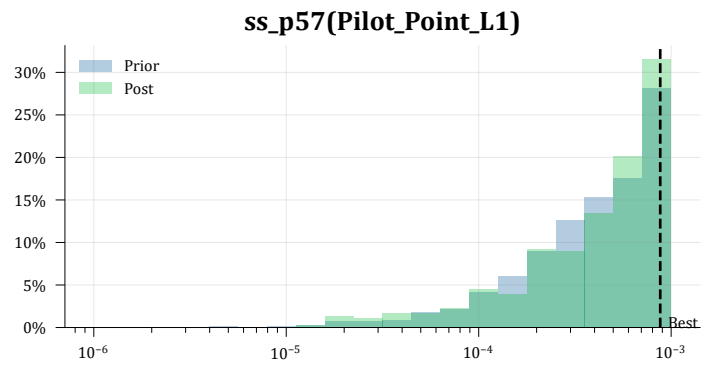
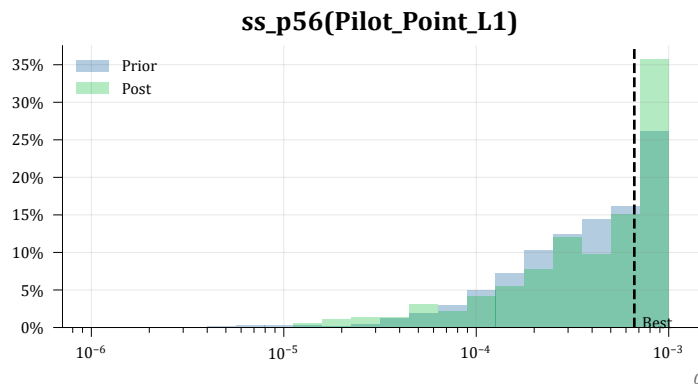
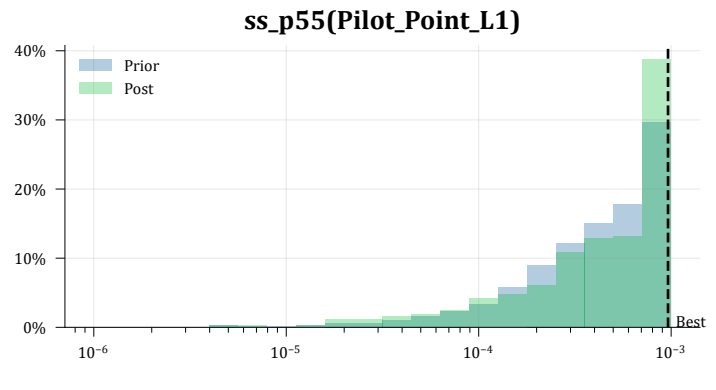
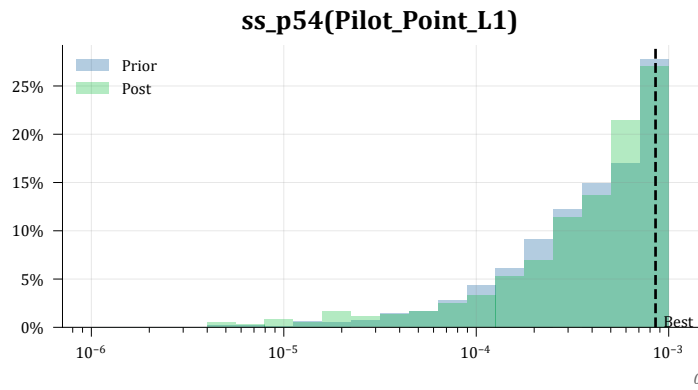
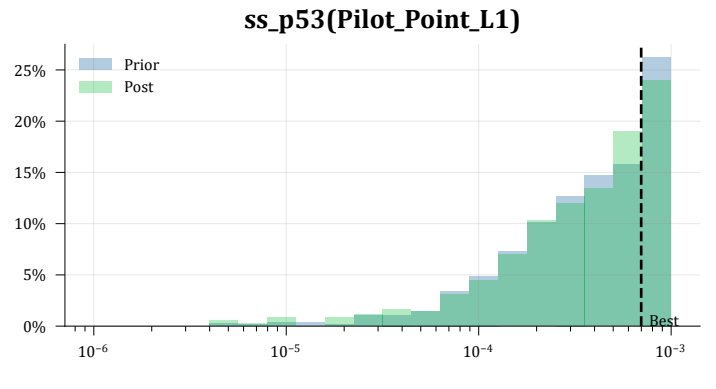
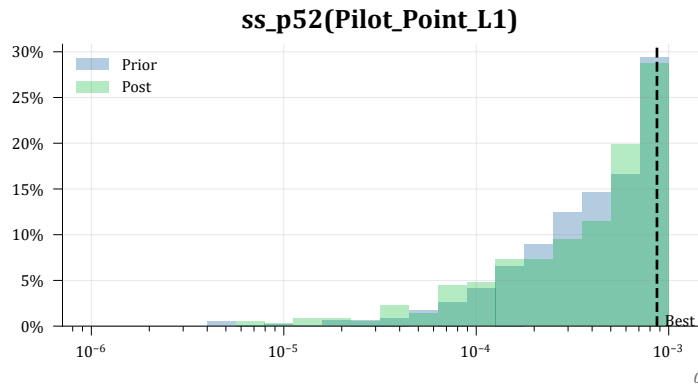
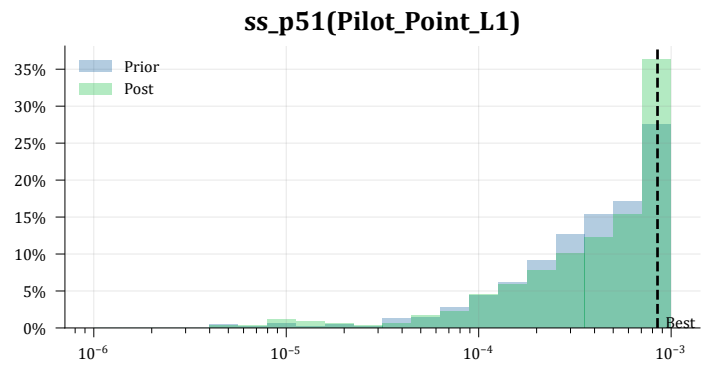
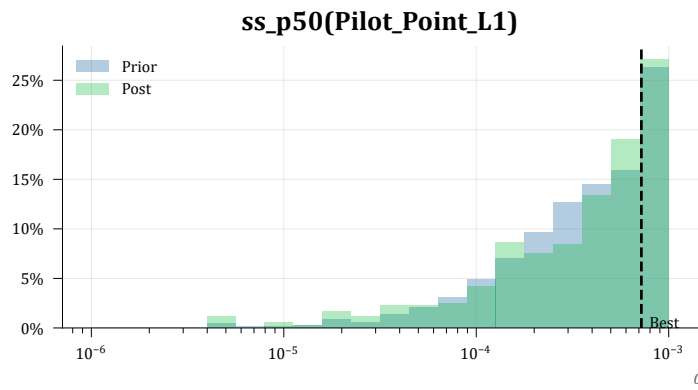
ss_p38(Pilot_Point_L1)



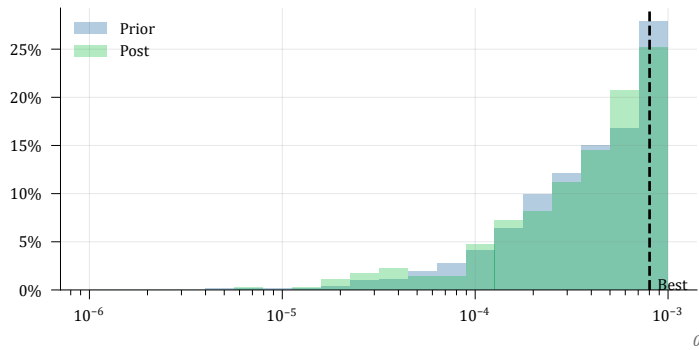
ss_p39(Pilot_Point_L1)



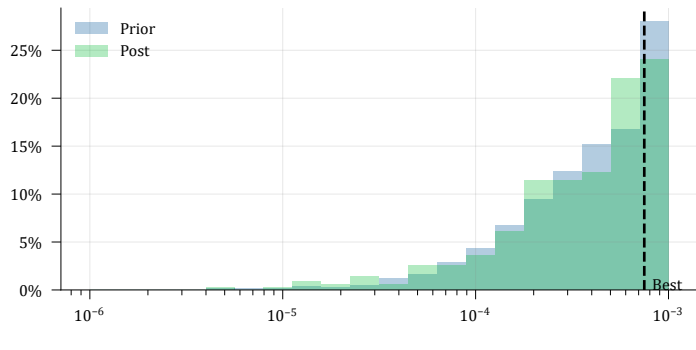




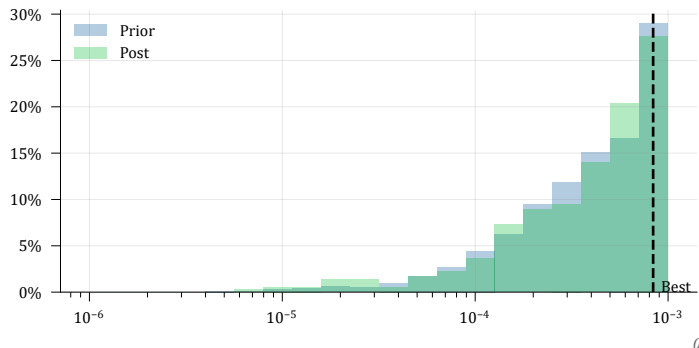
ss_p60(Pilot_Point_L1)



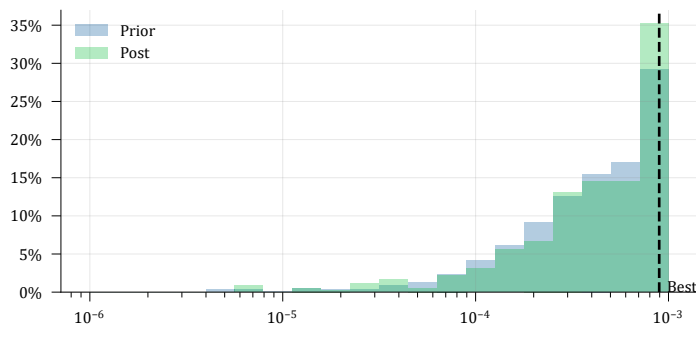
ss_p61(Pilot_Point_L1)



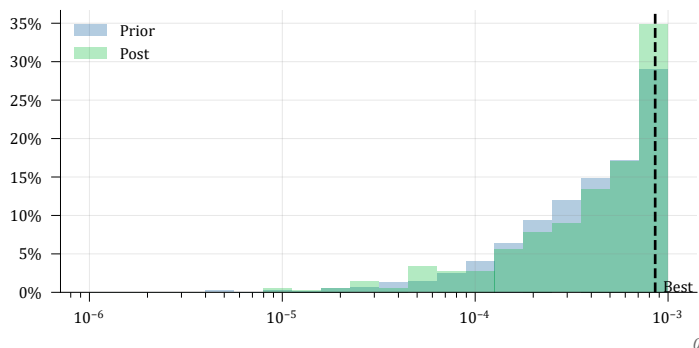
ss_p62(Pilot_Point_L1)



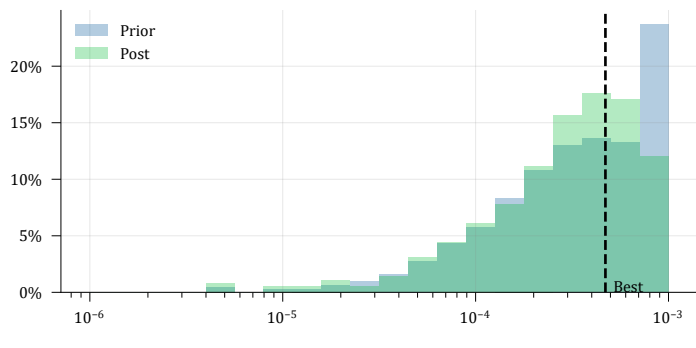
ss_p63(Pilot_Point_L1)



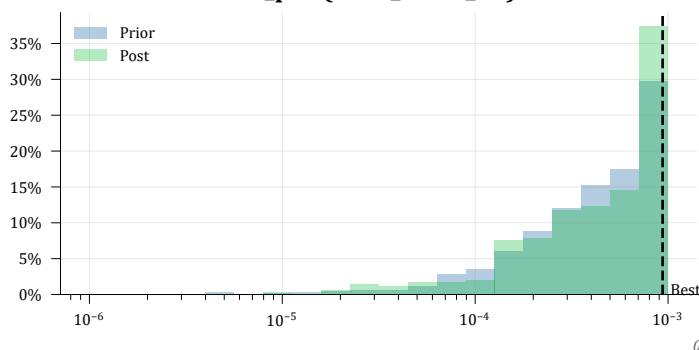
ss_p64(Pilot_Point_L1)



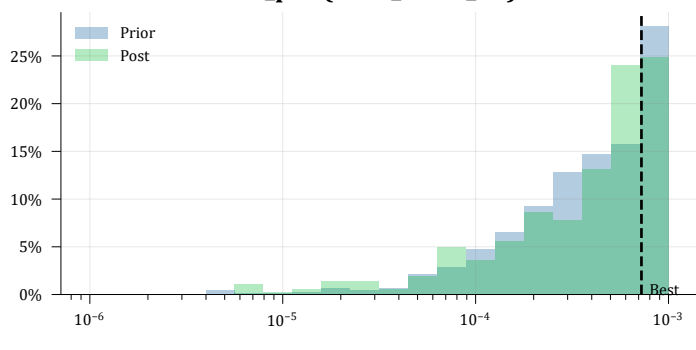
ss_p65(Pilot_Point_L1)



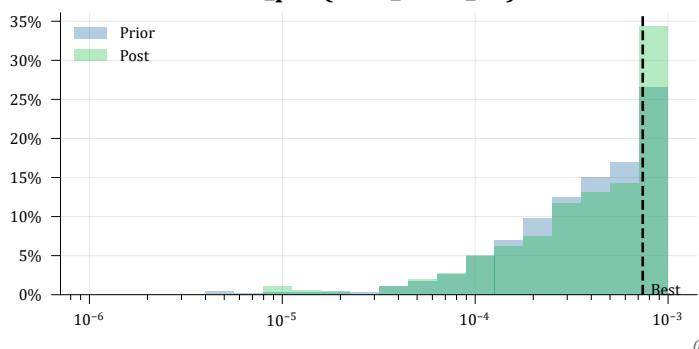
ss_p66(Pilot_Point_L1)



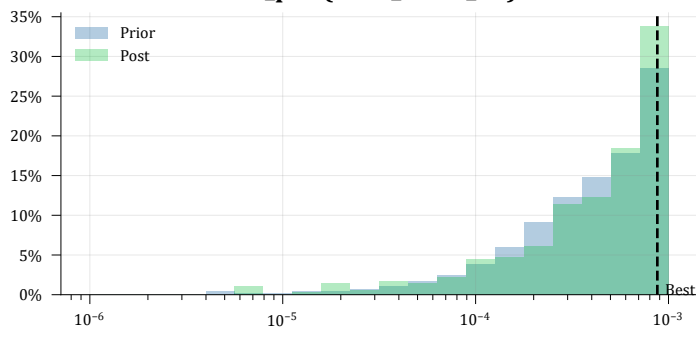
ss_p67(Pilot_Point_L1)

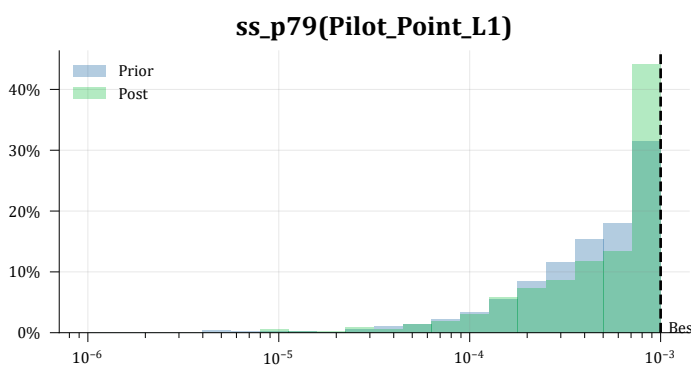
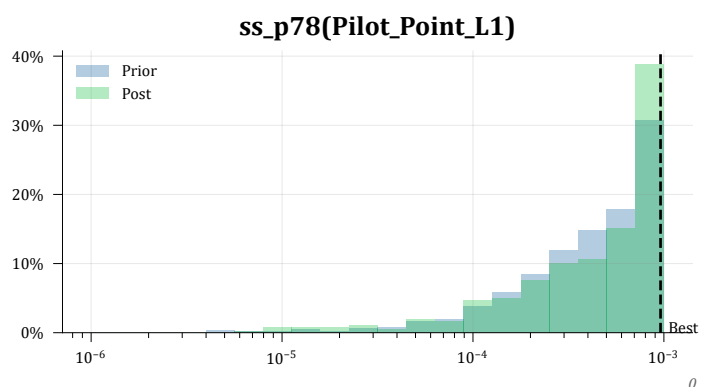
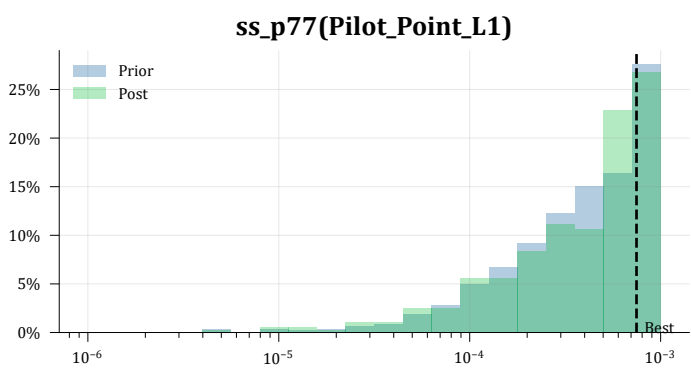
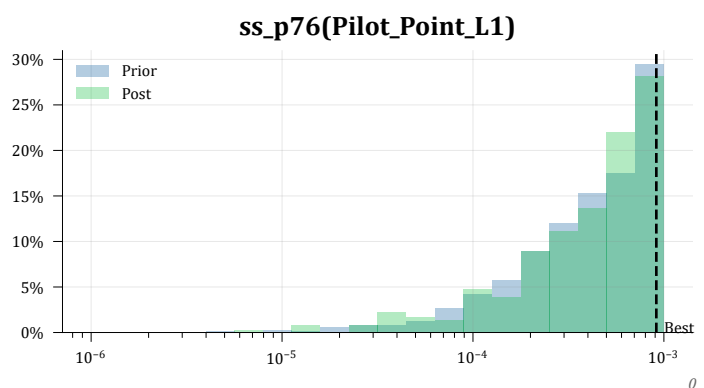
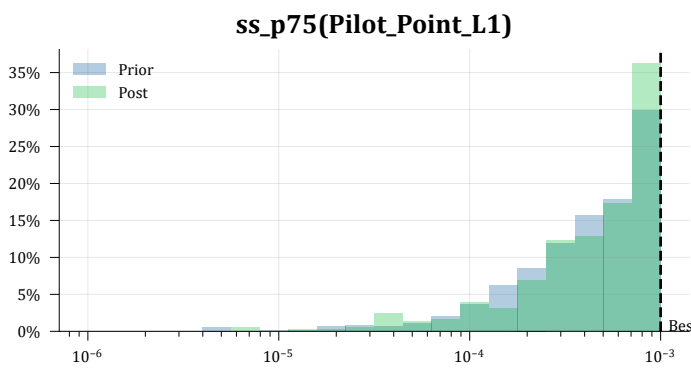
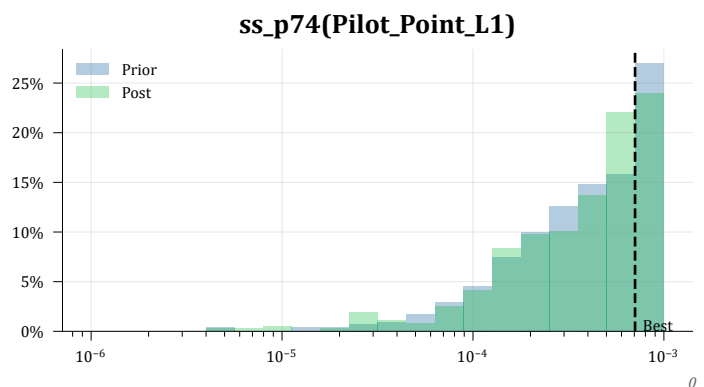
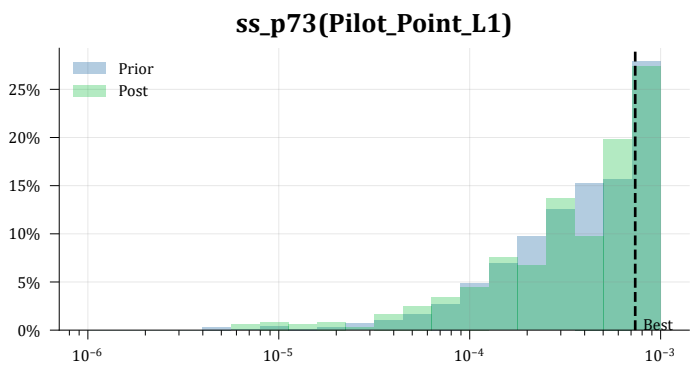
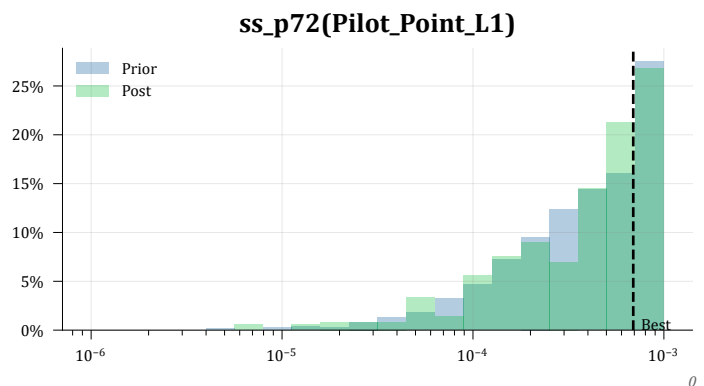
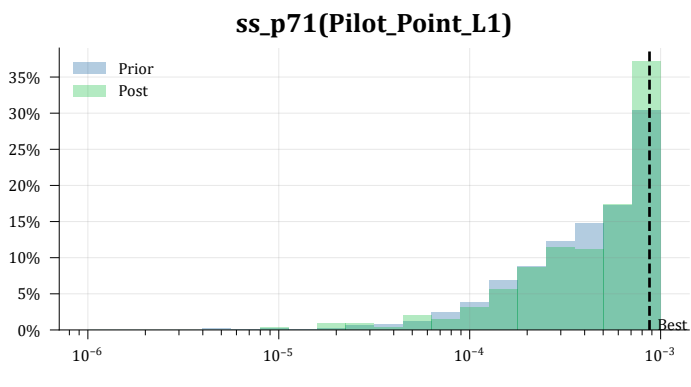
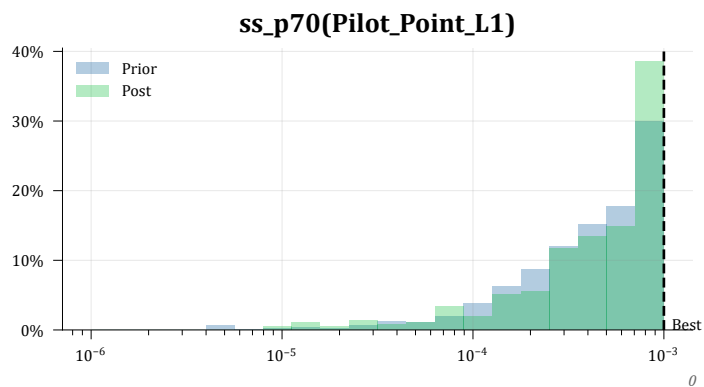


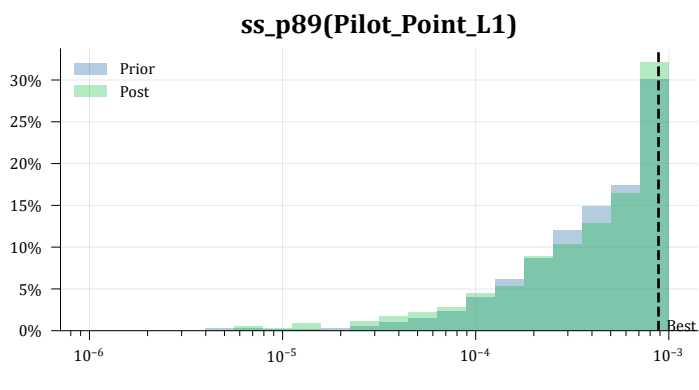
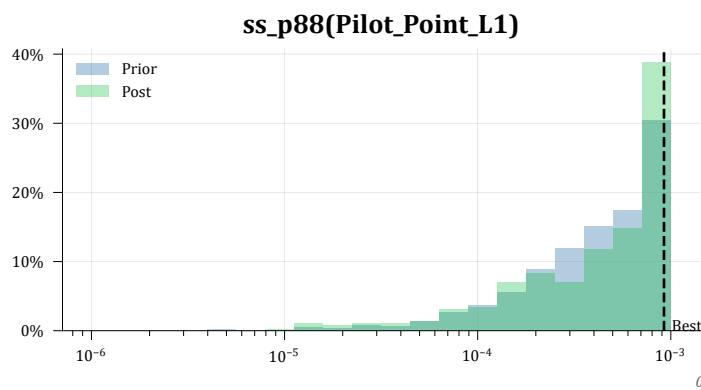
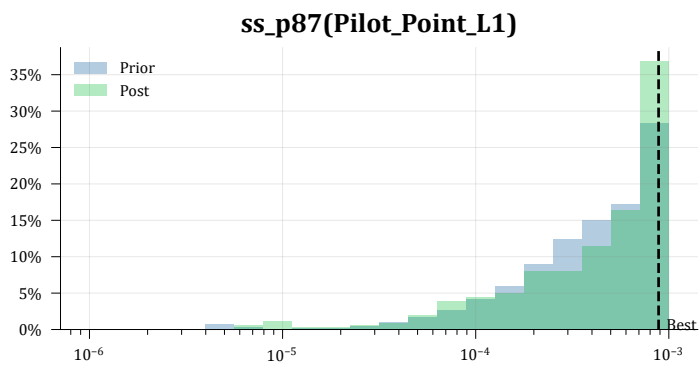
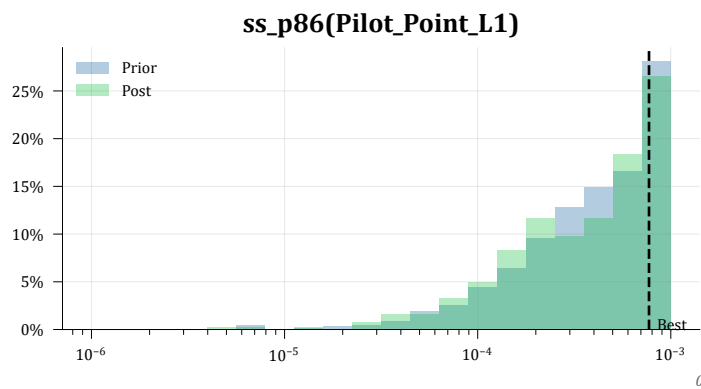
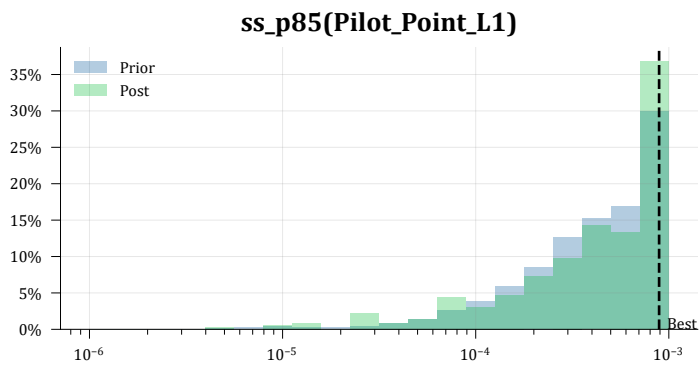
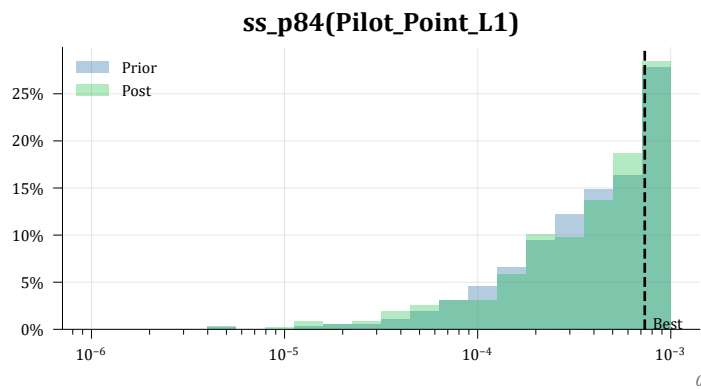
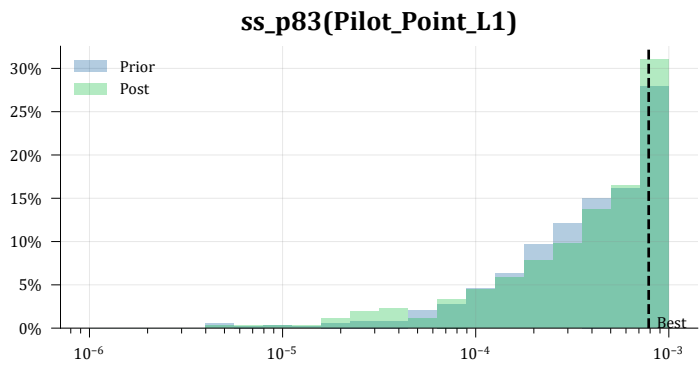
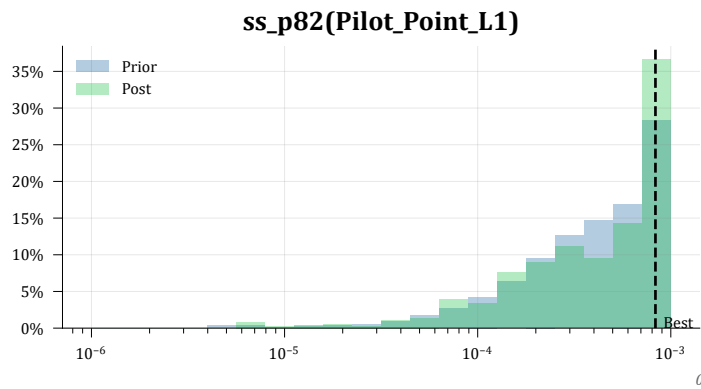
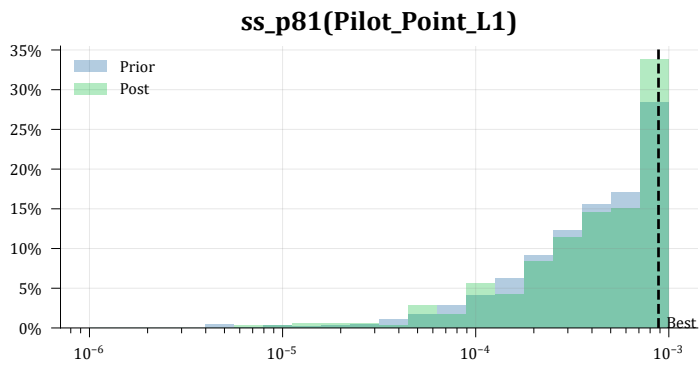
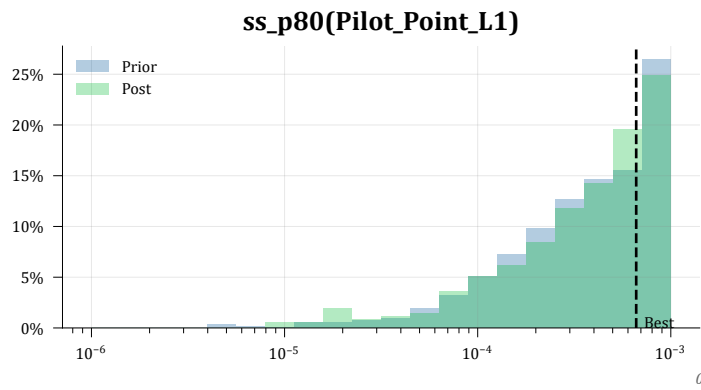
ss_p68(Pilot_Point_L1)

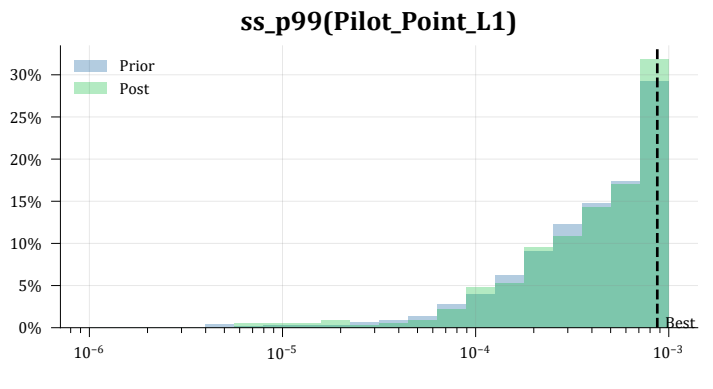
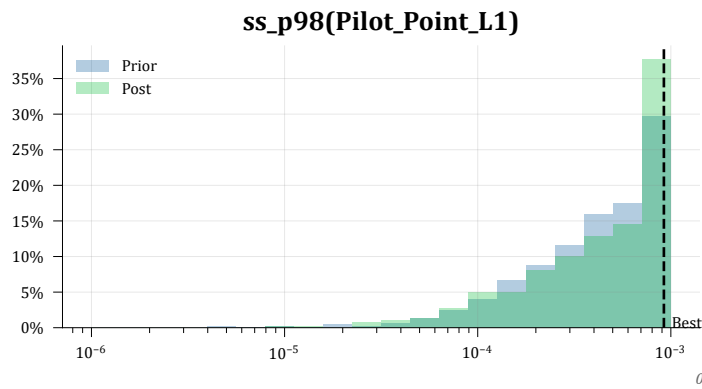
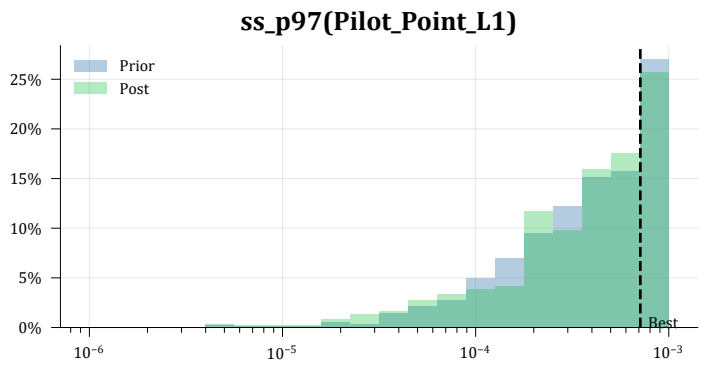
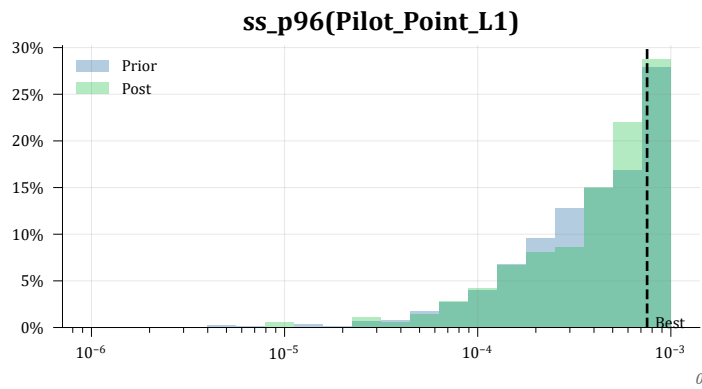
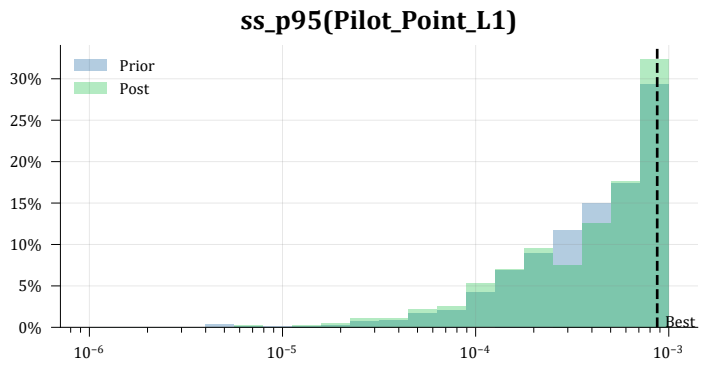
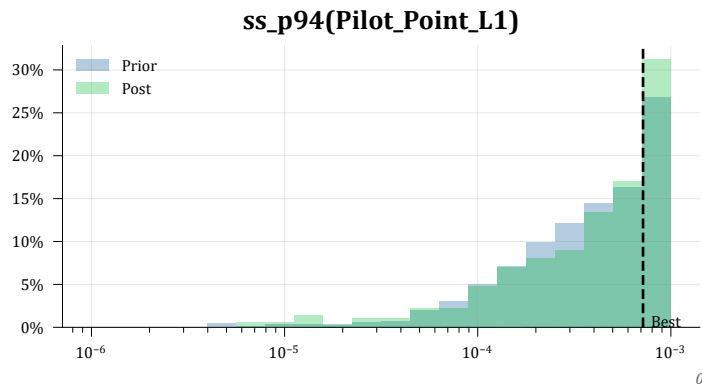
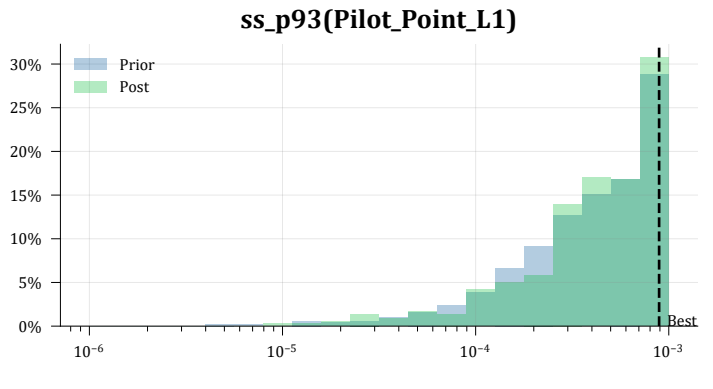
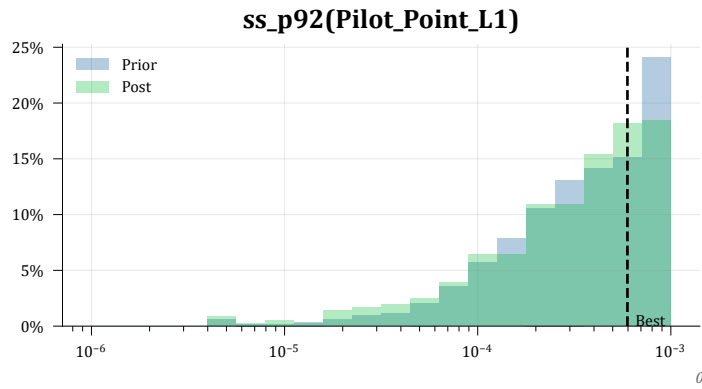
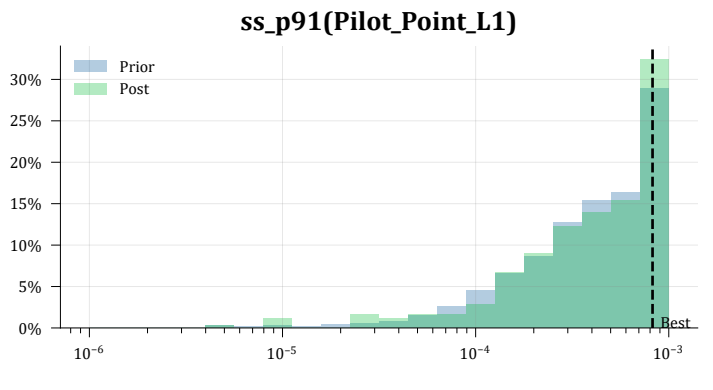
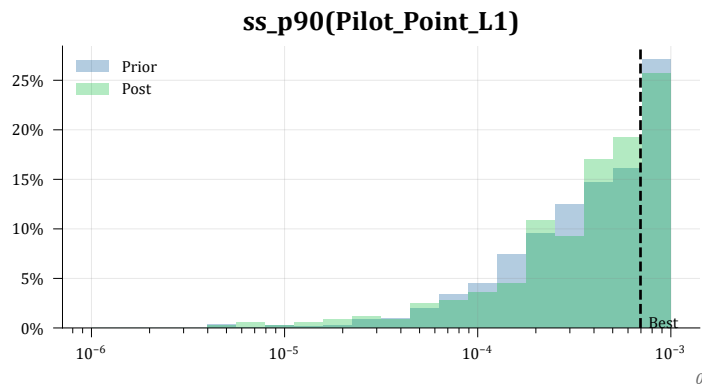


ss_p69(Pilot_Point_L1)

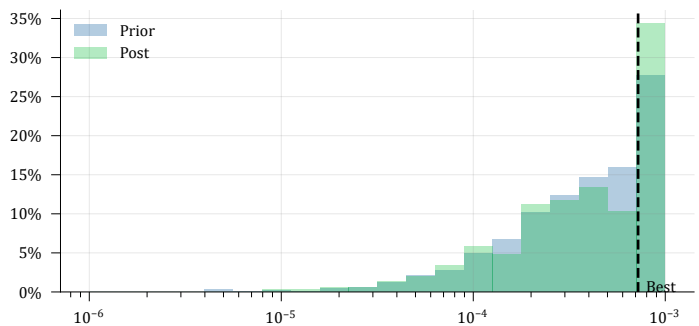




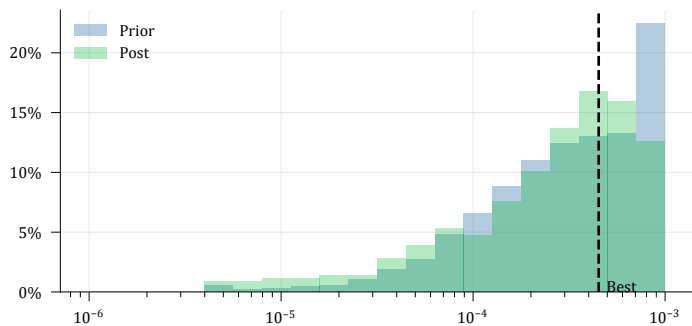




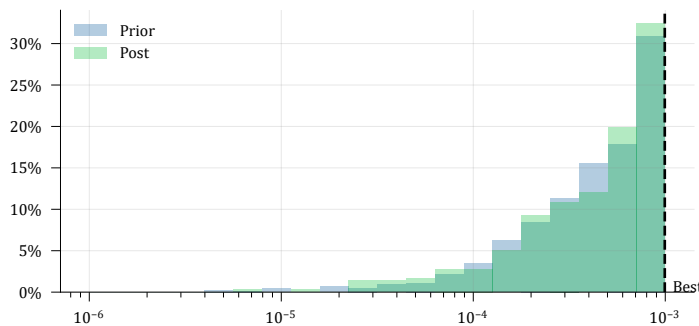
ss_p100(Pilot_Point_L1)



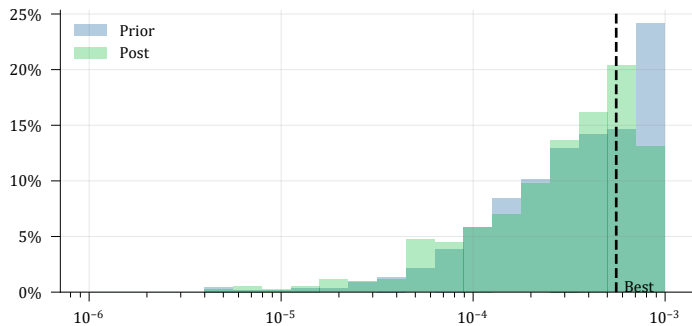
ss_p101(Pilot_Point_L1)



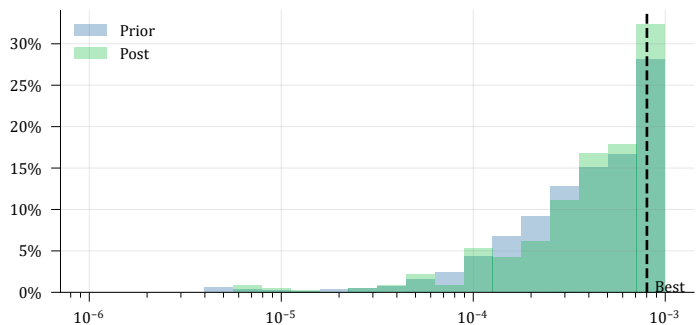
ss_p102(Pilot_Point_L1)



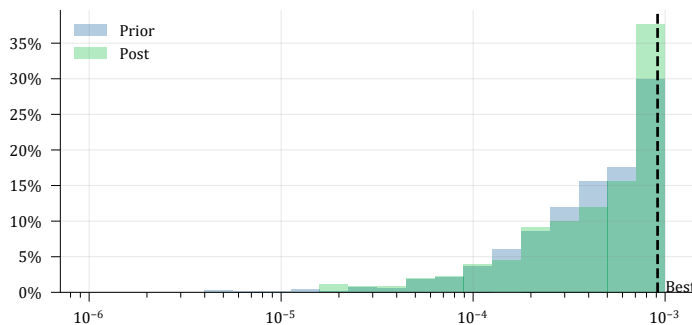
ss_p103(Pilot_Point_L1)



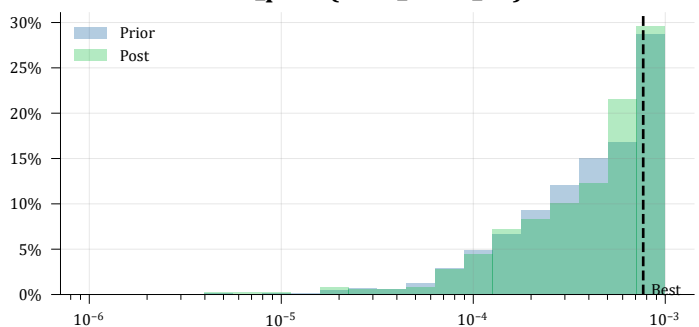
ss_p104(Pilot_Point_L1)



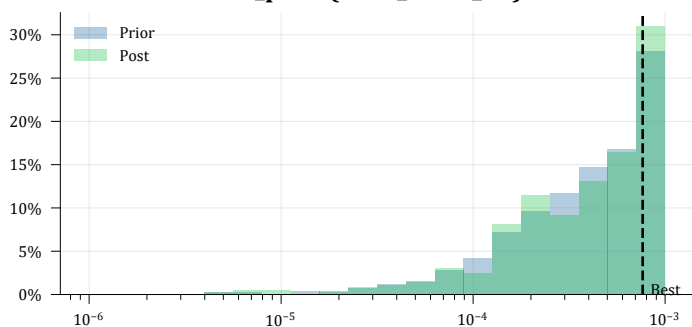
ss_p105(Pilot_Point_L1)



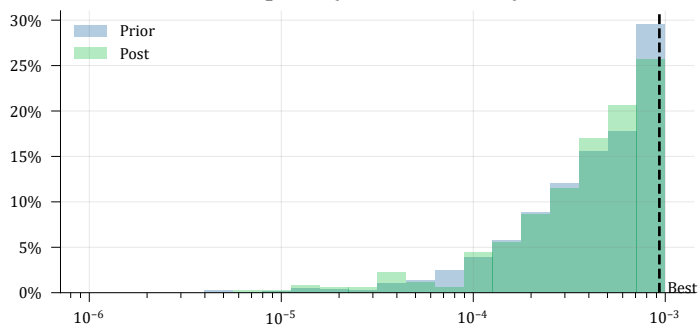
ss_p106(Pilot_Point_L1)



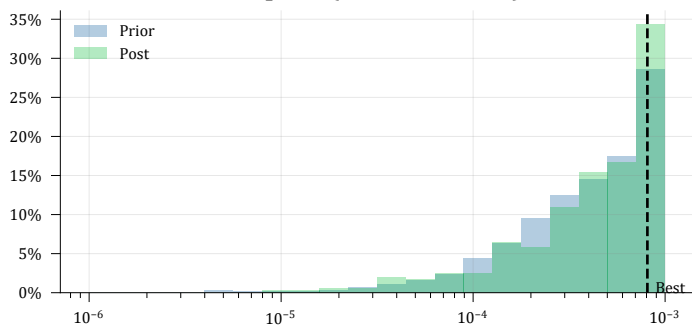
ss_p107(Pilot_Point_L1)



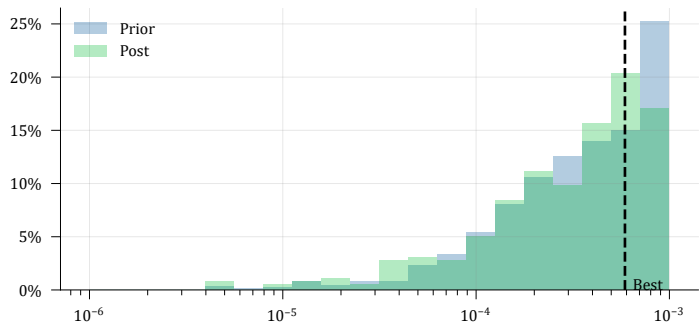
ss_p108(Pilot_Point_L1)



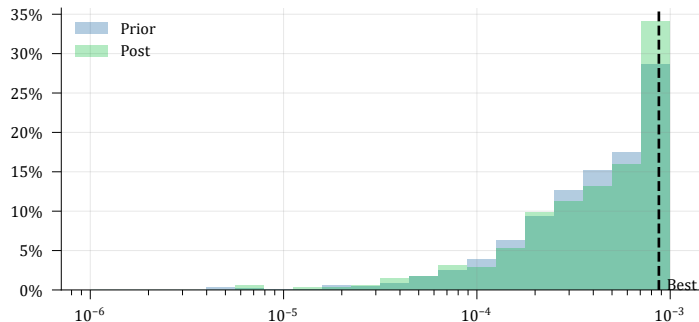
ss_p109(Pilot_Point_L1)



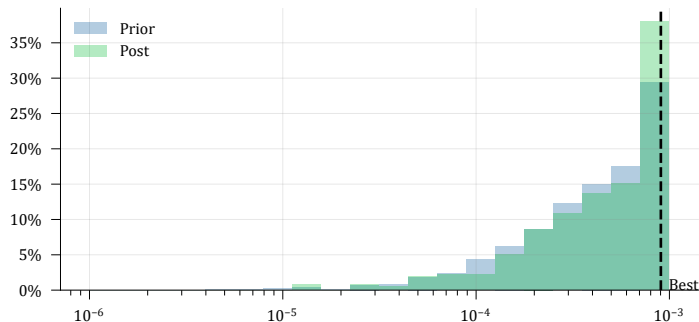
ss_p110(Pilot_Point_L1)



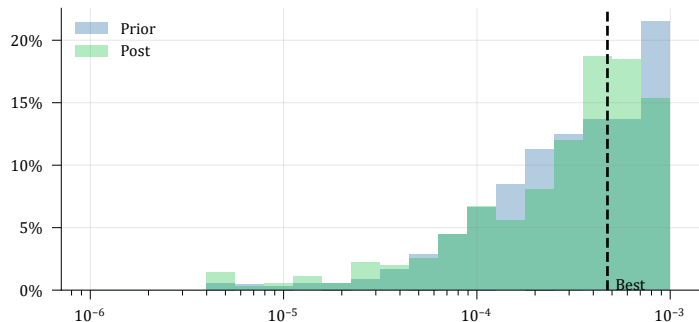
ss_p111(Pilot_Point_L1)



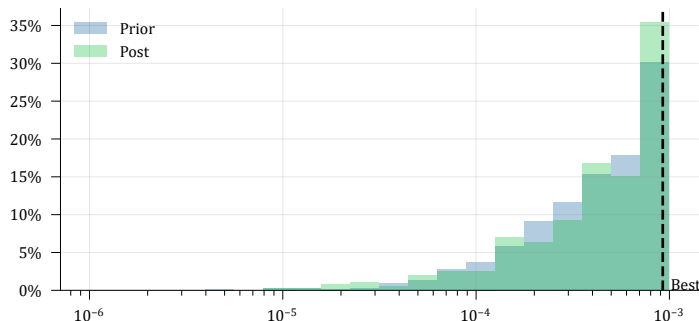
ss_p112(Pilot_Point_L1)



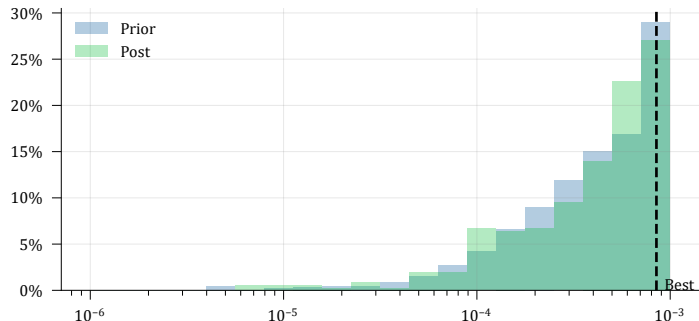
ss_p113(Pilot_Point_L1)



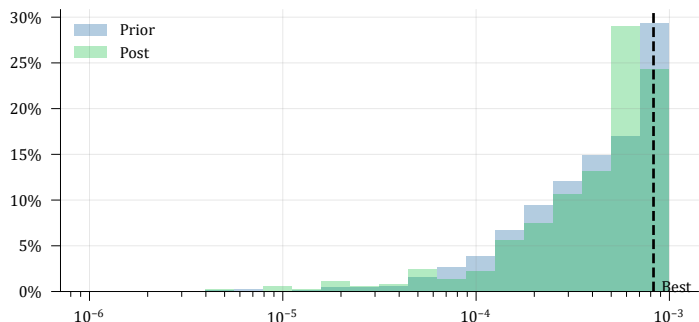
ss_p114(Pilot_Point_L1)



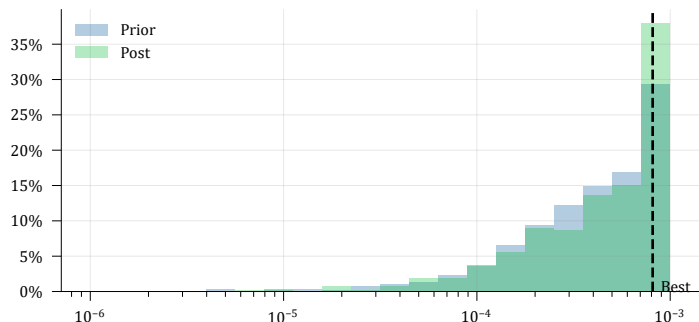
ss_p115(Pilot_Point_L1)



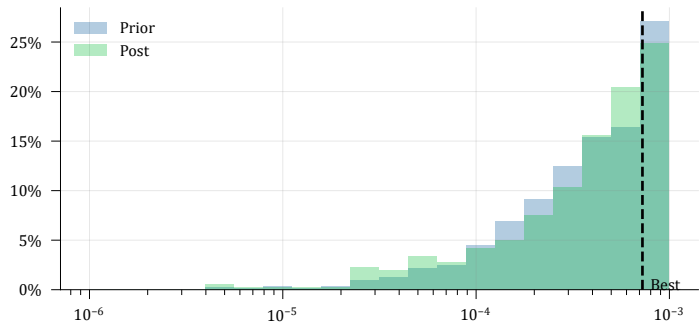
ss_p116(Pilot_Point_L1)



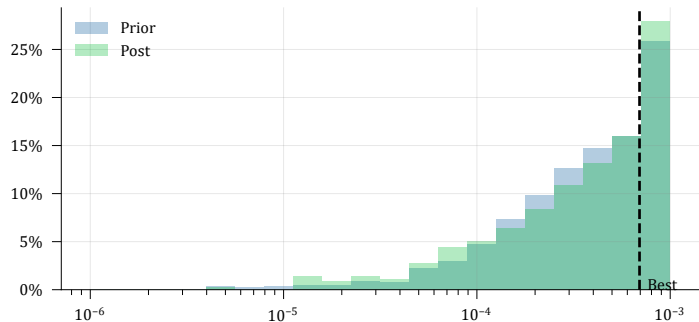
ss_p117(Pilot_Point_L1)



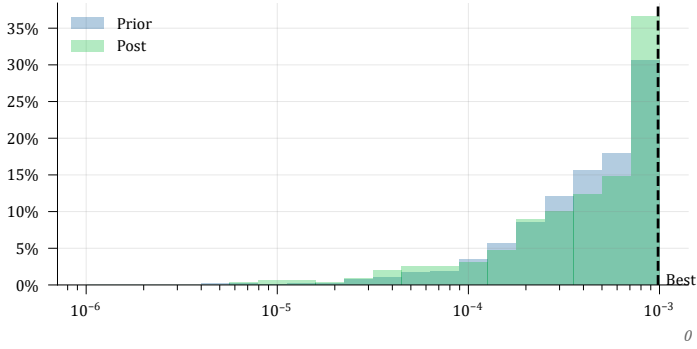
ss_p118(Pilot_Point_L1)



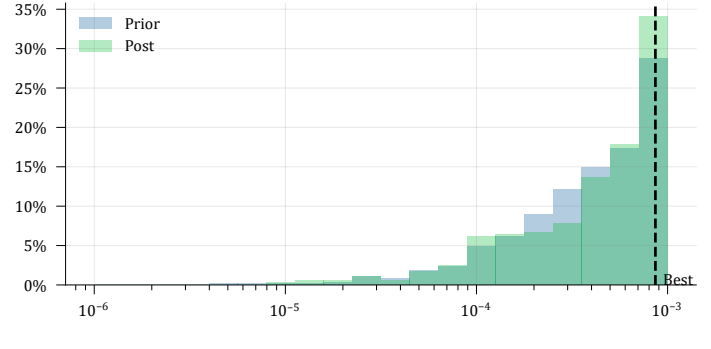
ss_p119(Pilot_Point_L1)



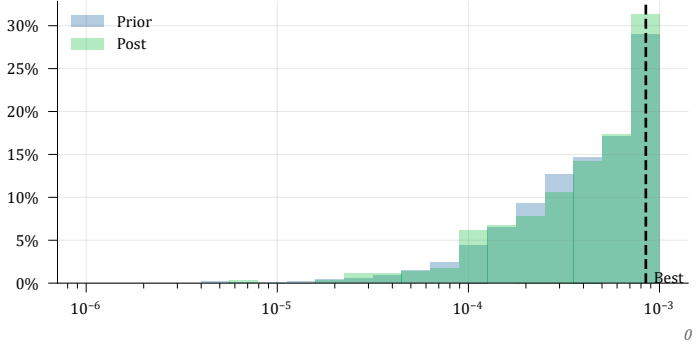
ss_p120(Pilot_Point_L1)



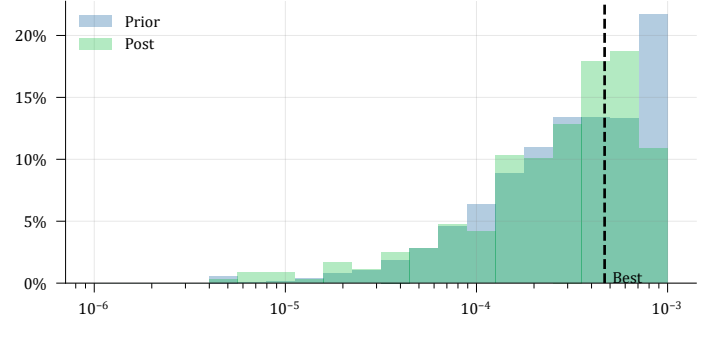
ss_p121(Pilot_Point_L1)



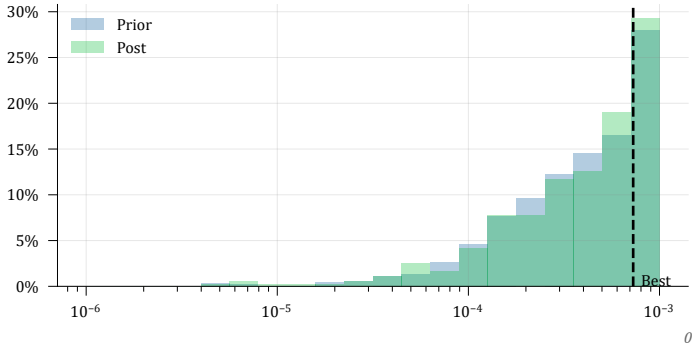
ss_p122(Pilot_Point_L1)



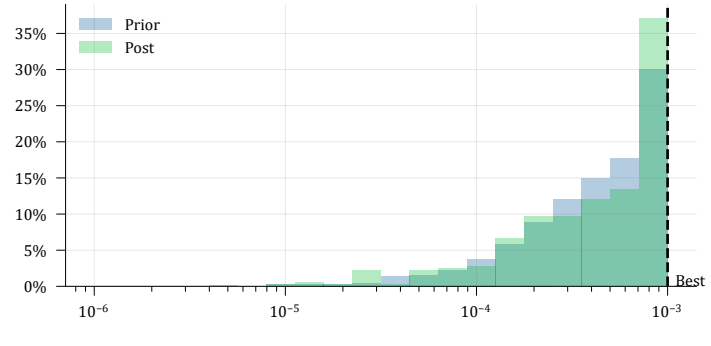
ss_p123(Pilot_Point_L1)



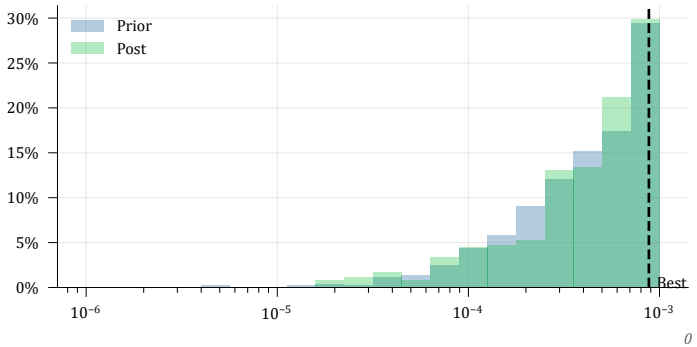
ss_p124(Pilot_Point_L1)



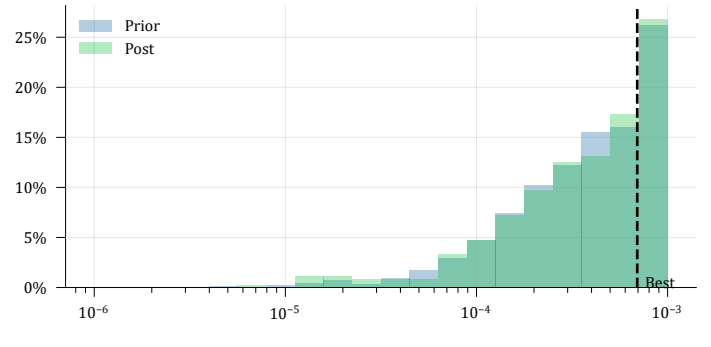
ss_p125(Pilot_Point_L1)



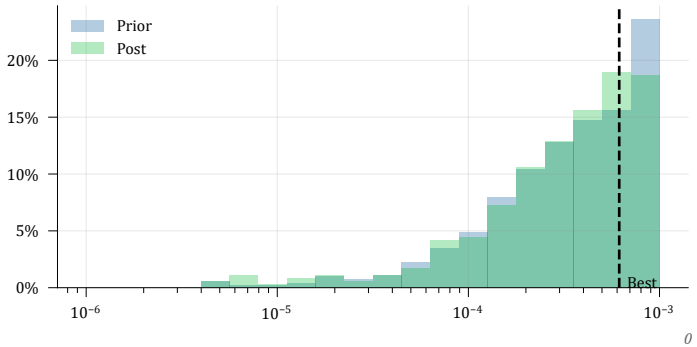
ss_p126(Pilot_Point_L1)



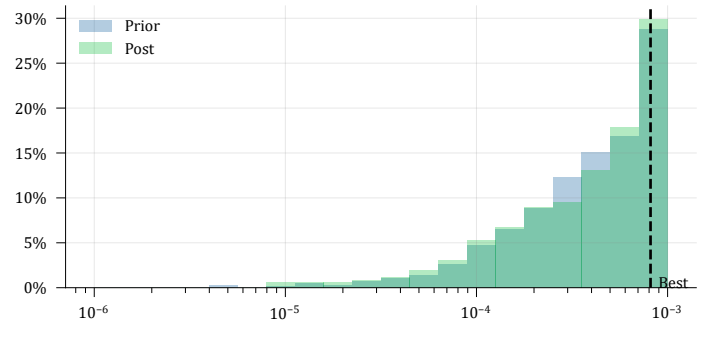
ss_p127(Pilot_Point_L1)



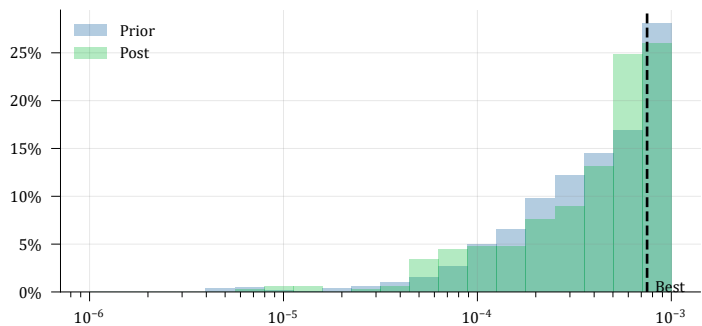
ss_p128(Pilot_Point_L1)



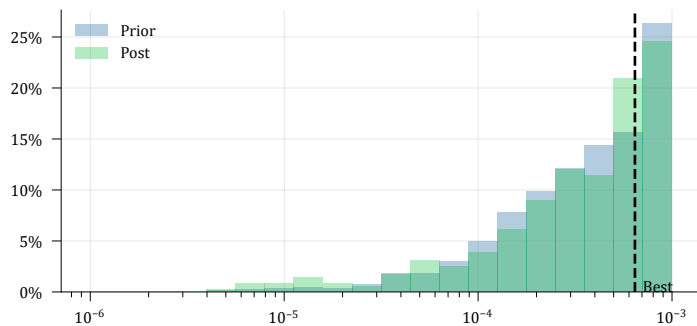
ss_p129(Pilot_Point_L1)



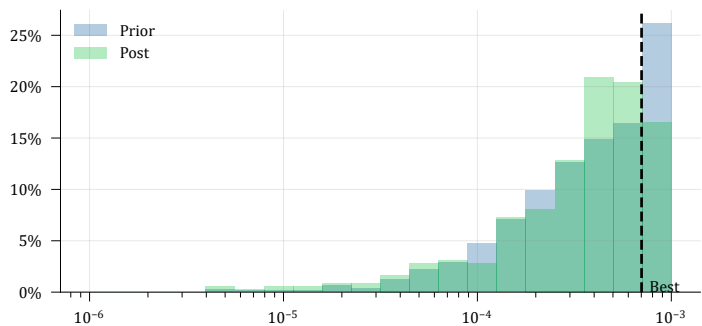
ss_p130(Pilot_Point_L1)



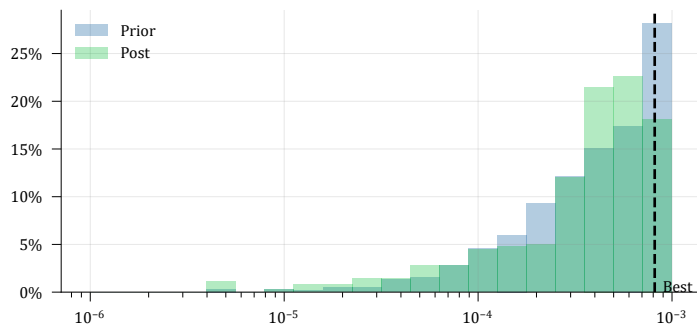
ss_p131(Pilot_Point_L1)



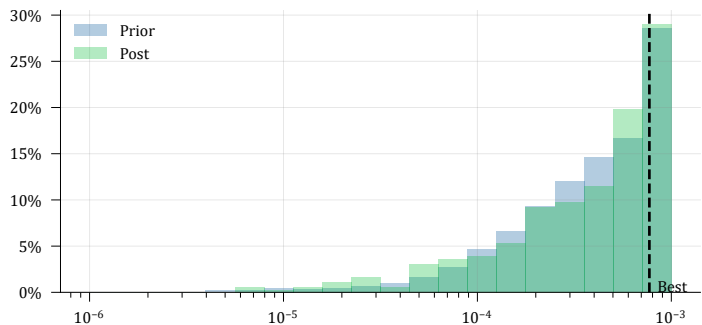
ss_p132(Pilot_Point_L1)



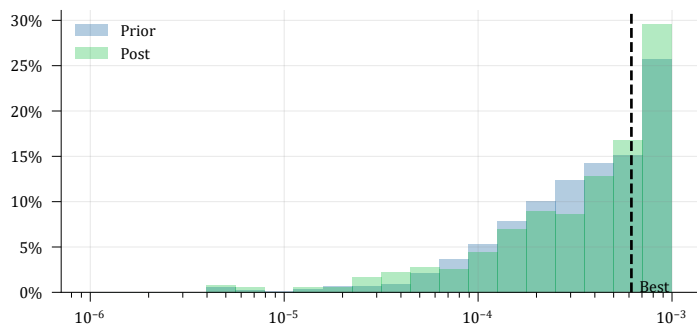
ss_p133(Pilot_Point_L1)



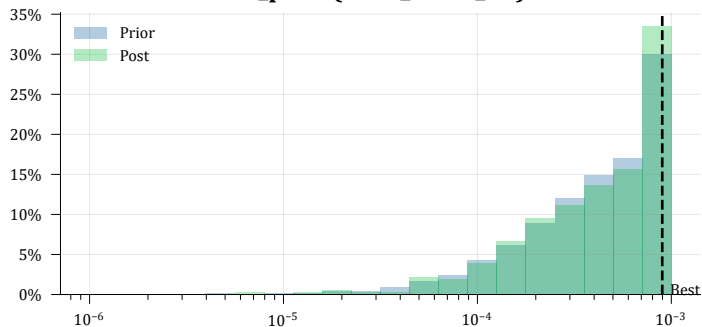
ss_p134(Pilot_Point_L1)



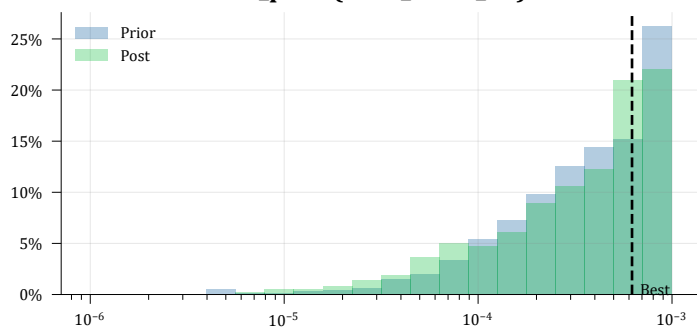
ss_p135(Pilot_Point_L1)



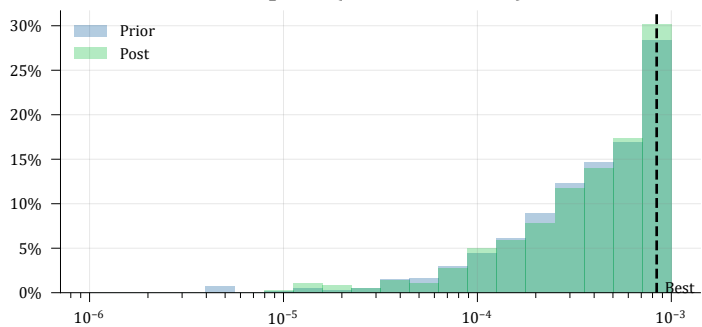
ss_p136(Pilot_Point_L1)



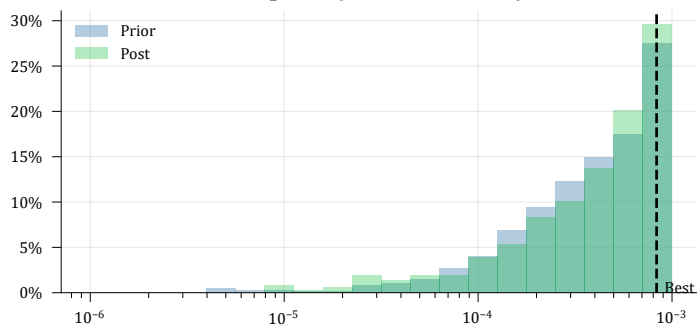
ss_p137(Pilot_Point_L1)

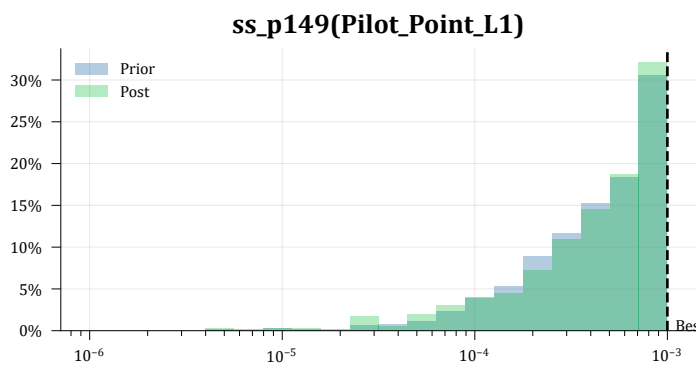
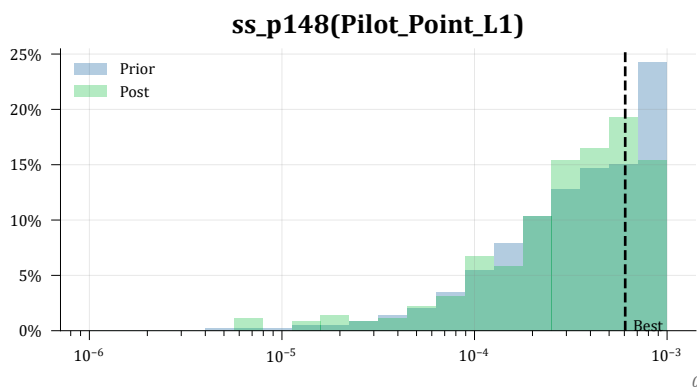
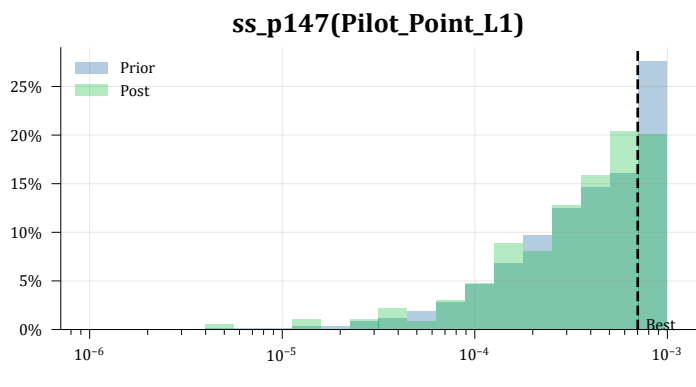
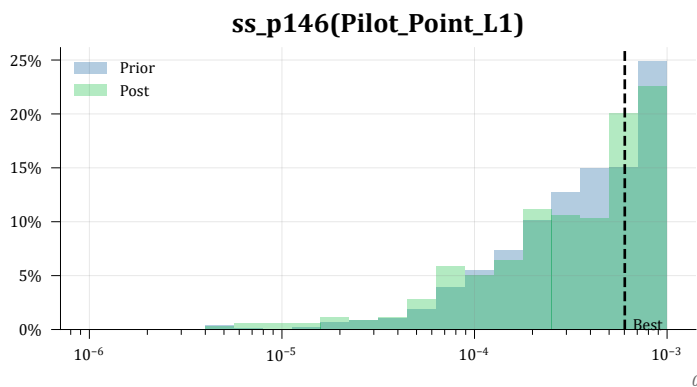
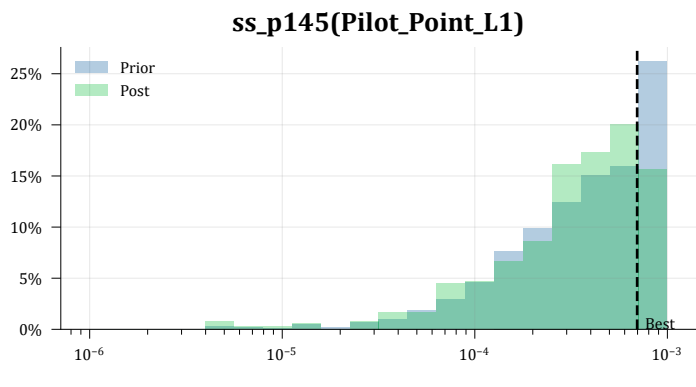
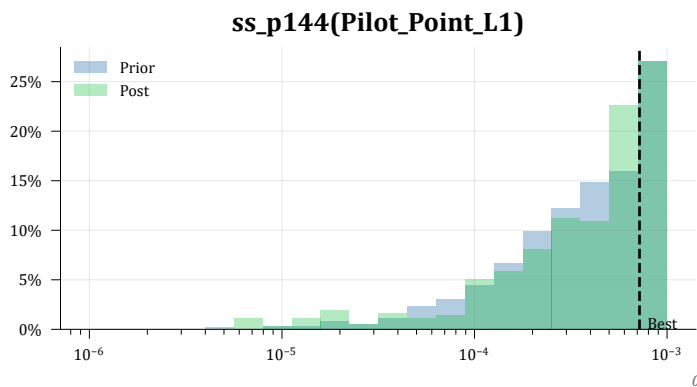
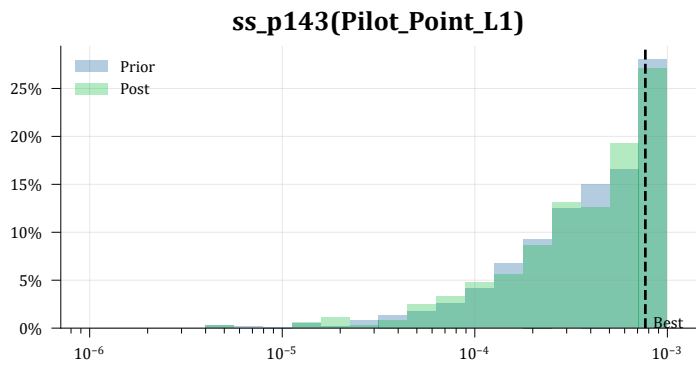
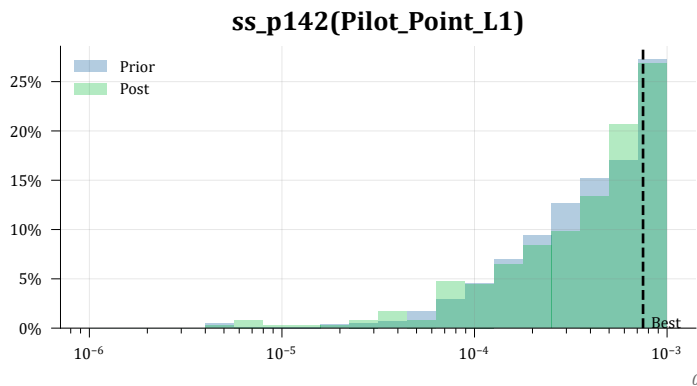
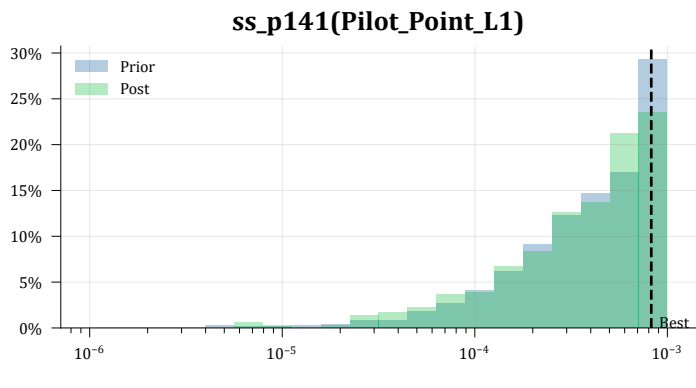
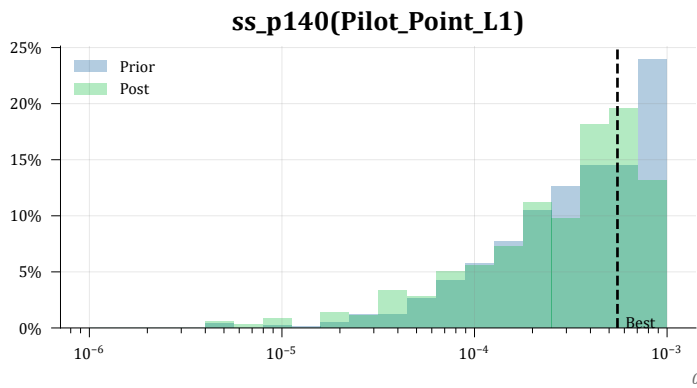


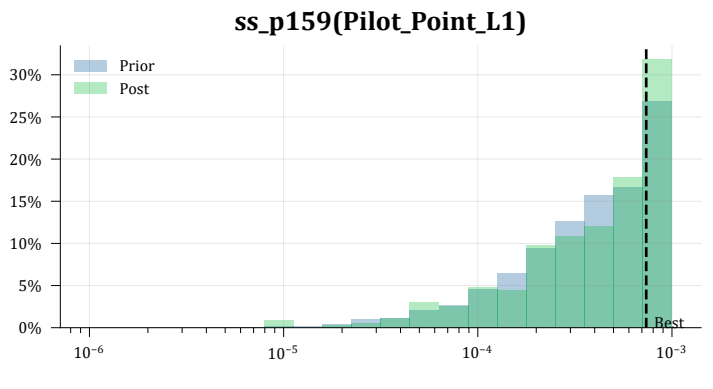
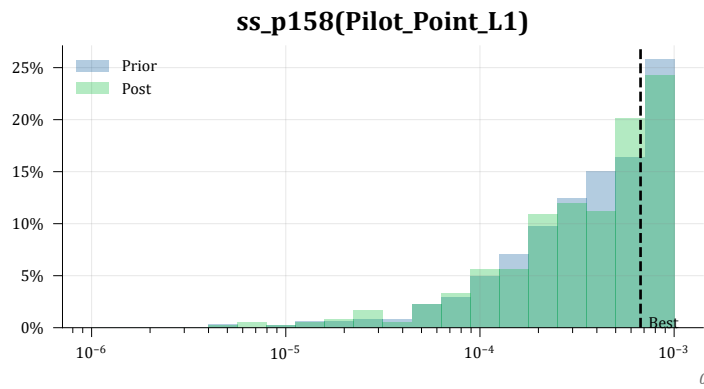
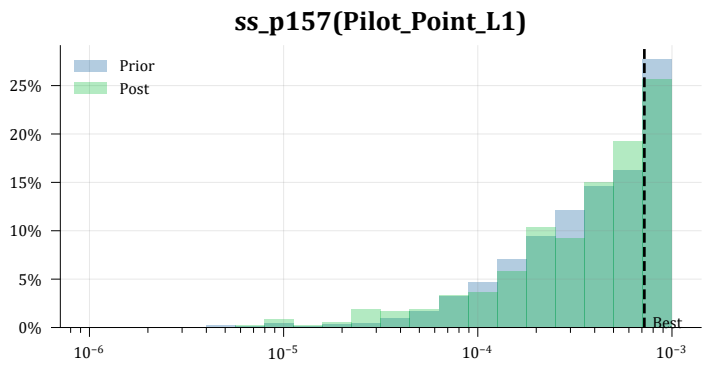
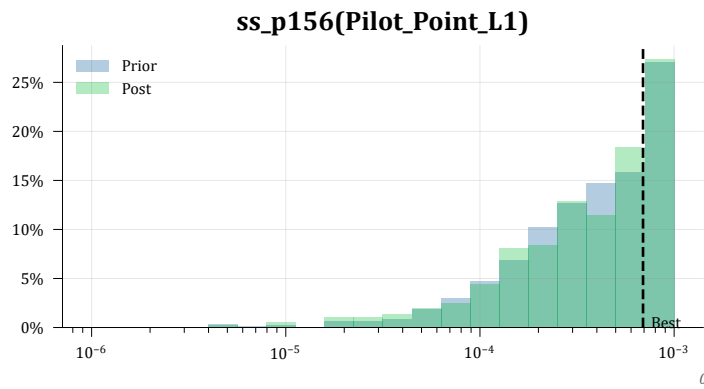
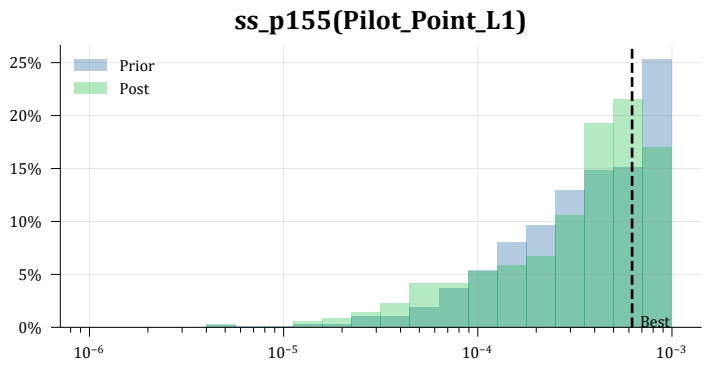
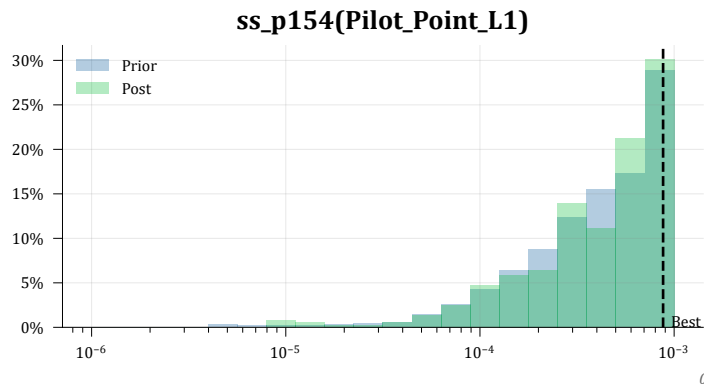
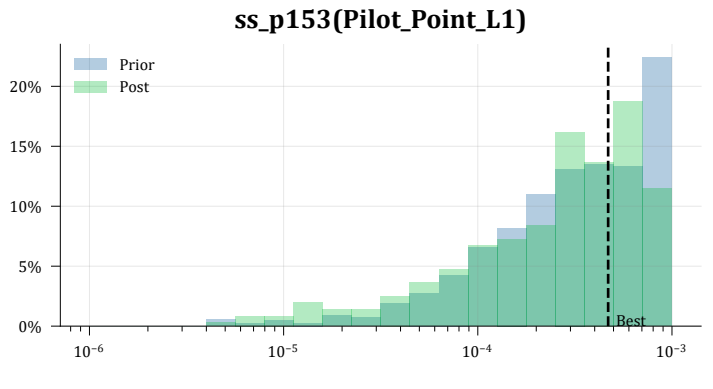
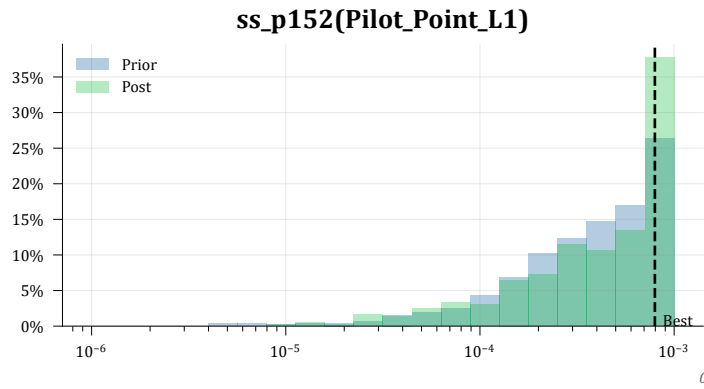
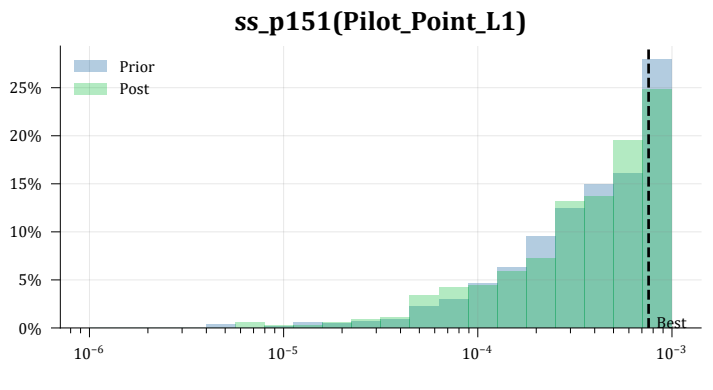
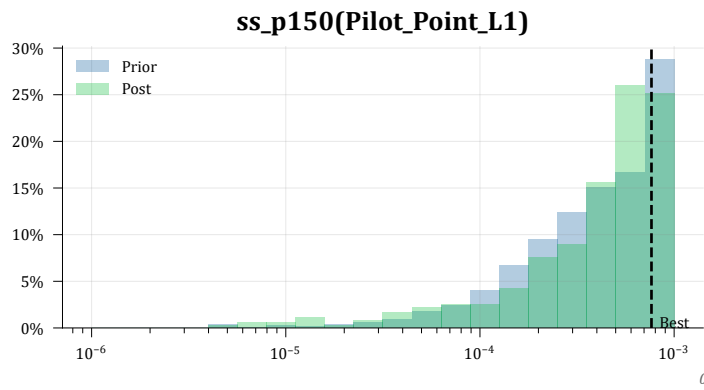
ss_p138(Pilot_Point_L1)



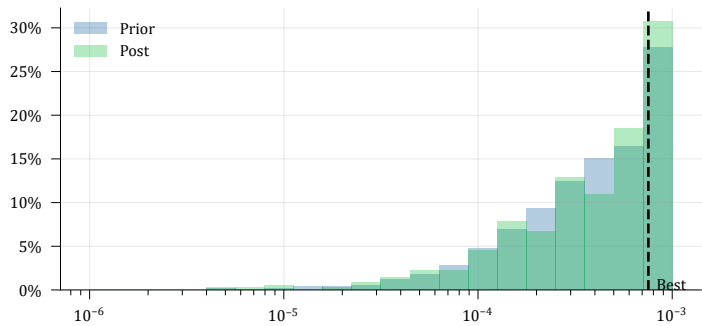
ss_p139(Pilot_Point_L1)



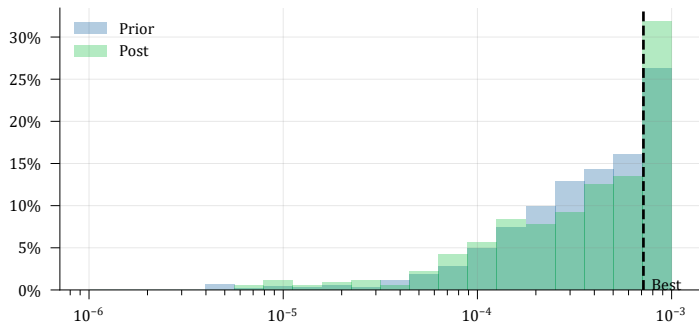




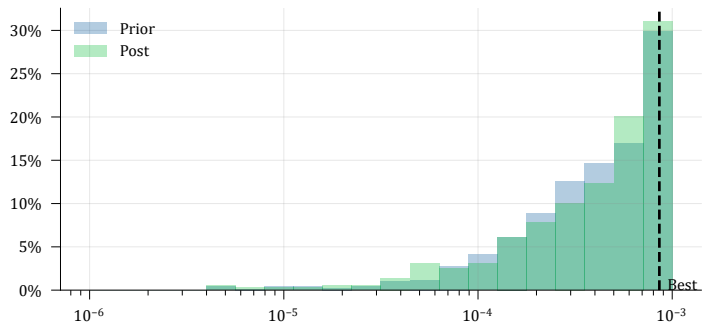
ss_p160(Pilot_Point_L1)



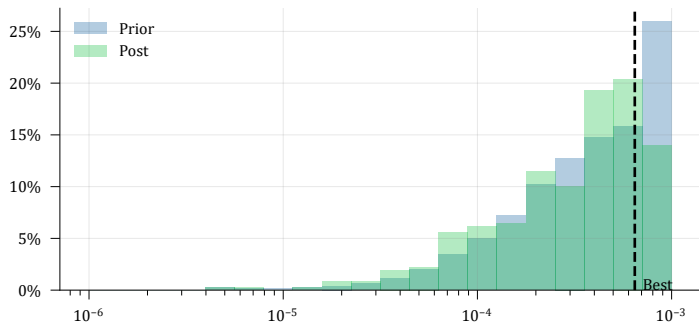
ss_p161(Pilot_Point_L1)



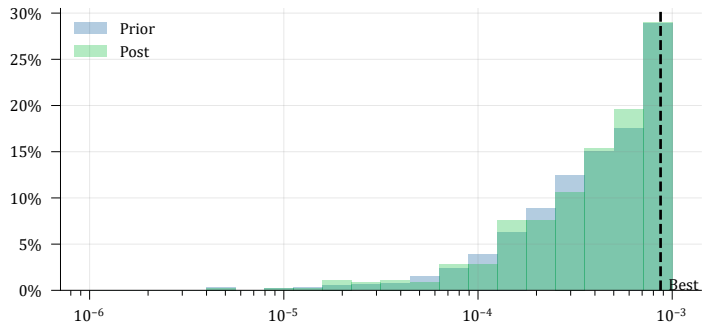
ss_p162(Pilot_Point_L1)



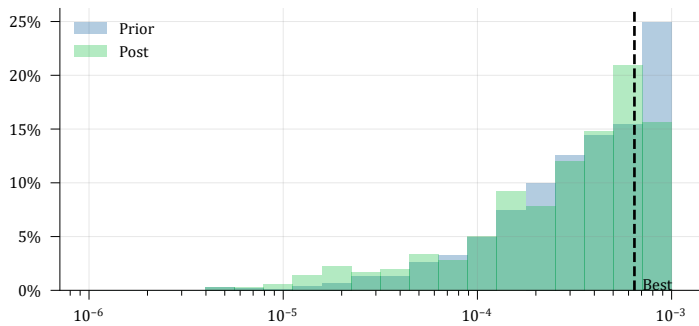
ss_p163(Pilot_Point_L1)



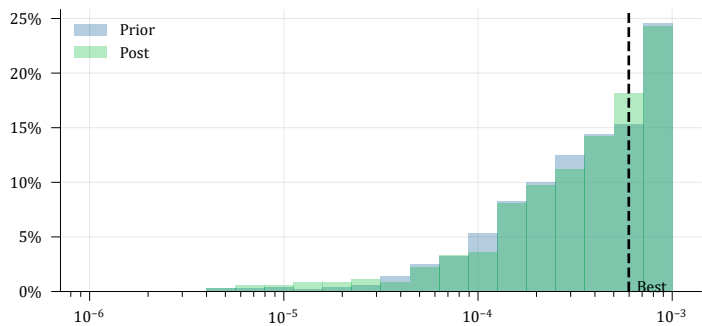
ss_p164(Pilot_Point_L1)



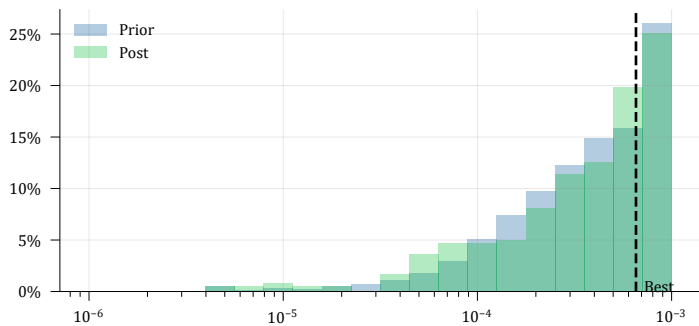
ss_p165(Pilot_Point_L1)



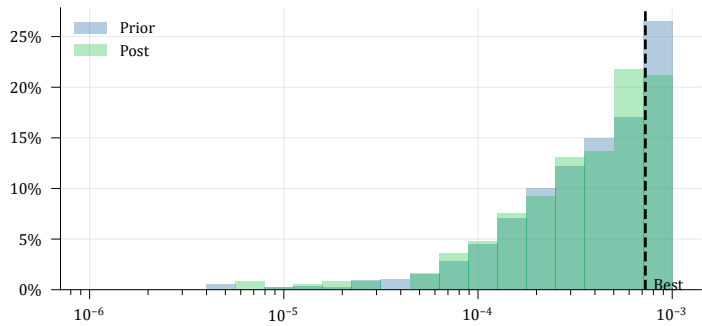
ss_p166(Pilot_Point_L1)



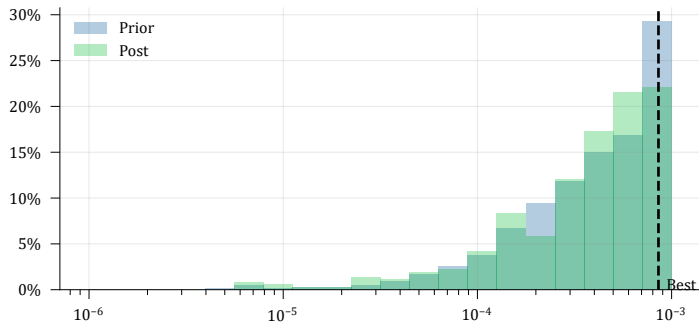
ss_p167(Pilot_Point_L1)



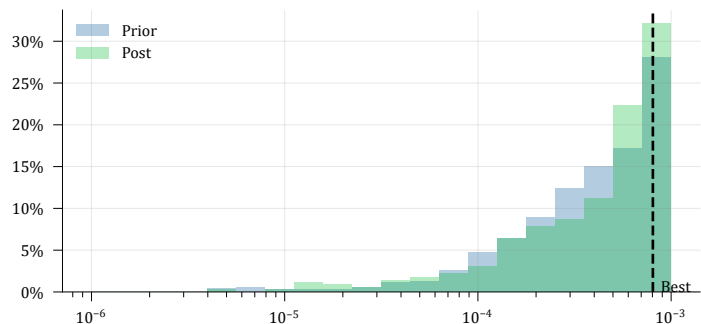
ss_p168(Pilot_Point_L1)



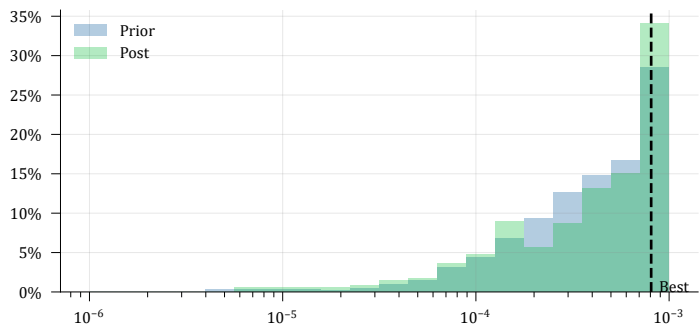
ss_p169(Pilot_Point_L1)



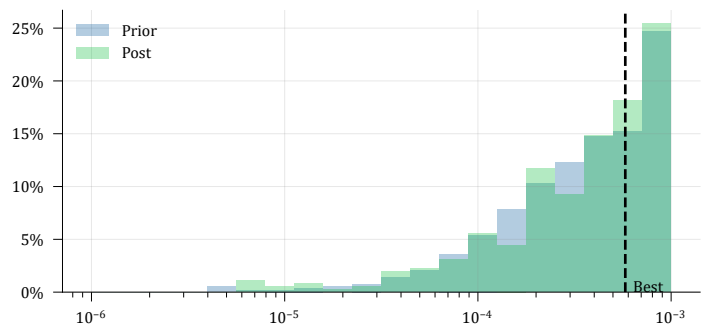
ss_p170(Pilot_Point_L1)



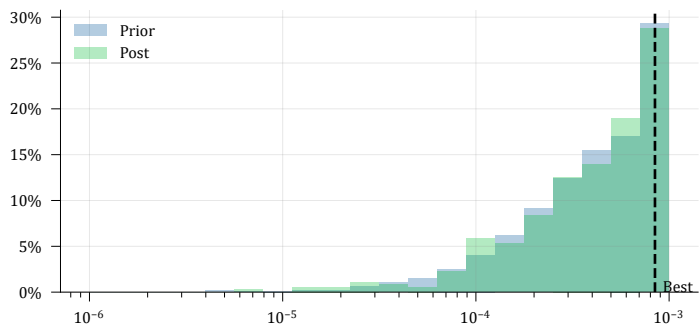
ss_p171(Pilot_Point_L1)



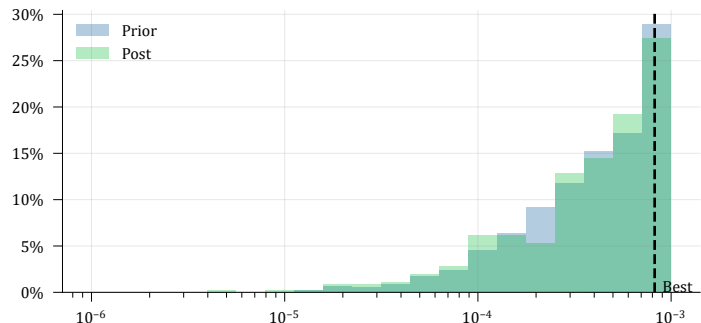
ss_p172(Pilot_Point_L1)



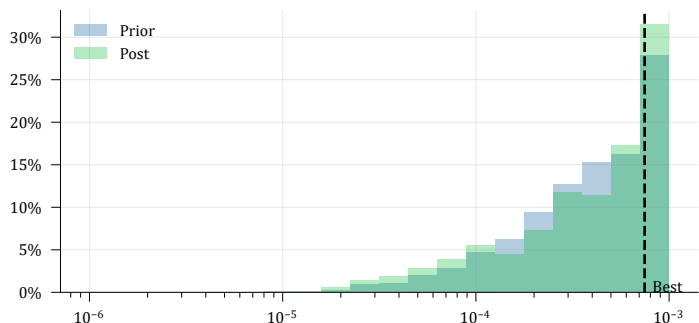
ss_p173(Pilot_Point_L1)



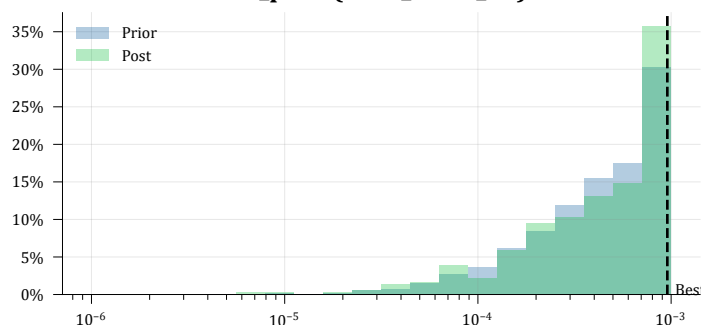
ss_p174(Pilot_Point_L1)



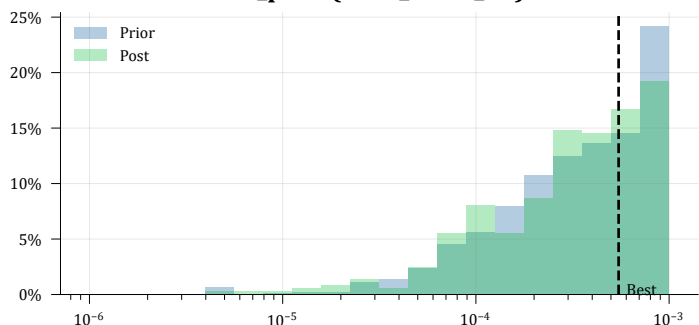
ss_p175(Pilot_Point_L1)



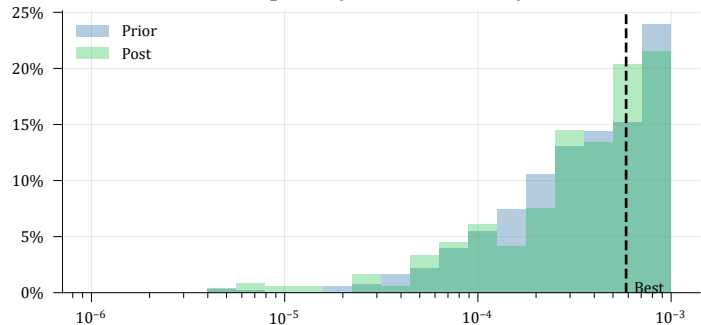
ss_p176(Pilot_Point_L1)



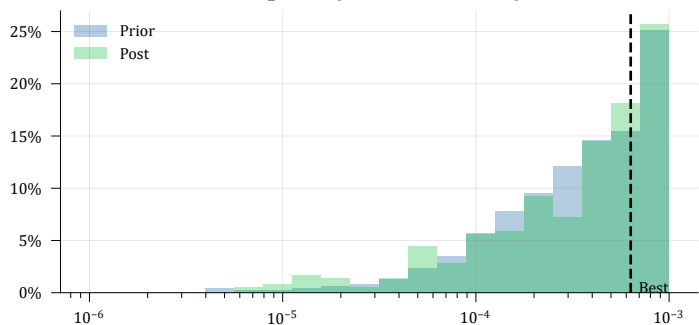
ss_p177(Pilot_Point_L1)



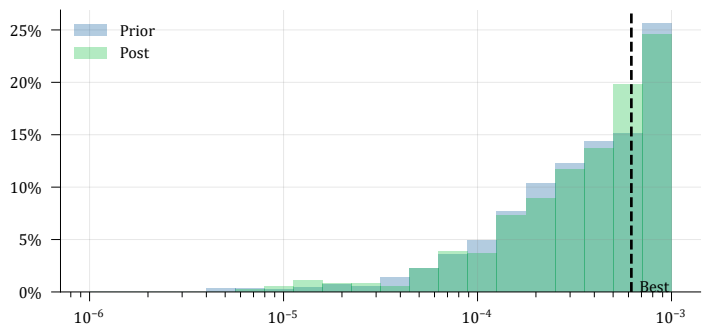
ss_p178(Pilot_Point_L1)



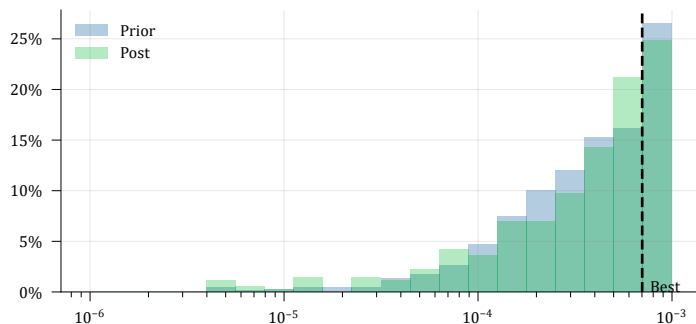
ss_p179(Pilot_Point_L1)



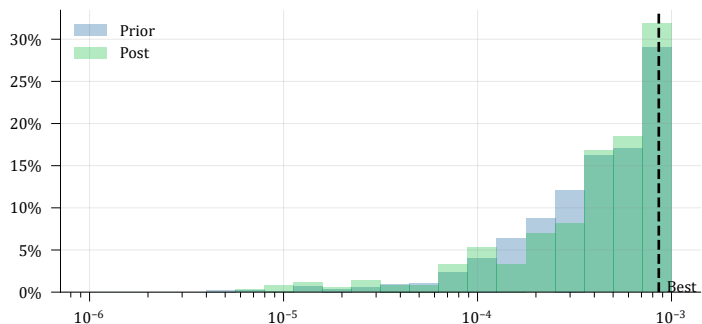
ss_p180(Pilot_Point_L1)



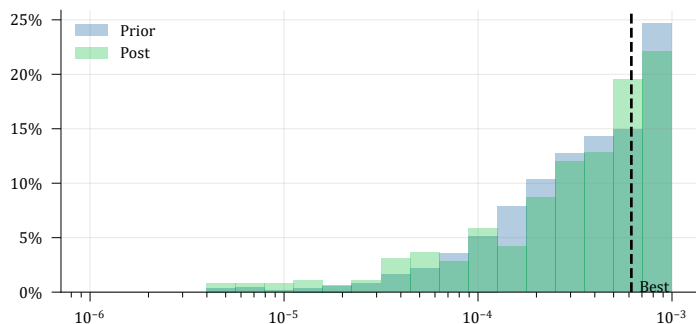
ss_p181(Pilot_Point_L1)



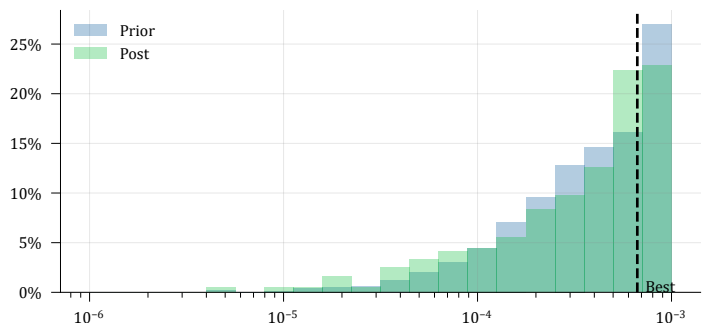
ss_p182(Pilot_Point_L1)



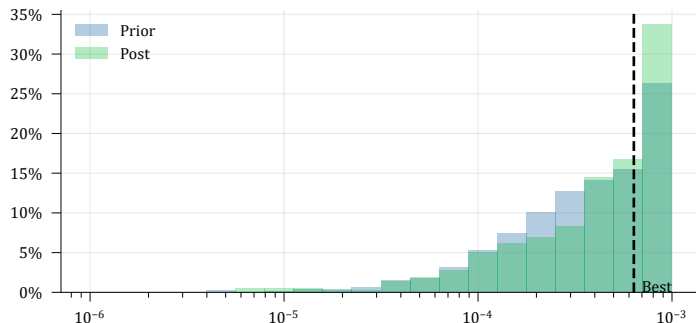
ss_p183(Pilot_Point_L1)



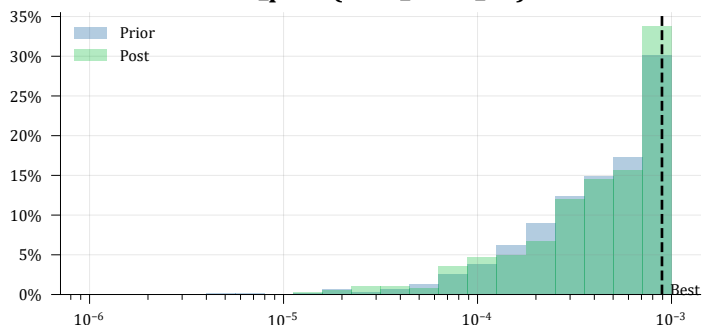
ss_p184(Pilot_Point_L1)



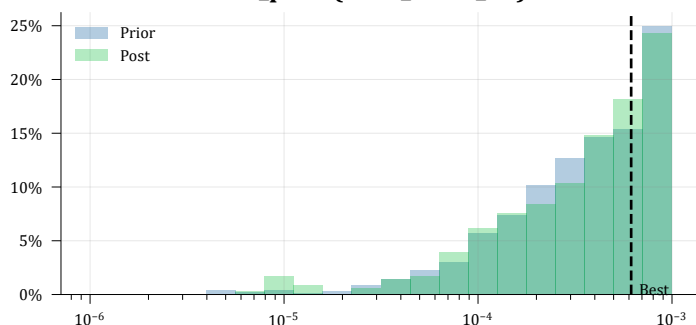
ss_p185(Pilot_Point_L1)



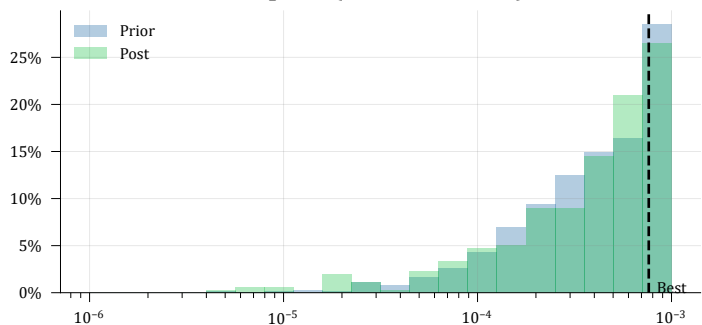
ss_p186(Pilot_Point_L1)



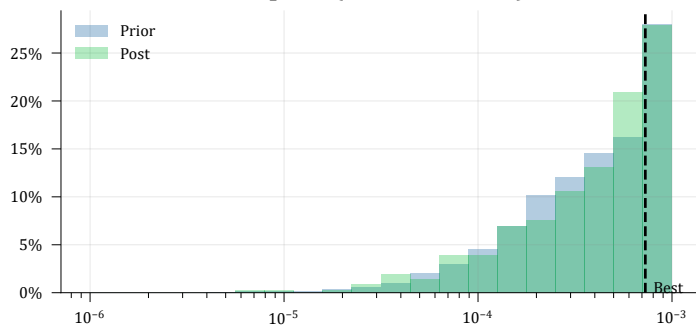
ss_p187(Pilot_Point_L1)



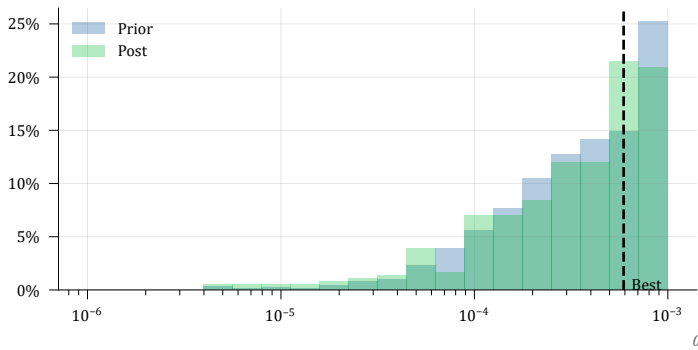
ss_p188(Pilot_Point_L1)



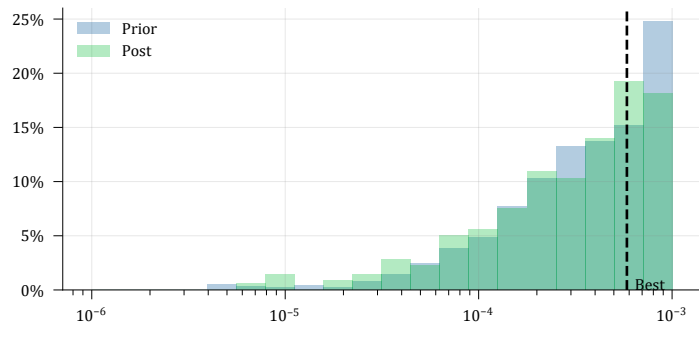
ss_p189(Pilot_Point_L1)



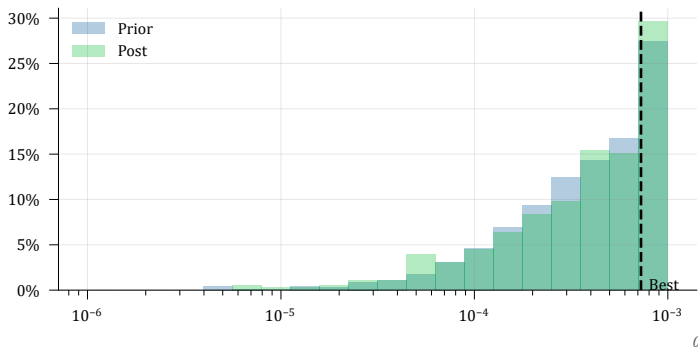
ss_p190(Pilot_Point_L1)



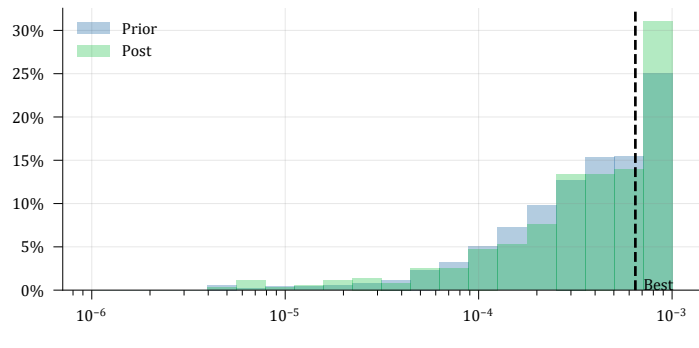
ss_p191(Pilot_Point_L1)



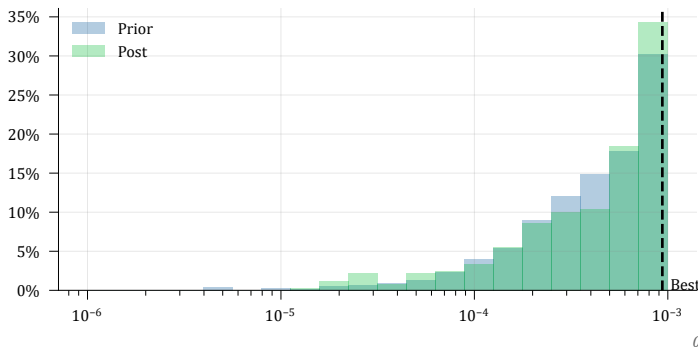
ss_p192(Pilot_Point_L1)



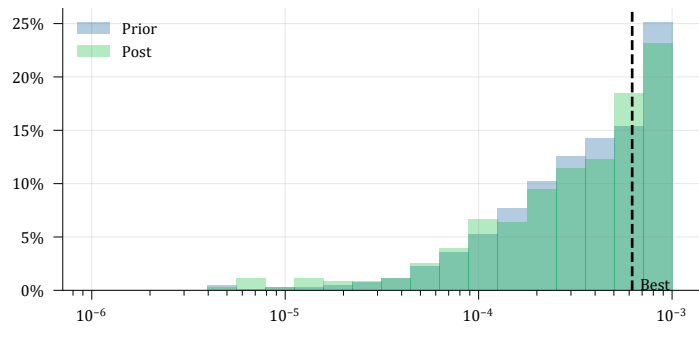
ss_p193(Pilot_Point_L1)



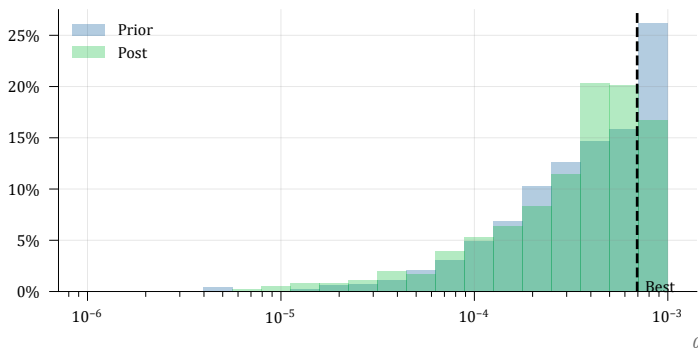
ss_p194(Pilot_Point_L1)



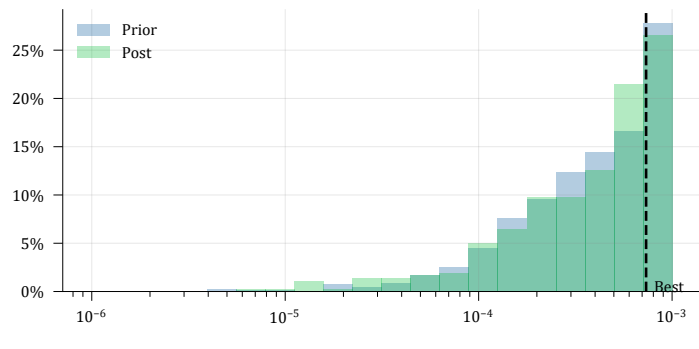
ss_p195(Pilot_Point_L1)



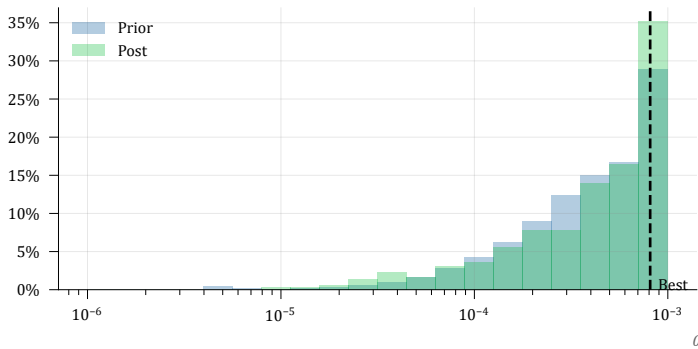
ss_p196(Pilot_Point_L1)



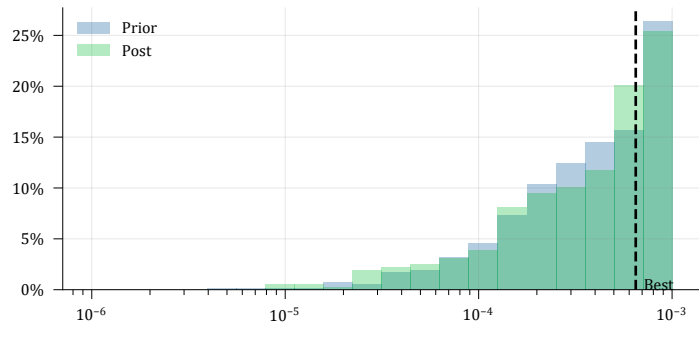
ss_p197(Pilot_Point_L1)

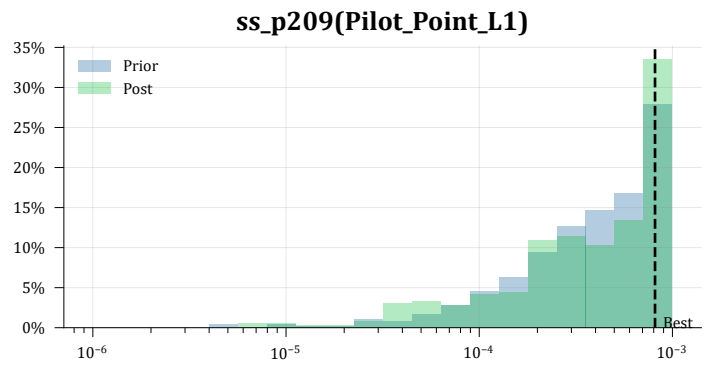
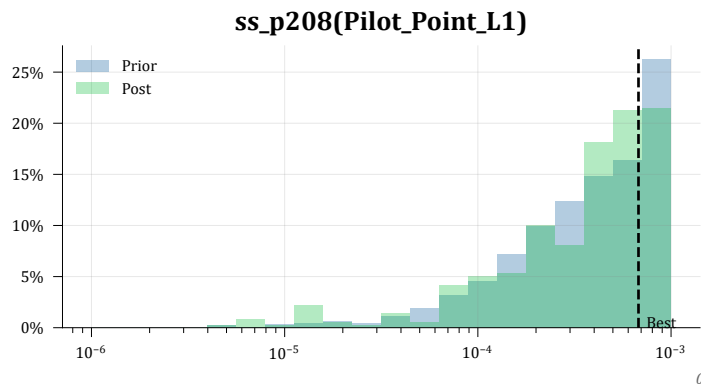
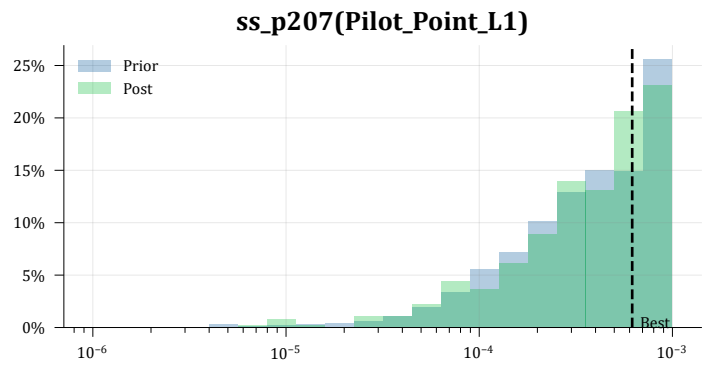
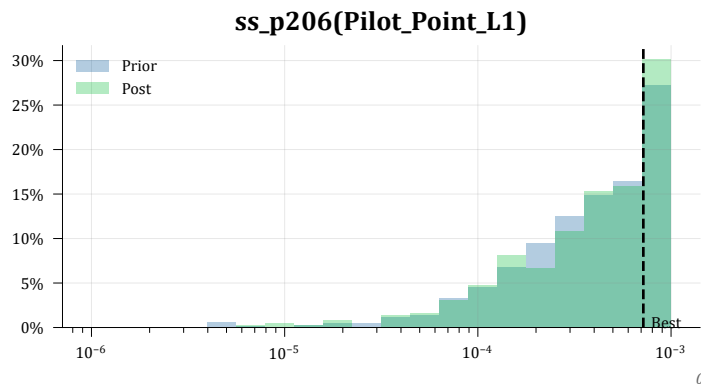
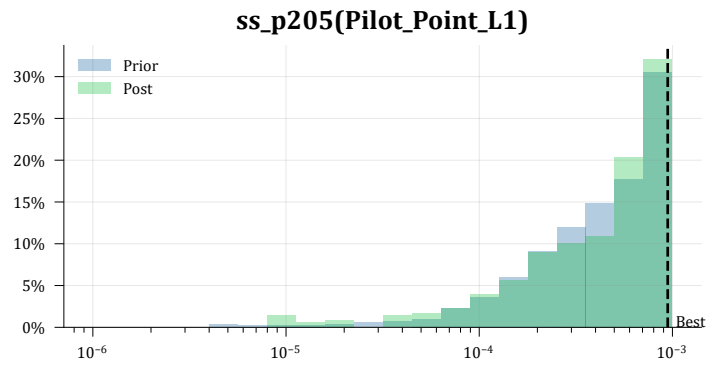
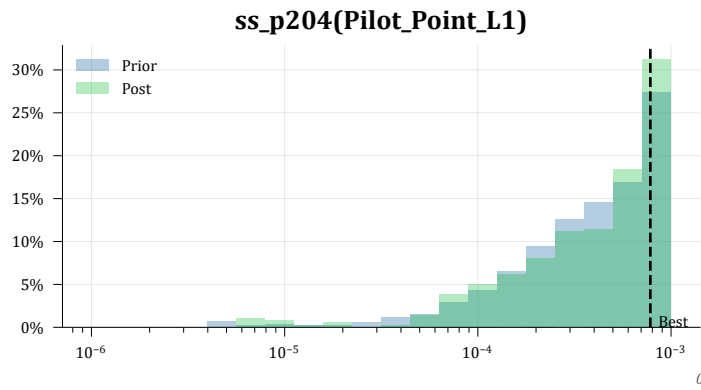
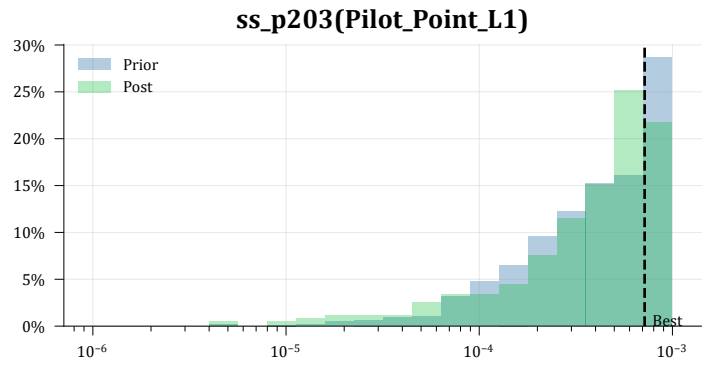
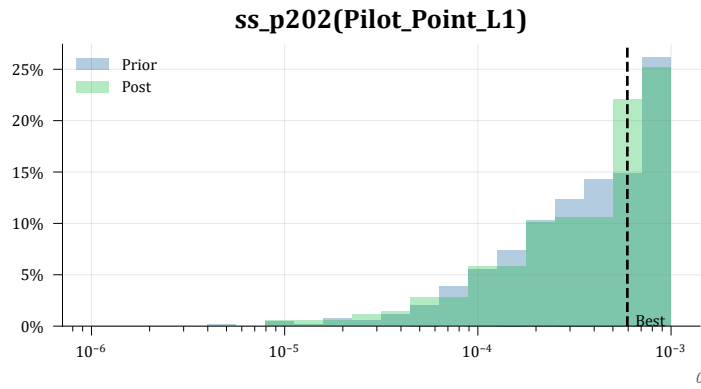
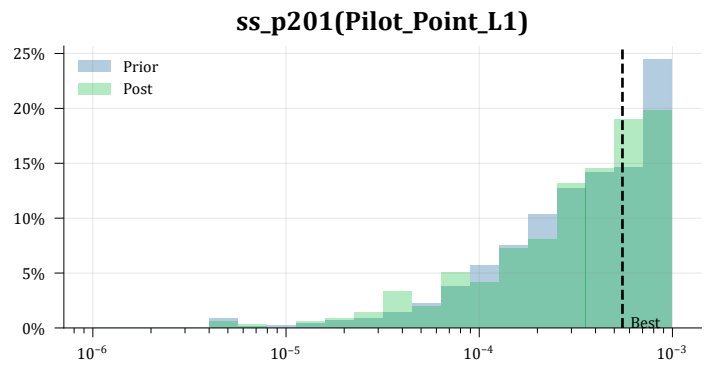
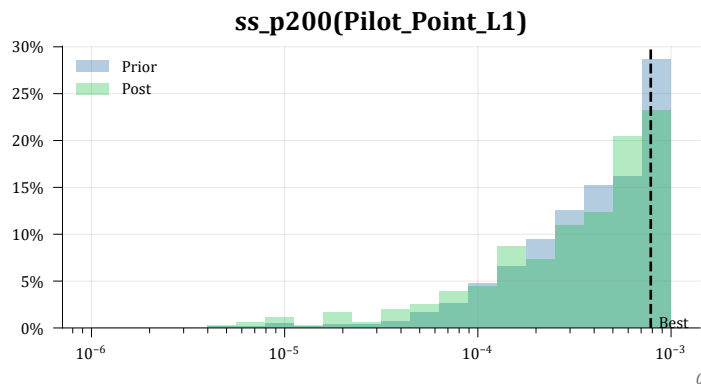


ss_p198(Pilot_Point_L1)

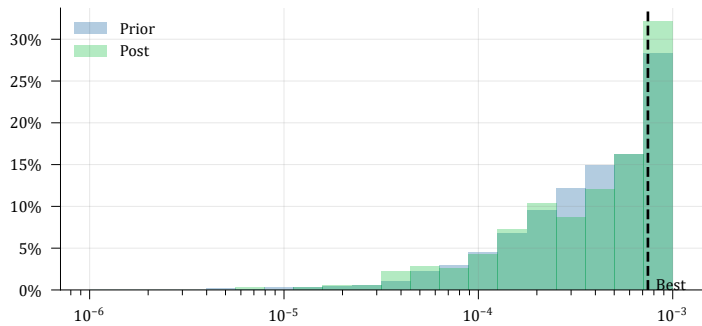


ss_p199(Pilot_Point_L1)

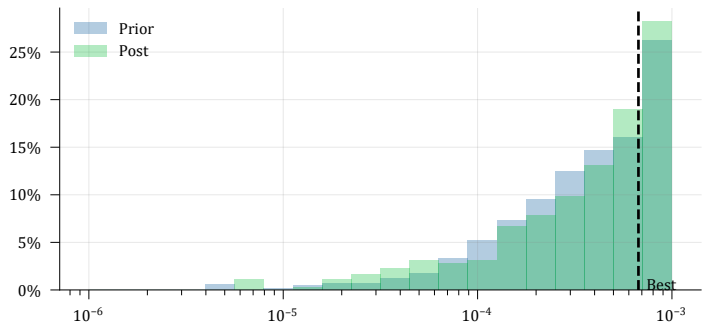




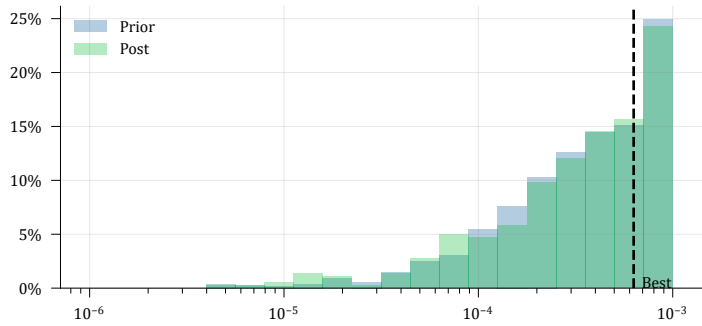
ss_p210(Pilot_Point_L1)



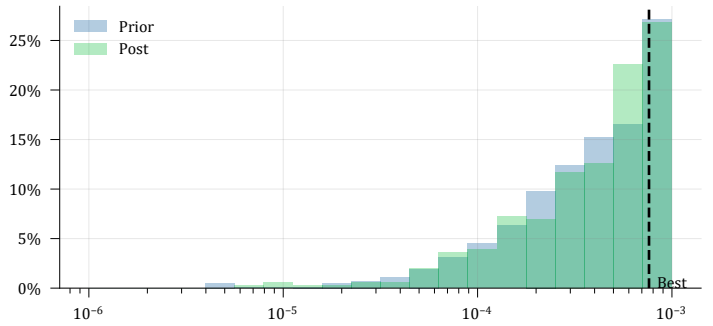
ss_p211(Pilot_Point_L1)



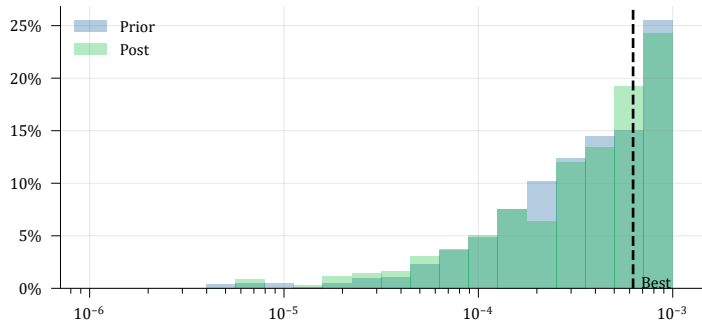
ss_p212(Pilot_Point_L1)



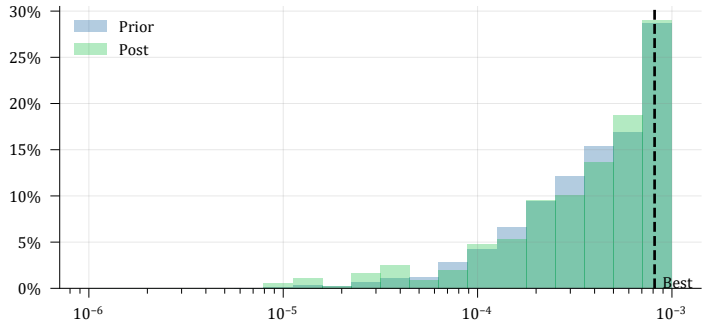
ss_p213(Pilot_Point_L1)



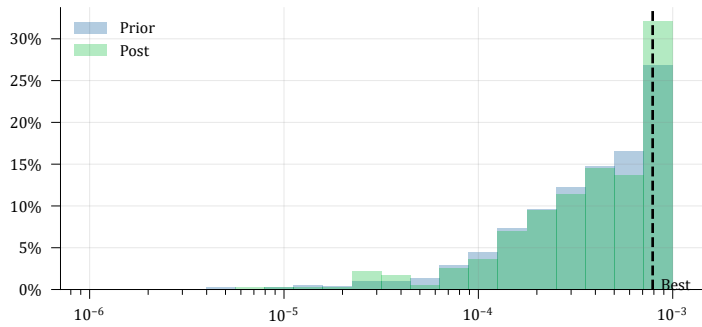
ss_p214(Pilot_Point_L1)



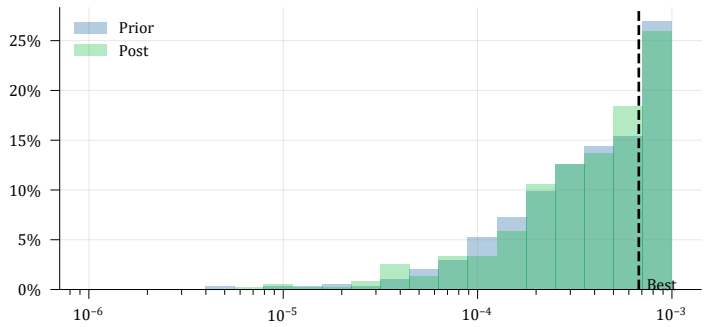
ss_p215(Pilot_Point_L1)



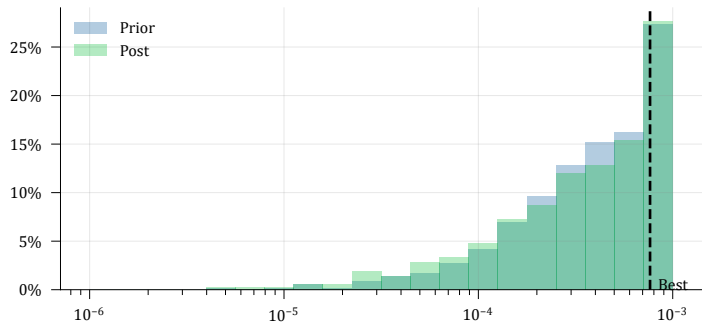
ss_p216(Pilot_Point_L1)



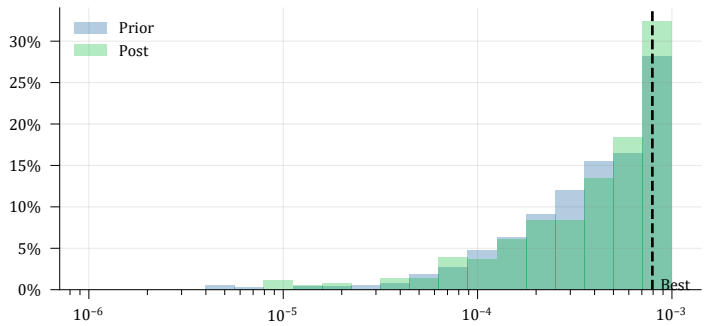
ss_p217(Pilot_Point_L1)



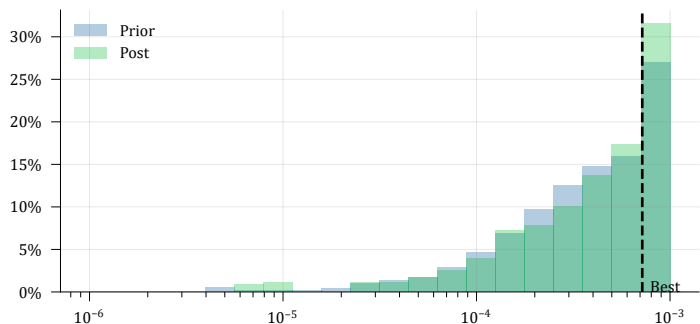
ss_p218(Pilot_Point_L1)



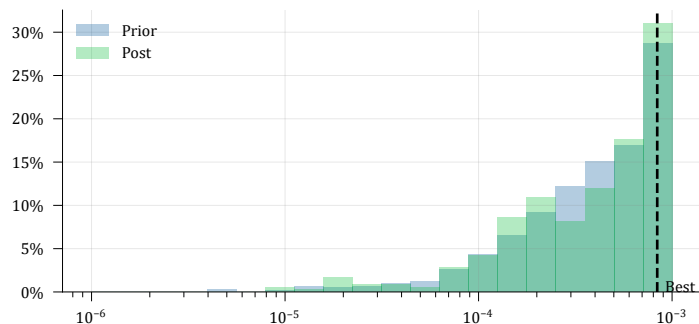
ss_p219(Pilot_Point_L1)



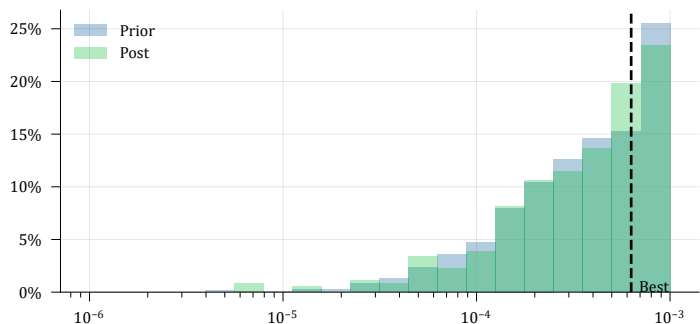
ss_p220(Pilot_Point_L1)



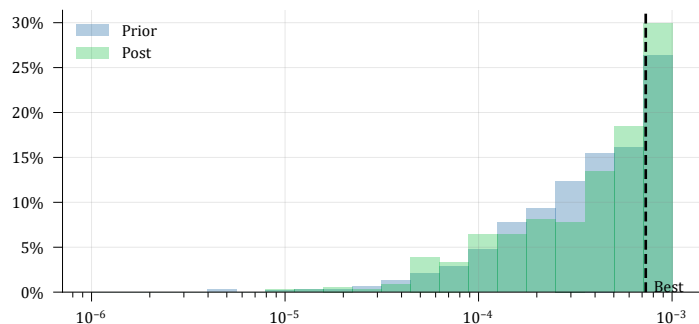
ss_p221(Pilot_Point_L1)



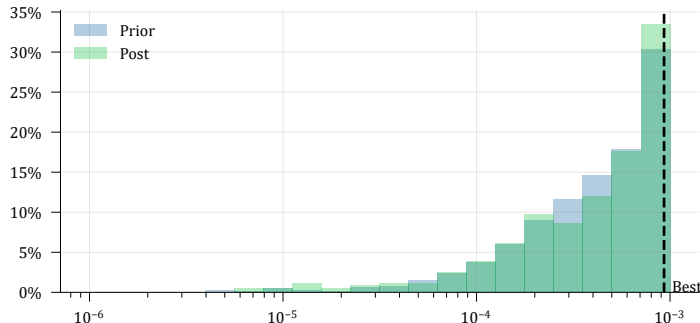
ss_p222(Pilot_Point_L1)



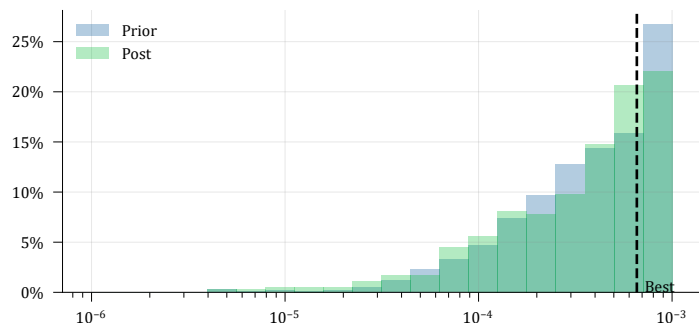
ss_p223(Pilot_Point_L1)



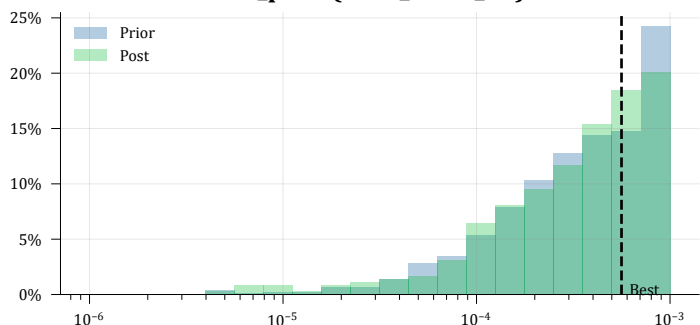
ss_p224(Pilot_Point_L1)



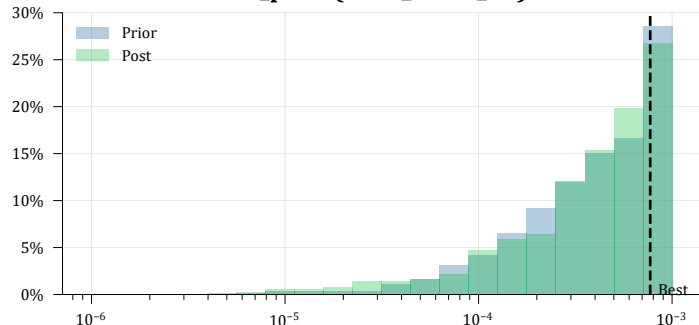
ss_p225(Pilot_Point_L1)



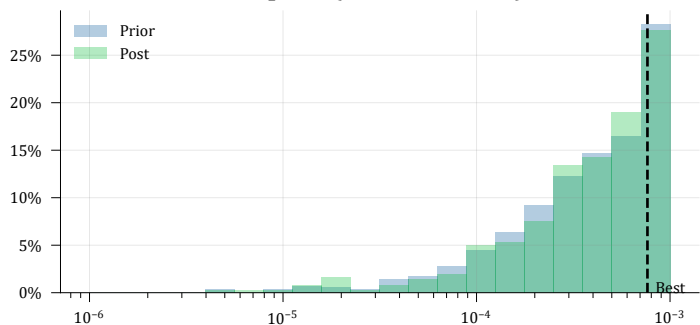
ss_p226(Pilot_Point_L1)



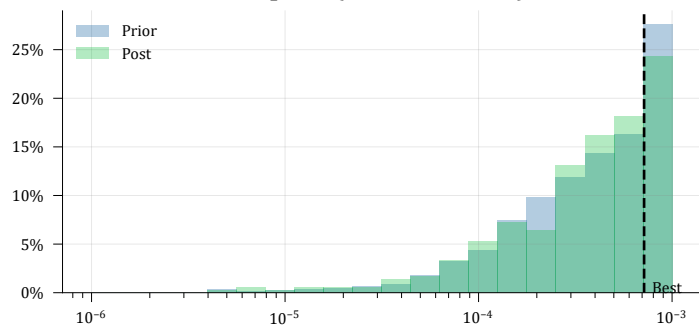
ss_p227(Pilot_Point_L1)



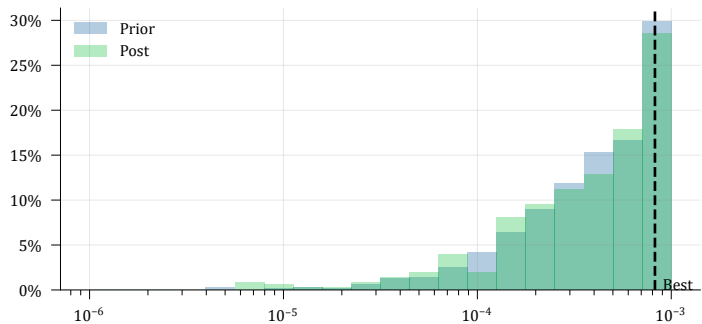
ss_p228(Pilot_Point_L1)



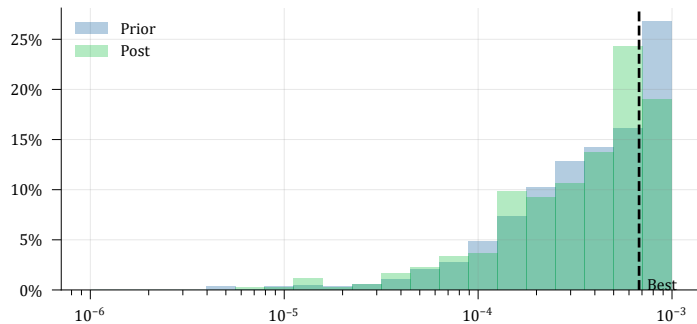
ss_p229(Pilot_Point_L1)



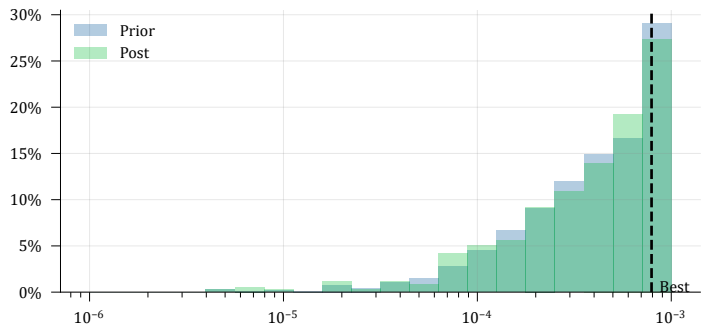
ss_p230(Pilot_Point_L1)



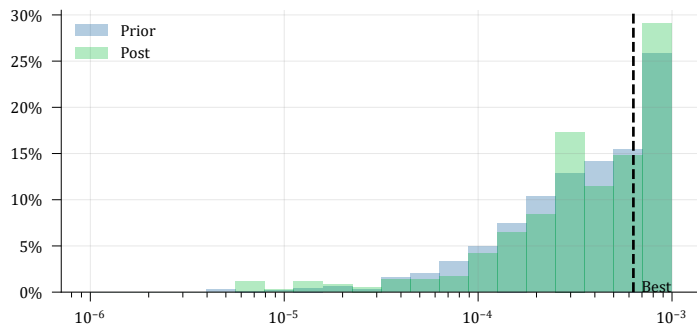
ss_p231(Pilot_Point_L1)



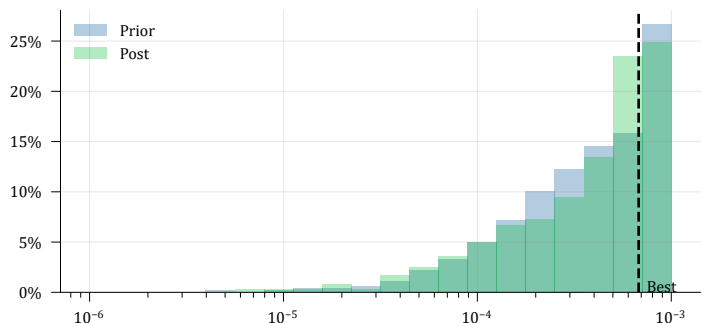
ss_p232(Pilot_Point_L1)



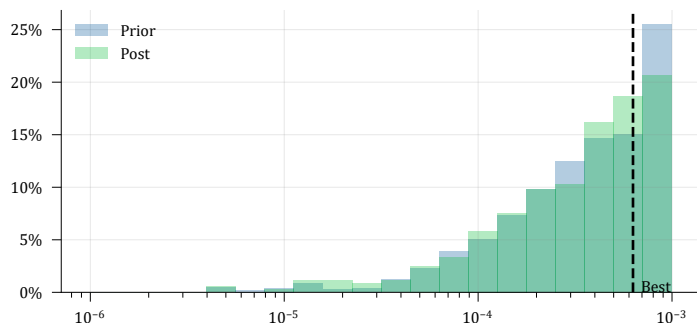
ss_p233(Pilot_Point_L1)



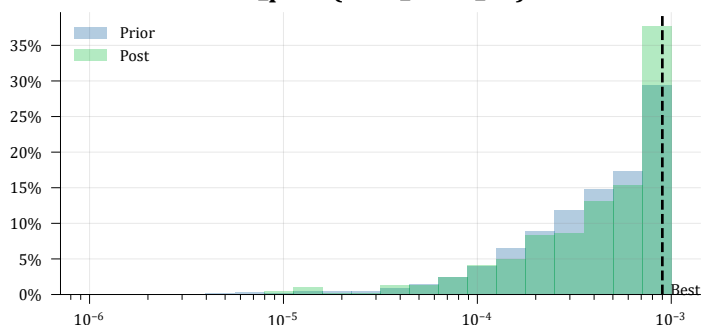
ss_p234(Pilot_Point_L1)



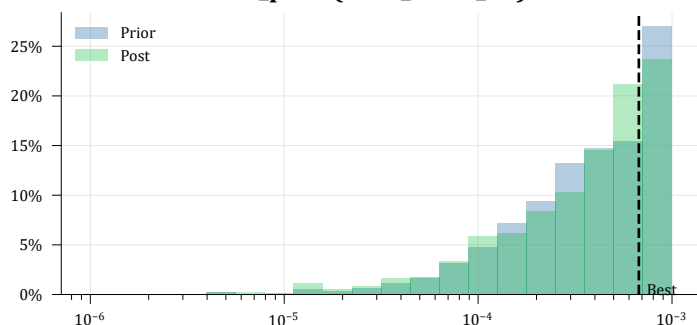
ss_p235(Pilot_Point_L1)



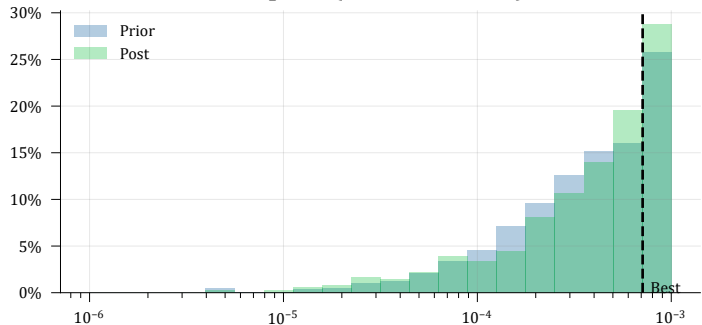
ss_p236(Pilot_Point_L1)



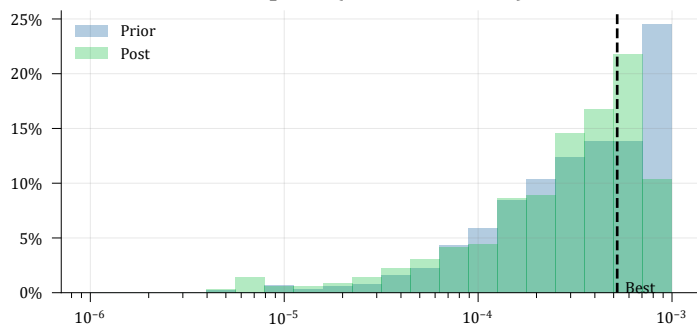
ss_p237(Pilot_Point_L1)



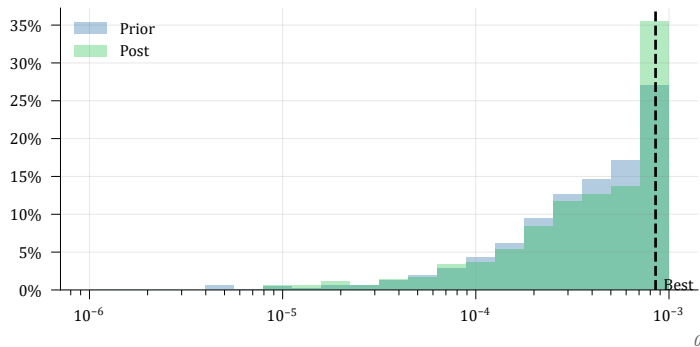
ss_p238(Pilot_Point_L1)



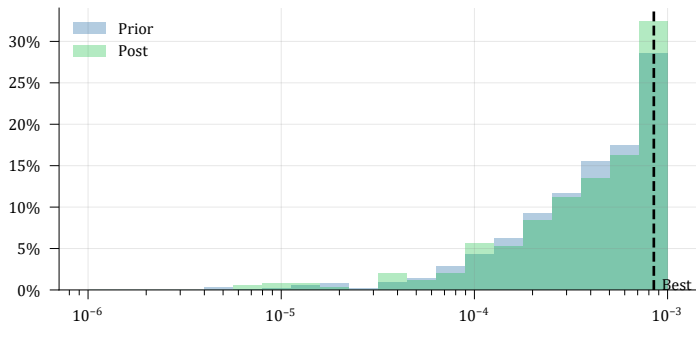
ss_p239(Pilot_Point_L1)



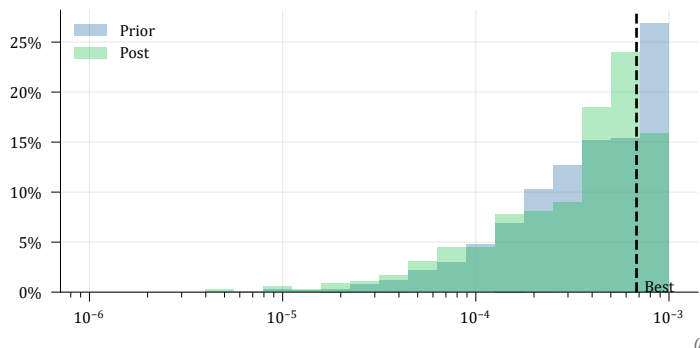
ss_p240(Pilot_Point_L1)



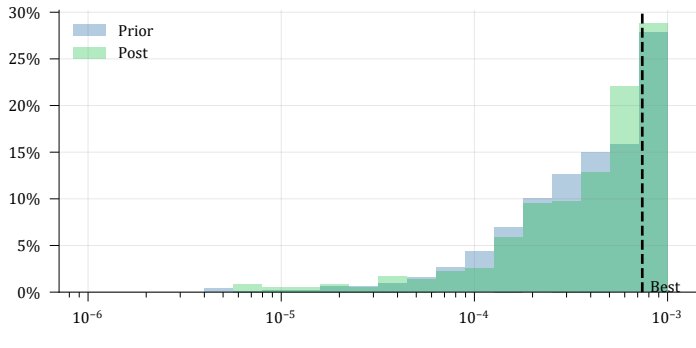
ss_p241(Pilot_Point_L1)



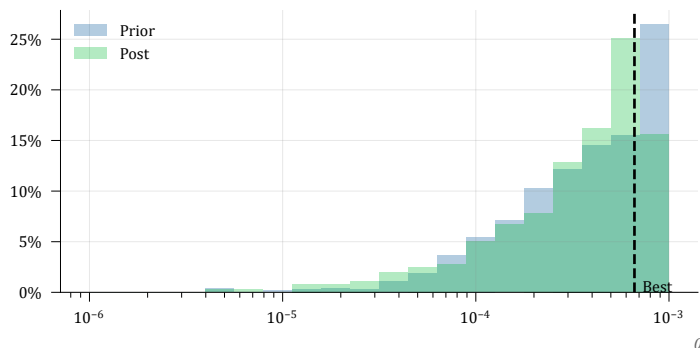
ss_p242(Pilot_Point_L1)



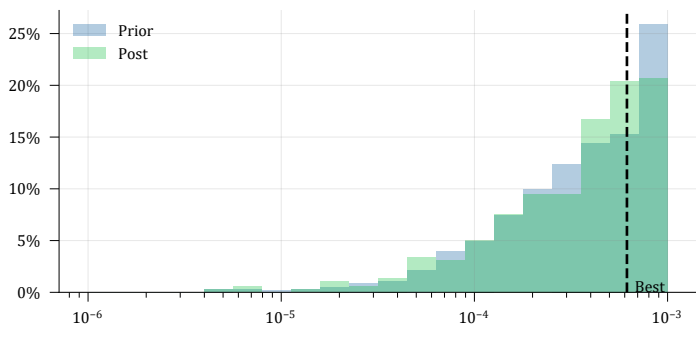
ss_p243(Pilot_Point_L1)



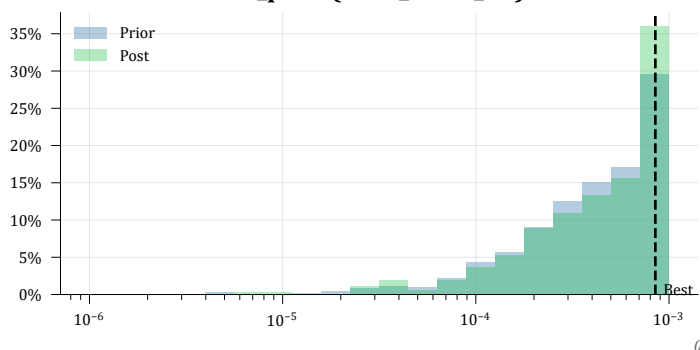
ss_p244(Pilot_Point_L1)



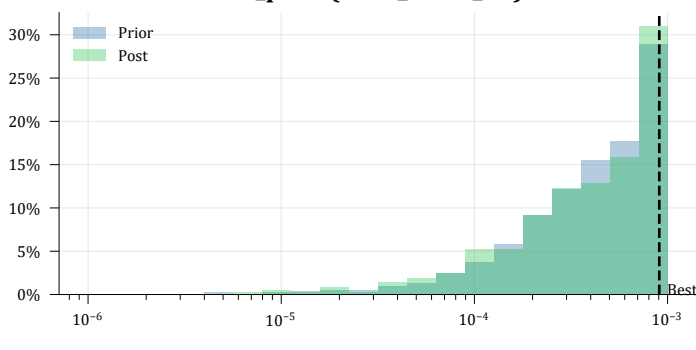
ss_p245(Pilot_Point_L1)



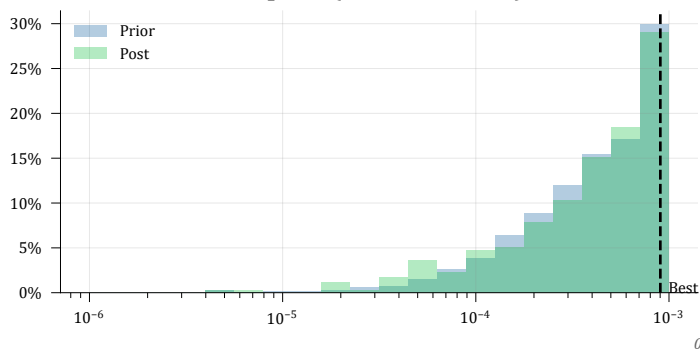
ss_p246(Pilot_Point_L1)



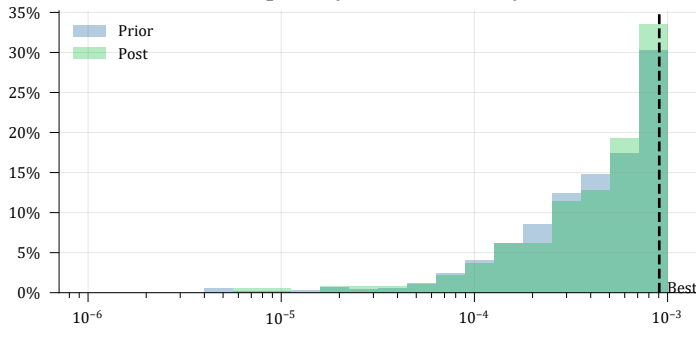
ss_p247(Pilot_Point_L1)



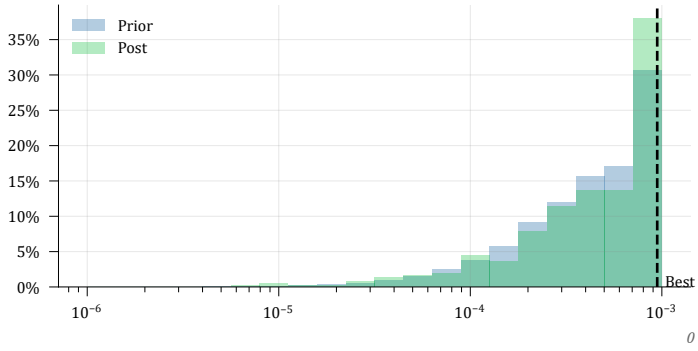
ss_p248(Pilot_Point_L1)



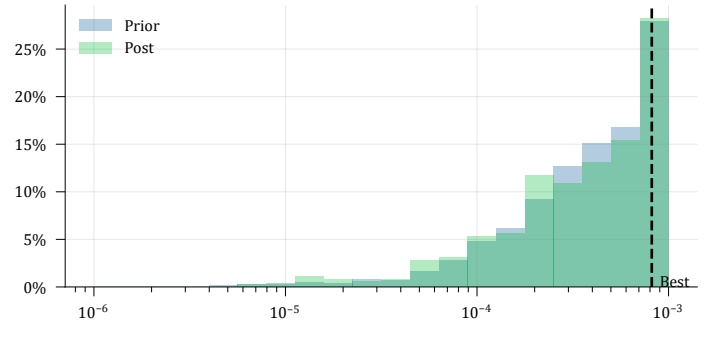
ss_p249(Pilot_Point_L1)



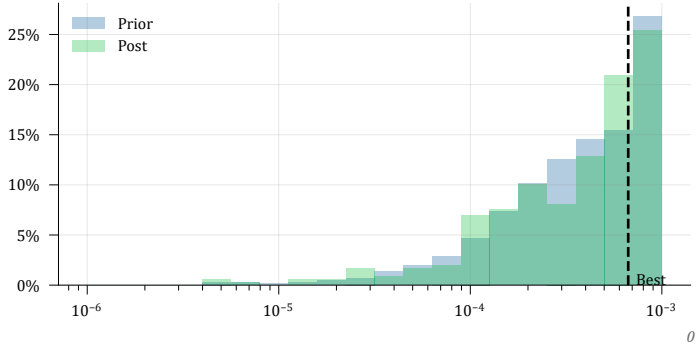
ss_p250(Pilot_Point_L1)



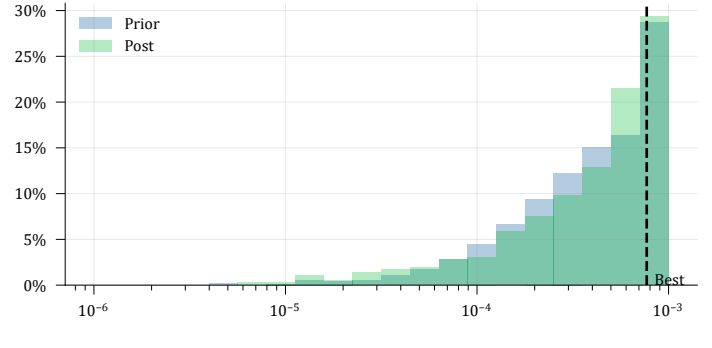
ss_p251(Pilot_Point_L1)



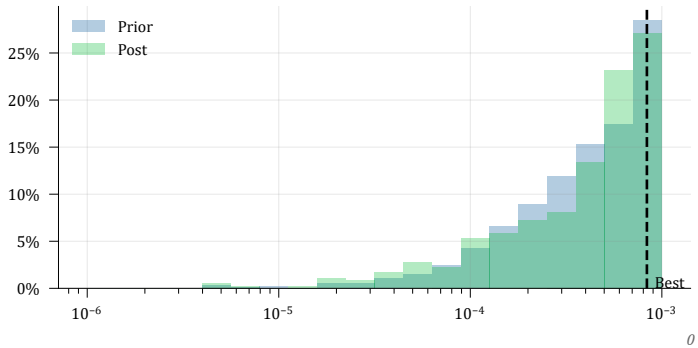
ss_p252(Pilot_Point_L1)



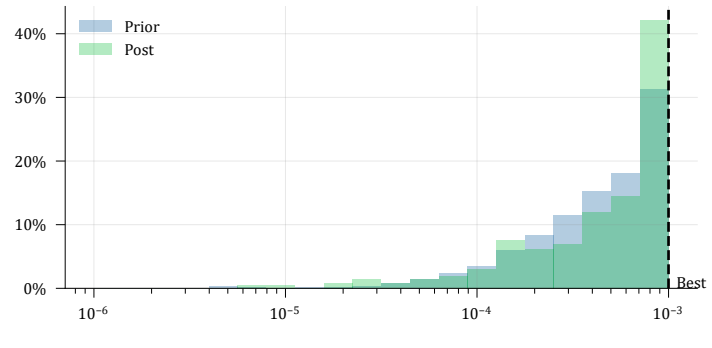
ss_p253(Pilot_Point_L1)



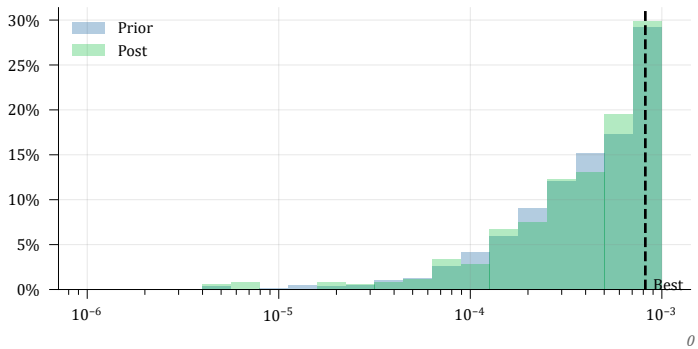
ss_p254(Pilot_Point_L1)



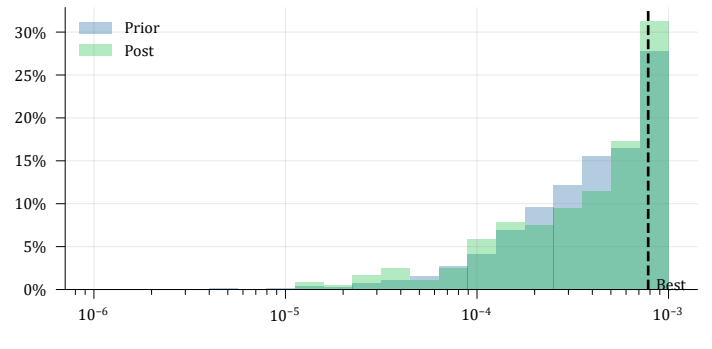
ss_p255(Pilot_Point_L1)



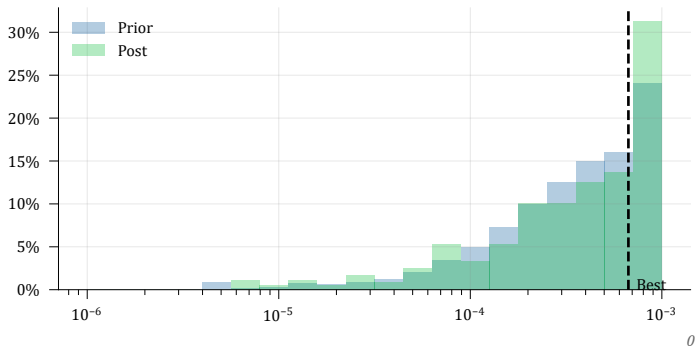
ss_p256(Pilot_Point_L1)



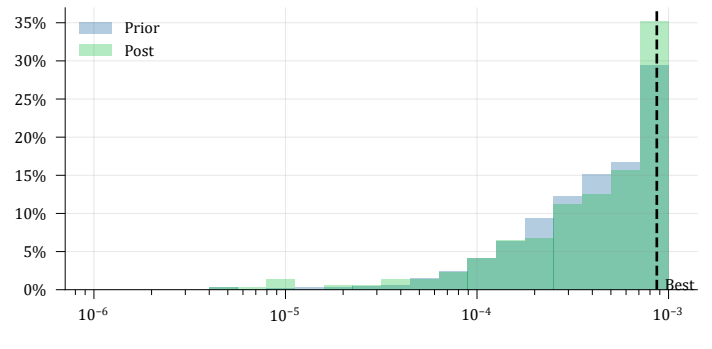
ss_p257(Pilot_Point_L1)



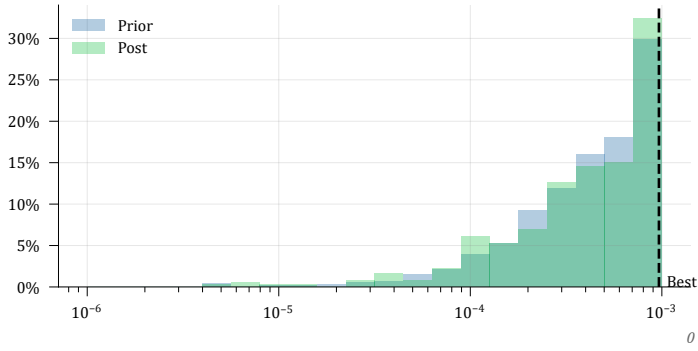
ss_p258(Pilot_Point_L1)



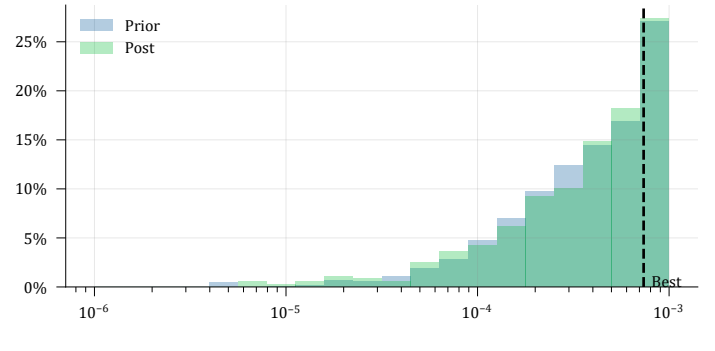
ss_p259(Pilot_Point_L1)



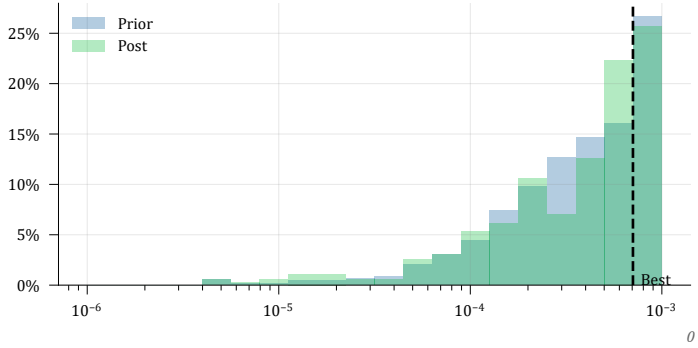
ss_p260(Pilot_Point_L1)



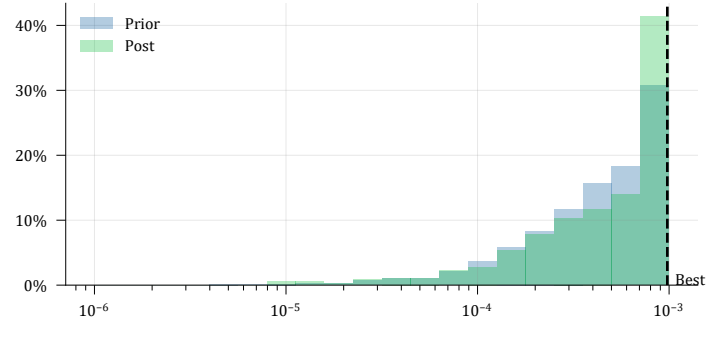
ss_p261(Pilot_Point_L1)



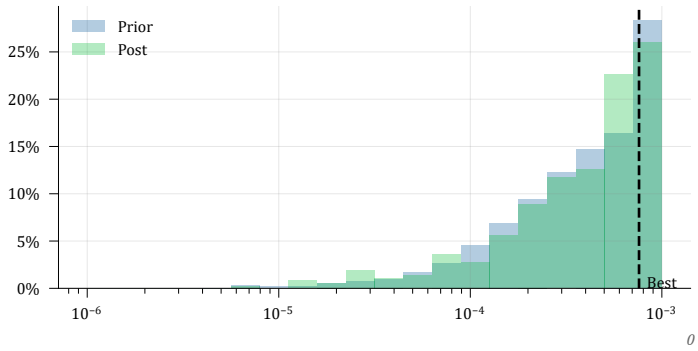
ss_p262(Pilot_Point_L1)



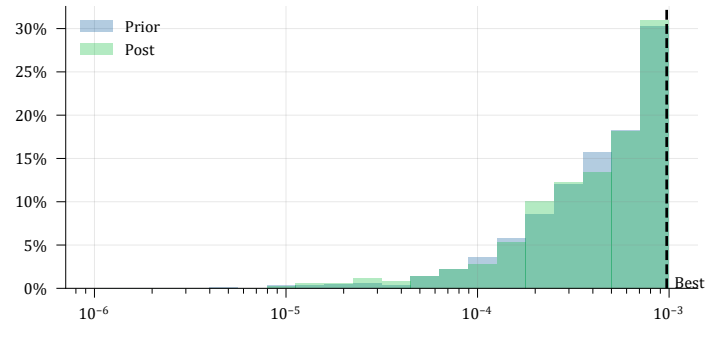
ss_p263(Pilot_Point_L1)



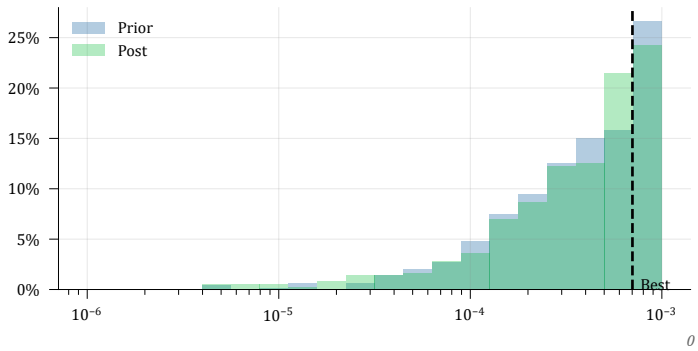
ss_p264(Pilot_Point_L1)



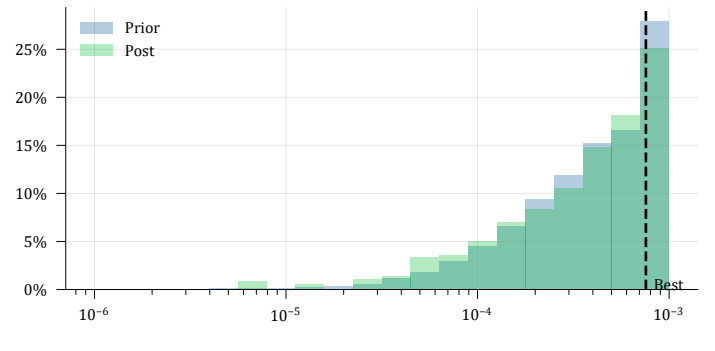
ss_p265(Pilot_Point_L1)



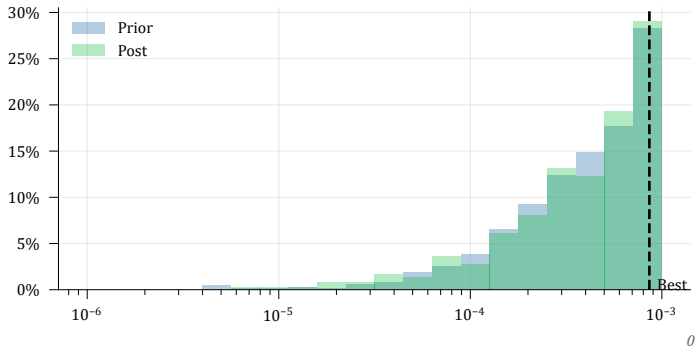
ss_p266(Pilot_Point_L1)



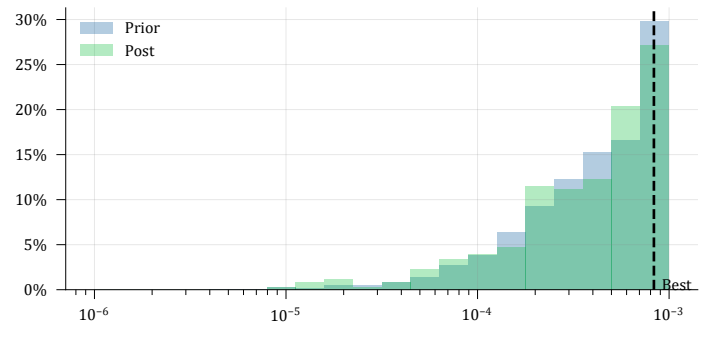
ss_p267(Pilot_Point_L1)



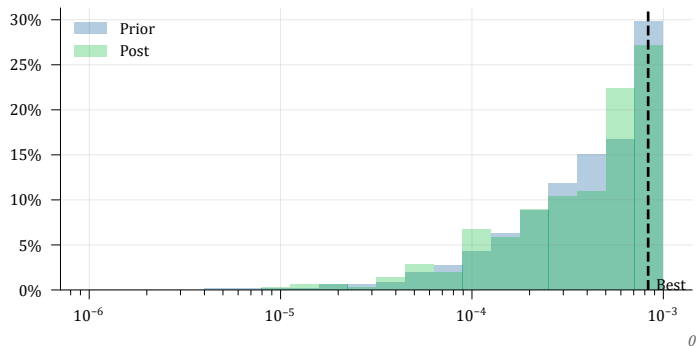
ss_p268(Pilot_Point_L1)



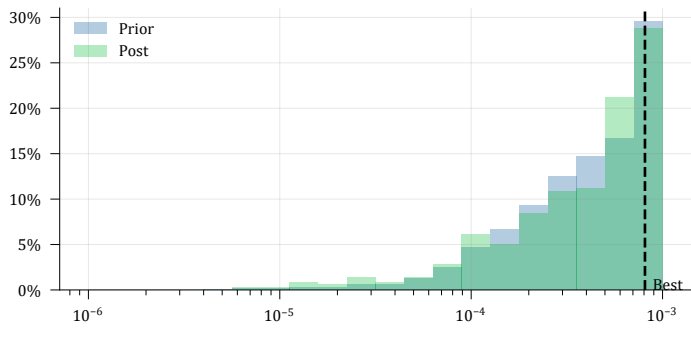
ss_p269(Pilot_Point_L1)



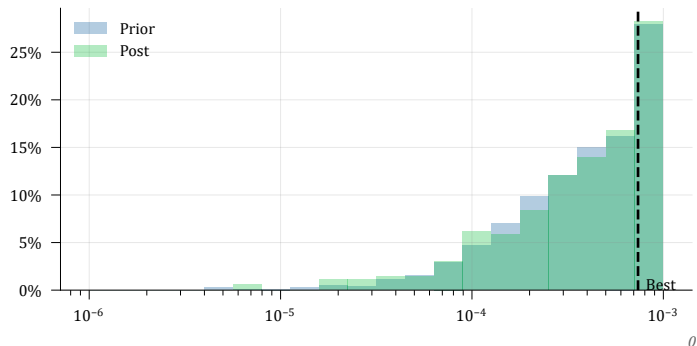
ss_p270(Pilot_Point_L1)



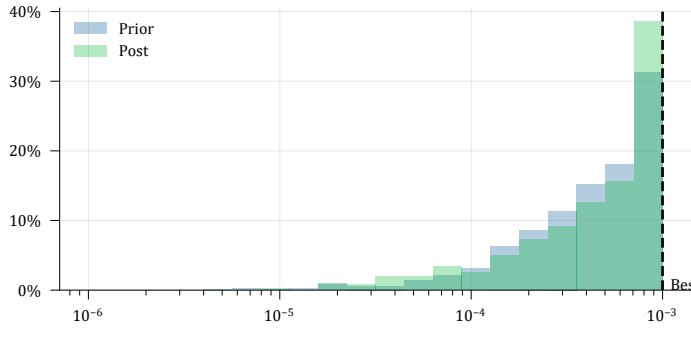
ss_p271(Pilot_Point_L1)



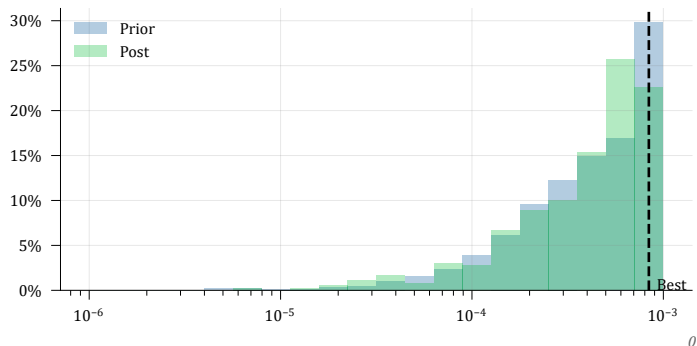
ss_p272(Pilot_Point_L1)



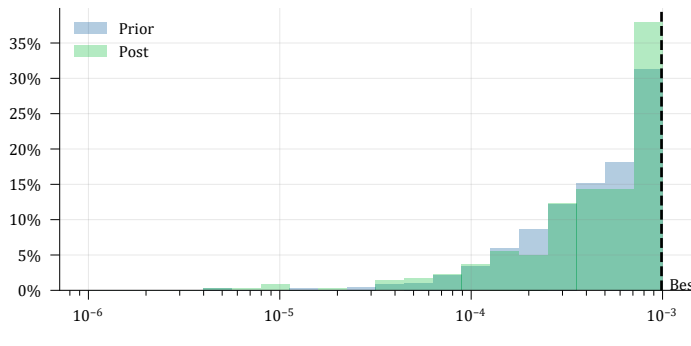
ss_p273(Pilot_Point_L1)



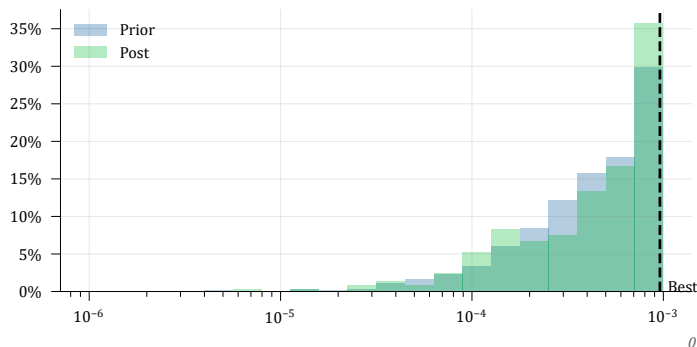
ss_p274(Pilot_Point_L1)



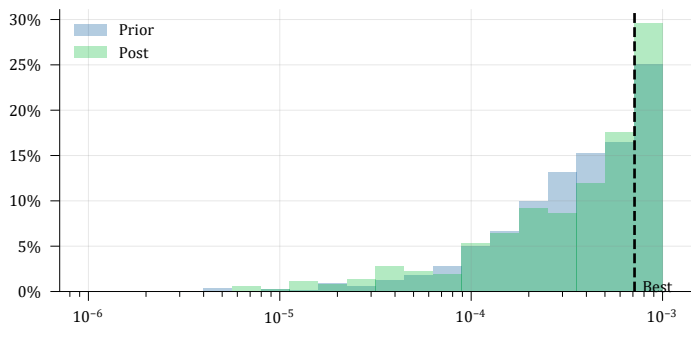
ss_p275(Pilot_Point_L1)



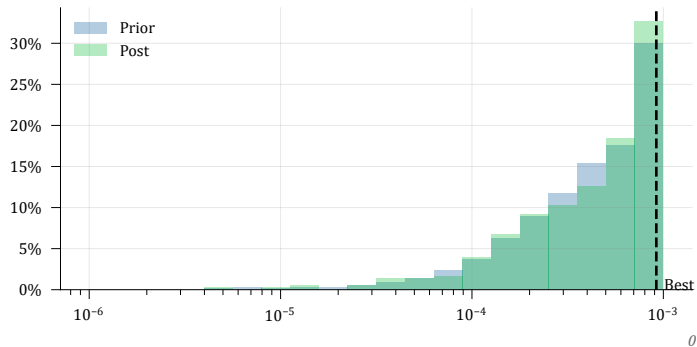
ss_p276(Pilot_Point_L1)



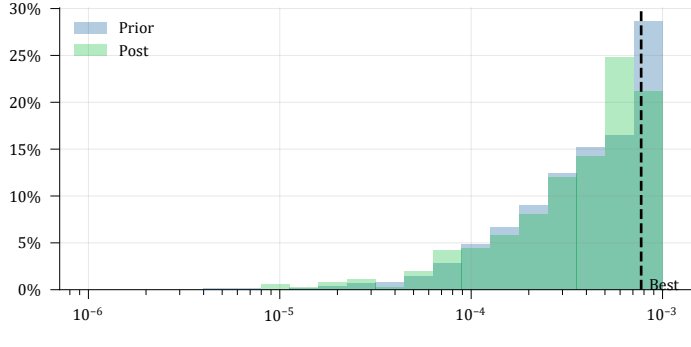
ss_p277(Pilot_Point_L1)



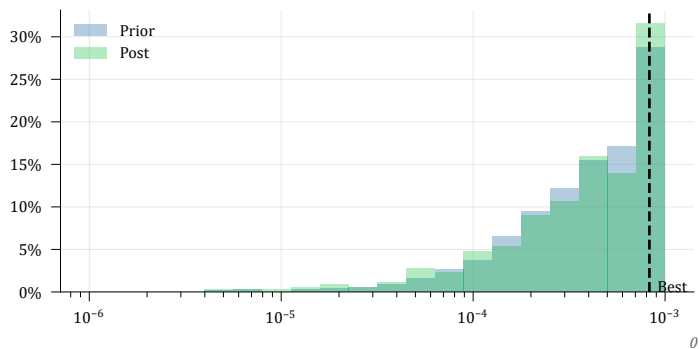
ss_p278(Pilot_Point_L1)



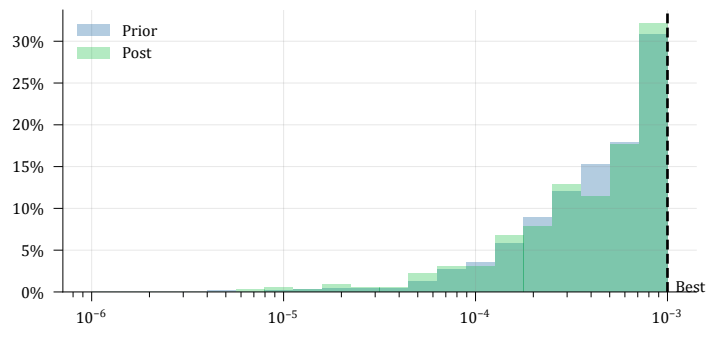
ss_p279(Pilot_Point_L1)



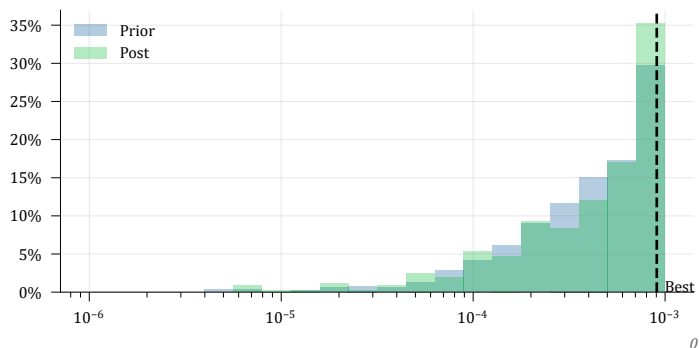
ss_p280(Pilot_Point_L1)



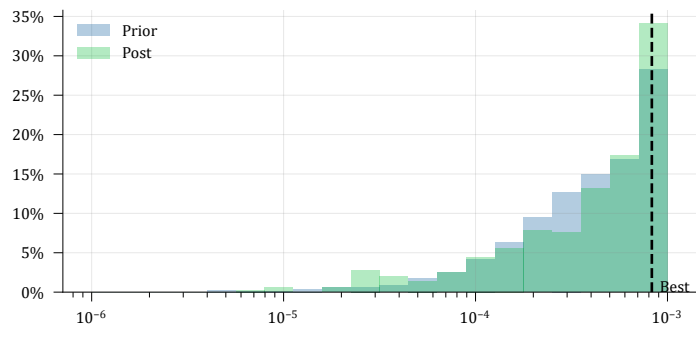
ss_p281(Pilot_Point_L1)



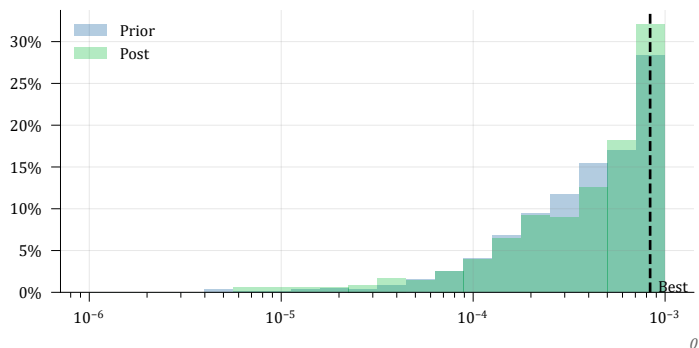
ss_p282(Pilot_Point_L1)



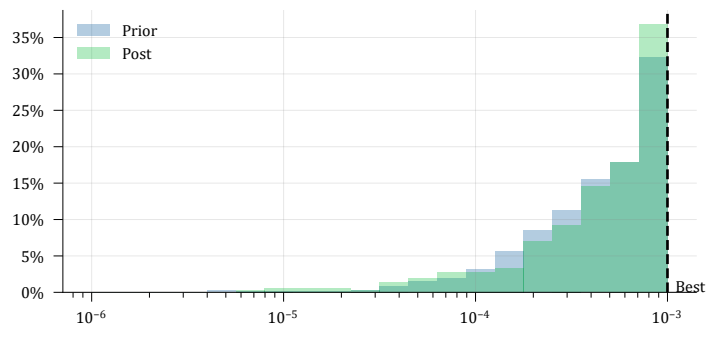
ss_p283(Pilot_Point_L1)



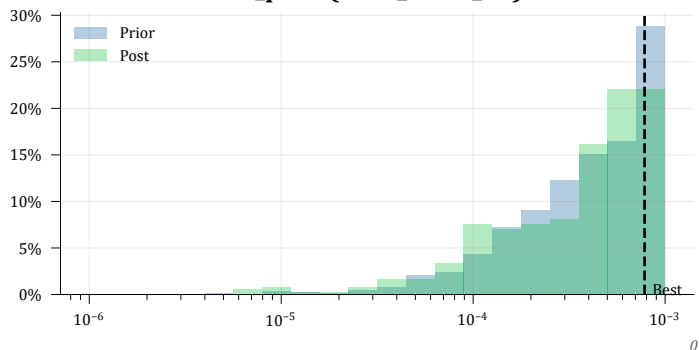
ss_p284(Pilot_Point_L1)



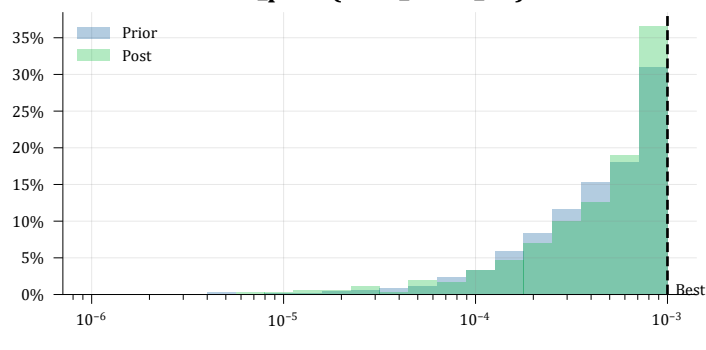
ss_p285(Pilot_Point_L1)



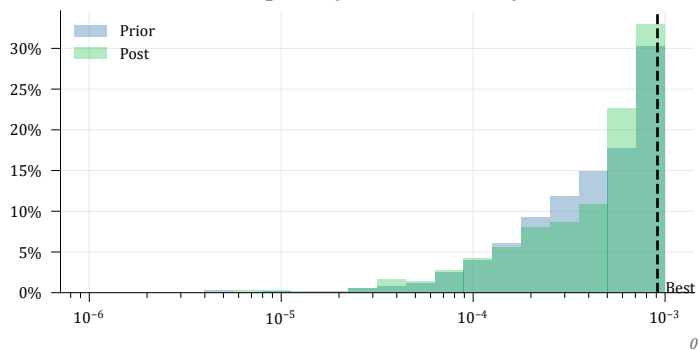
ss_p286(Pilot_Point_L1)



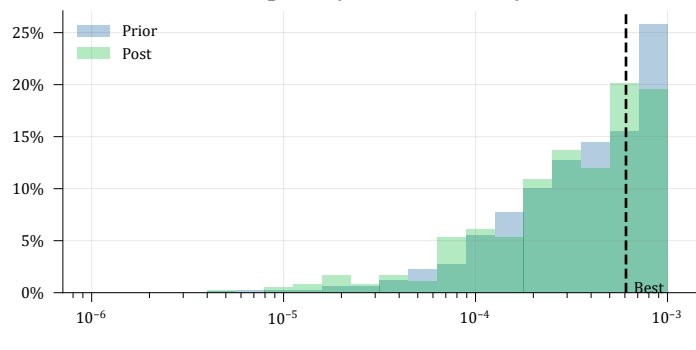
ss_p287(Pilot_Point_L1)



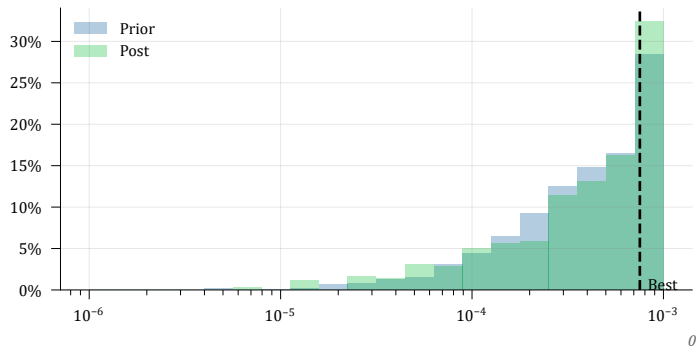
ss_p288(Pilot_Point_L1)



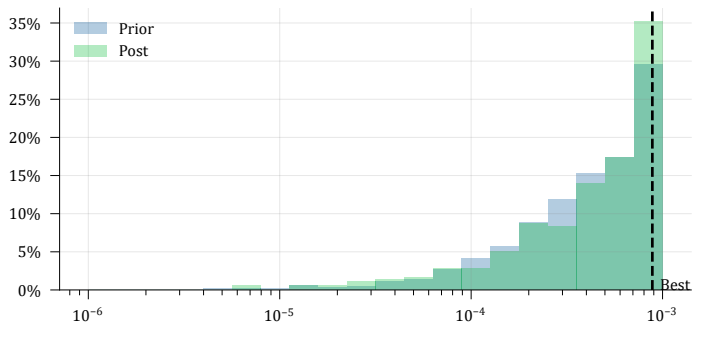
ss_p289(Pilot_Point_L1)



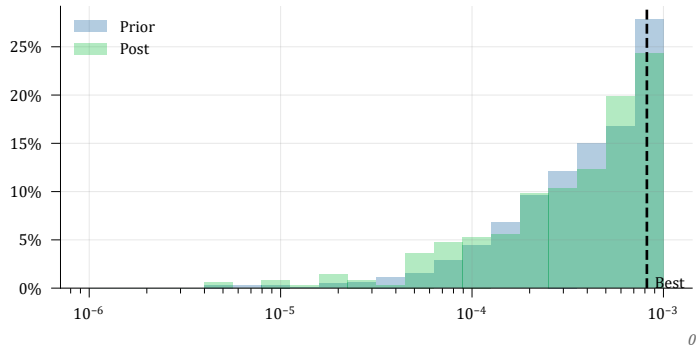
ss_p290(Pilot_Point_L1)



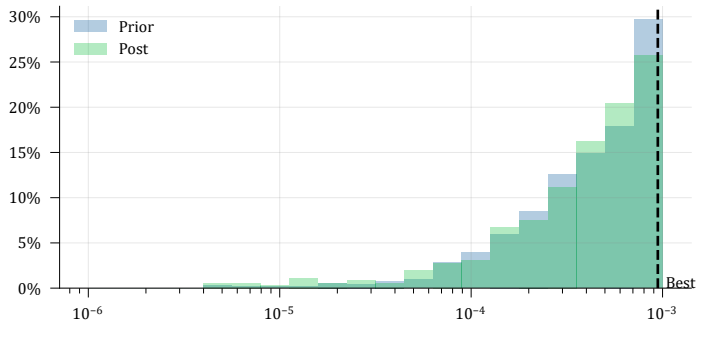
ss_p291(Pilot_Point_L1)



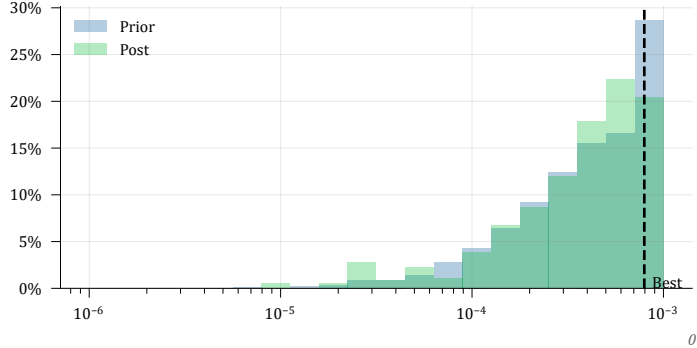
ss_p292(Pilot_Point_L1)



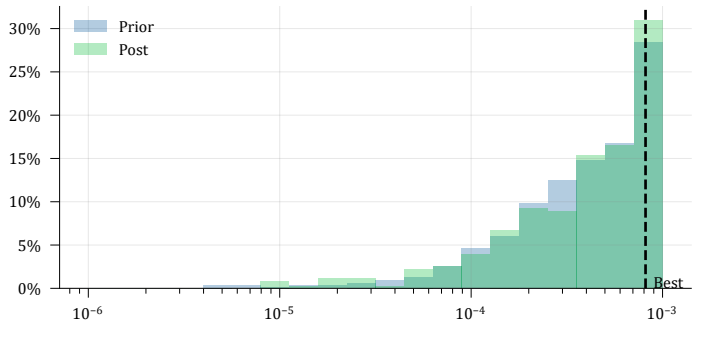
ss_p293(Pilot_Point_L1)



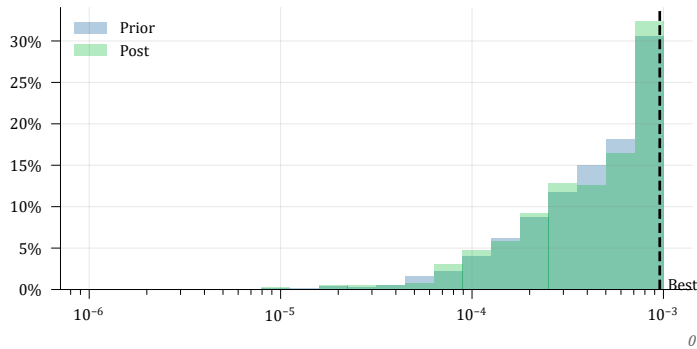
ss_p294(Pilot_Point_L1)



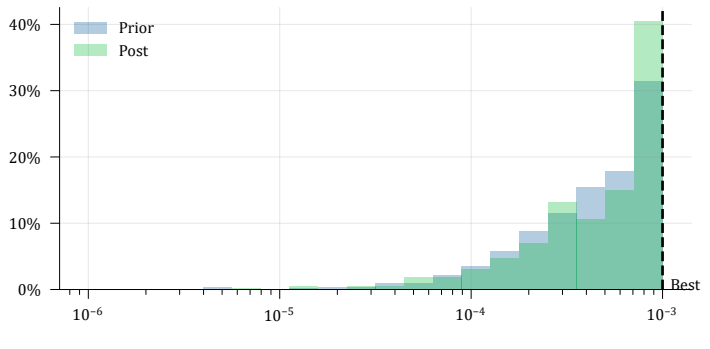
ss_p295(Pilot_Point_L1)



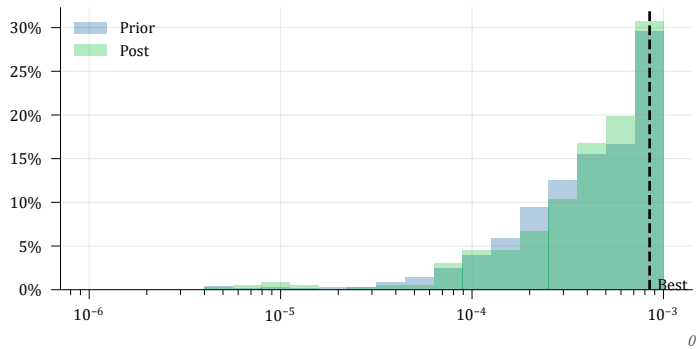
ss_p296(Pilot_Point_L1)



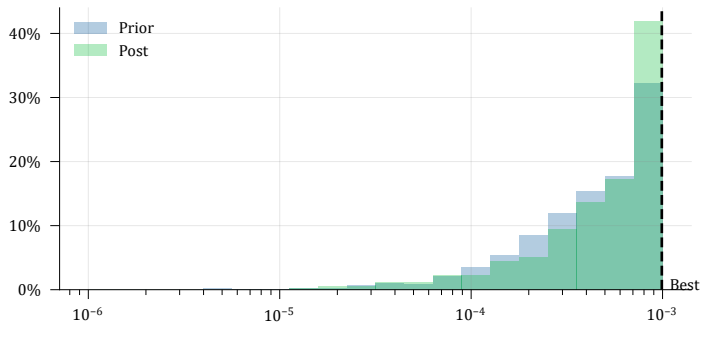
ss_p297(Pilot_Point_L1)



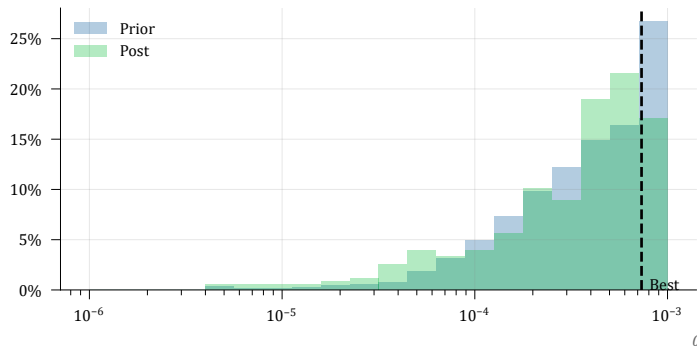
ss_p298(Pilot_Point_L1)



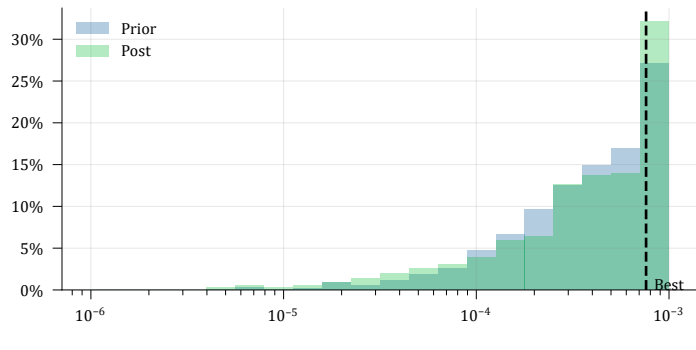
ss_p299(Pilot_Point_L1)



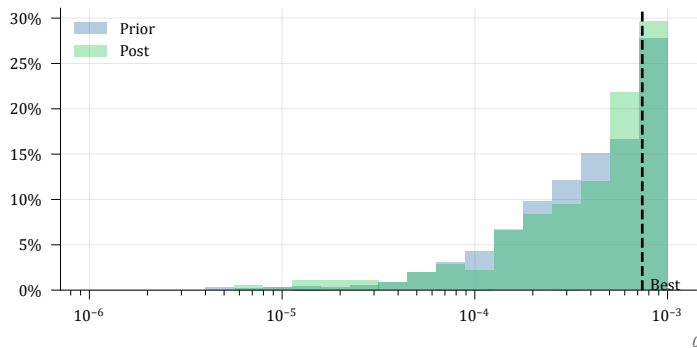
ss_p300(Pilot_Point_L1)



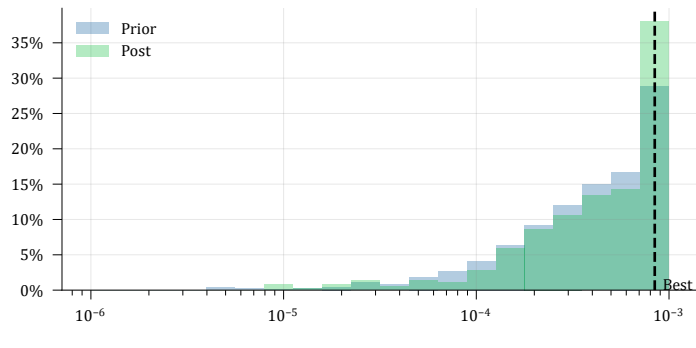
ss_p301(Pilot_Point_L1)



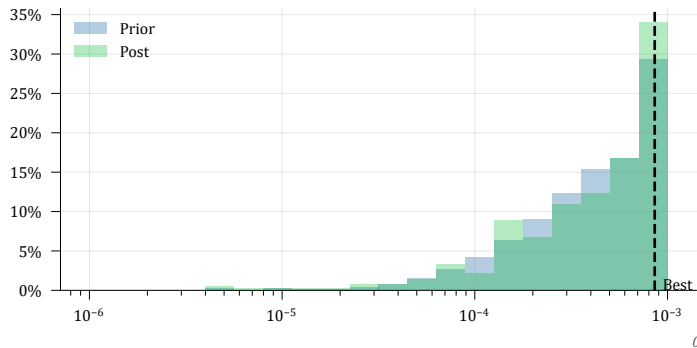
ss_p302(Pilot_Point_L1)



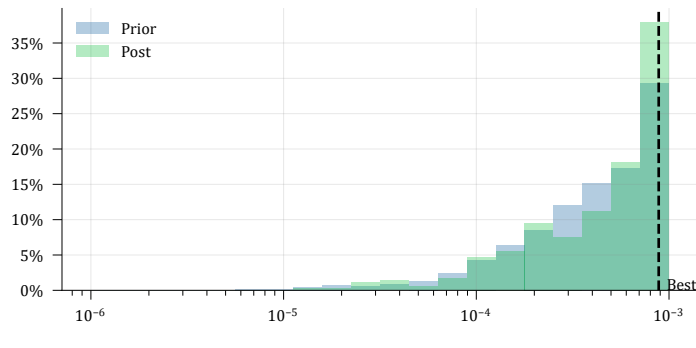
ss_p303(Pilot_Point_L1)



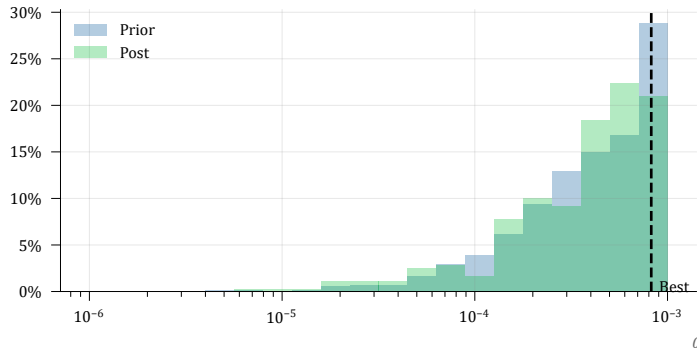
ss_p304(Pilot_Point_L1)



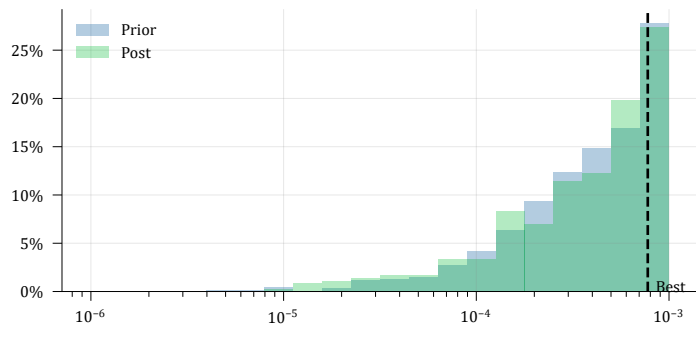
ss_p305(Pilot_Point_L1)



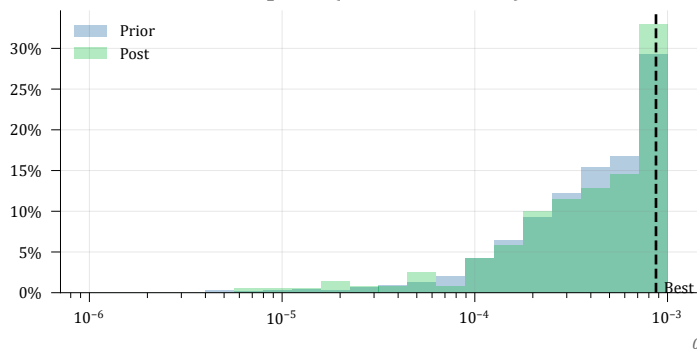
ss_p306(Pilot_Point_L1)



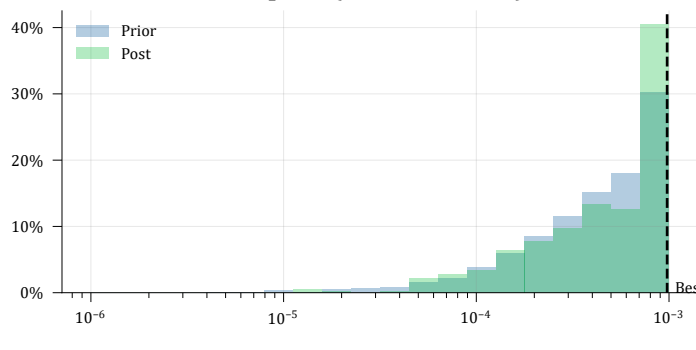
ss_p307(Pilot_Point_L1)



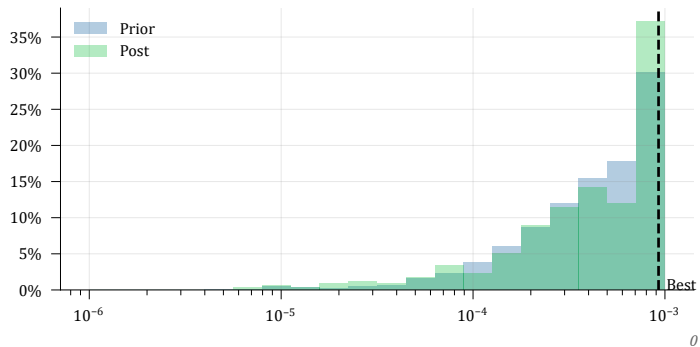
ss_p308(Pilot_Point_L1)



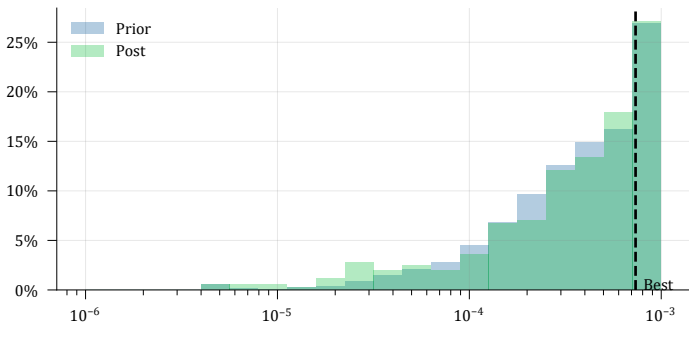
ss_p309(Pilot_Point_L1)



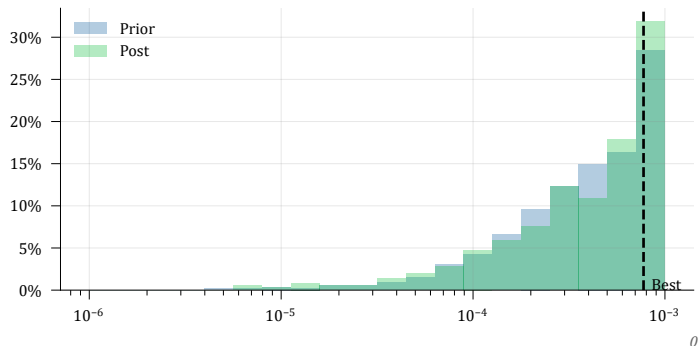
ss_p310(Pilot_Point_L1)



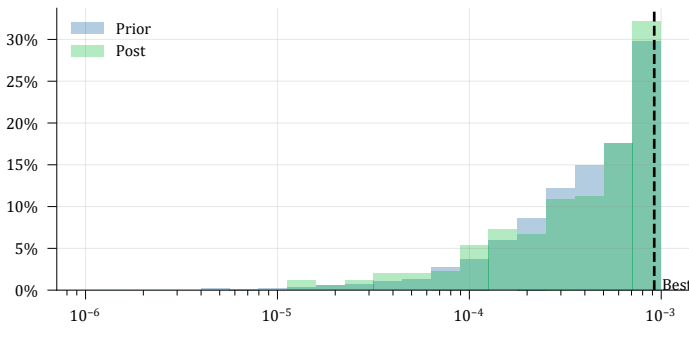
ss_p311(Pilot_Point_L1)



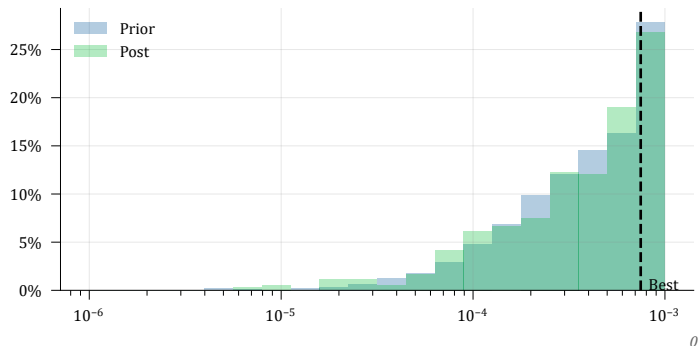
ss_p312(Pilot_Point_L1)



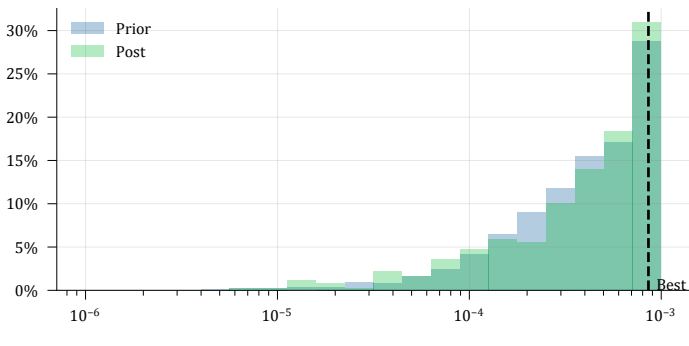
ss_p313(Pilot_Point_L1)



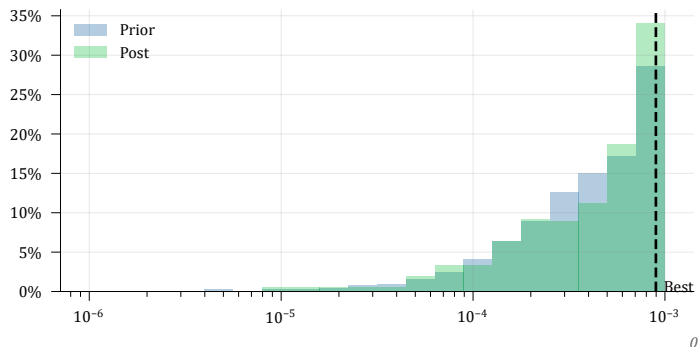
ss_p314(Pilot_Point_L1)



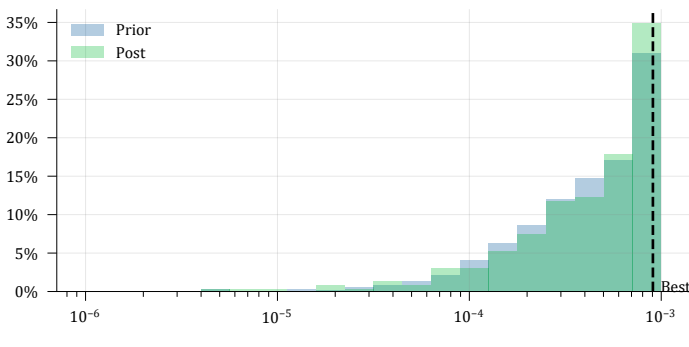
ss_p315(Pilot_Point_L1)



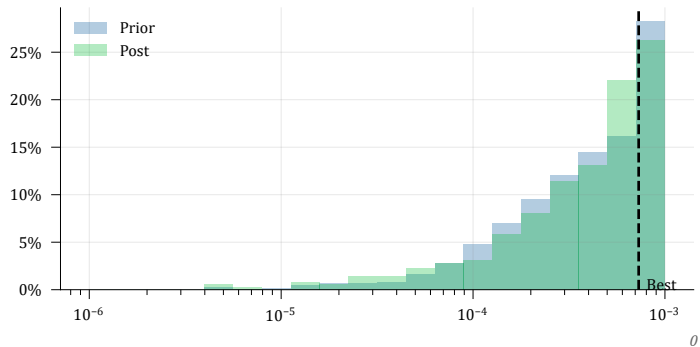
ss_p316(Pilot_Point_L1)



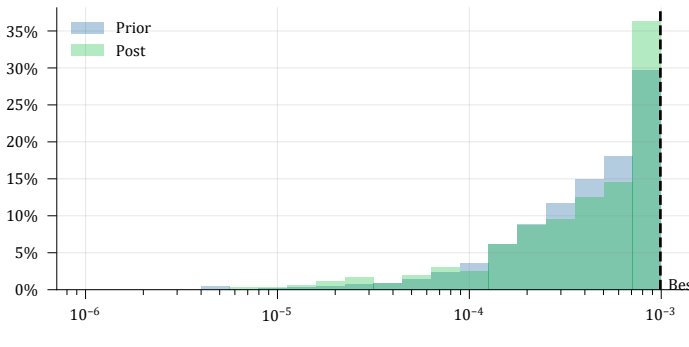
ss_p317(Pilot_Point_L1)



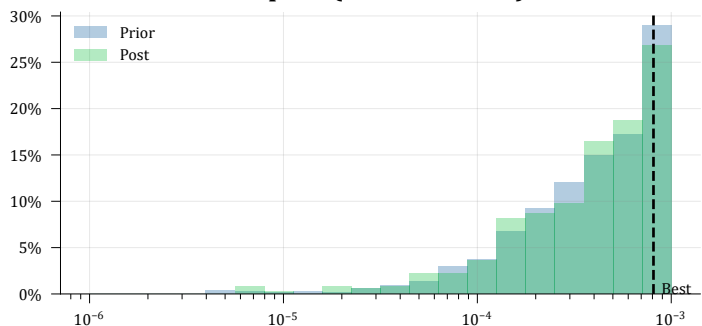
ss_p318(Pilot_Point_L1)



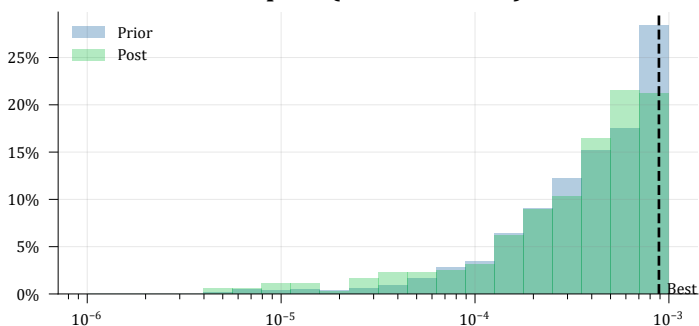
ss_p319(Pilot_Point_L1)



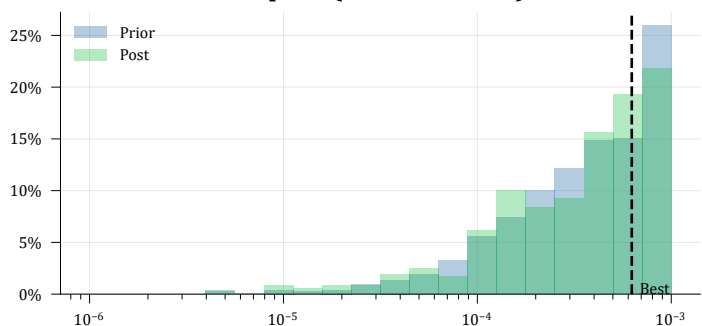
ss_p320(Pilot_Point_L1)



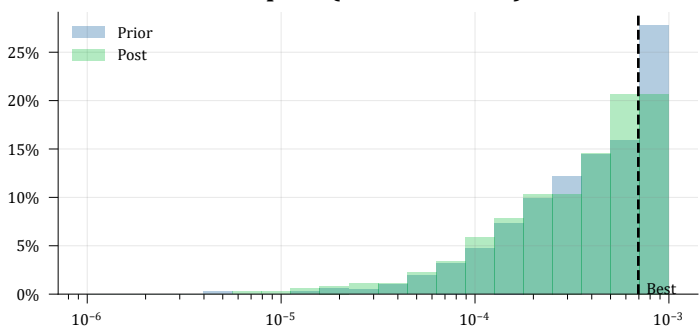
ss_p321(Pilot_Point_L1)



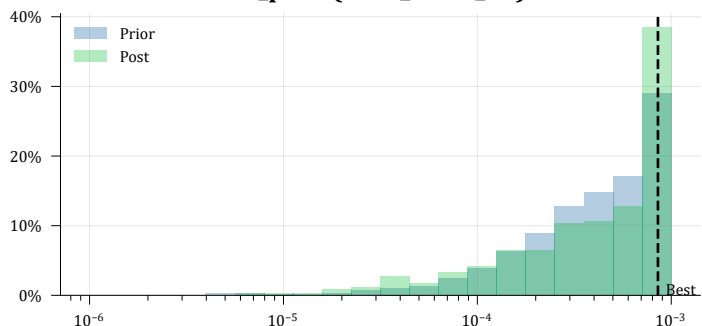
ss_p322(Pilot_Point_L1)



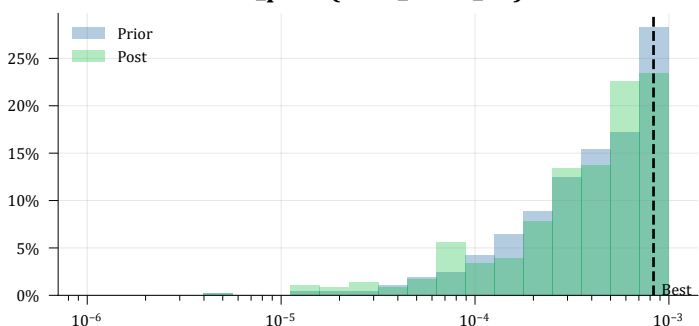
ss_p323(Pilot_Point_L1)



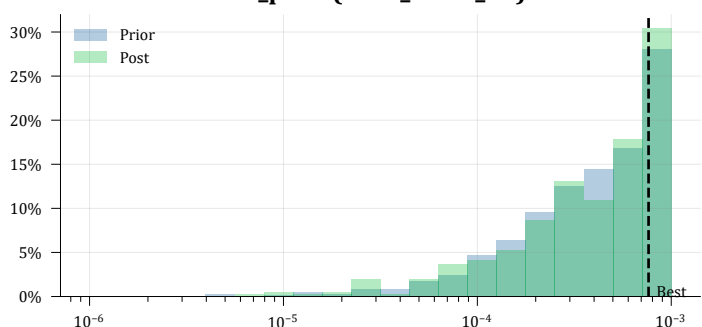
ss_p324(Pilot_Point_L1)



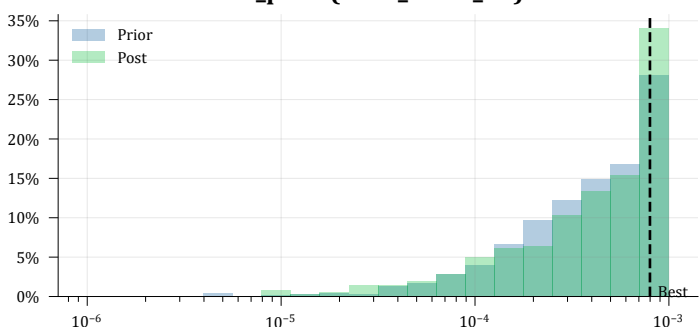
ss_p325(Pilot_Point_L1)



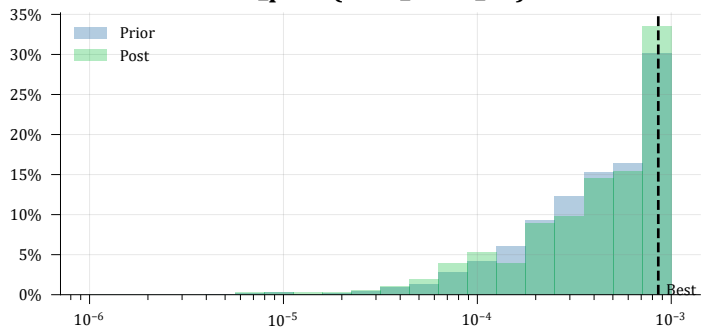
ss_p326(Pilot_Point_L1)



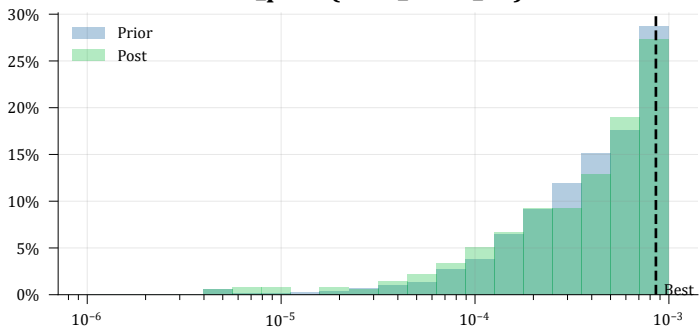
ss_p327(Pilot_Point_L1)



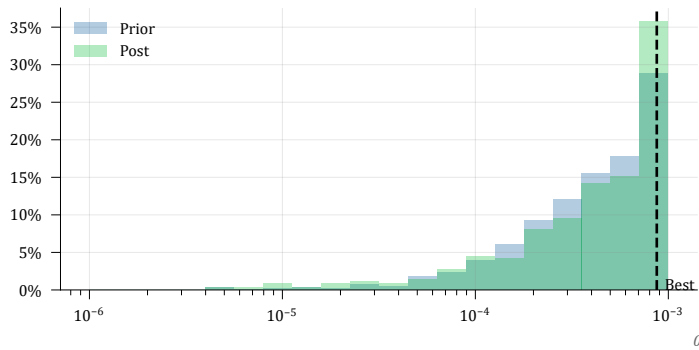
ss_p328(Pilot_Point_L1)



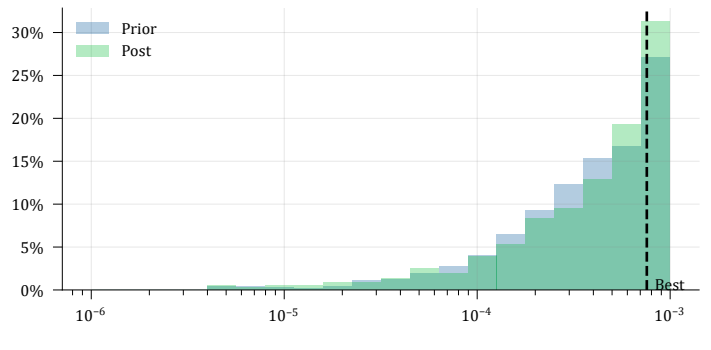
ss_p329(Pilot_Point_L1)



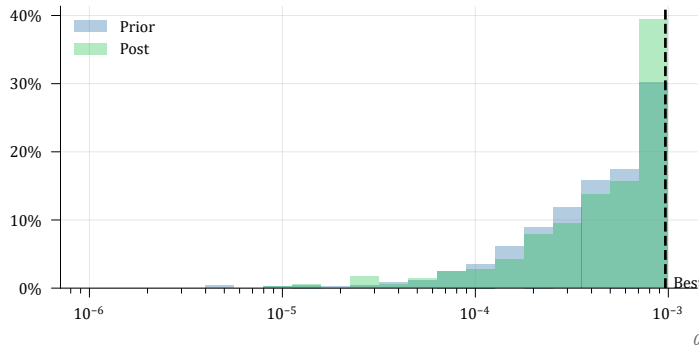
ss_p330(Pilot_Point_L1)



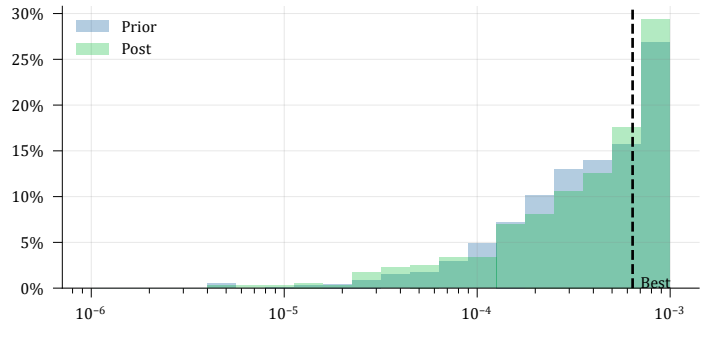
ss_p331(Pilot_Point_L1)



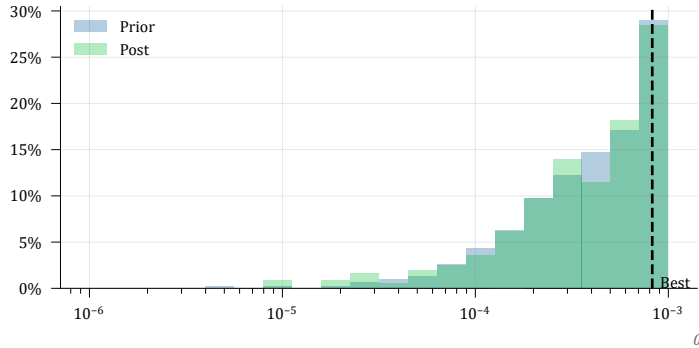
ss_p332(Pilot_Point_L1)



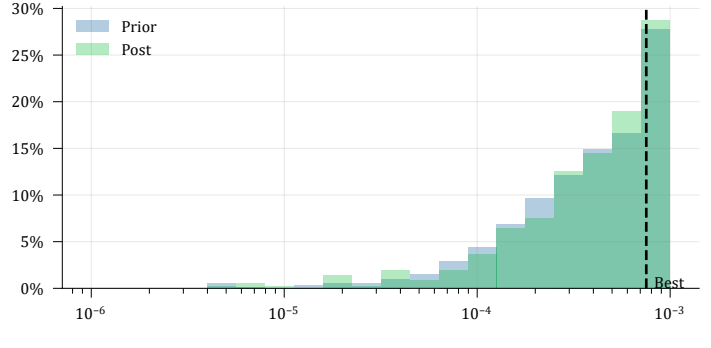
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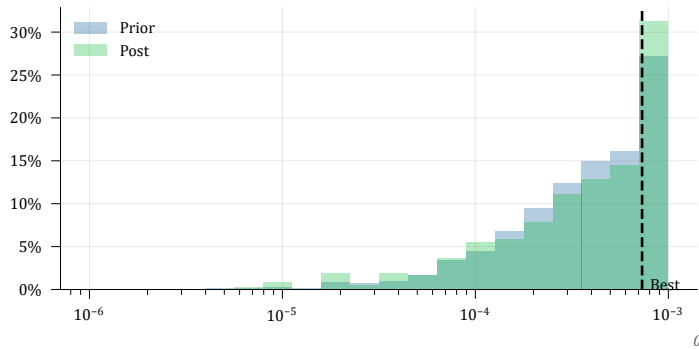
ss_p334(Pilot_Point_L1)



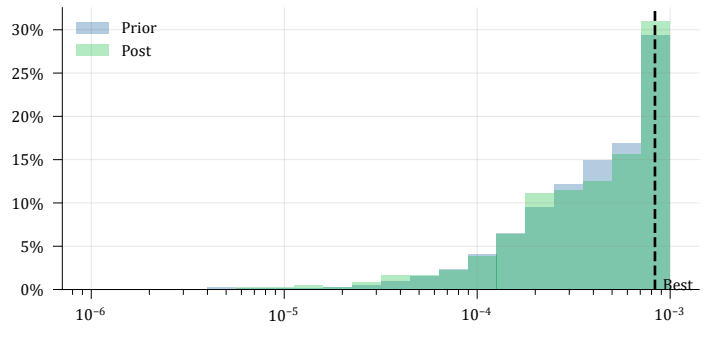
ss_p335(Pilot_Point_L1)



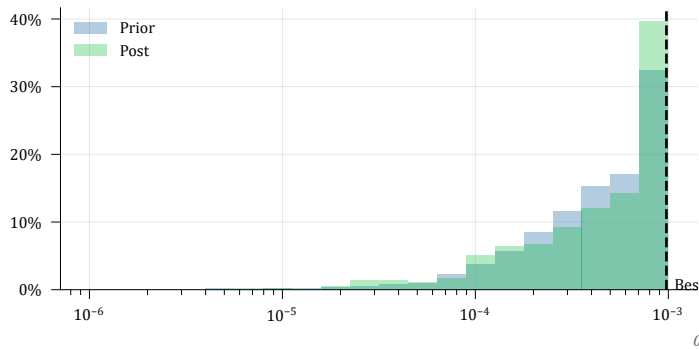
ss_p336(Pilot_Point_L1)



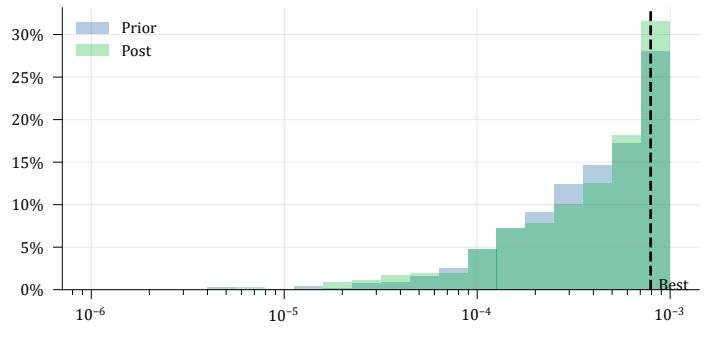
ss_p337(Pilot_Point_L1)



ss_p338(Pilot_Point_L1)

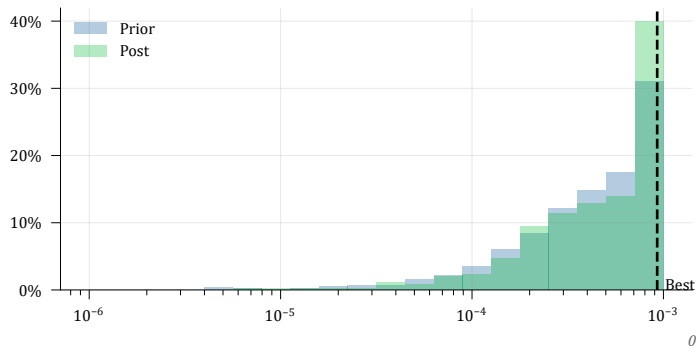


ss_p339(Pilot_Point_L1)

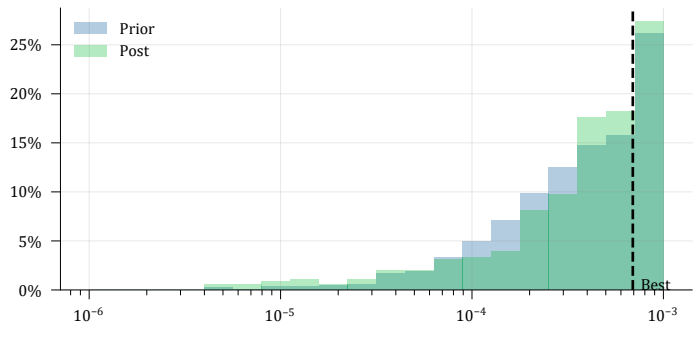


Parameters

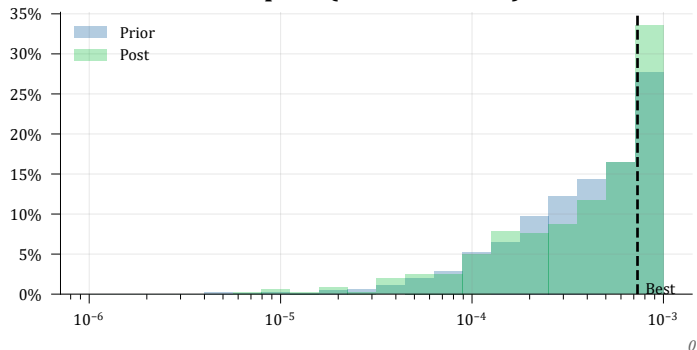
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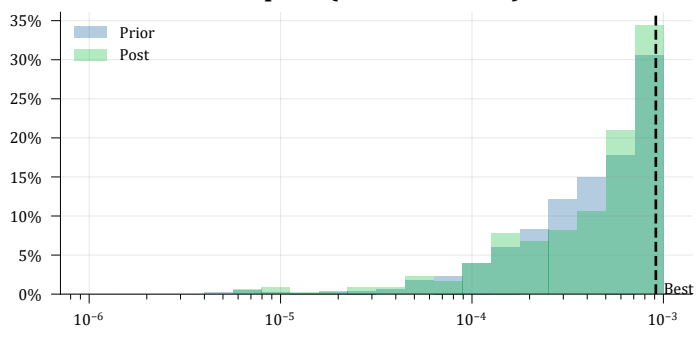
ss_p341(Pilot_Point_L1)



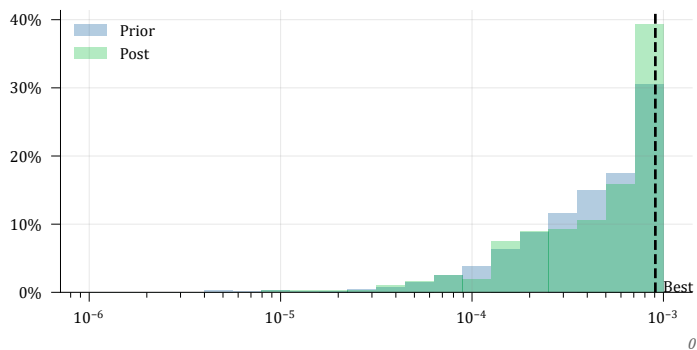
ss_p342(Pilot_Point_L1)



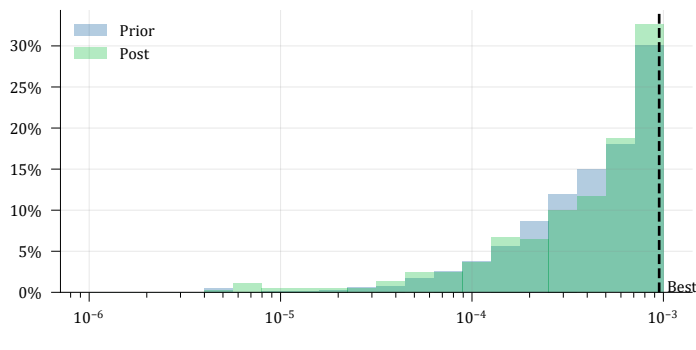
ss_p343(Pilot_Point_L1)



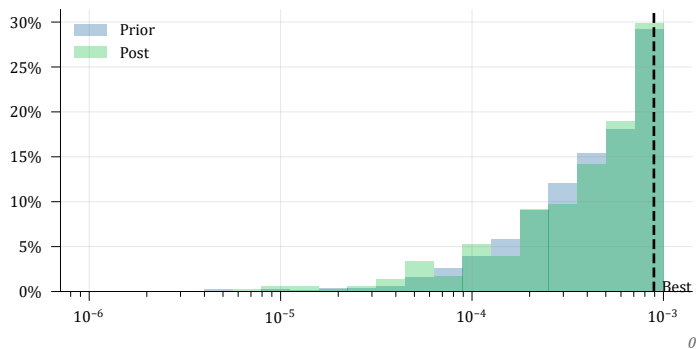
ss_p344(Pilot_Point_L1)



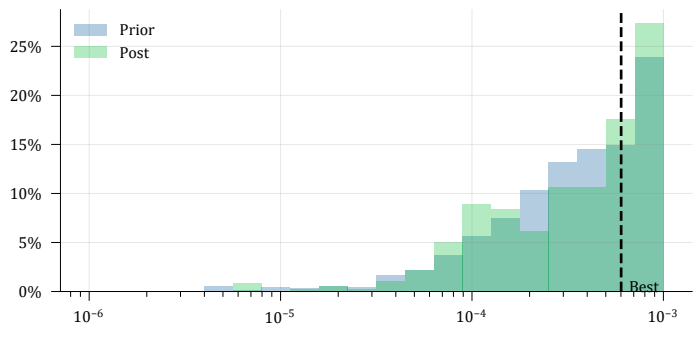
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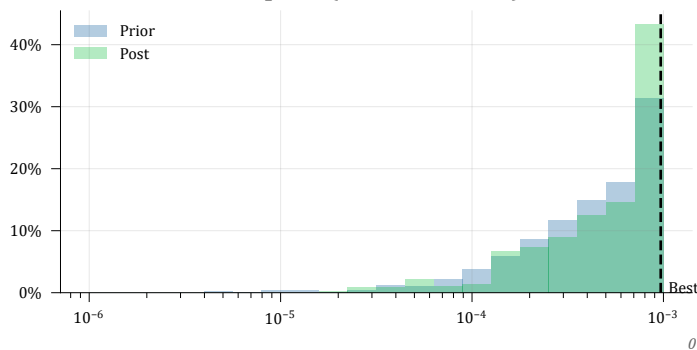
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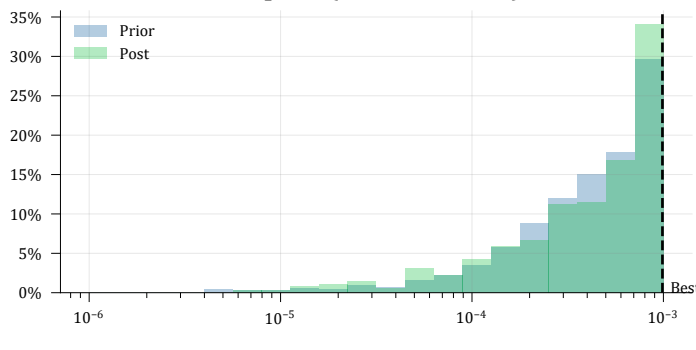
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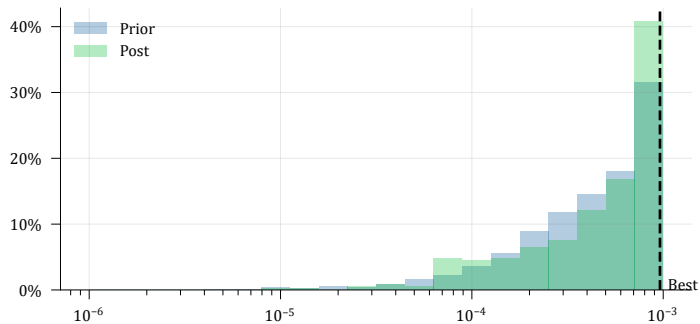
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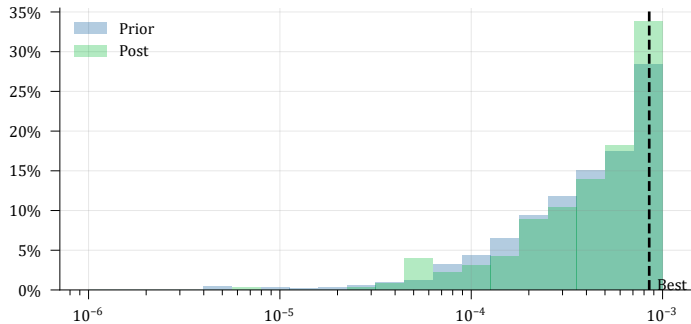
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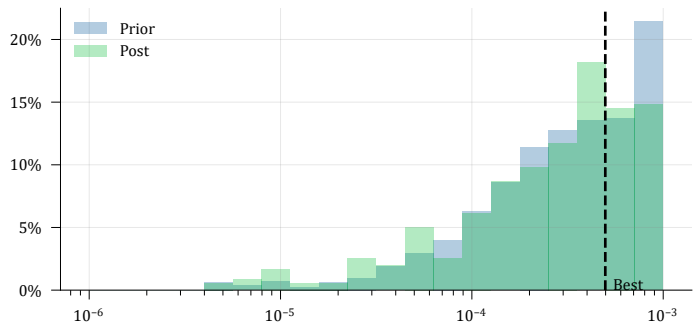
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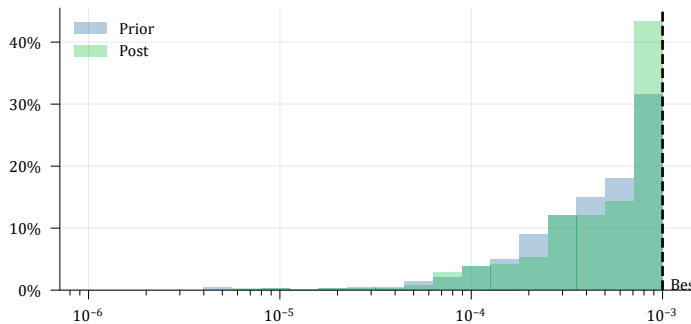
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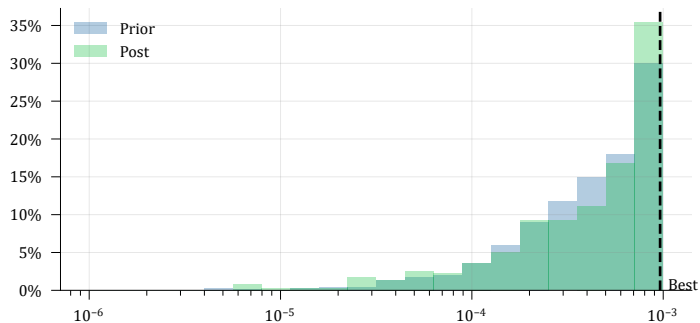
ss_p352(Pilot_Point_L1)



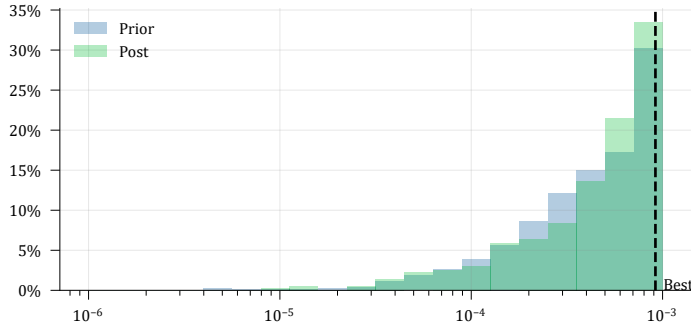
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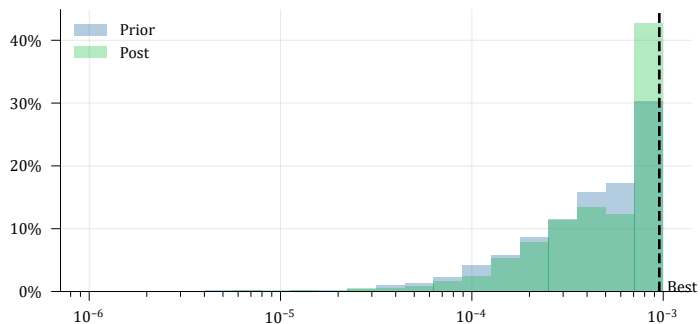
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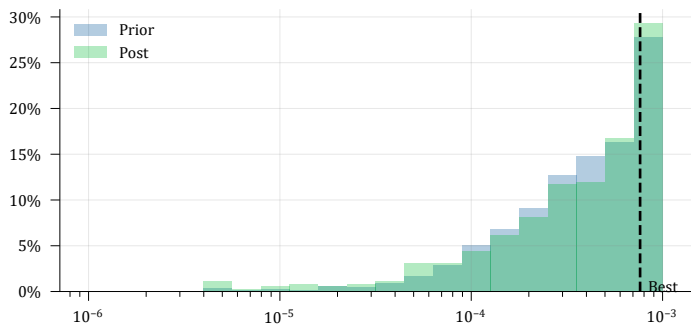
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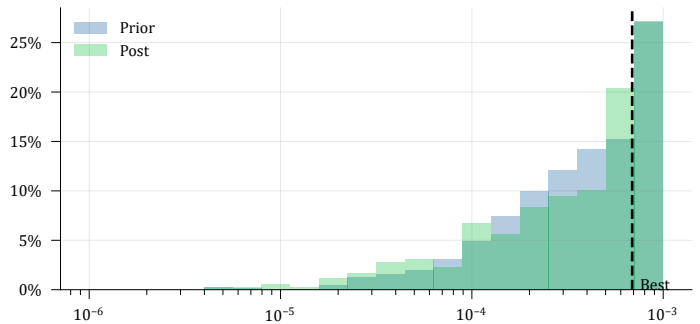
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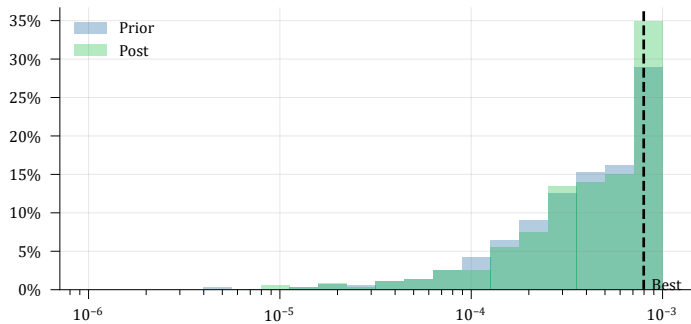
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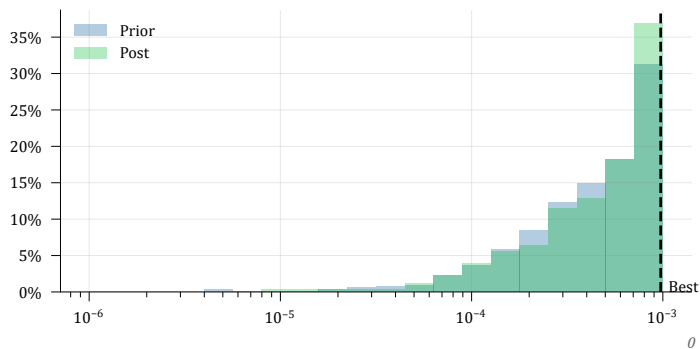
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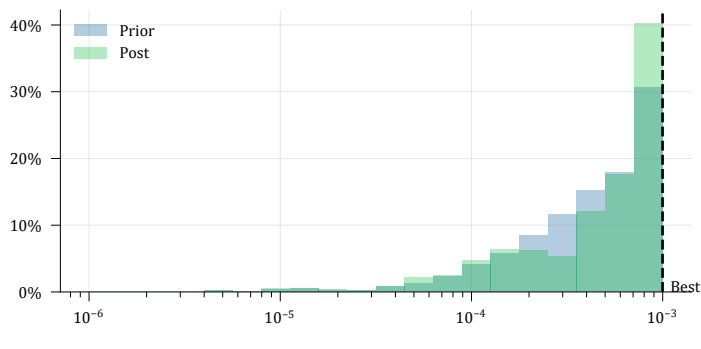
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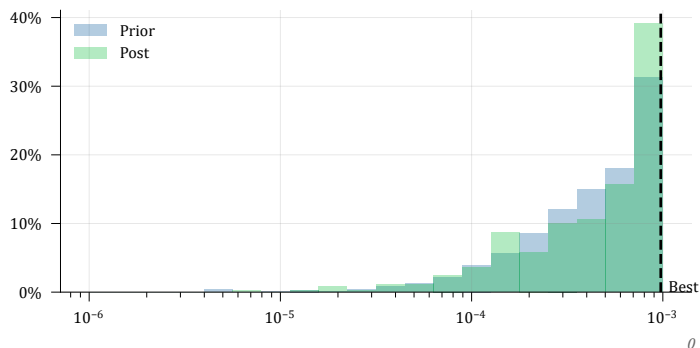
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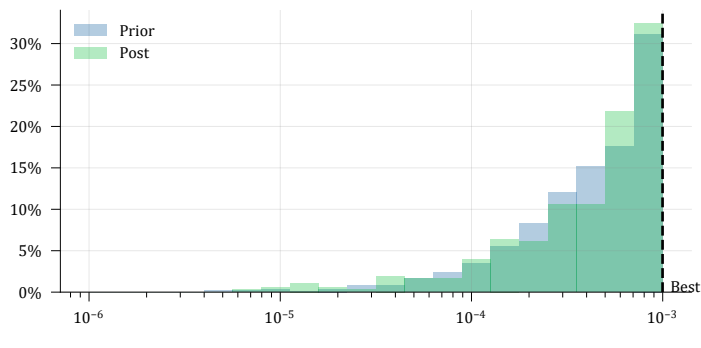
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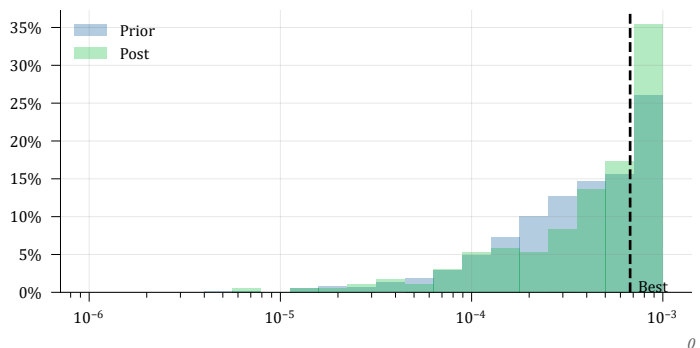
ss_p362(Pilot_Point_L1)



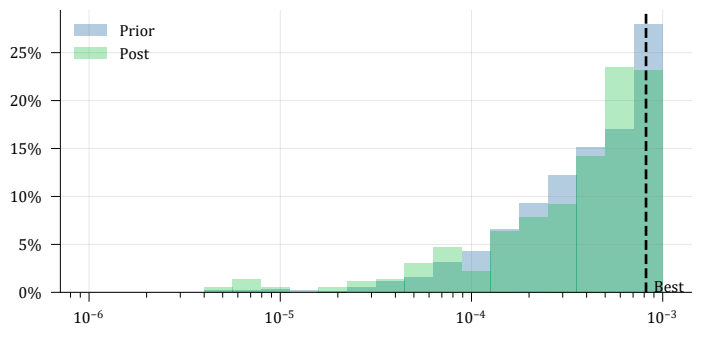
ss_p363(Pilot_Point_L1)



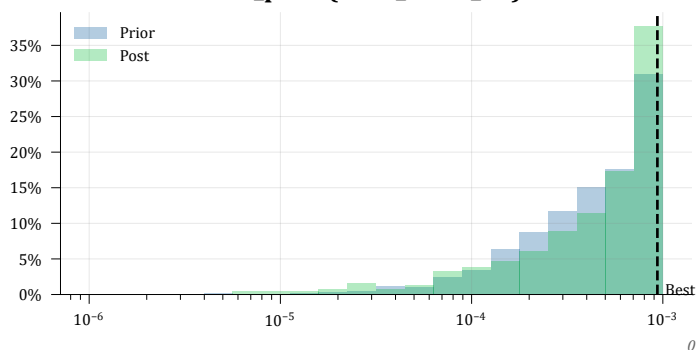
ss_p364(Pilot_Point_L1)



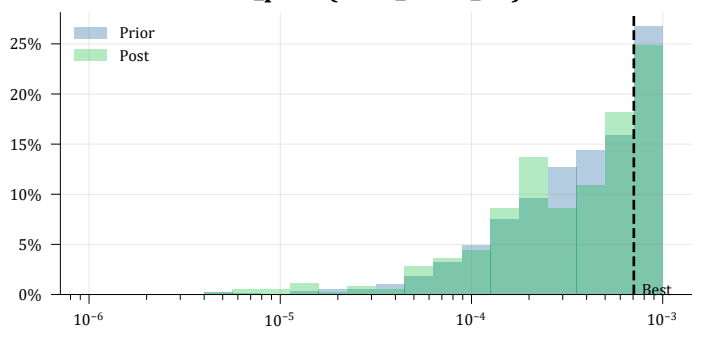
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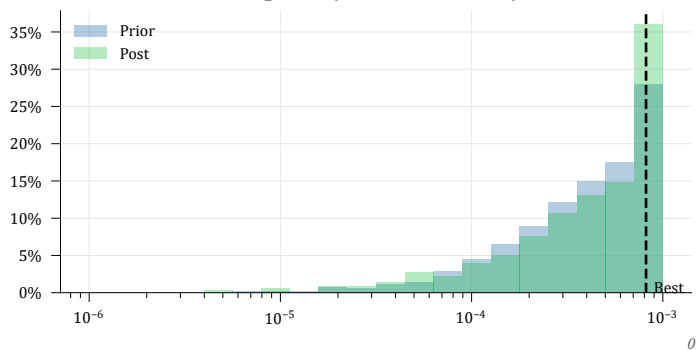
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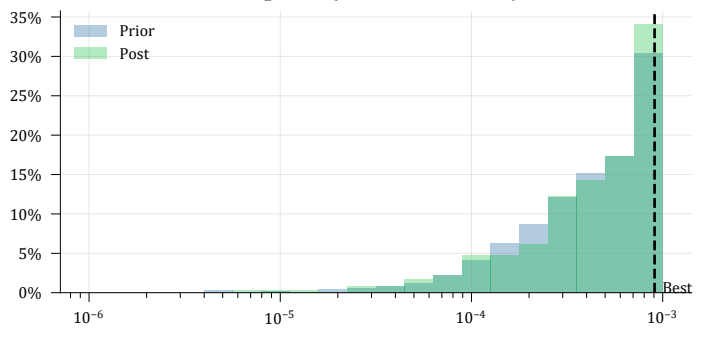
ss_p367(Pilot_Point_L1)



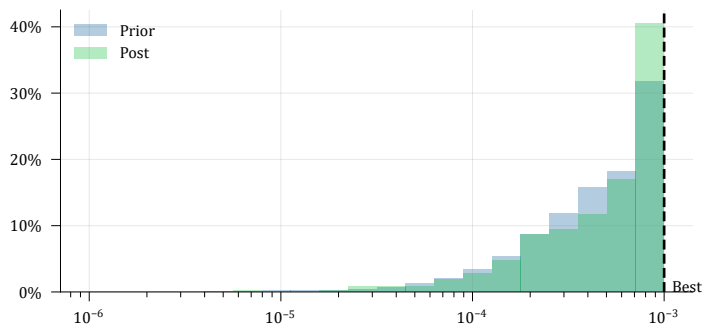
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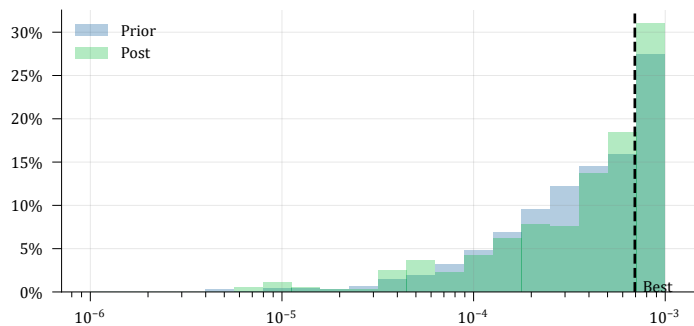
ss_p369(Pilot_Point_L1)



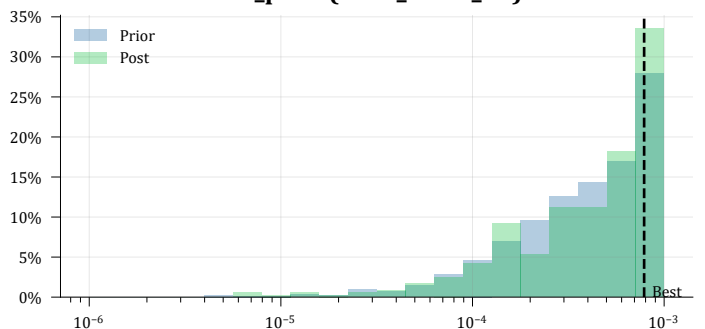
ss_p370(Pilot_Point_L1)



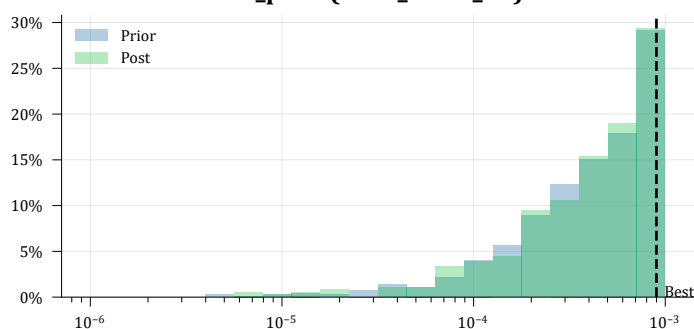
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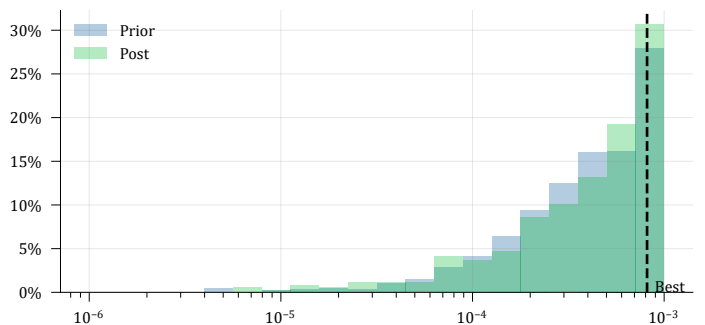
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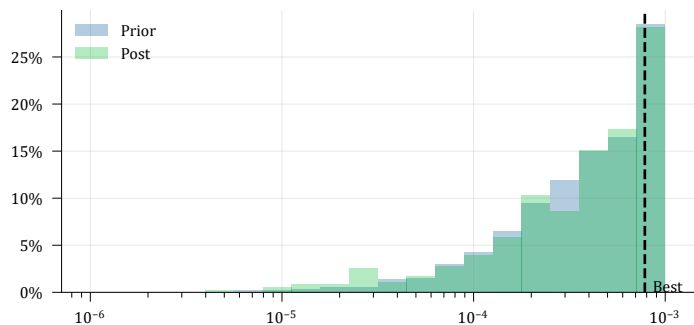
ss_p373(Pilot_Point_L1)



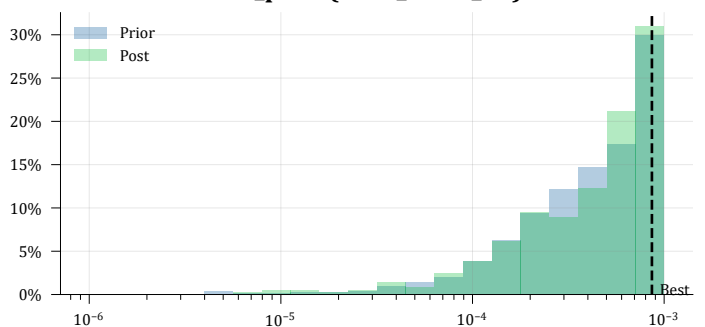
ss_p374(Pilot_Point_L1)



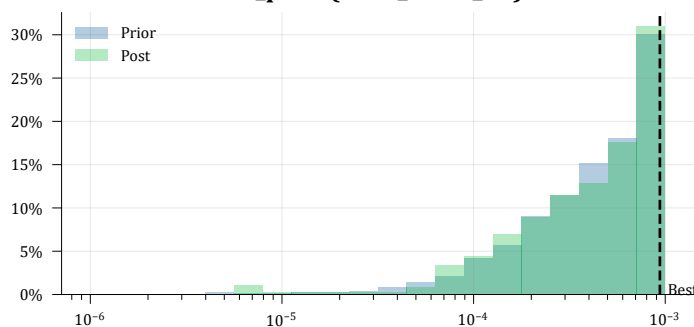
ss_p375(Pilot_Point_L1)



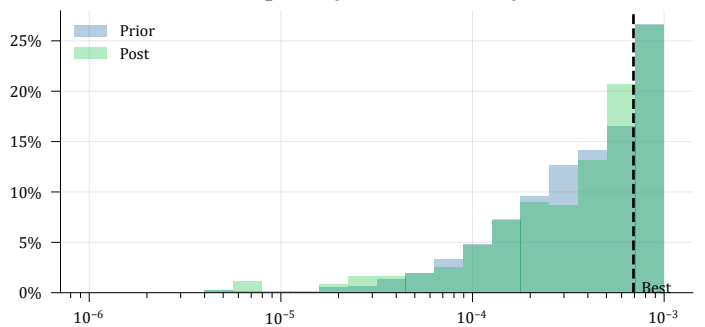
ss_p376(Pilot_Point_L1)



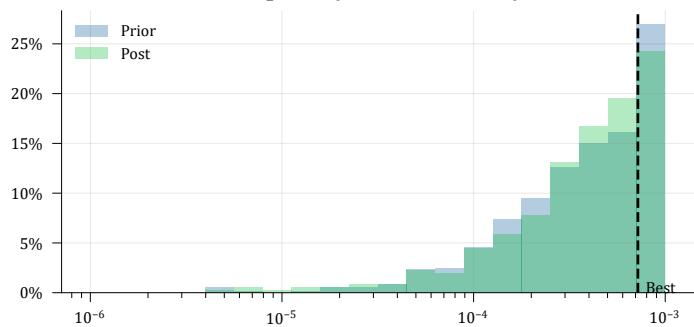
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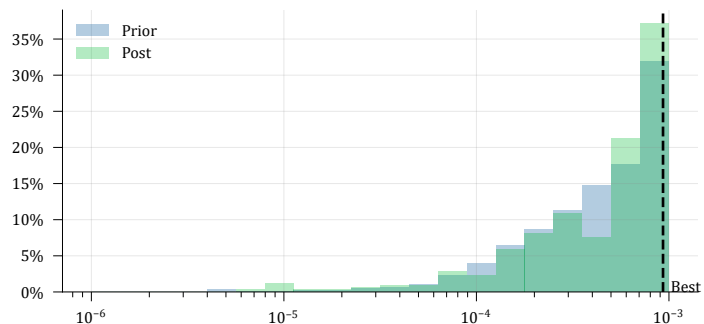
ss_p378(Pilot_Point_L1)



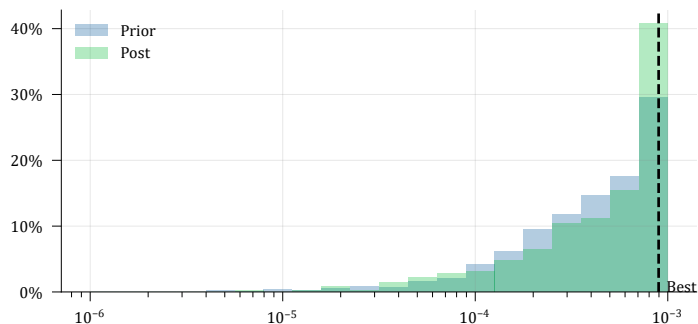
ss_p379(Pilot_Point_L1)



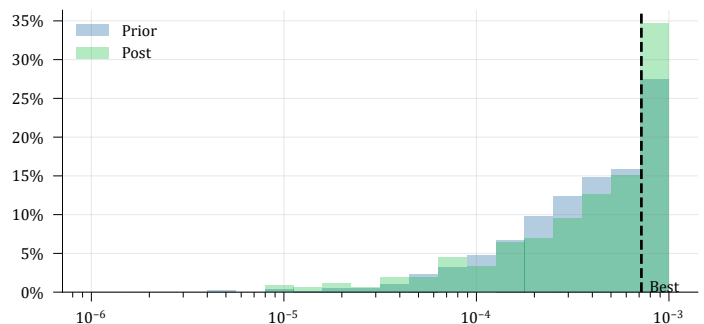
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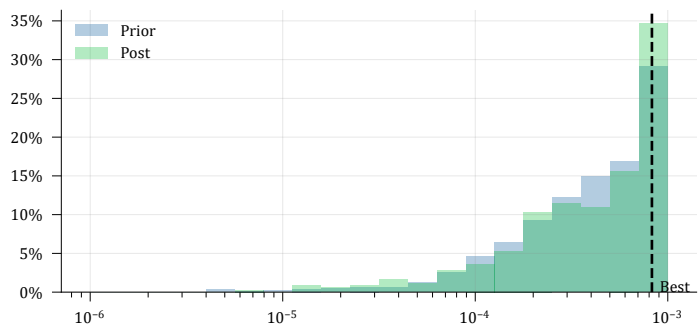
ss_p381(Pilot_Point_L1)



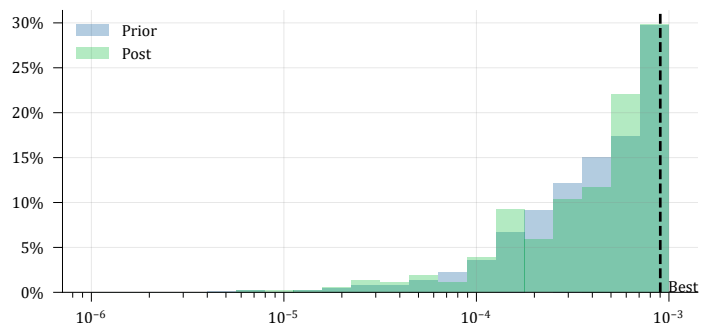
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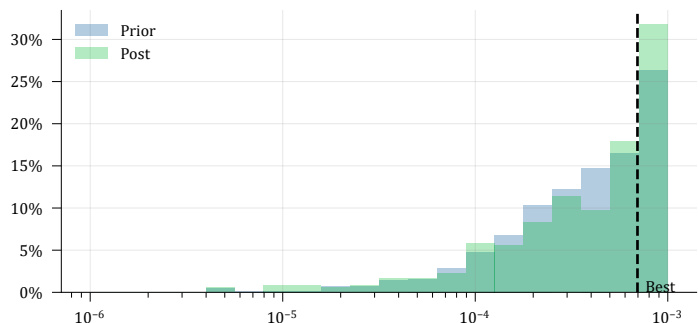
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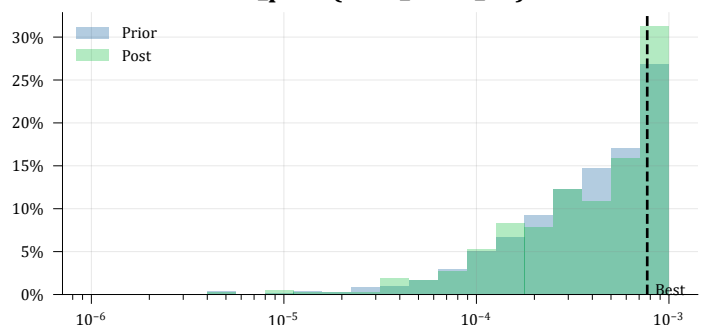
ss_p384(Pilot_Point_L1)



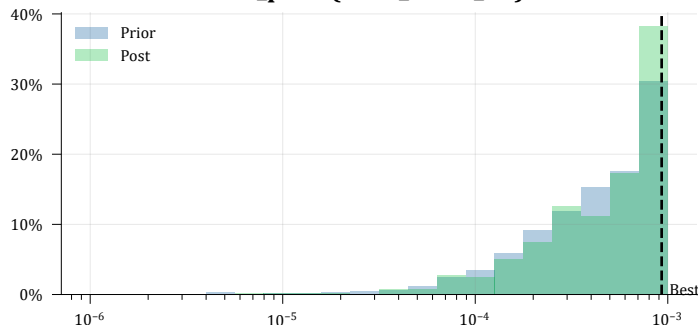
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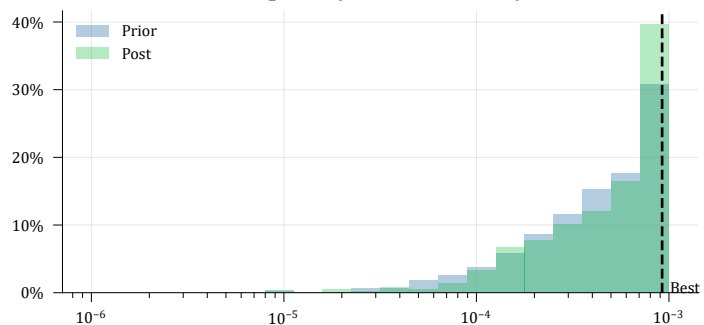
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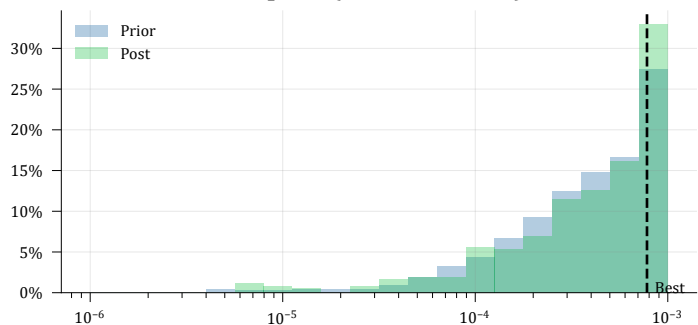
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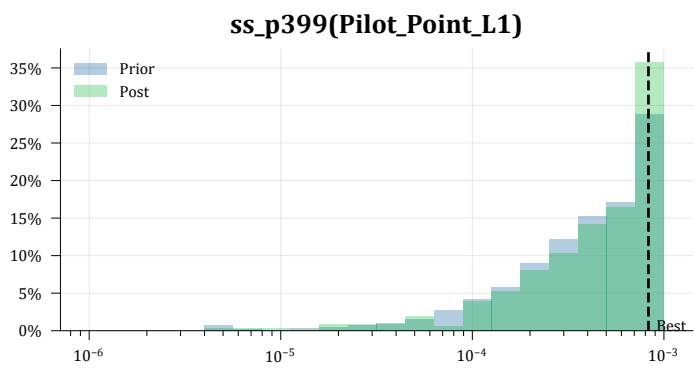
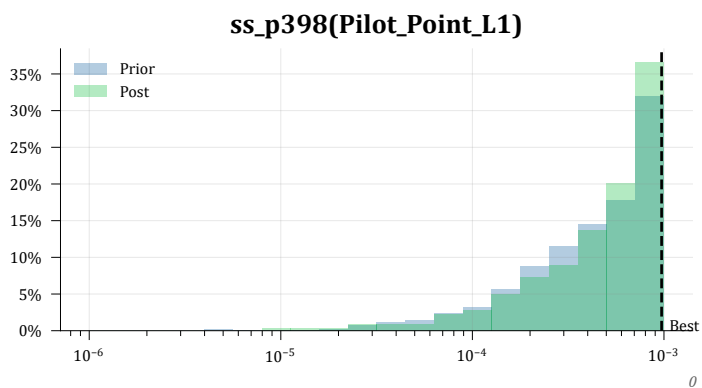
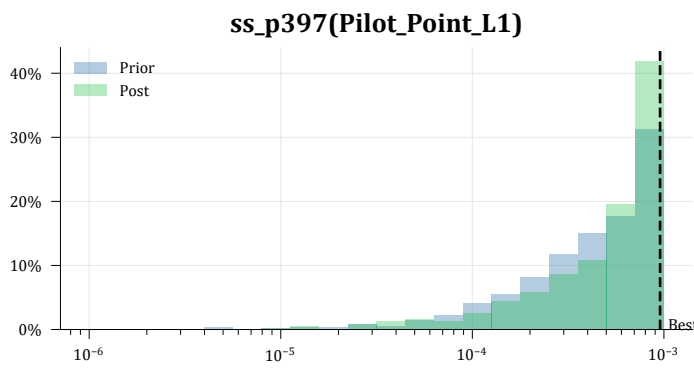
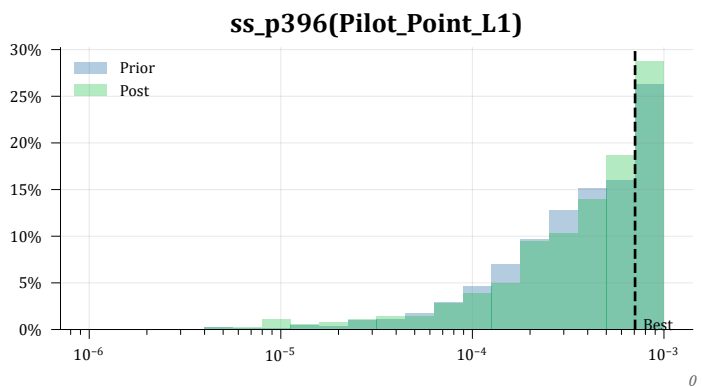
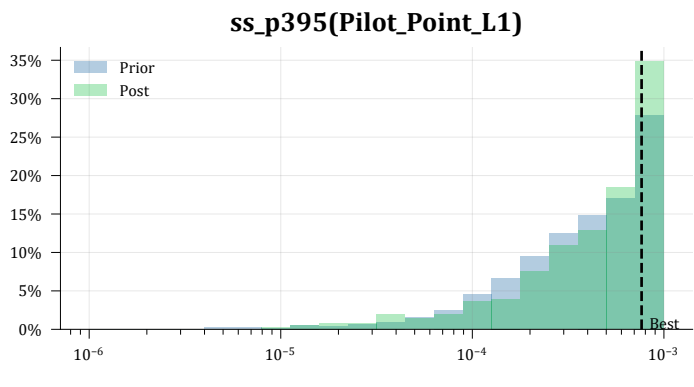
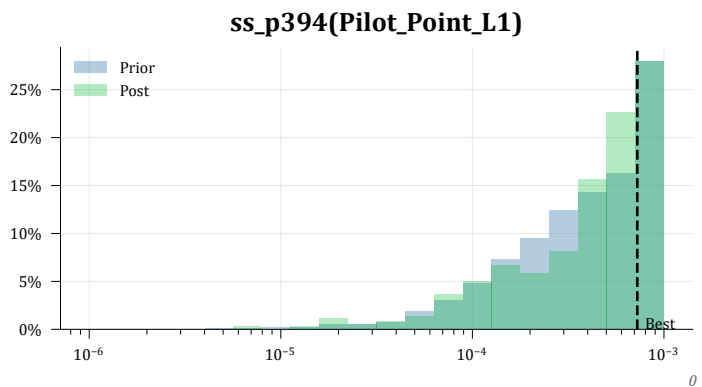
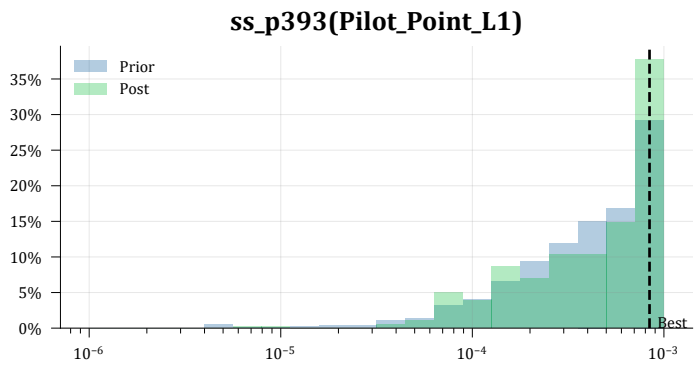
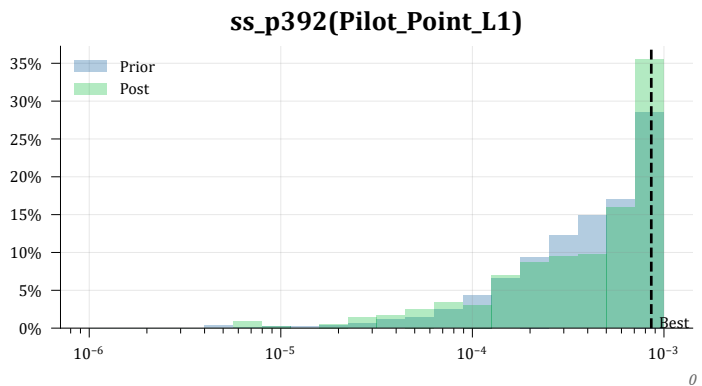
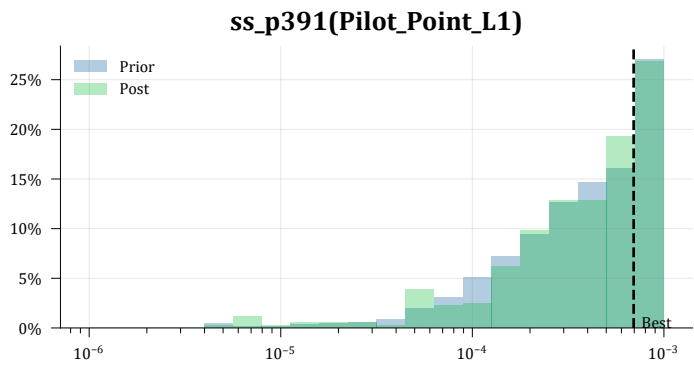
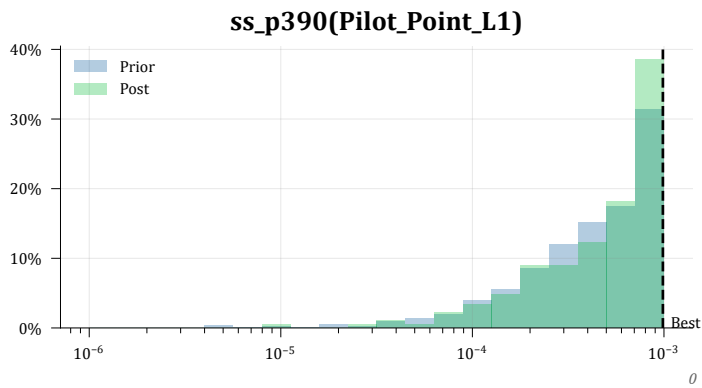


ss_p388(Pilot_Point_L1)

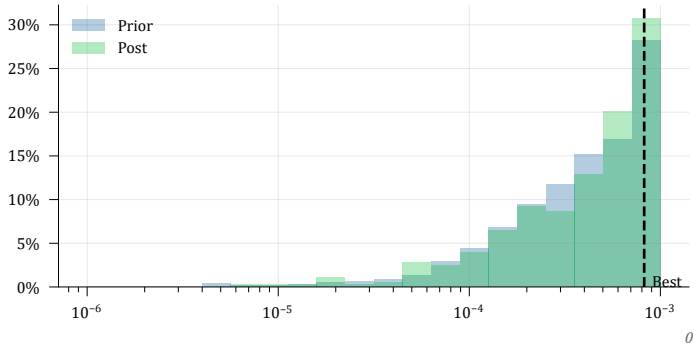


ss_p389(Pilot_Point_L1)

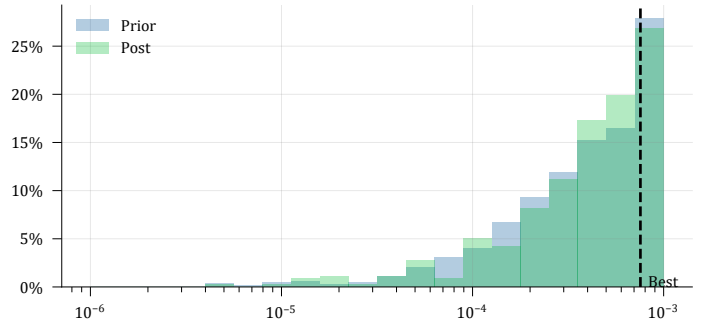




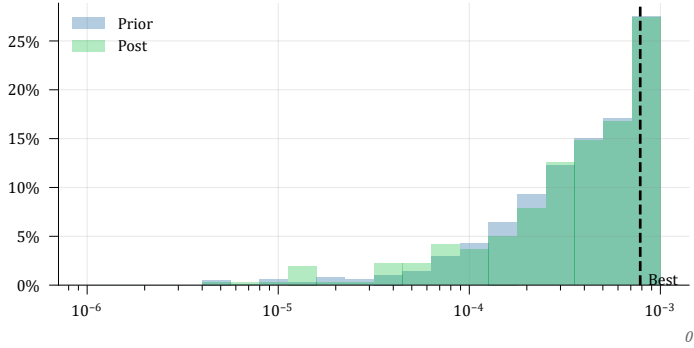
ss_p400(Pilot_Point_L1)



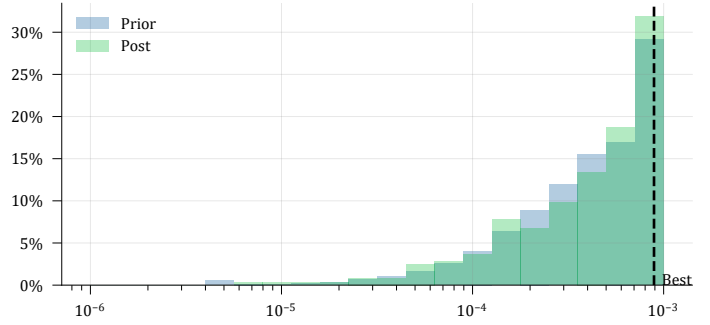
ss_p401(Pilot_Point_L1)



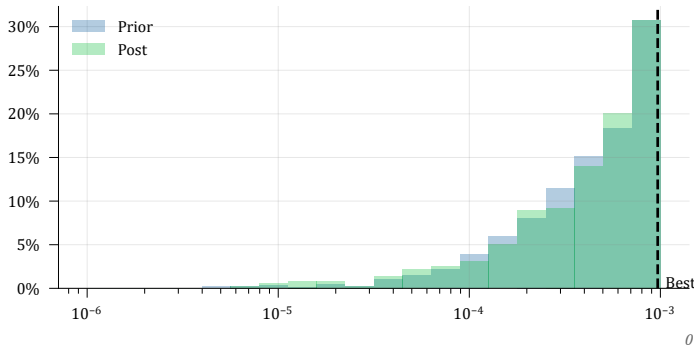
ss_p402(Pilot_Point_L1)



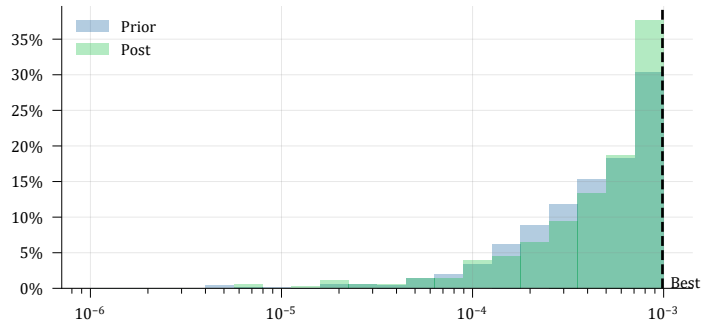
ss_p403(Pilot_Point_L1)



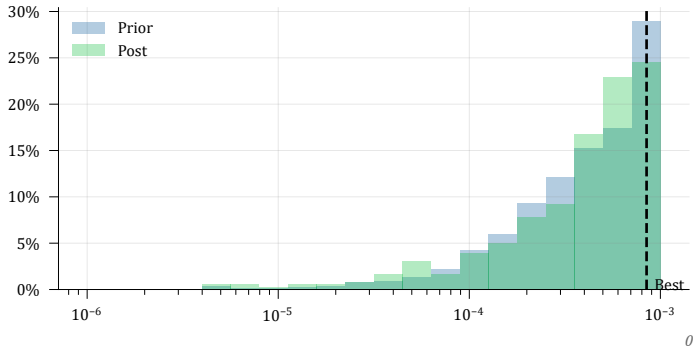
ss_p404(Pilot_Point_L1)



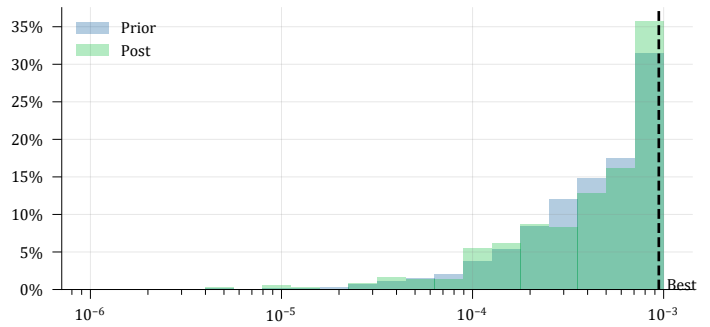
ss_p405(Pilot_Point_L1)



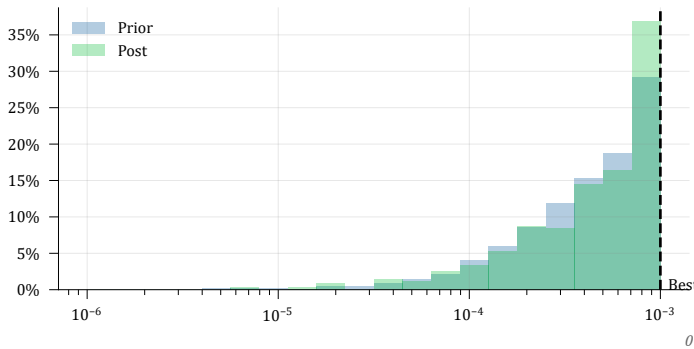
ss_p406(Pilot_Point_L1)



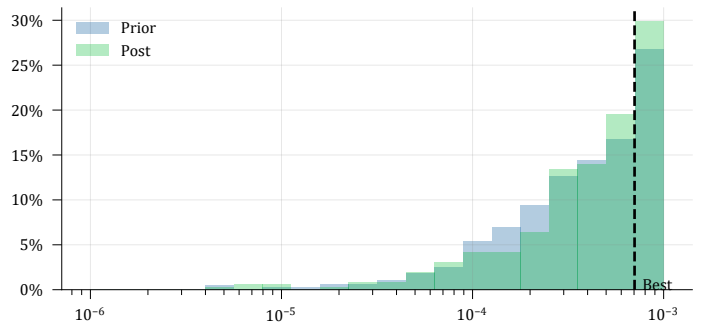
ss_p407(Pilot_Point_L1)



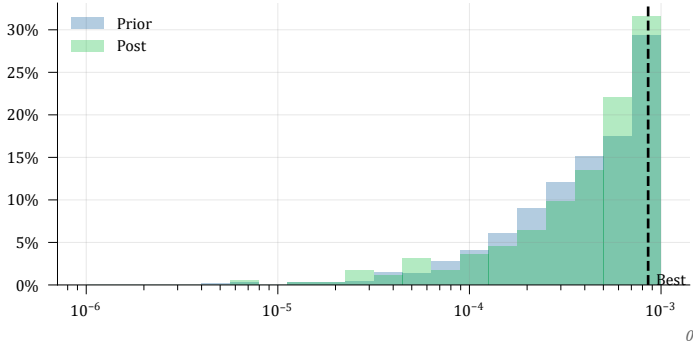
ss_p408(Pilot_Point_L1)



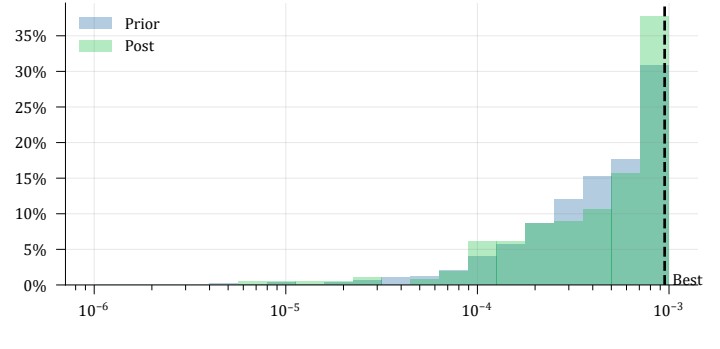
ss_p409(Pilot_Point_L1)



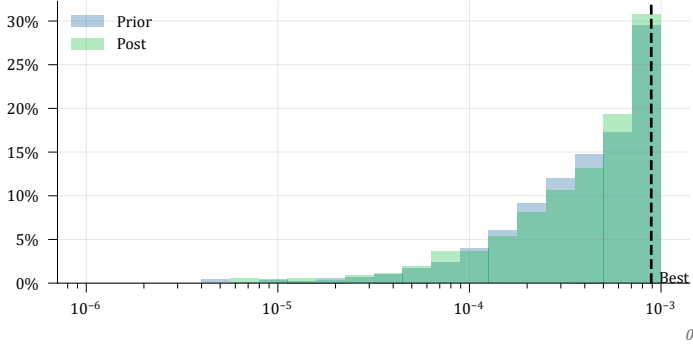
ss_p410(Pilot_Point_L1)



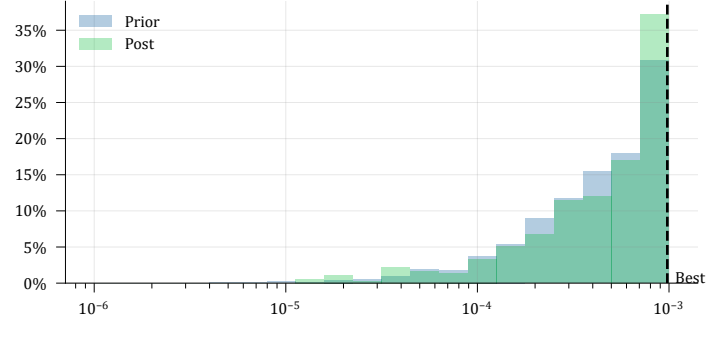
ss_p411(Pilot_Point_L1)



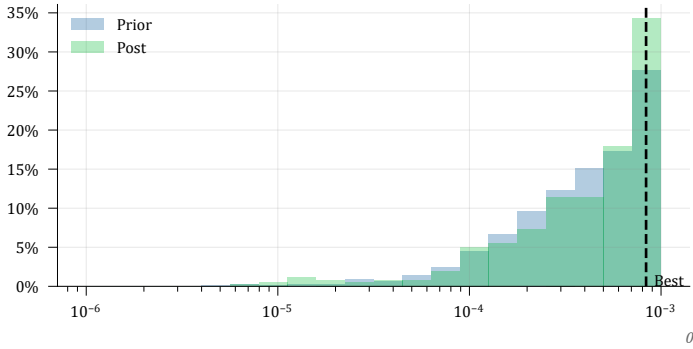
ss_p412(Pilot_Point_L1)



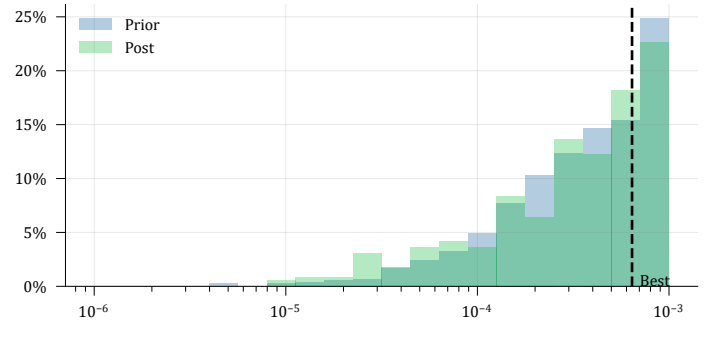
ss_p413(Pilot_Point_L1)



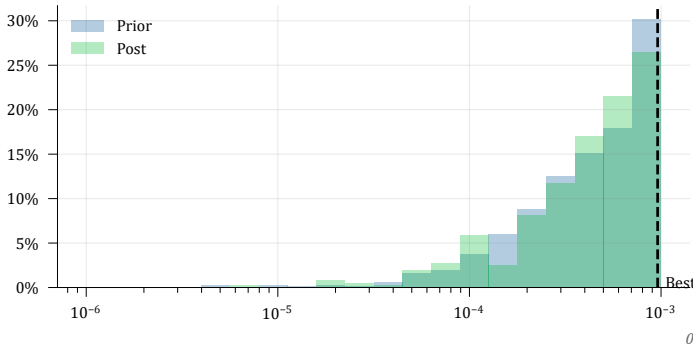
ss_p414(Pilot_Point_L1)



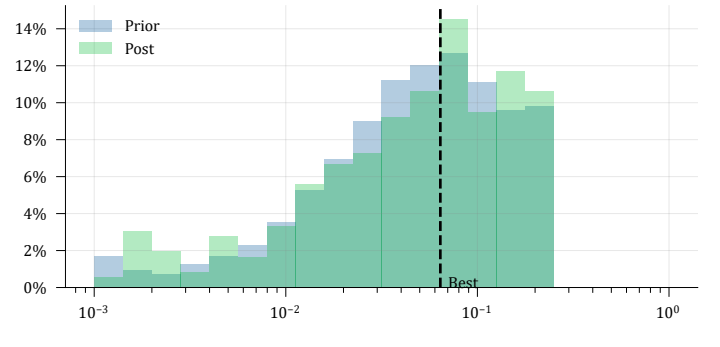
ss_p415(Pilot_Point_L1)



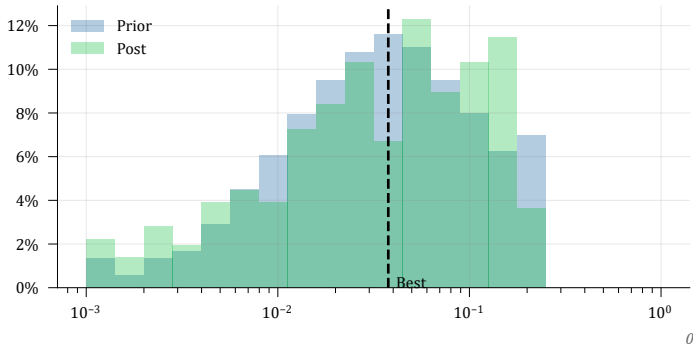
sy_p1(Pilot_Point_L1)



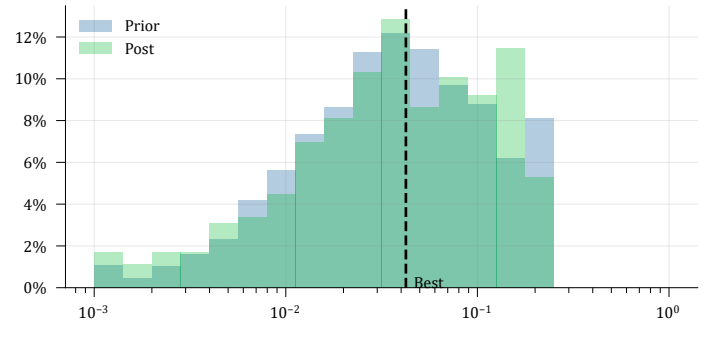
sy_p2(Pilot_Point_L1)

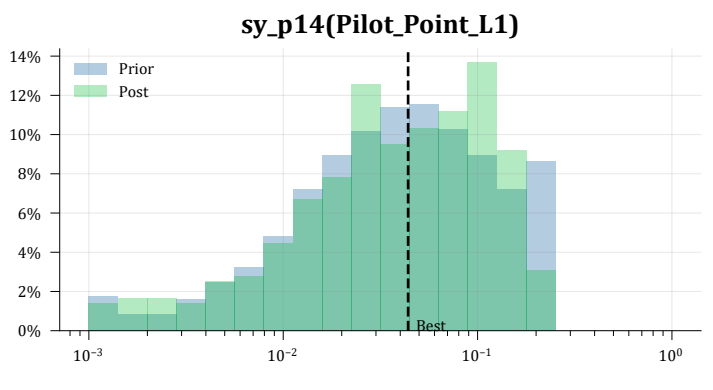
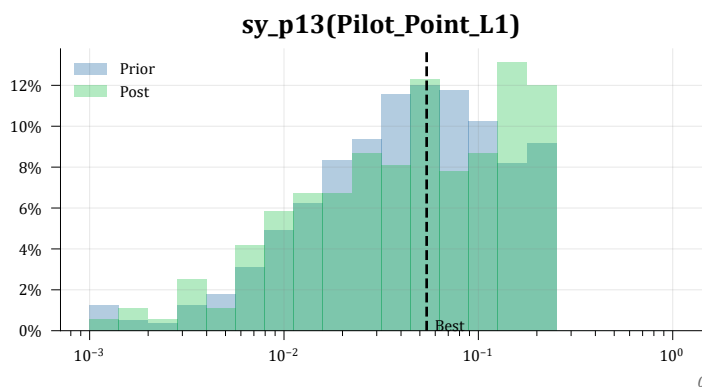
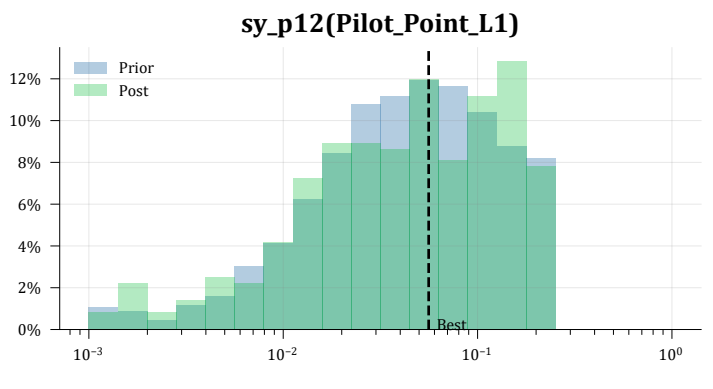
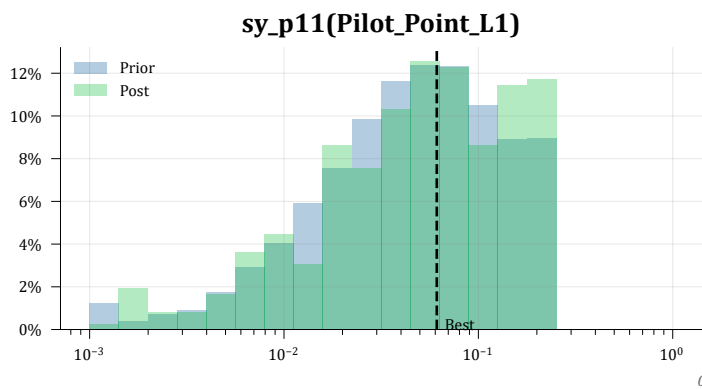
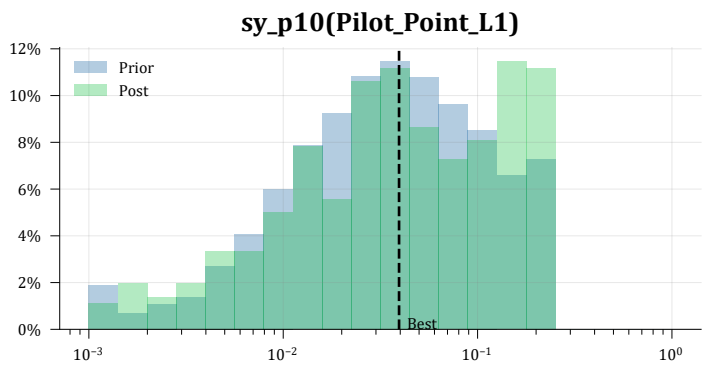
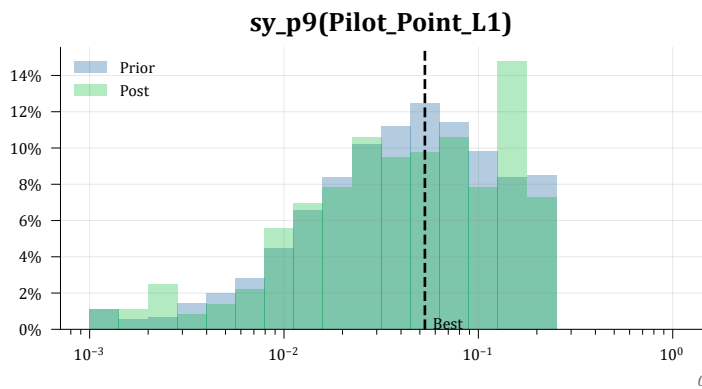
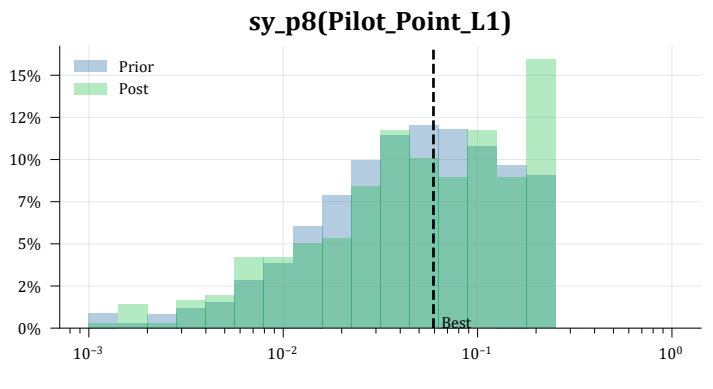
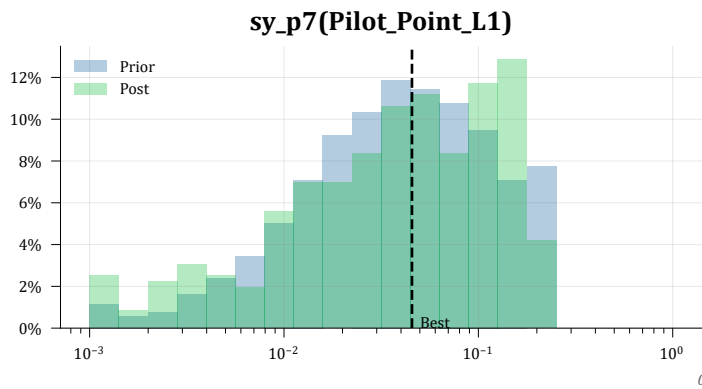
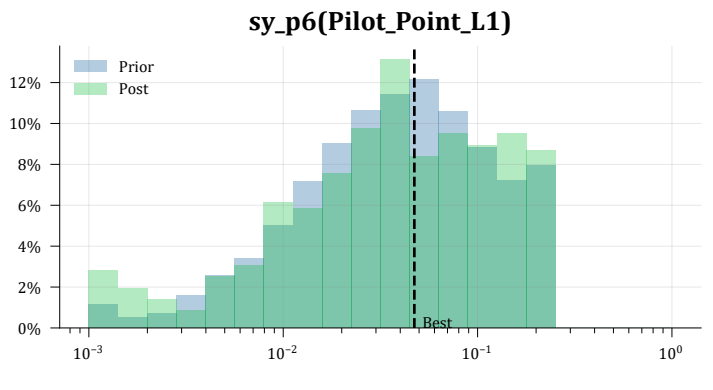
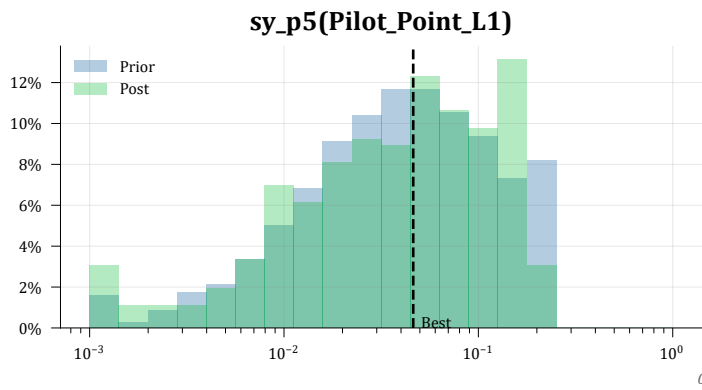


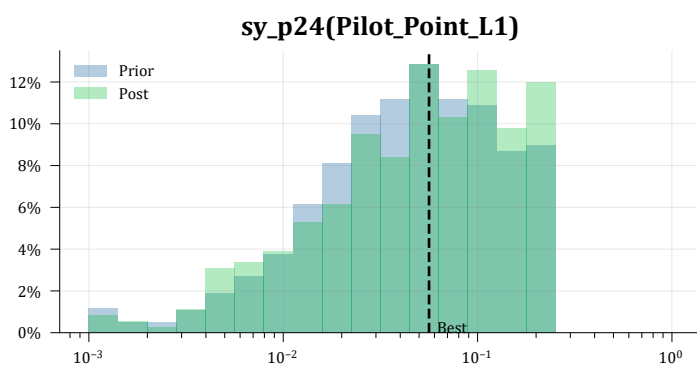
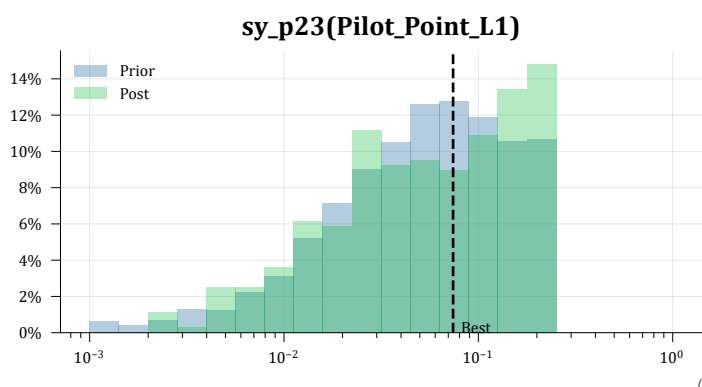
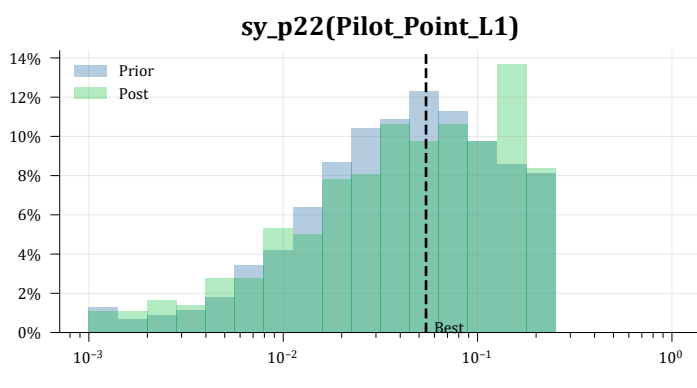
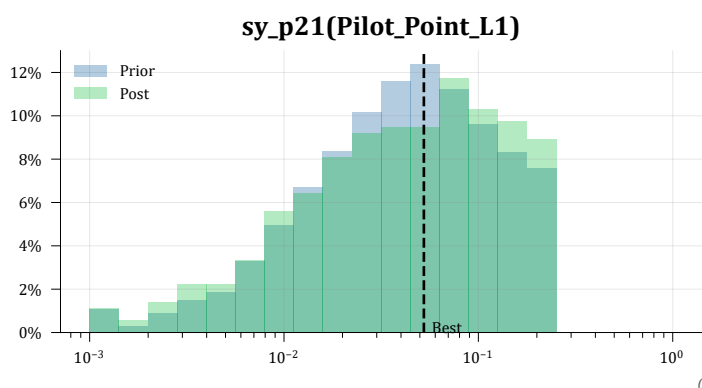
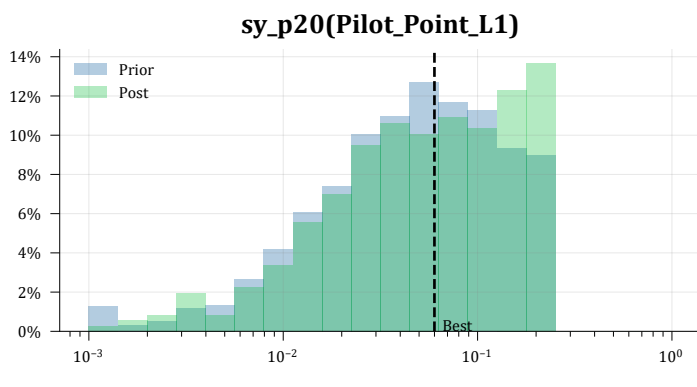
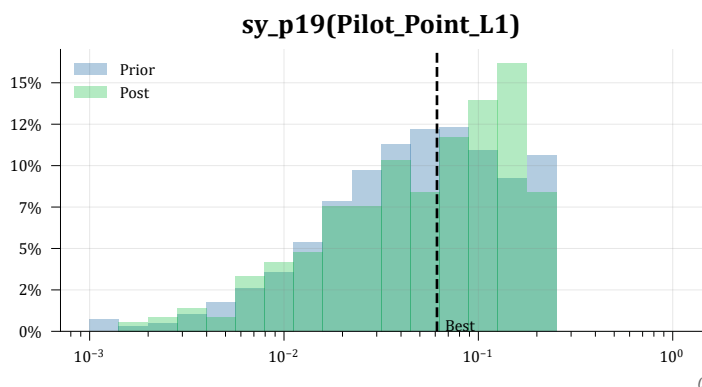
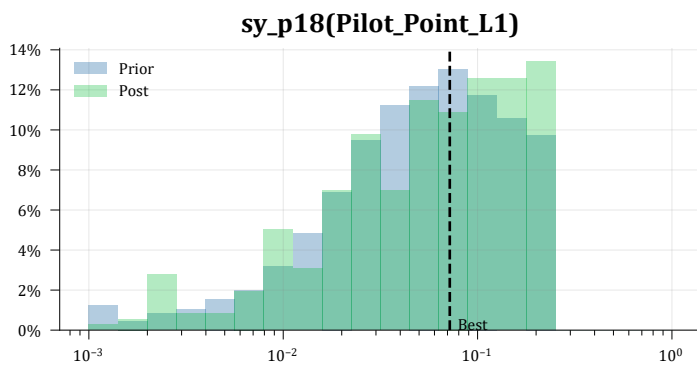
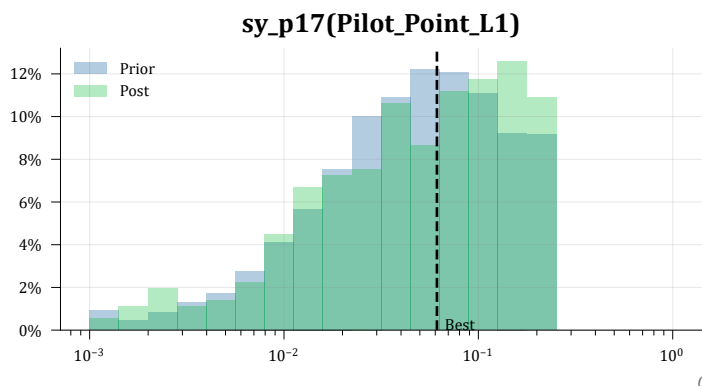
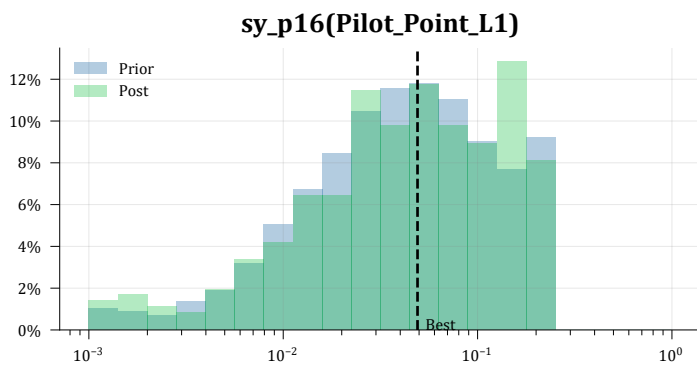
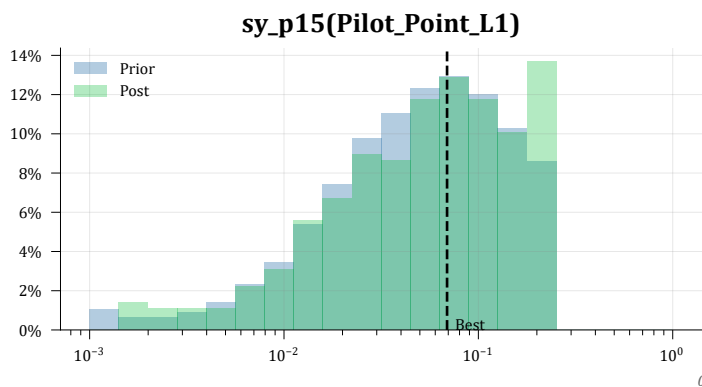
sy_p3(Pilot_Point_L1)

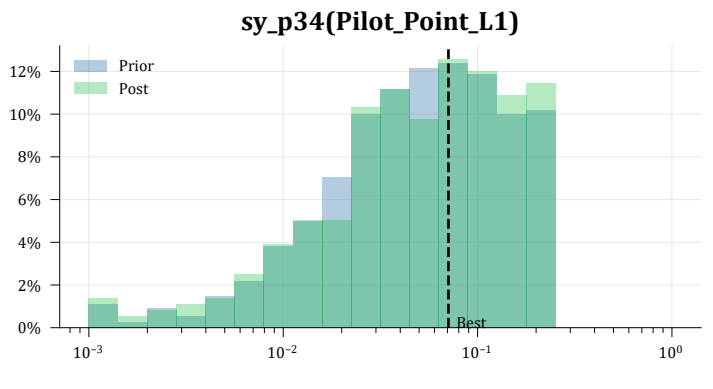
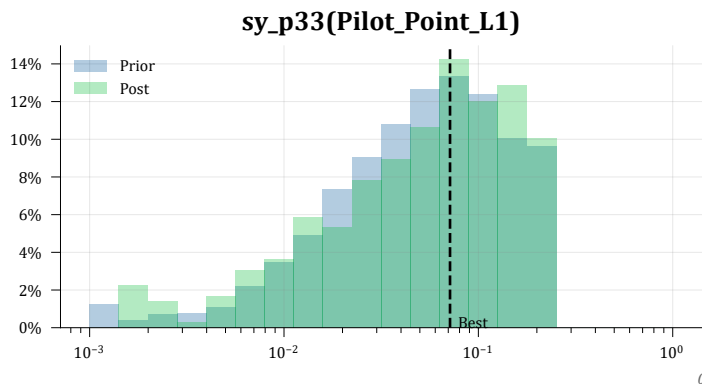
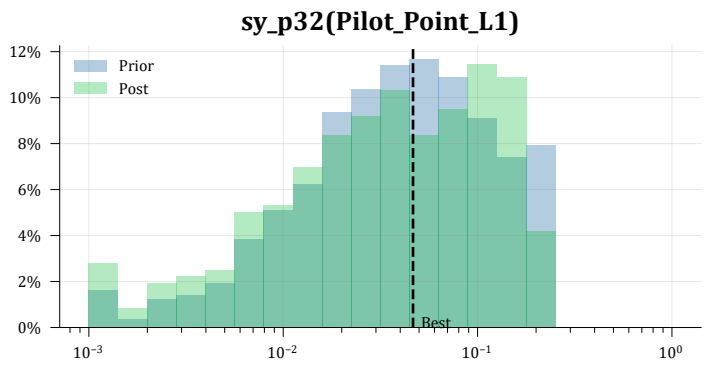
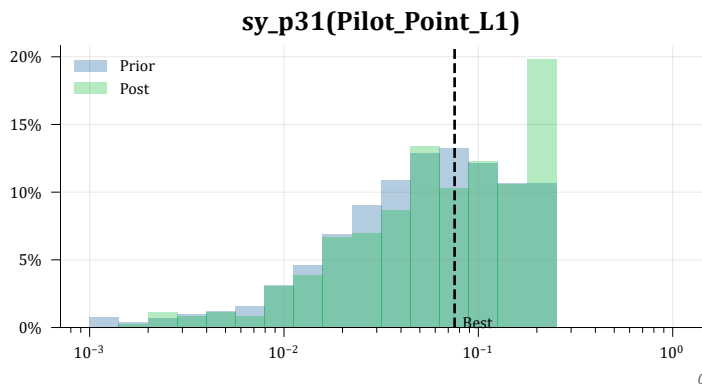
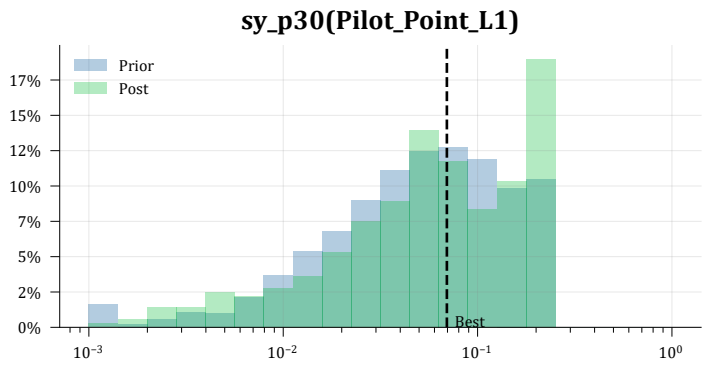
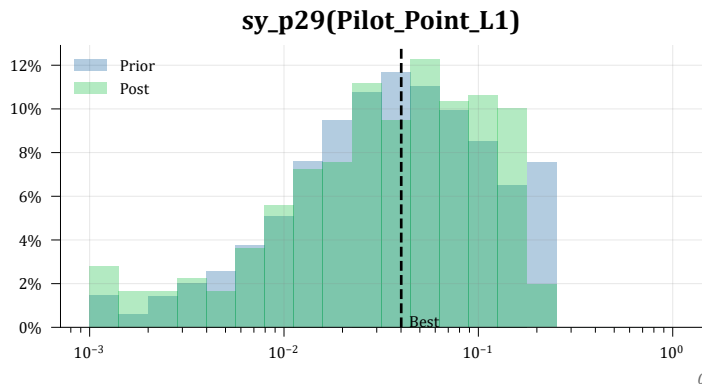
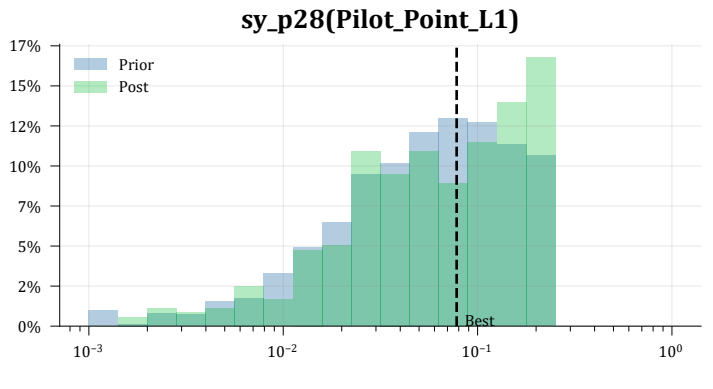
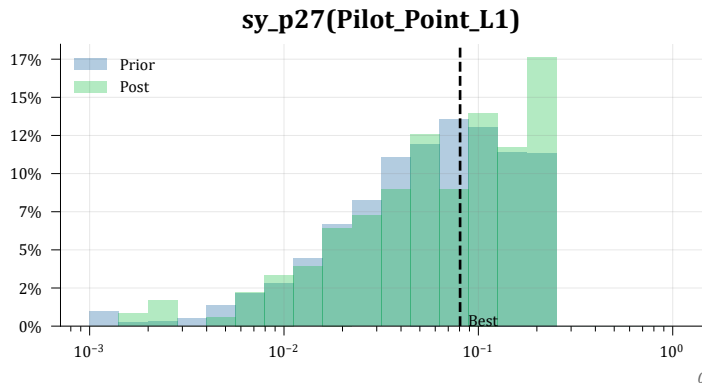
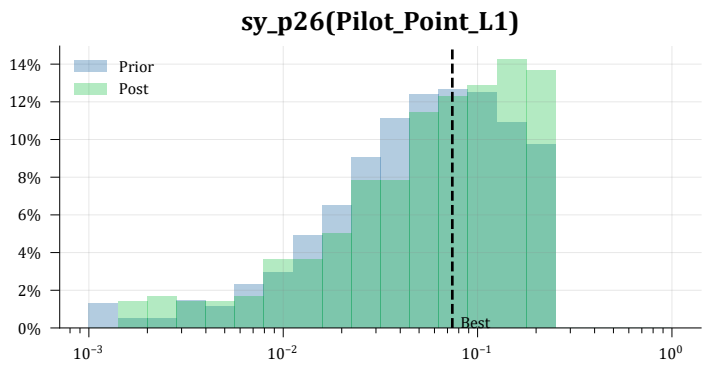
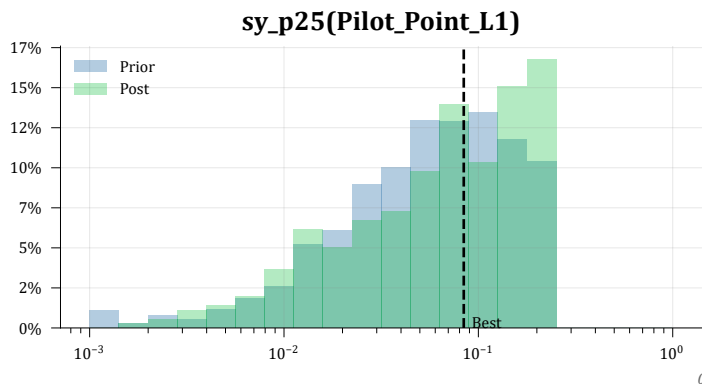


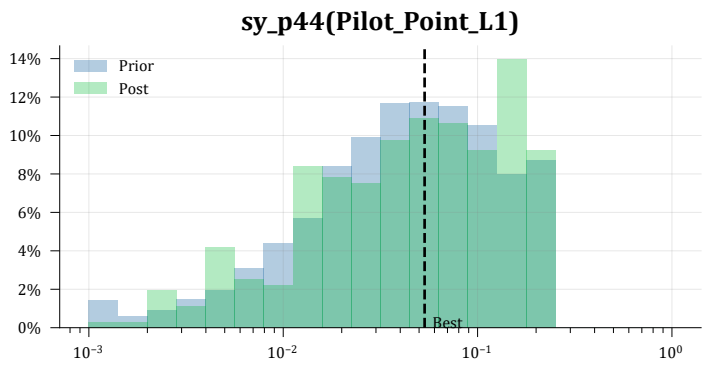
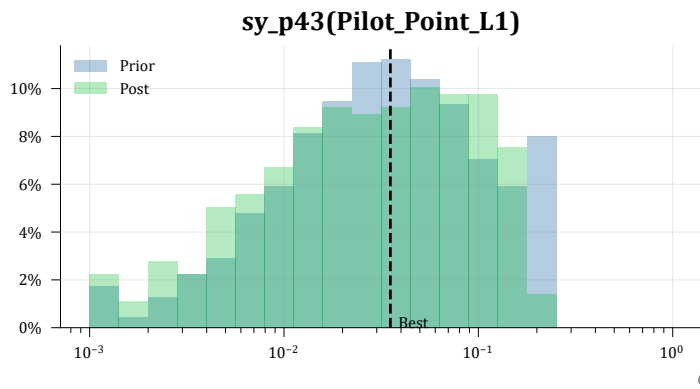
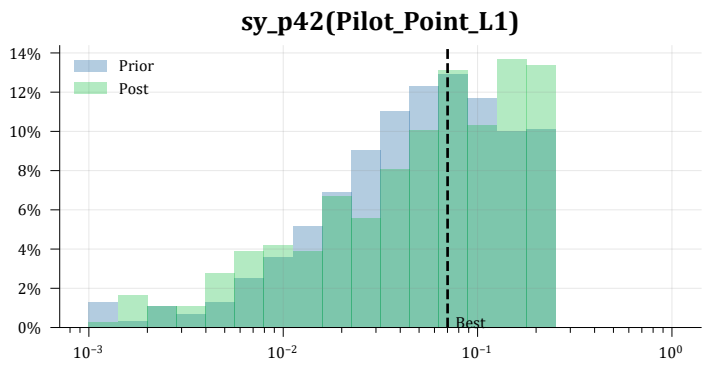
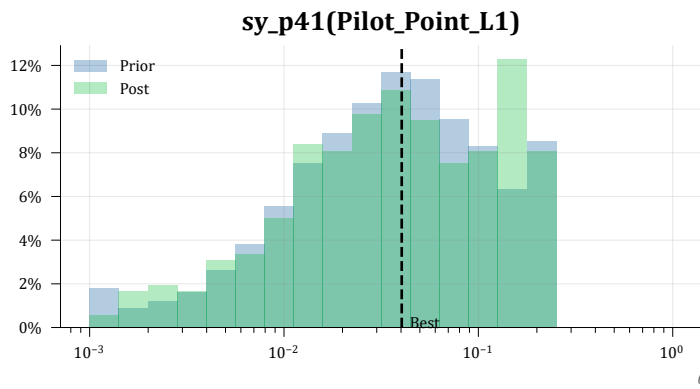
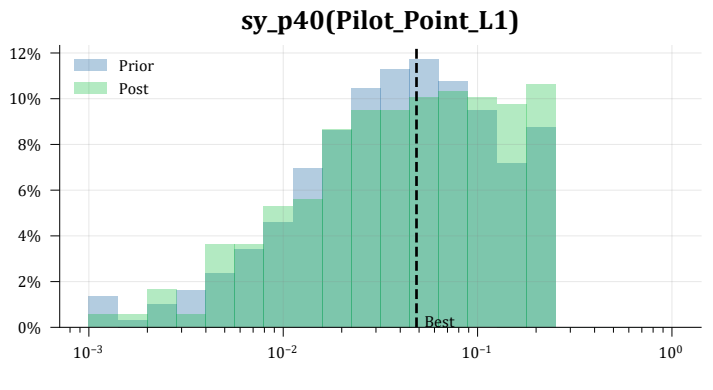
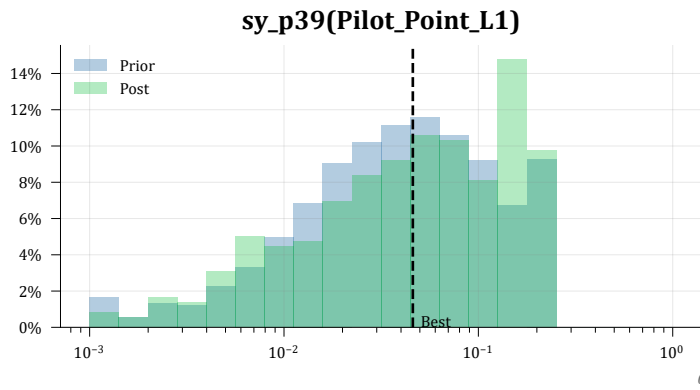
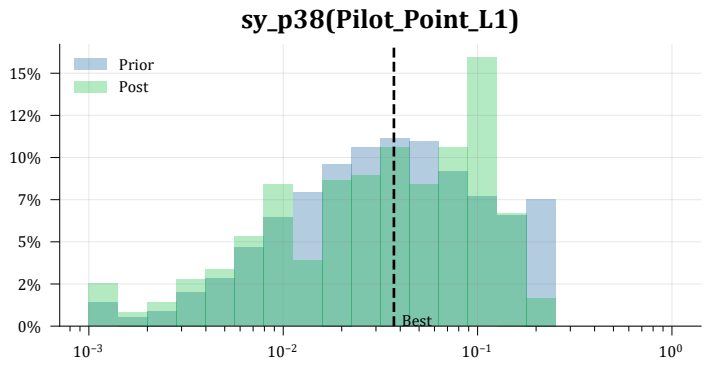
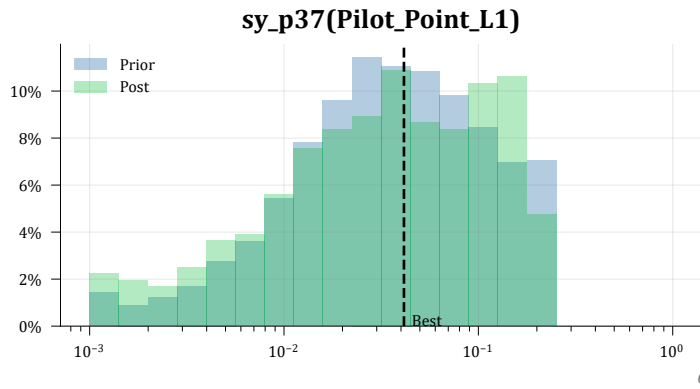
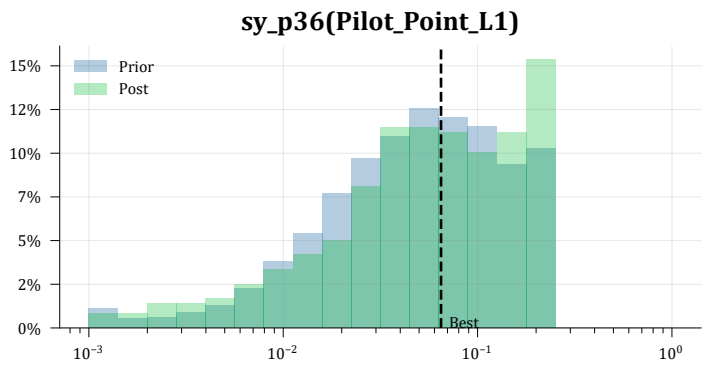
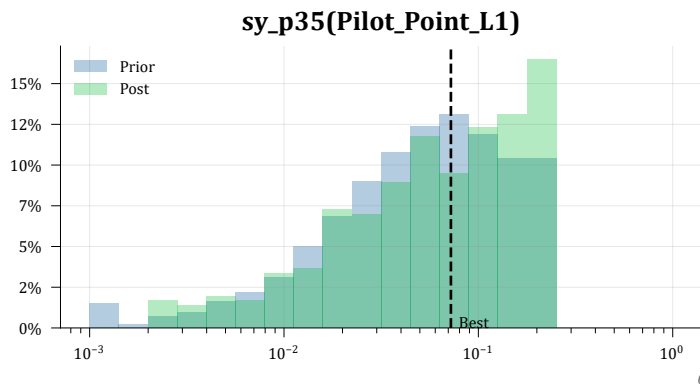
sy_p4(Pilot_Point_L1)

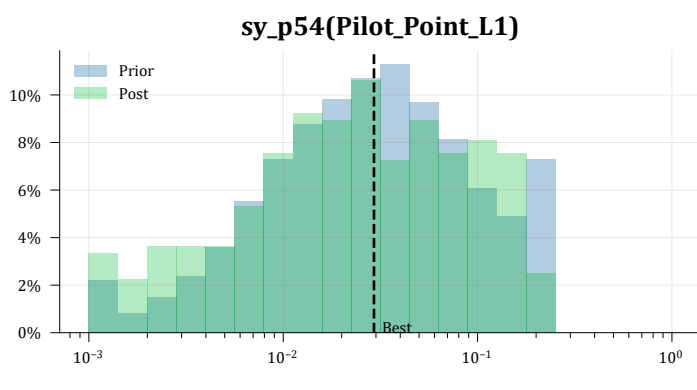
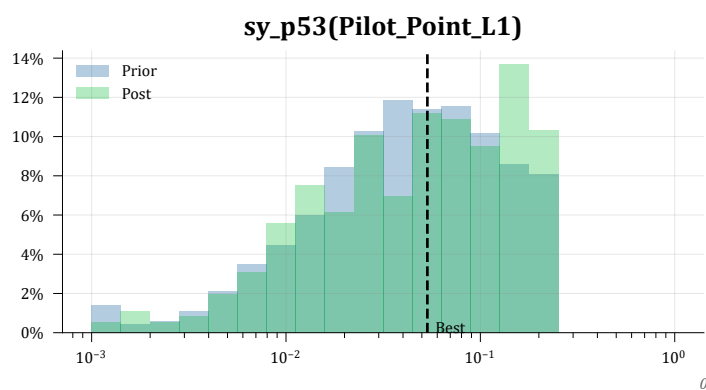
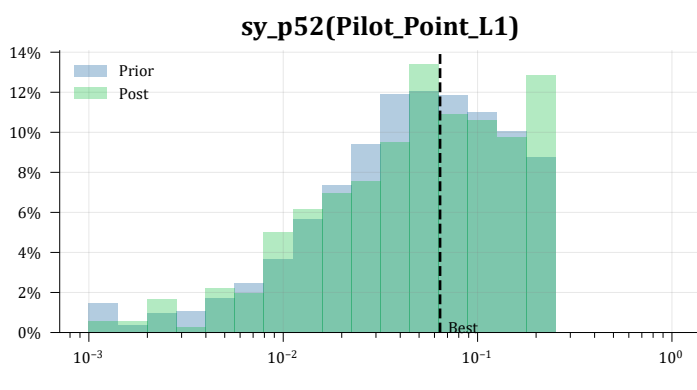
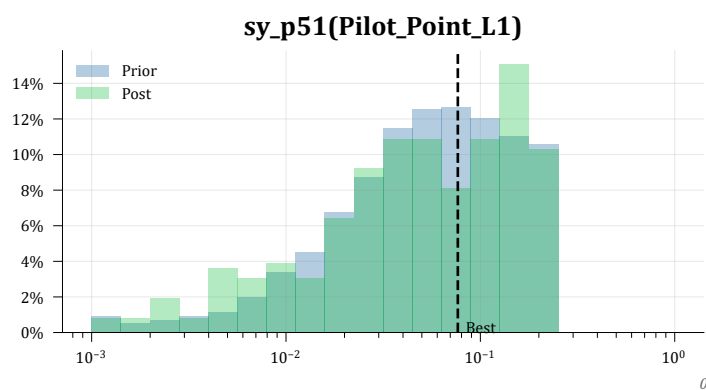
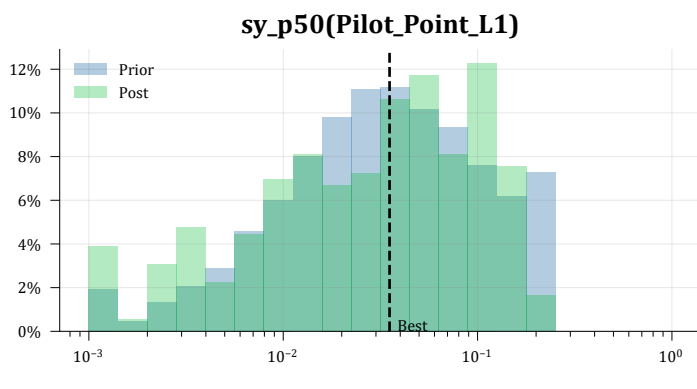
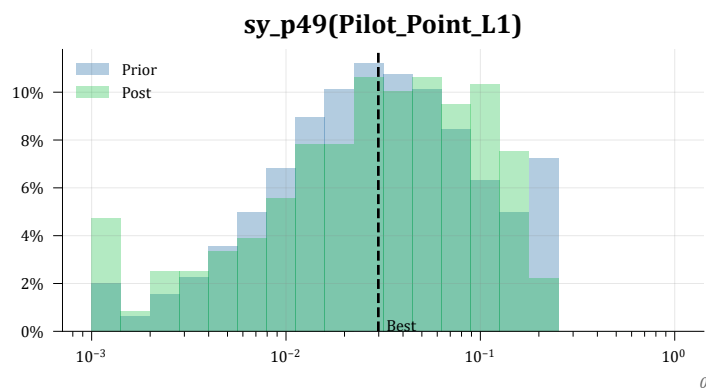
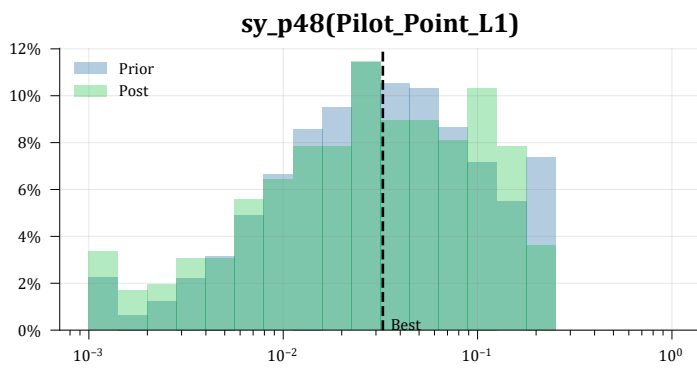
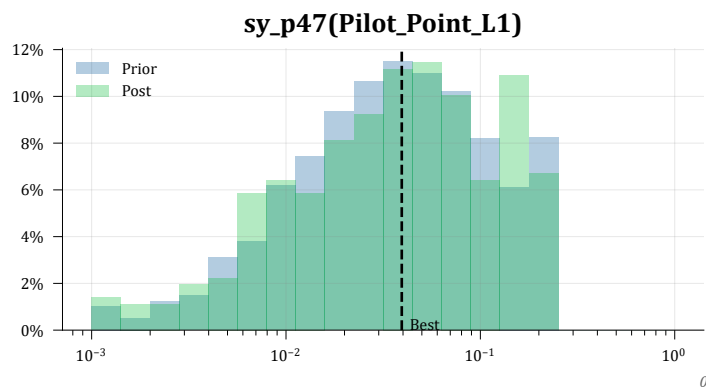
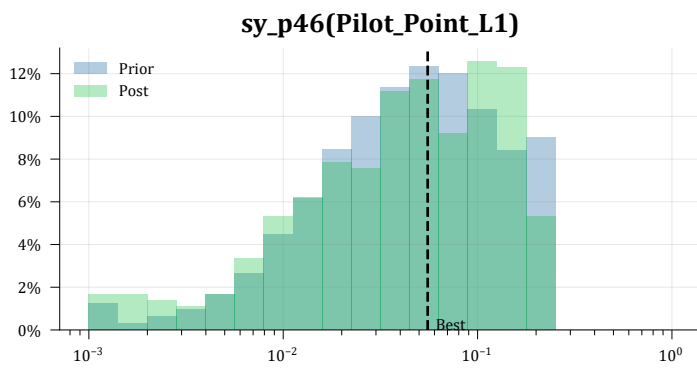
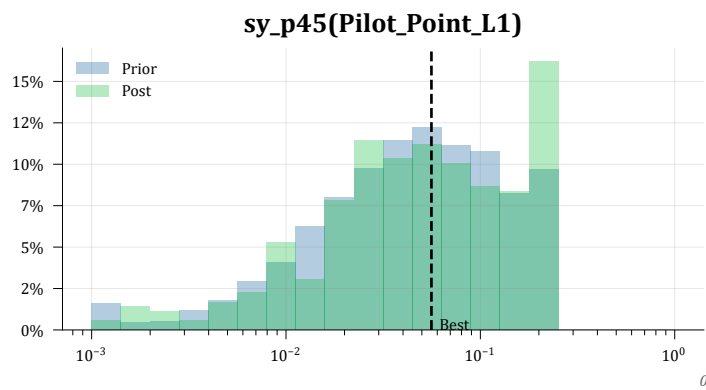


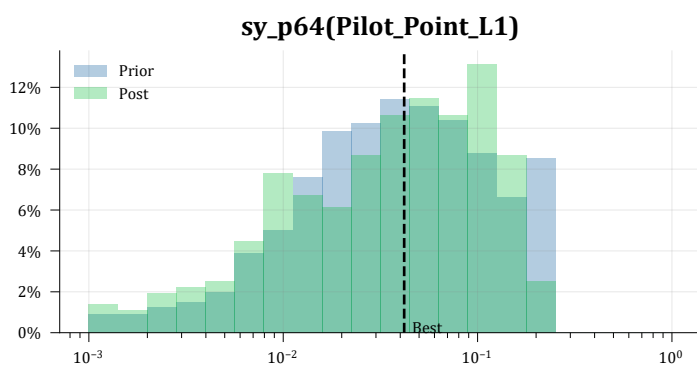
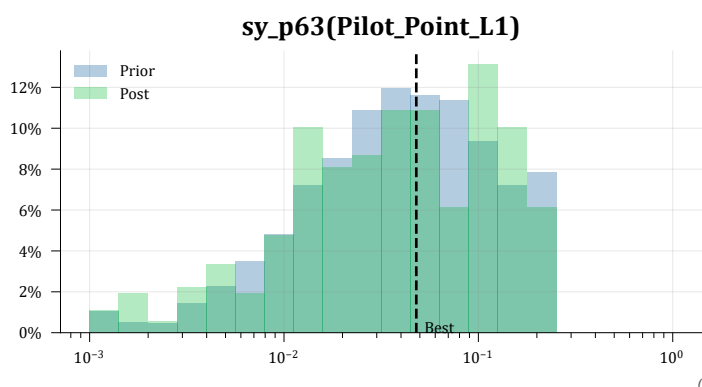
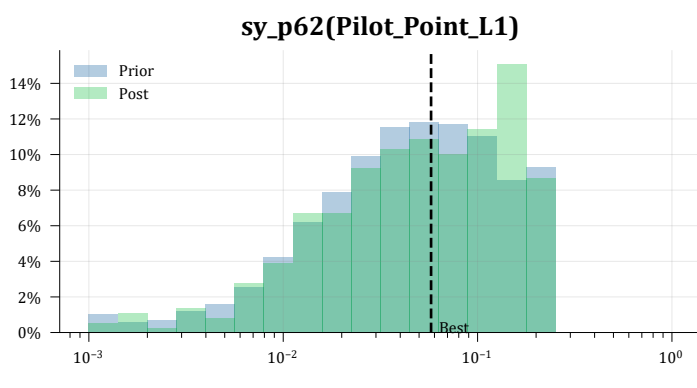
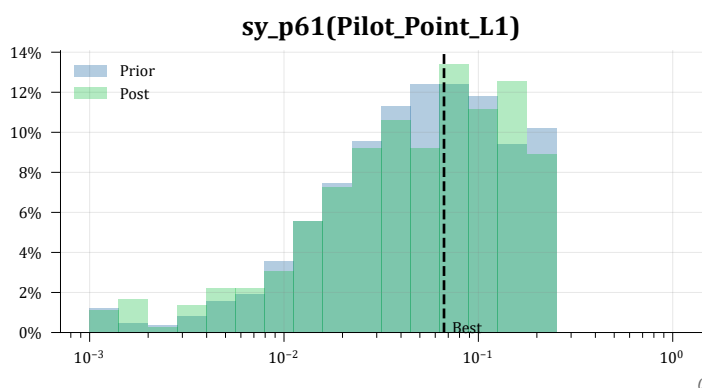
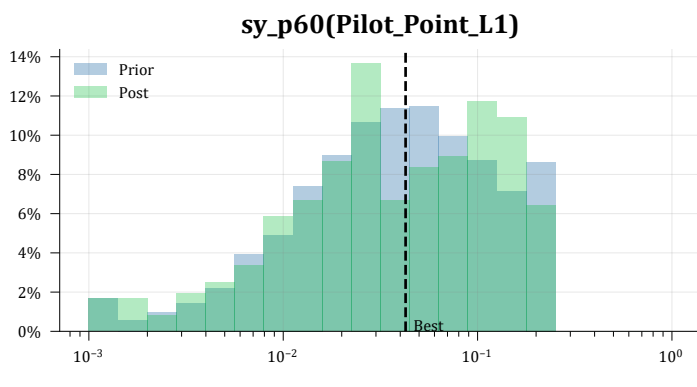
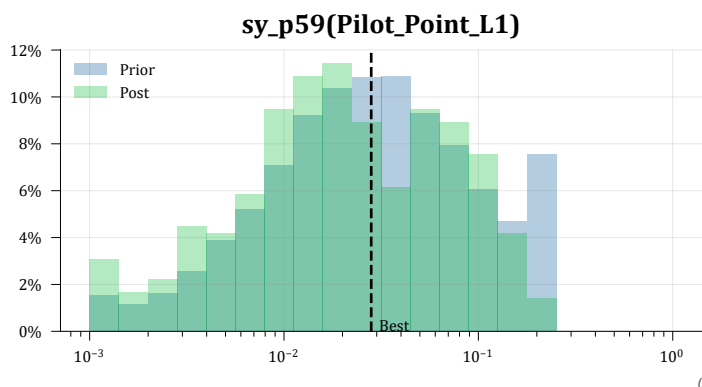
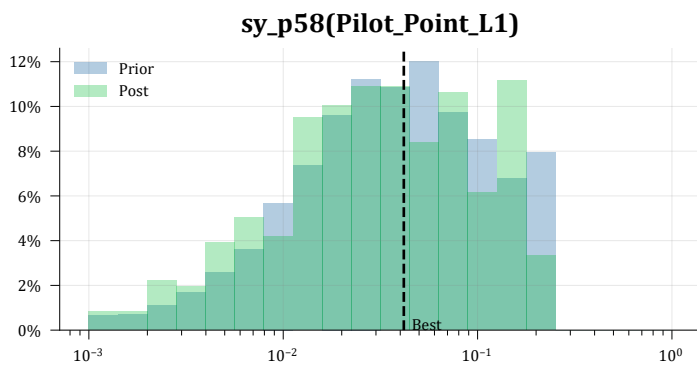
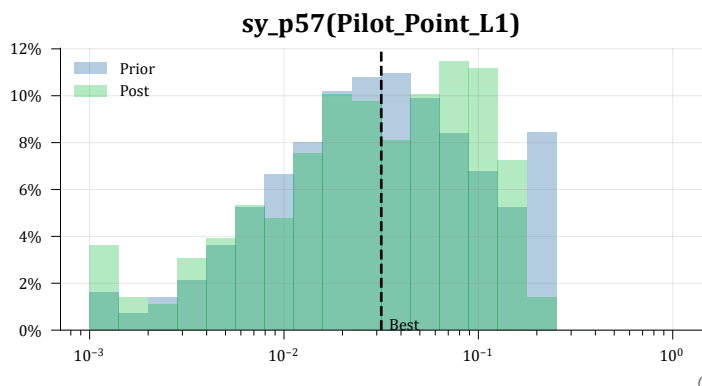
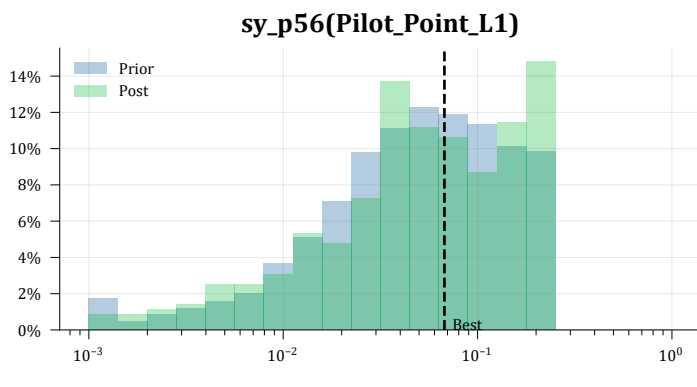
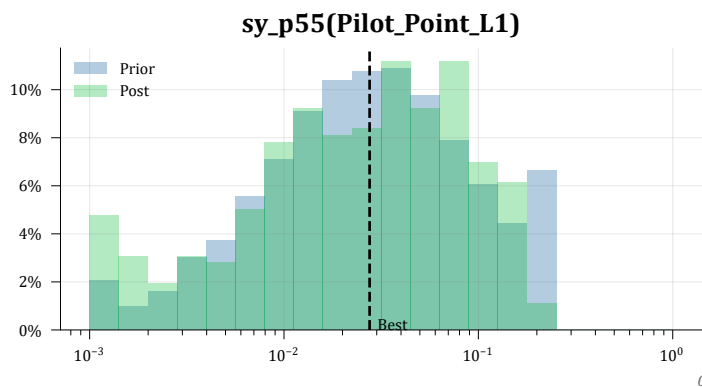


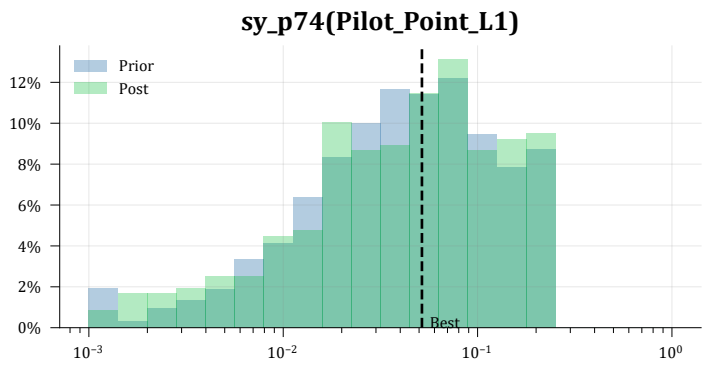
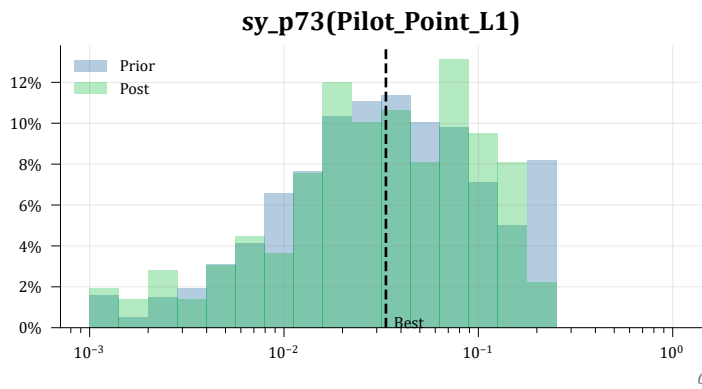
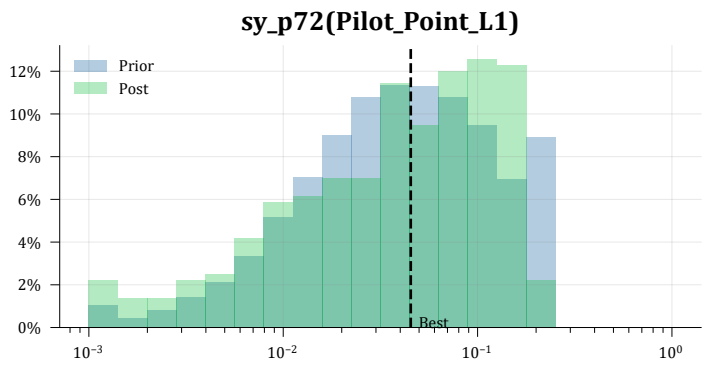
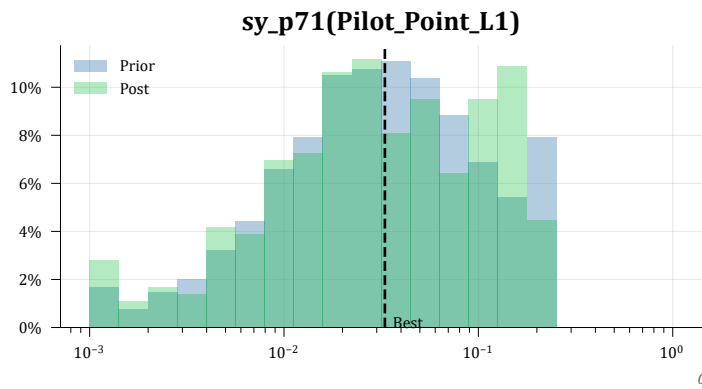
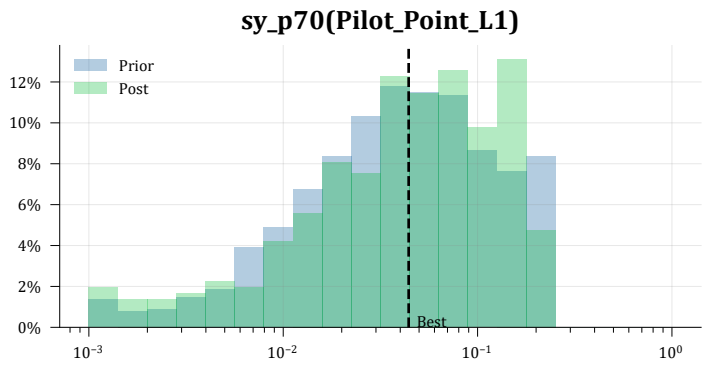
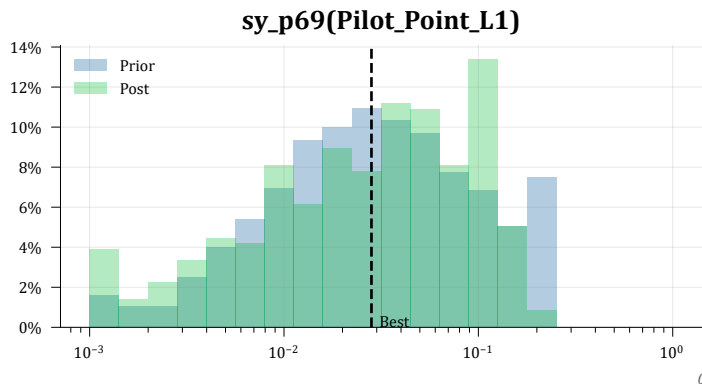
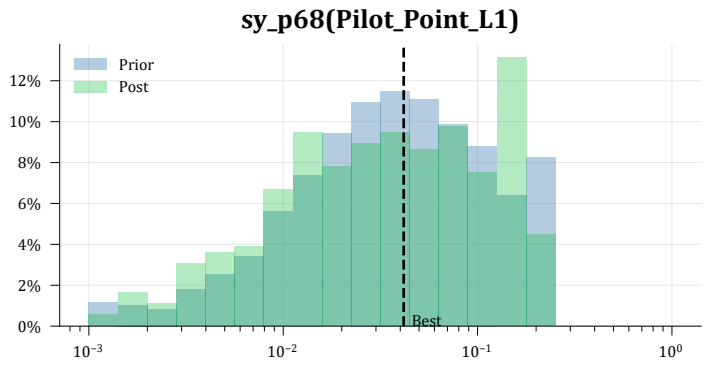
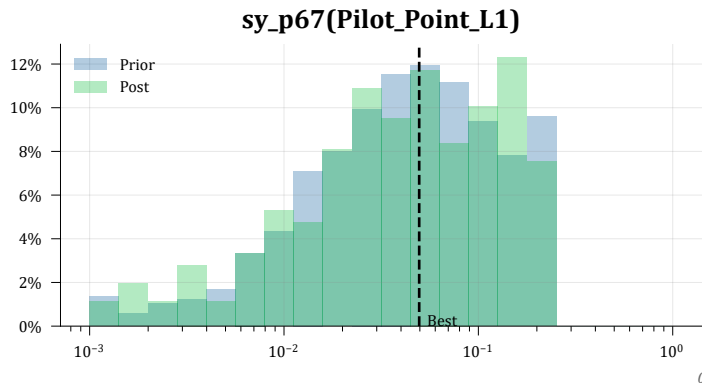
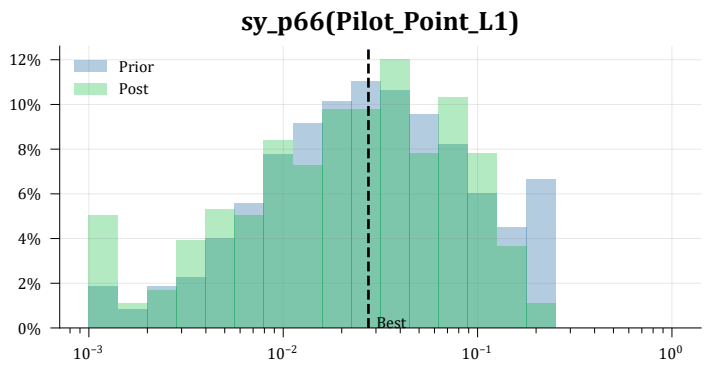
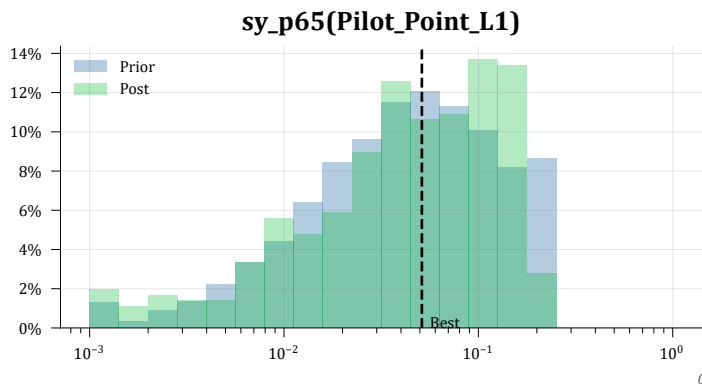


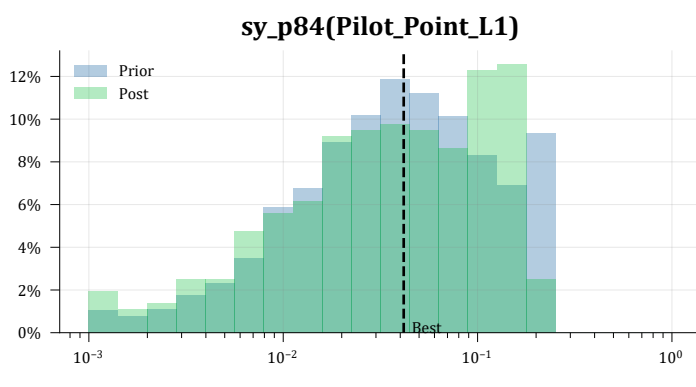
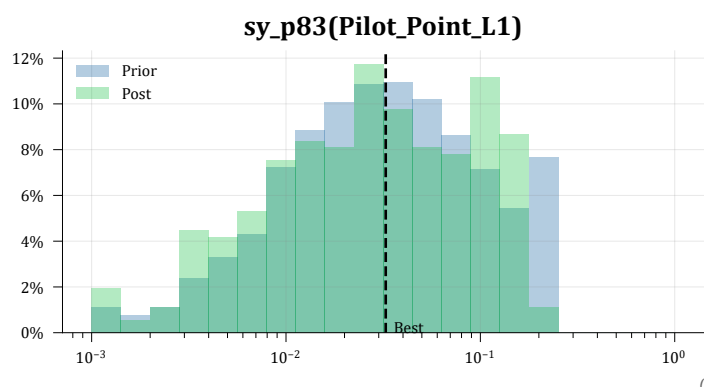
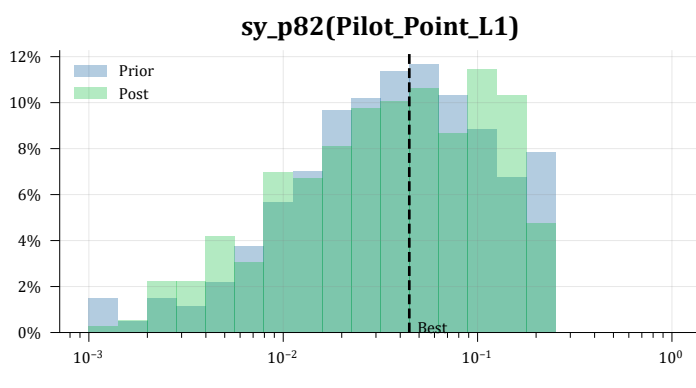
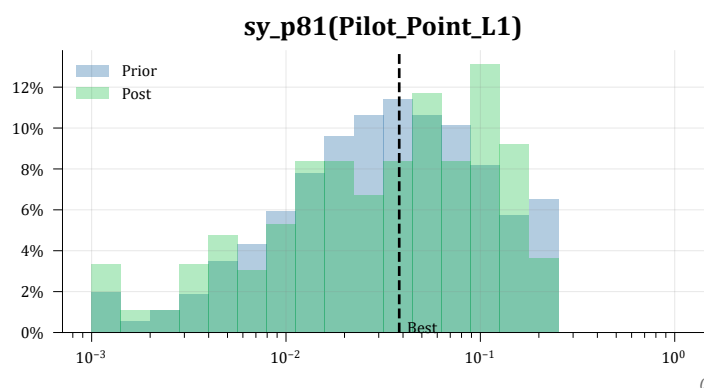
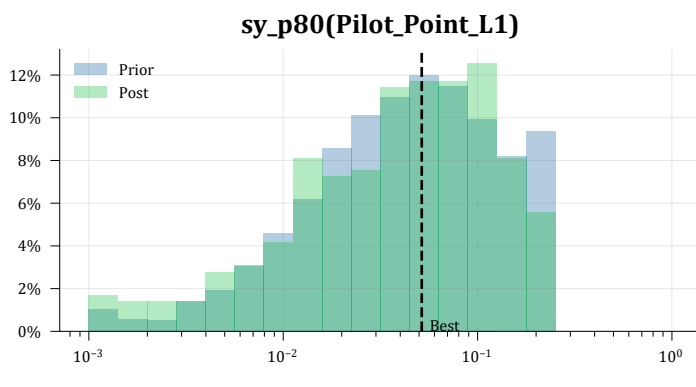
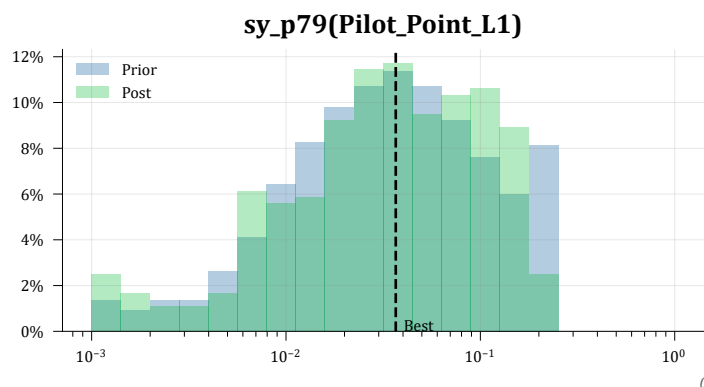
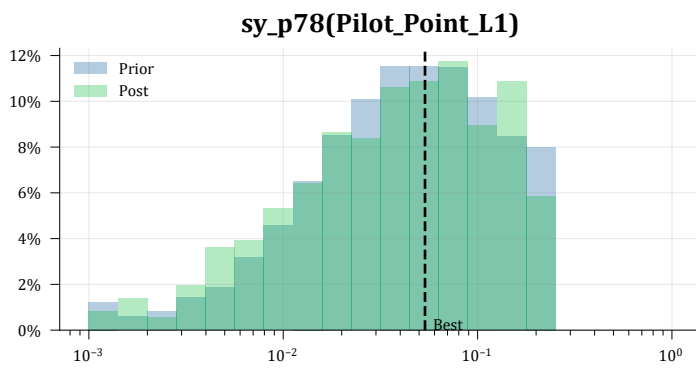
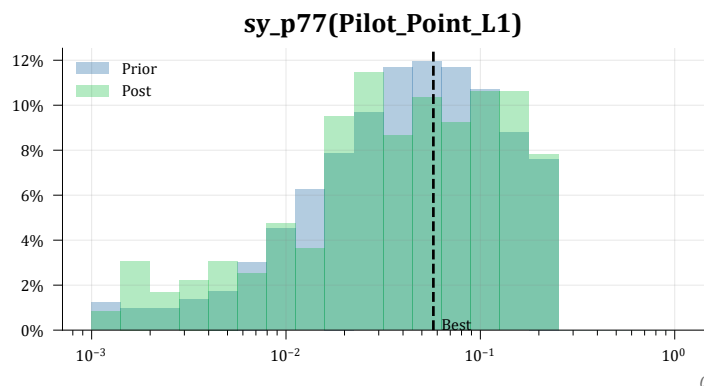
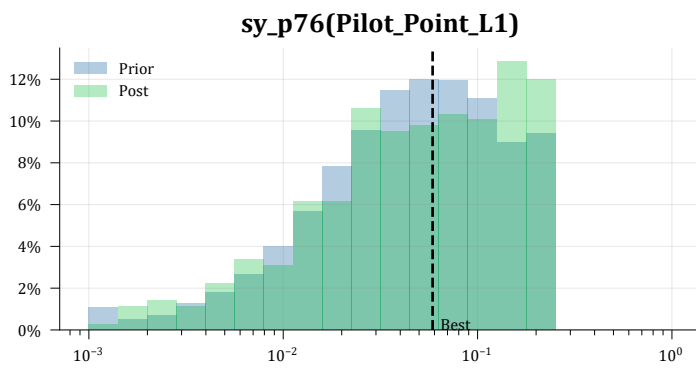
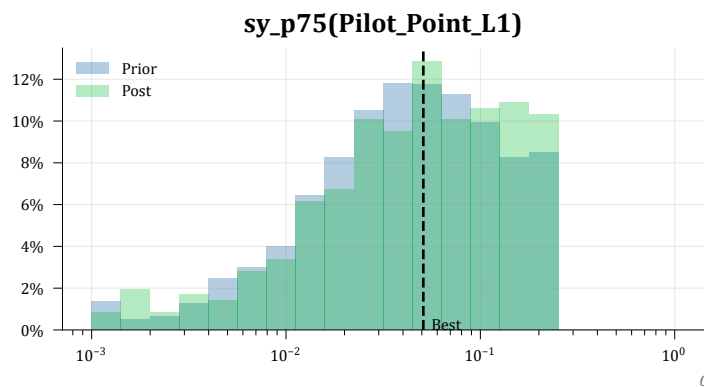


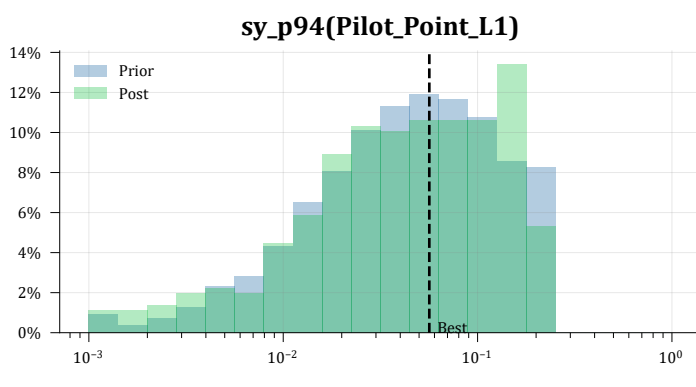
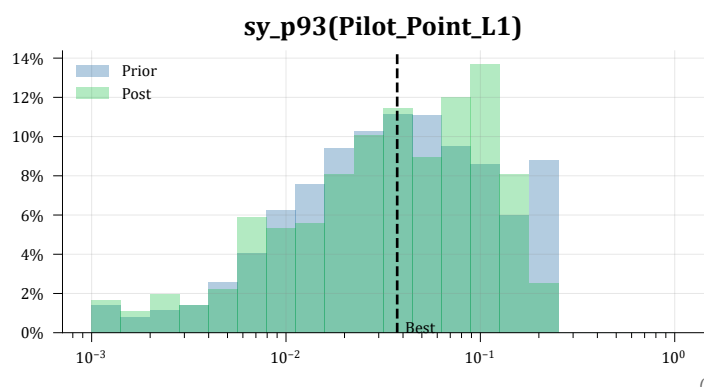
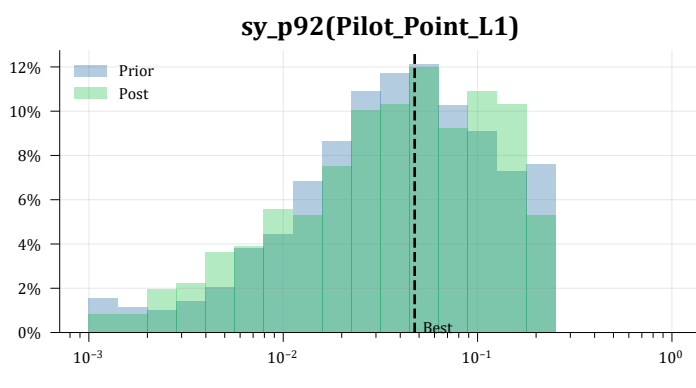
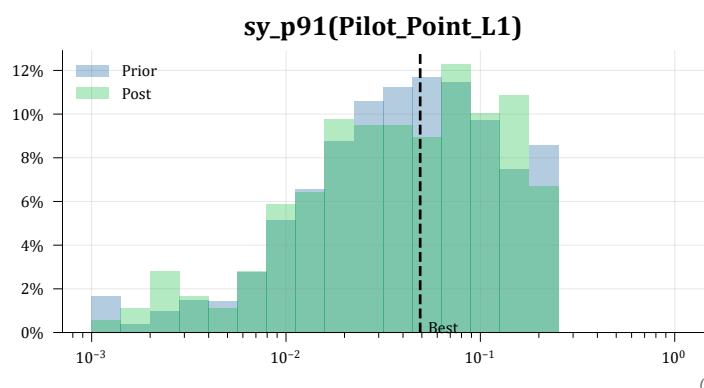
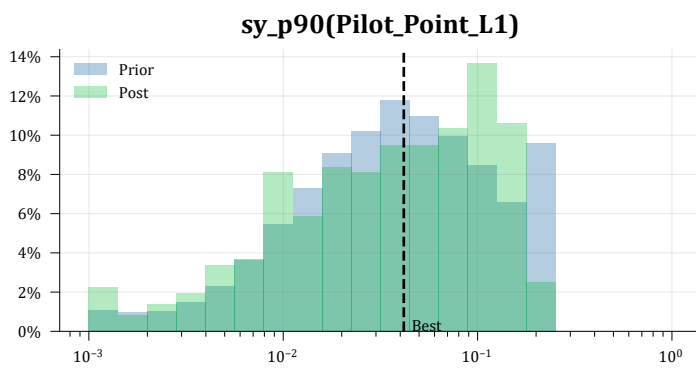
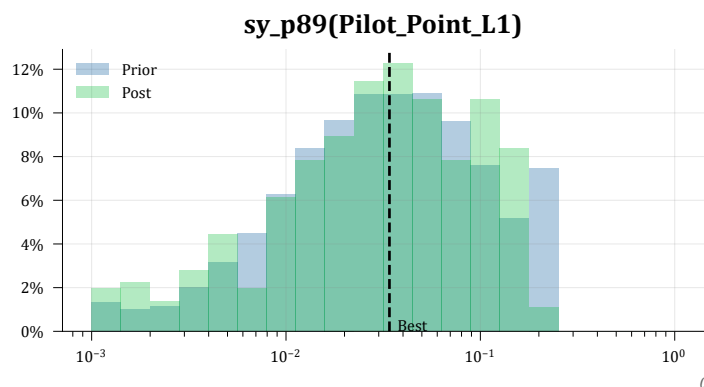
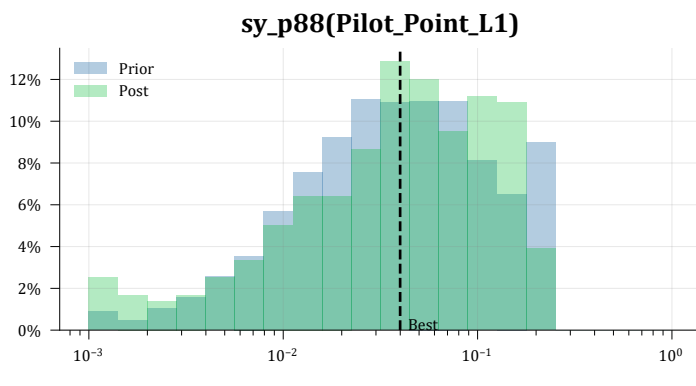
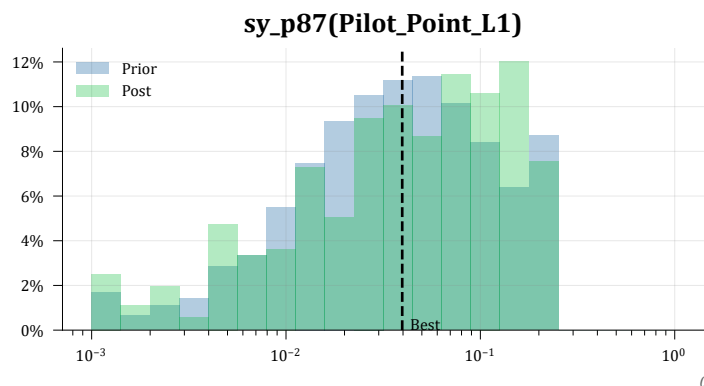
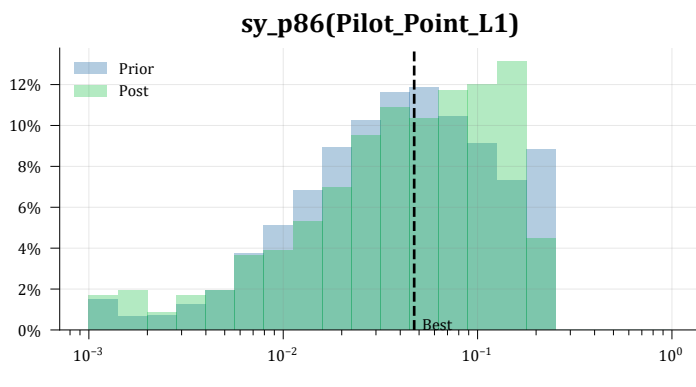
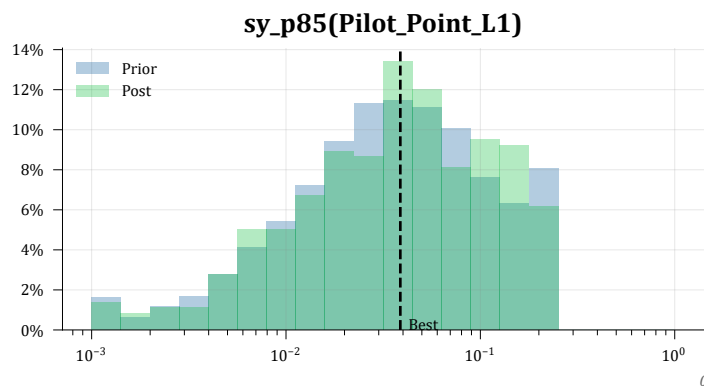


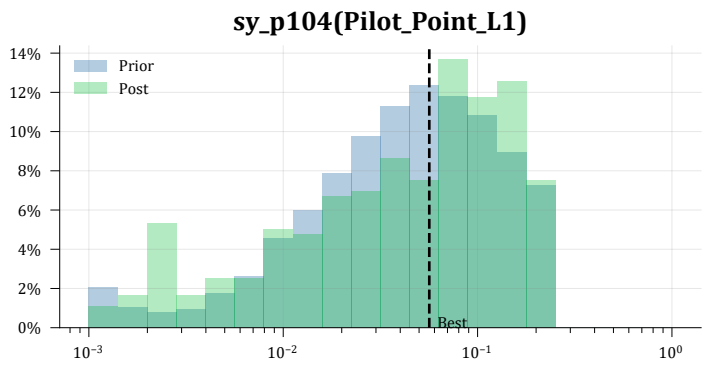
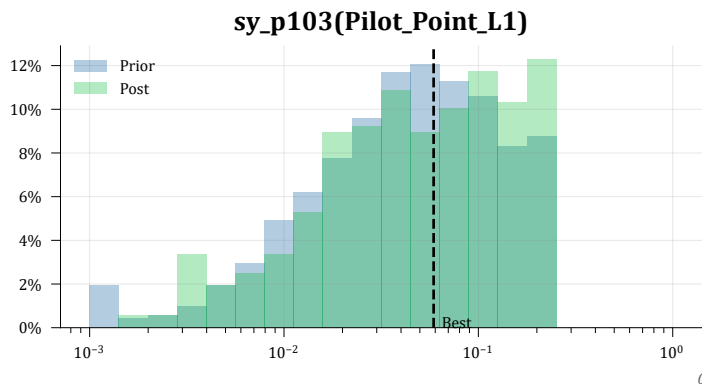
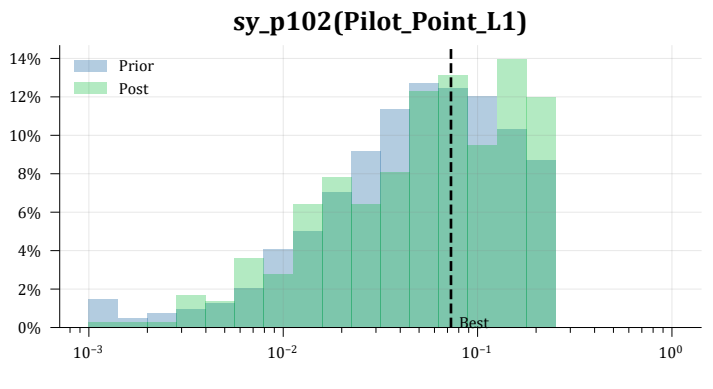
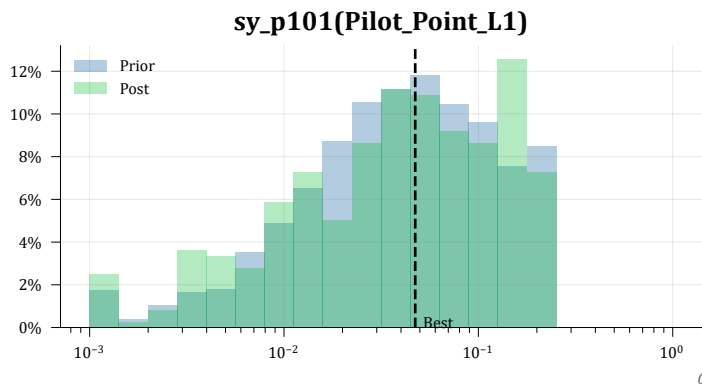
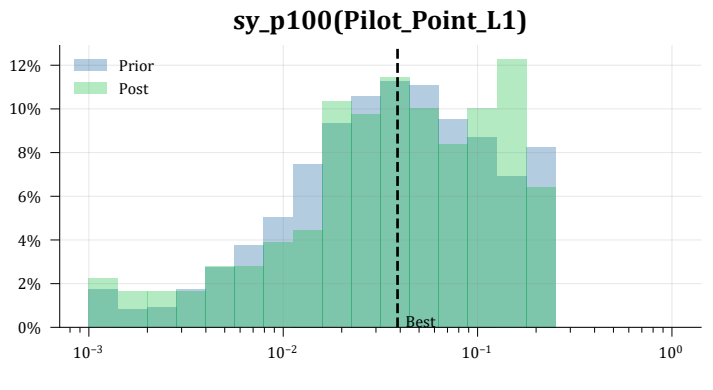
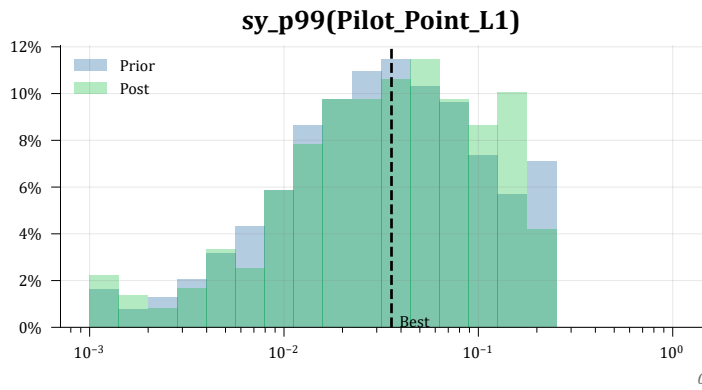
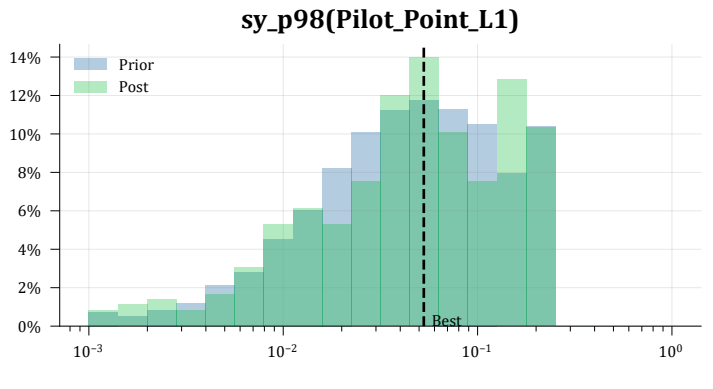
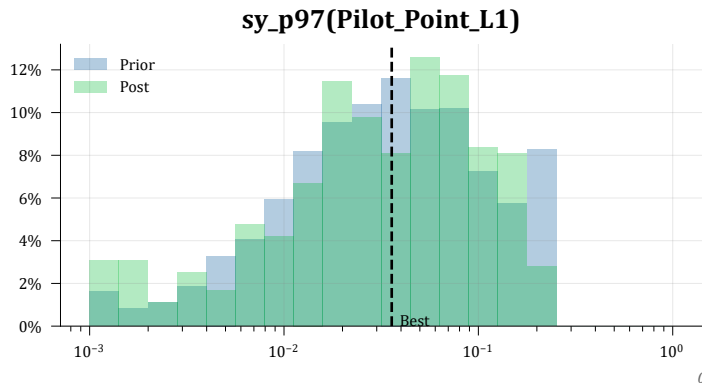
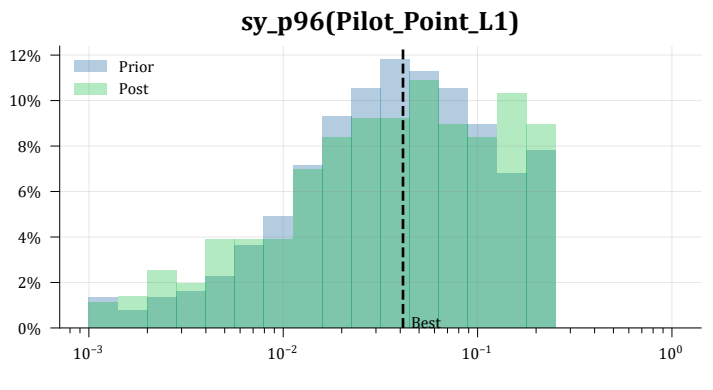
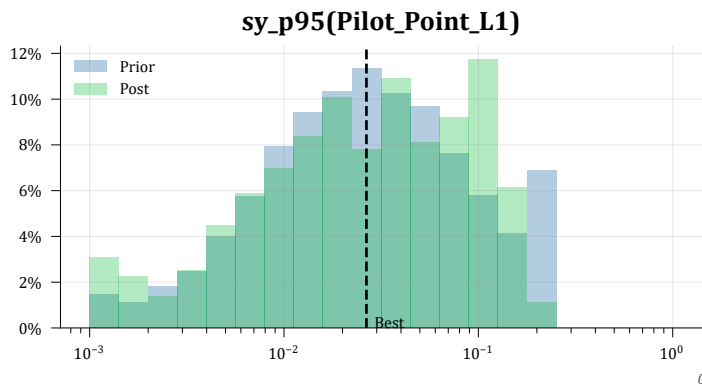


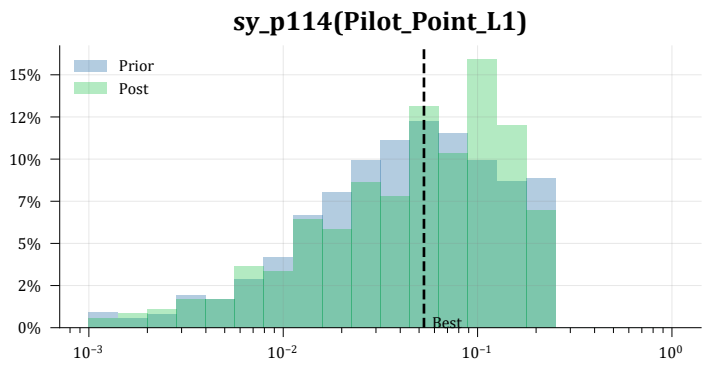
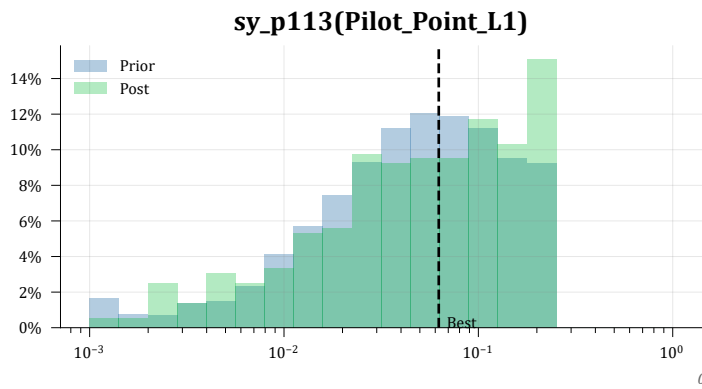
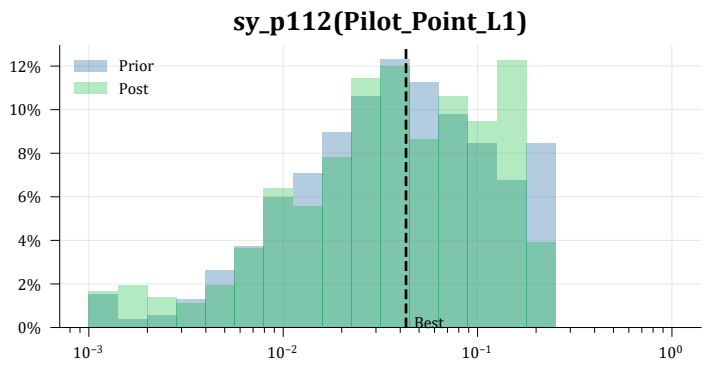
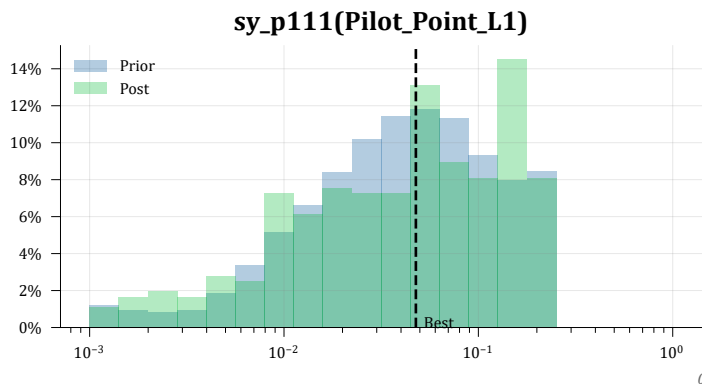
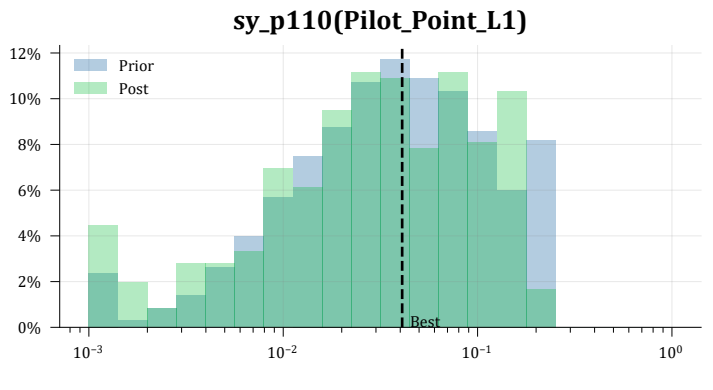
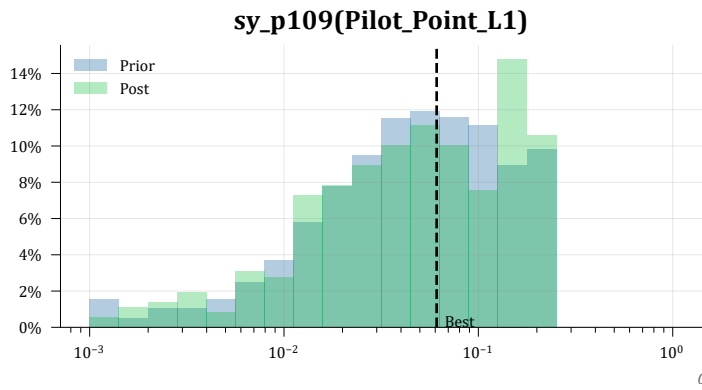
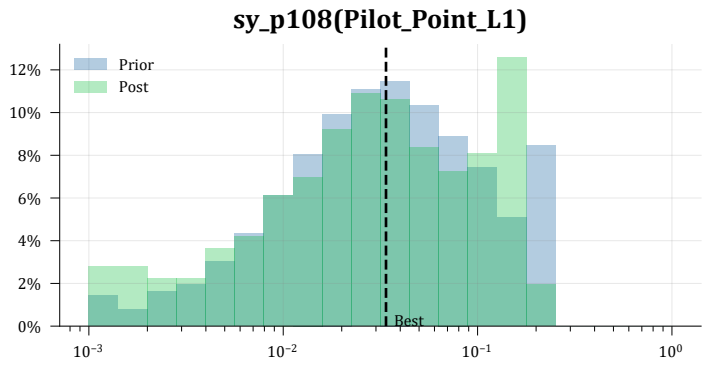
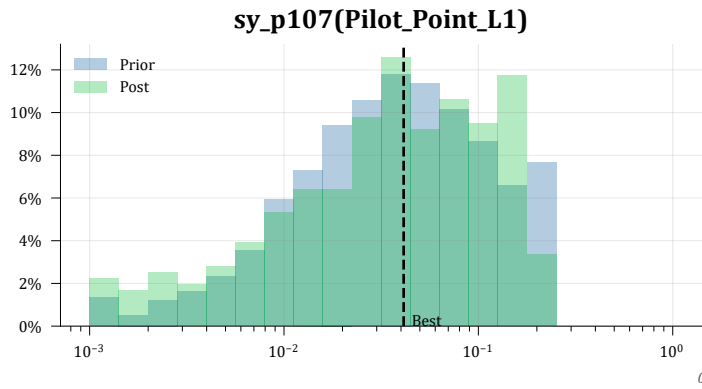
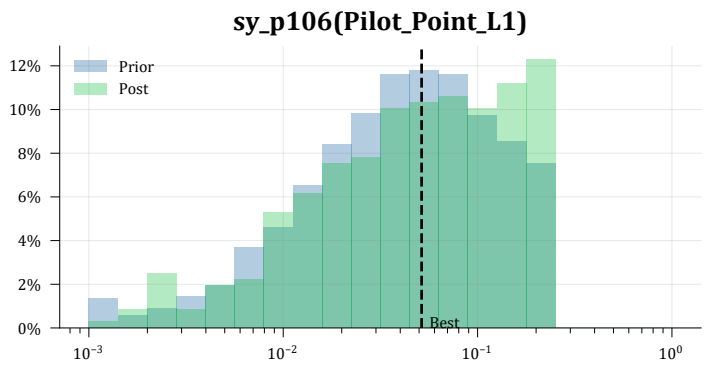
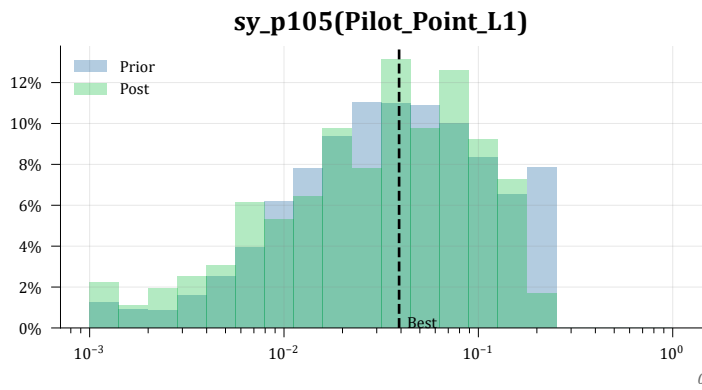


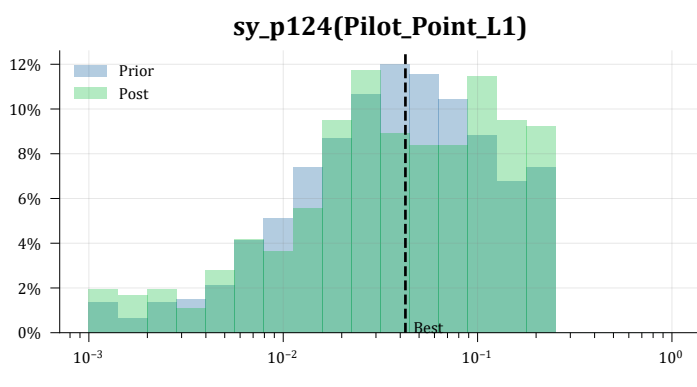
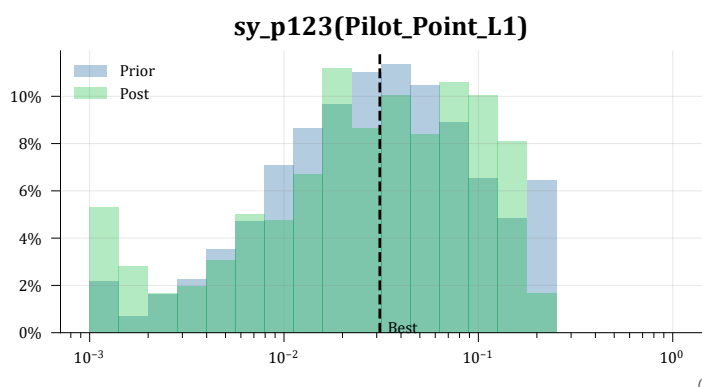
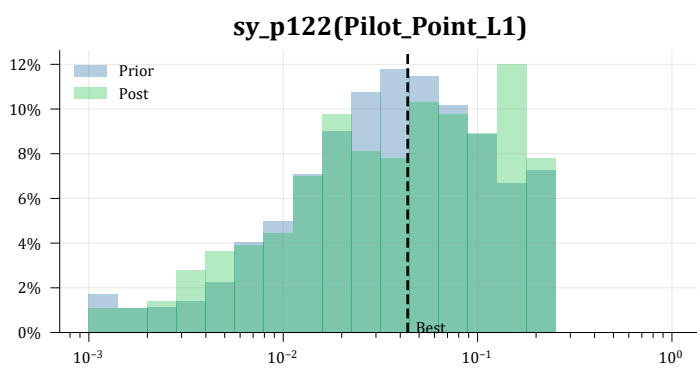
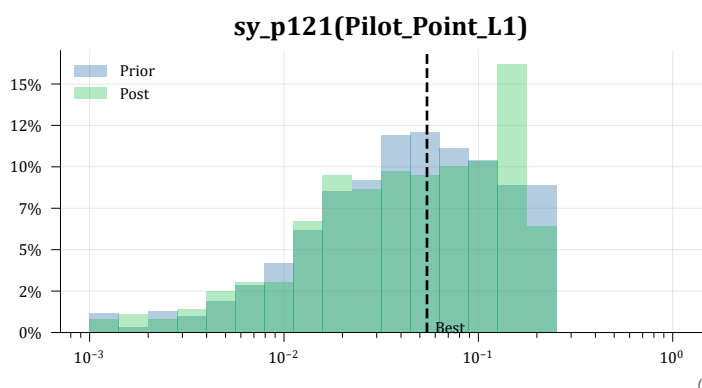
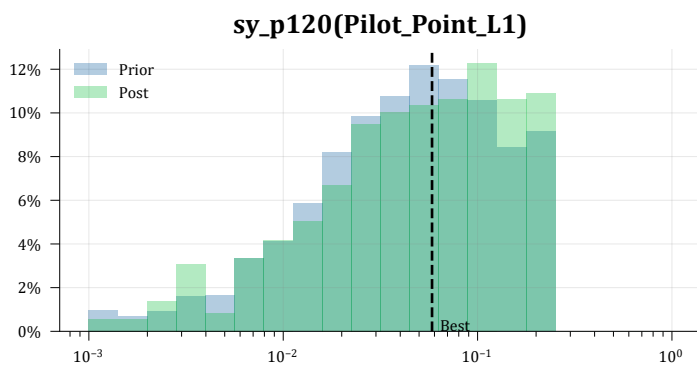
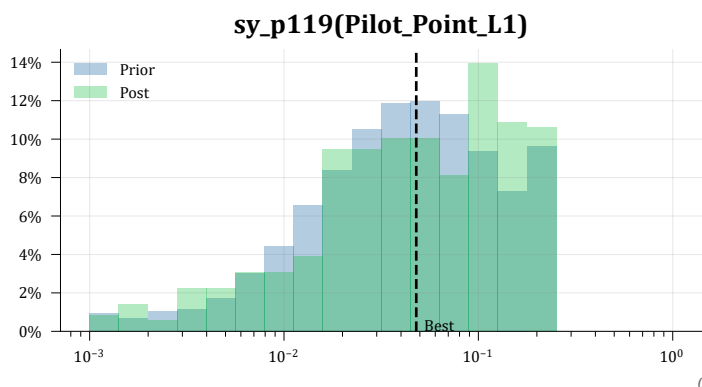
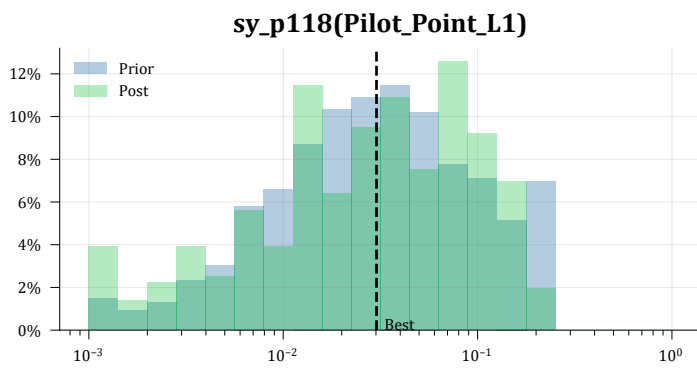
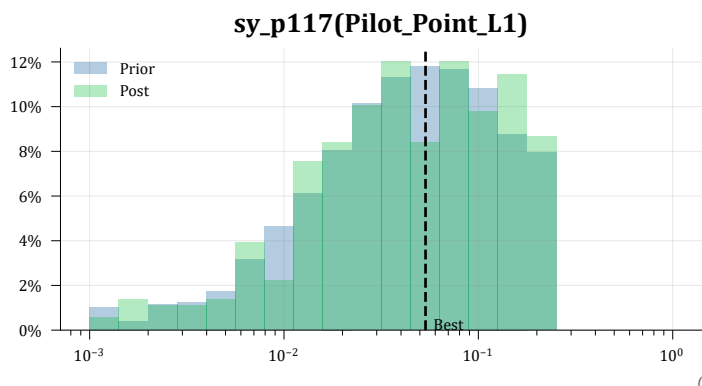
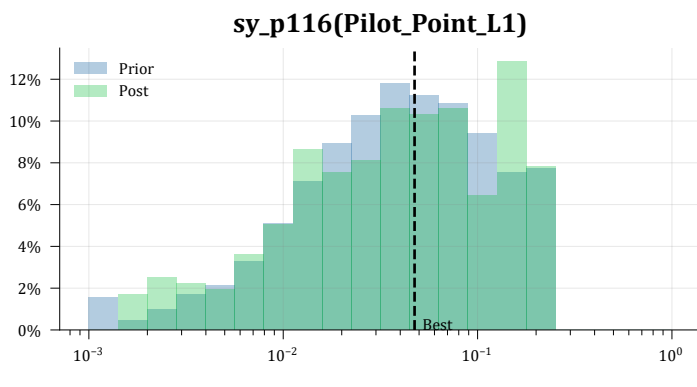
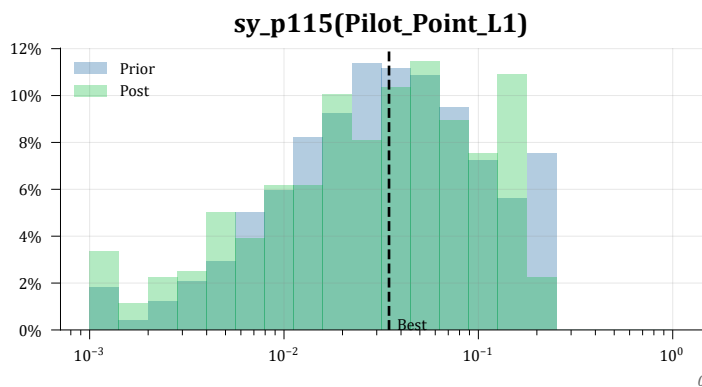


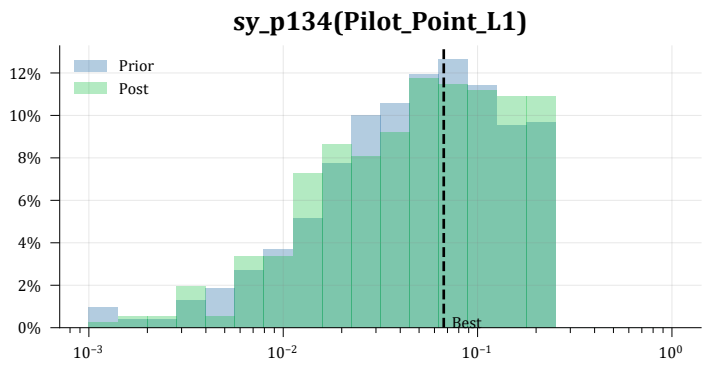
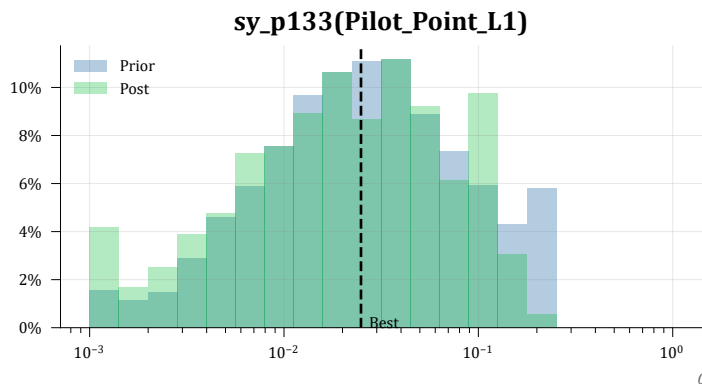
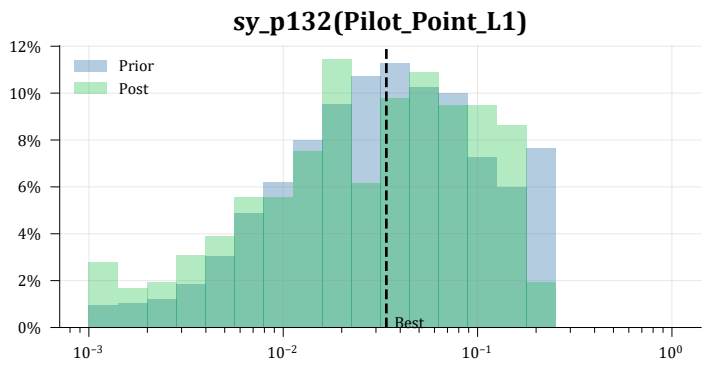
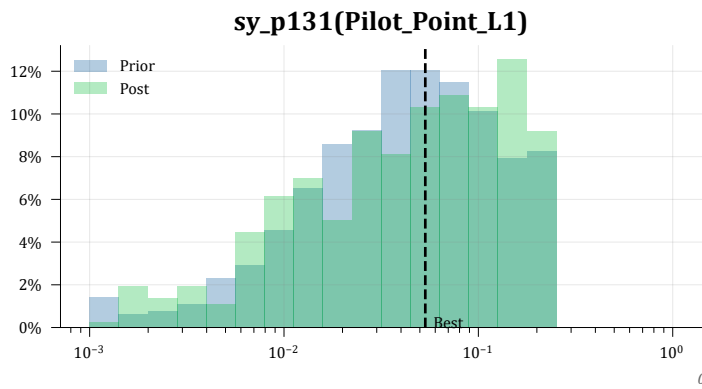
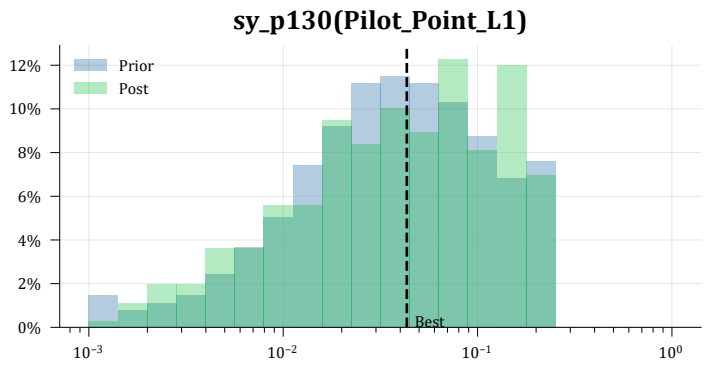
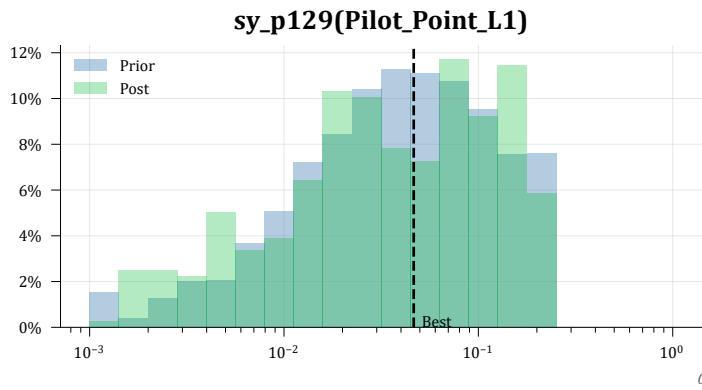
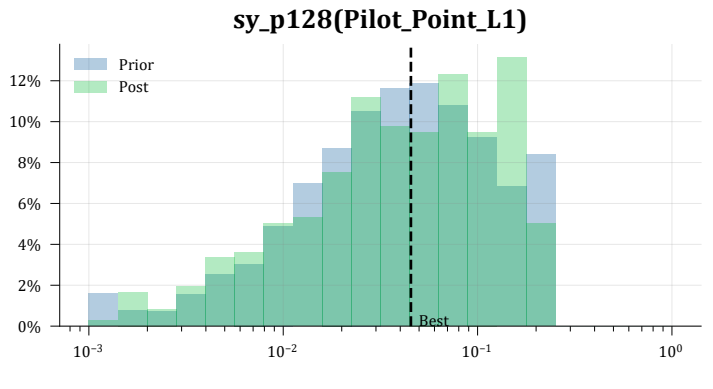
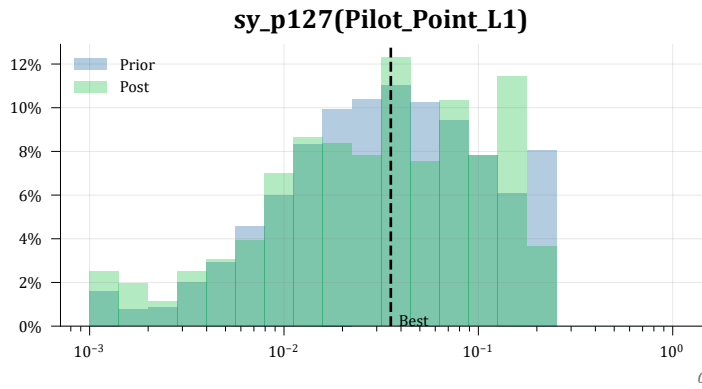
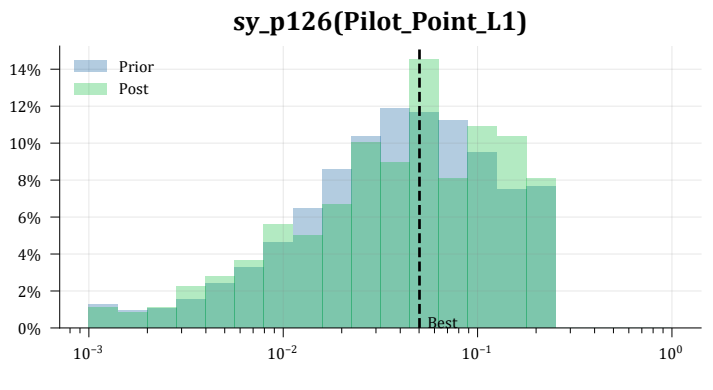
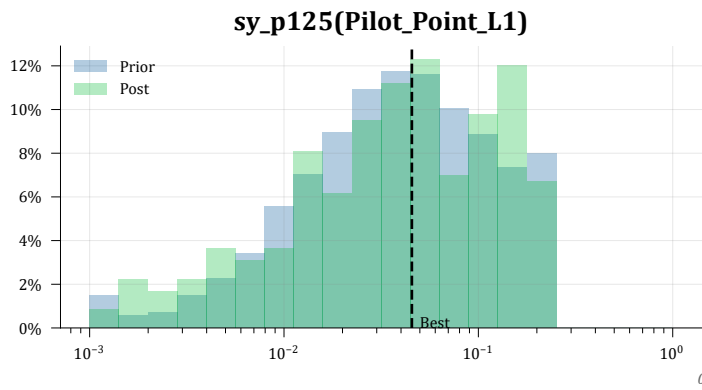




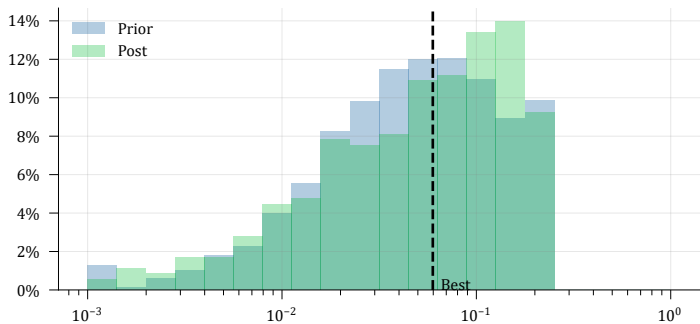




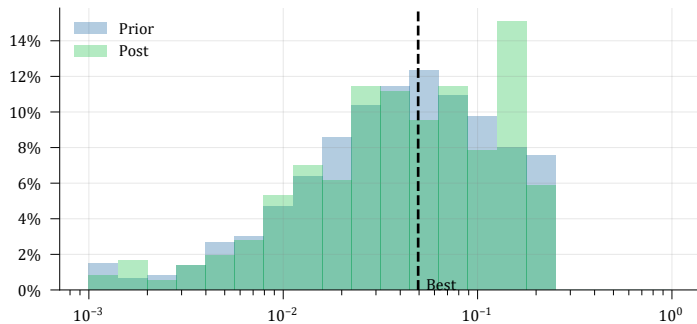




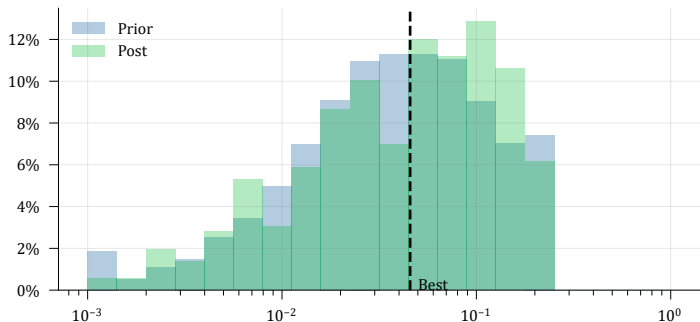
sy_p135(Pilot_Point_L1)



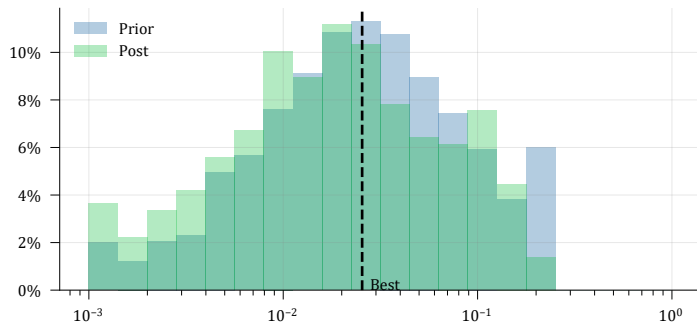
sy_p136(Pilot_Point_L1)



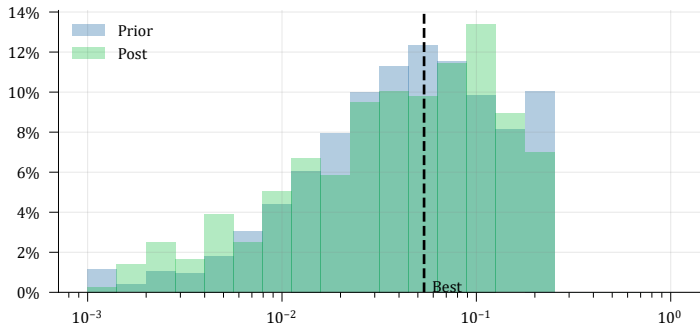
sy_p137(Pilot_Point_L1)



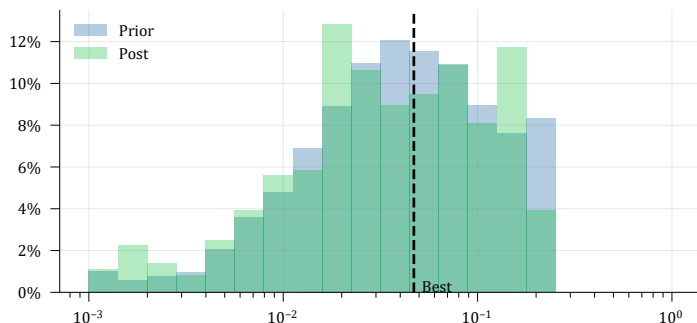
sy_p138(Pilot_Point_L1)



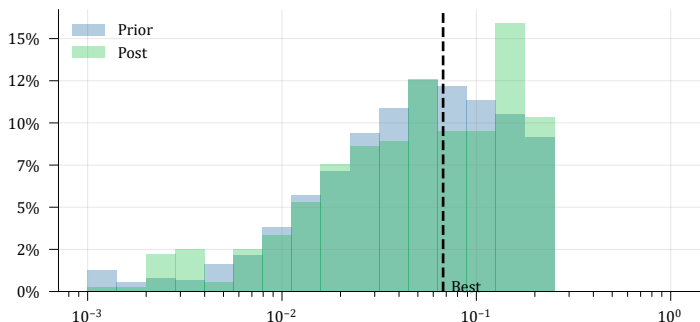
sy_p139(Pilot_Point_L1)



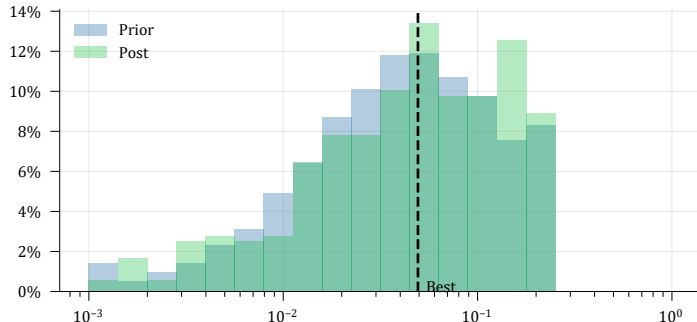
sy_p140(Pilot_Point_L1)



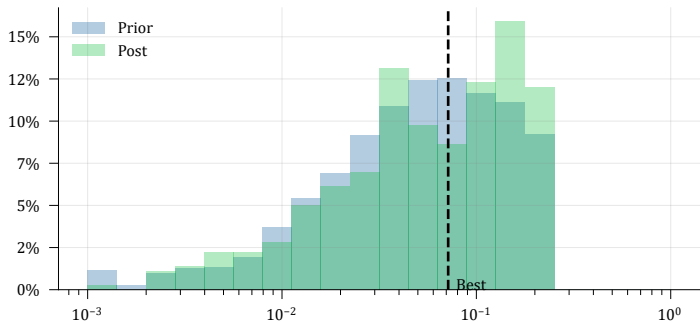
sy_p141(Pilot_Point_L1)



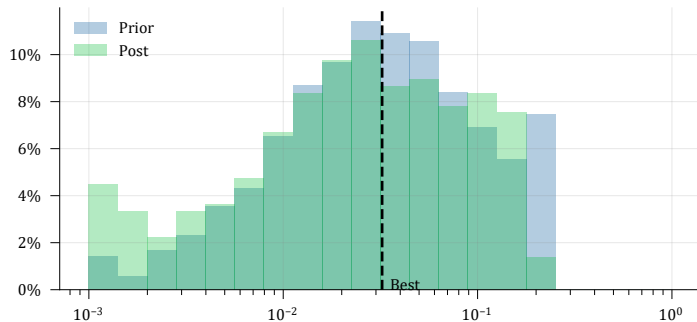
sy_p142(Pilot_Point_L1)

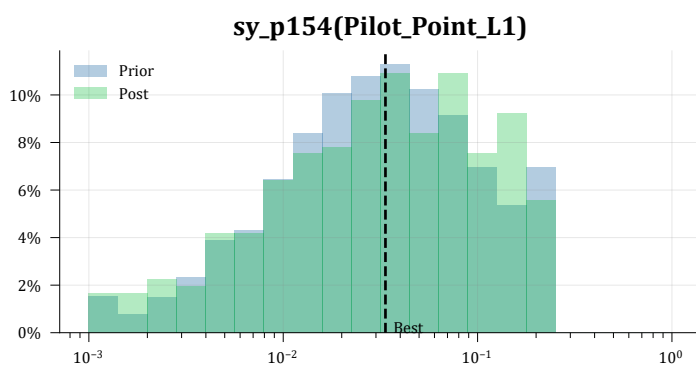
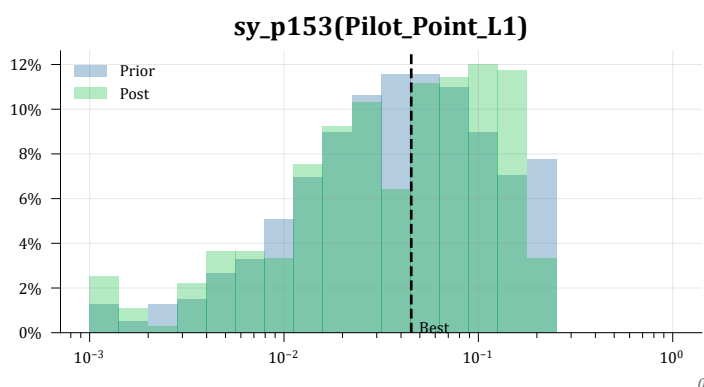
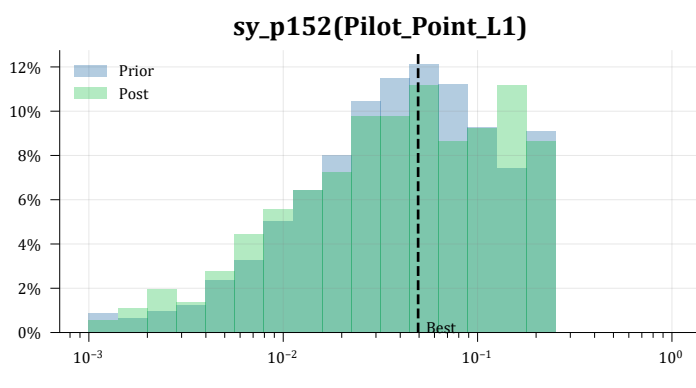
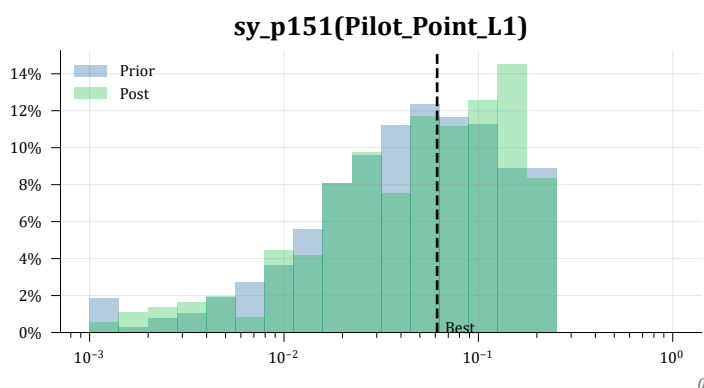
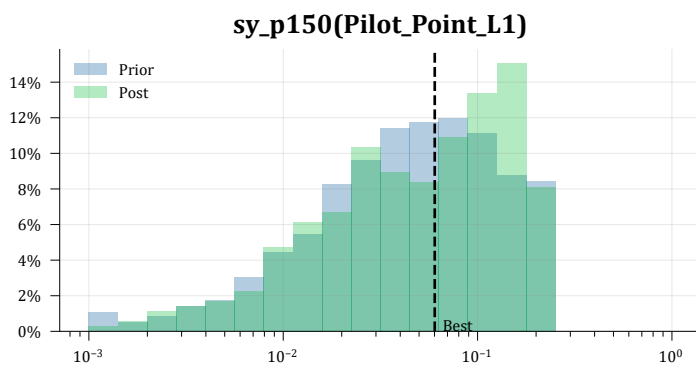
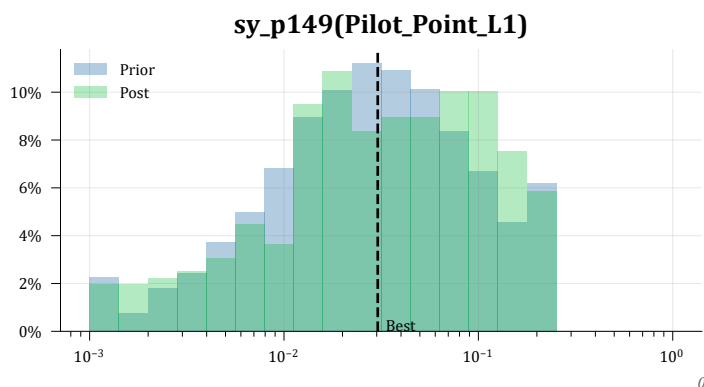
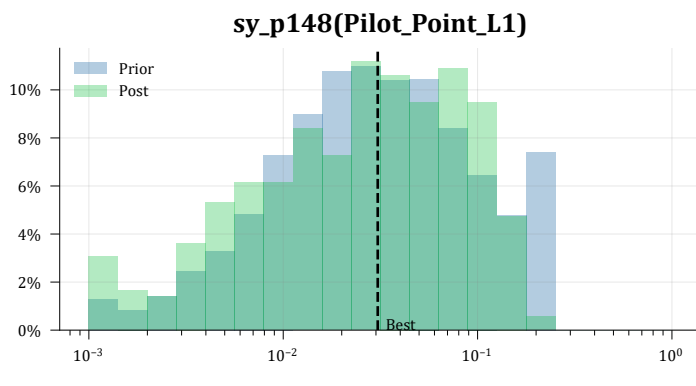
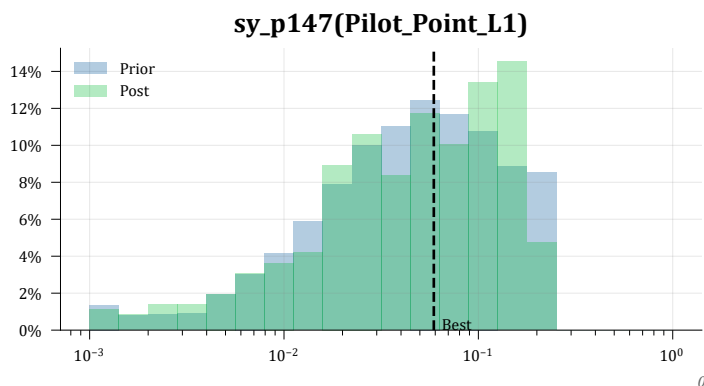
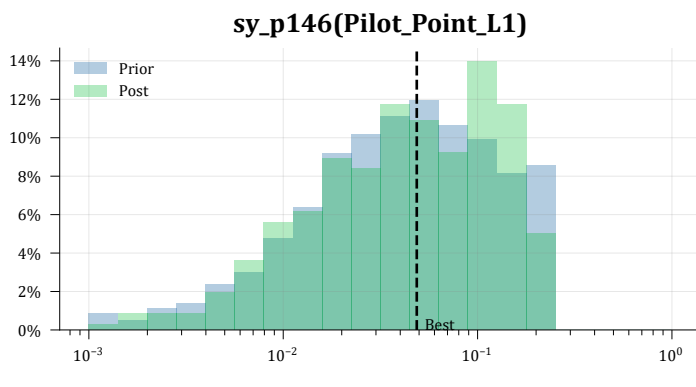
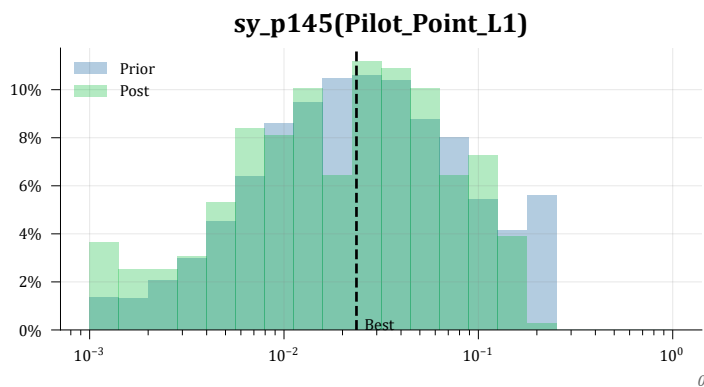


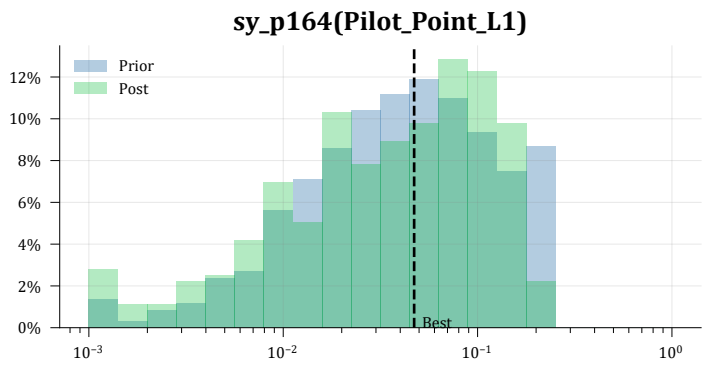
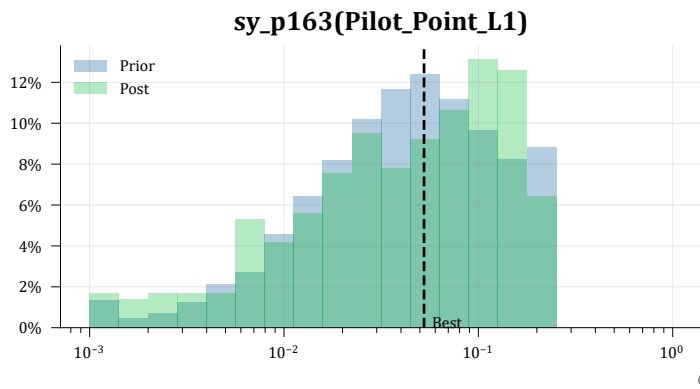
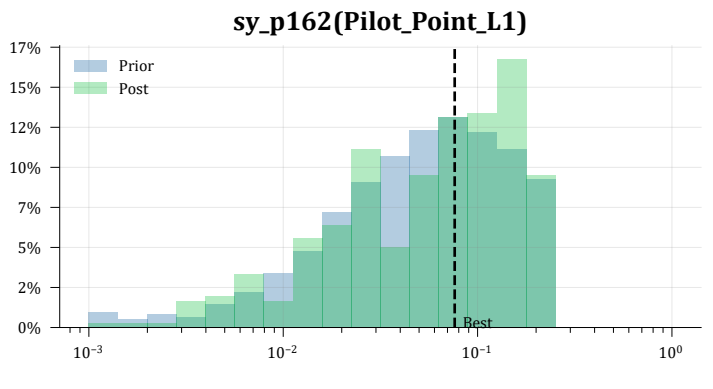
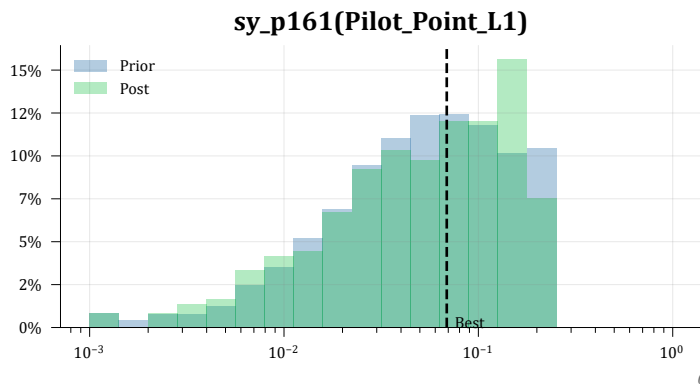
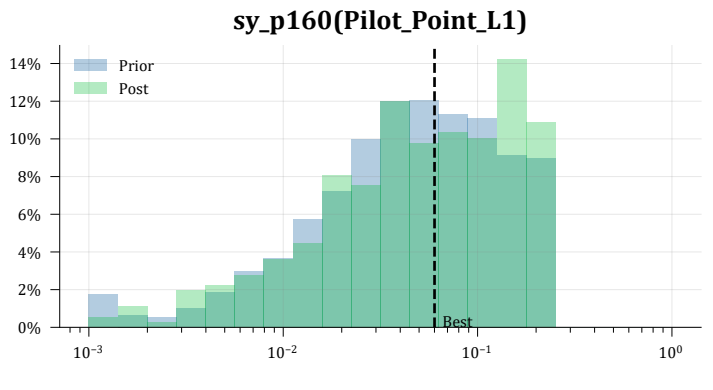
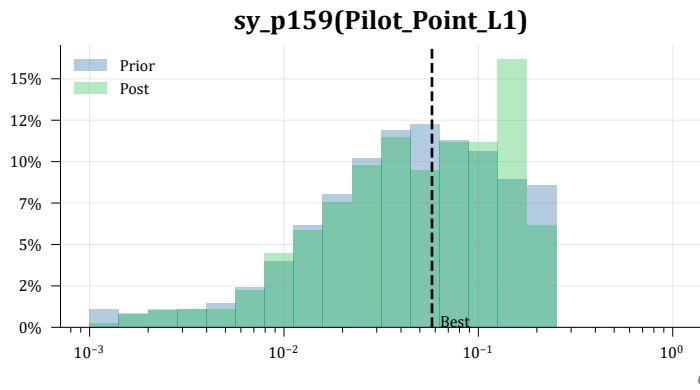
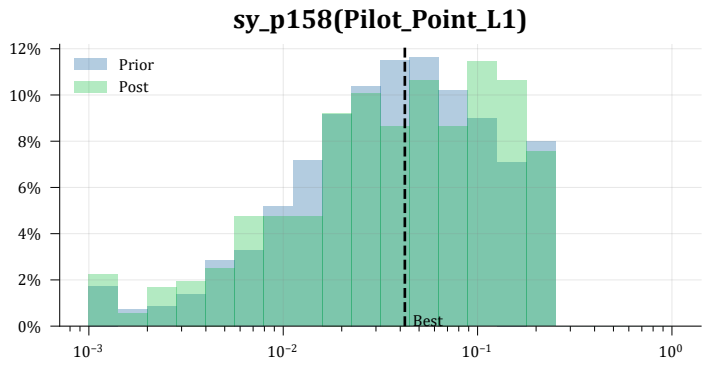
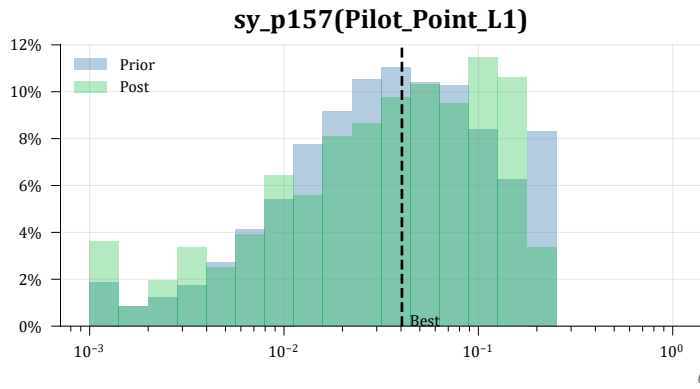
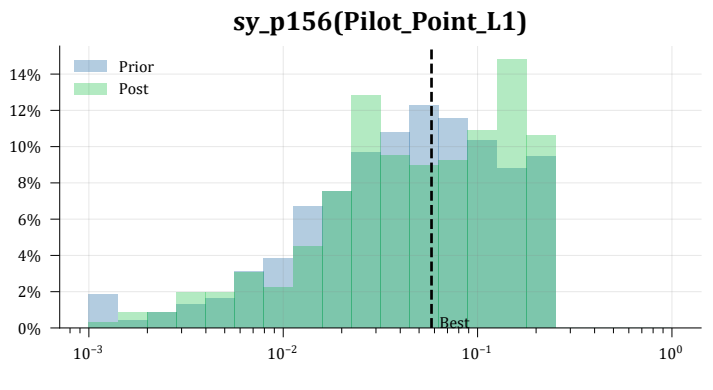
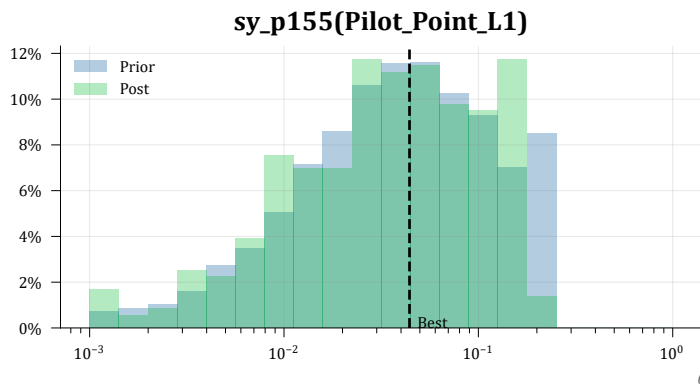
sy_p143(Pilot_Point_L1)



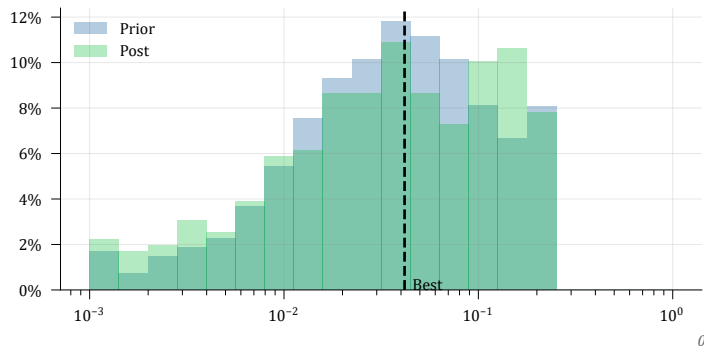
sy_p144(Pilot_Point_L1)



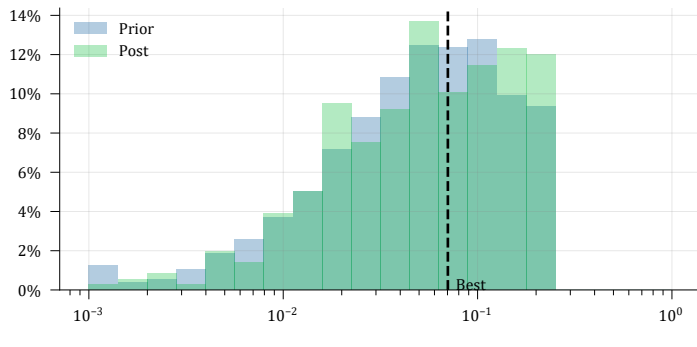




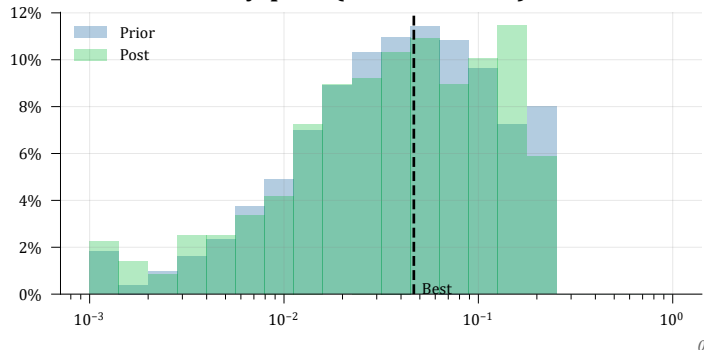
sy_p165(Pilot_Point_L1)



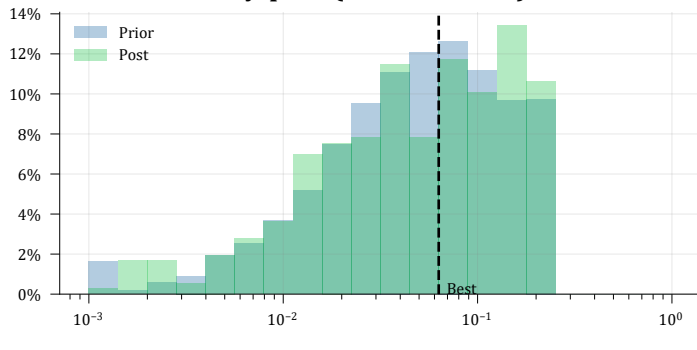
sy_p166(Pilot_Point_L1)



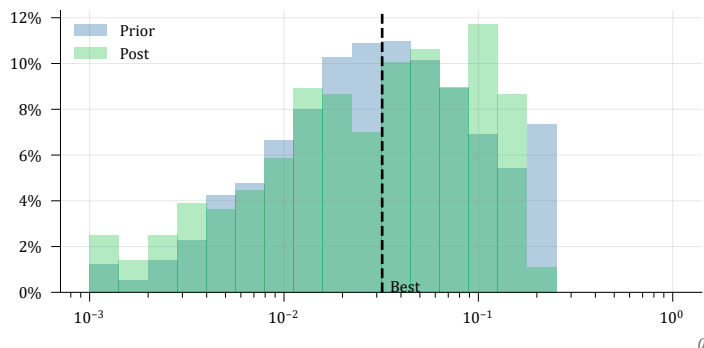
sy_p167(Pilot_Point_L1)



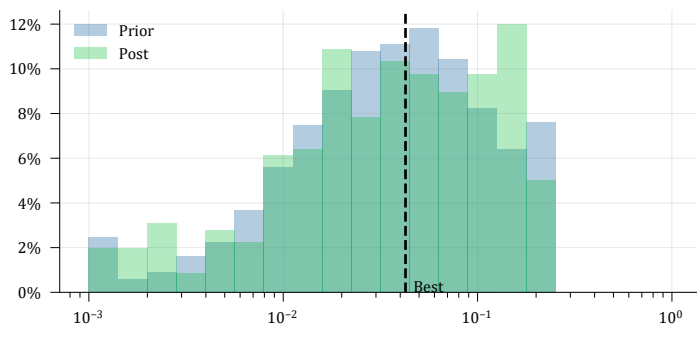
sy_p168(Pilot_Point_L1)



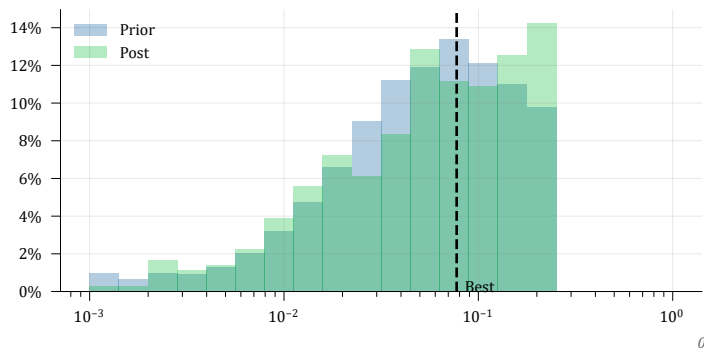
sy_p169(Pilot_Point_L1)



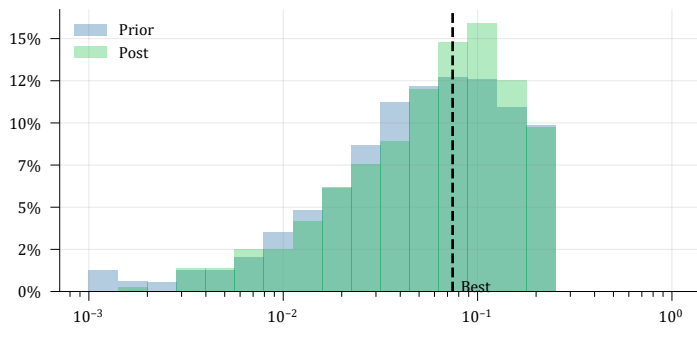
sy_p170(Pilot_Point_L1)



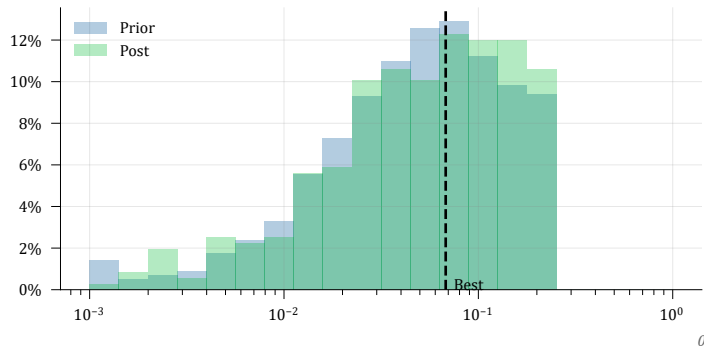
sy_p171(Pilot_Point_L1)



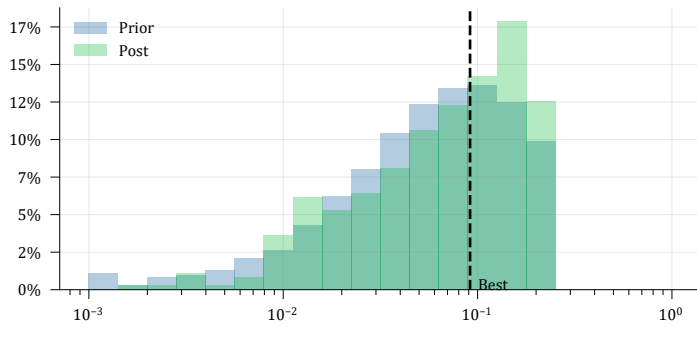
sy_p172(Pilot_Point_L1)

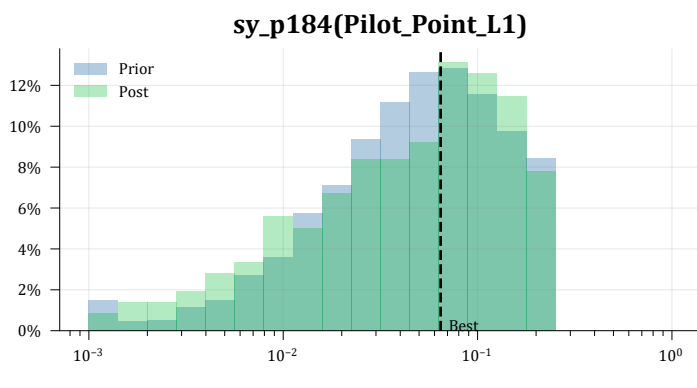
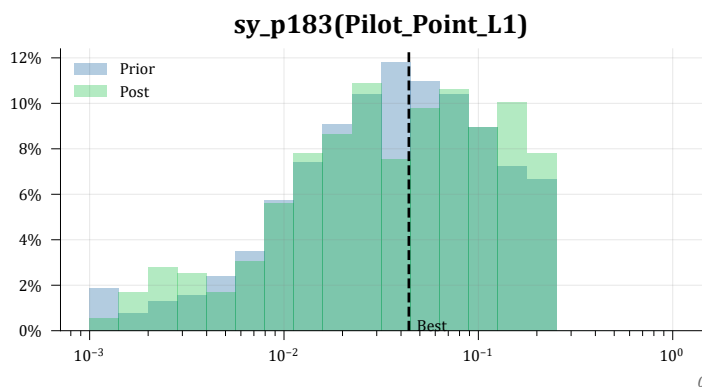
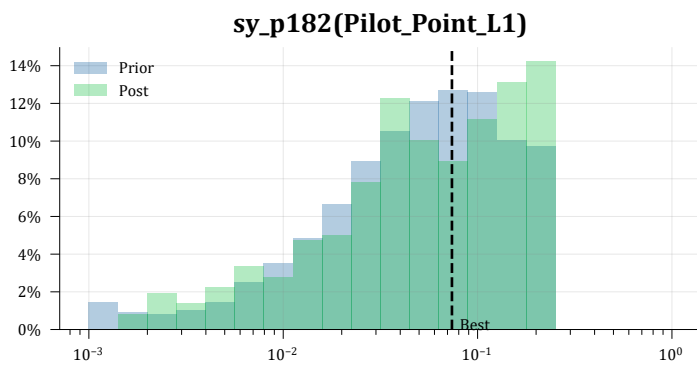
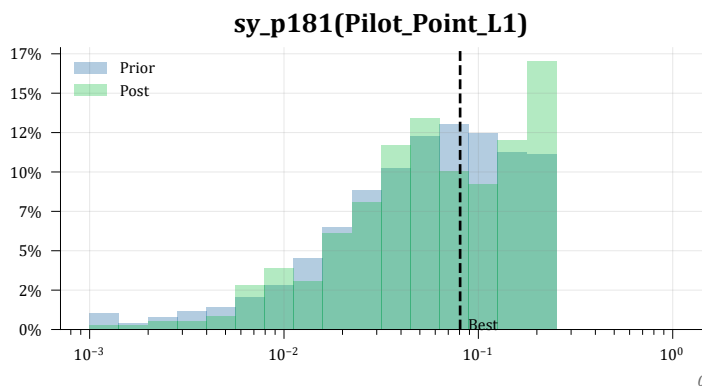
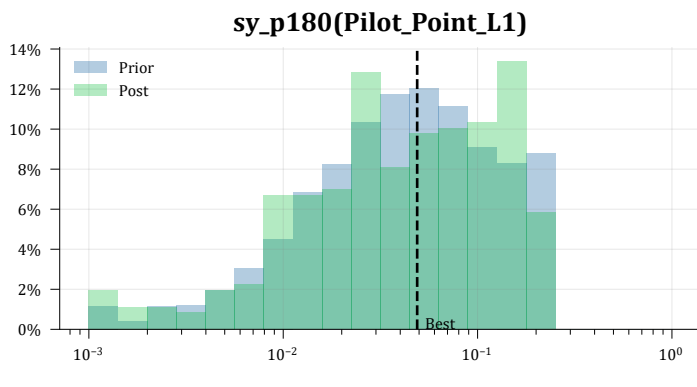
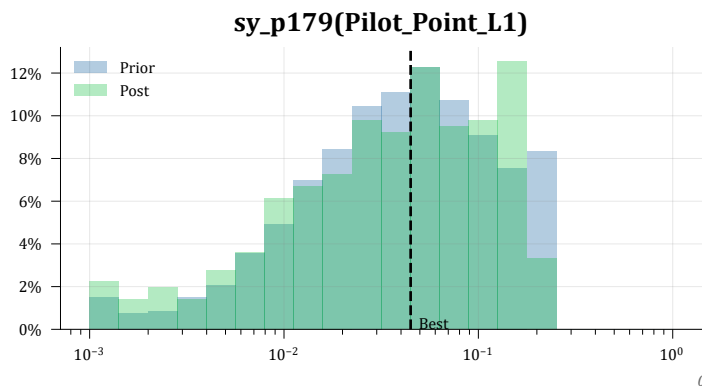
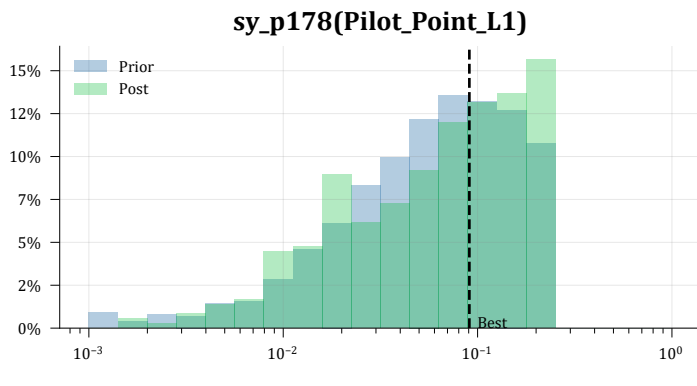
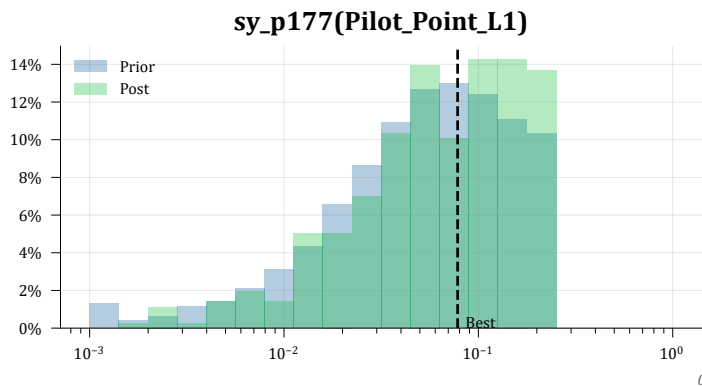
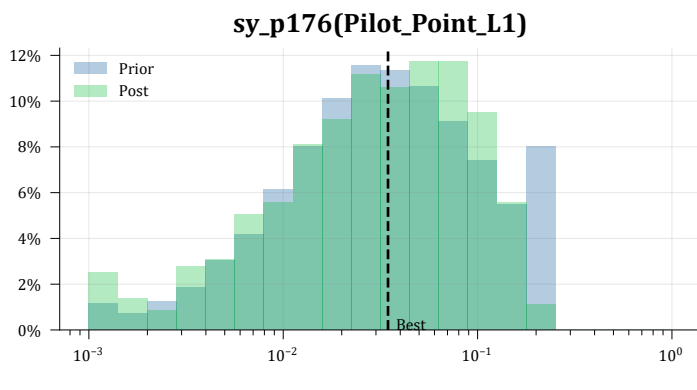
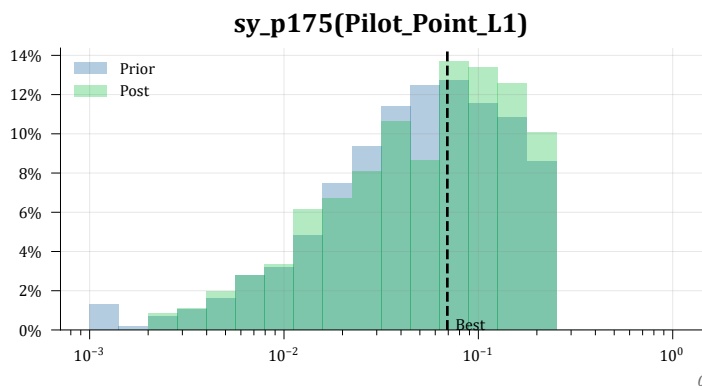


sy_p173(Pilot_Point_L1)

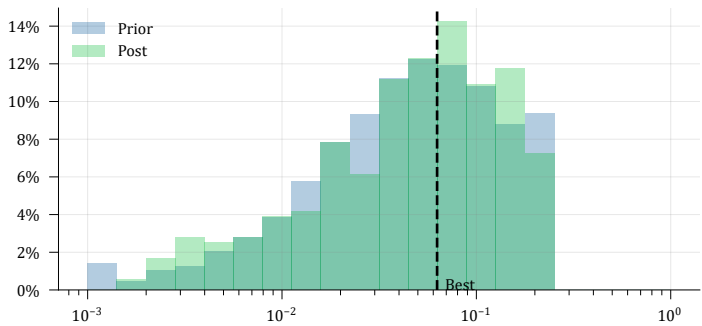


sy_p174(Pilot_Point_L1)

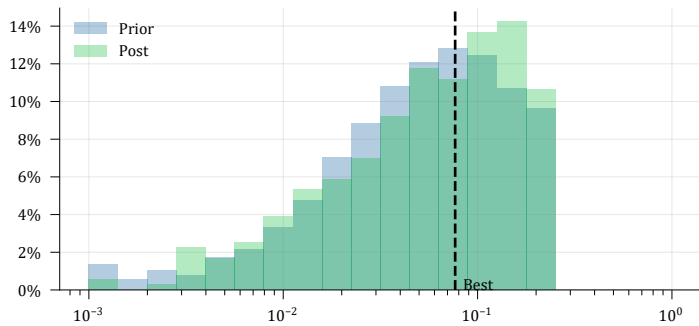




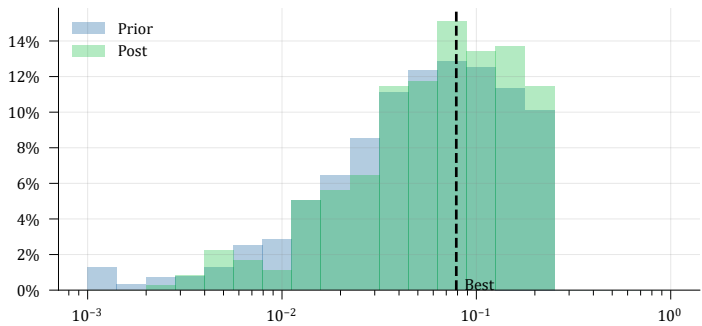
sy_p185(Pilot_Point_L1)



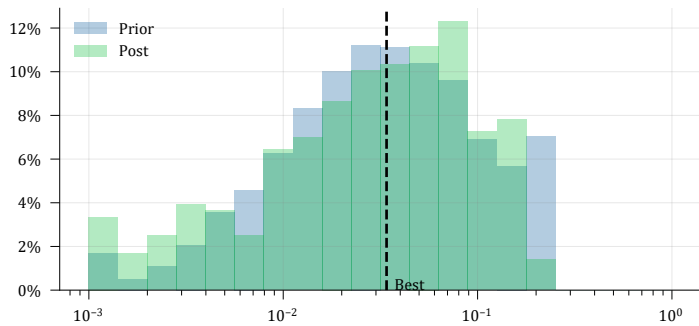
sy_p186(Pilot_Point_L1)



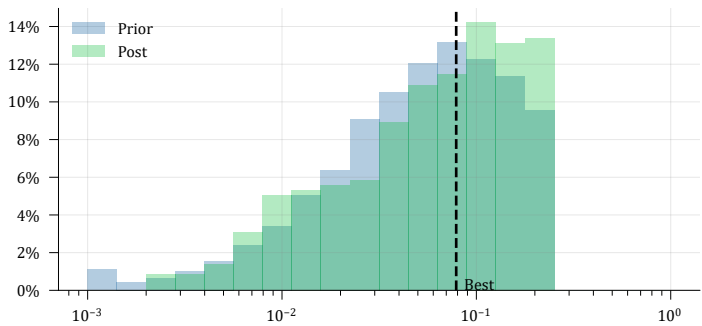
sy_p187(Pilot_Point_L1)



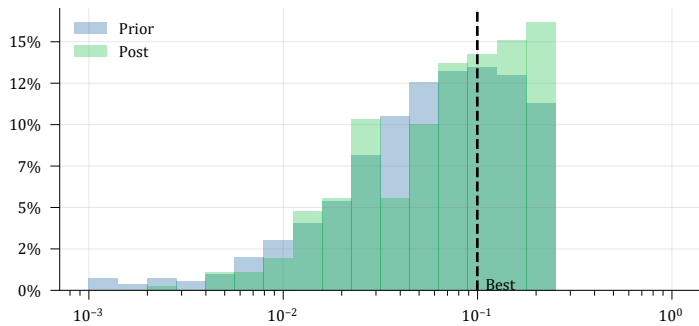
sy_p188(Pilot_Point_L1)



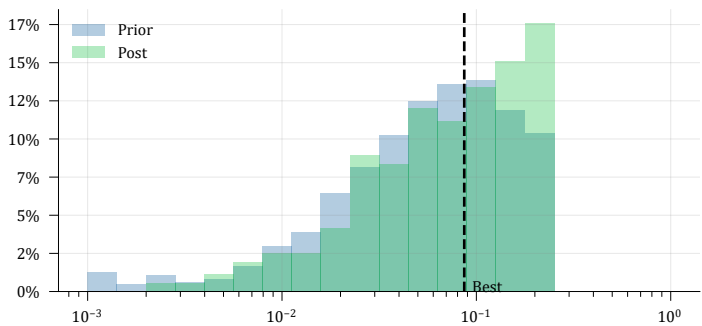
sy_p189(Pilot_Point_L1)



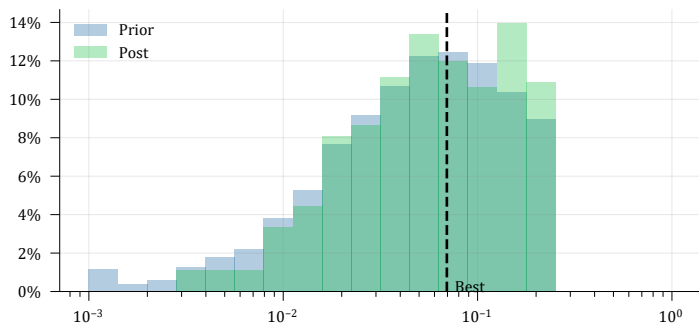
sy_p190(Pilot_Point_L1)



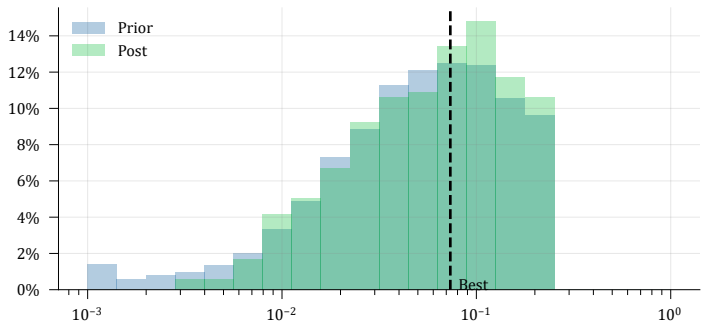
sy_p191(Pilot_Point_L1)



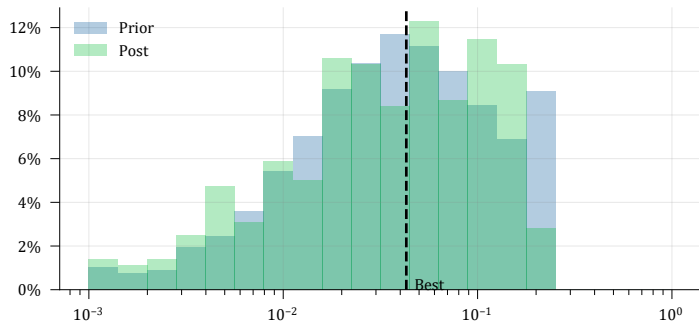
sy_p192(Pilot_Point_L1)



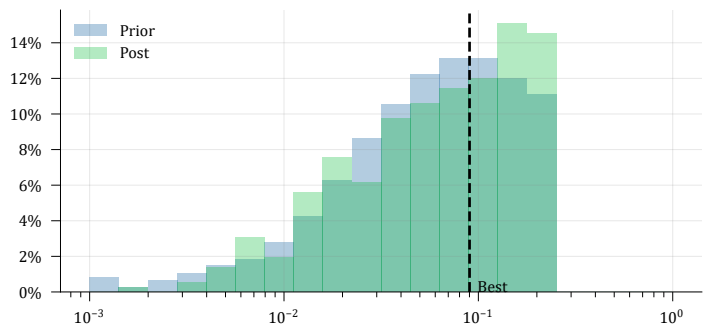
sy_p193(Pilot_Point_L1)



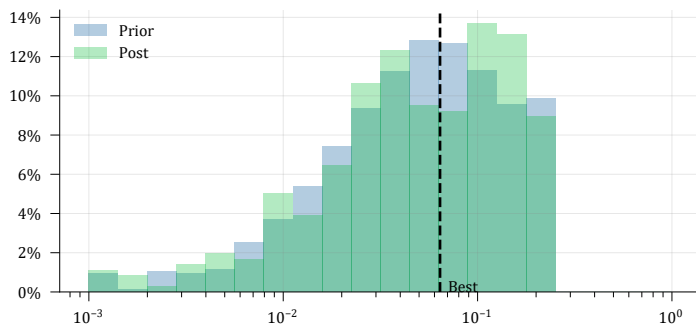
sy_p194(Pilot_Point_L1)



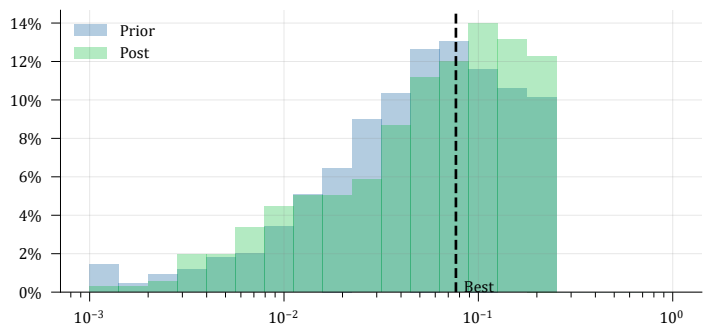
sy_p195(Pilot_Point_L1)



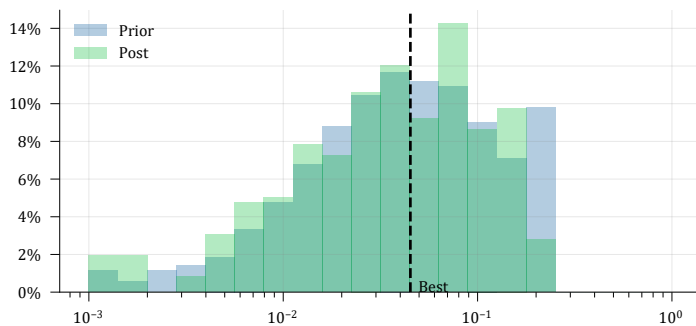
sy_p196(Pilot_Point_L1)



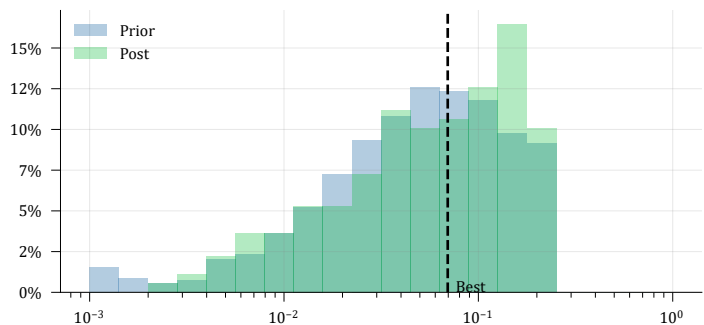
sy_p197(Pilot_Point_L1)



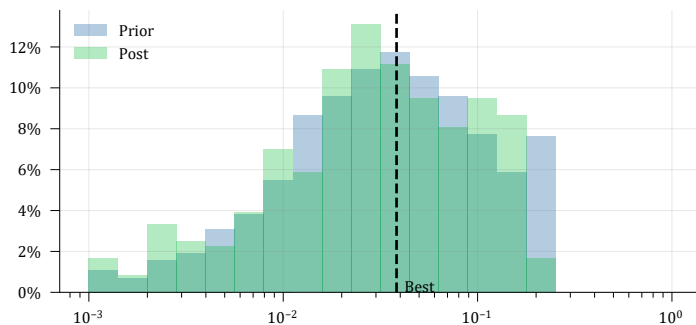
sy_p198(Pilot_Point_L1)



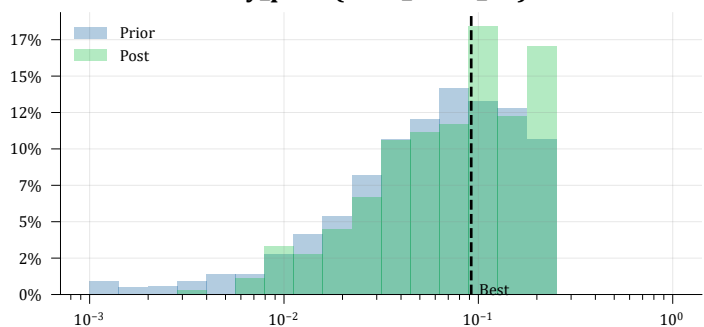
sy_p199(Pilot_Point_L1)



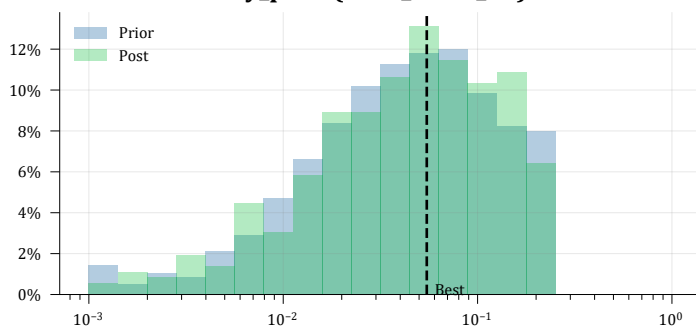
sy_p200(Pilot_Point_L1)



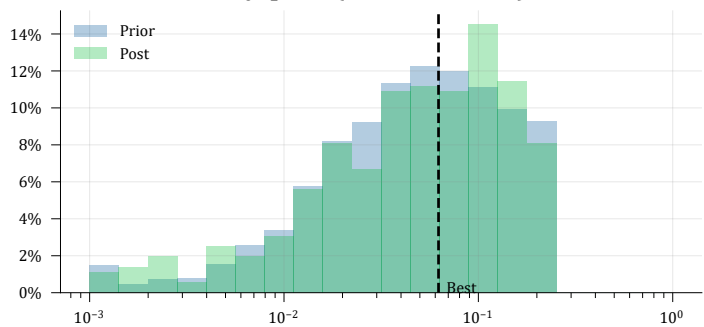
sy_p201(Pilot_Point_L1)



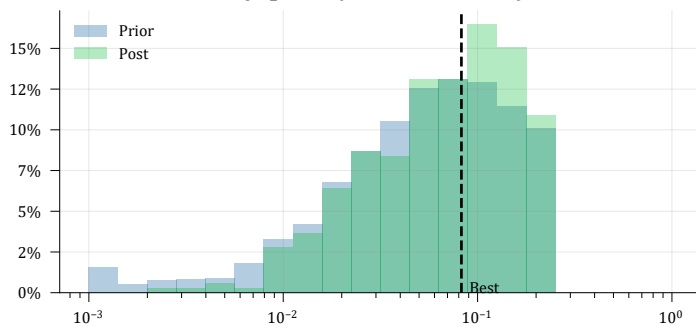
sy_p202(Pilot_Point_L1)



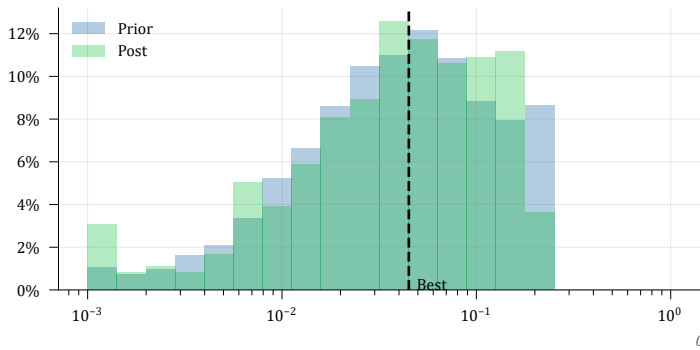
sy_p203(Pilot_Point_L1)



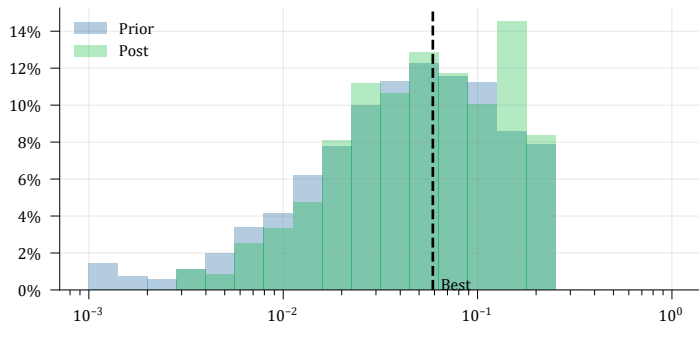
sy_p204(Pilot_Point_L1)



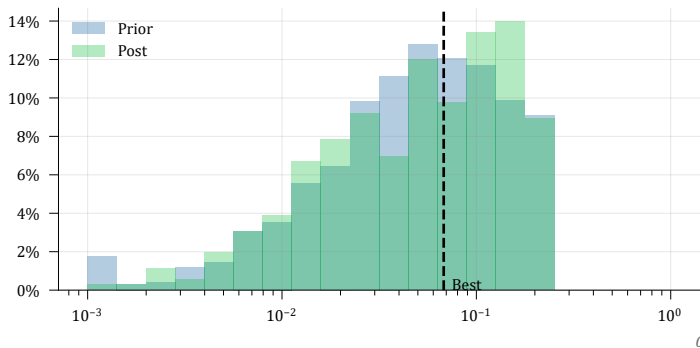
sy_p205(Pilot_Point_L1)



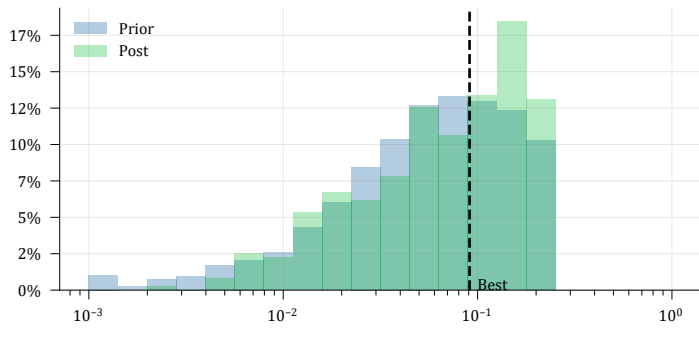
sy_p206(Pilot_Point_L1)



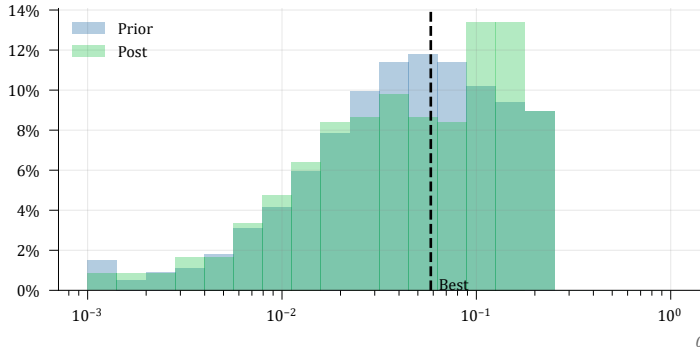
sy_p207(Pilot_Point_L1)



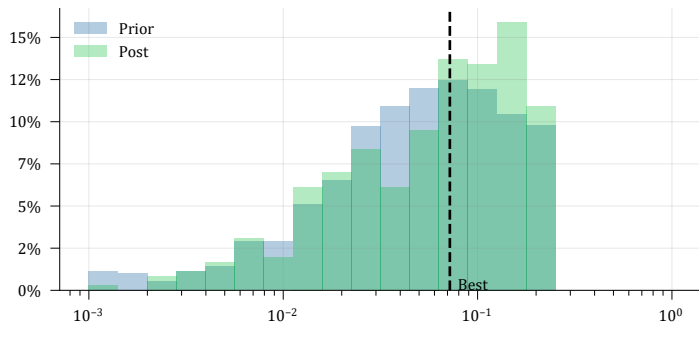
sy_p208(Pilot_Point_L1)



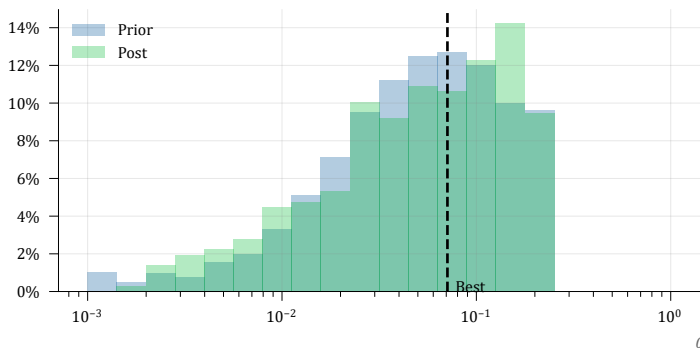
sy_p209(Pilot_Point_L1)



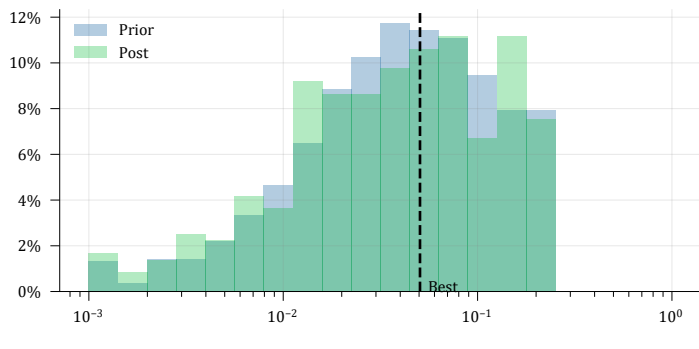
sy_p210(Pilot_Point_L1)



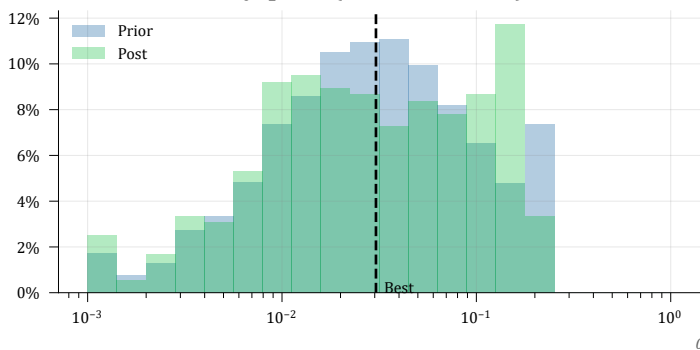
sy_p211(Pilot_Point_L1)



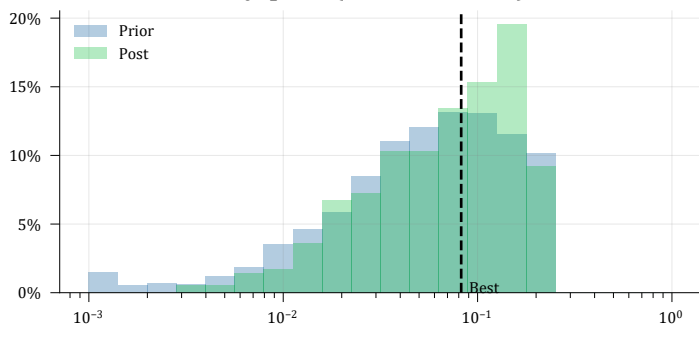
sy_p212(Pilot_Point_L1)



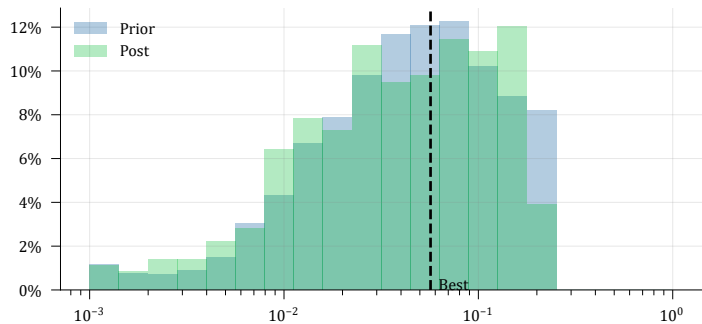
sy_p213(Pilot_Point_L1)



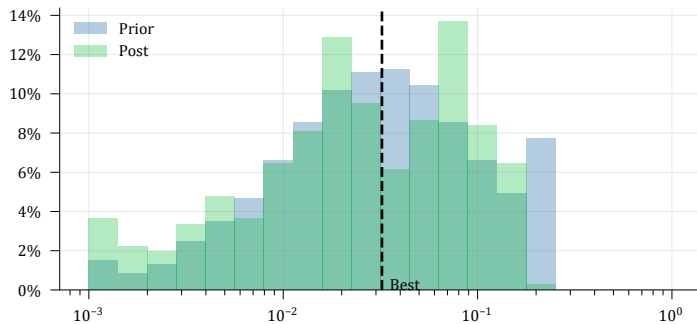
sy_p214(Pilot_Point_L1)



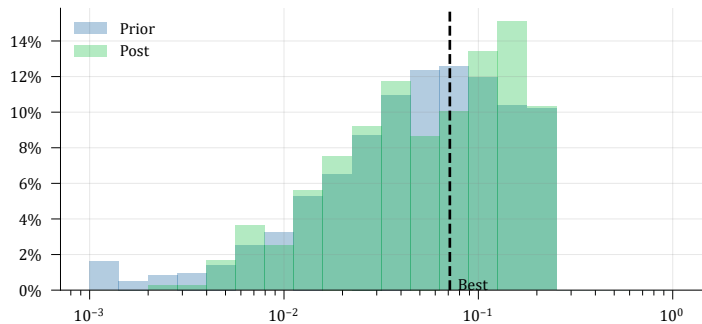
sy_p215(Pilot_Point_L1)



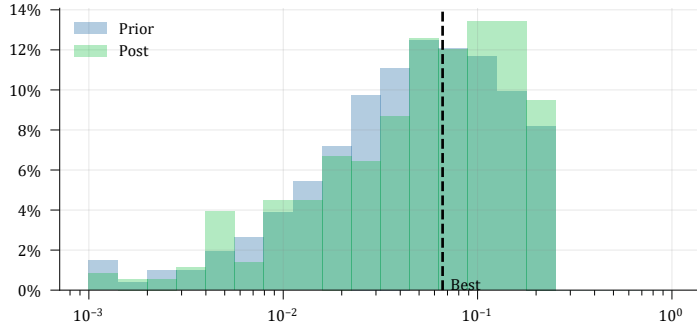
sy_p216(Pilot_Point_L1)



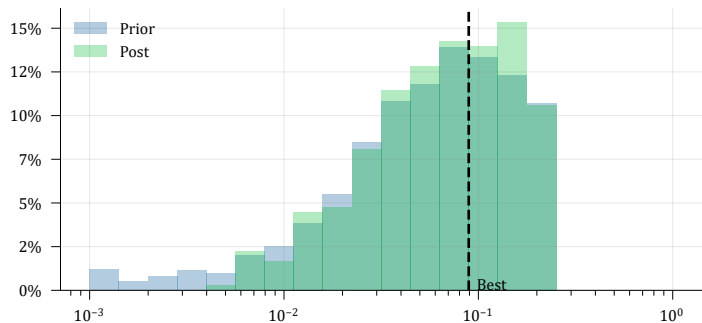
sy_p217(Pilot_Point_L1)



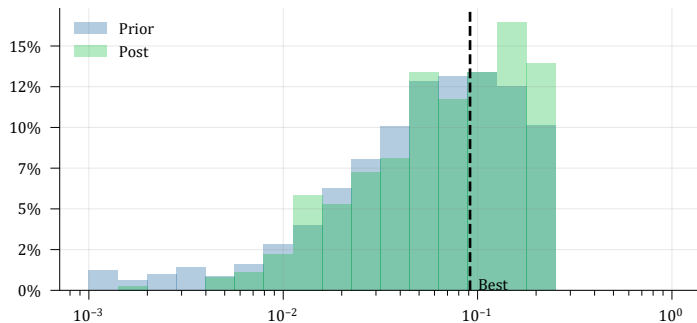
sy_p218(Pilot_Point_L1)



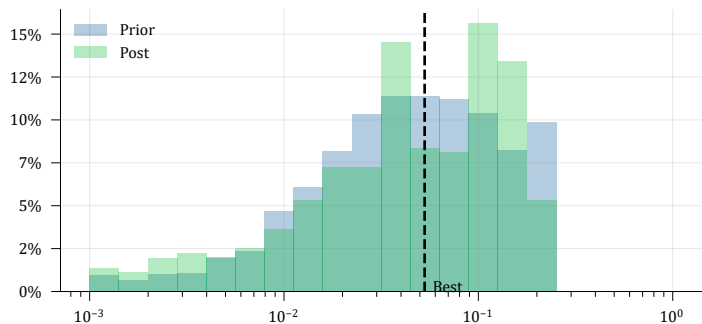
sy_p219(Pilot_Point_L1)



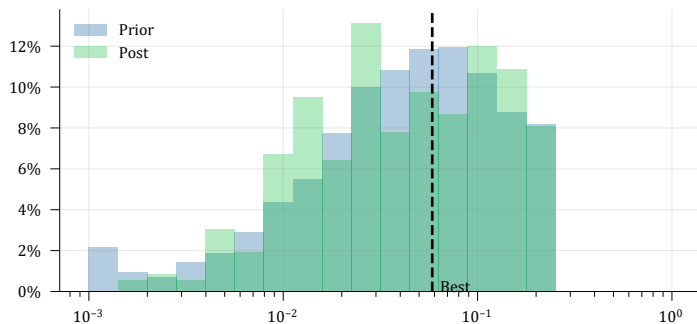
sy_p220(Pilot_Point_L1)



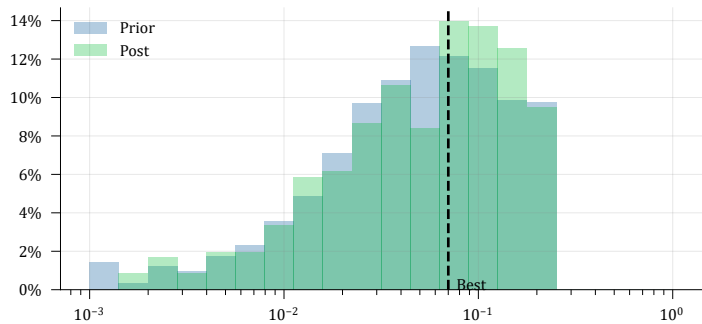
sy_p221(Pilot_Point_L1)



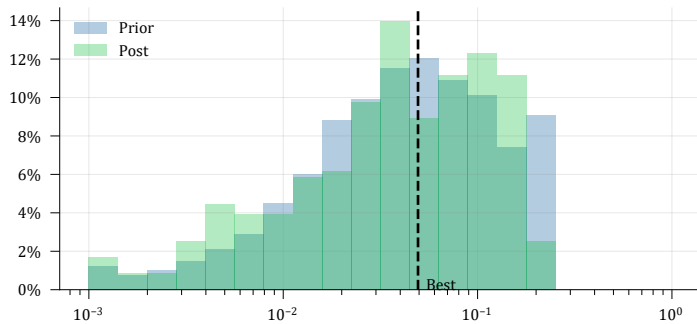
sy_p222(Pilot_Point_L1)

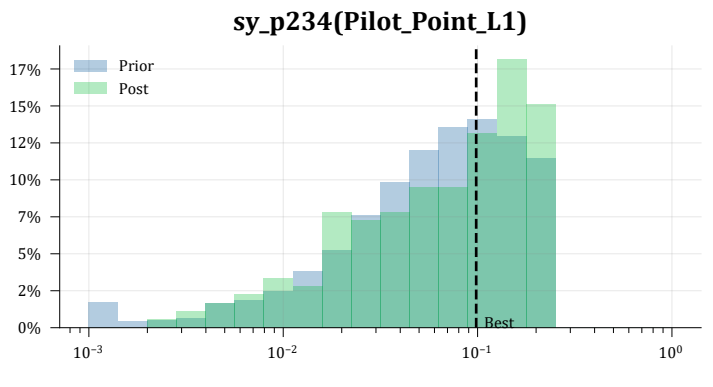
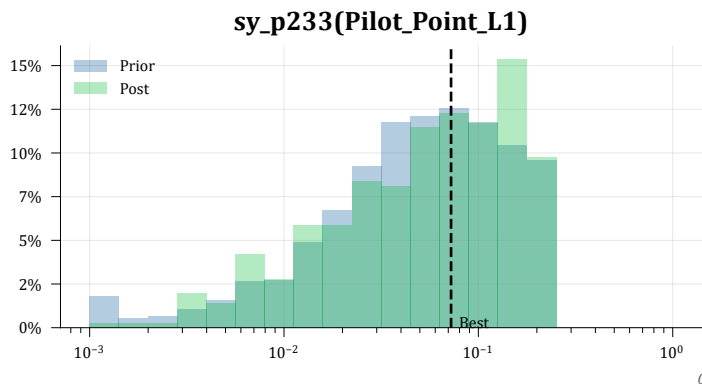
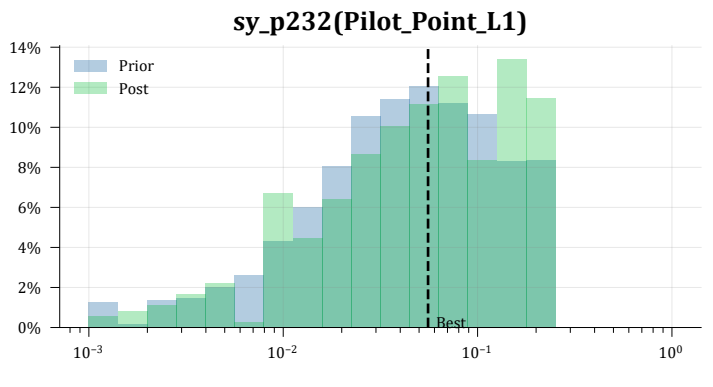
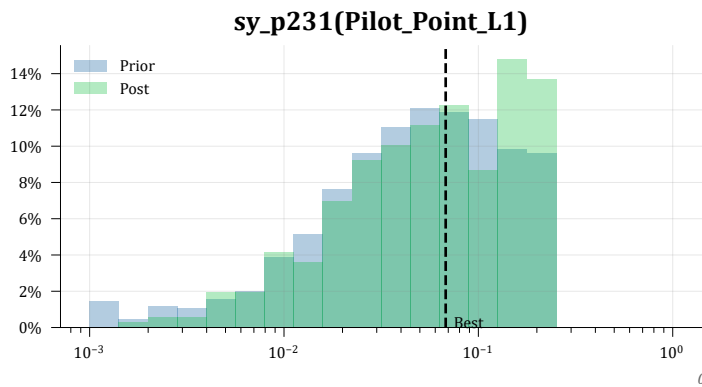
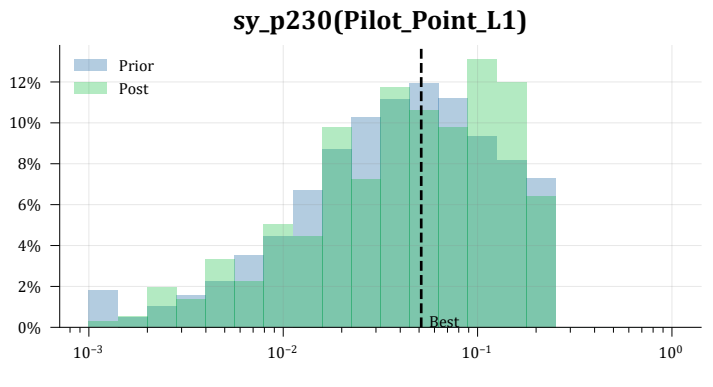
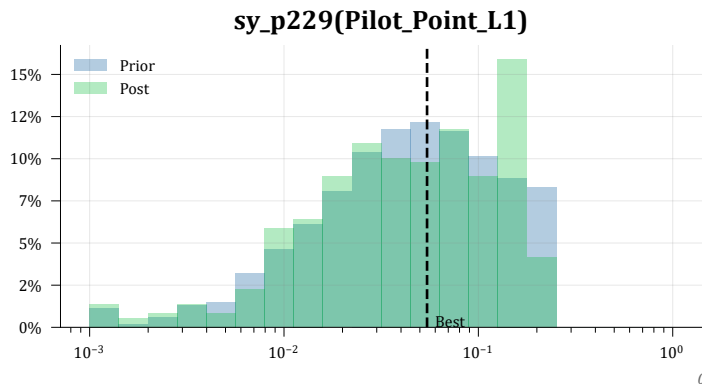
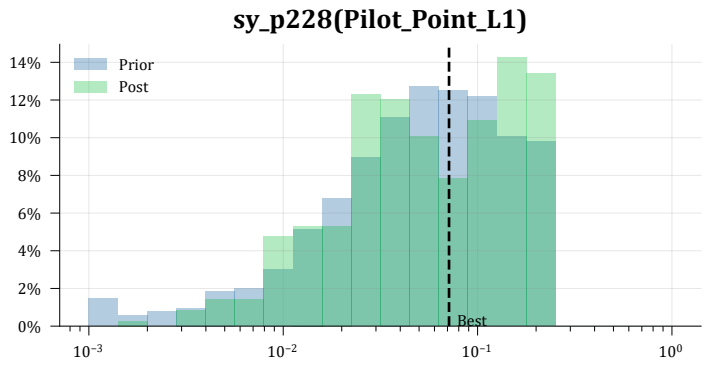
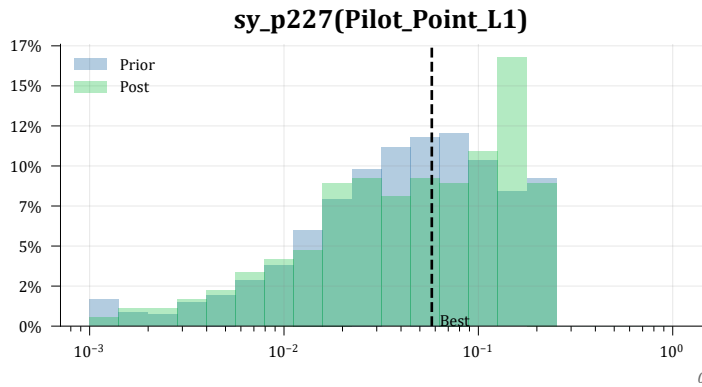
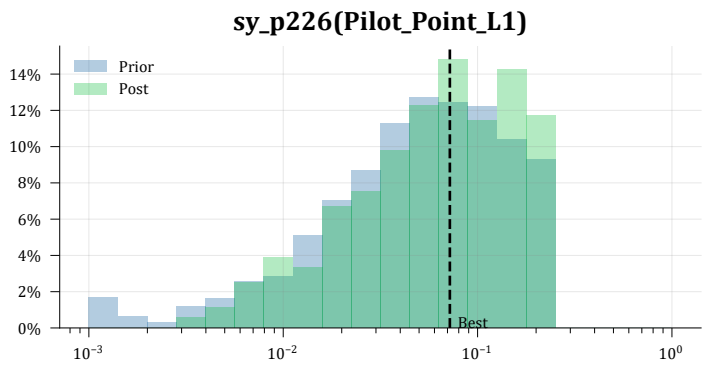
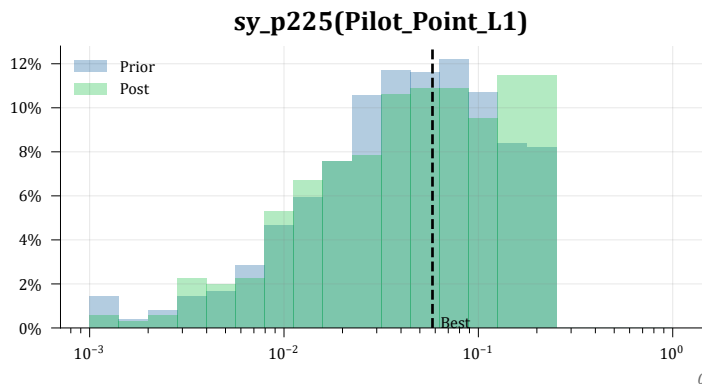


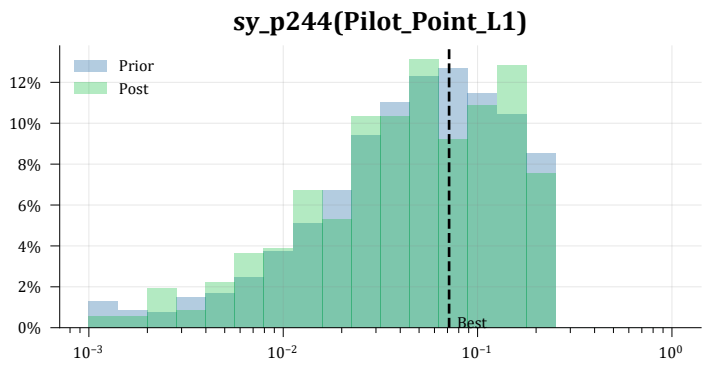
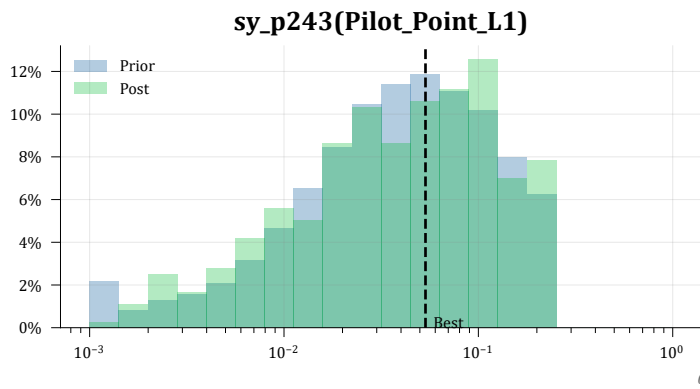
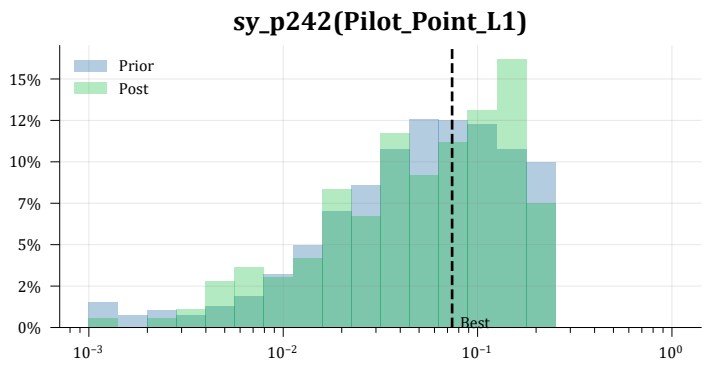
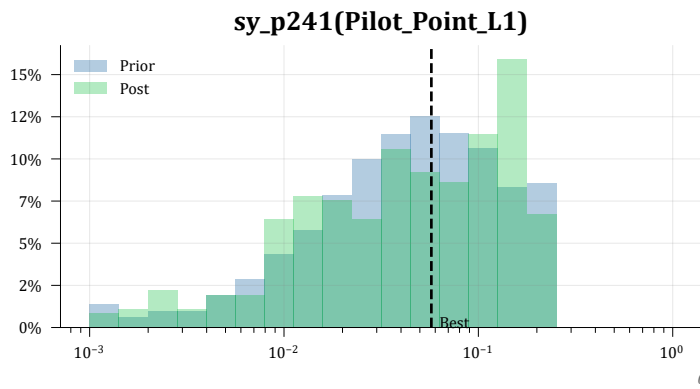
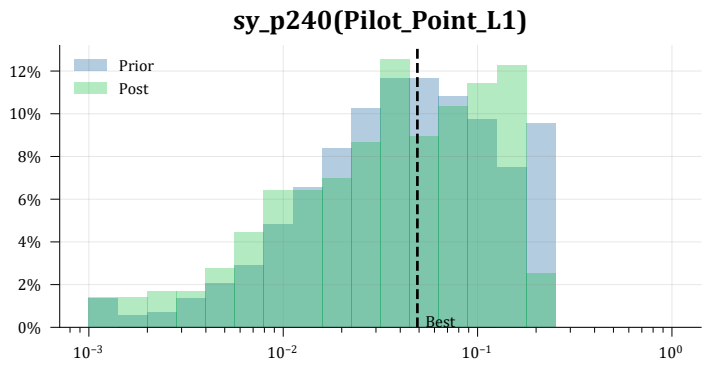
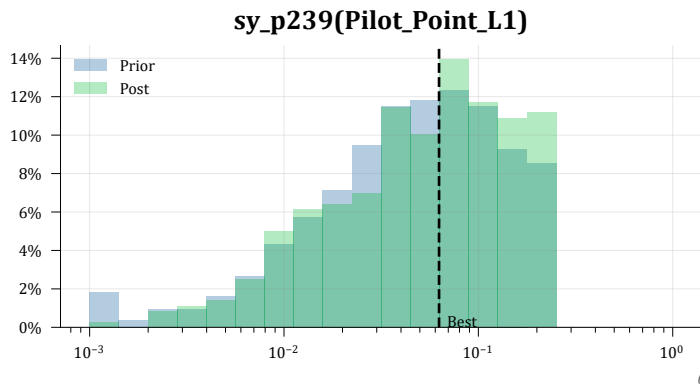
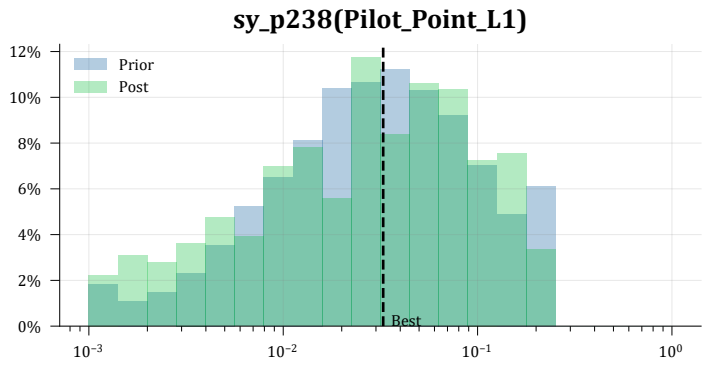
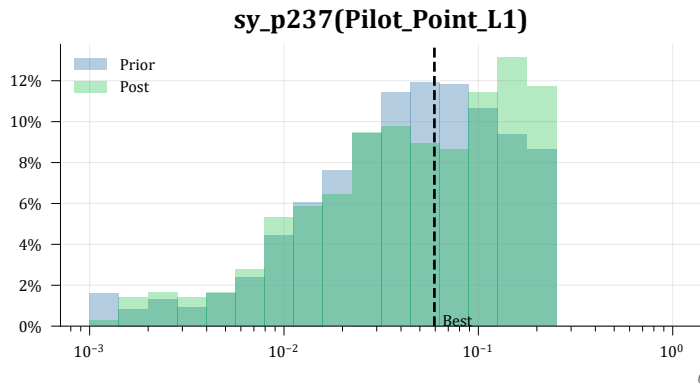
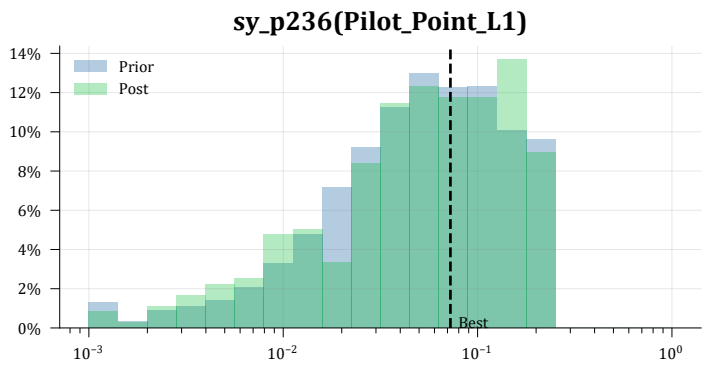
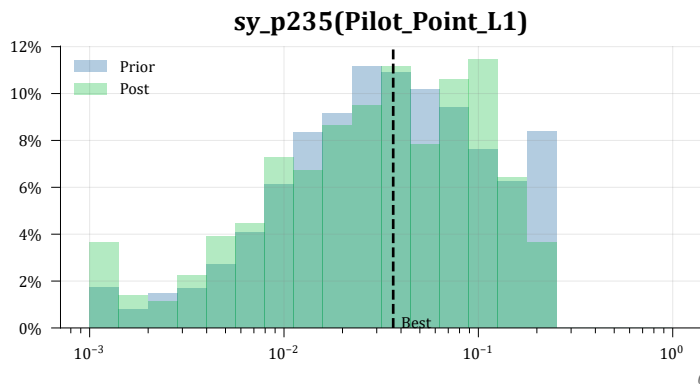
sy_p223(Pilot_Point_L1)



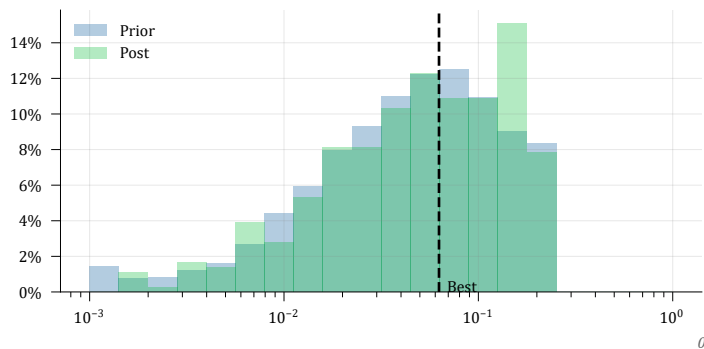
sy_p224(Pilot_Point_L1)



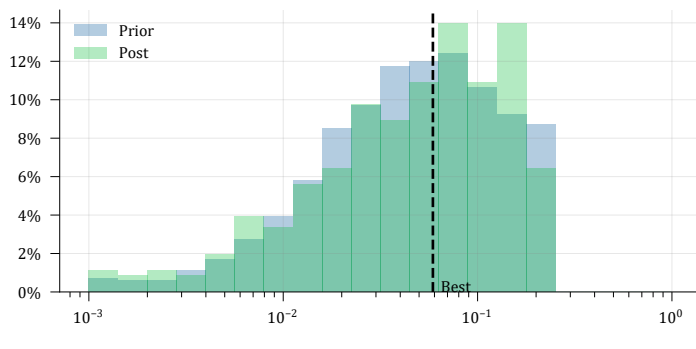




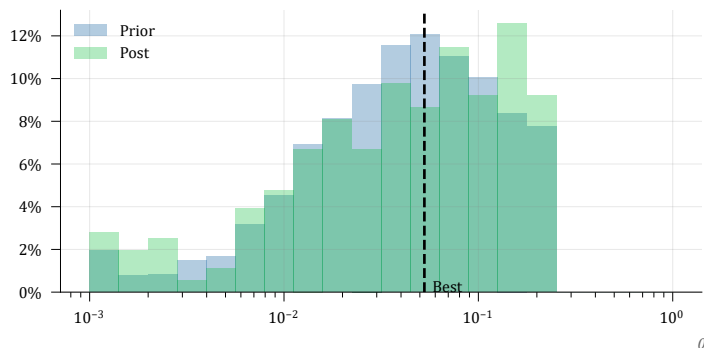
sy_p245(Pilot_Point_L1)



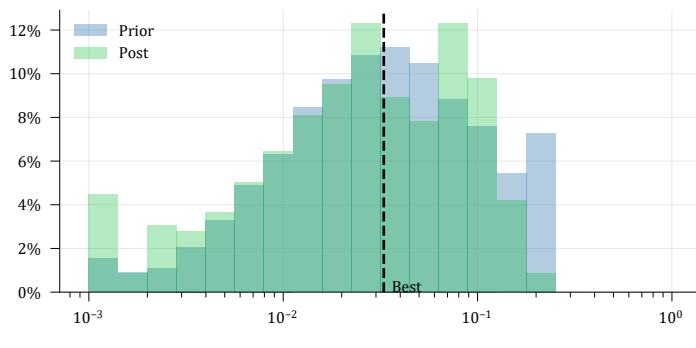
sy_p246(Pilot_Point_L1)



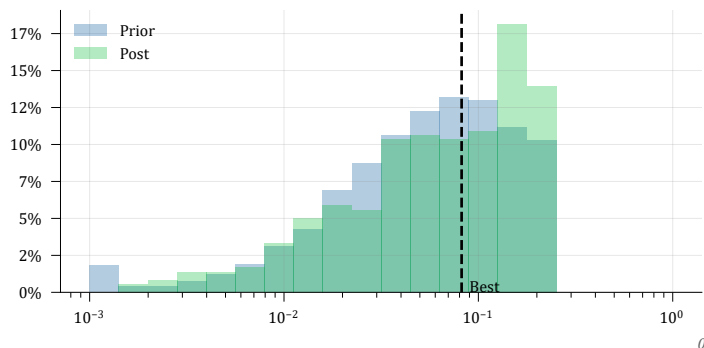
sy_p247(Pilot_Point_L1)



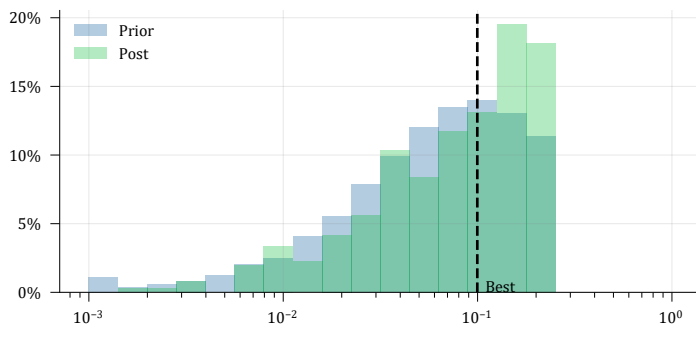
sy_p248(Pilot_Point_L1)



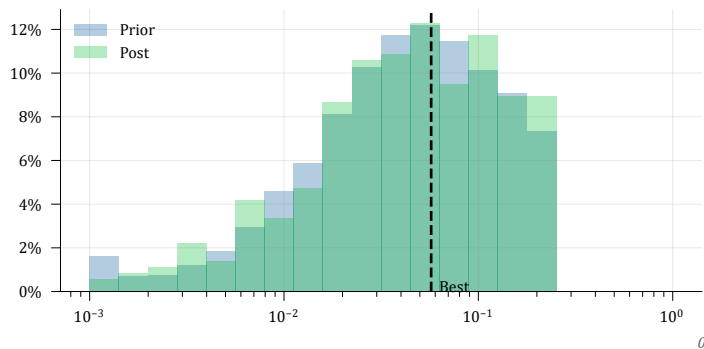
sy_p249(Pilot_Point_L1)



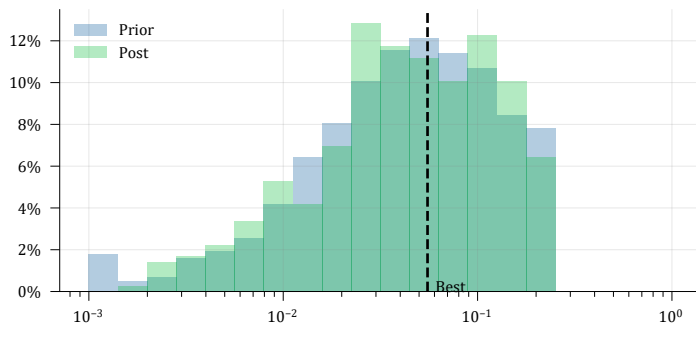
sy_p250(Pilot_Point_L1)



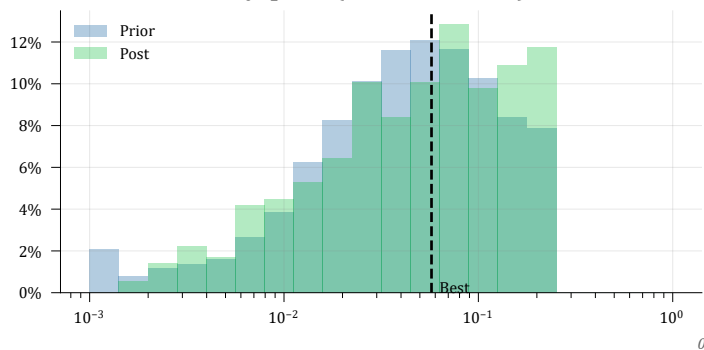
sy_p251(Pilot_Point_L1)



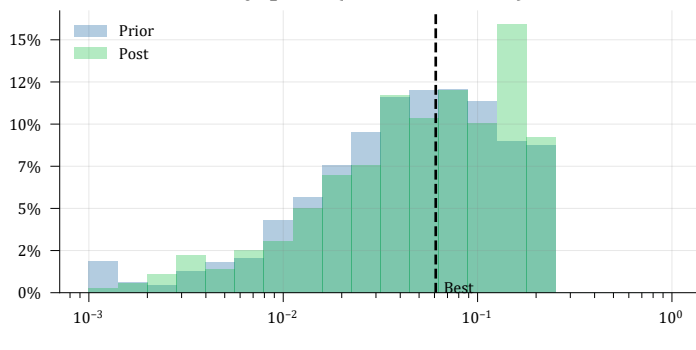
sy_p252(Pilot_Point_L1)



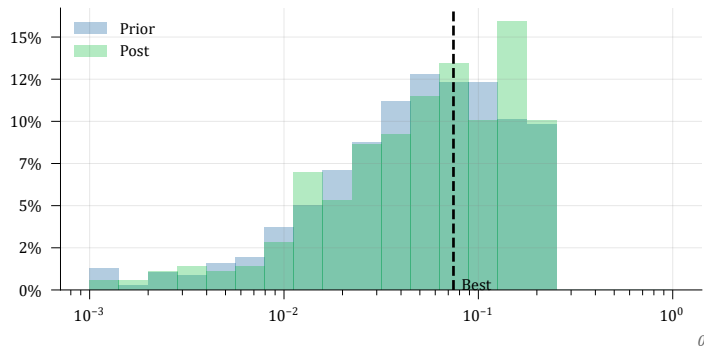
sy_p253(Pilot_Point_L1)



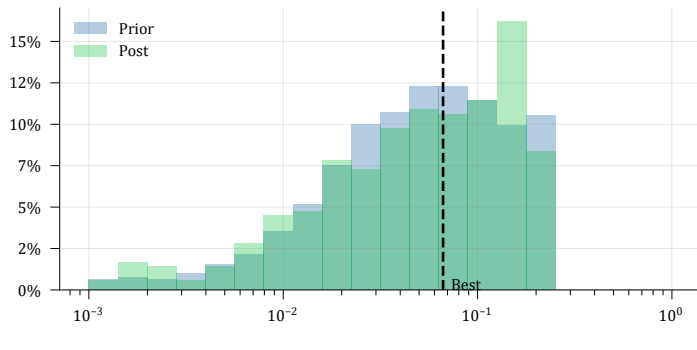
sy_p254(Pilot_Point_L1)



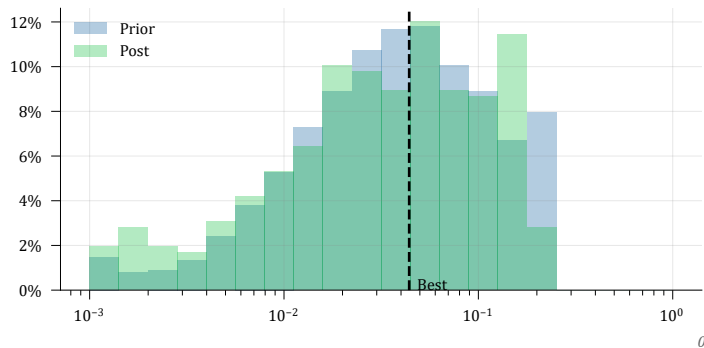
sy_p255(Pilot_Point_L1)



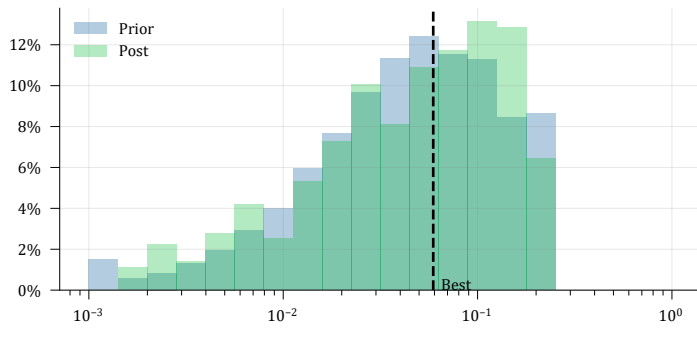
sy_p256(Pilot_Point_L1)



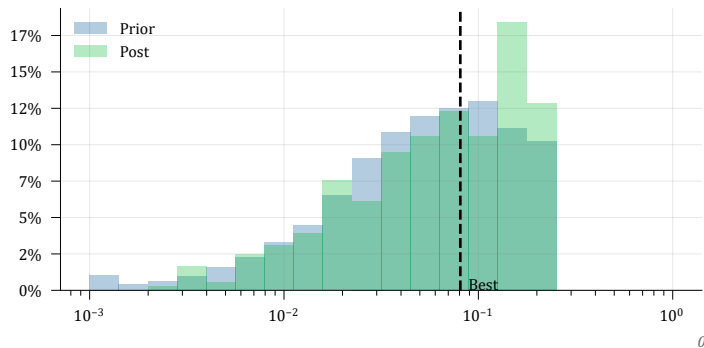
sy_p257(Pilot_Point_L1)



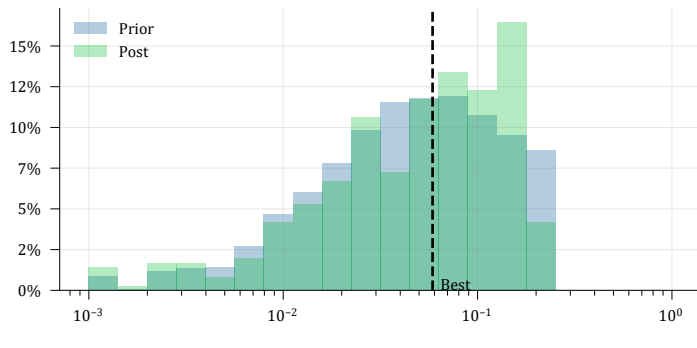
sy_p258(Pilot_Point_L1)



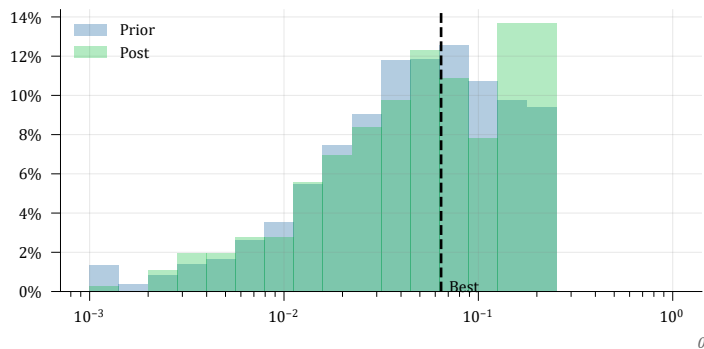
sy_p259(Pilot_Point_L1)



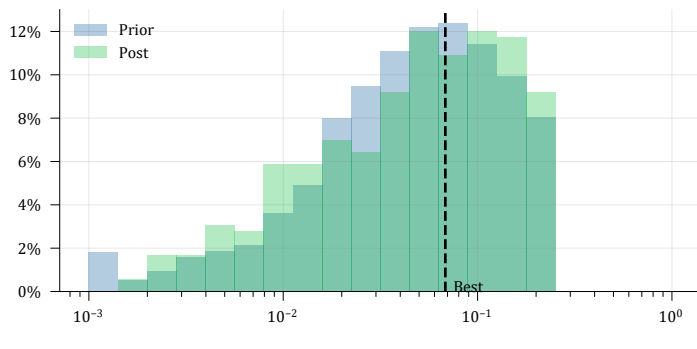
sy_p260(Pilot_Point_L1)



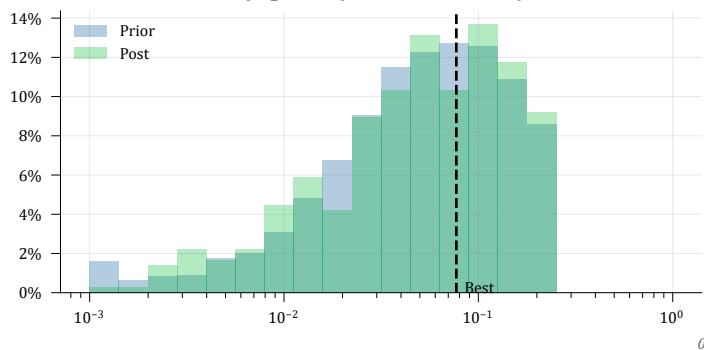
sy_p261(Pilot_Point_L1)



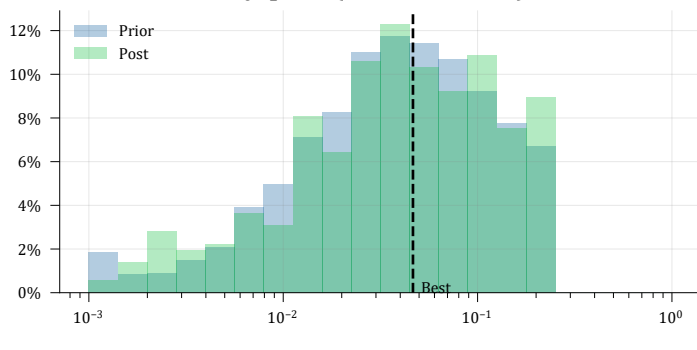
sy_p262(Pilot_Point_L1)



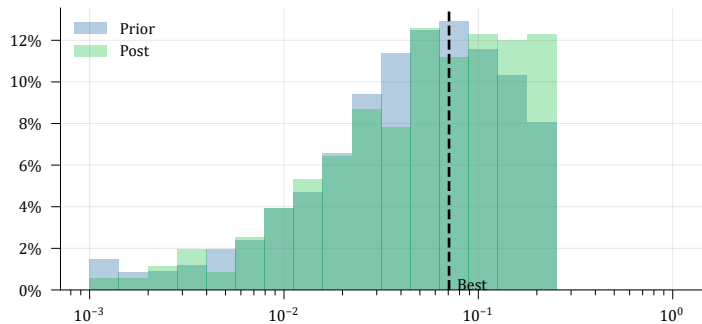
sy_p263(Pilot_Point_L1)



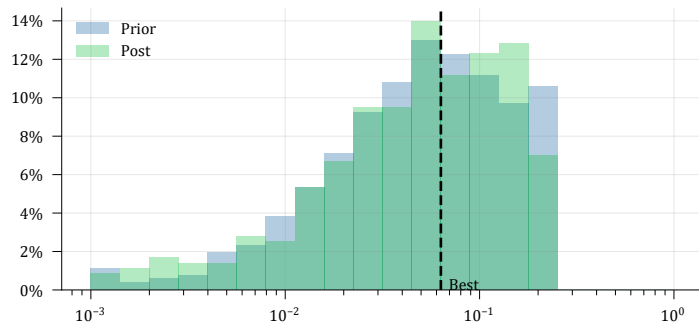
sy_p264(Pilot_Point_L1)



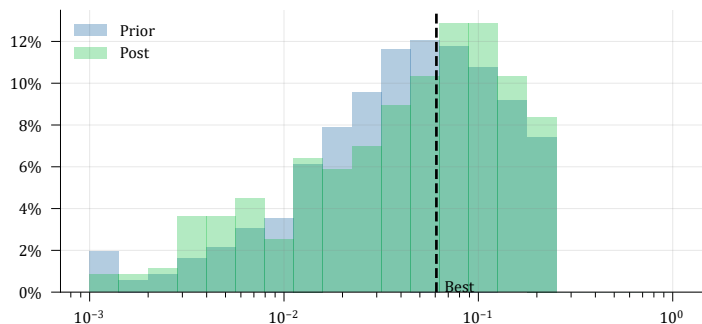
sy_p265(Pilot_Point_L1)



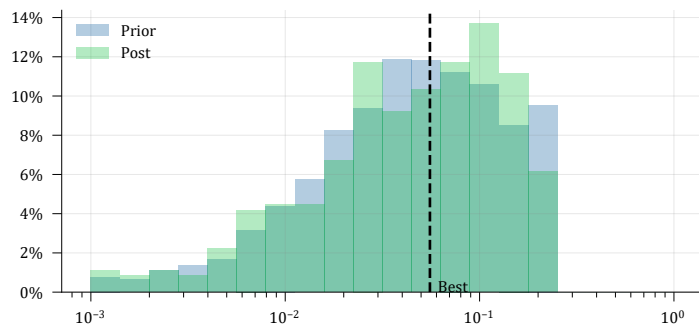
sy_p266(Pilot_Point_L1)



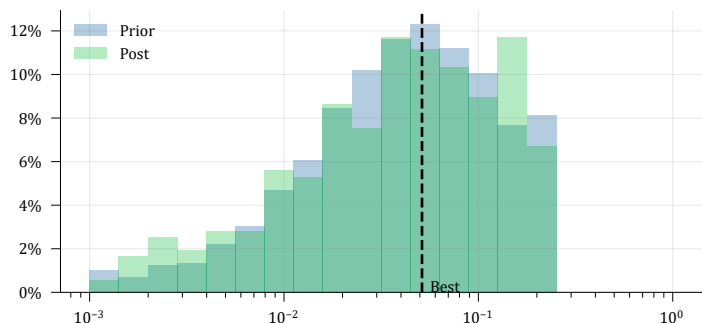
sy_p267(Pilot_Point_L1)



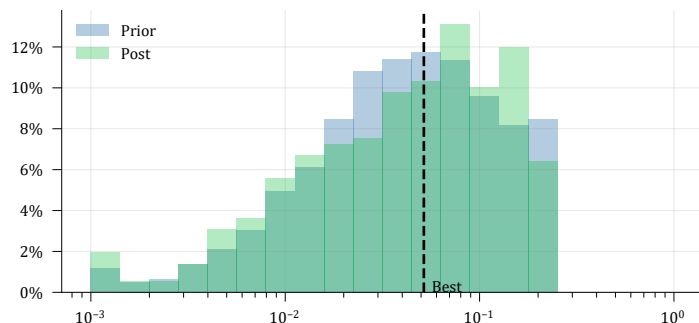
sy_p268(Pilot_Point_L1)



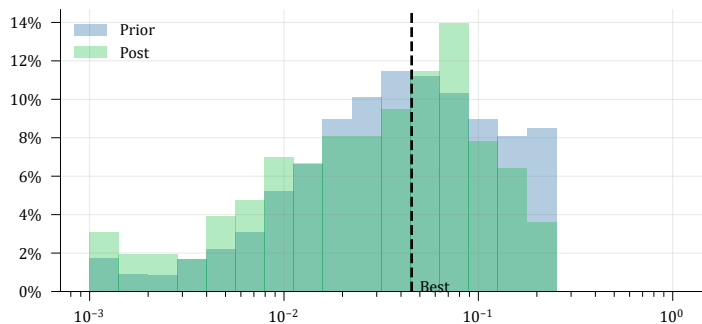
sy_p269(Pilot_Point_L1)



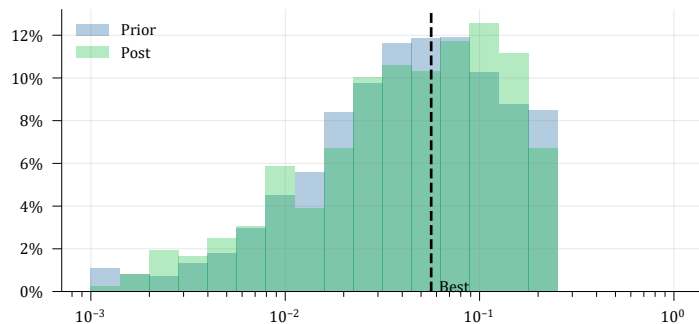
sy_p270(Pilot_Point_L1)



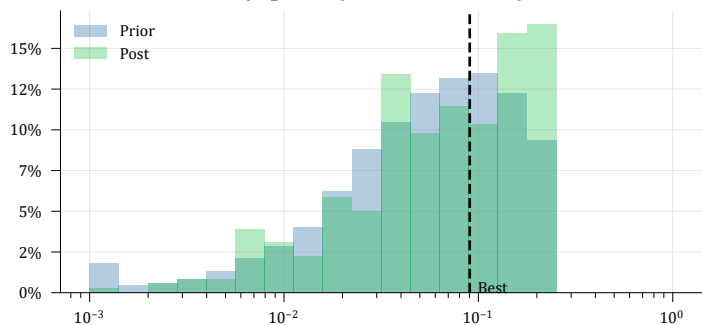
sy_p271(Pilot_Point_L1)



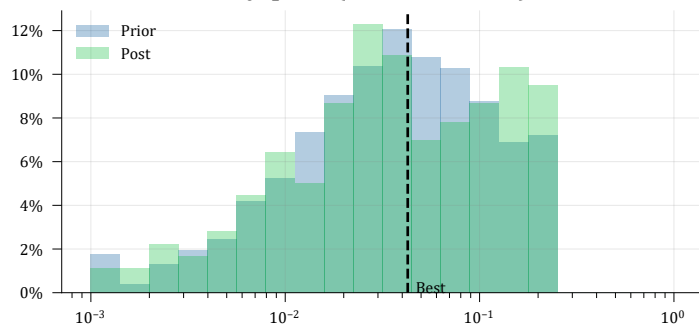
sy_p272(Pilot_Point_L1)



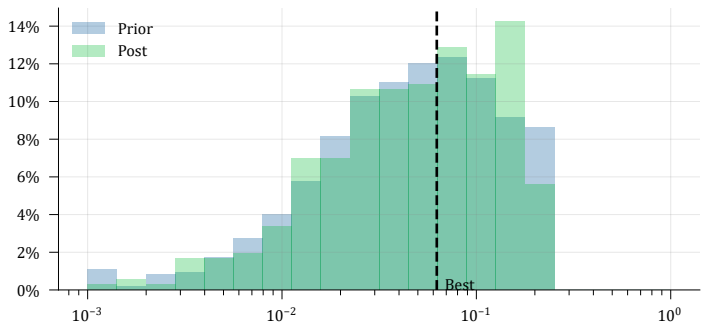
sy_p273(Pilot_Point_L1)



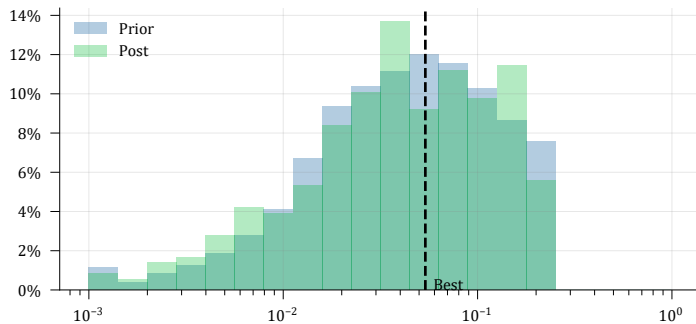
sy_p274(Pilot_Point_L1)



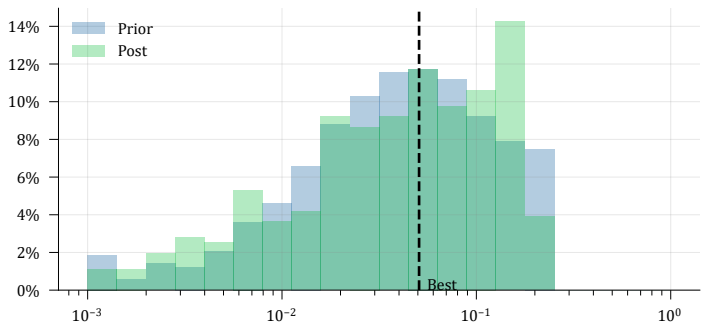
sy_p275(Pilot_Point_L1)



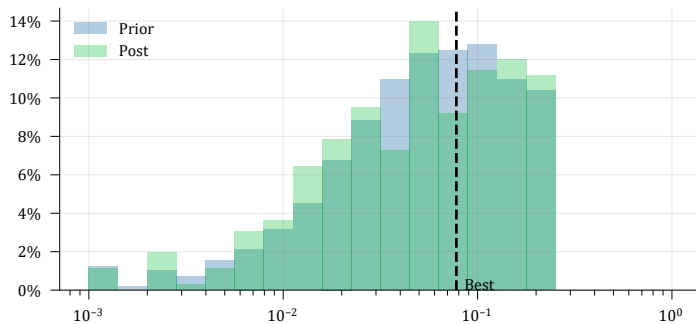
sy_p276(Pilot_Point_L1)



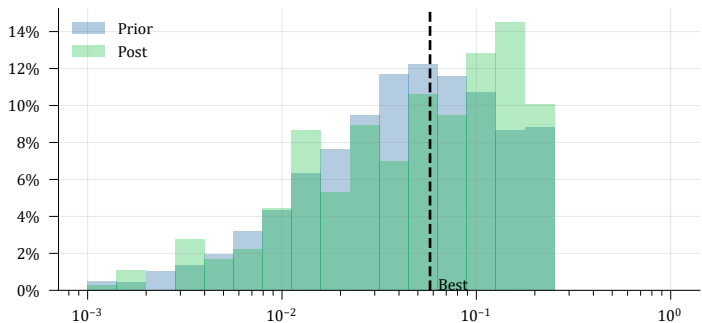
sy_p277(Pilot_Point_L1)



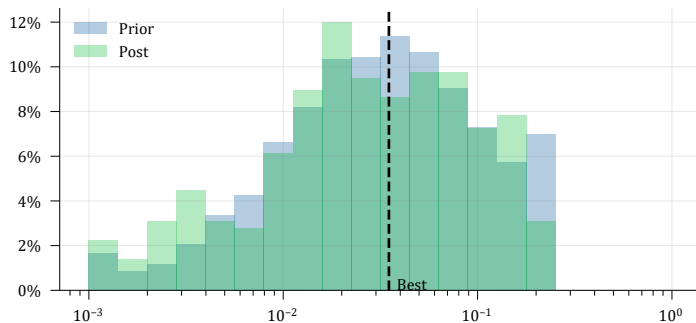
sy_p278(Pilot_Point_L1)



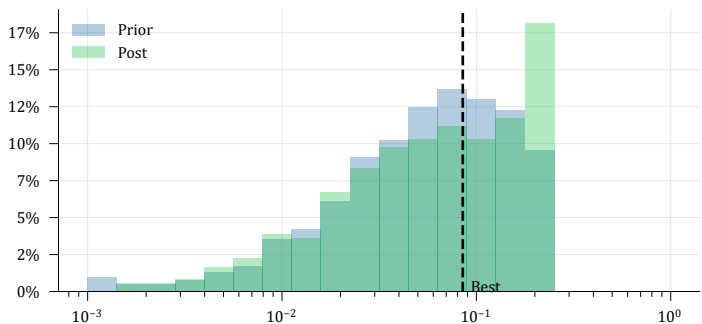
sy_p279(Pilot_Point_L1)



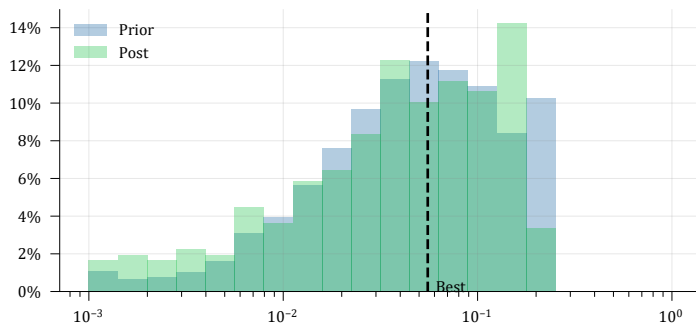
sy_p280(Pilot_Point_L1)



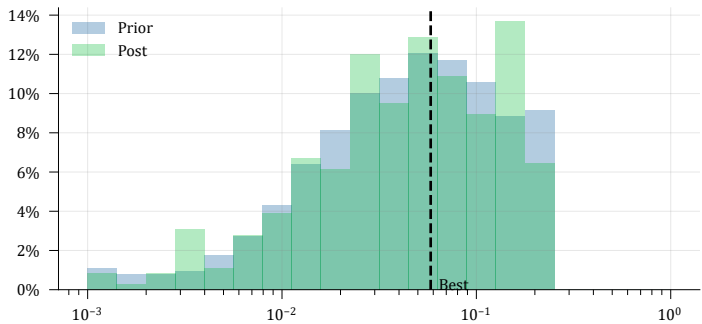
sy_p281(Pilot_Point_L1)



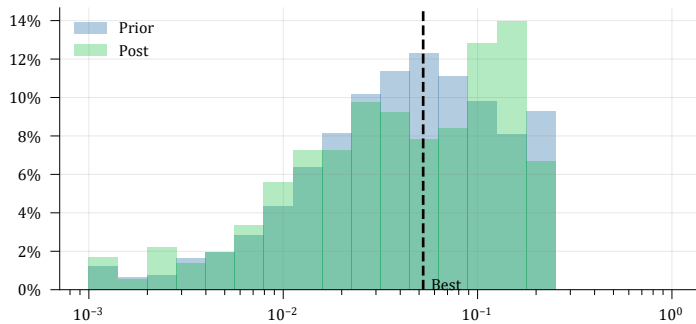
sy_p282(Pilot_Point_L1)

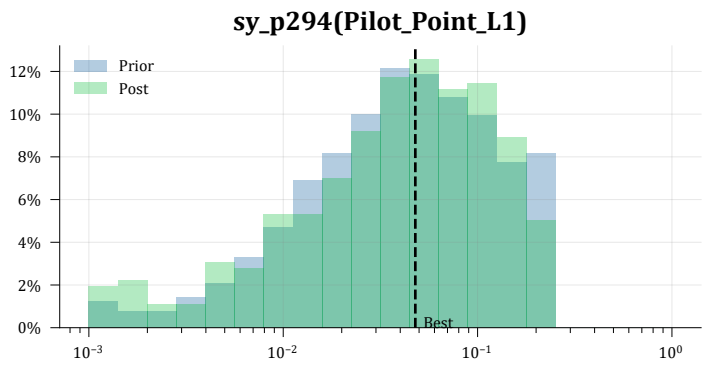
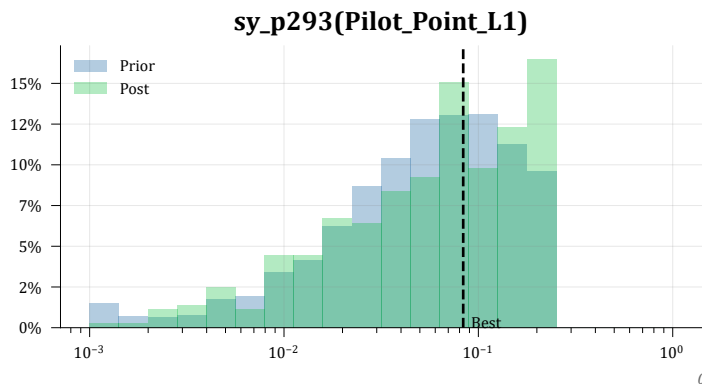
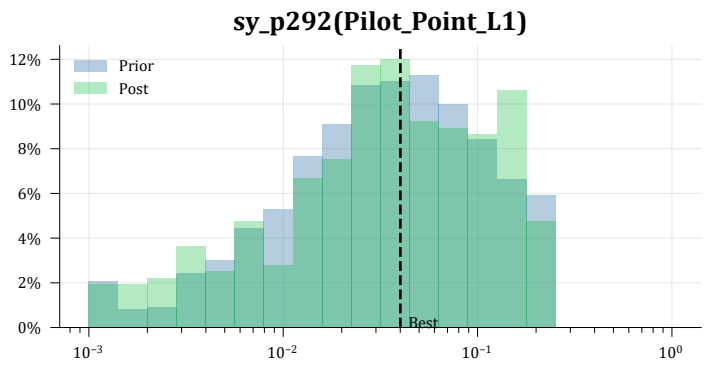
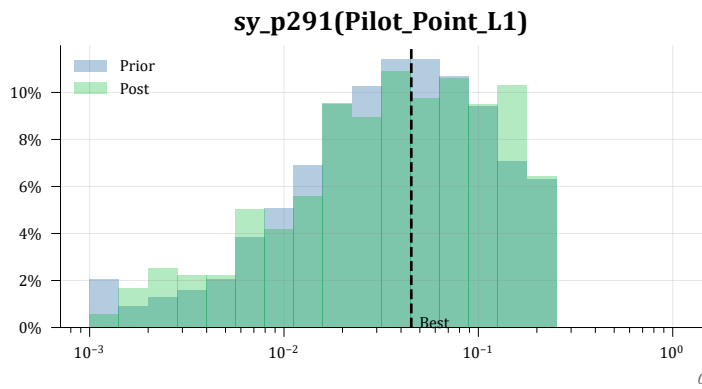
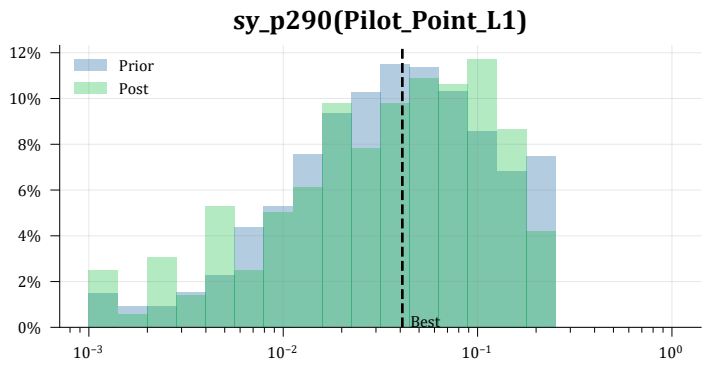
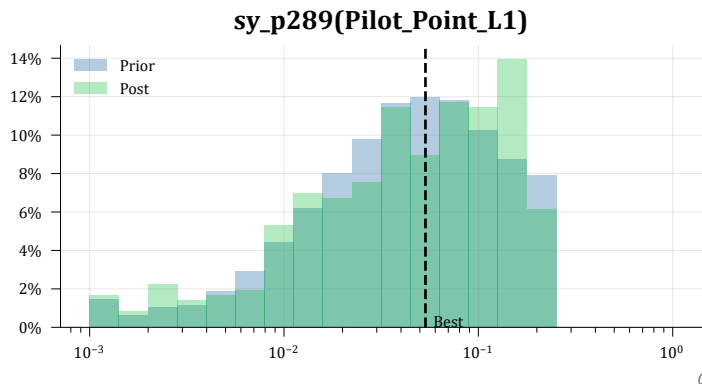
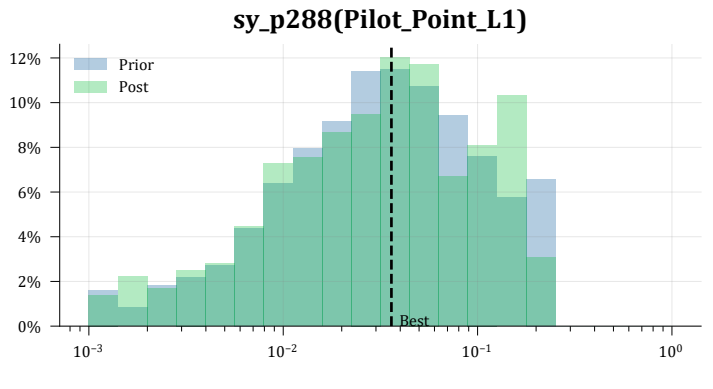
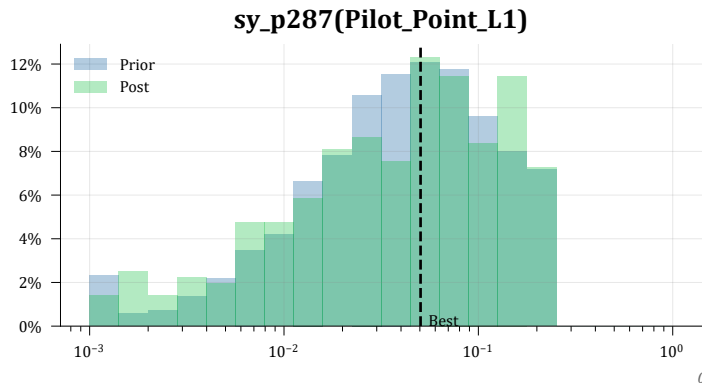
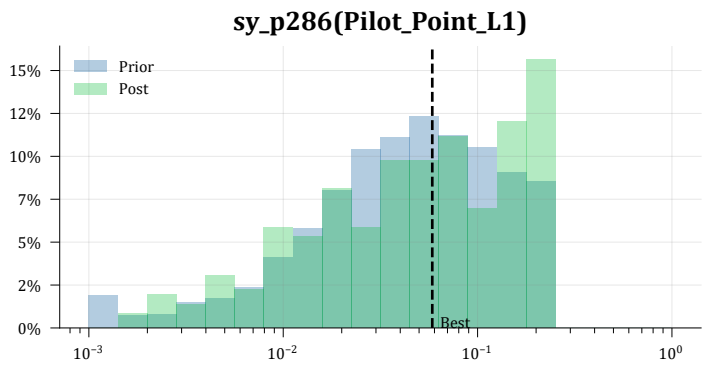
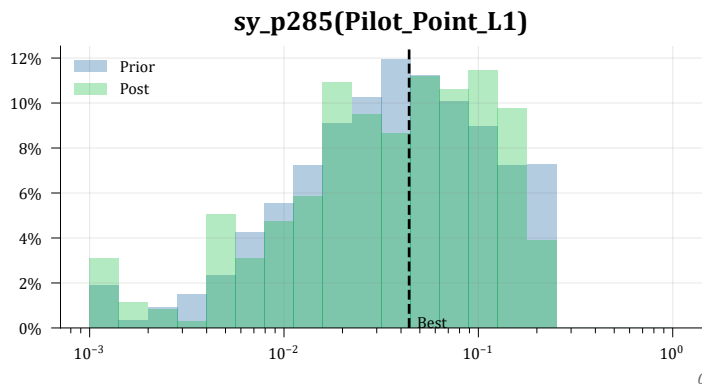


sy_p283(Pilot_Point_L1)

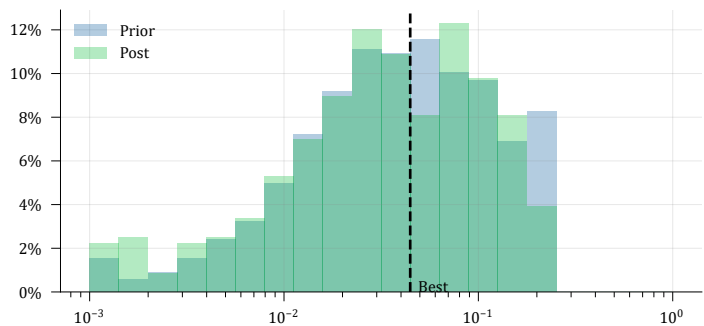


sy_p284(Pilot_Point_L1)

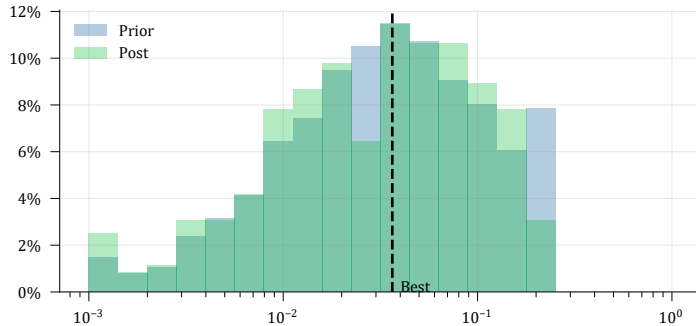




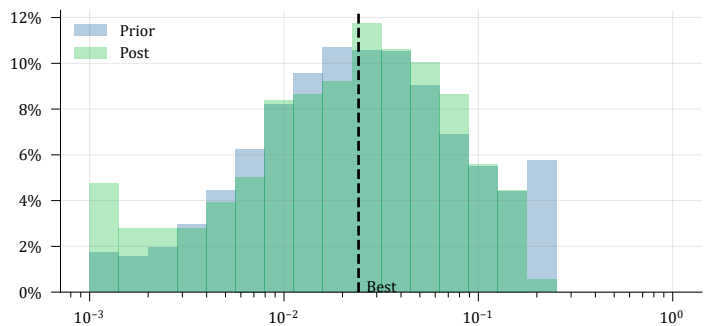
sy_p295(Pilot_Point_L1)



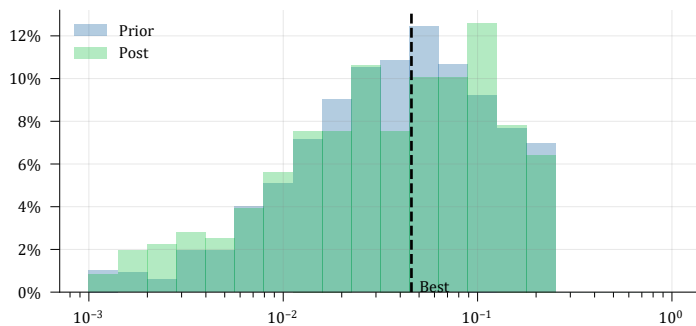
sy_p296(Pilot_Point_L1)



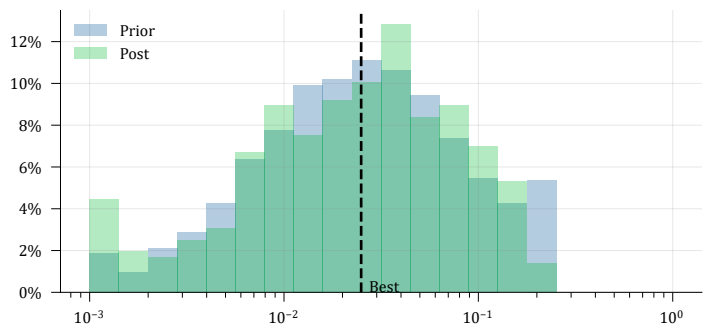
sy_p297(Pilot_Point_L1)



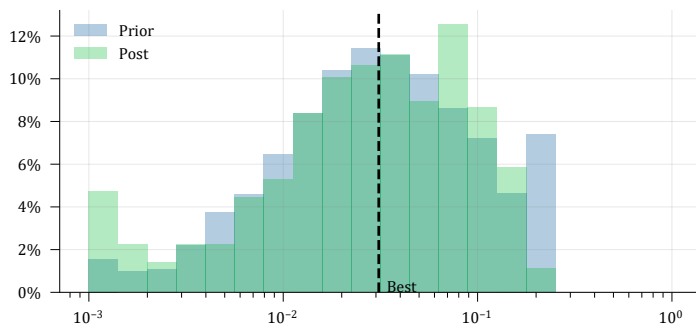
sy_p298(Pilot_Point_L1)



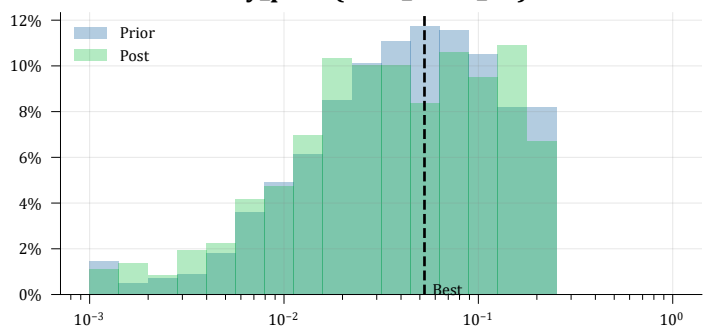
sy_p299(Pilot_Point_L1)



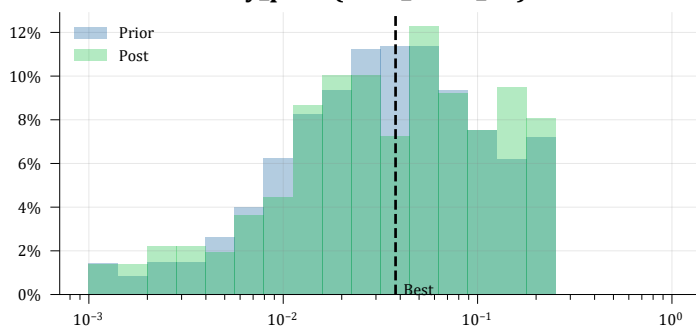
sy_p300(Pilot_Point_L1)



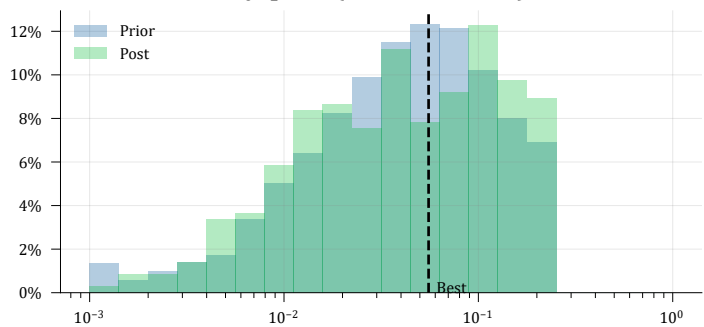
sy_p301(Pilot_Point_L1)



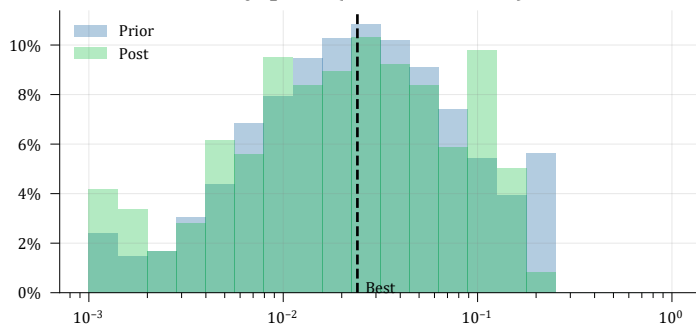
sy_p302(Pilot_Point_L1)

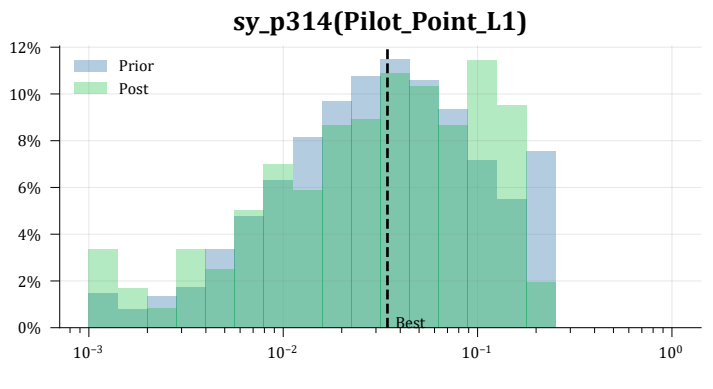
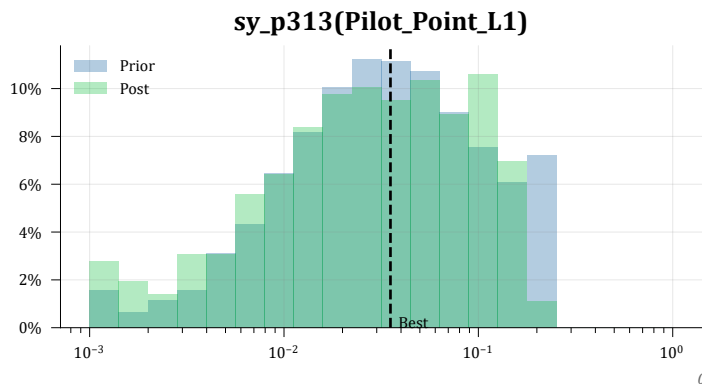
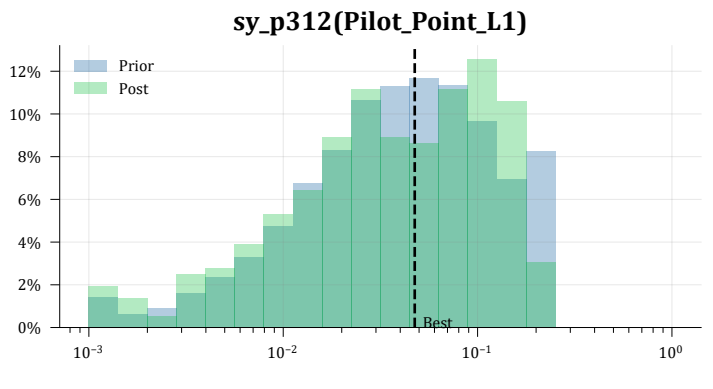
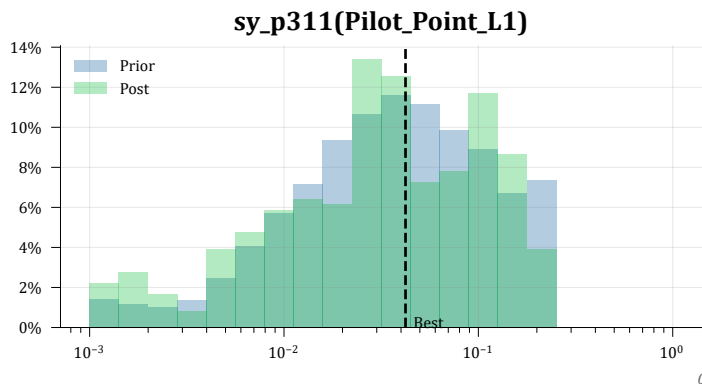
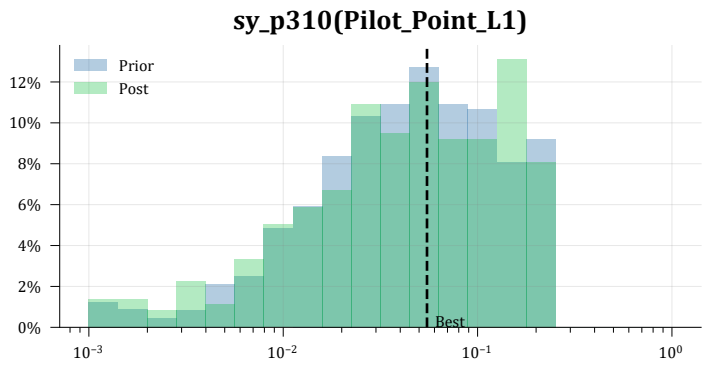
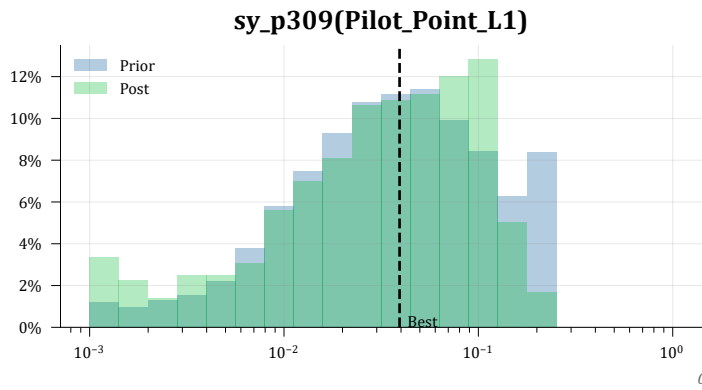
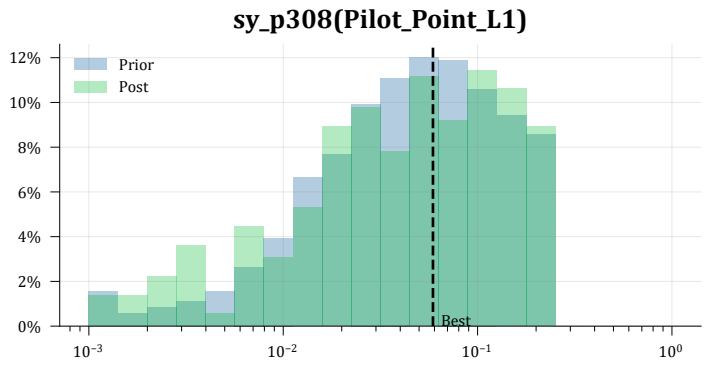
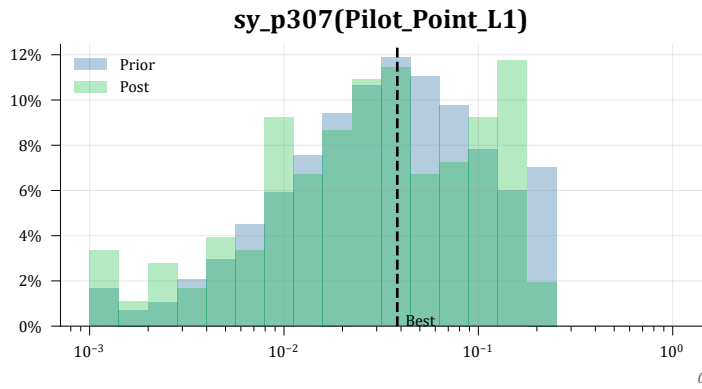
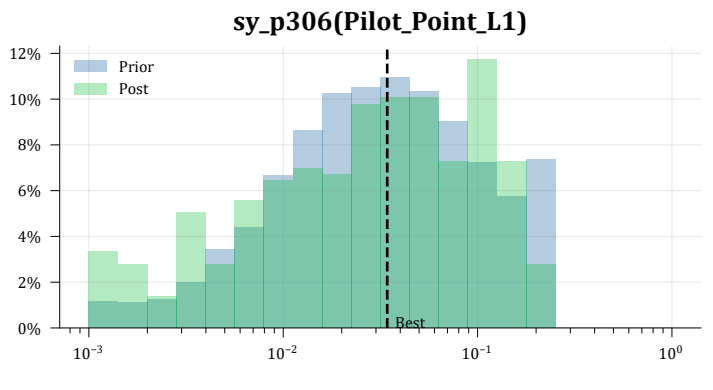
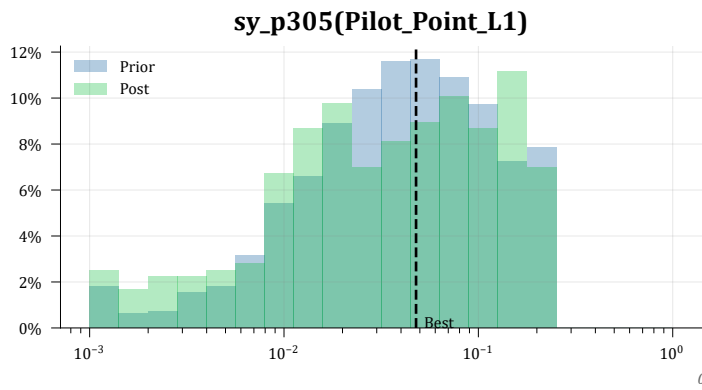


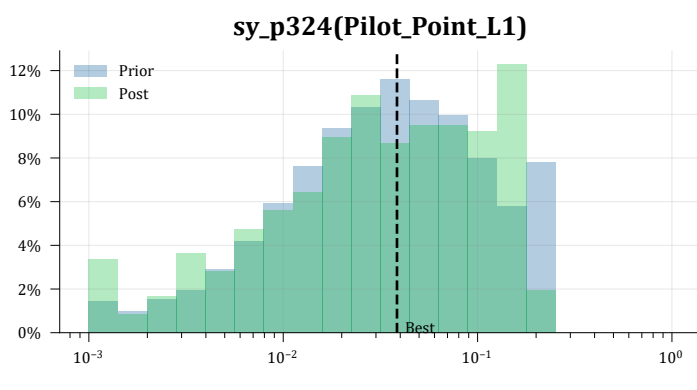
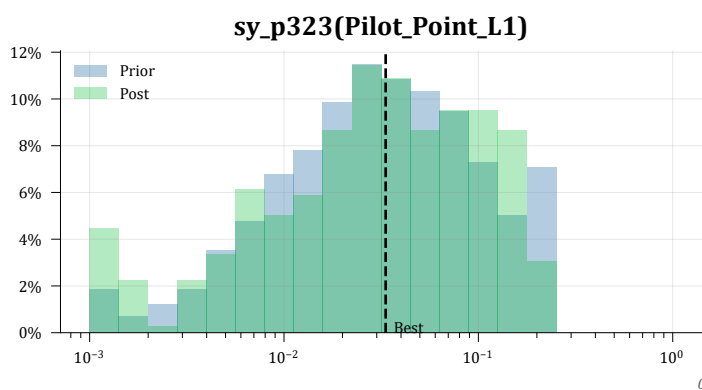
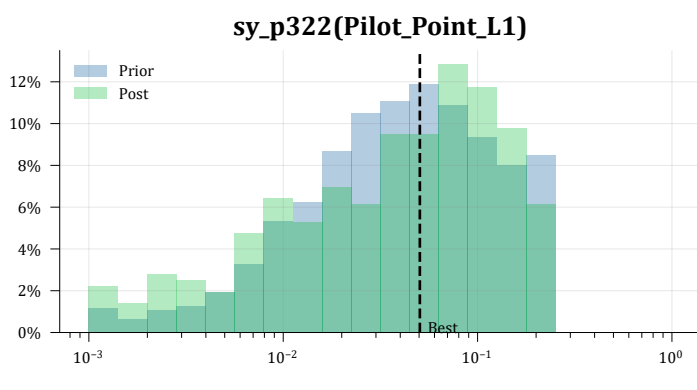
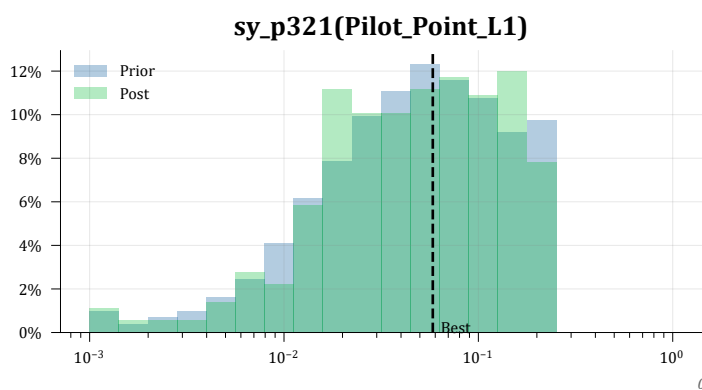
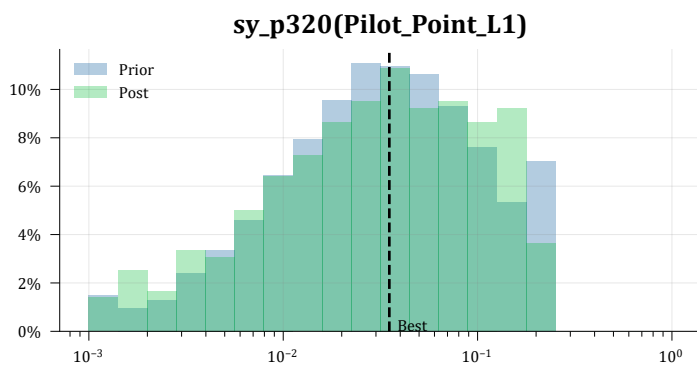
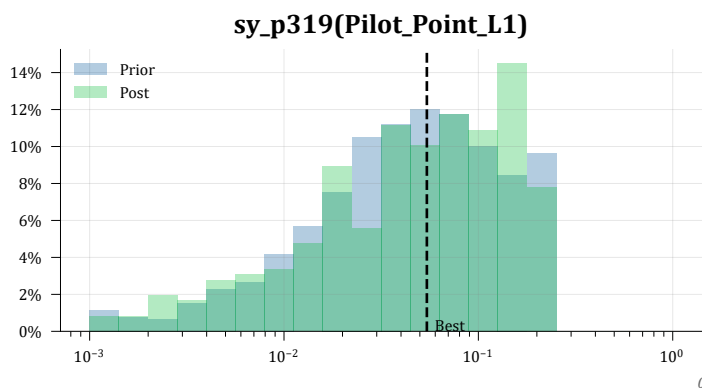
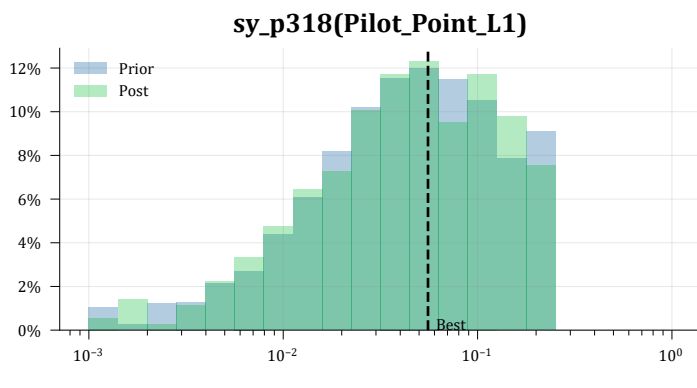
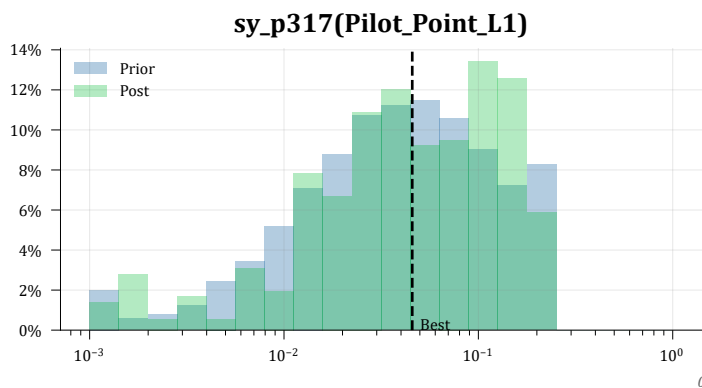
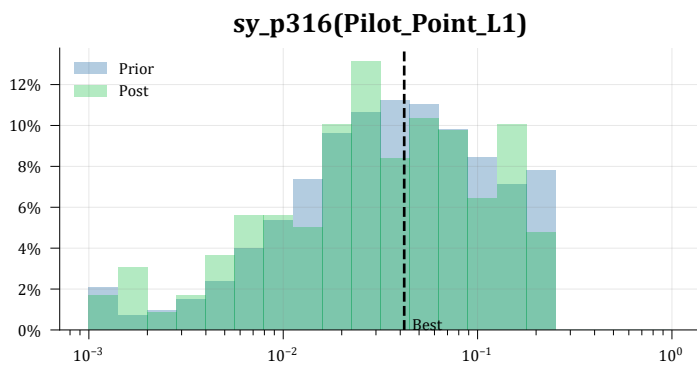
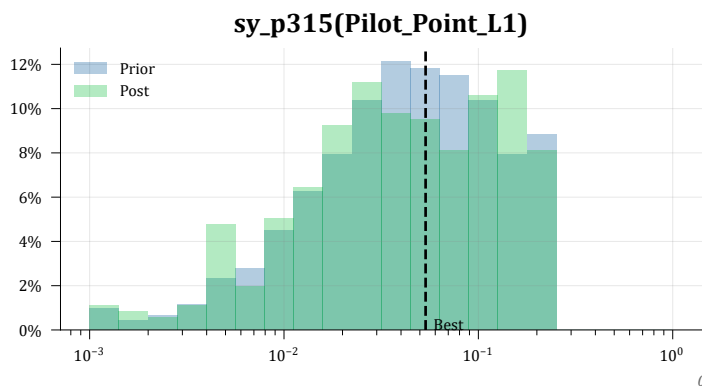
sy_p303(Pilot_Point_L1)



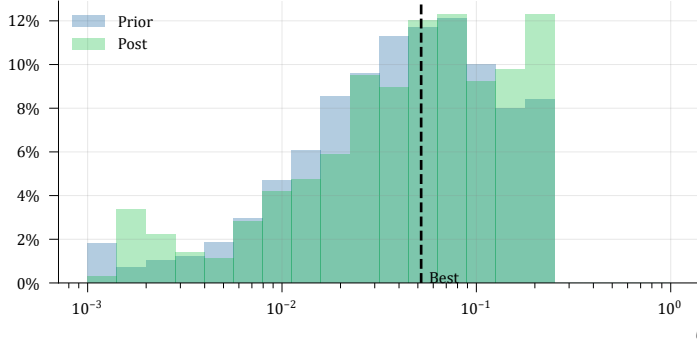
sy_p304(Pilot_Point_L1)



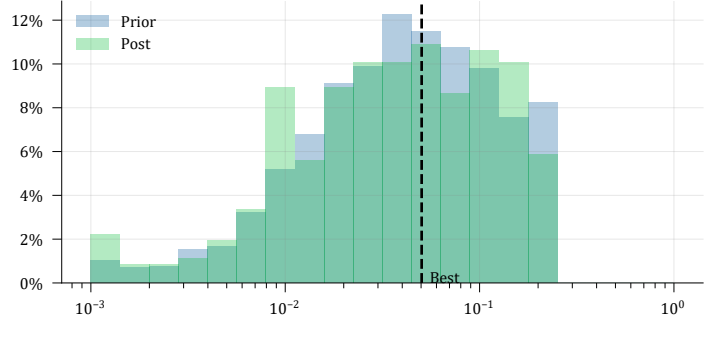




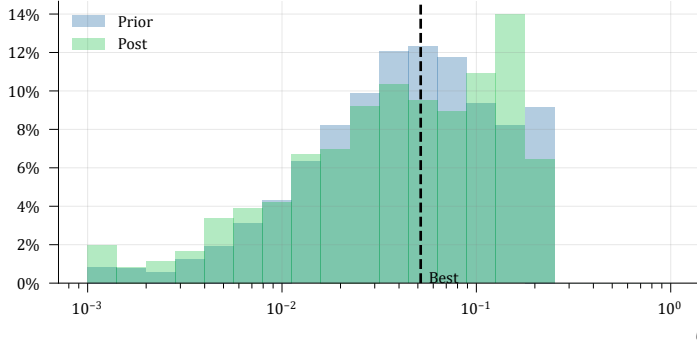
sy_p325(Pilot_Point_L1)



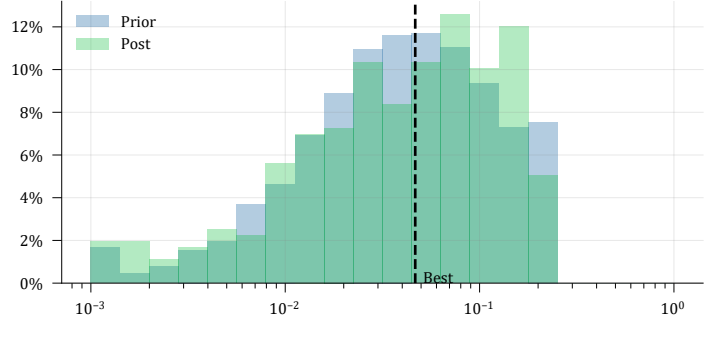
sy_p326(Pilot_Point_L1)



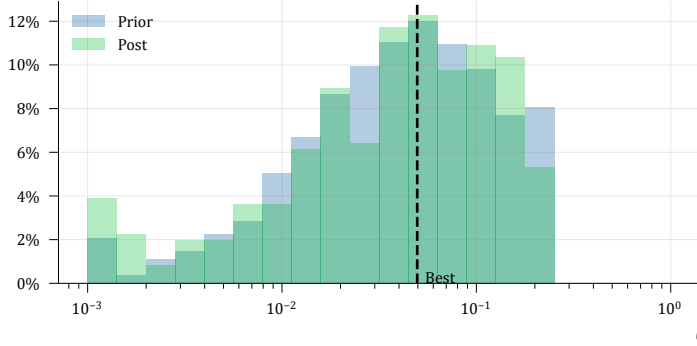
sy_p327(Pilot_Point_L1)



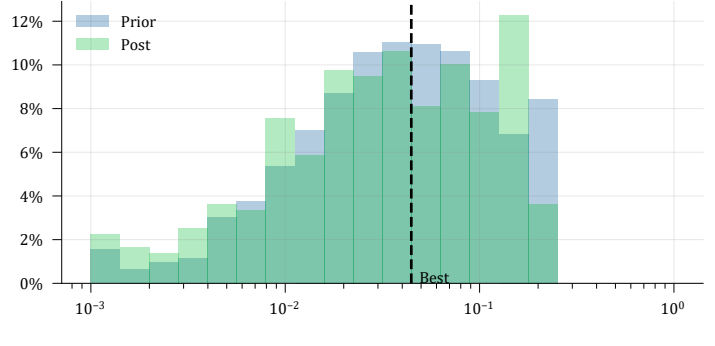
sy_p328(Pilot_Point_L1)



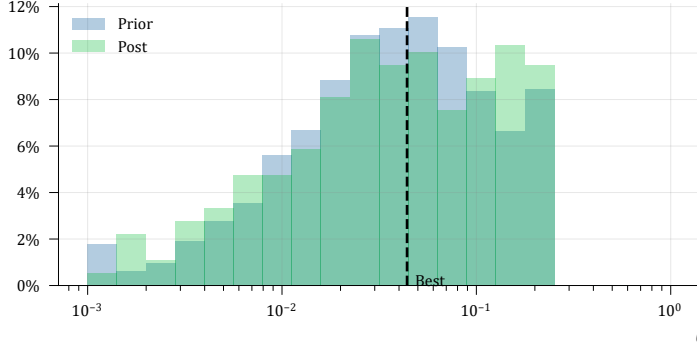
sy_p329(Pilot_Point_L1)



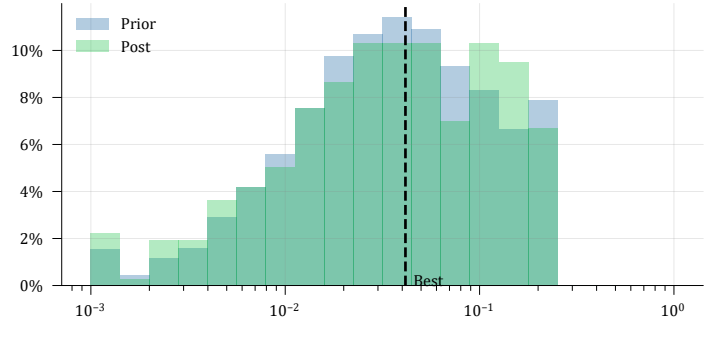
sy_p330(Pilot_Point_L1)



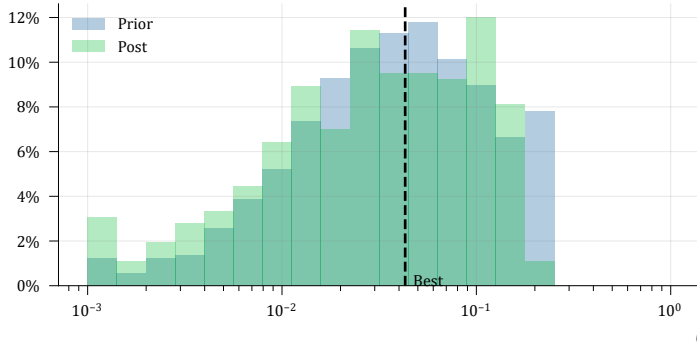
sy_p331(Pilot_Point_L1)



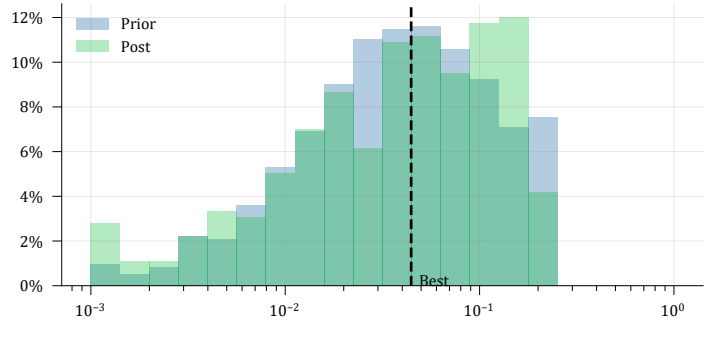
sy_p332(Pilot_Point_L1)



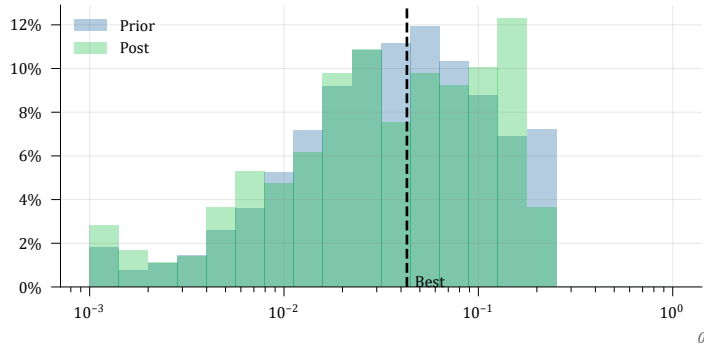
sy_p333(Pilot_Point_L1)



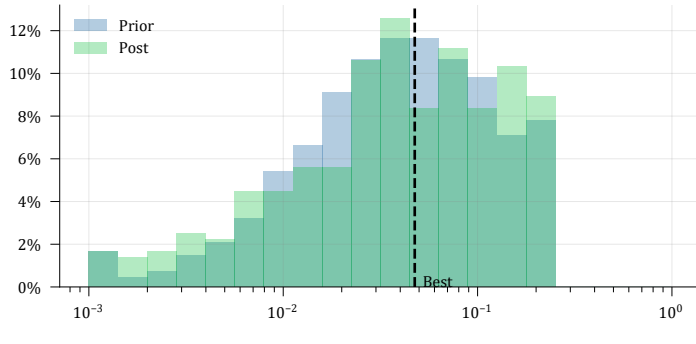
sy_p334(Pilot_Point_L1)



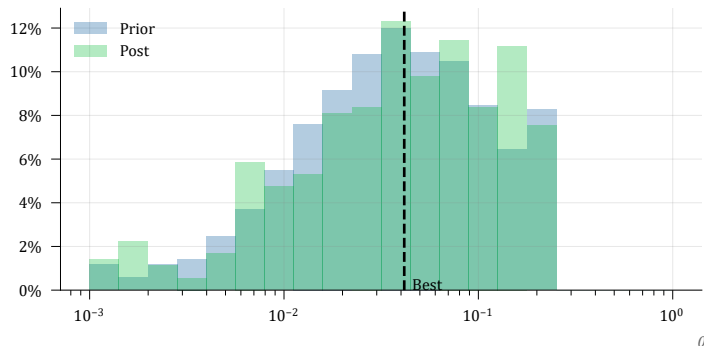
sy_p335(Pilot_Point_L1)



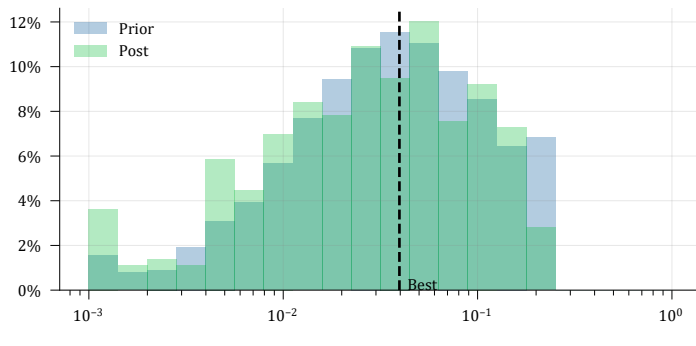
sy_p336(Pilot_Point_L1)



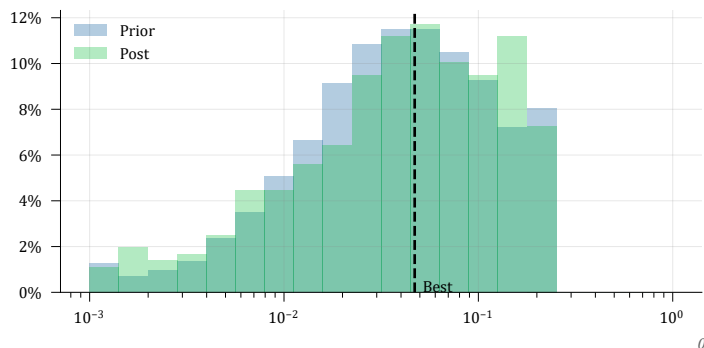
sy_p337(Pilot_Point_L1)



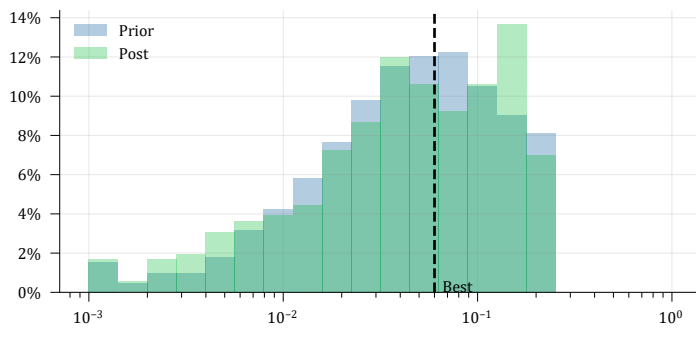
sy_p338(Pilot_Point_L1)



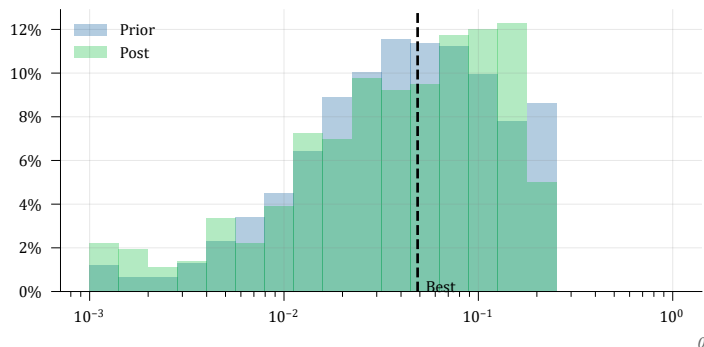
sy_p339(Pilot_Point_L1)



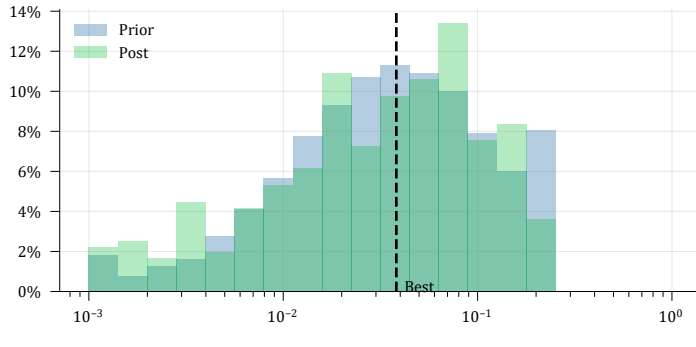
sy_p340(Pilot_Point_L1)



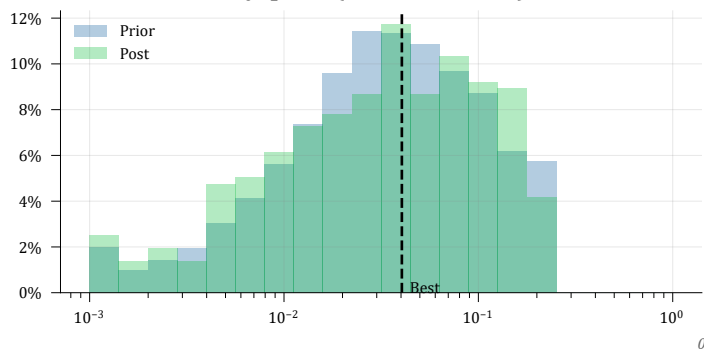
sy_p341(Pilot_Point_L1)



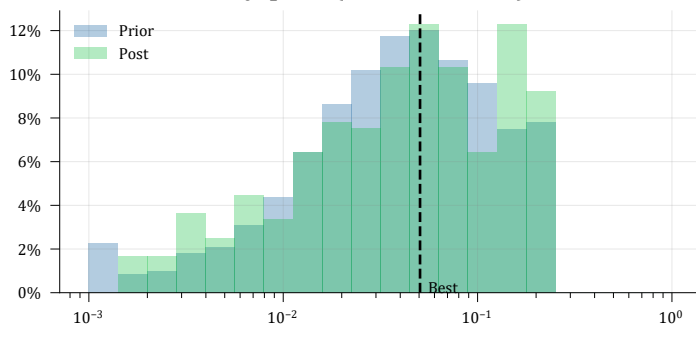
sy_p342(Pilot_Point_L1)

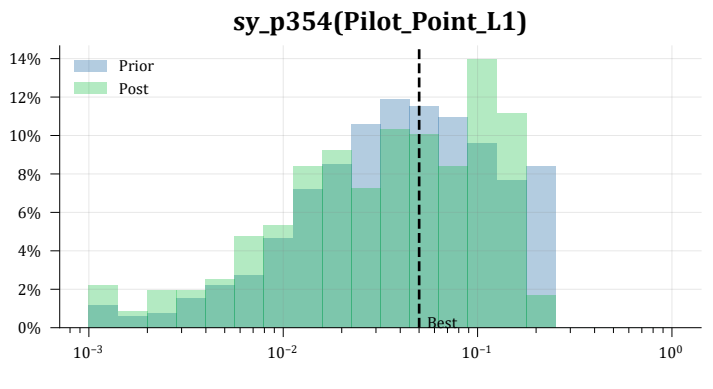
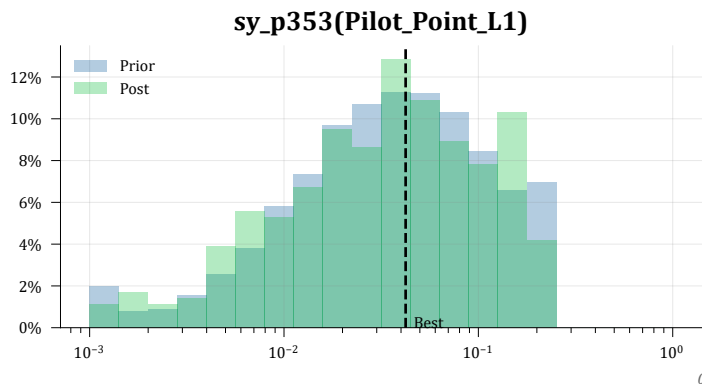
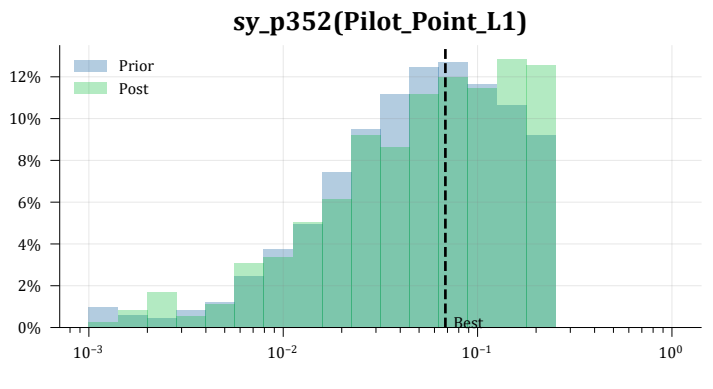
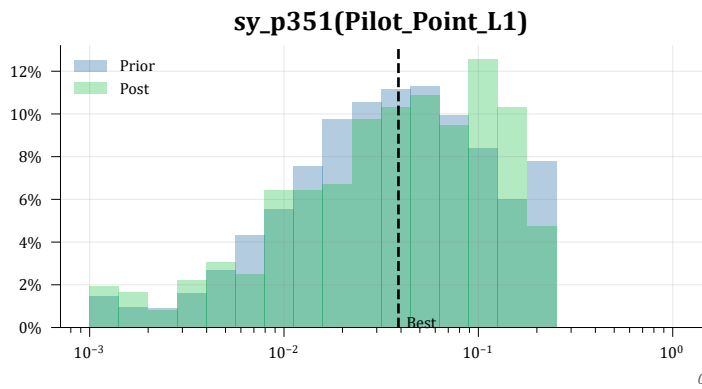
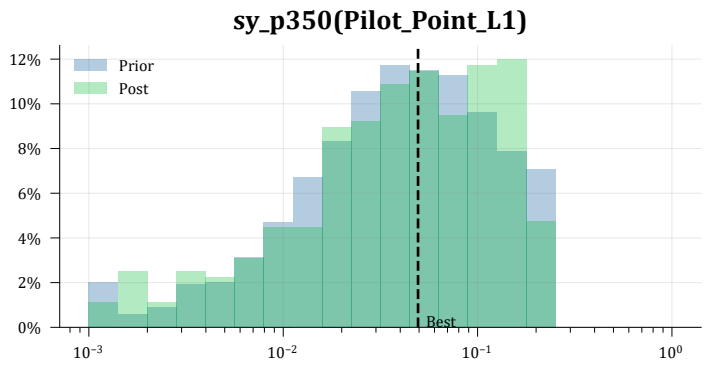
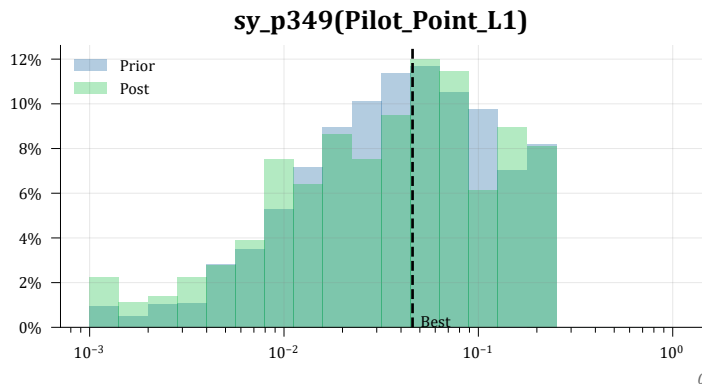
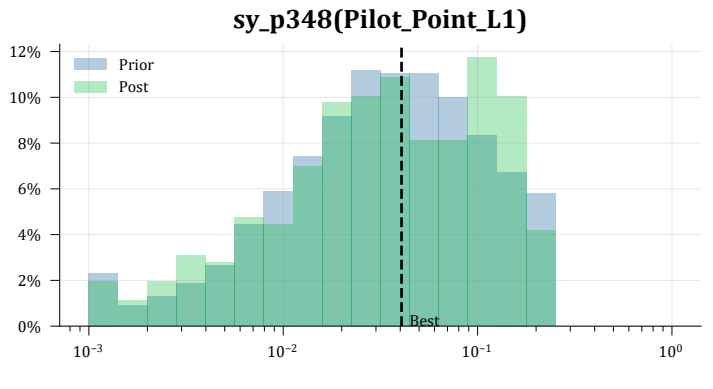
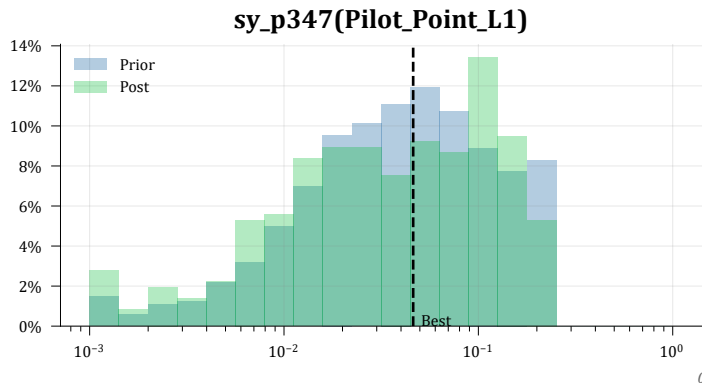
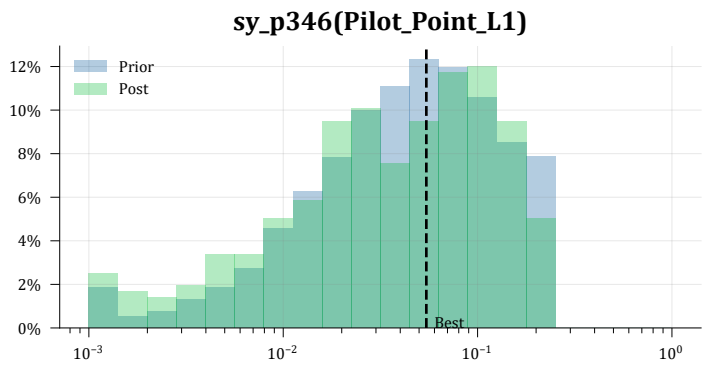
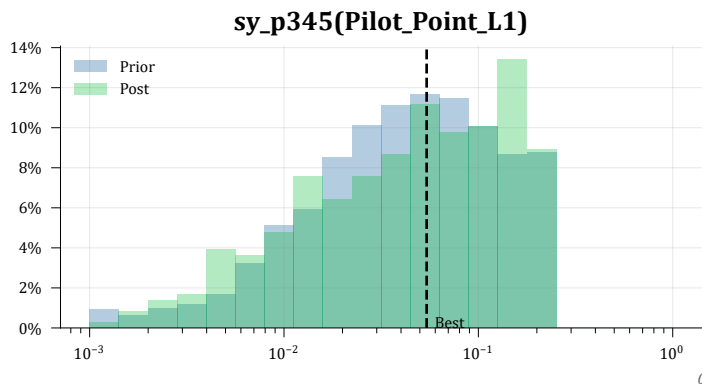


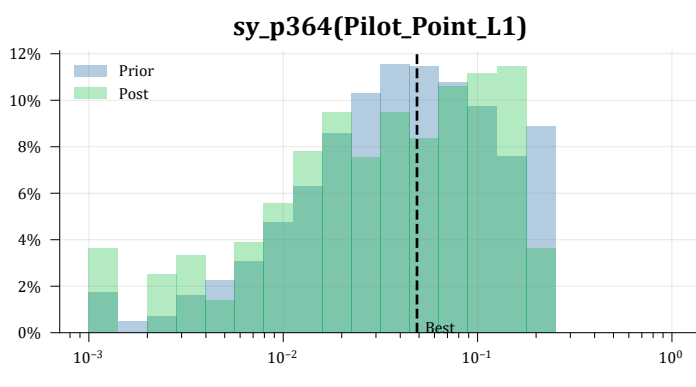
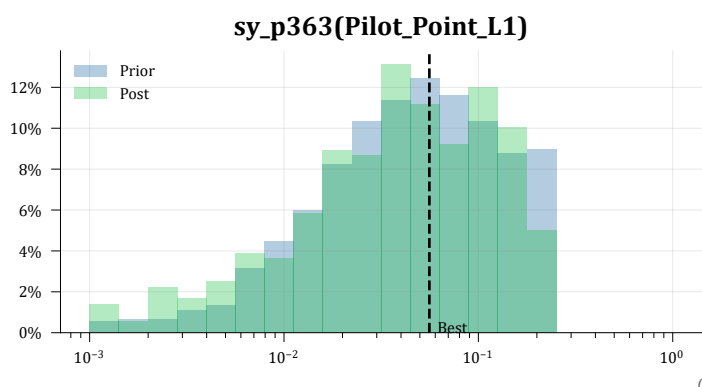
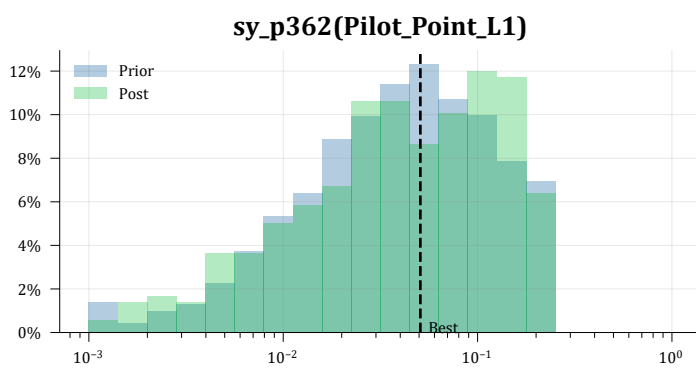
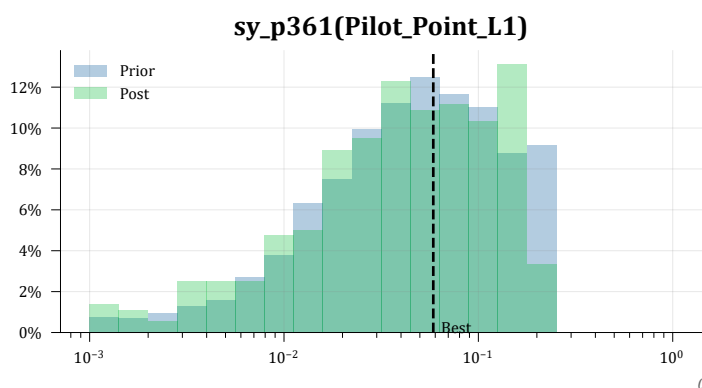
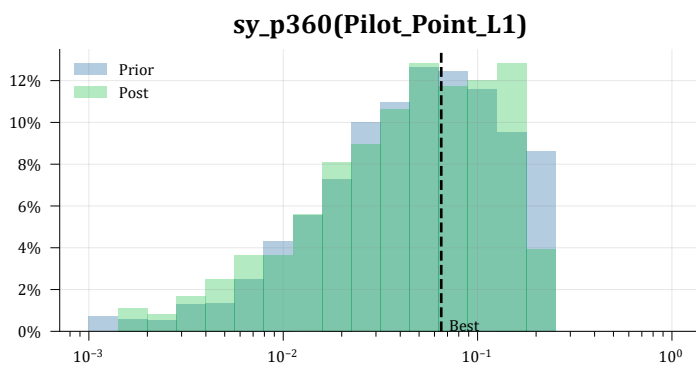
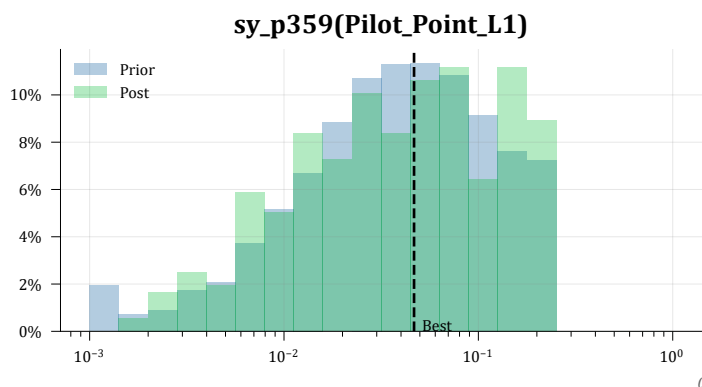
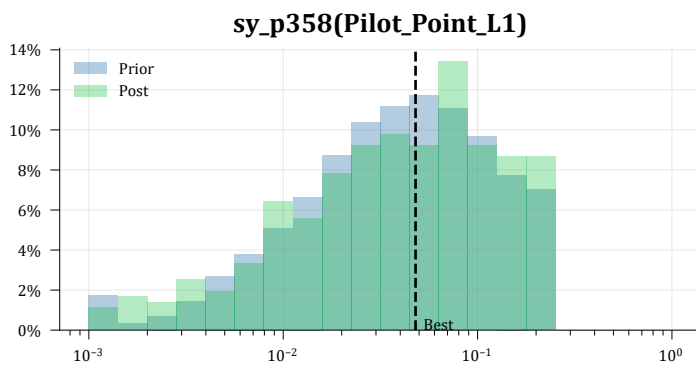
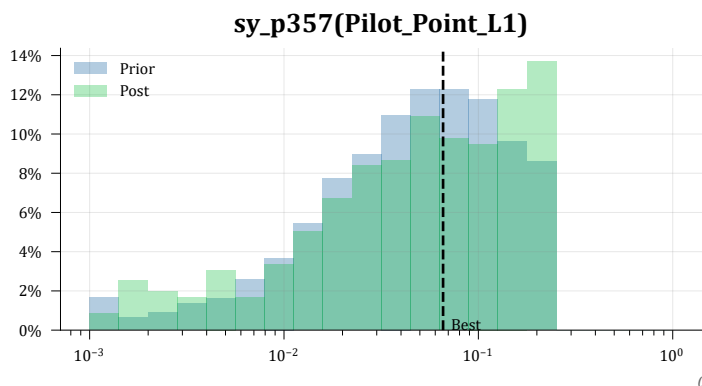
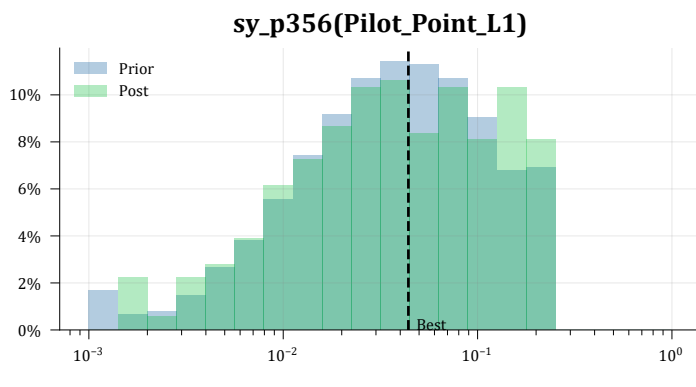
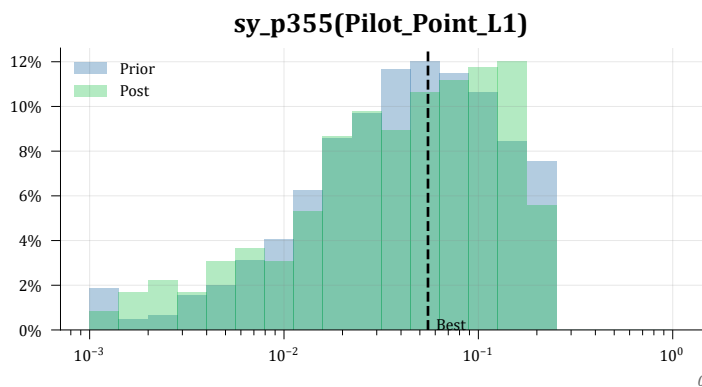
sy_p343(Pilot_Point_L1)

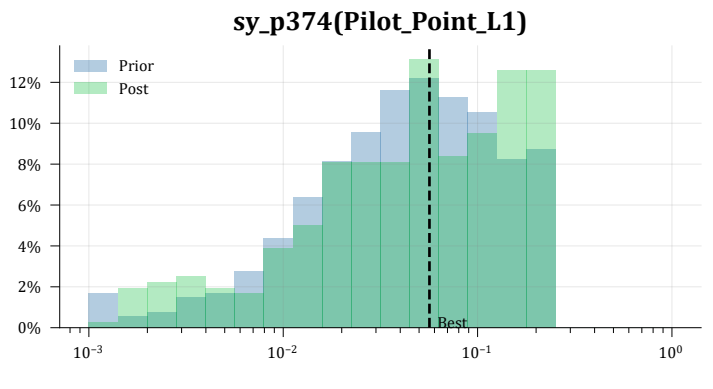
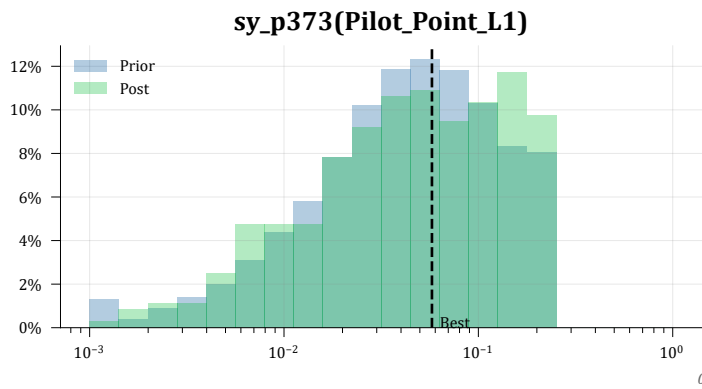
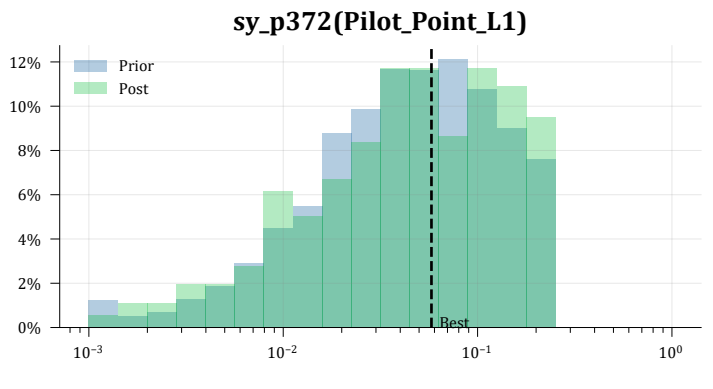
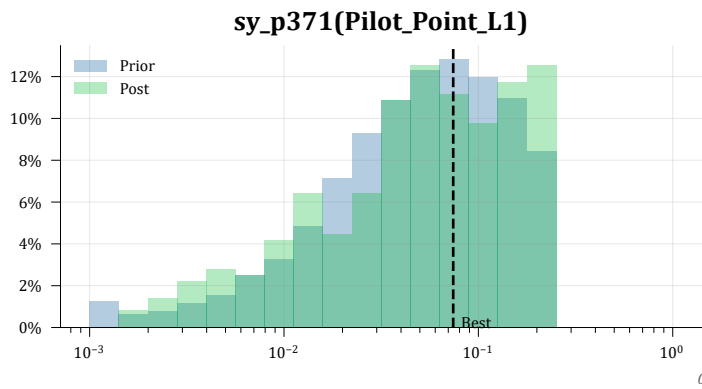
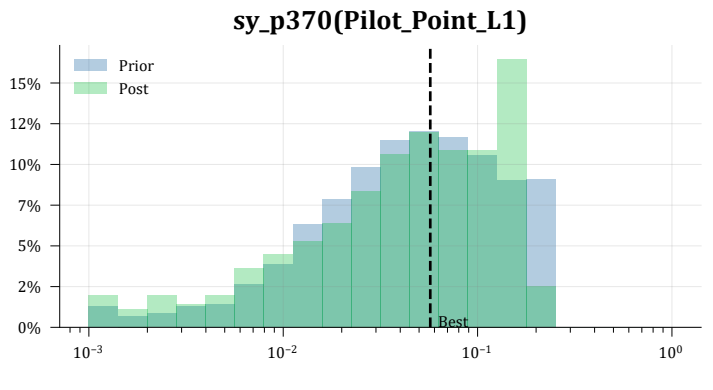
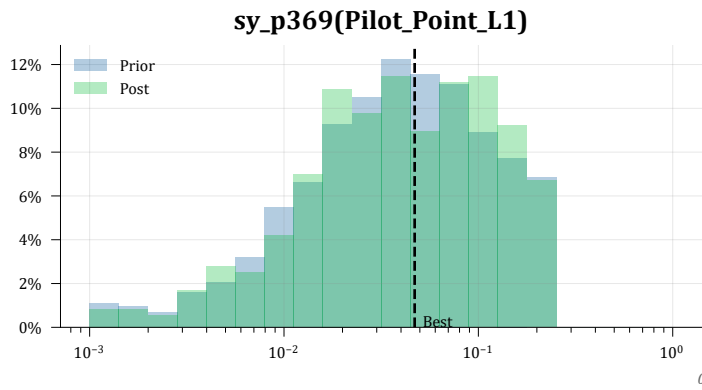
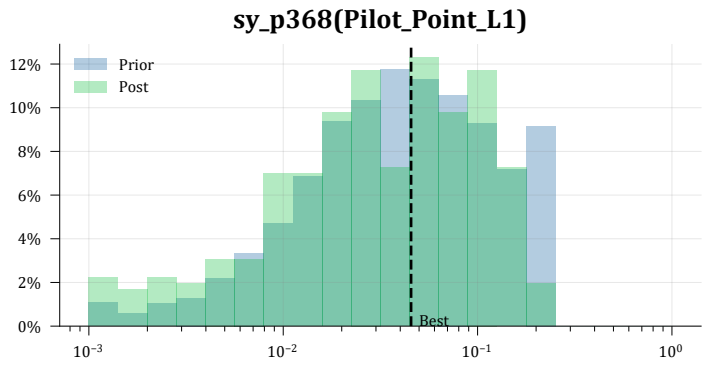
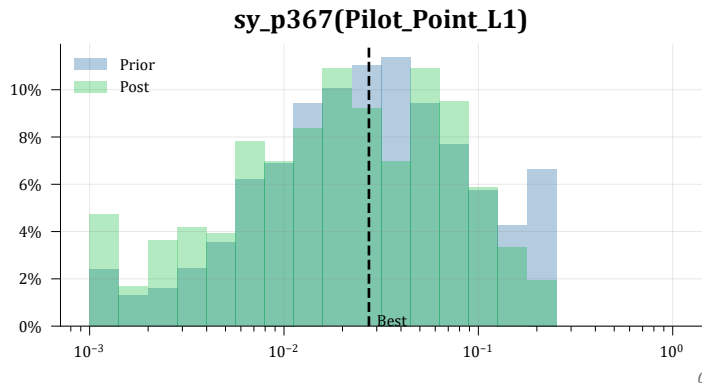
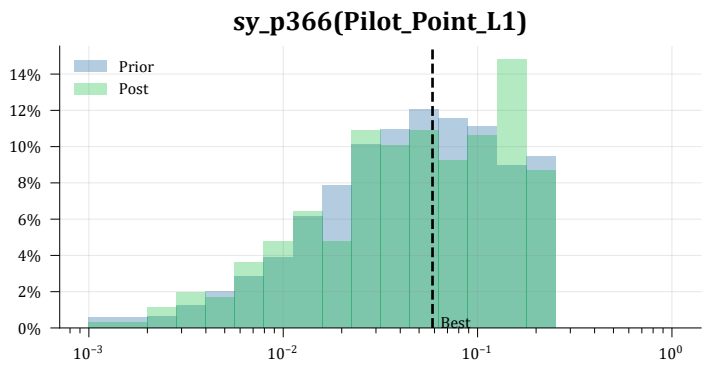
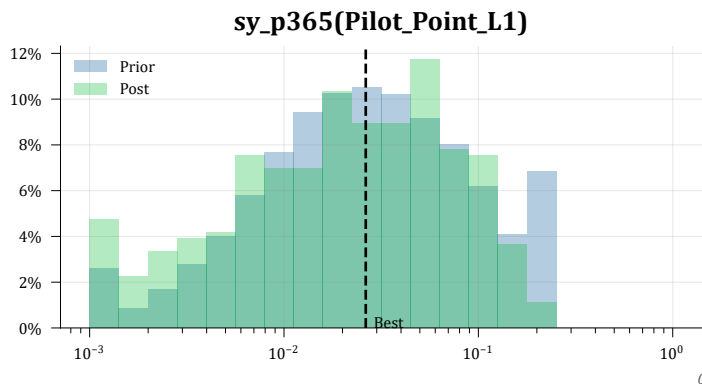


sy_p344(Pilot_Point_L1)

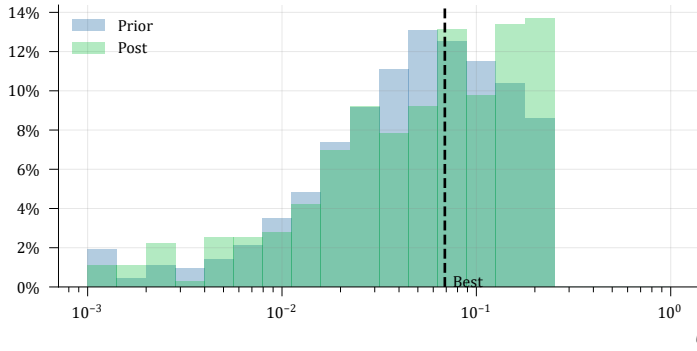




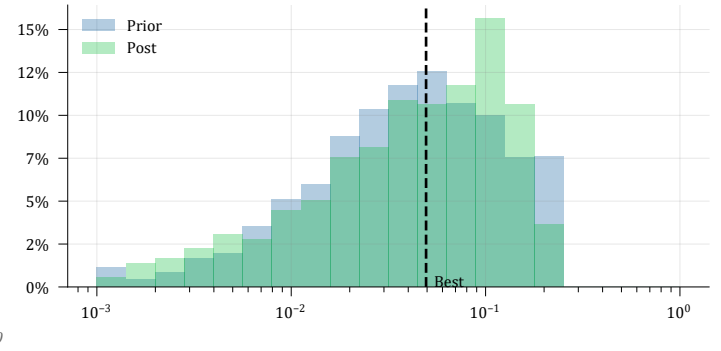




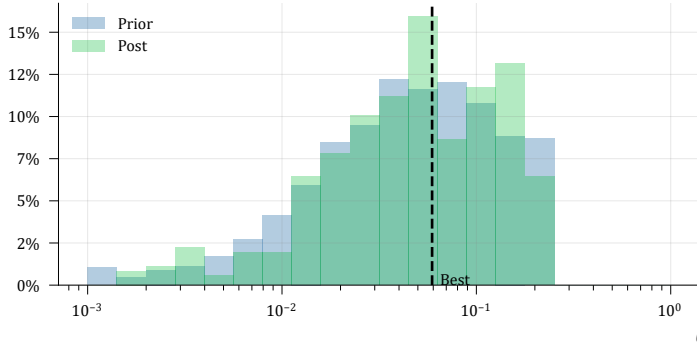
sy_p375(Pilot_Point_L1)



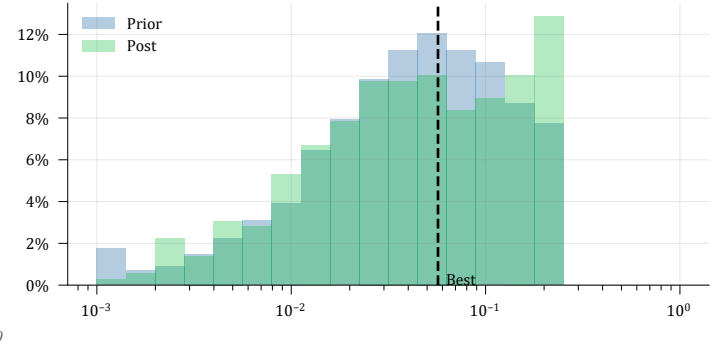
sy_p376(Pilot_Point_L1)



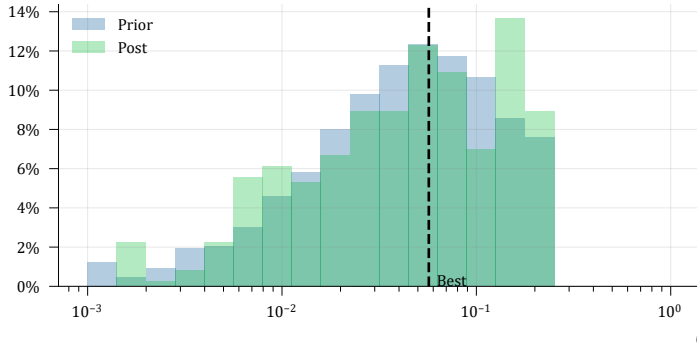
sy_p377(Pilot_Point_L1)



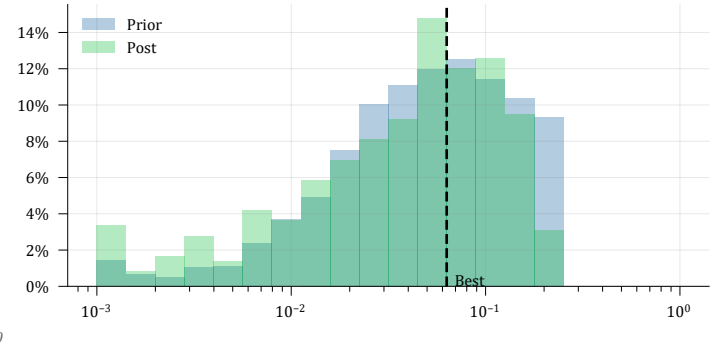
sy_p378(Pilot_Point_L1)



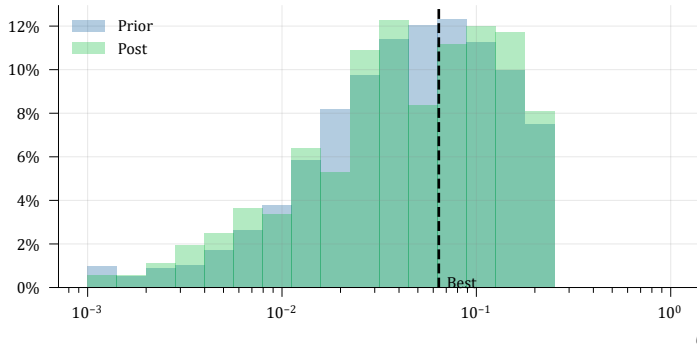
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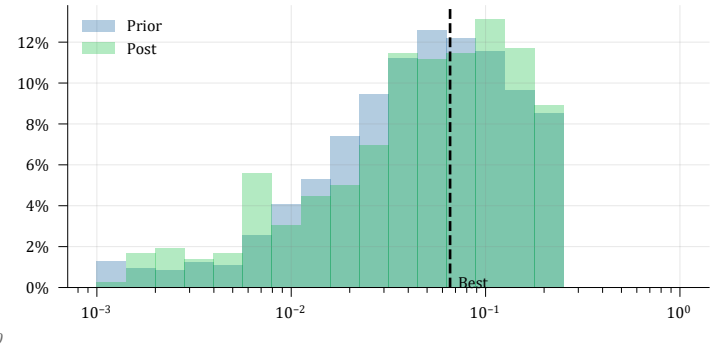
sy_p380(Pilot_Point_L1)



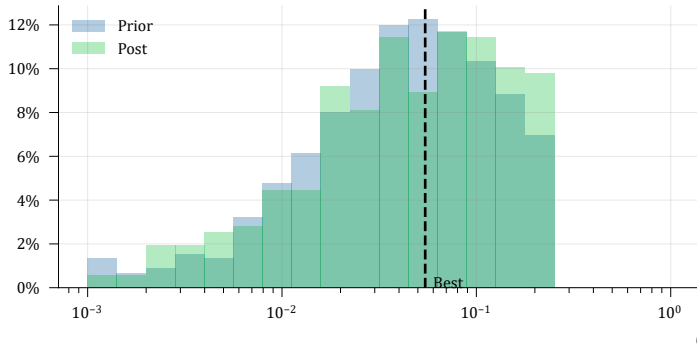
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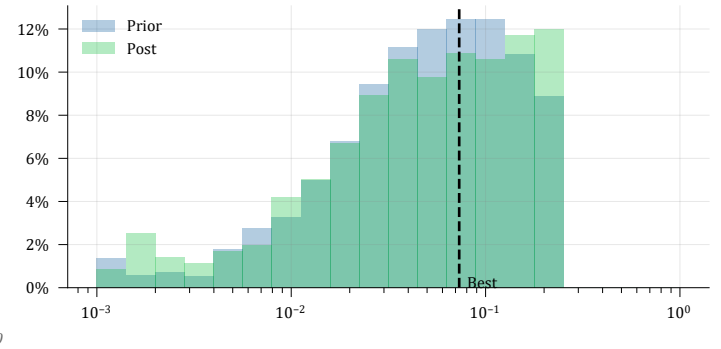
sy_p382(Pilot_Point_L1)



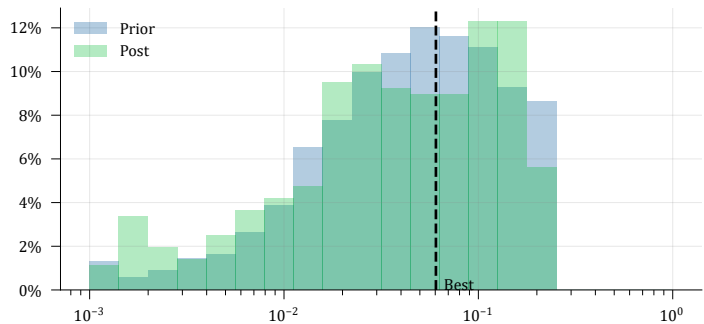
sy_p383(Pilot_Point_L1)



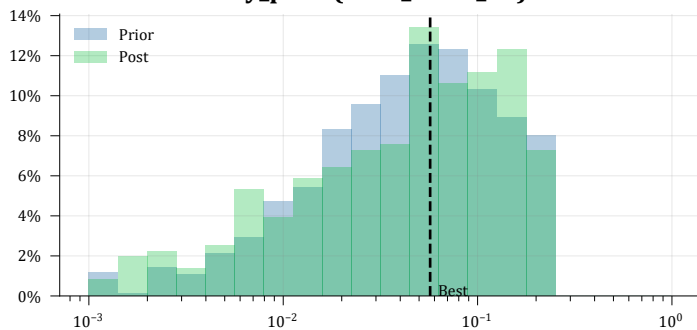
sy_p384(Pilot_Point_L1)



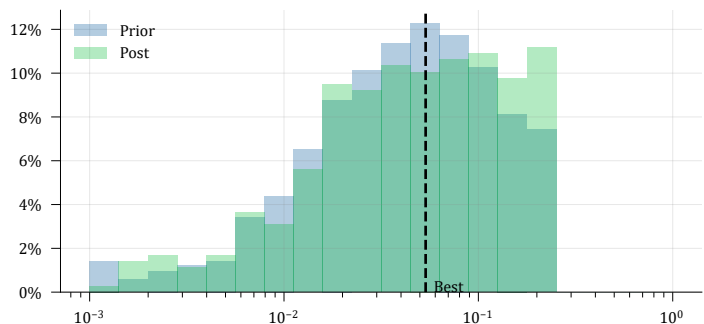
sy_p385(Pilot_Point_L1)



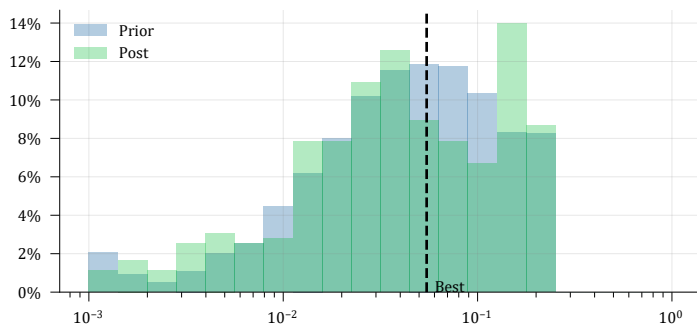
sy_p386(Pilot_Point_L1)



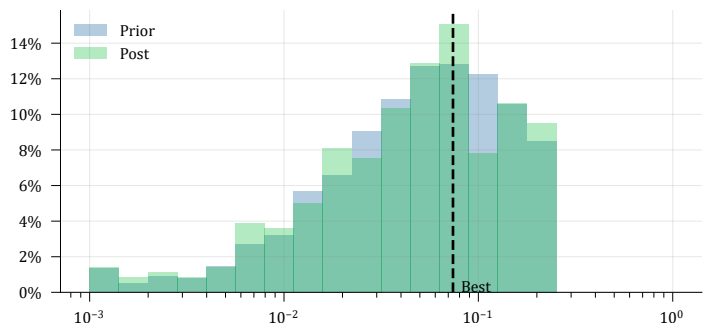
sy_p387(Pilot_Point_L1)



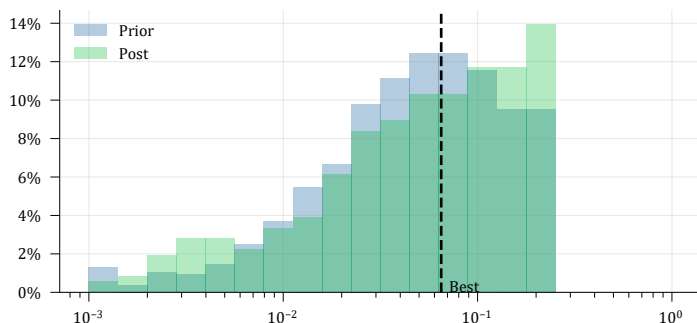
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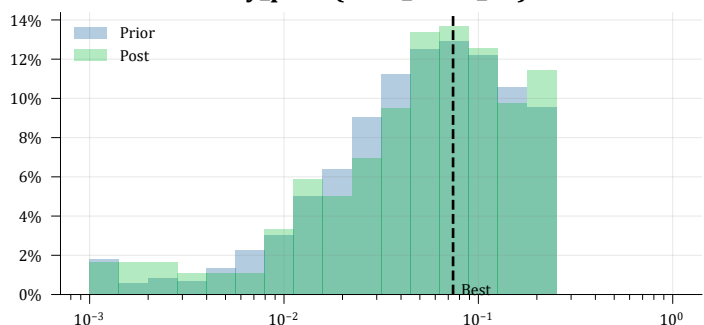
sy_p389(Pilot_Point_L1)



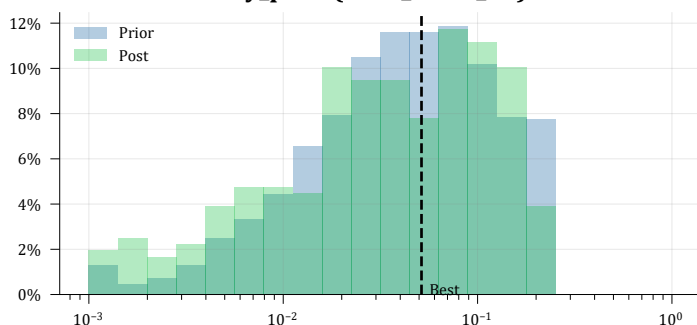
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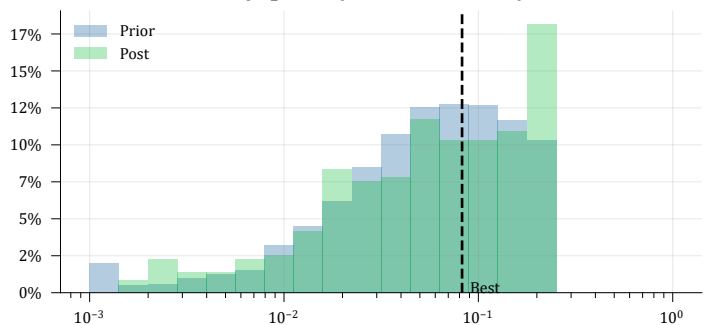
sy_p391(Pilot_Point_L1)



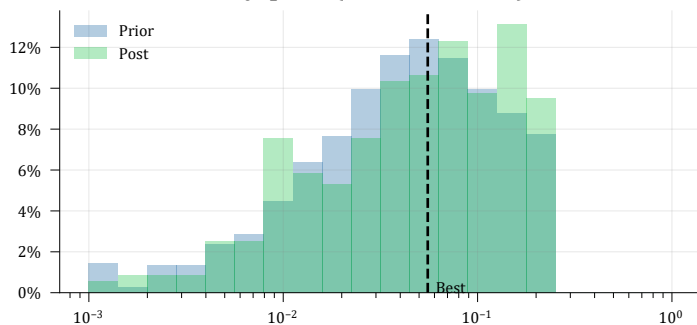
sy_p392(Pilot_Point_L1)

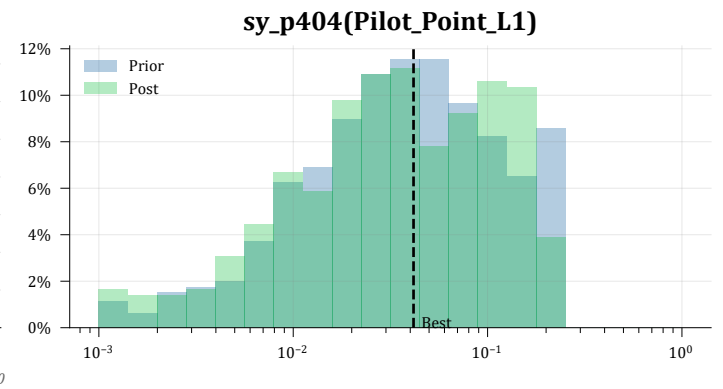
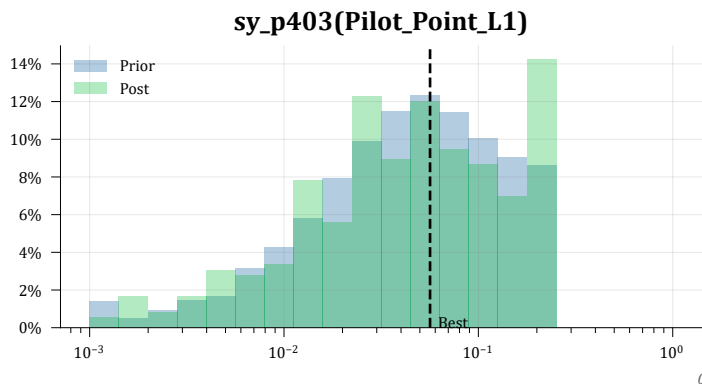
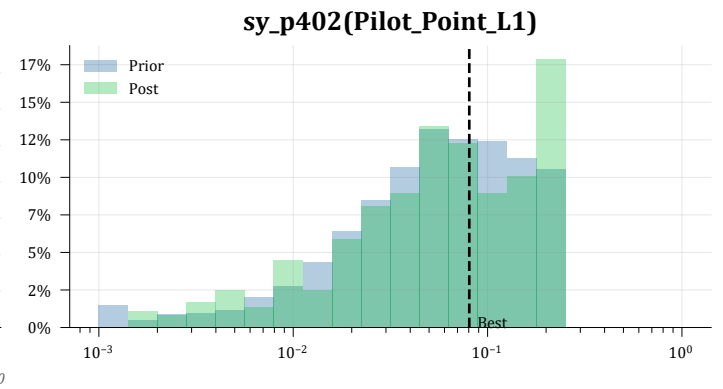
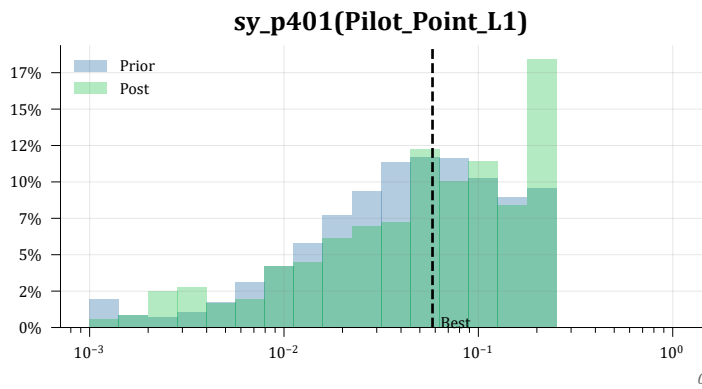
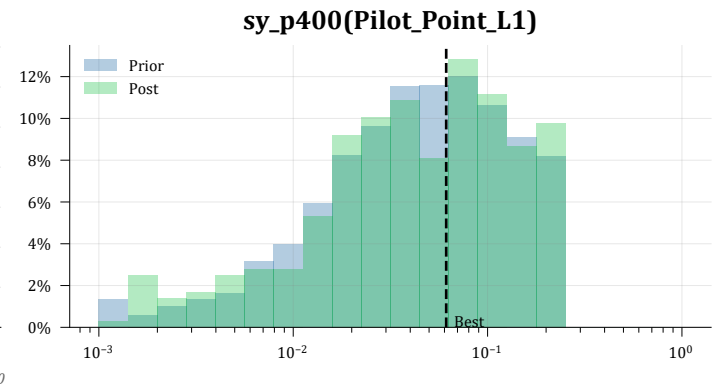
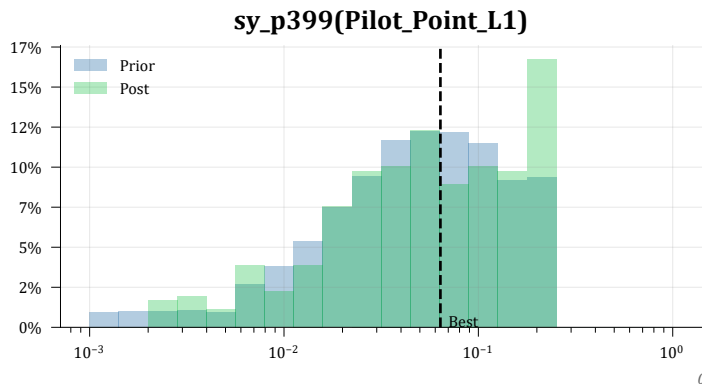
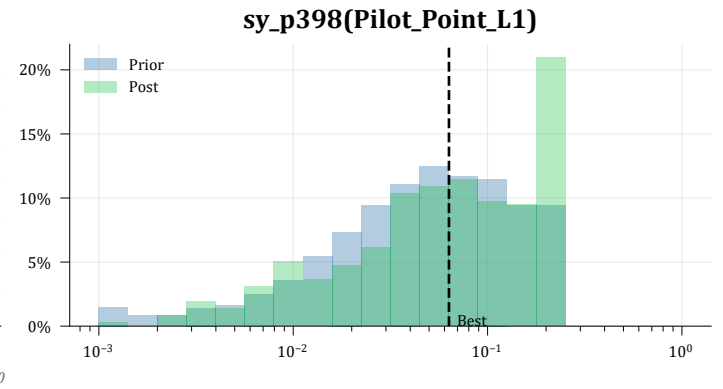
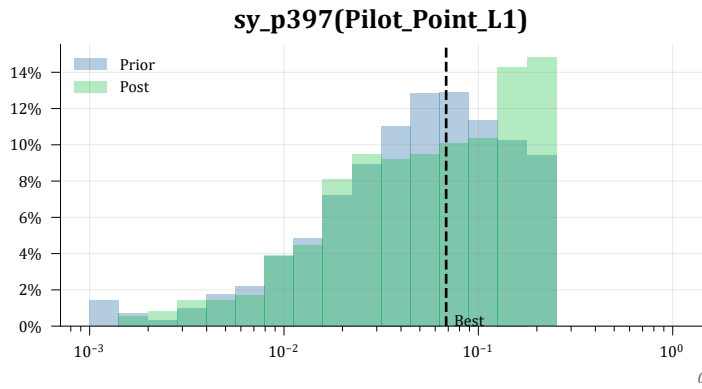
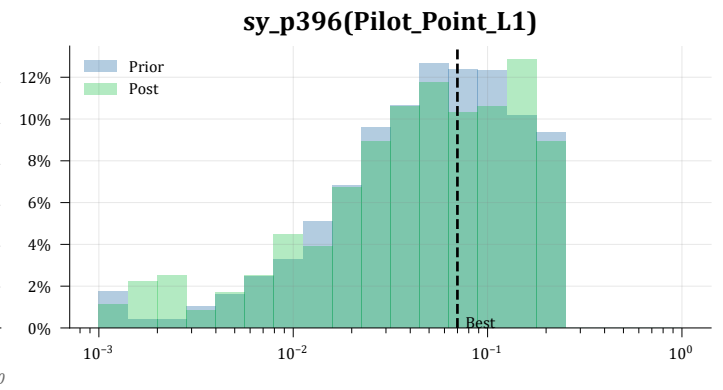
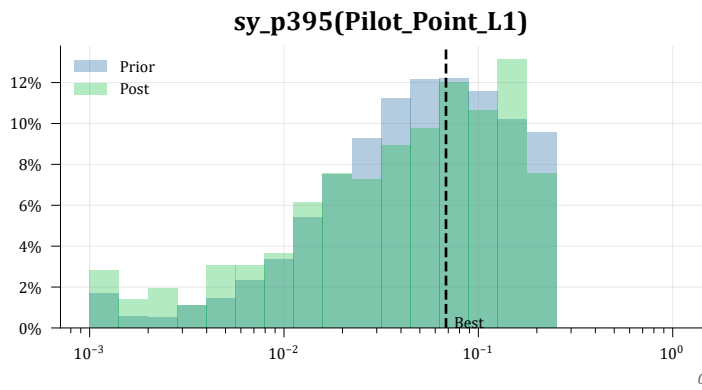


sy_p393(Pilot_Point_L1)

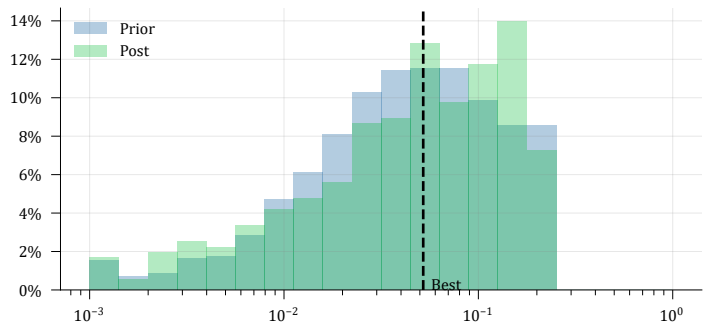


sy_p394(Pilot_Point_L1)

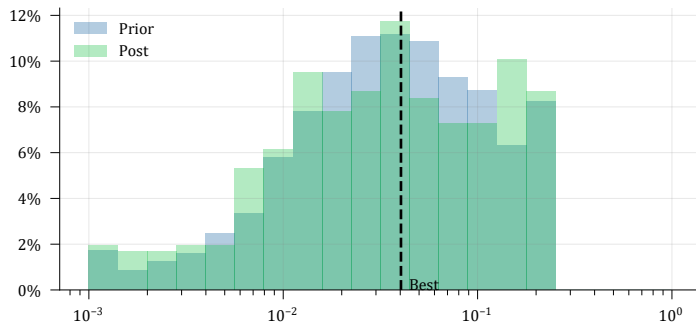




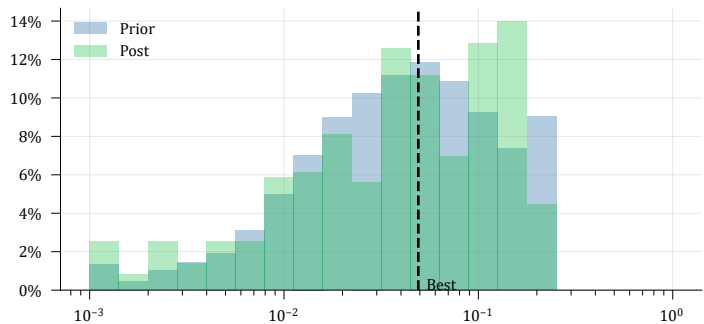
sy_p405(Pilot_Point_L1)



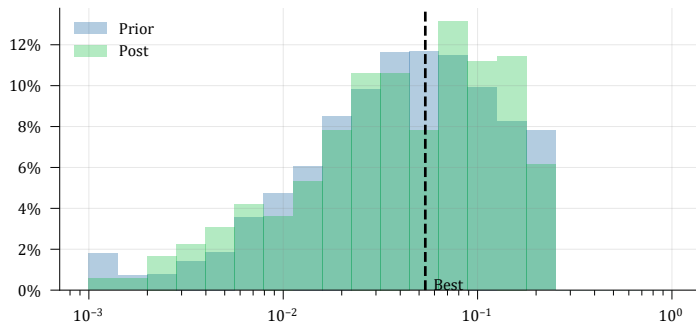
sy_p406(Pilot_Point_L1)



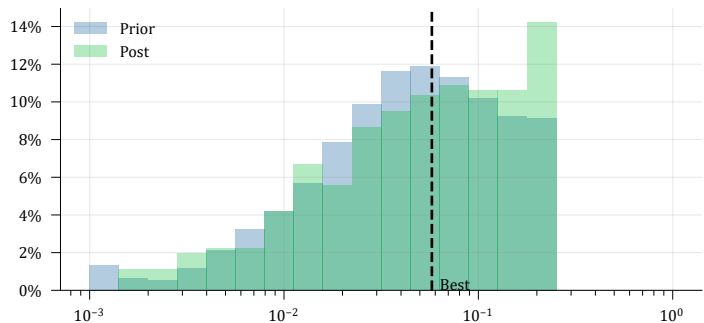
sy_p407(Pilot_Point_L1)



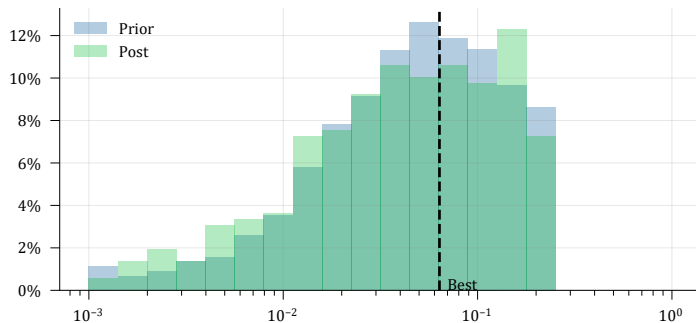
sy_p408(Pilot_Point_L1)



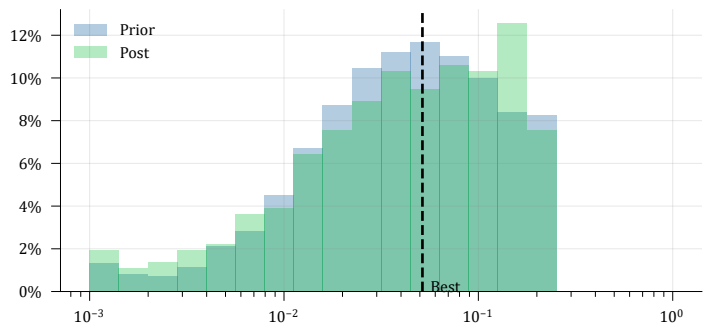
sy_p409(Pilot_Point_L1)



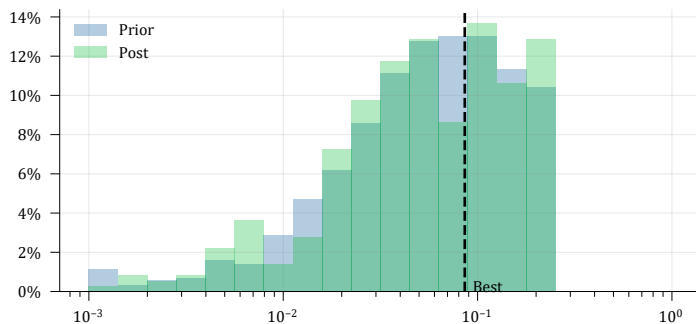
sy_p410(Pilot_Point_L1)



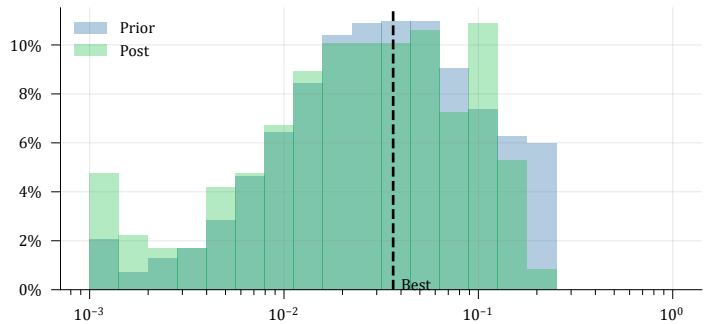
sy_p411(Pilot_Point_L1)



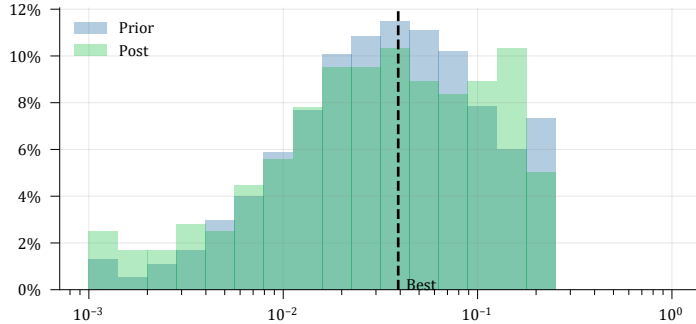
sy_p412(Pilot_Point_L1)

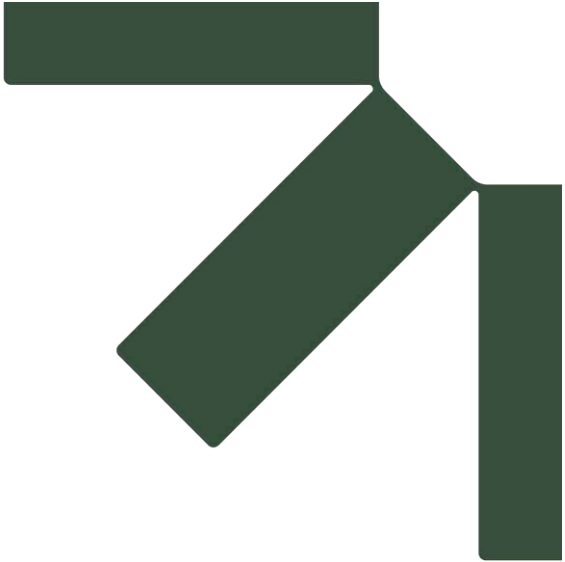


sy_p413(Pilot_Point_L1)



sy_p414(Pilot_Point_L1)





Appendix H Post-Mining Hydrographs

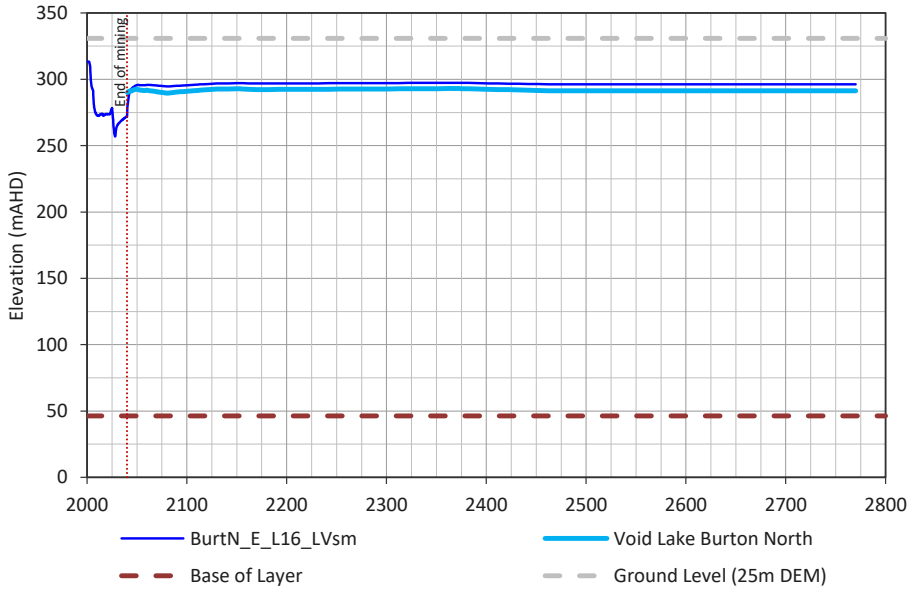
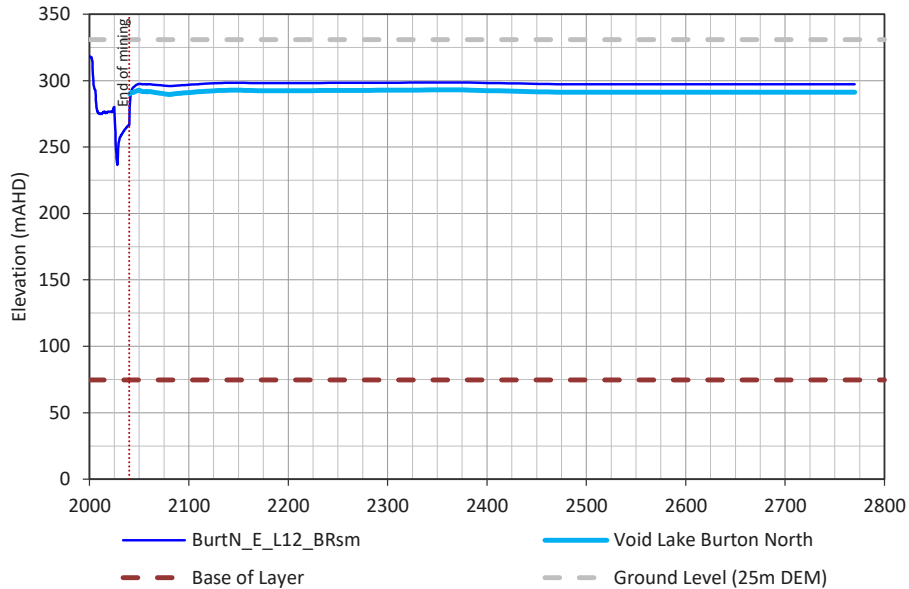
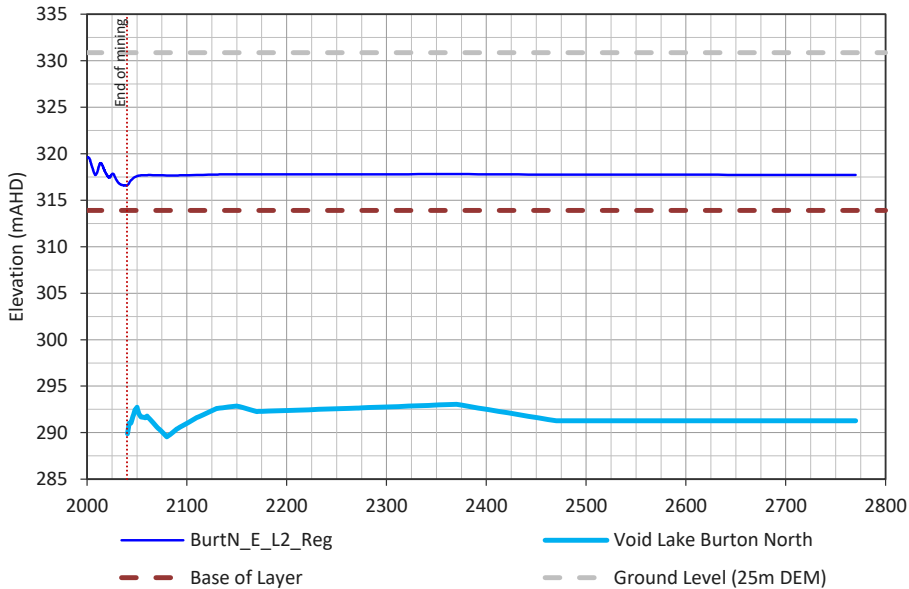
New Lenton & Burton

2023 Groundwater Modelling Technical Report

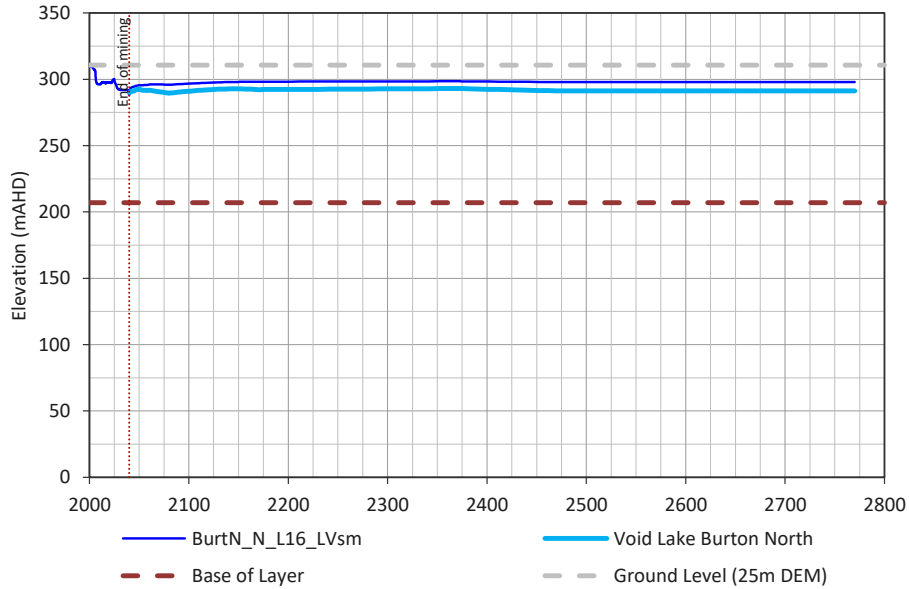
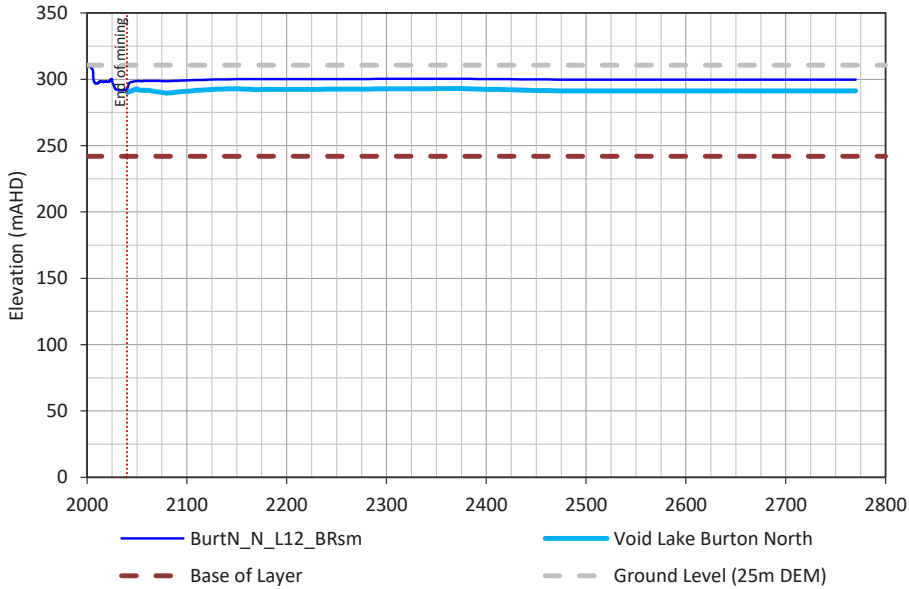
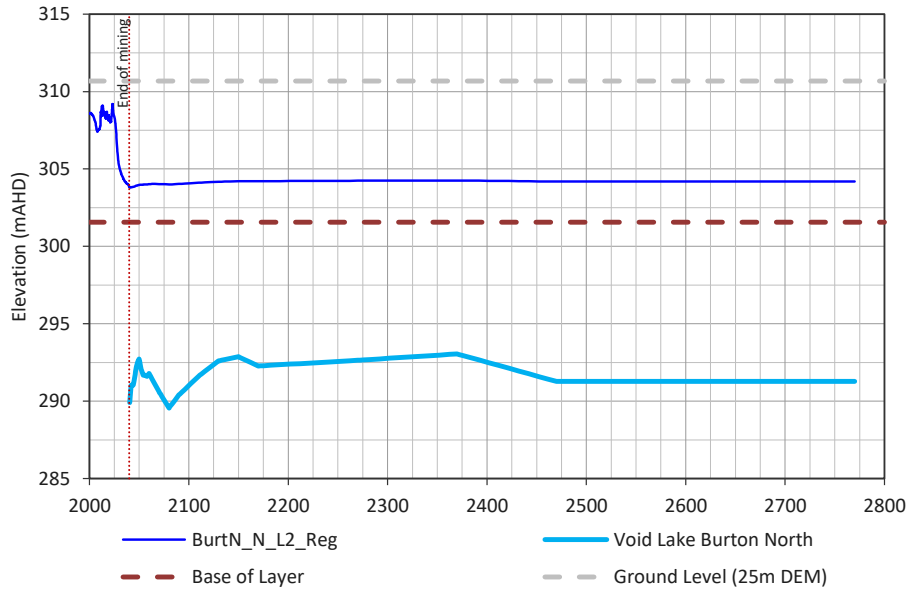
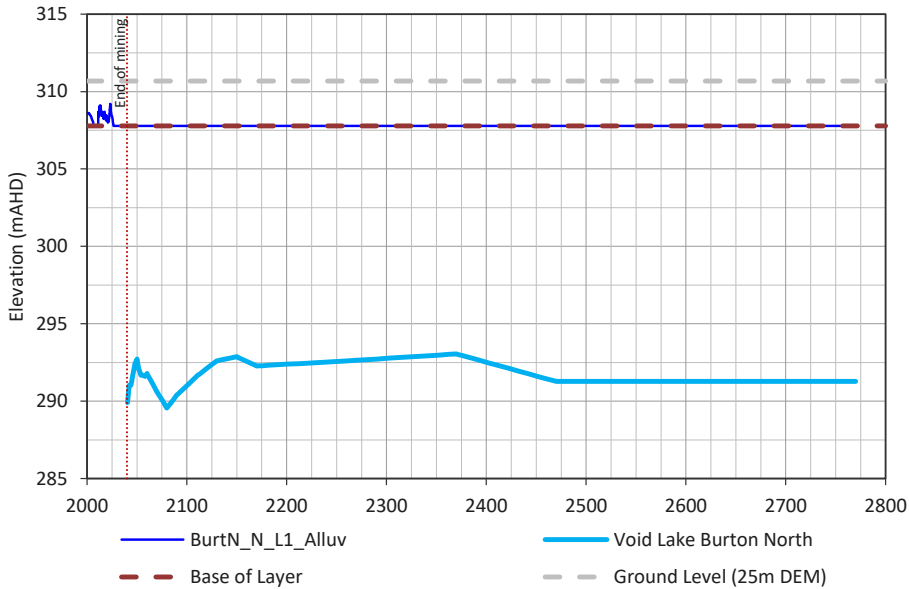
Lenton Joint Venture

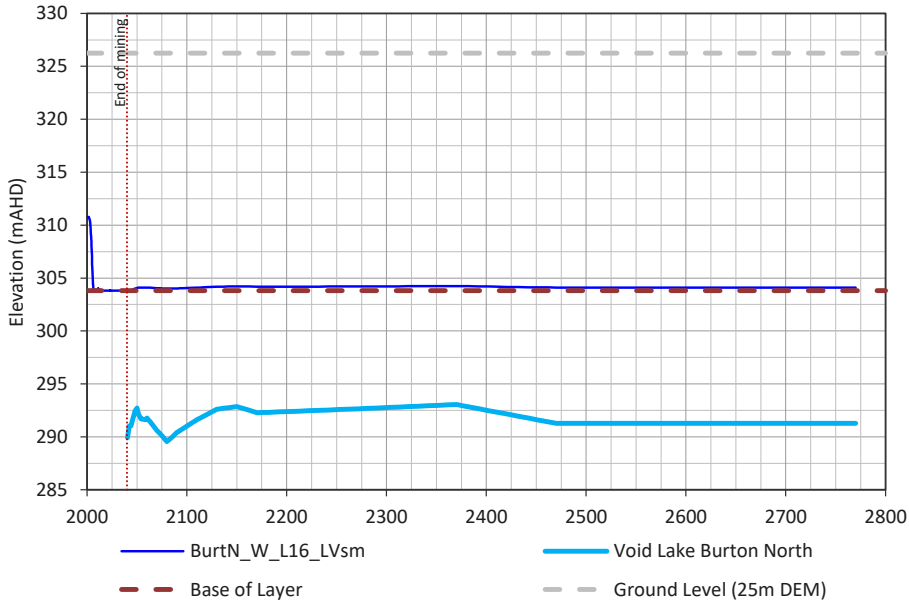
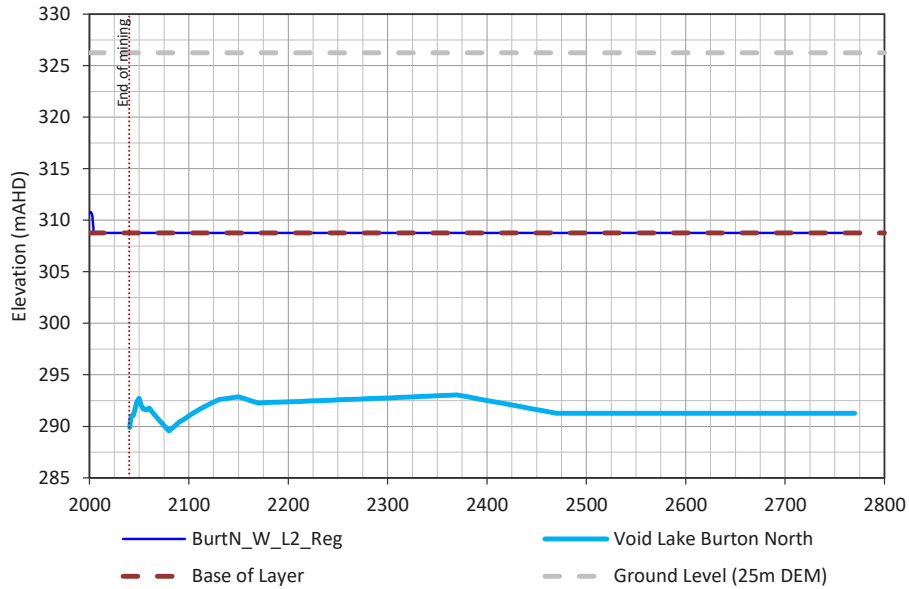
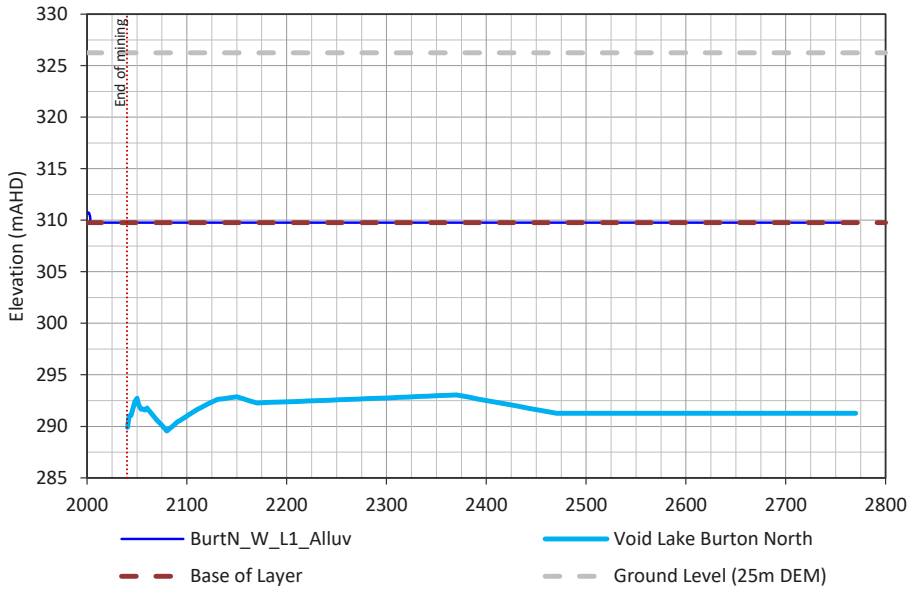
SLR Project No.: 620.31367.00000

11 September 2024

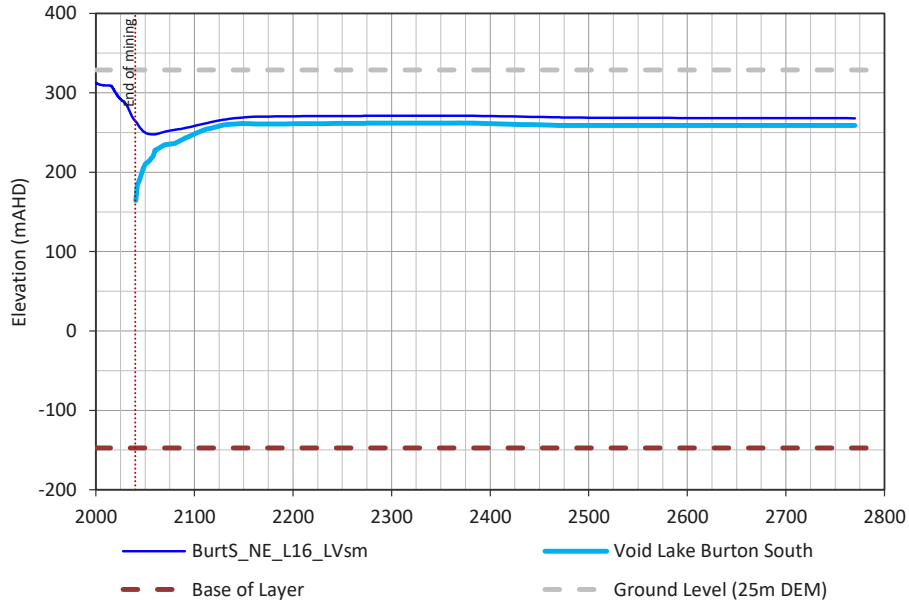
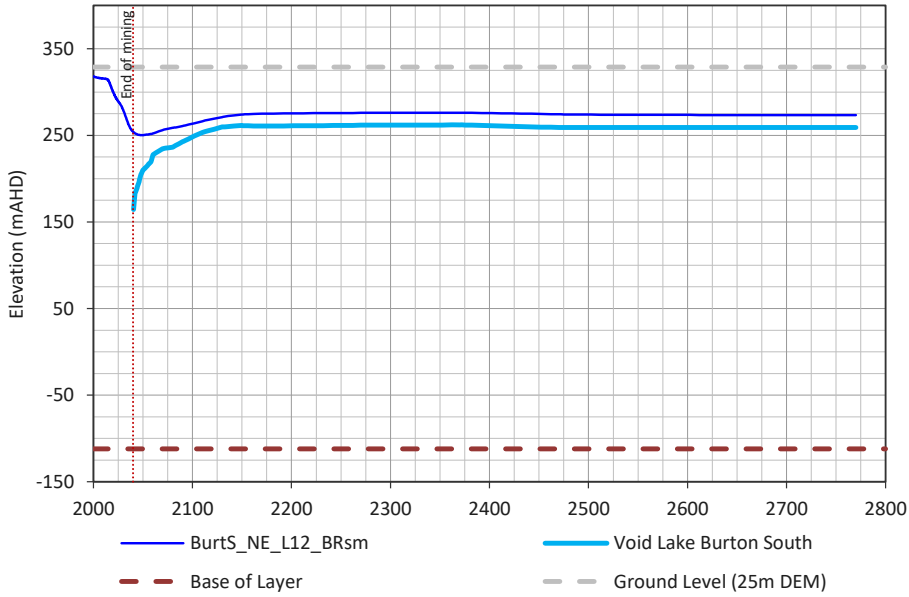
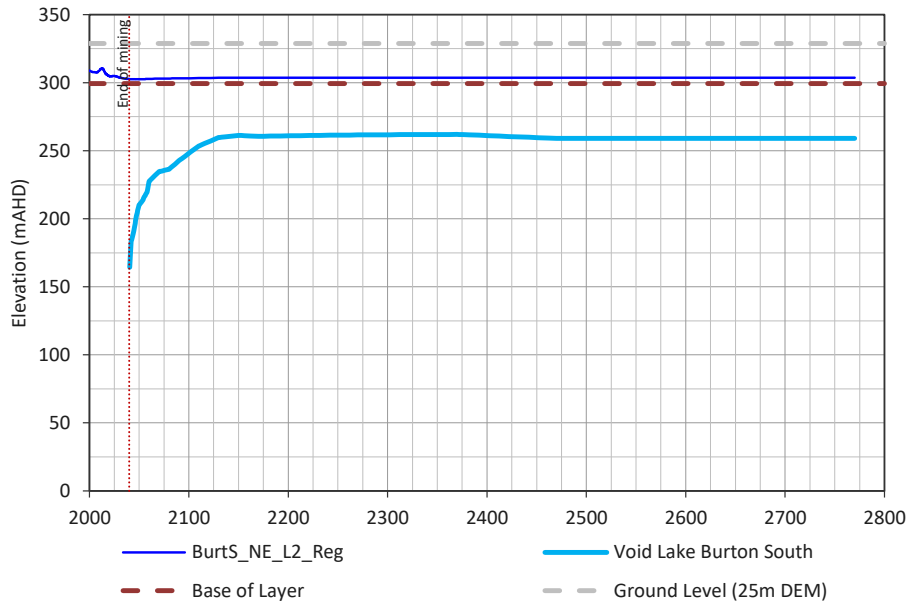
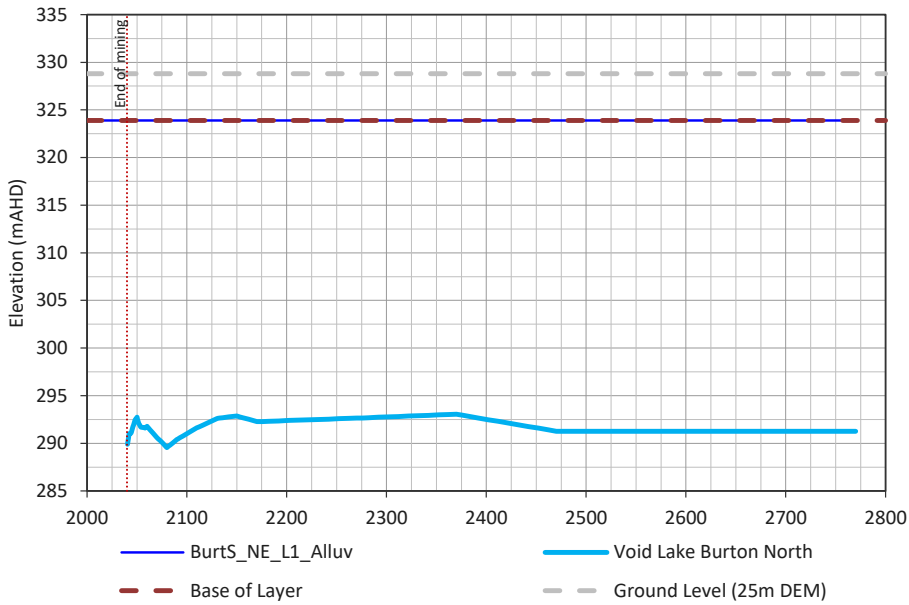


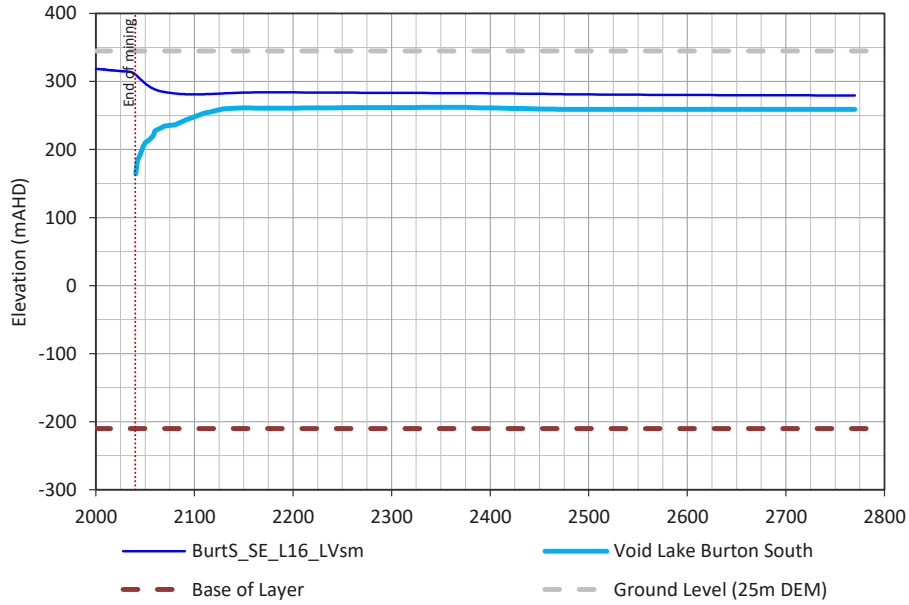
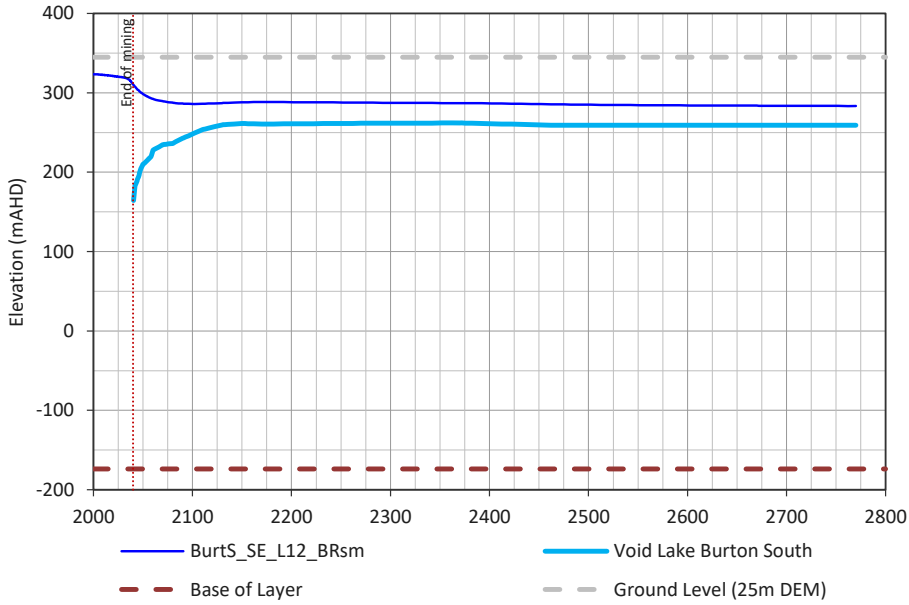
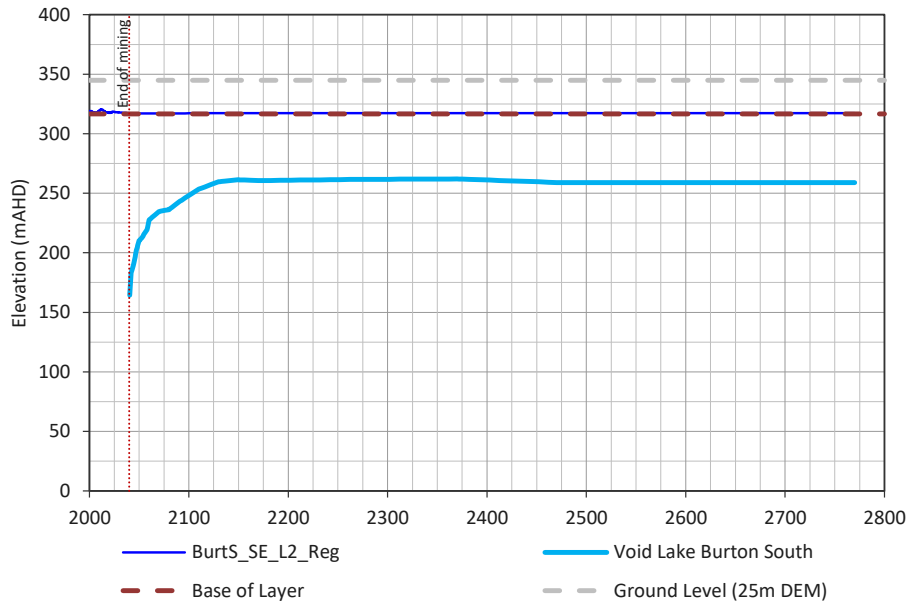
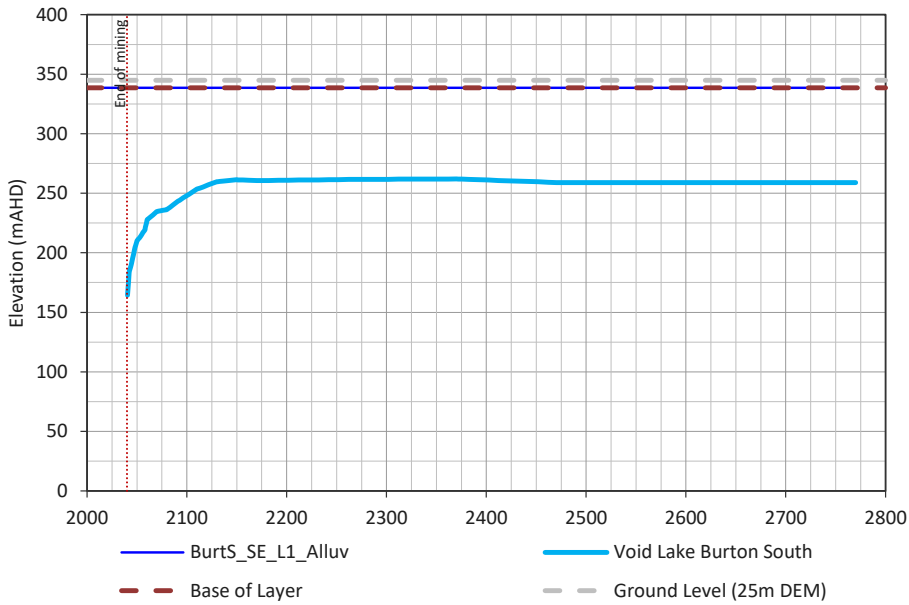
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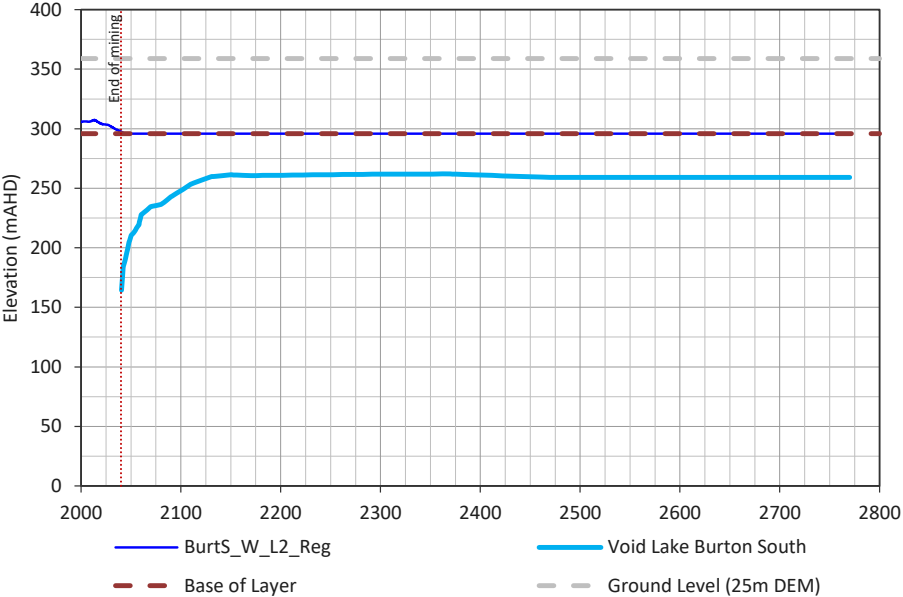




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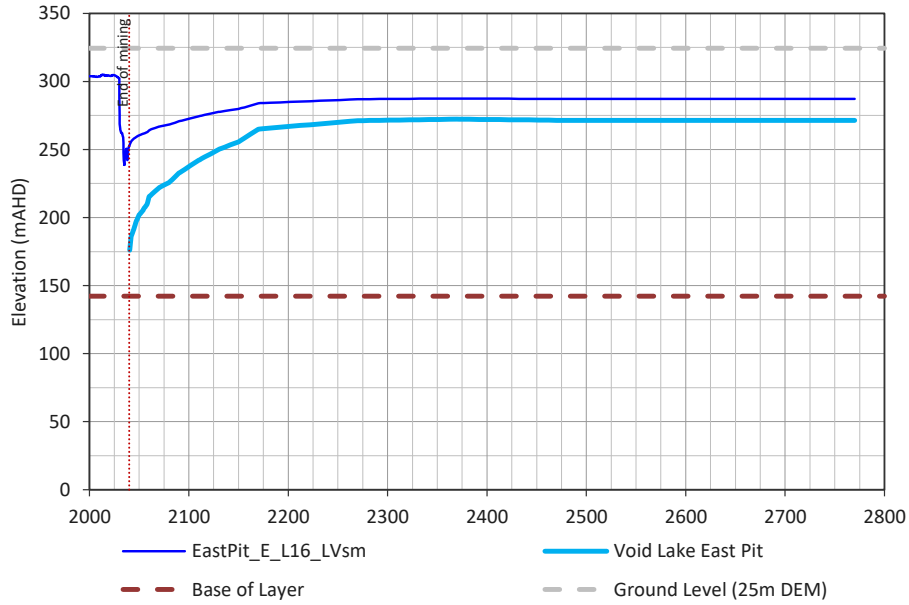
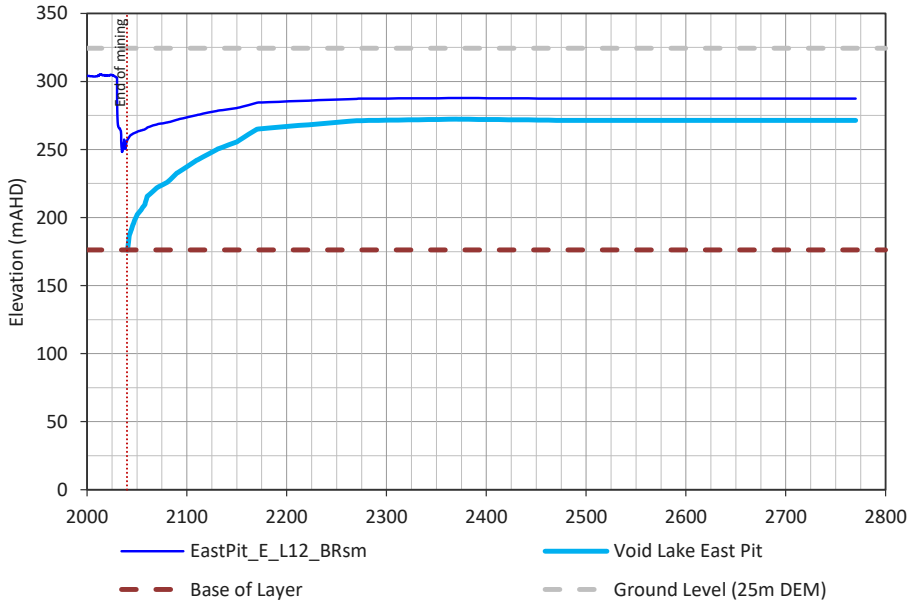
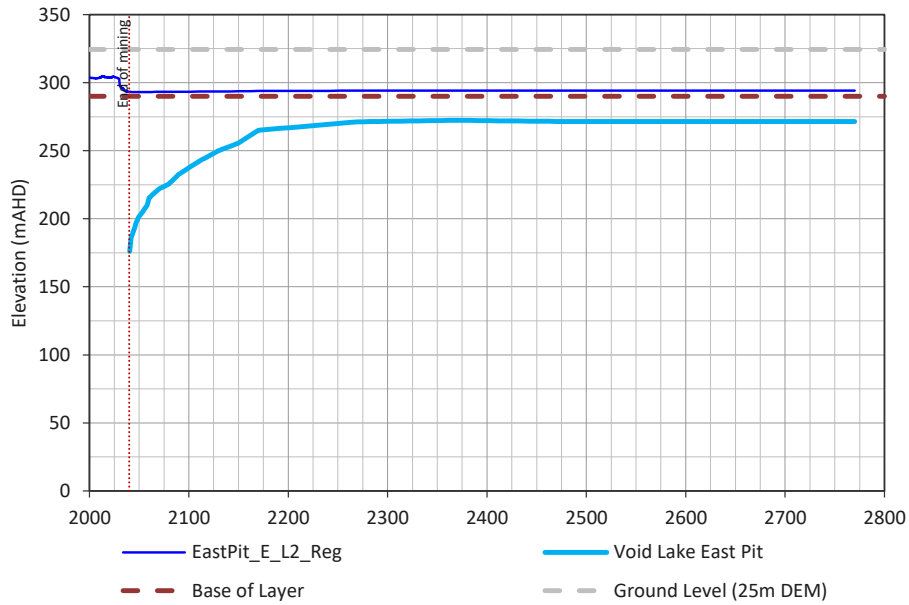
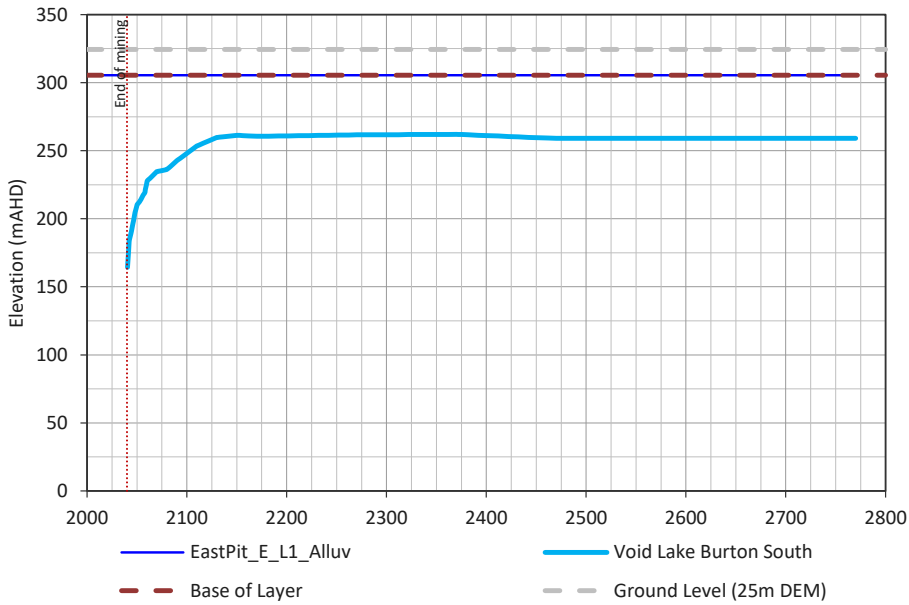


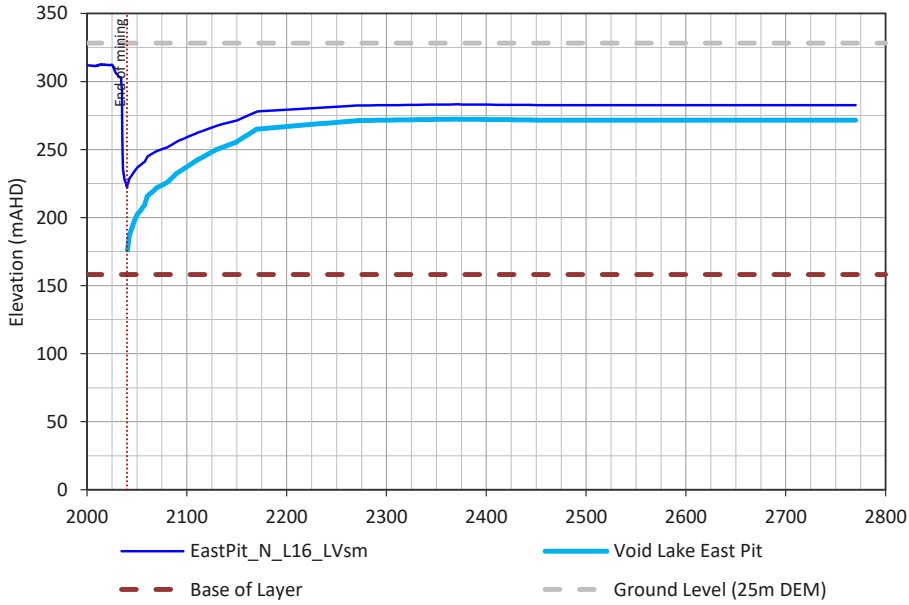
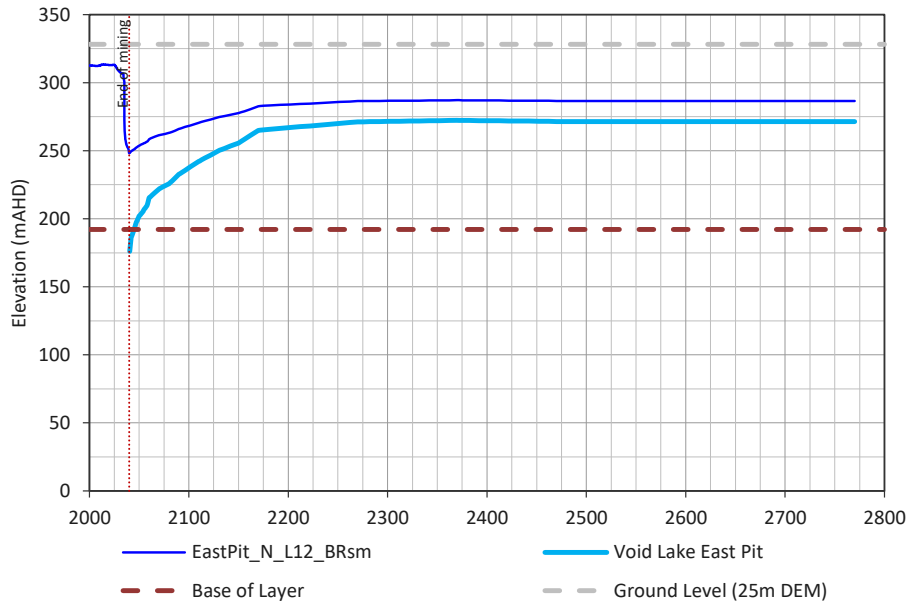
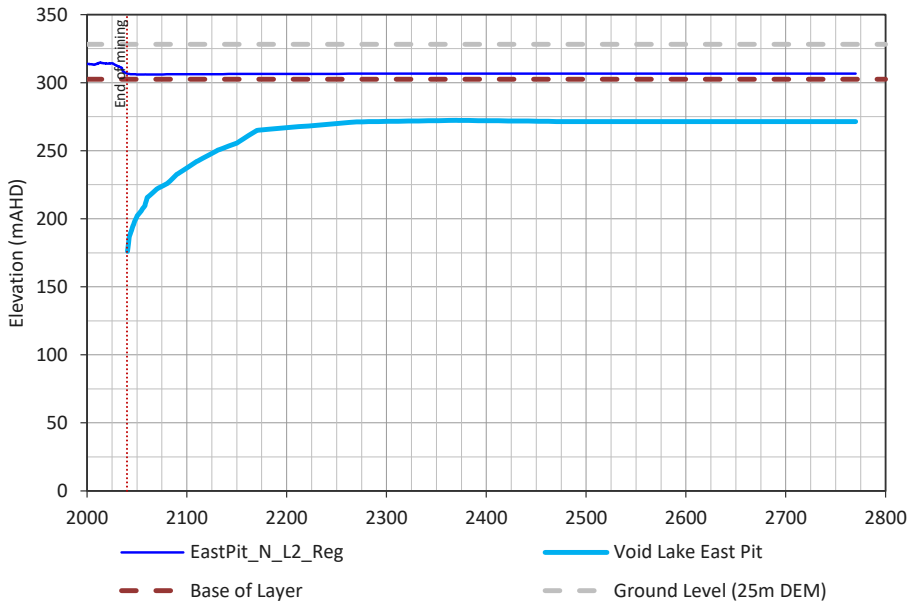


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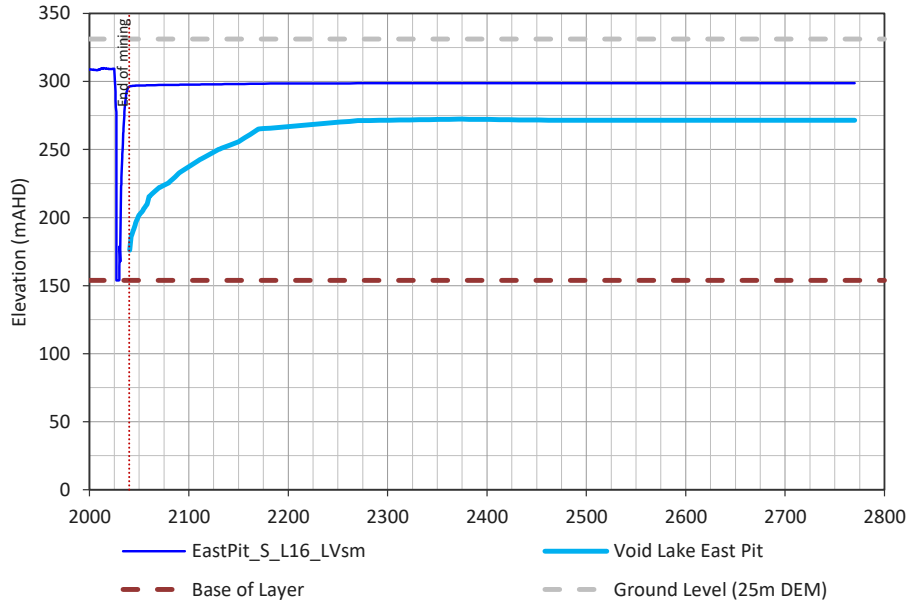
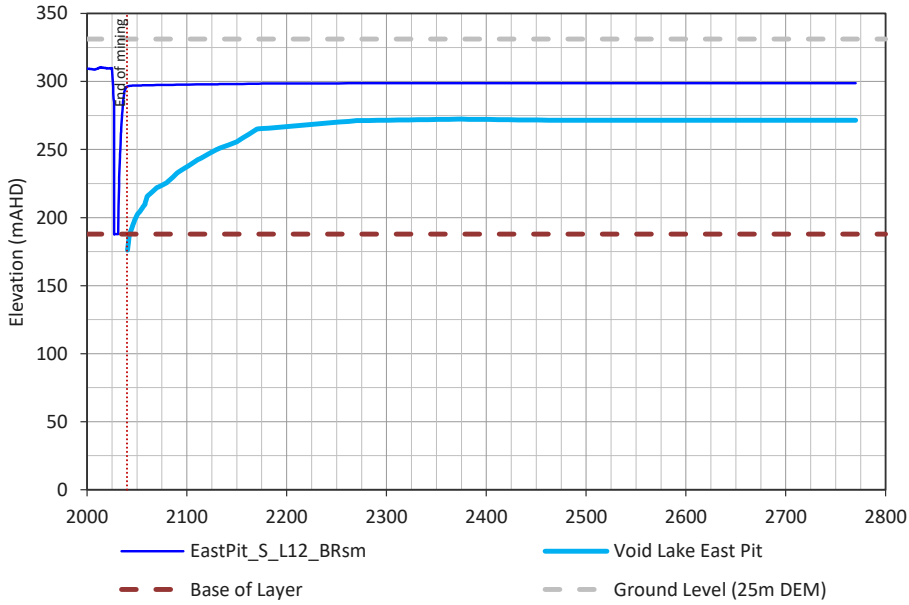
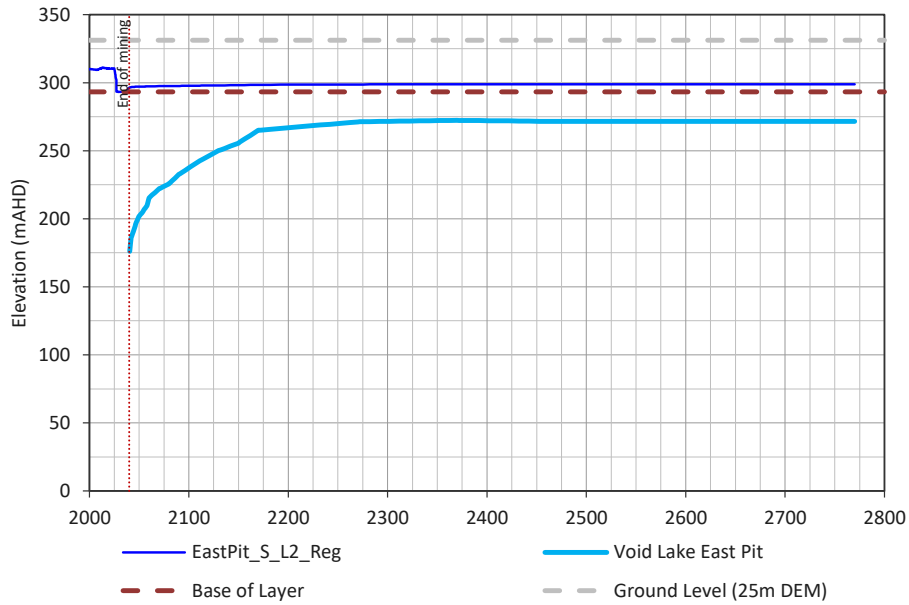
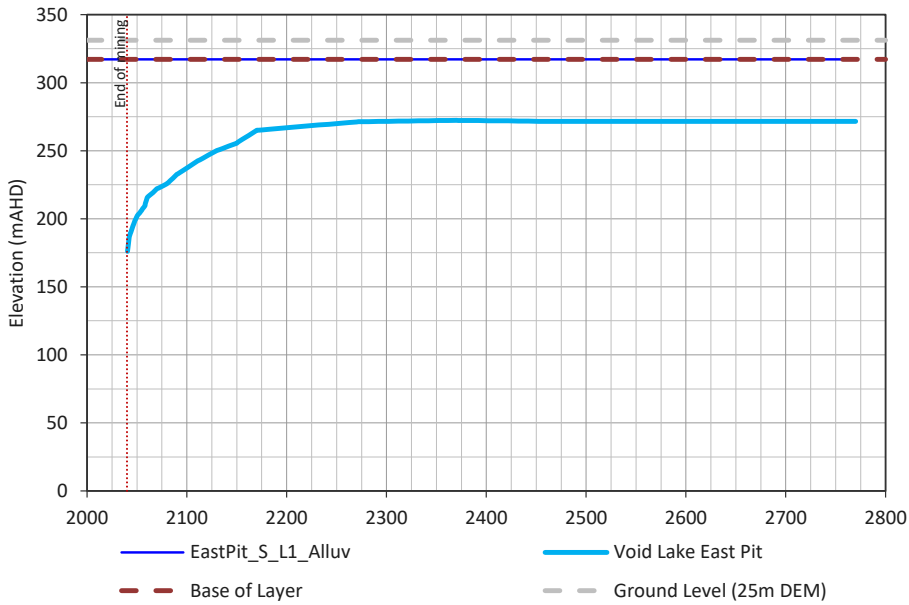
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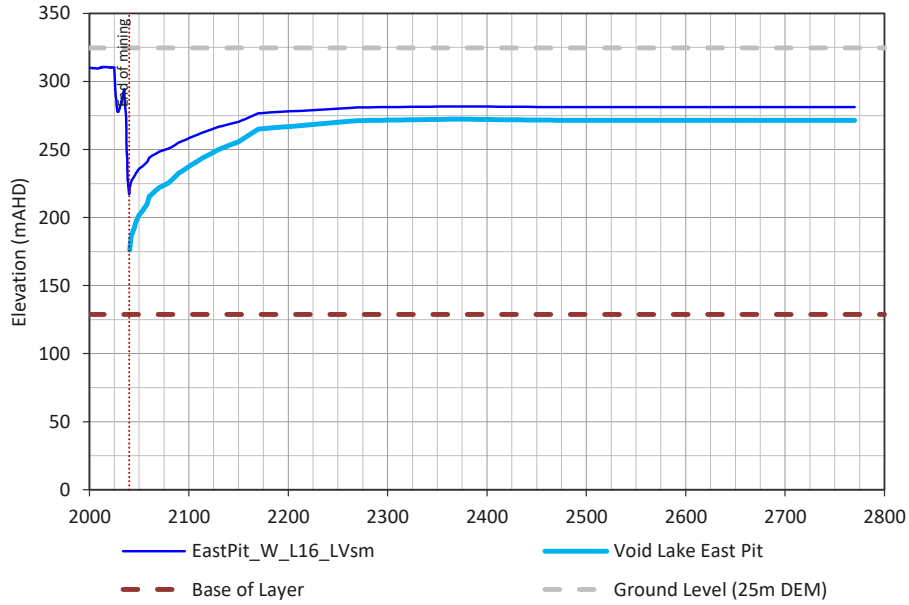
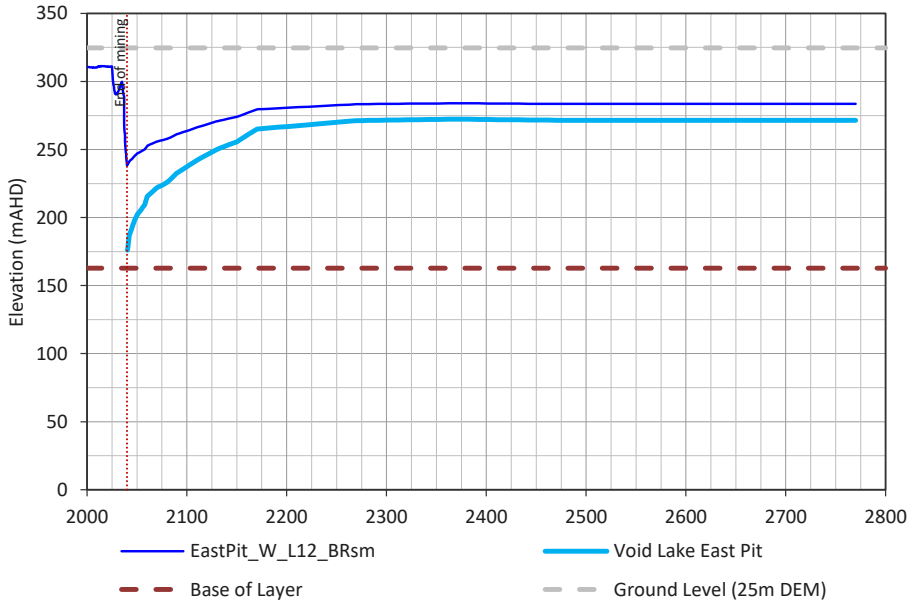
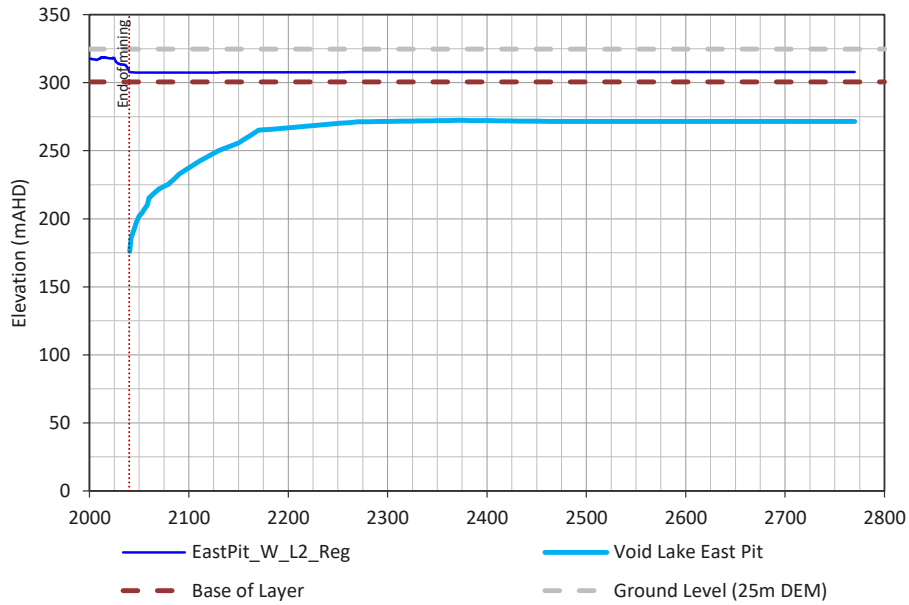
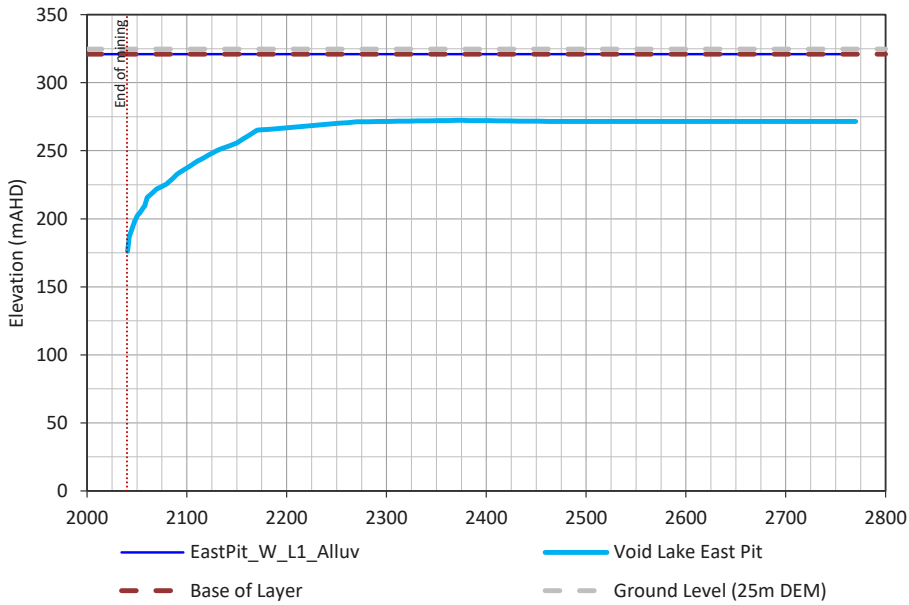
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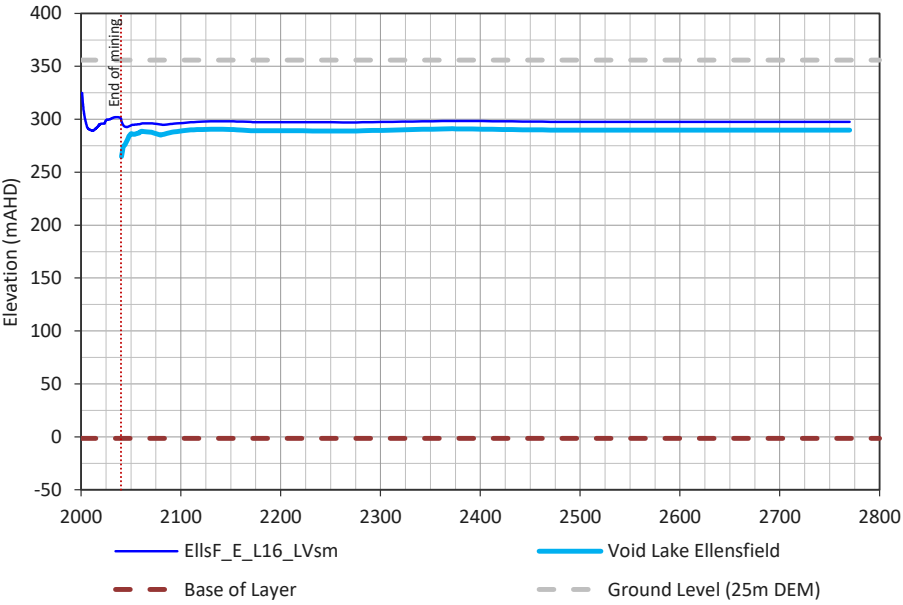
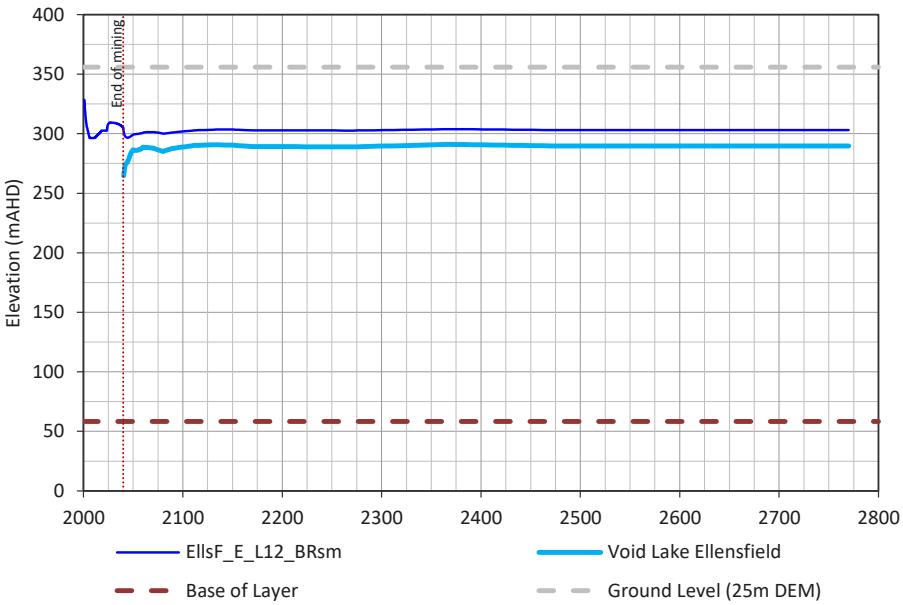
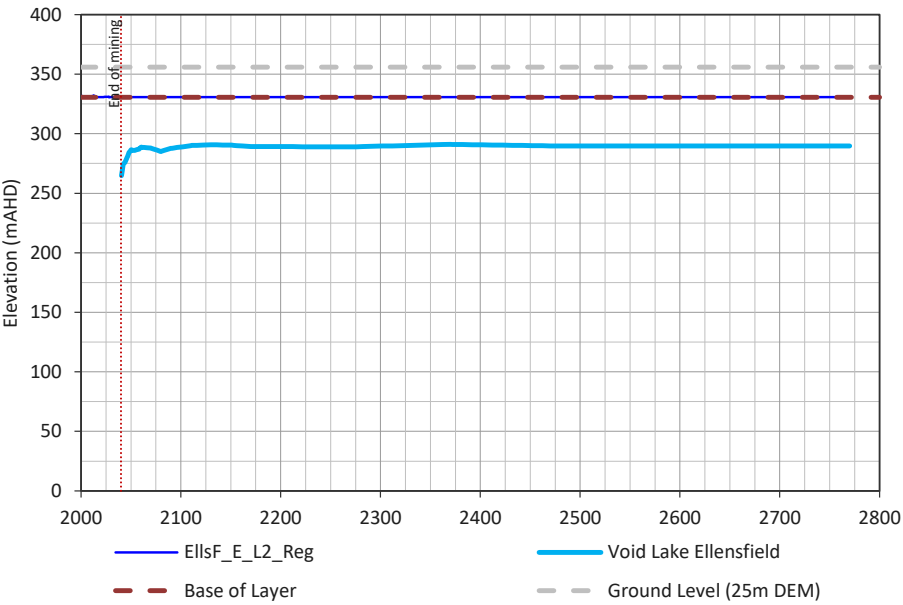




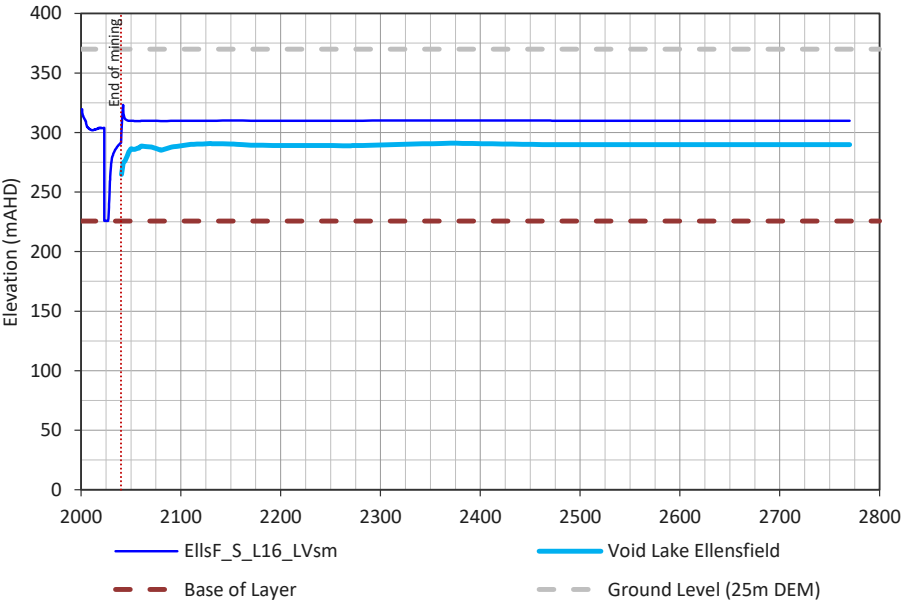
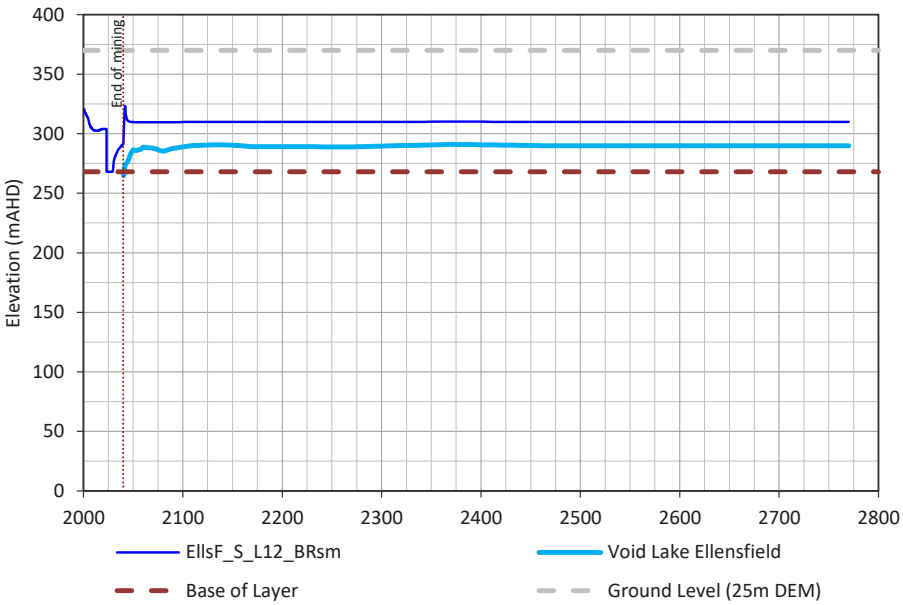
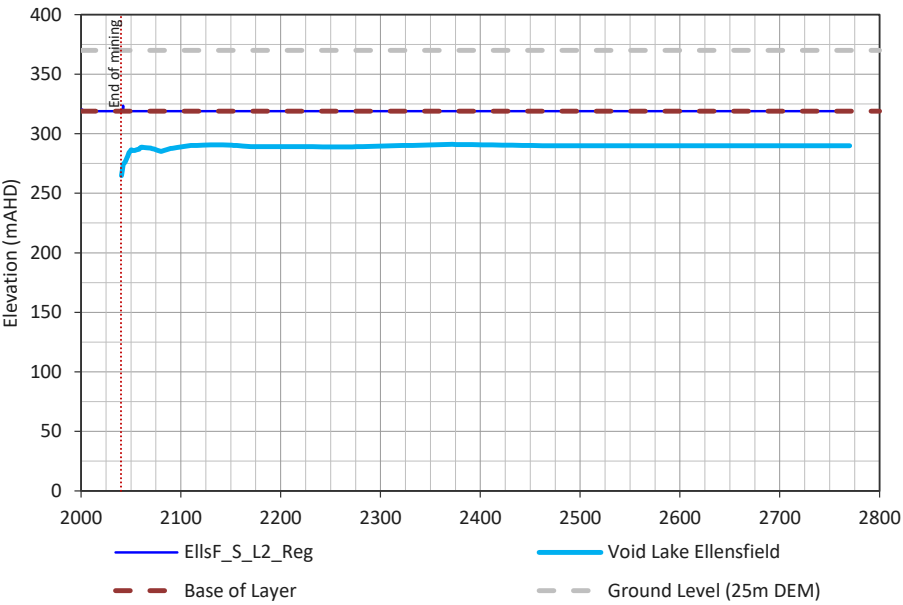
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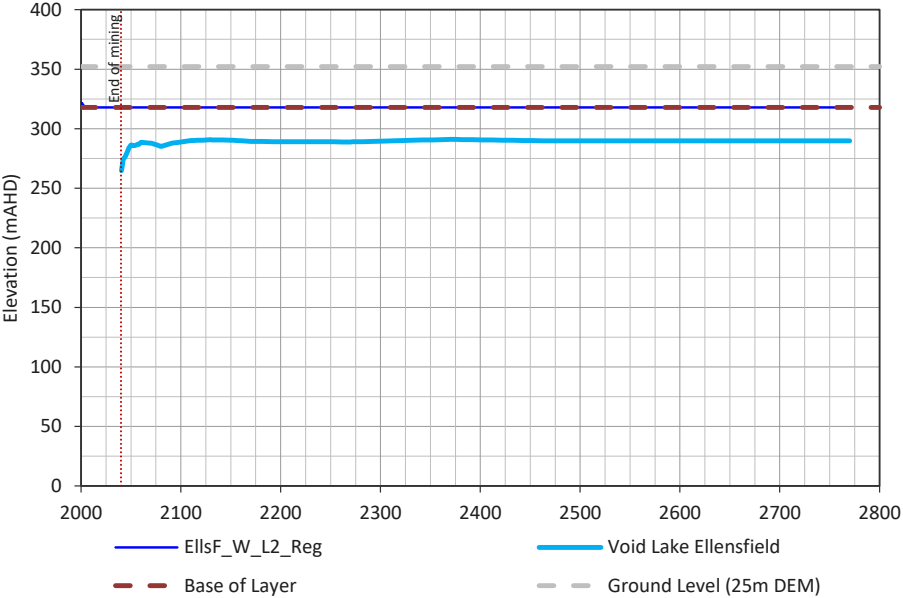




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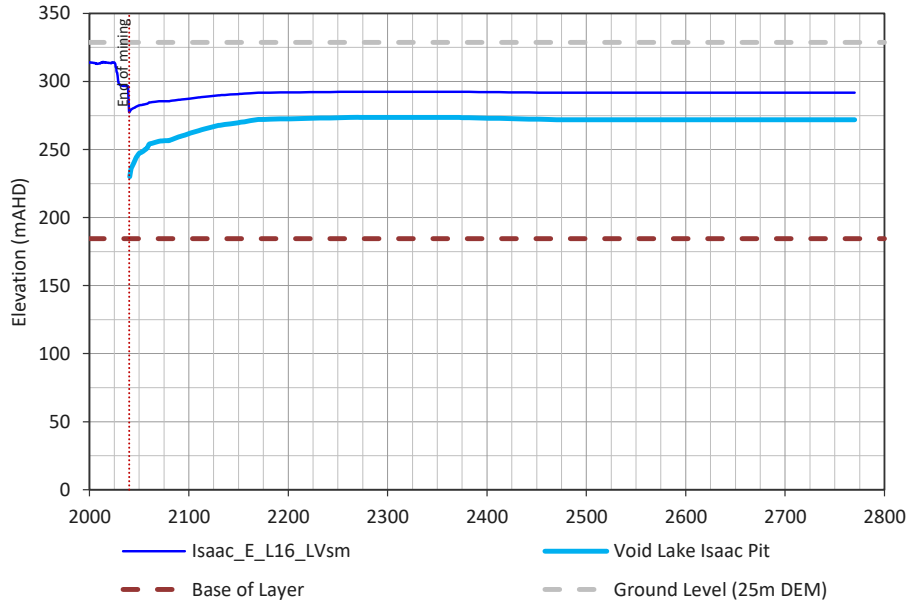
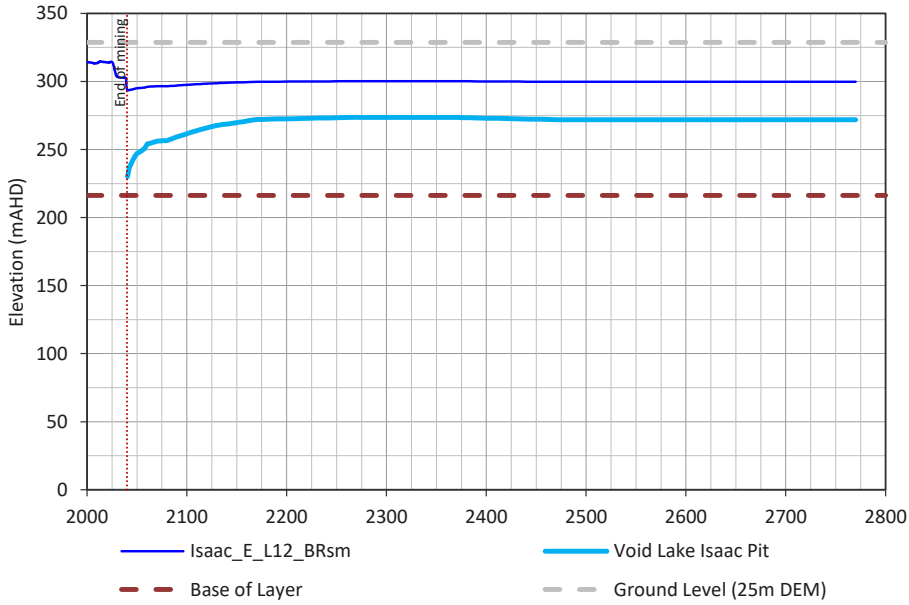
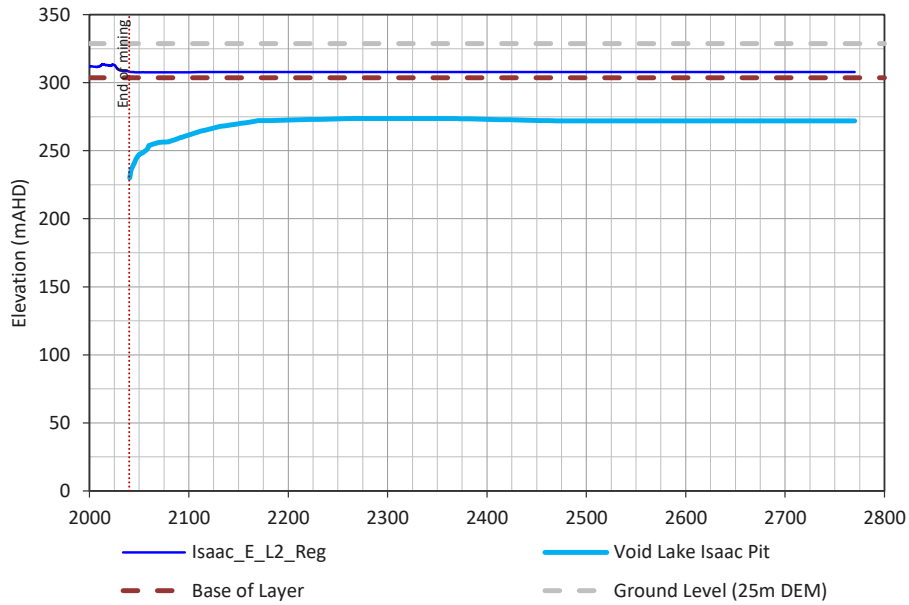
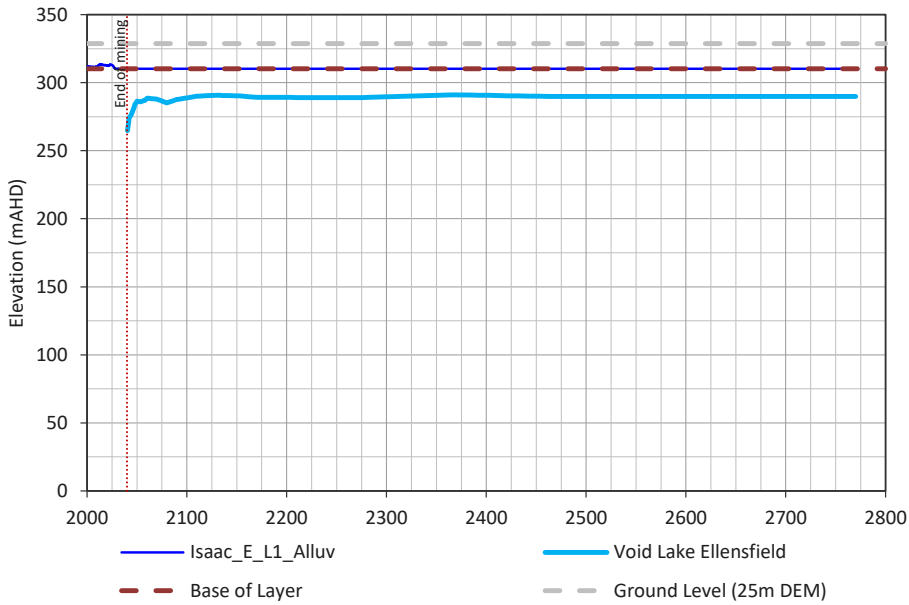
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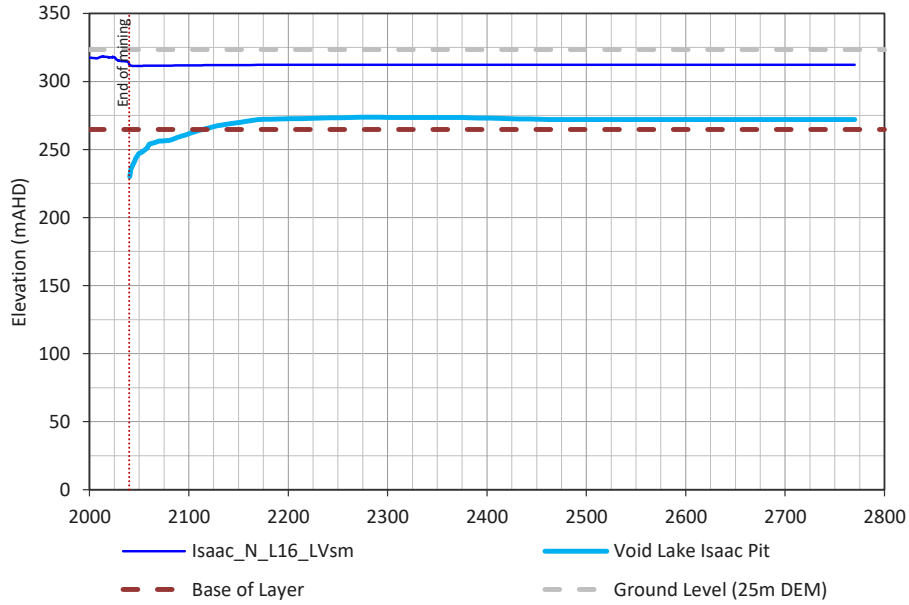
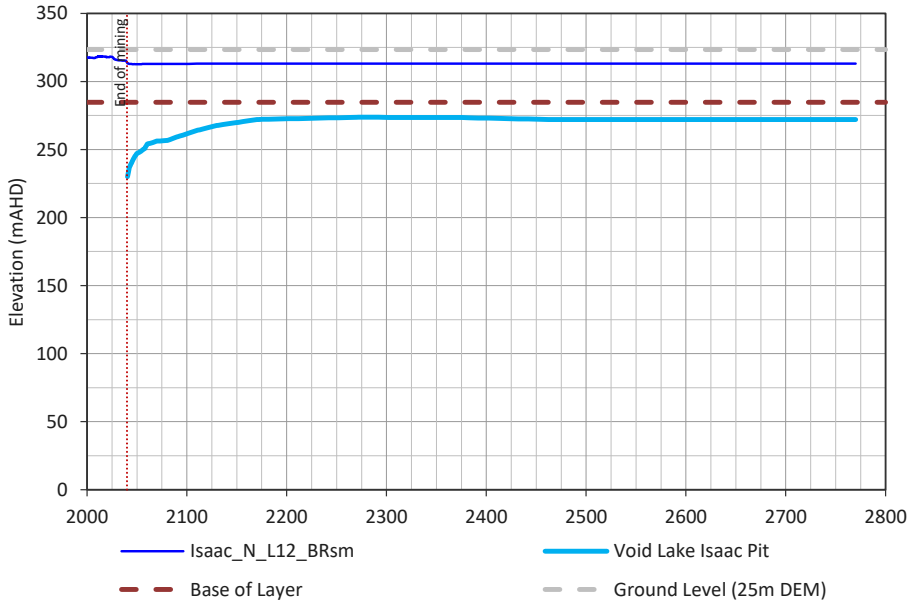
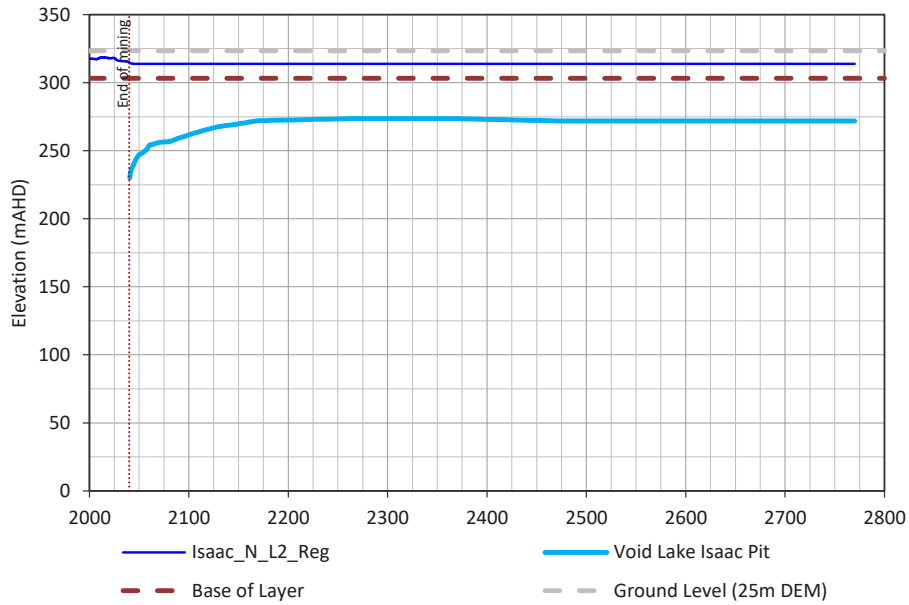
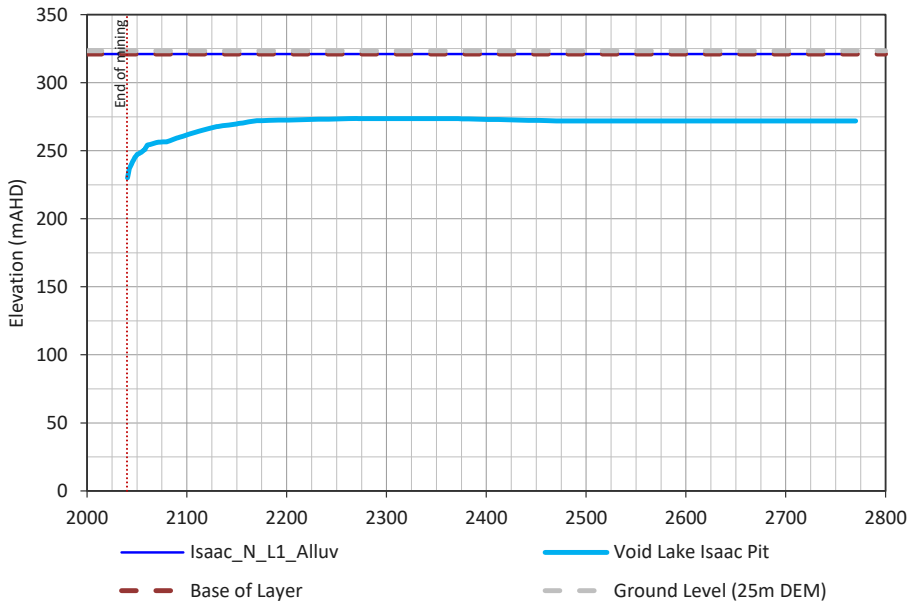


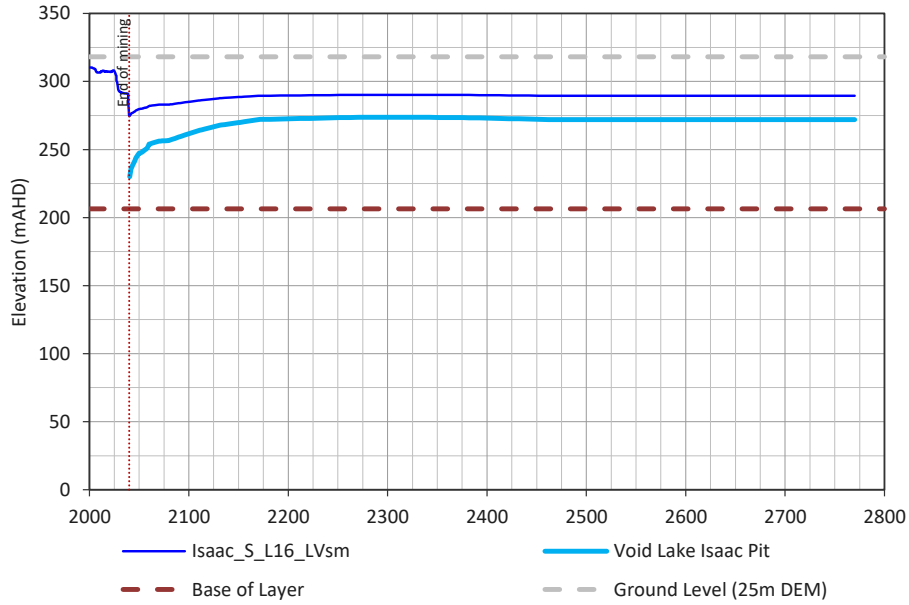
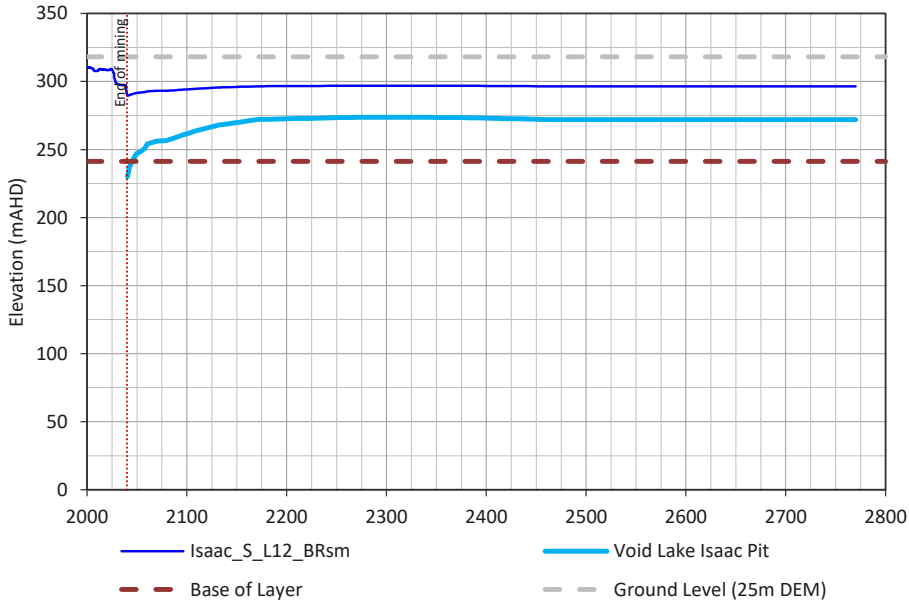
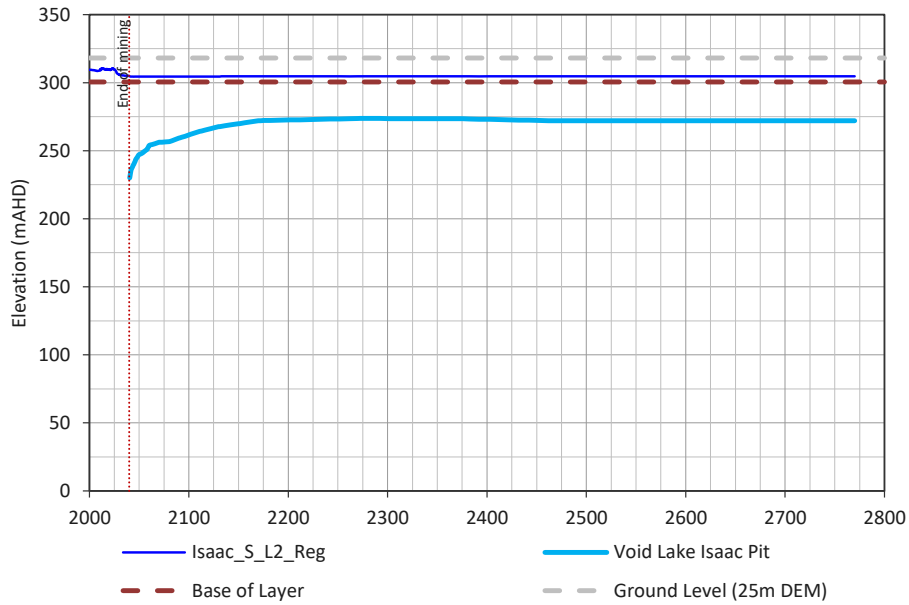
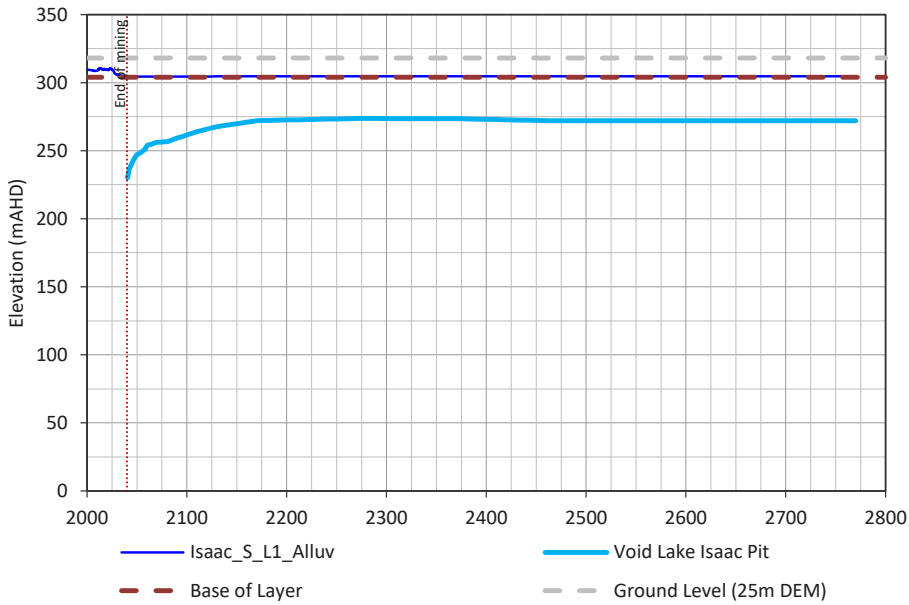
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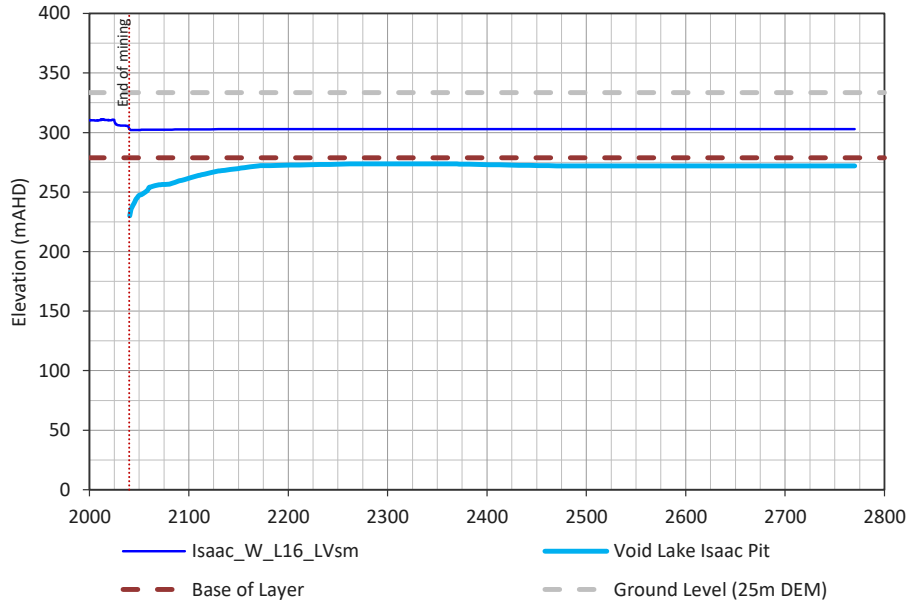
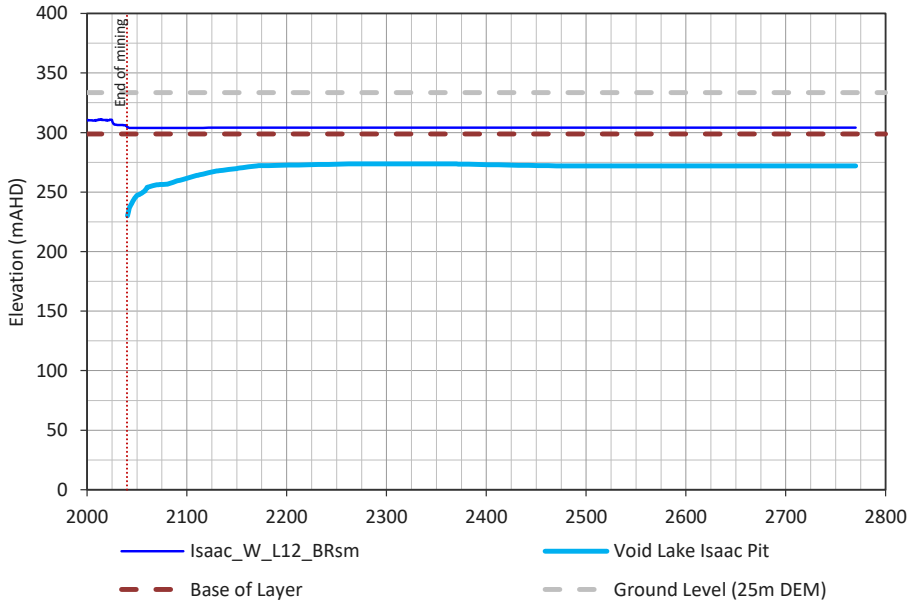
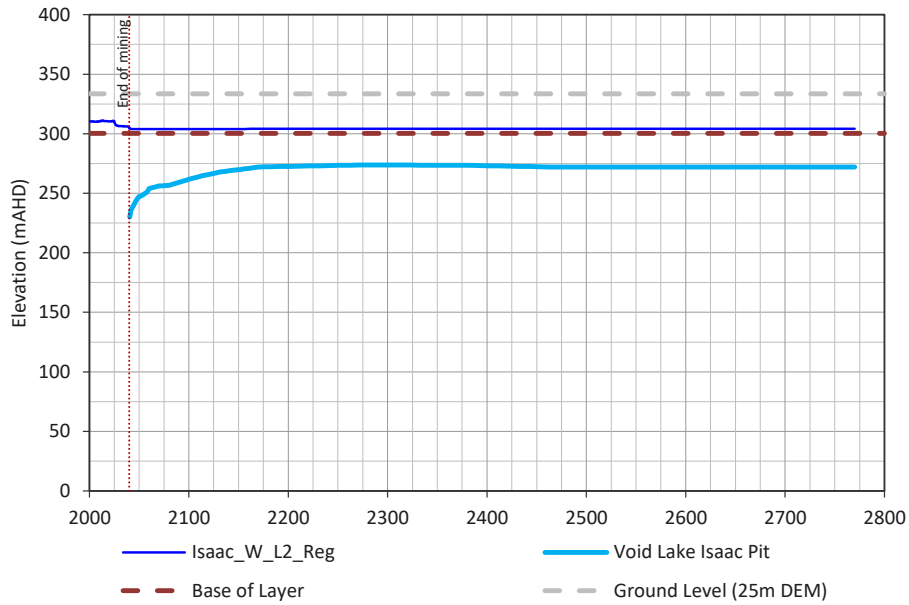
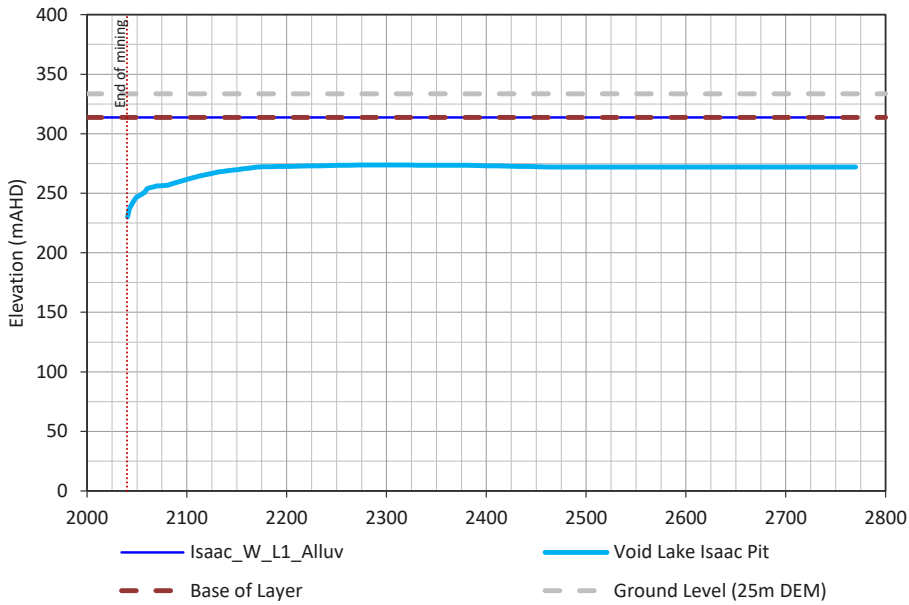
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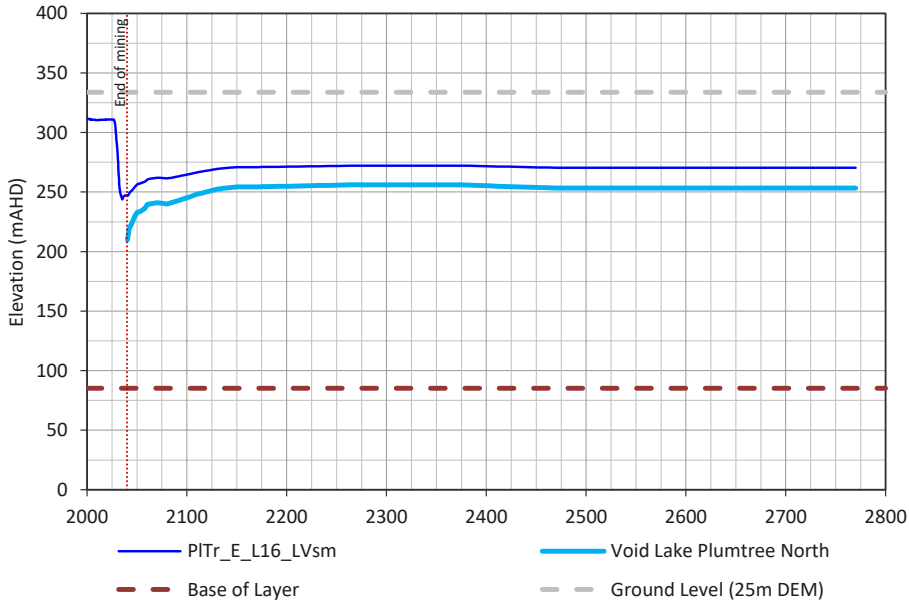
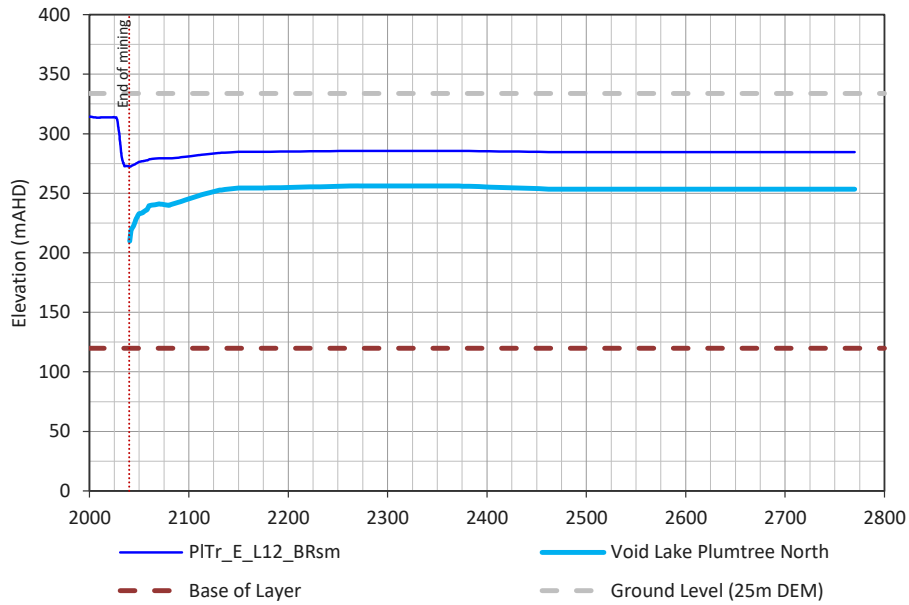
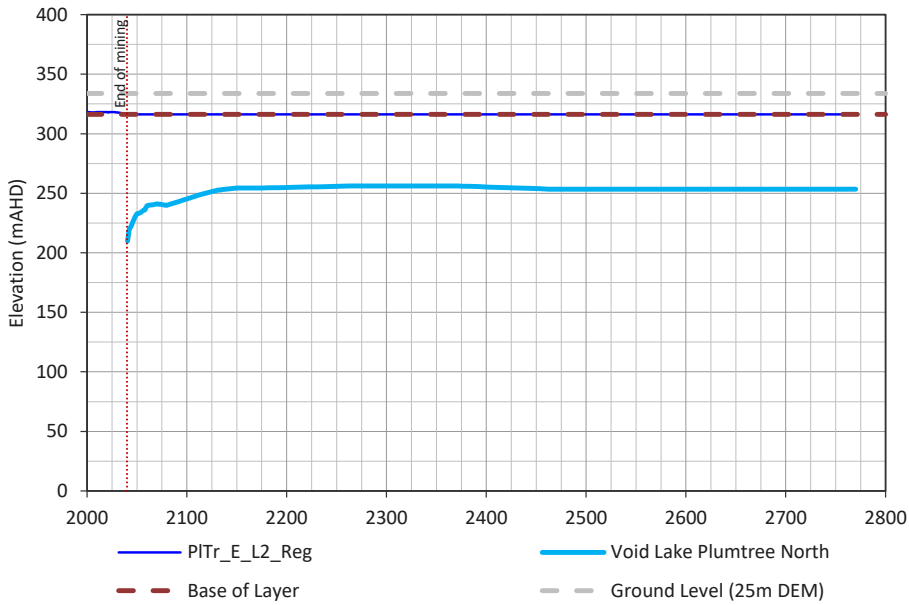
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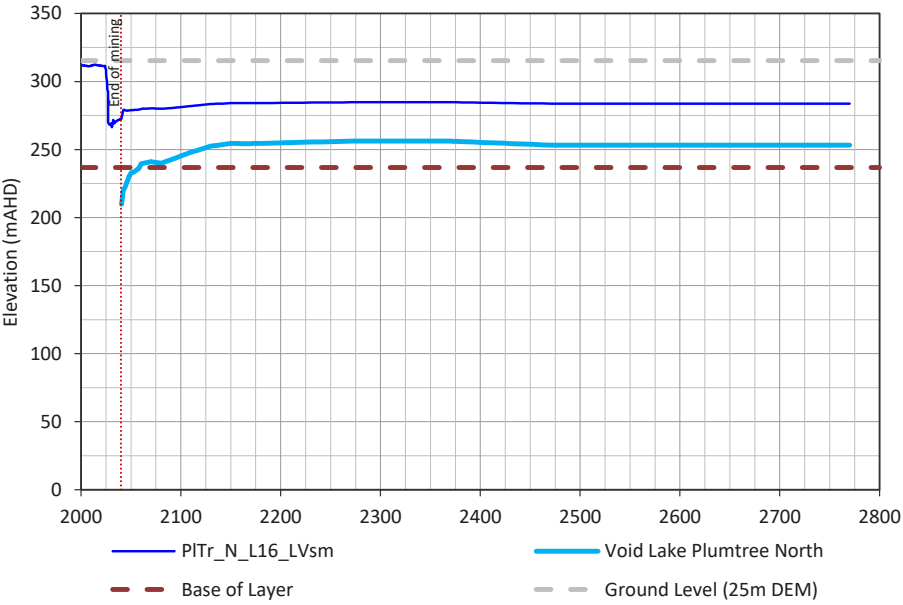
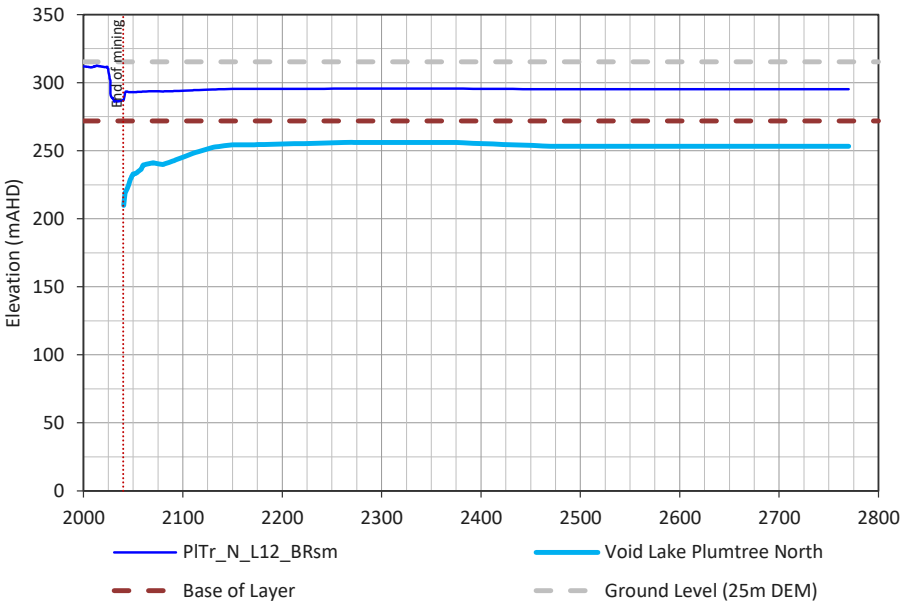
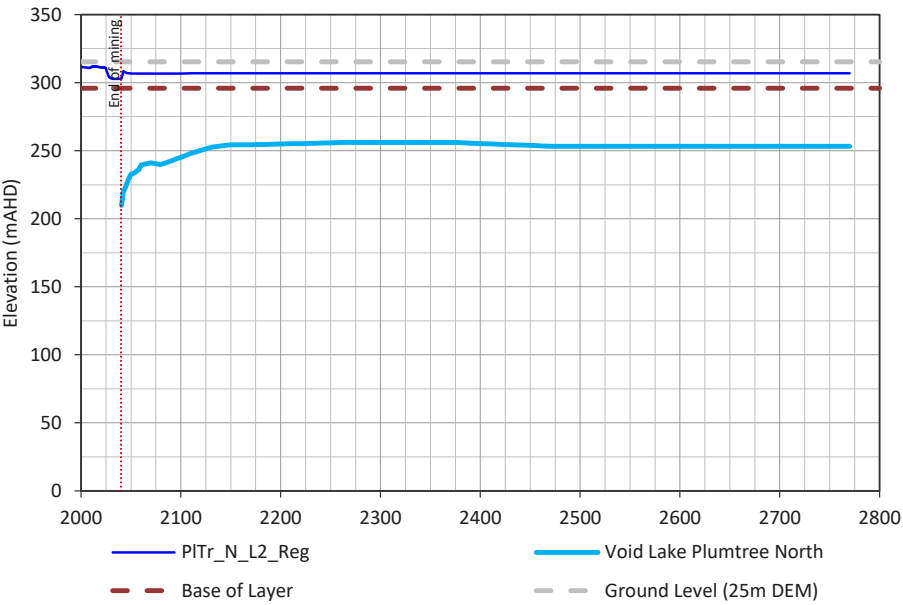




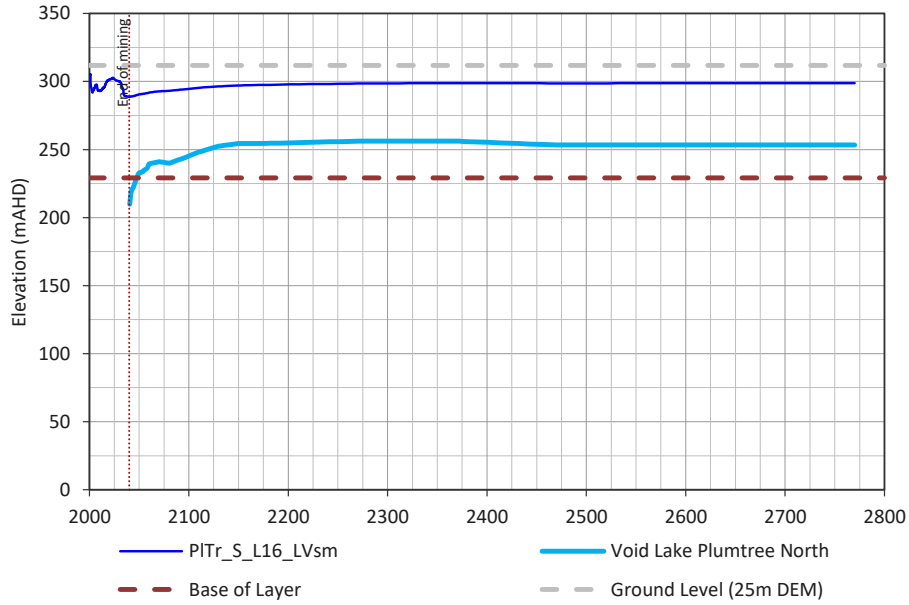
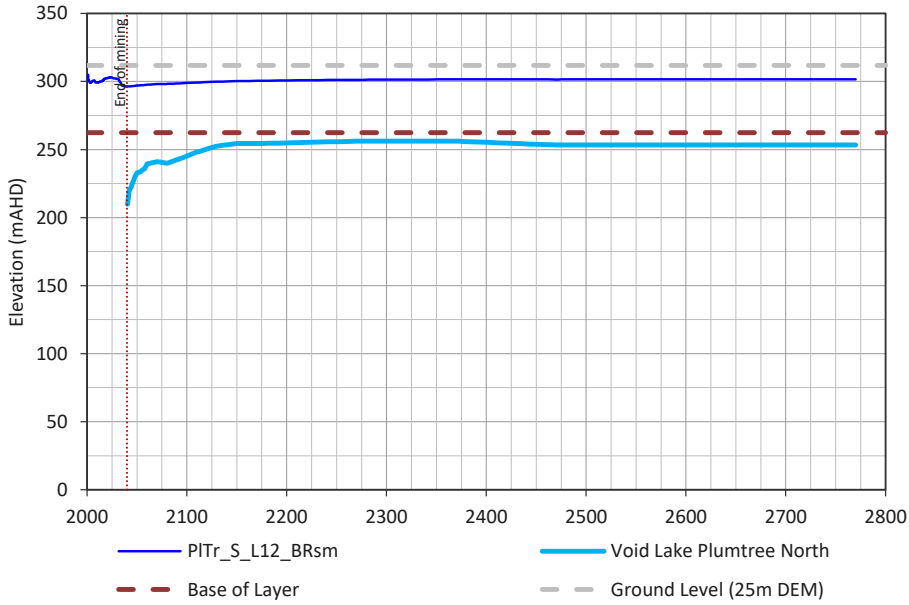
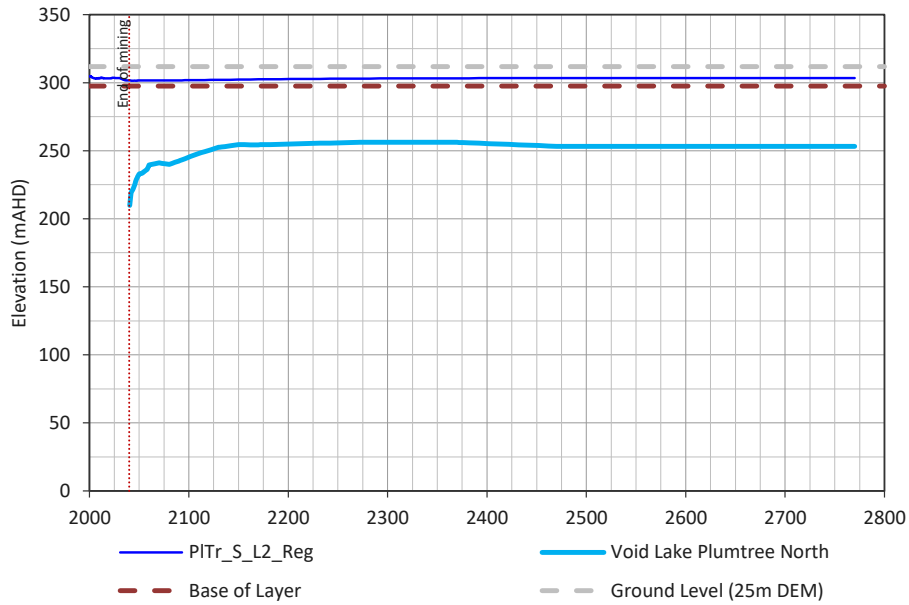
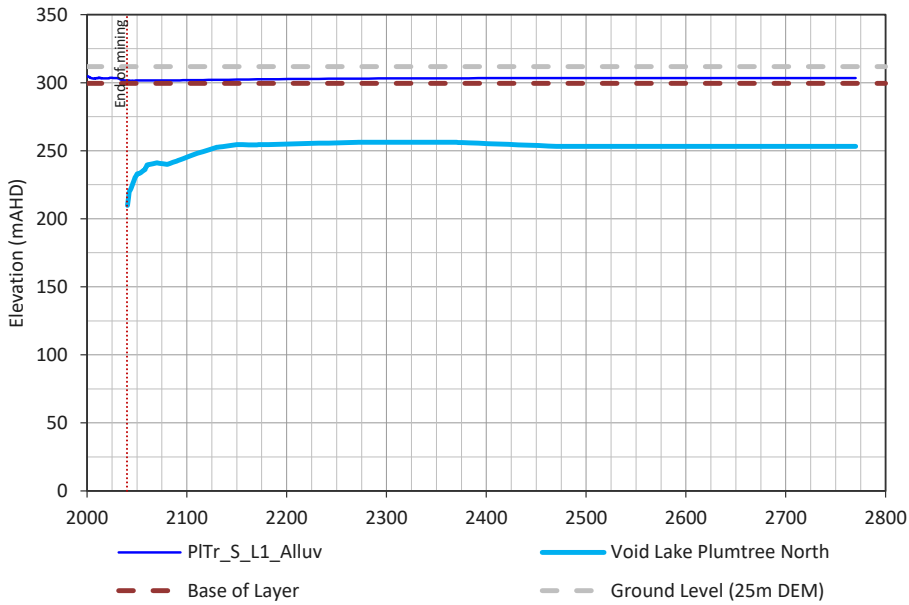


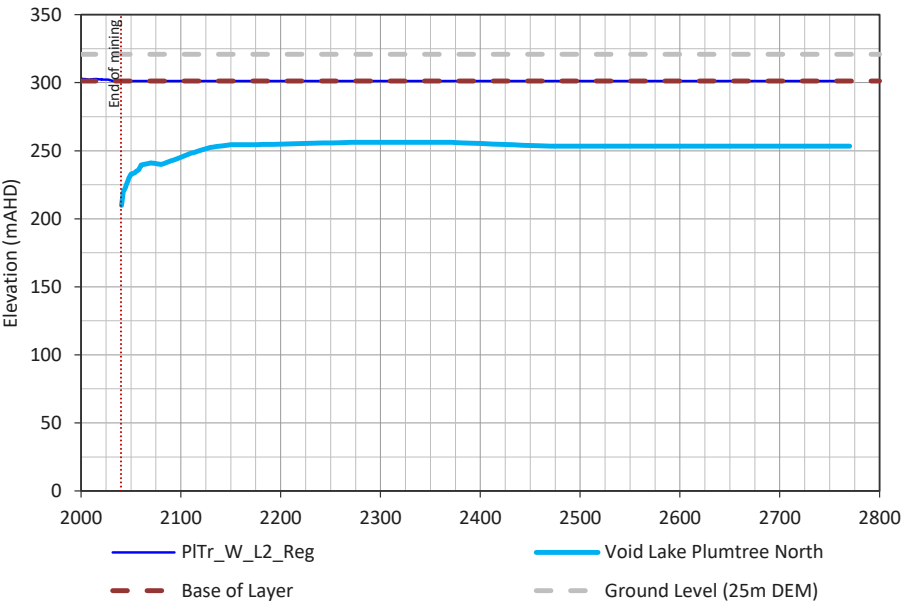


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Appendix E

Independant Peer Reviewer Report

New Lenton Coal Project

PER Groundwater Assessment

Lenton Joint Venture

SLR Project No.: 620.31367.00000

9 October 2024

NEW LENTON PROJECT

Independent peer review of the New Lenton Project
numerical groundwater model



1. Introduction

This report presents an independent technical peer review of the numerical groundwater model prepared for the New Lenton Project (the Project, New Lenton) public environmental report (PER) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2020/8778). The model incorporates the Project and the adjoining Burton Mine (Burton) and is used to make predictions. The aim of the review is to ensure technical competency and adherence to regulations for the numerical groundwater model.

New Lenton Coal Pty Ltd (NLC), a wholly owned subsidiary of Bowen Coking Coal Ltd (BCC), proposes to construct and operate an open-cut coal mine and associated infrastructure, located 65 kilometres north of Moranbah, Queensland. BCC has engaged SLR to prepare a groundwater impact assessment to support the Project. The Project comprises two opencut pit areas operating over a period of 17 years, after which a final void will remain. The Project will utilise infrastructure at Burton Mine, which is also operated by BCC.

It is noted that the model incorporates both the Project and Burton, which ensures that any cumulative predictions of groundwater impacts are explicitly modelled. Burton Mine targets the Burton/Rider and Leichardt/Vermont seams of the Rangal Coal Measures via open-cut mining. A proposed final landform for Burton Mine contains five residual final voids.

The controlling provisions for matters of national environmental significance (MNES) for the Project include a water resource, in relation to coal seam gas development and large coal mining development ('the water trigger'). The PER has been prepared to determine if there are likely to be significant impacts to water resources.

Pit dewatering is predicted to lower groundwater levels in the adjacent alluvium and Permian strata.. Previous modelling has indicated The Project is unlikely to significantly impact surrounding landholder bores and groundwater dependent ecosystems (GDEs) (SLR, 2020).

The numerical modelling has been developed in support of the PER for submission to DCCEEW under the EPBC Act for the Project. As the model incorporates Burton Mine it will also be used to support a State approvals process for a transitional progressive rehabilitation and closure plan (PRCP) schedule.

The objectives of the New Lenton PER are to predict inflows to mine workings, drawdown, impacts on surface water, changes to alluvial resources, and groundwater levels. The objectives of the Burton PRCP are to simulate post mining groundwater level recovery, long-term drawdown, and flux to residual voids.

2. Documentation

Familiarisation of the Project was undertaken by briefly reviewing the following reports:

- Hydrogeological Study (GHD, 2019)
- Groundwater Modelling Report (GHD, 2019)
- Groundwater Modelling Report (SLR, 2020)
- Conceptual model update report (SLR, 2020)
- Trigger-limits report (SLR, 2020)

This review is based on the following report:

- SLR, New Lenton & Burton. 2023 Groundwater Modelling Technical Report, SLR Project No.: 620.31367.00000, 20 December 2023, Revision: 3.0 + 8 Appendices (Modelling Technical Report)

The Groundwater Modelling Technical Report is an appendix to Project's PER Groundwater Assessment (SLR, 2023)

Manewell Groundwater attended numerous progressive groundwater peer review meetings during the course of model development for SLR 2023, namely the presentation of calibration results, predictive model setup, uncertainty analysis results, post mining setup.

3. Review methodology

The review methodology is in accordance with the principles and guidelines outlined in the Australian Groundwater Modelling Guidelines (Barnett et al, 2012). This technical review incorporates the latest guidance on best practices for uncertainty analysis methods as presented in Uncertainty analysis—Guidance for groundwater modelling within a risk management framework (Middlemis and Peeters, 2023). The technical review is also based on a combination of professional expertise and modelling methodology, together with the model appraisal checklist provided in the Australian Groundwater Modelling guidelines.

The technical review consults the following federal regulatory guidelines to assess the sufficiency of the numerical groundwater model developed for the PER (SLR, 2023) and assess compliance with the following:

- Information guidelines for proponents preparing coal seam gas and large coal mining development proposals, issued by the Independent Expert Scientific Committee of the Commonwealth of Australia (Peeters & Middlemis, 2023).
- Significant impact guidelines 1.3, issued by the Department of the Environment and Energy of the Commonwealth of Australia (DES, 2013).

4. Model review

4.1 Model conceptualisation

Conceptualisation is presented in the SLR, 2023. Sufficient rigor has been applied to the development of this model which represents a culmination a numerous hydrogeological investigations over the Project area.

4.2 Model code/extent and mesh design

The model utilises industry standard MODFLOW-USG with Voronoi cell unstructured model grid. The extent is sufficiently large to overcome boundary condition effects (9 to 14 km from open-pit mining). The grid is refined appropriately around key features, including creeks, rivers, dams, alluvium, faults and pits to reduce structural error. Model cells are ‘pinched’ where hydrostratigraphic units are not present.

4.3 Model layers

A total of 2 layers are used to represent near surface hydrostratigraphy. Layer 1 represents alluvium where present and a nominal 1m thick regolith outside the extent of alluvium. It is likely most of the regolith cells in layer 1 are dry and essentially inactive for the majority of the simulations. Layer 2 represents the underlying regolith and basalt. Thicknesses are based a composite of geological mapping, CSIRO thicknesses (assume 50th percentile estimate), bore data, and geological models. This segregation is appropriate given the expected hydraulic properties of the shallow strata. The Triassic and Permian have been segregated into nine hydrostratigraphic units whose layer elevations are based on geological mapping and models.

Each Triassic and Permian Rangel Coal Measures layer is split laterally into 2 separate layers to represent disconnect across the Burton Range Fault. Potential connection to neighbouring offset strata is appropriately represented through the use of the Lateral Connection Group option in Algomesh.

4.4 Timing

Steady state represents pre-mining (1998) conditions, progressing to a transient historic annual stress periods from 1998 to 2011. Quarterly stress periods commence Jan 2011 to July 2023 to represent seasonal fluctuations and to better represent mining progression.

Predictive simulations employ quarterly stress periods from July 2023 to January 2024. Annual stress periods are simulated during the predictive mining period (Jan 2024 to December 2039). Timing is presented in Section 3.1 of the Modelling Technical Report. Given the absence of significant quarterly variability in groundwater levels this approach is appropriate. Post mining is simulated using 6-monthly to 100 yearly stress periods – a common approach.

4.5 Boundary conditions and stresses

General head boundary (GHB) cells are used to represent regional groundwater flow into and out of the model. GHB cells are appropriately represented in *all* model layers using calculated conductance based on cell dimensions and simulated horizontal hydraulic conductivity. This implies that hydraulic conductance changed during the history matching and predictive uncertainty simulations. This is common practice. The GHB cells are sufficiently far from the mining areas to not compromise the reliability of the predictions.

River cells along the Isaac River are used to appropriately represent primarily ephemeral conditions using zero-stage height at all times. River stage heights are informed by LiDAR elevation data where available. Leakage following high rainfall events is simulated using the recharge package. No baseflow is expected to occur – this assumption has been included as a measurement target during the history matching process. Sufficient rigor has been implemented in the representation of surface water, given site observation data. Dams are represented using measurement stage height information.

Diffuse recharge is appropriately represented using LUMPREM2. Daily rainfall and potential evaporation was simulated using SILO point data. Although simulated temporal recharge is less variable than other soil-moisture bucket methods (i.e., there is positive recharge to the watertable during all quarterly stress periods), LUMPREM2 is an industry standard and commonly accepted approach. The parameters used in LUMPREM2 appear reasonable. It is not apparent if the recharge events from LUMPREM2 align with apparent increases in groundwater levels, and if the parameters were initially calibrated using site information. Regardless, hydrographs presented in Appendix D suggest recharge events align generally successfully to groundwater level signatures. Spatial factors were then applied to the LUMPREM2 generated rates to different hydrostratigraphic units appropriately.

Evapotranspiration cells are used to simulate the removal of groundwater from plant/tree roots that extend to the groundwater table. EVT depths are appropriately history matched using bounds representative of expected rooting depths. Rates are calibrated and based on the BOM EVT estimate map in a reasonable manner.

4.6 Mining

Mine dewatering associated with open-cut mining practices are simulated using the Drain package. Drain elevations are set to the base of the lowest mined elevation at a nominally high conductance rate, and advance at a quarterly or annual rate during the calibration phase. Predictive mine progression advances at an annual basis. Drains are held for a period of 2 years before spoil or mine water storage is emplaced using the TVM package. Open cut mining is represented to industry standards.

Water storages are simulated using the CHD package, and deactivated using the TIB package appropriately. One negative of the CHD package is that injection of groundwater is unrestricted, however, presented results

indicate reasonable volumes entering the model. Activation and removal of these storages are provided in the report.

4.7 History matching

The historical model was history-matched using industry standard data assimilation software PESTPP-IES (White, 2018). A sufficiently large ensemble of 250 realisations was used; current guidance is to generate an ensemble of equal size to the number of singular values present in the parameter/observation dataset. A total of 7 optimisation iterations were performed. Groundwater level and drawdown data from a relatively large dataset was used to history match. The spatial coverage of these bores generally extends a little further than the New Lenton Mining Lease. Burton observations are generally close to the pits, although there are a few bores that exist far field.

Sixty-six zero flux baseflow targets are applied to the 3 km section of the New Lenton mine pits. Both head, drawdown, and baseflow is appropriately weighted using a weight balancing script (PWTADJ1).

Horizontal, vertical hydraulic conductivity, specific yield, recharge, river bed vertical hydraulic conductivity, evaporation depths and rates were refined as common practice. Pilot point multipliers in layer 1 were added appropriately to represent heterogeneity. Spatial covariance information generated using PPCOV was added to PESTPP-IES to promote spatial correlation during the optimisation process (i.e., pilot points close to each other within the 'A range' of a semi-variogram will maintain similarity). PPCOV parameters are detailed in the report.

The performance metrics for the best calibrated model is presented in section 2.2.3 of the Modelling Technical Report as scatter plots and residual histograms. The SRMS from the best calibrated realisation is a fairly arbitrary metric for regional models. It is more important that trends and flows are replicated from the ensemble as a whole. Pleasingly, the results from the ensemble are presented and discussed with rigor. Calibrating to historic mining where mine progression and other stressors are uncertain is difficult. Representing complex hydrostratigraphy with uniform parameters that employ a depth dependence function without further spatial variability means that the models can only fit an average head (and drawdown) to the spatial measurement dataset. The ensemble generally spans the range of measured groundwater levels with expected and appropriate precision. This reviewer agrees with the conclusions presented in section 2.2.5.4 of the Modelling Technical Report that explain ongoing mismatch.

Simulated water level and depth to water level maps from the best calibrated realisation reveal levels and saturated extents that are consistent with model conceptualisation. Baseflow rates along Isaac River are low and correspond to LUMPREM2 recharge rates. It is not reported how the baseflow varies within the ensemble, although Figure 2-39 indicates the ensemble is generally well behaved. Importantly however, measured groundwater levels in the Isaac River Alluvium are generally well-matched across the model ensemble.

Whole of model flows appear reasonable and consistent across steady state and transient phases. There are some stress periods where CHD inflows are high as water storage is emplaced, although these appear to be temporary, reducing to more reasonable consistent inflows to the system. EVT is the highest outflow, which suggests that EVT cells act as a surrogate for surface drainage in low lying areas.

Calibrated hydraulic parameters are presented from the best calibrated realisation and appear reasonable and consistent with site measurements and other regional studies. The range of parameters considered in the historic ensemble are presented as Appendix B. Generally, the imposed range is broad and wider than what is typically applied in similar environments. It is noted that specific storage is higher than contentious ranges implied from ongoing research and poroelastic theory. However, given the averages for specific storage was calibrated towards the lower range, it is not anticipated that artificially high values of specific storage would significantly influence the range of predictions. Recharge, evapotranspiration and river parameters for the

best calibrated parameter set appear reasonable. Recharge to spoil is based on MER (2009) – a common approach.

Despite structural error discussed in section 2.2.5 of the Modelling Technical Report this reviewer agrees the ensemble of models are deemed fit for purpose.

4.8 Predictions

Three predictive models were used to make predictions in cumulative conditions using the standard Cumulative, Approved, Null approach. Mass balances are consistent with the historic phases.

Predictive drain cells are simulated according to an operation window indicated by mine plan surfaces. Enhanced spoil recharge is emplaced immediately with spoil emplacement. In reality, spoil recharge to the watertable occurs several years after emplacement, however, given the progression of the opencut at New Lenton it is likely this potentially buffering capacity is minimised.

Predicted drawdowns in the watertable and alluvium are as expected. Incremental watertable and alluvial drawdown extends up to 2 km from the New Lenton mine pits. Drawdown predictions for the best calibrated realisation appear reasonable.

Absolute inflows to the New Lenton workings appear reasonable. Inflow peaks to over 800 ML/year from East Pit.

Incremental alluvial takes peak at approximately 180 ML/year at 2030, as expected. Negligible take from the Isaac Connors Alluvium is predicted.

No baseflow was encountered in the best calibrated realisation during the predictive phase, therefore there is no anticipated take. If seasonal recharge were applied during the predictive phase, it might be reasonable to assume that the model could predict a maximum of approximately 7 ML/year (from average historic predictions of 0.02 ML/day), although it is important to note that baseflow does not occur, and this rate is more representative of local evapotranspiration from recharge, rather than watertable derived baseflow. Simulating this detail is difficult in models of this scale (even quarterly or monthly stress periods is an oversimplification) and is beyond the capabilities of such a regional scale model.

4.9 Calibration sensitivity analysis

PESTPP-IES does not record parameter sensitivities during the optimisation process. A separate sensitivity analysis was undertaken, assumedly using the best calibrated realisation, by creating a traditional sensitivity or Jacobian Matrix through perturbation. The discussion on identifiability is thorough. Results are as expected given the observation dataset. Values of high identifiability are encountered where a given parameter is estimable to measurement data. If many measurements inform a single parameter, such as Kx-L8-Rewan, identifiability is high. This could be an issue if posterior parameter realisations are generated using this information, however, the sensitivity matrix was not used to generate realisations used for uncertainty analysis.

4.10 Predictive uncertainty analysis

A Type 3 uncertainty analysis was undertaken to assess future impacts. The posterior ensemble from PESTPP-IES was analysed and the posterior standard deviation was adjusted. Then the final posterior was attained via model performance rejection. 162 realisations from the calibration ensemble met this performance criteria, so were included in predictive uncertainty. As such, the 'prior' is not really the 'prior', as it has been history matched already. Regardless, the range of parameters appears wide in all instances, suggesting that the predictive uncertainty steers towards the conservative end.

A total of 362 realisations were tested. Confidence intervals were tested using an increasing number of model realisations to reveal that little would be gained using a higher number of runs. This is expected – generally most information of the pertinent predictions within the 90th percentile are gained using less than 100 realisations.

Inflow predictions into the New Lenton mine are presented according to IESC guidelines. Maximum inflows appear reasonable and likely conservative due to the wide posterior parameter ranges assessed. Uncertainty of take from the alluvium is presented in a table. Results suggest that the calibrated model sits higher than 50th percentile from the uncertainty analysis. Very little impact on the Isaac Connors Alluvium Groundwater sub-area is predicted at the 90th percentile.

Percentiles of maximum drawdown encountered at any time during the predictions are presented. Results suggests that it is unlikely that incremental drawdowns of 1 m or more will extend an additional 1 km from the best calibrated realisation. Given the conservatism of the impacts and the range of parameters assessed in the uncertainty analysis this is likely a conservative estimate. This is because distal drawdown is partially controlled by the drawdown extent of the underlying Triassic/Permian strata.

4.11 Post mining recovery modelling

Following mine closure, the recovery of groundwater is simulated using the industry standard ‘high K lake’ approach. After an iterative process with a surface water model, CHD cells are used to represent pit lake using predictive transient pit lake stages.

The recovery of pit lake levels within the New Lenton void appear reasonable. Equilibrated groundwater levels appear to remain approximately 20 m below the regional groundwater table, and significantly lower than the base of shallow geological formations, suggesting a perpetual groundwater sink.

Water balances to the void appear reasonable and in line with predictions at the end of predictive mining. The properties of the spoil, evapotranspiration and recharge rates are reasonable.

Post mining drawdown and flow changes from New Lenton mine in the alluvium is consistent with the predictive phase. As expected, drawdown in the Permian strata extends further than the predictive phase.

Particle tracking confirms the voids for both New Lenton and Burton form a long-term sink to groundwater flow.

Hydrographs are presented at key receptors that indicate groundwater receptors do not experience significant impacts, although it important to note this is the best calibrated case, and other realisations are likely to experience higher, yet less likely drawdown at these locations.

Uncertainty analysis on the recovery model was undertaken using the same posterior ensemble used during predictive analysis to predict the likelihood in inflows, indirect flow changes and maximum incremental drawdown. This approach is aligned to guiding principles presented in Tomlin et al (2022). Results suggest all voids remain long-term groundwater sinks, with the exception of the Ellensfield void at Burton, which shows a very low likelihood (10th percentile) of being a long-term source. Indirect flow changes to the alluvium are reasonable and consistent with rates at end of the predictive simulation. It is noted that all realisations use the same transient pit lake recovery curve as calculated from surface water modelling. If predicted equilibrated pit lake levels vary significantly given different hydraulic properties, recharge rates, and evaporation, different pit lake levels could be considered within the ensemble for future post-mining studies.

Predicted incremental post-mining drawdown extents are extensive due to broad parameter ranges assessed. Commendably, lateral connection imposed in the model DISU package allows significant hydraulic connection to adjacent layers. It is likely that strong hydraulic connectivity is impeded by clay gouge along the fault, and layer wide hydraulic connectivity is less than explored in the uncertainty analysis. These factors suggest 90th percentile impact predictions are overstated.

5. Report review

The Modelling Technical Report is a high-quality document of about 190 pages long including 8 appendices that contain information of spatial hydraulic properties, history matching performance, water budgets, drawdowns, hydrographs and parameter distributions. SLR, 2023 contains useful information regarding the implications of drawdown to GDEs. Modelling objectives are clearly stated and adequately addressed in the report.

The report is well-structured and well-written, the majority of the figures and maps are of high quality and easy to understand. An executive summary in the modelling appendix is not provided.

Progressive review comments were provided by the reviewer in the working modelling 'docx' document. Reviewer comments have been considered by SLR and have been accommodated satisfactorily in revisions of the report.

6. Data review

The hydrogeological model for which this model is built upon was derived from four field programs undertaken from 2014 to 2023. Drilling programs and geophysics have been used to build the geological model. Slug testing forms the basis of the hydraulic testing program. This is suitably covered in SLR, 2023. Given slug tests provide a snapshot of average hydraulic properties, literature ranges have been used to form hydraulic parameter assessed under uncertainty. As a result, parameters ranges remain suitably wide. Posterior uncertainty could only be reduced through the acquisition of additional hydraulic testing, such as packer, pumping tests, or laboratory analysis. If there are concerns over the range of predictions presented more hydraulic information is required.

Generally, the quality of groundwater level measurements within the model domain is adequate and captures episodic climate variability and longer-term trends. There are frequent readings from many bores that screen multiple groundwater model layers.

Groundwater recharge and surface water flow has been conceptualised with rigor, considering the arid environment in which the Project exists. Groundwater quality is suitably discussed in SLR, 2023.

The identification of potential GDEs is thorough and implications considering groundwater impacts is discussed. There are very few groundwater users in the model domain.

It is likely that historical groundwater inflows to Burton Mine are uncertain. The model would benefit from measured flows during the history matching process to reduce non-uniqueness.

7. Model level classification

Similar to the Modelling Technical Report, this report applies a new concept for assessing model confidence.

The 2023 IESC Explanatory Note for Uncertainty Analysis defines a model is fit for purpose when results are:

- Useable – Relevant to the decision-making process, provide information on the uncertainty in conceptualisations and model simulations that allows decision-makers understand the effects of uncertainty on project objectives and potential bias.
- Reliable – Demonstrate that the range of model outcomes is consistent with system knowledge. Uncertainties affecting decision-critical predictions are not underestimated.
- Feasible - Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the project.

Table 1 presents this reviewers assessment of the four sources of uncertainty (structural, parameterisation, measurement error, predictions).

Table 1 Model confidence assessment

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	Model extent sufficiently large so that drawdown does not significantly interact with GHB boundaries. MODFLOW-USG Voronoi grid with more than sufficient refinement area key features.
	Layers	Fit for purpose	Top of model uses LiDAR data where available.
		Fit for purpose	Model layer elevation sourced from best available data sources (TEM, CSIRO regolith, drilling, site geological models)
	Conceptualisation – Geological Structure	Fit for purpose, future improvements possible where new data collected	Geological structure based on best available data. Validated from observed and mapped geology. Geological layers displaced by the Burton fault. Connection to different units across the fault automatically calculated using Algomesh.
	Conceptualisation – GDEs	Fit for purpose, future improvements possible	GDE conceptualisation provided in accompanying SLR, 2023.
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose, future improvements possible	Surface water-groundwater interaction considered minimal in the New Lenton Project area. Detailed discussion in provided in SLR, 2023.
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose	Saturation extents informed by site monitoring bores.
Parameterisation	Hydraulic Conductivity – Shallow layers	Fit for purpose, future improvements possible	Heterogeneity represented using pilot points. Future analysis could involve pumping tests to key parts of the alluvium to reduce parameter uncertainty and validate variogram used to impose spatial connectivity.
	Hydraulic Conductivity – Depth Dependence	Fit for purpose, future improvements possible	Depth dependence equation used to impose average changes in hydraulic conductivity with depth. Future analysis could involve pumping tests (if possible) Future modelling should consider pilot points/linear structures to validate connectivity between the pit and the Permian/Triassic below the alluvium.
	Storage	Fit for purpose, future improvements possible	Field hydraulic testing of specific storage and specific yield appears limited.
	Vertical Hydraulic Conductivity	Fit for purpose, future improvements possible	Literature and model used to attain vertical hydraulic conductivity estimates. Nested monitoring bores or VWP's could be used to constrain ranges of Kv. Laboratory hydraulic testing could constrain lower bound Kv.
	Spoil Properties	Fit for purpose, future improvements possible	As usual, limited site-specific information is available. The model was used constrain spoil properties. Future work should hydraulically test emplaced saturated spoil.
	Rivers	Fit for purpose	Isaac River is highly ephemeral. Flow occurs for a few days per year. Observed groundwater indicate baseflow is unlikely to exist. Isaac River represented using river cells with zero stage height representing baseflow only. Zero baseflow was targeted during the calibration process.

Type	Part	Status	Comment
	Recharge	Fit for purpose	Recharge calculated using LUMPREM2. Recharge distributed as factors using surface geological zones.
Measurement Error	Observation Data Quality	Fit for purpose, future improvements possible	Bore logs and construction details available for most site bores. Most units have long-term water level data available. Measurement noise implied by the accuracy of the measurement devices/bore construction could be incorporated more accurately into inversion exercise (if not done already).
	Landholder Bore Data Quality	Fit for purpose, future improvements possible	Landholder bore construction subject to more uncertainty. Field census survey data. Uncertainty of screen information could be incorporated into drawdown estimation (e.g., span observation bore level over multiple layers).
	Temporal spread	Fit for purpose	Timeseries water level data gathered for all units over relatively long monitoring period.
Scenario Uncertainties Future Stresses / Conditions	Calibration	Fit for purpose	Steady state/Transient (1998-2023) history-matching to groundwater levels, drawdown and baseflow undertaken using PESTPP-IES. Calibration includes historic mining at Burton Mine.
	Predictive	Fit for purpose	Predictive model simulated approved mining at Buron and proposed open cut at New Lenton.
	Sensitivity and uncertainty	Fit for purpose	Predictive uncertainty analysis undertaken on the 3 scenarios. Recharge and EVT parameters were varied within the ensemble that span the range of potential climate change scenarios. Predictive uncertainty undertaken on post mining recovery scenarios.

Overall, it is this reviewer's opinion that the model is indeed useable, reliable and feasible in accordance with the IESC uncertainty note criteria. There is room for improvement in the next phase of modelling, which would aim to further reduce predictive uncertainty.

8. GMDSI decision-support modelling guiding principles

In a similar vein to the IESC uncertainty note, the Groundwater Modelling Decision Support Initiative released 'Monograph: Decision-Support Modelling Viewed Through the Lens of Model Complexity' (Doherty & Moore, 2021). Manewell Groundwater has distilled the key guiding principles into checklist items to ensure the model is not overly complex and serves as a useful tool that appropriately assesses the likelihood of the "bad thing" from occurring. Table 2 presents pertinent guiding principles as checklist items.

Table 2 Decision-support guiding principles checklist

Category	Guiding Principle Item	Yes/No	Comment
Client/Regulator Concerns	Have the impacts that the client/regulator fears been clearly identified before starting the modelling process?	Yes	Several iterations of this model have been presented to regulators and peer reviewers.
Model Purpose and Uncertainty	Is the model specifically designed to make a particular prediction and quantify the uncertainty associated with that prediction?	Yes	Model designed to predict drawdown, inflow and flow change.
Simplicity Over Complexity	Has the model avoided unnecessary complexity, opting for simpler, effective approximations?	Yes/No	Simpler representations of localised parts of the connection between pit and the receptors possible, however, these are often interpreted to be "too simple", hence a complex simulator is used in isolation.
Conceptual Model Collaboration	Is the conceptual model developed in collaboration with relevant experts, addressing where key information resides?	Yes	Model developed with team of hydrogeologists, groundwater modellers, and surface water modellers.
Exploration of Hydrogeological Representations	Are multiple representations of specific hydrogeological details explored, acknowledging system unknowns?	Yes/No	Pilot points used to represent heterogeneity in the alluvium. Localised variability in the Triassic/Permian not assessed, however it is likely these features exist at a fine scale.
Historical Stress Response Simulation	Can the model simulate the system's response to historical stresses effectively?	Yes	Ensemble of models replicates absolute heads and transient trends appropriately.
Numerical Efficiency and Robustness	Does the model run reasonably fast and maintain numerical robustness for effective hypothesis testing?	Yes/No	Model runs at an appropriate speed to meet the model objectives. Future hypothesis testing would require a model that runs significantly faster, although this is not in the scope of this project.
Model-Partner Software Integration	Is there a non-intrusive interface with model-partner software, capable of running models in parallel?	Yes	History-matching and uncertainty analysis undertaken using PESTPP suite.
History Matching Approaches	Are appropriate numerical strategies, such as Tikhonov regularization and singular value decomposition, used in history matching?	Yes	Pilot point spatial covariance used as regularisation in PESTPP-IES.
Data-Driven Prediction Design	Is the primary model designed for calibration against historical field measurements?	Yes	Quarterly stress periods used to simulate climate response and historic dewatering.
Parameterization in Decision-Support Modelling	Are model parameters plentiful, adjustable, and capable of stochastic representation?	Yes/No	Shallow groundwater system has an appropriate number of pilot points. Deeper units have a simpler parameterisation scheme.

Category	Guiding Principle Item	Yes/No	Comment
Accommodation of Uncertainty in Decision-Modelling	Does decision-modelling accommodate uncertainty, exploring the pessimistic end of the uncertainty bell curve?	Yes	The posterior parameter ranges presents as wide. Given layer wide parameters in the Triassic/Permian are perturbed, it is assumed the predictions are at the pessimistic end of the bell curve.
Reduction of Decision-Critical Uncertainty	Is decision support modelling tuned to reduce the uncertainty of one or a few critical predictions?	Yes	Drawdown, inflow, baseflow and flow change predicted.
Avoiding Type 2 Statistical Error	Does the model avoid overstating the widths of decision-critical predictive uncertainty analysis?	Yes	Range of posterior parameter distribution enforced by expert knowledge, so worse case impacts are within reality.
Predictive Error Accounting	Is predictive error introduced by numerical methodologies accounted for and communicated effectively?	Yes	Posterior parameter distributions presented. Model rejection process adequately discussed. Appropriate range of predictions present as likelihood bands.
System Component Representation	Are essential system components that impact predictions represented in the numerical model?	Yes	Key processes relevant to dewatering and the saturated groundwater phase represented.
Parameter Importance and Hosting of Information	Is the importance of parameters and their role in hosting information acknowledged?	Yes	Pilot points used to expose heterogeneity in response to groundwater level measurements.
Hypothesis Testing for Future Stresses	Is the hypothesis that future stresses will result in negative outcomes only rejected when demonstrably incompatible with known system measurements or behaviours?	Yes/No	Predictive uncertainty used historic groundwater level, drawdown and flow information to reject unrepresentative realisation. Hypothesis testing not undertaken and not required at this stage of the Project.
Prediction Spectrum Awareness	Is there an understanding of the differences between data-driven, expert-knowledge-driven, and mixed predictions?	Yes	Not explicitly addressed, although mixed prediction approach used is appropriate.

Overall, it is this reviewers opinion that the model serves as a useful decision support tool. Generally, the model has the ability to harvest information. If hypothesis testing were required for future studies (e.g., if early dewatering indicates more impacts than simulated), a simpler, highly parameterised version of the model should be developed that has the ability to expose avenues for drawdown that were not previously represented in the complex approvals model.

9. Australian Modelling Guidelines checklists

Table 3 is the NWC Compliance Checklist from the Australian Groundwater Modelling Guidelines (Barnett, 2012). The results conclude that the groundwater model is “fit for purpose”, where the primary purpose is to develop upon an existing model that is reasonably well calibrated to historical groundwater levels, drawdown and baseflow (or lack thereof). The model is a suitable tool for decision support where the purpose is to provide predictions on potential impacts due to mining at New Lenton and Burton Mine.

Table 3 Compliance checklist

No.	Review Questions	Yes/No	Comment
1	Are the model objectives and model confidence level classification clearly stated?	Yes	Model objectives clearly stated, and model level classification discussed in detail.
2	Are the objectives satisfied?	Yes	The objectives of the study of assessment of effects from the mine have been satisfied through predictions of dewatering effects on receptors. Alluvial flow change and baseflow impacts are sufficiently calculated and discussed. The effects of the voids on the post mining groundwater system are presented and discussed.
3	Is the conceptual model consistent with objectives and confidence level classification?	Yes	The conceptual model is consistent to the geological structure and mining induced stresses. The interaction between surface and groundwater stresses is adequately simulated given the conceptualisation, field observations, and scale of the model. Although the model is high in cell count, it proves to be useable, reliable, and feasible. The numerical model is history matched to best practice and uncertainty analysis assessed to industry standards.
4	Is the conceptual model based on all available data, present clearly and reviewed by an appropriate reviewer?	Yes	The model was based on a cumulation of previous modelling designs. Although the conceptual model is not presented in the numerical report, a conceptual model is clearly outlined in SLR, 2023, and there are illustrations that include hydrogeological stresses and interactions. The differences between the previous models is clearly defined.
5	Does the model design conform to best practice?	Yes	An adequate conceptual model has been generated and is reflected in the numerical model. The simplistic surface/groundwater interactions are aligned to the conceptual model. Pilot points are used to represent heterogeneity in the alluvium. Heterogeneity is not represented in the hard rock, which likely results in conservative estimates, given the range of parameters tested remains high at a regional scale.
6	Is the model calibration satisfactory?	Yes	The model correctly replicates absolute groundwater levels and changes to groundwater levels around the areas of importance proximal to New Lenton Mine. Large mismatches remain close to uncertain historic mining/infrastructure. Importantly recharge trends are generally well matched within the ensemble of models. Remaining mismatches are exposed and discussed. The model ensemble is constrained using a baseflow target to reduce non-uniqueness.
7	Are the calibrated parameter values and estimated fluxes plausible?	Yes	History-matched parameter values are within plausible bounds and align to site information (although limited and reliant primarily on slug testing). Recharge rates and hydraulic parameters of the aquifer units are consistent with studies undertaken throughout the region. Fluxes into the mine workings appear plausible. Fluxes to surface water drains are aligned to site information.
8	Do the model predictions conform to best practice?	Yes	Model predictions include time variant pit seepage inflows and drawdown. Composite maximum drawdown maps are presented to show transient maxima. Impacts on baseflow and alluvial flow changes are presented. Predictive hydrographs with layer elevations are presented. Predictions are calculated using the difference between null, approved, cumulative scenarios at a time-step level.
9	Is the uncertainty associated with the predictions reported?	Yes	A comprehensive calibration constrained Monte Carlo predictive parametric uncertainty analysis using 362 realisations spanning a wide range of parameters. Structural uncertainty is discussed and attempts made to reduce error. Measurement error discussed and incorporated into the history matching process (as noise). Different scenarios assessed. Variability in recharge across the uncertainty analysis arguably spans reduction in recharge implied by climate change. Post mining uncertainty analysis was undertaken and presents long-term drawdowns that are likely over-stated.
10	Is the model fit for purpose?	Yes	The model is built and assessed to industry standards. Given site information around New Lenton suggesting surface-groundwater interactions are minimal, and predictive uncertainty presented is likely conservative, the model is considered fit for purpose.

Table 4 Review checklist

No.	Review Questions	Yes/No	Comment
1	Planning		
1.1	Are the project objectives stated?	Yes	Designed to comply with submission under the EPBC and EP Acts.
1.2	Are the model objectives stated?	Yes	Designed to comply with submission under the EPBC and EP Acts.
1.3	Is it clear how the model will contribute to meeting the project objectives?	Yes	The report states that the modelling results are to assess the likely impacts of the proposed mining activity.
1.4	Is a groundwater model the best option to address the project and model objectives?	Yes	Measuring the effects of the propagation of drawdowns on piezometric surface through time in this case is best tested through a numerical groundwater model.
1.5	Is the target model confidence-level classification stated and justified?	Yes	Contemporary model level classification not discussed.
1.6	Are the planned limitations and exclusions of the model stated?	Yes	Detailed coverage of model limitations including data gaps and interpolation factors in report.
2	Conceptualisation		
2.1	Has the literature review been completed, including examination of prior investigations?	Yes	Yes previous studies and models have been utilised to develop the current model.
2.2	Is the aquifer system adequately described?	Yes	The unconsolidated and consolidated strata have been described with a number of model layers - 9 in total (split in two each side of the Burton range fault). The hydrostratigraphy and vertical gradients have been adequately simulated.
2.2.1	Hydrostratigraphy including aquifer type (porous, fractured rock ...)	Yes	The hydrostratigraphy describes the main components of the system related to the desired project objectives - namely unconsolidated alluvial aquifers, weathered overburden and consolidated Permian formations.
2.2.2	Lateral extent, boundaries and significant internal features such as faults and regional folds.	Yes	The extent of the groundwater model is fit for purpose and well thought out. Fault displacement and potential lateral connectivity represented using lateral connection groups. Rivers and creeks are represented as baseflow conditions only, as per site information, although can leak via recharge.
2.2.3	Aquifer geometry including layer elevations and thicknesses.	Yes/No	SLR, 2023 presents layer elevations of base of alluvium and thickness. Elevation and depth of base of Triassic and Leichardt/Vermont seams presented only.
2.2.4	Confined or unconfined flow and the variation of these conditions in space and time?	Yes	Brief discussion on nature of unconfined/confined conditions in numerical report. Saturation thicknesses of the alluvium formation discussed.
2.3	Have data on groundwater stresses been collected and analysed?	Yes	
2.3.1	Recharge from rainfall, irrigation, floods, lakes.	Yes	Recharge calculated using LUMPREM2.
2.3.2	River or lake stage heights.	Yes	River stage heights set to river base to represent ephemeral creeks. Positive river stages used to represent dams and water bodies.
2.3.3	Groundwater usage (pumping, returns etc.)	N/A	Well package not required in the calibration or predictive scenarios.

No.	Review Questions	Yes/No	Comment
2.3.4	Evapotranspiration.	Yes	EVT package used to simulate groundwater take from tree roots. In some areas this is used as a surrogate for surface drainage.
2.3.5	Other?	No	
2.4	Have groundwater level observations been collected and analysed?	Yes	Relatively extensive groundwater level dataset.
2.4.1	Selection of representative bore hydrographs.	Yes	Key hydrographs presented and discussed. All other hydrographs presented in an Appendix.
2.4.2	Comparison of hydrographs.	Yes	Observed and simulated groundwater levels presented on the same chart.
2.4.3	Effect of stresses on hydrographs.	Yes	Groundwater drawdown and short-term recovery replicated.
2.4.4	Watertable maps/piezometric surfaces?	Yes	Historic and simulated contoured heads presented.
2.4.5	If relevant, are density and barometric effects taken in account in the interpretation of groundwater head and flow data?	N/A	Not relevant to the scale of this study.
2.5	Have flow observations been collected and analysed?	Yes/No	Observed baseflow discussed. Estimated inflows to existing workings (at Burton) not discussed in the numerical modelling report as they are not the focus of this Project.
2.5.1	Baseflow in rivers.	Yes	The absence of measured baseflow used as a history-matching target.
2.5.2	Discharge in springs.	N/A	SLR, 2023 suggests no springs were mapped within the vicinity of the project area.
2.5.3	Location of diffuse discharge areas?	N/A	Out of the scope of this study.
2.6	Is the measurement error or data uncertainty reported?	No	Briefly discussed, although measurement error assumed in the inversion exercise not presented.
2.6.1	Measurement error for directly measured quantities (e.g. piezometric level, concentration, flows).	No	Briefly discussed, although measurement error assumed in the inversion exercise not presented.
2.6.2	Spatial variability/heterogeneity of parameters.	Yes/No	Discussion of local heterogeneity discussed in limitations section. Heterogeneity represented in the alluvium via pilot points. Depth dependence applied to Triassic/Permian strata, although local heterogeneity not represented in the model.
2.6.3	Interpolation algorithm(s) and uncertainty of gridded data?	No	Uncertainty of gridded data (e.g. model layer surfaces) not discussed.
2.7	Have consistent data units and geometric datum been used?	Yes	ML/day and ML/year consistently used where appropriate.
2.8	Is there a clear description of the conceptual model?	Yes	Presented in the SLR, 2023 report.
2.8.1	Is there a graphical representation of the conceptual model?	Yes	Presented in the SLR, 2023 report as a hydrostratigraphical cross section with inferred groundwater levels. Groundwater flow and some hydrogeological stresses presented. 3D schematics also presented.
2.8.2	Is the conceptual model based on all available, relevant data?	Yes	Cross section based on geological information from drill-logs and geological models. Key processes are presented. Post mining conditions are presented as a second conceptual model.
2.9	Is the conceptual model consistent with the model objectives and target model confidence level classification?	Yes	The key system components have been integrated to target the project objectives, the objectives being effects of mine pit development on groundwater levels, groundwater users, alluvial aquifer levels and river and stream baseflows. Effects on GDE can be inferred from the section.

No.	Review Questions	Yes/No	Comment
2.9.1	Are the relevant processes identified?	Yes	The main components of the hydrology, hydraulics of the system have been included and the transient stresses from mine pit development. A separate conceptual model in numerical modelling report presents post mining conditions. Key interactions are identified.
2.9.2	Is justification provided for omission or simplification of processes?	Yes	The report limitation section discusses these.
2.10	Have alternative conceptual models been investigated?	No	
3	Design and construction		
3.1	Is the design consistent with the conceptual model?	Yes	
3.2	Is the choice of numerical method and software appropriate (Table 4-2)?	Yes	Model is simulated using MODFLOW-USG Transport using the upstream weighting function - details on the nature of layer types and saturation functions not detailed in the report.
3.2.1	Are the numerical and discretisation methods appropriate?	Yes	The cell refinement (60x60m within mining areas and 100-150 around rivers/dams) are appropriate. and the total of number of cells ((291,564) provides adequate spatial resolution and relatively fast model run times.
3.2.2	Is the software reputable?	Yes	MODFLOW-USG is an accepted industry standard for this type of application.
3.2.3	Is the software included in the archive or are references to the software provided?	Yes	MODFLOW-USG is referenced.
3.3	Are the spatial domain and discretisation appropriate?	Yes	Spatial domain is well thought out. The minimum cell size of 60 x 60m replicates the yearly progression of the pit areas more than adequately.
3.3.1	1D/2D/3D.	Yes	3D
3.3.2	Lateral extent.	Yes	These are well thought out and defined in the model. The lateral boundaries are located far enough from area stressed during simulation and prediction.
3.3.3	Layer geometry?	Yes	The model uses nine major model layers (split in half along the Burton range fault), this is thought appropriate for this level of study.
3.3.4	Is the horizontal discretisation appropriate for the objectives, problem setting, conceptual model and target confidence level classification?	Yes	The model could be thought of as finely discretised.
3.3.5	Is the vertical discretisation appropriate? Are aquitards divided in multiple layers to model time lags of propagation of responses in the vertical direction?	Yes	Aquitards have been included, in some case multiple layers have been used.
3.4	Are the temporal domain and discretisation appropriate?	Yes	
3.4.1	Steady state or transient.	Yes	Steady state and transient calibration undertaken, followed by transient predictive analysis.
3.4.2	Stress periods.	Yes	Stress period information well documented. Appropriately simulated using quarterly periods during historic phase, then annual for predictions. Stress periods grow to 100 years during the recovery phase.

No.	Review Questions	Yes/No	Comment
3.4.3	Time steps?	Yes	Adaptive Time-Stepping (ATS) option used and minimum time step size reported.
3.5	Are the boundary conditions plausible and sufficiently unrestrictive?	Yes	Cumulative drawdown extents do not significantly interference with general head boundaries. River and CHD cells used to represent water storage do not leak unrealistic flows into the groundwater system.
3.5.1	Is the implementation of boundary conditions consistent with the conceptual model?	Yes	GHBs used to simulate regional throughflow. DRN cells used to represent dewatering. CHD cells used to represent post mining pit lake.
3.5.2	Are the boundary conditions chosen to have a minimal impact on key model outcomes? How is this ascertained?	Yes	Predictive impacts from New Lenton do not interact with the GHBs, no flow boundaries and fixed heads. River cells representing drains act as baseflow only. River leakage represented via recharge package and assess via uncertainty analysis.
3.5.3	Is the calculation of diffuse recharge consistent with model objectives and confidence level?	Yes	Recharge has been zoned based on conceptual understanding of the system - e.g., highest recharge over flat permeable sediments and less recharge over steeper slope less permeable sediments. LUMPREM2 used to calculate base diffuse recharge rates.
3.5.4	Are lateral boundaries time-invariant?	Yes	General heads using fixed levels used for the entire simulation.
3.6	Are the initial conditions appropriate?	Yes	Steady state groundwater levels used that override any initial conditions. Pre-mining and steady state representative of 1998 conditions that appear representative of average climate conditions based on hydrographs and flows.
3.6.1	Are the initial heads based on interpolation or on groundwater modelling?	Yes	Steady state levels using ~1998 levels as steady state targets.
3.6.2	Is the effect of initial conditions on key model outcomes assessed?	Yes	Steady state heads reformulated for every parameter combination.
3.6.3	How is the initial concentration of solutes obtained (when relevant)?	N/A	
3.7	Is the numerical solution of the model adequate?	Yes	The numerical model solver settings produce percentage discrepancies well-under the AGMG guidelines (<1%) at 0.02% at any timestep in the simulation.
3.7.1	Solution method / solver.	Yes	Sparse Matrix Solver (SMS) used.
3.7.2	Convergence criteria.	Yes	Appropriate HICLOSE criteria (0.001 m) used.
3.7.3	Numerical precision.	No	No discussion on numerical precision in the report.
4	Calibration and sensitivity		
4.1	Are all available types of observations used for calibration?		
4.1.1	Groundwater head data.	Yes	Model history matched using all available head and drawdown measurements.
4.1.2	Flux observations.	Yes/No	Baseflow estimations were qualitatively checked against site information proximal to New Lenton. Flux to existing Burton workings not discussed as they are not available.
4.1.3	Other: environmental tracers, gradients, age, temperature, concentrations etc.	Yes	SLR, 2023 discusses isotopes, concentrations.

No.	Review Questions	Yes/No	Comment
4.2	Does the calibration methodology conform to best practice?	Yes	The reporting of the calibration process is well-documented. History matching was achieved using PESTPP-IES. Statistics, hydrographs, water budgets and adequately presented. Statistics regarding drawdown are not presented (although not essential).
4.2.1	Parameterisation.	Yes	Calibrated to groundwater heads and baseflow while maintaining other model parameters with pre-defined realistic bounds based on site data or literature.
4.2.2	Objective function.	Yes/No	Briefly discussed in the observation weighting scheme. The evolution of phi during the calibration process not discussed or presented.
4.2.3	Identifiability of parameters.	Yes	Identifiability results including tables and maps are thoroughly presented and discussed.
4.2.4	Which methodology is used for model calibration?	Yes	PESTPP-IES using an ensemble smoother approach.
4.3	Is a sensitivity of key model outcomes assessed against?	Yes/No	Not directly assessed in the report, however it is noted that the calibration process revealed the hydraulic parameters and recharge to be the most identifiable (or estimable) parameter.
4.3.1	Parameters.	Yes/No	As above.
4.3.2	Boundary conditions.	Yes/No	Recharge, EVT and river conductance identifiability discussed.
4.3.3	Initial conditions.	Yes	Prescribed groundwater levels at GHBs discussed. Rest of model solves steady state heads at stress period 1
4.3.4	Stresses.	Yes	Recharge, EVT and river conductance identifiability discussed.
4.4	Have the calibration results been adequately reported?	Yes	
4.4.1	Are there graphs showing modelled and observed hydrographs at an appropriate scale?	Yes	Ensemble and best calibrated results presented in report and Appendix.
4.4.2	Is it clear whether observed or assumed vertical head gradients have been replicated by the model?	Yes/No	The absence of nested observations makes vertical gradients difficult to verify. Heads discussed at length, although simulated vertical gradients not specifically discussed.
4.4.3	Are calibration statistics reported and illustrated in a reasonable manner?	Yes	Appropriate statistics, scatter, and histograms presented.
4.5	Are multiple methods of plotting calibration results used to highlight goodness or fit robustly? Is the model sufficiently calibrated?	Yes	Scatter, hydrographs and spatial residual maps presented. The model is sufficiently calibration given the scale of the model.
4.5.1	Spatially.	Yes	Piezometric surfaces and spatial residuals presented.
4.5.2	Temporally.	Yes	Transient calibration hydrographs presented.
4.6	Are the calibrated parameters plausible?	Yes	Within plausible bounds from available data.
4.7	Are the water volumes and fluxes in the water balance realistic?	Yes	Comparison was made to like hydrogeological examples in the regional project area. Water fluxes to alluvial aquifers and streams/ rivers are consistent with the conceptual model.
4.8	Has the model been verified?	No	No verification section in the report.
5	Prediction		

No.	Review Questions	Yes/No	Comment
5.1	Are the model predictions designed in a manner that meets the model objectives?	Yes	Progressive drain cells simulate open cut dewatering. Average climate conditions assumed. Predictions calculated as difference from Null and Approved model scenarios.
5.2	Is predictive uncertainty acknowledged and addressed?	Yes	Predictive uncertainty comprehensively addressed and acknowledged through demonstration and summarised in Table 4-1.
5.3	Are the assumed climatic stresses appropriate?	Yes	Diffuse recharge applied using LUMPREM2. Annual climatic stresses during predictive period which are appropriate given the climate. Future modelling exercises may consider applying quarterly stress periods and associated climate stresses (although this would add computational effort).
5.4	Is a null scenario defined?	Yes	All predictive runs are compared to a null scenario (where no mining occurs) and an approved scenario.
5.5	Are the scenarios defined in accordance with the model objectives and confidence level classification?	Yes	Predictive modelling undertaken throughout the entire mining operation and includes a sufficient recovery period.
5.5.1	Are the pumping stresses similar in magnitude to those of the calibrated model? If not, is there reference to the associated reduction in model confidence?	N/A	There are no pumping stresses simulated in this model.
5.5.2	Are well losses accounted for when estimating maximum pumping rates per well?	N/A	There are no pumping stresses simulated in this model.
5.5.3	Is the temporal scale of the predictions commensurate with the calibrated model? If not, is there reference to the associated reduction in model confidence?	Yes	The predictive time period (~25 years) is similar to the transient calibration simulation duration (25 years).
5.5.4	Are the assumed stresses and timescale appropriate for the stated objectives?	Yes	As above. Recovery stress periods are adequate given pit lake estimates are derived from daily stress period models.
5.6	Do the prediction results meet the stated objectives?	Yes	The predictive results measure changes in groundwater level, flux to alluvial aquifers, changes to river baseflows and pit seepage - this meets the stated study objectives.
5.7	Are the components of the predicted mass balance realistic?	Yes	Inflows and discharge rates going into the model are realistic, and adequately reported and presented.
5.7.1	Are the pumping rates assigned in the input files equal to the modelled pumping rates?	N/A	There are no pumping stresses simulated in this model.
5.7.2	Does predicted seepage to or from a river exceed measured or expected river flow?	Yes	The river boundary volumes are realistic.
5.7.3	Are there any anomalous boundary fluxes due to superposition of head dependent sinks (e.g. evapotranspiration) on head-dependent boundary cells (Type 1 or 3 boundary conditions)?	No	Fixed head cells representing water storage during predictions and historic phase do not significantly contribute to the groundwater flow budget (aside from a brief moment in 2023).
5.7.4	Is diffuse recharge from rainfall smaller than rainfall?	Yes	Recharge rates range from 0.2 - 4.4% of rainfall.
5.7.5	Are model storage changes dominated by anomalous head increases in isolated cells that receive recharge?	No	

No.	Review Questions	Yes/No	Comment
5.8	Has particle tracking been considered as an alternative to solute transport modelling?	Yes	Particle tracking used to simulate long-term movement of groundwater to the pit lakes.
6	Uncertainty		
6.1	Is some qualitative or quantitative measure of uncertainty associated with the prediction reported together with the prediction?	Yes	Calibration constrained Monte Carlo predictive analysis undertaken and presented.
6.2	Is the model with minimum prediction-error variance chosen for each prediction?	Yes/No	An ensemble of models are used in the predictive analysis that meet calibration criteria thresholds. Each model does not necessarily possess a combination of parameters that are statistically minimised through inversion.
6.3	Are the sources of uncertainty discussed?	Yes	Discussed in Table 4-1.
6.3.1	Measurement of uncertainty of observations and parameters.	No	Not specifically discussed. If not specifically provided measurement uncertainty assumed equal to the reciprocal of observation weights.
6.3.2	Structural or model uncertainty.	Yes	Discussed in Table 4-1.
6.4	Is the approach to estimation of uncertainty described and appropriate?	Yes	Parametric uncertainty explored using relatively wide, aquifer wide perturbations. Ensemble of models assessed remain calibrated. Pleasingly, uncertainty applied to the predictive and recovery phases.
6.5	Are there useful depictions of uncertainty?	Yes	Predictions are presented as estimates of likelihood as per the IESC uncertainty guidelines.
8	Surface water-groundwater interaction		
8.1	Is the conceptualisation of surface water-groundwater interaction in accordance with the model objectives?	Yes	The conceptual model determined that surface water-groundwater interactions in the New Lenton Project area were minimal. The model validates this assumption and predictions of baseflow are assessed appropriately for the scale of the model. Future iterations may consider simulation of quarterly stress periods, although potential baseflow intercepted would be expected to be very low (<7 ML/year).
8.2	Is the implementation of surface water-groundwater interaction appropriate?	Yes	Given the absence of significant baseflow in the project area the simplistic representation of surface water-groundwater interaction is appropriate.
8.3	Is the groundwater model coupled with a surface water model?	Yes	Although not explicitly coupled, recharge rates are prescribed by LUMPREM2, and the pit lake recovery stages are derived from AWBM simulations.
8.3.1	Is the adopted approach appropriate?	Yes	The simulation of rivers and streams through the application of boundary conditions is appropriate.
8.3.2	Have appropriate time steps and stress periods been adopted?	Yes	Quarterly stress periods used to replicate historic phase. Annual for predictive phase. Given baseflow impacts are not deemed significant these stress periods are appropriate for this stage of assessment.
8.3.3	Are the interface fluxes consistent between the groundwater and surface water models?	Yes/No	Quarterly/annual recharge averaged and applied as a factor from the daily LUMPREM2 model. Similarly, daily pit lake stage estimates are averaged from 2 yearly to 100 yearly representations. This approach is appropriate.

10. Conclusions

It is this reviewer's opinion that the documented groundwater modelling in the Modelling Technical Report meets professional industry standards. The authors should be commended with the rigor applied to the analysis and insights provided in the technical report. The conclusions from the review and checklists indicate that the model is *fit for purpose*, where the purpose is to produce a calibrated groundwater model up to 2023. The ensemble of predictive models are *fit for purpose* for use as a decision support tool to predict future impacts due to open cut mining at the Project.

Stated modelling objectives have been met, the model is reasonably well calibrated, and the likelihood of future predictions appear reasonable. Expected drawdown occurs in the alluvium proximal to the Project mining areas. In the most likely scenario, it is unlikely that groundwater receptors will be significantly affected by dewatering and the post mining void at the Project.

The ensemble of models are well calibrated and simulated baseflow is generally consistent with site observations. Uncertainty analysis is robust and likely overstates expected impacts determined at the higher percentiles. For this reason, the clients and stakeholders can have confidence that the model is a reasonable predictor of future mining impacts.

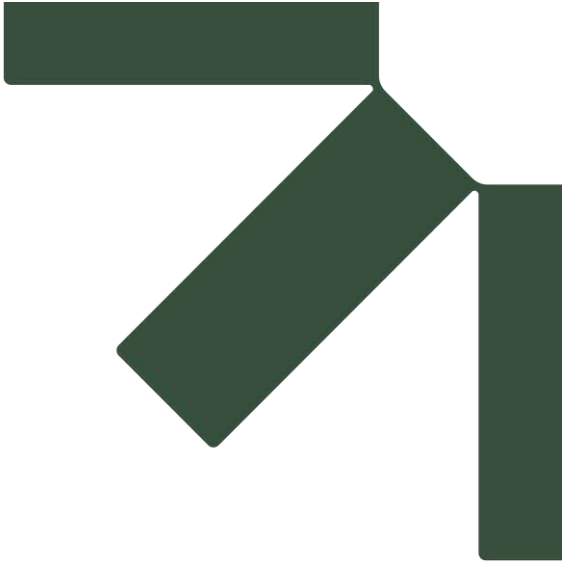
There are minor improvements that can be made at the onset of the Project to validate the expected impacts, and the range of potential impacts. Future studies should aim to sequentially validate the performance of the model ensemble as more data are available.



Neil Manewell
Director | Principal Groundwater Modeller
Manewell Groundwater

11. References

- Barnett et al, (2012) Australian groundwater modelling guidelines, Waterlines report, National Water Commission, Canberra.
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- Peeters LJM and Middlemis H (2023). Information Guidelines Explanatory Note: Uncertainty analysis for groundwater modelling, A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of Climate Change, Energy, the Environment and Water, Commonwealth of Australia, 2023’.
- SLR (2020), Environment Authority Amendment Supporting Information Document, New Lenton Mine, SLR Ref: 620.12614, Version No: V 2.0.
- SLR (2023), New Lenton Coal Project, PER Groundwater Assessment, 620.31367, Rev: 3.0, incorporating the New Lenton & Burton 2023 Groundwater Modelling Technical Report, 620.31367, Rev: 3.0
- Tomlin, J., Phillipson, K., Lenahan, M., Durick, A., Manewell, N., Newton, D., Briody, M., and Dunlop, J. (2022) Review of current approaches to model residual mine voids for rehabilitation planning: Technical paper 1, 2, 3.
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Appendix F

Additional Post-Mining Climate Scenario Groundwater Modelling

New Lenton Coal Project

PER Groundwater Assessment

Lenton Joint Venture

SLR Project No.: 620.31367.00000

9 October 2024

To: Richard Oldham

From: Dariarne Edwards
Derwin Lyons

Company: Lenton Joint Venture c/o Reach
Environmental

SLR Consulting Australia

Date: 27 September 2024

Project No. 620.V31367.00001

**RE: New Lenton Coal Project
Response to IESC Advice
Additional Climate Scenario Groundwater Modelling**

1.0 Background

The Lenton Joint Venture (LJV) engaged SLR Consulting Australia Pty Ltd (SLR) to undertake a groundwater assessment in support of LJV's New Lenton Coal Project (New Lenton, the Project) Public Environment Report (PER) for submission to Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) in 2023. Following submission of the New Lenton PER, DCCEEW requested advice from the Independent Expert Scientific Committee on Unconventional Gas Development and Large Coal Mining Development (the IESC) to support their assessment of the Project.

The purpose of this memorandum is to address the following comment included in the IESC's advice that pertain to the numerical groundwater model, developed by SLR in support of the New Lenton PER submission:

IESC Response 4f

Consideration is needed of climate change. The groundwater modelling does not incorporate climate change because the proponent assumes the 18-year project life is too short to warrant consideration (SLR 2023a, p. 103). This assumption is questionable during mining and not appropriate for the post-mining simulations which continue to 2770. Post-mining modelling should be updated to consider relevant plausible climate scenarios (e.g., CSIRO and BOM 2024).

Consideration of climate change is not warranted during the Project's 18-year operational life. Assessment of the Project-relevant climate change projections adopted by WRM (2023) (see **Section 2.1**) indicates that the key climate stressors related to groundwater (rainfall and evapotranspiration) would typically only vary by less than +/-10% over the 18-year Project life under even the most conservative emissions scenario (RCP8.5) (**Table 1-1**). These projected annual change to rainfall and evapotranspiration under the RCP8.5 scenario to 2040 amount to up to a 70% reduction in the magnitude of climate change compared to the projected annual change under the RCP8.5 scenario adopted in the new post-mining modelling considering climate change (see **Section 2.2**). Furthermore, as during-mining impacts associated with the Project are computed by the difference between predictive model runs with and without the Project, consideration of climate change would be equal in all predictive model runs and therefore the incremental difference between model runs (i.e. the Project effect) would not change as a result of inclusion of climate change.

Table 1-1 Projections of Change to Climate – Year 2040¹ (RCP8.5)²

Projection Scenario	Climate Model	Annual Change (%)	
		Rainfall	Evapotranspiration
Best Case	HadGEM2-CC	-22.6%	4.9%
Maximum Consensus Case	CNRM-CM5	-9.5%	4.6%
Worst Case	CESM1_CAM5	1.2%	7.4%

1. Published projections are only available at 5 yearly intervals. The year 2040 is the closest available year to the scheduled end of Project mining.
2. <https://www.climatechangeinaustralia.gov.au/en/projections-tools/climate-futures-tool/projections-builder/results/>

It is agreed however that consideration of climate change may be warranted for the 730 year post-mining simulation, as the affects of climate change in terms of the climate mechanisms represented in the groundwater model would be expected to be apparent over this timespan, and the presence of a residual void lake dominated by surface water processes would increase the potential for climate related influence on the groundwater system. Therefore, the following steps have been taken to address this request:

- Additional post-mining recovery modelling has been completed, to include assessment of the post-mining groundwater system recovery based on the maximum variability in climate scenarios (best and worst case) previously simulated in the Project's void water balance model (WRM, 2023); and
- Additional post-mining groundwater model predictions have been provided to include the results of the simulated climate scenarios.

A description of the additional numerical groundwater modelling is provided in **Section 2.0** of this memorandum and a summary of the additional post-mining recovery model results are presented in **Sections 2.2 to 2.2.8**.



2.0 Additional Post-Mining Recovery Modelling

2.1 Post-Mining Recovery Model Setup

The existing numerical model reported in the PER (SLR, 2024) was adopted for consideration of climate change in the post-mining model predictions. No changes to the previously reported model were made other than the simulation of additional transient post-mining recovery model scenarios that were developed as described in this section.

The model setup for the additional post-mining recovery predictions was consistent with that described in Section 6.1 and 6.2 of the New Lenton & Burton Groundwater Modelling Technical Report (SLR, 2024), with relevant updates made to the void lake boundary condition represented using the MODFLOW-USG Constant Head (CHD) package only. The time-variant CHD conditions applied to the residual voids were updated to reflect the predicted void lake levels from the void water balance modelling (WRM, 2023) for the 'best case' and 'worst case' climate scenarios reported therein. A description of the climate scenarios was reported in WRM (2023) as follows:

The potential impacts of climate change on residual void behaviour were assessed using the projections and methodologies given in the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Commonwealth Bureau of Meteorology (BoM) report entitled Climate Change in Australia Technical Report (CSIRO, 2015). The CSIRO report provides guidance on the possible projections of future climate for the Australian East Coast based on a current understanding of the climate system, historical trends and model simulations of the climate response to changing greenhouse gas and decreasing aerosol emissions.

Projections are given for a number of climatic variables including (but not limited to) temperature, rainfall, wind speed and potential evapotranspiration. CSIRO (2015) presents a number of possible approaches to quantify risks associated with climate change impacts.

For this assessment, the conservative Representative Concentration Pathway 8.5 (RCP8.5) emissions scenario has been adopted. The year 2090 was selected as the representative year, being approximately 50 years post-mine closure. Potential changes in climate have been obtained using the projection builder tool provided in the Climate Change Australia website. Climate variable inputs for the 'best case', 'maximum consensus' case and 'worst case' as defined by CSIRO (2015) for the RCP8.5 climate change scenarios are provided in Table 7.3. Year 2090 is the current limit of climate change projections as defined by CSIRO (2015).

Rainfall is expected to change by between plus 19.1% and minus 34.0% and evapotranspiration is expected to increase by between 8.3% and 15.2%. The climate variable inputs (rainfall and evaporation) to the water balance model were adjusted to undertake the climate change impact assessment.

Table 7.3 Projections of change to climate – Year 2090 (RCP8.5)

Projection scenario	Climate model	Annual change (%)	
		Rainfall	Evapotranspiration
Best case	GFDL-ESM2M	-34.0%	14.5%
Maximum consensus	ACCESS1-0	-15.4%	15.2%
Worst Case	NorESM1-M	19.1%	8.3%



The 'best case' and 'worst case' predictions from the void water balance model developed by WRM (2023) were adopted in the additional climate scenario groundwater modelling reported herein. It is noted that the adopted RCP8.5 emissions scenario represents a "a future with little curbing of emissions" (CSIRO, 2020) and is therefore the most conservative (greatest predicted amount of climate change) scenario of the four Representative Concentration Pathway (RCP) scenarios.

2.2 Additional Post-Mining Predictions

Predictive model outputs from the additional climate scenarios presented in the following sections are the same as those output types presented within the PER.

2.2.1 Residual Void Lake Levels

Figure 2-1 provides a graphical representation of the updated simulated recovery of water levels in the residual void at East Pit, for the base scenario as presented in the PER, as well as the best and worst climate scenarios described above. Note that, as discussed in **Section 6.2** of the Modelling Technical Report (SLR, 2023), the void lake levels simulated in the groundwater model are a simplified (time averaged) version of the WRM (2023) reported lake levels because of the inherent difference in time step setup between the two types of model.

Figure 2-1 shows that water levels in the residual void recover at a similar rate for the three climate scenarios, reaching equilibrium conditions after approximately 300 years. The predicted equilibrated water level in the residual void at 300 years post-mining for each of the climate scenarios is included in **Table 2-1**. The groundwater model predicted void lake levels at the end of the recovery period of 271.5, 228.7 and 274.9 mAHd for the base, best and worst climate scenarios, respectively, driven by the time-averaged level adopted in the groundwater model. It is noted that the base case results are very similar to the worst case results such that minimal difference in groundwater model outputs would be expected between these two scenarios. Note that WRM (2023) report fluctuating lake levels as shown in **Figure 2-1**. The difference between simulated lake levels is not considered significant enough to invalidate the convergence between the two types of model, or affect the groundwater model predictions described later in this report.



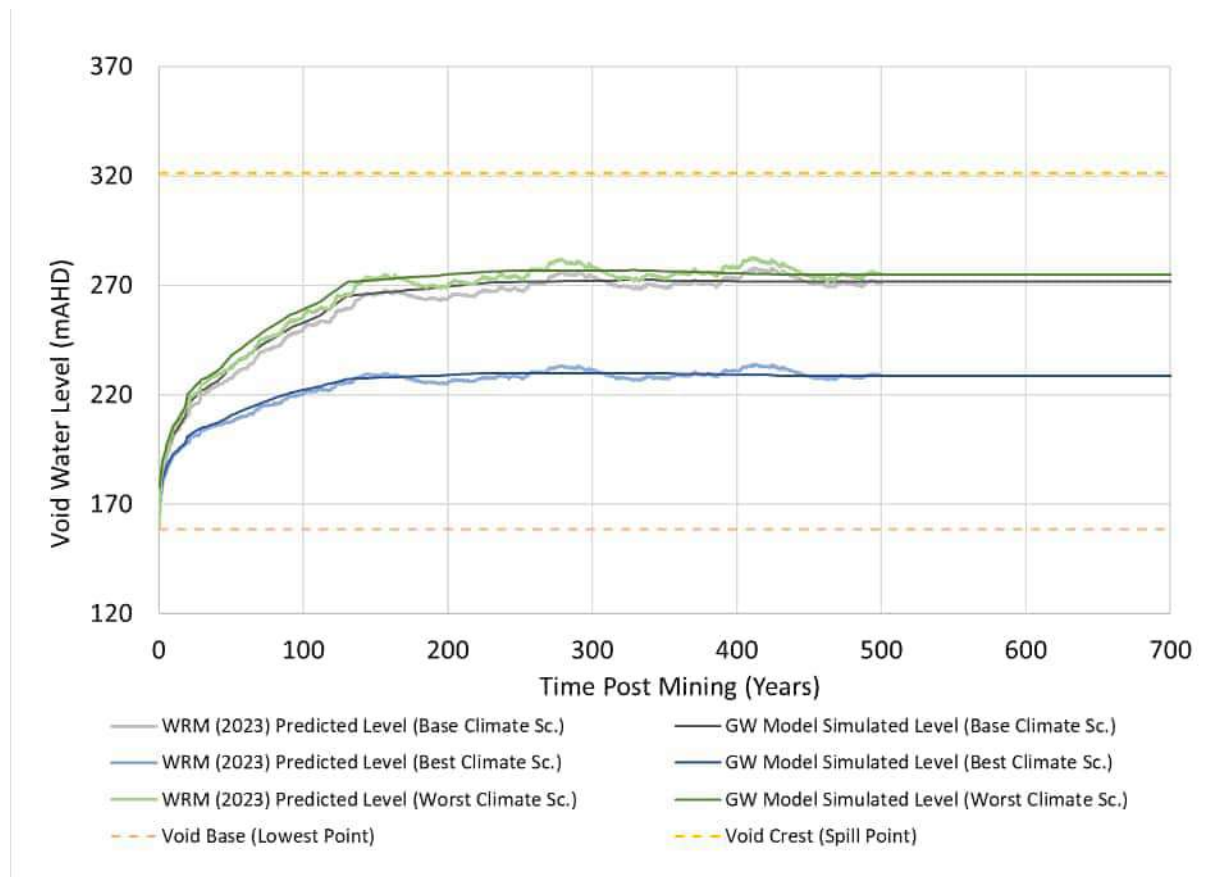


Figure 2-1 Simulated East Pit Void Water Level Recovery - Post-mining

The freeboard for the residual void is calculated as the difference in elevation between the equilibrium void lake levels and the maximum void storage elevation. The freeboard for the residual void is shown in **Table 2-1**.

Table 2-1 Approximate Equilibrium Conditions for East Pit Void

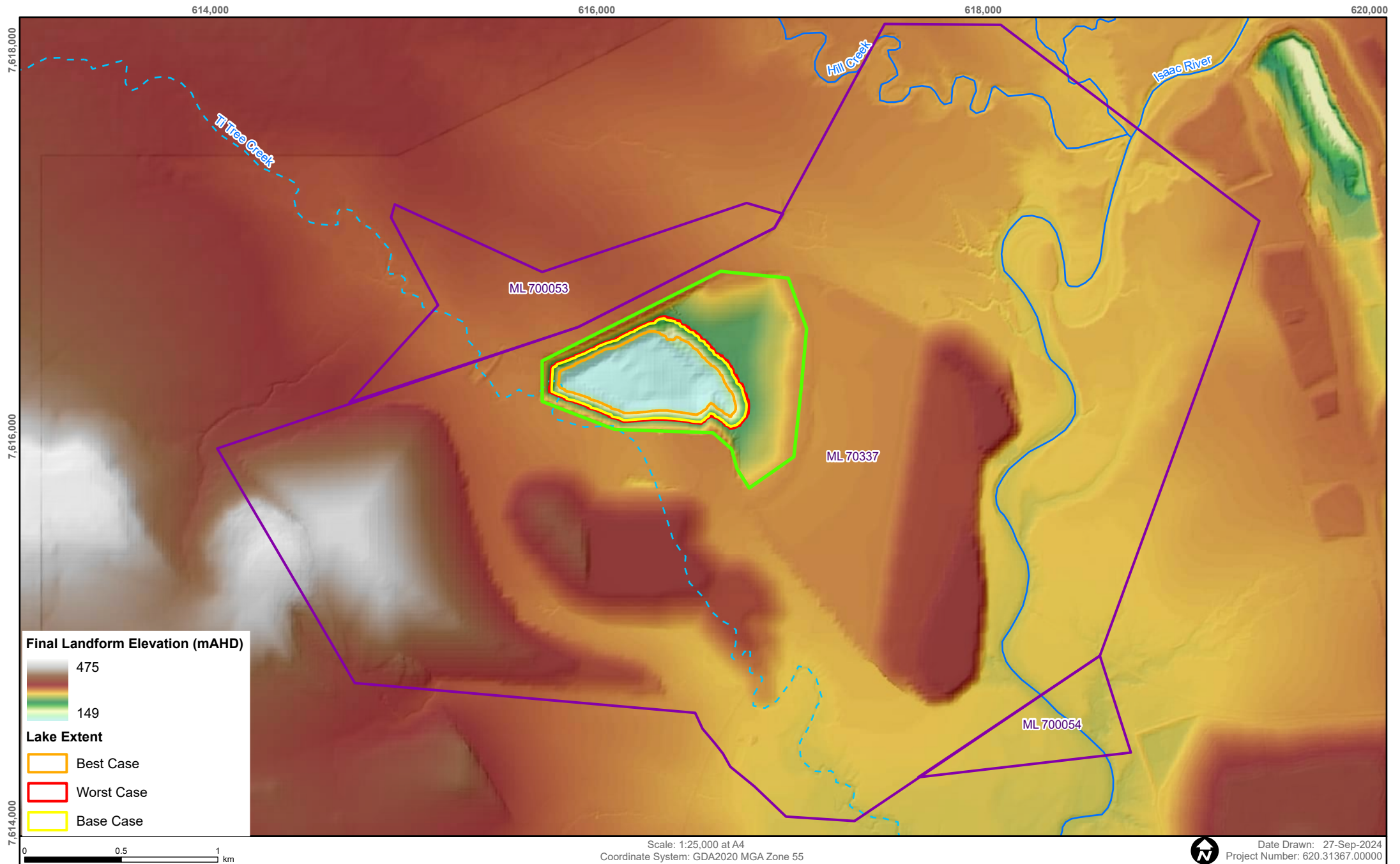
Residual Void	Climate Scenario	Spill Elevation (mAHD)	Approximate Time to Equilibrium (years)	Equilibrium Water Level (mAHD)	Freeboard (m)
East Pit	Base Case ¹	320	300	271.5	48.5
	Best Case			228.7	91.3
	Worst Case			274.9	45.1

1. As reported in SLR (2024)

Model results indicate that equilibrium void lake levels are predicted to have a range of approximately 46 m between the best case and worst case climate scenarios, and that the worst case scenario is very similar to the base case scenario reported in the PER.

The extents of the Project's residual void lake between the three climate scenarios, given the equilibrium lake water levels shown in **Table 2-1**, are shown on **Figure 2-2**.





**NEW LENTON PER IESC RESPONSE
GROUNDWATER
PREDICTED RESIDUAL VOID LAKE EXTENTS
– CLIMATE CHANGE**

FIGURE 2-2



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2.2.2 Residual Void Groundwater Inflow

The groundwater inflows to the East Pit void predicted by the groundwater model, for each of the climate scenarios, are shown in **Figure 2-3**. Consistent with previous reporting in the PER, the inflows are partitioned between flow into the residual void through spoil, and that which flows into the residual void through only surrounding natural geological formations (i.e. where the natural geology remains exposed to the void shell).

Figure 2-3 shows the predicted groundwater inflows for each of the climate scenarios follow the same trends, due to variability in simulated groundwater fluxes to the voids being largely controlled by variability in levels predicted by the WRM (2023) surface water balance model.

The groundwater inflows predicted by the groundwater model are highly variable in the first 50 years post-mining when groundwater levels remain suppressed. As can be seen for all climate scenarios, groundwater inflow to the void is predicted to stabilise between 300 to 500 years post-closure, consistent with the stabilisation of void lake levels.

It is noted that the base case results are very similar to the worst case results, with only relatively minor difference to the best case results. Total groundwater inflow volumes in the two climate extremes vary over a range of less than 6% of the base case groundwater inflows reported in the PER, considered very small. That is, the climate extremes do not result in a significant change in predicted groundwater inflow volumes.

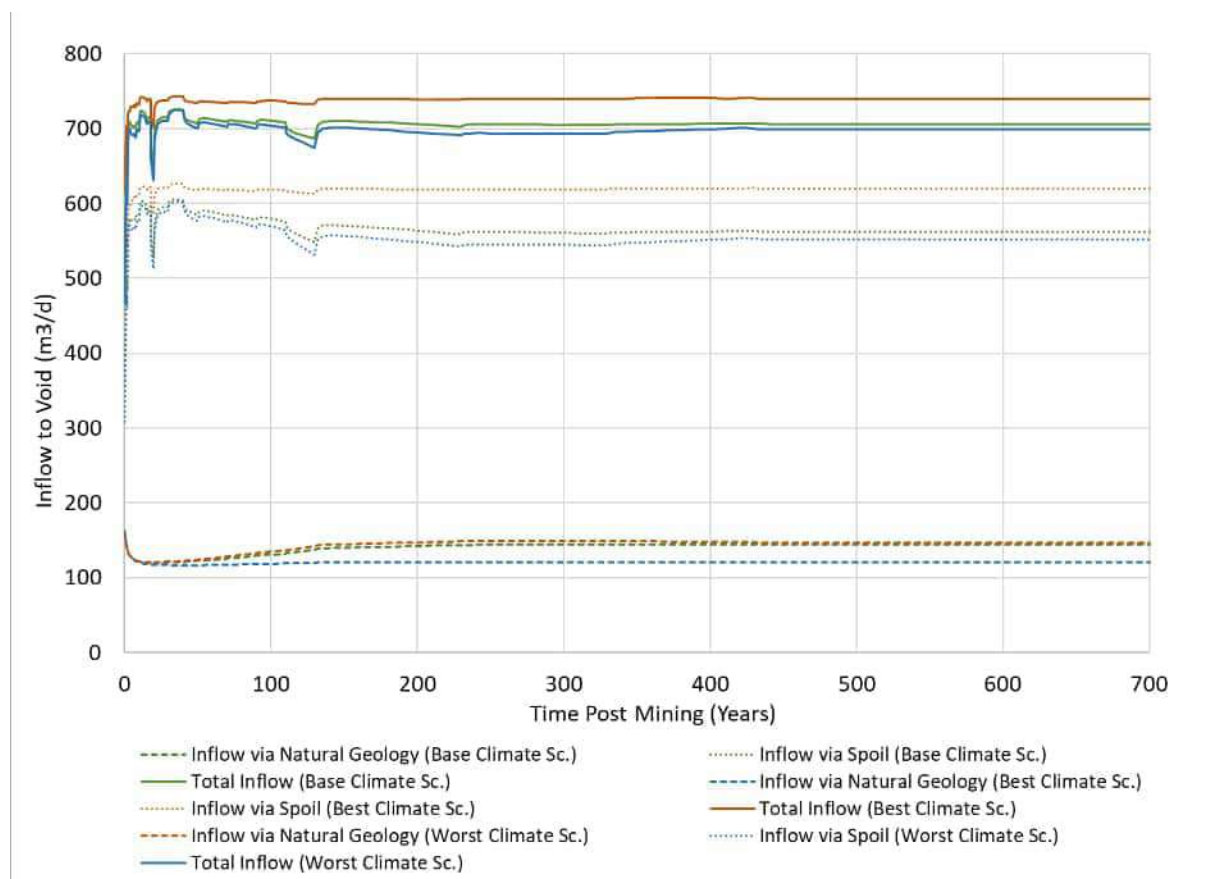


Figure 2-3 Simulated Residual Void Groundwater Inflows to East Pit Void

The predicted post-mining equilibrium flux to the New Lenton East Void is summarised in **Table 2-2**.



The total inflow to the residual void is indicative of the total long-term average take from the groundwater system. This comprises groundwater inflow to the void directly from natural geologic formations and groundwater moving to the void through spoil material in the backfilled pit shell. As the source of groundwater simulated within the backfilled pit shell includes both rainfall recharge and flux from surrounding natural geologic formations, the predicted component of groundwater moving through the spoil material from each of these compartments is also provided in **Table 2-2**.

Table 2-2 indicates that for the East Pit void, 75 to 80% of the long-term groundwater inflow to the void comes via the spoil, which is a composition of both direct rainfall recharge to spoil areas and groundwater inflows from natural geologic formations.



Table 2-2 Predicted Equilibrium Groundwater Inflows to the East Pit (Backfilled Pit Shell and Void)

Climate Scenario	Inflow to Backfilled Pit Shell (m ³ /d)		Inflow to Void from Backfilled Pit Shell (m ³ /d)	Inflow to Void from Natural Geological Formations (m ³ /d)	Total Groundwater Inflow to Void (m ³ /d)
Base Case ¹	Flux through Natural Geological Formations	491.6	562.3	143.9	706.2
	Flux through Rainfall Recharge	70.7			
Best Case	Flux through Natural Geological Formations	548.9	619.7	120.1	739.7
	Flux through Rainfall Recharge	70.7			
Worst Case	Flux through Natural Geological Formations	481.0	551.7	147.0	698.7
	Flux through Rainfall Recharge	70.7			

1. As reported in SLR (2024)



2.2.3 Post Mining Equilibrium Groundwater Levels

2.2.3.1 Best Case Climate Scenario

The groundwater levels presented in this section are model predictions for the ‘best case’ climate scenario.

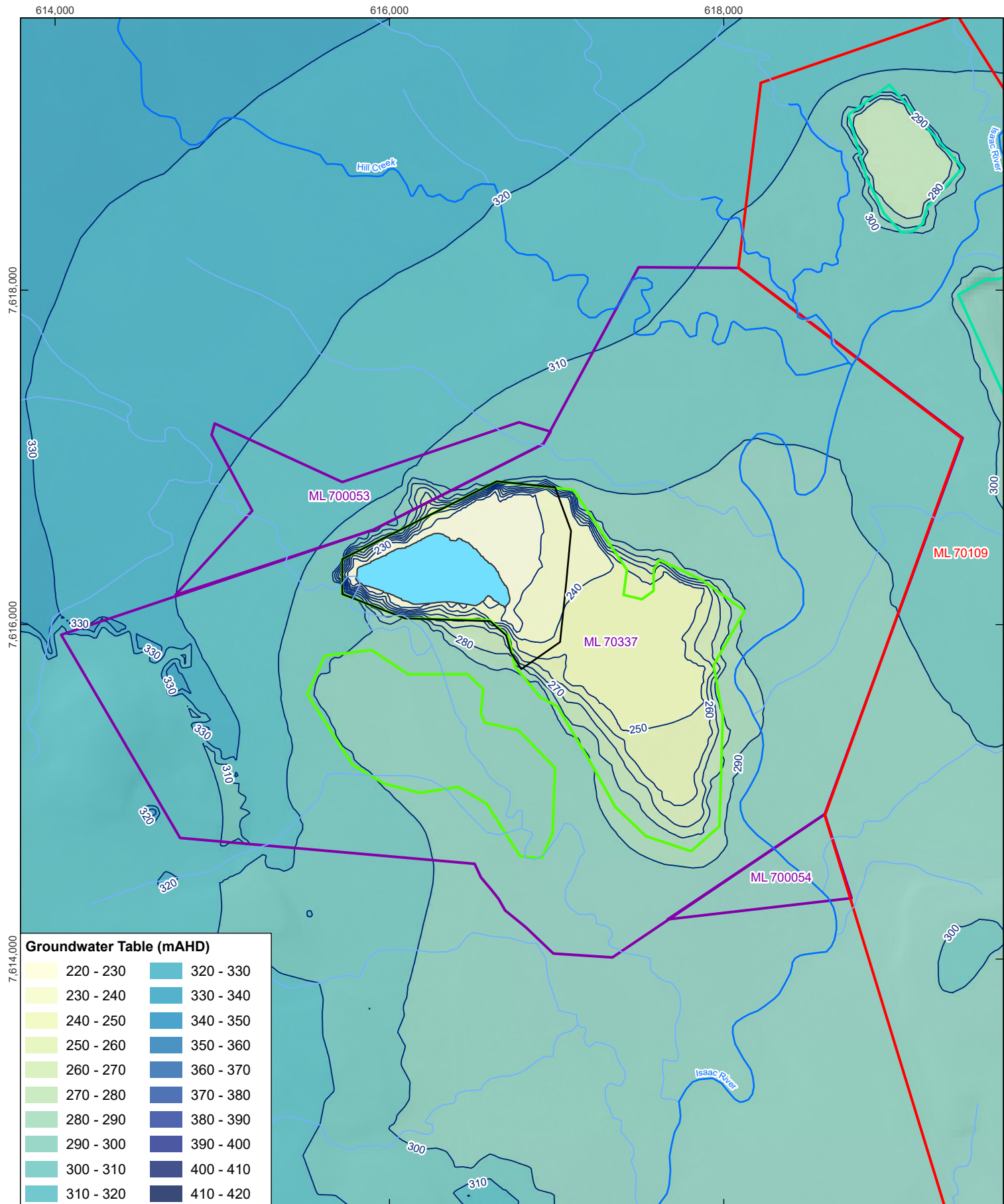
The predicted equilibrium groundwater table is shown in **Figure 2-4**. Predicted equilibrium groundwater levels for the Alluvium, Regolith, Burton/Rider and Leichhardt/Vermont seams are shown in **Figure 2-5** to **Figure 2-8**.

The predicted equilibrium water table for the ‘best case’ scenario shown in **Figure 2-4** is consistent with the predicted equilibrium water levels for the ‘base case’ presented in Figure 6-16 of the PER’s New Lenton & Burton Groundwater Modelling Technical Report (SLR, 2024), with notable differences in predicted levels confined to the East Pit at New Lenton, where the water levels are controlled by the simulated void lake level. The predicted ‘best case’ equilibrium groundwater flow directions across the model domain match those predicted for the ‘base case’ scenario (SLR, 2024).

Figure 2-5 and **Figure 2-6** show post-mining groundwater levels predicted in the alluvium and regolith, respectively, for the ‘best case’ are consistent with those predicted for the ‘base case’ scenario (Figure 6-17 and Figure 6-18 of the PER’s New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Predicted post-mining groundwater levels for the coal seams presented in **Figure 2-7** and **Figure 2-8** indicate that in the ‘best case’ scenario, groundwater levels in the Permian coal seams are predicted to remain depressed to a lower elevation than for the ‘base case’ scenario (Figure 6-19 and Figure 6-20 of the PER’s New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024) in the long term. This additional depression of the system is driven by the ongoing evaporation-driven groundwater discharge to the residual void lakes and governed by the lower residual void lake elevations predicted by the water balance model (WRM, 2023).





Groundwater Table (mAHd)			
	220 - 230		320 - 330
	230 - 240		330 - 340
	240 - 250		340 - 350
	250 - 260		350 - 360
	260 - 270		360 - 370
	270 - 280		370 - 380
	280 - 290		380 - 390
	290 - 300		390 - 400
	300 - 310		400 - 410
	310 - 320		410 - 420

0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:30,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 26-Sep-2024
 Drawn by: RB

LEGEND

- River
- Watercourse and Drainage
- Groundwater Contour (mAHd)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- East Pit Void Crest
- Void Lake Extent

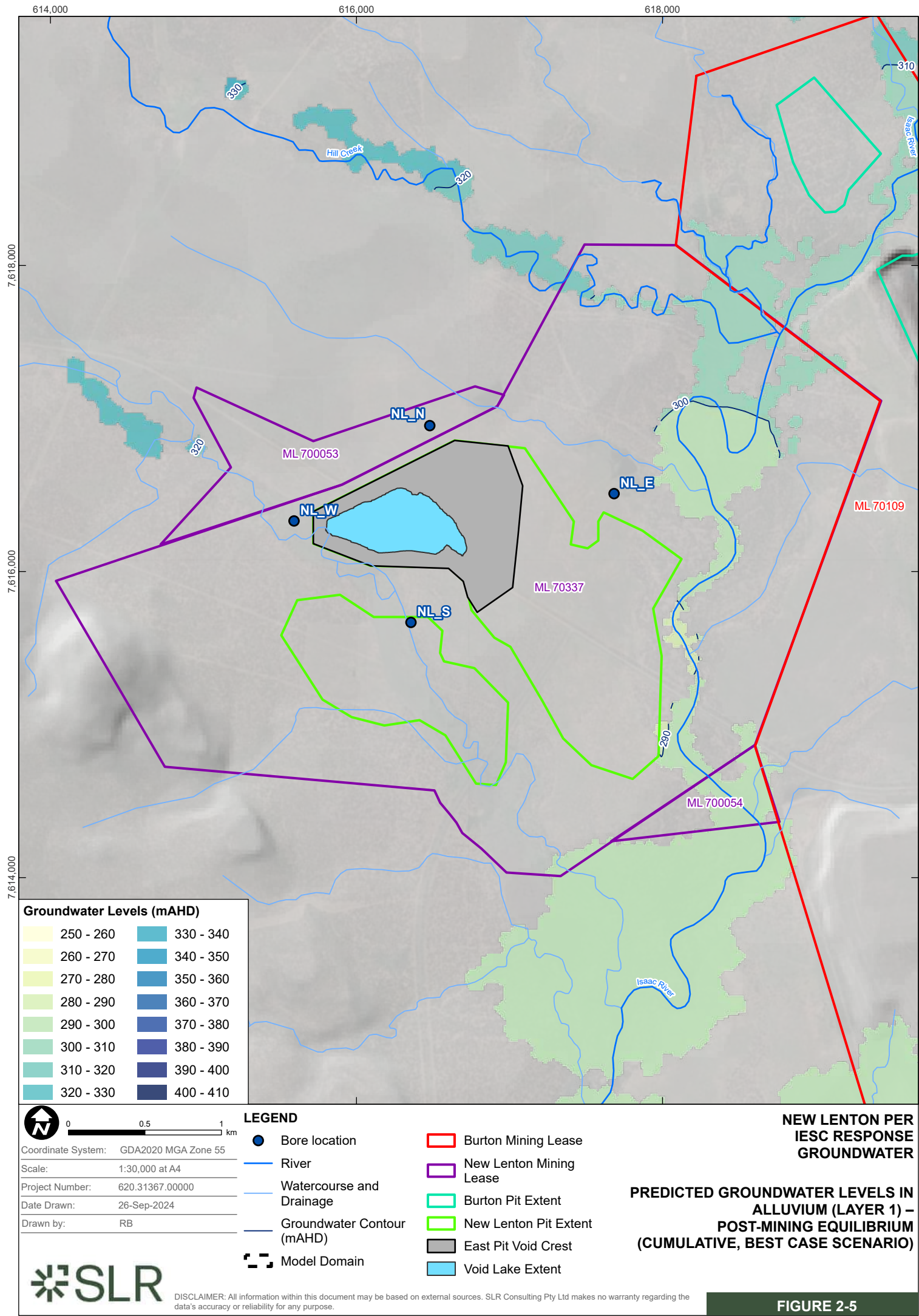
NEW LENTON PER IESC RESPONSE GROUNDWATER

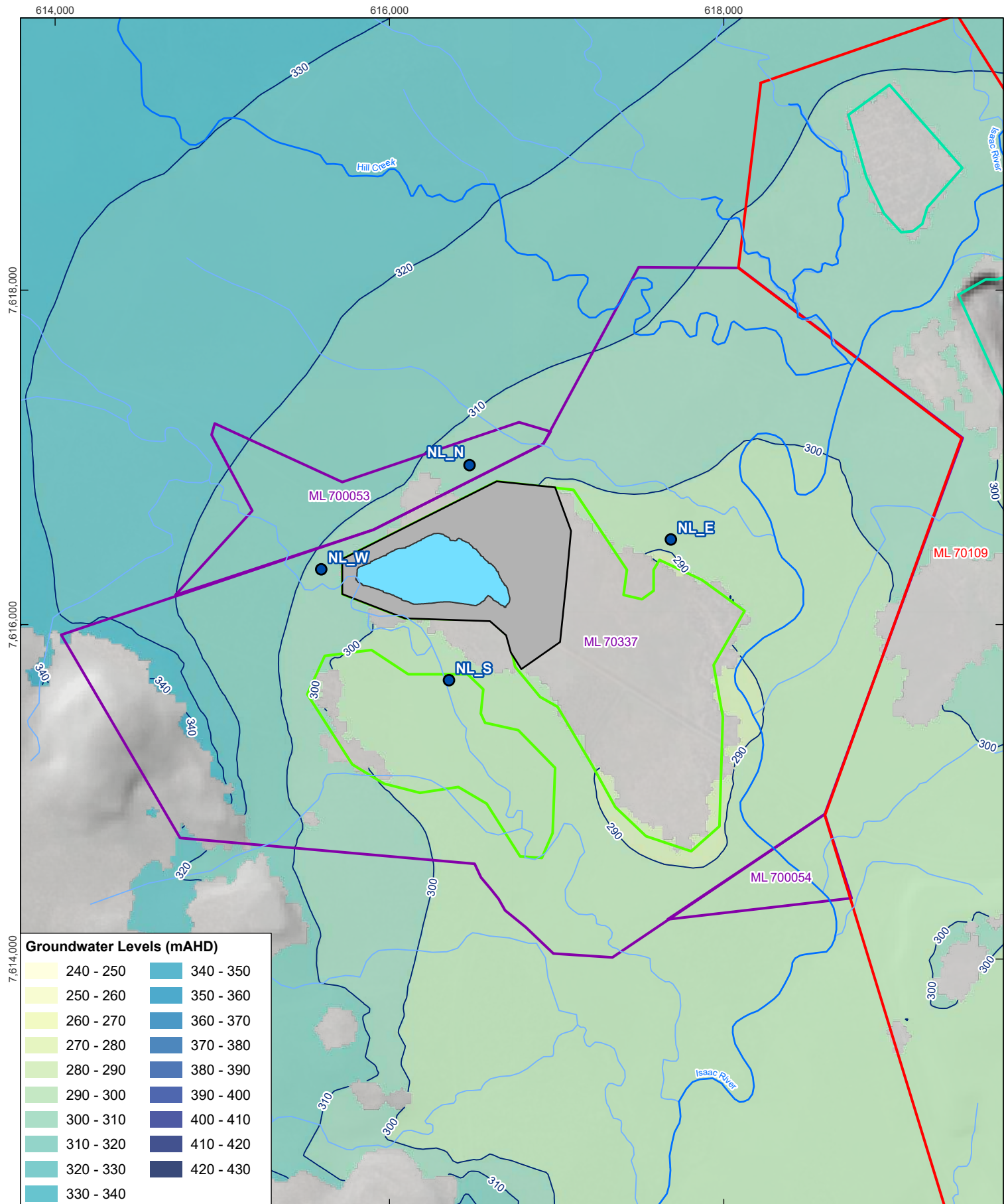
PREDICTED WATER TABLE – POST-MINING EQUILIBRIUM (CUMULATIVE, BEST CASE SCENARIO)



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FIGURE 2-4





0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:30,000 at A4

Project Number: 620.31367.00000

Date Drawn: 26-Sep-2024

Drawn by: RB

LEGEND

- Bore location
- River
- Watercourse and Drainage
- Groundwater Contour (mAHD)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- East Pit Void Crest
- Void Lake Extent

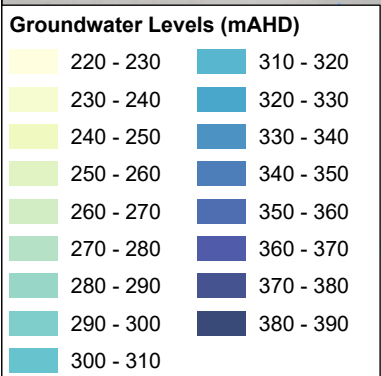
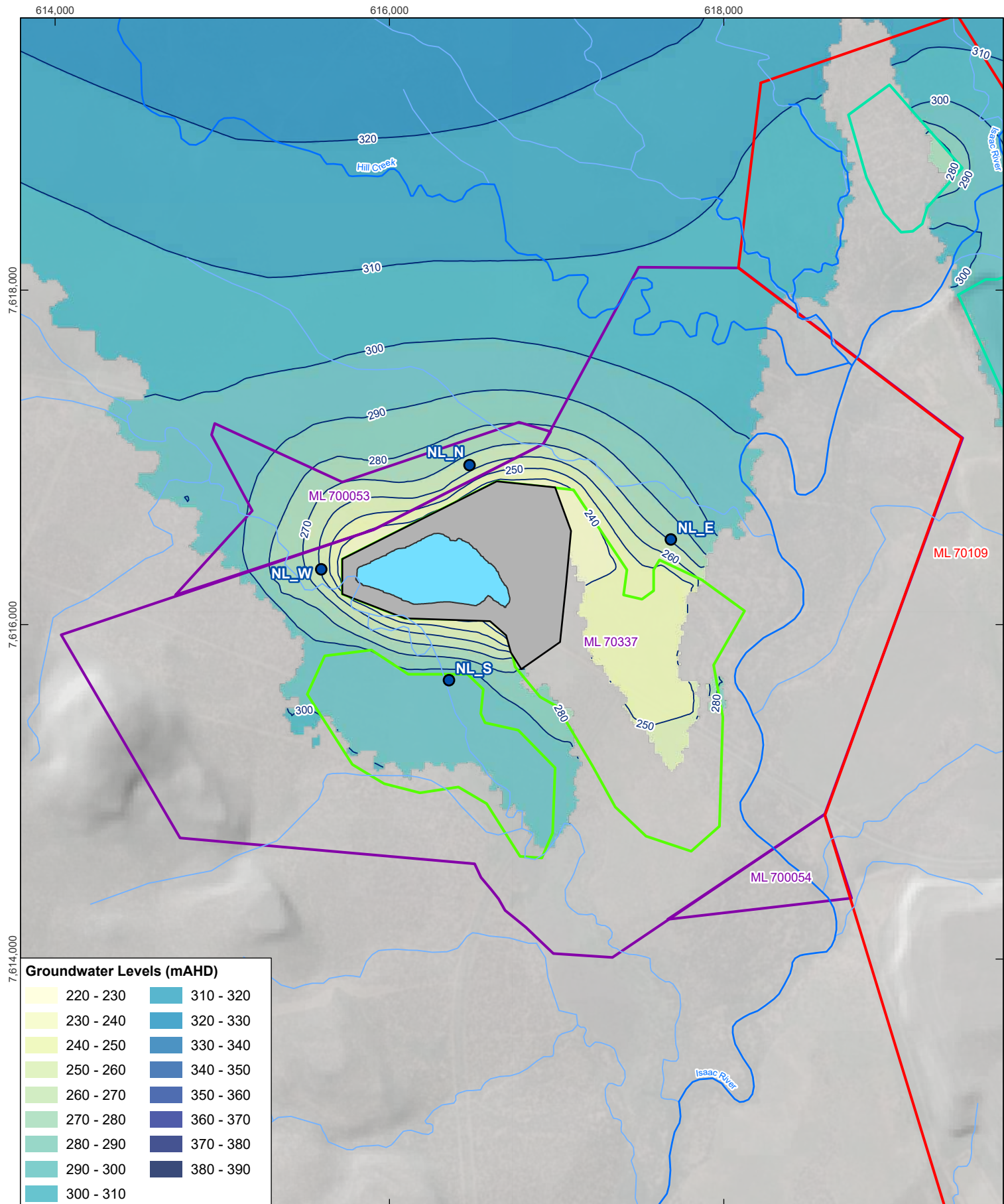
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED GROUNDWATER LEVELS IN REGOLITH (LAYER 2) – POST-MINING EQUILIBRIUM (CUMULATIVE, BEST CASE SCENARIO)



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FIGURE 2-6



 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:30,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 26-Sep-2024
 Drawn by: RB

LEGEND

-  Bore Location
-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  East Pit Void Crest
-  Void Lake Extent

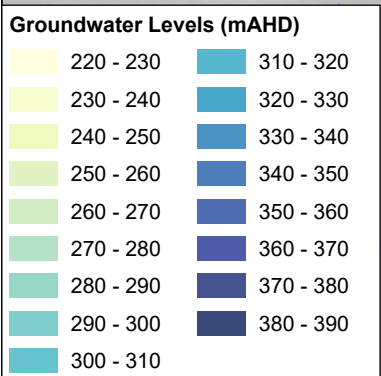
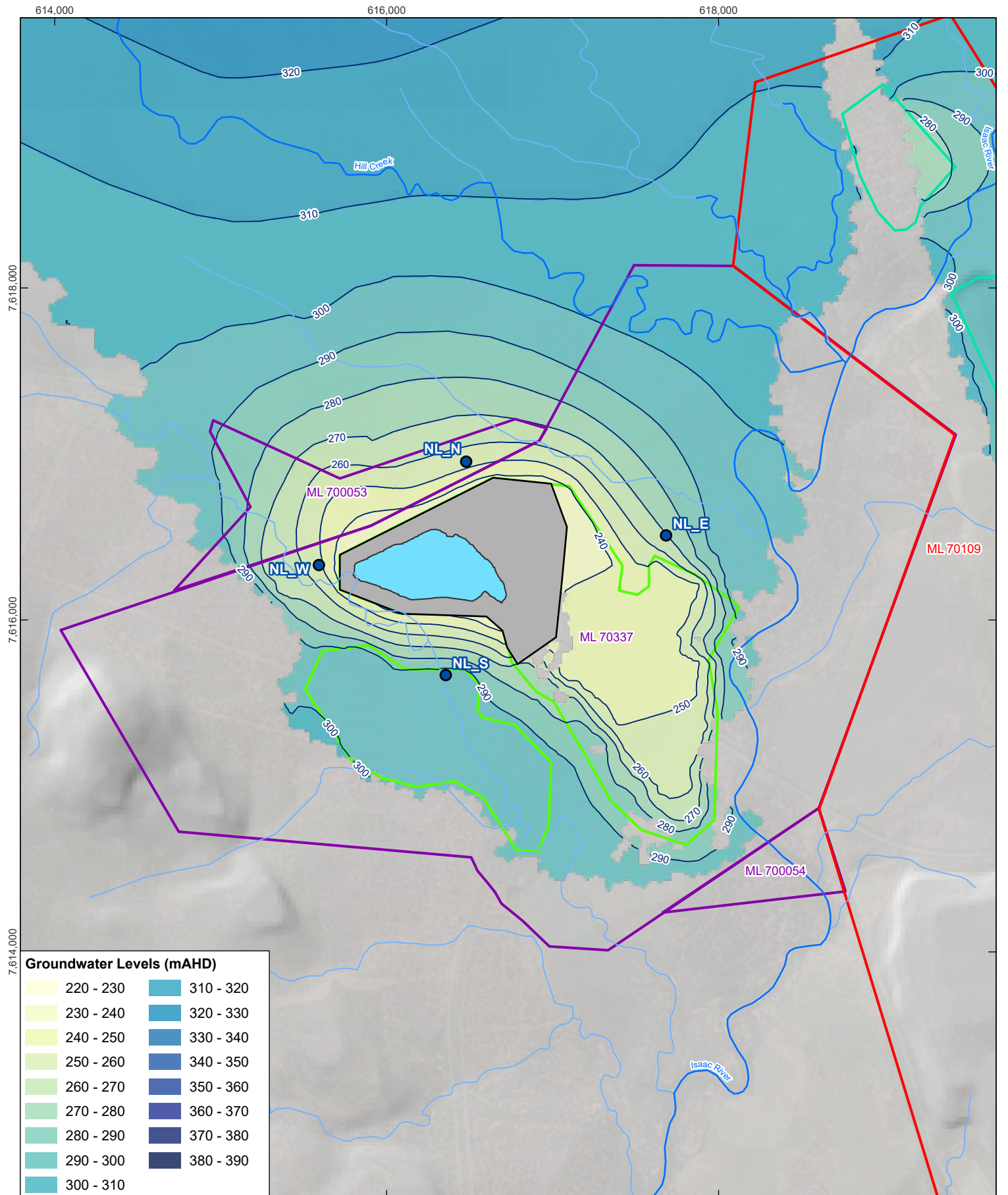
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED GROUNDWATER LEVELS IN BURTON/RIDER SEAM (LAYER 12) – POST-MINING EQUILIBRIUM (CUMULATIVE, BEST CASE SCENARIO)



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FIGURE 2-7



 0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:30,000 at A4

Project Number: 620.31367.00000

Date Drawn: 26-Sep-2024

Drawn by: RB

LEGEND

-  Bore location
-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  East Pit Void Crest
-  Void Lake Extent

**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED GROUNDWATER LEVELS IN
LEICHHARDT/VERMONT SEAM (LAYER 16) –
POST-MINING EQUILIBRIUM
(CUMULATIVE, BEST CASE SCENARIO)**



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FIGURE 2-8

2.2.3.2 Worst Case Climate Scenario

The groundwater levels presented in this section are model predictions for the 'worst case' climate scenario.

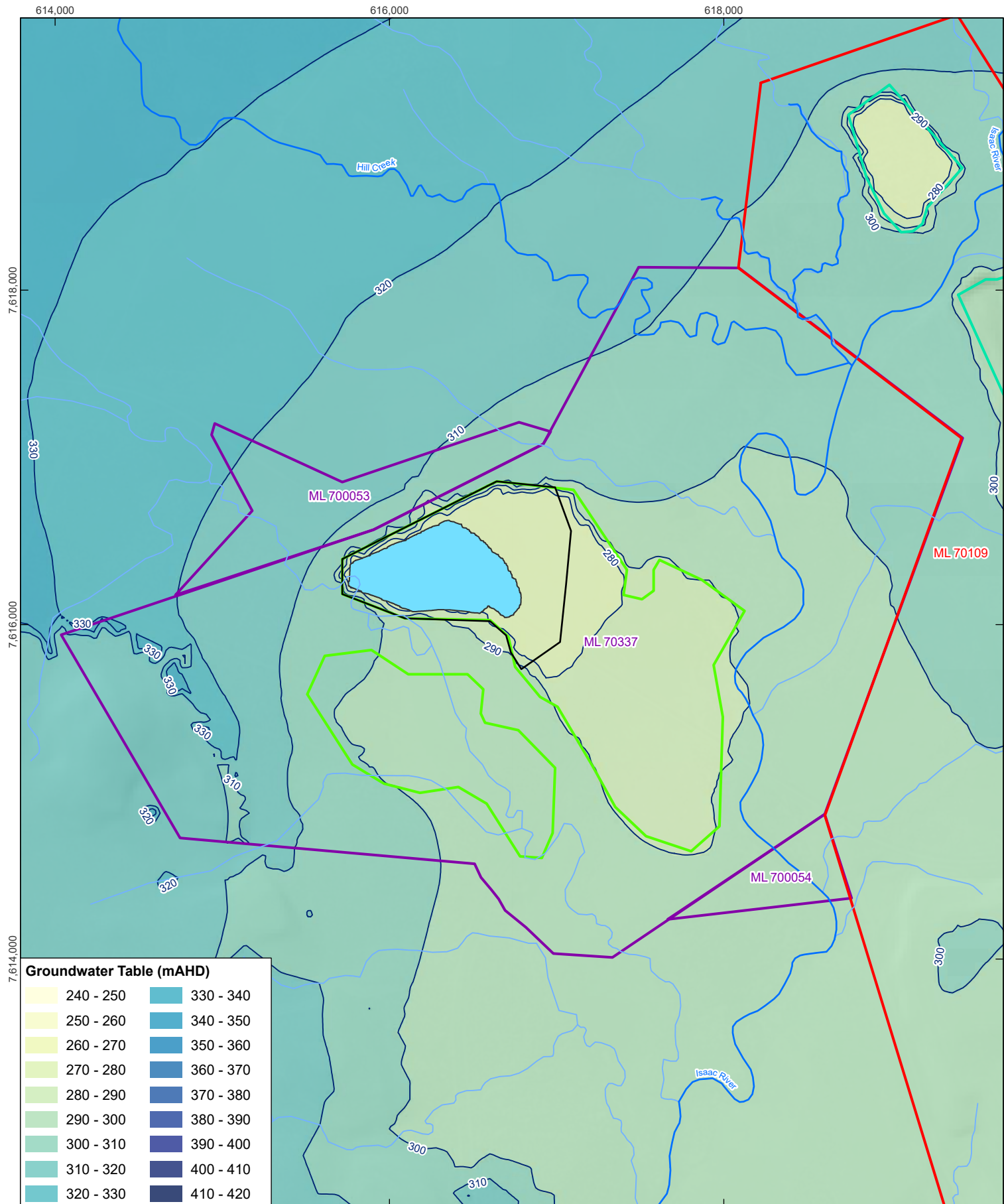
The predicted equilibrium groundwater table is shown in **Figure 2-9**. Predicted equilibrium groundwater levels for the Alluvium, Regolith, Burton/Rider and Leichhardt/Vermont seams are shown in **Figure 2-10** to **Figure 2-13**.

The water level contours shown in **Figure 2-9** for the predicted equilibrium water table for the 'worst case' scenario is consistent with the predicted equilibrium water table for the 'base case' presented in Figure 6-16 of the PER's New Lenton & Burton Groundwater Modelling Technical Report (SLR, 2024), which is to be expected given the very similar predicted void lake levels and groundwater inflows (**Sections 2.2.1 and 2.2.2**). Differences in predicted groundwater levels are only notable on **Figure 2-9** within the simulated void lake area. The predicted 'worst case' equilibrium flow directions across the model domain match those predicted for the 'base case' scenario (Figure 6-17 and Figure 6-18 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Figure 2-10 and **Figure 2-11** show post-mining groundwater levels predicted in the alluvium and regolith, respectively, for the 'worst case' are consistent with those predicted for the 'base case' scenario (Figure 6-17 and Figure 6-18 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Predicted post-mining groundwater levels for the coal seams presented in **Figure 2-12** and **Figure 2-13** indicate that in the 'worst case' scenario, groundwater levels in the Permian coal seams are predicted to remain depressed to approximately the same elevation as the 'base case' scenario (Figure 6-19 and Figure 6-20 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024) in the long term.





0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:30,000 at A4

Project Number: 620.31367.00000

Date Drawn: 26-Sep-2024

Drawn by: RB

LEGEND

- River
- Watercourse and Drainage
- Groundwater Contour (mAHD)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- East Pit Void Crest
- Void Lake Extent

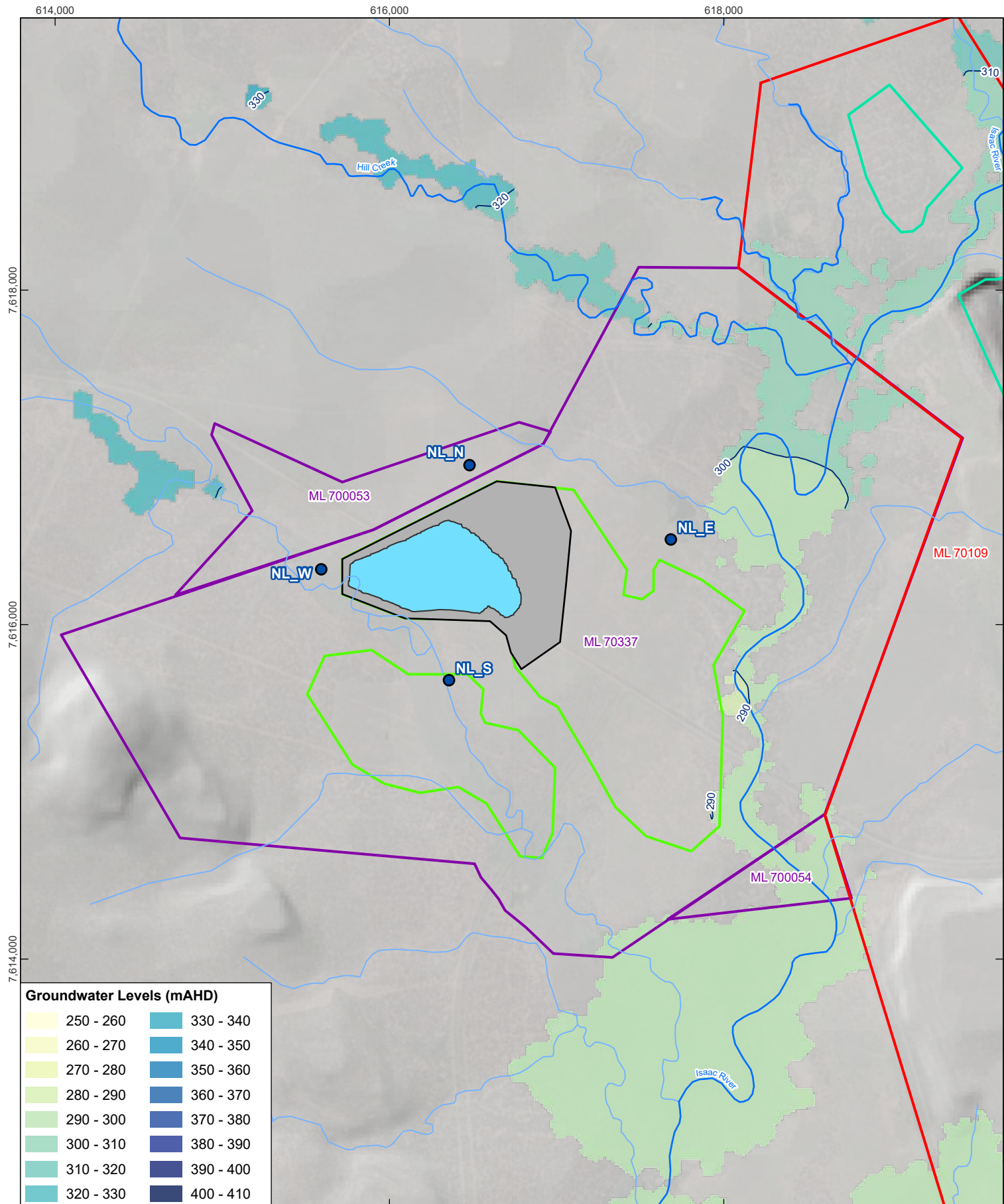
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED WATER TABLE –
POST-MINING EQUILIBRIUM
(CUMULATIVE, WORST CASE
SCENARIO)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-9



0 0.5 1 km

LEGEND

- Bore location
- River
- Watercourse and Drainage
- Groundwater Contour (mAHD)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- East Pit Void Crest
- Void Lake Extent

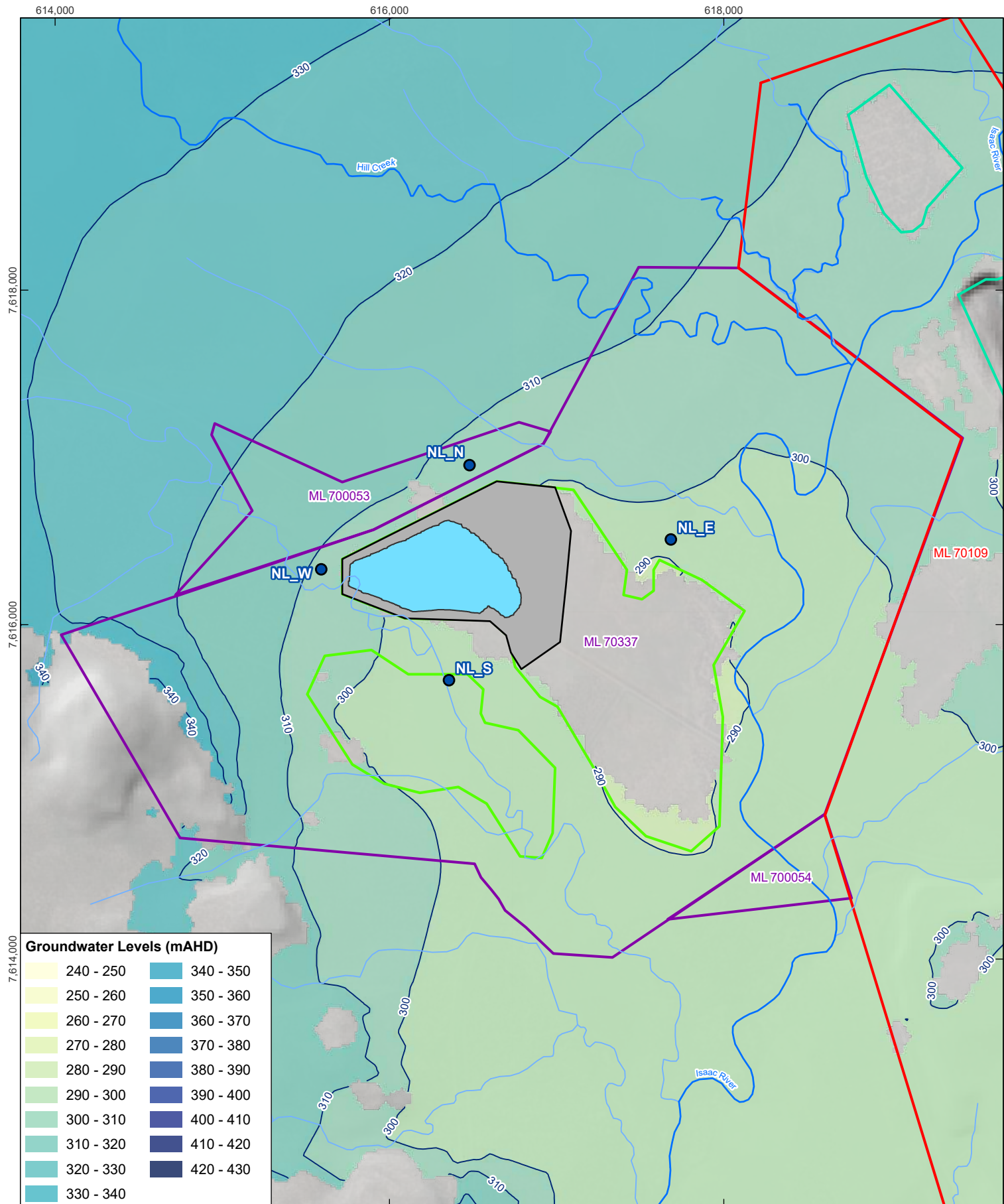
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED GROUNDWATER LEVELS IN ALLUVIUM (LAYER 1) – POST-MINING EQUILIBRIUM (CUMULATIVE, WORST CASE SCENARIO)



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FIGURE 2-10



Coordinate System: GDA2020 MGA Zone 55

Scale: 1:30,000 at A4

Project Number: 620.31367.00000

Date Drawn: 26-Sep-2024

Drawn by: RB

LEGEND

- Bore location
- River
- Watercourse and Drainage
- Groundwater Contour (mAHd)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- East Pit Void Crest
- Void Lake Extent

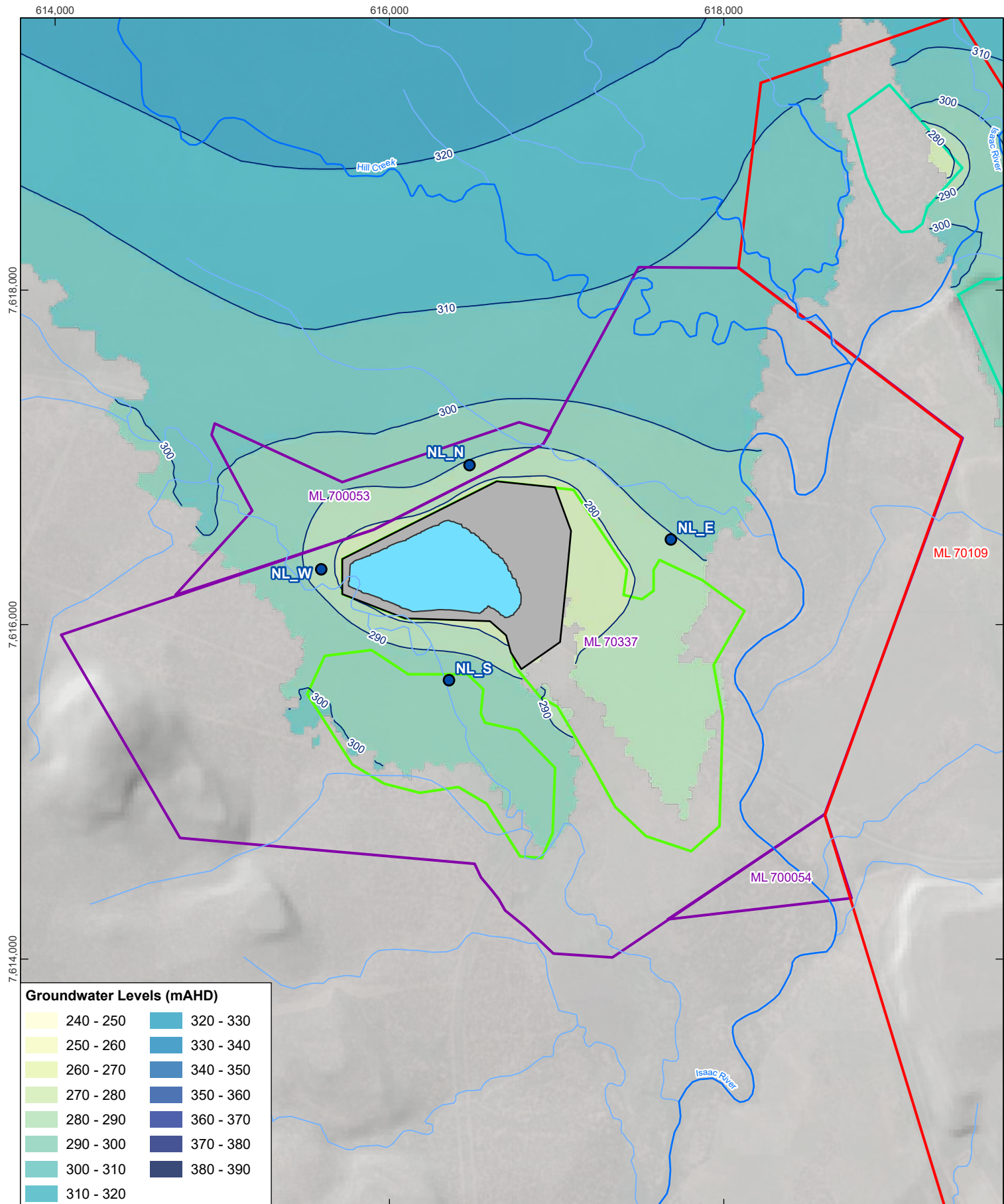
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED GROUNDWATER LEVELS IN REGOLITH (LAYER 2) – POST-MINING EQUILIBRIUM (CUMULATIVE, WORST CASE SCENARIO)



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FIGURE 2-11



Groundwater Levels (mAHd)			
	240 - 250		320 - 330
	250 - 260		330 - 340
	260 - 270		340 - 350
	270 - 280		350 - 360
	280 - 290		360 - 370
	290 - 300		370 - 380
	300 - 310		380 - 390
	310 - 320		



00.51 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:30,000 at A4

Project Number: 620.31367.00000

Date Drawn: 26-Sep-2024

Drawn by: RB

- LEGEND
- Bore Location

River

Watercourse and Drainage

Groundwater Contour (mAHd)

Model Domain

Burton Mining Lease

New Lenton Mining Lease

Burton Pit Extent

New Lenton Pit Extent

East Pit Void Crest

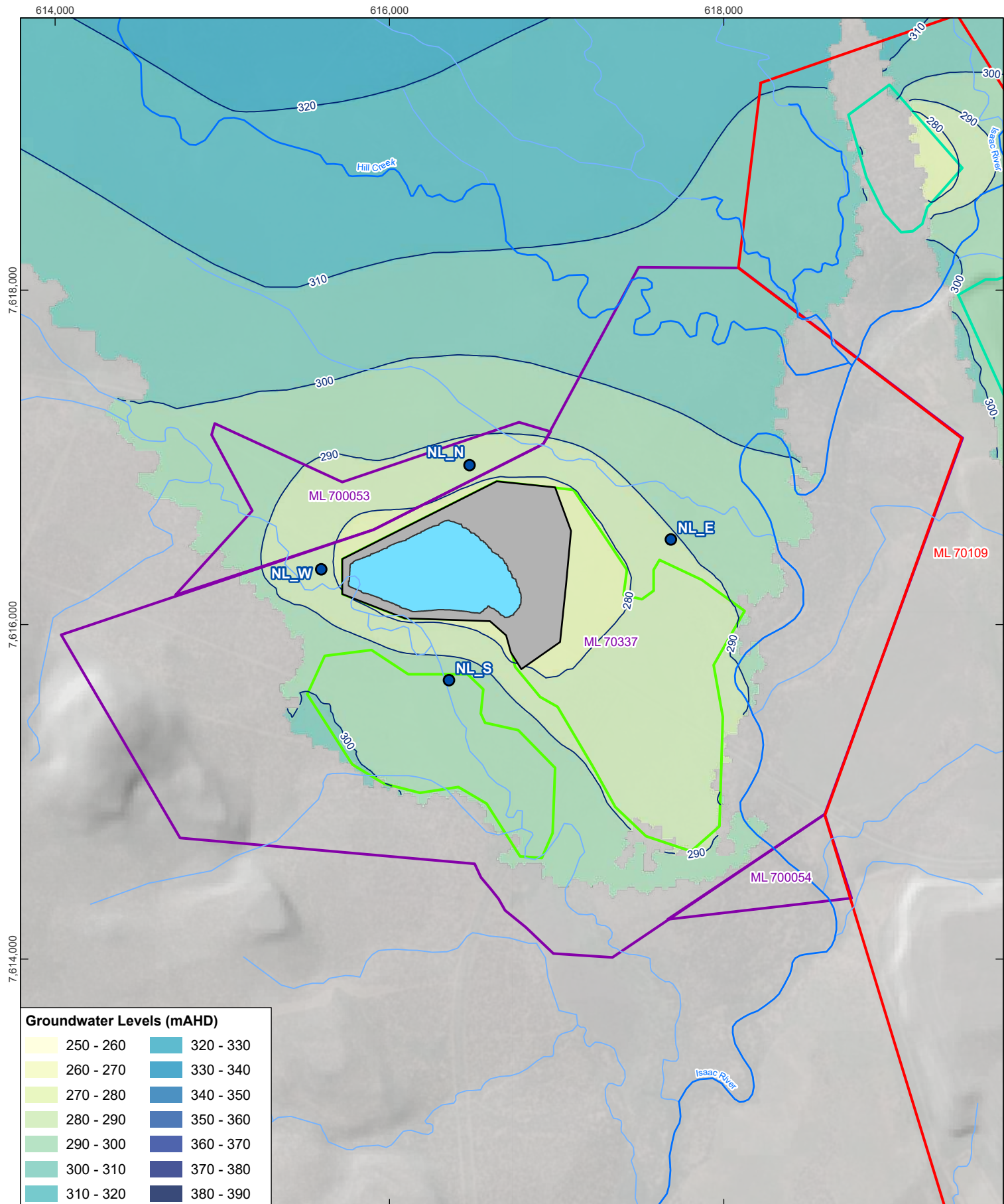
Void Lake Extent
- NEW LENTON PER
IESC RESPONSE
GROUNDWATER

PREDICTED GROUNDWATER LEVELS IN
BURTON/RIDER SEAM (LAYER 12) –
POST-MINING EQUILIBRIUM
(CUMULATIVE, WORST CASE SCENARIO)
- 

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FIGURE 2-12

Path: H:\Projects\SLR\620-BNE\620-BNE\620.31367.00000 New Lenton PER Groundwater\03 SLR Data\01 CAD\GIS\GIS\ArcPro\New_Lenton_PER_Groundwater\New_Lenton_PER_Groundwater.aprx\SLR62031367_IESC_F02-12 Predicted Groundwater Levels in Burton Rider Seam (Layer 12) – Post-Mining Equilibrium (Cumulative, Worst Case Scenario)



Groundwater Levels (mAHd)	
250 - 260	320 - 330
260 - 270	330 - 340
270 - 280	340 - 350
280 - 290	350 - 360
290 - 300	360 - 370
300 - 310	370 - 380
310 - 320	380 - 390

 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:30,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 26-Sep-2024
 Drawn by: RB

LEGEND

-  Bore location
-  River
-  Watercourse and Drainage
-  Groundwater Contour (mAHd)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  East Pit Void Crest
-  Void Lake Extent

NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED GROUNDWATER LEVELS IN LEICHHARDT/VERMONT SEAM (LAYER 16) – POST-MINING EQUILIBRIUM (CUMULATIVE, WORST CASE SCENARIO)



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FIGURE 2-13

2.2.4 Post-Mining Hydrographs

Predictive hydrographs showing the change in groundwater levels over time for the alluvium, regolith, Burton/Rider and Leichhardt/Vermont seams just outside the East Pit residual void at New Lenton are provided for both climate scenarios within **Appendix A**. The hydrograph locations shown in **Figure 2-5** through to **Figure 2-8**.

The hydrographs demonstrate that for both additional climate scenarios, the groundwater levels in all geological units surrounding the residual void lakes are higher than the void lake levels, indicating that there is no potential for the movement of water from the void lakes into the surrounding geological formations. The predicted levels shown in the hydrographs show that the voids are predicted to act as sinks to the groundwater system for both climate scenarios.

2.2.5 Post-Mining Equilibrium Residual Drawdown

This section presents the residual groundwater level drawdown at post-mining equilibrium, for the best- and worst-case climate scenarios. The residual cumulative drawdown considers drawdown of groundwater levels due to both New Lenton and the adjoining Burton mine, while the residual incremental drawdown considers the residual drawdown impact attributable to New Lenton only.

2.2.5.1 Post-Mining Residual Cumulative Drawdown

Residual cumulative drawdown refers to the remaining groundwater level drawdown after post-mining recovery to equilibrium compared to pre-mining groundwater levels. The residual drawdown is a comparison of groundwater levels between a 'mining and closure' situation, and a 'no mining' situation.

Best Case Climate Scenario

Figure 2-14 shows the predicted residual groundwater table drawdown (greater than 1m) at post-mining equilibrium for the 'best case' scenario. **Figure 2-14** shows that at post-mining equilibrium, there is predicted water table drawdown of up to 75 m within or closely around the mining pits, gradually reducing with distance from the mines.

Figure 2-15 to **Figure 2-18** show the predicted residual cumulative drawdown in the alluvium, regolith, Burton/Rider and Leichhardt/Vermont seams at post-mining equilibrium, for the 'best case' scenario.

Figure 2-15 shows the maximum cumulative residual drawdown predicted in the alluvium for the 'best case' scenario reaches up to 1.5 km to the southwest and 1 km to the east.

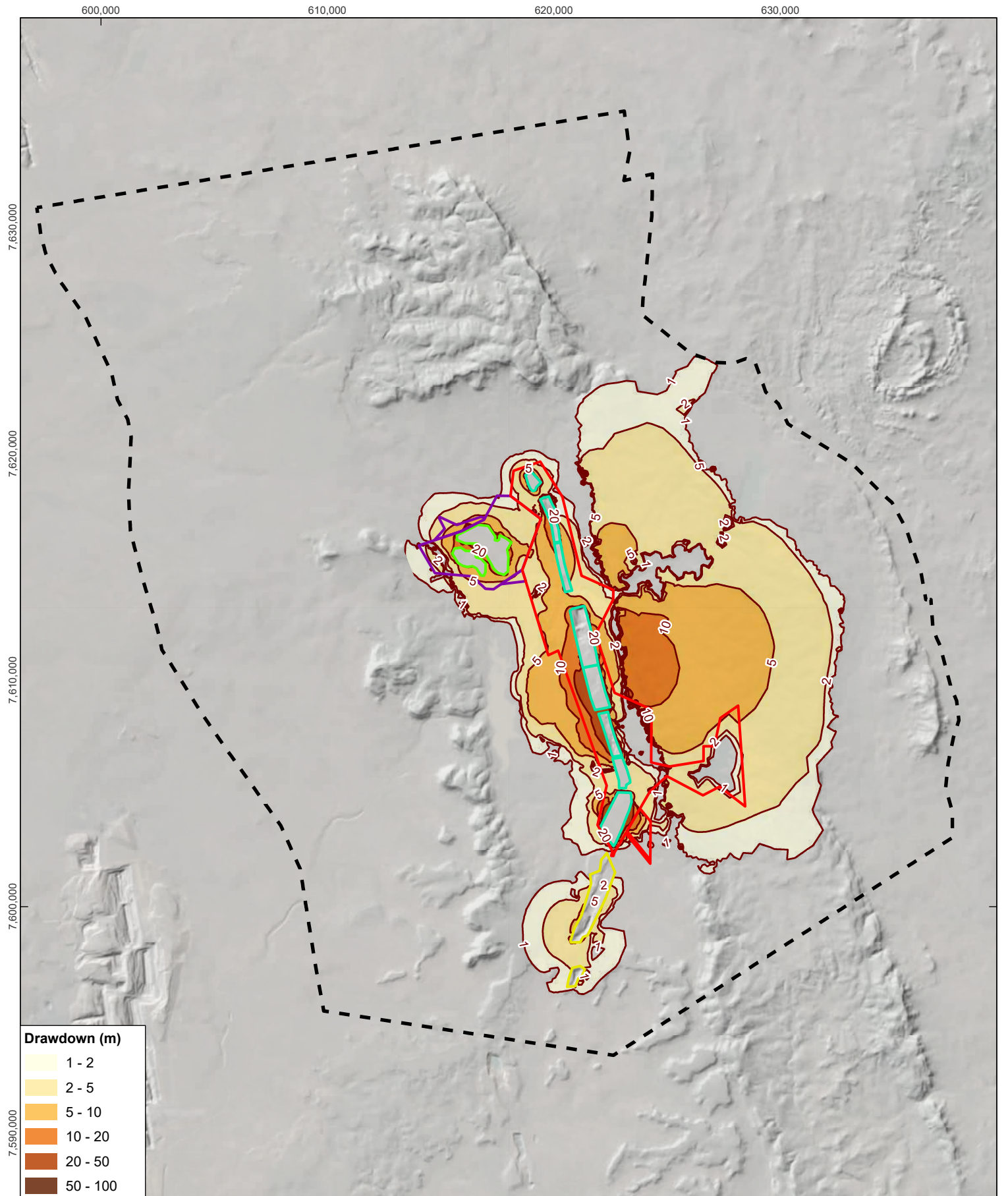
Figure 2-15 indicates minimal difference when compared to the prediction for post-mining cumulative drawdown extent in the alluvium for the 'base case' scenario (Figure 6-22 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Figure 2-16 shows the maximum predicted cumulative drawdown extent in the regolith, for the 'best case' scenario, extending approximately 2 km to the northwest, 2 km to the south and approximately 1.5 km to the east of New Lenton, where the zone of impact from the post-mining system at New Lenton interacts with the zone of impact from the Burton Mine. The predicted drawdown in the regolith shown in **Figure 2-16** extends no more than 100m further than that predicted for the 'base case' scenario (Figure 6-23 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).



Figure 2-17 and **Figure 2-18** show that for the 'best case' scenario, the model predicts residual cumulative drawdown in the coal seams at a maximum of approximately 75 m at the edge of East Pit, extending 3.3 km to the northwest, approximately 300 m further than that predicted for the 'base case' scenario (Figure 6-24 and Figure 6-25 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).





Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 13-Aug-2024
 Drawn by: RB

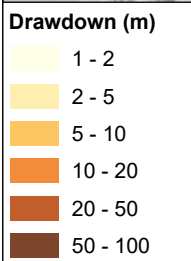
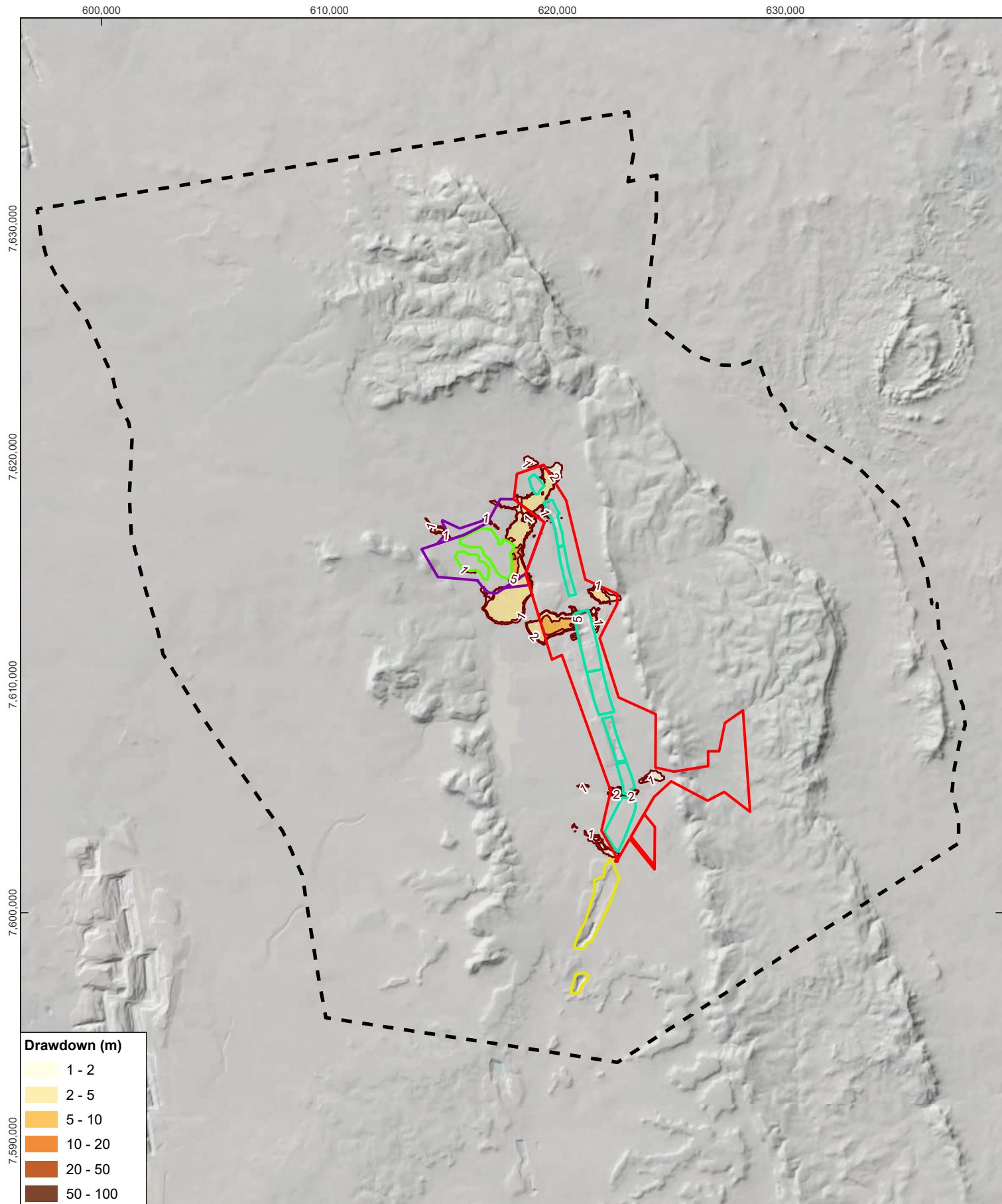


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**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL CUMULATIVE
GROUNDWATER TABLE DRAWDOWN –
POST-MINING EQUILIBRIUM
(BEST CASE SCENARIO)**

FIGURE 2-14



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 16-Aug-2024
 Drawn by: RB

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

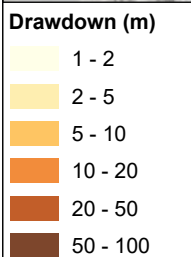
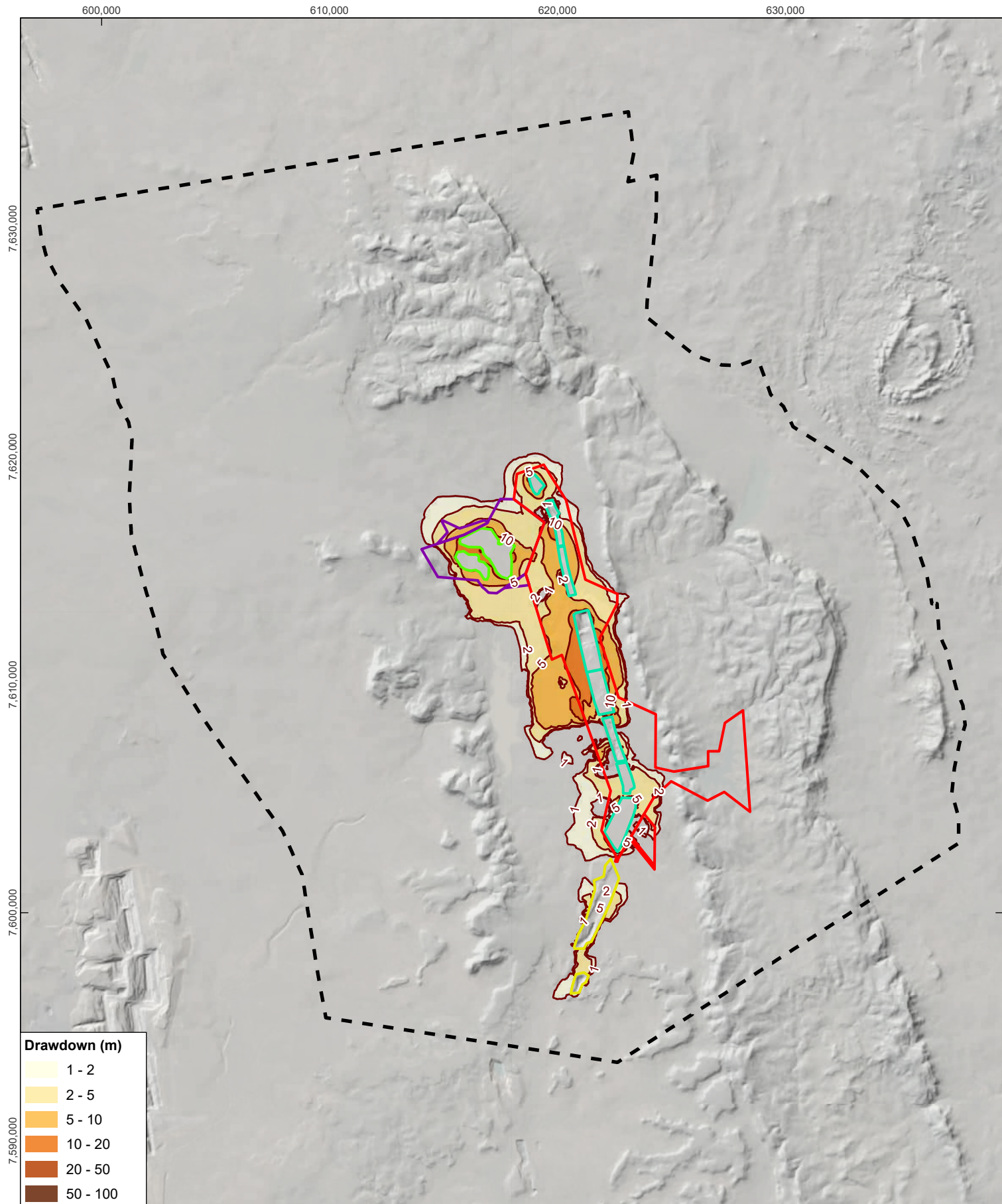
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL CUMULATIVE
DRAWDOWN IN ALLUVIUM LAYER 1 -
POST-MINING EQUILIBRIUM
(BEST CASE SCENARIO)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-15




 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 16-Aug-2024
 Drawn by: RB

LEGEND

-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

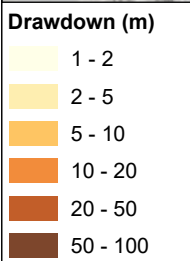
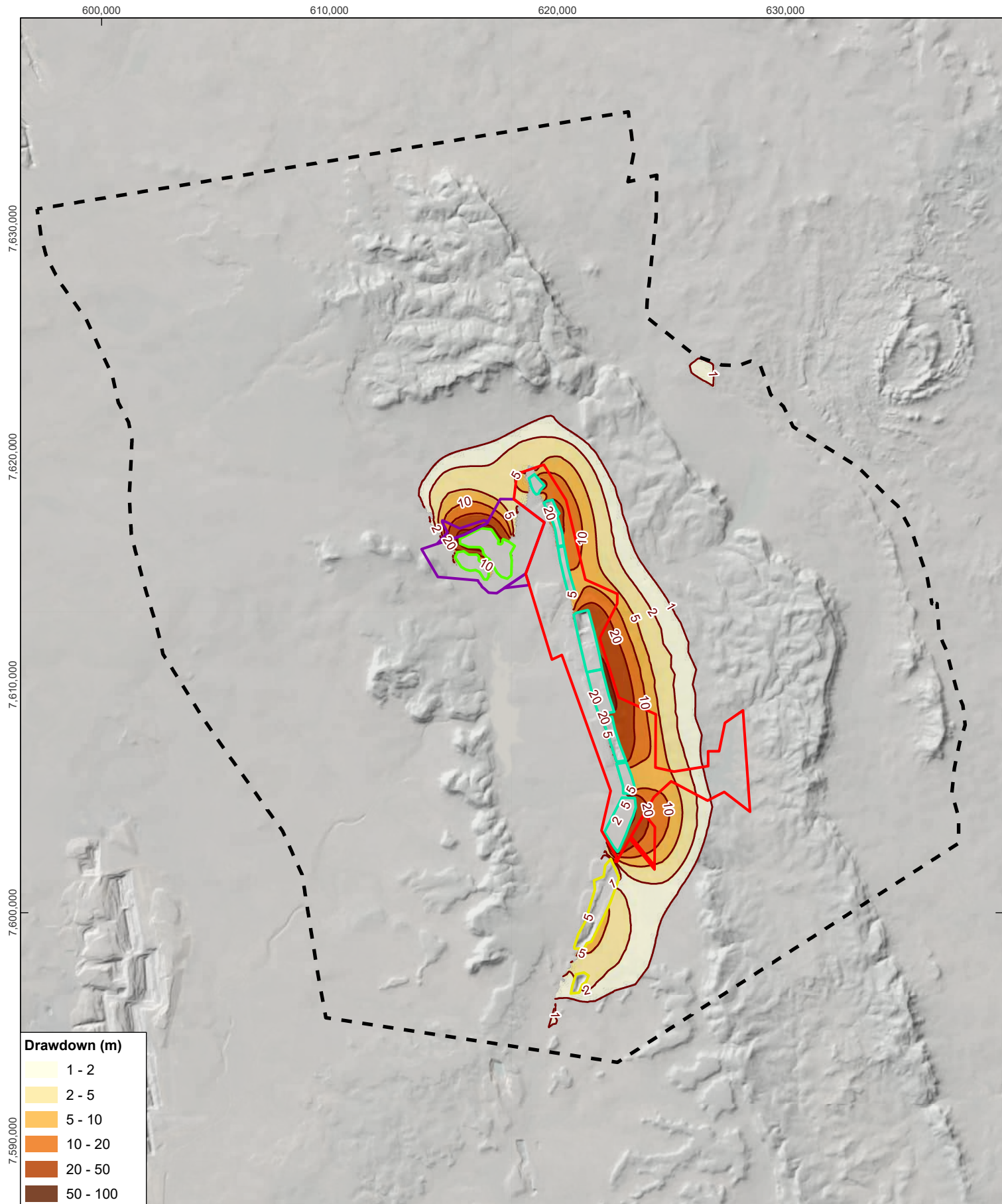
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL CUMULATIVE
DRAWDOWN IN REGOLITH LAYER 2 -
POST-MINING EQUILIBRIUM
(BEST CASE SCENARIO)**



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FIGURE 2-16



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 19-Aug-2024
 Drawn by: RB

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

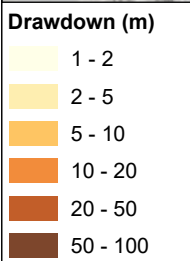
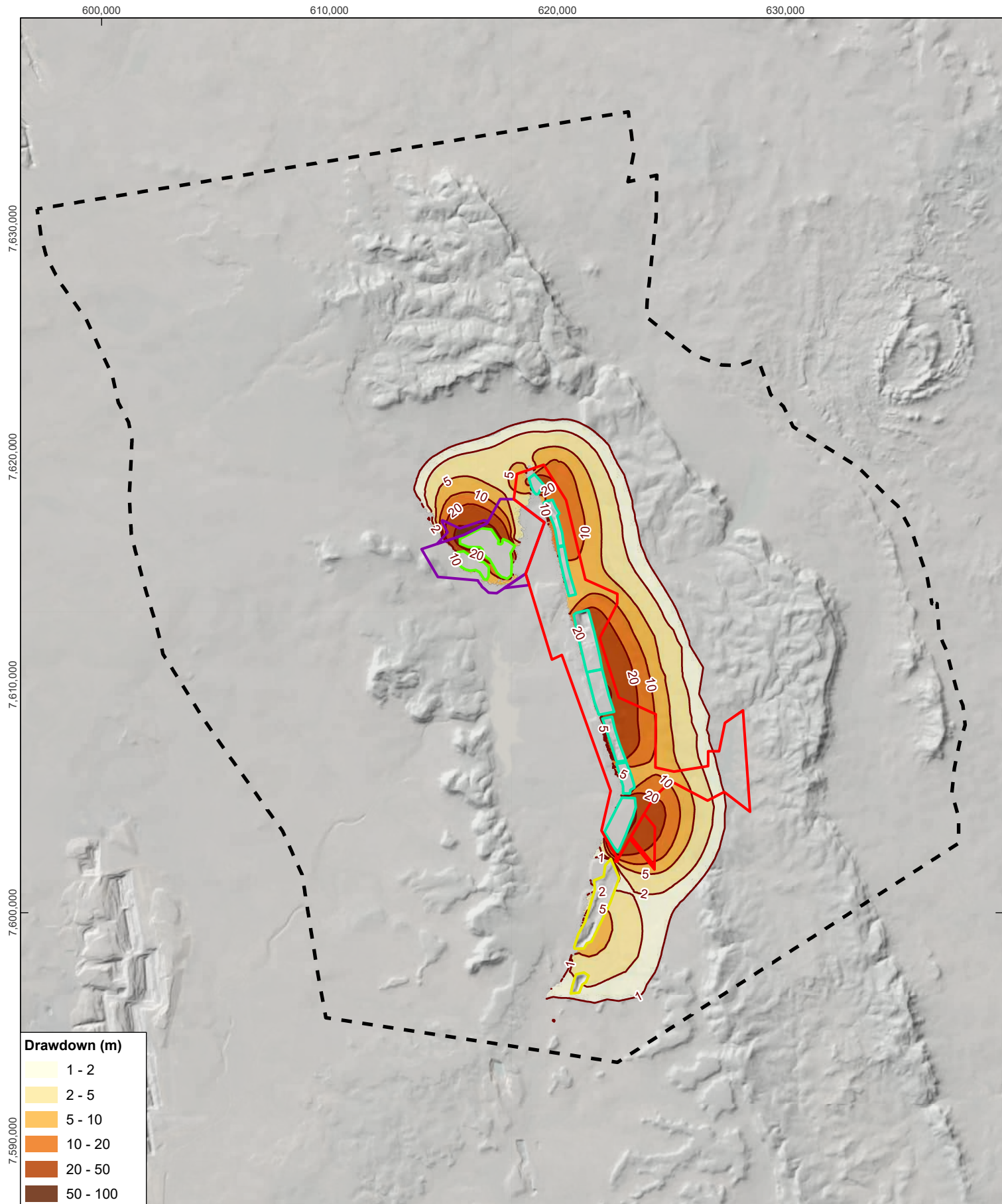
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL CUMULATIVE
DRAWDOWN IN BURTON/RIDER SEAM-
POST-MINING EQUILIBRIUM
(BEST CASE SCENARIO)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-17



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 19-Aug-2024
 Drawn by: RB

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL CUMULATIVE
DRAWDOWN IN LEICHHARDT/VERMONT SEAM-
POST-MINING EQUILIBRIUM
(BEST CASE SCENARIO)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-18

Worst Case Climate Scenario

Figure 2-19 shows the predicted residual groundwater table drawdown (greater than 1m) at post-mining equilibrium for the 'worst case' scenario. **Figure 2-19** shows that at post-mining equilibrium, there is predicted water table drawdown of up to 50 m within or closely around the mining pits, gradually reducing with distance from the mines.

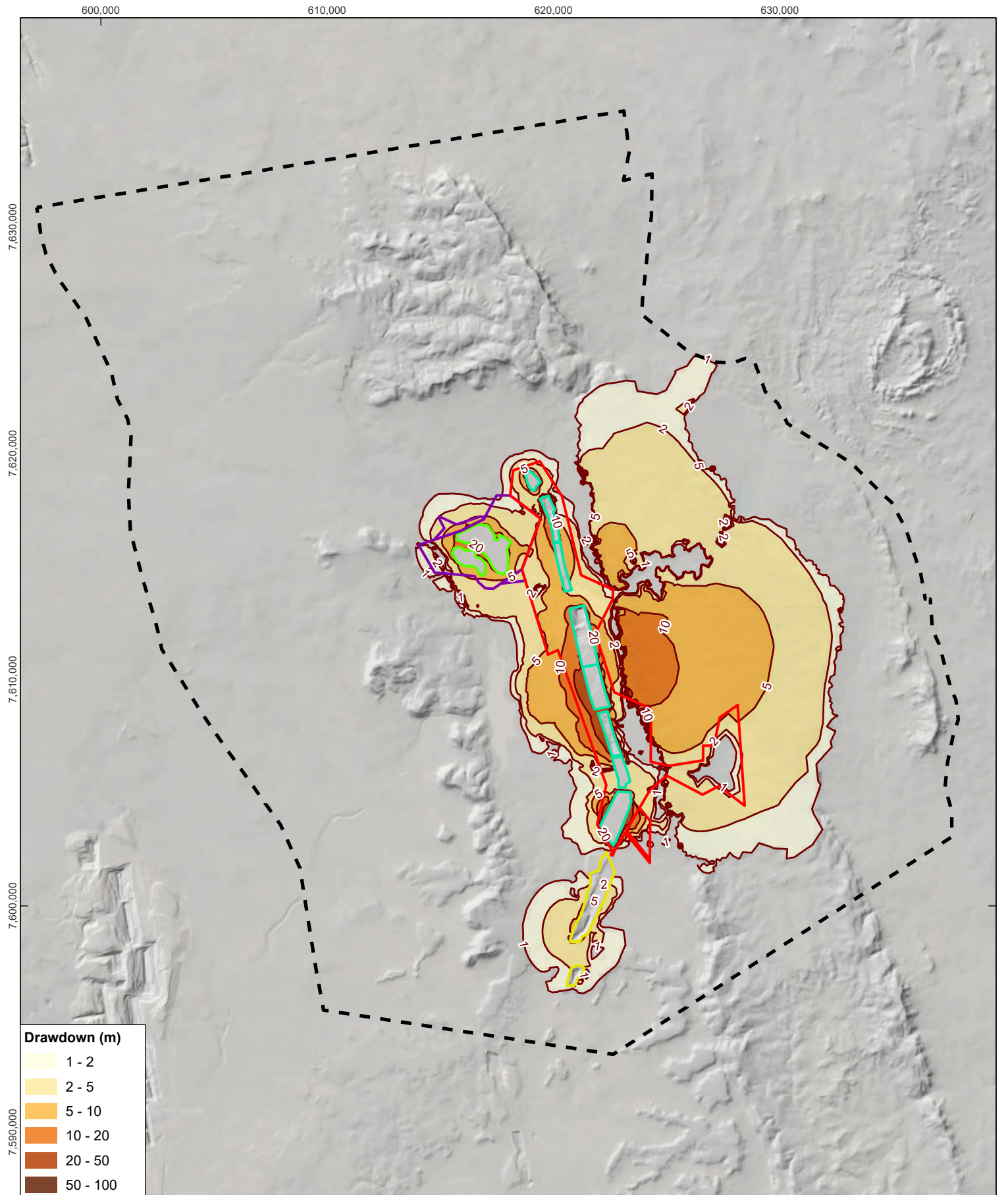
Figure 2-20 to **Figure 2-23** show the predicted residual cumulative drawdown in the alluvium, regolith, Burton/Rider and Leichhardt/Vermont seams at post-mining equilibrium, for the 'worst case' scenario.

Figure 2-20 shows the maximum cumulative residual drawdown predicted in the alluvium for the 'worst case' scenario is consistent with the predictions for both the 'base case' scenario (Figure 6-22 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024) and the 'best case' scenario (**Figure 2-15**).

Figure 2-21 shows the maximum predicted cumulative drawdown extent in the regolith, for the 'worst case' scenario, extending up to 2 km to the northwest, 2 km to the south and approximately 1.5 km to the east of New Lenton, where the zone of impact from the post-mining system at New Lenton interacts with the zone of impact from the Burton Mine. The extent of predicted residual cumulative drawdown in the regolith for the 'worst-case' scenario is consistent with that predicted for the 'base-case' scenario (Figure 6-23 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Figure 2-22 and **Figure 2-23** show that for the 'worst case' scenario, the model predicts residual cumulative drawdown in the coal seams to be consistent with that predicted for the 'base case' scenario (Figure 6-24 and Figure 6-25 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).





 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 16-Aug-2024
 Drawn by: RB

LEGEND

- | | |
|---------------------------|---------------------------|
| — Drawdown Contour (m) | — Burton Pit Extent |
| - - - Model Domain | — New Lenton Pit Extent |
| — Burton Mining Lease | — Former Burton Mine Pits |
| — New Lenton Mining Lease | |

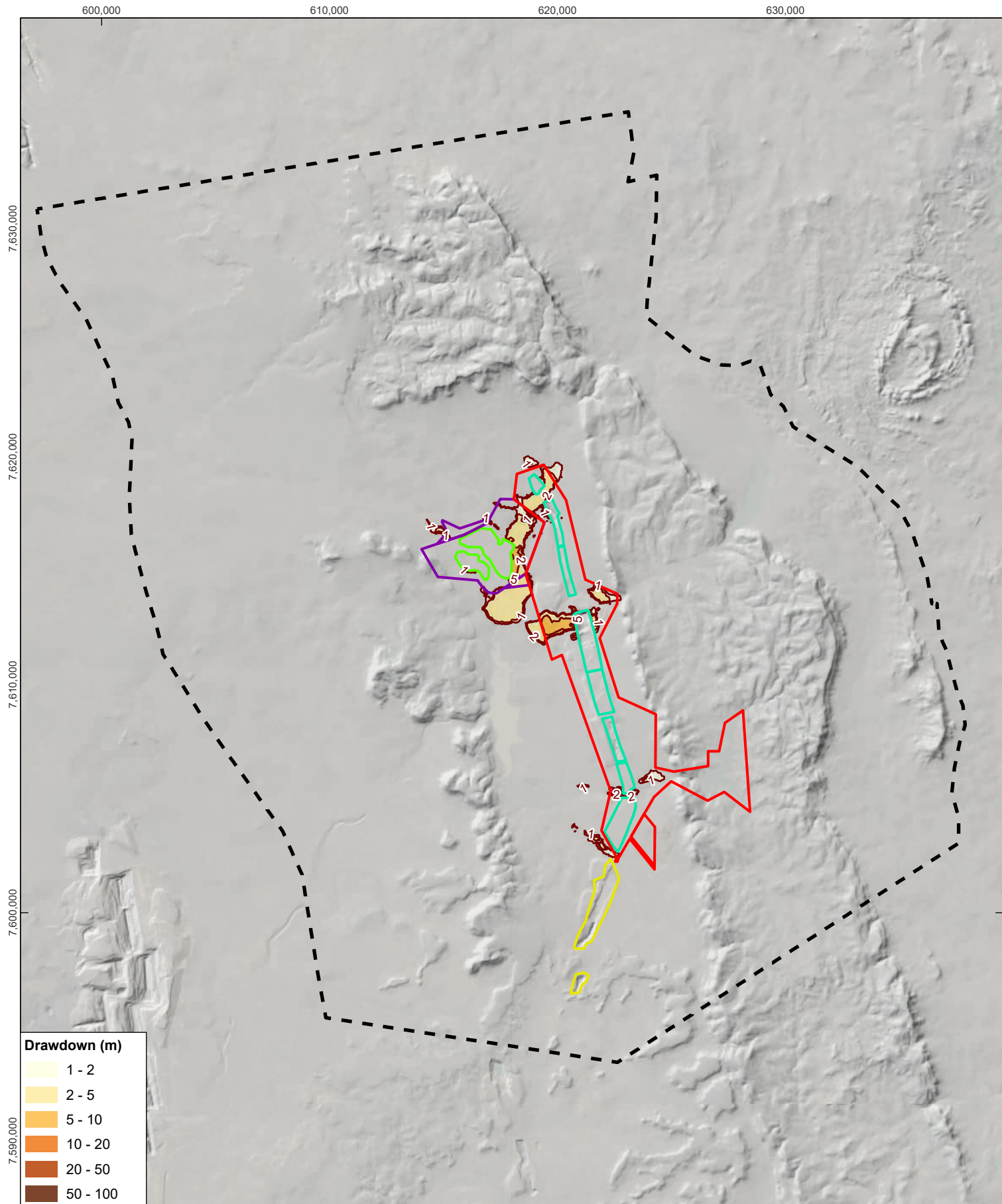
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED RESIDUAL CUMULATIVE GROUNDWATER TABLE DRAWDOWN – POST-MINING EQUILIBRIUM (WORST CASE SCENARIO)



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FIGURE 2-19



Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100

 0 2.5 5 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:220,000 at A4

Project Number: 620.31367.00000

Date Drawn: 16-Aug-2024

Drawn by: RB

LEGEND

- Drawdown Contour (m)
- - - Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

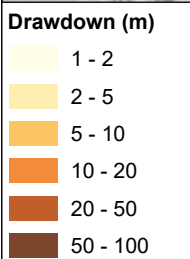
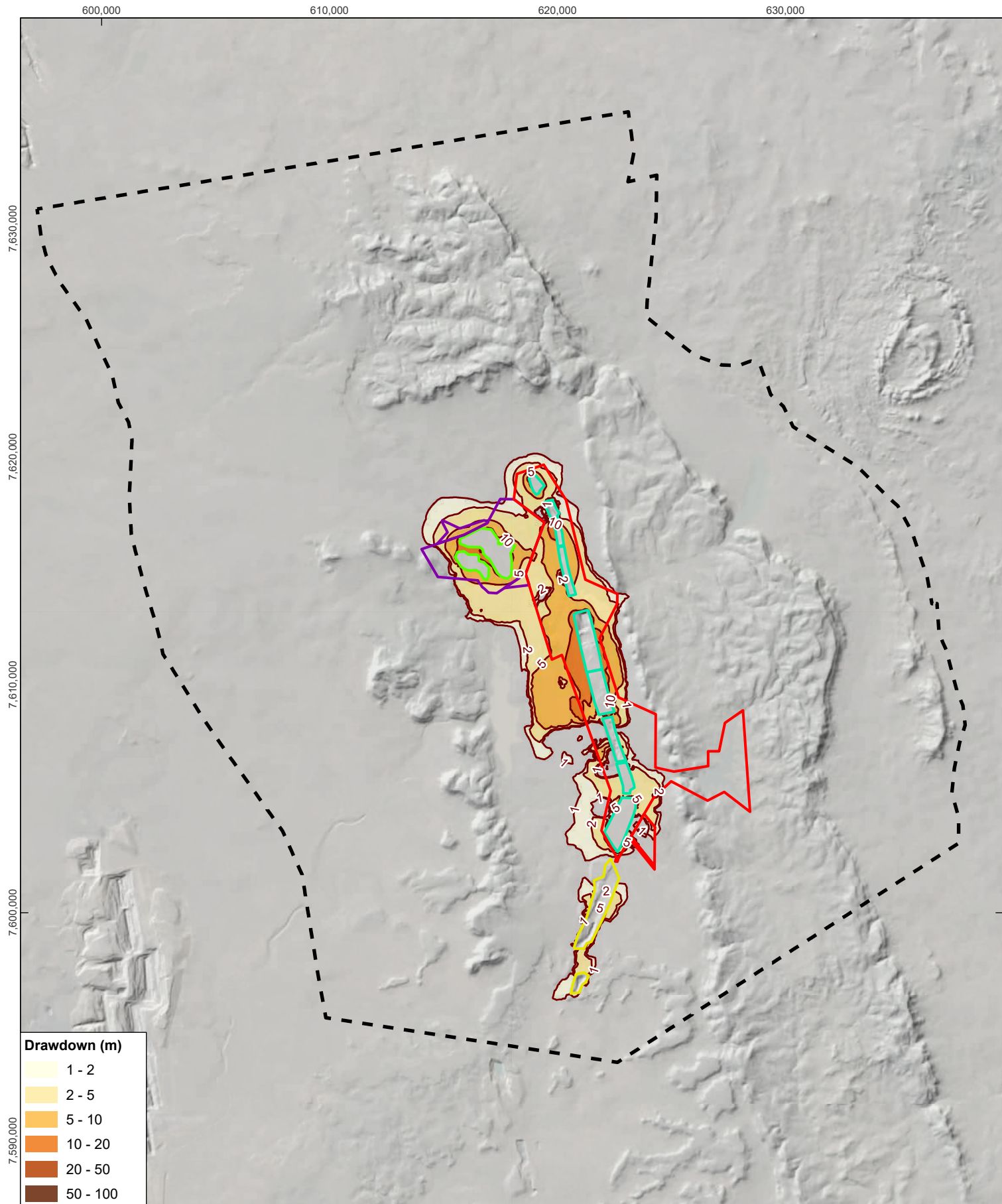
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL CUMULATIVE
DRAWDOWN IN ALLUVIUM LAYER 1 -
POST-MINING EQUILIBRIUM
(WORST CASE SCENARIO)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-20



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 16-Aug-2024
 Drawn by: RB

LEGEND

- | | |
|---|---|
|  Drawdown Contour (m) |  Burton Pit Extent |
|  Model Domain |  New Lenton Pit Extent |
|  Burton Mining Lease |  Former Burton Mine Pits |
|  New Lenton Mining Lease | |

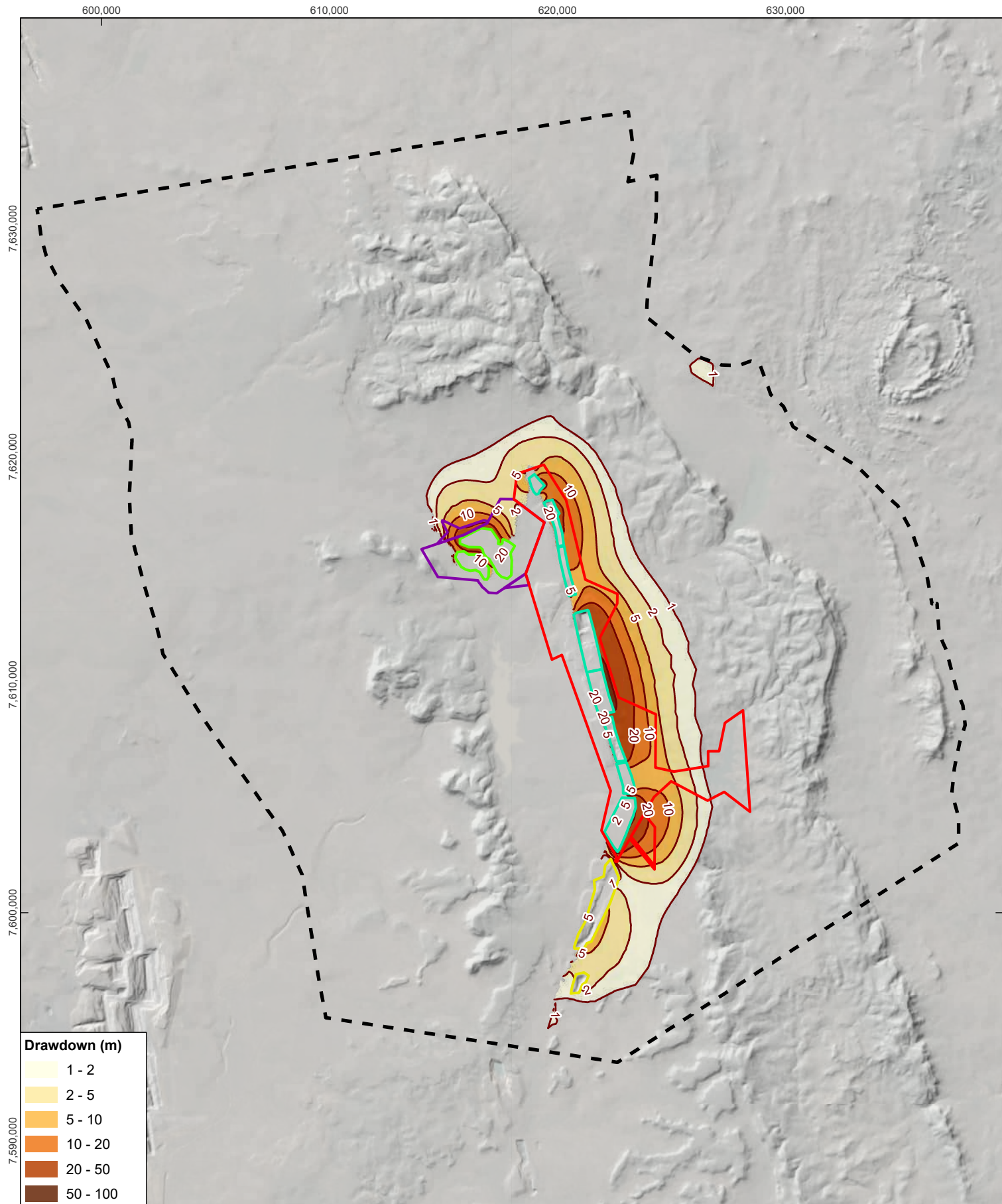
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL CUMULATIVE
DRAWDOWN IN REGOLITH LAYER 2 -
POST-MINING EQUILIBRIUM
(WORST CASE SCENARIO)**



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FIGURE 2-21



Drawdown (m)	
	1 - 2
	2 - 5
	5 - 10
	10 - 20
	20 - 50
	50 - 100

	0 2.5 5 km
Coordinate System: GDA2020 MGA Zone 55	
Scale: 1:220,000 at A4	
Project Number: 620.31367.00000	
Date Drawn: 19-Aug-2024	
Drawn by: RB	

LEGEND

— Drawdown Contour (m)	 Burton Pit Extent
 Model Domain	 New Lenton Pit Extent
 Burton Mining Lease	 Former Burton Mine Pits
 New Lenton Mining Lease	

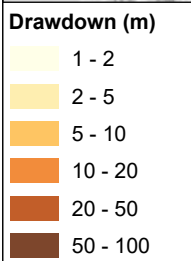
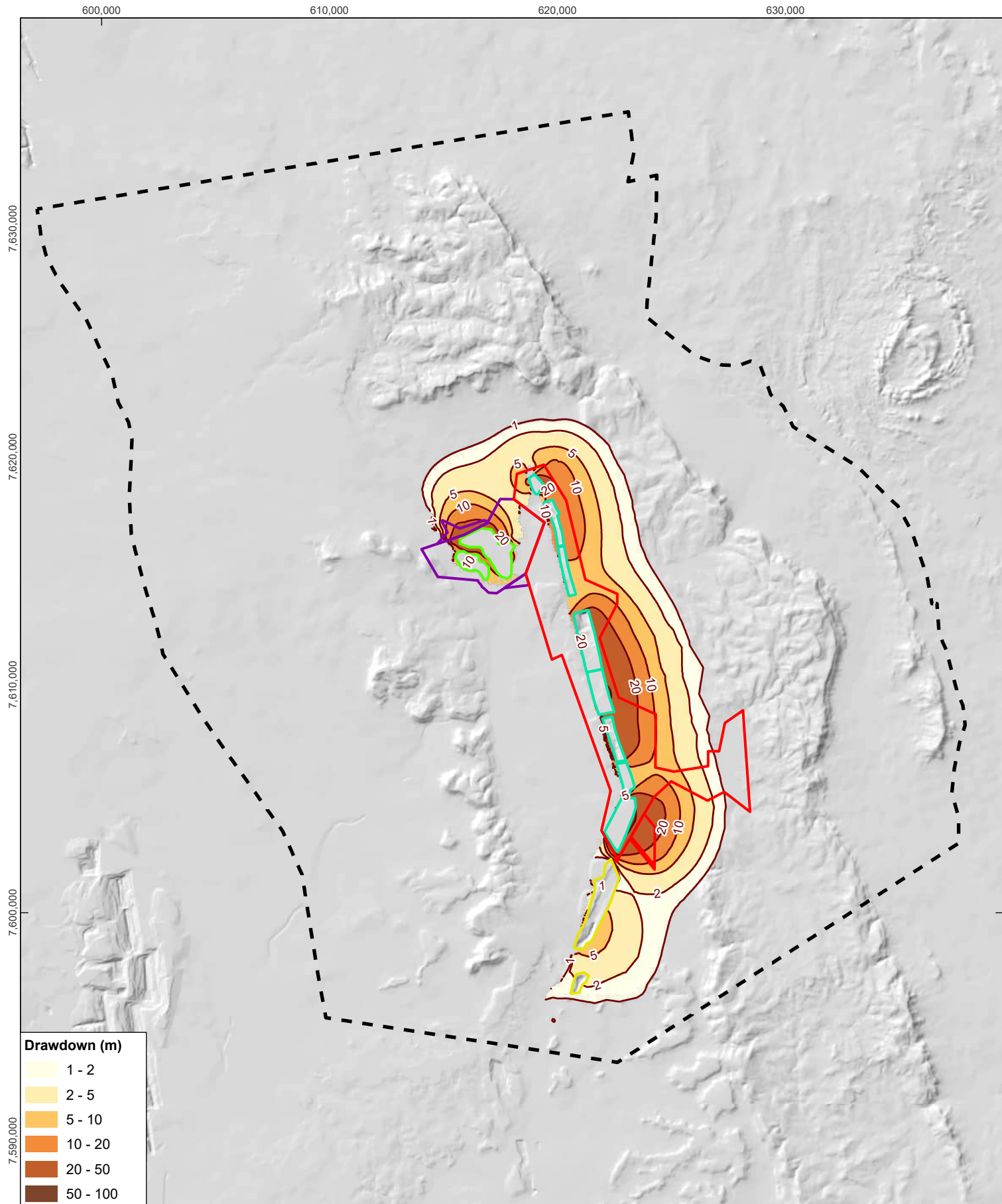
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED RESIDUAL CUMULATIVE DRAWDOWN IN BURTON/RIDER SEAM- POST-MINING EQUILIBRIUM (WORST CASE SCENARIO)



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FIGURE 2-22



 0 2.5 5 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:220,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 19-Aug-2024
 Drawn by: RB

LEGEND

-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL CUMULATIVE
DRAWDOWN IN LEICHHARDT/VERMONT SEAM-
POST-MINING EQUILIBRIUM
(WORST CASE SCENARIO)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-23

2.2.5.2 Post-Mining Residual Incremental Drawdown - New Lenton Mine

The residual incremental drawdown at post-mining equilibrium due to the proposed mining and final landform at New Lenton is a comparison of groundwater levels between a 'mining and closure' situation including New Lenton Mine, and a 'mining and closure' situation excluding New Lenton Mine but including the adjoining Burton mine.

Best Case Climate Scenario

Figure 2-24 shows the predicted residual incremental groundwater table drawdown (greater than 1m) due to the New Lenton Mine at post-mining equilibrium, for the 'best case' scenario. **Figure 2-24** shows that at post-mining equilibrium, the incremental water table drawdown extends up to approximately 2.0 km in all directions from the pits. In comparison with the drawdown predicted for the 'base case' scenario (Figure 6-26 of the PER's New Lenton & Burton Groundwater Modelling Technical Report SLR, 2024), the predicted residual water table drawdown for the 'best-case' scenario extends approximately 450m further to the west and 50m further to the north and east.

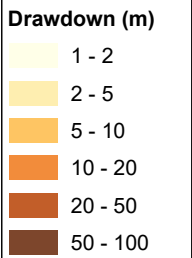
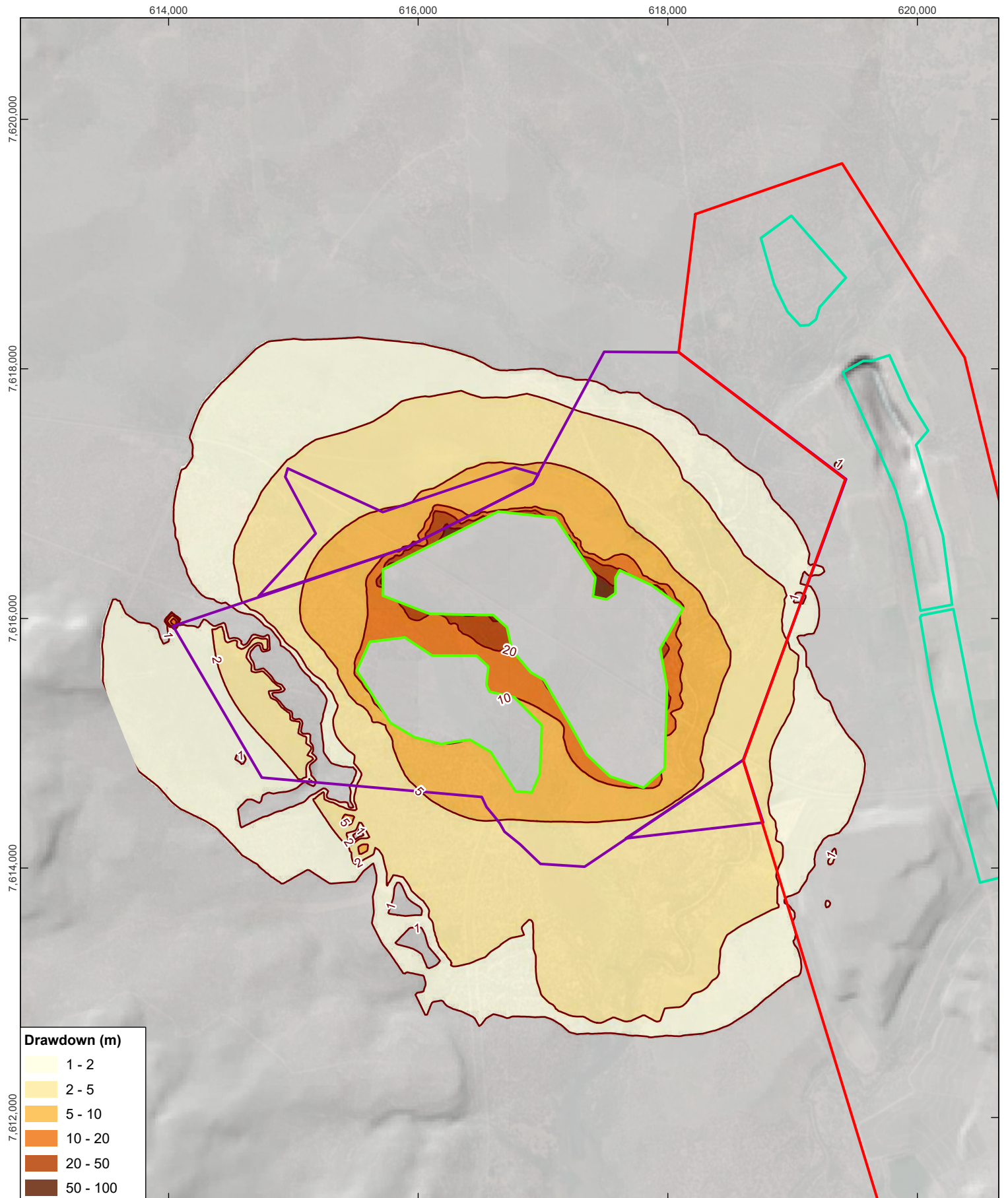
Figure 2-25 to **Figure 2-28** show the predicted residual incremental groundwater table drawdown (greater than 1m) for the 'best case' scenario, due to the New Lenton Mine at post-mining equilibrium, in the alluvium, regolith, Burton/Rider and Leichhardt/Vermont seams.

Figure 2-25 shows that the model predicts post-mining incremental drawdown extending up to 2 km downstream and 1 km upstream of the East Pit at New Lenton in the alluvium, for the 'best case' scenario. The predicted residual incremental drawdown in the alluvium for the 'best-case' scenario is approximately 50m more extensive to the northeast than that predicted for the 'base case' scenario (Figure 6-27 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Figure 2-26 shows the predicted post-mining incremental drawdown extent in the regolith, for the 'best case' scenario, extends up to 2 km to the northwest and 2 km to the southeast for the New Lenton pits. The predicted residual incremental drawdown in the regolith for the 'best-case' scenario is approximately 100m more extensive to the northwest, and 50m more extensive to the east, than that predicted for the 'base case' scenario (Figure 6-28 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Figure 2-27 to **Figure 2-28** show the extent of post-mining incremental drawdown in the Permian coal seams (Burton/Rider and Leichhardt/Vermont seams, respectively), for the 'best case' scenario. These figures illustrate that the predicted post-mining incremental drawdown is 0.5 km more extensive than the drawdown predicted for the 'base case' scenario (Figure 6-29 and Figure 6-30 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).





Drawdown (m)
 1 - 2
 2 - 5
 5 - 10
 10 - 20
 20 - 50
 50 - 100

Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:40,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 20-Aug-2024
 Drawn by: RB

LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

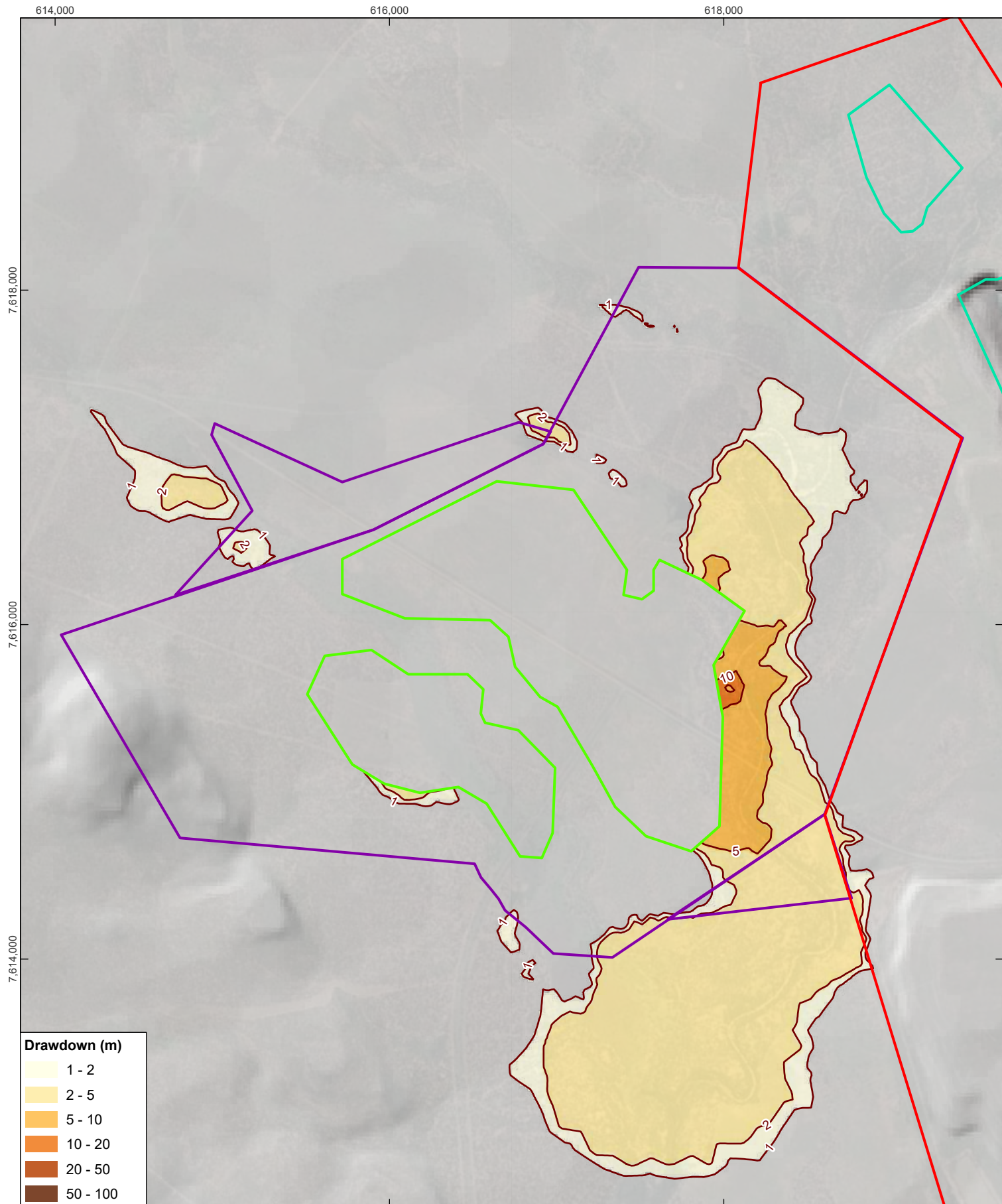
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL INCREMENTAL
GROUNDWATER TABLE DRAWDOWN –
NEW LENTON
(BEST CASE SCENARIO)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-24



Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:30,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 16-Aug-2024
 Drawn by: RB

LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

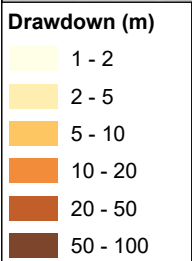
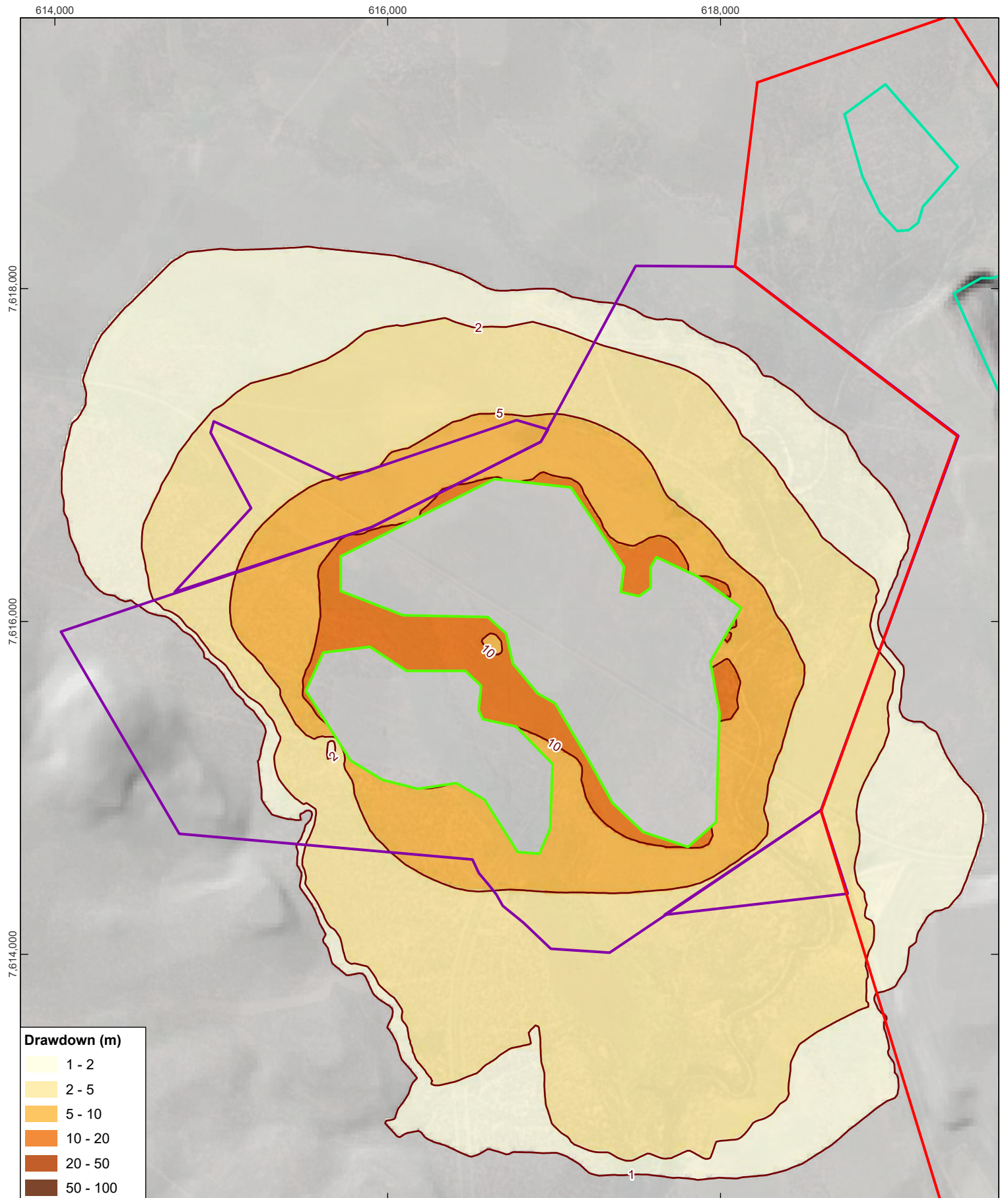
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN ALLUVIUM (LAYER 1) – NEW LENTON (BEST CASE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-25



Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:30,000 at A4

Project Number: 620.31367.00000

Date Drawn: 16-Aug-2024

Drawn by: RB

LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

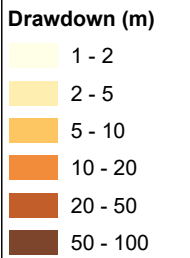
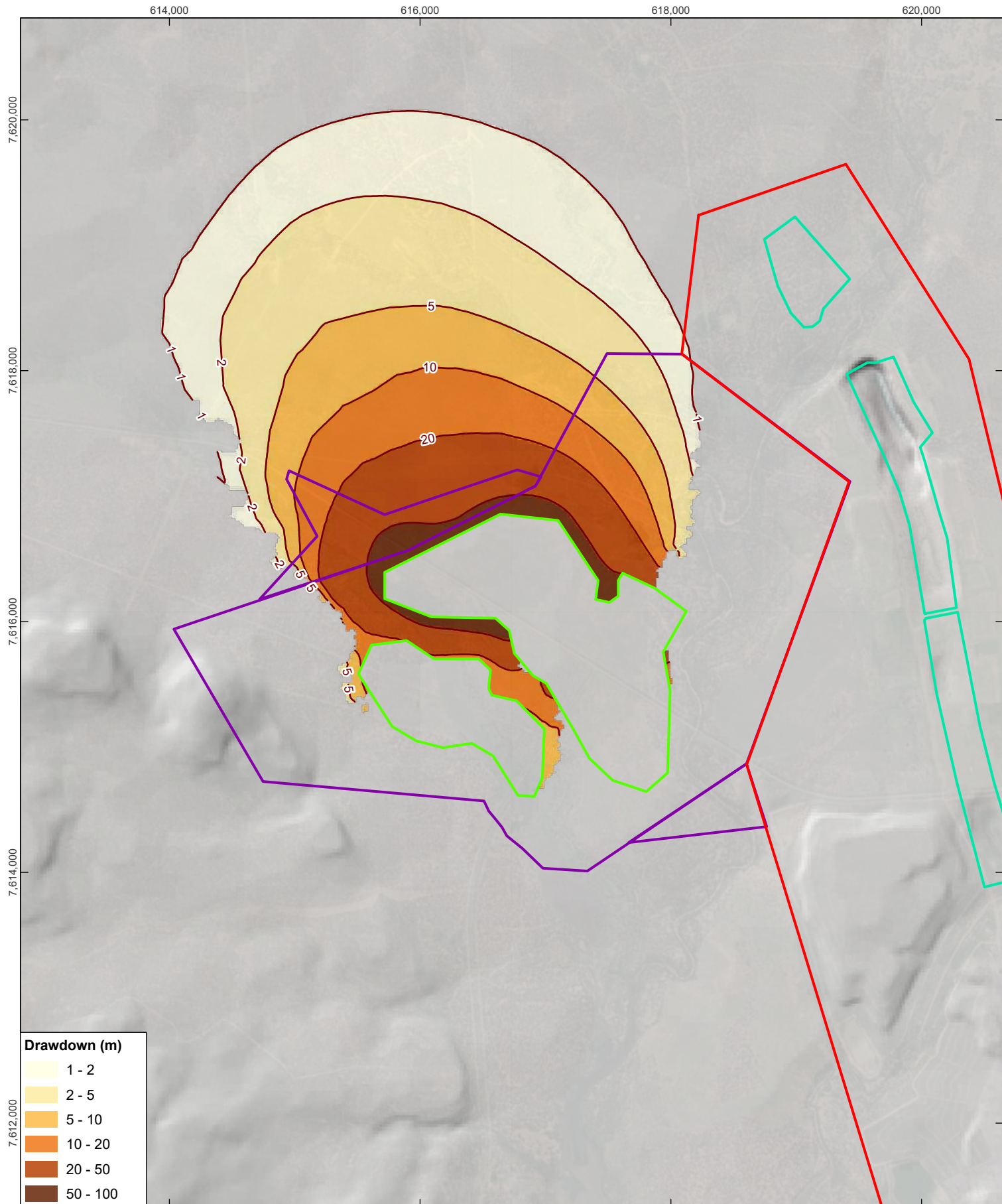
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN REGOLITH (LAYER 2) – NEW LENTON (BEST CASE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-26



 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:40,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 20-Aug-2024
 Drawn by: RB

LEGEND

-  Drawdown Contour (m)
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Model Domain
-  Burton Mining Lease
-  Former Burton Mine Pits
-  New Lenton Mining Lease

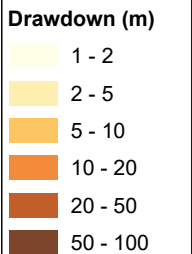
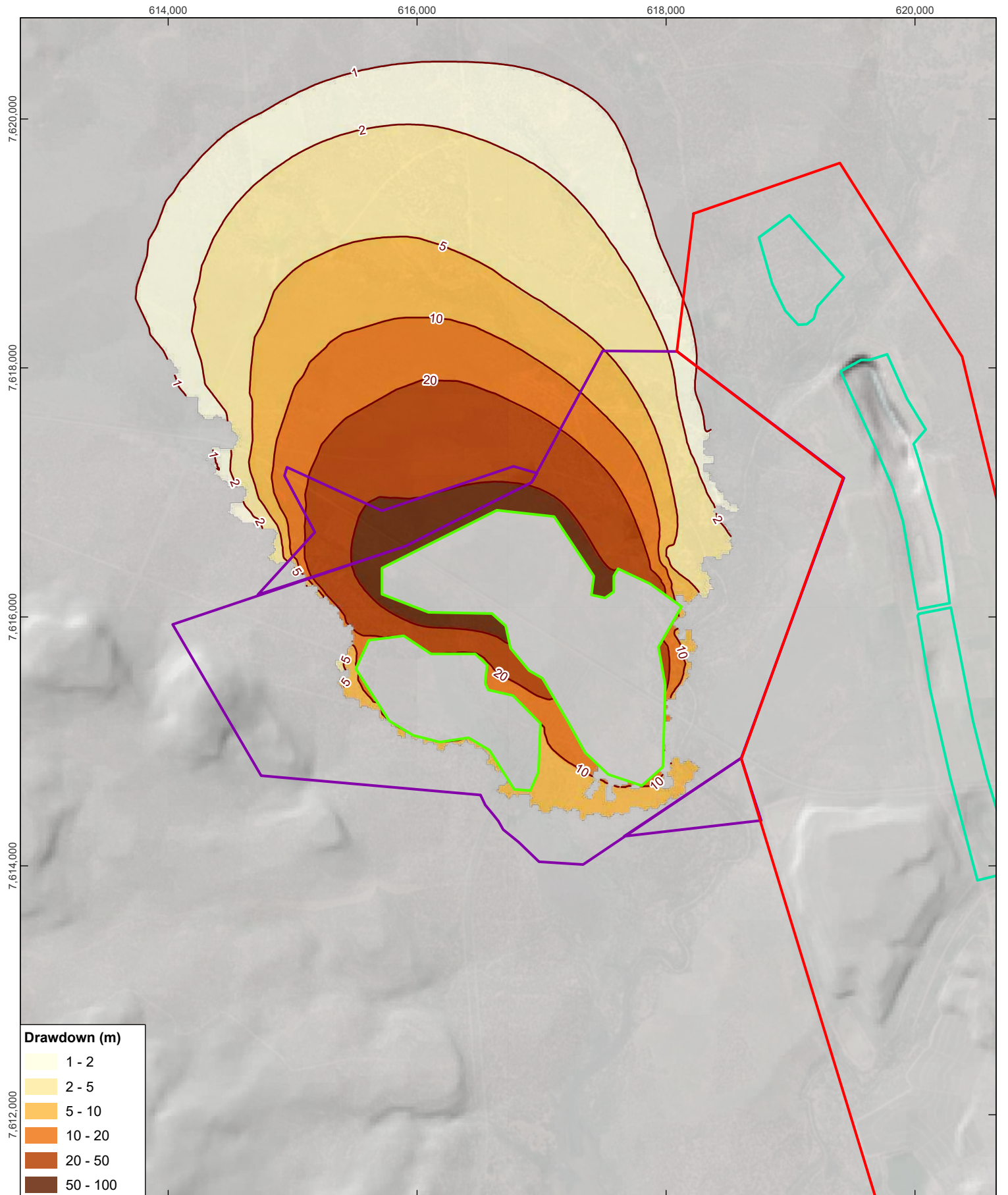
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL INCREMENTAL
DRAWDOWN IN BURTON/RIDER SEAM –
NEW LENTON
(BEST CASE SCENARIO)**



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FIGURE 2-27



LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:40,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 20-Aug-2024
 Drawn by: RB

**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL INCREMENTAL
DRAWDOWN IN LEICHHARDT/VERMONT SEAM –
NEW LENTON
(BEST CASE SCENARIO)**



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FIGURE 2-28

Worst Case Climate Scenario

Figure 2-24 shows the predicted residual incremental groundwater table drawdown (greater than 1m) due to the New Lenton Mine at post-mining equilibrium, for the 'worst case' scenario. **Figure 2-24** shows that at post-mining equilibrium, the incremental water table drawdown extends up to approximately 2.0 km in all directions from the pits. In comparison with the drawdown predicted for the 'base case' scenario (Figure 6-26 of the PER's New Lenton & Burton Groundwater Modelling Technical Report SLR, 2024), the predicted residual water table drawdown for the 'worst-case' scenario is approximately 40m less extensive to the west and otherwise consistent.

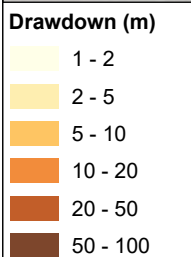
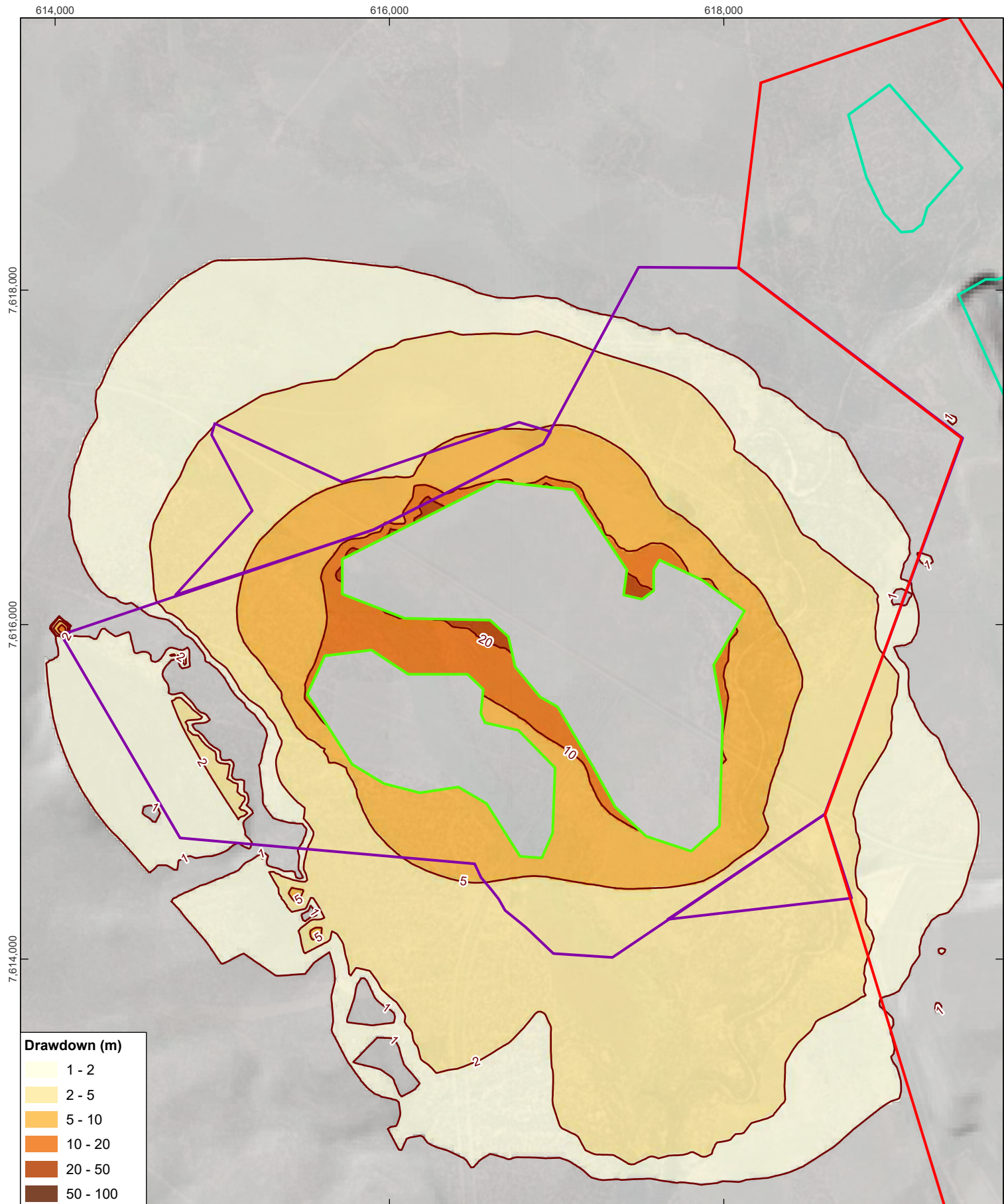
Figure 2-25 to **Figure 2-28** show the predicted residual incremental groundwater table drawdown (greater than 1m) for the 'worst case' scenario, due to the New Lenton Mine at post-mining equilibrium, in the alluvium, regolith, Burton/Rider and Leichhardt/Vermont seams.

Figure 2-25 shows that the model predicts post-mining incremental drawdown extending up to 2 km downstream and 1 km upstream of the East Pit at New Lenton in the alluvium, for the 'worst case' scenario. The predicted residual incremental drawdown in the alluvium for the 'worst-case' scenario is consistent with that predicted for the 'base case' scenario (Figure 6-27 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Figure 2-26 shows the predicted post-mining incremental drawdown extent in the regolith, for the 'worst case' scenario, extends up to 2 km to the northwest and 2 km to the southeast for the New Lenton pits. The predicted residual incremental drawdown in the regolith for the 'worst-case' scenario is consistent with that predicted for the 'base case' scenario (Figure 6-28 of the PER's New Lenton & Burton Groundwater Modelling Technical Report; SLR, 2024).

Figure 2-27 to **Figure 2-28** show the extent of post-mining incremental drawdown in the Permian coal seams (Burton/Rider and Leichhardt/Vermont seams, respectively), for the 'worst case' scenario. These figures illustrate that the predicted post-mining incremental drawdown for the 'worst case' scenario is approximately 70 m less extensive to the north than the drawdown predicted for the 'base case' scenario (Figure 6-29 and 6-30 of the PER's New Lenton & Burton Groundwater Modelling Technical Report SLR, 2024).





Coordinate System: GDA2020 MGA Zone 55
Scale: 1:30,000 at A4
Project Number: 620.31367.00000
Date Drawn: 16-Aug-2024
Drawn by: RB

LEGEND

- Drawdown Contour (m)
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

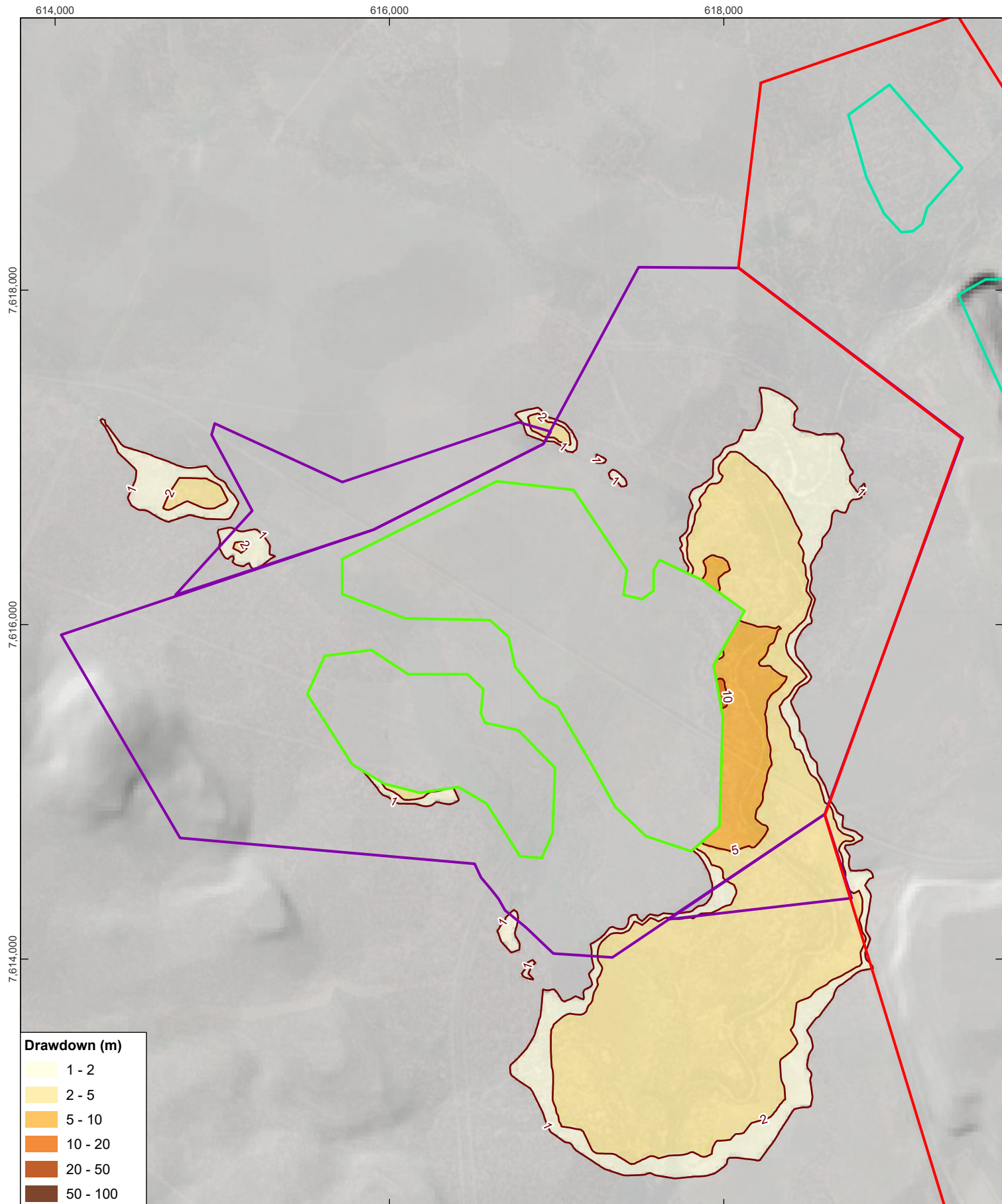
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PREDICTED RESIDUAL INCREMENTAL
GROUNDWATER TABLE DRAWDOWN –
NEW LENTON
(WORST CASE SCENARIO)**



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-29



Drawdown (m)	
	1 - 2
	2 - 5
	5 - 10
	10 - 20
	20 - 50
	50 - 100

	0 0.5 1 km
Coordinate System: GDA2020 MGA Zone 55	
Scale: 1:30,000 at A4	
Project Number: 620.31367.00000	
Date Drawn: 16-Aug-2024	
Drawn by: RB	

LEGEND

	Drawdown Contour (m)		Burton Pit Extent
	Model Domain		New Lenton Pit Extent
	Burton Mining Lease		Former Burton Mine Pits
	New Lenton Mining Lease		

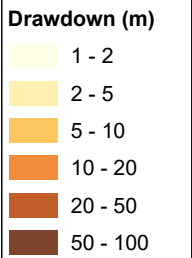
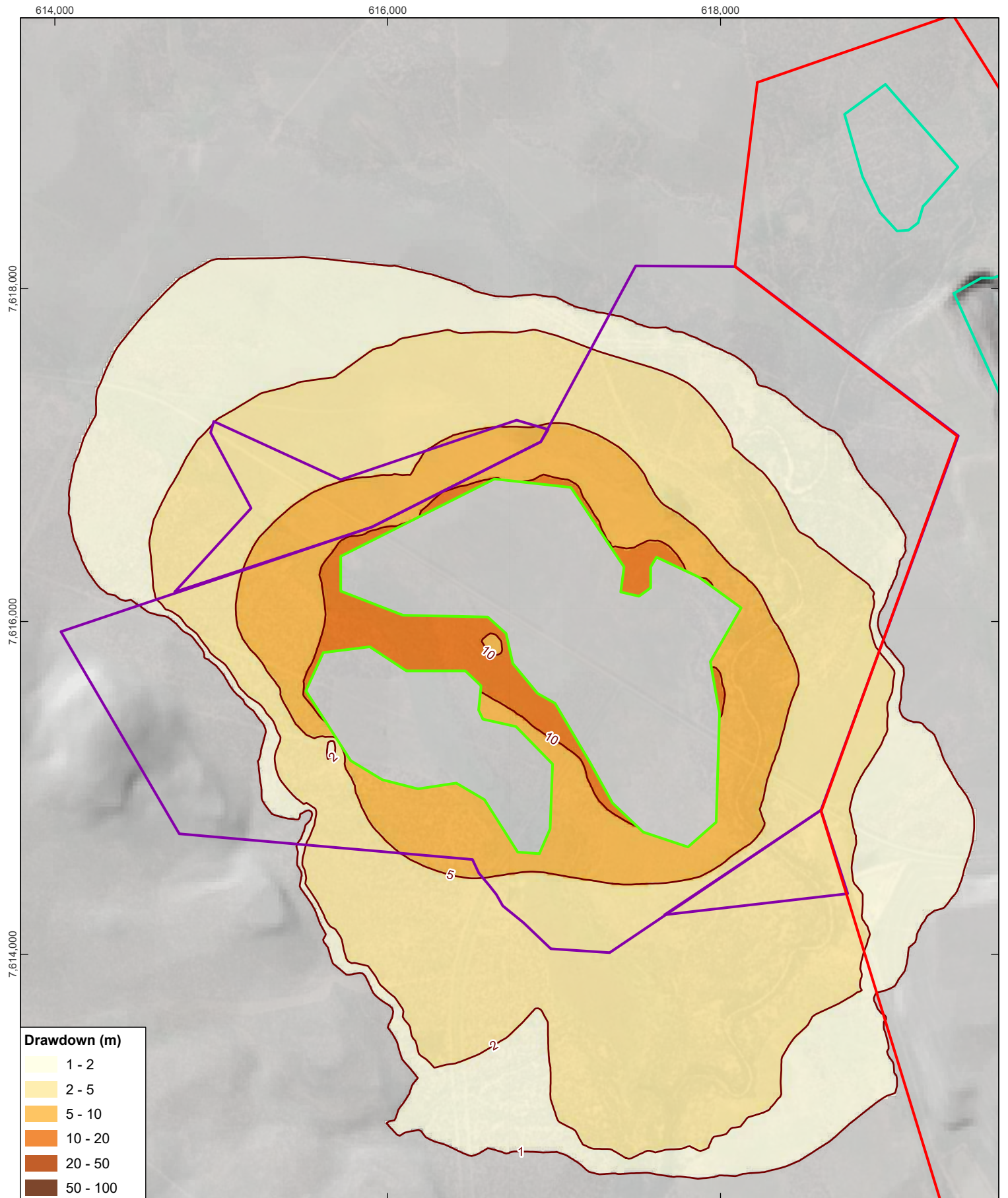
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN ALLUVIUM (LAYER 1) – NEW LENTON (WORST CASE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-30



Drawdown (m)
 1 - 2
 2 - 5
 5 - 10
 10 - 20
 20 - 50
 50 - 100

0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:30,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 16-Aug-2024
 Drawn by: RB

LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

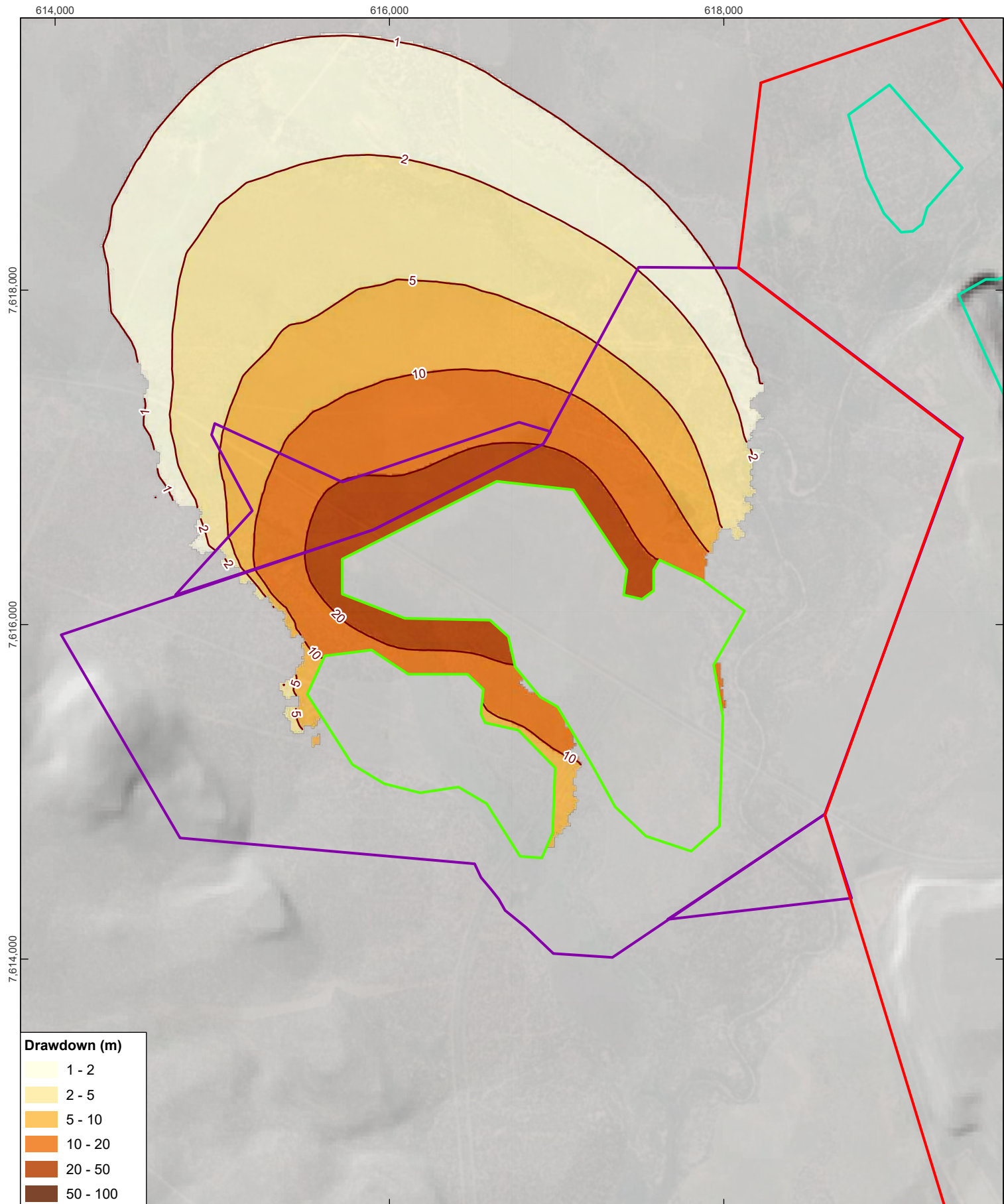
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN REGOLITH (LAYER 2) – NEW LENTON (WORST CASE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-31



Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100

 0 0.5 1 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:30,000 at A4
 Project Number: 620.31367.00000
 Date Drawn: 19-Aug-2024
 Drawn by: RB

LEGEND

-  Drawdown Contour (m)
-  Model Domain
-  Burton Mining Lease
-  New Lenton Mining Lease
-  Burton Pit Extent
-  New Lenton Pit Extent
-  Former Burton Mine Pits

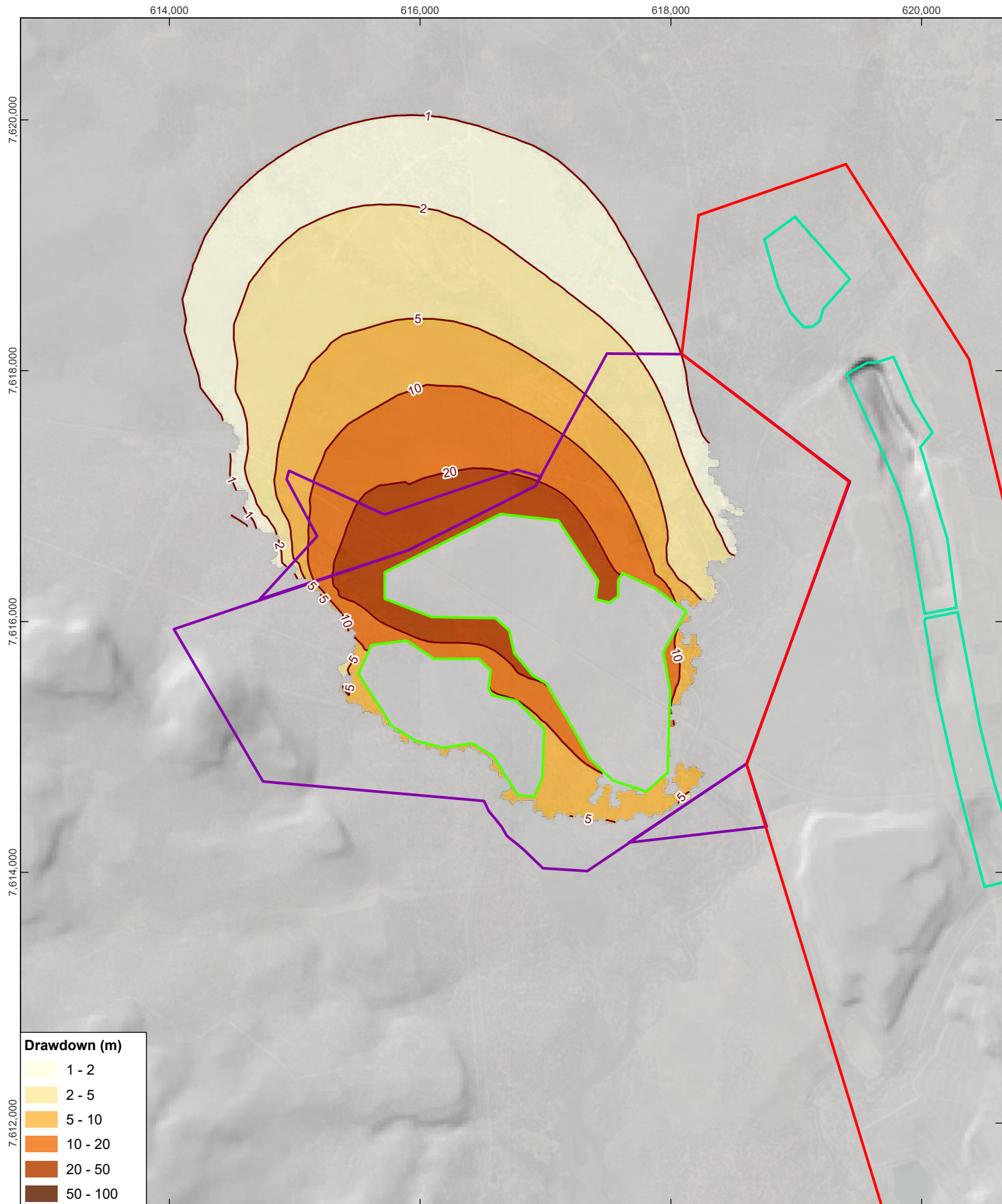
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN BURTON/RIDER SEAM – NEW LENTON (WORST CASE SCENARIO)



DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-32



Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:40,000 at A4

Project Number: 620.31367.00000

Date Drawn: 20-Aug-2024

Drawn by: RB

LEGEND

- Drawdown Contour (m)
- Model Domain
- Burton Mining Lease
- New Lenton Mining Lease
- Burton Pit Extent
- New Lenton Pit Extent
- Former Burton Mine Pits

NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED RESIDUAL INCREMENTAL DRAWDOWN IN LEICHHARDT/VERMONT SEAM – NEW LENTON (WORST CASE SCENARIO)



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FIGURE 2-33

2.2.6 Influence on Alluvium

The main alluvial resources in the area include:

- Alluvium associated with the Isaac River downstream of the Burton Gorge Dam, scheduled under the Queensland *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (under the *Environmental Protection Act 1994*) as part of the Isaac Connors Alluvium Groundwater Sub-area (within the Isaac Connors Groundwater Management Area of the Fitzroy Basin water plan (WQ1310)); and
- Other mapped Quaternary alluvium localised along Isaac River upstream of the Burton Gorge Dam, Hill Creek, Anna Creek and other minor drainage lines.

The cumulative change in alluvial water resources during post-mining recovery has been calculated for each of the climate scenarios by comparing water budgets for alluvial zones using scenarios of the model that included and excluded mining activity, respectively.

Figure 2-34 compares the predicted cumulative decrease in flux to the alluvium during the post-mining period, for each of the climate scenarios. The difference in predicted flux decrease between the extreme climate scenarios and the base climate scenario is less than 2%. That is, the climate extremes do not result in a significant change in predicted groundwater flux associated with alluvium. The simulated flux shown in **Figure 2-34** predicts higher variability in the first 100 years post-mining, stabilising after approximately 400 years of recovery where the system reached an equilibrium condition.

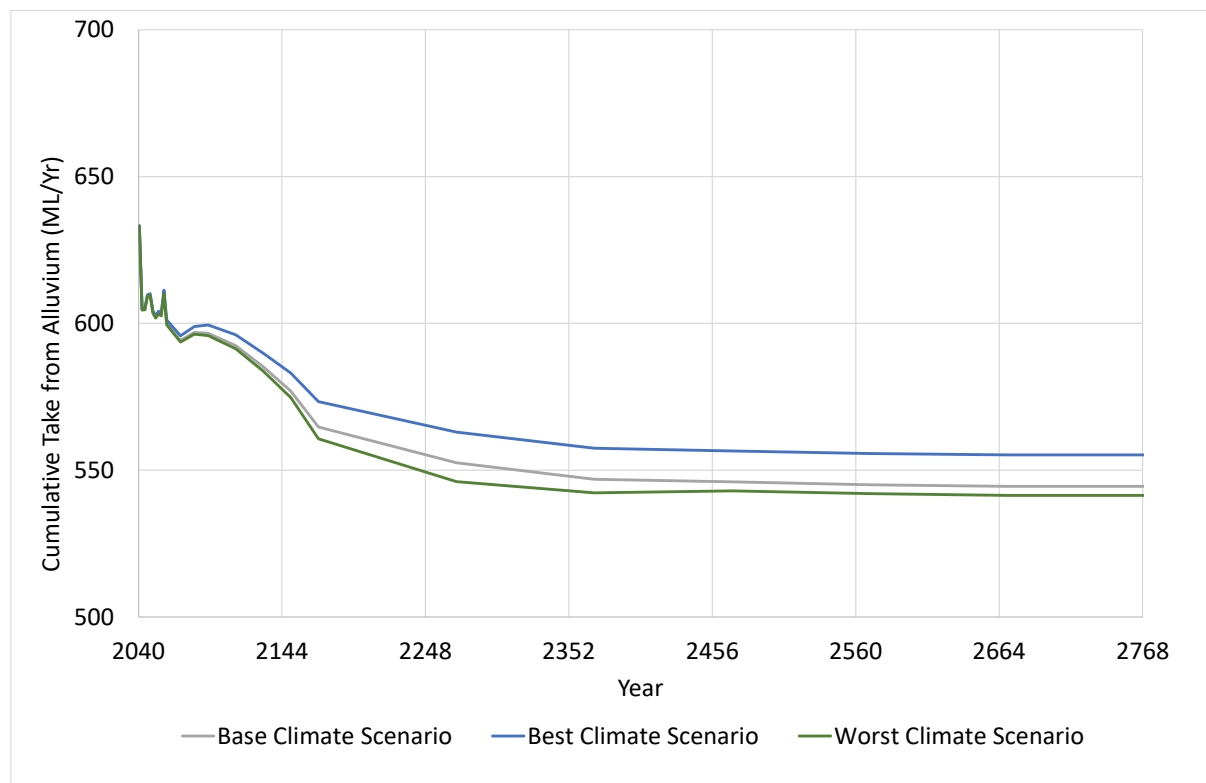


Figure 2-34 Predicted Cumulative Change in Flux from Alluvium to Permian (ML/year) for the Base, Best and Worst Climate Scenarios



Figure 2-35 shows the predicted incremental decrease in total flux to the alluvium due to post-mining recovery at New Lenton, for each of the climate scenarios. The incremental flux was calculated by comparing the water budgets for the scenarios excluding and including mining at New Lenton, respectively.

The figure shows that base-, best- and worst-case climate scenarios, the post-mining landform at New Lenton results in a long-term equilibrated decrease in flux to the Quaternary Alluvium of 157.8, 168.5 and 154.7 ML/year, respectively. Total change in flux in the two climate extremes varies over a range of less than 9% of the base case change in flux reported in the PER, considered very small. That is, the climate extremes do not result in a significant change in predicted change in alluvial flux.

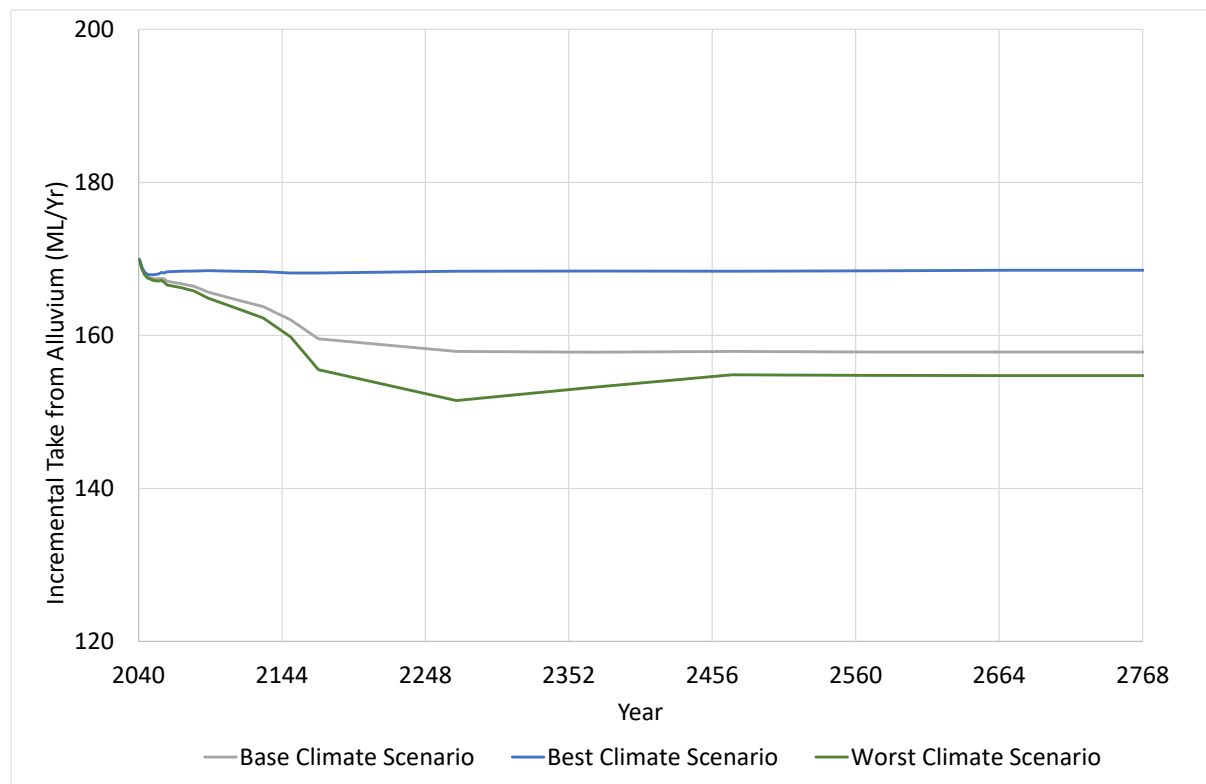


Figure 2-35 Predicted Incremental (New Lenton Mine) Change in Flux from Alluvium to Permian (ML/year) for the Base, Best and Worst Climate Scenarios

The model predicted negligible cumulative or incremental change (less than 1%) in the alluvial water resources downstream of Burton Gorge Dam scheduled as part of the Isaac Connors Alluvium Groundwater Sub-area as a result of mining at New Lenton and Burton, in both extreme climate scenarios that were simulated.

2.2.7 Influence on Surface Water Flow

The model predicts no baseflow along Isaac River within 3 km of the site, for any of the climate or predictive scenarios. This is consistent with the conceptualisation, i.e. that the alluvium associated with the Isaac River near the site is unsaturated for the majority of the year and groundwater does not supply a baseflow component to the Isaac River. During the recovery simulation, the application of long-term average recharge reflects this general condition.



2.2.8 Flow Path Simulation (Particle Tracking)

Particle tracking was undertaken on each of the extreme climate scenarios (best and worst case) to illustrate the simulated post-mining groundwater flow field (advection) in the vicinity of the mined pits using mod-PATH3DU (MP3DU) (S.S. Papadopoulos & Associates, Inc., 2018). Particle tracking can be considered as the advection component contributing to solute transport, and thus can also assist with identifying potential contaminant flow paths.

Particles were placed around and within the final voids and across the in-pit spoil emplacements in the recovery groundwater model. MP3DU simulates the movement of these particles through the groundwater flow field from the end of mining, during recovery through to the end of the recovery simulation (730 years). MP3DU used the transient head outputs from the groundwater flow model to simulate the particle flow paths. The particles were released at the start of the post-mining simulation, with the movement of the particles then recorded during the post-mining simulation.

The particles were placed at the ground surface of the model around the pit shells, final voids and across areas of spoil backfill and out of pit spoil dumps. It should be noted that the MP3DU code automatically moves the particle from the model surface to the shallowest saturated layer at the commencement of the simulation. For many of the particles this represents the Permian layers as the shallow layers (Quaternary Alluvium and regolith) are partly unsaturated across the New Lenton and Burton areas at the commencement of the post-mining simulation (including areas of spoil backfill).

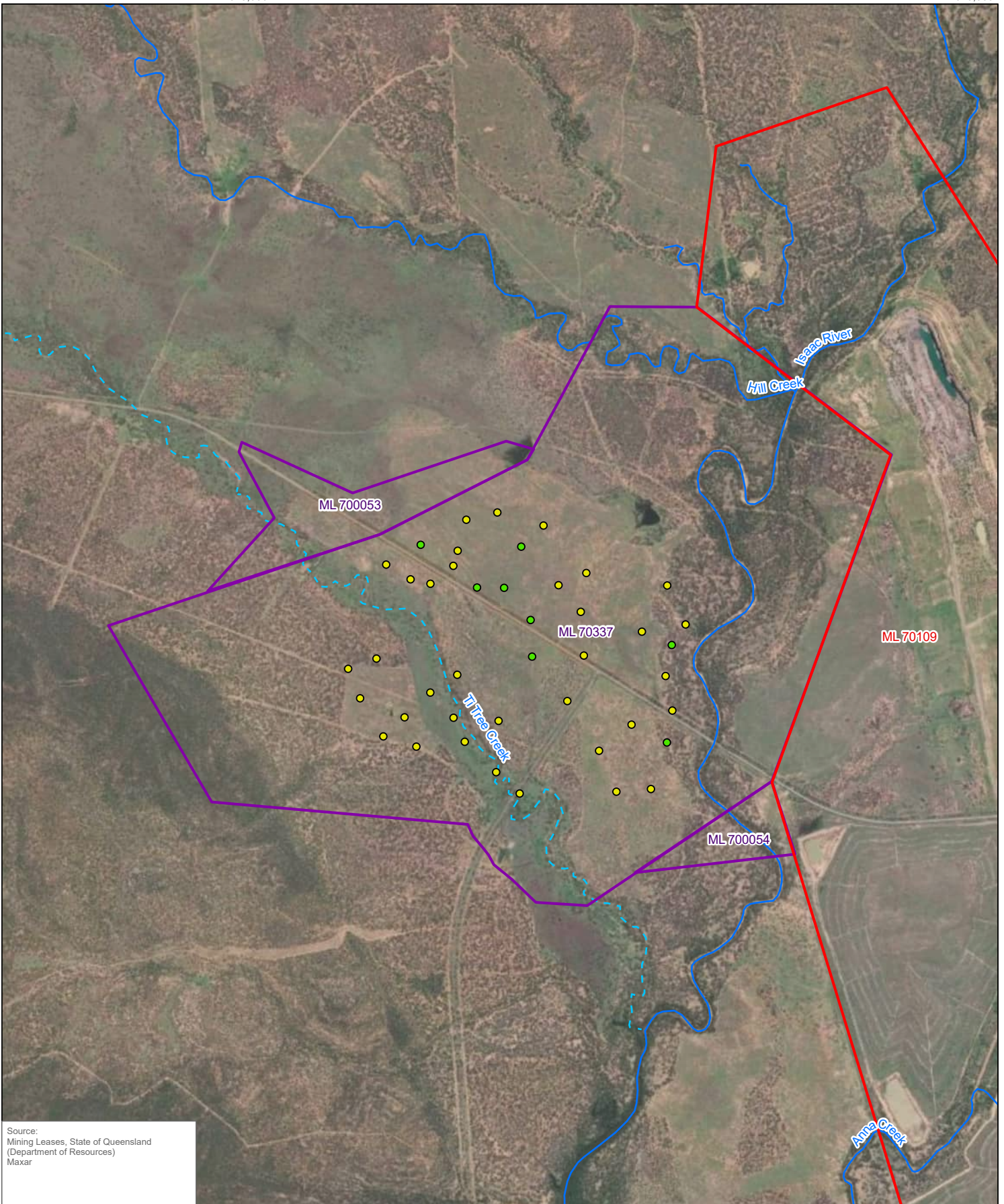
Figure 2-36 shows the initial location and starting layer of particles on the final landform for the New Lenton Mine area.

Figure 2-37 and **Figure 2-38** show the predicted movement of water particles at New Lenton in the 730-year recovery simulation, for the best- and worst-case scenarios, respectively. The colours along the predicted particle flow paths indicates the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallow to deep model layers. The flow path analysis indicated generally the particles move toward the residual void lake, with particles that enter void lake remaining there once they have entered the lake.

For both climate scenarios, particles commencing in the residual voids were predicted to remain in the residual voids for the duration of the simulation, indicating no potential for water discharge to the surrounding groundwater environment. Locations where the model predicts saturation in the shallow groundwater system (i.e., along Isaac River Alluvium) at the end of mining, were predicted not to be affected by post-mining recovery at the New Lenton and Burton mines.

Note that the void lake extents shown in **Figure 2-37** and **Figure 2-38** are at end of recovery steady state equilibrium (maximum level/extent). Head contours shown on the map are also at steady state equilibrium and do not represent the transient head changes that occur over the duration of the post-mining recovery period, therefore particle movement pre-equilibrium results in some particle tracks that are counter to head gradients or other particle tracks on the map.





0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:35,000 at A4

Project Number: 620.31208.00000

Date Drawn: 20-Dec-2023

Drawn by: RB

LEGEND

Starting Model Layer

● 16

● 18

- - - Non-designated
Watercourse

— River

□ Burton Mining Lease

□ New Lenton Mining Lease

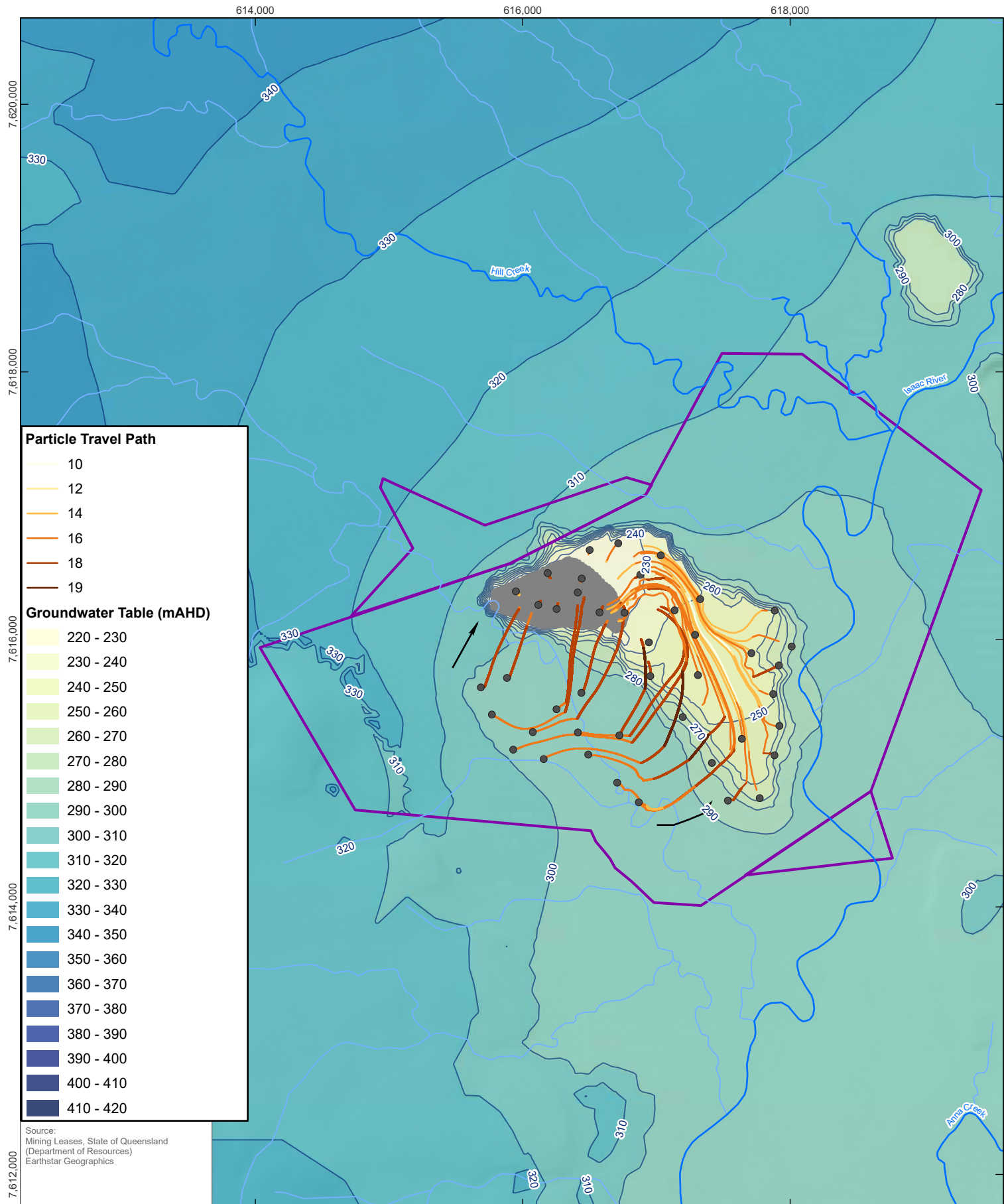
**NEW LENTON PER
IESC RESPONSE
GROUNDWATER**

**PARTICLE STARTING LOCATIONS
(NEW LENTON MINE)**



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FIGURE 2-36



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:37,500 at A4

Project Number: 620.31367.00000

Date Drawn: 20-Aug-2024

Drawn by: RB

LEGEND

- Particle Starting Location
- Arrows
- Watercourse and Drainage
- Groundwater Contour (mAHd)
- ▭ New Lenton Mining Lease
- ▭ Void Lake

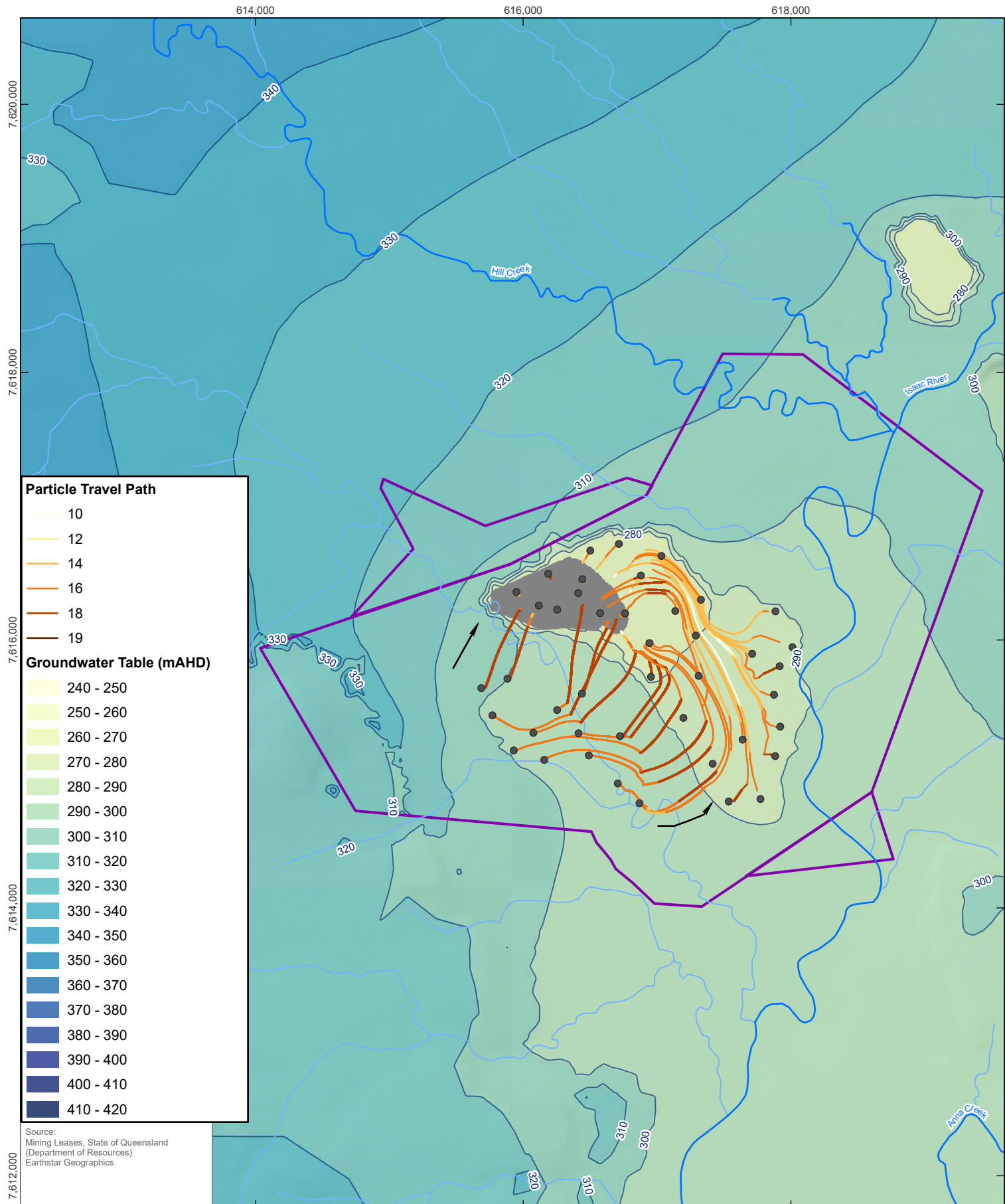
NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED MOVEMENT OF PARTICLES (BEST CASE SCENARIO)



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FIGURE 2-37



0 0.5 1 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:37,500 at A4

Project Number: 620.31367.00000

Date Drawn: 20-Aug-2024

Drawn by: RB

LEGEND

- Particle Starting Location
- Arrows
- Watercourse and Drainage
- Groundwater Contour (mAHd)
- ▭ New Lenton Mining Lease
- ▭ Void Lake

NEW LENTON PER IESC RESPONSE GROUNDWATER

PREDICTED MOVEMENT OF PARTICLES (WORST CASE SCENARIO)



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FIGURE 2-38

3.0 Summary and Conclusions

In response to IESC comment 4f of the New Lenton Project PER's groundwater assessment, additional climate scenario groundwater modelling has been undertaken to assess the effect of climate change on post-mining groundwater predictions.

The existing numerical model reported in the PER was adopted for consideration of climate change in the post-mining model predictions. No changes to the previously reported model were made other than the simulation of additional transient post-mining recovery model scenarios, whereby the time-variant CHD conditions applied to the residual voids were updated to reflect the predicted void lake levels from the PER's existing void water balance modelling (WRM, 2023). Two additional climate scenarios were modelled, being the 'best case' and 'worst case' climate scenarios previously reported the PER's void water balance prepared by WRM (2023).

Results indicate:

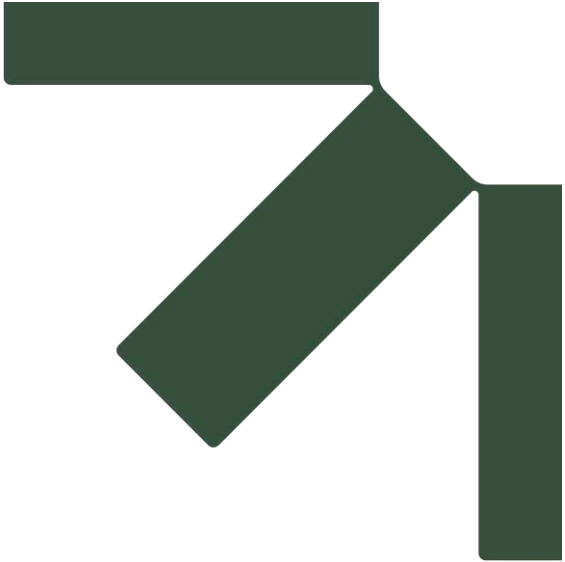
- Lake water levels in the residual void recover at a similar rate for the three climate scenarios, reaching equilibrium conditions after approximately 300 years.
- Equilibrium lake water levels vary by an approximate 46 m range across the climate scenarios, and are very similar between the 'worst case' scenario and the base case reported in the PER such that minimal difference in groundwater model outputs would be expected between these two scenarios. The 'best case' scenario results in void lake levels approximately 46 m below the levels predicted in the 'worst case' scenario.
- Total groundwater inflow volumes to the residual void in the two climate extremes vary over a range of less than 6% of the base case groundwater inflows reported in the PER, considered very small. That is, the climate extremes do not result in a significant change in predicted groundwater inflow volumes to the residual void.
- Predicted groundwater levels and residual drawdown in all aquifers are almost identical between the 'worst case' scenario and the base case reported in the PER, which is to be expected given the very similar void lake levels in these scenarios. Very minor additional drawdown is predicted for the 'best case' scenario, driven by the lower void lake levels under that scenario. The additional drawdown is unlikely to result in a meaningful change in impact assessment outcomes.
- The climate extremes do not result in a significant change in predicted groundwater flux associated with alluvium or the Isaac River. That is, any change in alluvium or River water quantity impacts resulting from the climate extremes is negligible compared to the base case reported in the PER.
- Particle tracking simulations show no change in the predicted fate of groundwater movement in the final landform under the climate extremes compared to the base case reported in the PER. That is, all groundwater emanating from the landform continues to be captured by the final void.



4.0 References

- CSIRO, 2020. Greenhouse gas scenarios (Representative Concentration Pathways - RCPs).
<https://www.climatechangeinaustralia.gov.au/en/changing-climate/future-climate-scenarios/greenhouse-gas-scenarios/>
- SLR, 2024. New Lenton & Burton Groundwater Modelling Technical Report. Report prepared for Lenton Joint Venture. Report reference: 620.31367.00000-R02-v6.0.
- WRM, 2023. New Lenton Coal Project, Surface Water and Flood Impact Assessment for Bowen Coking Coal Ltd, Report 1927-01-B3, November 2023.





Appendix G

Groundwater Monitoring and Management Plan

New Lenton Coal Project

PER Groundwater Assessment

Lenton Joint Venture



New Lenton Coal Project

Groundwater Monitoring and Management Plan

Lenton Joint Venture

GPO Box 1465, Brisbane 4000

Prepared by: Jade Darvell

SLR Consulting Australia

SLR Project No.: 620.040892.00001

2 October 2024

Revision: 3.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
3.0	2 October 2024	Jade Darvell	Derwin Lyons	Jade Darvell
3.0	1 October 2024	Jade Darvell	Derwin Lyons	Jade Darvell
1.0	20 September 2024	Jade Darvell	Derwin Lyons	Jade Darvell

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Lenton Joint Venture (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.



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Appendices

Appendix A	Groundwater Compliance 2024 Updated Limit and Trigger Development
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1.0 Introduction

1.1 Overview

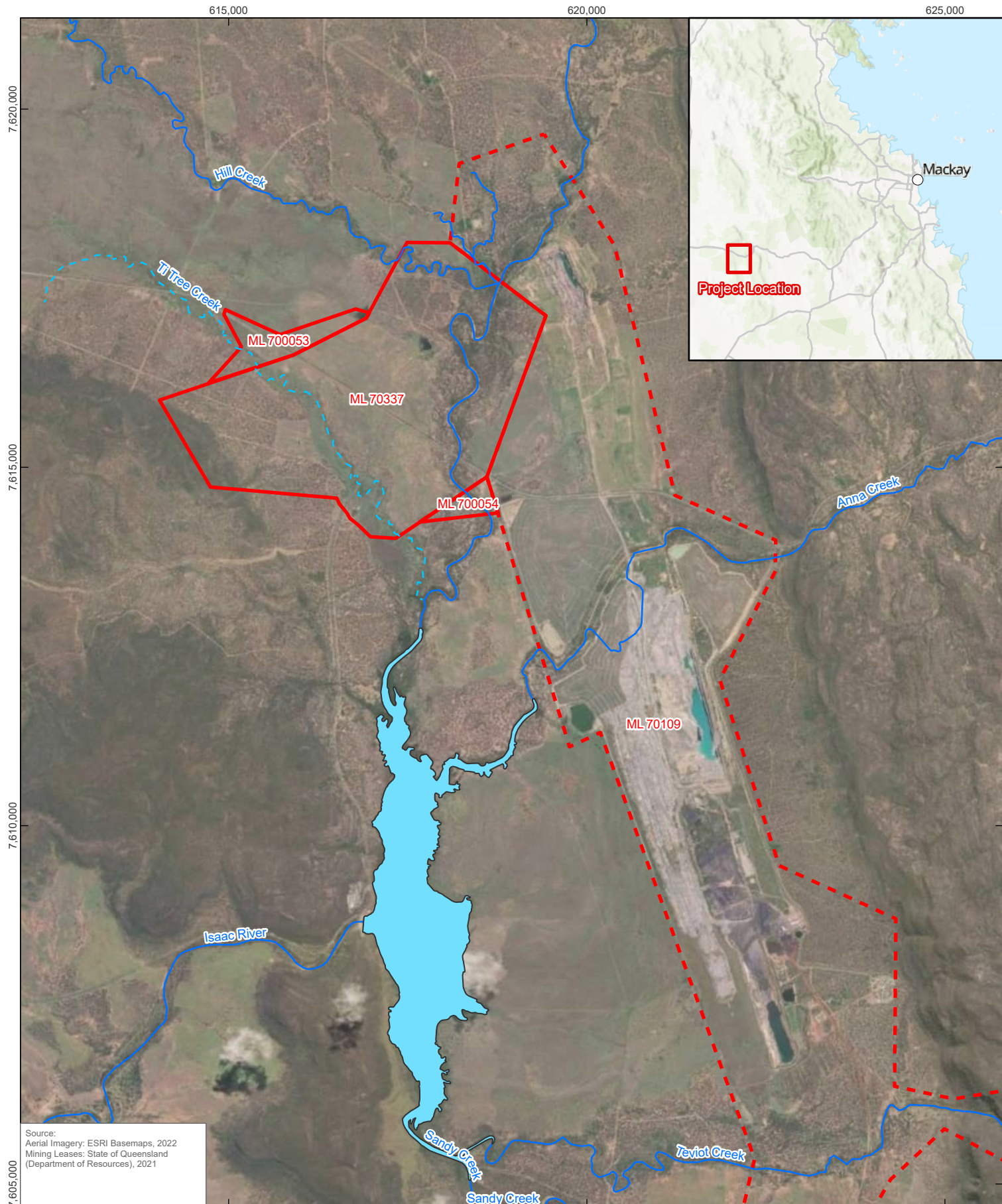
SLR Consulting Australia Pty Ltd (SLR) has been engaged by the Lenton Joint Venture (LJV) to develop and update Groundwater Monitoring and Management Plan (GMMP) for the New Lenton Coal Project (New Lenton; the Project). This GMMP is intended to support a number of environmental approvals related to groundwater at the Project, including the Associated Water License (AWL), the Project Environmental Authority (EA), approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and Progressive Rehabilitation and Closure Plan (PRCP) conditions once approved.

This GMMP has been prepared to monitor and manage the potential impacts on groundwater at and surrounding the Project. It outlines the groundwater monitoring plan for the Project and associated groundwater impact limits and triggers that will invoke further assessment and groundwater impact management during the life of the Project and in the early years post-closure. This GMMP is an updated version of the Project's first GMMP prepared in 2020 (SLR, 2020), and takes into account relevant changes that have occurred since 2020 in relation to groundwater at the Project, including:

- Finalisation of the Project EA;
- Approval of the Project's PRCP; and
- Development of an updated groundwater model in support of the Project's Public Environment Report (PER) under the EPBC Act as reported in SLR (2024a).

The Project is located within the northern part of the Bowen Basin, approximately 65 km north of Moranbah and 120 km south-west of Mackay (**Figure 1-1**). The Project is to be developed on Mining Lease (ML) 70337, ML 700053 and ML 700054, with planned active mining between January 2025 and December 2040. The current EA (EPML00475513) allows the Project to operate at the rate of two million tonnes per annum (Mtpa) Run-of-Mine (RoM) coal extraction. The LJV owns the adjacent Burton Mine on ML 70109 and ML 70260. Bowen Coking Coal (BCC) acquired the New Hope Group's (NHG's) share of the LJV in July 2022 and along with taking over the New Lenton Project, recommenced mining operations at Burton Mine after a period of care and maintenance by the previous owners. Burton Mine is located to the south-east of the Project (**Figure 1-1**).





Source:
Aerial Imagery: ESRI Basemaps, 2022
Mining Leases: State of Queensland
(Department of Resources), 2021

 0 1 2 km
 Coordinate System: GDA2020 MGA Zone 55
 Scale: 1:70,000 at A4
 Project Number: 620.040892.00001
 Date Drawn: 11-Jul-2024
 Drawn by: RB

- LEGEND**
- Major Watercourse
 - - - Non-designated Watercourse
 - Project Area
 - Burton Mining Lease
 - Burton Gorge Dam

NEW LENTON COAL PROJECT GROUNDWATER MONITORING AND MANAGEMENT PLAN

PROJECT LOCATION



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FIGURE 1-1

1.2 Relevant Conditions and Requirements

The relevant conditions and requirements as they relate to the GMMP for the Projects EA, AWL and PRCP, and where they are addressed in this GMMP, are detailed in **Table 1-1**.

Table 1-1 Project Conditions and Requirements relevant to this GMMP

Approval	Condition Number	Details and relevant section(s) of this report
EA	D1	The holder of this environmental authority must not release contaminants, directly or indirectly, to groundwater. Refer Sections 7.1.3 and 7.1.4.
EA	D2	Baseline Monitoring Program A baseline groundwater monitoring program must be developed and implemented by a suitably qualified person(s) and be provided to the administering authority. The baseline groundwater monitoring program must result in the holder of this environmental authority finalising the program that must be provided to the administering authority at least ninety (90) days prior to commencement of mining activities including construction. The baseline groundwater monitoring program must: (a) Continue until the Groundwater Monitoring and Management Program (GMMP) required under Condition D14 commences (refer Section 5.3). (b) contain representative groundwater quality samples from the geological units identified as potentially affected by mining activities (refer Appendix A); (c) include at least twelve (12) sampling events that are no more than two (2) months apart over a two (2) year period, so as to determine background groundwater quality (refer Appendix A); (d) conceptual model used to determine the location of ground water bores (refer Section 5.2); (e) include background groundwater quality in hydraulically isolated background bore(s) (refer Appendix A); (f) Allow for the identification of natural groundwater level trends and groundwater contaminant trigger levels (refer Appendix A and Section 7.1.3); (g) Identify groundwater water level trigger limits as per Table D3 Groundwater level monitoring (refer Section 7.1.1 and 7.1.2); (h) Complete an investigation to demonstrate that groundwater drawdown resulting from the activity will not impact environmental values including but not limited to Groundwater Dependent Ecosystems (GDEs) (refer Section 4.2.2, 4.2.3 and 4.2.4). (i) Proposed mitigation and monitoring measures to ensure the activity will not impact environmental values (refer Sections 7.2, 4.2.3 and 5.0). (j) How impacts to prescribed environmental matters have been or will be avoided as a result of the disturbance with the installation of proposed bores (refer Section 8.4).



Approval	Condition Number	Details and relevant section(s) of this report
EA	D3	Groundwater quality and levels must be monitored at the locations and frequencies defined in Table – D1 Groundwater monitoring locations and frequency and Appendix 5 – Groundwater Monitoring Locations for quality characteristics identified in Table D2 – Groundwater quality limits. Groundwater monitoring must commence prior to the commencement of mining activities (including construction activities, excluding exploration activities). This EA must be amended to populate all missing / TBA monitoring locations and values within Table D1 – Groundwater monitoring locations and frequency and Table D3 – Groundwater level monitoring prior to commencement of mining activities (including construction activities, excluding exploration activities). Refer Table 5-1, Sections 5.3.1 and 5.3.2.
EA	D4	Results of monitoring of groundwater from water quality compliance bores identified in Table D1 -Groundwater monitoring locations and frequency, must not exceed any of the Contaminant Limits specified in Table D2 - Groundwater quality limits on three (3) consecutive occasions. Refer Table 5-1, Table 7-3 and Section 7.1.4.
EA	D5	Groundwater levels when measured at the water level compliance bores specified in Table D1 -Groundwater monitoring locations and frequency must not exceed the groundwater Level Trigger Thresholds specified in Table D3 - Groundwater level monitoring. The current Level trigger thresholds included in Table D3 Groundwater level monitoring must be amended to the actual trigger level thresholds prior to the commencement of mining (including construction activities, excluding exploration activities). Refer Table 5-1, Table 7-2 and Section 7.1.4.
EA	D6	Pre-mining groundwater baseline level to be provided through an amendment application prior to the commencement of mining activities (Table D3 – Groundwater level monitoring). Refer Table 7-1.
EA	D7	The environmental authority holder must notify the administering authority within twenty-four (24) hours via WaTERS of receiving any monitoring result that shows an exceedance of any limit for any quality characteristic specified in Table D2 – Groundwater Quality Limits and any exceeded Groundwater Level Trigger Threshold specified in Table D3 – Groundwater level monitoring. For condition D7, an exceedance is when a limit for any quality characteristic specified in Table D2 – Groundwater quality limits is exceeded on any three (3) consecutive sampling occasions. Refer Section 7.1.4.
EA	D8	Within fourteen (14) days of the notification given under condition D7, the environmental authority holder must commence an investigation to determine if the exceedance is a result of: (a) mining activities authorised under this environmental authority; or (b) natural variation; or (c) neighbouring land use resulting in groundwater impacts. Refer Section 7.1.4.



Approval	Condition Number	Details and relevant section(s) of this report
EA	D9	The investigation required by condition D8 must be completed and submitted to the administering authority via WaTERS within three (3) months of notification under condition D7. Refer Section 7.1.4.
EA	D10	If the investigation under condition D8 determines that the exceedance was the result of mining authorised under this environmental authority, then investigations must be undertaken by the holder of this environmental authority to establish whether environmental harm has occurred or may occur. Refer Section 7.1.4.
EA	D11	Within twenty-eight (28) days of the investigation under D10, the environmental authority holder must have: (a) implemented short-term measures to mitigate the potential for environmental harm; and (b) develop long-term mitigation measures to address any existing groundwater contamination and prevent recurrence of groundwater contamination; and (c) if environmental harm has occurred as a result of groundwater drawdown exceedances, the environmental authority holder must: (i) determine any actions required to reduce the potential for environmental harm; and (ii) determine any mitigation measures required to limit the drawdown in the affected groundwater resource. Refer Section 7.1.4.
EA	D12	The construction, maintenance and management of groundwater bores (including groundwater monitoring bores) must be undertaken in a manner that prevents or minimises impacts to the environment and ensures the integrity of the bores to obtain accurate monitoring. Refer Section 8.4.
EA	D13	All determinations of groundwater quality and biological monitoring must be performed by a suitably qualified person(s). Refer Sections 6.1.5 and 6.1.1.
EA	D14	Groundwater Monitoring and Management Program A Groundwater Monitoring and Management Program (GMMP) must be developed (this GMMP report), implemented and provided to the administering authority at least ninety (90) days prior to commencement of mining activities including construction (excluding exploration and ecological monitoring activities). The GMMP will: (a) Identify all potential sources of contamination to groundwater from construction, mining activities and rehabilitation activities (refer Appendix A); (b) Provide a hydrogeological conceptual groundwater model (refer Section 3.0); and (c) Identify all environmental values that must be protected (refer Section 3.3); (d) Detail groundwater levels in all identified aquifers present across and adjacent to the site to confirm existing groundwater flow paths (refer Appendix A);



Approval	Condition Number	Details and relevant section(s) of this report
		(e) Estimate the groundwater inflow to rehabilitated landforms and surface water ingress to groundwater from flooding events using the groundwater model (refer Section 4.2.2); (f) Ensure all potential groundwater impacts due to mining activities and rehabilitation activities are identified, monitored and mitigated (refer Sections 4.0 and 7.2); (g) Ensure adequate groundwater monitoring and data analysis is undertaken to achieve the following objectives: (i) Detect any impacts to groundwater level due to the mining activities and rehabilitation activities (refer Sections 7.1.1, 7.1.2 and 7.1.4); (ii) Detect any impacts to groundwater quality due to the mining activities and rehabilitation activities (refer Section 7.1.3 and 7.1.4); (iii) Determine compliance with Groundwater Quality Limits and Level Trigger Thresholds (refer Sections 7.1.4 and 8.1); and (iv) Determine trends in groundwater quality (refer Section 8.1); (h) Document groundwater management and monitoring methodologies undertaken for the duration of all mining activities and rehabilitation activities (refer Section 5.3, 6.0 and 8.0); (i) Provide an appropriate quality assurance and quality control program (refer Section 6.0); and (j) Include a review process to identify improvements to the program that includes addressing any comments provided by the administering authority (refer Section 8.2).
EA	D15	An Annual Groundwater Monitoring Report (AGMR) is required to be completed and submitted to the administering authority commencing after the first year of mining activities (excluding exploration activities). The AGMR must include: (a) the groundwater quality and standing water level of all groundwater bores listed within Table D1 - Groundwater monitoring locations and frequency (b) an assessment of long-term water quality and water level trends at all groundwater bores listed in Table D1 - Groundwater monitoring locations and frequency; (c) details of any review undertaken of the groundwater conceptual model; (d) an assessment of any differences between the groundwater level impact predicted and actual impacts for corresponding period. Refer Section 8.1.
EA	D16	The following information must be recorded in relation to all groundwater water sampling: (a) the date on which the sample was taken; (b) the time at which the sample was taken; (c) the monitoring point at which the sample was taken; and (d) the results of all monitoring; and (e) submit all groundwater monitoring data required by this environmental authority or related to environmental management activities to the administering authority via WaTERS. Refer Section 6.1.5 and 6.1.8.
PRCP	PRCP6	Monitoring and maintenance must be carried out in accordance with:



Approval	Condition Number	Details and relevant section(s) of this report
		i. the monitoring and maintenance program described in the rehabilitation planning part relating to this PRCP schedule; and ii. any requirement under this PRCP schedule. Refer Section 5.4.
PRCP	PRCP7	The holder must keep records in relation to relevant matters for a minimum of five years and provide such records to the administering authority on request. Relevant matters for this condition include, but are not necessarily limited to, the following: i. Rehabilitation activities and the results of these activities ii. Maintenance activities and the results of maintenance activities iii. Monitoring activities and the results of monitoring iv. Designs, drawings, specifications or any similar documents required under the PRCP schedule v. Certifications, assessments, investigations, inspections, audits or any similar processes carried out in relation to rehabilitation milestones or milestone criteria. Refer Section 6.1.8.2.
PRCP	RM8	k. For a minimum of five (5) consecutive years groundwater quality must be monitored quarterly at, but not limited to, compliance bores specified in Attachment 6 'Groundwater monitoring locations and frequency', for all quality characteristics listed in Attachment 7 'Groundwater quality limits'. l. Groundwater quality results must not exceed the limits in Attachment 7 'Groundwater quality limits', for 3 consecutive results. Groundwater level is monitored quarterly and all results comply with Level Trigger Thresholds outlined in Attachment 8 'Groundwater level monitoring' for 10 consecutive years. Refer Sections 5.4 and 7.1.4.
AWL	41	The approved Underground Water Monitoring Program as at the date of this licence is the document titled "New Lenton Project - Groundwater Monitoring and Mitigation Plan" prepared by SLR Consulting for Lenton Management and Marketing Pty Ltd dated July 2020. Refer Section 1.0, noting that this GMMP report supersedes that developed by SLR (2020).
AWL	42	The licensee must, through an appropriately qualified person, undertake monitoring in accordance with the relevant approved Underground Water Monitoring Program. Underground water levels in the monitoring bores are to be measured on a daily frequency. Refer Sections 5.3.1 and 5.3.2.
AWL	43	Revisions to the approved Underground Water Monitoring Program must be undertaken by an appropriately qualified person, and submitted to the chief executive for approval. An approved officer of the Department must, following receipt of a proposed revision to the approved Underground Water Monitoring Program, advise the licensee in writing of: (a) approval of the revised or amended Underground Water Monitoring Program; or (b) why the revised or amended program is considered inadequate and how it must be modified in order to be approved.



Approval	Condition Number	Details and relevant section(s) of this report
		Refer Section 8.2.
AWL	44	An approved officer of the Department may direct the licensee to make amendments to an approved Underground Water Monitoring Program, including (without limitation), installing additional monitoring bores, if the approved officer of the Department is reasonably satisfied that the existing approved Underground Water Monitoring Program is no longer meeting the objectives of an Underground Water Monitoring Program. If the licensee receives a notice under this condition, the licensee must, through an appropriately qualified person, make the required amendments and submit the amended program to the chief executive for approval under Condition 43. Refer Section 8.2.
AWL	45	The licensee must publish water level monitoring data required to be collected under the approved Underground Water Monitoring Program within 10 business days from measurement. Data must remain published and publicly available. Refer Section 6.1.8.1.
AWL	47	The licensee must provide an Annual Monitoring Report to the chief executive. Each Annual Monitoring Report must include: (a) the underground water levels in the monitoring bores identified in the approved Underground Water Monitoring Program; (b) maps showing the actual water level drawdown contours for each aquifer; (c) details of the numerical underground water model and any review undertaken of the numerical underground water model since the previous Annual Monitoring Report; (d) an assessment of any differences between the actual water level impact and the impact predicted for the same period by the numerical underground water model; (e) details of any bores which are predicted by the numerical underground water model to be located in the affected area; and (f) raw data provided in a format as requested by the chief executive. Refer Section 8.1.
AWL	48	The first Annual Monitoring Report must be provided to the chief executive within three months of the end of the first water year, and subsequent Annual Monitoring Reports must be provided to the chief executive within three months of the end of each relevant water year. Refer Section 8.1.



2.0 Site Setting

2.1 Location and Topography

The Project is located in the Bowen Basin, a geological basin spanning an extent of approximately 200,000 km² and one of five major foreland sedimentary basins formed along the eastern side of Australia during the Permian period. The Project Area is surrounded by escarpments, including the Burton Range to the southwest, the Kerlong Range to the east and the Denham Range to the north.

2.2 Climate

The climate of the Project area is sub-humid/sub-tropical, with a distinct wet and dry season. Historical climate data was obtained for the period January 1900 to September 2024 from the SILO database (for the grid point latitude -21.5, longitude 148.15). The total average annual rainfall is 630 mm, with higher rainfall occurring over the summer months, from December to March. Evaporation exceeds rainfall in all months of the year, with the average annual evaporation of 1,934 mm exceeding average annual rainfall by over three times.

In order to place rainfall over the years into an historical context and also provide context for potential climate driven groundwater system variability, cumulative rainfall departure (CRD) was calculated for the full data period (**Figure 2-1**). This is a summation of the monthly departures of rainfall from the long-term average monthly rainfall. A rising slope in the CRD plot indicates periods of rainfall above the long term average, as is the case from January 2016 to June 2017, whereas a falling slope indicates periods when rainfall is below the long-term average (e.g. June 2017 to May 2021). Rainfall volumes over the more recent period of the record (i.e. May 2021 to September 2024) have been higher than average, as is indicated by the rising slope in the CRD (**Figure 2-1**).



Figure 2-1 Cumulative Rainfall Departure and Total Monthly Rainfall



3.0 Hydrogeological Setting

The hydrogeological setting at the Project is summarised below for relevance to this GMMP and is based on that reported in the most recent hydrogeological study for the project, being the PER Groundwater Assessment (SLR, 2024a).

3.1 Hydrogeological Units

The surface geology and underlying solid geology at the Project are shown on **Figure 3-1** and **Figure 3-2**, respectively. The following presents a summary discussion of the hydrogeological characteristics of the local geology, with the purpose of describing the groundwater bearing units relevant to this GMMP.

3.1.1 Alluvium and Regolith

The Quaternary floodplain alluvium associated with surface watercourses (Isaac River, and its tributaries including Hill Creek and other smaller unnamed tributaries) is comprised of clay, silt, sand, and gravel sediments. The thickness of the alluvium is greater close to the Isaac River channel and decreases with distance from the river. There is significant lithological heterogeneity in the alluvium with nearby bores exhibiting variations in lithology with depth.

Several Project groundwater bores installed into the Quaternary alluvium are dry, indicating the alluvium is unsaturated and does not form an aquifer at these locations. Where groundwater is present in the basal alluvium closer to the Isaac River main channel however, groundwater levels in the alluvium are relatively flat, with flow generally towards and coincident with the Isaac River surface flow direction. Where it occurs, groundwater within the basal alluvium is recorded at depths of around 8 to 11 mBGL, typically significantly disconnected from the streambed elevation. Immediately below and adjacent the Isaac River channel and banks, limited seasonally recharged perched water is present around 5 m above the groundwater in the basal alluvium/regolith (around 1 to 4 mBGL).

The regolith is mainly comprised of shallow Tertiary to Quaternary age colluvium and residual soils, derived from weathered underlying Triassic and Permian bedrock strata. The depth of weathering is variable, ranging from 10 m to 50 mBGL, with an average of approximately 25 mBGL. The regolith has been identified as hosting groundwater at various locations across the Study Area. The inferred groundwater flow direction in the regolith, where present and saturated, is expected to follow topography, and has the potential to interact with groundwater within the alluvium where present along drainage alignments and rivers.

Losing streamflow conditions from the Isaac River to the underlying alluvium and regolith are evident during flow periods and recharge to shallow groundwater is considered to be primarily from streamflow or flooding, with direct infiltration of rainfall also occurring rapidly where there are no substantial clay barriers in the shallow sub surface. Perching of recharged water inhibits the downwards migration of recharged water to the basal alluvium aquifer. Discharge of shallow groundwater occurs primarily via evapotranspiration, including from Terrestrial GDEs that access the seasonally variable perched water table but not the deeper basal alluvial groundwater.

3.1.2 Basalt

Minor occurrences of Tertiary age basalts are found sporadically to the northwest of the Project. Given the limited extent and discontinuity of this unit likely offers limited aquifer potential and has not been identified as a hydrostratigraphic unit of significance to the GMMP development.



3.1.3 Triassic Aged Strata

Triassic age strata near the to the Project consists of the Moolayember Clematis Group, and the Rewan Formation.

The Moolayember Formation, where it exists outside the Project Area, overlies the Clematis Group and is generally considered a regional scale aquitard within the Bowen Basin. The Clematis Group is generally considered a major aquifer particularly for the sandstones within the unit, although its presence within ML 70337 is isolated and disconnected from the major regional occurrence of the Clematis Group aquifer. Both the Moolayember Formation and Clematis Group have been significantly eroded, such that the Moolayember Formation is absent from within the Project Area itself and the Clematis Group is only present across a limited section of ML 70337 to the west of the Burton Range Fault. As such, neither unit is considered a significant hydrostratigraphic unit in the context of the GMMP development.

The Rewan Formation, which overlies the Permian age Rangal Coal Measures, dominates a significant outcrop area across the Project. The Rewan Formation is generally considered a major regional scale aquitard within the Bowen Basin, limiting groundwater connectivity between the underlying Permian coal measures and any overlying shallower groundwater systems where it occurs. There is limited groundwater occurrence within the Rewan Formation itself, associated mainly with localised fracturing and weathered horizons.

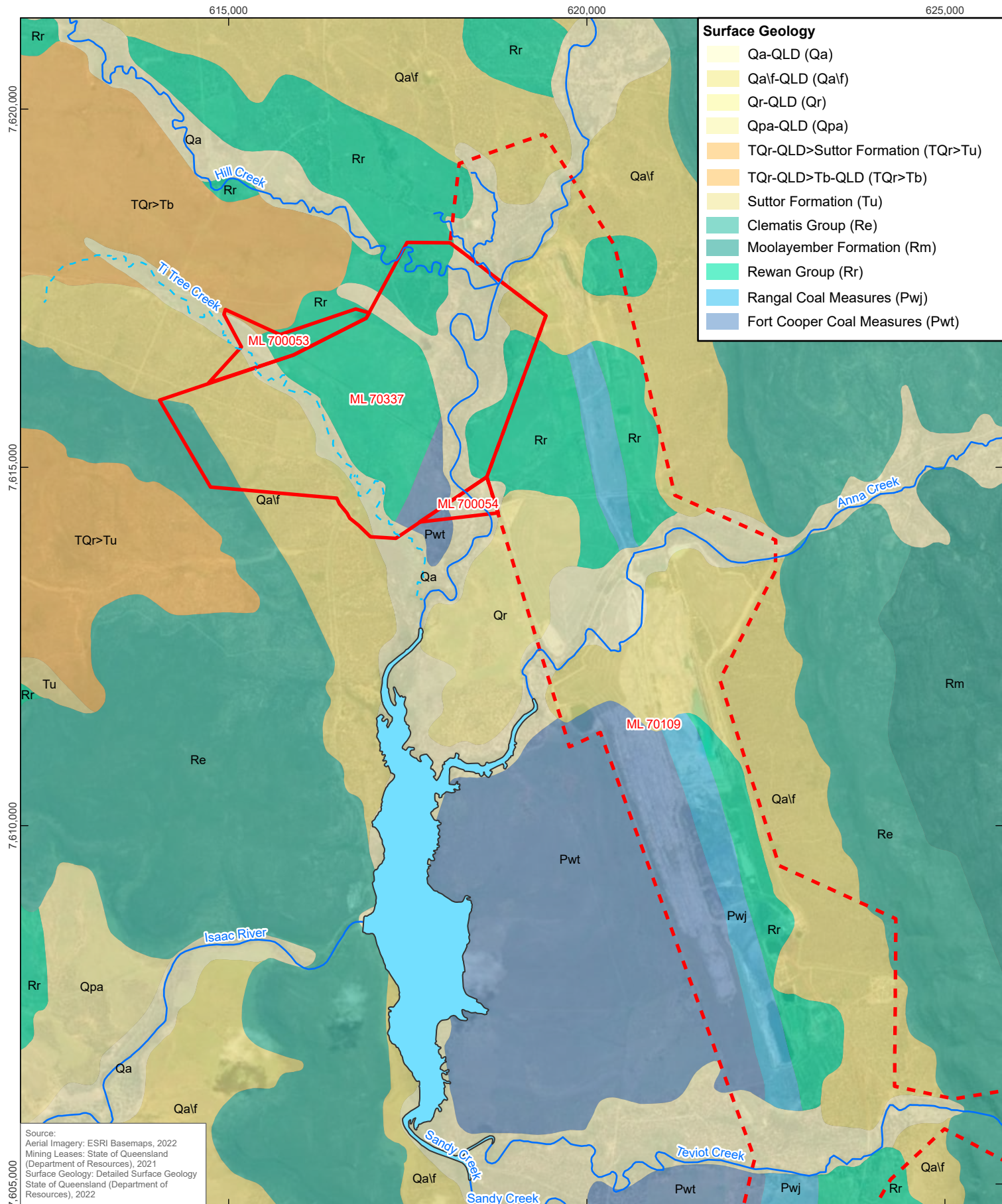
3.1.4 Permian Coal Measures

The Permian Coal Measures are composed of interbedded sequences of sandstone, siltstone, and coal. Groundwater is encountered in both the coal seams and in the lower permeability interburden units. The coal seams within the Rangal Coal Measures are typically considered the main aquifer units of the Permian Coal Measures and may be significantly more permeable than the interburden material of interbedded mudstone, siltstone, and sandstone. The main coal seams present at the Project are the Burton Rider seam and the deeper Leichhardt / Vermont coal seams. The coal seams are classified as a dual-porosity, dual-permeability medium with water stored and transmitted through both the primary matrix porosity and secondary fracture porosity. The adjoining sandstone and siltstone interbeds act as low hydraulic conductivity confining units. Groundwater within these coal measures is considered confined and sub-artesian.

Recharge to the coal measures occurs where the coal seams outcrop or subcrop beneath the alluvium or regolith. The interburden material (sandstone and siltstone) typically has a low vertical hydraulic conductivity and limits the downward vertical movement of water. When groundwater levels are locally reduced in the coal seams due to seepage inflow to mining pits, these interburden units will provide a source of water by vertical leakage into the depressurised coal seams. Discharge from this unit is dominated by evaporation and groundwater extraction from mining activities at the neighbouring Burton Mine.

Regionally groundwater levels in the Permian coal seams correlate with ground surface elevations (GHD, 2019; SLR, 2024a), with groundwater flow dominantly horizontal through the coal seams themselves following the regional topography, but locally influenced by existing mining at the Burton Mine.





Source:
Aerial Imagery: ESRI Basemaps, 2022
Mining Leases: State of Queensland
(Department of Resources), 2021
Surface Geology: Detailed Surface Geology
State of Queensland (Department of
Resources), 2022

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:70,000 at A4
Project Number: 620.040892.00001
Date Drawn: 19-Jul-2024
Drawn by: RB

LEGEND

- Major Watercourse
- - - Non-designated Watercourse
- Project Area
- Burton Mining Lease
- Burton Gorge Dam

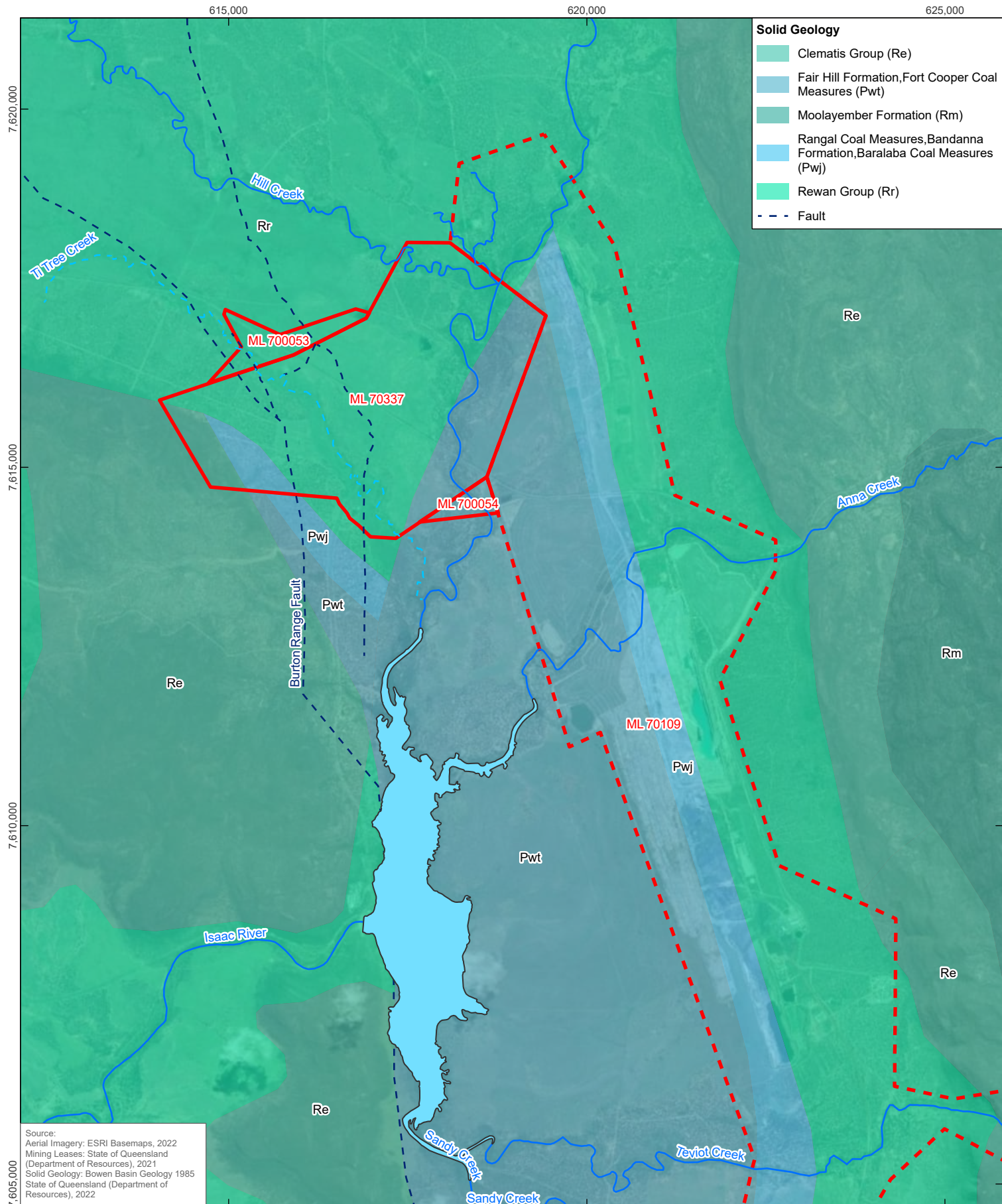
NEW LENTON COAL PROJECT GROUNDWATER MONITORING AND MANAGEMENT PLAN

SURFACE GEOLOGY



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FIGURE 3-1



Source:
 Aerial Imagery: ESRI Basemaps, 2022
 Mining Leases: State of Queensland
 (Department of Resources), 2021
 Solid Geology: Bowen Basin Geology 1985
 State of Queensland (Department of
 Resources), 2022

 0 1 2 km

Coordinate System: GDA2020 MGA Zone 55

Scale: 1:70,000 at A4

Project Number: 620.040892.00001

Date Drawn: 11-Jul-2024

Drawn by: RB

LEGEND

-  Major Watercourse
-  Non-designated Watercourse
-  Project Area
-  Burton Mining Lease
-  Burton Gorge Dam

NEW LENTON COAL PROJECT GROUNDWATER MONITORING AND MANAGEMENT PLAN

SOLID GEOLOGY



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FIGURE 3-2

3.2 Groundwater Receptors

3.2.1 Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is a natural ecosystem that requires “access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services” (Richardson, S., et al., 2011).

The BoM’s National Atlas of Groundwater Dependent Ecosystems (GDE Atlas) (BoM, 2017) indicates areas with possible low, moderate and high potential for groundwater interaction occur in the vicinity of the Project. A local GDE field assessment was completed by 3D Environmental in 2023 with the aim of ground-truthing the GDE Atlas mapping. The field assessment indicated that the inferred spatial extent of Terrestrial GDEs are highly confined to close to the Isaac River channel and do not extend any significant distance upstream along tributary watercourses. Previous field investigations at the Project (AARC, 2019a) have identified that groundwater does not discharge to surface water or maintain surface water pools, and as a result does not support aquatic GDEs. Recent ground-truthing along the Isaac River and its tributaries in the area of the Project (AARC, 2024) also confirmed that there was no presence of pooled water and therefore no aquatic GDEs.

The ground-truthed area of terrestrial GDEs resulting from the field assessment completed by 3D Environmental is presented on **Figure 3-3**.

It is noted that the area of field confirmed GDEs mostly conforms with the GDE Atlas mapping of high potential GDEs, and therefore the GDE Atlas mapping of those high potential GDEs can provide an identification of GDE areas outside the area surveyed by 3D Environmental (2023). It is also noted however, that at the Isaac River tributary area (where Hill Creek and smaller unnamed creeks meet the Isaac River), where BoM GDE Atlas shows mapping of high potential GDEs, the 3D Environmental (2023) survey indicated that these areas are not groundwater dependent i.e. not Terrestrial GDEs.

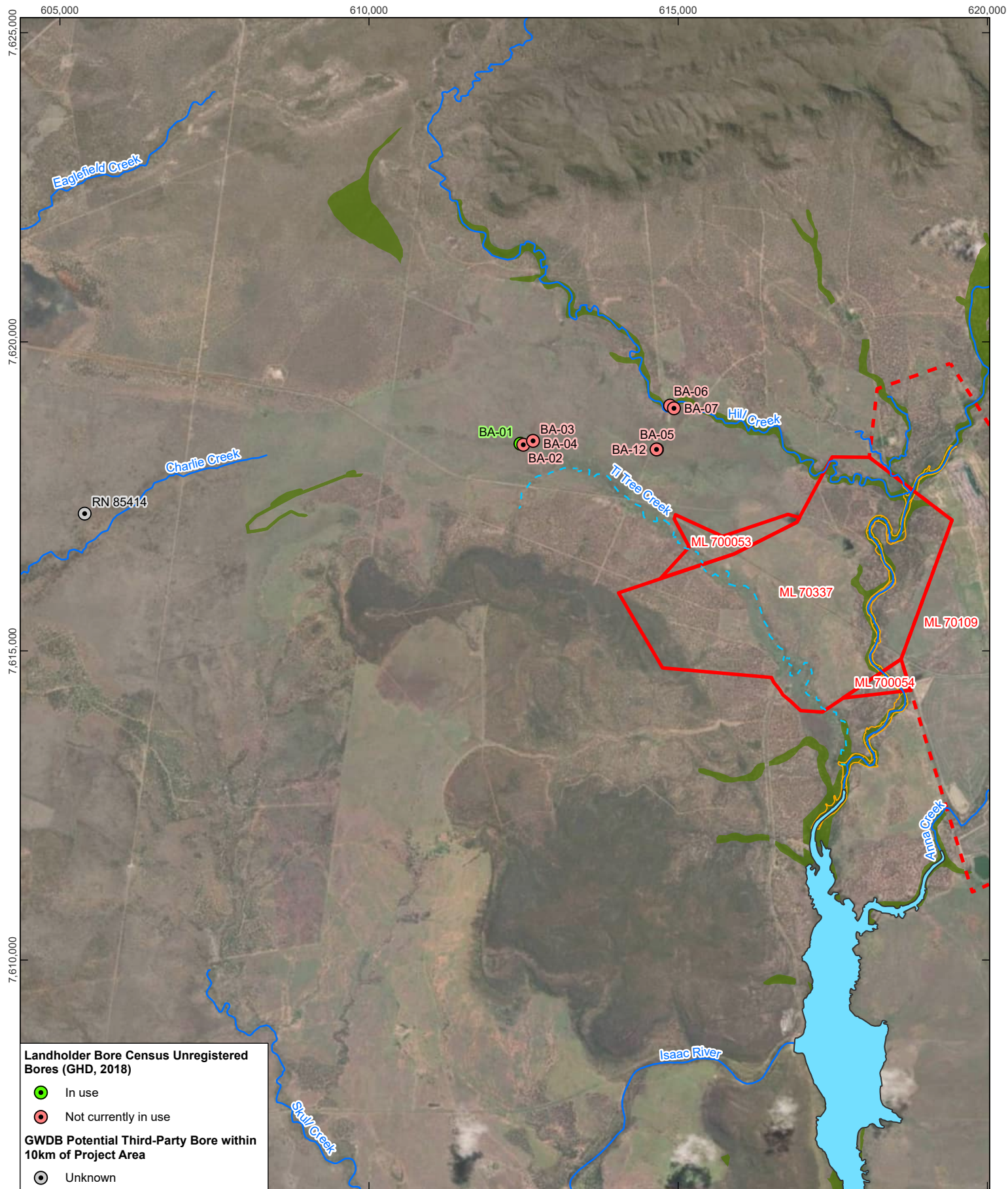
The riparian vegetation fringing the Isaac River (which was the only Terrestrial GDE identified from the 3D Environmental, 2023 ground truthing) was concluded to be supported by shallow perched alluvial water which is seasonally recharged and hydraulically disconnected from the basal alluvial groundwater system. The field assessment was completed during a wetter than average period, and the perched alluvial groundwater features may only exist temporarily, drying during extended drought periods, accelerated by evapotranspiration. In this sense, this perched, and most likely discontinuous feature is likely to be seasonal with riparian trees demonstrating facultative dependence on the resource, with a shift to utilization of soil moisture when the seasonally variable perched water is depleted (3D Environmental, 2023). The interpretation that these GDEs demonstrate facultative dependence is consistent with previous GDE field studies by AARC (2019b) which suggested that potential GDEs along the Isaac River are not solely reliant on groundwater for survival, with these vegetation communities capable of surviving on residual rainfall derived soil moisture present in unsaturated shallow soil layers.



The GDE field study by 3D Environmental (2023) also concluded that the regolith and Permian aquifers are not considered to be a suitable resource to support GDEs due to depth to groundwater being considerably deeper (>10 mBGL) than the maximum rooting depth of the vegetation present (poplar box and narrow leaf ironbark) (3D Environmental, 2023).

To detect potential impacts to the health and function of TGDEs associated with the Project a GDE Monitoring and Management Plan (GDEMMP) has been prepared for the Project (3D Environmental, 2024). This GDEMMP will provide additional baseline data to corroborate the 2023 assessment (including by establishment of four additional shallow groundwater monitoring bores targeted to assess the seasonality and persistence of the perched alluvial groundwater system which supports GDEs), as well as establish triggers for investigative actions and potential corrective actions or biodiversity offsets.





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FIGURE 3-3

3.2.2 Landholder Bores

A search of the Queensland Government's Registered Groundwater Bore Database (GWBD) (DoR, 2023) was carried out for registered bores within 10 km of the Project Area. The search returned 19 bores with registered uses as mine monitoring, petroleum exploration, and unknown (1 bore). That is, the database search identified one potential groundwater supply bore within 10 km of the Project (i.e. the bore with use listed as unknown). This bore (RN85414) is located approximately 8.7 km northeast of ML 70337, and is 27.4 m deep (**Figure 3-3**).

A landholder bore census was conducted by GHD in December 2018 for an area extending 10 km from the Project Area (GHD, 2019). The census identified eight unregistered bores (**Figure 3-1** and **Figure 3-3**). The results of the survey indicated that one of the bores was in use while the others were not currently in use. The details of these bores are provided **Table 3-1** and locations shown on **Figure 3-3**. No information is available for which aquifer the potential third party water supply bores are screened in. A comparison of available bore depths with the numerical groundwater model developed for the Project's PER (SLR, 2024a) infers that BA02, BA03, BA04 and RN85414 are screened in the regolith, while BA01 and BA05 are screened in the Triassic Strata.

Table 3-1 Unregistered groundwater bores within 10 km of the Project

Bore	Easting	Northing	Status	Depth (m)	Survey Date
BA-01	612505	7618350	In use (stock watering)	51.05	2018
BA-05	614658	7618258	Not currently in use (previously used for stock watering)	40.3	2018
BA-06	614868	7618966	Not currently in use (blocked)	Unknown	2018
BA-07	614931	7618923	Not currently in use (filled)	Unknown	2018
BA-12	614649	7618257	Not currently in use (casing and rods in hole)	Unknown	2018
BA-02	612494	7618333	Not currently in use	37.38	2018
BA-03	612652	7618396	Not currently in use	39	2018
BA-04	612652	7618396	Not currently in use	40.32	2018



3.3 Groundwater Environmental Values

The relevant Environmental Values (EVs) for the Project pertaining to groundwater are summarised in the PER Groundwater Assessment report developed by SLR (2024a) as follows.

Groundwater resources within the vicinity of the Project are scheduled under the Queensland *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (under the *Environmental Protection Act 1994*) as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310) (DEHP, 2011). The legislated Environmental Values (EVs) for these groundwaters are:

- Biological integrity of aquatic ecosystems – these occur where groundwater baseflow supports streams and water holes to some extent (e.g. seasonally or permanently).
- Human use EVs:
 - Suitability of water supply for irrigation – where groundwater is used to grow crops and pastures for commercial purposes.
 - Farm water supply/use – where groundwater is used to provide domestic supply and support growing of domestic produce.
 - Stock watering – where groundwater is used to provide stock water supplies.
 - Drinking water supply – where groundwater is used for potable water supply.
 - Primary recreation – where groundwater supports recreational use that involves direct contact and a high probability of being swallowed, e.g. diving, swimming, water skiing.
 - Cultural and spiritual values – where groundwater supports both indigenous and non-indigenous values, e.g. recreational fishing, heritage, ecology.

Earlier hydrogeological studies conducted for the Project (GHD, 2019) concluded that Irrigation, Recreation, Drinking Water and Cultural/Spiritual EV's were not relevant to the Project area and surrounds, due to lack of evidence for the presence of those EV's. The three EV's that apply to groundwater at the Project were therefore identified as:

- Biological integrity of Aquatic Ecosystems;
- Farm Supply; and
- Stock Watering.

For the Biological integrity of Aquatic Ecosystems EV, this is considered applicable only where groundwater at the Project site may interact with surface water. It should be noted however that the Project's updated conceptual hydrogeological model (SLR, 2024a) indicates that groundwater discharge to surface water does not occur, and therefore any interactions only occur through river recharge to the alluvium and through downwards seepage from the alluvium to the Permian.

3.4 Groundwater Quality

The following provides a summary of groundwater quality as is presented in the Projects conceptual hydrogeological model (SLR, 2024a).

Analysis of the baseline (pre-Project) groundwater quality dataset (available historical data for all bores between 2006 and 2023) indicates the following:



- Alluvium: Mildly acidic to moderately alkaline pH (6.3 to 8.4, averaging near neutral at 7.1) and fresh to saline water quality (517 to 16,500 $\mu\text{S/cm EC}$, averaging 5,604 $\mu\text{S/cm EC}$).
- Regolith: Mildly acidic to mildly alkaline pH (6.7 to 7.9, averaging near neutral at 7.1) and mildly brackish to saline water quality (1,549 to 12,400 $\mu\text{S/cm EC}$, averaging 9,902 $\mu\text{S/cm EC}$); and
- Permian coal seams: Mildly acidic to moderately alkaline pH (6.3 to 8.5, averaging 7.5) and mildly brackish to saline water quality (2,030 to 18,450 $\mu\text{S/cm EC}$, averaging 9,921 $\mu\text{S/cm EC}$).

With respect the above EVs/WQOs mentioned above and existing historical groundwater monitoring data, SLR (2024a) found that:

- Alluvium monitoring bore data generally suggests that alluvial groundwater from the Project Area is unsuitable for supporting the irrigation water EV with respect to fluoride, boron, iron, manganese, molybdenum or uranium. Alluvium groundwater data also generally indicates it is not suitable for supporting the aquatic ecosystems EV with respect to boron, chromium, cobalt, copper, nickel, uranium, vanadium or zinc. The 80th percentile values at the alluvial bores did not exceed any of the stock watering EV guidelines, except for EC (salinity) at GW06, suggesting that alluvial groundwater is mostly suitable for stock watering.
- Regolith monitoring bore data generally suggests that groundwater from the regolith is unsuitable supporting the irrigation water EV with respect to boron, iron, manganese or uranium. Regolith groundwater data also suggests that is generally unsuitable to support the aquatic ecosystems EV with respect to cobalt, copper, nickel, uranium or zinc. The data also suggests that regolith groundwater is generally unsuitable for supporting the stock watering EV with respect to EC (salinity).
- Groundwater quality data from the bore screened in the basalt (GW20) suggests that is it not suitable for supporting the aquatic ecosystems EV with respect to pH, cadmium and copper. The 80th percentile statistics for this bore did not exceed any of the stock watering or irrigation EV guidelines, suggesting that the basalt groundwater is suitable for supporting the stock watering and irrigation EVs.
- As with the Alluvium and Regolith, Permian monitoring bore data generally suggests that Permian groundwater at the Project Area is also unsuitable supporting the irrigation EV with respect to fluoride, boron, iron, manganese or molybdenum and the aquatic ecosystems EV with respect to pH, aluminium, arsenic, boron, cobalt, copper, molybdenum, uranium or zinc. The 80th percentile values at the Permian bores are above the stock watering EV with respect to EC (salinity) at four out of eleven bores, suggesting that Permian groundwater is suitable to support stock watering across most Permian bores, but approximately one third of Permian bores report groundwater salinities above stock tolerance levels.

Generally speaking, there is a high degree of observed variability in groundwater quality between hydrostratigraphic units, and between individual bores within individual hydrostratigraphic units. This inherent variability has been incorporated within the Project's groundwater quality impact limit and trigger derivation as reported in **Appendix A**.



4.0 Predicted Groundwater Impacts

4.1 Overview

The most recent hydrogeological impact assessment for the Project is the PER Hydrogeology Groundwater Assessment (SLR, 2024a). This most recent hydrogeological assessment included the production of an updated numerical groundwater model covering the New Lenton Project and the adjoining Burton Mine (referred to as the “New Lenton and Burton Groundwater Model” as detailed in SLR, 2024b).

This section describes the potential impacts from the New Lenton Project operations on the groundwater system, as relevant to this GMMP.

4.2 Impacts on Groundwater Levels

4.2.1 Predicted Groundwater Inflow

4.2.1.1 During Mining

Total combined predicted groundwater inflows to the New Lenton Project pits from the New Lenton and Burton numerical groundwater model (SLR, 2024b) are provided in **Figure 4-1**. As shown total groundwater inflows to the West Pit are predicted to peak in 2027 at 524 ML/year, and in 2030 at 856 ML/year in the East Pit. The total groundwater inflow to the New Lenton Project pits is predicted to reach a maximum of 1026 ML/year in 2030, coinciding with operations commencing in the East Pit; though in reality these inflows would be managed by dewatering the workings prior to the pit intersecting them. It should also be noted that these predicted inflow estimates from the model include water removed in rock material with mining, as well as water evaporated from the surface of the pit walls and floor. It is therefore an over-estimate of groundwater that could report to the site water balance or require physical management within the mine water management system.

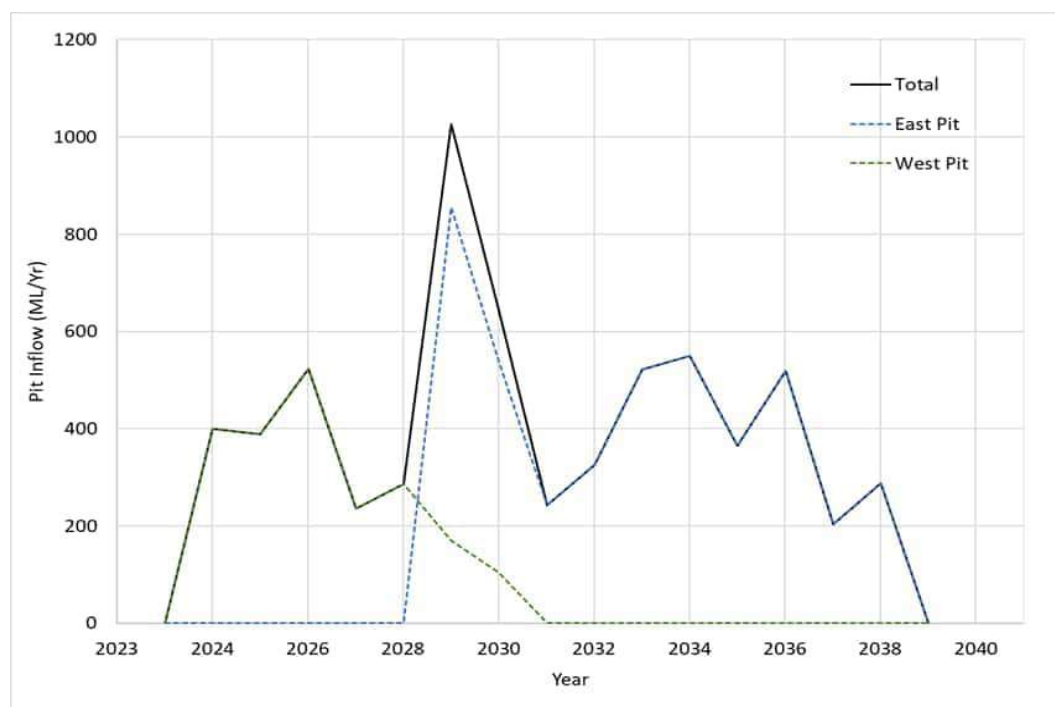


Figure 4-1 Predicted Groundwater Inflow to New Lenton Project Mine Pits During Mining



Planned mining at the Project targets the Burton Rider seam and the Leichhardt / Vermont coal seams of the Rangal Coal Measures. The dominant form of potential groundwater impact from the Project operations is groundwater level drawdown that occurs as a result of passive groundwater inflow to the active mine pit voids (i.e. associated water take). As excavation of the active mine pits proceeds below the water table within the Rangal Coal Measures, groundwater will discharge into the pits that target the Burton Rider seam and Leichhardt / Vermont seams. This passive dewatering of the Permian Coal Measures will result in the lowering of groundwater levels in the aquifer in the immediate vicinity of the New Lenton Project pit voids. Groundwater levels in the other aquifers around the site may also be affected due to induced through-flow and leakage of groundwater from these aquifers to the Permian Coal Measures. Furthermore, mine pits may also directly intersect the overlying or partially overlying units in places, and as a result, it is predicted that there may be direct groundwater level impacts to the other aquifers.

4.2.1.2 Post-Mining

In the post-mining period, ongoing groundwater inflows to the residual void are controlled by the relationship between any the established lake in the post-mining landform, which are dominantly controlled by surface water (rainfall and runoff) inputs, and the recovered groundwater levels in the surrounding aquifers. Where lakes form in the post-mining landform with hydraulic heads below the hydraulic head in the surrounding groundwater system, those lakes may have an inwards flux of water from the groundwater system (groundwater take/ sinks with respect to groundwater). Conversely, an opposite head gradient between the lakes and groundwater would result in the potential for an outwards flux of water to the groundwater system.

The numerical groundwater model (SLR, 2024b) coupled with a groundwater/surface water model for the residual voids (WRM, 2023) was used to assess the water balance associated with the voids as a means of assessing postmining groundwater fluxes. As reported in SLR (2024a) and SLR (2024b), the results indicate that net groundwater inflow rates into the East Pit Void (including that from spoil) are predicted in the long term to approximate 257.9 ML/year.

4.2.2 Predicted Groundwater Levels and Drawdown

The following outlines the key outcomes of the New Lenton numerical model as they pertain to groundwater levels and drawdown. Discussion in the following sections makes reference to the maximum incremental groundwater level drawdowns due to the proposed mining at the Project at any point during active future mining through to the end of mining. The maximum incremental drawdown is an aggregate of the maximum groundwater level drawdown values recorded at each model cell at any time during the future active mining years.

4.2.2.1 During Mining

During the life of the Project, groundwater depressurisation of aquifers due to direct take and pit inflow will lead to local drawdown of the water table and potentiometric surfaces around the Project site. Modelling predicts a steep groundwater cone of depression around the Project pit, mainly due to the low horizontal hydraulic conductivity of the units. The Project is predicted to result in long-term depressurisation of the coal seams in the vicinity of the mine.

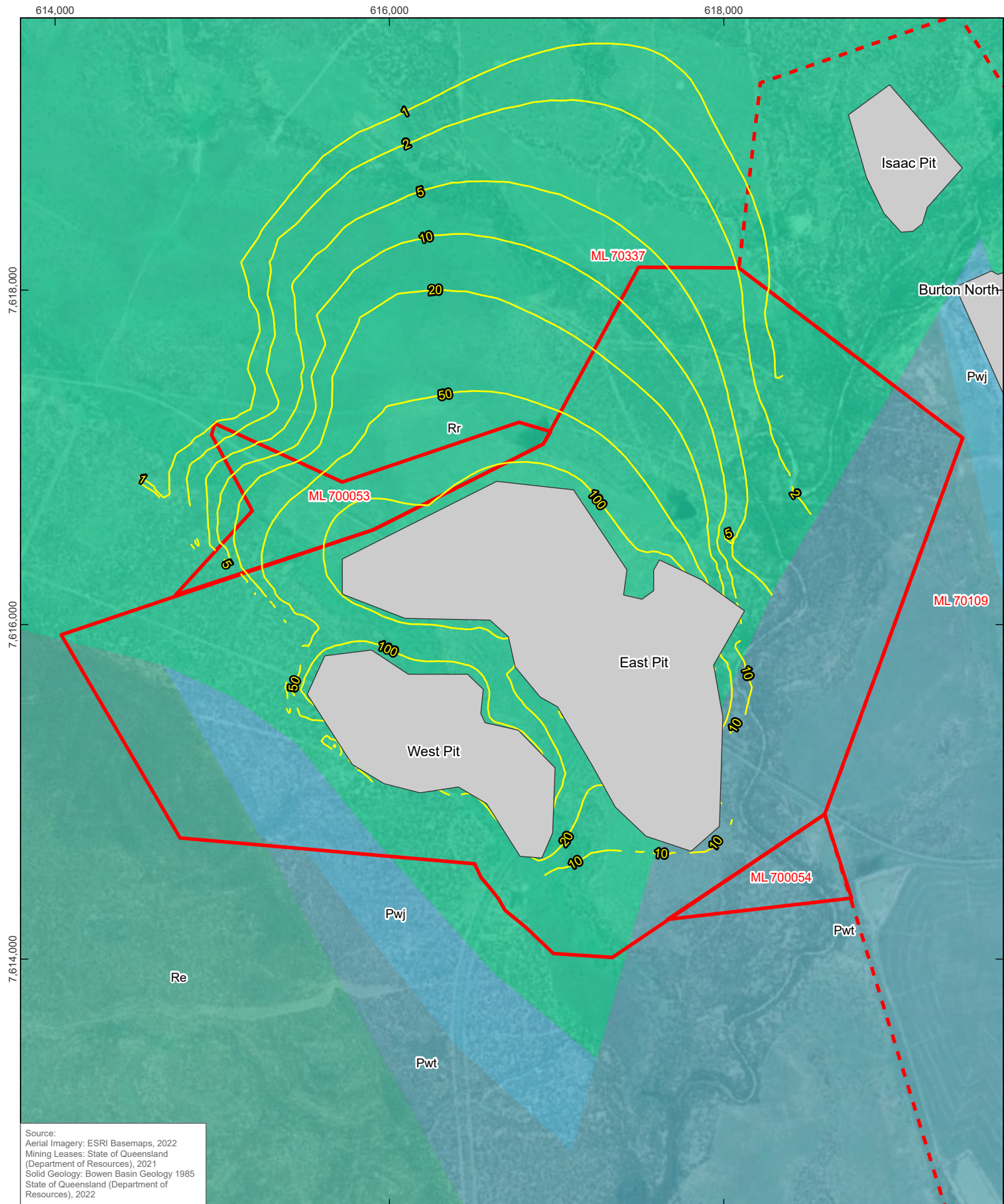
The Leichhardt / Vermont seams of the Permian Rangal Coal Measures are the lowermost target coal resource for future mining at the Project and is therefore subject to direct mining impacts, and accordingly would be expected to show the largest groundwater level impacts for all the hydrostratigraphic units at the Project and surrounds.



Predicted Project related maximum incremental drawdown contours for the Leichhardt / Vermont coal seams over the duration of the groundwater model simulation are provided in **Figure 4-2**. Predicted depressurisation of the Permian coal seams extends approximately 2.5 km to the northeast, as the Permian units sub-crop to the south and west of the Project pits and the model layers are not present.

Figure 4-3 shows that the maximum incremental drawdown predicted in the Isaac River alluvium due to proposed mining at the Project reaches up to 12 m in magnitude along the south-eastern edge of East Pit, where the Isaac River is within 150 m of the mine pit crest. Predicted drawdown of approximately 2 m in the alluvium extends 2 km downstream and 1 km upstream of East Pit at the Project.





Source:
Aerial Imagery: ESRI Basemaps, 2022
Mining Leases: State of Queensland
(Department of Resources), 2021
Solid Geology: Bowen Basin Geology 1985
State of Queensland (Department of
Resources), 2022

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:30,000 at A4
Project Number: 620.040892.00001
Date Drawn: 02-Sep-2024
Drawn by: RB

LEGEND

- Maximum Drawdown (m)
- Project Area
- Burton Mining Lease
- Mining Disturbance Area

Solid Geology

- Clematis Group (Re)
- Fair Hill Formation, Fort Cooper Coal Measures (Pwt)
- Rangal Coal Measures, Bandanna Formation, Baralaba Coal Measures (Pwj)
- Rewan Group (Rr)

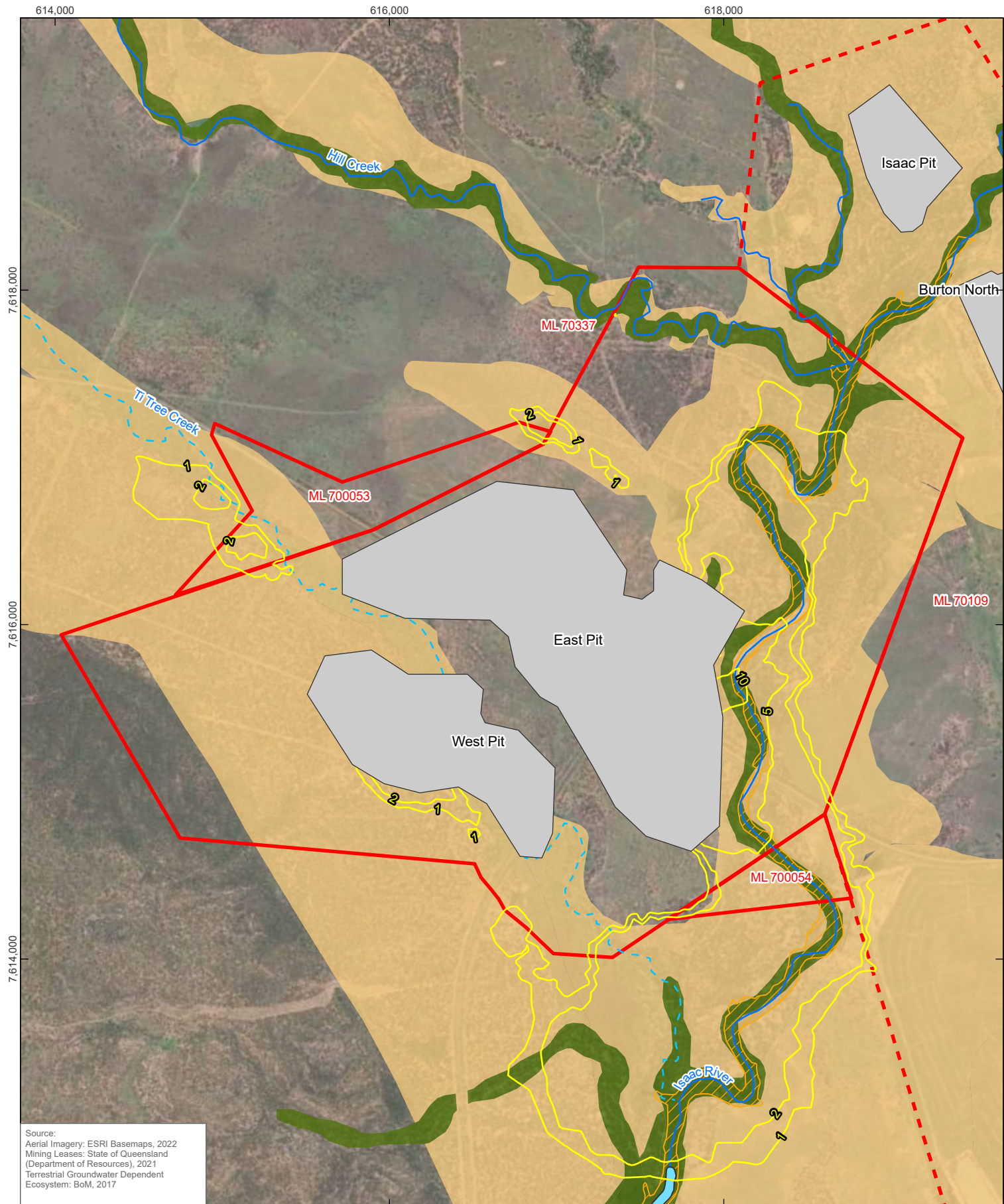
NEW LENTON COAL PROJECT GROUNDWATER MONITORING AND MANAGEMENT PLAN

MAXIMUM INCREMENTAL DRAWDOWN IN THE PERMIAN LEICHHARDT/ VERMONT COAL SEAMS



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FIGURE 4-2



Source:
Aerial Imagery: ESRI Basemaps, 2022
Mining Leases: State of Queensland
(Department of Resources), 2021
Terrestrial Groundwater Dependent
Ecosystem: BoM, 2017

Coordinate System: GDA2020 MGA Zone 55
Scale: 1:30,000 at A4
Project Number: 620.040892.00001
Date Drawn: 02-Sep-2024
Drawn by: RB

LEGEND

- Maximum Drawdown (m)
- Major Watercourse
- Non-designated Watercourse
- Project Area
- Burton Mining Lease
- Burton Gorge Dam

- Mining Disturbance Area
- Alluvium (Modelled Extent)
- Ground-truthed Known/Likely GDE Area (3D Environmental, 2023)
- Terrestrial Groundwater Dependent Ecosystem (BoM, 2017)
- High potential GDE

NEW LENTON COAL PROJECT GROUNDWATER MONITORING AND MANAGEMENT PLAN

MAXIMUM INCREMENTAL DRAWDOWN IN THE ALLUVIUM



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FIGURE 4-3

4.2.2.2 Post-Mining

Groundwater levels in the Permian coal measures are expected to recover partially in the post-mining period. The recovery of groundwater levels in the coal measures is governed by the recovery of the void lakes, with the final lake levels dictating the degree to which groundwater levels in the surrounding spoil and natural geologies recover. Ongoing limited recovery of Permian coal measures groundwater levels (and residual void lake formation) has the net effect of limiting the potential impacts of closure on the groundwater system by maintaining a permanent inwards hydraulic gradient in the groundwater system towards the residual void lakes, and thus it is assessed that there no potential for potentially poor quality groundwater in the spoil or water in the residual void lakes to discharge to the receiving environment (such as shallow aquifer systems).

4.2.3 Groundwater Dependent Ecosystems

As discussed in **Section 3.2**, based on the results of the GDE ground truthing survey, it was concluded by 3D Environmental (2023) that riparian vegetation associated with the Isaac River floodplain and alluvium (Terrestrial GDEs; TGDEs) presents the only GDEs identified within the vicinity of the Project. The location of the TGDEs identified by 3D Environmental (2023) are restricted to a narrow passage along the Isaac River (**Figure 3-3**).

Predicted maximum incremental alluvium drawdown from the SLR (2024b) groundwater model shows the area mapped as containing known/likely TGDEs by 3D Environmental (2023) is expected to experience drawdowns of typically between 1 and 5 m, but up to 12 m drawdown in a small area (**Figure 4-3**).

Potential impacts to the identified TGDEs were assessed by 3D Environmental (2023) following the steps set out in the GDE Toolbox (Richardson et al 2011). The major impact mechanisms and potential impacts to groundwater vegetation resulting from the Project as discussed by 3D Environmental (2023) include:

- Direct Clearing: within the disturbance footprint will impact 2.21 ha of mapped TGDEs on the Isaac River; however, these impacts will be mitigated by reducing construction width of linear infrastructure and rehabilitating construction disturbance.
- Depressurisation / dewatering: Drawdown of the basal alluvial groundwater unit may result in faster drying of the soil profile, and possibly reduced seasonal persistence of the hydraulically separate overlying perched groundwater unit relied upon by the TGDEs, if hydraulic linkage between these two units occurs. The magnitude of impact will depend on the degree of disconnection (if any) between the seasonally variable perched and the basal alluvial groundwater units, and whether any vegetation associated with the mapped TGDE areas have developed deeper rooting systems which penetrate to the basal alluvial groundwater unit.

The risk to TGDE function due to depressurisation/dewatering is however ameliorated due to the following factors:

- The limited to no hydraulic connectivity between the perched and basal alluvial groundwater systems based on the current understanding of the interactions between these two groundwater units.
- Tree species which characterise the riparian GDE areas, particularly forest red gum (*Eucalyptus tereticornis*), are resilient and have capacity to adapt to the possible minor reductions in soil moisture availability that may propagate above areas of groundwater drawdown.
- The groundwater hosted in the seasonally variable perched groundwater unit that supports GDEs is subject to natural volume fluctuations in response to changing



seasonal conditions and may dry for significant periods. This means that dependent vegetation will be adapted to varying degrees of moisture availability.

- The seasonally variable perched groundwater system that supports GDEs on the frontage of the Isaac River is supported and recharged by surface flows. The impact of the Project on surface flows is negligible.

Mapped known/likely GDE areas outside of the area of groundwater drawdown in the alluvium are not considered to be at risk from Project development.

To detect potential impacts to the health and function of TGDEs associated with the Project a GDEMMP has been prepared for the Project (3D Environmental, 2024). The GDEMMP is designed to accommodate for uncertainties in ecological response of GDEs to disturbance. This GDEMMP will provide methods for the early detection of impacts through development of trigger thresholds of ecological condition and proposes mitigations to be applied should decline in ecological condition be linked to project related mining operations.

As mentioned earlier, field investigations at the Project (AARC, 2024; 2019b) have identified groundwater does not discharge to the surface or maintain surface pools, and as a result does not support aquatic GDEs and therefore no associated impacts to aquatic GDEs could occur.

4.2.4 Landholder Bores

Chapter 3 of the *Water Act 2000* (Water Act) defines bore drawdown trigger thresholds for consolidated and unconsolidated aquifers as 5 m and 2 m, respectively, with drawdowns above the relevant bore trigger threshold considered to have a potential material impact on bore yield.

As discussed in **Section 3.2.2**, a landholder bore census identified one current bore in use that is used for stock watering (BA-01), as well as seven other bores that are not currently in use, three of which have been blocked or filled (BA-05, BA-02, BA-03, BA-04 and BA-06, BA-07, BA-12 respectively, **Figure 3-3**). A search of the GWDB also identified one potential third-party bore (RN85414) located 8.7 km northeast of the Project (**Figure 3-3**). No impacts are predicted to these bores by the SLR (2024b) numerical groundwater model, as the bores are all located outside of the extent of predicted drawdown of >1 m.



4.3 Impacts on Groundwater Quality

4.3.1 Groundwater Movement Induced Quality Changes

Potential impacts from the Project activities have been identified as primarily groundwater level drawdown as a result of mining. Groundwater level drawdown has the potential to result in groundwater quality changes where the drawdown results in changes in aquifer potentiometric head gradients sufficient to cause significant alteration of groundwater flow systems, and moves groundwaters of different quality into different areas of the hydrogeologic system. Furthermore, groundwater level drawdown also has the somewhat less likely potential to result in desaturation and oxidation of the aquifer matrix that results in release of the matrix chemical constituents into groundwater. This type of oxidation effect may also occur within overburden spoil emplacements associated with the Project.

4.3.2 Potential Sources of Contamination During Mining

Project related activities that have the potential to directly release contaminants to groundwater include fuel and waste storage, including mine waste (spoil and tailings). Project related activities that have the potential for direct groundwater quality impacts through contaminant release (e.g. fuel spills) are managed through established industry standard practices such that any spills would be minor, localised and subject to standard onsite remediation and management. Blasting activities also have the potential to release contaminants such as ammonia to groundwater. More significant potential sources of contaminants include spoil and tailings. Tailings will be emplaced within purpose designed and engineered in-pit tailings facilities, whilst spoil emplacements are subject to continual rehabilitation (contouring and capping with topsoil) over the life of Project operations as part of the mining plan. The inwards hydraulic gradients within the local groundwater system created by active mine pits will prevent migration of seepage from spoil and/tailings, or other potential contaminant release such as from blasting, to the groundwater system offsite.

4.3.3 Potential Sources of Contamination Post-Mining

Post-mining, spoil and tailings contained within the rehabilitated final landform continue to form potential sources of contaminants to groundwater. Additionally, perpetual lakes are predicted to form within the residual void in the rehabilitated final landform (SLR, 2024a) with the lake subject to evapoconcentration of dissolved salts and other constituents. The residual void lake is therefore also a potential source of contaminants to groundwater post-mining. Planned rehabilitation strategies for spoil and tailings will minimise the potential for generation of seepage reporting to groundwater. Furthermore, modelling shows residual void lakes would be hydraulic sinks, both capturing any local poor quality seepage from tailings or spoil, and preventing lake water movement outwards to the surrounding groundwater system (SLR, 2024a).



4.3.4 Characterisation of Potential Groundwater Quality Impacts

At a single monitoring bore location, the potential groundwater quality changes identified above may manifest as one or a combination of:

- Changes to groundwater salinity (measured as electrical conductivity (EC) or Total Dissolved Solids (TDS)).
- Changes to groundwater pH.
- Modification of the ionic composition of the groundwater.
- Changes to the concentration of metal and metalloids in groundwater.
- Changes to the concentration of nitrogen compounds ('nutrients') in groundwater.



5.0 Groundwater Monitoring and Management Program

5.1 Overview

This GMMP has been developed for the New Lenton Project to assess the mining activities potential impacts on groundwater resources as discussed in the previous sections.

This GMMP has been developed to be consistent with the Projects EA, AWL and PRCP (refer **Table 1-1**) and is intended to support future versions as well as other groundwater related approvals.

5.2 Monitoring Network

The Project groundwater monitoring network has resulted from extensive field work and the use of collected data to update conceptual modelling as detailed in SLR (2024a).

The GMMP monitoring network includes reference and compliance bores as detailed in **Table 5-1** and shown in **Figure 5-1**. Compliance bores are bores that have impact criteria thresholds established in the GMMP, whereas reference bores are bores primarily intended to provide for background (upgradient) monitoring data outside of the potential mining impact area that would support the assessment of any limit or trigger breach at a compliance bore.

It is noted that the four additional shallow bores proposed to be installed as part of the GDEMMP (3D Environmental, 2024) (refer **Section 3.2.1**) are not included in the table below, given that their primary purpose is to inform GDE monitoring. However, any data collected from these bores will none the less be considered in any future updates to this GMMP.



Table 5-1 Project GMMP Monitoring Network

Bore	Easting ¹	Northing ¹	Casing RL (mAHD)	Bore Depth	Screen (mBGL)	Aquifer	Status	Current AWL Bore?	Current EA Bore?	Proposed GMMP Bore
GW01	617299	7618210	326.8	15.2	6.17 – 12.17	Alluvium	dry	Reference	Interpretation	Reference
GW19	612323	7620097	376.7	26.5	22.9 – 25.9	Alluvium/Regolith	dry	Reference	-	Reference
GW20	612676	7618392	355.5	33.9	24 – 30	Basalt	Active	Reference	-	Reference
GW22	614463	7622201	401.7	11.6	5 – 8	Alluvium	dry	Reference	-	Reference
GW23	617807	7622169	369.9	11.6	5 – 8	Alluvium	dry	Reference	-	Reference
GW06	618097	7616723	313.9	20.6	3.6 – 18.6	Alluvium	dry	Compliance	Compliance	Compliance
GW03	618094	7614389	307.6	12.1	3.1 – 12.1	Alluvium	dry	Compliance	Compliance	Compliance
GW09	617525	7614070	307.1	24	6 – 18	Alluvium	Active	Compliance	Compliance	Compliance
GW19_37a	618034	7615771	309.6	26	16.5 – 20.0	Alluvium	Active	Compliance	Compliance	Compliance
GW08	617041	7613900	306.7	11.7	5.72 – 8.72	Alluvium	dry	Compliance	Compliance	Compliance
GW07	617640	7613075	299.5	24.5	9 – 18	Alluvium	Active	Reference	Compliance	Compliance
GW26	619185	7616679	315.7	9.6	6 – 9	Alluvium	dry	Compliance	-	Compliance
GW19_33	618664	7617348	312	16	11.1 – 12.6	Alluvium/Regolith	Active	Compliance	Compliance	Compliance
GW30c	618094	7617368	318.2	31.1	23 – 29	Regolith	Active	Compliance	Compliance	Compliance
GW31b	617621	7617680	322*	21.2	17 – 20	Regolith	Active	Compliance	Compliance	Compliance
GW30b	618088	7617382	318.5	76.2	70 – 73	Permian (Burton Seam)	Active	Compliance	Compliance	Compliance
GW10	616032	7617014	335.2	205.1	178.16– 190.16	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW13	616881	7615480	319.3	192.4	170.5 – 179.5	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW30a	618084	7617395	318.5	112.2	97 – 109	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance



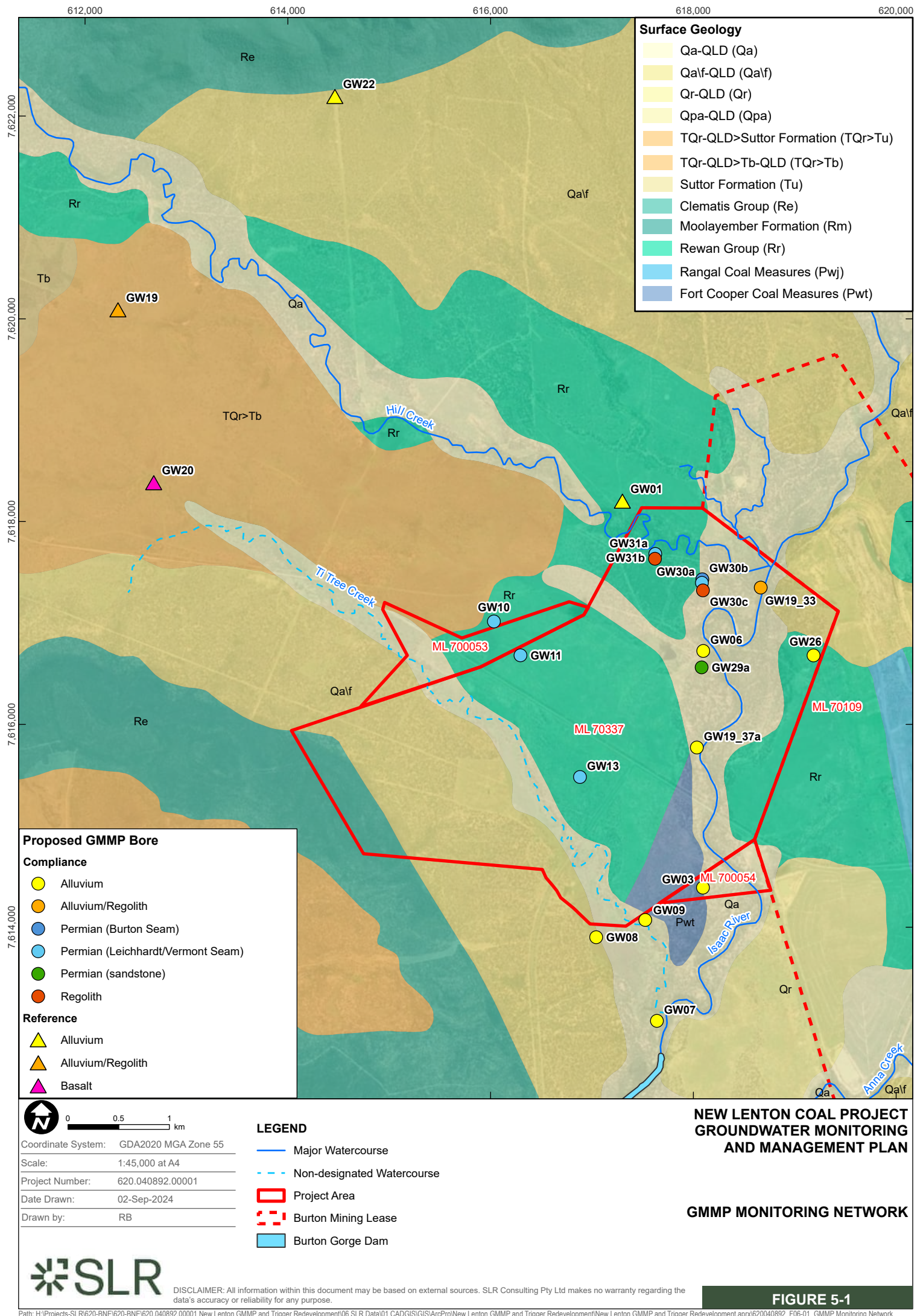
Bore	Easting ¹	Northing ¹	Casing RL (mAHD)	Bore Depth	Screen (mBGL)	Aquifer	Status	Current AWL Bore?	Current EA Bore?	Proposed GMMP Bore
GW31a	617624	7617680	321.9*	165.2	153 – 162	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW11	616294	7616680	332.3	150	114 – 126	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW29a	618081	7616561	313.6	83.6	62 – 80	Permian (sandstone)	Active	Compliance	Compliance	Compliance

¹ Coordinates are GDA94 z55

* Ground level

L/V = Leichhardt / Vermont Seam





5.3 Monitoring Regime – Baseline and During Mining

Routine monitoring prior to the commencement of the mining operation (i.e. baseline period) will provide for continued assessment and characterisation of the pre-mining groundwater system, including quantification of natural variability. Continuing to capture data to quantify natural variability is important on the context of allowing the LJV to distinguish any future mining related impacts from inherent natural variability later during the Project's operational phase. Consistent with condition D2 of the EA, the baseline monitoring program will continue until the during mining monitoring phase commences.

Routine monitoring during the mining operation will provide early warning of any variation in response of the groundwater system to that predicted. This will enable the LJV to undertake mitigation measures to minimise any potential groundwater related impacts, such as to surrounding groundwater users and the environment, e.g. through the implementation of make-good measures or measures described in the GDEMMP (3D Environmental, 2024).

5.3.1 Groundwater Levels

5.3.1.1 Manual Measurements

Groundwater level monitoring will be undertaken as follows:

- On a quarterly basis for compliance bores where Groundwater Level Trigger Thresholds and Level Reference Values have been established.
- On a quarterly basis for reference bores.
- On a bi-monthly (every 2 months) basis for compliance bores where Groundwater Level Trigger Thresholds or Level Reference Values are not yet defined, until such time as they are established or its determined that a bore is permanently dry.

5.3.1.2 Data Loggers

Groundwater level monitoring will be undertaken using automated level loggers in each of the GMMP bores listed in **Table 5-1**. The status of current data logger installation across the GMMP bores is provided in **Table 5-2**. It is noted that there are currently loggers installed within six non-GMMP bores within the mining disturbance area i.e. at GW19_40, GW19_41a, GW19_41b, GW27a, GW28a and LEN486, including seven groundwater level loggers and one barometric logger. It is recommended to move the loggers to the GMMP bores that do not have loggers prior to the commencement of mining operations, including the barometric logger currently installed within GW19_41b. Of the bores listed in the table below, it is noted that even if some bores are listed as dry, then the logger installation would allow measurement of groundwater levels if the bore becomes saturated. Furthermore, the resetting of loggers in dry bores at quarterly intervals will act to mitigate instrument drift due to being dry.

Pursuant to condition 42 of the AWL, logging intervals will be set to record a measurement at daily intervals.

A barometric pressure logger will be installed to the GMMP bores (or moved from GW19_41b which is in the proposed mining footprint) and the water level logger data will be barometric pressure corrected using the barometric pressure logger data prior to any analysis.

Loggers will be downloaded at least every three months. At the time of each download, a manual water level measurement will be recorded at each bore using a conventional groundwater level monitoring e-tape to confirm logger data accuracy. Any discrepancies observed in the automated monitoring data when compared to the manual measurements



will be immediately investigated and where necessary the loggers reset or replaced to ensure data reliability. Loggers installed into dry bores should be reset at each monitoring event if the bore remains dry to mitigate instrument drift.

Table 5-2 GMMP Bore Data Logger Status

Bore	Aquifer	Status	Bore Type	Logger installed?
GW01	Alluvium	dry	Reference	N - repurpose logger from bores in mining footprint
GW19	Alluvium/Regolith	dry	Reference	N - repurpose logger from bores in mining footprint
GW20	Basalt	Active	Reference	N - repurpose logger from bores in mining footprint
GW22	Alluvium	dry	Reference	N - repurpose logger from bores in mining footprint
GW23	Alluvium	dry	Reference	N - repurpose logger from bores in mining footprint
GW06	Alluvium	dry	Compliance	Y (bore dry)
GW03	Alluvium	dry	Compliance	N - repurpose logger from bores in mining footprint
GW09	Alluvium	Active	Compliance	Y (bore dry)
GW19_37a	Alluvium	Active	Compliance	Y
GW08	Alluvium	dry	Compliance	N - repurpose logger from bores in mining footprint
GW07	Alluvium	Active	Compliance	Y
GW26	Alluvium	dry	Compliance	N - repurpose logger from bores in mining footprint
GW19_33	Alluvium/Regolith	Active	Compliance	Y
GW30c	Regolith	Active	Compliance	Y
GW31b	Regolith	Active	Compliance	Y
GW30b	Permian (Burton Seam)	Active	Compliance	Y
GW10	Permian (L/V Seam)	Active	Compliance	Y
GW13	Permian (L/V Seam)	Active	Compliance	Y
GW30a	Permian (L/V Seam)	Active	Compliance	Y
GW31a	Permian (L/V Seam)	Active	Compliance	Y
GW11	Permian (L/V Seam)	Active	Compliance	Y
GW29a	Permian (sandstone)	Active	Compliance	Y



5.3.2 Groundwater Quality

5.3.2.1 Overview

Groundwater quality sampling will be undertaken as follows:

- On a quarterly basis for compliance bores where Groundwater Quality Limits have been established.
- On a quarterly basis for reference bores.
- On a bi-monthly (every 2 months) basis for compliance bores where Groundwater Quality Limits are not yet defined, until such time as they are established, or its determined that a bore is permanently dry.

5.3.2.2 Parameter Suite

The groundwater quality parameter suite identified in **Table 5-3** has been selected to detect the potential changes in groundwater quality outlined in **Section 4.3** as they may relate to causing harm to the relevant groundwater EVs (further detail provided in **Appendix A**).



Table 5-3 Groundwater Quality Parameter Suite

Parameter Group	Parameter	Unit	Method
Physico-chemical parameters	pH		Field
	Electrical Conductivity (EC)	µS/cm	Field and Lab
	Total Dissolved Solids (TDS)	mg/L	Lab
Major Ions	Sodium	mg/L	Lab
	Calcium	mg/L	Lab
	Magnesium	mg/L	Lab
	Potassium	mg/L	Lab
	Chloride	mg/L	Lab
	Sulfate	mg/L	Lab
	Carbonate	mg/L	Lab
	Bicarbonate	mg/L	Lab
Nutrients	Ammonia as N	mg/L	Lab
Metals (dissolved and total)	Aluminium	mg/L	Lab
	Arsenic	mg/L	Lab
	Boron	mg/L	Lab
	Cadmium	mg/L	Lab
	Cobalt	mg/L	Lab
	Chromium	mg/L	Lab
	Copper	mg/L	Lab
	Mercury	mg/L	Lab
	Lead	mg/L	Lab
	Manganese	mg/L	Lab
	Molybdenum	mg/L	Lab
	Nickel	mg/L	Lab
	Silver	mg/L	Lab
	Selenium	mg/L	Lab
	Uranium	mg/L	Lab
	Vanadium	mg/L	Lab
	Zinc	mg/L	Lab



5.4 Monitoring Regime – Post-Mining

Pursuant to condition PRCP6 of the PRCP, monitoring and maintenance must be carried out in accordance with the monitoring and maintenance program described in the rehabilitation planning part relating to the PRCP schedule; and any requirement under the PRCP schedule, as detailed within this Section, and **Sections 6.1.8.2** and **7.1.4** of this report (refer **Table 1-1**).

The GMMP groundwater monitoring program will continue unchanged in the post-mining period until relinquishment of the EA and MLs, with the exception of incorporating any additional requirements that may arise through the PRCP implementation process.

The post-mining monitoring program will also include additional monitoring for the void lake as follows:

- Void Water Level - Quarterly survey consistent with the frequency of groundwater level monitoring at groundwater bores.
- Void Water Quality – Quarterly sampling consistent with the frequency and parameter suite (**Section 5.3.2.2**) for groundwater quality monitoring at groundwater bores.

The GMMP will continue to be implemented during the post-mining period until such time as mining lease relinquishment is achieved, in accordance with relevant State regulatory approvals associated with satisfactory completion of implementation of the PRCP. These statutory obligations will include assessment and demonstration that the ongoing risk to groundwater associated with the final landform has been successfully managed and mitigated.

Consistent with condition RM8 of the PRCP, LJV will continue groundwater monitoring after the completion of final landform establishment and surface preparation (i.e. post-mining and completion of landform construction and topsoiling):

- Quarterly for water quality a minimum period of 5 consecutive years, at but not limited to compliance bores and for all quality characteristics; and
- Quarterly for groundwater level for 10 consecutive years.

After 5 years of rehabilitation monitoring, a review is to be undertaken to determine if there is a requirement for additional monitoring, or if post-mining groundwater system behaviour is sufficiently consistent with model predictions of minimal potential for groundwater environmental impact such that monitoring can be discontinued.



6.0 Quality Assurance / Quality Control

The QA/QC procedures that will be adopted by LJV are detailed in the following sections.

6.1 Field Procedures

Field procedures are detailed in **Sections 6.1.1 to 6.1.6** and have been developed to be compliant with the following guidelines:

- Groundwater Sampling and Analysis—A Field Guide (Geoscience Australia, 2009);
- DES (2018). Monitoring and Sampling Manual: Environmental Protection (Water) Policy. Brisbane: Department of Environment and Science Government.
- Australian and New Zealand Standard AS/NZS 5667.1:1998 Water quality - Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples (AS/NZS5667).

6.1.1 Qualified Personnel

Groundwater monitoring will be undertaken by appropriately qualified personnel with experience in conducting groundwater monitoring and sampling programs in accordance with the above mentioned guidelines.

6.1.2 Equipment Calibration

All field equipment will be maintained according to the accordance with the manufacturer's recommendations.

The field water quality meter used during the program implementation will be calibrated to the relevant calibration standard solutions daily, and prior to each day's work. Daily calibration records will be noted in a dedicated register and provided with the monitoring event report (see **Section 6.1.6**) for record keeping purposes.

6.1.3 Equipment Decontamination

All field equipment used in the execution of the GMMP monitoring program will be thoroughly decontaminated before and after conducting any field measurements and sampling at each and every bore. This decontamination process includes the water level dip meter probe and tape, field water quality meter, and water quality sample pumps and tubing.

6.1.4 Groundwater Level Measurement Procedure

Manual groundwater level measurements will be collected by appropriately qualified personnel using an industry standard groundwater level e-tape prior to any disturbance for groundwater quality sample collection at any bore. The e-tape will be checked for operational readiness before each use, including a test of the probe function prior to use in the field. Measurements of the groundwater level will be taken from the top of the PVC casing at each bore.

6.1.5 Groundwater Quality Sampling Procedures

Pursuant to condition D13 of the EA, groundwater quality sampling must be performed by suitably qualified personnel. Groundwater quality sampling procedures have been developed to be compliant with the following guidelines listed in **Section 6.1** and are detailed in the below sections.



6.1.5.1 Bore Purging Procedures

In accordance with the above listed guidelines, appropriate groundwater sampling procedures require that stagnant water that has been standing in the bore casing be purged prior to collection of a groundwater sample, so that sample is representative of the groundwater within the aquifer screened by the bore. The following purge methods will be adopted depending on which is more appropriate depending on the characteristics of each bore being sampled (e.g. bore depth, water column height, and rate of inflow to the bore):

- Three bore volumes/parameter stabilisation via a conventional submersible purge pump; or
- Low-flow sampling using specialised low-flow sampling equipment.

6.1.5.2 Field Water Quality Readings

Recording of field water quality parameters will be undertaken using appropriate field water quality equipment, after bore purging is confirmed to be satisfactorily complete with parameter stabilisation confirmed. The equipment will be calibrated prior to use as outlined in **Section 6.1.2**.

6.1.5.3 General Sample Collection Procedures

Following confirmation of field parameter stabilisation identifying representative aquifer water is being produced from the bore, groundwater samples will be collected from each bore in the monitoring program. Groundwater samples will be collected as follows.

- Only collected once parameter stabilisation has been confirmed.
- Collected in accordance with the relevant guidelines.
- Placed into the appropriate laboratory supplied bottles containing any appropriate preservative solutions for the analyte suite to be tested.
- Clearly labelled with the Bore ID, sampling date/time and field personnel initials.
- Field filtered to 0.45 µm where relevant for particular bottles/analytes (e.g. dissolved metals).
- Placed onto ice in a cooler box with ice immediately after sampling for transfer to the analytical laboratory.
- Following sampling, all equipment will be cleaned and decontaminated in preparation for moving to the next bore.

Sample transfer will occur under industry standard Chain of Custody (CoC) protocols/documentation and within the relevant holding times for each parameter. Copies of each CoC form will be taken in the field prior to shipping the samples and the CoC forms will be included with the monitoring data (see **Section 6.1.6**) for record keeping purposes.

6.1.5.4 Quality Control Samples

The DES Monitoring and Sampling Manual (DES, 2018) provides guidance on the types of quality control measures and the frequency of collection of quality control samples. The types and quantities of quality control samples that will be taken are explained in the below text.

Sample Duplicates

Duplicate samples are used to check and provide consistency in laboratory analytical processes. Duplicate samples involve the collection of a second set of samples from a bore



in an identical manner to the primary samples. The duplicate samples will be tested for the same analytical suite as the primary samples. Additionally, duplicate samples will be collected as “blind duplicates”, where an alternate naming convention is adopted for the duplicates so that the analytical laboratory cannot match a duplicate sample to its relevant primary sample. The blind duplicate sample will be clearly matched to its relevant primary sample in the field documentation (see **Section 6.1.6**).

One duplicate sample will be collected for every 10 primary samples per monitoring event (or one per program when there are less than 20 samples).

Sample Blanks

Blank samples are used to identify if any possible sample contamination has occurred during the sample collection and storage/shipping process. Blank samples will be tested for the same analytical suite as the primary samples. Two types of sample blanks will be adopted in the program:

- Field blank.
 - Deionised water is placed into sample containers whilst in the field and stored/transported to the analytical laboratory in the same manner as the primary samples. The container blank testing is used to identify if any contamination of samples may have occurred as a result of the sample collection process or use of non-sterile sample containers.

One field blank will be collected per monitoring event.

- Rinsate / Equipment Blank
 - Following field equipment cleaning/decontamination in the field, deionised water is poured over and through the field equipment and then placed into sample containers and stored/transported to the analytical laboratory in the same manner as the primary samples. The equipment blank testing is used to identify if any contamination of samples may have occurred as a result of insufficient equipment cleaning/decontamination processes.

One Rinsate / Equipment blank will be collected per monitoring event.

6.1.5.5 Field Sheet Documentation

LJV will compile all field documentation at the conclusion of each monitoring event in conjunction with the monitoring data (see **Section 6.1.6**). A Field Sheet (field documentation) will be developed by the field team for use during the monitoring program at each bore being monitored.

The Field Sheet will be used to record the following information:

- The date, time and the monitoring point on which the sample was taken and the results of all monitoring (Pursuant to condition D16 of the EA) (noting that the resting standing water level measurement will be recorded pre purging/sampling).
- Date and time when purging commenced.
- Details of the purging method including pump/intake depth.
- Records of field water quality parameters during purging at routine time intervals.
- Colour and odour of purged water during purging at routine time intervals.
- Purge time, volume and standing water level during purging at routine time intervals.
- Observations of any degassing of water during purging.



- Sample collection date, time and ID, including the ID of any QA/QC (e.g. duplicate) samples taken.
- A daily calibration record for the field water quality meter.
- Any notes relating to condition of the bore e.g. headworks and general surrounding area.

A daily report will be emailed to the LJV environment team manager containing:

- The field sheet information as above;
- A completed Chain of Custody (CoC) record for samples;
- A digital photographic record for each bore, clearly labelled with the bore ID, showing condition of the headworks and the general area.

6.1.6 Factual Field Work Reporting

Following each monitoring event, all factual data will be prepared for record keeping purposes.

This will contain the following information:

- Summary details regarding the dates of the field program covered by the report.
- Identification of staff who undertook the program and their relevant qualifications.
- Details of any monitoring restrictions encountered during the program.
- A summary table of measured standing water levels.
- A summary table of final field groundwater quality measurements.
- A summary of the water quality sampling.
- Details of sample QA/QC.
- Appendices containing:
 - Laboratory Certificate of Analysis (COA)
 - Field Sheets for each bore;
 - The daily Calibration Record for the field water quality meter;
 - Copies of the Chain of Custody (CoC) form(s); and
 - The photographic record for each bore.

Additionally, electronic appendices will be attached containing:

- The site water quality and level database (excel format); and
- Laboratory water quality analysis data (excel format).

6.1.7 Sample Analysis Quality Assurance and Laboratory Procedures

Groundwater sample analysis will be undertaken by a laboratory accredited by the National Association of Testing Authorities (NATA).

The sample analysis will include duplicates and blanks collected in the field consistent with industry standard QA/QC procedures compliant with the relevant guidelines, as described in **Section 6.1.5.4**.



Additionally, the NATA accredited laboratories will employ as standard practice an internal QA/QC program (intra-lab QC) that will include laboratory control samples, method blanks, matrix spikes, laboratory duplicates and surrogates, at frequencies at or above those recommended in the NEPM (2013) guidelines.

6.1.8 Data Storage, Management and Processing

6.1.8.1 General

The data gathered from the GMMP groundwater monitoring program will be collated into a dedicated electronic database managed by the LJV Environment team. Data will be entered into the database after it is received by the LJV Environment team. The database will be routinely backed up in accordance with LJV electronic information backup procedures.

Pursuant to EA and AWL conditions, LJV will:

- Submit all groundwater monitoring data required by the EA or related to environmental management activities to the administering authority via WaTERS (condition D16 of the EA);
- Publish water level monitoring data required to be collected within 10 business days from measurement. Data must remain published and publicly available (condition 45 of the AWL);

Data will be managed and processed in the following steps:

1. Within the dedicated electronic database managed by the LJV Environment team, flags will be implemented to automatically identify data that breaches any of the Groundwater Quality Limits or Groundwater Level Trigger Thresholds established and thus automatically notify the LJV Environment Team personnel to enact the Groundwater Impact Investigation Procedure (see **Section 7.0**), the first step of which is to confirm the data validity.
2. The GMMP Annual Groundwater Monitoring Report (AGMR) (see **Section 8.1**) will include a thorough review of the groundwater monitoring database that will allow identification of any spurious data e.g. through comparison with baseline data and outlier analysis in accordance with the procedures identified in DES (2021).
3. Any formal investigation into the potential for environmental harm enacted as a result of a limit or trigger breach followed by implementation of the Groundwater Impact Investigation Procedure (see **Section 7.0**), will include identification of any spurious data through comparison with baseline data and statistical trend and outlier analysis in accordance with the procedures identified in DES (2021).

Should any of the above result in identification of spurious data, the LJV Environment team will implement an investigation into the source of the data error, including review of the data collection procedures (**Section 6.1**), and where relevant the sample analysis quality assurance and laboratory procedures (**Section 6.1.7**), to identify the source of the error, where possible. Where the error source is conclusively identified, the procedures identified in this GMMP will be updated if necessary, to mitigate the error reoccurring.



6.1.8.2 Post-Mining

Pursuant to condition PRCP7 of the PRCP, LJV will keep records in relation to relevant matters for a minimum of five years and provide such records to the PRCP's administering authority on request. Relevant records may include:

- Rehabilitation activities and the results of these activities
- Maintenance activities and the results of maintenance activities
- Monitoring activities and the results of monitoring
- Designs, drawings, specifications or any similar documents required under the PRCP schedule
- Certifications, assessments, investigations, inspections, audits or any similar processes carried out in relation to rehabilitation milestones or milestone criteria.



7.0 Groundwater Impact Criteria, Triggers and Investigation Procedures

7.1.1 Groundwater Level Reference Values

Groundwater Level Reference Values (i.e. Pre-mining baseline levels) established in this GMMP will be compared to the measured groundwater level for a bore at any point in time. The resulting computed groundwater level drawdown will be compared to the Level Trigger Thresholds for that bore (refer **Table 7-2**), where a computed groundwater level drawdown greater than the Level Trigger Threshold constitutes an exceedance under the EA.

Groundwater Level Reference Values for compliance bores are provided in **Table 7-1** and have been established based on the statistical analysis of the historical baseline dataset of each bore (**Appendix A**). Note that no Groundwater Level Reference Values are provided for GMMP reference bores, or for dry bores (refer **Table 5-1**).

The statistical analysis included QA/QC of the dataset to screen any outliers through a visual assessment of time series plots (further details provided in **Appendix A**). The time series plots and Mann-Kendall trend test (see **Appendix A**) highlight the fact that local groundwater levels are highly variable, with variability driven by natural causes (i.e. climate variability). Furthermore, the large range between the maximum and minimum groundwater levels presented in the summary statistics in (see **Appendix A**) highlights the fact that groundwater level change compliance criteria needs to appropriately recognise the significant natural variability in groundwater levels.

The Groundwater Level Reference Values have therefore been based on the 20th percentile of the baseline dataset summary statistics (see **Appendix A**), similar to the approach proposed within DES (2021) for establishing statistically appropriate groundwater quality limits. Adoption of the 20th percentile takes into account the historic variability in groundwater levels when proposing a bore specific groundwater level that will be compared to model predictions for EA compliance purposes.



Table 7-1 Groundwater Level Reference Values

Aquifer	Compliance Bore	20 th Percentile (mAHD)
Alluvium	GW06	Dry bore, no Reference Level proposed
Alluvium	GW03	Dry bore, no Reference Level proposed
Alluvium	GW09	Dry bore, no Reference Level proposed
Alluvium	GW19_37a	297.8
Alluvium	GW08	Dry bore, no Reference Level proposed
Alluvium	GW07	294.0
Alluvium	GW26	TBA
Alluvium/Regolith	GW19_33	301.5
Regolith	GW30c	301.8
Regolith	GW31b	307.1
Permian (Burton Seam)	GW30b	301.4
Permian (L/V Seam)	GW10	299.2
Permian (L/V Seam)	GW13	296.1
Permian (L/V Seam)	GW30a	301.8
Permian (L/V Seam)	GW31a	305.9
Permian (L/V Seam)	GW11	300.8
Permian (sandstone)	GW29a	300.9

TBA = insufficient baseline data to compute reference levels at the present time.
L/V Seam = Leichhardt / Vermont Seam



7.1.2 Groundwater Level Drawdown Triggers (Level Trigger Thresholds)

Groundwater level drawdown triggers (Level Trigger Thresholds) established in this GMMP are used to establish groundwater level impact compliance criteria for the Project.

The predictive results of the New Lenton Project numerical groundwater model (SLR, 2024b) have been utilised to develop updated bore specific groundwater Level Trigger Thresholds for each proposed GMMP bore listed. Level Trigger Thresholds have been based on the following criteria:

- Level Trigger Thresholds have been calculated using the latest version of the New Lenton groundwater model (SLR, 2024b).
- Level Trigger Threshold derivation is based on the difference between the predicted groundwater level in the “no-mining” model, and the minimum (lowest) predicted water level at any time during the future modelled life of mining from the “cumulative mining” model (i.e. between the years 2024 and 2040 and considering the effects of the adjacent Burton Mine). That is, Level Trigger Thresholds are based on the predicted future groundwater level drawdown at each bore between 2024 and 2040 from the latest numerical groundwater model. Noting that the numerical groundwater model is actually an ensemble of calibrated models each with different parameter sets (SLR, 2024b), uncertainty in model predictions across the calibrated ensemble of models is considered as described in the following dot point.
- GMMP compliance monitoring bores have been assigned a Level Trigger Threshold value equal to the maximum cumulative 90th percentile model drawdown prediction at each bore over the future life of the New Lenton mining operation to 2040. Adoption of the 90th percentile prediction of drawdown allows for consideration of model predictive uncertainty to provide a conservative upper limit of groundwater level drawdown allowed under the EA.
- Where the maximum 90th percentile model drawdown prediction for the alluvium/regolith is less than the natural variability observed in the alluvium/regolith within the current monitoring dataset (see **Appendix A**) for a particular bore, then the trigger has been set equal to the range in observed natural variability at that bore to avoid the false enacting of a drawdown trigger that is only due to natural variability and not mining activities. For alluvium/regolith bores with no existing data, an average of the natural variability across the entire baseline dataset for alluvium/regolith bores with sufficient data has been used (i.e. 3.6 m).
- Where the proposed Groundwater Level Trigger Threshold resulting from either of the above two points would result in a level trigger elevation below the base of the model layer, then the Groundwater Level Trigger Threshold has been limited to drawdown to the base of the model layer.

The groundwater Level Trigger Thresholds derived using the methodology as above for compliance bores are presented in **Table 7-2**. Note that no Level Trigger Thresholds are provided for GMMP reference bores (refer **Table 5-1**), or for dry bores.



Table 7-2 Groundwater Level Trigger Thresholds

Aquifer	Compliance Bore	Level Trigger Threshold (m)
Alluvium	GW06	Dry bore, no Level Trigger Threshold proposed
Alluvium	GW03	Dry bore, no Level Trigger Threshold proposed
Alluvium	GW09	Dry bore, no Level Trigger Threshold proposed
Alluvium	GW19_37a	7.1 ^{1,2}
Alluvium	GW08	Dry bore, no Level Trigger Threshold proposed
Alluvium	GW07	3.8 ¹
Alluvium	GW26	3.6 ³
Alluvium/Regolith	GW19_33	3.4 ⁴
Regolith	GW30c	4.7 ⁴
Regolith	GW31b	3.7 ⁴
Permian (Burton Seam)	GW30b	9.2 ¹
Permian (L/V Seam)	GW10	86.3 ¹
Permian (L/V Seam)	GW13	75.1 ¹
Permian (L/V Seam)	GW30a	10.1 ¹
Permian (L/V Seam)	GW31a	23.8 ¹
Permian (L/V Seam)	GW11	108.3 ^{1,2}
Permian (sandstone)	GW29a	15.2 ¹

L/V Seam = Leichhardt / Vermont Seam

1. Maximum cumulative 90th percentile modelled drawdown prediction.

2. Maximum drawdown limited to base of model layer.

3. Based on the range of natural variability observed at this bore.

4. Based on the average range of natural variability observed at all existing alluvium/regolith bores.

7.1.3 Groundwater Quality Limits

Groundwater Quality Limits established in this GMMP are used to establish groundwater quality impact compliance criteria for the Project.

Groundwater Quality Limits for compliance bores have been established in accordance with the DES (2021) guideline *“Using monitoring data to assess groundwater quality and potential environmental impacts”* as detailed in **Appendix A**.

The Groundwater Quality Limits are presented in **Table 7-3**. Note that no Groundwater Quality Limits are provided for GMMP reference bores (refer **Table 5-1**).



Table 7-3 Groundwater Quality Limits for Compliance Bores

Analyte	pH (Field)	EC (Lab)	Ca	NH ₃ -N	SO ₄	Al	As	B	Cd	Co	Cr	Cu	Hg	Pb	Mn	Mo	Ni	Ag	Se	U	V	Zn
Unit	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GW06	6.5 - 8.5	TBD	TBD	0.9	TBD	0.055	0.013	TBD	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	0.008
GW03	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW09	6.5 - 8.5	TBD	TBD	0.9	42	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	TBD
GW19_37a	6.5 - 8.5	2500	1000	0.9	31	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.025	0.00005	0.005	0.002	0.006	TBD
GW08	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW07	6.5 - 8.5	8661	271	0.9	51	0.055	0.013	0.94	0.0002	0.004	0.001	0.0046	0.00006	0.0034	1.9	0.034	0.021	0.00005	0.005	0.012	0.006	0.038
GW26	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW19_33	6.5 - 8.5	720	63	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.018	0.00005	0.005	TBD	0.006	0.019
GW30c	6.5 - 8.5	15875	357	0.9	185	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	0.008
GW31b	6.5 - 8.5	2739	90	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.002	0.006	TBD
GW30b	6.5 - 8.5	18285	679	3.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.029
GW10	6.5 - 8.5	6244	60	1.3	25	0.055	0.013	0.94	0.0002	0.0014	TBD	0.0014	0.00006	0.0034	1.9	0.049	0.027	0.00005	0.005	0.0005	0.006	0.009
GW13	6.5 - 8.5	12700	143	3.5	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.024
GW30a	6.5 - 8.5	15600	299	3.6	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.023
GW31a	6.5 - 8.5	4820	23	1.0	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW11	6.5 - 8.5	4161	106	1.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.018
GW29a	6.5 - 8.5	9870	140	TBD	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.02

Note: Dissolved metals

TBD = To be defined once sufficient data becomes available



7.1.4 Groundwater Exceedance Criteria and Investigation Procedure

Consistent with condition D4 of the EA and RM8 of the PRCP the results of groundwater quality monitoring from compliance bores (**Table 5-1**) must not exceed the bore specific Groundwater Quality Limits (**Table 7-3**) on three consecutive occasions.

Consistent with condition D5 of the current EA and RM8 of the PRCP the results of groundwater level monitoring from compliance bores (which are not dry) (**Table 5-1**) must not exceed any of the Groundwater Level Trigger Thresholds (**Table 7-2**).

A breach of the Groundwater Level Trigger Thresholds is confirmed where a comparison of the measured groundwater for a compliance bore at any point in time with the Reference Level for that bore results in a groundwater level drawdown greater than the Groundwater Level Trigger Threshold.

Any breach should be confirmed through conducting a data review and/or resample at the affected bore.

Pursuant to condition D7 of the current EA, if any monitoring result from groundwater compliance bores identified in **Table 5-1** exceed any of the Groundwater Quality Limits stated in **Table 5-3** on three consecutive occasions, or exceed any of the Groundwater Level Trigger Thresholds stated in **Table 7-2**, LJV must notify the administering authority within twenty-four (24) hours via WaTERS.

Following the initial notification given under EA condition D7, as per condition D8 of the EA, within fourteen (14) days of the notification, the LJV must commence an investigation to determine if the exceedance is a result of:

- a) Mining activities authorised under the EA; or
- b) Natural variation; or
- c) Neighbouring land use resulting in groundwater impacts.

If required, this investigation will be completed by a by an independent and appropriately qualified specialist in accordance with ANZECC and ARMCANZ (2000).

The investigation will include as a minimum:

- Comparison of the results for the bore subject to the breach with those from other bores, including comparison of Compliance bore results against Interpretation bore results;
- Review of groundwater flow pathways;
- Comparison to baseline groundwater monitoring results;
- A review of authorised mining activities that may be responsible for the breach;
- The prevailing and preceding natural conditions (e.g. meteorological conditions);
- A review of neighbouring land use and groundwater use; and
- A review of the physical integrity of the bore network (i.e. when an issue is identified by anomalous monitoring results).

Pursuant to condition D9 of the EA, the resulting investigation report will be sent to the administering authority of the EA via WaTERS within three (3) months of notification of the monitoring exceedance under D7.

Pursuant to condition D10 of the EA, if the result of the above investigation determines that the exceedance was the result of mining authorised under the EA, then investigations must be undertaken by LJV to establish whether environmental harm has occurred or may occur.



If an investigation is required due to the exceedance being deemed a result of approved mining (as per condition D10 of the EA), then pursuant to condition D11 of the EA, within twenty-eight (28) days of the investigation, LJV Will:

- Implement short-term measures to mitigate the potential for environmental harm; and
- Develop long-term mitigation measures to address any existing groundwater contamination and prevent recurrence of groundwater contamination; and
- If environmental harm has occurred as a result of groundwater drawdown exceedances, LJV must:
 - Determine any actions required to reduce the potential for environmental harm; and
 - Determine any mitigation measures required to limit the drawdown in the affected groundwater resource.

Further discussion on impact mitigation is provided in **Section 7.2**.

7.2 Mitigation

7.2.1 General

Where it is identified that there is potential for environmental harm in any investigation undertaken following a breach of the Groundwater Quality Limits or Level Trigger Thresholds as outlined in **Section 7.1.4** above, an action plan to mitigate potential environmental harm will be developed by a suitably qualified person. These mitigation measures will be implemented within 3 months of the completion of the exceedance investigation.

The selection of the most effective mitigation measures will be based on providing the best outcome for protection of the affected groundwater resource and/or user as determined by the investigation into the potential for environmental harm. The selection of the most effective mitigation measures therefore will only be possible following the completion of the investigation into the potential for environmental harm. The GDEMMP will guide any assessments, investigations or corrective actions for potential impacts to TGDEs.



7.2.2 Impacts to Third Party Groundwater Users

In the event that a formal groundwater investigation conclusively identifies that Project operations have adversely impacted a neighbouring groundwater bore user (affected groundwater user), the LJV will attempt in 'good faith' to negotiate suitable mitigation measures in a timely manner to rectify the identified groundwater impact in accordance the LJV's obligations under the *Water Act 2000*. The LJV will involve an appropriately qualified environmental specialist to assist with development of the mitigation measures. The development of suitable mitigation measures will be based on the outcomes of an appropriate scientific investigation.

Possible third party bore impact mitigation measures that may be applied by the LJV include:

- The refurbishment of an existing groundwater bore;
- The installation of a new groundwater bore;
- The establishment of an alternative water supply arrangement; and/or
- The use of another mutually agreed form of mitigation.

The LJV will ensure as a minimum that the proposed mitigation measures are acceptable to the affected groundwater user, and if acceptable, will enter into a legal agreement for the installation of the proposed mitigation measures at the LJV's expense. The LJV will also ensure the proposed mitigation measures are commensurate with the identified groundwater loss. The LJV may be required to install interim mitigation measures until the permanent mitigation measures have been developed and installed. As required, the LJV will seek agreement with the affected groundwater user and pay all reasonable cost for the use of any interim mitigation measures. If agreement cannot be reached with the affected groundwater user in relation to the proposed mitigation measures, the LJV will facilitate some form of legal disputes resolution for the matter.



8.0 Reporting, Review and Improvement Process

During the life of New Lenton Project operations, data collected through the GMMP will be used to assess the mine's actual impact on groundwater resources, and if deemed necessary update and refine the numerical groundwater model and its predictions of future impacts. These outcomes will in turn be used to review and improve this GMMP through a continual Reporting, Review and Improvement process as described herein.

8.1 Annual Groundwater Monitoring Reports

LJV will conduct an annual review of the environmental performance of this GMMP. The annual review will be reported in an Annual Groundwater Monitoring Report (AGMR) and will satisfy requirements under EA condition D15 and AWL condition 47 and will include:

- A review of the updated groundwater quality and level data to allow for identification of any outliers e.g. through the comparison of baseline data and outlier analysis in accordance with the procedures identified in DES (2021);
- The standing water level of all groundwater bores listed within **Table 5-1** (consistent with EA D15 and AWL condition 47);
- The groundwater quality of all groundwater bores listed within **Table 5-1** (consistent with EA condition D15);
- An assessment of long-term water quality and water level trends at all groundwater bores listed within **Table 5-1** (consistent with EA condition D15);
- A comparison of groundwater quality against the trigger levels listed within **Table 7-3**;
- Details of any review undertaken of the groundwater conceptual model (consistent with EA condition D15);
- Details of the numerical underground water model and any review undertaken of the numerical underground water model since the previous AGMR (consistent with AWL condition 47);
- Maps showing the actual water level drawdown contours for each aquifer (AWL condition 47);
- An assessment of any differences between the groundwater level impact predicted and actual impacts for corresponding period (consistent with EA Condition D15 and AWL condition 47);
- Details of any bores which are predicted by the numerical underground water model to be located in the affected area (consistent with AWL condition 47);
- Raw data provided in a format as requested by the chief executive (consistent with AWL condition 47).

Pursuant to EA condition D15 and condition 48 of the AWL, the AGMR is required to be completed and submitted to the administering authority commencing after the first year of mining activities, the first AGMR must be provided to the chief executive within three months of the end of the first water year (i.e. the period from the commencement of take of underground water), and subsequent AGMRs must be provided to the chief executive within three months of the end of each relevant water year.



8.2 Groundwater Monitoring and Management Program Review

Consistent with condition D14 of the EA, the GMMP will include a review process to identify improvements to the program, where deemed warranted as part of an AGMR.

The GMMP will be reviewed and modified as necessary over the mine life based on revisions to the Project's groundwater model, reviews of monitoring results and/or changed mining conditions, as identified in any AGMR. This might include:

- Revision of assessment outcomes if updated numerical groundwater modelling is available;
- Revision of monitoring parameters and/or frequency; and/or
- Expanding the existing groundwater monitoring network over time to enable ongoing groundwater impact evaluations.

Pursuant to condition 43 of the AWL, revisions of the GMMP must be undertaken by an appropriately qualified person, and submitted to the chief executive for approval.

Where an AGMR deems it required, the GMMP will be reviewed by an appropriately qualified person, with a report provided on the outcome of the review to the administering authorities of the EA and AWL within 3 months of completion of any GMMP review.

A review of the GMMP may include:

- an assessment of the outcome of the groundwater management and monitoring program against the objectives in the Project's EA and performance against compliance criteria;
- a review of the adequacy of the monitoring locations, frequencies and Groundwater Quality Limits specified in the EA with respect to any updated groundwater impact predictions; and
- a review of the adequacy of the groundwater monitoring program with respect to any updated groundwater impact predictions, including for the post-closure period.

As required, this GMMP may be updated or revised based on the outcomes of the review process. The administering authorities will be consulted in relation to any significant changes to this GMMP and as necessary will be re-issued any new versions of the document.

Consistent with conditions 43 and 44 of the AWL and D14 of the EA, the GMMP may be updated to address any comments provided by the administering authorities as necessary as part of the review and improvements process.

It is noted that the GMMP is also intended to support EPBC Act approvals related to groundwater at the Project.



8.3 Groundwater Impact Prediction, Validation and Review

During the life of the Project (starting from commencement of the take of associated water), as deemed required data collected through the GMMP may be used to review and if deemed necessary update and refine the Project groundwater model and its impact predictions consistent with AWL conditions 49 and 50. In addition to the AWL requirement these reviews, the need for such a review may also be identified within the AGMR as described above, and in particular if an assessment of any differences between the groundwater level impact predicted and actual impacts for corresponding period determines that a significant departure from model predictions has occurred. Consistent with AWL condition 49, the review must provide a revised report, including:

- a) information about a revised numerical underground water model based on a transient calibration;
- b) incorporation of measured mine dewatering volumes and underground water monitoring data;
- c) any revised hydrogeological conceptualisation and assumptions of the model,
- d) including:
 - (i) any revised geological interpretation;
 - (ii) any revised hydrogeological parameters or assumptions on recharge; and
 - (iii) any assumptions of outflows from springs and other water users;
- e) an update of predicted impacts including:
 - (i) any revised predicted impacts on springs and watercourses dependent on underground water flow, and other users, including any changes to the affected area;
 - (ii) any revised predicted underground water inflows into mine workings during mining operations and post closure;
 - (iii) maps showing the revised prediction of the total water level impact from the commencement of underground extraction to post closure;
 - (iv) maps showing the difference between these predicted water level impacts and the water level impacts as predicted at the time of application for this water licence;
 - (v) sensitivity analysis; and
- f) an evaluation of the accuracy of the predicted impacts from the model.



8.4 Monitoring Network Maintenance

Over the lifespan of the Project and the post closure monitoring period, it is inevitable that groundwater monitoring bores will become unserviceable and need to be replaced. The LJV will proactively maintain the groundwater monitoring network, replacing bores as necessary, and use the regular review of monitoring data to inform the location of additional monitoring bores, if required.

Pursuant to condition D12 of the EA, the construction, maintenance and management of groundwater bores (including groundwater monitoring bores) will be undertaken in a manner that prevents or minimises impacts to the environment and ensures the integrity of the bores to obtain accurate monitoring.

Pursuant to condition D2 of the EA, LJV must avoid impacts to prescribed environmental matters as a result of disturbance due to installation of any proposed bores.

In the event that monitoring bores require replacement or additional monitoring bores are deemed required to supplement the existing network, LJV will, consistent with above EA conditions D2 and D12, mitigate impacts to the environment or to environmental matters by ensuring that bore installation will:

- Occur under the supervision of a person possessing appropriate qualifications and experience in the fields of hydrogeology and groundwater monitoring program design to be able to competently make recommendations about these matters; and
- Be constructed in accordance with methods prescribed in the latest edition of the Minimum Construction Requirements for Water Bores in Australia by an appropriately qualified and licensed water bore driller.



9.0 References

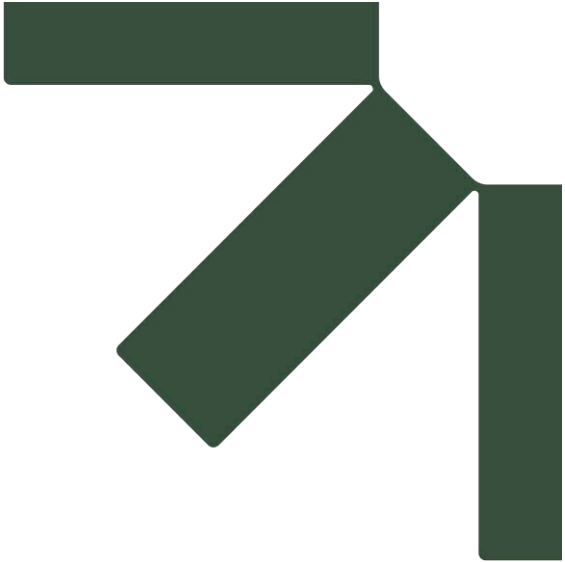
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Appendix A Groundwater Compliance 2024 Updated Limit and Trigger Development

New Lenton Coal Project

Groundwater Monitoring and Management Plan

Lenton Joint Venture

SLR Project No.: 620.040892.00001

2 October 2024



Groundwater Compliance 2024 Updated Limit and Trigger Development

New Lenton Coal Project

Lenton Joint Venture

GPO Box 1465, Brisbane 4000

Prepared by: Jade Darvell

SLR Consulting Australia

SLR Project No.: 620.040927.00001

25 September 2024

Revision: v3.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
v3.0	25 September 2024	Jade Darvell	Derwin Lyons	Derwin Lyons
v2.0	10 September 2024	Jade Darvell	Derwin Lyons	Derwin Lyons
v1.0	6 September 2024	Jade Darvell	Derwin Lyons	Derwin Lyons

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Lenton Joint Venture (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.



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Appendix D	Water Quality Summary Statistics (Outliers Removed) and Limit Derivation
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1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by the Lenton Joint Venture (LJV) to develop updated groundwater quality and level compliance limits and triggers as part of producing an updated Groundwater Monitoring and Management Plan (GMMP) for the New Lenton Coal Project (the Project). The GMMP is required to be updated to meet the Project's Environmental Authority (EA), Associated Water License (AWL), Progressive Rehabilitation and Closure Plan (PRCP) schedule conditions, and incorporate the Project's updated baseline dataset and groundwater impact assessment pursuant to the 2023 Public Environment Report (PER) that supersedes the Project's previous groundwater assessments developed for the EA, AWL and PRCP. In addition, the updated GMMP will support of the Project's Commonwealth approvals (EPBC 2020/8778), assessed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) by PER.

SLR previously prepared a groundwater assessment for the Project in 2020 in support of Queensland State approvals, namely an EA amendment application (SLR, 2020a) and an AWL application (SLR, 2020b), both of which were subsequently approved by the State. A PRCP was also prepared based on the groundwater assessment presented in SLR (2020a and 2020b), and subsequently approved by the State. The Project's most recent hydrogeological assessment and groundwater model – the PER Groundwater Assessment report (SLR, 2024a) – builds upon that 2020 body of work, however elements of the 2020 work remain appropriate, particularly the initial groundwater quality limit setting (SLR, 2020c). Therefore, the relevant parts of the 2020 work have also been adopted in this report.

The following report details the methodology used to develop the updated groundwater compliance limits and triggers, in accordance with the DES (2021) guideline *"Using monitoring data to assess groundwater quality and potential environmental impacts"*.



2.0 Methodology Overview

This report follows the structure prescribed in the DES (2021) groundwater assessment guideline. It is noted that although the focus of this guideline is on developing groundwater quality limits and triggers, the methodology and guidance has also been adopted for the development of groundwater level triggers. Relevant sections/chapters of DES (2021) and corresponding sections of this report addressing specific requirements of DES (2021) are listed in **Table 2-1**.

Table 2-1 Sections of the DES (2021) Guideline and Corresponding Sections of this Report

Section of DES (2021)		Sections of this report (or external reports) where requirements of DES (2021) have been addressed
Section 3: Understanding the system		The PER Groundwater Assessment developed by SLR (2024a) presents all information to meet the requirements of Chapter 2 of DES (2021). Section 3.0 Contaminants of Concern and Section 3.1 Environmental Values and Water Quality Objectives of this report summarises the identified environmental values (EV's) relevant to the Project and discusses the relevant chemical parameters to be assessed for protection of those EV's.
Section 4: Background information and data analysis	4.1 Site and bore characteristics	The PER Groundwater Assessment developed by SLR (2024a) presents all information to meet the requirements of Section 4.1 of DES (2021). Section 4.0 Bores and Site Characteristics of this report summarise bores details and locations used in this assessment.
	4.2 Water quality monitoring data analysis	Section 5.12.2 of the PER Groundwater Assessment developed by SLR (2024a) presents a comparison of the ionic composition of each bore. Section 5.0 Groundwater Quality Data Analysis of this report presents the remaining data analysis for water quality data undertaken in accordance with the 4-step methodology detailed in section 4.2 of DES (2021) for water quality data analysis. Section 7.0 Groundwater Level Data Analysis presents the data analysis for water level data following the guidance of the methodology detailed in section 4.2 of DES (2021) where applicable for water levels.
Section 5: Identify local groundwater quality triggers		Section 6.0 Groundwater Quality Limit Derivation follows the 4-step methodology detailed in Chapter 5 of DES (2021) to identify local (site-specific) groundwater quality limits. Section 7.4 Groundwater Level Trigger and Threshold Derivation presents the water level trigger and threshold derivation following the guidance of the methodology detailed in Chapter 5 of DES (2021) where applicable for water levels.



3.0 Contaminants of Concern

The contaminants of concern (CoCs) were assessed by SLR (2020c) for the most recent GMMP as part of the 2020 groundwater assessment for the Project, based upon the identification of applicable Environmental Values for groundwater. The PER Groundwater Assessment report (SLR, 2024a) builds upon this earlier body of work and does not provide any new information that suggests that the 2020 identification of CoCs is inappropriate or requires revision. Therefore, it is considered appropriate to adopt the 2020 definition of CoCs for the updated groundwater quality limit derivation and GMMP. The following **Section 3.1** to **Section 3.2** of this report present a summary of this work completed for the Project by SLR (2020c). It is noted that the work of SLR (2020c) references the previous version of the State guideline for developing water quality limits (DSITI, 2017), however, the references are still consistent in the most up to date version of this guideline (DES, 2021) and hence references have been updated for the following text to refer to the current guideline.

As discussed in SLR (2020c), the contaminants to be monitored and for which a groundwater quality limit should be imposed are selected based on:

1. Potential impact from the activity: Natural groundwater conditions could potentially be impacted by the alteration of physiochemical parameters or the increase in/introduction of chemical species as a result of the activity and;
2. Their relevance to protect identified Environmental Values (EV): The parameter/contaminant has been identified as necessary to protect an EV relevant to the project based on relevant guidelines and Water Quality Objectives (WQO) (e.g. ANZECC, 2000a).

Selected groundwater quality parameters to monitor and assess against relevant limits are summarised in **Table 3-1**. A detailed justification for the selection of these parameters is provided in the below sections.



Table 3-1 Selected water quality parameters to be monitored in groundwater

Parameter to be monitored	Limit required	Justification reported in SLR (2020c); see Section 3.1 to Section 3.2
Physiochemical parameters		
pH	Yes	Identified in DEHP (2011) and ANZECC (2000a) for the relevant EV's
EC	Yes	Identified in DEHP (2011) and ANZECC (2000a) for the relevant EV's
TDS	No	Identified in ANZECC (2000b) for the stock watering (cattle) EV
Metal and metalloids		
Aluminium	Yes	Identified in ANZECC (2000a) for the relevant EV's
Arsenic	Yes	Identified in ANZECC (2000a) for the relevant EV's
Boron	Yes	Identified in ANZECC (2000a) for the relevant EV's
Cadmium	Yes	Identified in ANZECC (2000a) for the relevant EV's
Chromium	Yes	Identified in ANZECC (2000a) for the relevant EV's
Cobalt	Yes	Identified in ANZECC (2000b) for the stock watering (cattle) EV
Copper	Yes	Identified in ANZECC (2000a) for the relevant EV's
Iron	No	Not identified in any relevant guideline for the relevant EV's
Lead	Yes	Identified in ANZECC (2000a) for the relevant EV's
Manganese	Yes	Identified in ANZECC (2000a) for the relevant EV's
Mercury	Yes	Identified in ANZECC (2000a) for the relevant EV's
Molybdenum	Yes	Identified in ANZECC (2000b) for the stock watering (cattle) EV
Nickel	Yes	Identified in ANZECC (2000a) for the relevant EV's
Selenium	Yes	Identified in ANZECC (2000a) for the relevant EV's
Silver	Yes	Identified in ANZECC (2000a) for the relevant EV's
Uranium	Yes	Identified in ANZECC (2000b) for the stock watering (cattle) EV
Vanadium	Yes	Identified in ANZECC (2000a) for the relevant EV's
Zinc	Yes	Identified in ANZECC (2000a) for the relevant EV's
Major Ions		
Sulfate	Yes	Identified in DEHP (2011) and in ANZECC (2000b) for the stock watering (cattle) EV
Calcium	Yes	Identified in ANZECC (2000b) for the stock watering (cattle) EV
Magnesium	No	Not identified in any relevant guideline for the relevant EV's
Potassium	No	Not identified in any relevant guideline for the relevant EV's
Carbonate	No	Not identified in any relevant guideline for the relevant EV's
Bicarbonate	No	Not identified in any relevant guideline for the relevant EV's
Sodium	No	Not identified in any relevant guideline for the relevant EV's
Chloride	No	Not identified in any relevant guideline for the relevant EV's
Non-Metallic Elements		
Ammonia	Yes	Identified in DEHP (2011) and ANZECC (2000a) for the relevant EV's
Other parameters		
Hardness	No	Identified in ANZECC (2000b) for the farm supply EV



3.1 Environmental values and water quality objectives

The relevant Environmental Values (EVs) for the Project pertaining to groundwater are summarised in the PER Groundwater Assessment report developed by SLR (2024a) as follows.

Groundwater resources within the vicinity of the Project are scheduled under the Queensland *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (under the *Environmental Protection Act 1994*) as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). The legislated Environmental Values (EVs) for these groundwaters are:

- Biological integrity of aquatic ecosystems – these occur where groundwater baseflow supports streams and water holes to some extent (e.g. seasonally or permanently).
- Human use EVs:
 - Suitability of water supply for irrigation – where groundwater is used to grow crops and pastures for commercial purposes.
 - Farm water supply/use – where groundwater is used to provide domestic supply and support growing of domestic produce.
 - Stock watering – where groundwater is used to provide stock water supplies.
 - Drinking water supply – where groundwater is used for potable water supply.
 - Primary recreation – where groundwater supports recreational use that involves direct contact and a high probability of being swallowed, e.g. diving, swimming, water skiing.
 - Cultural and spiritual values – where groundwater supports both indigenous and non-indigenous values, e.g. recreational fishing, heritage, ecology.

The *Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part)*, including all waters of the Isaac River Sub-basin (including Connors River) (WQ1310; DEHP, 2011) provides Water Quality Objectives (WQO) for surface water and groundwater relevant to the Project Area. WQOs are long-term goals for water quality management and the purpose of the WQOs is to support and protect EVs. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural, economic). Where groundwater quality analysis results exceed a particular WQO for a particular EV, it is considered indicative that the groundwater may be unsuitable for supporting that particular EV.

WQ1310 also provides limited WQOs specifically for aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs vary across the Fitzroy Basin and are defined on the basis of groundwater Chemistry Zones. These WQOs are classified by groundwater depth ('shallow' being <30 m depth, and 'deep' being >30 m depth). However, the Project Area lies outside of any of the defined Chemistry Zones within WQ1310, noting that Chemistry Zones are not defined in areas where there is insufficient information available to establish a WQO (DEHP, 2011). In the absence of any defined WQO relevant to the Project Area in WQ1310 for aquatic ecosystem protection in groundwaters, the ANZG (2018) guideline for aquatic ecosystem protection for slightly to moderately disturbed systems (95% level of protection) is an appropriate surrogate indicator.

With respect to the above EVs/WQOs and existing Project groundwater monitoring data, SLR (2024a) found that:



- Alluvium monitoring bore data generally suggests that alluvial groundwater from the Project Area is unsuitable for supporting the irrigation water EV with respect to fluoride, boron, iron, manganese, molybdenum or uranium. Alluvium groundwater data also generally indicates it is not suitable for supporting the aquatic ecosystems EV with respect to boron, chromium, cobalt, copper, nickel, uranium, vanadium or zinc. The 80th percentile values at the alluvial bores did not exceed any of the stock watering EV guidelines, except for EC (salinity) at GW06, suggesting that alluvial groundwater is mostly suitable for stock watering.
- Regolith monitoring bore data generally suggests that groundwater from the regolith is unsuitable supporting the irrigation water EV with respect to boron, iron, manganese or uranium. Regolith groundwater data also suggests that is generally unsuitable to support the aquatic ecosystems EV with respect to cobalt, copper, nickel, uranium or zinc. The data also suggests that regolith groundwater is generally unsuitable for supporting the stock watering EV with respect to EC (salinity).
- Groundwater quality data from the bore screened in the basalt (GW20) suggests that it is not suitable for supporting the aquatic ecosystems EV with respect to pH, cadmium and copper. The 80th percentile statistics for this bore did not exceed any of the stock watering or irrigation EV guidelines, suggesting that the basalt groundwater is suitable for supporting the stock watering and irrigation EVs.
- As with the Alluvium and Regolith, Permian monitoring bore data generally suggests that Permian groundwater at the Project Area is also unsuitable supporting the irrigation EV with respect to fluoride, boron, iron, manganese or molybdenum and the aquatic ecosystems EV with respect to pH, aluminium, arsenic, boron, cobalt, copper, molybdenum, uranium or zinc. The 80th percentile values at the Permian bores are above the stock watering EV with respect to EC (salinity) at four out of eleven bores, suggesting that Permian groundwater is suitable to support stock watering across most Permian bores, but approximately one third of Permian bores report groundwater salinities above stock tolerance levels.

As mentioned above, the earlier work by SLR (2020c) is directly applicable to developing the updated groundwater quality limits for the Project. The work by SLR (2020c) included an assessment in relation to GMMP groundwater quality limit setting for the above applicable EVs. The following **Sections 3.1.2 to 3.2.4** of this report present a summary of the previous work by SLR (2020c).

3.1.1 Applicable EVs

Previous hydrogeological studies conducted for the Project (GHD, 2019) concluded that Irrigation, Recreation, Drinking Water and Cultural/Spiritual EV's were not relevant to the Project area and surrounds, due to lack of evidence for the presence of those EV's. The three EV's that apply to groundwater at the Project were therefore identified as:

- Biological integrity of Aquatic Ecosystems;
- Farm Supply; and
- Stock Watering.

3.1.2 Aquatic Ecosystems

The WQ1310 (DEHP, 2011) provides WQO for surface water and groundwater. WQO for aquatic ecosystem protection in groundwater within WQ1310 are based on aquifer depth and defined chemistry zones. For each chemistry zone, WQO are provided as statistical distribution (percentiles) of pooled data from bores screened in each zone. The Project,



however, is located in an area where no chemistry zone has been defined within WQ1310, likely due to insufficient background data availability at the time of publication of DEHP (2011). Consequently, no previously defined WQO for aquatic ecosystem protection are available for the Project groundwaters.

Nevertheless, variation of groundwater levels in alluvium bores indicates potential connectivity between the Quaternary alluvium aquifer and the ephemeral waters of the Isaac River, albeit in the direction of River recharge into the alluvium and not discharge from alluvial groundwater into the river. Additionally, there may also be hydraulic connection between the alluvial aquifer and the underlying Permian coal measures aquifer, again in a downwards flow direction. As such, surface water WQO for the protection of aquatic ecosystems as defined for the Upper Isaac River Catchment Waters (moderately disturbed aquatic ecosystems) can be considered to apply to the groundwater at the Project. These WQO are defined for physiochemical and biological parameters (DEHP 2011, table 2, p11). For toxicants such as metal and metalloids, in the absence of WQO for these within DEHP (2011), the ANZG (2018) guidelines WQO for aquatic ecosystem protection are relevant to the Project groundwaters. DES (2021) states: *“The use of ANZG 2018 default guideline values for metals or toxicants often provides a conservative approach to protect surface and groundwater.”*

3.1.3 Farm Supply

Farm supply refers to farm uses other than drinking water, Irrigation and stock watering. WQO for general agricultural water uses are not specific to regional areas and are defined in the national water quality guidelines (ANZECC, 2000b). They are mainly associated with physiochemical parameters with potential for corrosion and fouling of farm equipment such as hardness and salinity. WQO for Farm supply are somewhat less conservative than aquatic ecosystem or stock watering for physiochemical parameters.

3.1.4 Stock Watering

WQO for the stock watering EV aim at protecting drinking water quality to minimise risk to stock health. In and surrounding the Project area, cattle are the most prevalent type of stock. WQO for stock water (cattle) are based on potential health impact on individual species and are therefore not specific to regional areas. The WQO for stock as defined in the regional guideline (DEHP, 2011) are based on national WQO as defined in ANZECC (2000b). WQO are available for salinity (TDS) and several toxicants (metals). Since these WQO are for drinking water (i.e. water is ingested), total metal concentration is used.

3.2 Selected water quality analytes and parameters

The following provides the selected groundwater quality analytes and parameters relevant to the groundwater quality limit setting, based on the information provided in the above sections.

3.2.1 Physiochemical parameters

pH and salinity are the two main physiochemical parameters used to assess overall groundwater quality. TDS and EC are both a measure of salinity and thus do not need to be both measured. EC is the parameter selected by DEHP (2011) to provide WQOs for the Fitzroy Sub Basin surface and groundwaters. pH and EC should therefore be monitored and assessed against relevant limits.



3.2.2 Major Ions

DES (2021) states: *“regardless of the activity, major anions and cations should be monitored for all bores in order to characterise the groundwater. Such data allows the ionic signature to be compared between bores, which will assist in identifying whether reference and test bores are chemically comparable”*

Major ion concentrations are directly correlated with salinity (EC/TDS). If EC has an associated limit, it is thus not relevant to include additional limits to individual ions except for:

- Sulfate, as it can allow early detection of mining impact (Rikard and Kunkle, 1990) and can also have adverse effect on stock at concentration above 1,000 mg/L (ANZECC, 2000b); and
- Calcium, as it can have adverse effect on stock at concentration above 1,000mg/L (ANZECC, 2000b).

However, in accordance with DES (2021) it is considered that major ion concentrations add considerable value in the interpretation of groundwater quality and thus should be included in routine monitoring for interpretive purposes only (i.e. no limits except for Sulfate and Calcium (i.e. for the stock watering EV)).

3.2.3 Metal and Metalloids

All metal and metalloids identified as potential stressor and for which a guideline value is available either from Aquatic ecosystem protection ANZG (2018) or Stock Watering (DEHP, 2011) should be included in routine monitoring. These are: aluminium, arsenic, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, uranium, vanadium and zinc.

3.2.4 Ammonia

Ammonia is identified as a potential contaminant of concern and a guideline is available for DEHP (2011) and therefore should be monitored.



4.0 Bores and Site Characteristics

Detailed site characteristics as well as a conceptual hydrogeological model of the Project site are provided in SLR (2024a). Details of the bores used for this updated limit and trigger assessment are summarised in **Table 4-1** and locations shown in **Figure 4-1**.

As shown in **Table 4-1**, the proposed updated GMMP monitoring network is based on consideration of the previous GMMP (SLR, 2020d), but updated to consider the relevant conditions of the current EA and updated groundwater modelling and impact assessment results provided in SLR (2024a). As shown in the table, the only change to the network from the previous GMMP (SLR, 2020d) is that bore GW07 (alluvium) is now included in the updated GMMP as a compliance bore for consistency with the current EA, whereas in the previous GMMP it was denoted as a reference bore.

Groundwater limit and trigger derivation has been undertaken in this report and are proposed for the compliance bores listed in **Table 4-1** as follows:

- Groundwater quality limit – proposed for all compliance bores (**Section 6.1.2**);
- Groundwater level reference levels and level trigger thresholds – proposed for compliance bores, except for those that are dry (**Sections 7.4 and 7.5**).



Table 4-1 Project GMMP Monitoring Network

Bore	Easting ¹	Northing ¹	Casing RL (mAHD)	Bore Depth	Screen (mBGL)	Aquifer	Status	Current AWL / GMMP ²	Current EA Bore	Proposed Updated GMMP Bore
GW01	617299	7618210	326.8	15.2	6.17 – 12.17	Alluvium	Dry	Reference	Interpretation	Reference
GW19	612323	7620097	376.7	26.5	22.9 – 25.9	Alluvium/Regolith	Dry	Reference	Not in current EA	Reference
GW20	612676	7618392	355.5	33.9	24 – 30	Basalt	Active	Reference	Not in current EA	Reference
GW22	614463	7622201	401.7	11.6	5 – 8	Alluvium	Dry	Reference	Not in current EA	Reference
GW23	617807	7622169	369.9	11.6	5 – 8	Alluvium	Dry	Reference	Not in current EA	Reference
GW06	618097	7616723	313.9	20.6	3.6 – 18.6	Alluvium	Dry	Compliance	Compliance	Compliance
GW03	618094	7614389	307.6	12.1	3.1 – 12.1	Alluvium	Dry	Compliance	Compliance	Compliance
GW09	617525	7614070	307.1	24	6 – 18	Alluvium	Dry	Compliance	Compliance	Compliance
GW19_37a	618034	7615771	309.6	26	16.5 – 20.0	Alluvium	Active	Compliance	Compliance	Compliance
GW08	617041	7613900	306.7	11.7	5.72 – 8.72	Alluvium	Dry	Compliance	Compliance	Compliance
GW07	617640	7613075	299.5	24.5	9 – 18	Alluvium	Active	Reference	Compliance	Compliance
GW26	619185	7616679	315.7	9.6	6 – 9	Alluvium	Dry (TBC)	Compliance	Not in current EA	Compliance



Bore	Easting ¹	Northing ¹	Casing RL (mAHD)	Bore Depth	Screen (mBGL)	Aquifer	Status	Current AWL / GMMP ²	Current EA Bore	Proposed Updated GMMP Bore
GW19_33	618664	7617348	312	16	11.1 – 12.6	Alluvium/Regolith	Active	Compliance	Compliance	Compliance
GW30c	618094	7617368	318.2	31.1	23 – 29	Regolith	Active	Compliance	Compliance	Compliance
GW31b	617621	7617680	322	21.2	17 – 20	Regolith	Active	Compliance	Compliance	Compliance
GW30b	618088	7617382	318.5	76.2	70 – 73	Permian (Burton Seam)	Active	Compliance	Compliance	Compliance
GW10	616032	7617014	335.2	205.1	178.16–190.16	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW13	616881	7615480	319.3	192.4	170.5 – 179.5	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW30a	618084	7617395	318.5	112.2	97 – 109	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW31a	617624	7617680	321.9	165.2	153 – 162	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW11	616294	7616680	332.3	150	114 – 126	Permian (L/V Seam)	Active	Compliance	Compliance	Compliance
GW29a	618081	7616561	313.6	83.6	62 – 80	Permian (sandstone)	Active	Compliance	Compliance	Compliance

1 Coordinates are GDA94 z55

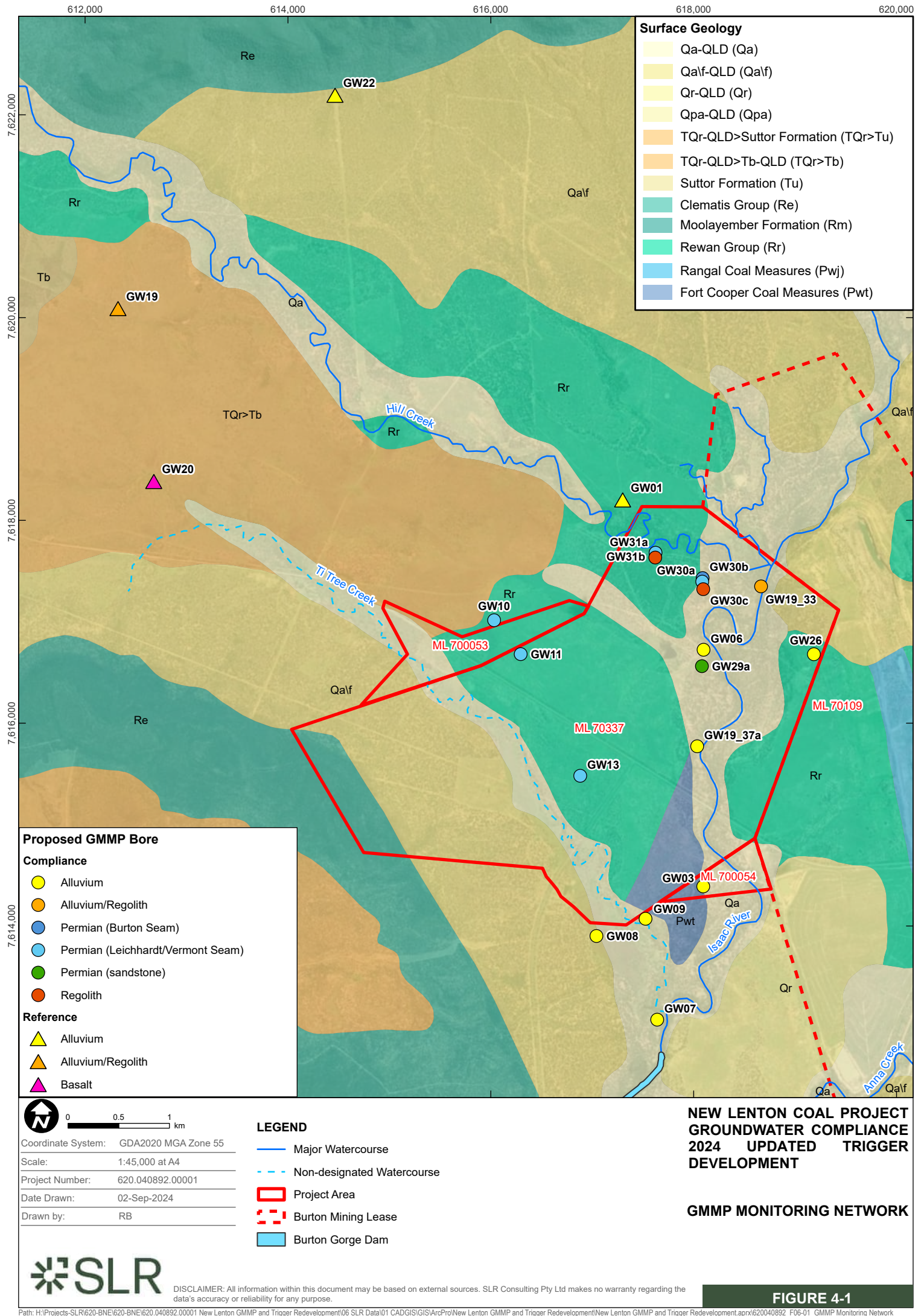
* Ground level

L/V = Leichhardt / Vermont Seam

TBC = To be confirmed

2 Current AWL SLR (2020b) and previous GMMP SLR (2020d)





5.0 Groundwater Quality Data Analysis

This section presents the development of updated groundwater quality statistics for the GMMP compliance bores presented in **Table 4-1** and the relevant water quality analytes as discussed in **Section 3.2**. Analysis of updated baseline groundwater quality data was undertaken as per the four-step methodology detailed in Section 4 of DES (2021).

5.1 Summary Statistics

Appendix A presents statistics for relevant groundwater quality parameters at the GMMP compliance monitoring network bores that have data (see **Table 4-1**).

The summary statistics include number of samples analysed; outlier count; minimum and maximum values and 5th, 20th, 50th, 80th and 95th percentile for each parameter analysed and trend analysis using non-seasonal Mann-Kendall test. These statistics have been performed on the raw dataset, i.e. statistical outliers are identified according to Tukey's Method, but are not removed from the dataset at this stage.

5.2 Time Series and Box Plot Analysis

Time series plots for the relevant analyte data from each bore are provided in **Appendix B**.

Box plots are provided in **Appendix C** to visualise differences between bores, the data spread, where statistical outliers are identified, and to compare with the relevant EV protection water quality default guideline. Box plots for each parameter indicate the median, 25th, 75th percentile and statistical outliers, for the available dataset for each bore.

5.2.1 Outlier Analysis

Outliers have been statistically screened using Tukey's method (1977) and are reported in the summary statistics (**Appendix A**) as total count.

As recommended by DES (2021), each detected outlier was further investigated. This was done manually by conducting a visual assessment of each outlier on the time series plots. The datapoints that were assessed as still being outliers visualised in **Appendix B**. Updated summary statistics (i.e. without manually screened outliers) are provided in **Appendix D**.

5.2.2 Trend Analysis

The non-seasonal Mann-Kendall statistical trend test was used to detect potential trends in the dataset (filtered dataset with manual outliers removed, refer to **Section 5.2.1**), with the results provided in **Table 5-1** (and **Appendix D**).

The Mann-Kendal test is used as a first pass check if a dataset contains a statistically significant trend that warrants further analysis to assess if a real trend exists, and therefore the data may be inappropriate to use in the derivation of site-specific limits. Interpretation of Mann-Kendall results relies on the p-value and the Kendall rank correlation coefficient, tau. A p-value less than 0.05 means that there is statistically significant trend in the data. The Kendall rank correlation coefficient (tau) shows the relation between the variance of data, with a positive tau indicating an increasing trend and a negative tau indicating a decreasing trend. If the p-value is greater than 0.05, no statistically significant trend is present in the data.



Table 5-1 Mann Kendall Trend Test

Analyte	GW06	GW03	GW09	GW19_37a	GW08	GW07	GW26	GW19_33	GW30c	GW31b	GW30b	GW10	GW13	GW30a	GW31a	GW11	GW29a
pH (Field)	No Trend	N/A	No Trend	Downward	N/A	Upward	N/A	No Trend	No Trend	No Trend	Downward	No Trend	No Trend	No Trend	No Trend	Upward	No Trend
EC (Lab)	Upward	N/A	Upward	No Trend	N/A	No Trend	N/A	No Trend	No Trend	Upward	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
Ca	Upward	N/A	Upward	Downward	N/A	No Trend	N/A	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend	Downward	No Trend
NH ₃ -N	N/A	N/A	No Trend	No Trend	N/A	No Trend	N/A	No Trend	No Trend	No Trend	No Trend	No Trend	Downward	No Trend	No Trend	No Trend	No Trend
SO ₄	No Trend	N/A	No Trend	No Trend	N/A	No Trend	N/A	No Trend	No Trend	Downward	Downward	Downward	No Trend	Downward	Downward	Downward	No Trend
Al	No Trend	N/A	No Trend	No Trend	N/A	Downward	N/A	No Trend	Downward	Downward	No Trend	Downward	Downward	Downward	No Trend	Downward	No Trend
As	No Trend	N/A	No Trend	No Trend	N/A	Downward	N/A	No Trend	Downward	Downward	Downward	No Trend	Downward	Downward	Downward	No Trend	No Trend
B	No Trend	N/A	No Trend	No Trend	N/A	No Trend	N/A	No Trend	No Trend	No Trend	No Trend	Downward	No Trend	No Trend	No Trend	No Trend	No Trend
Cd	No Trend	N/A	Downward	Downward	N/A	Downward	N/A	Downward	No Trend	Downward	No Trend	Downward	No Trend	No Trend	Downward	Downward	Downward
Co	No Trend	N/A	No Trend	Downward	N/A	No Trend	N/A	No Trend	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
Cr	No Trend	N/A	No Trend	No Trend	N/A	Downward	N/A	Downward	Downward	Downward	Downward	Upward	Downward	Downward	Downward	Downward	Downward
Cu	No Trend	N/A	No Trend	No Trend	N/A	No Trend	N/A	No Trend	Downward	Downward	No Trend	No Trend	Downward	No Trend	No Trend	No Trend	No Trend
Hg	No Trend	N/A	No Trend	Downward	N/A	Downward	N/A	Downward	Downward	Downward	No Trend	Downward	Downward	No Trend	Downward	Downward	Downward
Pb	No Trend	N/A	No Trend	Downward	N/A	Downward	N/A	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
Mn	Upward	N/A	No Trend	Downward	N/A	No Trend	N/A	No Trend	No Trend	Upward	Upward	Upward	Upward	Downward	Downward	Downward	No Trend
Mo	N/A	N/A	N/A	No Trend	N/A	No Trend	N/A	No Trend	Downward	No Trend	No Trend	No Trend	Downward	No Trend	No Trend	No Trend	No Trend
Ni	No Trend	N/A	No Trend	No Trend	N/A	No Trend	N/A	No Trend	No Trend	Upward	Downward	No Trend	No Trend	Downward	No Trend	Upward	No Trend
Ag	No Trend	N/A	No Trend	Downward	N/A	Downward	N/A	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
Se	No Trend	N/A	No Trend	Downward	N/A	Downward	N/A	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
U	No Trend	N/A	No Trend	No Trend	N/A	No Trend	N/A	No Trend	No Trend	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
V	No Trend	N/A	No Trend	No Trend	N/A	Downward	N/A	No Trend	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward	Downward
Zn	No Trend	N/A	No Trend	No Trend	N/A	No Trend	N/A	No Trend	No Trend	No Trend	No Trend	No Trend	Upward	No Trend	No Trend	No Trend	No Trend

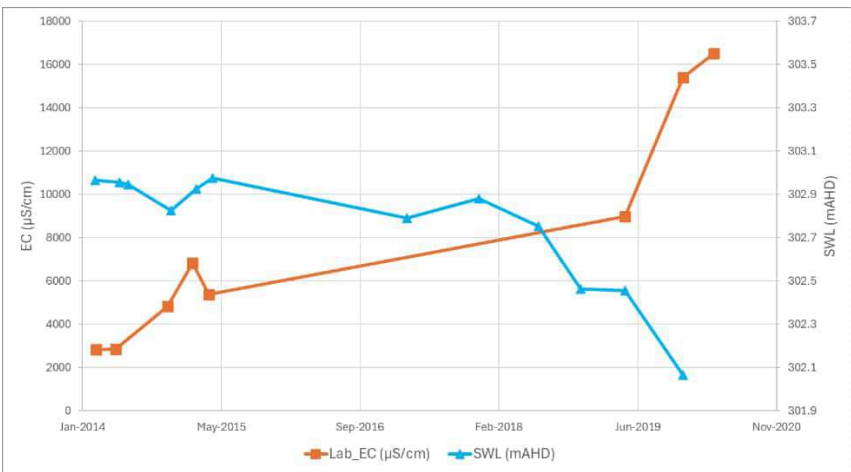
N/A = Grey highlight - not applicable, insufficient number of data points to assess trend
No Trend = Blue highlight – Mann Kendall test did not identify statistically significant trend
Upward = Orange highlight – Mann Kendall test identified positive trend
Downward = Green highlight - Mann Kendall test identified negative trend
Note: Dissolved metals



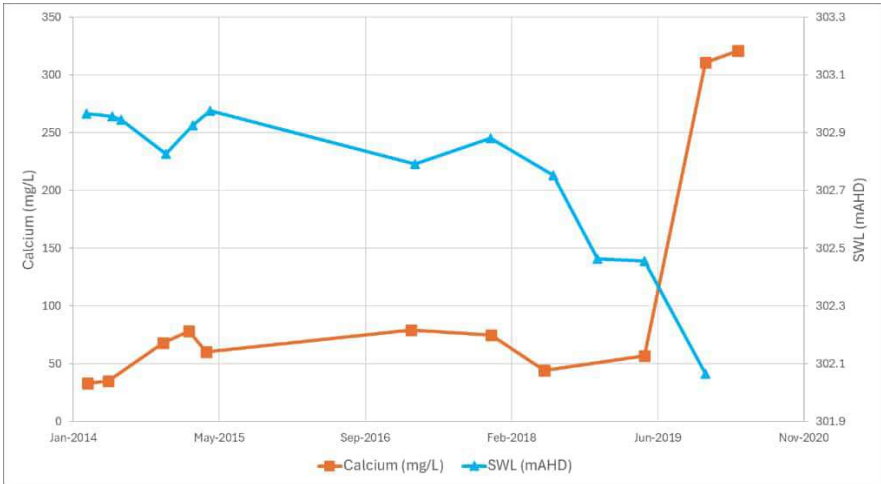
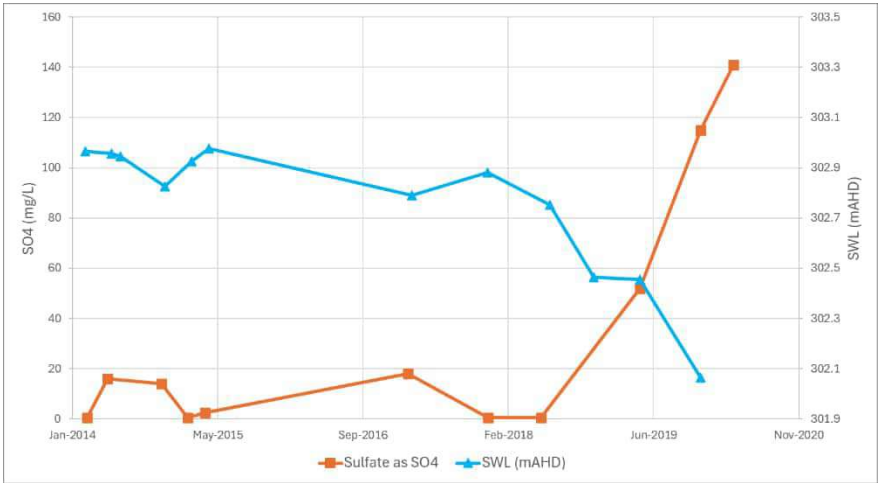
As shown in **Table 5-2**, the Mann-Kendall test has identified increasing trends for some bores/parameters.

In accordance with the DES (2021) guideline, bores with increasing trends also need to be investigated for mining influence before site-specific limits can be derived from the dataset. Additionally, decreases to groundwater pH are relevant to the mobilisation of metals and hence any decreasing trends for pH were also investigated for mining influence. It is noted that the Project's mining activities have not yet commenced and so it is considered very unlikely that the trends observed can be a result of Project activities. Records of sampling methodologies are not available to SLR and so it remains possible that in addition to natural variability, the trends may be related to sampling practices. An assessment of those bores with parameters with increasing trends identified by the Mann-Kendall test is provided in **Table 5-2**.

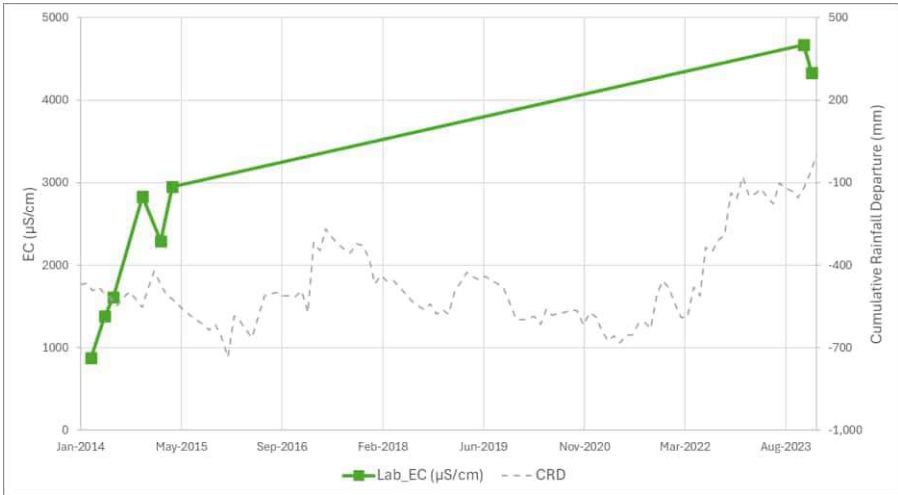
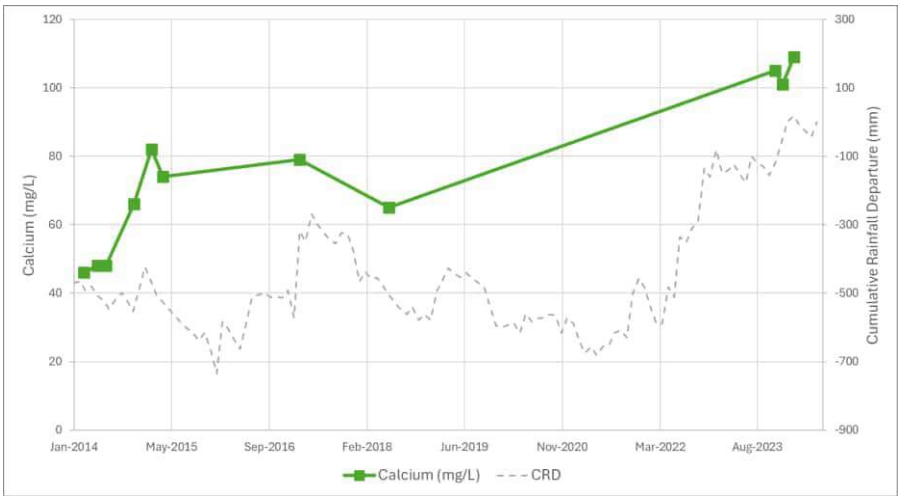
Table 5-2 Man Kendall Trend Test

Bore	Analyte	Trend Assessment
GW06	EC (lab)	The data shows a statistically significant upward trend in parallel with decreasing water level before the bore went dry. The trend is interpreted to be due the bore going dry, however the data can not be used for limit derivation as the upwards trend is in the last few measurements and is already above the 95th percentile of the dataset which would be used for a site-specific limit. Therefore limits at this bore for analytes with increasing trends are TBD and would be established if the bore becomes saturated, following stabilisation of data. 

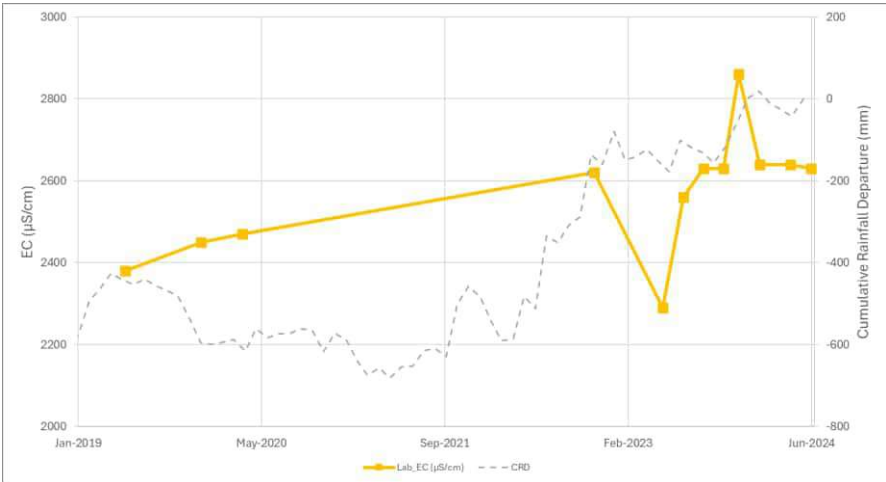


Bore	Analyte	Trend Assessment
GW06	Calcium	The data shows a statistically significant upward trend in parallel with decreasing water level before the bore went dry. The trend is interpreted to be due the bore going dry, however the data can not be used for limit derivation as the upwards trend is in the last few measurements and is already above the 95th percentile of the dataset which would be used for a site-specific limit. Therefore limits at this bore for analytes with increasing trends are TBD and would be established if the bore becomes saturated, following stabilisation of data. 
GW06	SO ₄	The data shows a visual trend in the upwards direction in the last few measurements. As above the trend is in parallel with the bore going dry and limits are TBD for trending analytes. 
GW06	Manganese (dissolved)	The data was not used for limit derivation (due to the 80th percentile being less than the default guideline, refer to Section 6.1.1.15) and hence the trend is not relevant in this setting.
GW07	pH (field)	The data was not used for limit derivation (due to the 80th percentile being not substantially different to the default guideline, refer to Section 6.1.1.1) and hence the trend is not relevant in this setting.

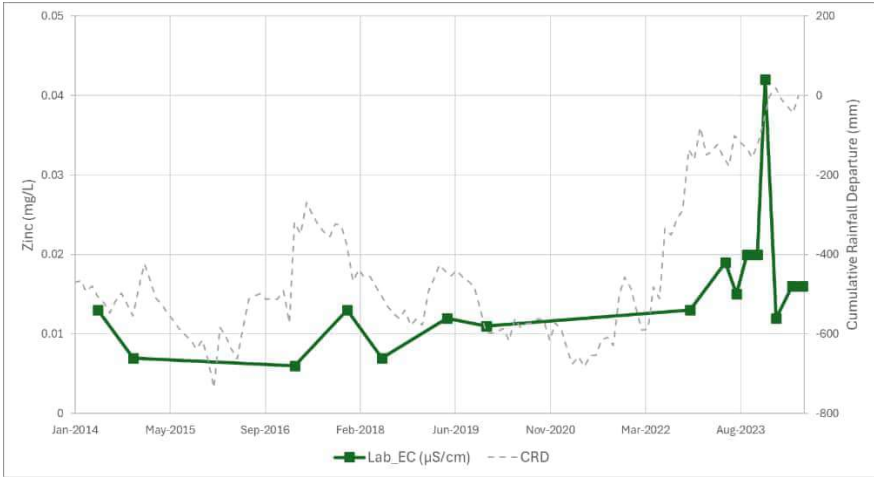


Bore	Analyte	Trend Assessment
GW09	EC (lab)	The data shows a statistically significant upward trend. The trend is interpreted to be due the bore going dry, however the data can not be used for limit derivation as the upwards trend is in the last few measurements and is already above the 95th percentile of the dataset which would be used for a site-specific limit. Therefore limits at this bore for analytes with increasing trends are TBD and would be established if the bore becomes saturated, following stabilisation of data. 
GW09	Calcium	The data shows a visual trend in the upwards direction in the last few measurements. As above the trend is in parallel with the bore going dry and limits are TBD for trending analytes. 
GW19_37a	pH (field)	The data was not used for limit derivation (due to the 80th percentile being not substantially different to the default guideline, refer to Section 6.1.1.1) and hence the trend is not relevant in this setting.



Bore	Analyte	Trend Assessment
GW31b	EC (lab)	The dataset shows a statistically significant upward trend, however the magnitude of change is considerably small and the trend appears to have now halted. It is therefore proposed to use the dataset to derive site-specific limits. 
GW31b	Manganese (dissolved)	The data was not used for limit derivation (due to the 80 th percentile being less than the default guideline, refer to Section 6.1.1.15) and hence the trend is not relevant in this setting.
GW31b	Nickel (dissolved)	The data was not used for limit derivation (due to the 80 th percentile being less than the default guideline, refer to Section 6.1.1.17) and hence the trend is not relevant in this setting.
GW30b	pH (field)	The data was not used for limit derivation (due to the 80 th percentile being not substantially different to the default guideline, refer to Section 6.1.1.1) and hence the trend is not relevant in this setting.
GW30b	Manganese (dissolved)	The data was not used for limit derivation (due to the 80 th percentile being less than the default guideline, refer to Section 6.1.1.15) and hence the trend is not relevant in this setting.
GW10	Chromium (dissolved)	The data was not used for limit derivation (due to insufficient data, refer to Section 5.3) and hence the trend is not relevant in this setting.
GW10	Manganese (dissolved)	The data was not used for limit derivation (due to the 80 th percentile being less than the default guideline, refer to Section 6.1.1.15) and hence the trend is not relevant in this setting.
GW13	Manganese (dissolved)	The data was not used for limit derivation (due to the 80 th percentile being less than the default guideline, refer to Section 6.1.1.15) and hence the trend is not relevant in this setting.



Bore	Analyte	Trend Assessment
GW13	Zinc (dissolved)	The dataset shows a statistically significant upwards trend however appears to have stabilised within the most recent measurements. It is therefore proposed to use the dataset to derive site-specific limits. 
GW11	pH (field)	The data was not used for limit derivation (due to the 80th percentile being not substantially different to the default guideline, refer to Section 6.1.1.1) and hence the trend is not relevant in this setting.
GW11	Nickel (dissolved)	The data was not used for limit derivation (due to the 80th percentile being less than the default guideline, refer to Section 6.1.1.17) and hence the trend is not relevant in this setting.



5.3 Number of Relevant Sampling Events

The first step to identifying site-specific guidelines (and therefore limits) for groundwater quality (DES, 2021; Section 5) is to confirm the number of sampling events (data points) available for each bore and analyte. DES (2021) recommends a minimum of 18 samples over at least 12 months but allows using eight or more samples to derive site specific guidelines. **Table 5-3** shows the number of samples for each bore and analyte in the filtered dataset (outliers removed).

Further, the DES (2021) guideline specifies a limit of 10 to 15 percent of values below the laboratory limit of reporting (LOR) for a dataset to be suitable to derive site specific limits from. **Table 5-4** shows the percentage of samples below LOR.

Table 5-5 shows the number of datapoints remaining excluding LOR greater than 15%. **Green** highlighted cells indicate that the data set is sufficient for site specific limit derivation for the particular bore and parameter, in accordance with DES (2021) requirements.

In accordance with the DES (2021) guideline, if more than eight samples were available, then values below LOR were removed before recalculating statistics if over 15 percent of the dataset. The results of the below analysis show that this applies at GW07 (for copper and zinc), GW19_33 (for boron and cobalt), GW30b (for nickel), GW10 (for sulfate, nickel and zinc), GW13 (for nickel), GW30a (for nickel), GW31 (for aluminium), GW11 (for sulfate, nickel and zinc) and GW29a (for nickel).

The updated summary statistics after removing the below LOR values if greater than 15% of the dataset and manually screened outliers in accordance with DES (2021) are provided in **Appendix D**.



Table 5-3 Number of Relevant Sampling Events

Analyte	pH (Field)	EC (Lab)	Ca	NH ₃ -N	SO ₄	Al	As	B	Cd	Co	Cr	Cu	Hg	Pb	Mn	Mo	Ni	Ag	Se	U	V	Zn
GW06	9	8	11	3	11	8	7	7	7	6	7	7	8	8	7	0	7	7	8	7	7	7
GW03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW09	7	9	11	4	11	7	7	6	7	5	7	6	7	7	6	3	7	5	7	6	6	7
GW19_37a	11	11	7	6	11	9	11	10	11	10	10	10	11	10	11	8	11	10	11	11	7	9
GW08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW07	19	18	17	9	21	16	18	17	14	17	18	18	18	17	17	7	18	16	18	17	13	17
GW26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW19_33	10	10	8	6	10	9	9	10	10	10	9	9	10	10	9	8	10	9	10	9	7	9
GW30c	13	12	9	8	13	13	13	13	13	13	13	13	13	13	13	9	13	12	13	13	9	11
GW31b	13	12	9	7	13	13	13	13	13	13	13	12	13	13	13	9	13	12	13	13	9	13
GW30b	13	12	9	8	11	13	10	12	13	12	13	13	13	13	13	9	13	12	13	13	9	13
GW10	16	15	15	10	18	13	15	15	15	15	16	16	16	16	15	8	16	14	16	15	12	16
GW13	17	16	15	10	19	15	17	15	16	15	17	15	17	17	16	9	16	15	17	16	12	17
GW30a	12	11	9	8	12	11	12	11	12	11	12	12	12	12	12	8	12	11	12	12	9	12
GW31a	12	11	9	8	12	11	12	12	12	12	12	11	12	12	12	8	12	11	12	12	9	12
GW11	19	14	15	9	19	14	16	15	17	16	17	16	17	17	16	9	16	15	17	16	12	16
GW29a	11	11	8	6	11	10	11	10	11	10	10	9	11	10	10	8	10	10	11	10	8	10

Note: Dissolved metals



Table 5-4 Percent of Datapoints below LOR

Analyte	pH (Field)	EC (Lab)	Ca	NH ₃ -N	SO ₄	Al	As	B	Cd	Co	Cr	Cu	Hg	Pb	Mn	Mo	Ni	Ag	Se	U	V	Zn
GW06	0	0	0	0	45	100	14	0	100	100	100	86	100	100	14	N/A	29	100	100	14	100	71
GW03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW09	0	0	0	0	0	100	14	0	86	60	86	33	100	100	0	0	29	100	100	0	33	43
GW19_37a	0	0	0	0	0	78	0	0	100	50	80	30	100	100	0	0	9	100	100	9	71	33
GW08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW07	0	0	0	0	0	100	72	0	100	0	94	44	100	94	0	0	0	100	94	0	62	35
GW26	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW19_33	0	0	0	0	0	89	44	20	100	20	78	22	100	100	0	13	0	100	100	33	29	11
GW30c	0	0	0	0	0	92	69	0	100	77	85	92	100	100	0	44	46	100	85	46	78	82
GW31b	0	0	0	0	0	92	92	0	92	92	77	92	100	100	0	33	46	100	100	0	44	46
GW30b	0	0	0	0	45	62	30	0	100	75	92	62	100	100	0	22	15	100	100	100	100	0
GW10	0	0	0	0	56	85	0	0	100	87	63	63	100	94	0	0	31	100	100	67	67	44
GW13	0	0	0	0	63	100	0	0	100	93	100	73	100	100	0	0	31	93	94	100	83	0
GW30a	0	0	0	0	67	91	50	0	100	100	100	58	100	100	0	25	33	100	100	92	100	0
GW31a	0	0	0	0	83	18	0	0	100	100	100	64	100	100	25	0	50	100	100	92	100	42
GW11	0	0	0	0	47	100	81	0	100	88	94	81	100	100	0	33	44	100	100	100	58	25
GW29a	0	0	0	0	73	80	0	0	100	70	100	67	100	100	0	13	20	100	91	100	100	0

N/A = Not applicable, no data available

Note: Dissolved metals



Table 5-5 Number of Datapoints Remaining

Analyte	pH (Field)	EC (Lab)	Ca	NH ₃ -N	SO ₄	Al	As	B	Cd	Co	Cr	Cu	Hg	Pb	Mn	Mo	Ni	Ag	Se	U	V	Zn
GW06	9	8	11	3	6	0	7	7	0	0	0	1	0	0	7	0	5	0	0	7	0	2
GW03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW09	7	9	11	4	11	0	7	6	1	2	1	4	0	0	6	3	5	0	0	6	4	4
GW19_37a	11	11	7	6	11	2	11	10	0	5	2	7	0	0	11	8	11	0	0	11	2	6
GW08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW07	19	18	17	9	21	0	5	17	0	17	1	10	0	1	17	7	18	0	1	17	5	11
GW26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW19_33	10	10	8	6	10	1	5	8	0	8	2	7	0	0	9	8	10	0	0	6	5	9
GW30c	13	12	9	8	13	1	4	13	0	3	2	1	0	0	13	5	7	0	2	7	2	2
GW31b	13	12	9	7	13	1	1	13	1	1	3	1	0	0	13	6	7	0	0	13	5	7
GW30b	13	12	9	8	6	5	7	12	0	3	1	5	0	0	13	7	11	0	0	0	0	13
GW10	16	15	15	10	8	2	15	15	0	2	6	6	0	1	15	8	11	0	0	5	4	9
GW13	17	16	15	10	7	0	17	15	0	1	0	4	0	0	16	9	11	1	1	0	2	17
GW30a	12	11	9	8	4	1	6	11	0	0	0	5	0	0	12	6	8	0	0	1	0	12
GW31a	12	11	9	8	2	9	12	12	0	0	0	4	0	0	9	8	6	0	0	1	0	7
GW11	19	14	15	9	10	0	3	15	0	2	1	3	0	0	16	6	9	0	0	0	5	12
GW29a	11	11	8	6	3	2	11	10	0	3	0	3	0	0	10	8	8	0	1	0	0	10

Green highlight = number of datapoints is sufficient for site-specific limit derivation

Orange highlight = number of datapoints is insufficient due to greater than 15% of the dataset below LOR as per DES (2021)

Note: Dissolved metals



6.0 Groundwater Quality Limit Derivation

Updated groundwater quality limit derivation was undertaken as per the four-step methodology detailed in Section 5 of DES (2021).

The filtered (outliers removed) dataset summary statistics shown in **Appendix D** were used in the following **Section 5.3** through **Section 6.2** to derive appropriate site specific water quality limits where possible.

Appendix D summarises all the findings below in table format, as per the example shown in **Table 6-1** below. For each of the assessed bores, a table is provided with the following:

- Default water quality guideline or WQO for each parameter, row 1;
- Summary statistics (after outlier removal and removal of greater than 15% LOR where 8 samples were available), row 2-17 ;
- Comparison of the 80th percentile with the default guideline (20th and 80th percentile for pH), row 10;
- Limit derivation considerations: number of samples, percentage of LOR and trends (row 18-21);
- Proposed updated limits (row 22), using the 95th percentile for site specific or default guideline, depending on which is most appropriate in accordance with the DES (2021) guideline.

Table 6-1 Example of the groundwater quality limit derivation table (See Appendix D)

	Analyte	pH (Field)	Lab_EC	NH3-N
Row	Unit	-	µS/cm	mg/L
1	Default Guideline	6.5 - 8.5	720	0.9
2	Statistics			
3	Total Number	9	8	3
4	from	01-02-2014	20-02-2014	01-03-2017
5	to	23-03-2020	24-03-2020	01-06-2018
6	Min	6.8	2820	0.03
7	5th %ile	6.8	2834	0.031
8	20th %ile	7.0	3652	0.034
9	Median	7.2	6105	0.04
10	80th %ile	7.4	12828	0.046
11	95th %ile	7.4	16115	0.049
12	Max	7.4	16500	0.05
13	Tau	0.25	0.93	N/A
14	2-sided-p	0.40	0.00	N/A
15	Trend	No	Upward	N/A
16	Number of Obs Below LOR	0	0	0
17	Percent Below LOR	0%	0%	0%
18	Limit Derivation Considerations			
19	Limit development not possible due to insufficient number of samples			x
20	Limit development not possible due to more than 15% of values <LOR			
21	Limit development not possible due to trend		x	
22	Proposed Limits	8.5	TBD	0.9

6.1 Appropriateness of Available Guidelines

EVs relevant to the Project are discussed in **Section 3.1**. DES (2021) states:

“Where multiple EVs (with associated water quality guidelines) have been identified for an area of interest, surface or groundwater quality should be managed to comply with the most conservative water quality guideline so that the most sensitive EV is protected.”

The relevant guidelines considered are presented in **Table 6-2**, and consistent with DES (2021) form a conservative combination of the relevant WQO described in **Section 3.1**.

Table 6-2 Relevant Water Quality Guidelines

Parameter	Value	Unit	Source
pH	6.5 - 8.5	-	DEHP (2011) Isaac River Sub Basin Surface Water WQO
Electrical Conductivity	720	µS/cm	DEHP (2011) Isaac River Sub Basin Surface Water WQO
Calcium	1000	mg/L	ANZECC (2000) Stock Watering Guideline
Ammonia as N (NH ₃ -N)	0.9	mg/L	ANZG (2018) Aquatic ecosystem protection ³
Sulfate as SO ₄	25	mg/L	DEHP (2011) Isaac River Sub Basin Surface Water WQO
Aluminium (dissolved)	0.055	mg/L	ANZG (2018) Aquatic ecosystem protection ^{1,3}
Arsenic (dissolved)	0.013	mg/L	ANZG (2018) Aquatic ecosystem protection ²
Boron (dissolved)	0.94	mg/L	ANZG (2018) Aquatic ecosystem protection ³
Cadmium (dissolved)	0.0002	mg/L	ANZG (2018) Aquatic ecosystem protection ³
Cobalt (dissolved)	0.0014	mg/L	ANZG (2018) Aquatic ecosystem protection ⁴
Chromium (dissolved)	0.001	mg/L	ANZG (2018) Aquatic ecosystem protection ^{3,5}
Copper (dissolved)	0.0014	mg/L	ANZG (2018) Aquatic ecosystem protection ³
Mercury (dissolved)	0.00006	mg/L	ANZG (2018) Aquatic ecosystem protection ⁶
Lead (dissolved)	0.0034	mg/L	ANZG (2018) Aquatic ecosystem protection ³
Manganese (dissolved)	1.9	mg/L	ANZG (2018) Aquatic ecosystem protection ³
Molybdenum (dissolved)	0.034	mg/L	ANZG (2018) Aquatic ecosystem protection ⁴
Nickel (dissolved)	0.011	mg/L	ANZG (2018) Aquatic ecosystem protection ³
Silver (dissolved)	0.05	mg/L	ANZG (2018) Aquatic ecosystem protection ³
Selenium (total)	0.005	mg/L	ANZG (2018) Aquatic ecosystem protection ⁶
Uranium (dissolved)	0.0005	mg/L	ANZG (2018) Aquatic ecosystem protection ⁴
Vanadium (dissolved)	0.006	mg/L	ANZG (2018) Aquatic ecosystem protection ⁴
Zinc (dissolved)	0.008	mg/L	ANZG (2018) Aquatic ecosystem protection ³

¹ pH >6.5

² Conservative value for As(V) used

³ 95% species protection for slightly to moderately disturbed systems

⁴ No level of species protection defined

⁵ More conservative value for Cr(VI) used

⁶ 99% level of protection as recommended for slightly to moderately disturbed systems (for bioaccumulating toxicants)

6.1.1 Approach to Assess Most Suitable Guidelines

Once the monitoring data has been reviewed and filtered as appropriate (refer to **Section 5.2.1**) the general approach detailed in DES (2021) to derive groundwater quality limits is to:

- Derive and compare the 20th (for pH lower guideline) and 80th percentile of the site-specific dataset to the relevant default guidelines (see **Section 6.1** for relevant default guidelines) - **Appendix D**.
- Determine whether the site-specific groundwater limits are more appropriate than the default guidelines (**Section 6.1.1.1** to **Section 6.1.1.22**).

DES (2021) provide four scenarios that may arise when determining whether default or site-specific groundwater guidelines are most appropriate for the area:

- *“Default guidelines and WQOs are available and the 80th percentile from site-specific bores are not substantially different from the default guideline or WQO. In this case it is recommended that the default values are adopted.*
- *Where default guidelines are available, and the 80th percentile from values from site-specific bores are significantly less than the default guideline or WQO. In this situation, for indicators where the site-specific values are significantly better than default values, then the site-specific values should be adopted. However, for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable.*
- *Default guidelines and WQOs are not available. In this situation, the 80th percentile value from the local bores (even where slightly impacted in some circumstances, which would need to be agreed by the regulator) may be the best available option for deriving a site-specific guideline. It is therefore, recommended that the site-specific values be adopted.*
- *Default guidelines and WQOs are available and the 80th percentile values from site-specific bores exceed the default guidelines. If the site-specific values better reflect the local conditions, then site-specific values would typically be adopted.”*

6.1.1.1 pH (Field)

The 80th percentile values for pH (Field) in the filtered dataset are below, though not substantially different to the DEHP (2011) Isaac River Sub Basin WQO of 6.5 to 8.5 for GW06, GW03, GW09, GW19_37a, GW08, GW07, GW26, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. The DES (2021) guideline states that if *“Default guidelines and WQOs are available and the 80th percentile from site-specific bores are not substantially different from the default guideline or WQO. In this case it is recommended that the default values are adopted”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile value for pH (Field) in the filtered dataset is below the DEHP (2011) Isaac River Sub Basin WQO of 6.5 to 8.5 for GW09. There is insufficient data available to derive site-specific limits in accordance with the DES (2021) requirements. It is therefore recommended to adopt the default guideline for this bore.

It is not possible to derive site specific limits for bores GW03, GW08 and GW26 that have no data. It is therefore recommended to adopt the default guideline values (i.e. the DEHP (2011) Isaac River Sub Basin WQO of 6.5 to 8.5) for these bores.

6.1.1.2 EC (Lab)

The 80th percentile values for EC (Field) in the filtered dataset are above the default guideline (i.e. the DEHP, 2011 Isaac River Sub Basin WQO of 720 µS/cm for GW06 and

GW09. It is not possible to derive site specific limits in accordance with DES (2021) due to trending data, therefore the limit is to be defined once sufficient stable data becomes available.

The 80th percentile values for EC (Lab) in the filtered dataset are above the default guideline (i.e. the DEHP, 2011 Isaac River Sub Basin WQO of 720 $\mu\text{S}/\text{cm}$) for GW19_37a, GW07, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. As indicated in the boxplots for EC (**Appendix C**), there is great variability in EC across all hydrogeological units at New Lenton. It is therefore not possible to pool EC data for any groundwater unit as the limit would be inadequate (i.e. too conservative for some bores, not conservative enough for others). It is therefore recommended that site specific limits are adopted at these bores.

The 80th percentile values for EC (Lab) in the filtered dataset are below, though not substantially different to the DEHP, 2011 Isaac River Sub Basin WQO of 720 $\mu\text{S}/\text{cm}$ for GW19_33. The DES (2021) guideline states that if *“Default guidelines and WQOs are available and the 80th percentile from site-specific bores are not substantially different from the default guideline or WQO. In this case it is recommended that the default values are adopted”*. Therefore it is recommended to adopt the default guideline.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.3 Calcium

The 80th percentile value for calcium in the filtered dataset is below the ANZECC (2000) stock watering guideline of 1000 mg/L for GW19_37a. There is insufficient data available to derive site-specific limits in accordance with the DES (2021) requirements. It is therefore recommended to adopt the default guideline.

The 80th percentile values for calcium in the filtered dataset are below the ANZECC (2000) stock watering guideline of 1000 mg/L for GW07, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. The DES (2021) guideline states that *“Guidelines should not be adopted as upper limits to which groundwater contaminant concentrations can be increased. Rather, if existing groundwater quality is below the water quality guidelines, then the groundwater should be managed within the range of natural water quality variability determined through baseline characterisation (Australian Government 2013)”*. Due to the substantial difference between the default value and 80th percentile of site specific for each bore, it is recommended to derive site specific limits for these bores.

The 80th percentile values for calcium in the filtered dataset are below the ANZECC (2000) stock watering guideline of 1000 mg/L for GW06 and GW09. It is not possible to derive site specific limits in accordance with DES (2021) due to trending data, therefore the limit is to be defined once sufficient stable data becomes available.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.4 Ammonia as N ($\text{NH}_3\text{-N}$)

The 80th percentile values for $\text{NH}_3\text{-N}$ in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.9 mg/L for GW06, GW09, GW19_37a and GW19_33. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

The 80th percentile values for $\text{NH}_3\text{-N}$ in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.9 mg/L for GW07, GW30c and GW31b. The DES (2021)

guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile values for NH₃-N in the filtered dataset are above the default guideline (i.e. aquatic ecosystem 95% protection guideline of 0.9 mg/L) GW30b, GW10, GW13, GW30a, GW31a and GW11. As indicated in the boxplots for NH₃-N (**Appendix C**), there is great variability in NH₃-N across all hydrogeological units at New Lenton. It is therefore not possible to pool NH₃-N data for any groundwater unit as the limit would be inadequate (i.e. too conservative for some bores, not conservative enough for others). It is therefore recommended that site specific limits are adopted at these bores.

The 80th percentile value for dissolved NH₃-N in the filtered dataset is above the default guideline (i.e. aquatic ecosystem 95% protection guideline of 0.9 mg/L) for GW29a. There is currently insufficient data available to derive a site specific limit in accordance with the DES (2021) guideline. Therefore, it is recommended to a derive site-specific limit at this bore once sufficient data becomes available.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.5 Sulfate as SO₄

The 80th percentile value for SO₄ in the filtered dataset is above the default guideline (i.e. the DEHP, 2011 Isaac River Sub Basin WQO of 25 mg/L for GW06. It is not possible to derive site specific limits in accordance with DES (2021) due to trending data, therefore the limit is to be defined once sufficient stable data becomes available.

The 80th percentile values for SO₄ in the filtered dataset is above the default guideline (i.e. the DEHP, 2011 Isaac River Sub Basin WQO of 25 mg/L) for GW09, GW19_37a, GW07 and GW30c. As indicated in the boxplots for SO₄ (**Appendix C**), there is great variability in SO₄ across all hydrogeological units at New Lenton. It is therefore not possible to pool SO₄ data for any groundwater unit as the limit would be inadequate (i.e. too conservative for some bores, not conservative enough for others). It is therefore recommended that site specific limits are adopted at these bores.

The 80th percentile values for SO₄ in the filtered dataset are below, though not substantially different to the DEHP, 2011 Isaac River Sub Basin WQO of 25 mg/L for GW19_33, GW31b, GW10 and GW11. The DES (2021) guideline states that *if “Default guidelines and WQOs are available and the 80th percentile from site-specific bores are not substantially different from the default guideline or WQO. In this case it is recommended that the default values are adopted”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile values for SO₄ in the filtered dataset are below the DEHP, 2011 Isaac River Sub Basin WQO of 25 mg/L for GW30b, GW13, GW30a, GW31a and GW29a. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.6 Aluminium (Dissolved)

The 80th percentile values for dissolved aluminium in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.055 mg/L for GW09 and GW31a. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile values for dissolved aluminium in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.055 mg/L for GW06, GW19_37a, GW07, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.7 Arsenic (Dissolved)

The 80th percentile values for dissolved arsenic in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.013 mg/L for GW06, GW09, GW19_37a, GW30b, GW10, GW13, GW31a, and GW29a. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile values for dissolved arsenic in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.013 mg/L for GW07, GW19_33, GW30c, GW31b, GW30a and GW11. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.8 Boron (Dissolved)

The 80th percentile value for dissolved boron in the filtered dataset is above the default guideline (i.e. aquatic ecosystem 95% protection guideline of 0.94 mg/L) for GW06. There is currently insufficient data available to derive a site specific limit in accordance with the DES (2021) guideline. Therefore, it is recommended to a derive site-specific limit at this bore once sufficient data becomes available.

The 80th percentile values for dissolved boron in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.94 mg/L for GW09, GW19_37a, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.9 Cadmium (Dissolved)

The 80th percentile values for dissolved cadmium in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.0002 mg/L for GW06 and GW09. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile values for dissolved a cadmium in the filtered dataset is below the aquatic ecosystem (95% protection) guideline of 0.0002 mg/L for GW19_37a, GW07, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. For these bores it is not possible to derive site specific limits due to greater than 15 percent

of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.10 Cobalt (Dissolved)

The 80th percentile values for dissolved cobalt in the filtered dataset are below the aquatic ecosystem guideline of 0.0014 mg/L for GW06, GW09 and GW19_33. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile value for dissolved cobalt in the filtered dataset is above the default guideline (i.e. the aquatic ecosystem 95% protection guideline of 0.0014 mg/L) for GW07. It is therefore recommended that a site specific limit is adopted at this bore.

The 80th percentile values for dissolved cobalt in the filtered dataset are below the aquatic ecosystem guideline of 0.0014 mg/L at GW19_37a, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. For these bores it is not possible to derive a site specific limit due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.11 Chromium (Dissolved)

The 80th percentile values for dissolved chromium in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.001 mg/L for GW06 and GW09. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline.

The 80th percentile values for dissolved chromium in the filtered dataset are below the aquatic ecosystem guideline of 0.001 mg/L at GW19_37a, GW07, GW19_33, GW30c, GW31b, GW30b, GW13, GW30a, GW31a, GW11 and GW29a. For these bores it is not possible to derive a site specific limit due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline.

The 80th percentile value for dissolved chromium in the filtered dataset is above the default guideline (i.e. the aquatic ecosystem 95% protection guideline of 0.001 mg/L) for GW10. There is currently insufficient data available to derive a site specific limit in accordance with the DES (2021) guideline. Therefore, it is recommended to a derive site-specific limit at this bore once sufficient data becomes available.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.12 Copper (Dissolved)

The 80th percentile value for dissolved copper in the filtered dataset is below the aquatic ecosystem (95% protection) guideline of 0.0014 mg/L for GW06. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline.

The 80th percentile values for dissolved copper in the filtered dataset are above the default guideline (i.e. the aquatic ecosystem 95% protection guideline of 0.0014 mg/L) for GW09,

GW19_37a, GW19_33, GW30b and GW30a. There is currently insufficient data available to derive a site specific limit in accordance with the DES (2021) guideline. Therefore, it is recommended to a derive site-specific limit at this bore once sufficient data becomes available.

The 80th percentile value for dissolved copper in the filtered dataset is above the default guideline (i.e. the aquatic ecosystem 95% protection guideline of 0.0014 mg/L) for GW07. It is therefore recommended that a site specific limit is adopted at this bore.

The 80th percentile values for dissolved copper in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.0014 mg/L for GW30c, GW31b, GW10, GW13, GW31a, GW11 and GW29a. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.13 Mercury (Dissolved)

The 80th percentile values for dissolved mercury in the filtered dataset are below the aquatic ecosystem (99% protection) guideline of 0.00006 mg/L for GW06, GW19_37a, GW07, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

The 80th percentile value for dissolved mercury in the filtered dataset is below the aquatic ecosystem (99% protection) guideline of 0.00006 mg/L for GW09. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.14 Lead (Dissolved)

The 80th percentile values for dissolved lead in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.0034 mg/L at GW06, GW19_37a, GW07, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. For these bores it is not possible to derive a site specific limit due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline.

The 80th percentile value for dissolved lead in the filtered dataset is below the aquatic ecosystem (95% protection) guideline of 0.0034 mg/L for GW09. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.15 Manganese (Dissolved)

The 80th percentile values for dissolved manganese in the filtered dataset are below the aquatic ecosystem guideline 1.9 mg/L for GW06, GW09, GW19_37a, GW07, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. The DES

(2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.16 Molybdenum (Dissolved)

The 80th percentile values for dissolved molybdenum in the filtered dataset are below the aquatic ecosystem guideline of 0.034 mg/L for GW06, GW09, GW19_37a, GW07, GW19_33, GW30b, GW13, GW31a and GW29a. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile values for dissolved molybdenum in the filtered dataset are below the aquatic ecosystem guideline of 0.034 mg/L for GW30c, GW31b, GW30a and GW11. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

The 80th percentile value for dissolved molybdenum in the filtered dataset is above the default guideline (i.e. the aquatic ecosystem guideline of 0.034 mg/L) for GW10. It is therefore recommended that a site specific limit is adopted at this bore.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.17 Nickel (Dissolved)

The 80th percentile values for dissolved nickel in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.011 mg/L for GW06, GW09, GW30c, GW31b, GW30b, GW13, GW30a, GW11 and GW29a. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile values for dissolved nickel in the filtered dataset are above the default guideline (i.e. the aquatic ecosystem 95% protection guideline of 0.011) for GW19_37a, GW07, GW19_33 and GW10. It is therefore recommended to adopt site specific limits.

The 80th percentile value for dissolved nickel in the filtered dataset is below the aquatic ecosystem (95% protection) guideline of 0.011 mg/L for GW31a. It is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.18 Silver (Dissolved)

Analysis of the historical dataset shows that prior to December 2023 the LOR for dissolved silver (<0.001 mg/L) was above the aquatic ecosystem (95% protection) guideline of 0.00005 mg/L and therefore it is not possible to compare the 80th percentile of the dataset to the guideline value. A comparison of the data after December 2023 (where the LOR is generally <0.0001 mg/L) however shows results for all bores with data are below the LOR and therefore below the default guideline. It is therefore recommended to adopt the default

guideline at all bores with data (GW06, GW09, GW19_37a, GW07, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a).

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.19 Selenium (Dissolved)

The 80th percentile values for dissolved selenium in the filtered dataset are below the aquatic ecosystem (99% protection) guideline of 0.005 mg/L for GW06, GW19_37a, GW07, GW19_33, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

The 80th percentile value for dissolved selenium in the filtered dataset is below the aquatic ecosystem (99% protection) guideline of 0.005 mg/L for GW09. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.20 Uranium (Dissolved)

The 80th percentile values for dissolved uranium in the filtered dataset are above the default guideline (i.e. the aquatic ecosystem guideline of 0.0005 mg/L) for GW06, GW09, GW19_33 and GW30c. There is currently insufficient data available to derive site specific limits in accordance with the DES (2021) guideline. Therefore, it is recommended to derive site-specific limit at these bores once sufficient data becomes available.

The 80th percentile values for dissolved uranium in the filtered dataset are above the default guideline (i.e. the aquatic ecosystem guideline of 0.0005 mg/L) for GW19_37a, GW07 and GW31b. It is therefore recommended that site specific limits are adopted at these bores.

The 80th percentile values for dissolved selenium in the filtered dataset are below the aquatic ecosystem guideline of 0.0005 mg/L for GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. For these bores it is not possible to derive site specific limits due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline for these bores.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.21 Vanadium (Dissolved)

The 80th percentile values for dissolved vanadium in the filtered dataset are below the aquatic ecosystem guideline of 0.006 mg/L for GW06, GW09, GW19_37a and GW19_33. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline for these bores.

The 80th percentile values for dissolved vanadium in the filtered dataset are below the aquatic ecosystem guideline of 0.006 mg/L at GW07, GW30c, GW31b, GW30b, GW10, GW13, GW30a, GW31a, GW11 and GW29a. It is not possible to derive a site specific limit due to greater than 15 percent of the dataset being made up of below LOR values. It is therefore recommended to adopt the default guideline.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.1.22 Zinc (Dissolved)

The 80th percentile values for dissolved zinc in the filtered dataset are below the aquatic ecosystem (95% protection) guideline of 0.008 mg/L for GW06 and GW31a. The DES (2021) guideline states that *“for toxicants, if the local groundwater quality is less than the default guideline (ANZG 2018), then the toxicant default guideline value may still be applicable”*. Therefore it is recommended to adopt the default guideline.

The 80th percentile values for dissolved zinc in the filtered dataset are above the default guideline (i.e. the aquatic ecosystem 95% protection guideline of 0.008 mg/L) for GW09, GW19_37a and GW31b. There is currently insufficient data available to derive site-specific limits in accordance with the DES (2021) guideline. Therefore, it is recommended to derive site-specific limits at these bores once sufficient data becomes available.

The 80th percentile values for dissolved zinc in the filtered dataset are above the default guideline (i.e. the aquatic ecosystem 95% protection guideline of 0.008 mg/L) for GW07, GW19_33, GW30b, GW10, GW13, GW30a, GW11 and GW29a. It is therefore recommended to adopt site specific limits.

There is no data is available for GW03, GW08 and GW26, and therefore it is not possible to derive site-specific limits. Therefore the default guideline should be adopted these bores.

6.1.2 Proposed Updated Groundwater Quality Limits

The current EA compliance approach uses a single limit per parameter, which is applied to three consecutive samples, i.e. three consecutive sampling events above the relevant limit are required to constitute a limit exceedance in the EA. No change to the compliance approach is proposed.

The proposed updated groundwater quality limits based on the assessment discussed above are summarised in **Table 6-3**.

Table 6-3 Proposed Updated Groundwater Quality Limits

Analyte	pH (Field)	EC (Lab)	Ca	NH ₃ -N	SO ₄	Al	As	B	Cd	Co	Cr	Cu	Hg	Pb	Mn	Mo	Ni	Ag	Se	U	V	Zn
Unit	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GW06	6.5 - 8.5	TBD	TBD	0.9	TBD	0.055	0.013	TBD	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	0.008
GW03	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW09	6.5 - 8.5	TBD	TBD	0.9	42	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	TBD
GW19_37a	6.5 - 8.5	2500	1000	0.9	31	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.025	0.00005	0.005	0.002	0.006	TBD
GW08	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW07	6.5 - 8.5	8661	271	0.9	51	0.055	0.013	0.94	0.0002	0.004	0.001	0.0046	0.00006	0.0034	1.9	0.034	0.021	0.00005	0.005	0.012	0.006	0.038
GW26	6.5 - 8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW19_33	6.5 - 8.5	720	63	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.018	0.00005	0.005	TBD	0.006	0.019
GW30c	6.5 - 8.5	15875	357	0.9	185	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	0.008
GW31b	6.5 - 8.5	2739	90	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.002	0.006	TBD
GW30b	6.5 - 8.5	18285	679	3.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.029
GW10	6.5 - 8.5	6244	60	1.3	25	0.055	0.013	0.94	0.0002	0.0014	TBD	0.0014	0.00006	0.0034	1.9	0.049	0.027	0.00005	0.005	0.0005	0.006	0.009
GW13	6.5 - 8.5	12700	143	3.5	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.024
GW30a	6.5 - 8.5	15600	299	3.6	25	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.023
GW31a	6.5 - 8.5	4820	23	1.0	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW11	6.5 - 8.5	4161	106	1.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.018
GW29a	6.5 - 8.5	9870	140	TBD	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.02

Note: Dissolved metals

TBD = To be defined once sufficient data becomes available

N/A = Not Applicable, reference bore, no limit proposed



6.2 Testing of Proposed Updated Groundwater Quality Limits

The proposed updated limits presented above have been tested against the historical dataset (including outliers) using the proposed compliance approach and are presented in the time series as **Appendix B**. It should be noted that GW03, GW08 and GW26 are not included in the time series due to having no data (these bores have historically been dry).

All updated groundwater quality limits were deemed suitable, i.e. none of the historical data set would have exceeded the newly defined single limit (95th percentile or applicable WQO/default guideline) three consecutive times, with the exception of removed outliers for EC at GW11, and Ag at all bores with data prior to December 2023 due to an LOR greater than two times the guideline (i.e. deemed not a real exceedance, refer **Section 5.2.1**). The proposed limits presented in **Section 6.1.2** are therefore deemed to be appropriate.



7.0 Groundwater Level Data Analysis

This section presents the development of updated groundwater Reference Level values on the basis of statistical analysis of the updated baseline monitoring dataset, followed by the establishment of updated Level Trigger Thresholds based on numerical groundwater modelling.

For the purpose of this report the following definitions are made, consistent with the EA.

- Reference Level (i.e. referred to as the pre-mining baseline level in the current EA)

The bore specific groundwater level that all future groundwater level measurements will be compared to for the purpose of calculating actual groundwater drawdown. The Reference Level is derived on the basis of historic groundwater level monitoring data (i.e. 'baseline' data) as outlined in **Section 7.1**.

- Level Trigger Threshold (i.e. consistent with the definition in the current EA).

The bore specific maximum groundwater level drawdown in the future that will be allowed under the EA without activating a compliance breach. The Level Trigger Threshold is derived on the basis of predictive groundwater modelling (refer SLR, 2024a) such that an exceedance of the Level Trigger Threshold represents greater groundwater level impact than predicted by modelling. The proposed Level Trigger Thresholds are derived in **Section 7.5.1**.

7.1 Baseline Data Analysis

Statistical analysis of the existing groundwater level database has been undertaken to aid in the derivation of Reference Levels. The analysis generally conforms to the processes outlined in DES (2021) for groundwater data analysis, and includes:

- Generation of time series plots (**Appendix E** and **Section 7.2**);
- Outlier analysis (**Appendix E** and **Section 7.2.1**);
- Summary Statistics (**Appendix F** and **Section 7.3**); and
- Trend (Mann-Kendall) analysis (**Appendix F** and **Section 7.3.1**).

7.2 Time Series Plots

Time series plots for each of the proposed GMMP compliance bores with data are provided in **Appendix E**. Note that plots are not provided for bores reported as 'dry' (a total of four compliance bores, in addition to four reference bores, refer **Table 4-1**).

7.2.1 Outlier Analysis

Outliers have been manually screened by conducting a visual assessment of the data presented on the time series plots presented in **Appendix E** and are listed in **Table 7-1** and shown on the time series as separate points. Based on the results of the manual outlier assessment only one datapoint was assessed as being an outlier as is listed in **Table 7-1** and it is not deemed necessary to create a filtered dataset for the purpose of statistical analysis.



Table 7-1 Manually Screened Outliers Flagged in Groundwater Level Database

Bore	Date	Groundwater Level (mAHD)	Aquifer
GW11	01-09-2023	297.851	Leichhardt / Vermont Seam

7.3 Summary Statistics

Appendix F presents statistics for groundwater levels for the proposed GMMP compliance bores that have data.

The summary statistics include number of samples analysed; minimum and maximum values and 5th, 20th, 50th, 80th and 95th percentile for each parameter analysed and trend analysis using non-seasonal Mann-Kendall test. These statistics have been performed on the baseline dataset (i.e. no outliers were removed, refer **Section 7.2.1**).

7.3.1 Trend Analysis

The non-seasonal Mann-Kendall statistical trend test was used to detect potential trends in the dataset (refer to **Section 7.1**), with the results provided in **Table 7-2** (and **Appendix D**).

A comparison of the trends listed in **Table 7-2** with a visual assessment of the time series plots presented in **Appendix E** shows that groundwater levels are highly variable within the baseline dataset, and strongly linked to climate variability. A detailed discussion of groundwater level trends at these bores is provided in SLR (2024a).

Table 7-2 Non-Seasonal Mann-Kendall Statistic Trend Test – Groundwater Levels

Aquifer	Bore	Trend
Alluvium	GW19_37a	No Trend
Alluvium	GW07	Yes (Downward)
Alluvium	GW26	N/A
Alluvium/Regolith	GW19_33	No Trend
Regolith	GW30c	Yes (Downward)
Regolith	GW31b	Yes (Downward)
Permian (Burton Seam)	GW30b	Yes (Downward)
Permian (L/V Seam)	GW10	Yes (Upward)
Permian (L/V Seam)	GW13	Yes (Downward)
Permian (L/V Seam)	GW30a	Yes (Downward)
Permian (L/V Seam)	GW31a	Yes (Downward)
Permian (L/V Seam)	GW11	Yes (Downward)
Permian (sandstone)	GW29a	No Trend

N/A = Not Applicable, insufficient data to be statistically significant
L/V Seam = Leichhardt / Vermont Seam



7.4 Groundwater Reference Level Derivation

The time series plots presented in **Appendix E** and Mann-Kendall trend test presented in **Table 7-2** highlight the fact that local groundwater levels are highly variable, with variability driven by natural causes (i.e. climate variability). Furthermore, the large range between the maximum and minimum groundwater levels presented in the summary statistics in **Appendix D** highlights the fact that groundwater level change compliance criteria needs to appropriately recognise the significant natural variability in groundwater levels. A detailed discussion on climate and groundwater level variability is provided in SLR (2024a).

It is therefore proposed to adopt the 20th percentile of the baseline dataset summary statistics (**Appendix F**) as the Reference Level values, similar to the approach proposed within DES (2021) for establishing statistically appropriate groundwater quality limits. Adoption of the 20th percentile takes into account the historic variability in groundwater levels when proposing a bore specific groundwater level that will be compared to model predictions for EA compliance purposes. The proposed groundwater Reference Level values are presented in **Table 7-3**.

Measured groundwater level drawdown will then be calculated on a bore by bore basis under the EA, by comparing the measured groundwater level for a bore at any point in time with the Reference Level values for that bore. The resulting computed groundwater level drawdown will be compared to the Level Trigger Thresholds for that bore, where a computed groundwater level drawdown greater than the Level Trigger Threshold constitutes an exceedance under the EA.



Table 7-3 Proposed Groundwater Reference Levels

Aquifer	Bore	20 th Percentile (mAHD)
Alluvium	GW01	Reference bore, no refence level proposed
Alluvium/Regolith	GW19	Reference bore, no refence level proposed
Basalt	GW20	Reference bore, no refence level proposed
Alluvium	GW22	Reference bore, no refence level proposed
Alluvium	GW23	Reference bore, no refence level proposed
Alluvium	GW06	Dry bore, no reference level proposed
Alluvium	GW03	Dry bore, no reference level proposed
Alluvium	GW09	Dry bore, no reference level proposed
Alluvium	GW19_37a	297.8
Alluvium	GW08	Dry bore, no reference level proposed
Alluvium	GW07	294.0
Alluvium	GW26	TBA
Alluvium/Regolith	GW19_33	301.5
Regolith	GW30c	301.8
Regolith	GW31b	307.1
Permian (Burton Seam)	GW30b	301.4
Permian (L/V Seam)	GW10	299.2
Permian (L/V Seam)	GW13	296.1
Permian (L/V Seam)	GW30a	301.8
Permian (L/V Seam)	GW31a	305.9
Permian (L/V Seam)	GW11	300.8
Permian (sandstone)	GW29a	300.9

TBA = insufficient baseline data to compute reference levels at the present time.
L/V Seam = Leichhardt / Vermont Seam



7.5 Groundwater Level Trigger Threshold Derivation and Testing

7.5.1 Proposed Updated Groundwater Level Trigger Thresholds

The predictive results of the 2023 New Lenton Project numerical groundwater model (SLR, 2024; SLR, 2024b) have been utilised to develop updated bore specific groundwater Level Trigger Thresholds for each proposed GMMP bore listed. Level Trigger Thresholds have been based on the following criteria:

- Level Trigger Thresholds have been calculated using the latest version of the New Lenton groundwater model (SLR, 2024b).
- Level Trigger Threshold derivation is based on the difference between the predicted groundwater level in the “no-mining” model, and the minimum (lowest) predicted water level at any time during the future modelled life of mining from the “cumulative mining” model (i.e. between the years 2024 and 2040 and considering the effects of the adjacent Burton Mine). That is, Level Trigger Thresholds are based on the predicted future groundwater level drawdown at each bore between 2024 and 2040 from the latest numerical groundwater model. Noting that the numerical groundwater model is actually an ensemble of calibrated models each with different parameter sets (SLR, 2024b), uncertainty in model predictions across the calibrated ensemble of models is considered as described in the following dot point.
- GMMP compliance monitoring bores have been assigned a Level Trigger Threshold value equal to the maximum cumulative 90th percentile model drawdown prediction at each bore over the future life of the New Lenton mining operation to 2040. Adoption of the 90th percentile prediction of drawdown allows for consideration of model predictive uncertainty to provide a conservative upper limit of groundwater level drawdown allowed under the EA.
- Where the maximum 90th percentile model drawdown prediction for the alluvium/regolith is less than the natural variability observed in the alluvium/regolith within the current monitoring dataset (**Sections 7.1 and 7.2**) for a particular bore, then the trigger has been set equal to the range in observed natural variability at that bore to avoid the false enacting of a drawdown trigger that is only due to natural variability and not mining activities. For alluvium/regolith bores with no existing data, an average of the natural variability across the entire baseline dataset for alluvium/regolith bores with sufficient data has been used (i.e. 3.6 m).
- Where the proposed groundwater level trigger threshold resulting from either of the above two points would result in a level trigger elevation below the base of the model layer, then the level trigger threshold has been limited to drawdown to the base of the model layer.

The updated groundwater Level Trigger Thresholds derived using the methodology as above are presented in **Table 7-4**.



Table 7-4 Proposed Updated Groundwater Level Trigger Thresholds

Aquifer	Bore	Level Trigger Threshold (m)
Alluvium	GW01	Reference bore, no level trigger threshold proposed
Alluvium/Regolith	GW19	Reference bore, no level trigger threshold proposed
Basalt	GW20	Reference bore, no level trigger threshold proposed
Alluvium	GW22	Reference bore, no level trigger threshold proposed
Alluvium	GW23	Reference bore, no level trigger threshold proposed
Alluvium	GW06	Dry bore, no level trigger threshold proposed
Alluvium	GW03	Dry bore, no level trigger threshold proposed
Alluvium	GW09	Dry bore, no level trigger threshold proposed
Alluvium	GW19_37a	7.1 ^{1,2}
Alluvium	GW08	Dry bore, no level trigger threshold proposed
Alluvium	GW07	3.8 ¹
Alluvium	GW26	3.6 ³
Alluvium/Regolith	GW19_33	3.4 ⁴
Regolith	GW30c	4.7 ⁴
Regolith	GW31b	3.7 ⁴
Permian (Burton Seam)	GW30b	9.2 ¹
Permian (L/V Seam)	GW10	86.3 ¹
Permian (L/V Seam)	GW13	75.1 ¹
Permian (L/V Seam)	GW30a	10.1 ¹
Permian (L/V Seam)	GW31a	23.8 ¹
Permian (L/V Seam)	GW11	108.3 ^{1,2}
Permian (sandstone)	GW29a	15.2 ¹

L/V Seam = Leichhardt / Vermont Seam

1 Maximum cumulative 90th percentile modelled drawdown prediction.

2 Maximum drawdown limited to base of model layer.

3 Based on the range of natural variability observed at this bore.

4 Based on the average range of natural variability observed at all existing alluvium/regolith bores.



7.5.2 Testing of Updated Groundwater Level Trigger Thresholds

The proposed updated Reference Levels and Level Trigger Thresholds presented above have been tested against the historical dataset using the proposed compliance approach and are presented in the time series plots provided in **Appendix E**. For the testing, the effective compliance trigger value is termed the Level Trigger Elevation and is calculated as:

Level Trigger Elevation = Groundwater Reference Level – Level Trigger Threshold should be noted that GW26 is not included in the time series due to having no data.

The results of the testing in **Appendix E** indicate none of the historical dataset for the bores would be below the level trigger elevation. The results of the testing in **Appendix E** therefore indicate that the proposed updated Groundwater Reference Levels and Level Trigger Thresholds are appropriate for the GMMP and represent groundwater levels that if reached in the future, would indicate a greater level of groundwater impact from mining than predicted by the current version of the Project's groundwater model.

The Level Trigger Elevations calculated as above are presented in **Table 7-5**.

Table 7-5 Proposed Groundwater Level Trigger Elevation

Aquifer	Bore	Level Trigger Threshold (mAHD)
Alluvium	GW01	Reference bore, no level trigger elevation proposed
Alluvium/Regolith	GW19	Reference bore, no level trigger elevation proposed
Basalt	GW20	Reference bore, no level trigger elevation proposed
Alluvium	GW22	Reference bore, no level trigger elevation proposed
Alluvium	GW23	Reference bore, no level trigger elevation proposed
Alluvium	GW06	Dry bore, no level trigger elevation proposed
Alluvium	GW03	Dry bore, no level trigger elevation proposed
Alluvium	GW09	Dry bore, no level trigger elevation proposed
Alluvium	GW19_37a	297.8
Alluvium	GW08	Dry bore, no level trigger elevation proposed
Alluvium	GW07	294.0
Alluvium	GW26	TBA
Alluvium/Regolith	GW19_33	301.5
Regolith	GW30c	301.8
Regolith	GW31b	307.1
Permian (Burton Seam)	GW30b	301.4
Permian (L/V Seam)	GW10	299.2
Permian (L/V Seam)	GW13	296.1
Permian (L/V Seam)	GW30a	301.8
Permian (L/V Seam)	GW31a	305.9
Permian (L/V Seam)	GW11	300.8
Permian (sandstone)	GW29a	300.9

TBA = To be advised



8.0 Conclusions and Recommendations

Based on the outcomes of this New Lenton Coal Project updated groundwater compliance trigger development report the following conclusions and are recommendations are made:

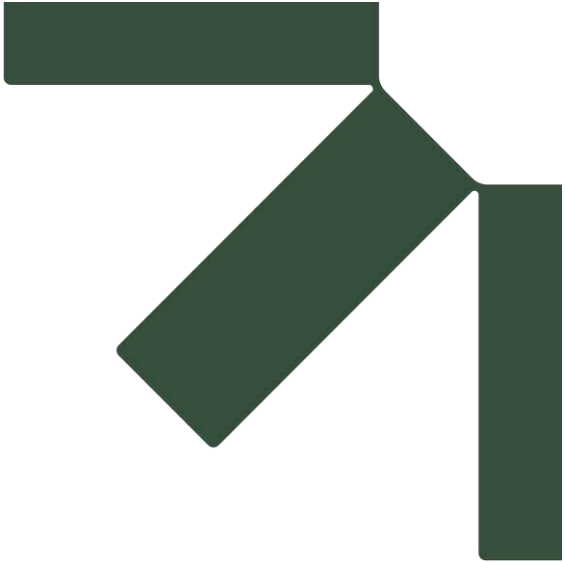
- The proposed updated groundwater quality and level triggers documented in this report are deemed appropriate for inclusion to the GMMP in support of the Project's EA, AWL, PRCP and PER, and will be included in a separate GMMP report to be prepared by SLR.
- GMMP bore GW06 is noted to be in need of maintenance in recent entries in the last version of the Project monitoring database (April 2024), including notes of damage, requiring a new monument, plus bailing and tree root removal. It is recommended that this should be actioned as soon as practicable to re-establish the monitoring function of the bore.
- It is also noted that GMMP bores GW20, GW22 and GW26 have no recent data and should be routinely visited as with the other bores, even if dry (i.e. to continually confirm that the bores remain dry).
- It is recommended to confirm the casing stick-up height for bores GW31a, GW31b and GW20.



9.0 References

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Appendix A Water Quality Summary Statistics with Statistical Outlier Count

Groundwater Compliance 2024 Updated Limit and Trigger Development

New Lenton Coal Project

Lenton Joint Venture

SLR Project No.: 620.040927.00001

25 September 2024

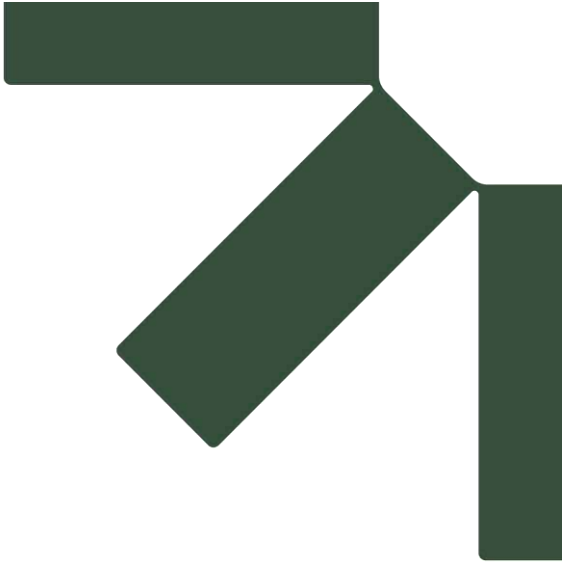
Bore	Statistics Unit	pH (Field)	Lab_EC	Calcium	NH4-N	SO4	Al (diss)	As (diss)	B (diss)	Cd (diss)	Co (diss)	Cr (diss)	Cu (diss)	Hg (diss)	Pb (diss)	Mn (diss)	Mo (diss)	Ni (diss)	Ag (diss)	Se (diss)	U (diss)	V (diss)	Zn (diss)
		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GW06	Total Number	9	8	11	3	11	8	8	7	8	7	8	8	8	8	7	0	8	7	8	7	7	8
GW06	from	01-02-2014	20-02-2014	20-02-2014	42795	20-02-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	N/A	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014
GW06	to	23-03-2020	24-03-2020	24-03-2020	43252	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	N/A	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020
GW06	Min	6.8	2820	33	0.03	0.5	0.005	5.00E-04	0.05	5.00E-05	5.00E-04	5.00E-04	5.00E-04	5.00E-05	5.00E-04	0.0005	N/A	5.00E-04	5.00E-04	0.005	0.0005	0.005	0.0025
GW06	5th %ile	6.8	2834	34	0.031	0.5	0.005	6.75E-04	0.185	5.00E-05	5.00E-04	5.00E-04	5.00E-04	5.00E-05	5.00E-04	0.01565	NA	5.00E-04	5.00E-04	0.005	0.00545	0.005	0.0025
GW06	20th %ile	7.0	3652	44	0.034	0.5	0.005	1.40E-03	0.514	5.00E-05	5.00E-04	5.00E-04	5.00E-04	0.0005	5.00E-05	5.00E-04	0.053	NA	7.00E-04	5.00E-04	0.005	0.018	0.005
GW06	Median	7.2	6105	68	0.04	14	0.005	3.00E-03	1.13	5.00E-05	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.076	NA	0.002	5.00E-04	0.005	0.024	0.005	0.0025
GW06	80th %ile	7.4	12828	79	0.046	52	0.005	0.0056	1.526	5.00E-05	5.00E-04	0.0005	0.0008	5.00E-05	5.00E-04	1.0364	NA	0.006	5.00E-04	0.005	0.029	0.005	0.0066
GW06	95th %ile	7.4	16115	316	0.049	128	0.005	0.01055	1.737	8.25E-05	8.50E-04	0.000825	0.00425	0.00005	5.00E-04	1.345	NA	0.01125	0.0005	0.005	0.0307	0.005	0.01415
GW06	Max	7.4	16500	321	0.05	141	0.005	0.013	1.8	1.00E-04	1.00E-03	0.001	0.006	5.00E-05	5.00E-04	1.39	N/A	0.013	0.0005	0.005	0.031	0.005	0.018
GW06	Tau	0.25	0.93	0.49	na	0.44	1.00	-0.33	-0.33	-0.36	0.53	-0.21	-0.16	1.00	1.00	0.71	na	-0.52	1.00	1.00	0.24	1.00	-0.27
GW06	2-sided-p	0.40	0.00	0.04	na	0.08	1.00	0.32	0.37	0.38	0.21	0.66	0.74	1.00	1.00	0.04	na	0.10	1.00	1.00	0.55	1.00	0.47
GW06	Trend	No	Yes-Upward	Yes-Upward	na	No	No	No	No	No	No	No	No	No	No	Yes-Upward	na	No	No	No	No	No	No
GW06	Number of Obs Below LOR	0	0	0	0	5	8	1	0	7	6	7	6	8	8	1	0	2	7	8	1	7	5
GW06	Number of Statistical Outliers	0	0	2	0	2	0	1	0	1	1	1	1	0	0	0	0	1	0	0	1	0	1
GW03	Total Number	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW03	from	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	to	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	Min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	5th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	20th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	Median	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	80th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	95th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	Max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	Tau	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	2-sided-p	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	Trend	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	Number of Obs Below LOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW03	Number of Statistical Outliers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW09	Total Number	8	9	11	4	11	7	7	6	7	6	7	7	7	7	6	3	7	5	7	6	6	7
GW09	from	01-02-2014	20-02-2014	20-02-2014	42795	20-02-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	29-10-2023	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014
GW09	to	04-02-2024	04-02-2024	04-02-2024	45326	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024
GW09	Min	6.8	875	46	0.04	14	0.0025	5.00E-04	0.14	2.50E-05	1.00E-04	1.00E-04	2.50E-04	2.00E-05	5.00E-05	0.0707	1.00E-03	5.00E-04	5.00E-05	0.0001	0.00253	0.0004	0.0025
GW09	5th %ile	6.8	1077	47	0.046	19	0.0025	9.50E-04	0.16	2.50E-05	1.25E-04	1.00E-04	3.25E-04	2.00E-05	5.00E-05	0.071325	1.06E-03	5.00E-04	5.00E-05	0.0001	0.0026275	0.000425	0.0025
GW09	20th %ile	6.8	1518	48	0.064	25	0.0025	2.00E-03	0.22	2.50E-05	2.00E-04	1.20E-04	0.0006	2.00E-05	5.00E-05	0.0732	1.24E-03	6.00E-04	5.00E-05	0.0001	0.00282	0.0005	0.0025
GW09	Median	6.9	2830	74	0.115	34	0.005	2.60E-03	0.2215	5.00E-05	5.00E-04	0.0005	0.002	5.00E-05	5.00E-04	0.1765	1.60E-03	0.0015	5.00E-04	0.005	0.003525	0.0028	0.0023
GW09	80th %ile	7.1	4382	101	0.574	36	0.005	0.00298	0.255	5.00E-05	5.00E-04	0.0005	0.00298	5.00E-05	5.00E-04	0.308	0.00196	0.00178	5.00E-04	0.005	0.005	0.005	0.0368
GW09	95th %ile	8.0	4586	107	1.051	41.5	0.005	0.0079	0.26625	1.55E-04	1.03E-03	0.0005	0.00888	0.00005	5.00E-04	0.344	0.00214	0.00264	0.0005	0.005	0.008	0.00875	0.0432
GW09	Max	8.4	4670	109	1.21	42	0.005	0.01	0.27	2.00E-04	1.20E-03	0.0005	0.0114	5.00E-05	5.00E-04	0.356	0.0022	0.003	0.0005	0.005	0.009	0.01	0.045
GW09	Tau	0.07	0.83	0.73	0.67	-0.46	-0.76	0.29	0.69	-0.73	-0.45	-0.58	0.24	-0.76	-0.76	0.00	-0.77	-0.76	-0.33	-0.69	0.31		
GW09	2-sided-p	0.90	0.00	0.00	0.31	0.06	0.05	0.45	0.09	0.05	0.31	0.13	0.55	0.05	0.05	0.06	na	1.00	0.15	0.05	0.45	0.09	0.43
GW09	Trend	No	Yes-Upward	Yes-Upward	No	No	No	No	No	Yes-Downward	No	No	No	No	No	No	na	No	No	No	No	No	No
GW09	Number of Obs Below LOR	0	0	0	0	0	7	1	0	6	3	6	2	7	7	0	0	2	5	7	0	2	3
GW09	Number of Statistical Outliers	0	0	0	0	0	1	0	2	1	1	0	1	0	0	0	0	0	0	0	1	0	0
GW19_37a	Total Number	11	11	7	7	11	11	11	11	11	11	11	11	11	11	11	9	11	10	11	11	7	11
GW19_37a	from	17-12-2019	17-12-2019	17-12-2019	14-05-2023	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	08-11-2022	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	43816
GW19_37a	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06					

Bore	Statistics	pH (Field)	Lab_EC	Calcium	NH4-N	SO4	Al (diss)	As (diss)	B (diss)	Cd (diss)	Co (diss)	Cr (diss)	Cu (diss)	Hg (diss)	Pb (diss)	Mn (diss)	Mo (diss)	Ni (diss)	Ag (diss)	Se (diss)	U (diss)	V (diss)	Zn (diss)
	Unit	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GW07	Total Number	19	18	17	10	21	18	18	17	18	17	18	18	18	18	17	9	18	16	18	17	13	18
GW07	from	01-02-2014	20-02-2014	20-02-2014	01-03-2017	20-02-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	08-11-2022	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	41760
GW07	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	45466
GW07	Min	6.27	4590	148	0.03	8	2.50E-03	0.0004	2.00E-01	2.50E-05	2.00E-03	0.0001	2.50E-04	2.00E-05	0.00005	2.78E-01	2.00E-03	0.00005	1.00E-04	0.005	0.0005	0.0005	0.0025
GW07	5th %ile	6.342	4590	148.8	0.0345	8	2.50E-03	0.0004	2.00E-01	2.50E-05	2.00E-03	0.0001	4.63E-04	2.00E-05	0.00005	2.84E-01	1.22E-03	2.00E-03	0.00005	1.00E-04	0.005	0.00056	0.0025
GW07	20th %ile	6.658	5360	194	0.048	22	2.50E-03	0.0004	2.28E-01	3.50E-05	2.00E-03	0.00014	5.00E-04	2.00E-05	0.00011	4.006	2.00E-03	3.94E-03	0.00005	1.40E-04	0.00601	0.00064	0.0025
GW07	Median	6.88	5935	229	0.07	28	5.00E-03	0.0005	3.00E-01	5.00E-05	0.003	0.0005	1.00E-03	5.00E-05	0.0005	0.527	0.004	6.50E-03	0.0005	0.005	0.008	0.005	0.0125
GW07	80th %ile	7.204	7420	255.4	0.146	43	0.005	0.0005	4.48E-01	0.00014	0.00394	0.0005	2.18E-03	5.00E-05	0.0005	1.0918	0.01448	0.01346	0.0005	0.005	0.01032	0.005	0.0262
GW07	95th %ile	7.365	8661	270.6	0.573	51	0.0315	0.0005	0.564	0.000345	0.00402	0.0005	4.15E-03	0.00005	0.000575	1.34	0.02786	0.02079	0.0005	0.005	0.01168	0.005	0.0411
GW07	Max	7.77	9460	277	0.87	54	0.04	0.0005	5.80E-01	0.0006	0.0041	0.0005	5.00E-03	0.00005	0.001	1.78	0.0315	0.0213	0.0005	0.005	0.012	0.005	0.053
GW07	Tau	0.39	0.16	-0.27	-0.13	0.30	-0.41	-0.65	0.31	-0.34	0.29	-0.67	0.01	-0.65	-0.58	0.13	-0.08	0.24	-0.63	-0.67	0.23	-0.76	0.329478
GW07	2-sided-p	0.02	0.36	0.15	0.65	0.07	0.04	0.00	0.09	0.08	0.14	0.00	0.97	0.00	0.00	0.48	0.83	0.19	0.00	0.00	0.23	0.00	0.0740197
GW07	Trend	Yes-Upward	No	No	No	No	Yes-Downward	Yes-Downward	No	No	No	Yes-Downward	No	Yes-Downward	Yes-Downward	No	No	No	Yes-Downward	Yes-Downward	No	Yes-Downward	No
GW07	Number of Obs Below LOR	0	0	0	0	0	16	13	0	14	0	17	8	18	16	0	0	0	16	17	0	8	6
GW07	Number of Statistical Outliers	0	0	0	1	0	2	0	0	5	0	0	1	0	1	1	2	4	0	0	0	0	1
GW26	Total Number	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW26	from	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	to	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	5th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	20th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Median	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	80th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	95th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Tau	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	2-sided-p	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Trend	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Number of Obs Below LOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Number of Statistical Outliers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW19_33	Total Number	10	10	8	7	10	10	10	10	10	10	10	10	10	10	10	8	10	9	10	10	7	10
GW19_33	from	17-12-2019	17-12-2019	17-12-2019	14-05-2023	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	14-05-2023	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	43916
GW19_33	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	45466
GW19_33	Min	6.77	517	41	0.02	1	2.50E-03	0.0004	2.50E-02	2.50E-05	5.00E-05	0.0001	5.00E-04	2.00E-05	0.00005	2.90E-03	4.00E-04	2.10E-03	0.00005	1.00E-04	0.00017	0.0003	0.0025
GW19_33	5th %ile	6.8735	526.45	43.1	0.02	1.45	2.50E-03	0.000445	2.50E-02	2.50E-05	1.18E-04	0.0001	5.00E-04	2.00E-05	0.00005	8.17E-03	4.00E-04	2.37E-03	0.00005	1.00E-04	0.0002825	0.00033	0.003175
GW19_33	20th %ile	7.112	575.6	47.8	0.022	2	2.50E-03	0.0005	5.70E-02	2.50E-05	2.00E-04	0.0001	9.00E-04	2.00E-05	0.00005	0.01796	4.40E-04	2.84E-03	0.00005	1.00E-04	0.000444	0.00042	0.0056
GW19_33	Median	7.26	634	54	0.07	2	5.00E-03	0.0005	8.35E-02	3.75E-05	0.0009	0.0005	1.80E-03	3.50E-05	0.000275	0.05945	0.0015	9.20E-03	0.0005	0.00255	0.0005	0.0011	0.0095
GW19_33	80th %ile	7.564	692.4	57.2	0.314	2.2	0.0054	0.0008	1.00E-01	0.00005	0.00112	0.0012	4.44E-03	5.00E-05	0.0005	0.0844	0.00344	0.0144	0.0005	0.005	0.000808	0.00426	0.0164
GW19_33	95th %ile	7.8195	709.7	62.55	0.738	4.65	0.02515	0.00439	0.10275	0.00005	0.000122	0.007005	8.65E-03	0.00005	0.0005	0.627	0.00465	0.0182	0.0005	0.005	0.00155	0.005	0.0264
GW19_33	Max	7.95	716	65	0.9	6	0.04	0.007	1.05E-01	0.00005	0.002	0.0111	1.00E-02	0.00005	0.0005	1.05	0.005	0.02	0.0005	0.005	0.002	0.005	0.03
GW19_33	Tau	-0.20	-0.16	-0.11	-0.68	-0.43	-0.34	-0.13	0.30	-0.75	-0.49	-0.25	0.11	-0.75	-0.05	-0.42	-0.18	-0.24	-0.75	-0.18	-0.29	0.027331	1
GW19_33	2-sided-p	0.47	0.59	0.80	0.05	0.15	0.25	0.70	0.28	0.01	0.07	0.40	0.72	0.01	0.01	0.11	0.62	0.37	0.02	0.01	0.53	0.45	1
GW19_33	Trend	No	No	No	Yes-Downward	No	No	No	No	Yes-Downward	No	No	No	Yes-Downward	Yes-Downward	No	No	No	Yes-Downward	Yes-Downward	No	No	No
GW19_33	Number of Obs Below LOR	0	0	0	0	0	8	4	2	10	2	7	2	10	10	0	1	0	9	10	3	2	1
GW19_33	Number of Statistical Outliers	0	0	0	1	3	1	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	1
GW30c	Total Number	13	12	9	8	13	13	13	13	13	13	13	13	13	13	13	9	13	12	13	13	9	13
GW30c	from	01-06-2018	09-05-2019	01-06-2018	43252	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	08-11-2022	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018
GW30c	to	22-06-2024	22-06-2024	22-06-2024	45465	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024
GW30c	Min	6.5	12300	167	0.04	25	0.0025	2.50E-04	0.28	2.50E-05	5.00E-05	1.00E-04	2.50E-04	2.00E-05	5.00E-05	0.0682	5.00E-05	2.50E-04	5.00E-05	0.0001	0.0004	0.0001	0.0005
GW30c	5th %ile	6.6	12355	168.6	0.11	25.8	0.0025	2.50E-04	0.31	2.50E-05	8.00E-05	1.90E-04	2.50E-04	2.00E-05	5.00E-05	0.07048	1.50E-04	4.00E-04	5.00E-05	0.00022	0.00046	0.00016	0.0014
GW30c	20th %ile	6.7	12660	178.8	0.276	32.4	0.0025	4.40E-04	0.3748	3.50E-05	1.00E-04	3.10E-04	0.00035	2.00E-05	1.00E-04	0.0772	3.60E-04	5.00E-04	6.00E-05	0.00094	0.0005	0.00025	0.0025
GW30c	Median	6.9	14400	226	0.39	43	0.005	5.00E-04	0.4	5.00E-05	5.00E-04	0.0005	5.00E-04	5.00E-05	5.00E-04	0.163	4.00E-04	0.001	5.00E-04	0.005	0.0005	0.0005	0.0025
GW30c	80th %ile	7.0	15040	334	0.676	98.8	0.005	0.0005	0.8094	5.00E-05	5.00E-04	0.0005	5.00E-05	5.00E-04	0.0005	0.0005	0.00188	5.00E-04	0.005	0.006138	0.005	0.0046	
GW30c	95th %ile	7.5	15475	356.8	0.9176	184.8	0.015	0.00076	0.8596	1.00E-04	7.00E-04	0.0005	0.0007	0.00005									

Bore	Statistics	pH (Field)	Lab_EC	Calcium	NH4-N	SO4	Al (diss)	As (diss)	B (diss)	Cd (diss)	Co (diss)	Cr (diss)	Cu (diss)	Hg (diss)	Pb (diss)	Mn (diss)	Mo (diss)	Ni (diss)	Ag (diss)	Se (diss)	U (diss)	V (diss)	Zn (diss)
	Unit	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GW30b	Total Number	13	12	9	8	13	13	13	13	13	13	13	13	13	13	13	9	13	12	13	13	9	13
GW30b	from	01-06-2018	09-05-2019	01-06-2018	43252	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	08-11-2022	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018
GW30b	to	22-06-2024	22-06-2024	22-06-2024	45465	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024
GW30b	Min	6.5	16600	437	3.22	0.5	0.0025	2.50E-04	0.19	2.50E-05	1.00E-04	2.00E-04	2.50E-04	2.00E-05	5.00E-05	0.081	5.00E-05	5.00E-05	0.0001	0.000025	0.0001	0.009	
GW30b	5th %ile	6.5	16600	448.2	3.227	0.5	0.0025	2.50E-04	0.2398	4.00E-05	1.00E-04	2.30E-04	4.00E-04	2.00E-05	8.00E-05	0.0876	2.30E-04	4.00E-04	5.00E-05	0.00004	0.00004	0.00016	
GW30b	20th %ile	6.7	16800	509.4	3.284	0.5	0.0025	5.40E-04	0.288	5.00E-05	2.00E-04	2.50E-04	0.0005	2.00E-05	1.00E-04	0.101	5.00E-04	1.44E-03	5.00E-05	0.001	0.00005	0.00025	
GW30b	Median	7.0	17200	552	3.48	4	0.005	1.00E-03	0.328	5.00E-05	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.105	1.00E-03	0.002	5.00E-04	0.005	0.0005	0.00025	
GW30b	80th %ile	7.2	17560	617	3.604	16.8	0.01	0.0066	0.3536	1.00E-04	5.00E-04	0.0005	0.002	5.00E-05	5.00E-04	0.1116	0.00212	0.0046	5.00E-04	0.005	0.0005	0.005	
GW30b	95th %ile	7.6	18285	679.4	3.8735	50	0.022	0.0128	0.3764	1.00E-04	1.50E-03	0.0005	0.003	7E-05	5.00E-04	0.1144	0.00392	0.0068	0.0005	0.005	0.0005	0.0288	
GW30b	Max	7.8	19000	705	4.01	56	0.04	0.014	0.38	1.00E-04	3.00E-03	0.0005	0.003	1.00E-04	5.00E-04	0.118	0.005	0.008	0.0005	0.005	0.0005	0.036	
GW30b	Tau	-0.45	0.13	-0.44	0.07	-0.89	-0.44	-0.61	-0.04	0.44	-0.73	-0.65	0.23	-0.38	-0.65	0.52	-0.37	-0.61	-0.70	-0.65	-0.65	-0.61	
GW30b	2-sided-p	0.04	0.63	0.12	0.90	0.00	0.06	0.01	0.90	0.07	0.00	0.01	0.34	0.13	0.01	0.02	0.21	0.00	0.01	0.01	0.01	0.05	
GW30b	Trend	Yes-Downward	No	No	No	Yes-Downward	No	Yes-Downward	No	No	Yes-Downward	Yes-Downward	No	No	Yes-Downward	Yes-Upward	No	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	No
GW30b	Number of Obs Below LOR	0	0	0	0	5	8	3	0	13	9	12	8	13	13	0	2	2	12	13	13	9	0
GW30b	Number of Statistical Outliers	1	1	2	0	2	1	3	1	0	1	0	0	1	0	1	1	1	0	0	0	0	0
GW10	Total Number	16	15	15	10	18	16	16	15	16	15	16	16	16	16	15	1	16	14	16	15	12	16
GW10	from	01-05-2014	01-05-2014	01-05-2014	01-03-2017	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	14-05-2023	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014
GW10	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024
GW10	Min	7.16	2030	12	0.85	0.5	2.50E-03	0.002	5.00E-01	2.50E-05	5.00E-05	0.0004	2.50E-04	2.00E-05	0.00005	5.00E-03	8.00E-03	5.00E-04	0.00005	1.00E-04	0.00011	0.0001	0.0025
GW10	5th %ile	7.2125	2177	14.8	0.85	0.5	2.50E-03	0.003275	5.13E-01	2.50E-05	5.00E-05	0.000475	2.50E-04	2.00E-05	0.00005	5.70E-03	8.11E-03	5.00E-04	0.00005	1.00E-04	0.000117	0.000155	0.0025
GW10	20th %ile	7.32	2762	17.8	0.85	0.5	2.50E-03	0.0042	5.38E-01	2.50E-05	1.70E-04	0.0005	5.00E-04	2.00E-05	0.00005	5.00E-03	8.98E-03	5.00E-04	0.00005	1.00E-04	0.00012	0.0003	0.0025
GW10	Median	7.42	3799	28	1.03	0.5	5.00E-03	0.006	8.70E-01	5.00E-05	0.0005	0.0005	5.00E-04	5.00E-05	0.0005	0.0285	0.04095	5.00E-03	0.0005	5.00E-04	0.0005	0.005	0.004
GW10	80th %ile	7.63	5814	56.2	1.196	5.6	0.01	0.007	9.40E-01	0.0005	0.0005	0.0027	1.00E-03	5.00E-05	0.0005	0.0847	0.04739	0.0224	0.0005	0.0005	0.005	0.005	0.008
GW10	95th %ile	7.93	6244	60.3	1.3465	8.15	0.0635	0.01325	1.01	0.0001125	0.0005	0.002625	2.00E-03	0.00005	0.000625	0.09876	0.048775	0.0262	0.0005	0.005	0.005	0.005	0.009
GW10	Max	8.05	6650	61	1.45	9	0.07	0.029	1.01E+00	0.0003	0.0005	0.0029	2.00E-03	0.00005	0.0001	0.122	0.0493	0.028	0.0005	0.005	0.0005	0.005	0.009
GW10	Tau	-0.08	0.16	-0.14	-0.16	-0.61	-0.36	-0.45	-0.49	-0.71	-0.65	0.45	-0.24	-0.68	-0.74	0.54	0.50	0.32	-0.66	-0.68	-0.69	-0.76	0.293447
GW10	2-sided-p	0.68	0.43	0.49	0.59	0.00	0.08	0.02	0.01	0.00	0.00	0.03	0.24	0.00	0.00	0.01	0.11	0.10	0.01	0.00	0.00	0.00	0.153748
GW10	Trend	No	No	No	No	Yes-Downward	No	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	No	Yes-Downward	Yes-Downward	Yes-Upward	No	No	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	No
GW10	Number of Obs Below LOR	0	0	0	0	10	11	0	15	13	10	10	10	16	15	0	0	5	14	16	10	8	7
GW10	Number of outliers	0	0	0	0	0	3	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
GW13	Total Number	18	16	15	10	19	17	17	16	17	16	17	17	17	17	16	9	17	15	17	16	12	17
GW13	from	01-05-2014	01-05-2014	01-05-2014	42795	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	08-11-2022	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014
GW13	to	22-06-2024	22-06-2024	22-06-2024	45465	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024
GW13	Min	7.1	11600	68	2.82	0.5	0.0025	7.00E-04	0.13	2.50E-05	5.00E-05	1.00E-04	2.50E-04	2.00E-05	5.00E-05	0.012	1.20E-03	2.50E-04	5.00E-05	0.0001	0.000025	0.0001	0.006
GW13	5th %ile	7.2	11825	77.8	2.847	0.5	0.0025	8.60E-04	0.39925	2.50E-05	5.00E-05	1.00E-04	2.50E-04	2.00E-05	5.00E-05	0.015	1.20E-03	4.50E-04	5.00E-05	0.0001	0.000025	0.0001	0.0068
GW13	20th %ile	7.2	12000	84.4	2.96	0.5	0.0025	1.06E-03	0.5	3.00E-05	1.00E-04	1.30E-04	0.0005	2.00E-05	1.00E-04	0.022	1.32E-03	5.00E-04	0.00036	0.000025	0.000021	0.011	
GW13	Median	7.3	12200	93	3.145	0.5	0.005	2.00E-03	0.57	5.00E-05	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.03045	1.70E-03	0.0014	5.00E-04	0.005	0.0005	0.005	0.013
GW13	80th %ile	7.5	12300	127	3.352	3.6	0.005	0.0056	0.64	5.00E-05	5.00E-04	0.0005	0.001	5.00E-05	5.00E-04	0.0364	0.002	0.003	5.00E-04	0.005	0.0005	0.005	0.0184
GW13	95th %ile	7.7	12700	143	3.4535	15.1	0.022	0.013	0.66	5.00E-04	8.75E-04	0.0005	0.0022	0.00005	5.00E-04	0.04125	0.0104	0.0092	0.00125	0.005	0.0005	0.005	0.0244
GW13	Max	8.0	13000	143	3.53	34	0.03	0.021	0.66	2.10E-03	2.00E-03	0.0005	0.003	5.00E-05	5.00E-04	0.042	0.016	0.03	0.003	0.005	0.0005	0.005	0.042
GW13	Tau	0.10	0.08	-0.08	-0.56	-0.34	-0.50	-0.38	0.08	-0.47	-0.57	-0.64	-0.16	-0.66	-0.61	0.42	-0.94	0.06	-0.63	-0.60	-0.65	-0.78	0.52
GW13	2-sided-p	0.57	0.71	0.73	0.03	0.07	0.01	0.04	0.68	0.02	0.01	0.00	0.43	0.00	0.00	0.03	0.00	0.68	0.00	0.00	0.00	0.00	0.01
GW13	Trend	No	No	No	Yes-Downward	No	Yes-Downward	Yes-Downward	No	Yes-Downward	Yes-Downward	Yes-Downward	No	Yes-Downward	Yes-Downward	Yes-Upward	Yes-Downward	No	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Upward
GW13	Number of Obs Below LOR	0	0	0	0	12	15	0	16	14	17	11	17	17	17	0	0	5	14	16	16	10	1
GW13	Number of outliers	1	1	0	0	3	2	2	1	3	1	0	2	0	0	0	1	1	1	0	0	0	0
GW30a	Total Number	12	11	9	8	12	12	12	12	12	12	12	12	12	12	12	8	12	11	12	12	9	12
GW30a	from	01-06-2018	09-05-2019	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	14-05-2023	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018
GW30a	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024
GW30a	Min	6.72	13900	170	3.08	0.5	2.50E-03	0.00025	1.90E-01	2.50E-05	5.00E-05	0.0001	2.50E-04	2.00E-05	0.00005	4.05E-02	4.00E-04	2.50E-04	0.00005	1.00E-04			

Bore	Statistics	pH (Field)	Lab_EC	Calcium	NH4-N	SO4	Al (diss)	As (diss)	B (diss)	Cd (diss)	Co (diss)	Cr (diss)	Cu (diss)	Hg (diss)	Pb (diss)	Mn (diss)	Mo (diss)	Ni (diss)	Ag (diss)	Se (diss)	U (diss)	V (diss)	Zn (diss)
	Unit	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GW11	Total Number	19	16	15	10	19	17	17	16	17	16	17	17	17	17	16	9	17	15	17	16	12	17
GW11	from	01-05-2014	01-05-2014	01-05-2014	01-03-2017	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	08-11-2022	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	41760
GW11	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	45465
GW11	Min	6.4	3540	32	0.6	0.5	2.50E-03	0.0001	2.50E-01	2.50E-05	5.00E-05	0.0001	2.50E-04	2.00E-05	0.00005	1.50E-02	4.00E-04	5.00E-04	0.00005	1.00E-04	0.000025	0.0004	0.0025
GW11	5th %ile	6.49	3577.5	32.7	0.9645	0.5	2.50E-03	0.0001	2.94E-01	2.50E-05	5.00E-05	0.0001	2.50E-04	2.00E-05	0.00005	1.69E-02	4.40E-04	5.00E-04	0.00005	1.00E-04	0.000025	0.000455	0.0025
GW11	20th %ile	6.758	3720	35.8	1.434	0.5	2.50E-03	0.00026	3.30E-01	2.50E-05	1.00E-04	0.00014	5.00E-04	2.00E-05	0.00005	0.0212	5.00E-04	5.00E-04	0.00005	1.00E-04	0.000025	0.00052	0.003
GW11	Median	7.04	3785	54	1.575	3	5.00E-03	0.0005	3.58E-01	5.00E-05	0.0005	0.0005	5.00E-04	5.00E-05	0.0005	0.0271	0.0005	1.00E-03	0.0005	0.005	0.0005	0.005	0.009
GW11	80th %ile	7.476	4140	95	1.768	7.4	0.005	0.0005	3.90E-01	0.00005	0.0005	0.0005	6.60E-04	5.00E-05	0.0005	0.029	0.00194	0.00194	0.0005	0.005	0.0005	0.005	0.0158
GW11	95th %ile	7.765	4672.5	105.8	1.832	16.3	0.032	0.0016	0.44	0.00005	0.0005	0.0005	2.16E-03	0.00005	0.0005	0.0325	0.00026	0.004	0.0005	0.005	0.0005	0.005	0.0292
GW11	Max	8.08	4920	110	2.04	19	0.04	0.004	5.60E-01	0.00005	0.0005	0.0005	6.00E-03	0.00005	0.0005	0.04	0.003	0.006	0.0005	0.005	0.0005	0.005	0.07
GW11	Tau	0.37	-0.53	-0.81	-0.11	-0.79	-0.42	-0.49	-0.12	-0.66	-0.65	-0.60	-0.11	-0.66	-0.66	-0.54	0.06	0.38	-0.65	-0.66	-0.68	-0.69	0.212219
GW11	2-sided-p	0.03	0.01	0.00	0.72	0.00	0.04	0.01	0.56	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.91	0.05	0.01	0.00	0.00	0.01	0.26189
GW11	Trend	Yes-Upward	Yes-Downward	Yes-Downward	No	Yes-Downward	Yes-Downward	Yes-Downward	No	Yes-Downward	Yes-Downward	Yes-Downward	No	Yes-Downward	Yes-Downward	Yes-Downward	No	Yes-Upward	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	No
GW11	Number of Obs Below LOR	0	0	0	0	9	14	13	0	17	14	16	13	17	17	0	3	7	15	17	16	7	4
GW11	Number of Statistical Outliers	0	2	0	1	2	3	5	2	0	0	0	5	0	0	1	0	2	0	0	0	0	1
GW29a	Total Number	11	11	8	7	11	11	11	11	11	11	11	11	11	11	11	8	11	10	11	11	8	11
GW29a	from	09-05-2019	09-05-2019	09-05-2019	45060	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	14-05-2023	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019
GW29a	to	22-06-2024	22-06-2024	22-06-2024	45465	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024
GW29a	Min	7.1	8480	92	1.59	0.5	0.0025	6.00E-03	0.47	2.50E-05	5.00E-05	1.00E-04	2.50E-04	2.00E-05	5.00E-05	0.0288	5.00E-04	5.00E-04	5.00E-05	0.0001	0.000025	0.0001	0.01
GW29a	5th %ile	7.1	8520	92.35	1.617	0.5	0.0025	6.00E-03	0.503	2.50E-05	5.00E-05	1.00E-04	2.50E-04	2.00E-05	5.00E-05	0.0294	1.38E-03	5.00E-04	5.00E-05	0.0001	0.000025	0.0001	0.011
GW29a	20th %ile	7.3	8650	97	1.716	0.5	0.0025	7.00E-03	0.546	2.50E-05	1.00E-04	1.00E-04	0.0005	2.00E-05	5.00E-05	0.03	3.00E-03	1.00E-03	5.00E-05	0.0001	0.000025	0.0001	0.013
GW29a	Median	7.5	9170	115	1.91	0.5	0.005	1.00E-02	0.578	5.00E-05	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.033	3.75E-03	0.0014	5.00E-04	0.005	0.0005	0.0001	0.015
GW29a	80th %ile	7.7	9530	123.6	1.92	2	0.006	0.0115	0.6	5.00E-05	5.00E-04	0.0005	0.001	5.00E-05	5.00E-04	0.0387	0.00404	0.0019	5.00E-04	0.005	0.0005	0.005	0.02
GW29a	95th %ile	7.8	9870	140.3	2.34	3.5	1.7	0.01565	0.672	5.00E-05	2.25E-03	0.00275	0.0113	0.00005	1.33E-02	0.20895	0.004265	0.009	0.0005	0.005	0.00125	0.005	0.1105
GW29a	Max	7.9	10190	148	2.52	5	3.36	0.017	0.684	5.00E-05	4.00E-03	0.005	0.021	5.00E-05	2.60E-02	0.377	0.0043	0.016	0.0005	0.005	0.002	0.005	0.201
GW29a	Tau	-0.43	-0.45	-0.36	-0.78	-0.26	-0.27	0.33	0.07	-0.74	-0.64	-0.62	-0.12	-0.74	-0.62	0.15	0.59	0.37	-0.73	-0.60	-0.62	-0.73	0.20
GW29a	2-sided-p	0.08	0.06	0.27	0.02	0.36	0.32	0.18	0.81	0.01	0.01	0.02	0.69	0.01	0.02	0.58	0.06	0.14	0.01	0.03	0.02	0.04	0.43
GW29a	Trend	No	No	No	Yes-Downward	No	No	No	No	Yes-Downward	Yes-Downward	Yes-Downward	No	Yes-Downward	Yes-Downward	No	No	No	Yes-Downward	Yes-Downward	Yes-Downward	Yes-Downward	No
GW29a	Number of Obs Below LOR	0	0	0	0	8	8	0	0	11	7	10	6	11	10	0	1	2	10	10	10	8	0
GW29a	Number of Statistical Outliers	0	0	0	1	1	2	0	2	0	1	1	2	0	1	1	1	1	0	0	1	0	1

N/A = insufficient data for statistical analysis



Appendix B Water Quality Time Series

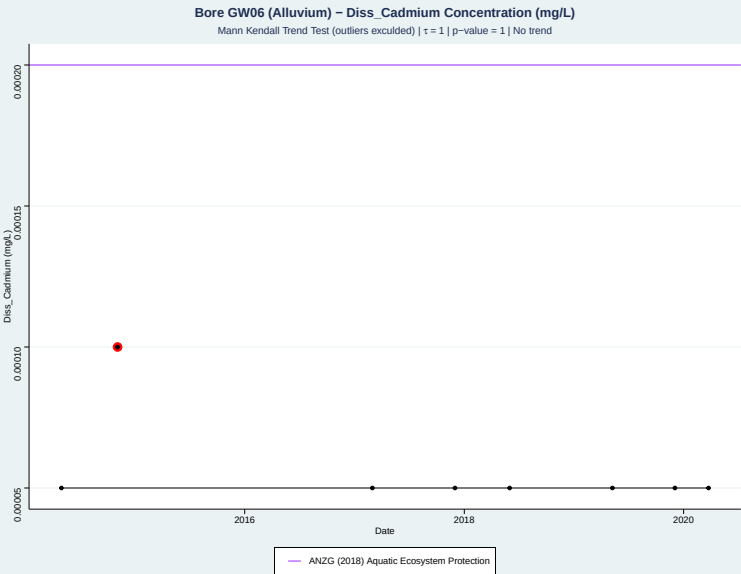
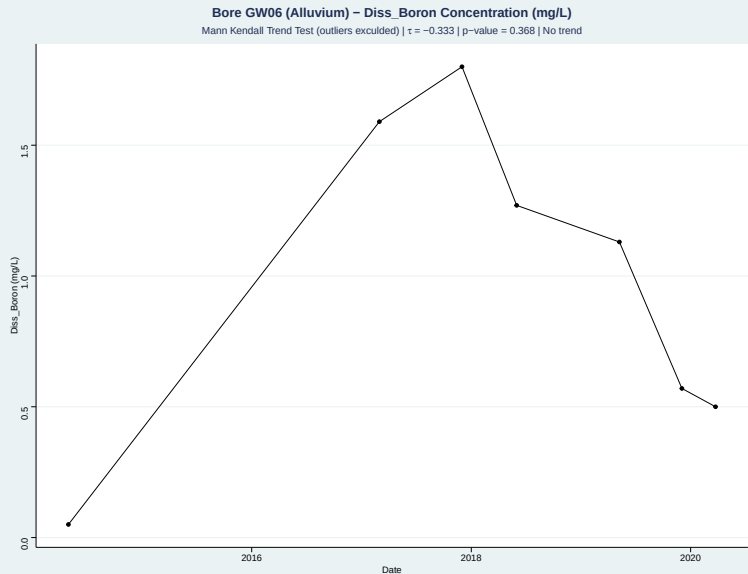
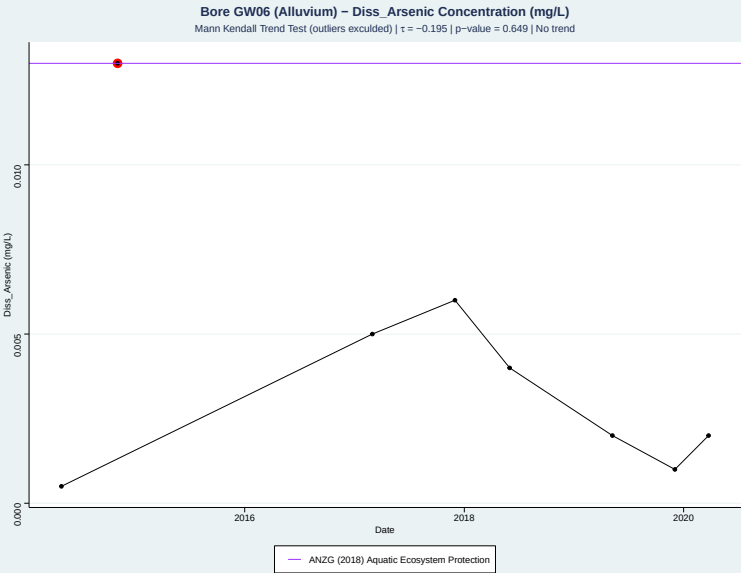
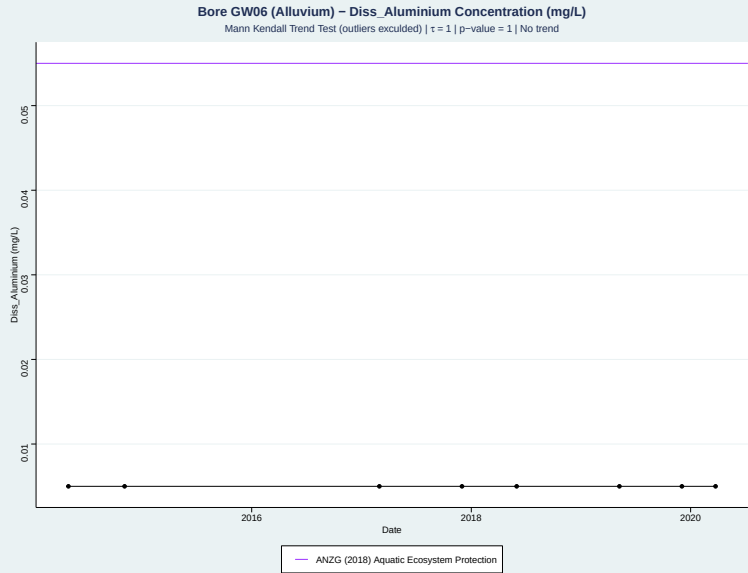
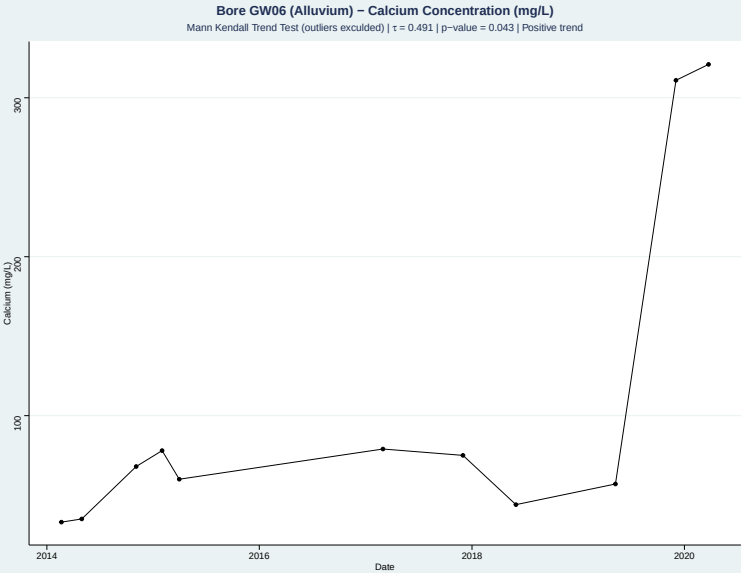
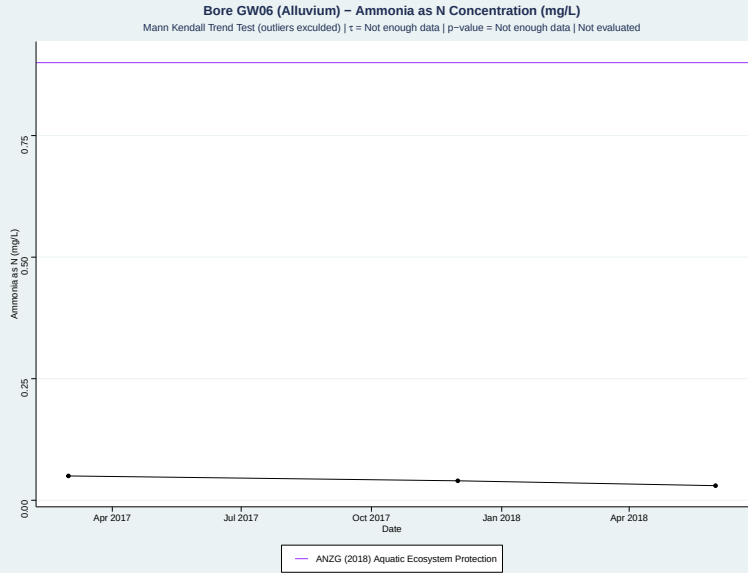
Groundwater Compliance 2024 Updated Limit and Trigger Development

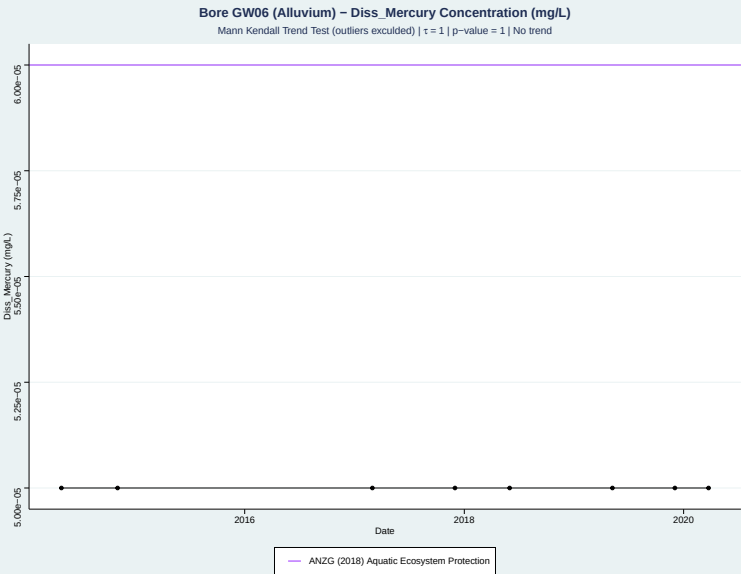
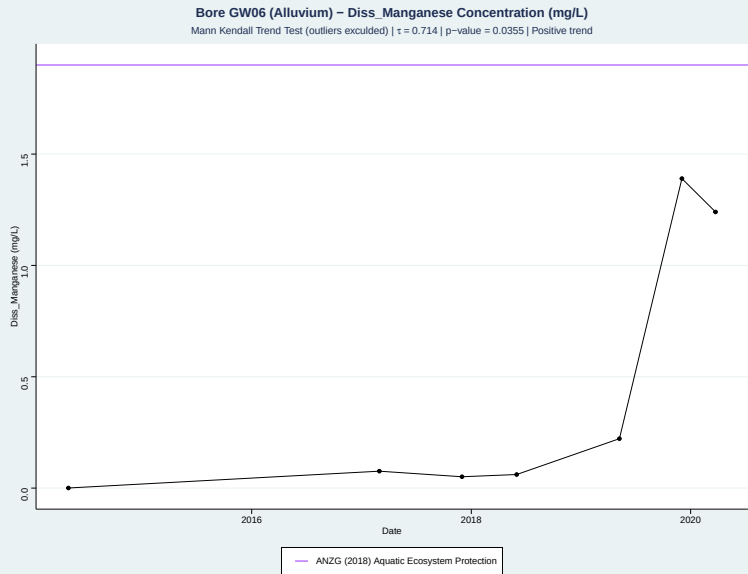
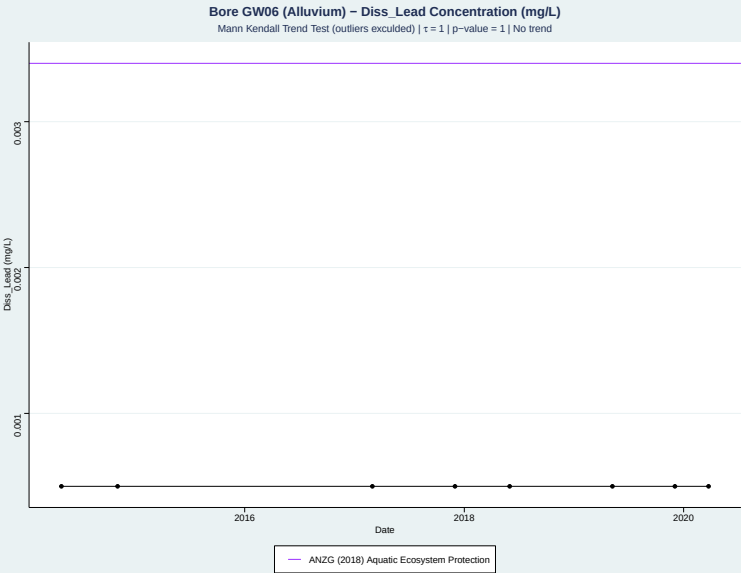
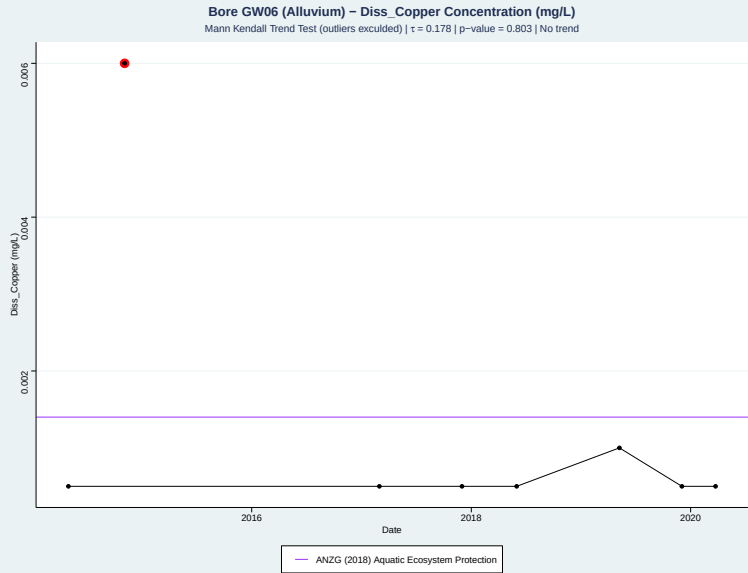
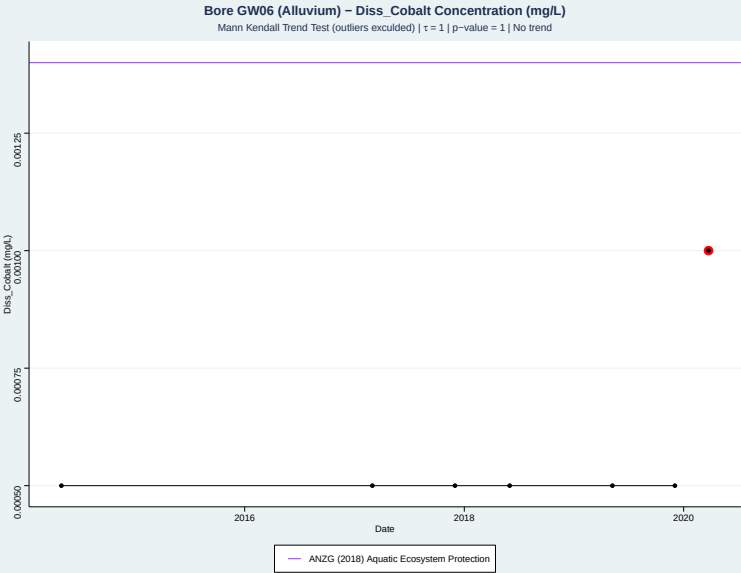
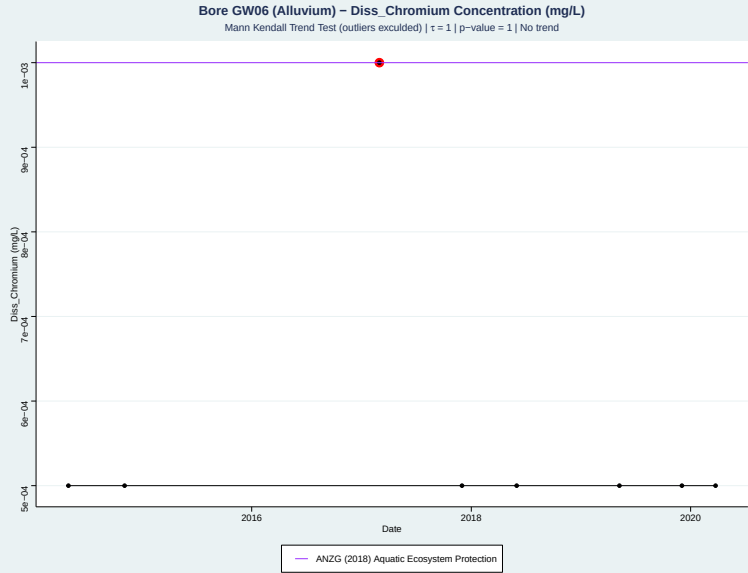
New Lenton Coal Project

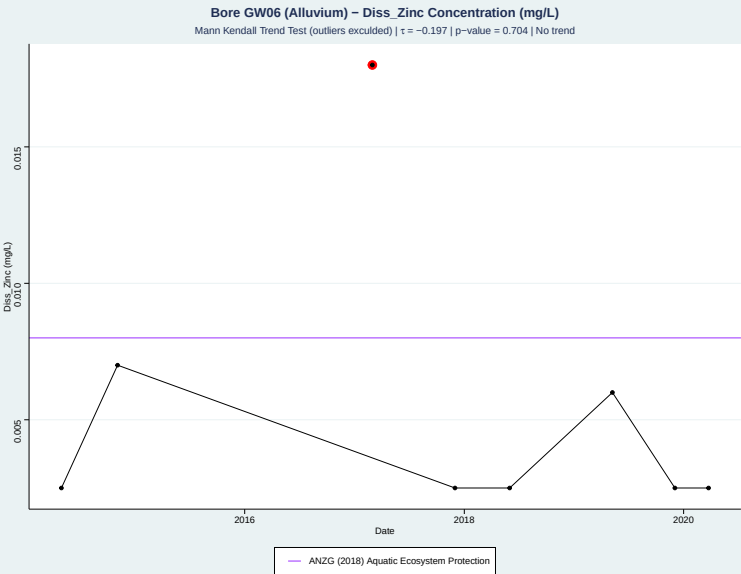
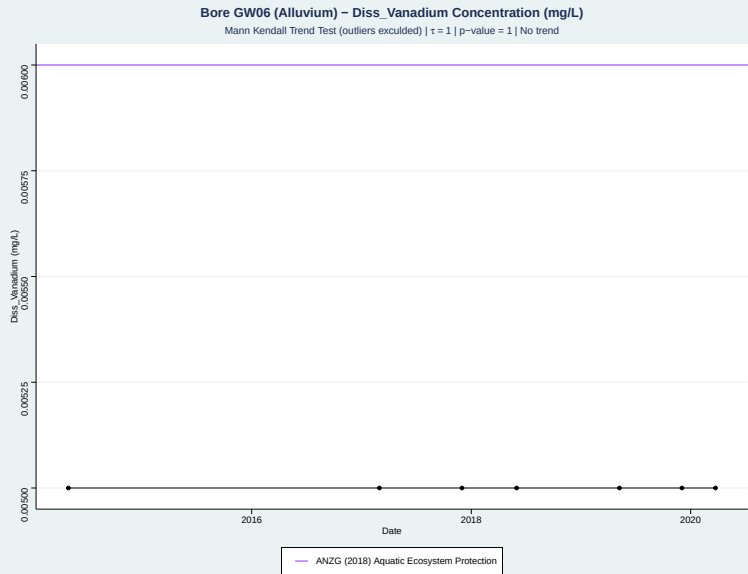
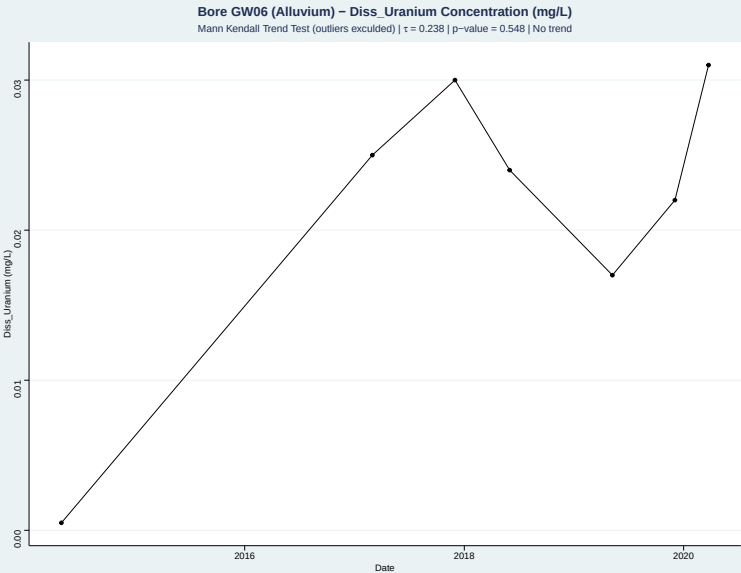
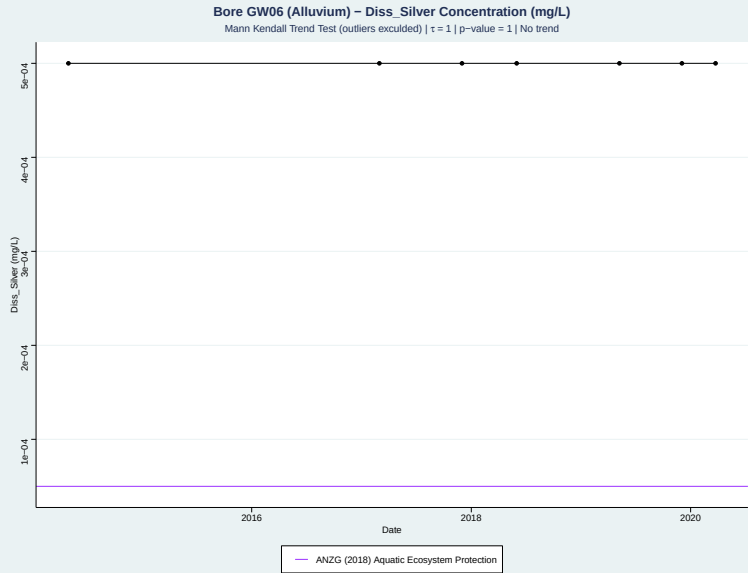
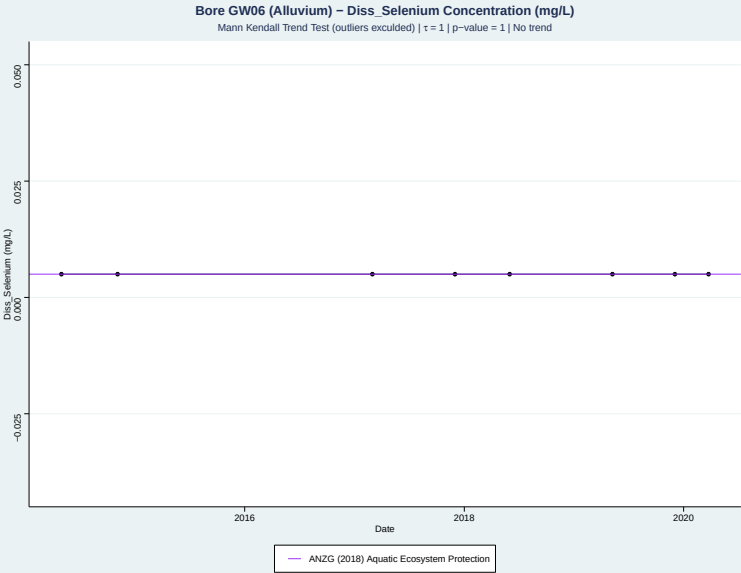
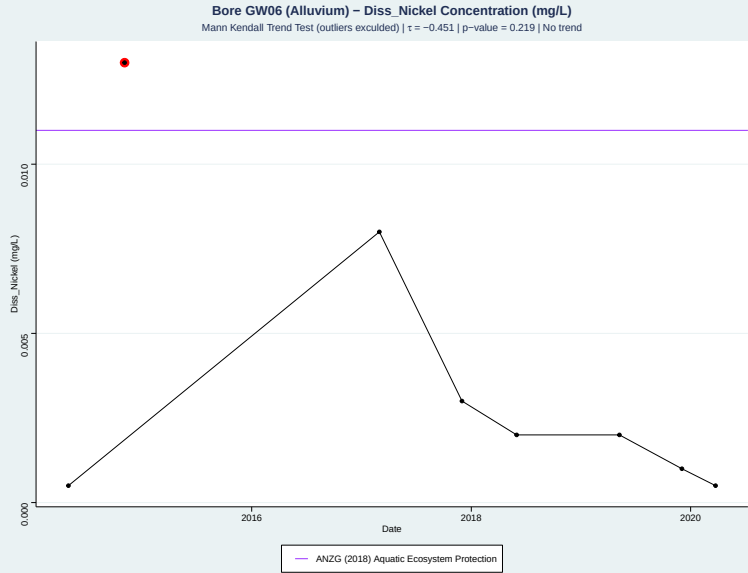
Lenton Joint Venture

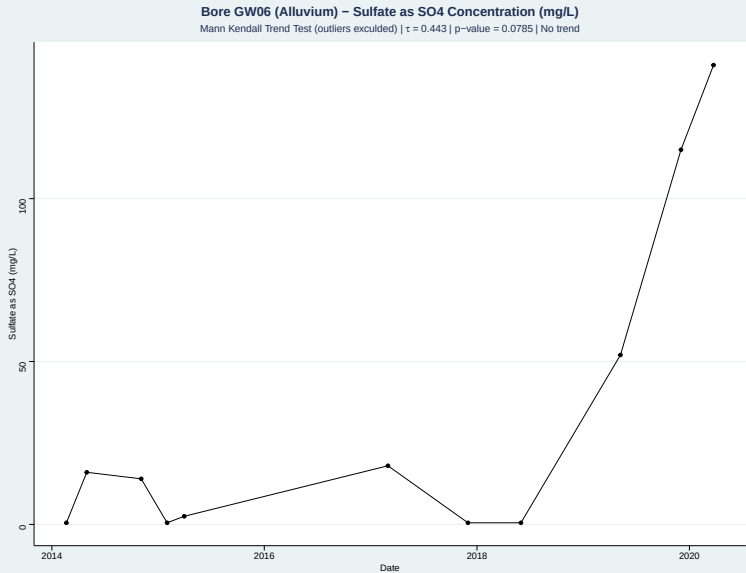
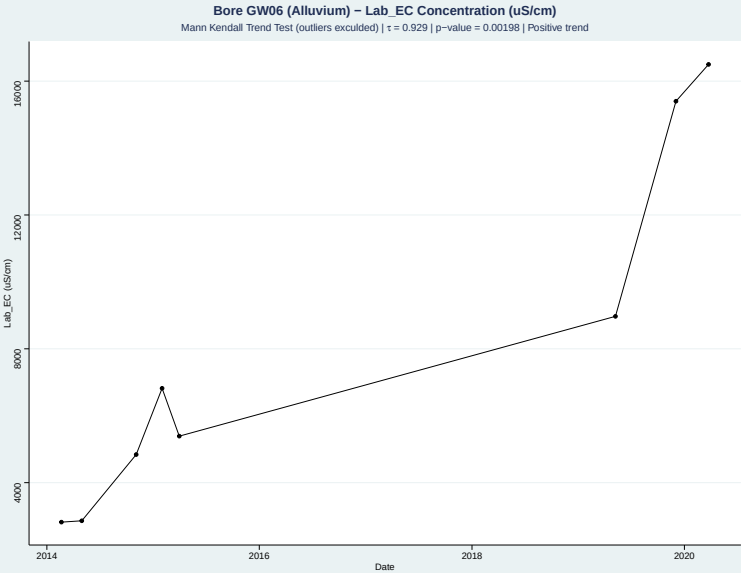
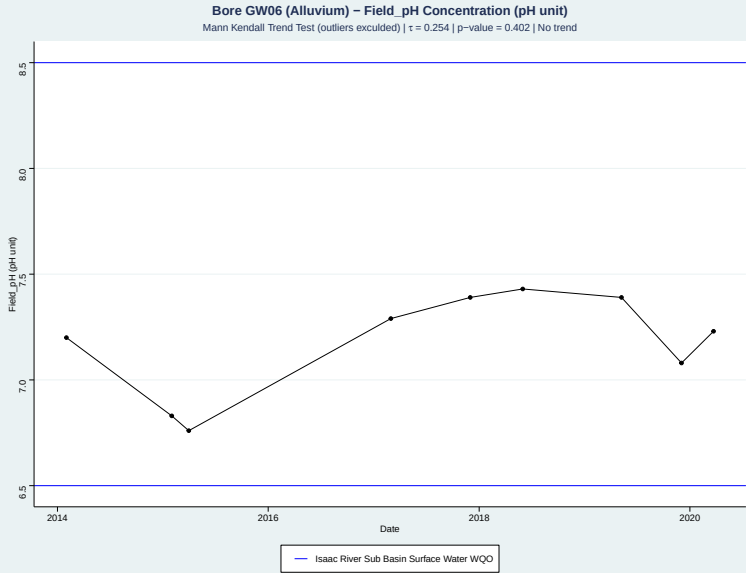
SLR Project No.: 620.040927.00001

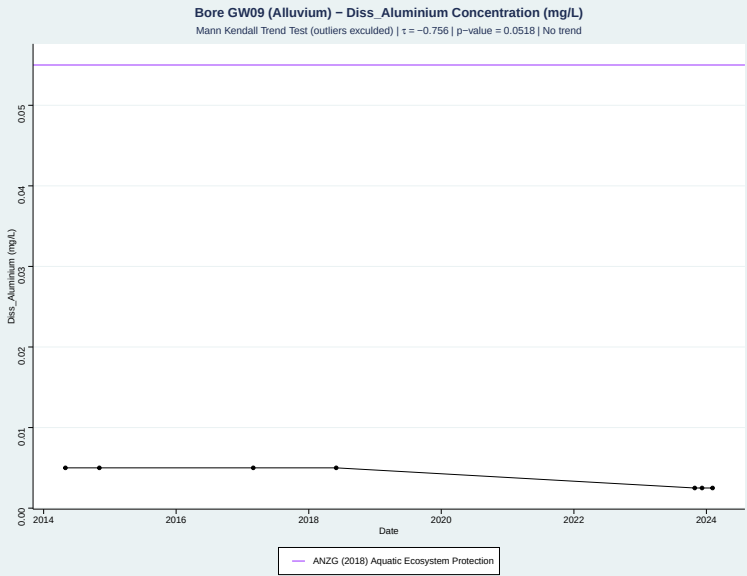
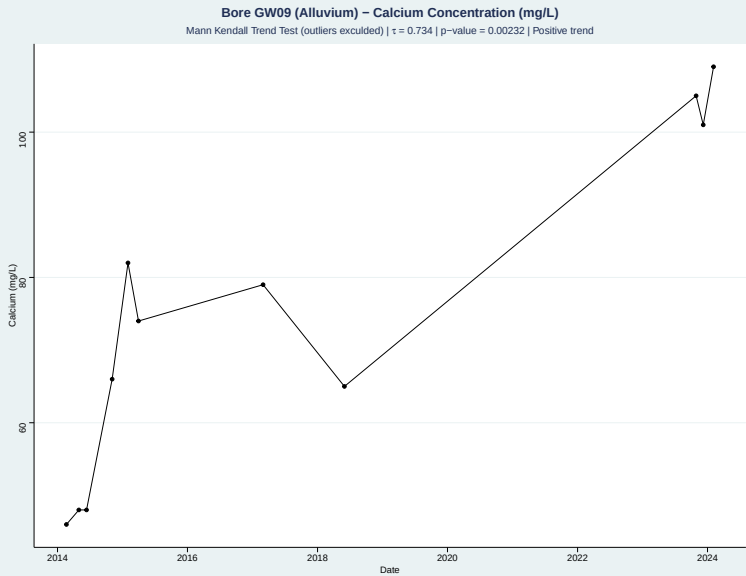
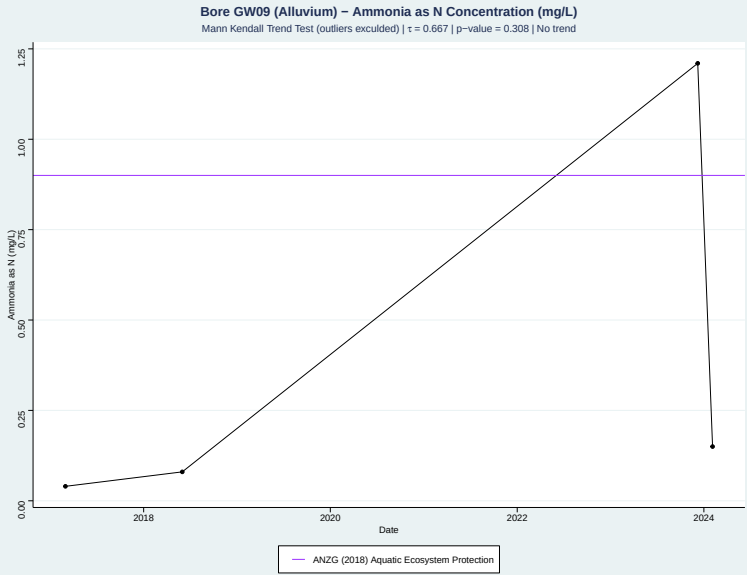
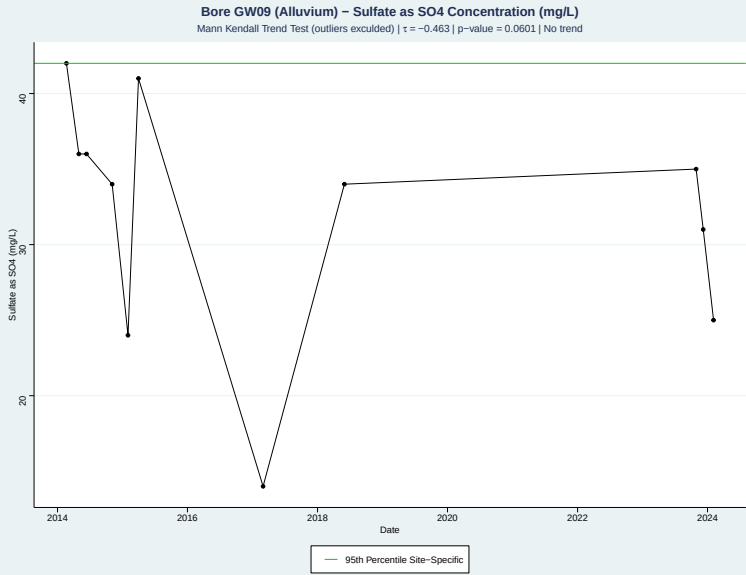
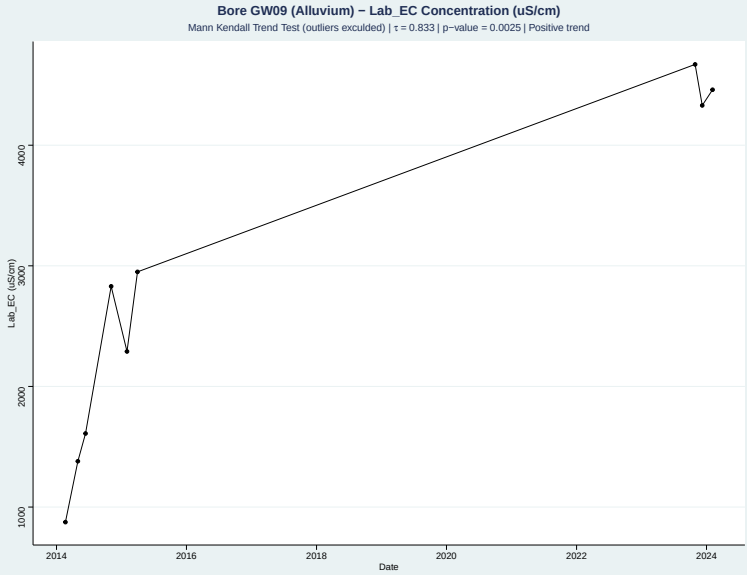
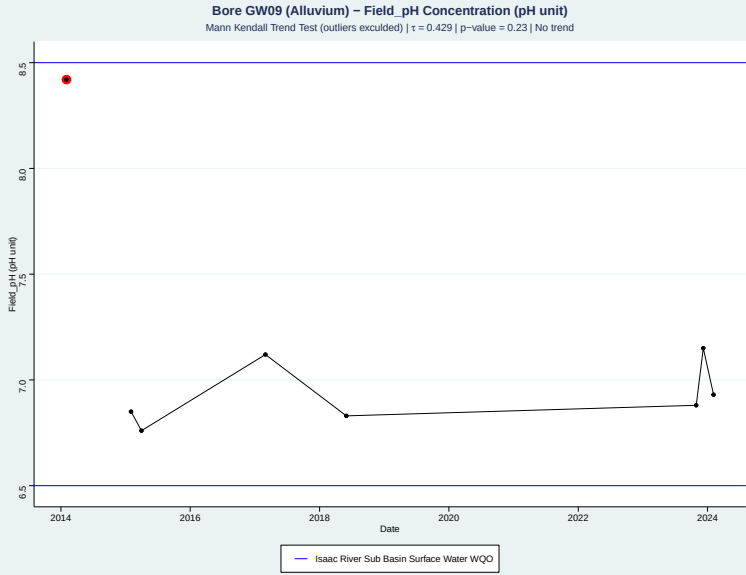
25 September 2024



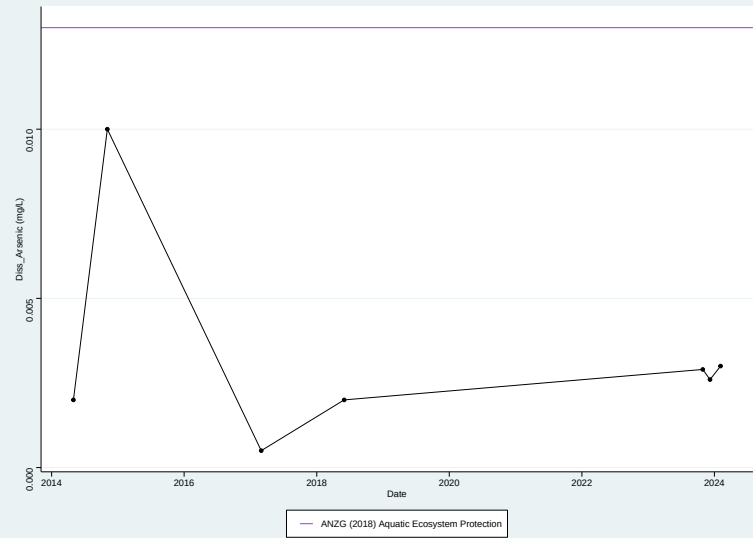




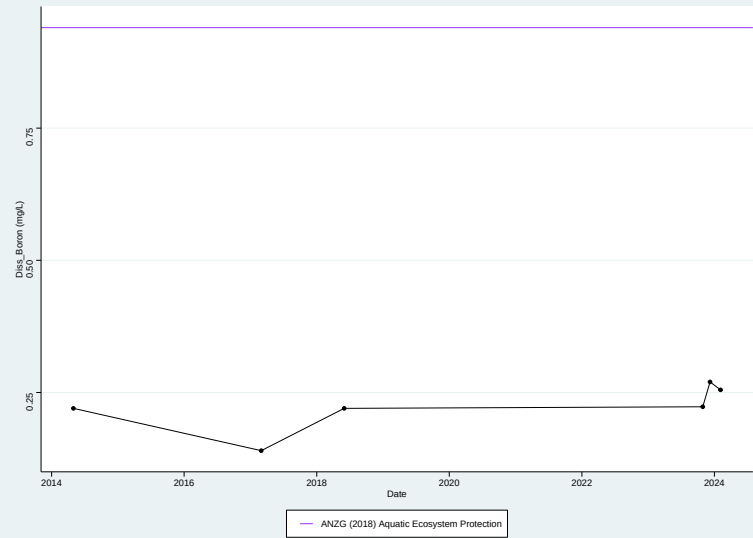




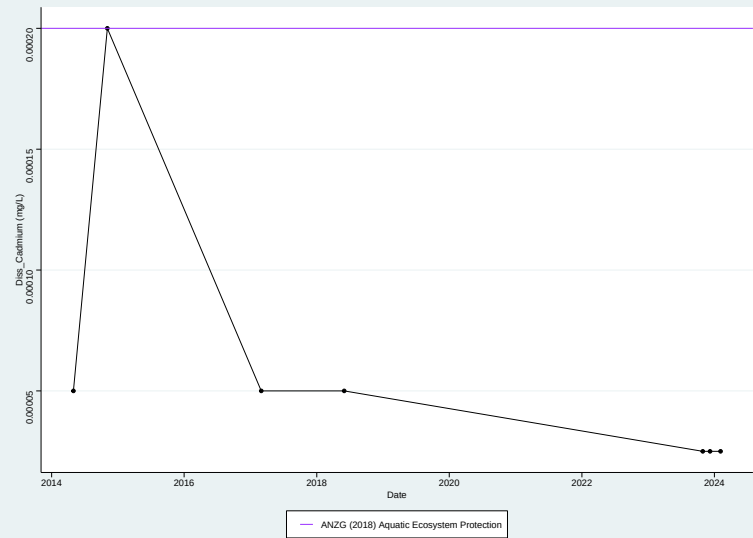
Bore GW09 (Alluvium) – Diss. Arsenic Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = 0.293$ | $p\text{-value} = 0.448$ | No trend



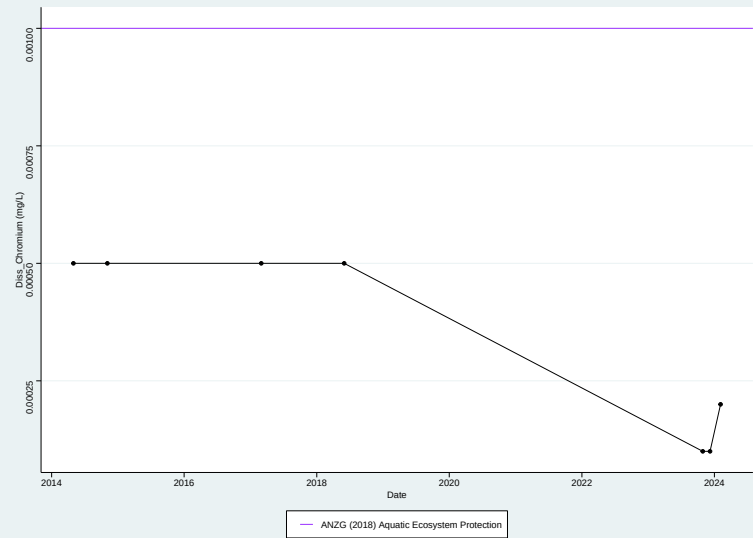
Bore GW09 (Alluvium) – Diss. Boron Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = 0.69$ | $p\text{-value} = 0.0852$ | No trend



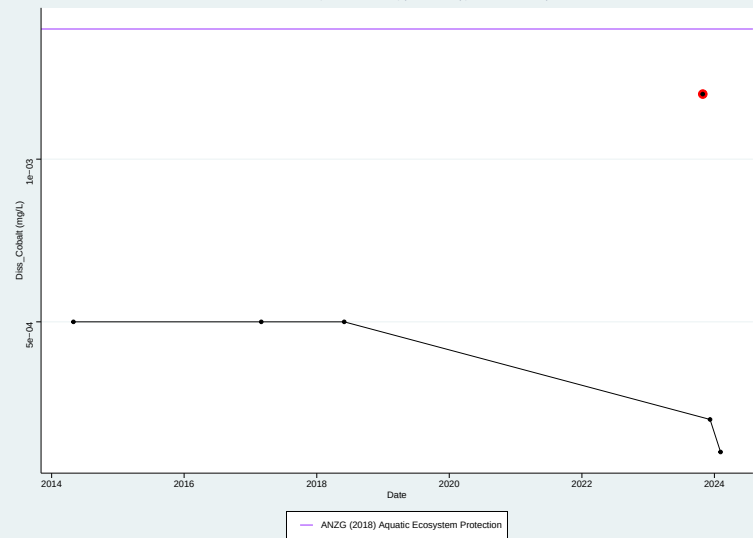
Bore GW09 (Alluvium) – Diss. Cadmium Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.732$ | $p\text{-value} = 0.0485$ | Negative trend



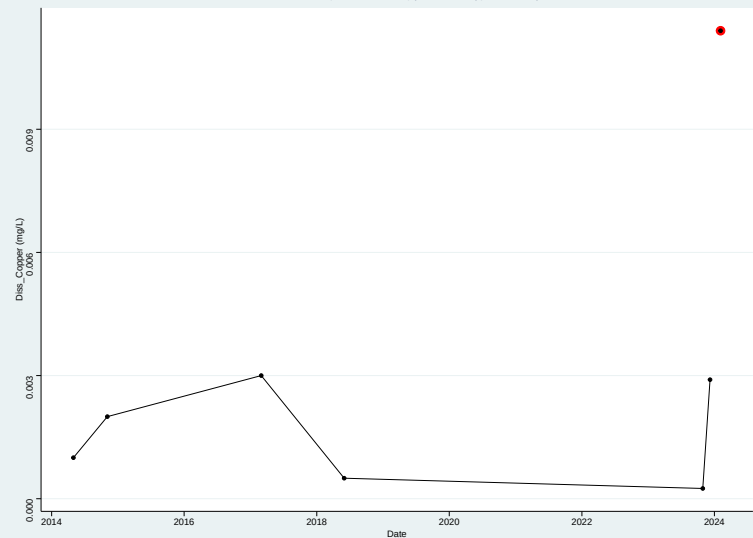
Bore GW09 (Alluvium) – Diss. Chromium Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.583$ | $p\text{-value} = 0.126$ | No trend

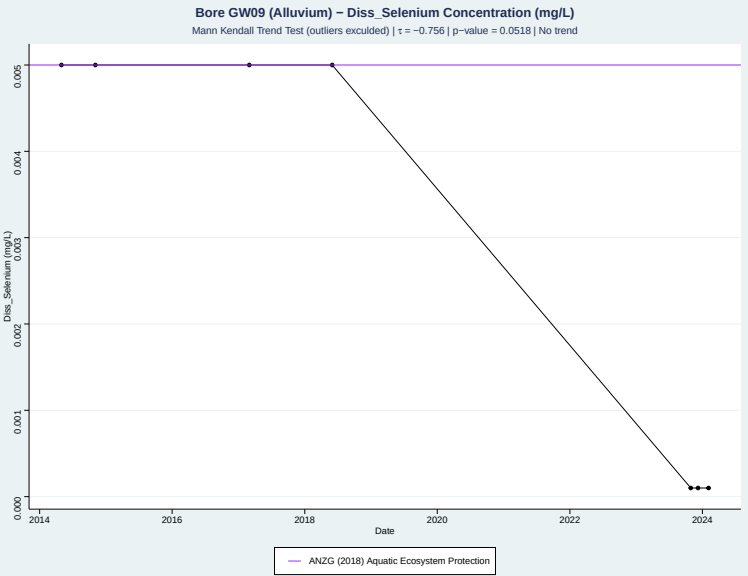
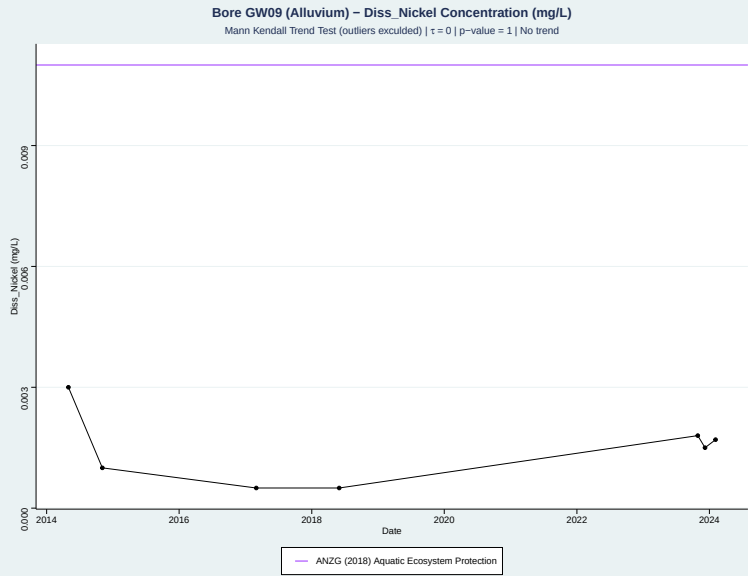
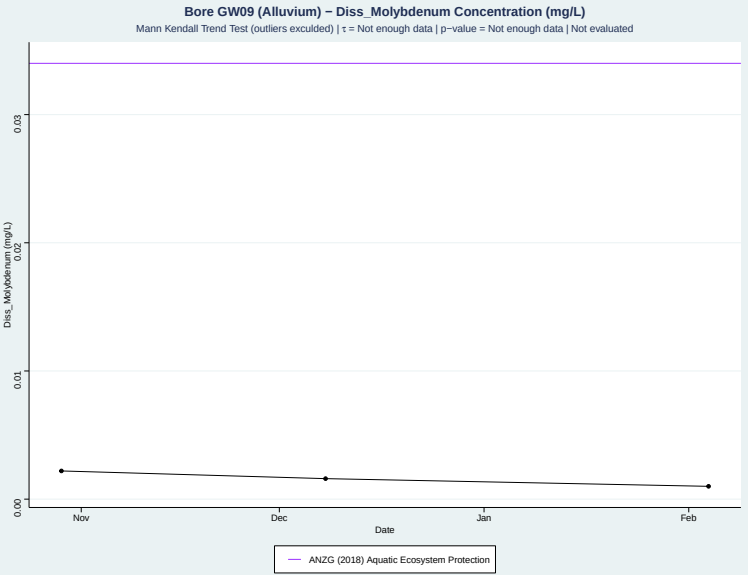
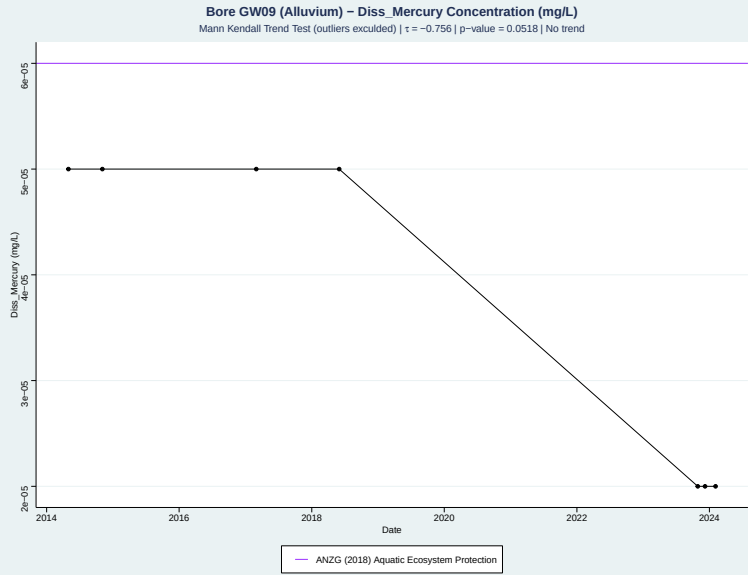
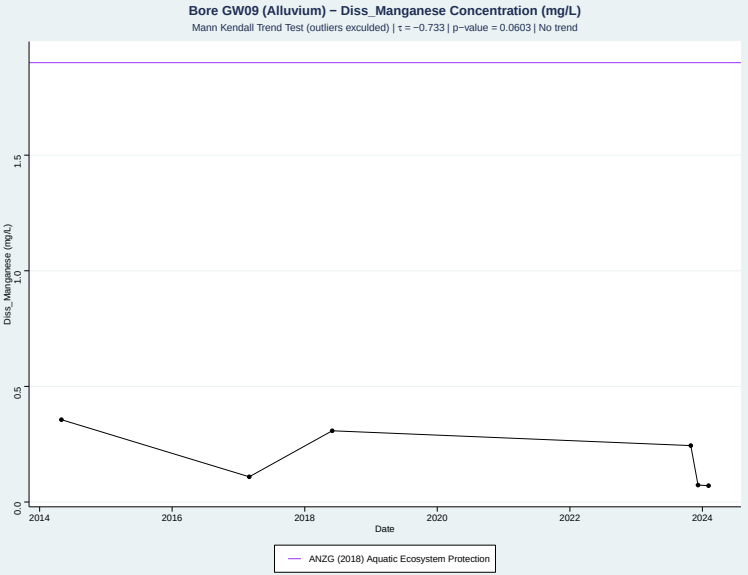
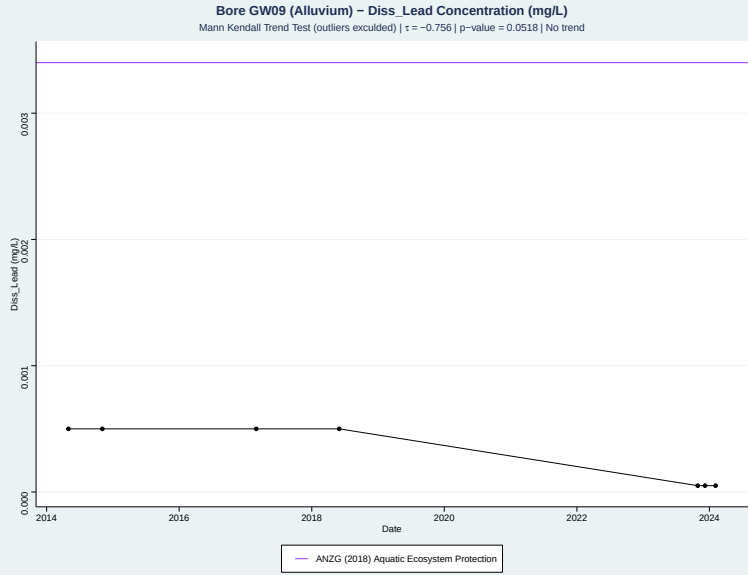


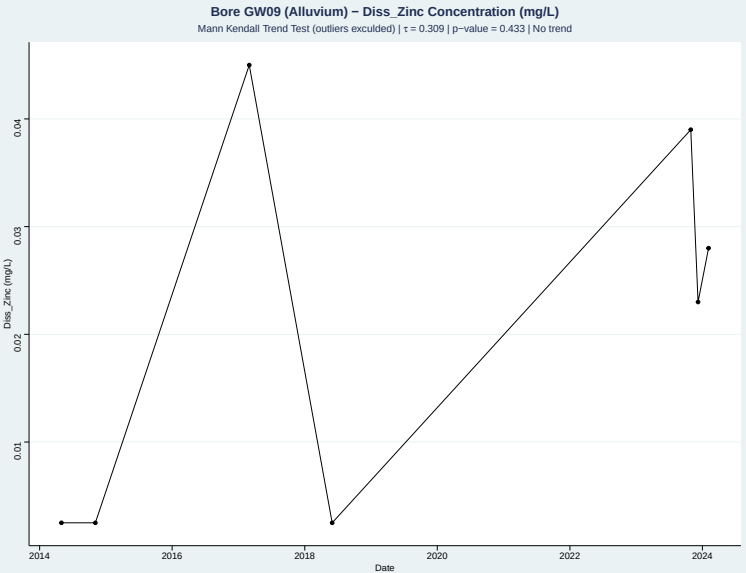
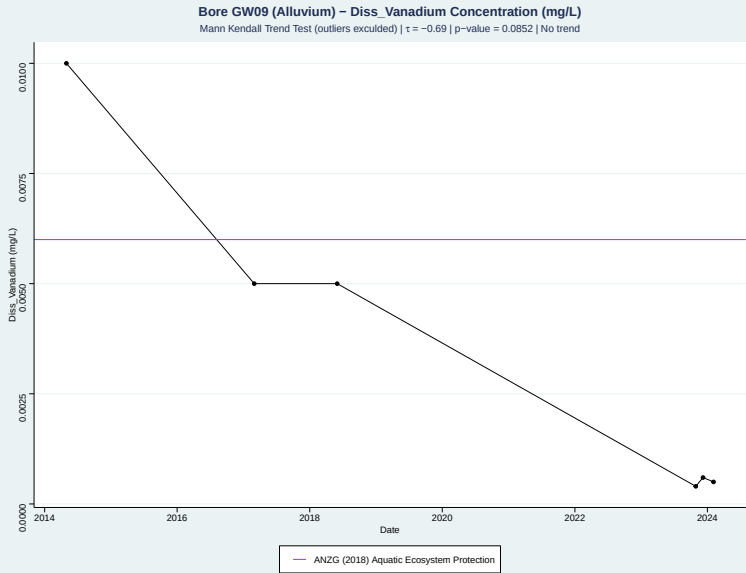
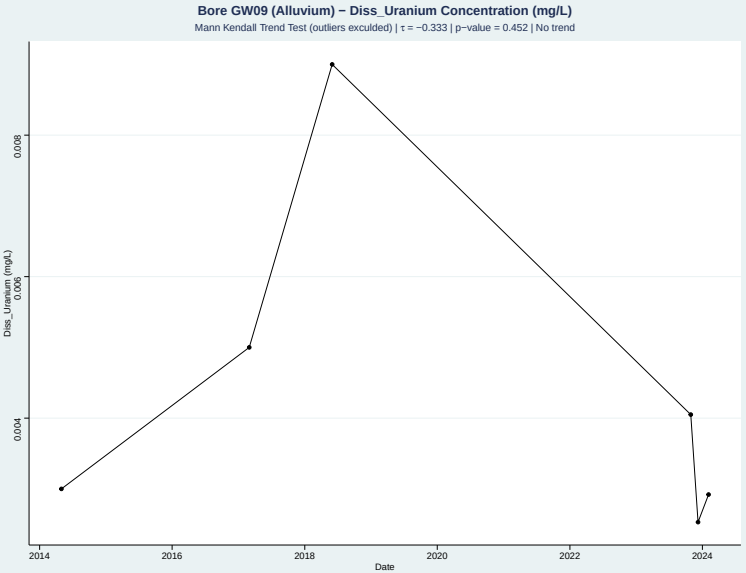
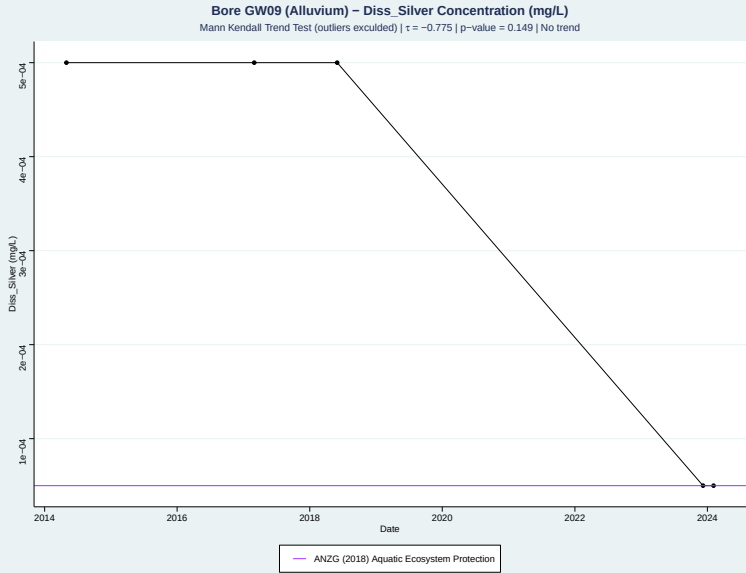
Bore GW09 (Alluvium) – Diss. Cobalt Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.837$ | $p\text{-value} = 0.0961$ | No trend

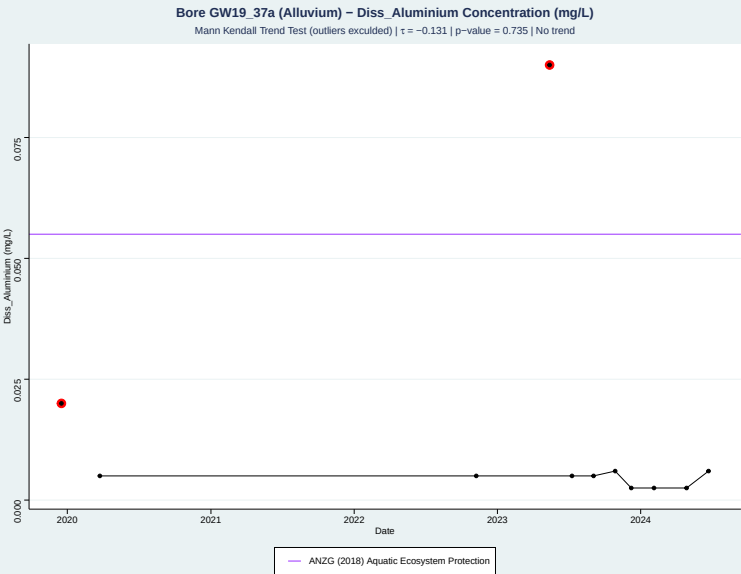
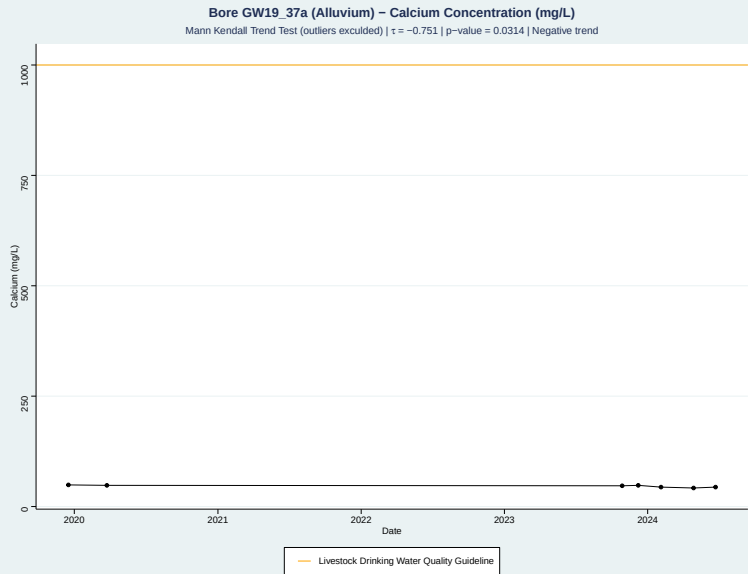
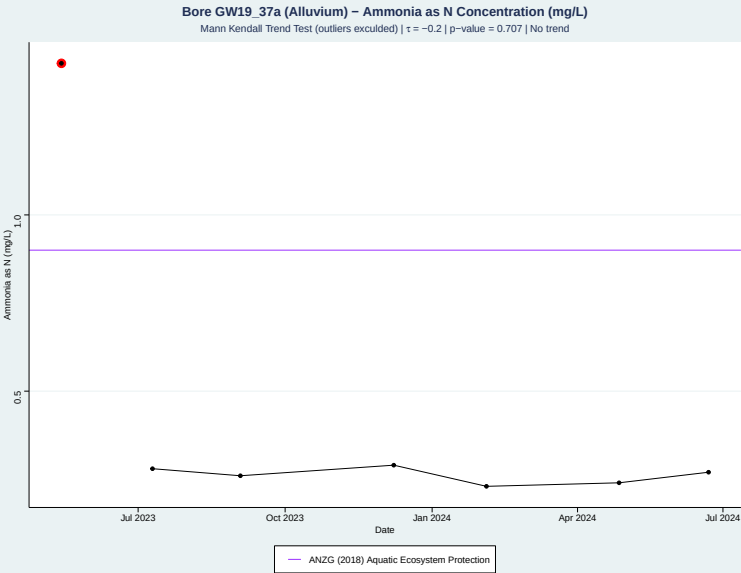
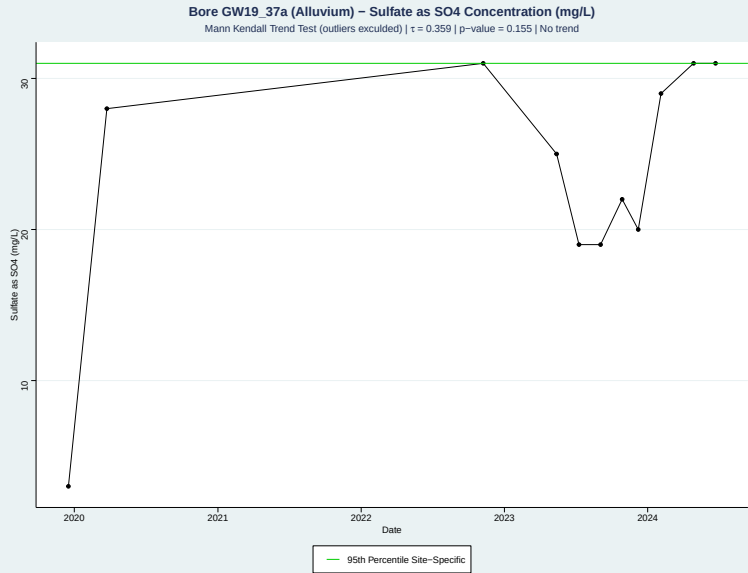
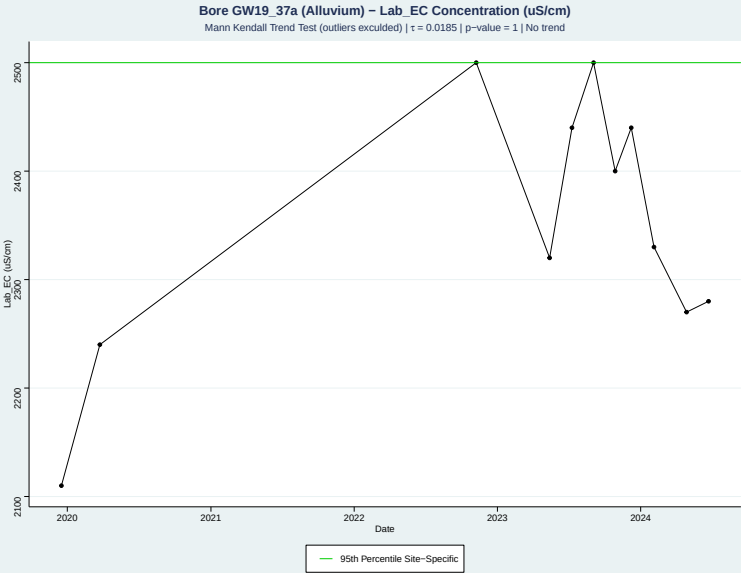
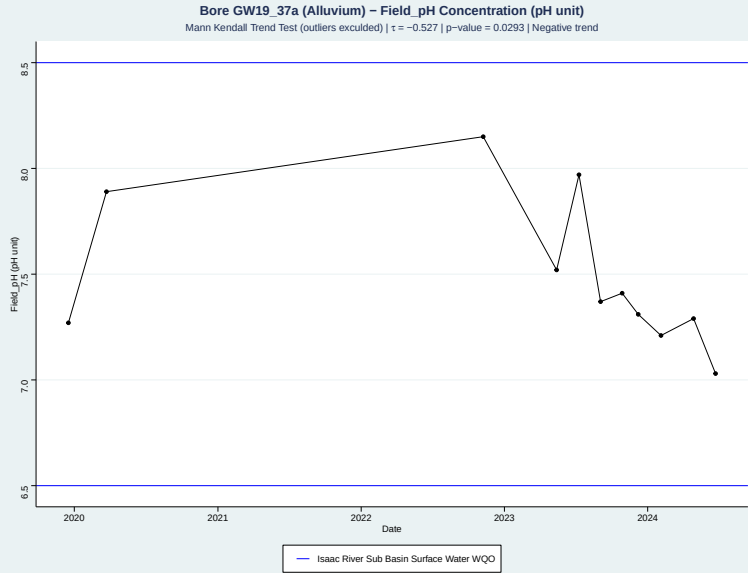


Bore GW09 (Alluvium) – Diss. Copper Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.0667$ | $p\text{-value} = 1$ | No trend

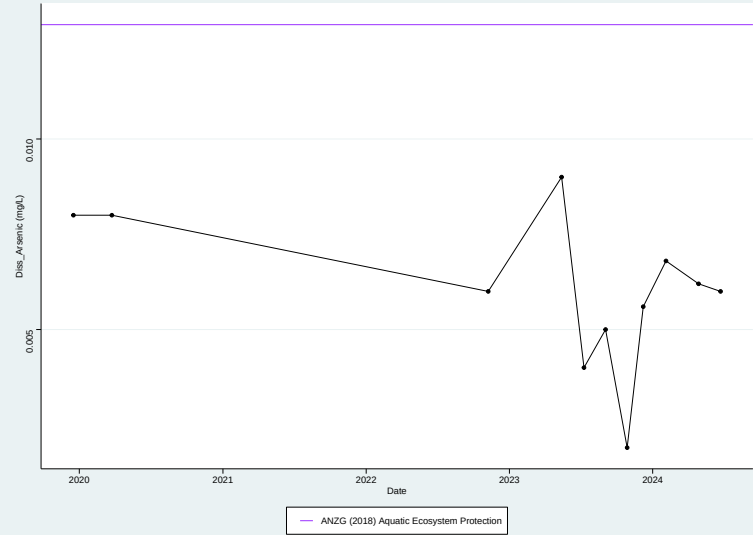




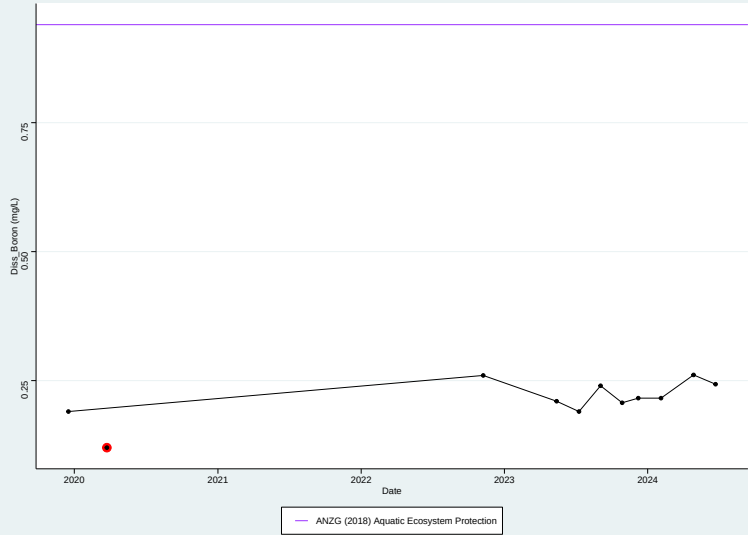




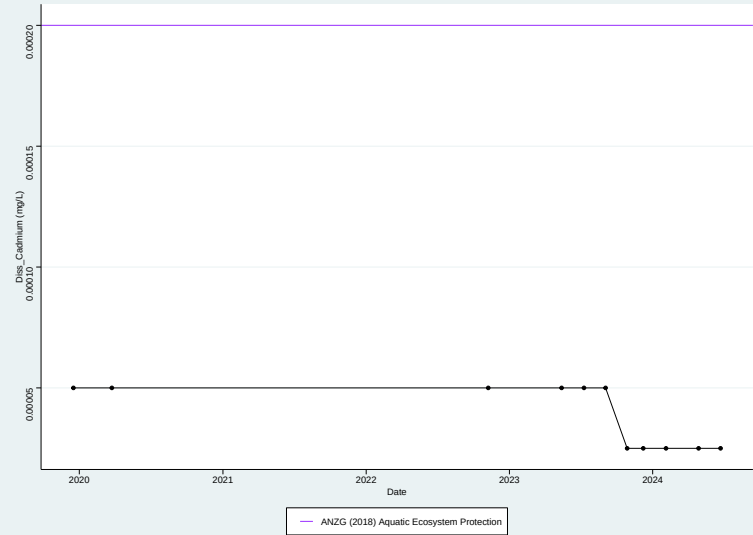
Bore GW19_37a (Alluvium) – Diss_Arsenic Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.204$ | p-value = 0.433 | No trend



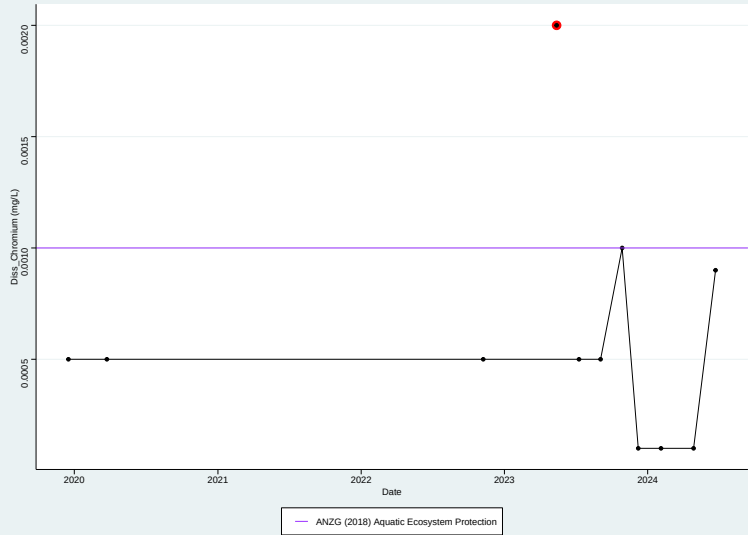
Bore GW19_37a (Alluvium) – Diss_Boron Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.386$ | p-value = 0.149 | No trend



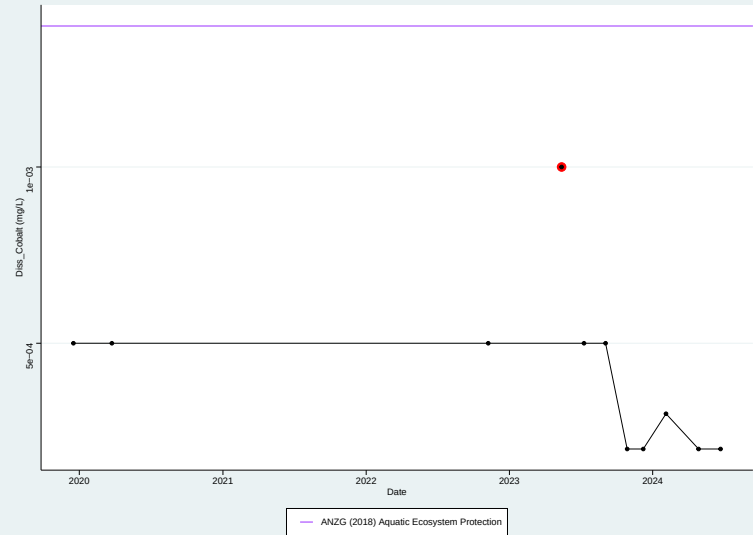
Bore GW19_37a (Alluvium) – Diss_Cadmium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.739$ | p-value = 0.00811 | Negative trend



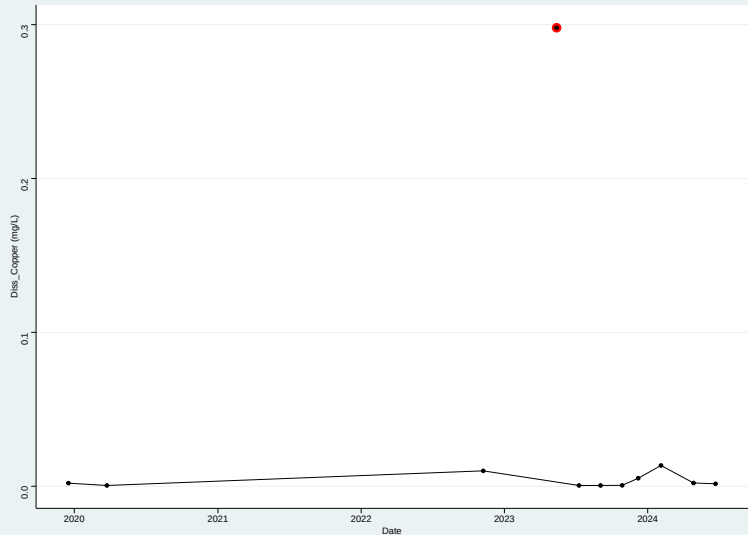
Bore GW19_37a (Alluvium) – Diss_Chromium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.158$ | p-value = 0.625 | No trend

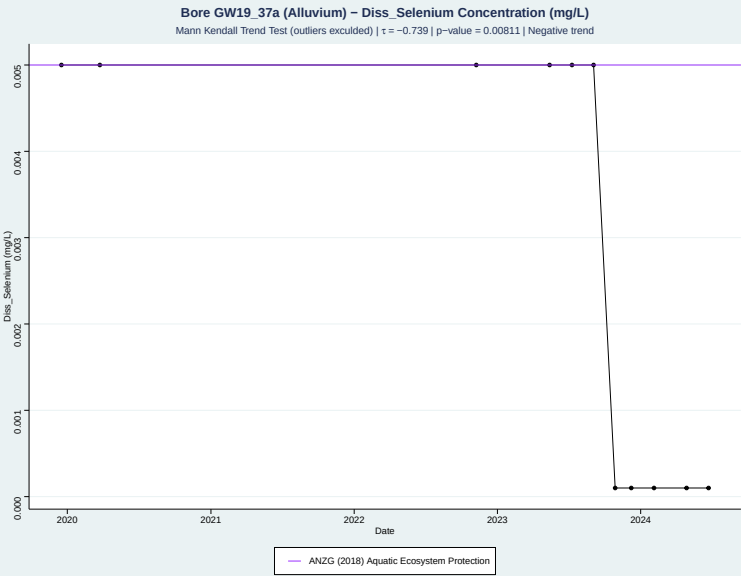
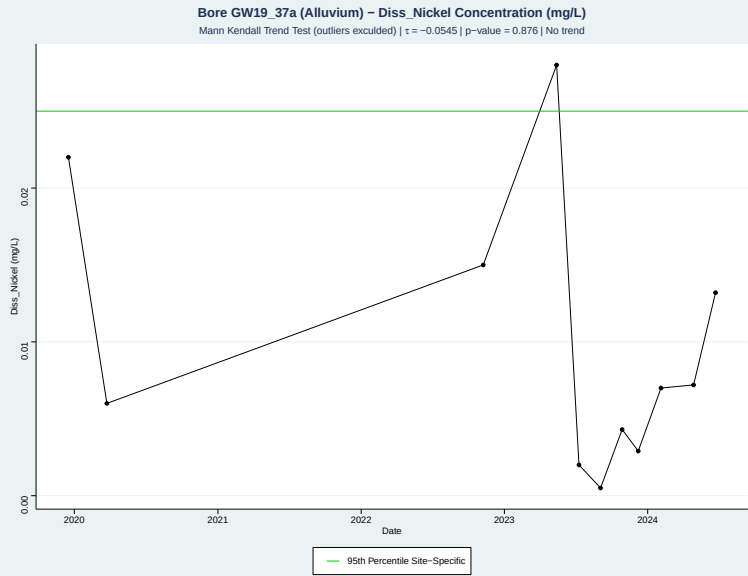
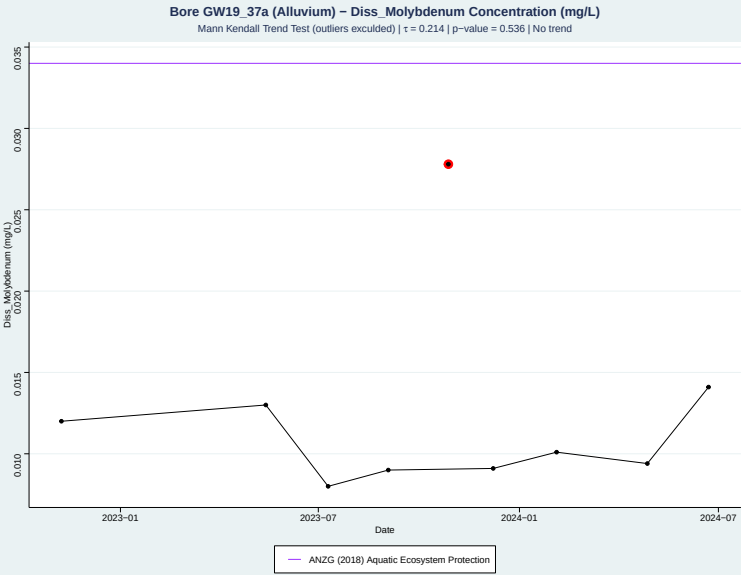
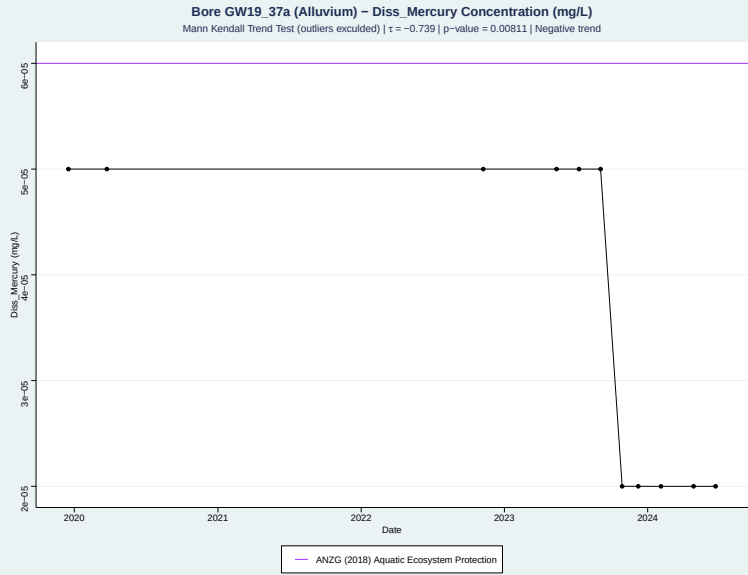
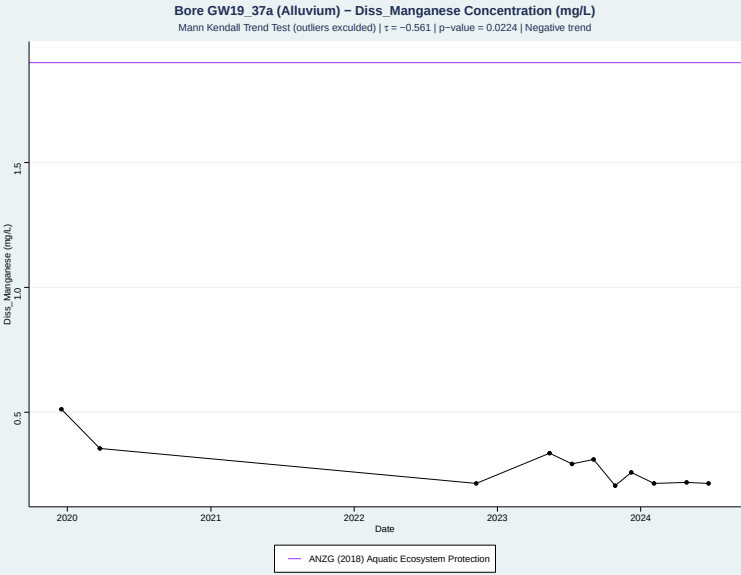
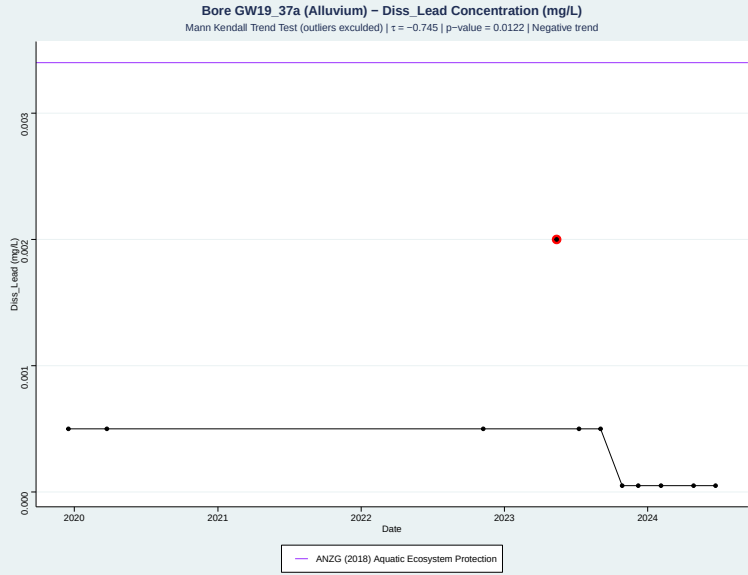


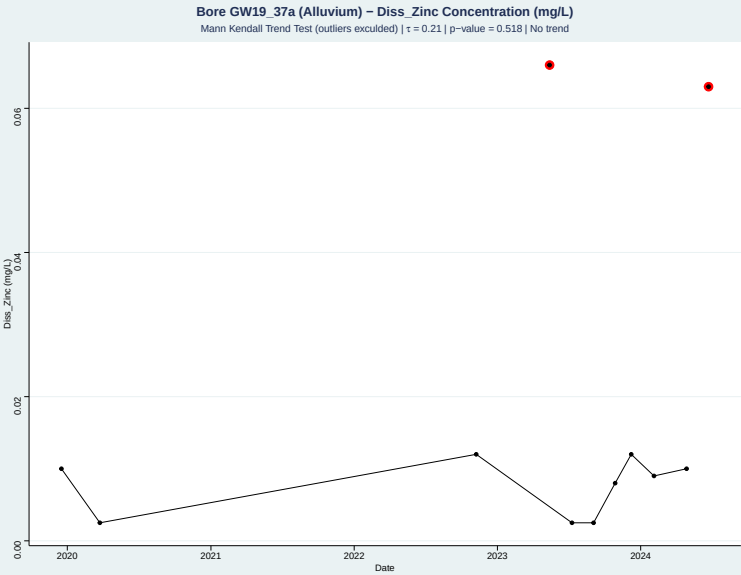
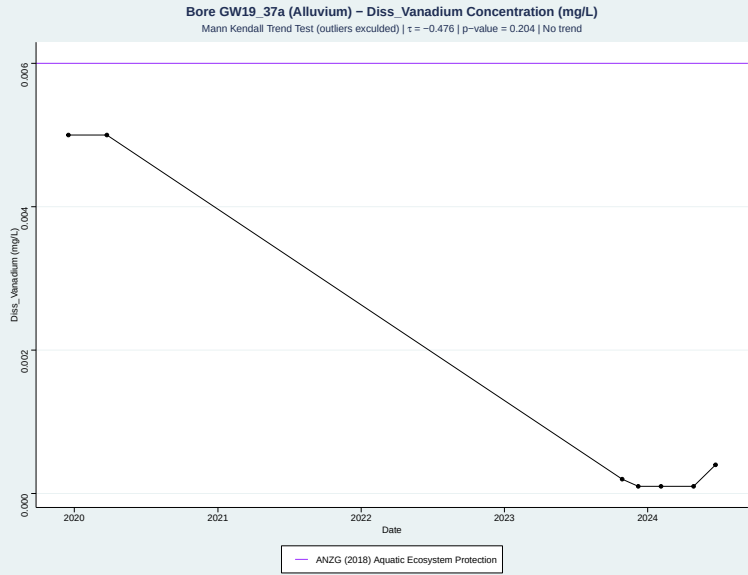
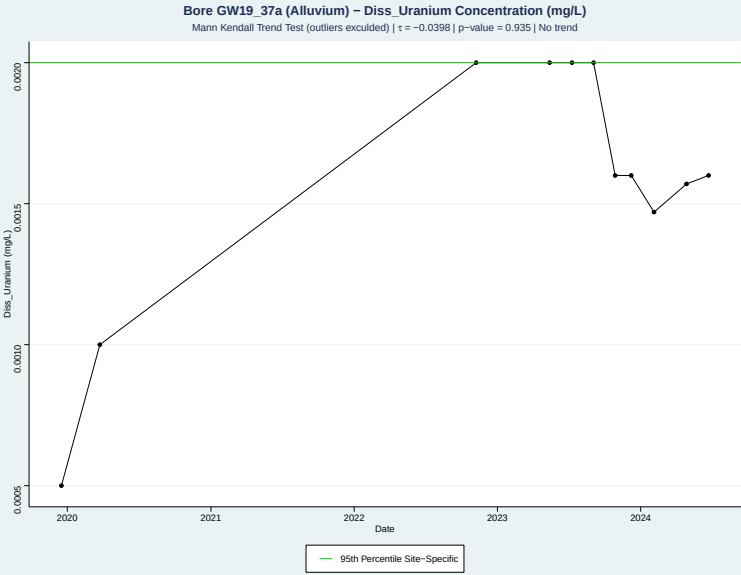
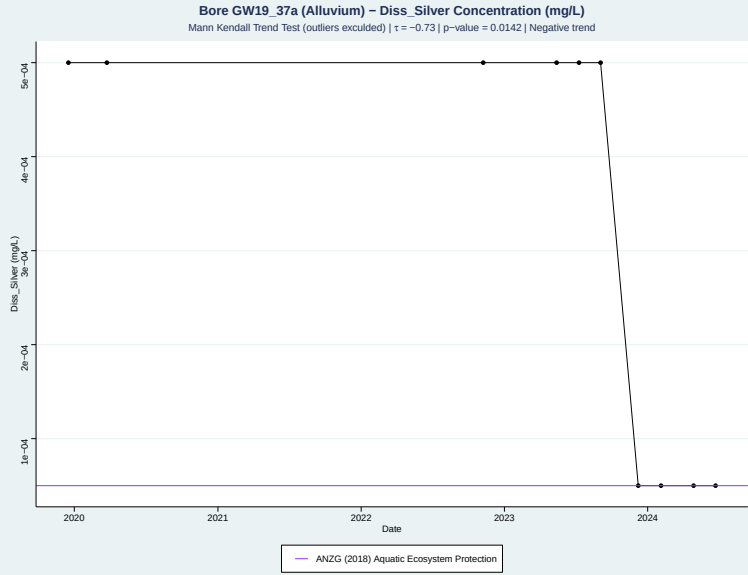
Bore GW19_37a (Alluvium) – Diss_Cobalt Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.692$ | p-value = 0.0162 | Negative trend

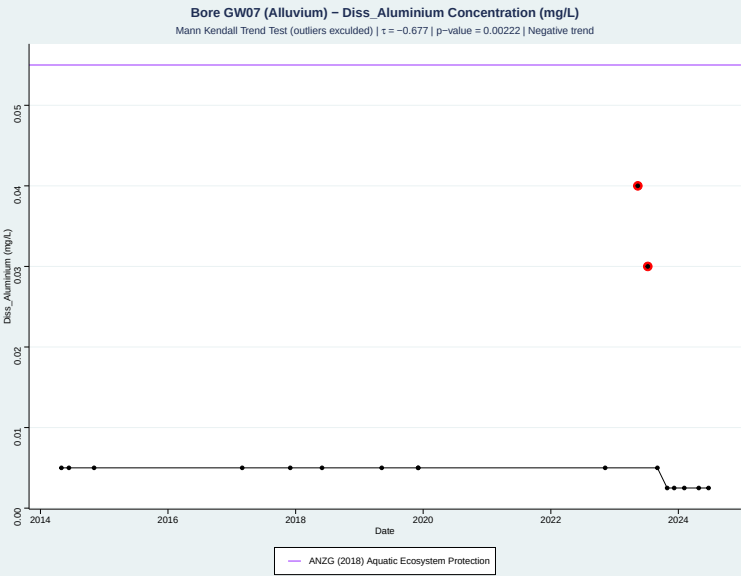
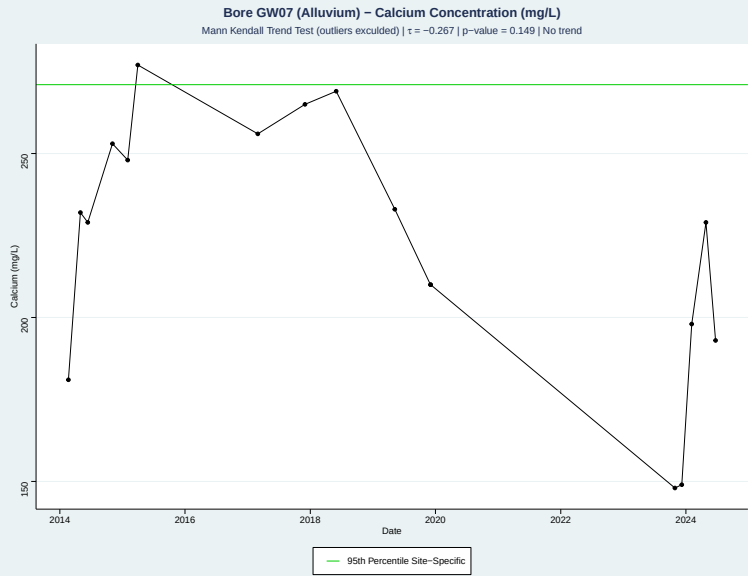
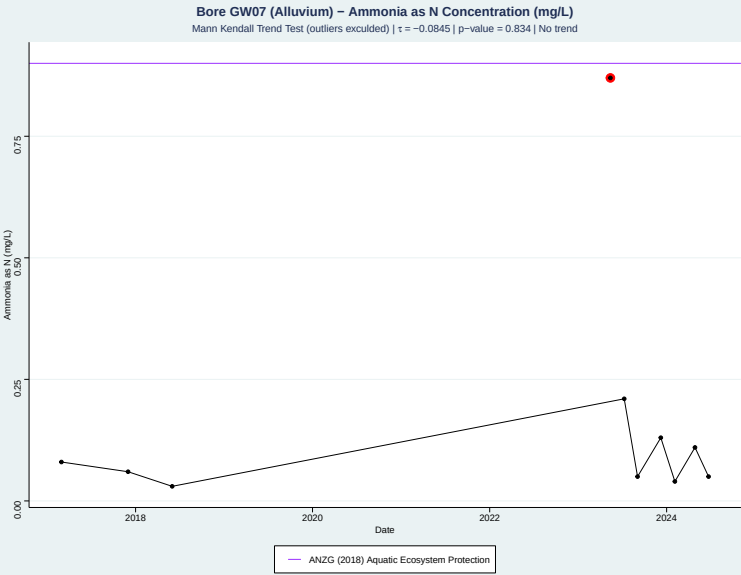
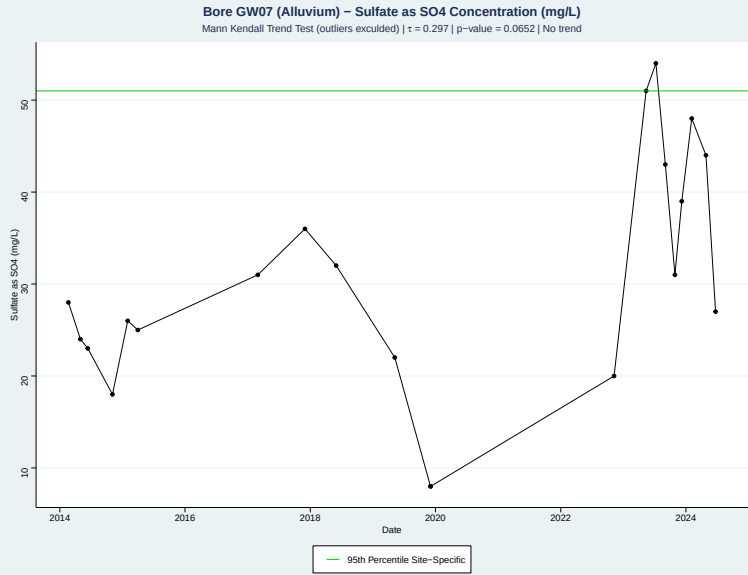
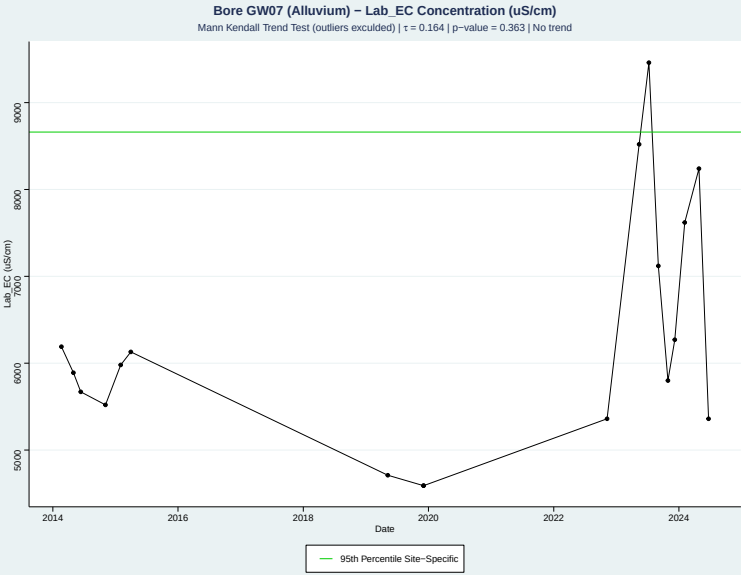
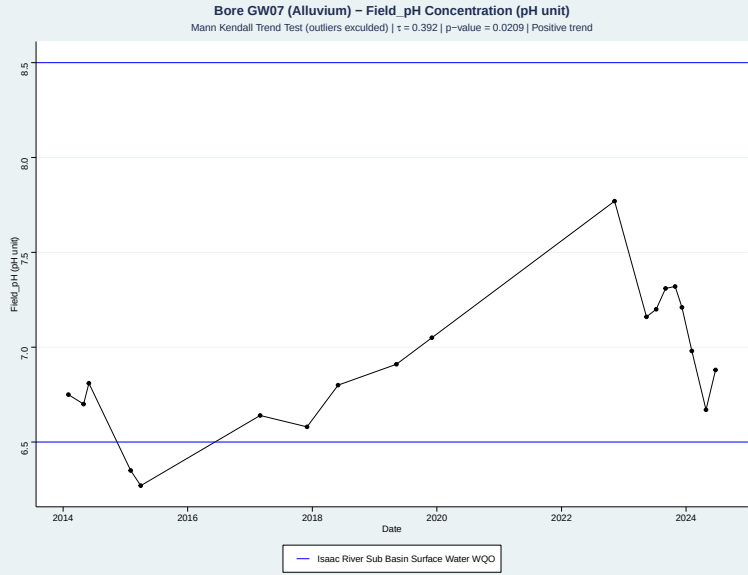


Bore GW19_37a (Alluvium) – Diss_Copper Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.23$ | p-value = 0.414 | No trend



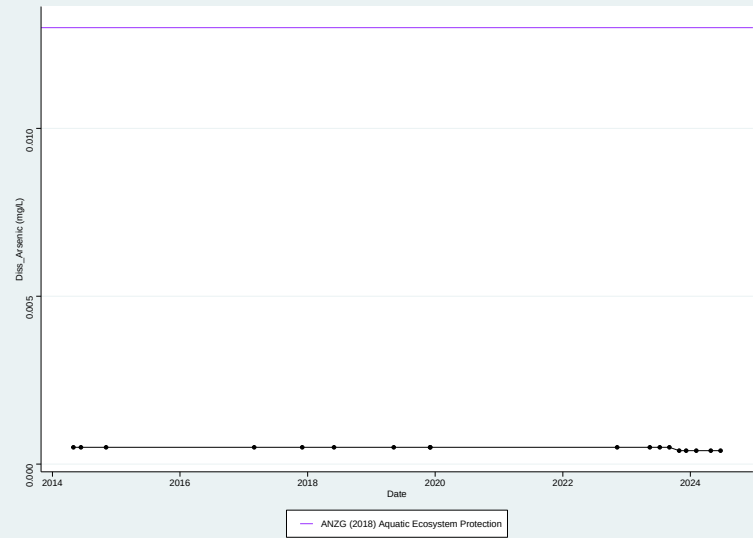






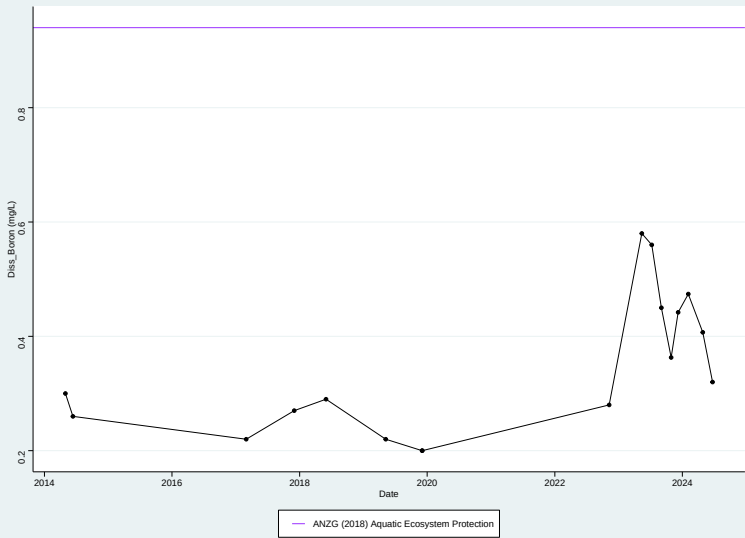
Bore GW07 (Alluvium) – Diss. Arsenic Concentration (mg/L)

Mann Kendall Trend Test (outliers excuded) | $\tau = -0.652$ | p-value = 0.00161 | Negative trend



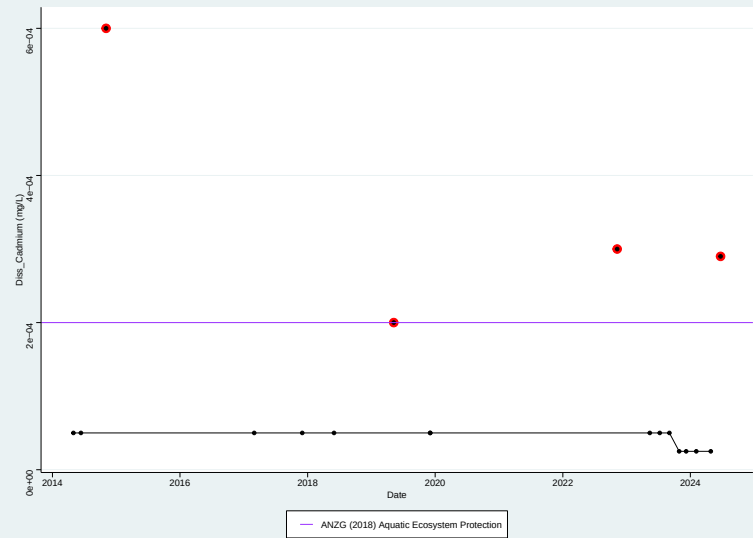
Bore GW07 (Alluvium) – Diss. Boron Concentration (mg/L)

Mann Kendall Trend Test (outliers excuded) | $\tau = 0.311$ | p-value = 0.0907 | No trend



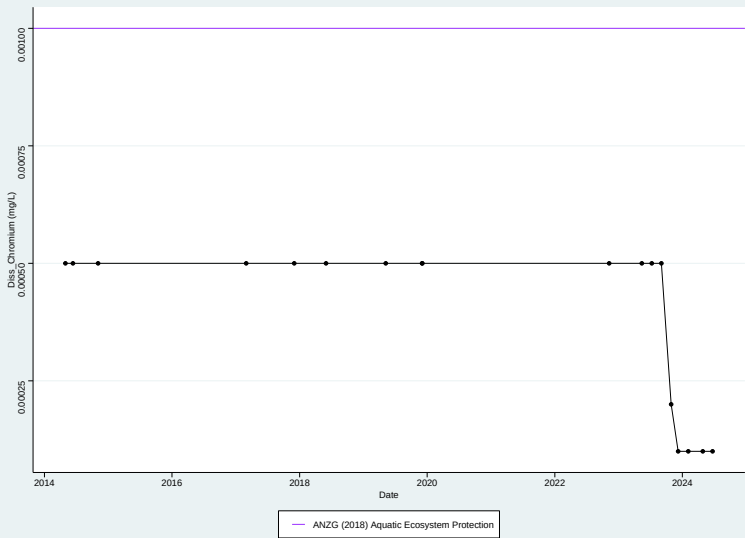
Bore GW07 (Alluvium) – Diss. Cadmium Concentration (mg/L)

Mann Kendall Trend Test (outliers excuded) | $\tau = -0.663$ | p-value = 0.00582 | Negative trend



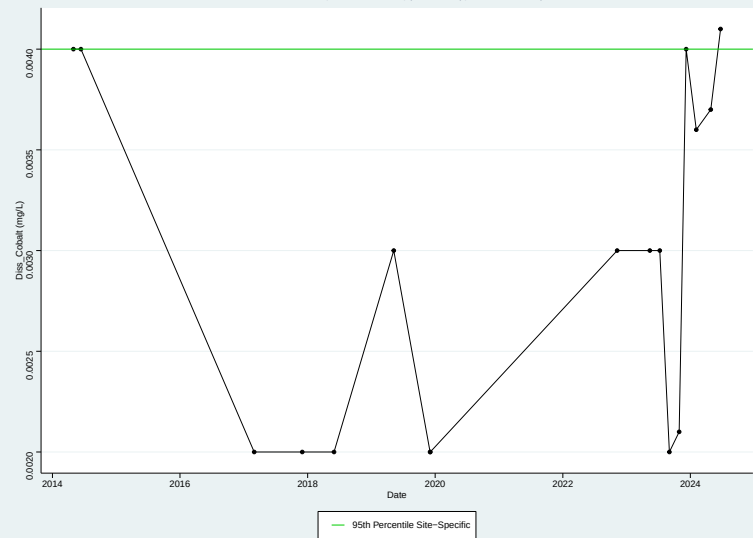
Bore GW07 (Alluvium) – Diss. Chromium Concentration (mg/L)

Mann Kendall Trend Test (outliers excuded) | $\tau = -0.672$ | p-value = 0.000902 | Negative trend



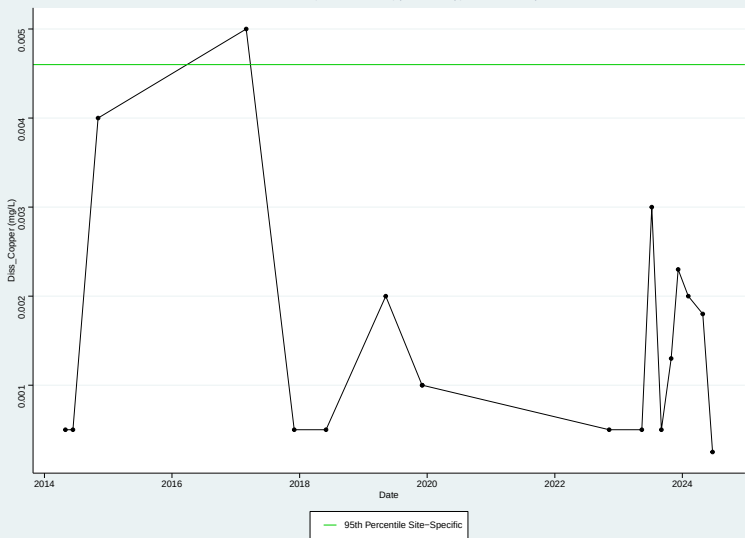
Bore GW07 (Alluvium) – Diss. Cobalt Concentration (mg/L)

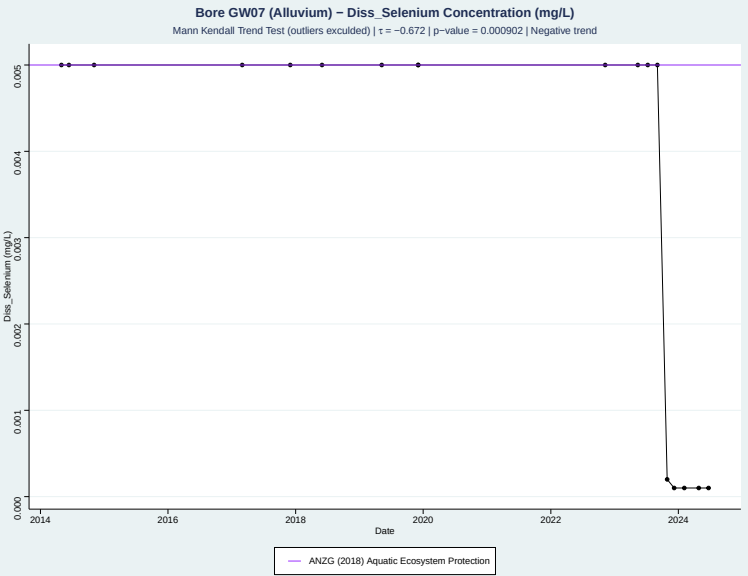
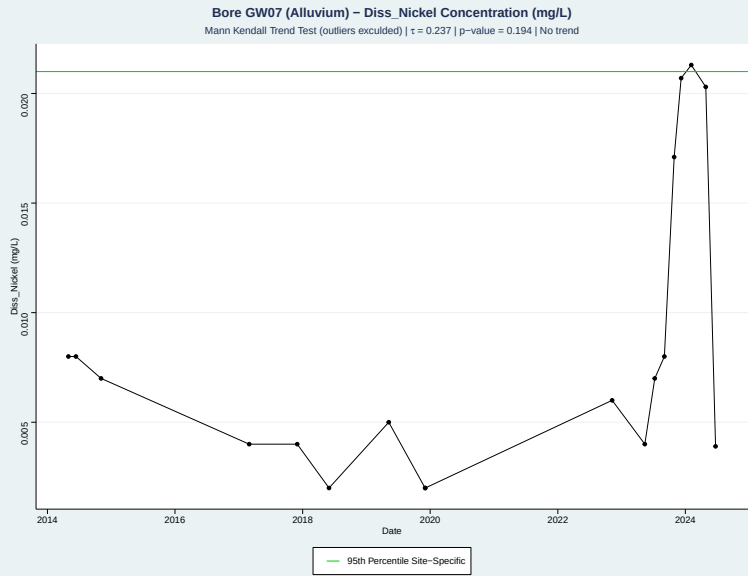
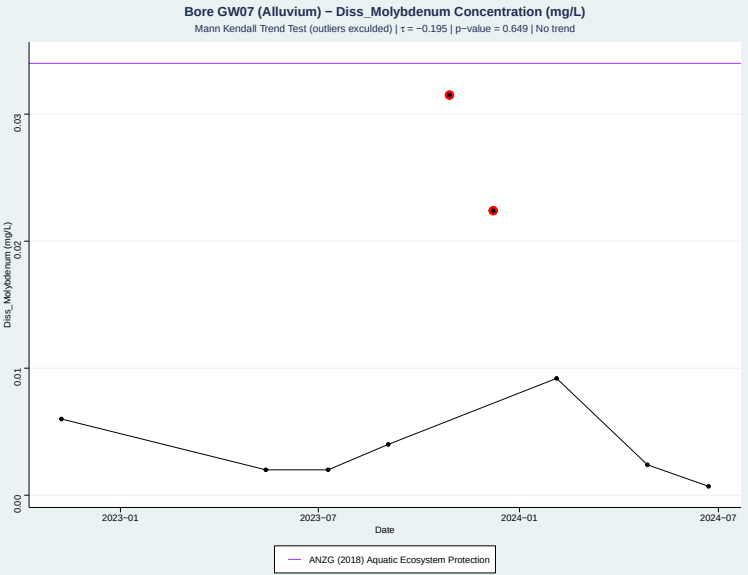
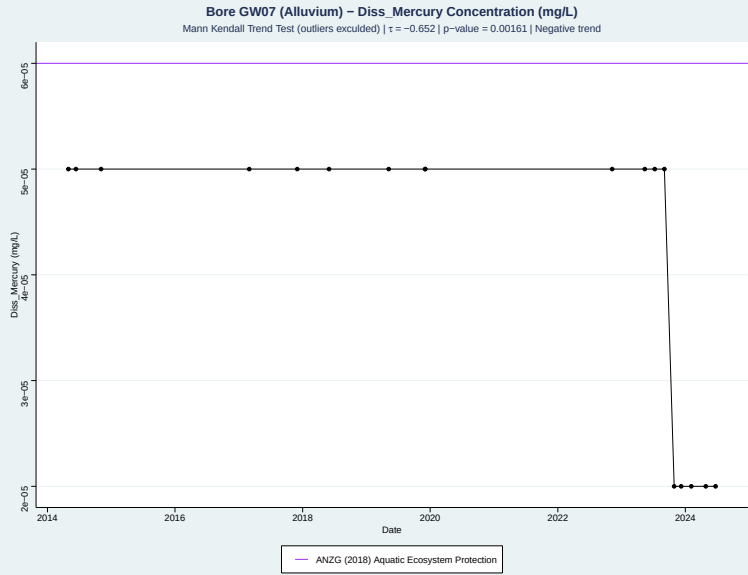
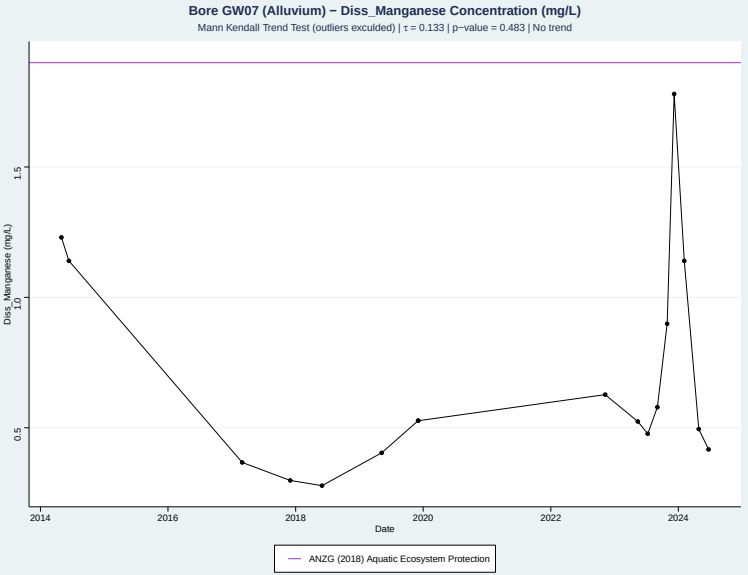
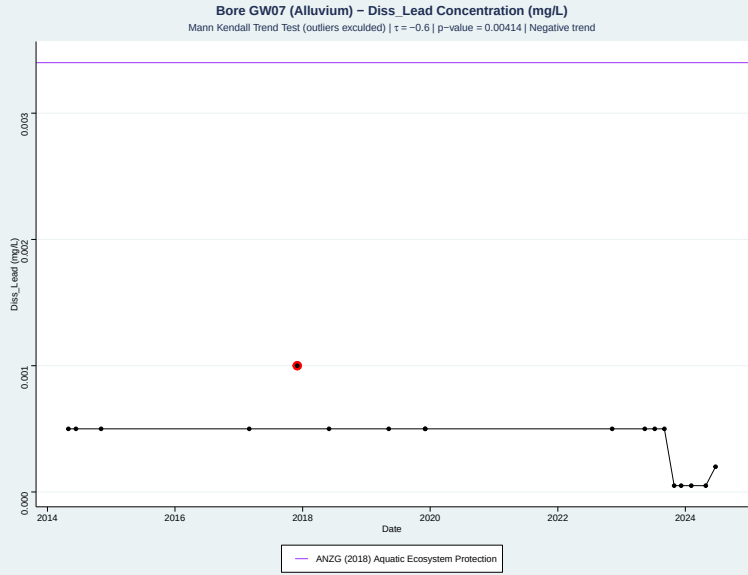
Mann Kendall Trend Test (outliers excuded) | $\tau = 0.292$ | p-value = 0.135 | No trend

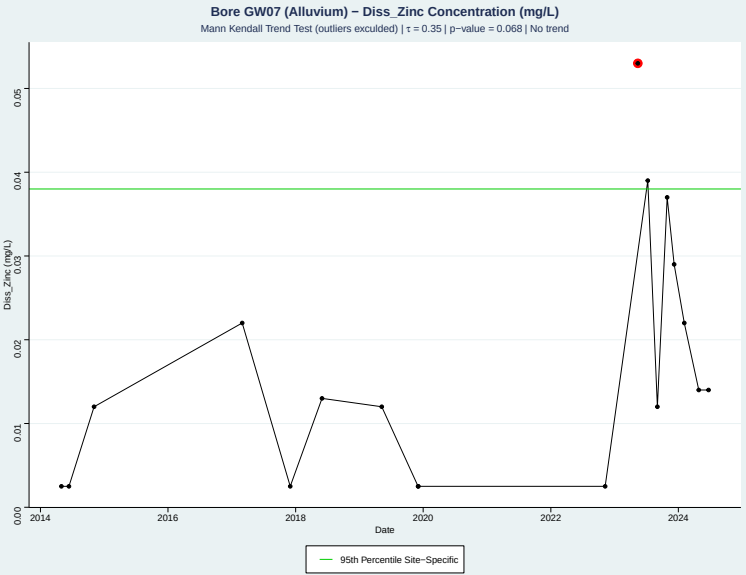
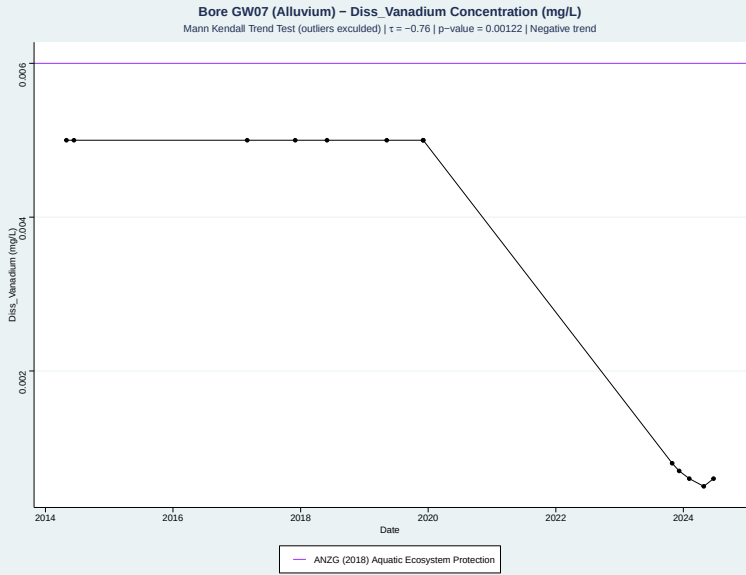
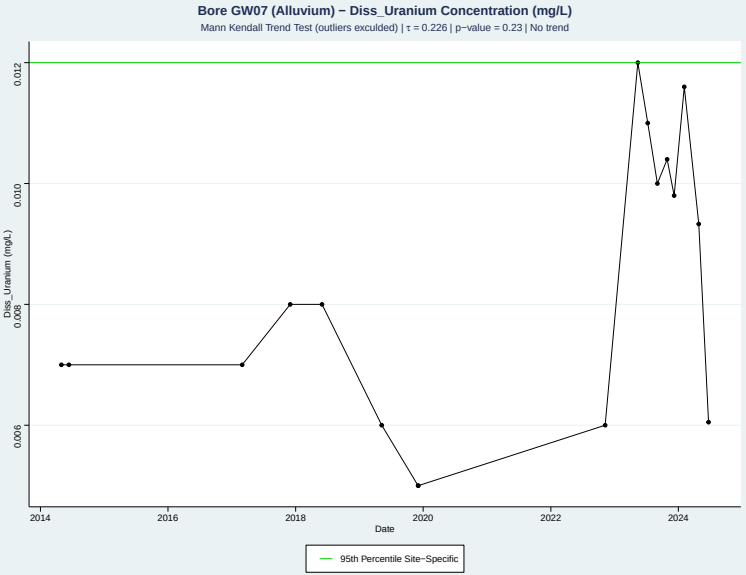
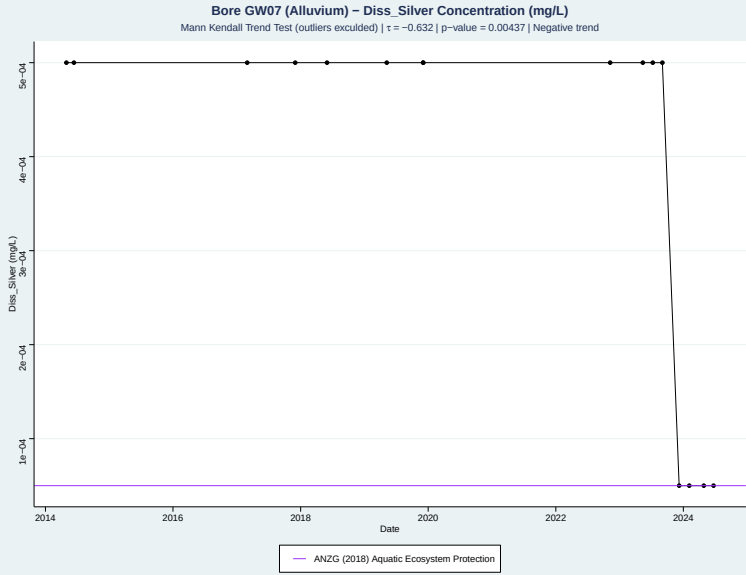


Bore GW07 (Alluvium) – Diss. Copper Concentration (mg/L)

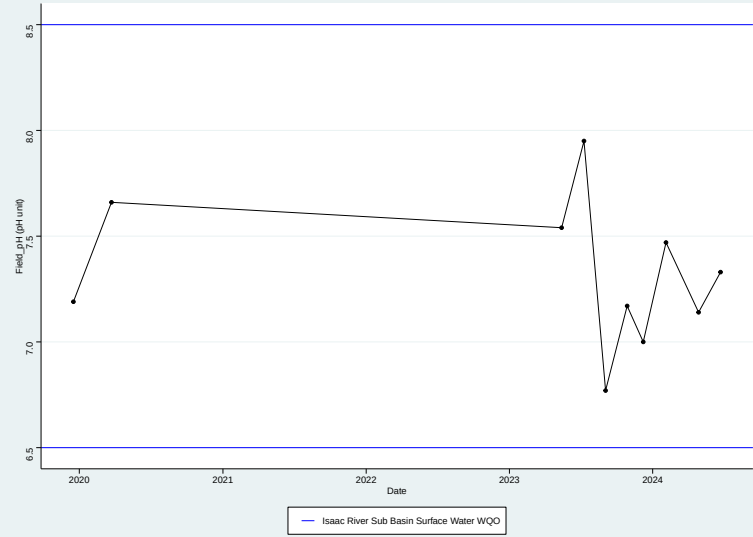
Mann Kendall Trend Test (outliers excuded) | $\tau = 0.0142$ | p-value = 0.969 | No trend



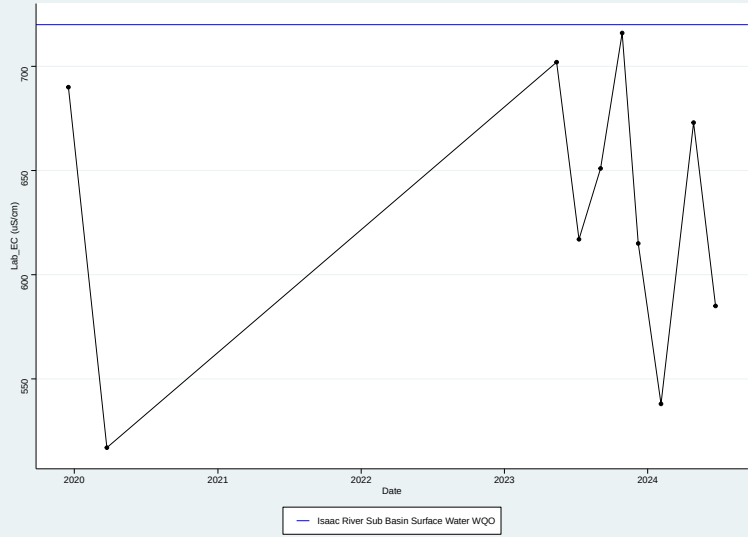




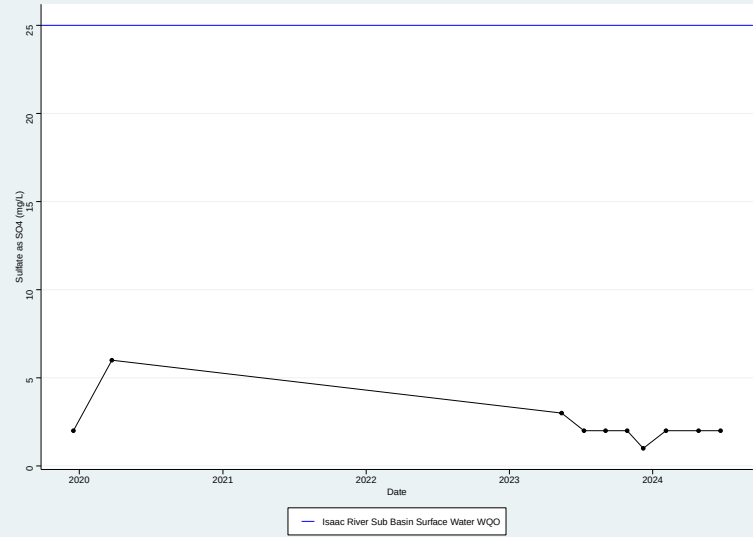
Bore GW19_33 (Alluvium/Regolith) – Field_pH Concentration (pH unit)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.2$ | p-value = 0.474 | No trend



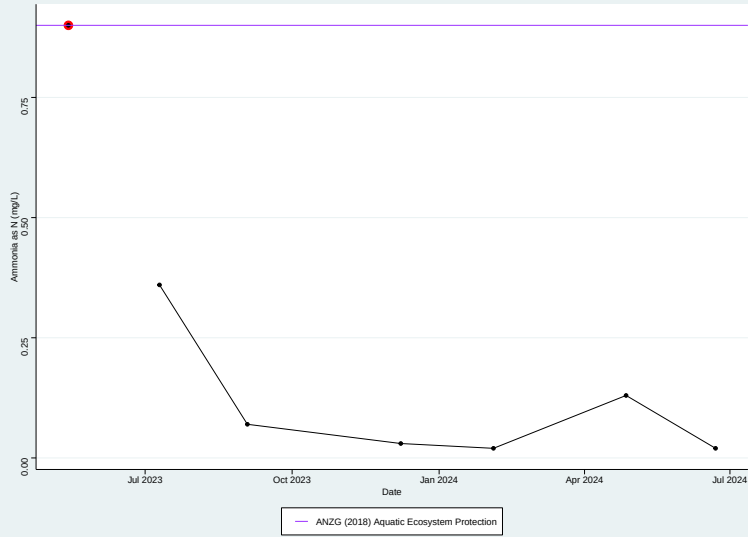
Bore GW19_33 (Alluvium/Regolith) – Lab_EC Concentration (uS/cm)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.156$ | p-value = 0.592 | No trend



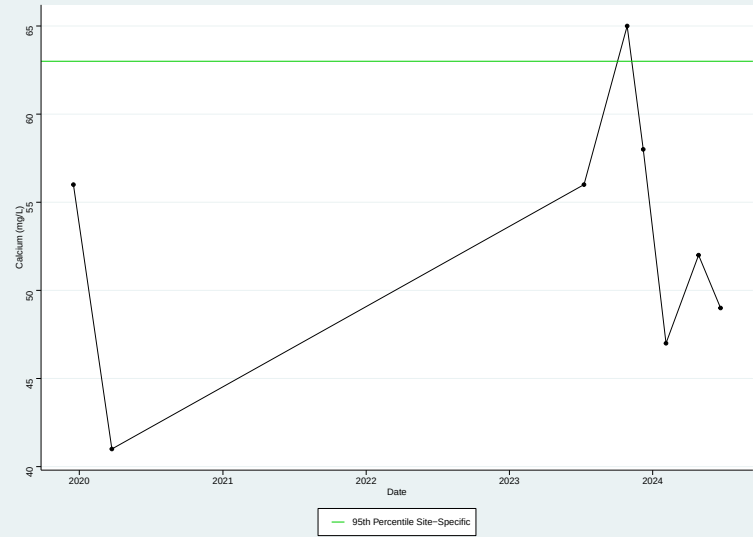
Bore GW19_33 (Alluvium/Regolith) – Sulfate as SO4 Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.426$ | p-value = 0.148 | No trend



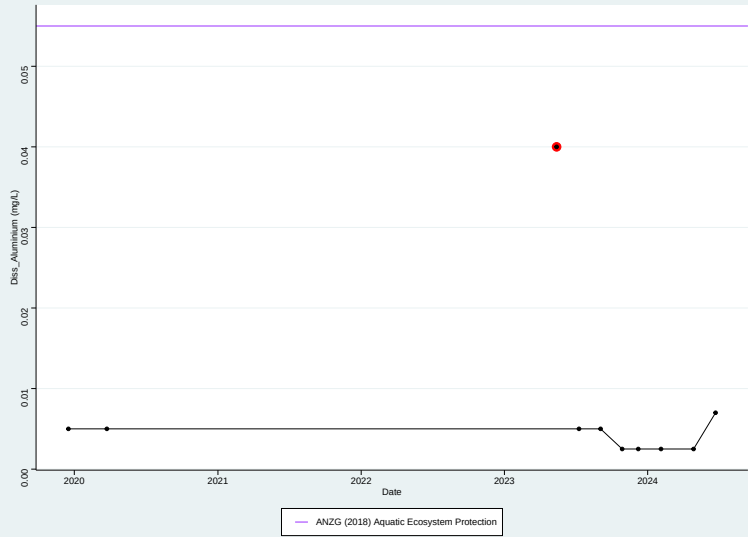
Bore GW19_33 (Alluvium/Regolith) – Ammonia as N Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.552$ | p-value = 0.181 | No trend



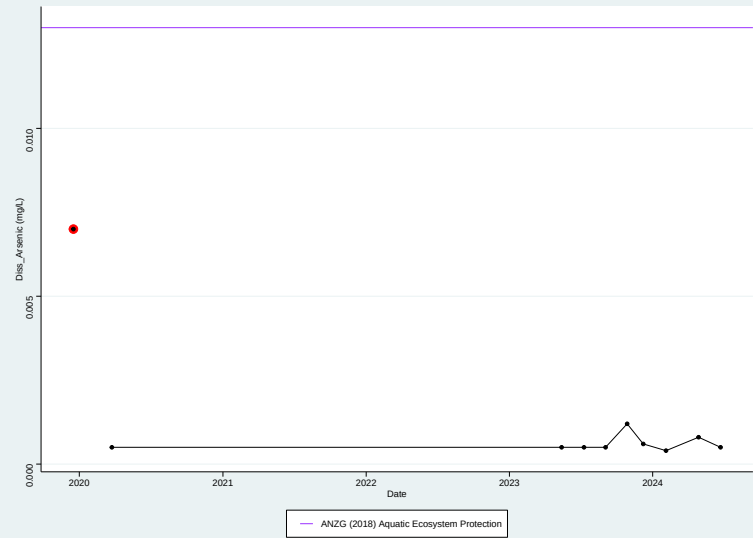
Bore GW19_33 (Alluvium/Regolith) – Calcium Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.109$ | p-value = 0.803 | No trend



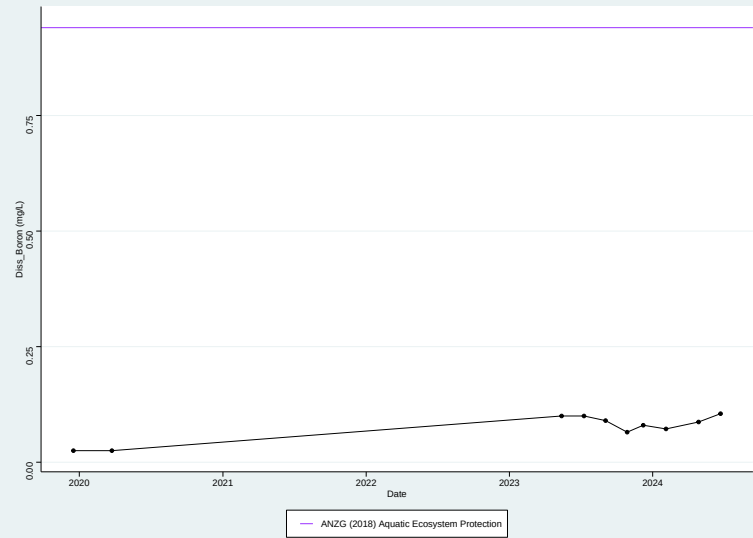
Bore GW19_33 (Alluvium/Regolith) – Diss_Aluminium Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.272$ | p-value = 0.418 | No trend



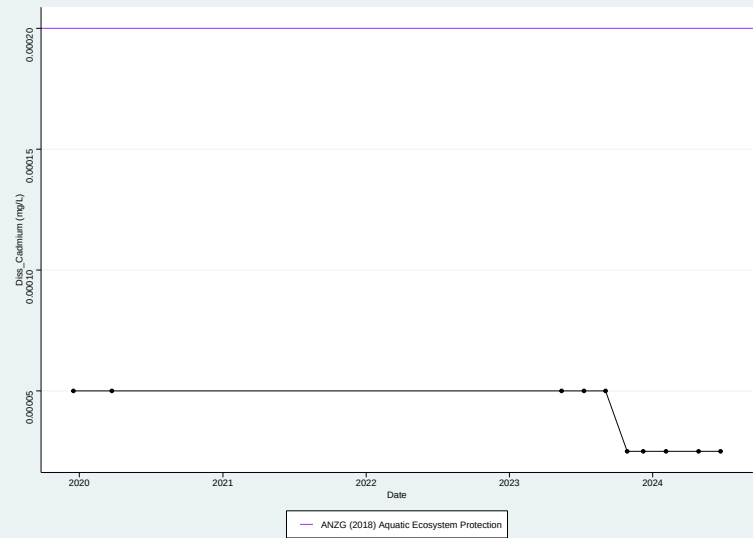
Bore GW19_33 (Alluvium/Regolith) – Diss. Arsenic Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.131$ | $p\text{-value} = 0.73$ | No trend



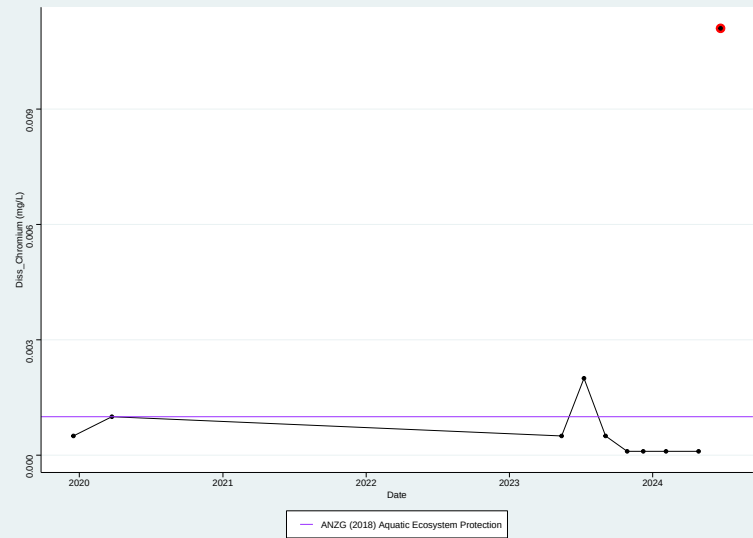
Bore GW19_33 (Alluvium/Regolith) – Diss. Boron Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.296$ | $p\text{-value} = 0.279$ | No trend



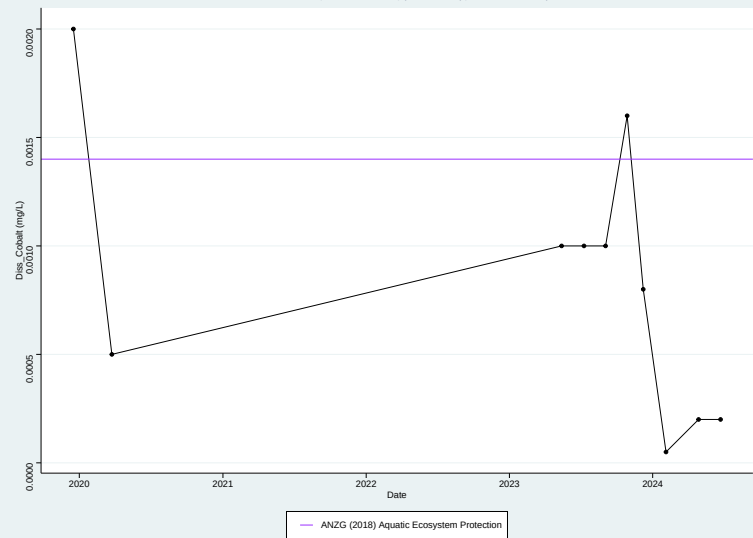
Bore GW19_33 (Alluvium/Regolith) – Diss. Cadmium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.745$ | $p\text{-value} = 0.0122$ | Negative trend



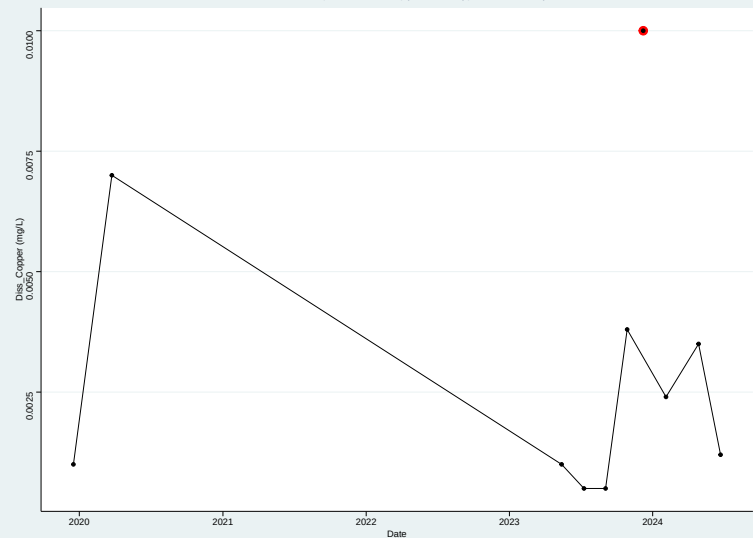
Bore GW19_33 (Alluvium/Regolith) – Diss. Chromium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.609$ | $p\text{-value} = 0.0437$ | Negative trend



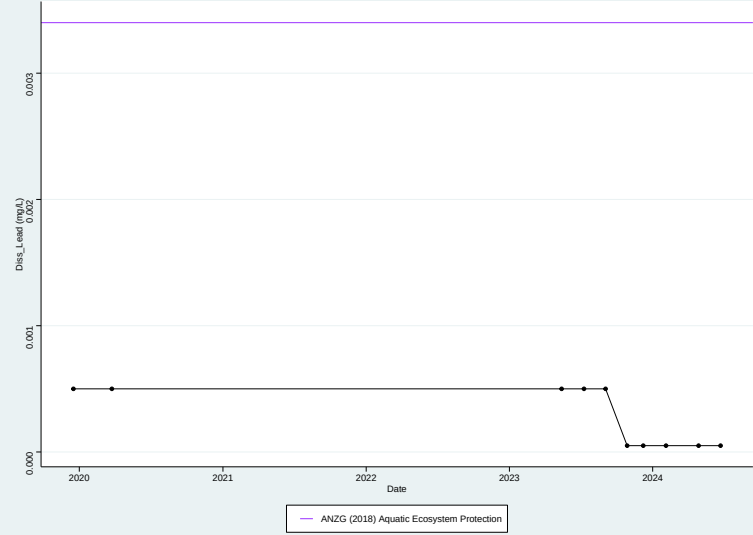
Bore GW19_33 (Alluvium/Regolith) – Diss. Cobalt Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.489$ | $p\text{-value} = 0.0683$ | No trend



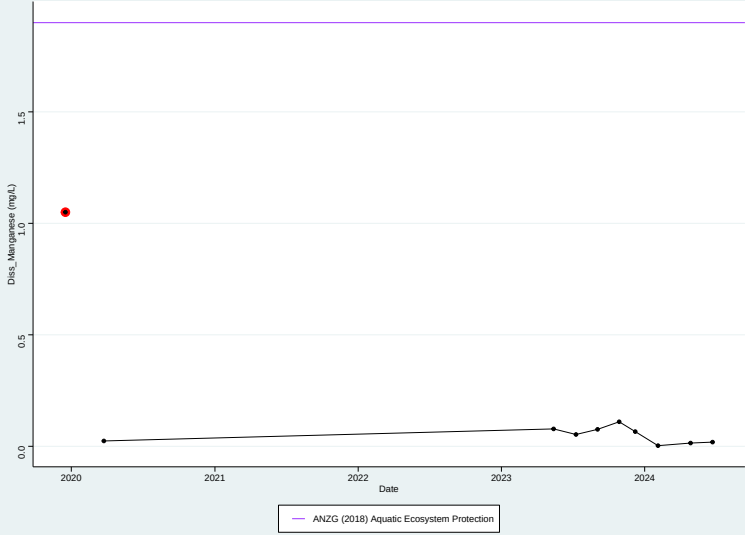
Bore GW19_33 (Alluvium/Regolith) – Diss. Copper Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.0572$ | $p\text{-value} = 0.916$ | No trend



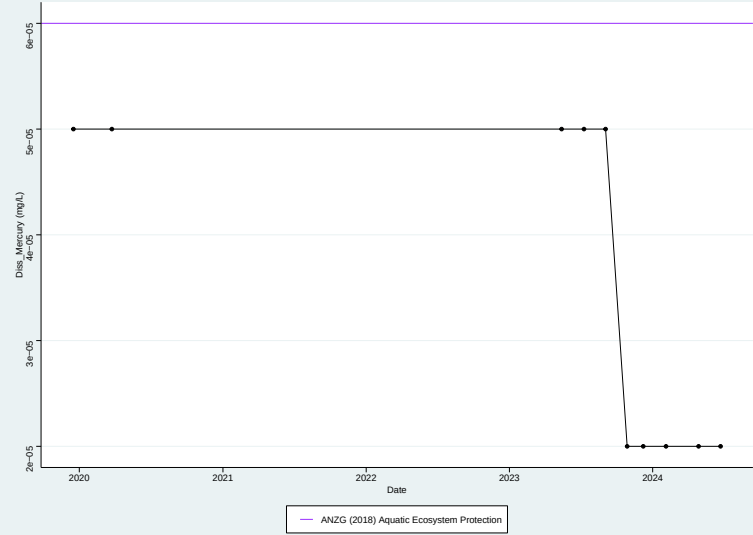
Bore GW19_33 (Alluvium/Regolith) – Diss. Lead Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.745$ | $p\text{-value} = 0.0122$ | Negative trend



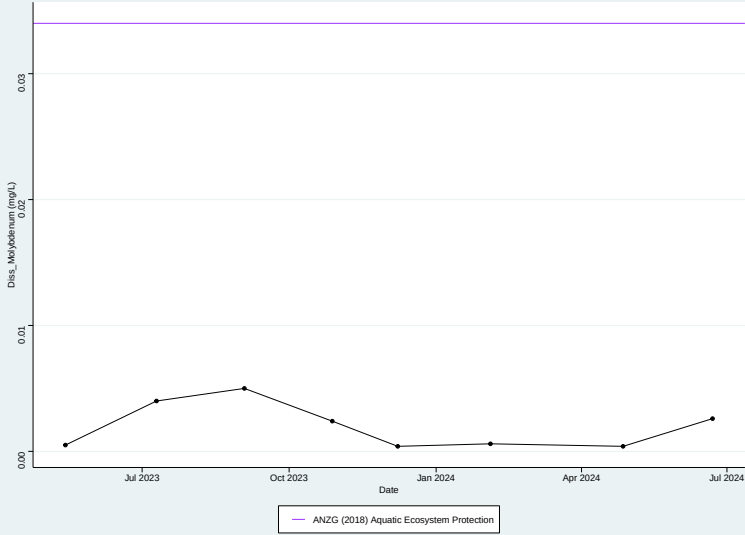
Bore GW19_33 (Alluvium/Regolith) – Diss. Manganese Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.278$ | $p\text{-value} = 0.348$ | No trend



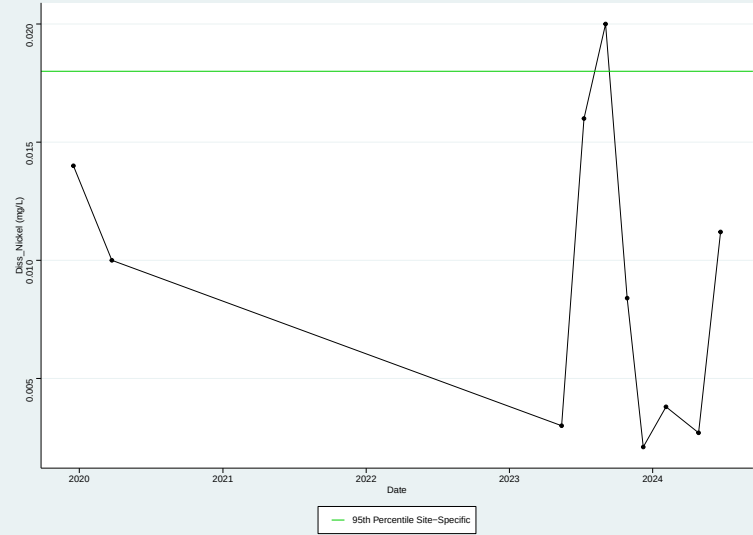
Bore GW19_33 (Alluvium/Regolith) – Diss. Mercury Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.745$ | $p\text{-value} = 0.0122$ | Negative trend



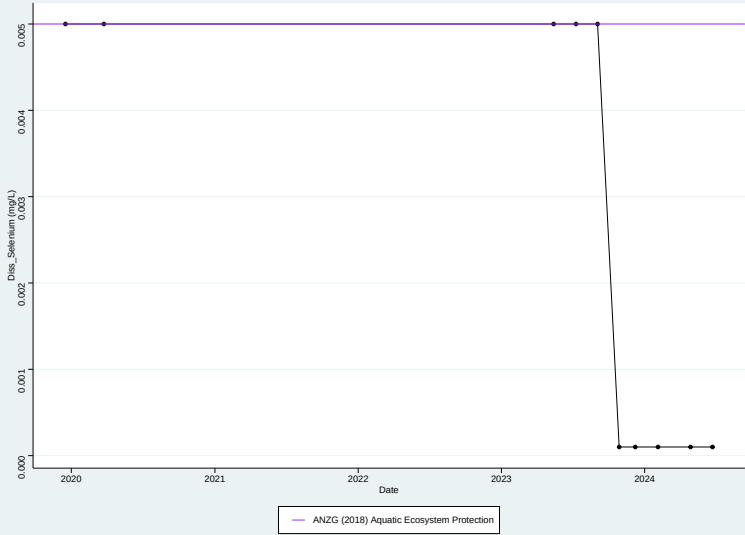
Bore GW19_33 (Alluvium/Regolith) – Diss. Molybdenum Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.182$ | $p\text{-value} = 0.618$ | No trend



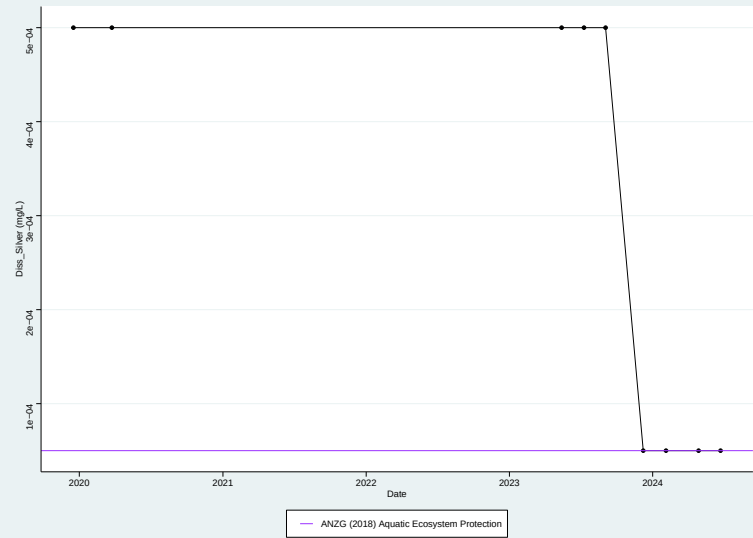
Bore GW19_33 (Alluvium/Regolith) – Diss. Nickel Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.244$ | $p\text{-value} = 0.371$ | No trend



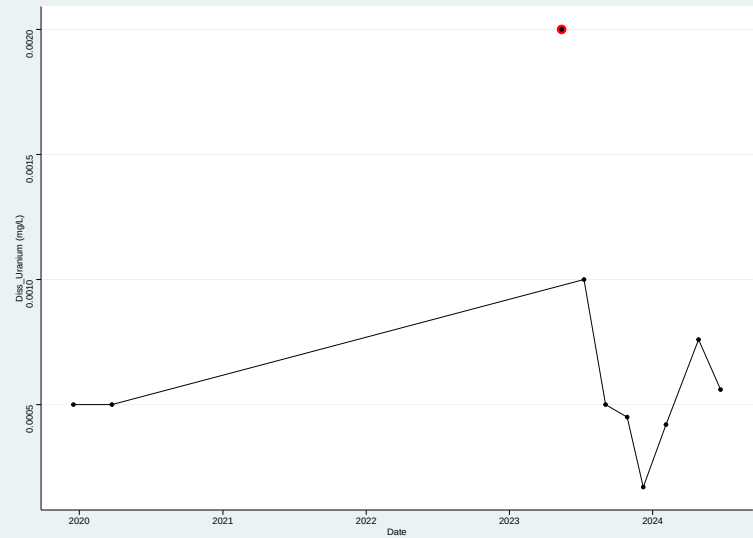
Bore GW19_33 (Alluvium/Regolith) – Diss. Selenium Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.745$ | $p\text{-value} = 0.0122$ | Negative trend



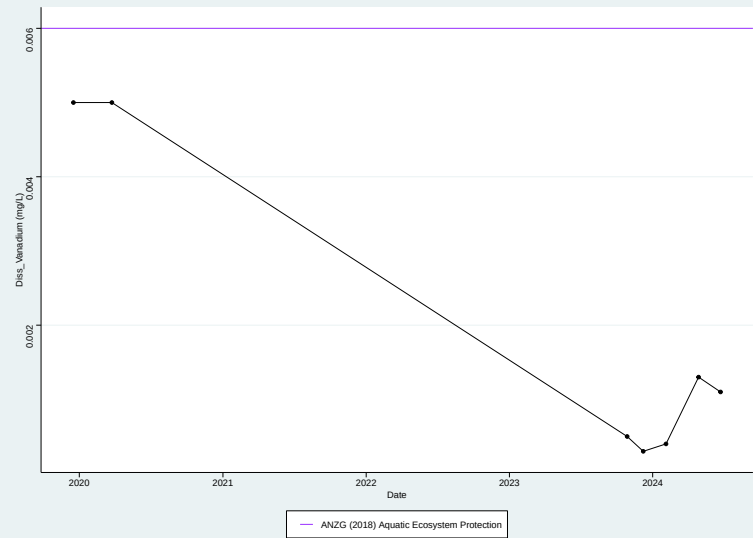
Bore GW19_33 (Alluvium/Regolith) – Diss_Silver Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.745$ | $p\text{-value} = 0.02$ | Negative trend



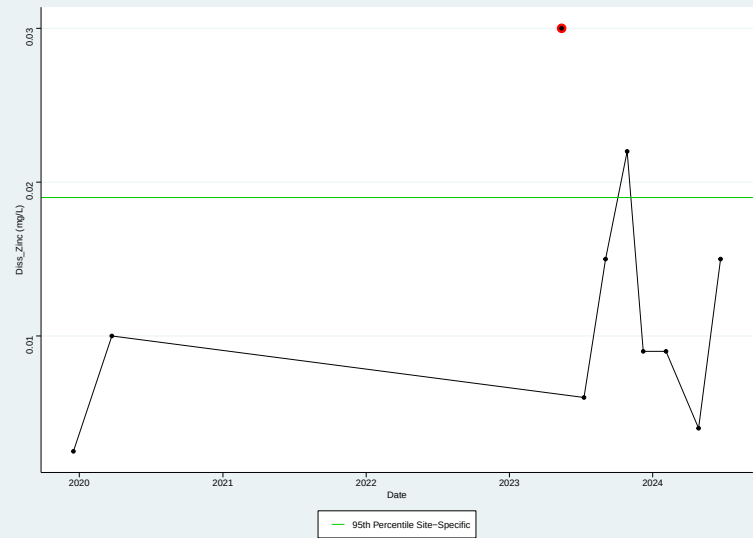
Bore GW19_33 (Alluvium/Regolith) – Diss_Uranium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.087$ | $p\text{-value} = 0.831$ | No trend

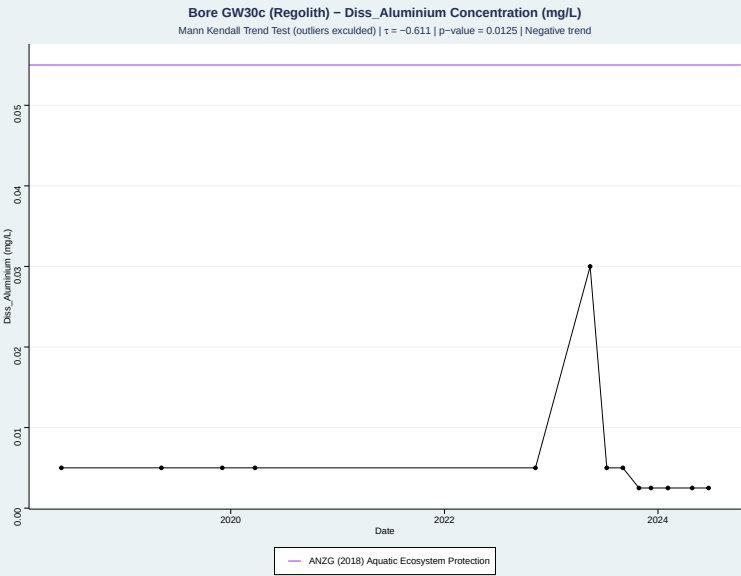
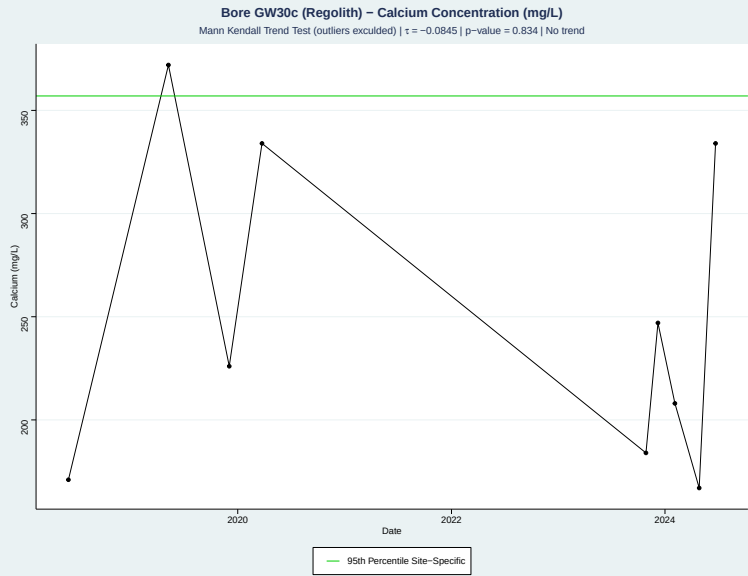
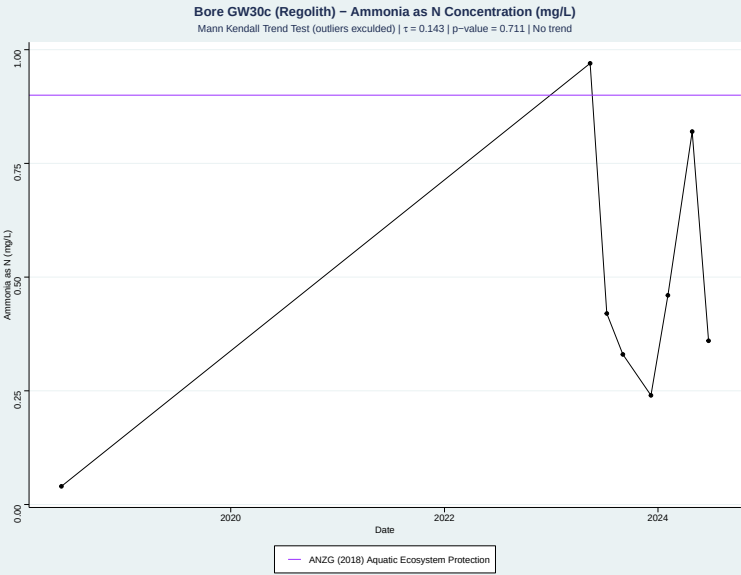
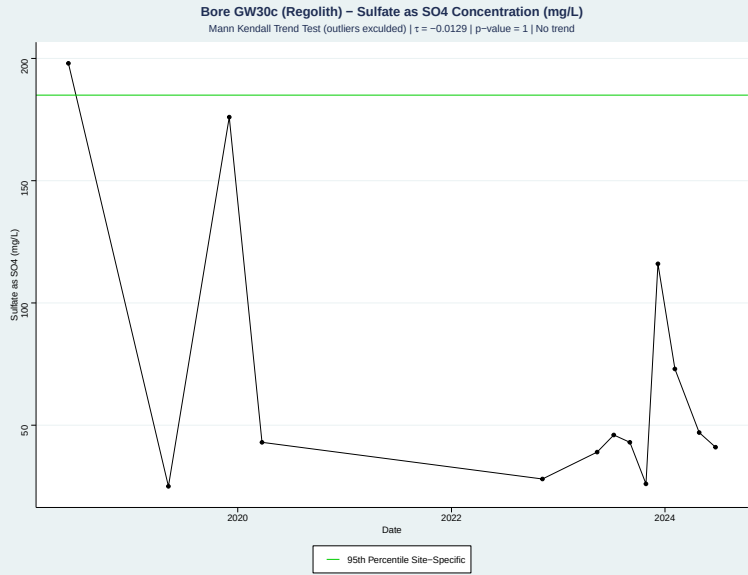
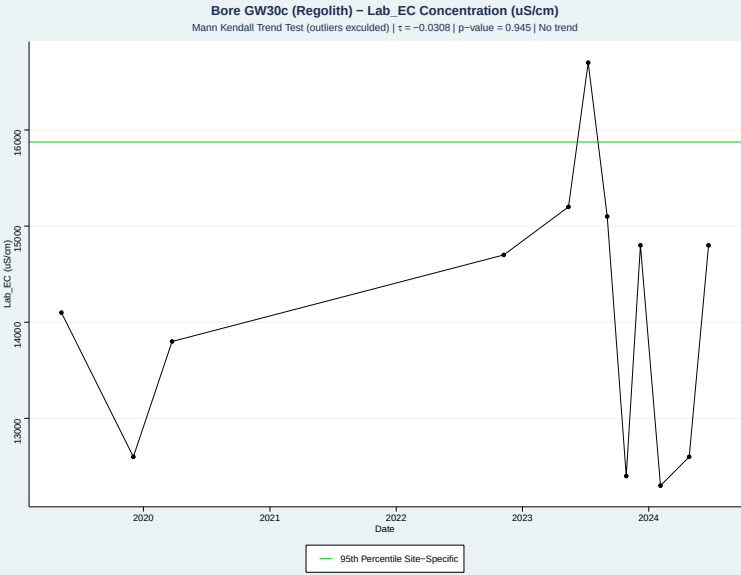
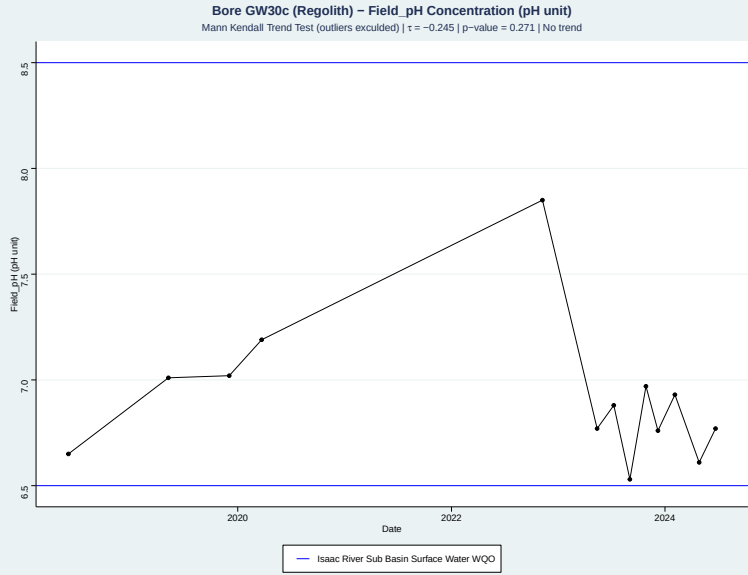


Bore GW19_33 (Alluvium/Regolith) – Diss_Vanadium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.293$ | $p\text{-value} = 0.448$ | No trend

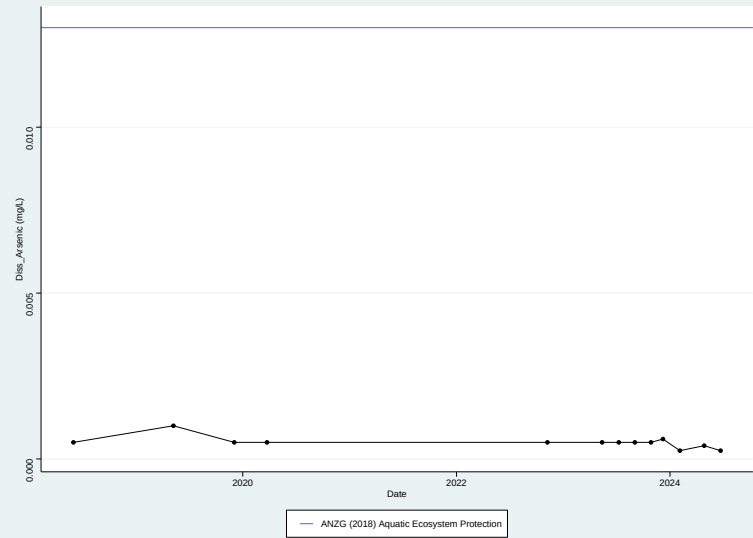


Bore GW19_33 (Alluvium/Regolith) – Diss_Zinc Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.171$ | $p\text{-value} = 0.598$ | No trend

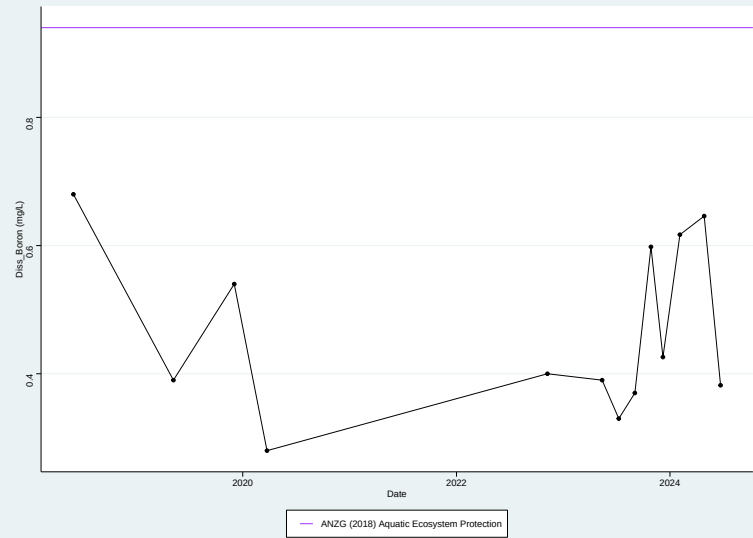




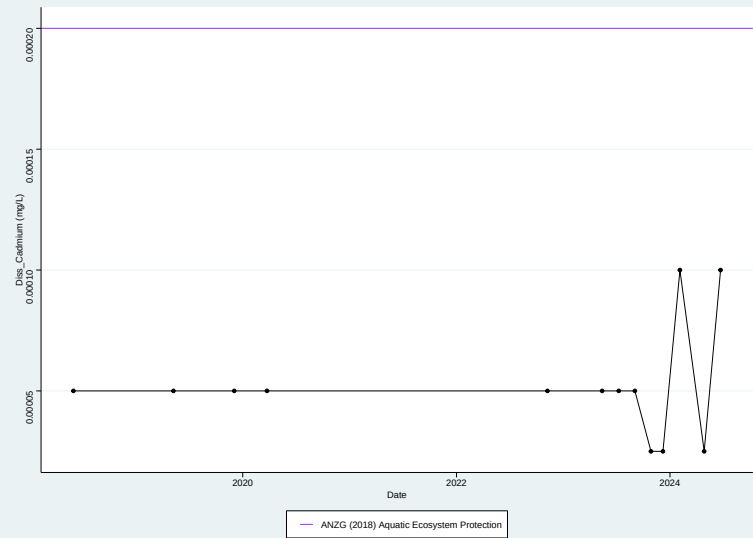
Bore GW30c (Regolith) – Diss_Arsenic Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.469$ | $p\text{-value} = 0.049$ | Negative trend



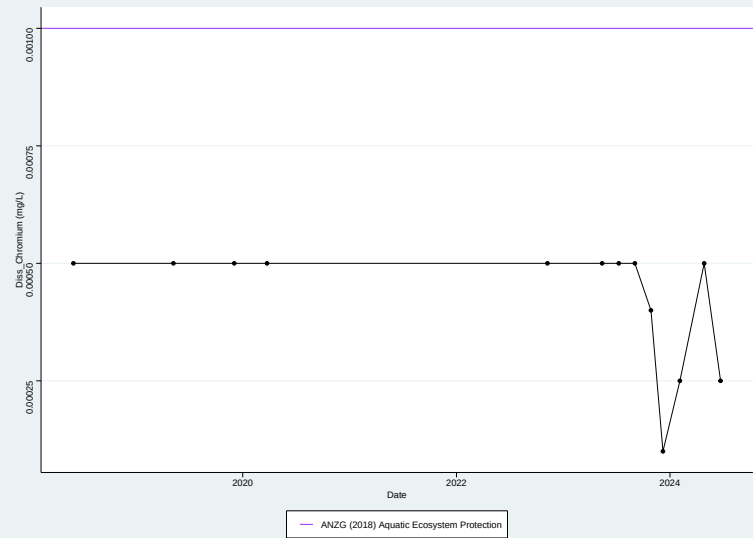
Bore GW30c (Regolith) – Diss_Boron Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = 0.0903$ | $p\text{-value} = 0.714$ | No trend



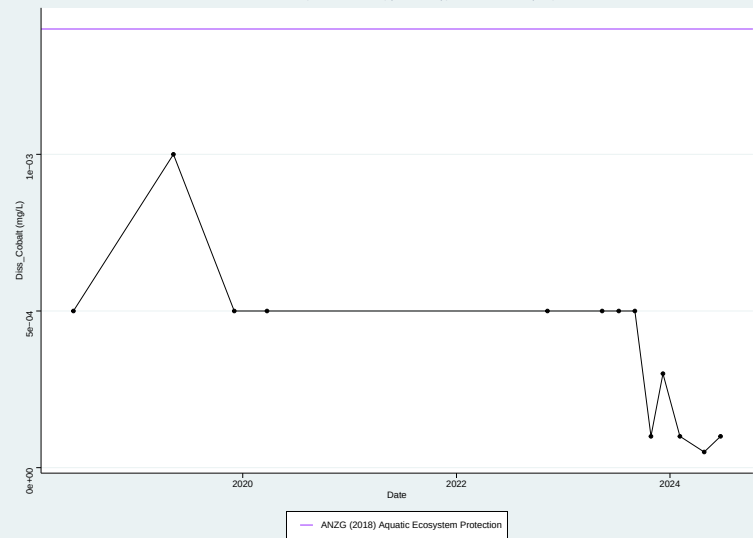
Bore GW30c (Regolith) – Diss_Cadmium Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.0668$ | $p\text{-value} = 0.831$ | No trend



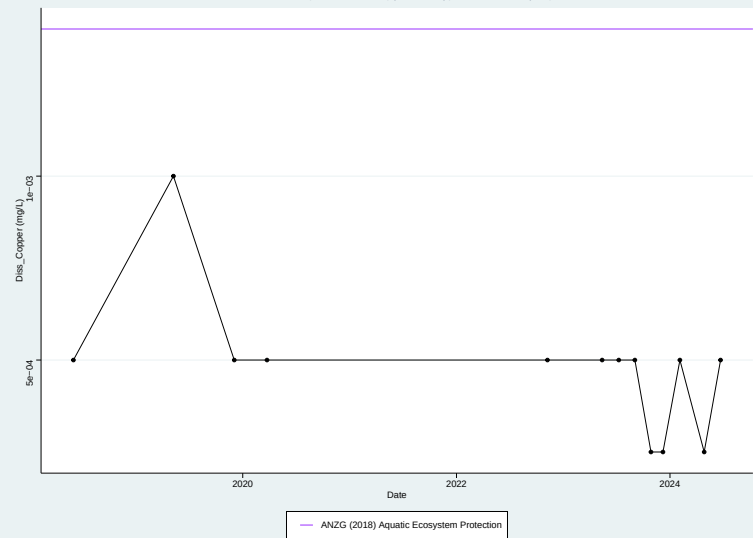
Bore GW30c (Regolith) – Diss_Chromium Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.548$ | $p\text{-value} = 0.0236$ | Negative trend

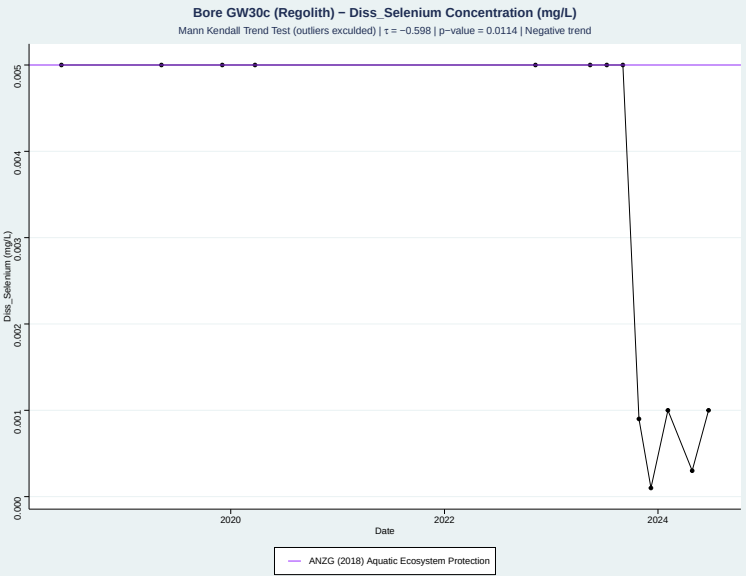
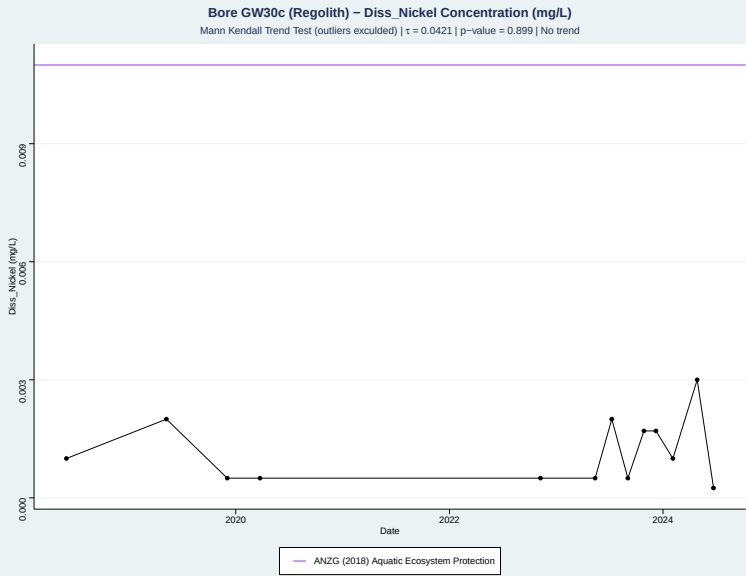
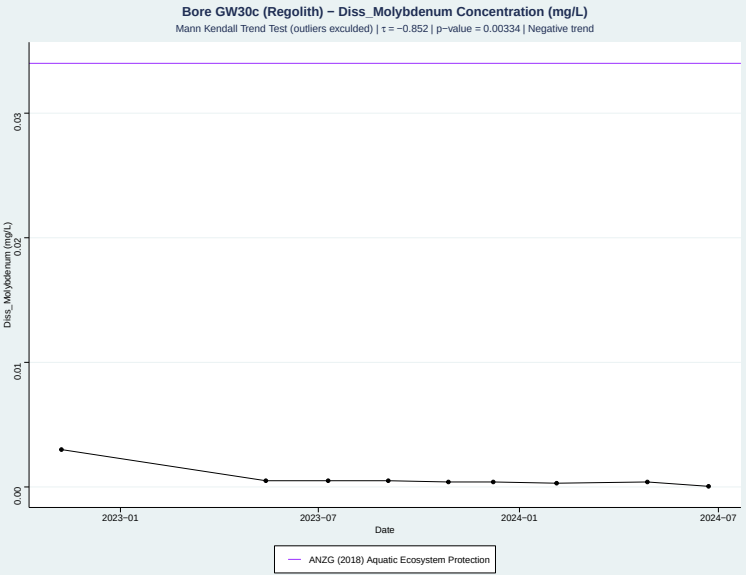
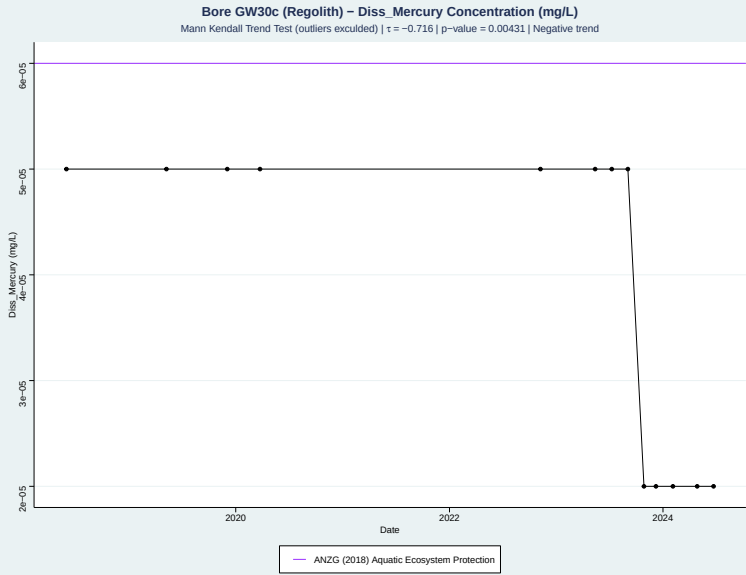
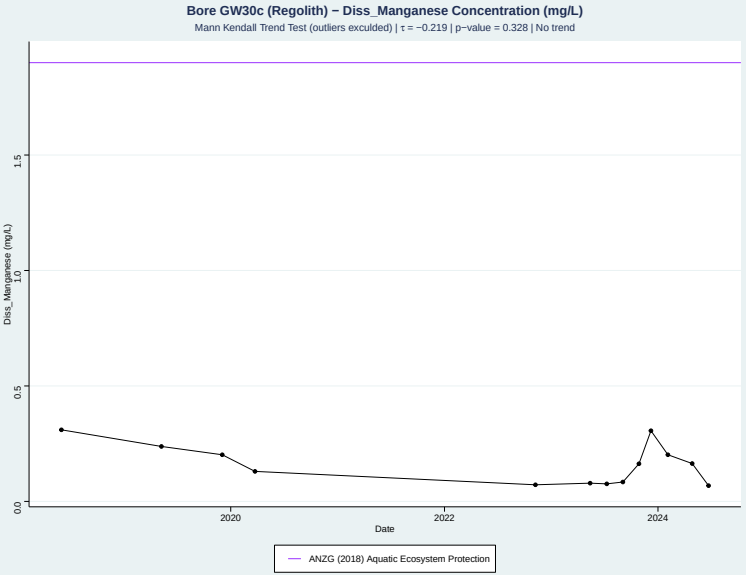
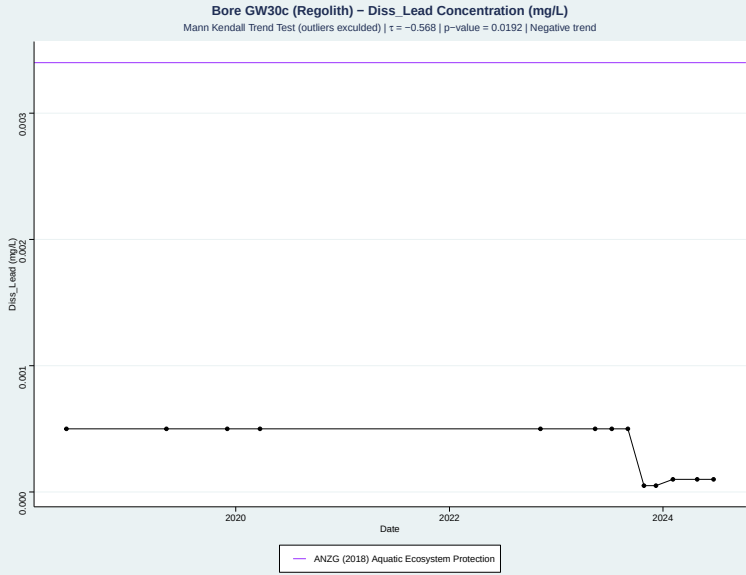


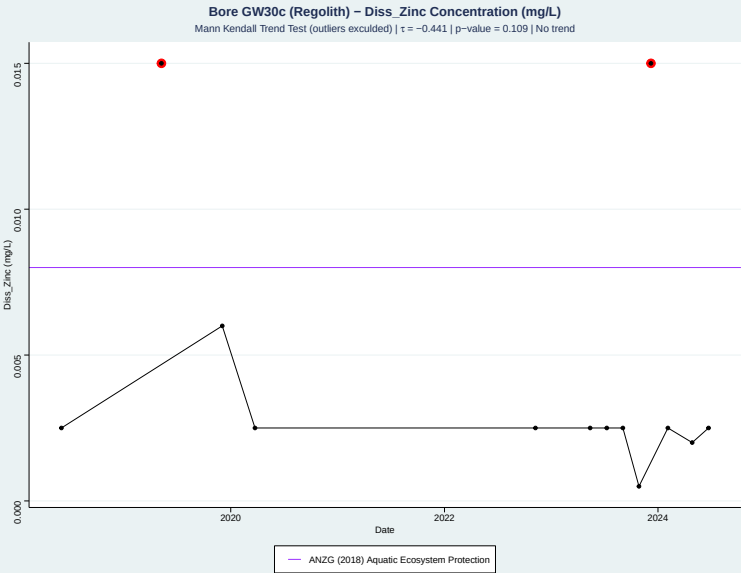
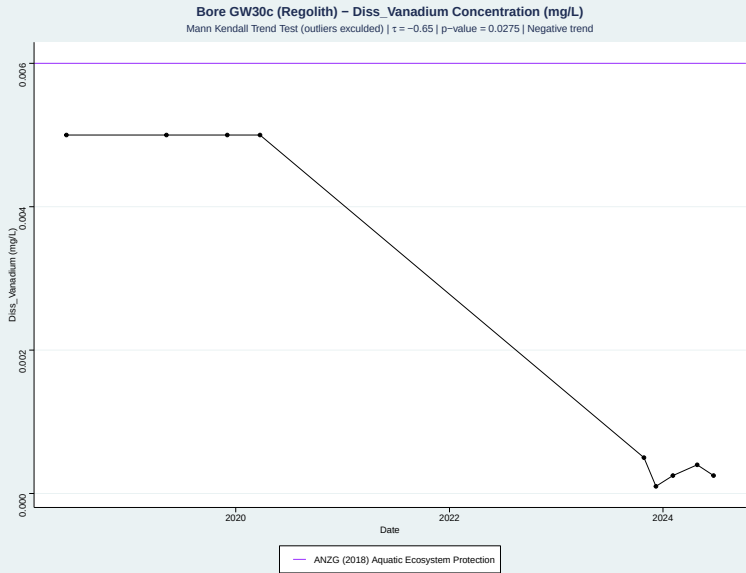
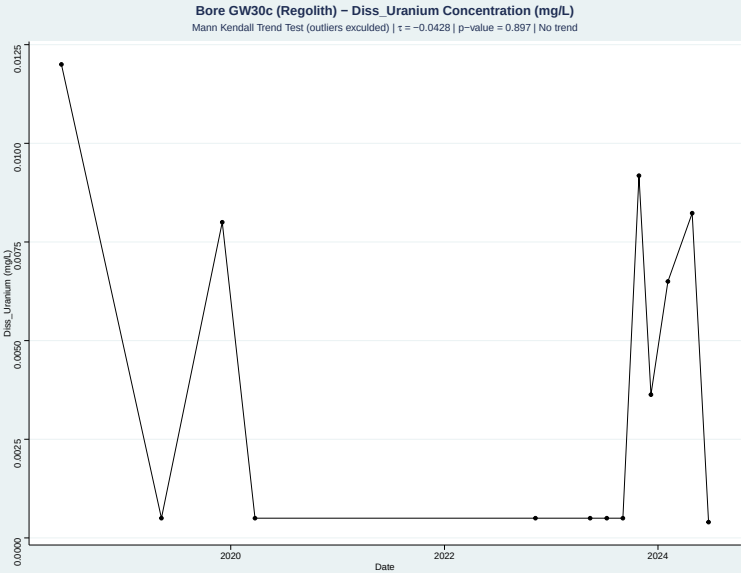
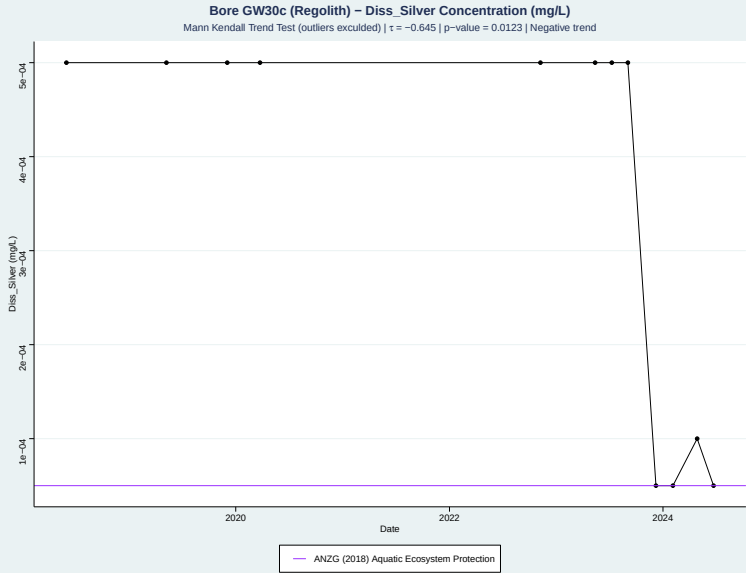
Bore GW30c (Regolith) – Diss_Cobalt Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.74$ | $p\text{-value} = 0.00156$ | Negative trend

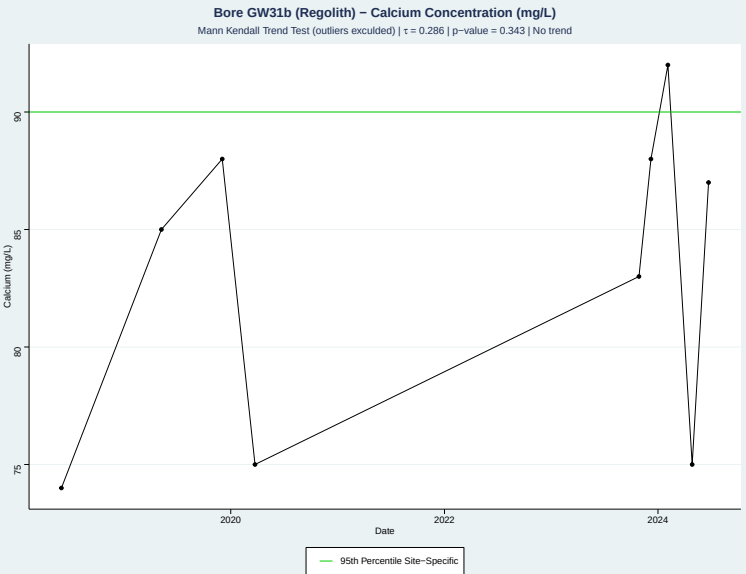
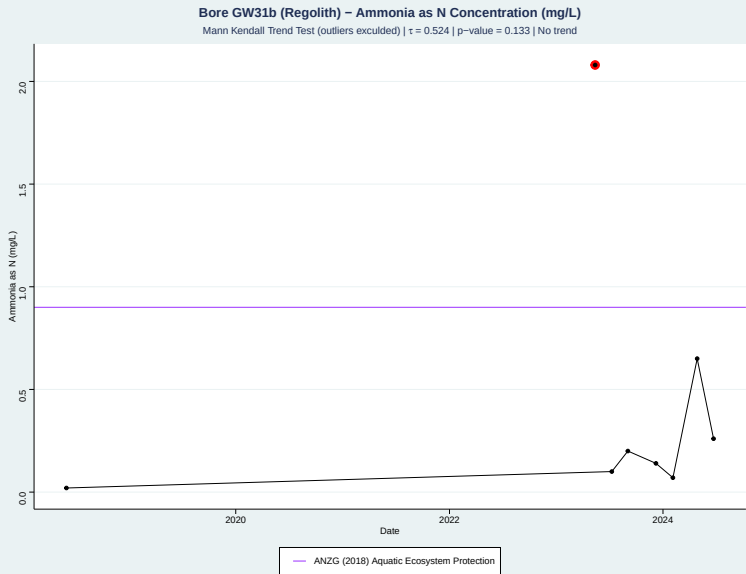
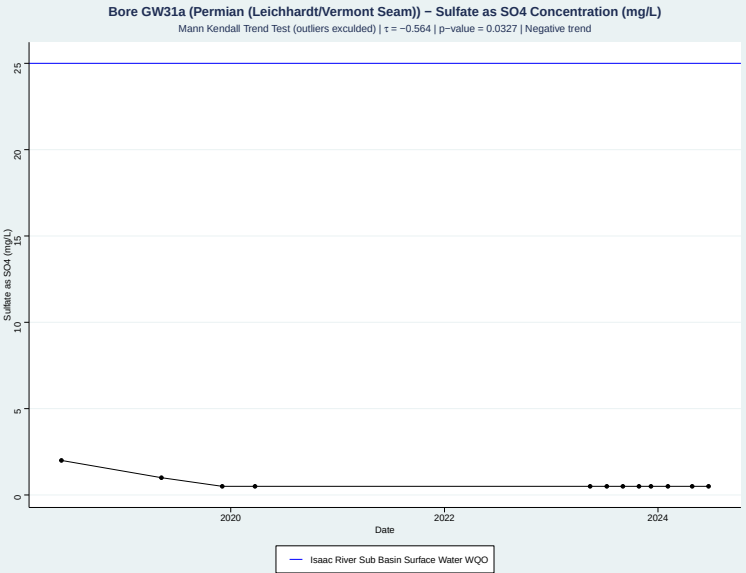
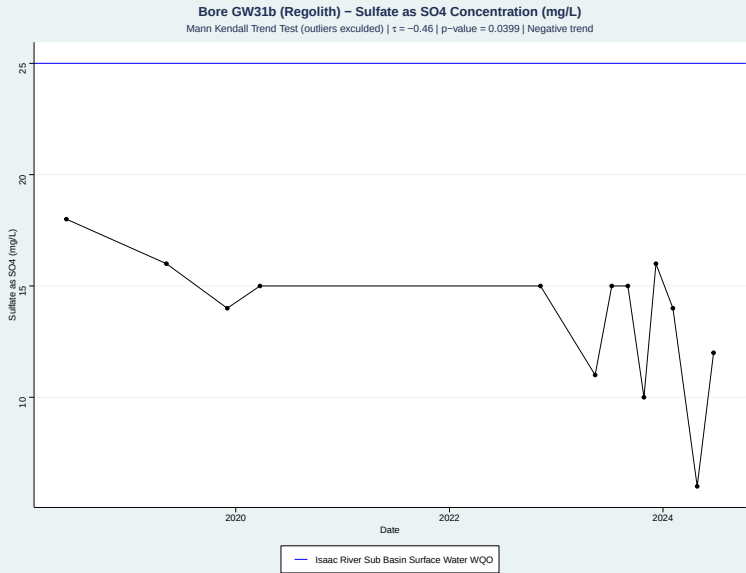
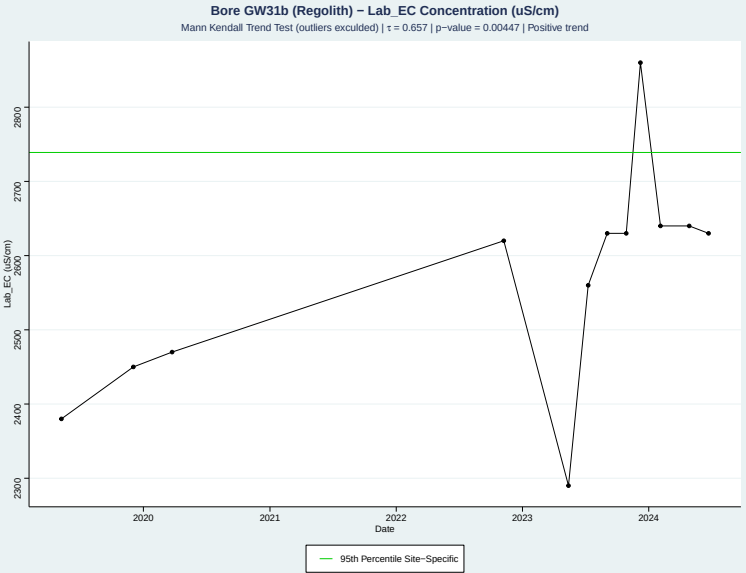
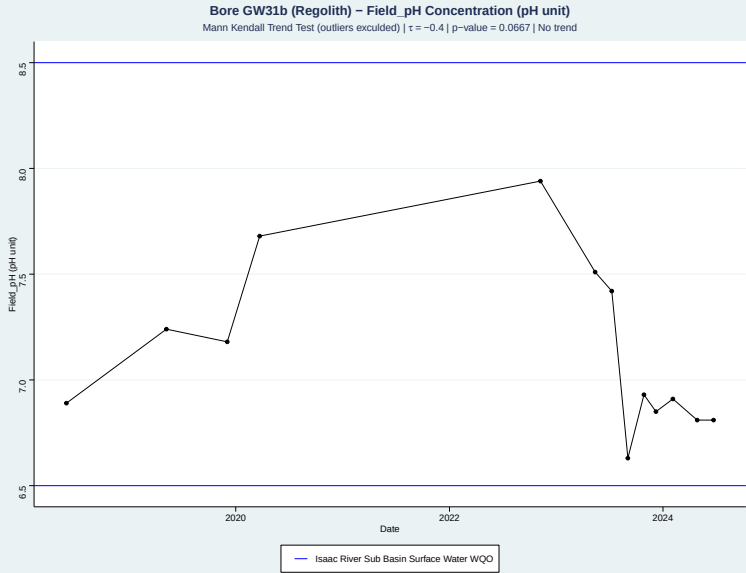


Bore GW30c (Regolith) – Diss_Copper Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.49$ | $p\text{-value} = 0.0481$ | Negative trend

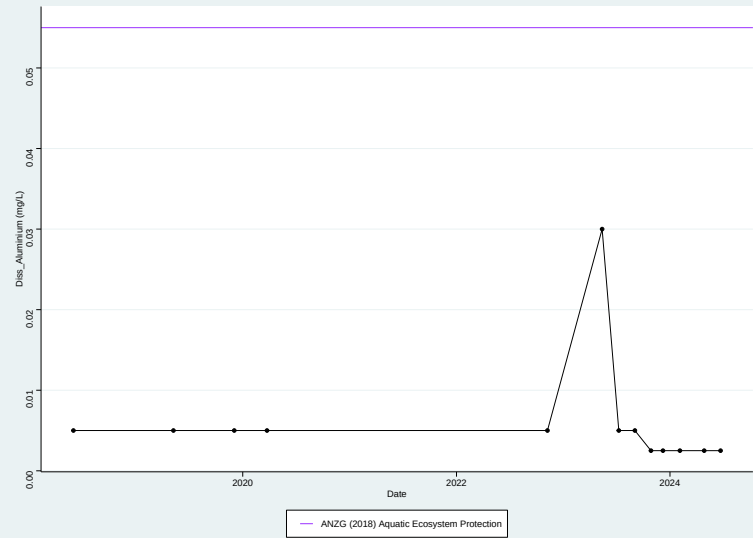




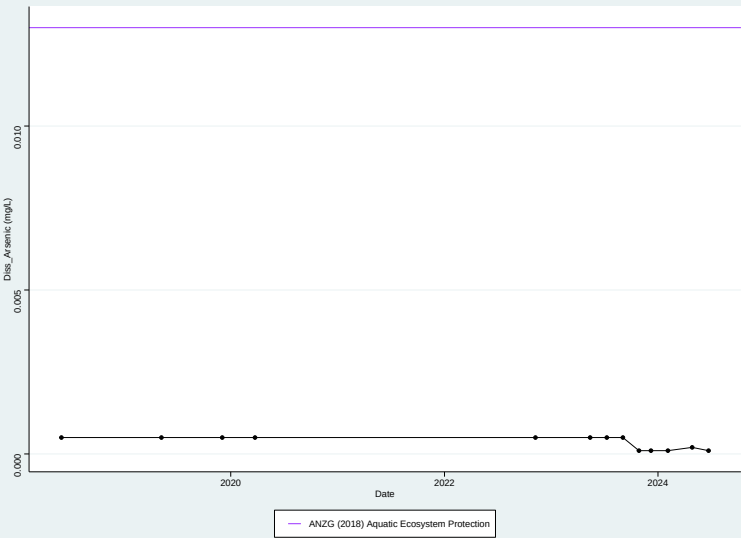




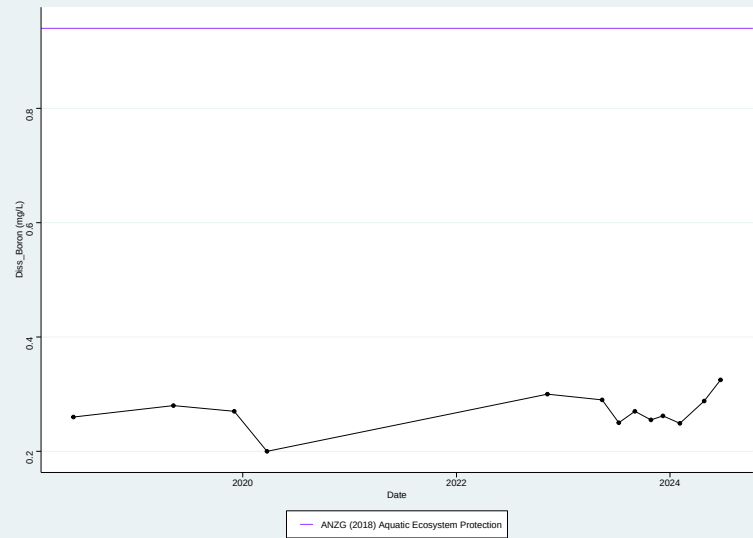
Bore GW31b (Regolith) – Diss_Aluminium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.611$ | $p\text{-value} = 0.0125$ | Negative trend



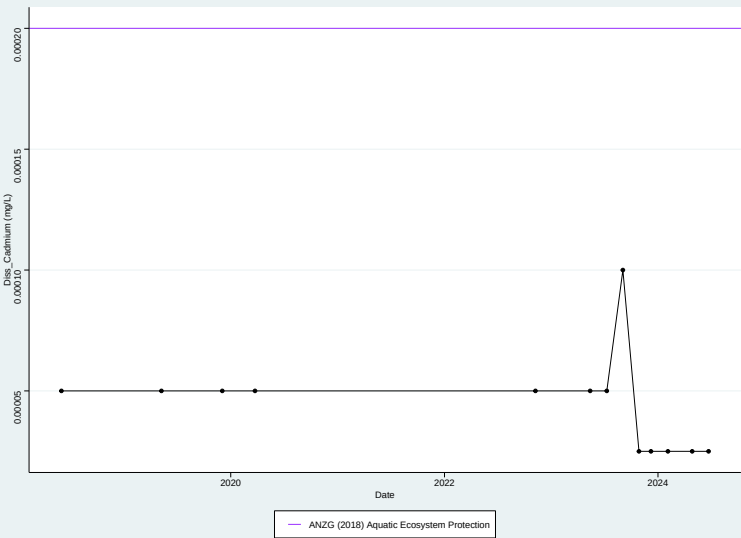
Bore GW31b (Regolith) – Diss_Arsenic Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.649$ | $p\text{-value} = 0.008$ | Negative trend



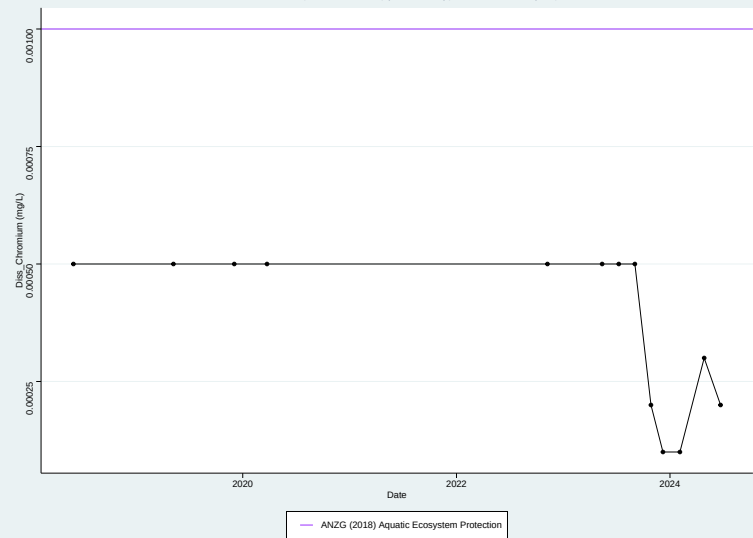
Bore GW31b (Regolith) – Diss_Boron Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.0903$ | $p\text{-value} = 0.714$ | No trend



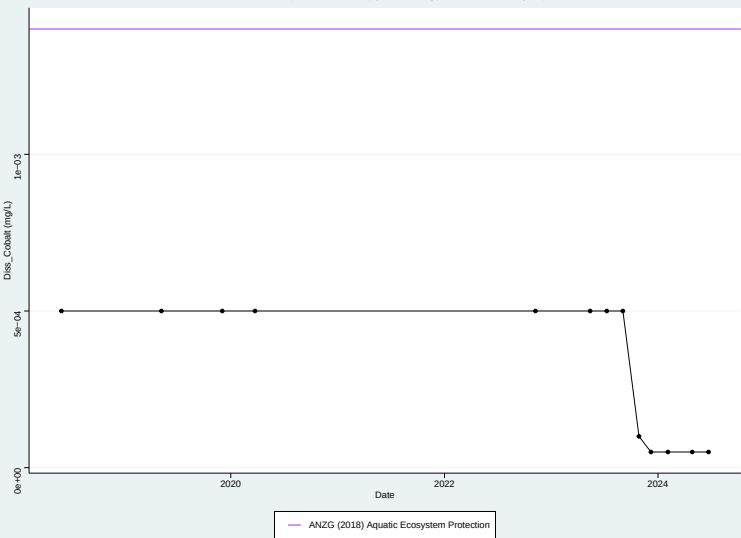
Bore GW31b (Regolith) – Diss_Cadmium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.545$ | $p\text{-value} = 0.0264$ | Negative trend

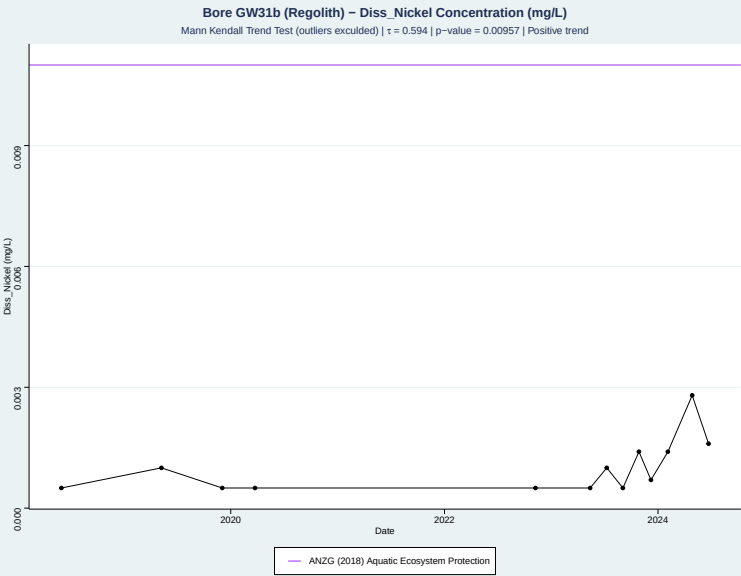
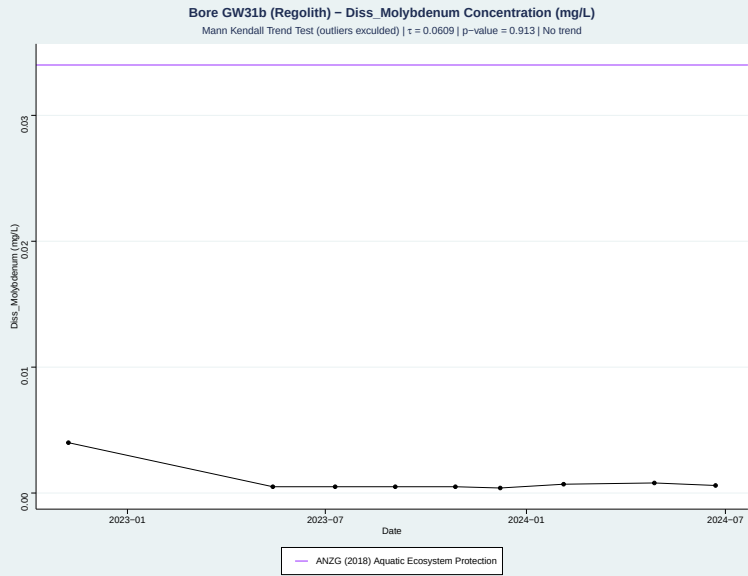
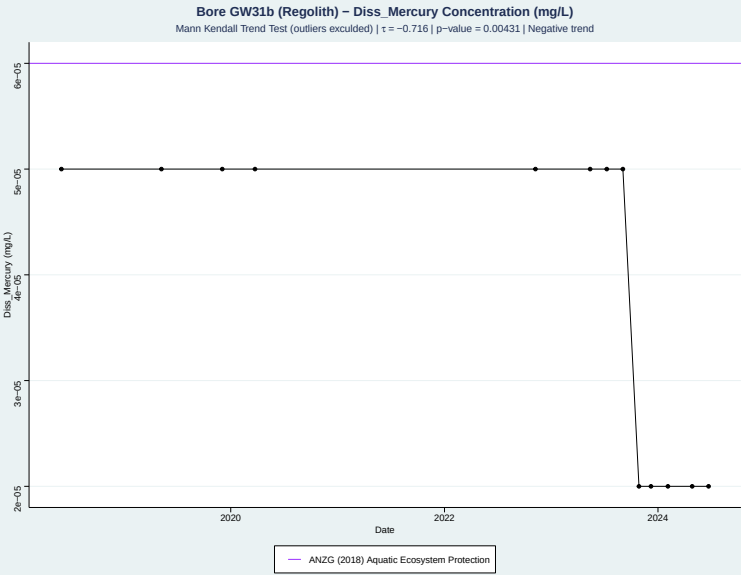
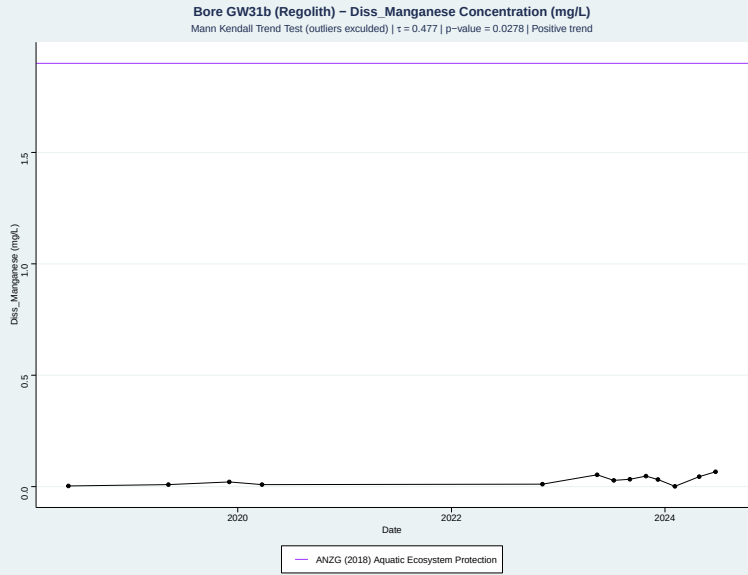
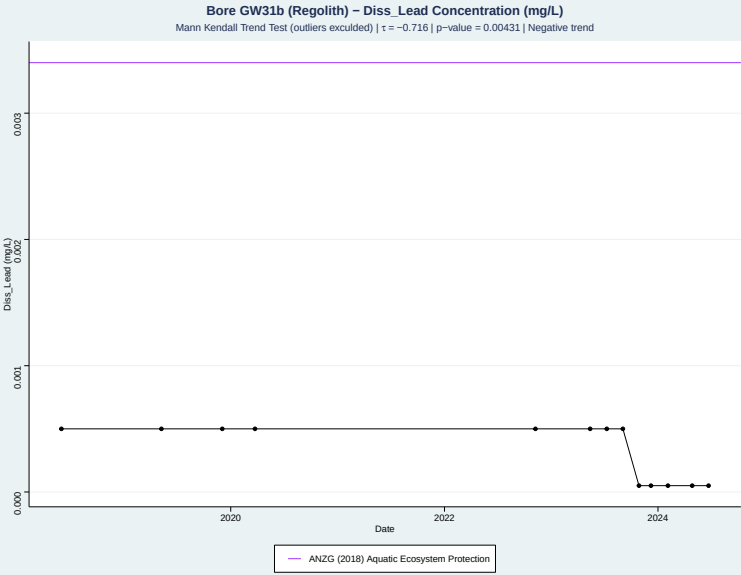
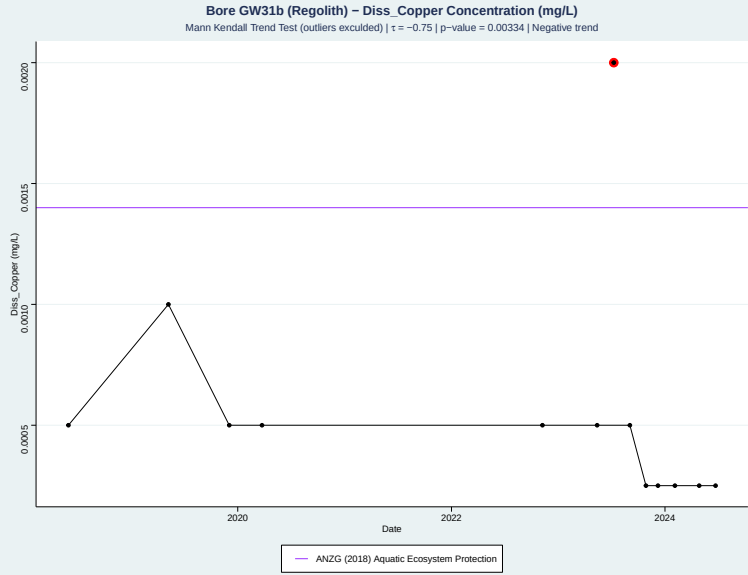


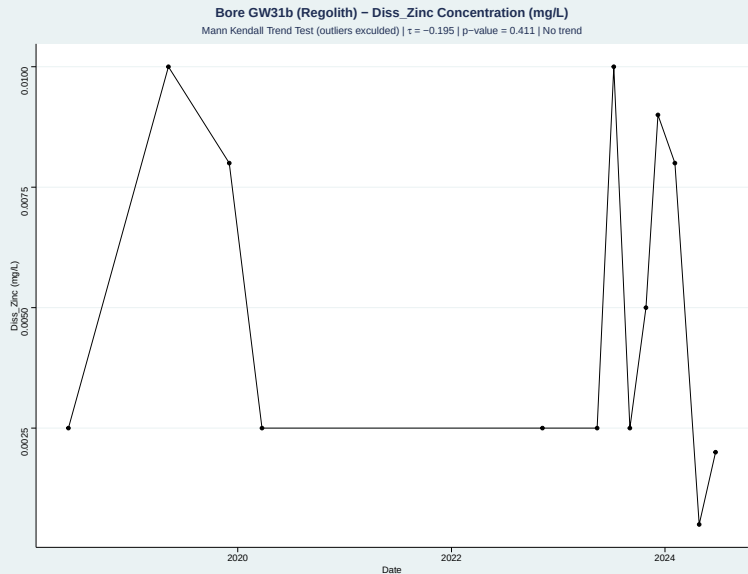
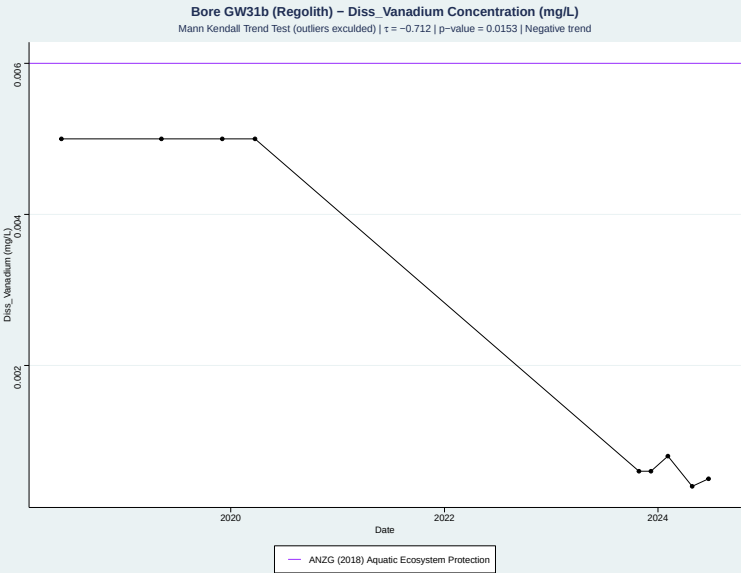
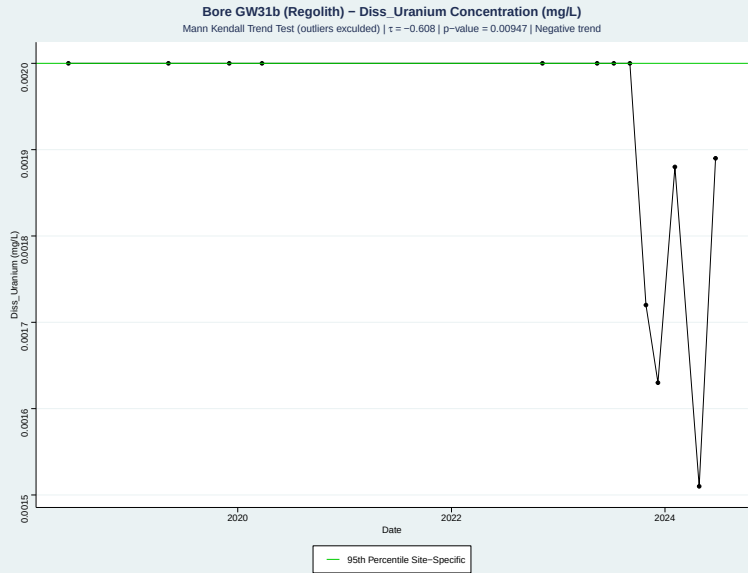
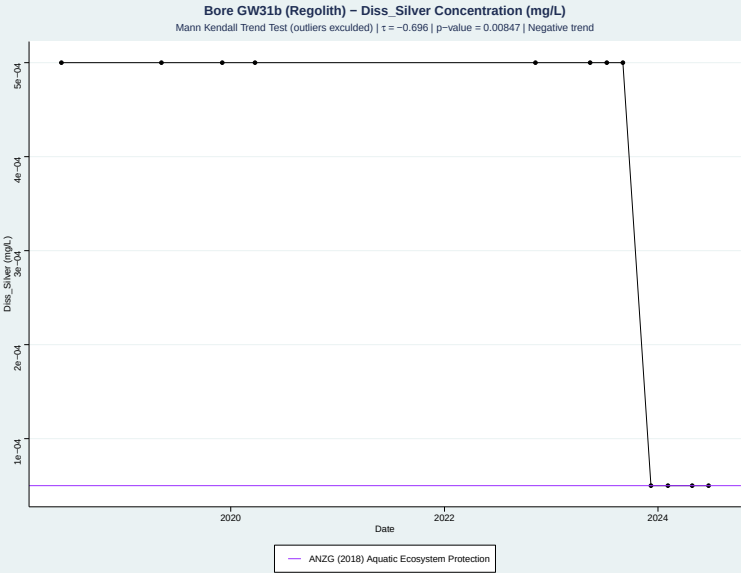
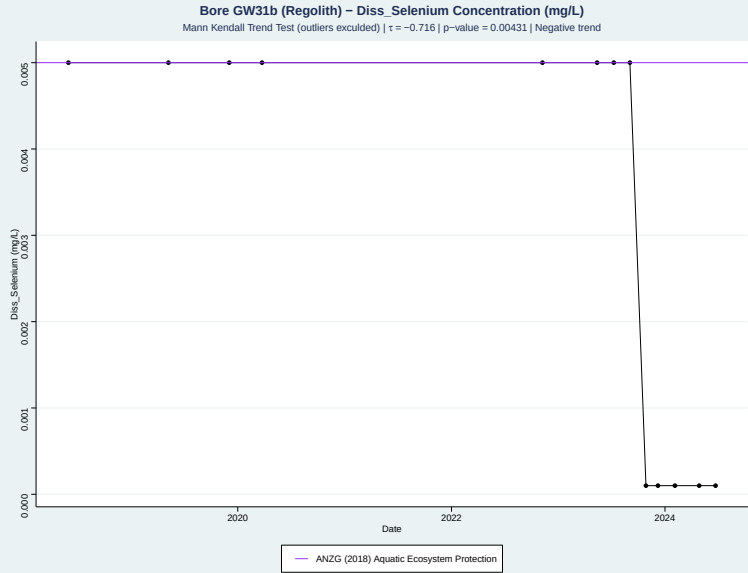
Bore GW31b (Regolith) – Diss_Chromium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.621$ | $p\text{-value} = 0.00912$ | Negative trend



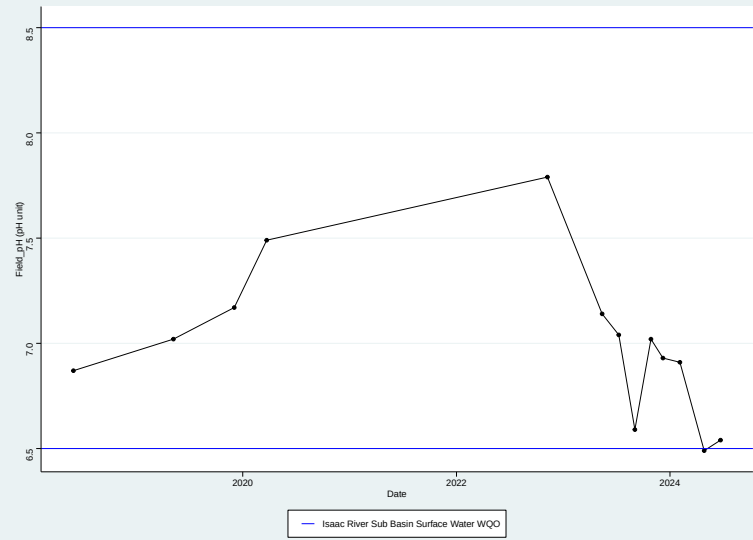
Bore GW31b (Regolith) – Diss_Cobalt Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.751$ | $p\text{-value} = 0.00206$ | Negative trend



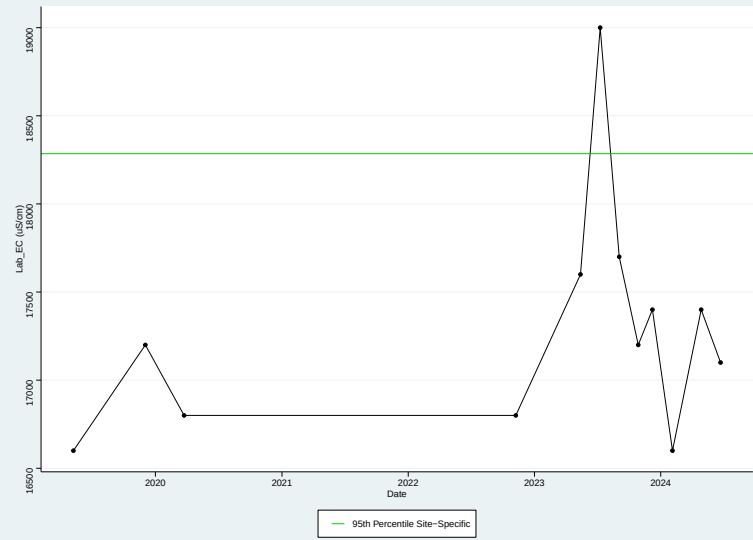




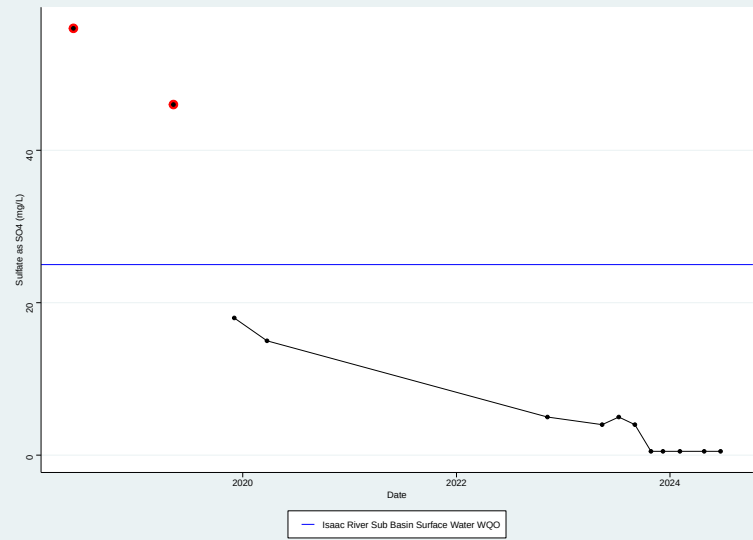
Bore GW30b (Permian (Burton Seam)) – Field_pH Concentration (pH unit)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.452$ | $p\text{-value} = 0.0377$ | Negative trend



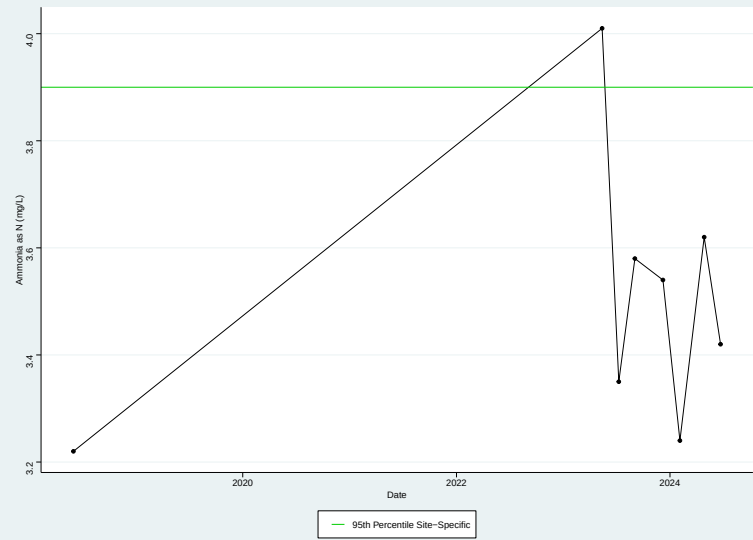
Bore GW30b (Permian (Burton Seam)) – Lab_EC Concentration (uS/cm)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.125$ | $p\text{-value} = 0.628$ | No trend



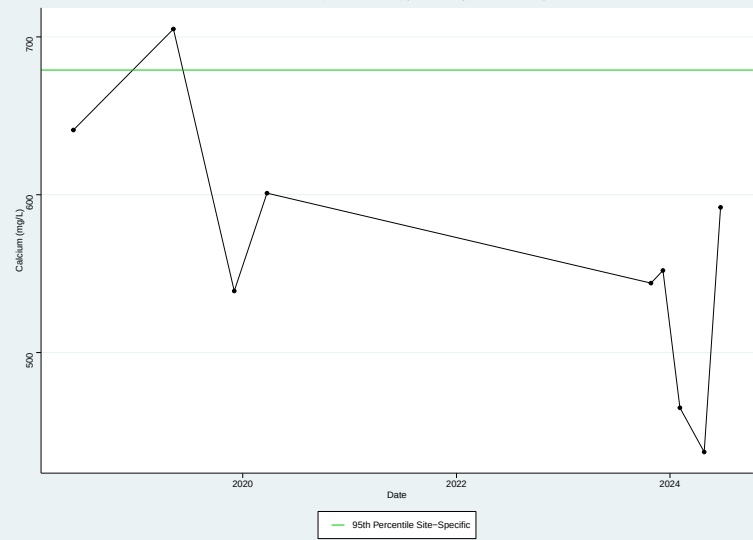
Bore GW30b (Permian (Burton Seam)) – Sulfate as SO4 Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.843$ | $p\text{-value} = 0.000944$ | Negative trend



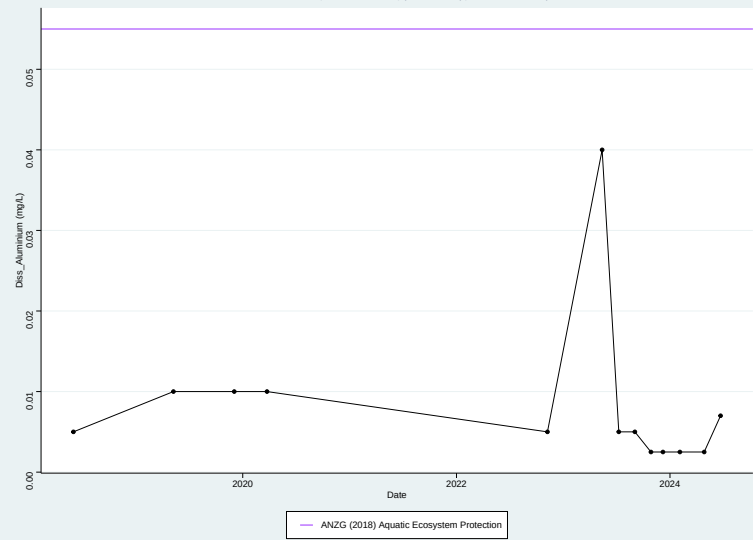
Bore GW30b (Permian (Burton Seam)) – Ammonia as N Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.0714$ | $p\text{-value} = 0.902$ | No trend



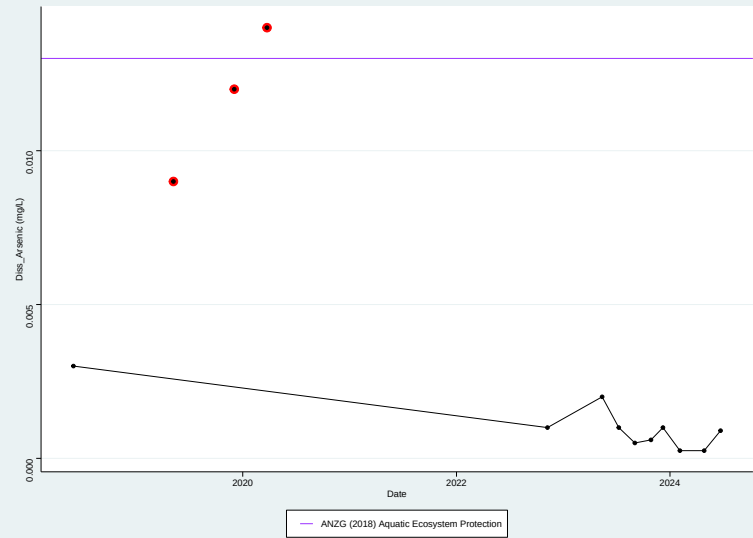
Bore GW30b (Permian (Burton Seam)) – Calcium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.444$ | $p\text{-value} = 0.118$ | No trend



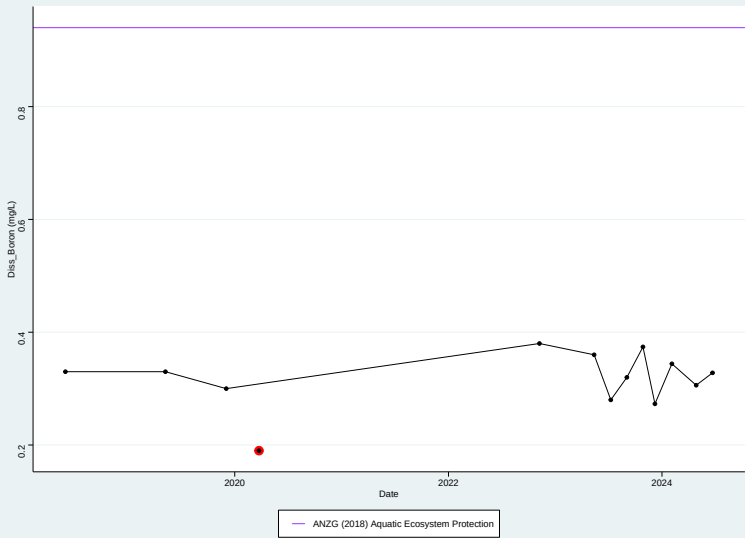
Bore GW30b (Permian (Burton Seam)) – Diss_Aluminium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.442$ | $p\text{-value} = 0.0566$ | No trend



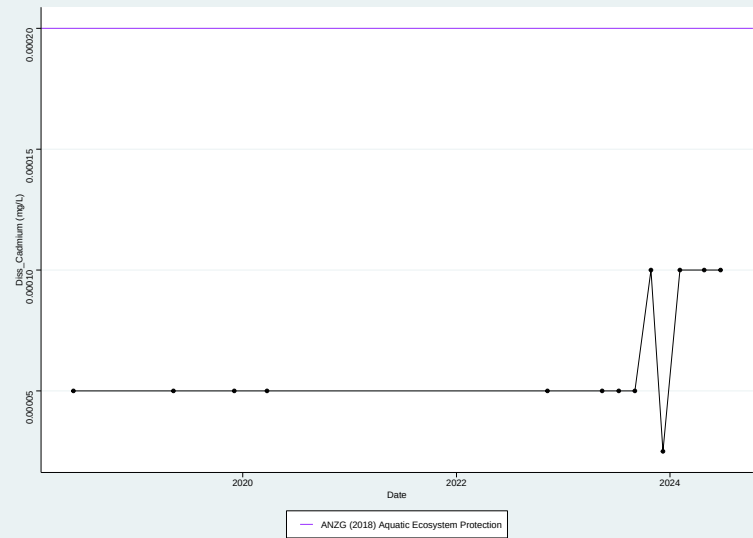
Bore GW30b (Permian (Burton Seam)) – Diss_Arsenic Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.582$ | p-value = 0.0287 | Negative trend



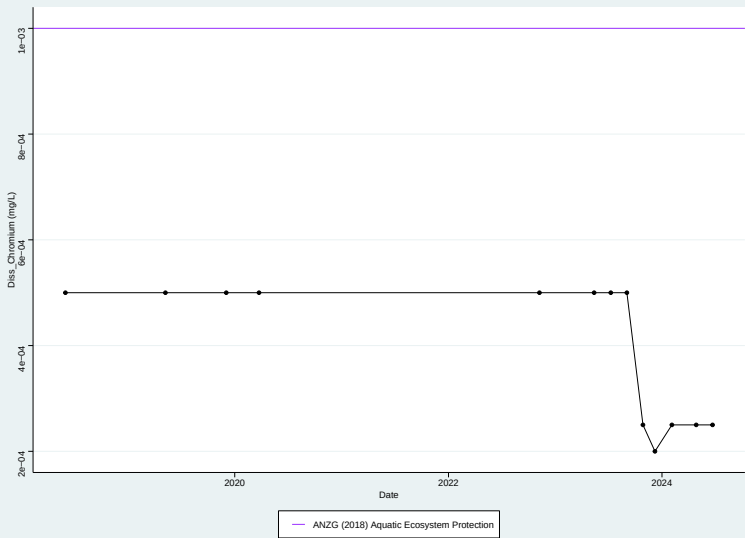
Bore GW30b (Permian (Burton Seam)) – Diss_Boron Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.137$ | p-value = 0.582 | No trend



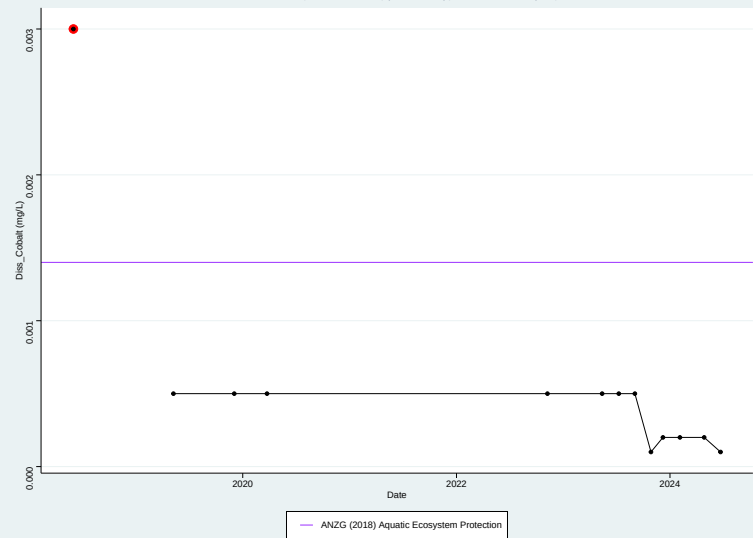
Bore GW30b (Permian (Burton Seam)) – Diss_Cadmium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.444$ | p-value = 0.0732 | No trend



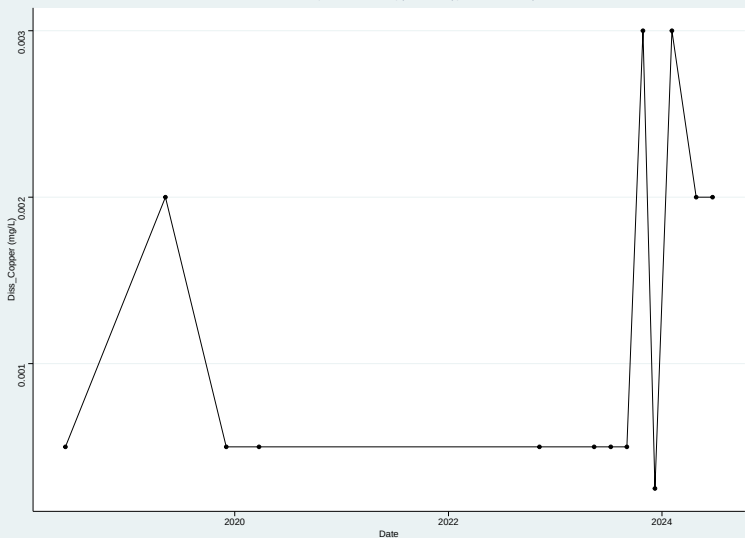
Bore GW30b (Permian (Burton Seam)) – Diss_Chromium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.649$ | p-value = 0.008 | Negative trend



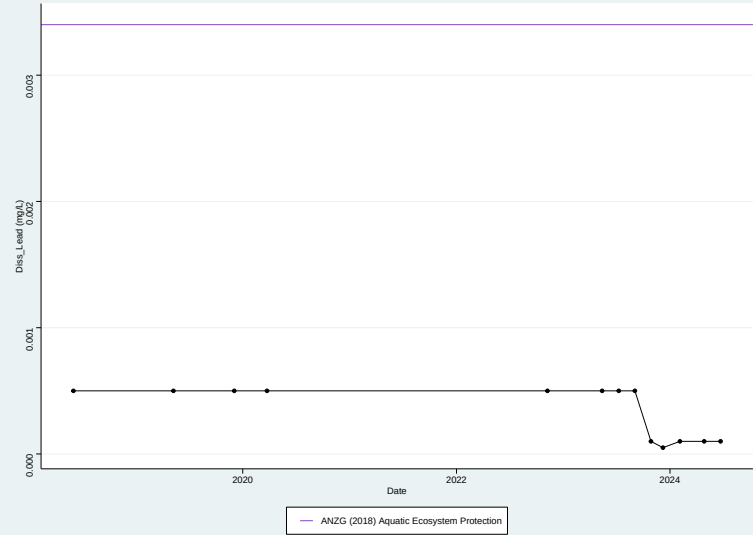
Bore GW30b (Permian (Burton Seam)) – Diss_Cobalt Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.673$ | p-value = 0.00787 | Negative trend



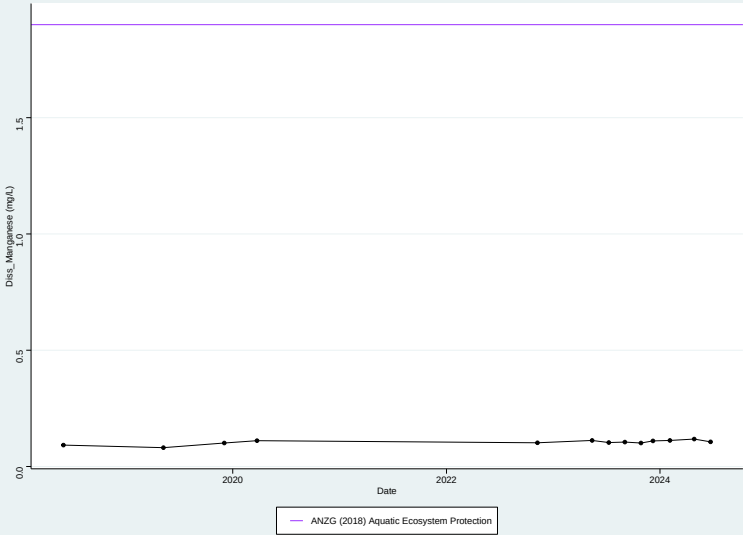
Bore GW30b (Permian (Burton Seam)) – Diss_Copper Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = 0.233$ | p-value = 0.345 | No trend



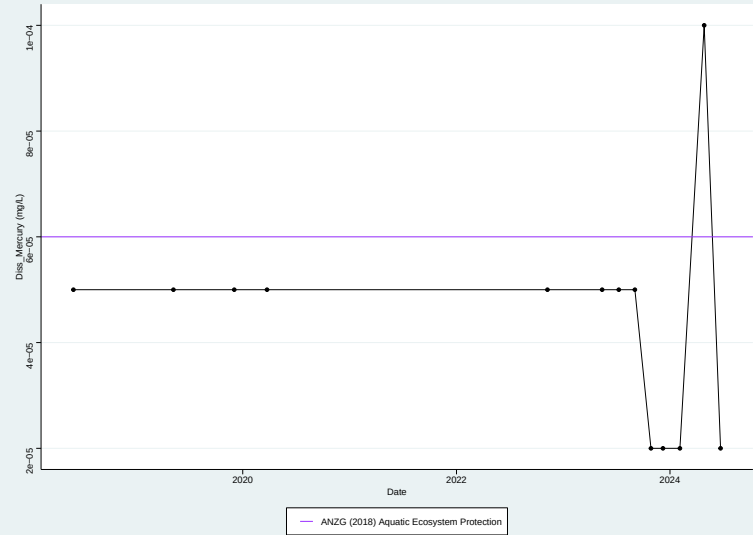
Bore GW30b (Permian (Burton Seam)) – Diss_Lead Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.649$ | p-value = 0.008 | Negative trend



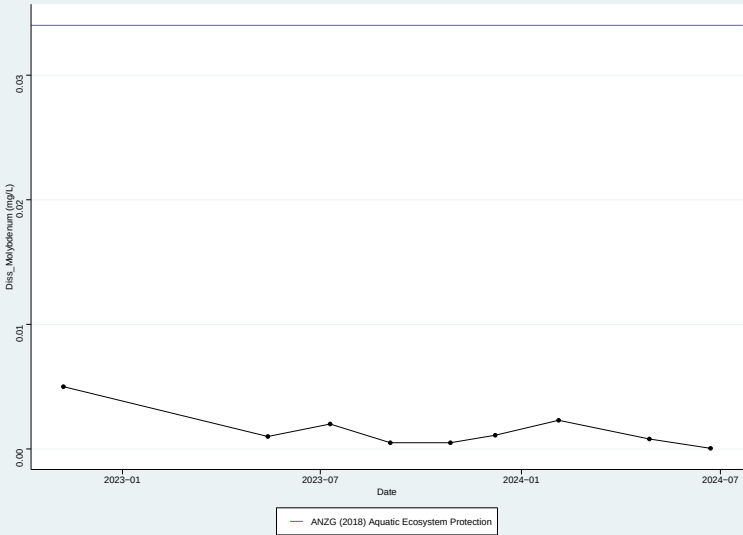
Bore GW30b (Permian (Burton Seam)) – Diss_Manganese Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = 0.52$ | p-value = 0.0169 | Positive trend



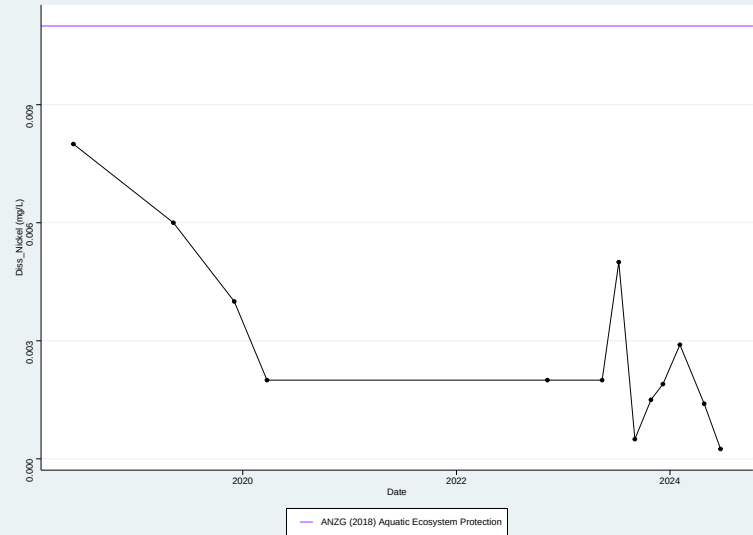
Bore GW30b (Permian (Burton Seam)) – Diss_Mercury Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.376$ | p-value = 0.132 | No trend



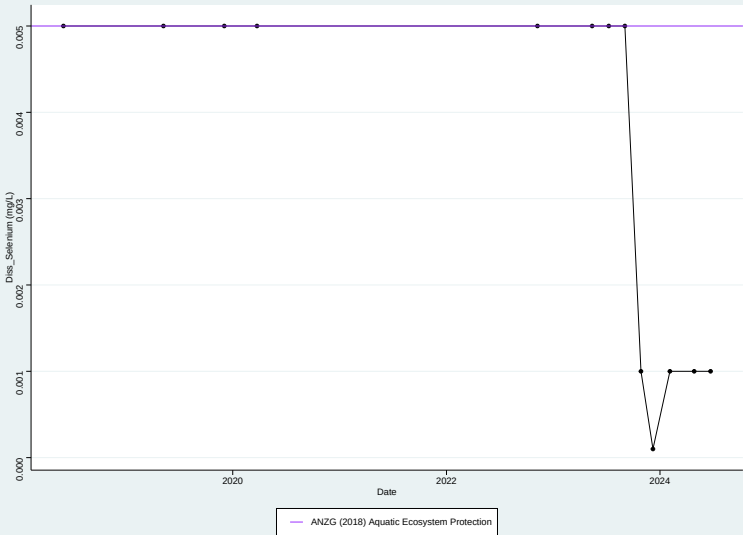
Bore GW30b (Permian (Burton Seam)) – Diss_Molybdenum Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.366$ | p-value = 0.208 | No trend



Bore GW30b (Permian (Burton Seam)) – Diss_Nickel Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.614$ | p-value = 0.00472 | Negative trend

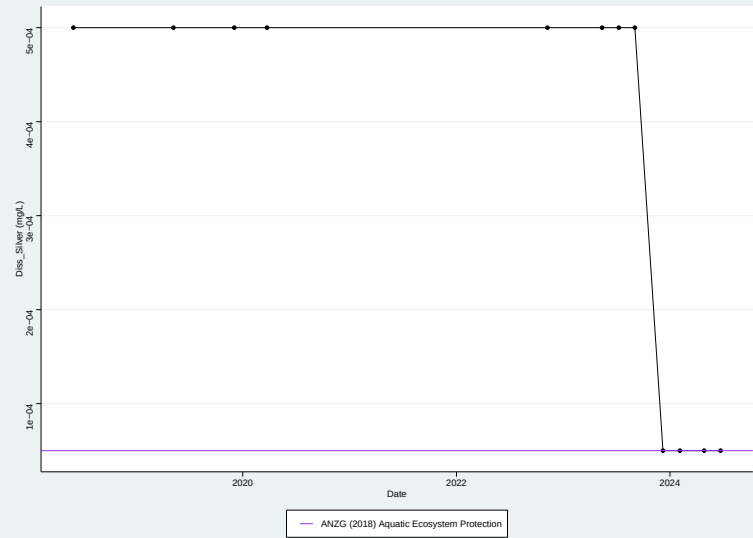


Bore GW30b (Permian (Burton Seam)) – Diss_Selenium Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.649$ | p-value = 0.008 | Negative trend



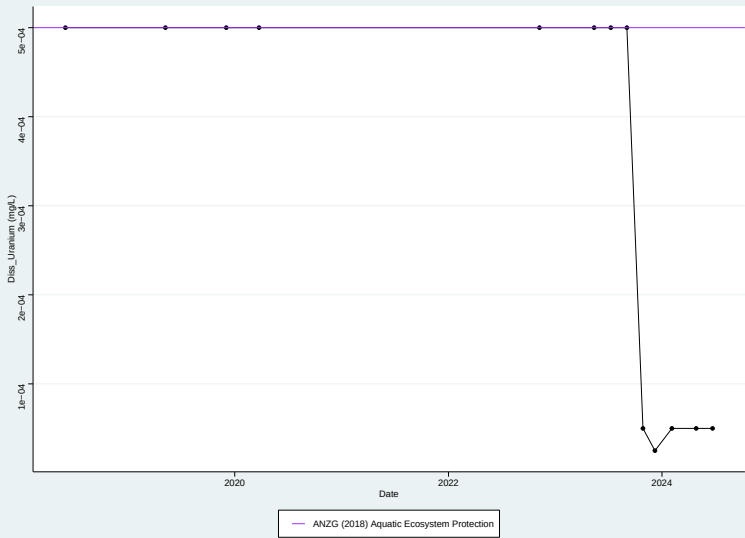
Bore GW30b (Permian (Burton Seam)) – Diss. Silver Concentration (mg/L)

Mann Kendall Trend Test (outliers excluded) | $\tau = -0.696$ | $p\text{-value} = 0.00847$ | Negative trend



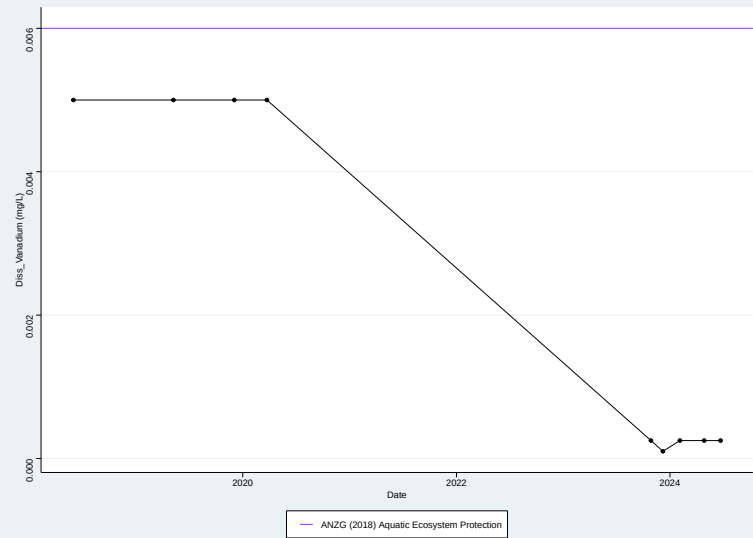
Bore GW30b (Permian (Burton Seam)) – Diss. Uranium Concentration (mg/L)

Mann Kendall Trend Test (outliers excluded) | $\tau = -0.649$ | $p\text{-value} = 0.008$ | Negative trend



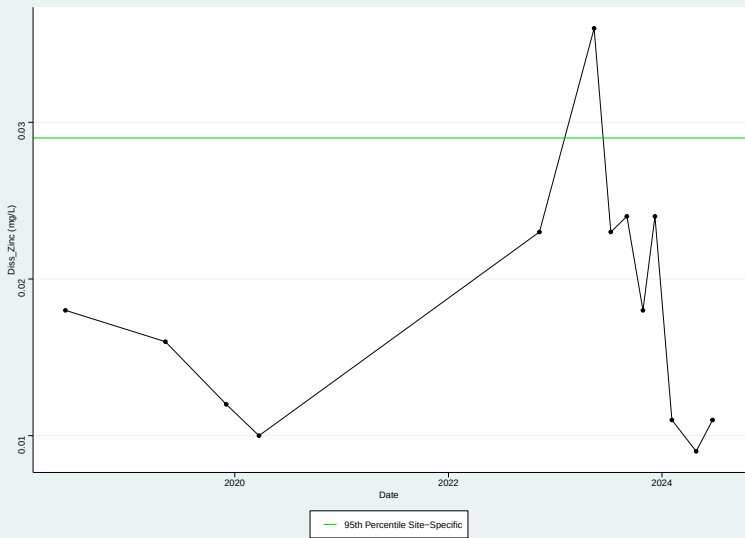
Bore GW30b (Permian (Burton Seam)) – Diss. Vanadium Concentration (mg/L)

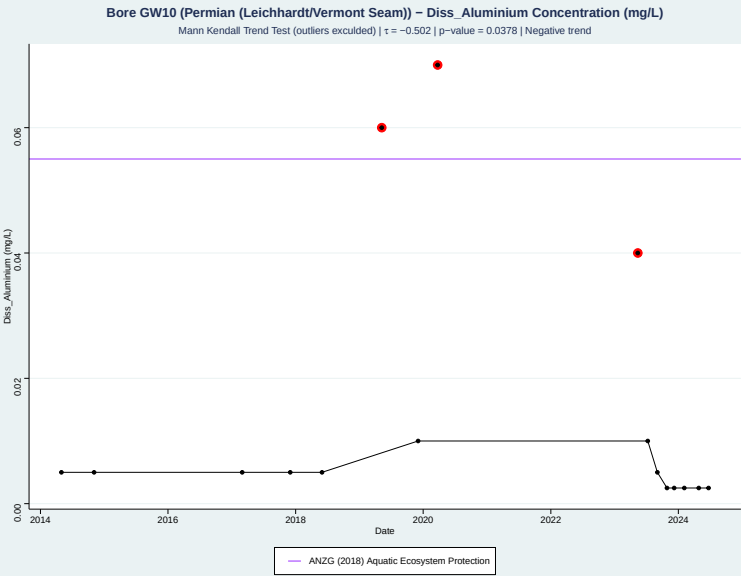
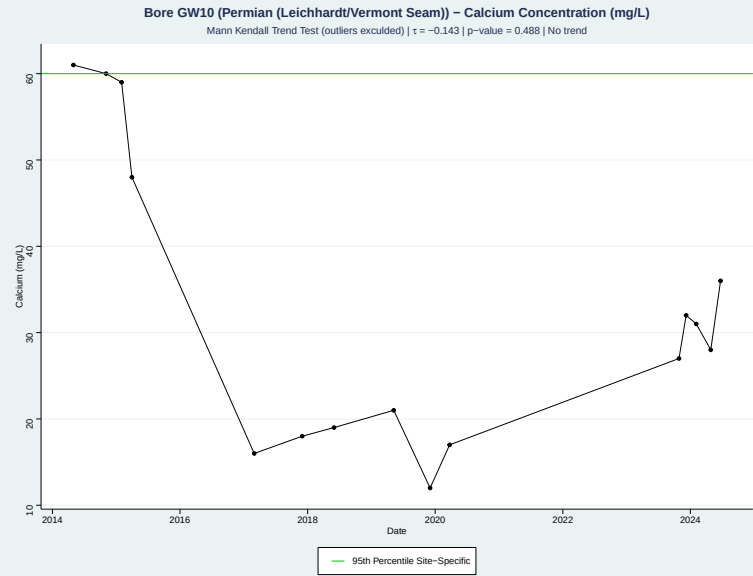
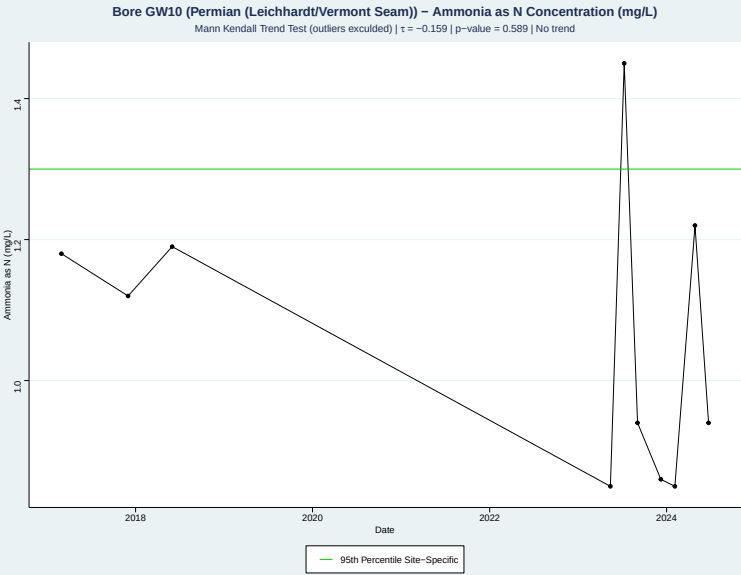
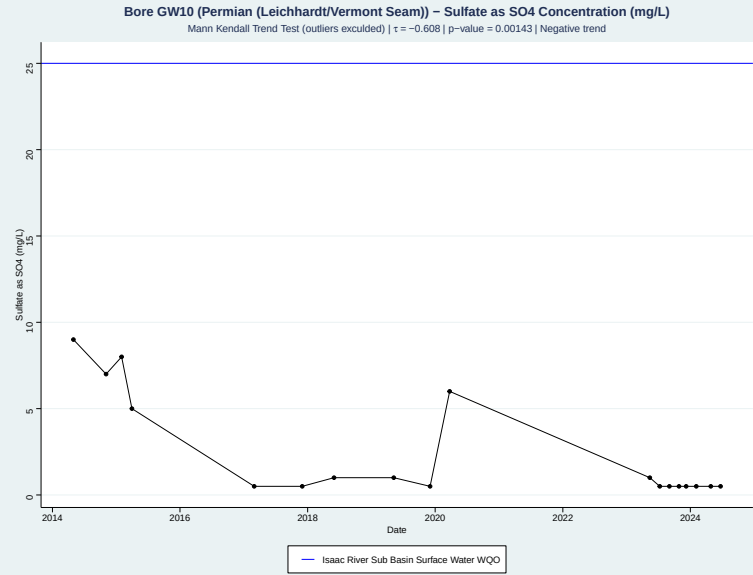
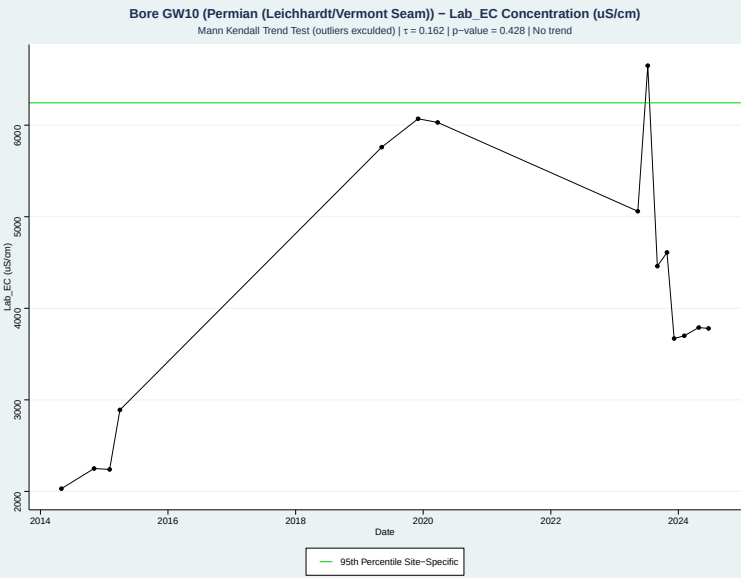
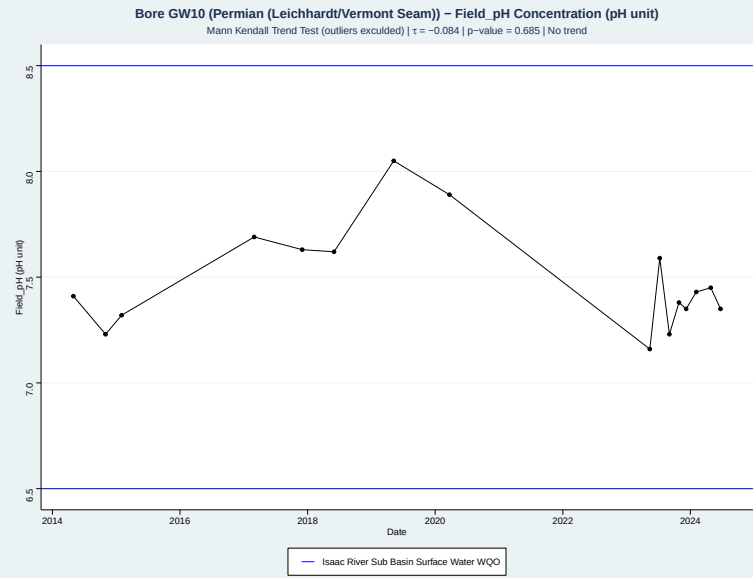
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.612$ | $p\text{-value} = 0.0491$ | Negative trend

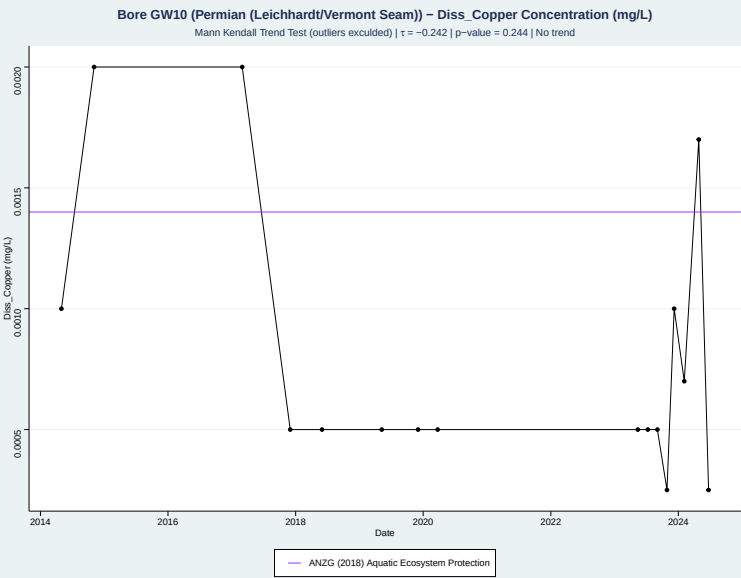
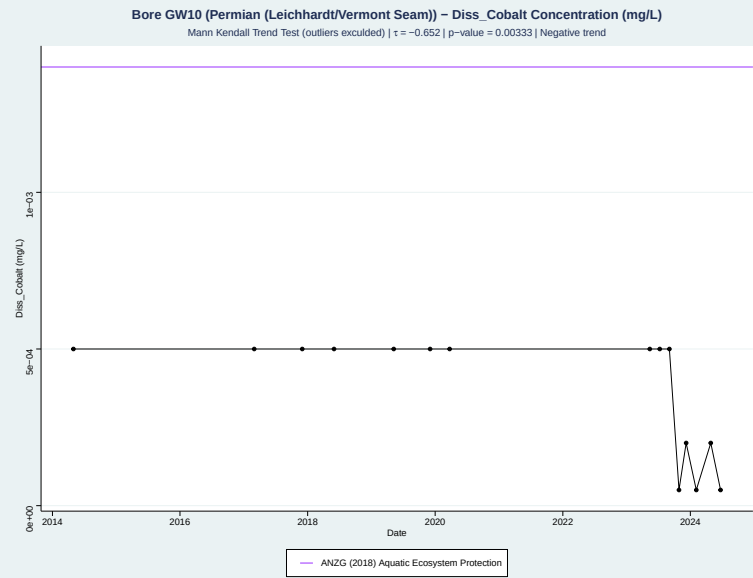
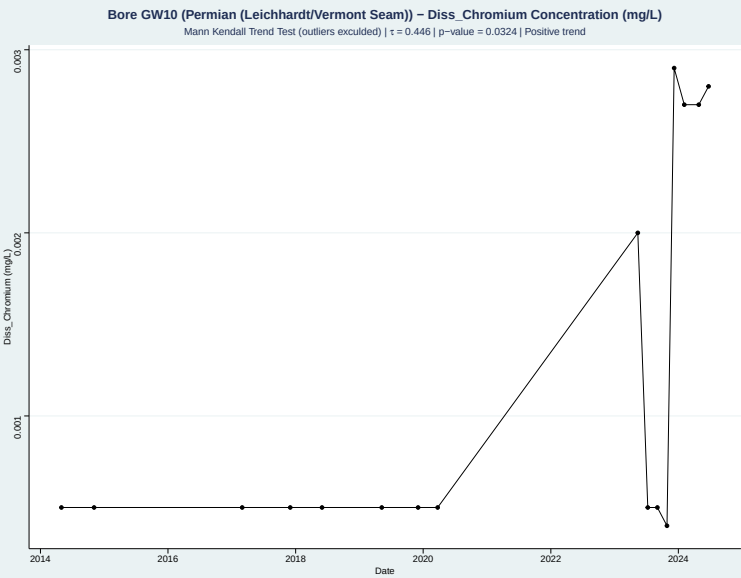
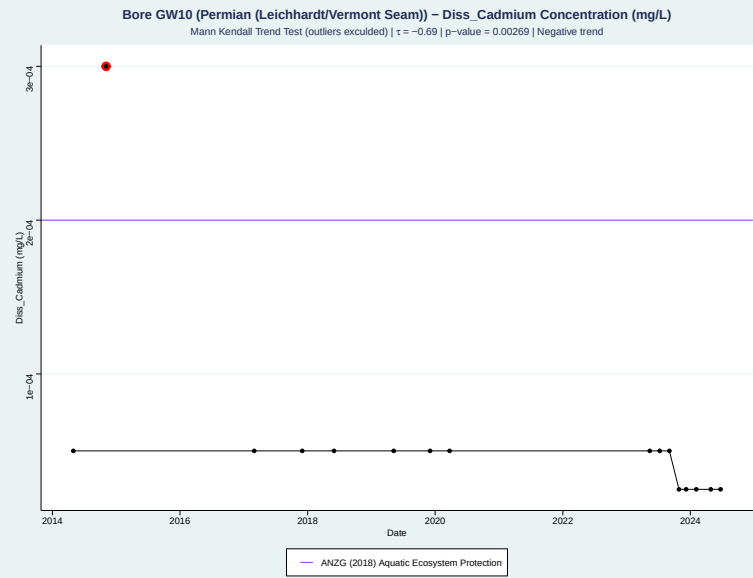
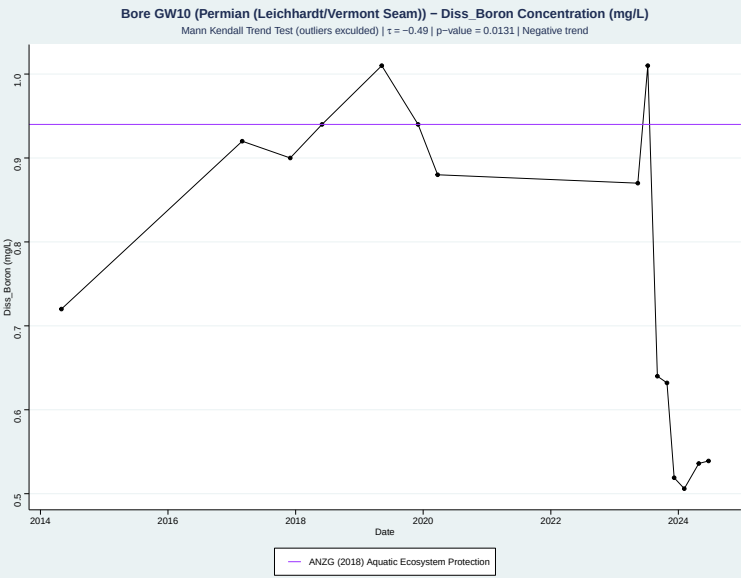
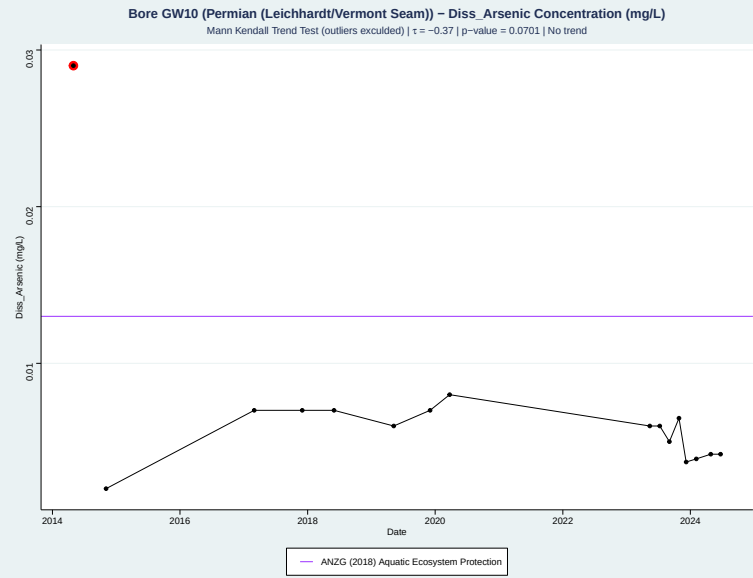


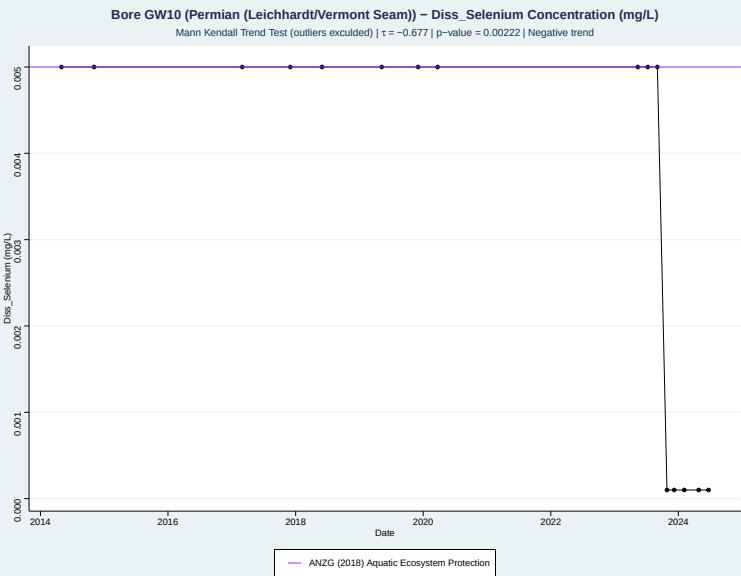
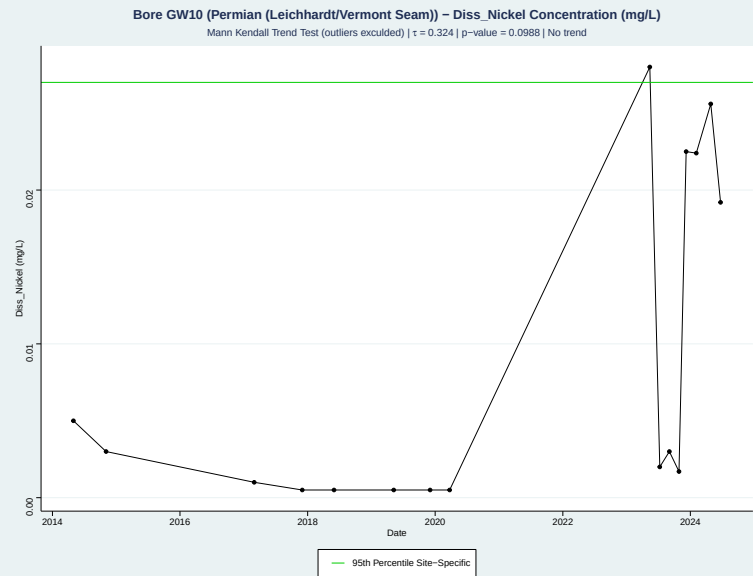
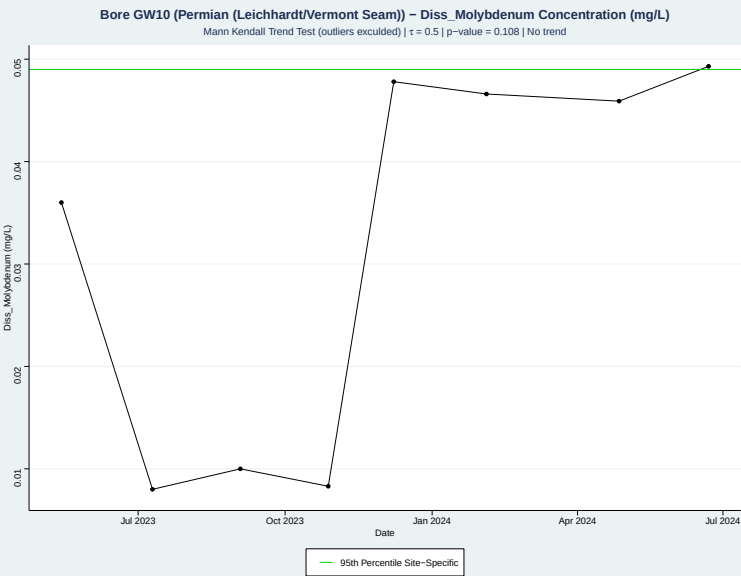
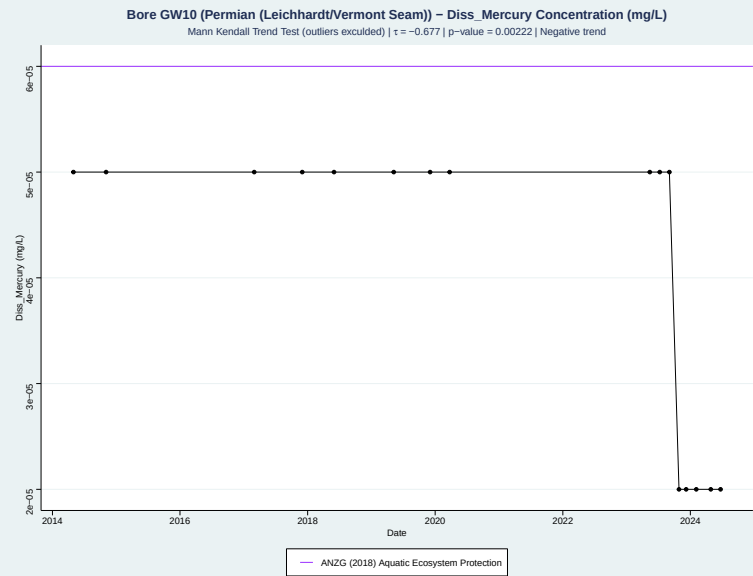
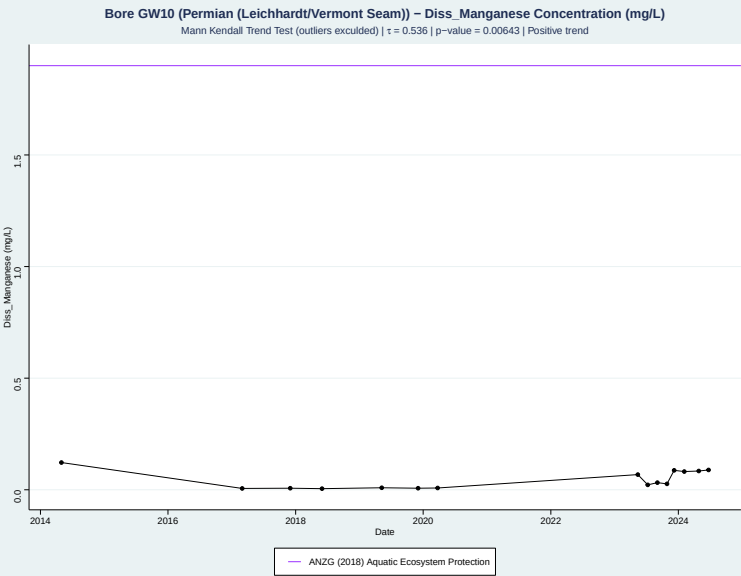
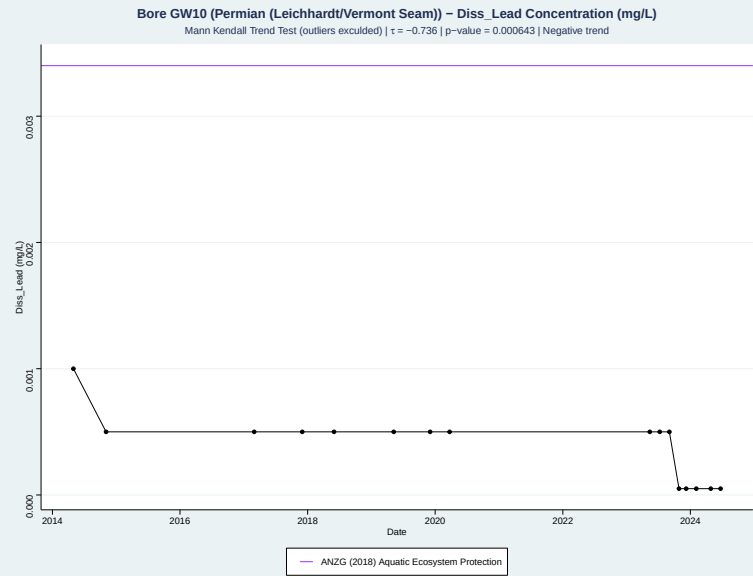
Bore GW30b (Permian (Burton Seam)) – Diss. Zinc Concentration (mg/L)

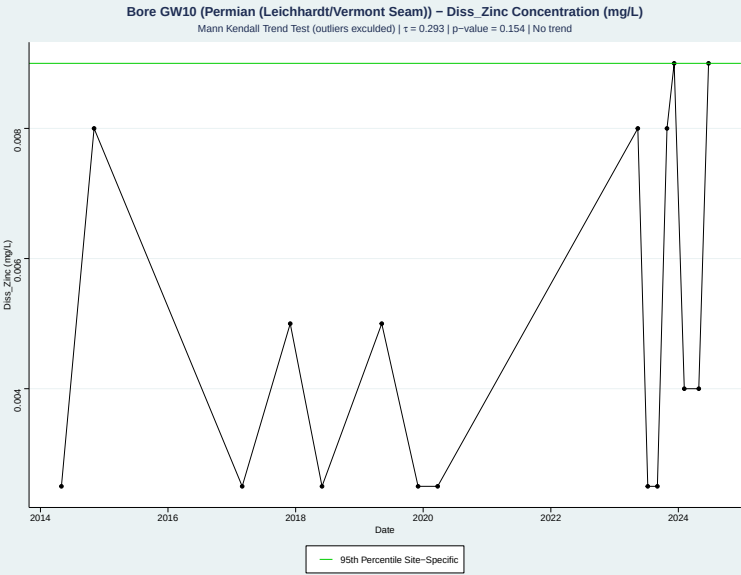
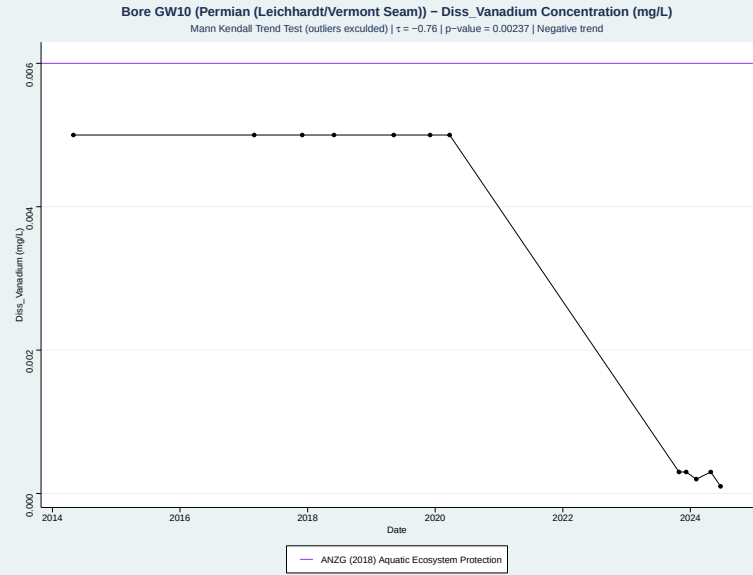
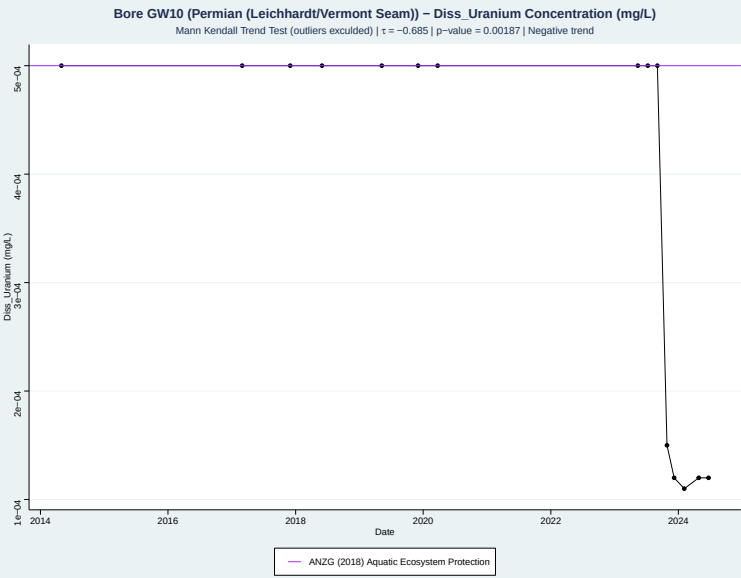
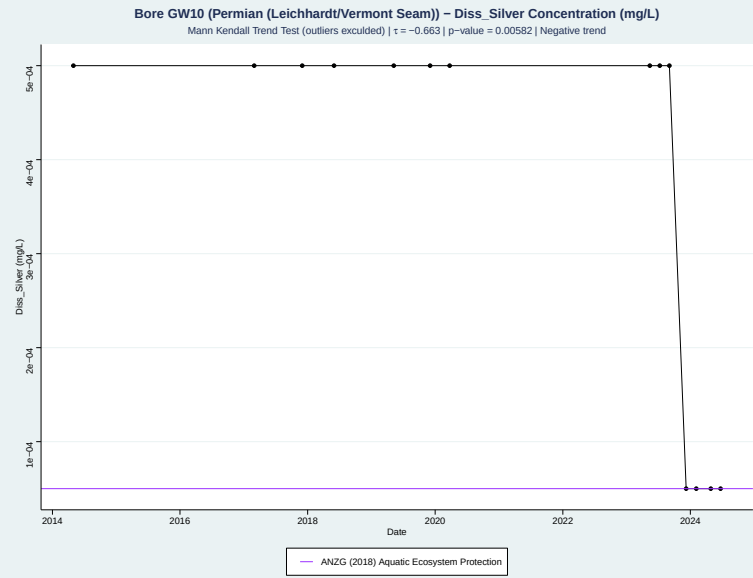
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.132$ | $p\text{-value} = 0.58$ | No trend

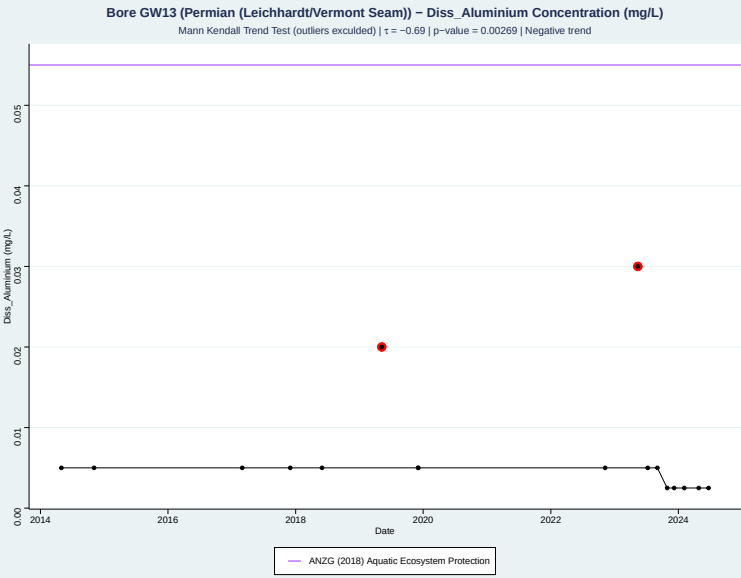
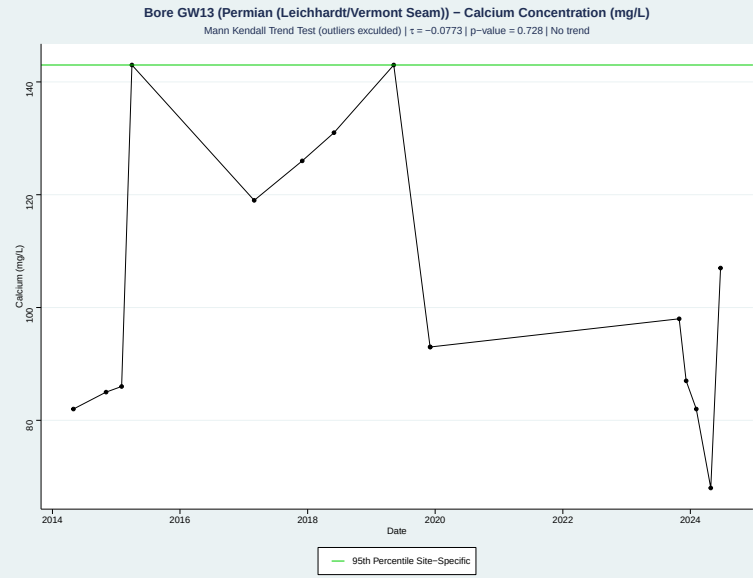
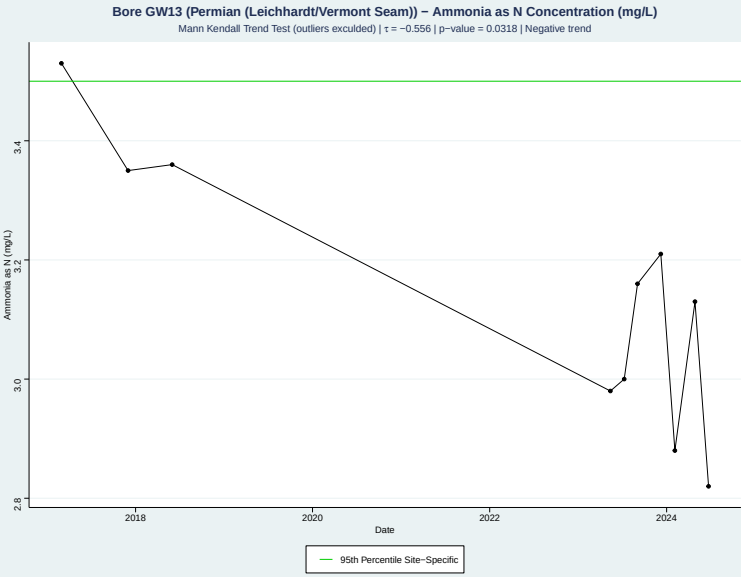
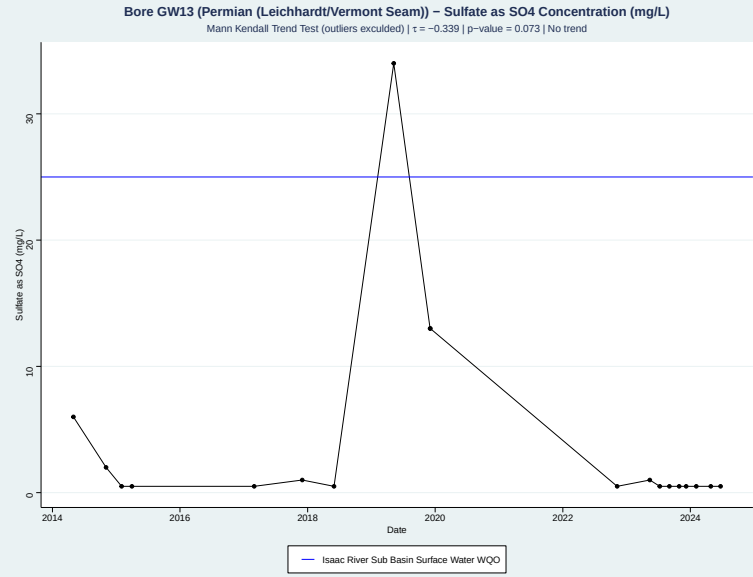
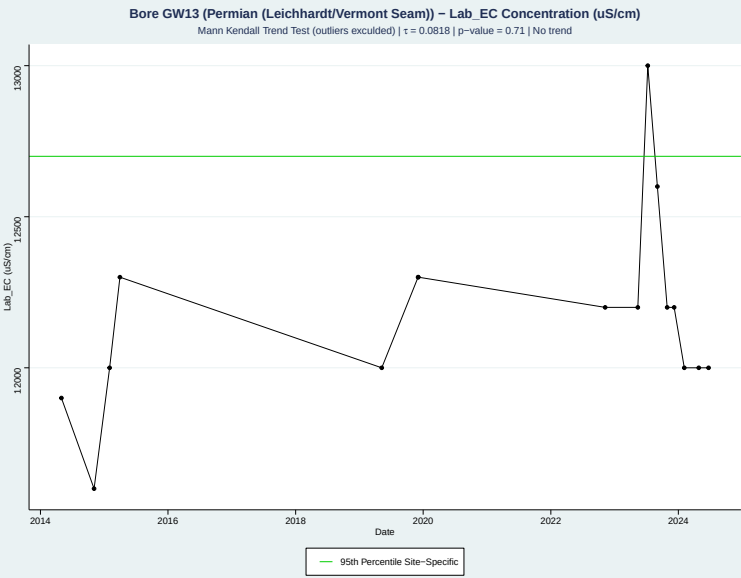
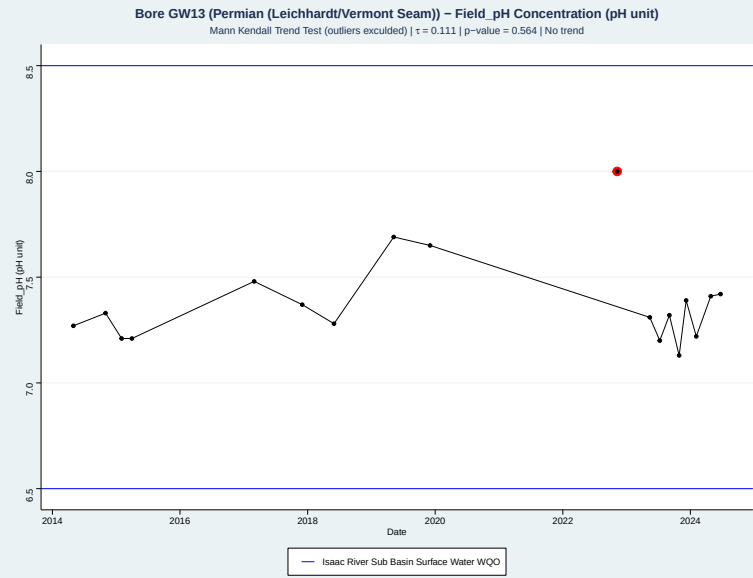


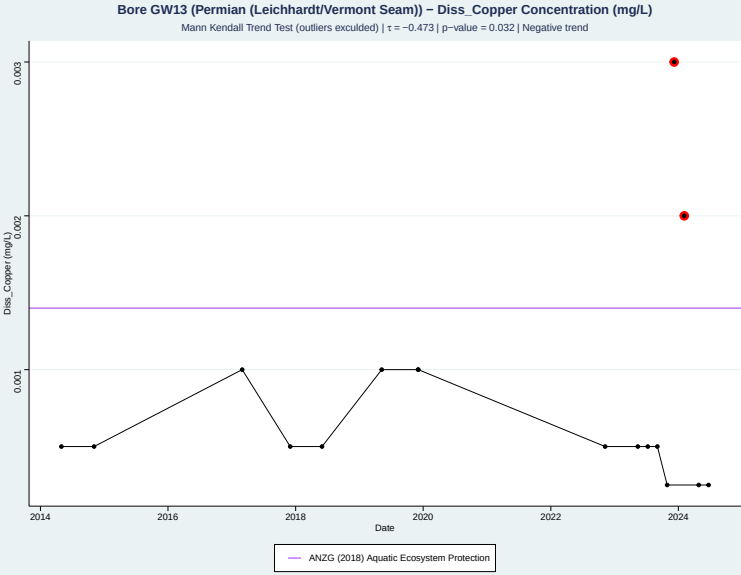
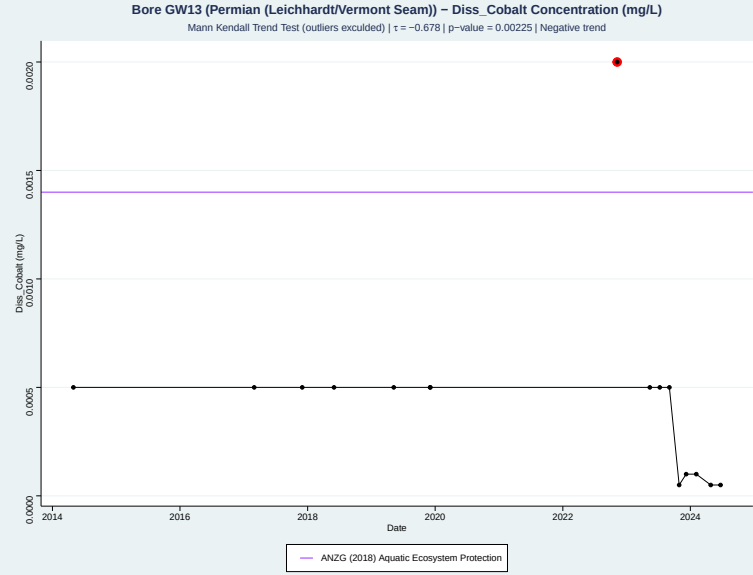
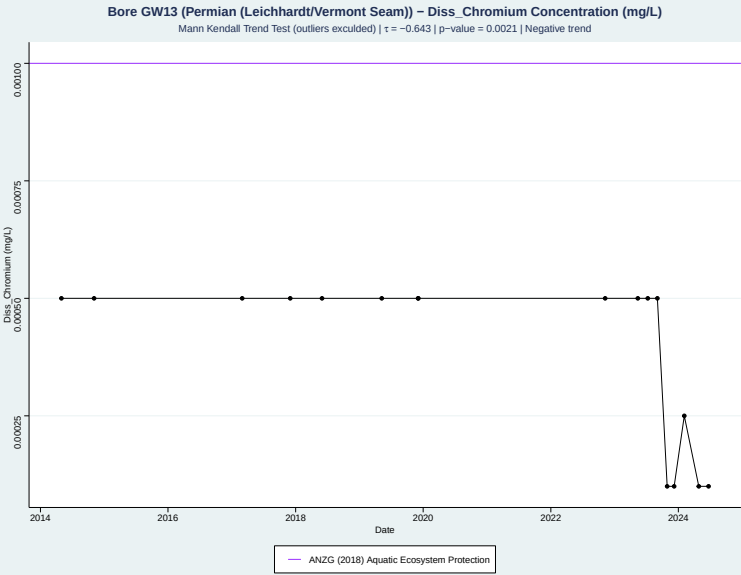
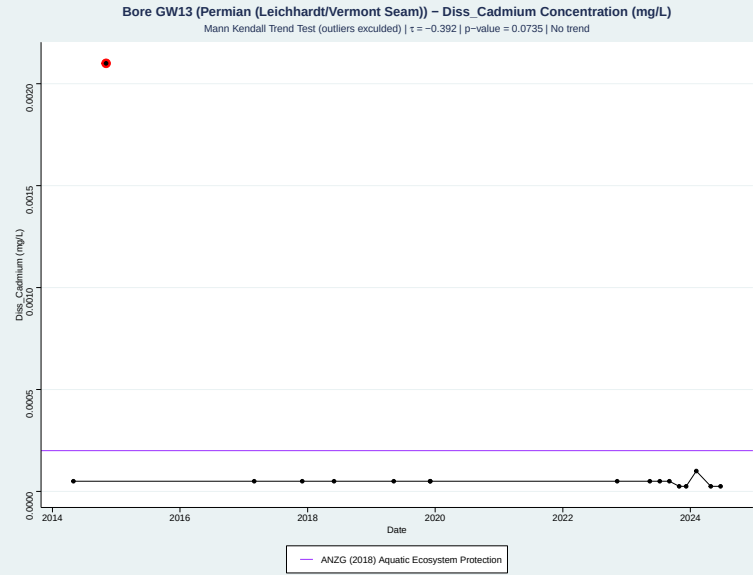
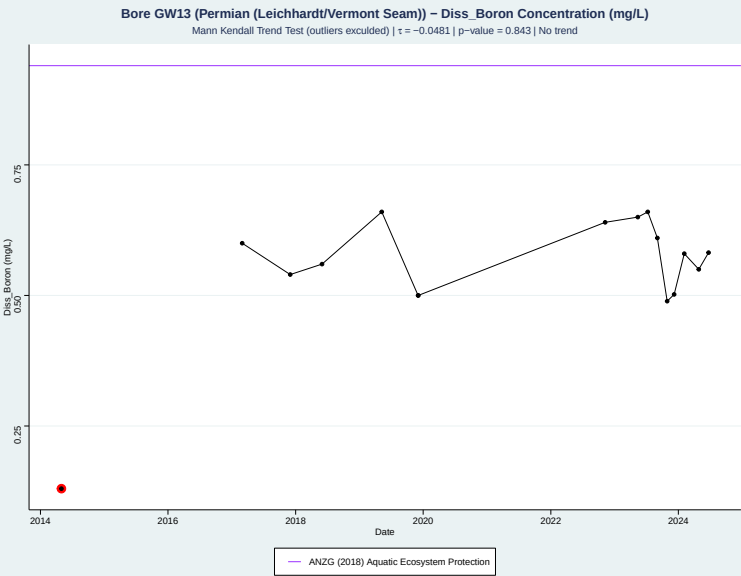
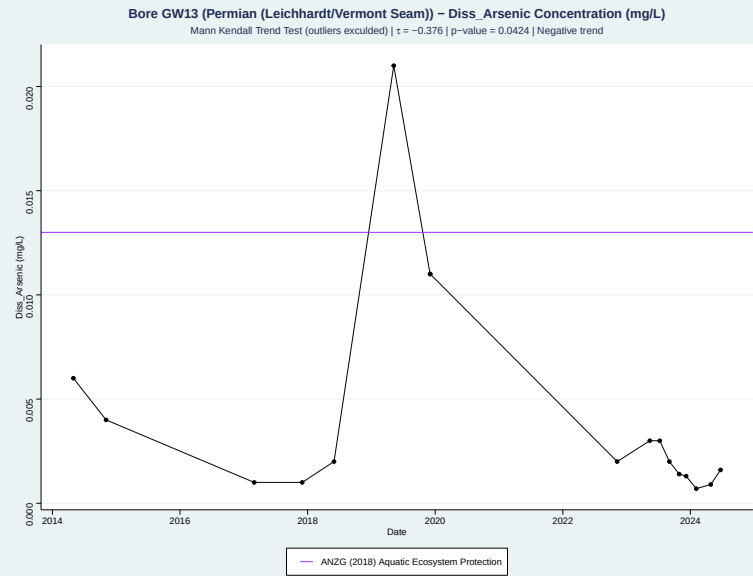


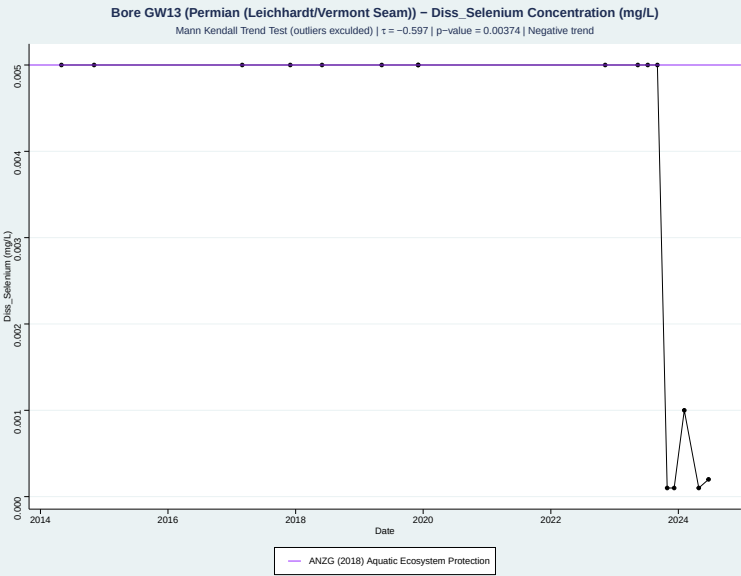
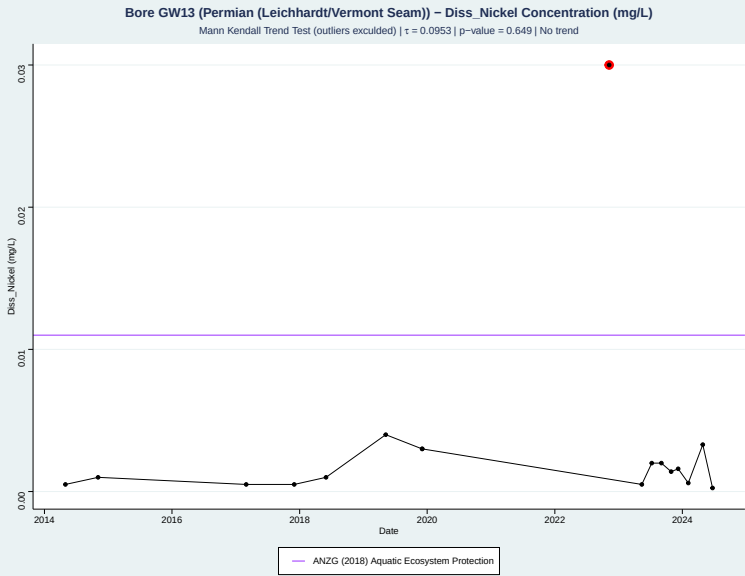
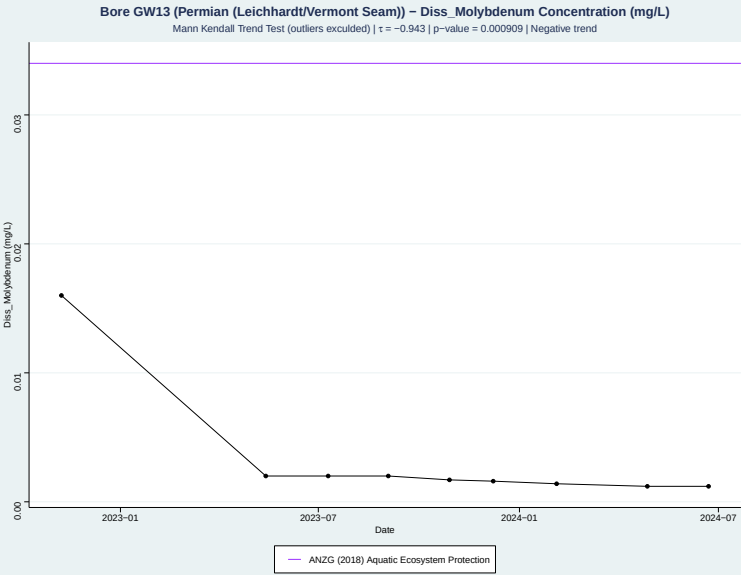
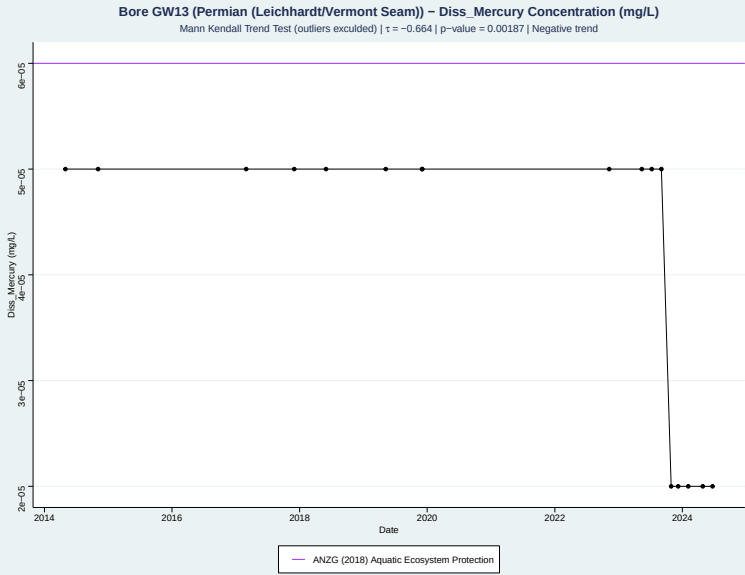
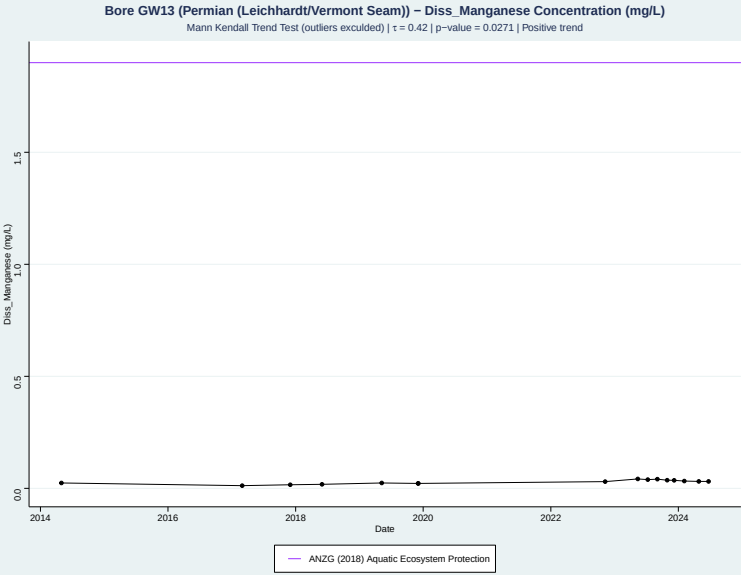
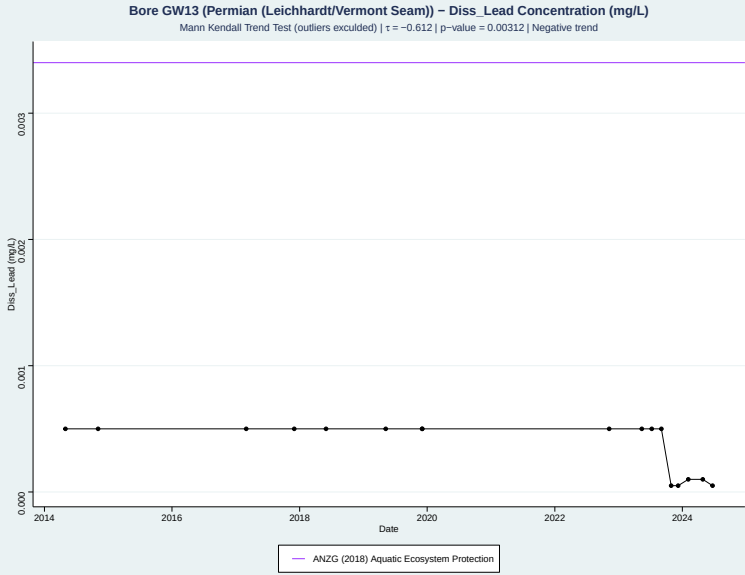


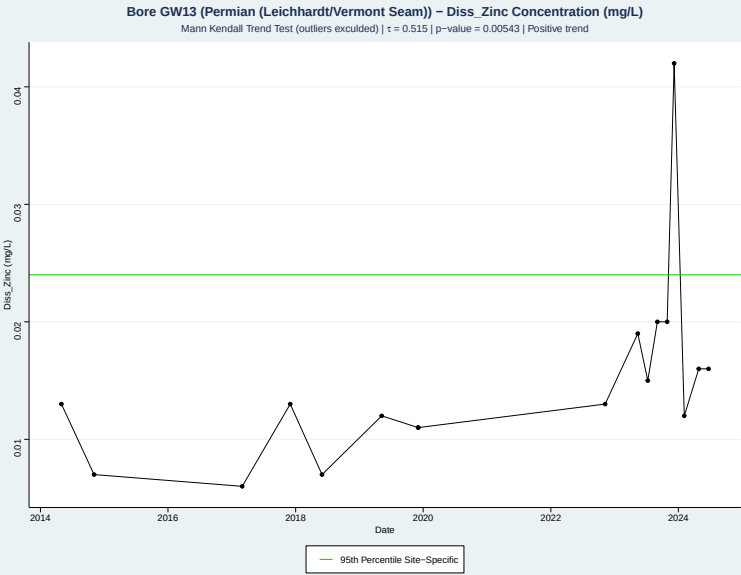
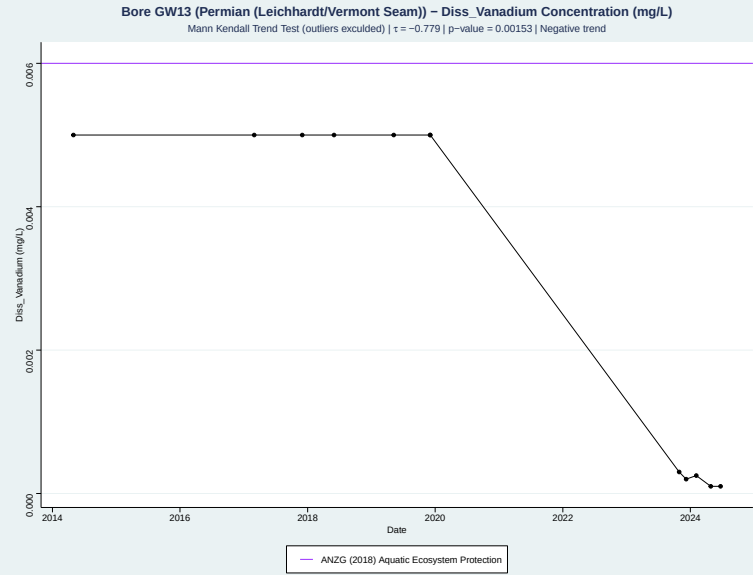
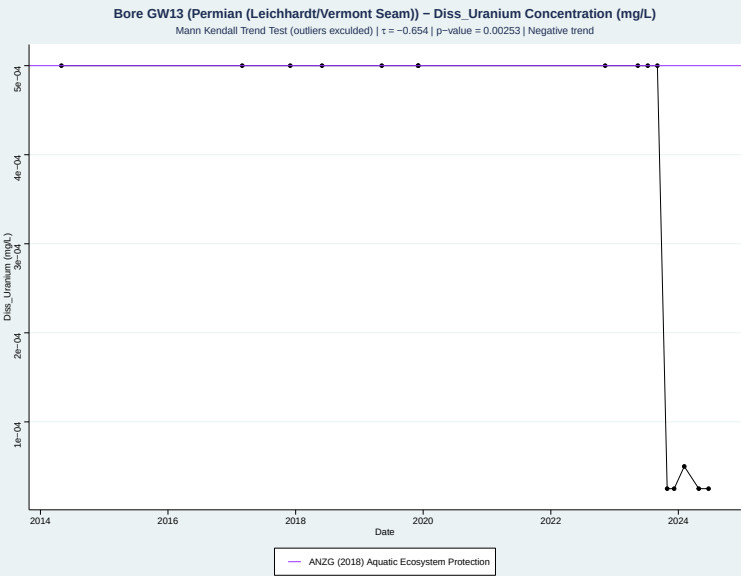
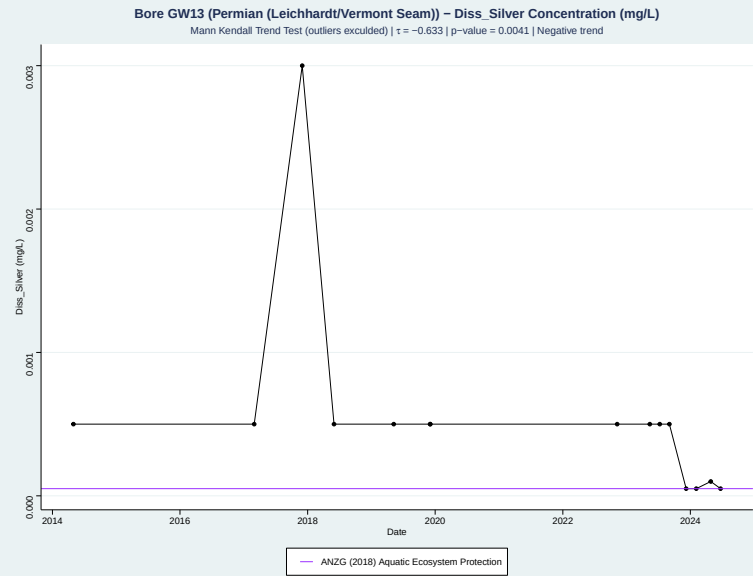


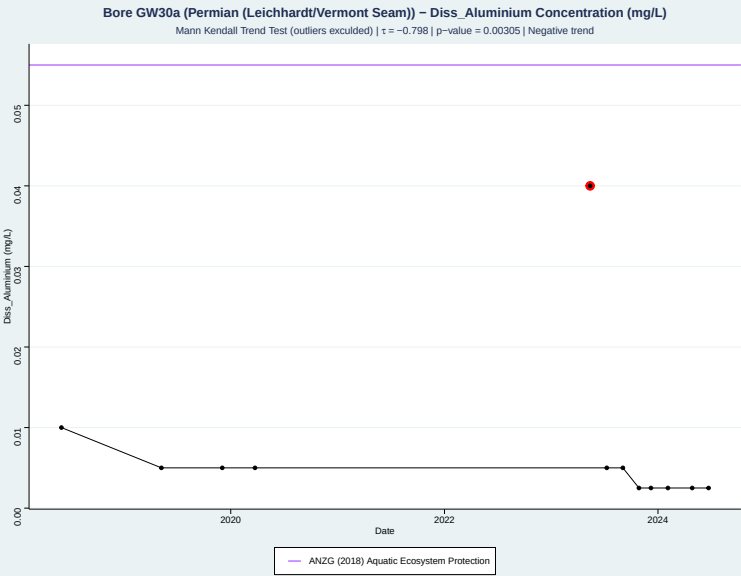
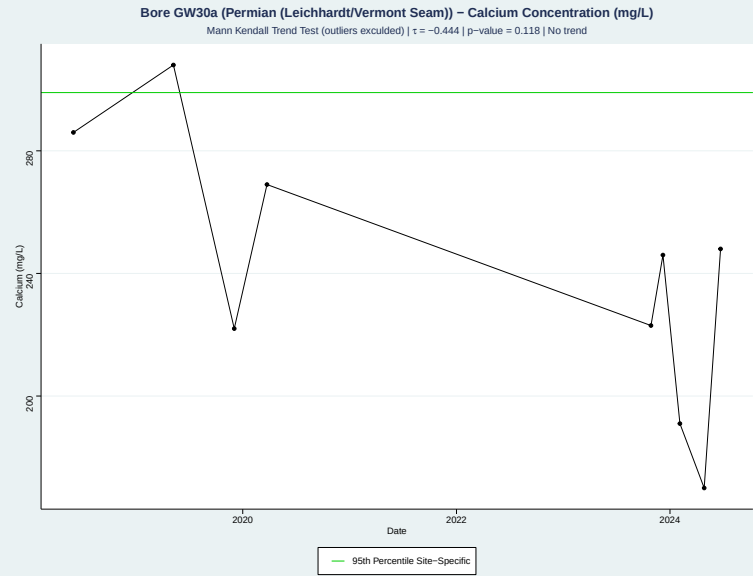
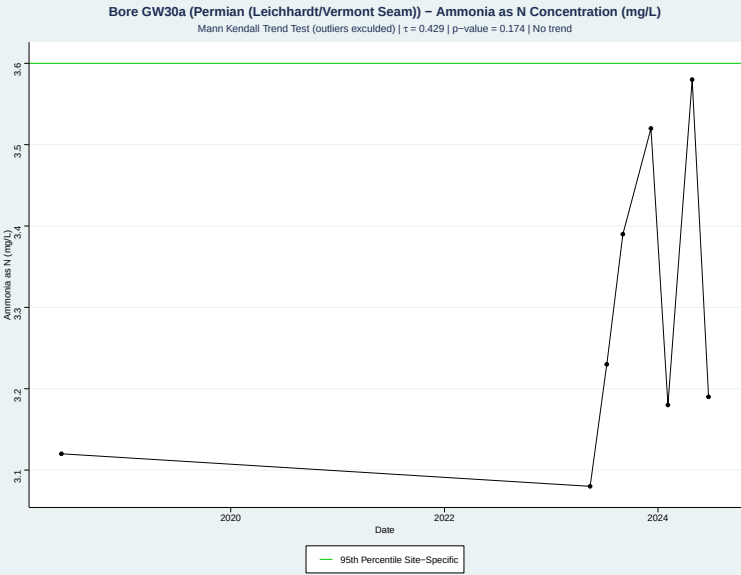
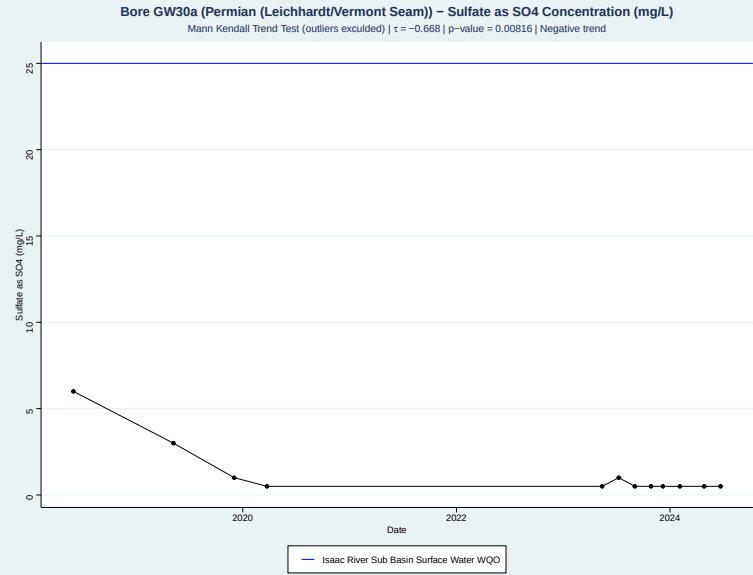
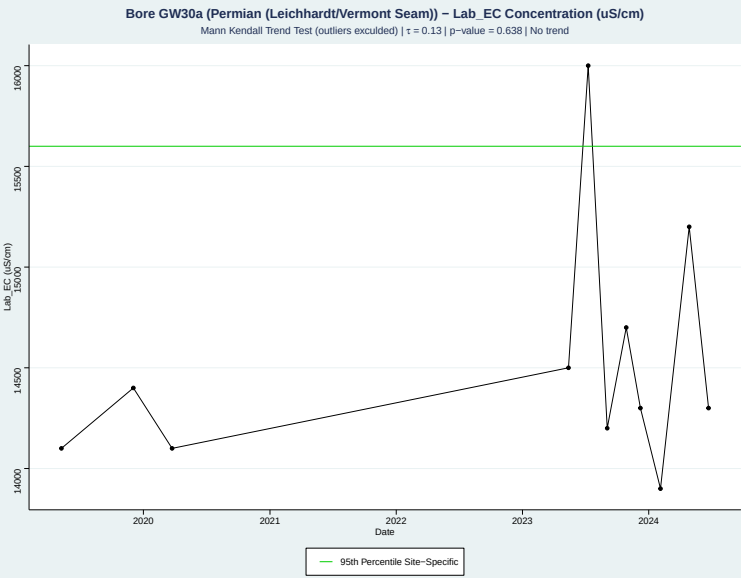
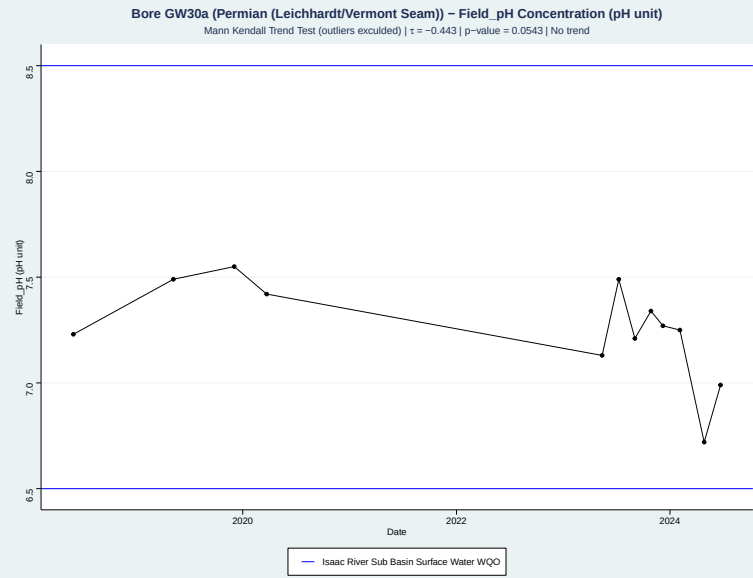


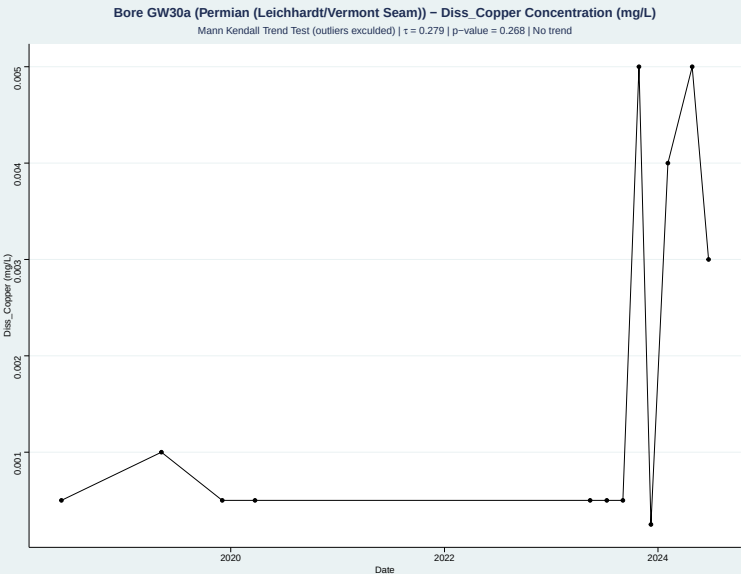
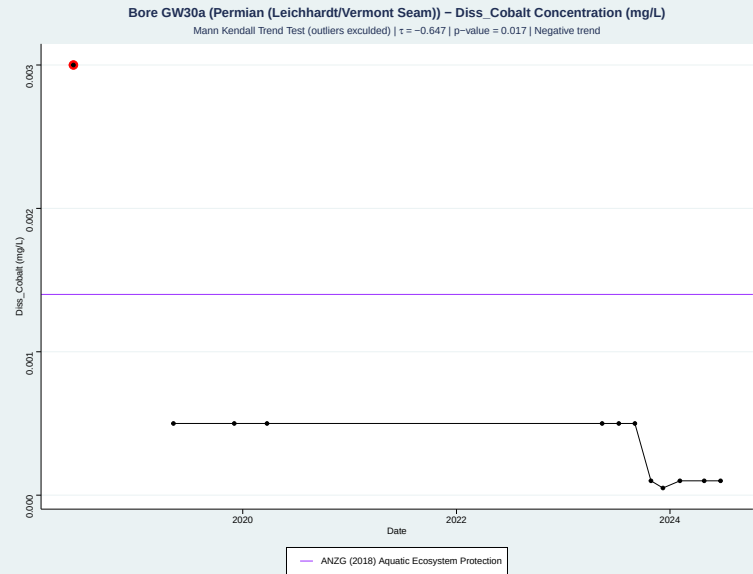
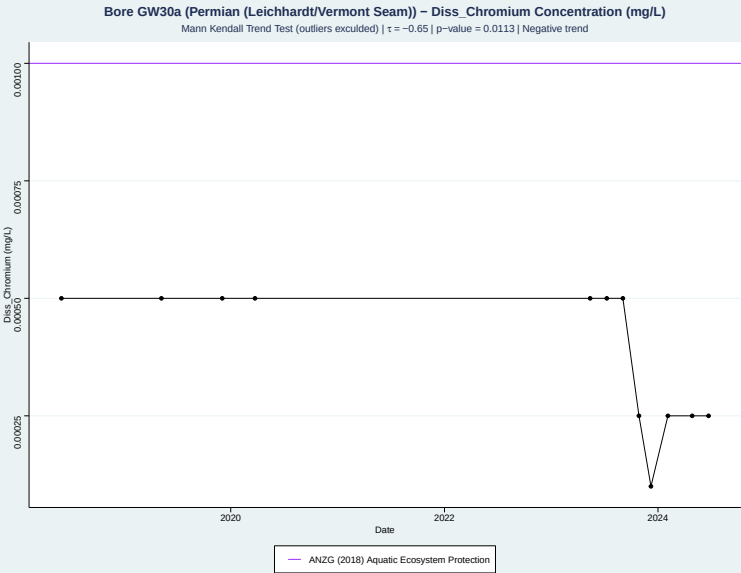
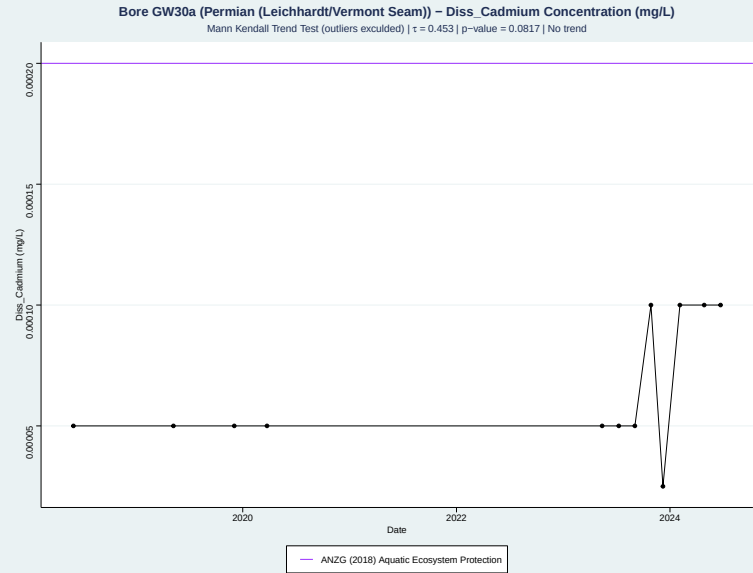
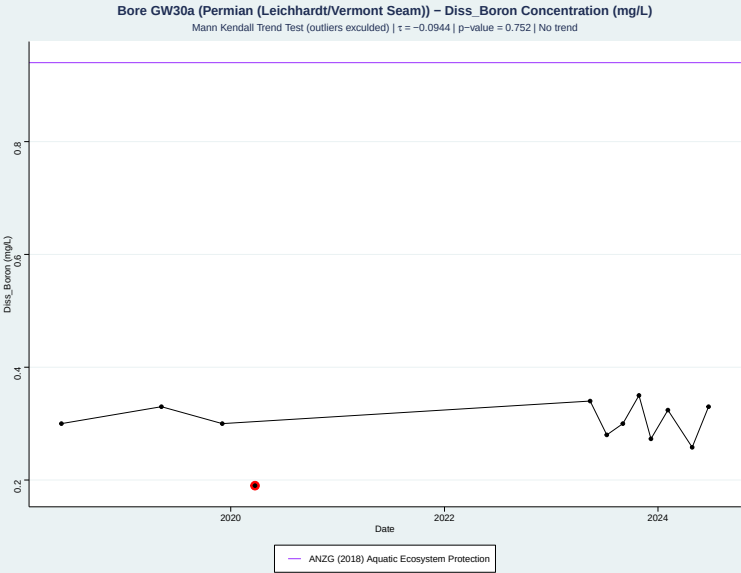
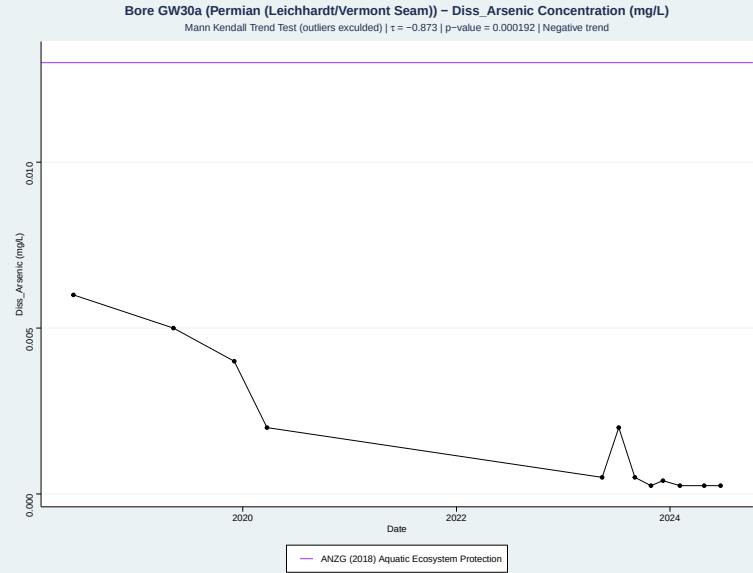


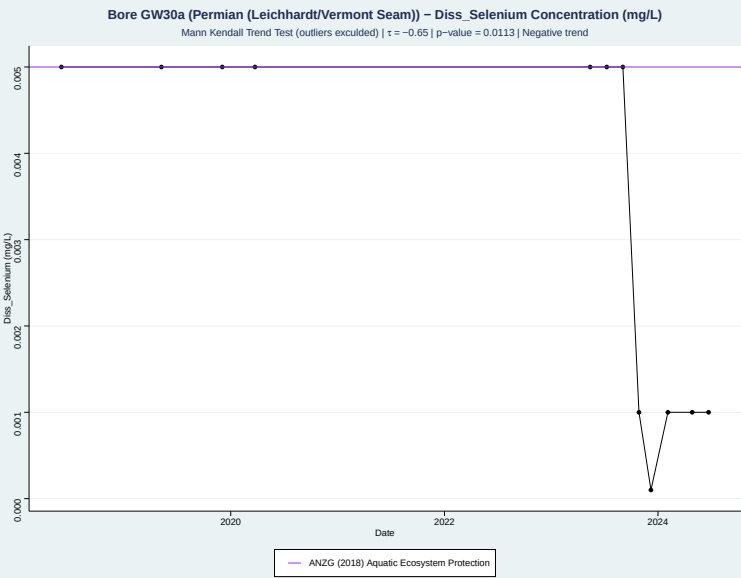
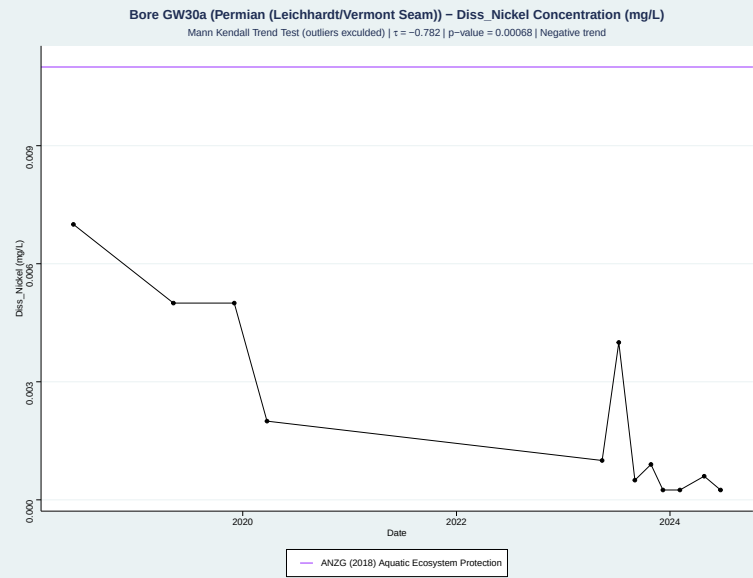
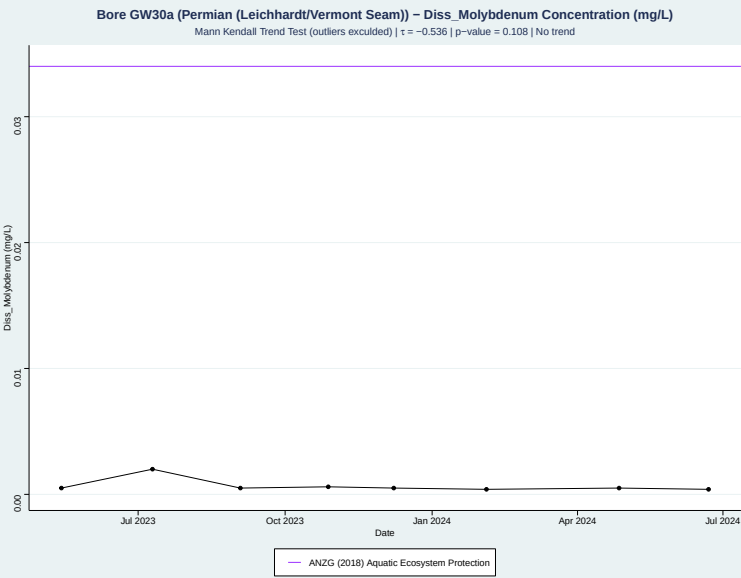
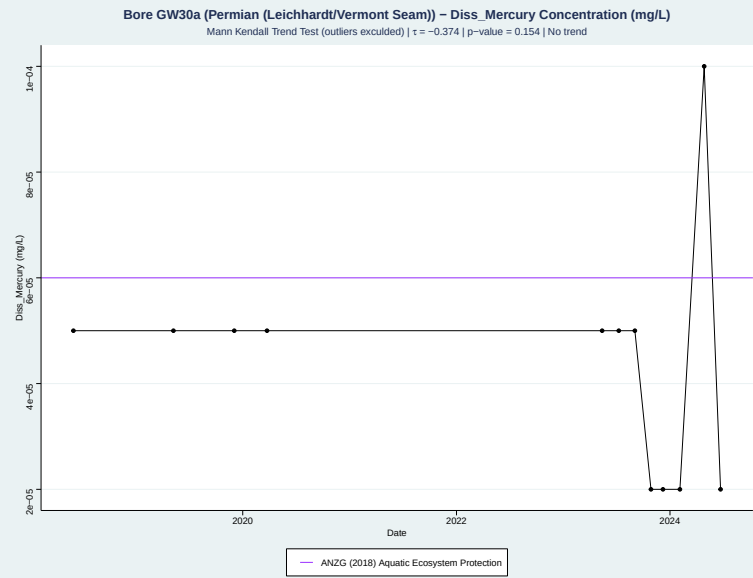
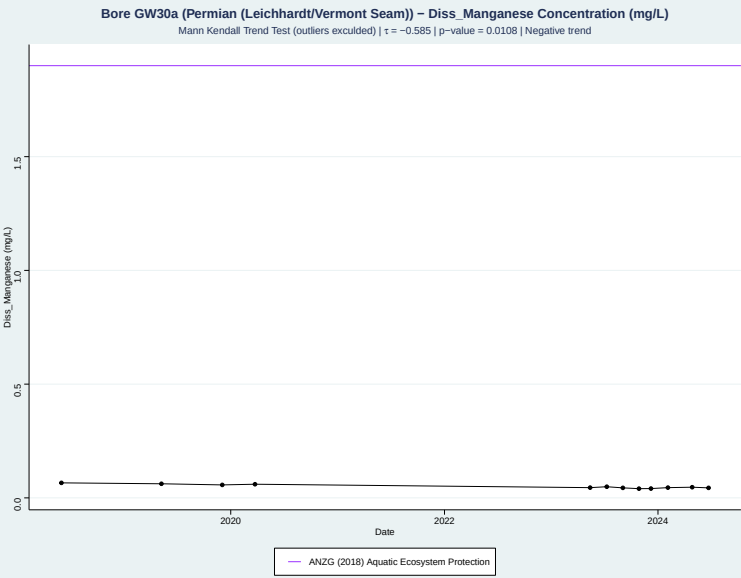
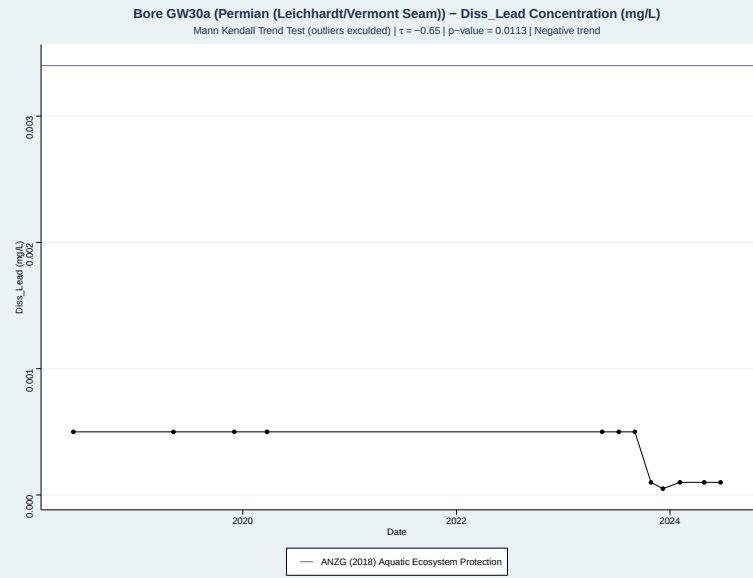


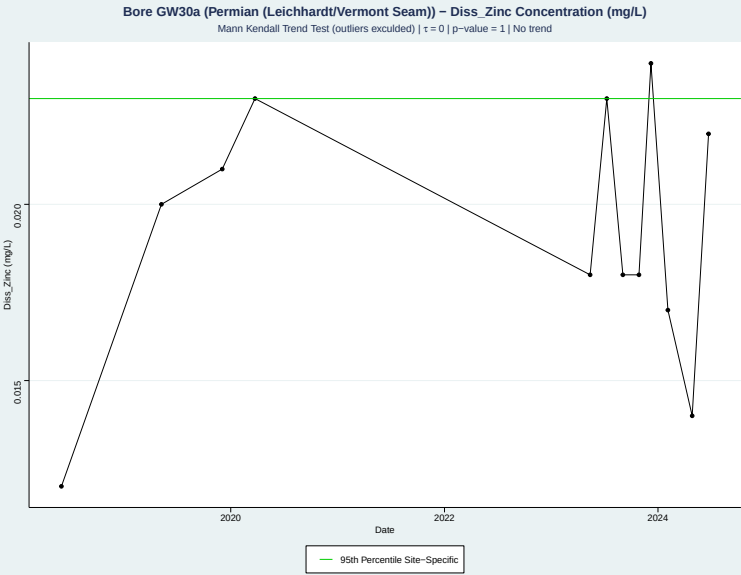
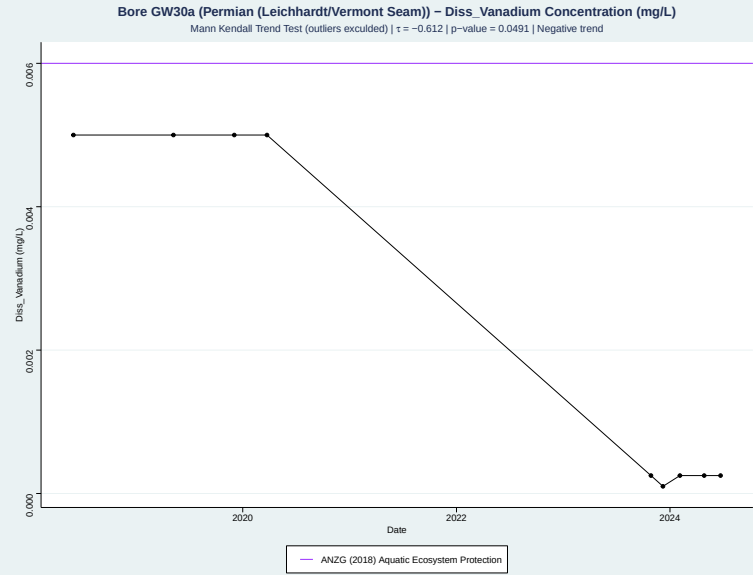
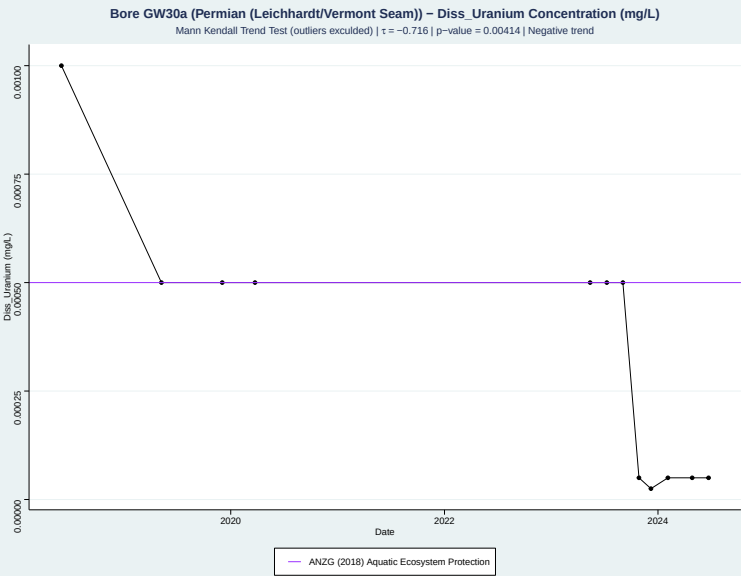
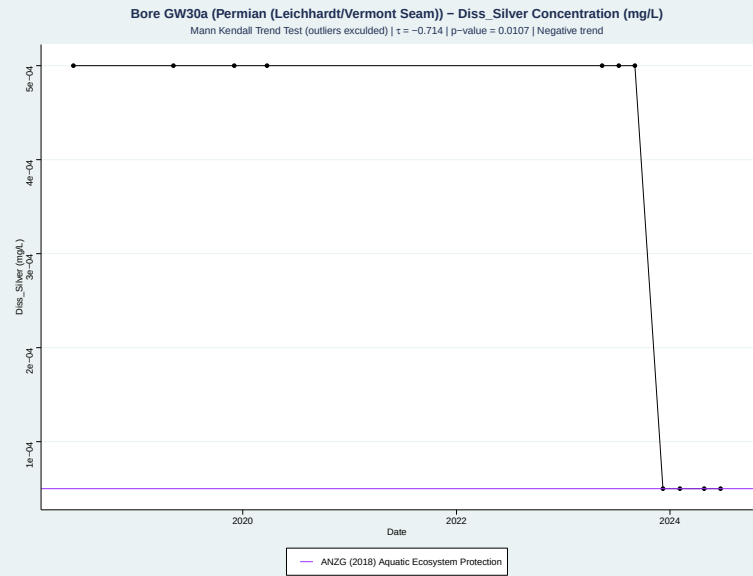


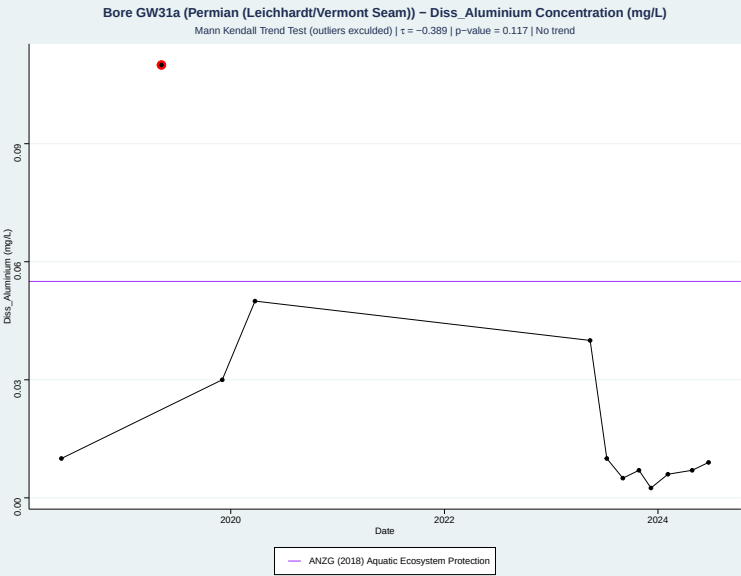
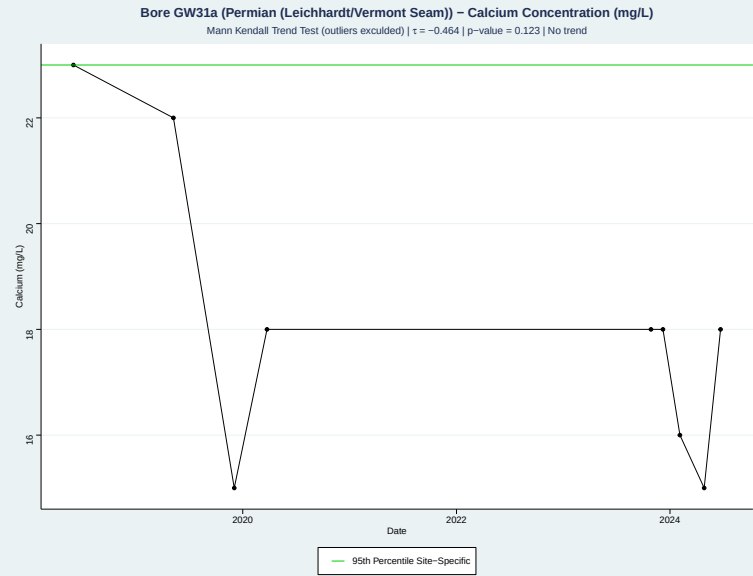
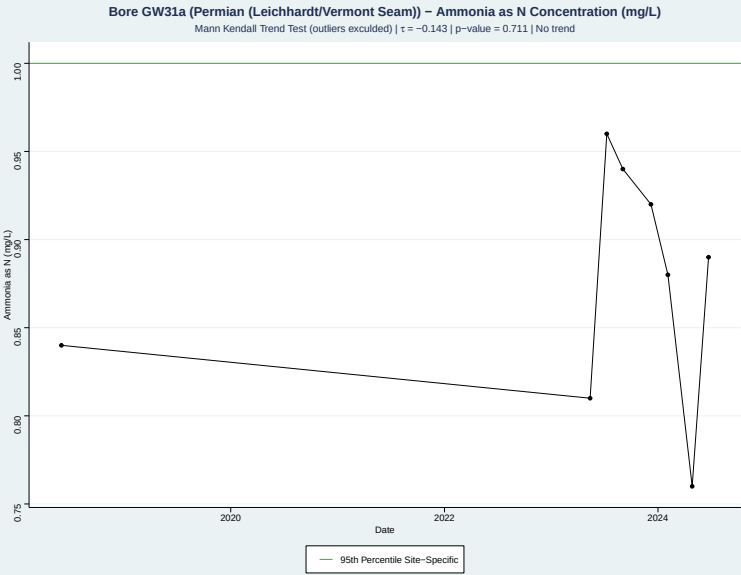
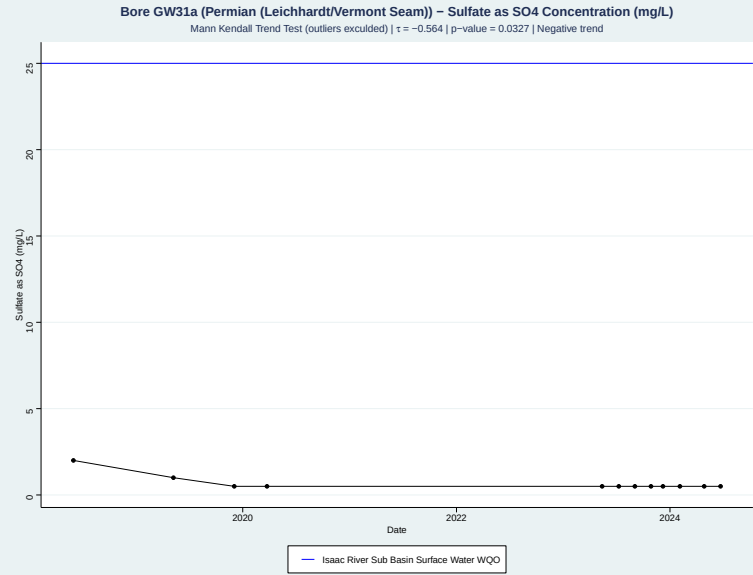
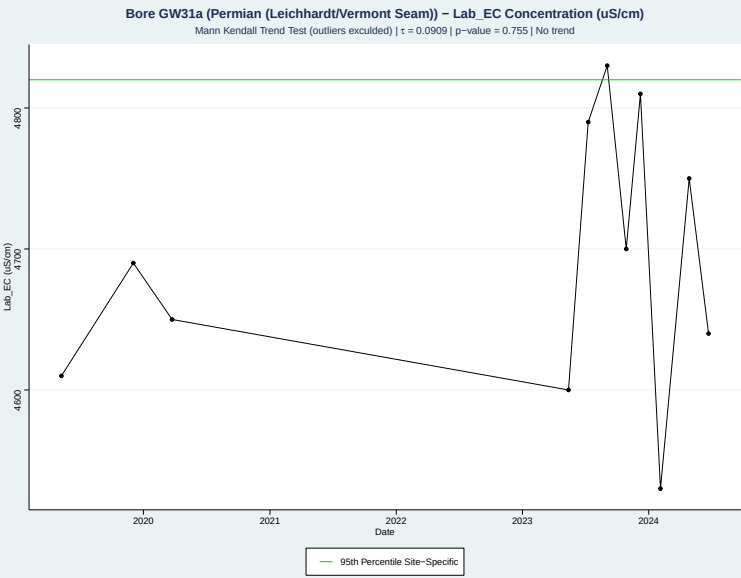
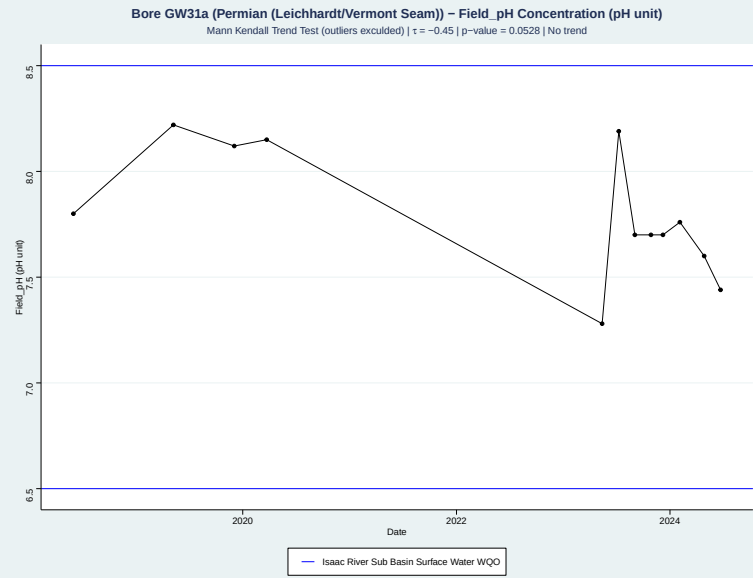


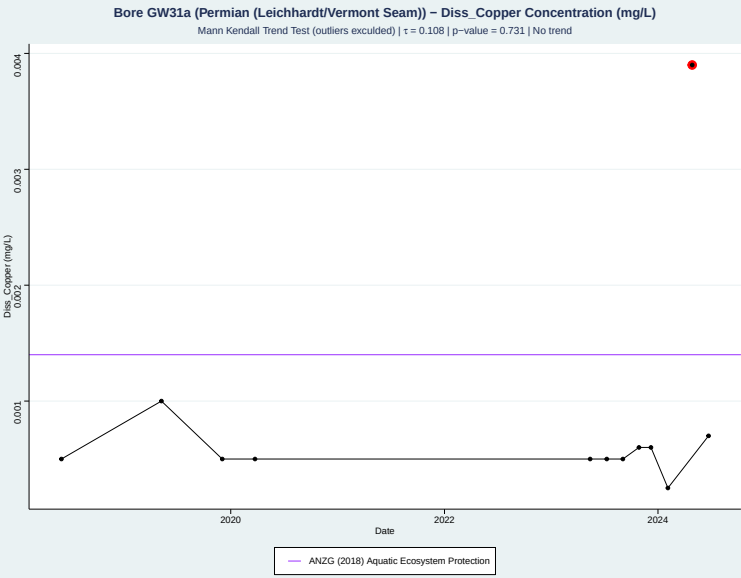
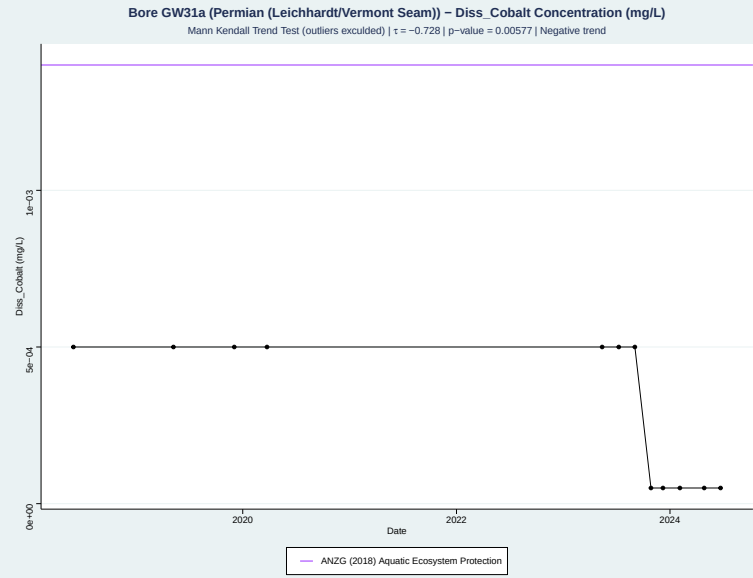
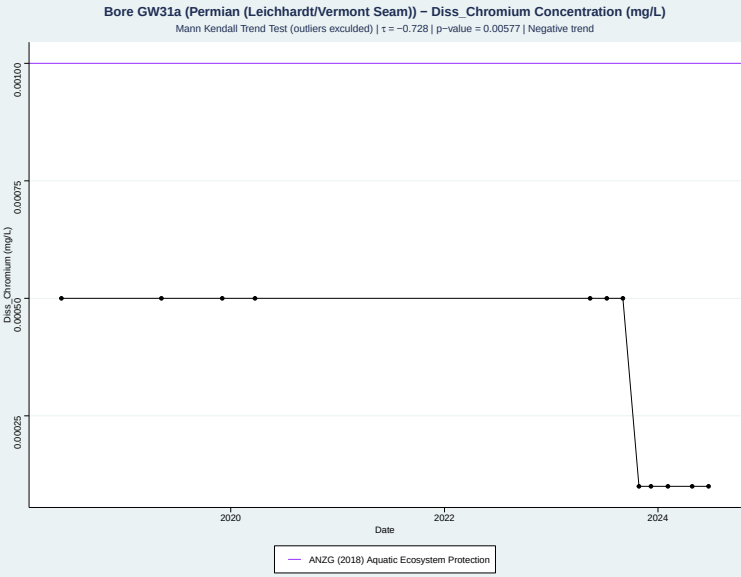
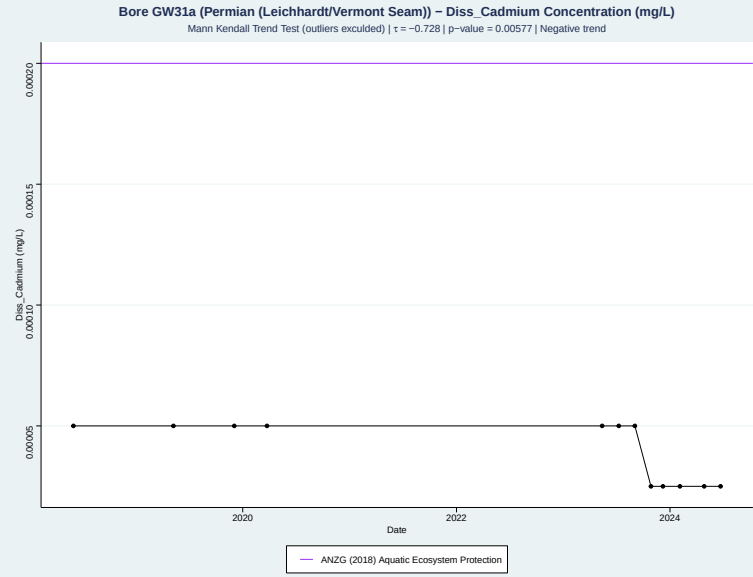
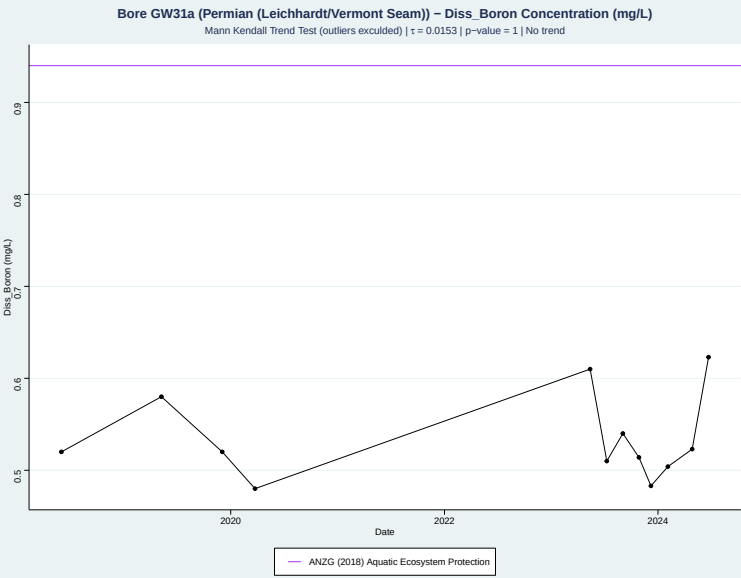
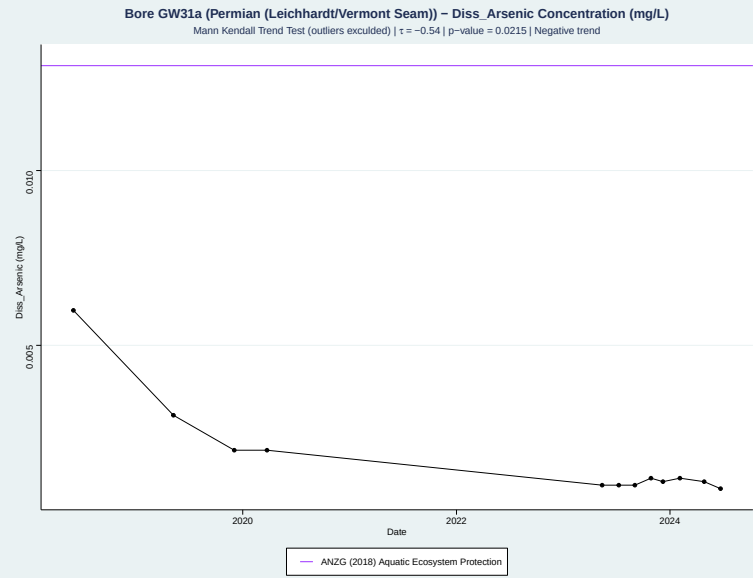


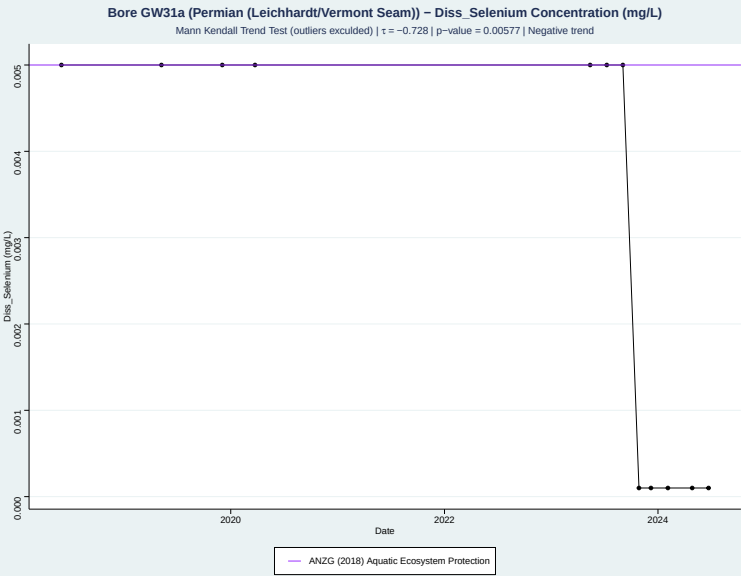
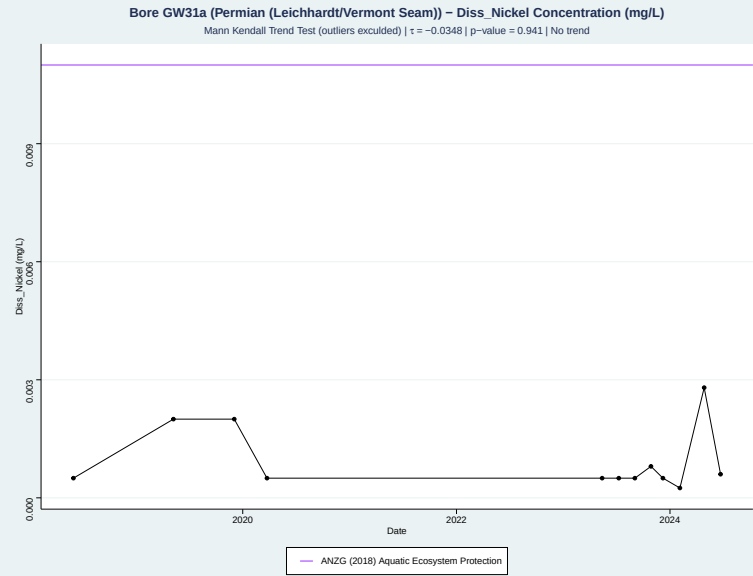
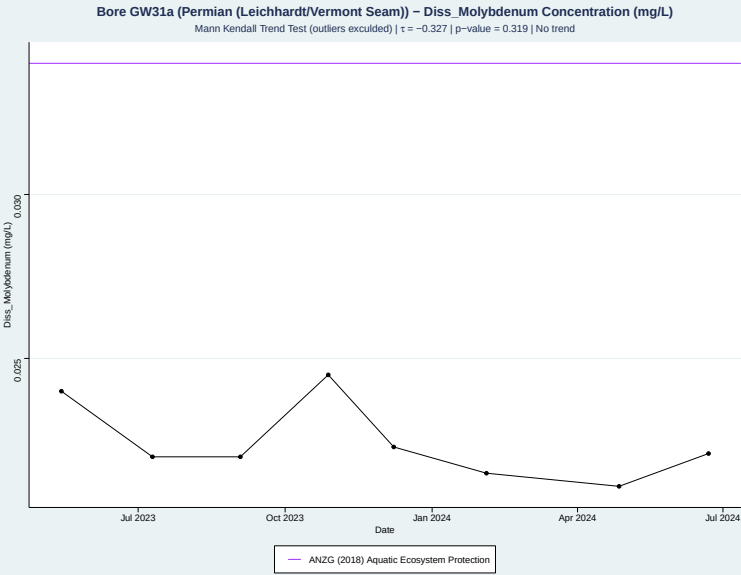
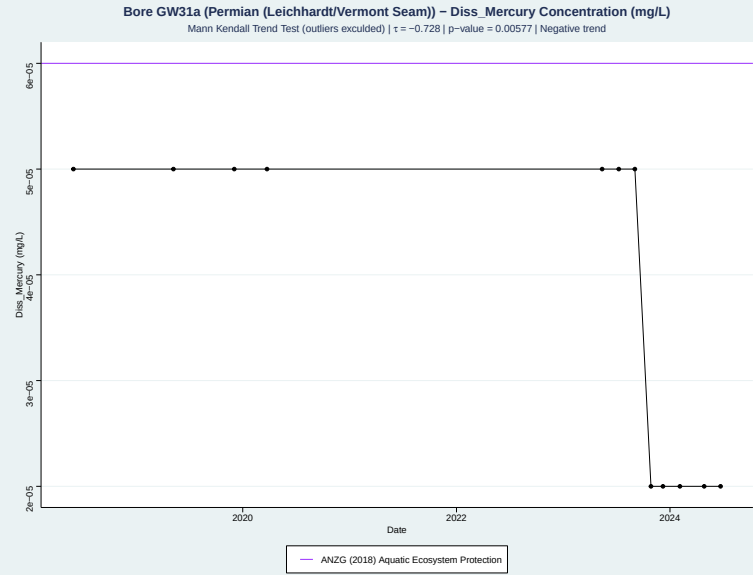
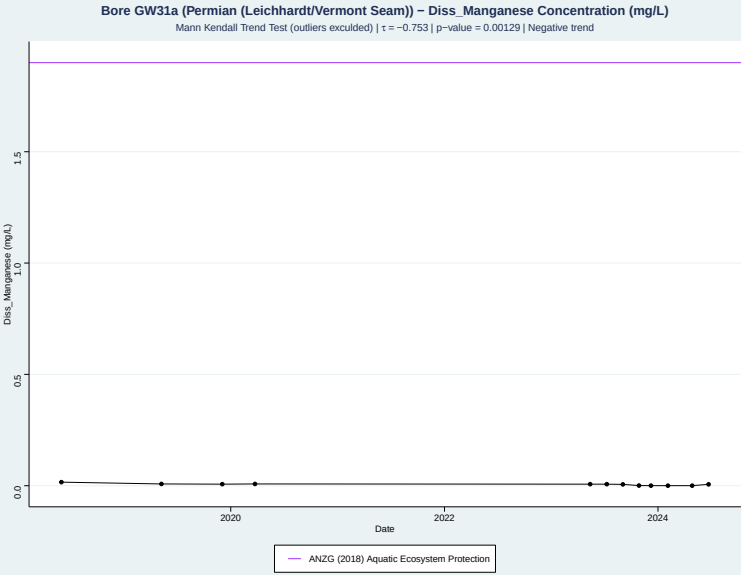
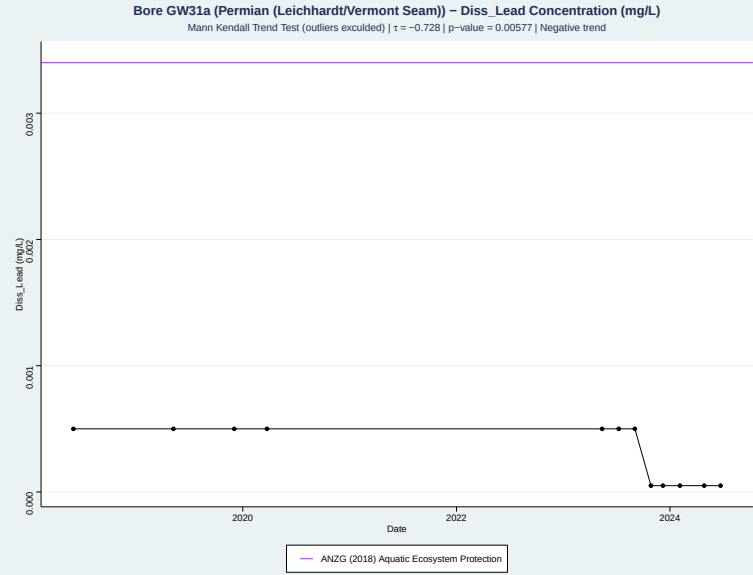


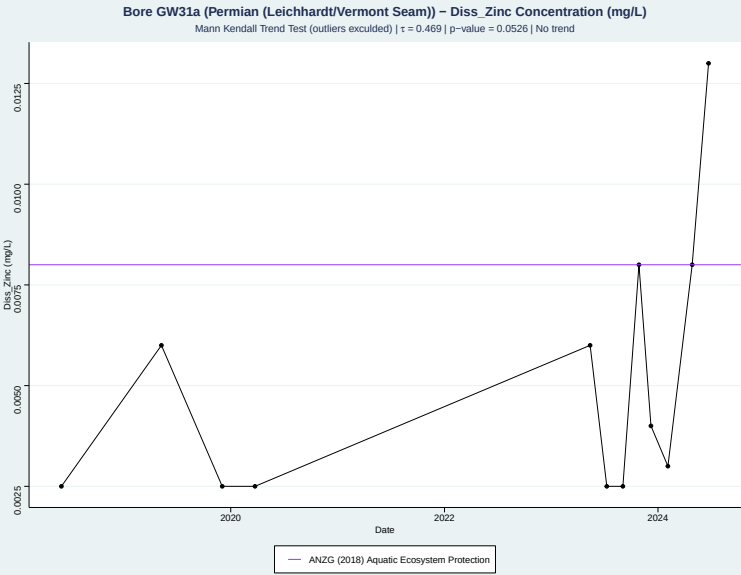
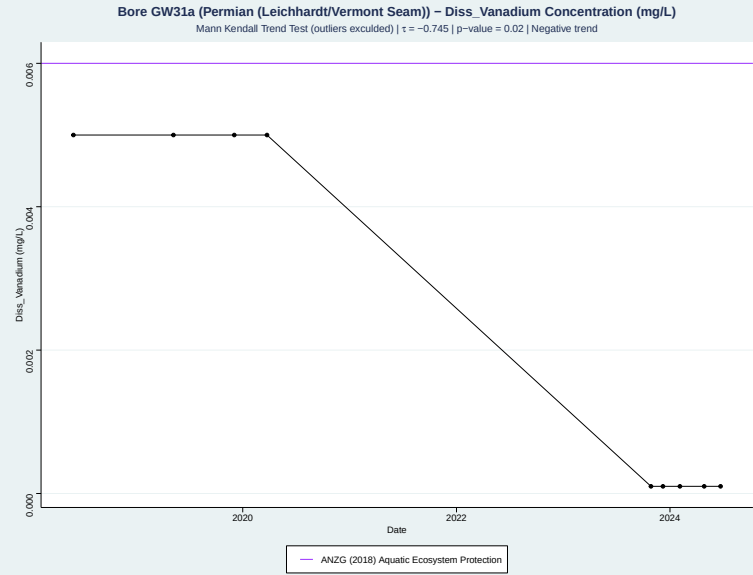
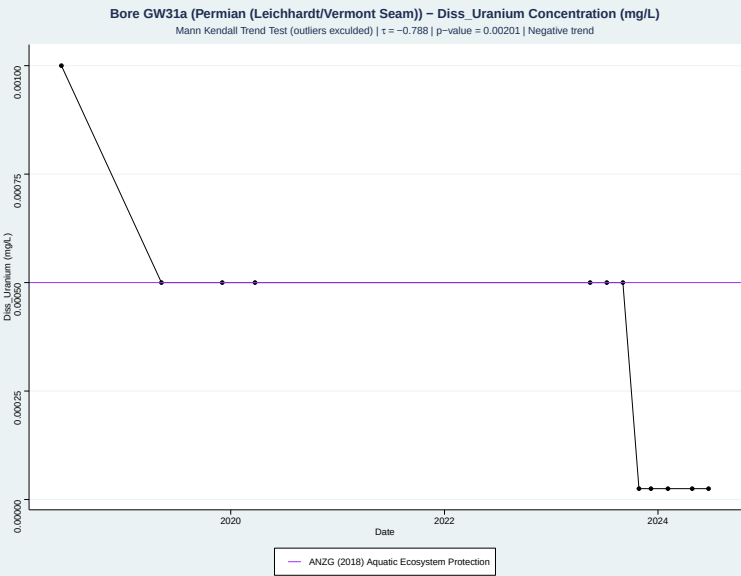
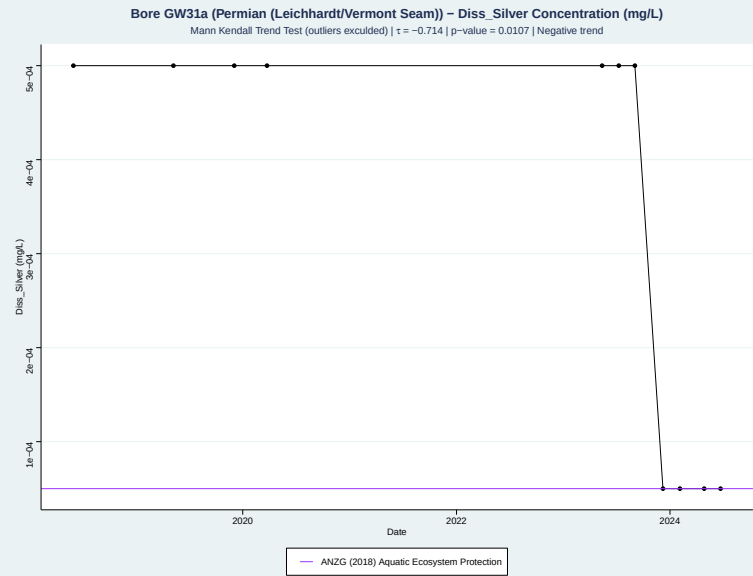


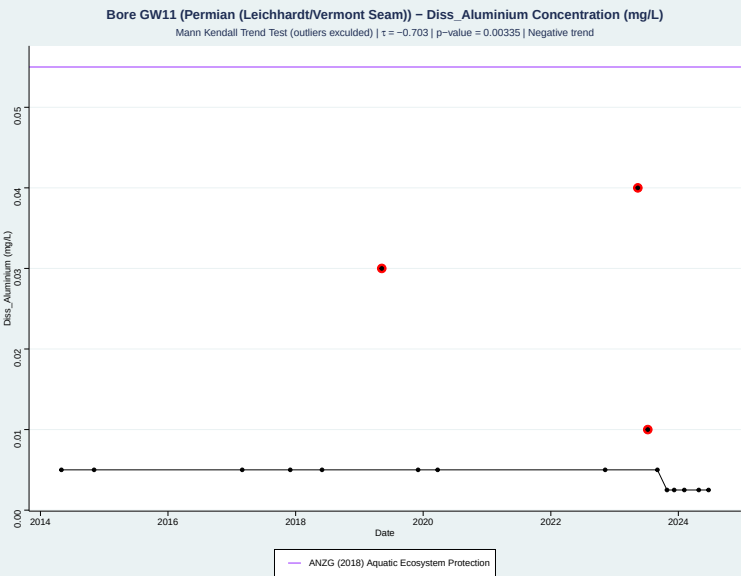
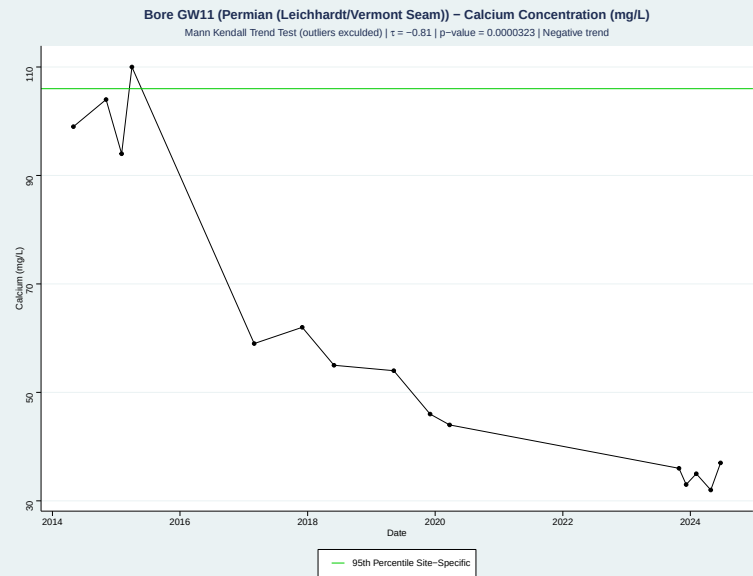
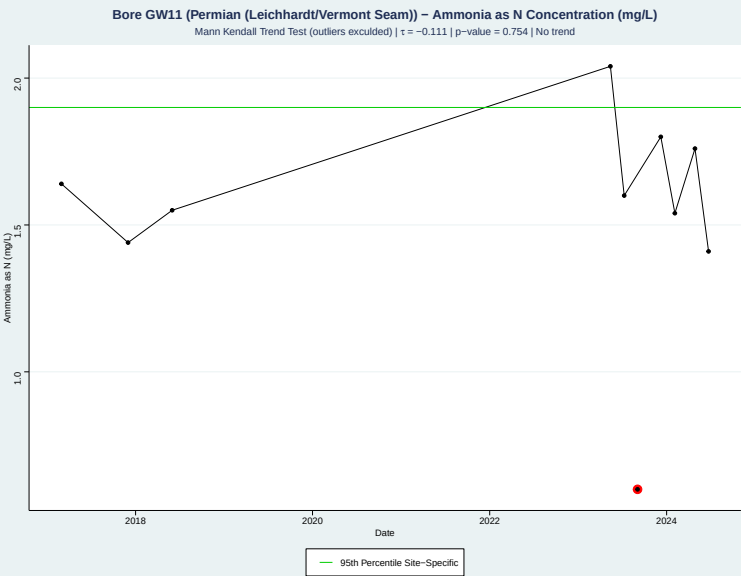
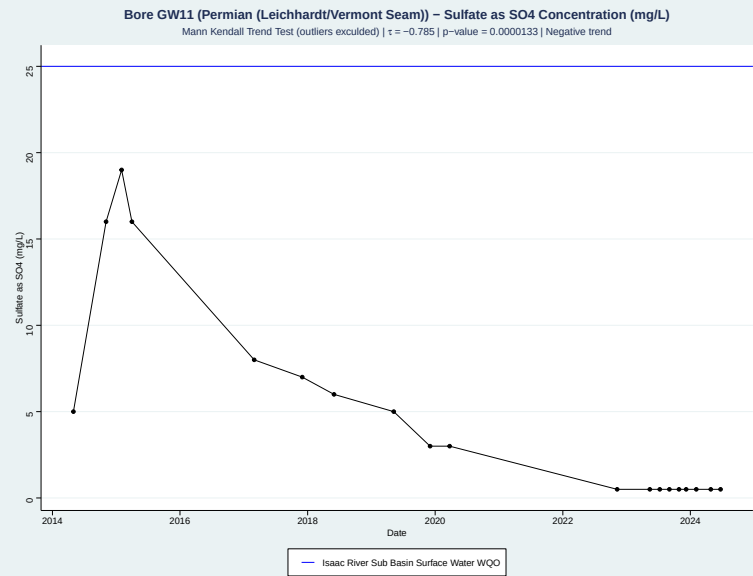
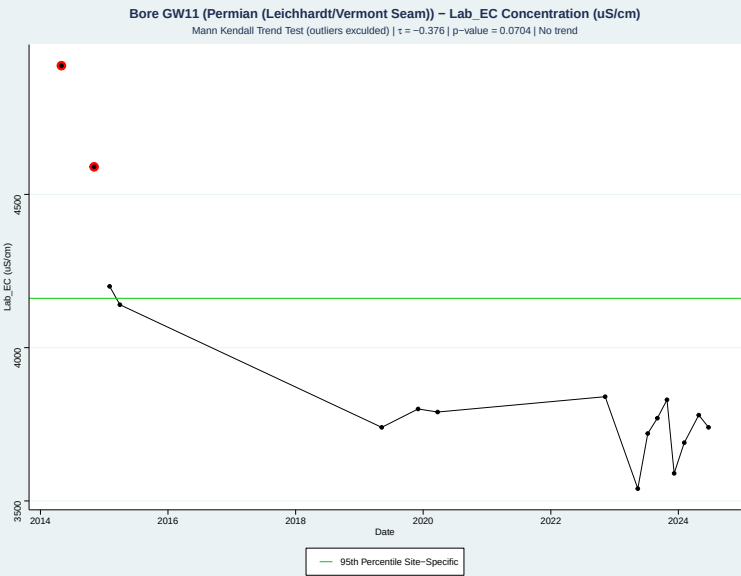
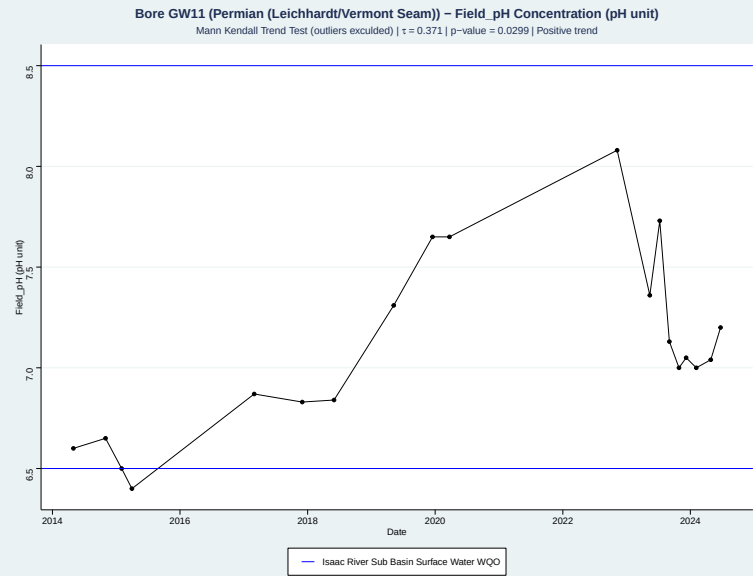


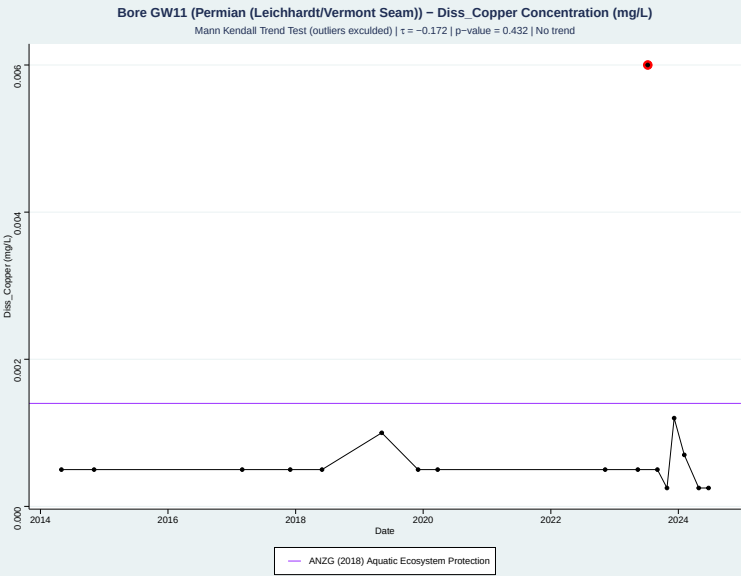
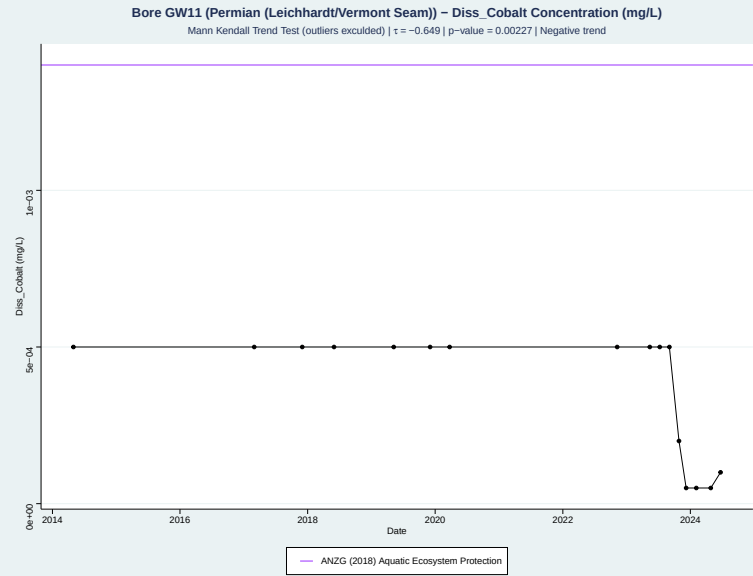
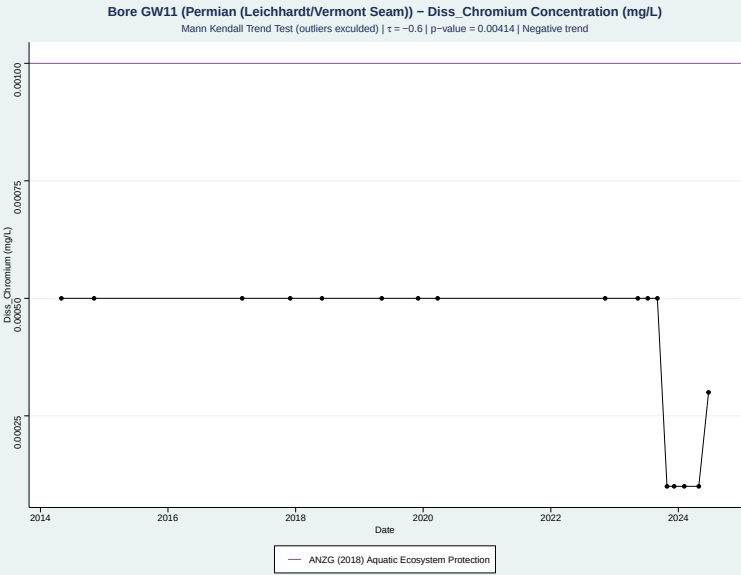
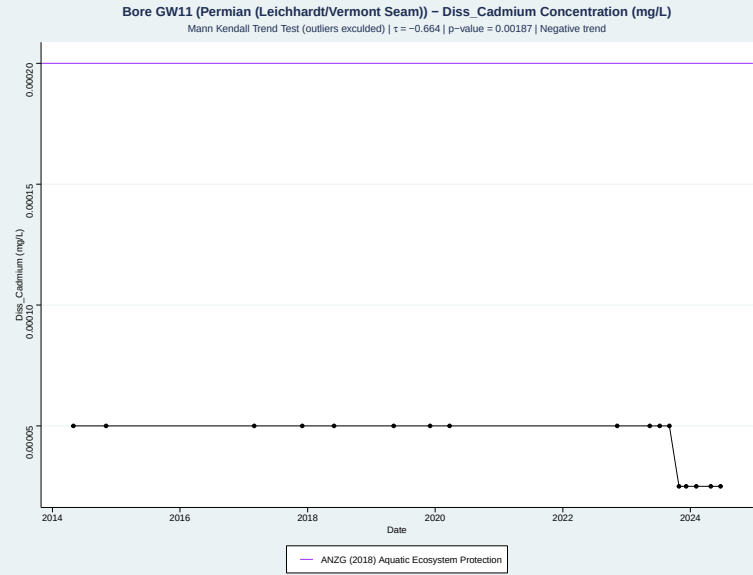
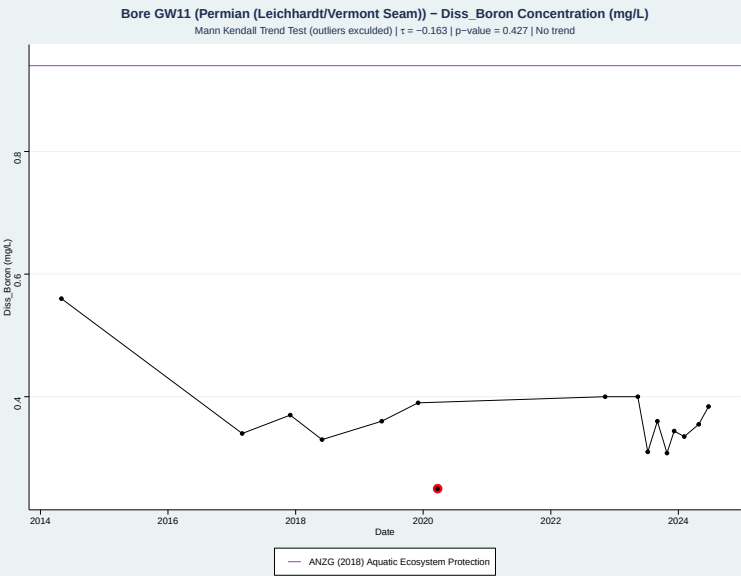
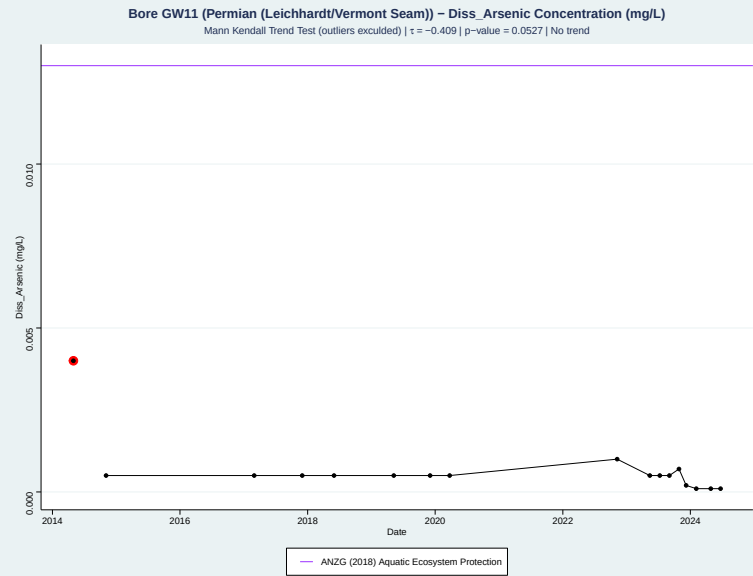


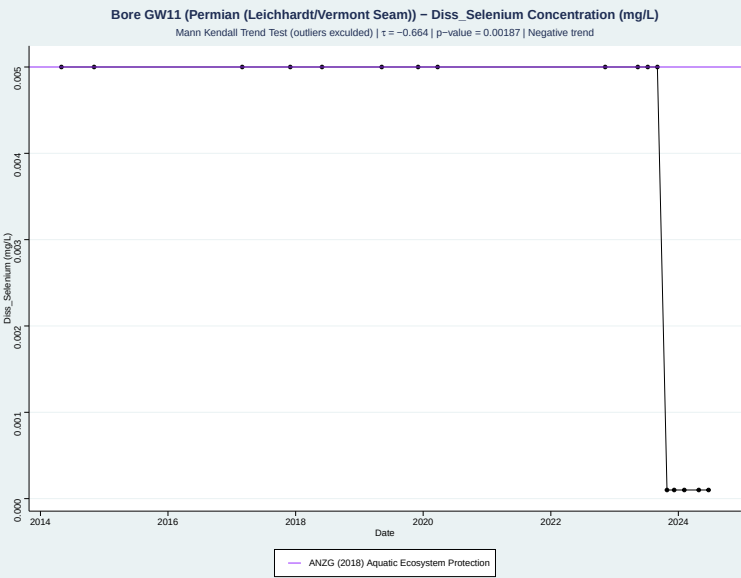
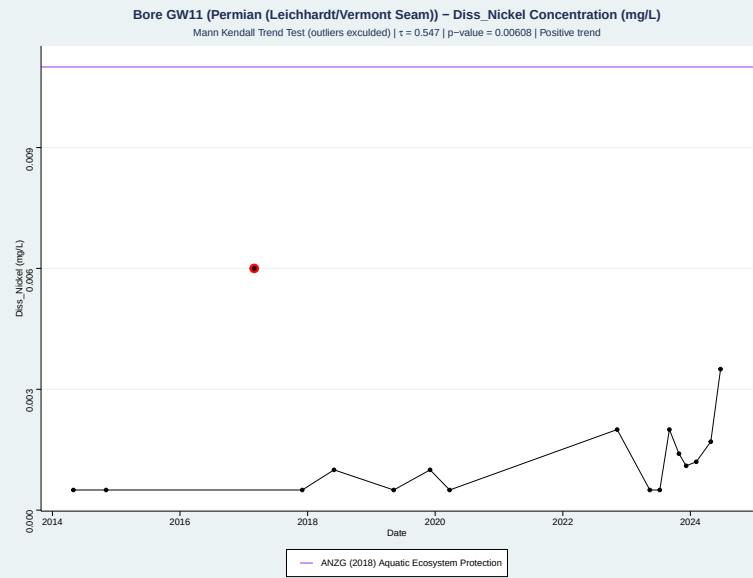
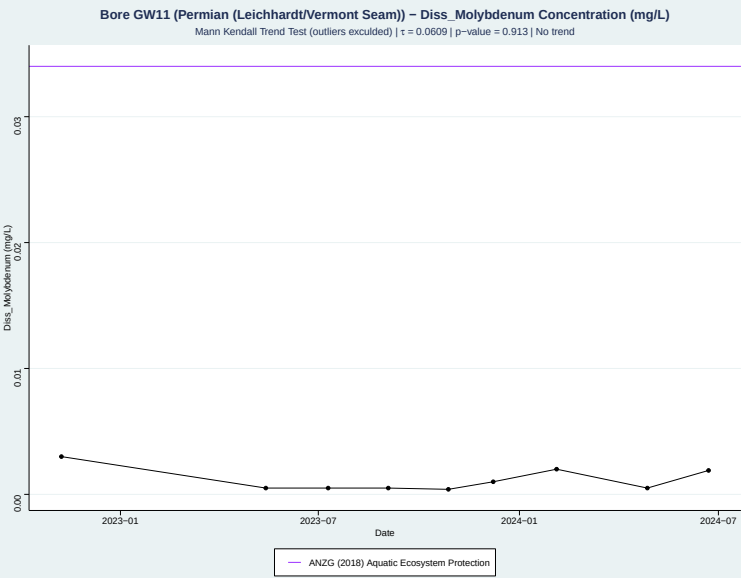
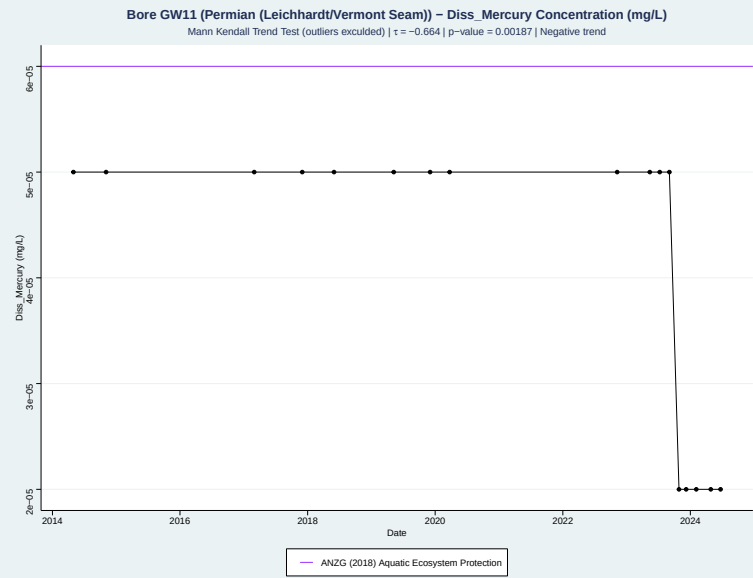
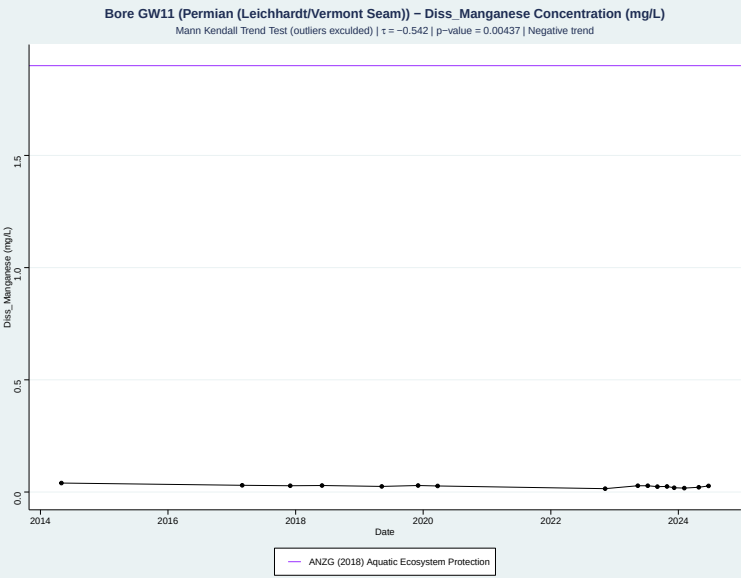
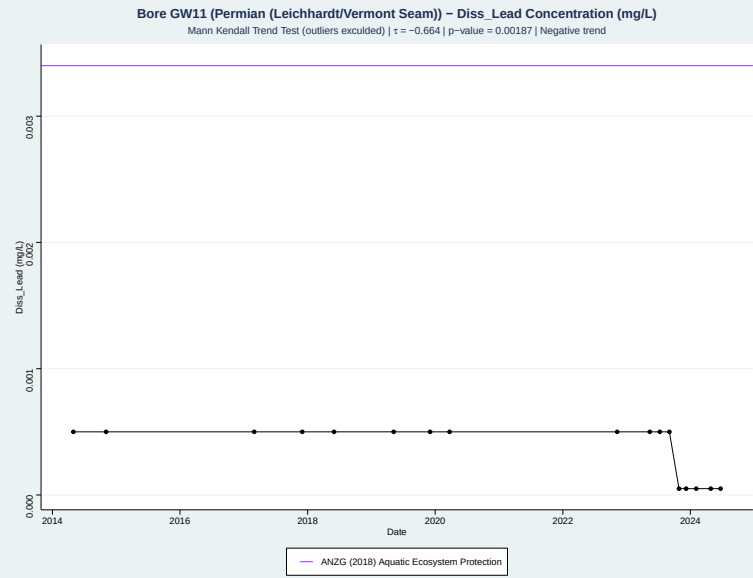


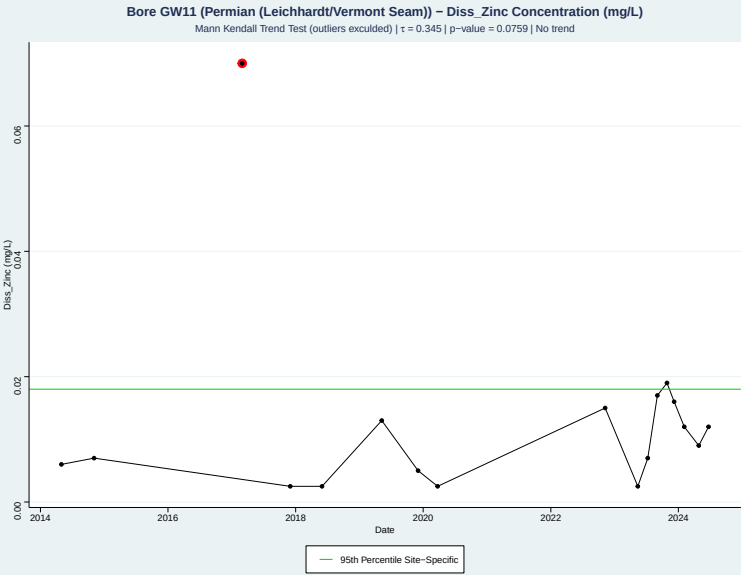
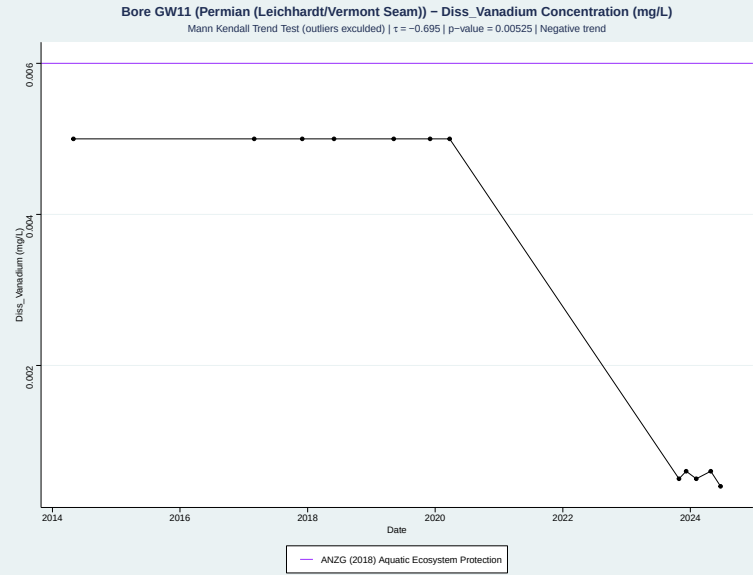
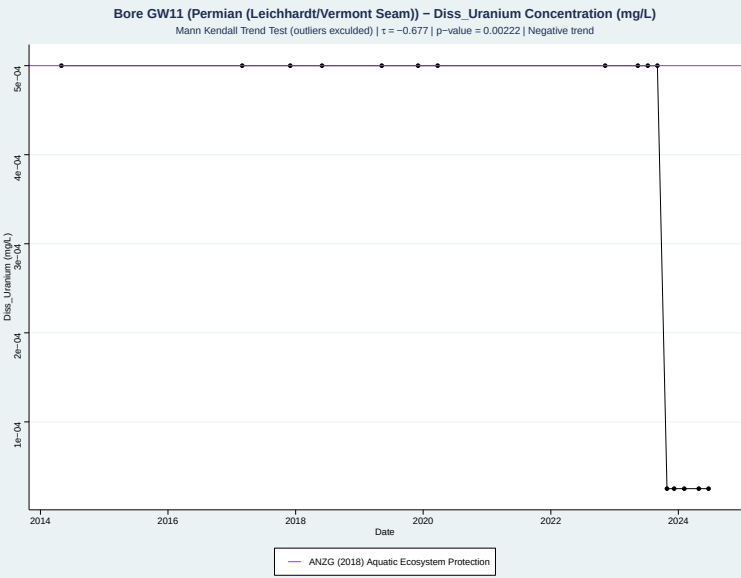
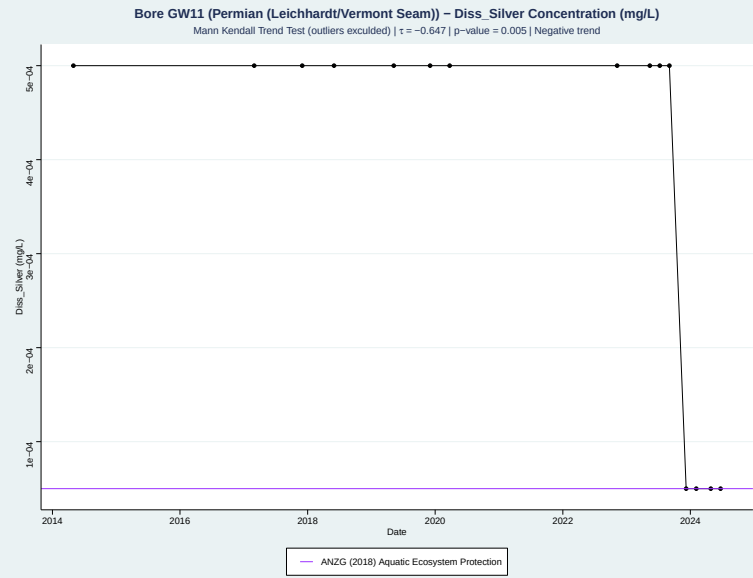




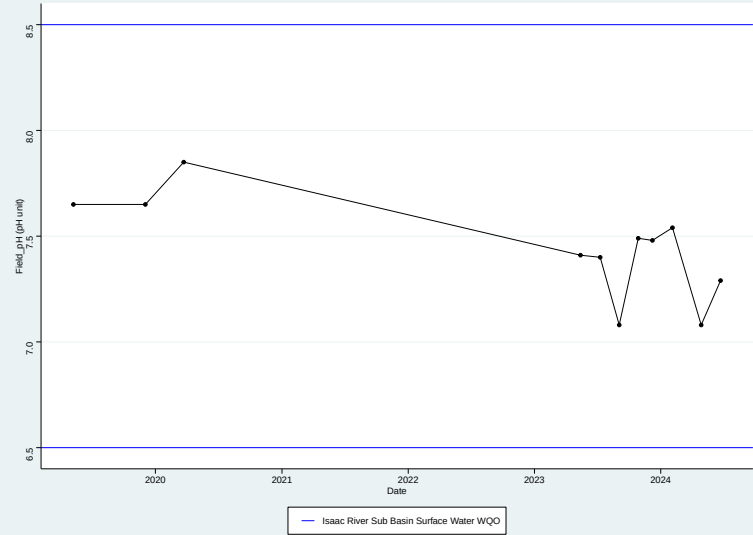




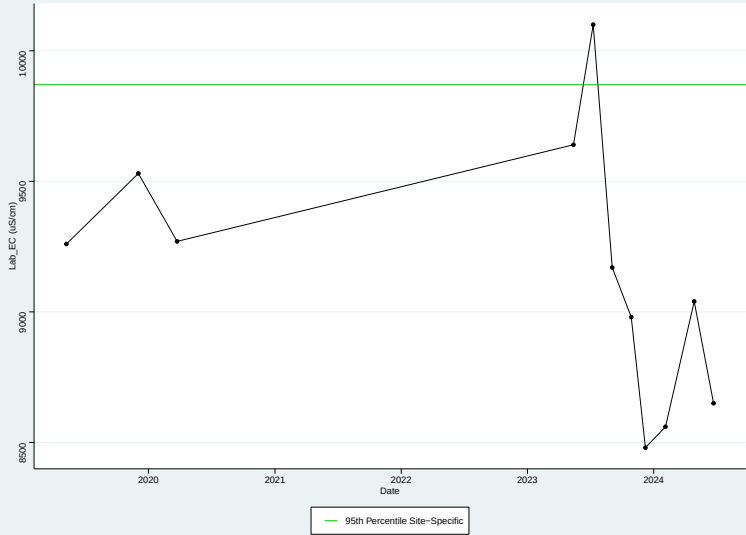




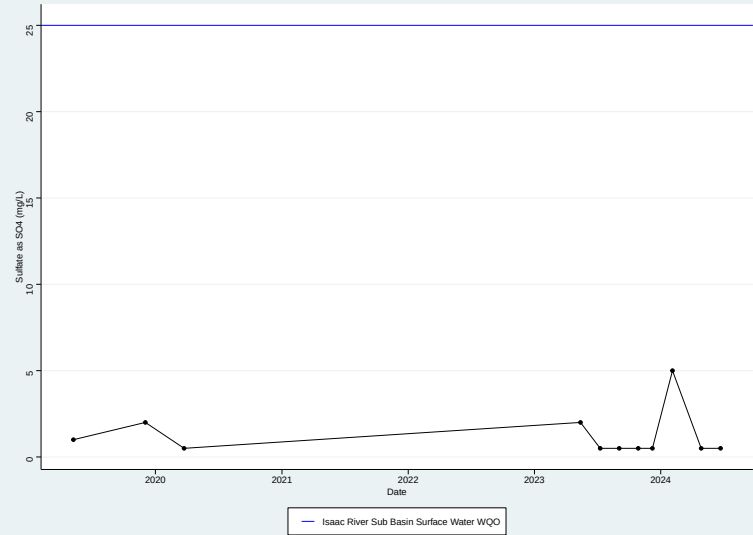
Bore GW29a (Permian (sandstone)) – Field_pH Concentration (pH unit)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.426$ | p-value = 0.0849 | No trend



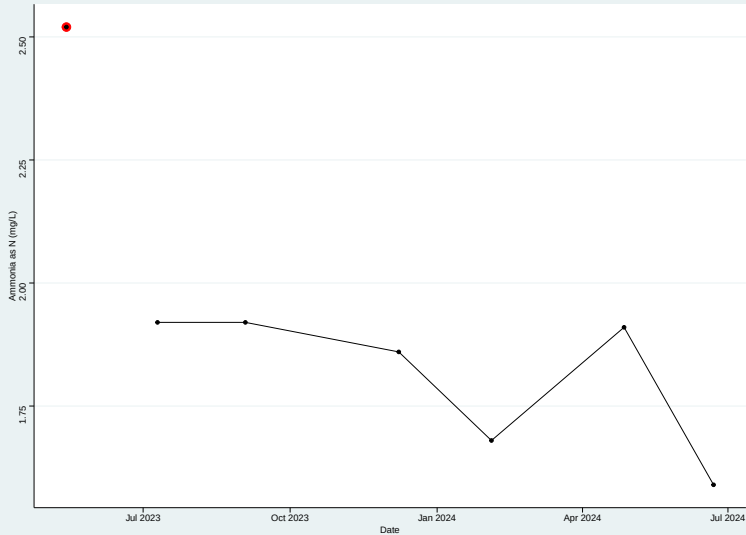
Bore GW29a (Permian (sandstone)) – Lab_EC Concentration (uS/cm)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.455$ | p-value = 0.0617 | No trend



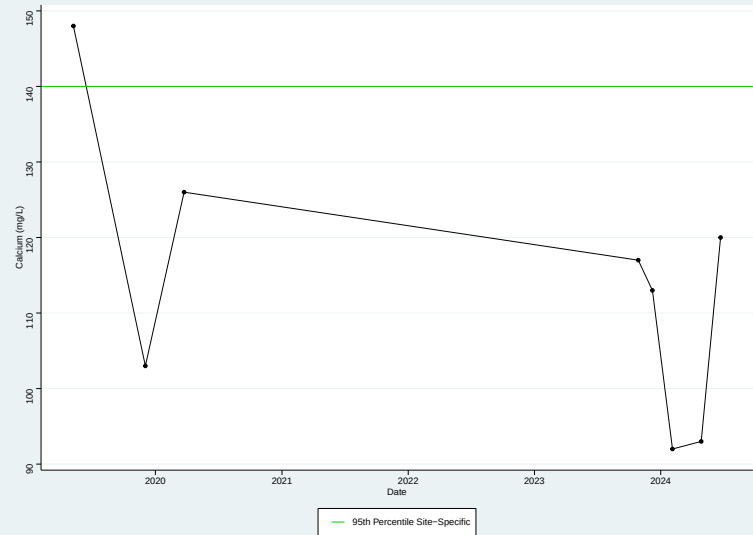
Bore GW29a (Permian (sandstone)) – Sulfate as SO4 Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.258$ | p-value = 0.361 | No trend



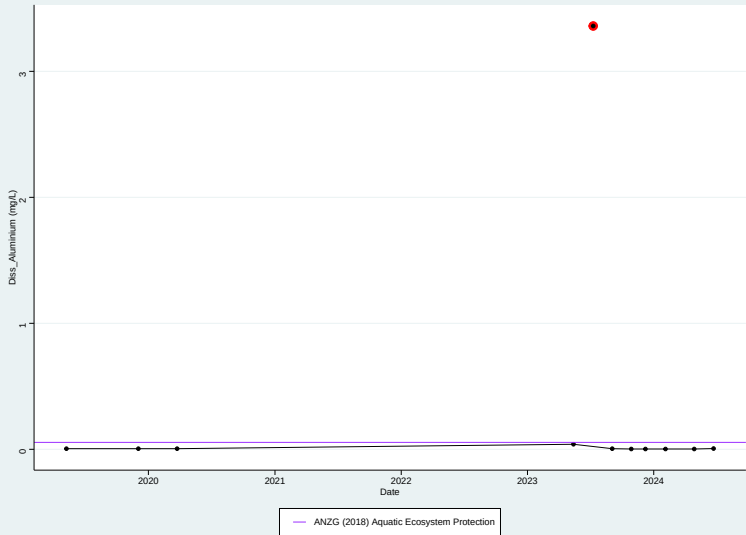
Bore GW29a (Permian (sandstone)) – Ammonia as N Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.69$ | p-value = 0.0852 | No trend



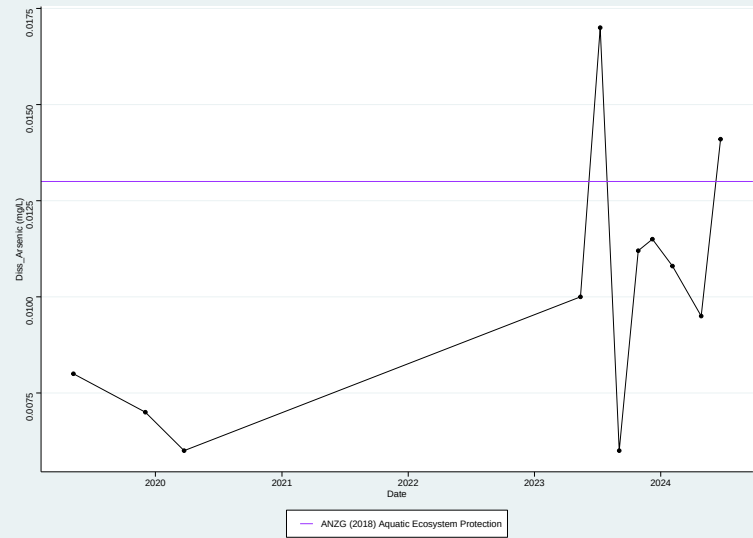
Bore GW29a (Permian (sandstone)) – Calcium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.357$ | p-value = 0.266 | No trend



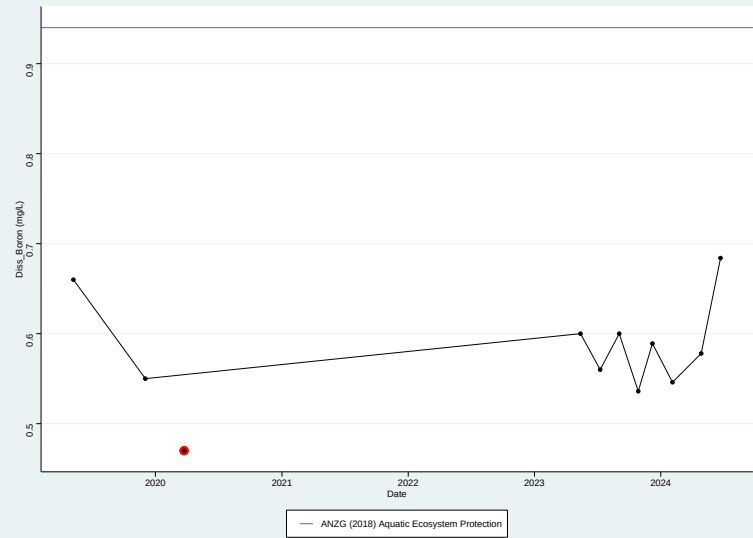
Bore GW29a (Permian (sandstone)) – Diss_Aluminium Concentration (mg/L)
Mann Kendall Trend Test (outliers exclded) | $\tau = -0.285$ | p-value = 0.335 | No trend



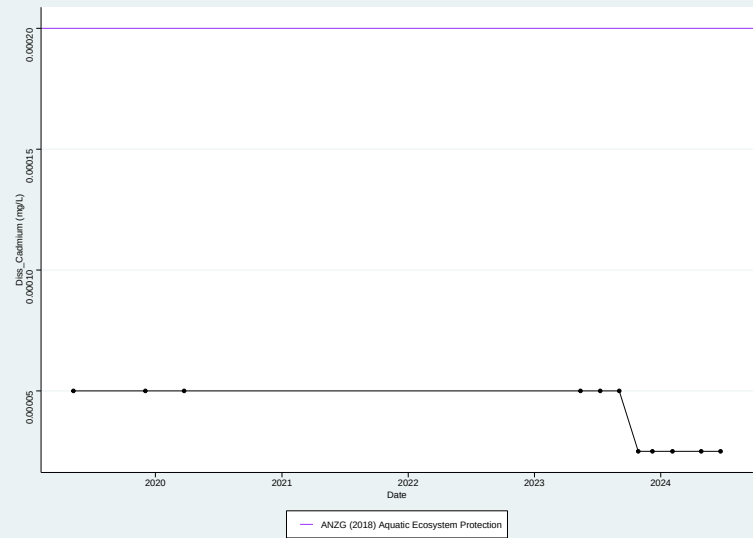
Bore GW29a (Permian (sandstone)) – Diss_Arsenic Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = 0.33$ | $p\text{-value} = 0.184$ | No trend



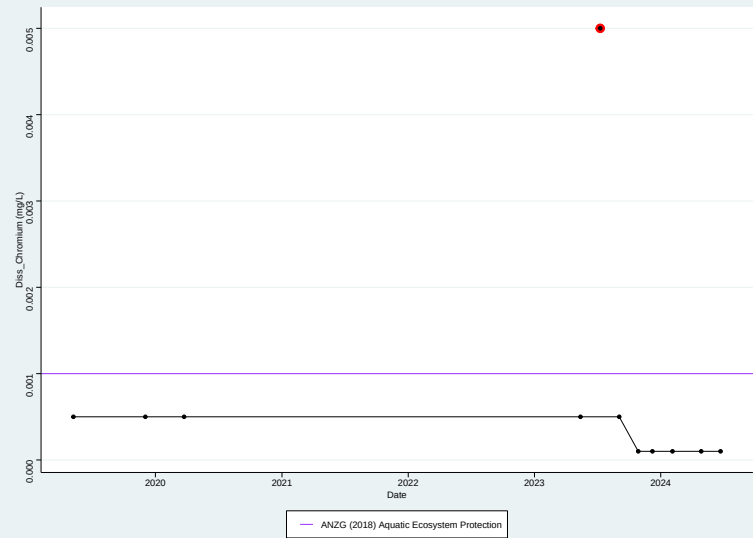
Bore GW29a (Permian (sandstone)) – Diss_Boron Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.0449$ | $p\text{-value} = 0.928$ | No trend



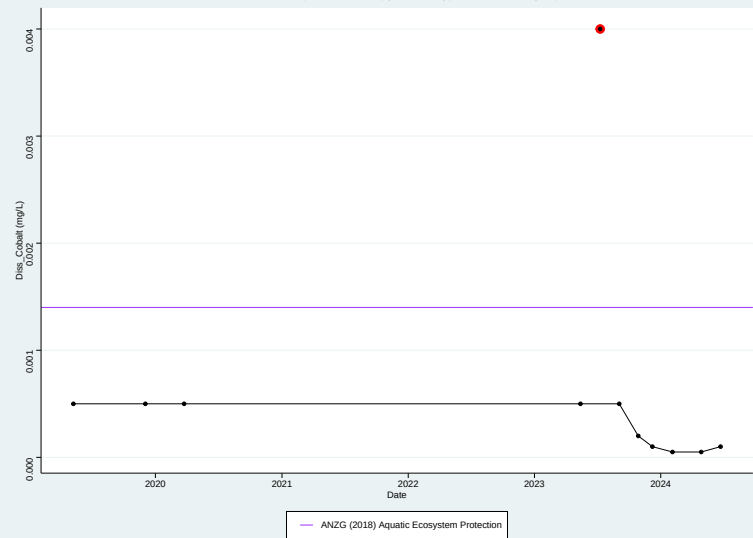
Bore GW29a (Permian (sandstone)) – Diss_Cadmium Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.739$ | $p\text{-value} = 0.00811$ | Negative trend



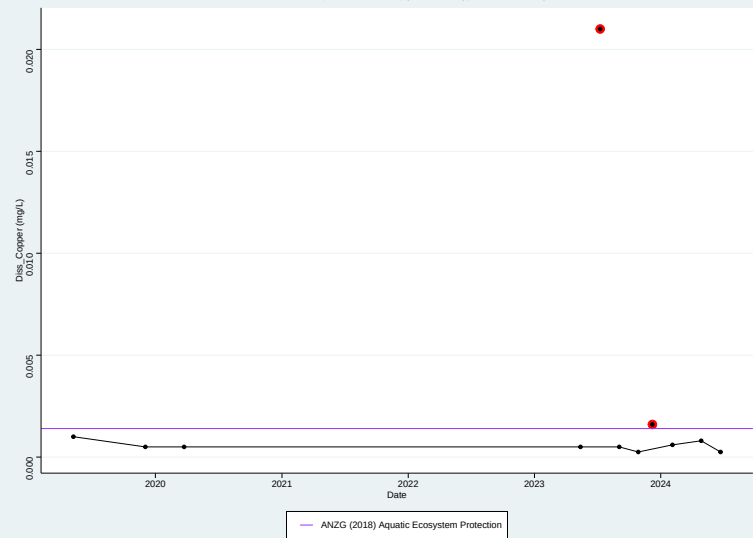
Bore GW29a (Permian (sandstone)) – Diss_Chromium Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.745$ | $p\text{-value} = 0.0122$ | Negative trend



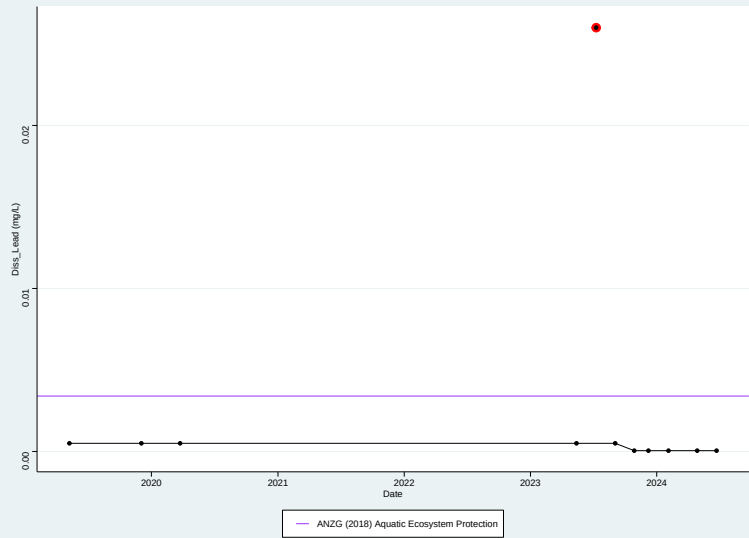
Bore GW29a (Permian (sandstone)) – Diss_Cobalt Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.753$ | $p\text{-value} = 0.00662$ | Negative trend



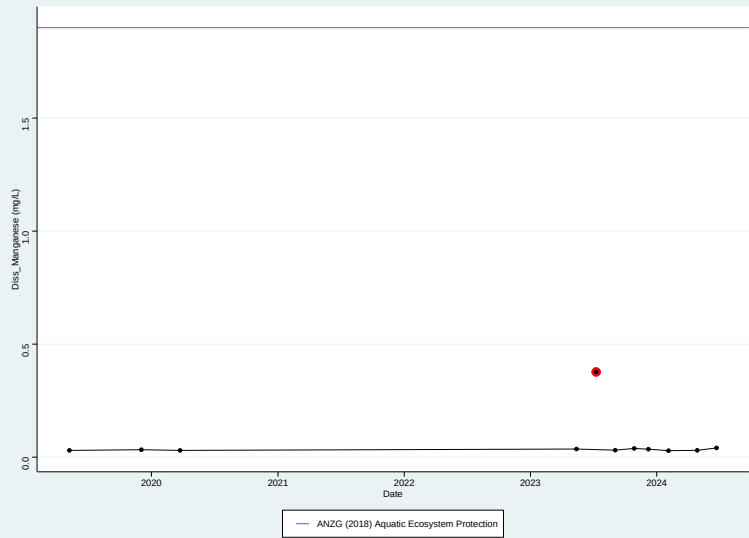
Bore GW29a (Permian (sandstone)) – Diss_Copper Concentration (mg/L)
Mann Kendall Trend Test (outliers excuded) | $\tau = -0.217$ | $p\text{-value} = 0.508$ | No trend



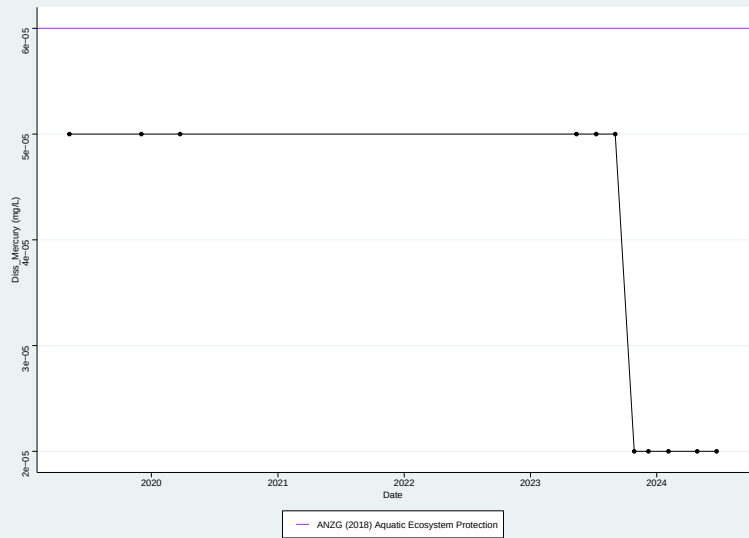
Bore GW29a (Permian (sandstone)) – Diss. Lead Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.745$ | p-value = 0.0122 | Negative trend



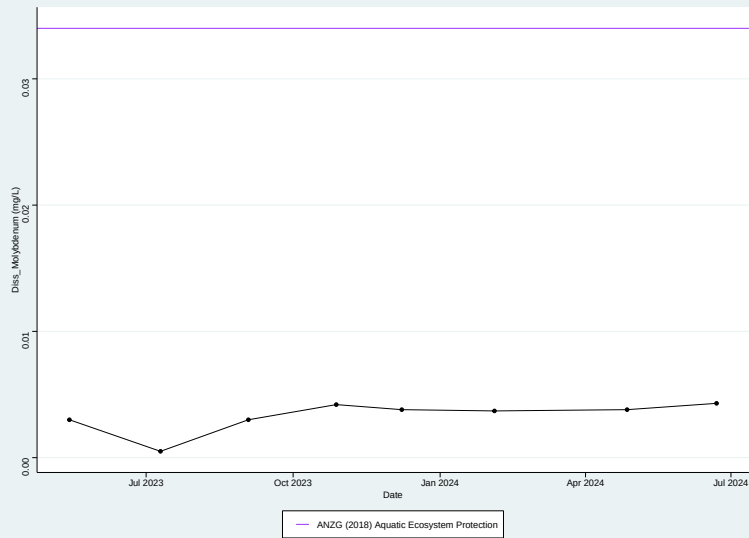
Bore GW29a (Permian (sandstone)) – Diss. Manganese Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = 0.225$ | p-value = 0.419 | No trend



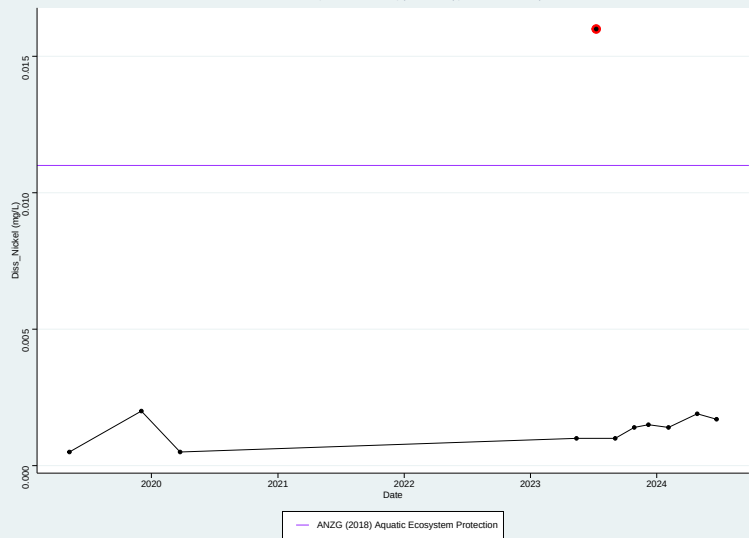
Bore GW29a (Permian (sandstone)) – Diss. Mercury Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.739$ | p-value = 0.00811 | Negative trend



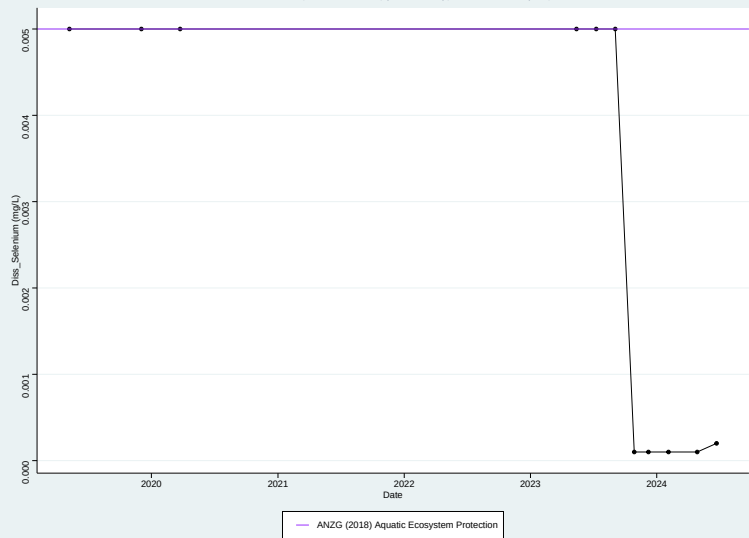
Bore GW29a (Permian (sandstone)) – Diss. Molybdenum Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = 0.593$ | p-value = 0.0595 | No trend



Bore GW29a (Permian (sandstone)) – Diss. Nickel Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = 0.506$ | p-value = 0.0573 | No trend

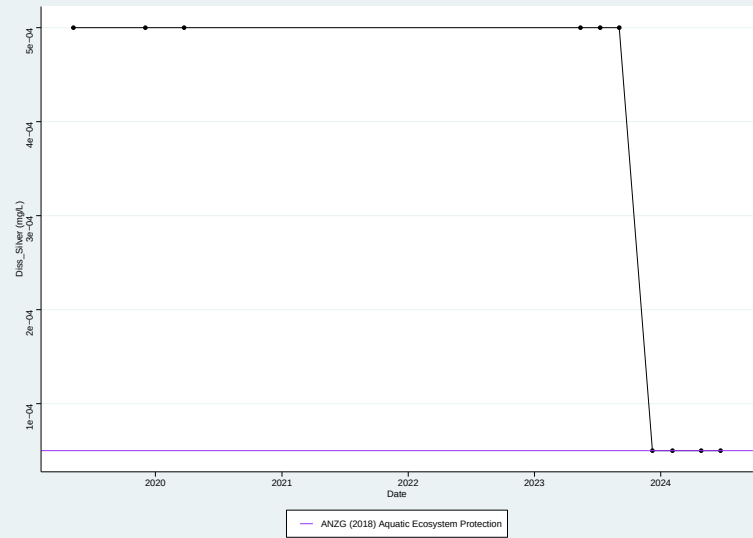


Bore GW29a (Permian (sandstone)) – Diss. Selenium Concentration (mg/L)
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.601$ | p-value = 0.0271 | Negative trend



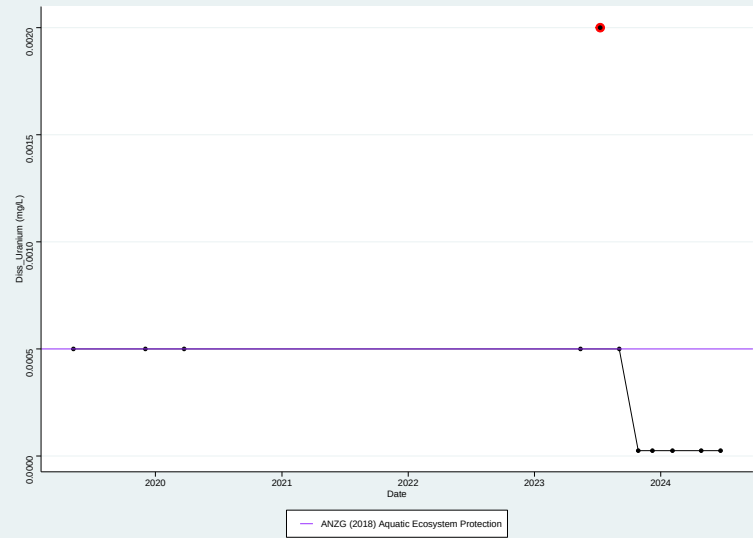
Bore GW29a (Permian (sandstone)) – Diss. Silver Concentration (mg/L)

Mann Kendall Trend Test (outliers excluded) | $\tau = -0.73$ | p-value = 0.0142 | Negative trend



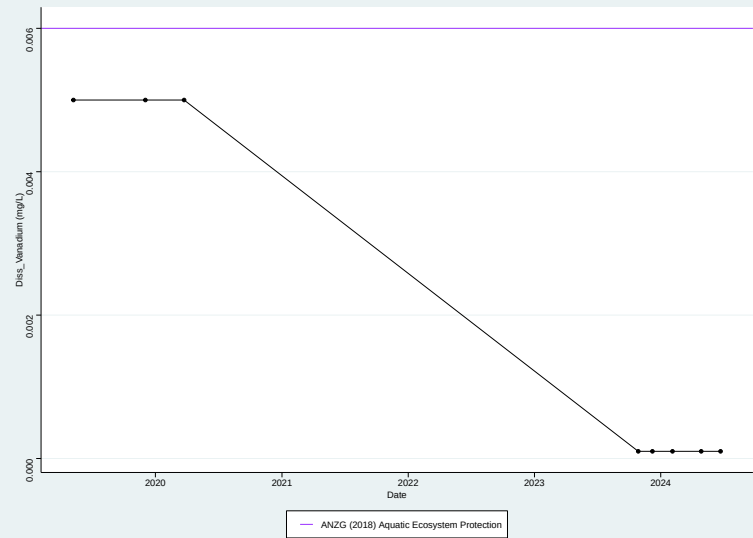
Bore GW29a (Permian (sandstone)) – Diss. Uranium Concentration (mg/L)

Mann Kendall Trend Test (outliers excluded) | $\tau = -0.745$ | p-value = 0.0122 | Negative trend



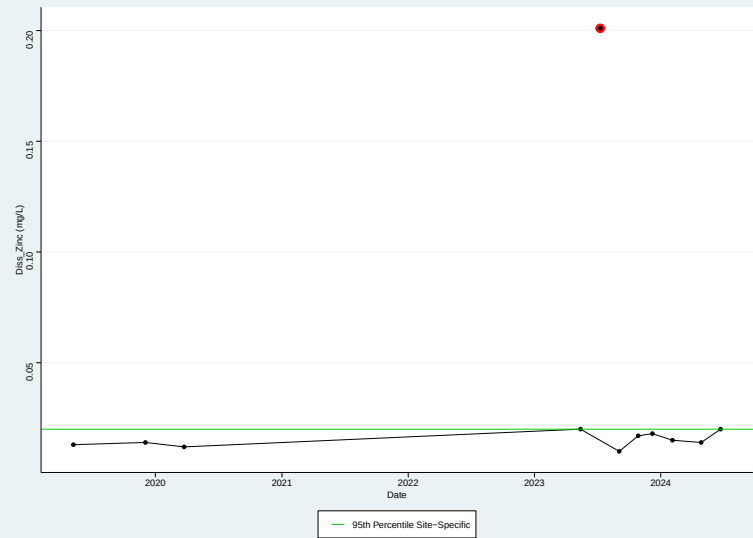
Bore GW29a (Permian (sandstone)) – Diss. Vanadium Concentration (mg/L)

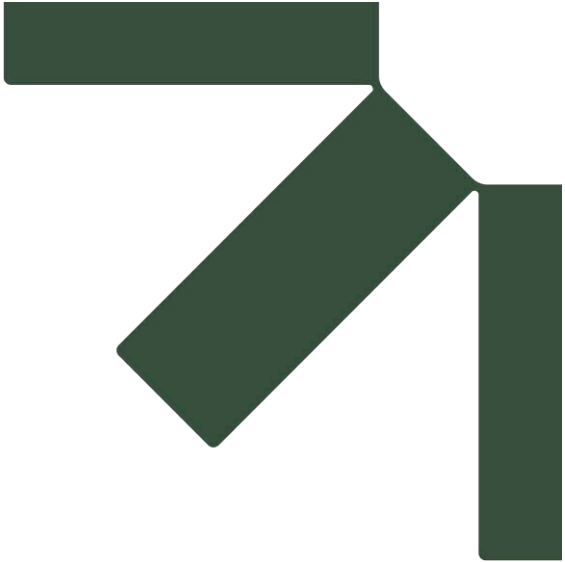
Mann Kendall Trend Test (outliers excluded) | $\tau = -0.732$ | p-value = 0.0369 | Negative trend



Bore GW29a (Permian (sandstone)) – Diss. Zinc Concentration (mg/L)

Mann Kendall Trend Test (outliers excluded) | $\tau = 0.296$ | p-value = 0.279 | No trend





Appendix C Water Quality Boxplots

Groundwater Compliance 2024 Updated Limit and Trigger Development

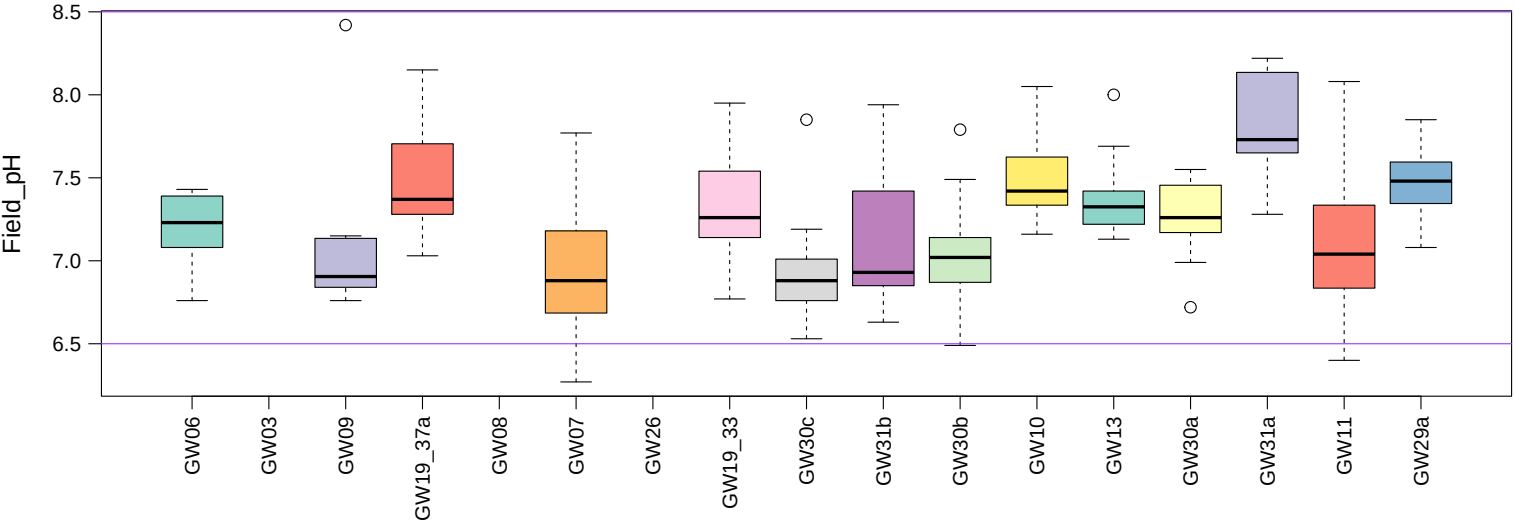
New Lenton Coal Project

Lenton Joint Venture

SLR Project No.: 620.040927.00001

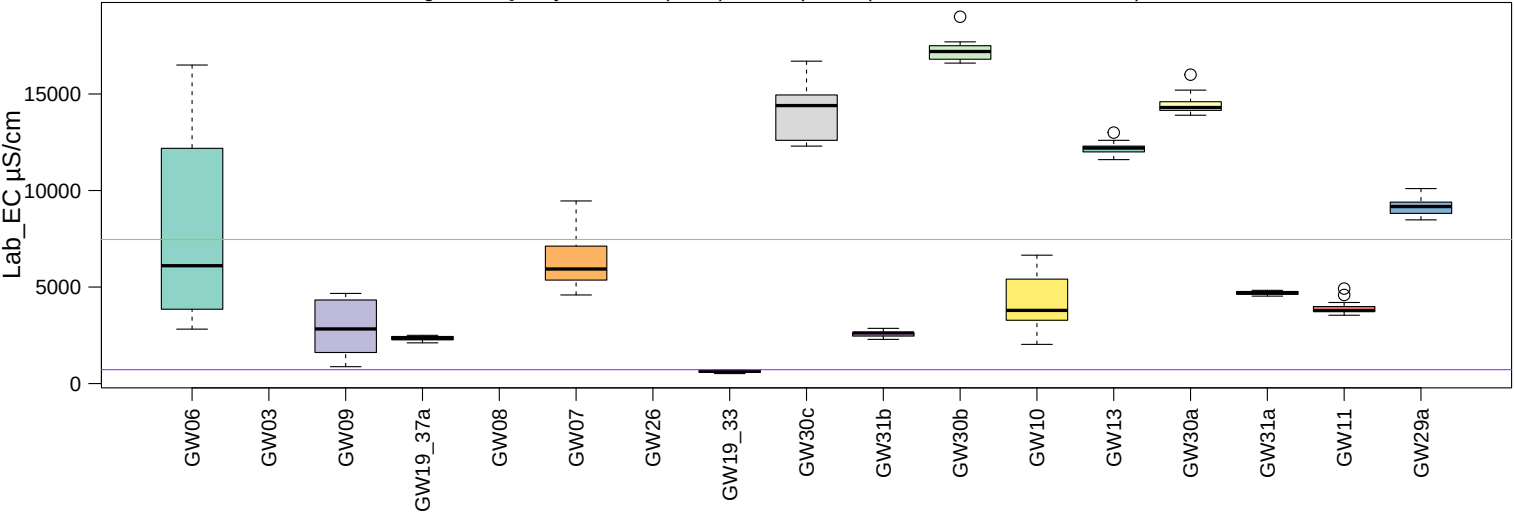
25 September 2024

Isaac River Sub Basin Surface Water WQO = 6.5 – 8.5



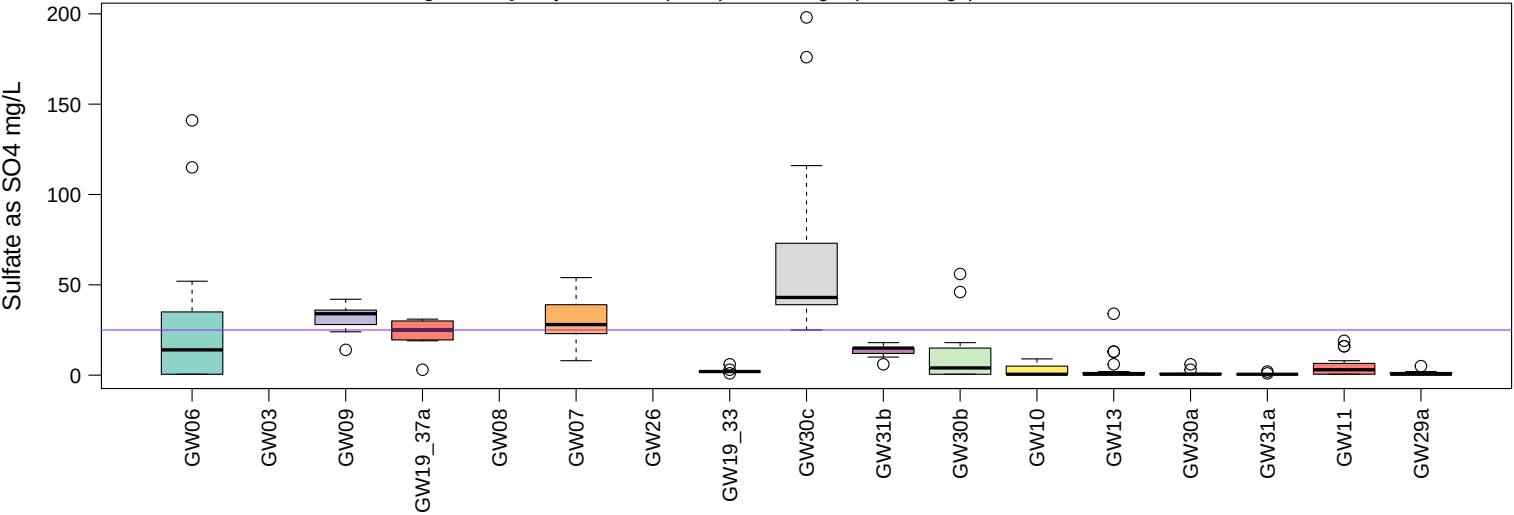
Isaac River Sub Basin Surface Water WQO = 720 μ S/cm (baseflow)

ANZECC Livestock Drinking Water Quality Guideline (cattle) = 7463 μ S/cm (converted from TDS as /0.65)

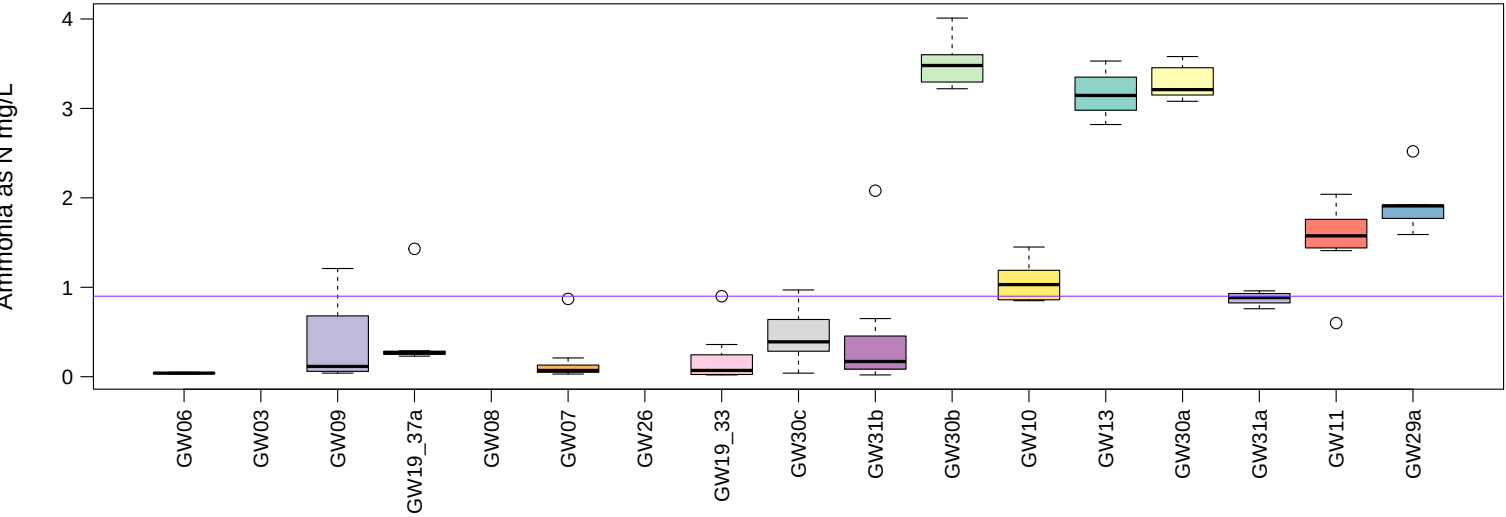


Isaac River Sub Basin Surface Water WQO = 25 mg/L

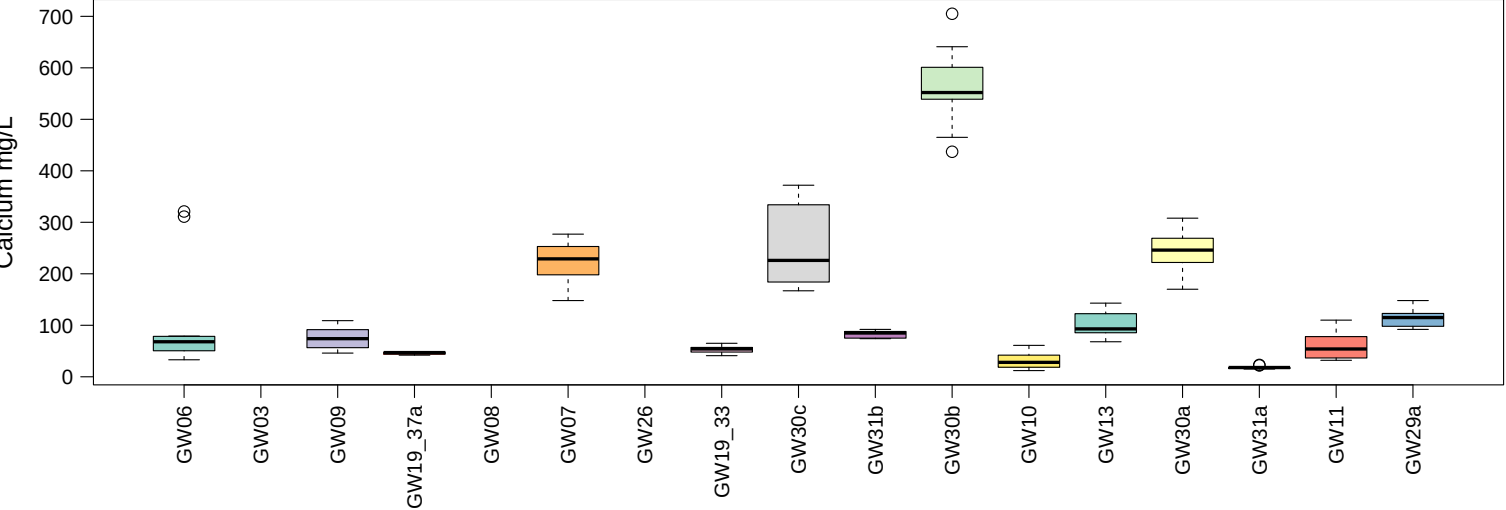
ANZECC Livestock Drinking Water Quality Guideline (cattle) = 1000 mg/L (out of range)



ANZG (2018) Aquatic Ecosystem Protection (95%) = 0.9 mg/L

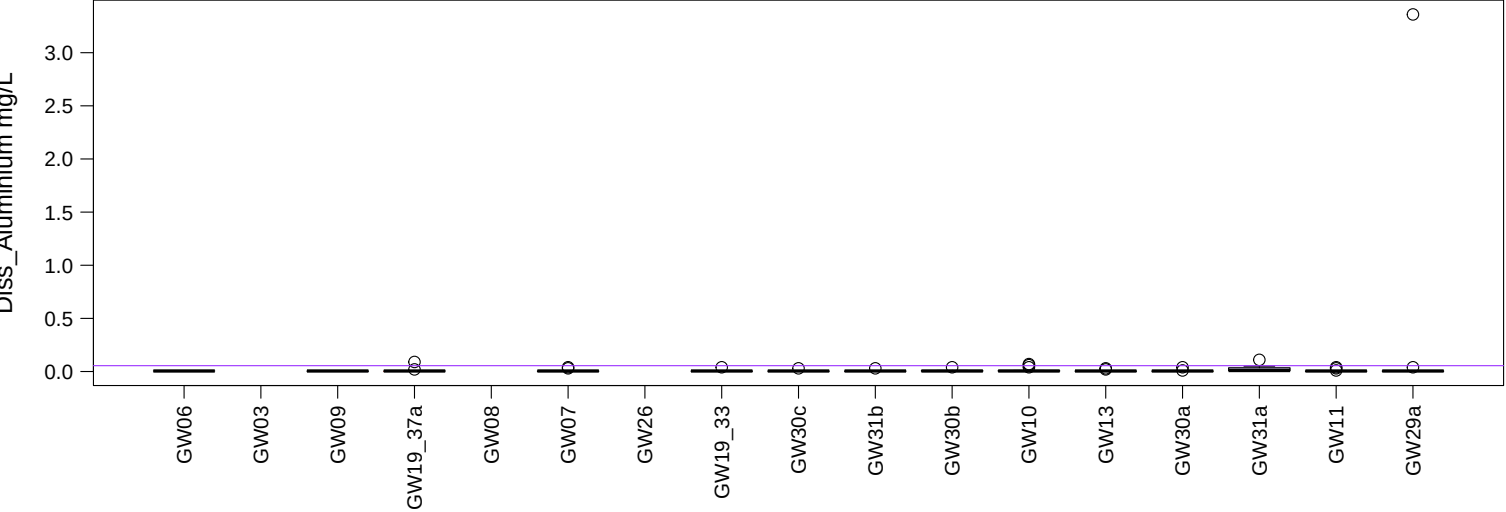


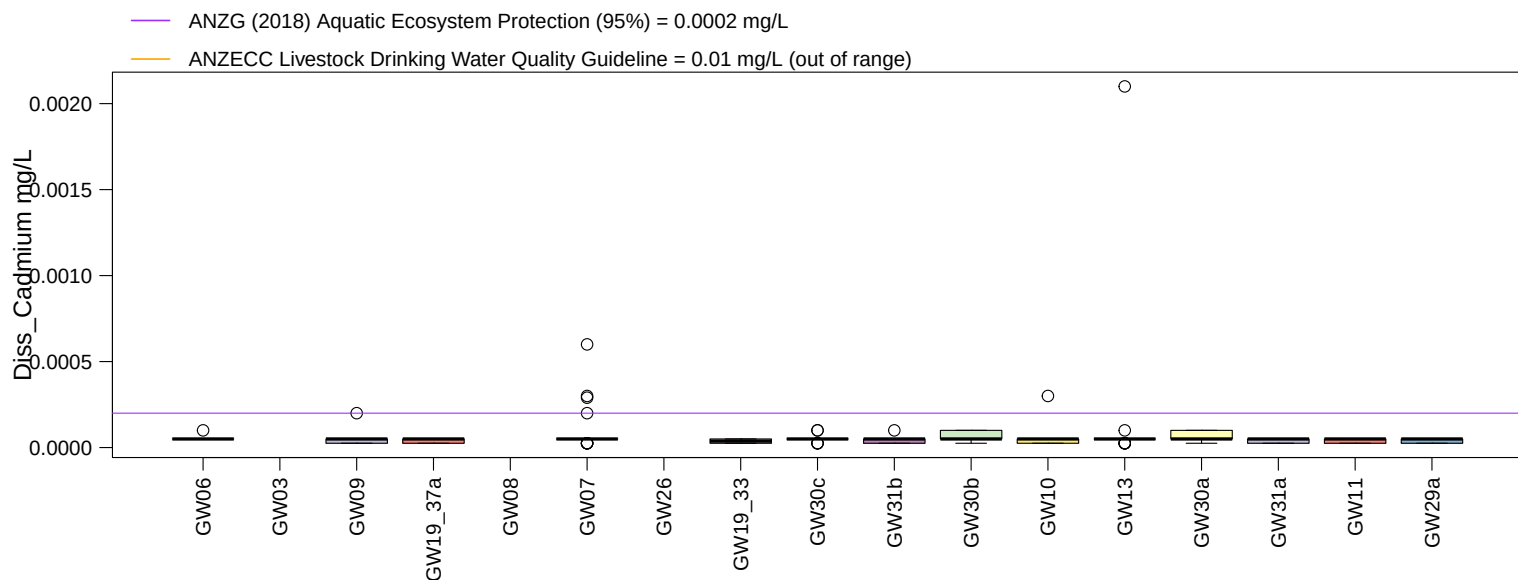
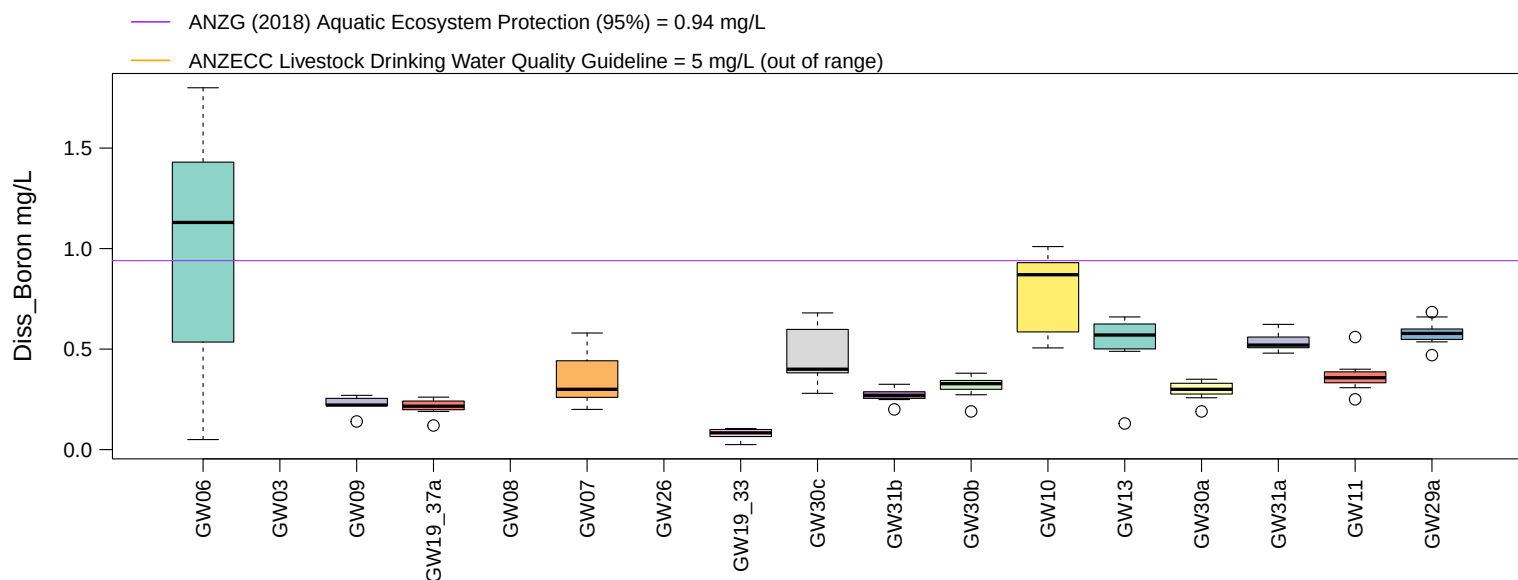
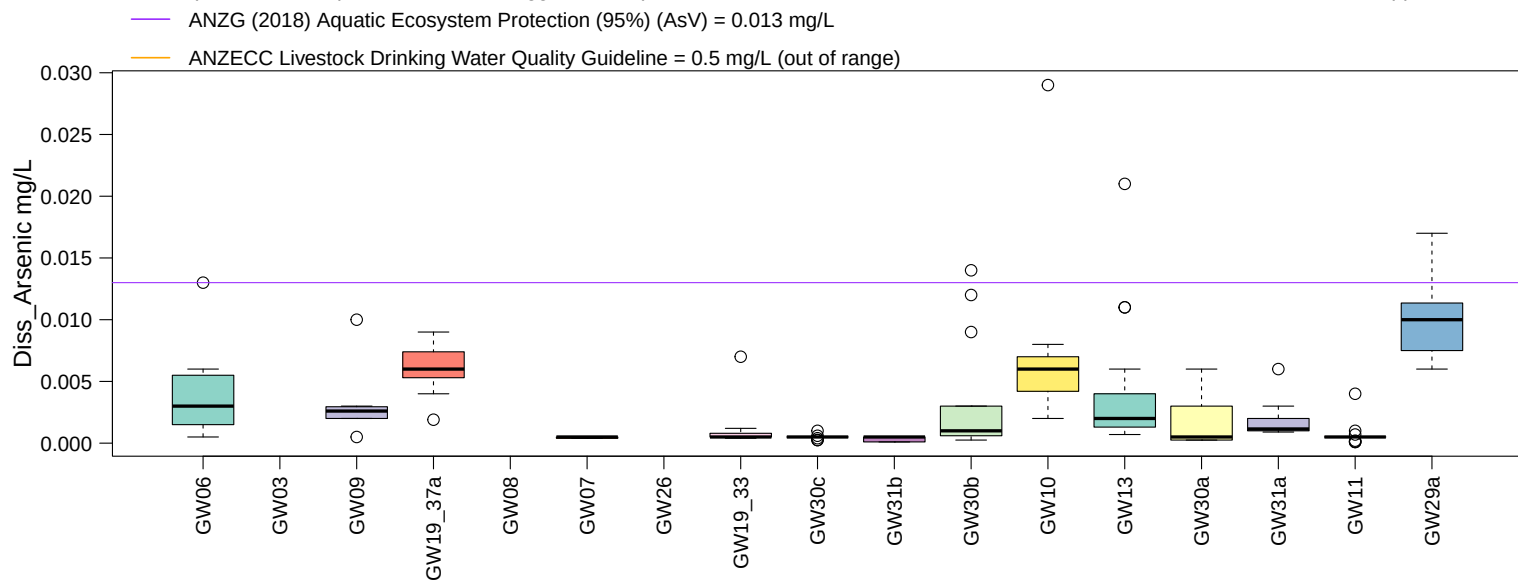
ANZECC Livestock Drinking Water Quality Guideline = 1000 mg/L (out of range)

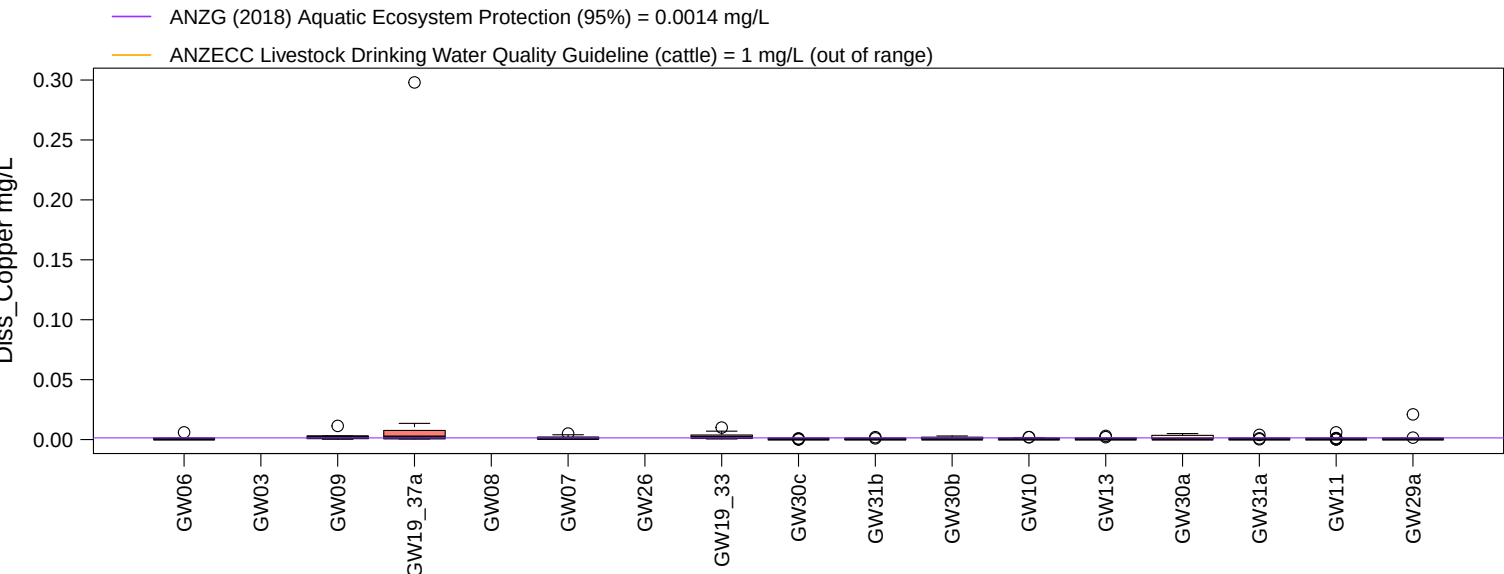
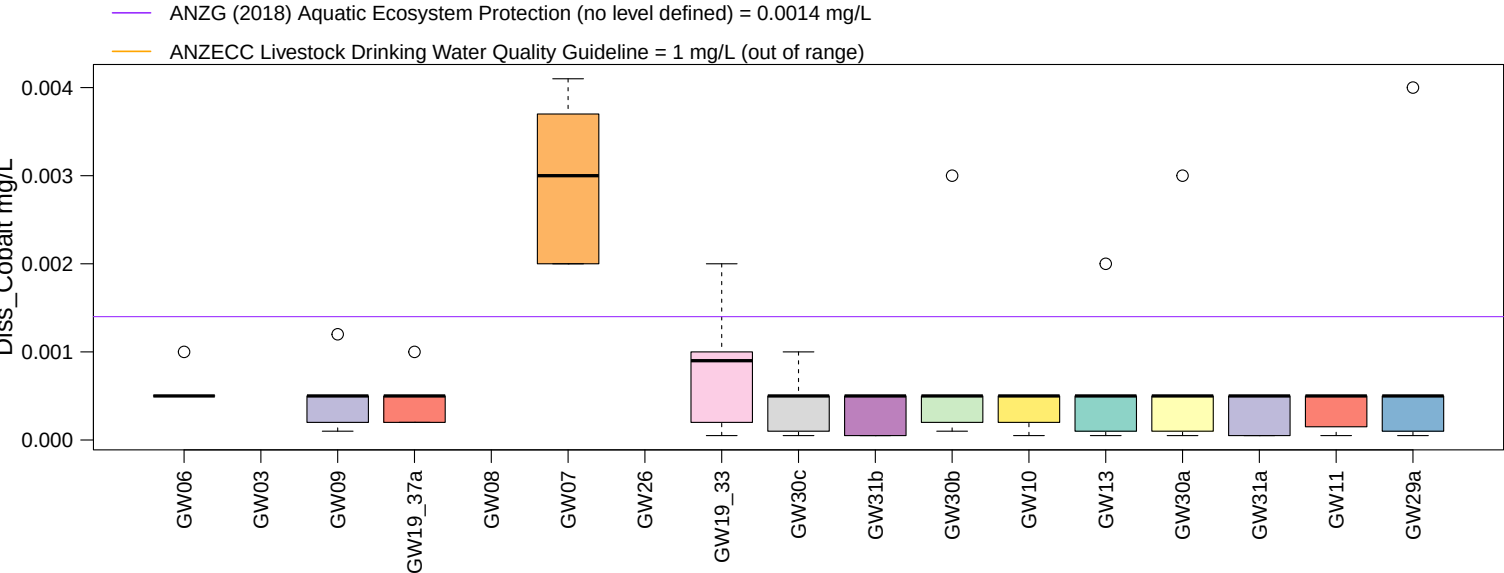
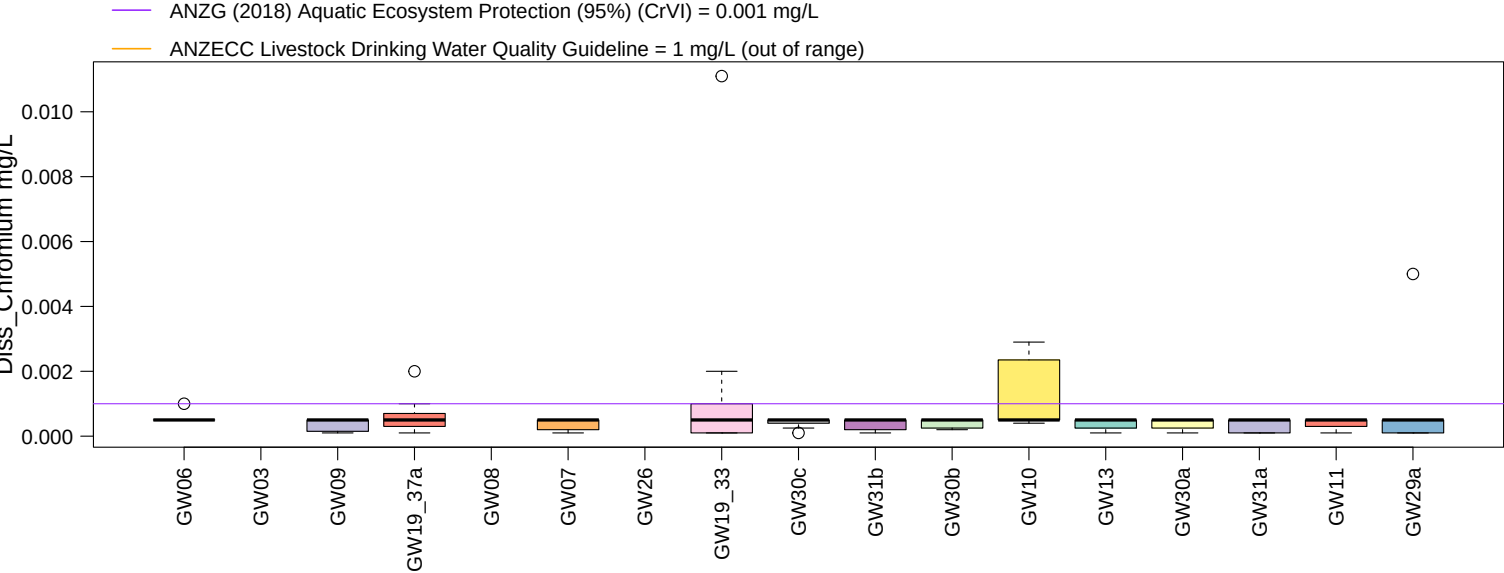


ANZG (2018) Aquatic Ecosystem Protection (95%) (pH > 6.5) = 0.055 mg/L

ANZECC Livestock Drinking Water Quality Guideline = 5 mg/L (out of range)

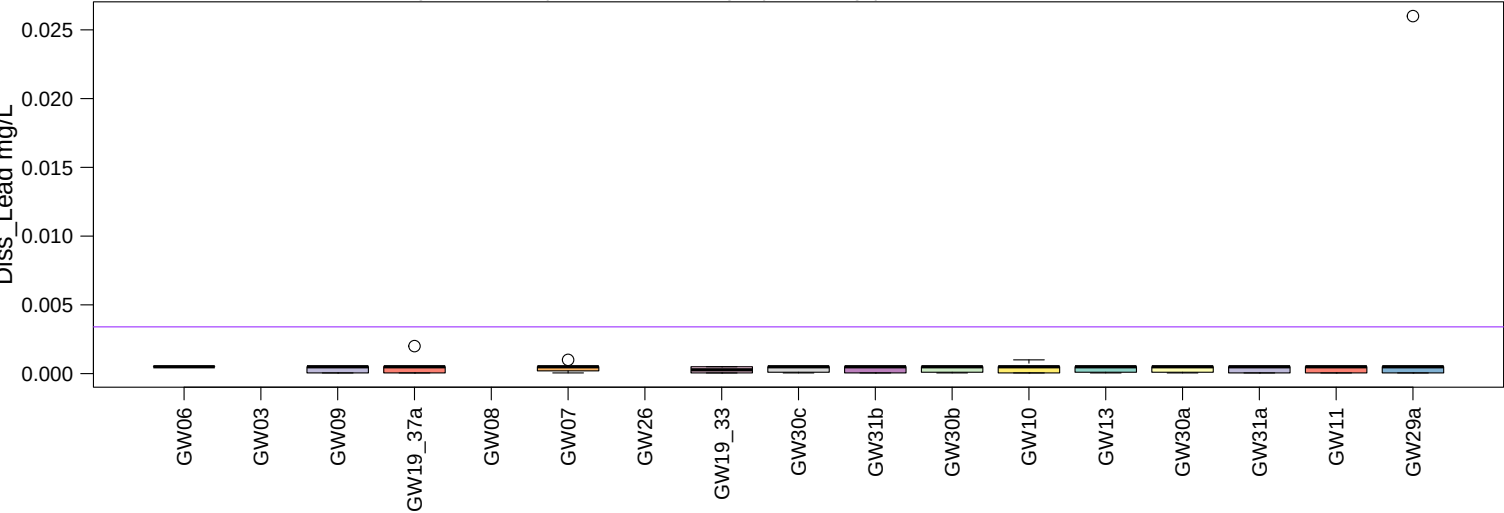




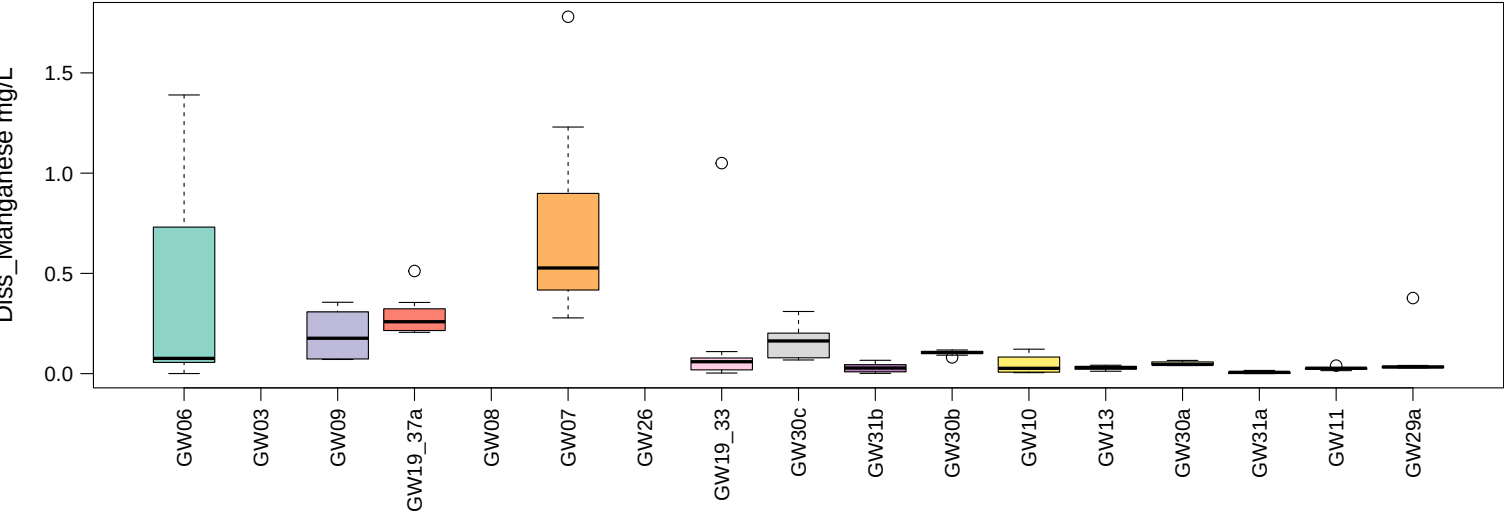


ANZG (2018) Aquatic Ecosystem Protection (95%) = 0.0034 mg/L

ANZECC Livestock Drinking Water Quality Guideline = 0.1 mg/L (out of range)

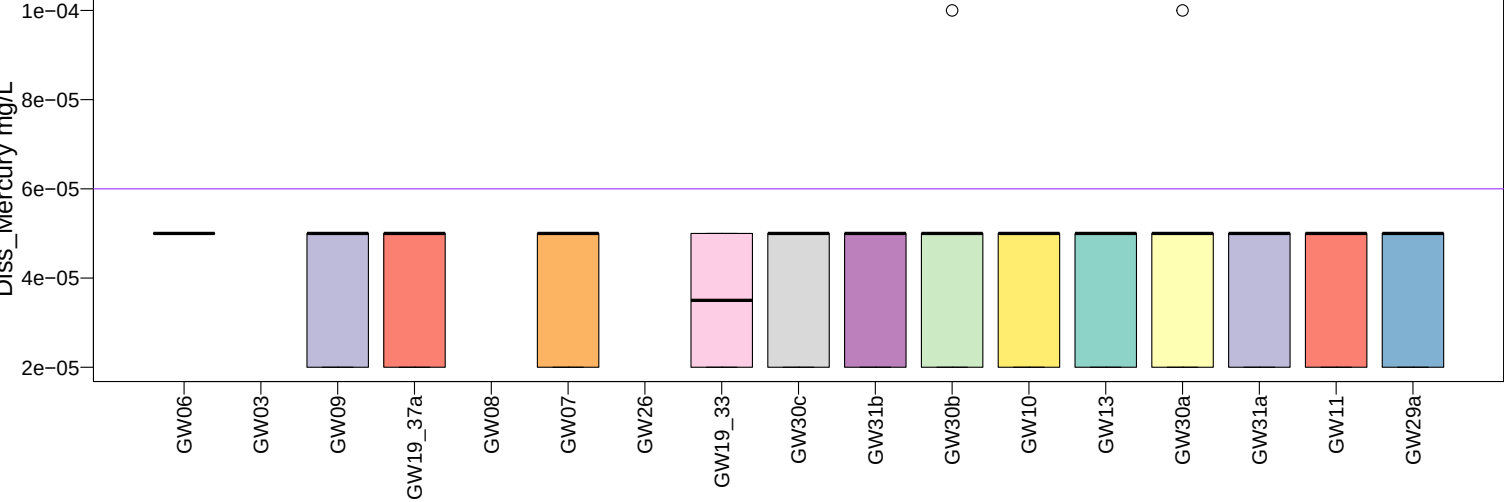


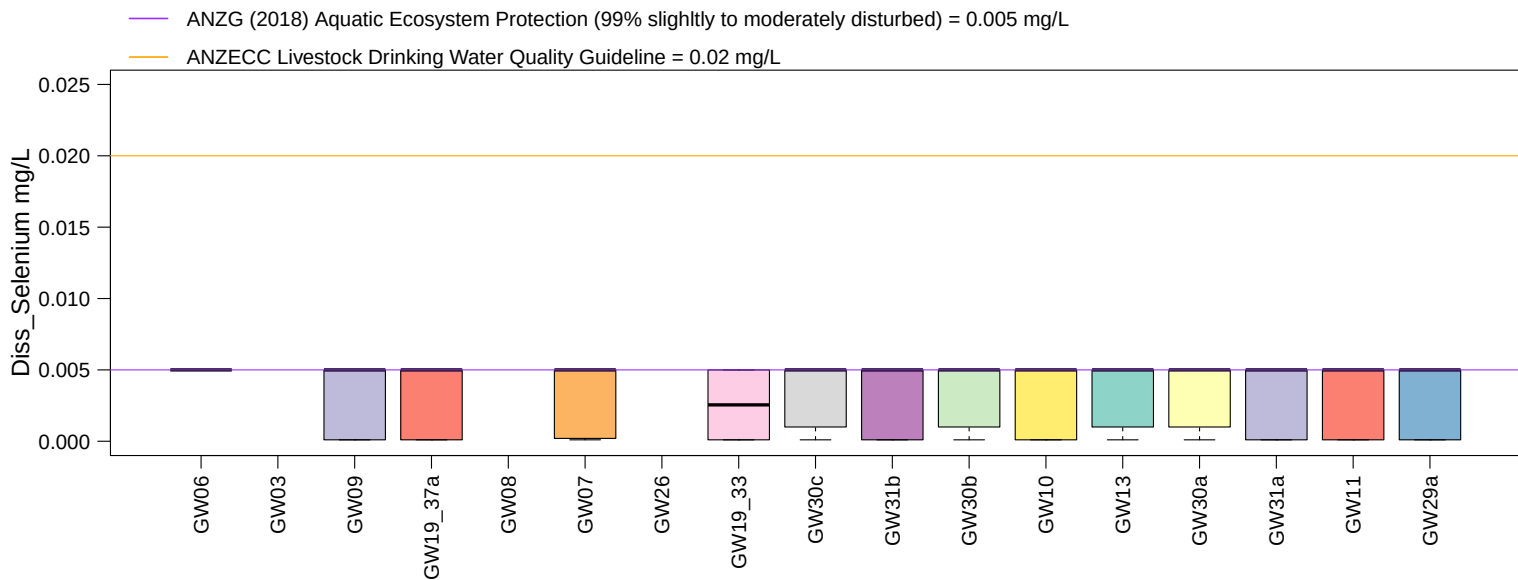
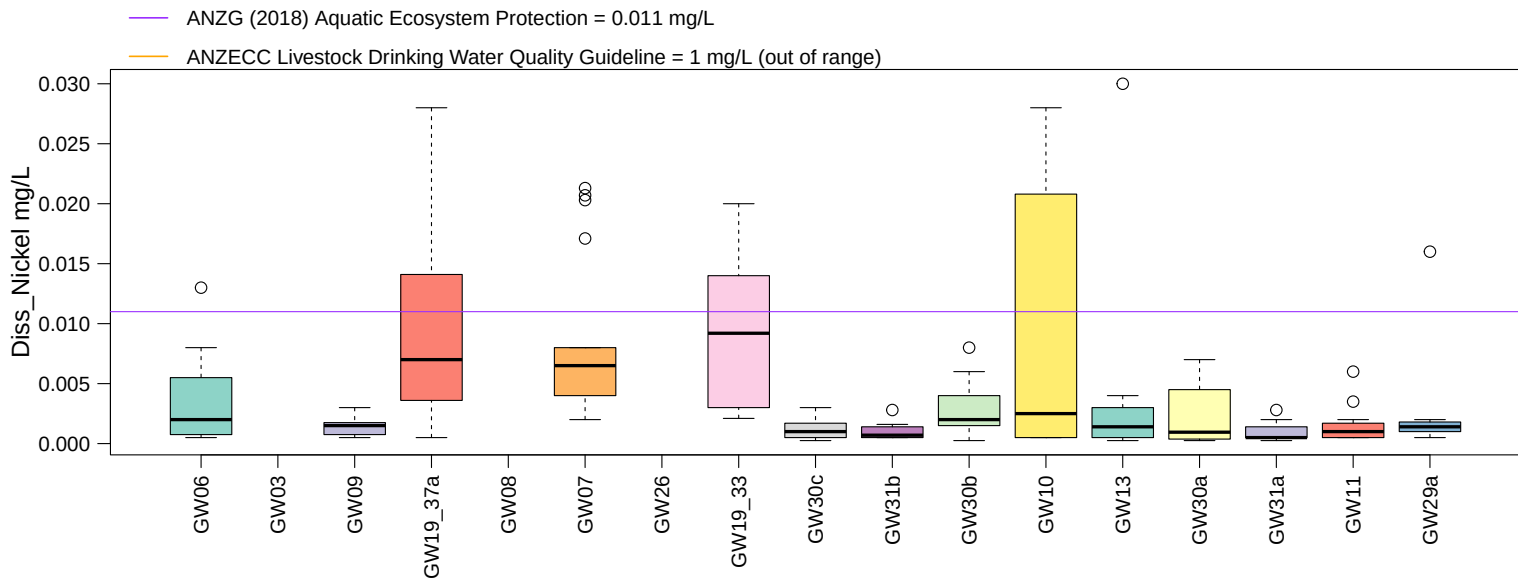
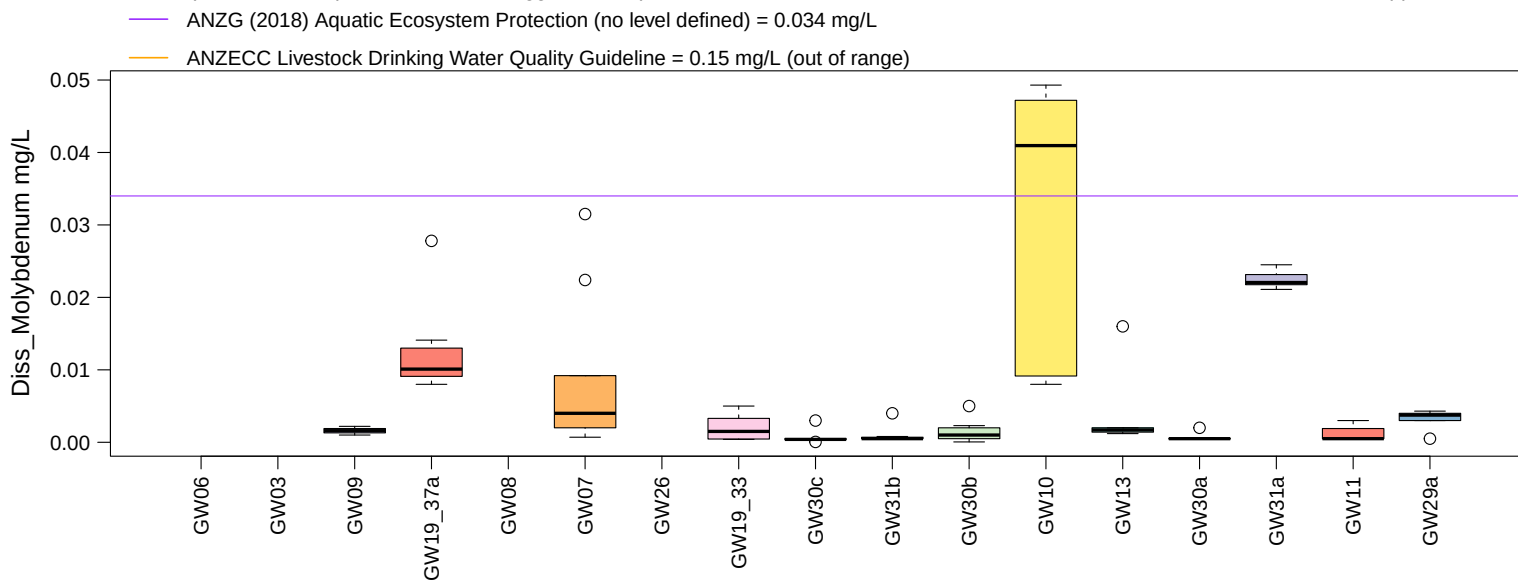
ANZG (2018) Aquatic Ecosystem Protection (95%) = 1.9 mg/L



ANZG (2018) Aquatic Ecosystem Protection (99%) = 0.00006 mg/L

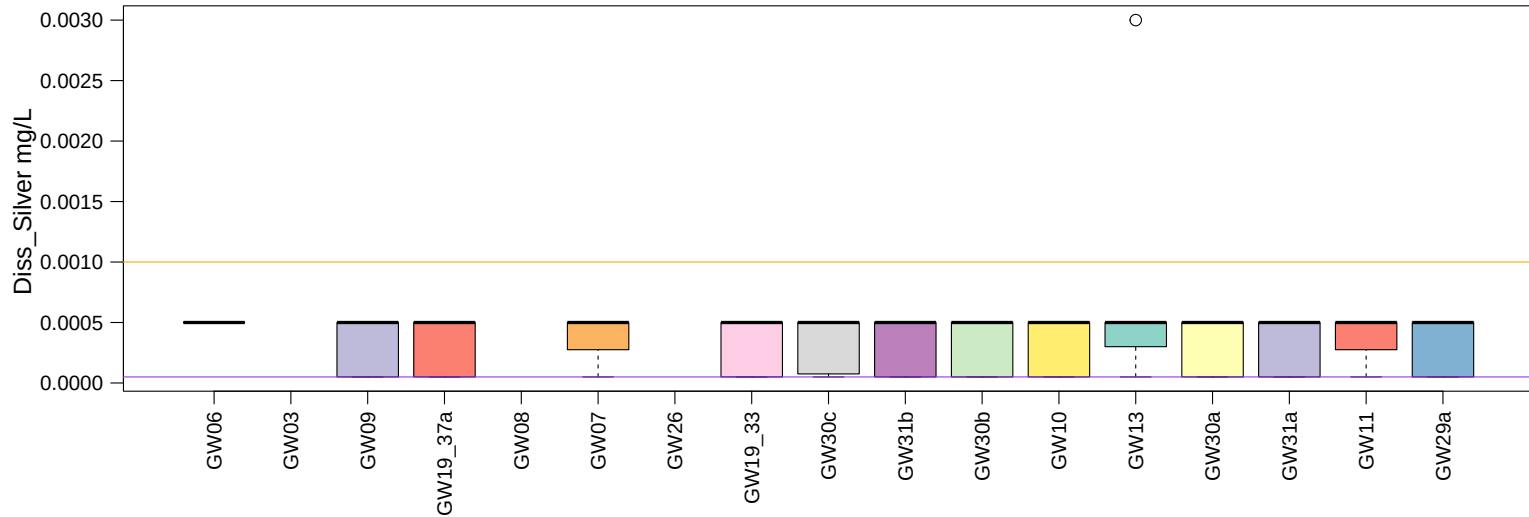
ANZECC Livestock Drinking Water Quality Guideline = 0.002 mg/L (out of range)





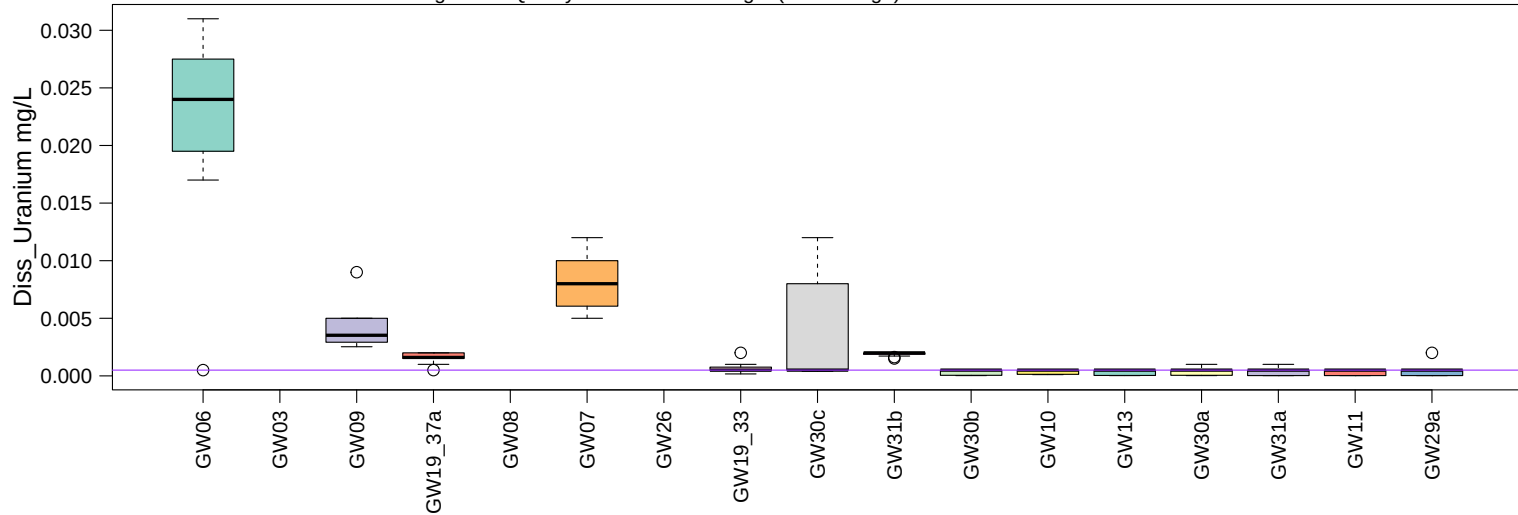
ANZG (2018) Aquatic Ecosystem Protection (no level defined) = 0.00005 mg/L

LOR prior to December 2023 = 0.001 mg/L

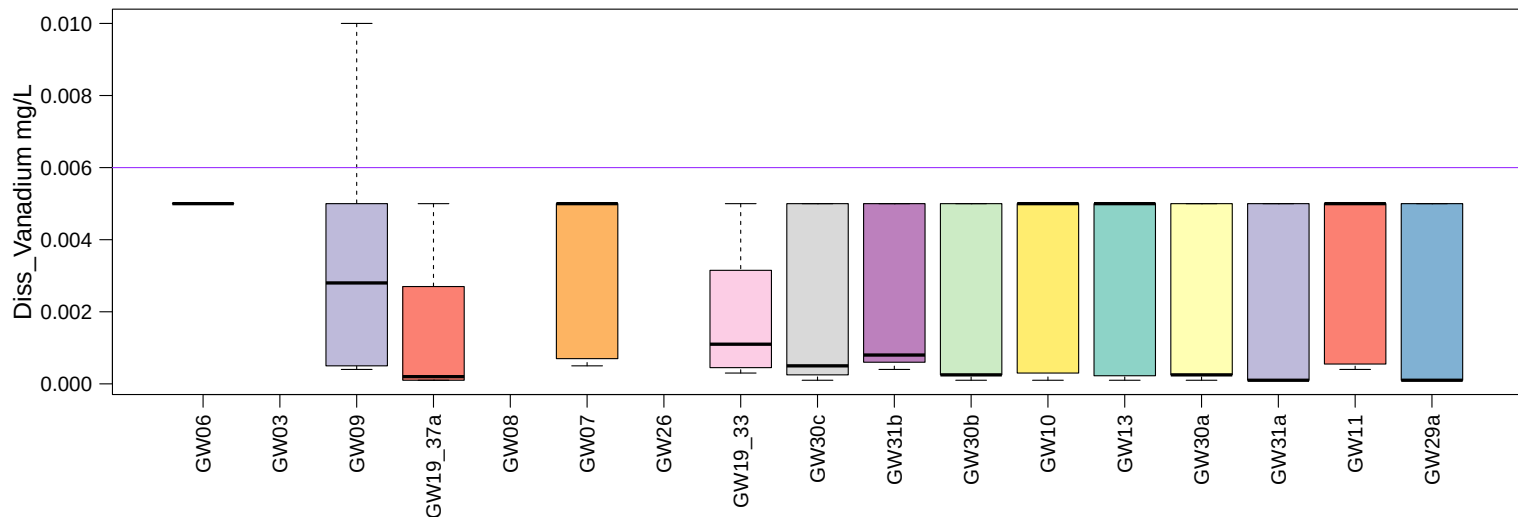


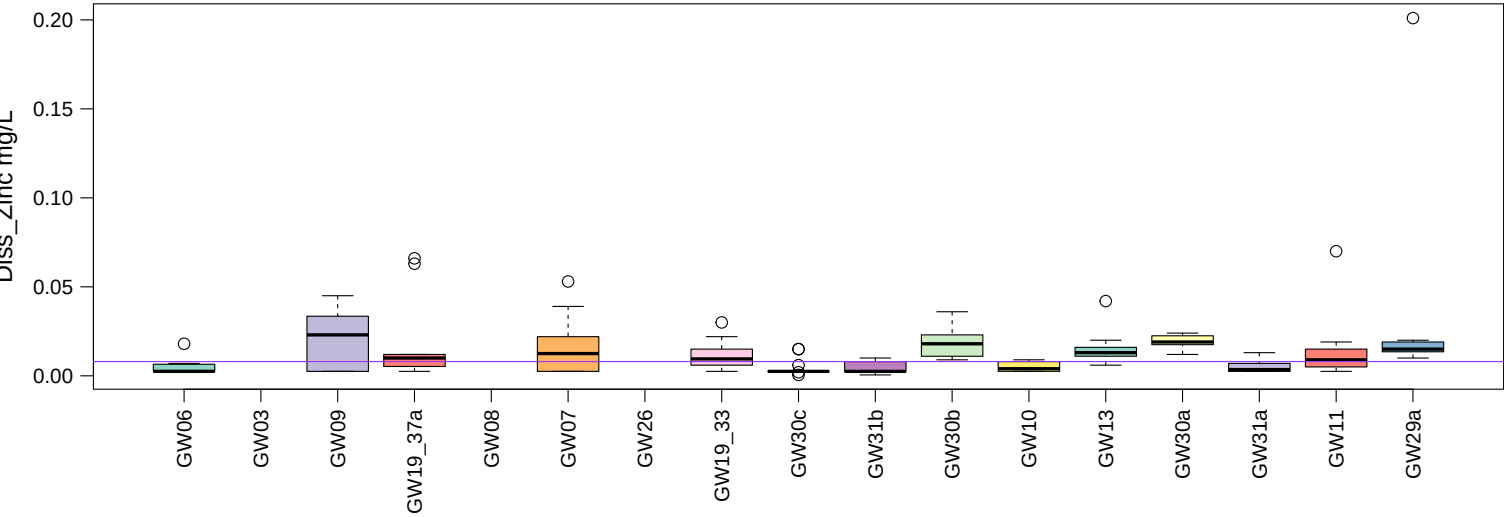
ANZG (2018) Aquatic Ecosystem Protection (no level defined) = 0.0005 mg/L

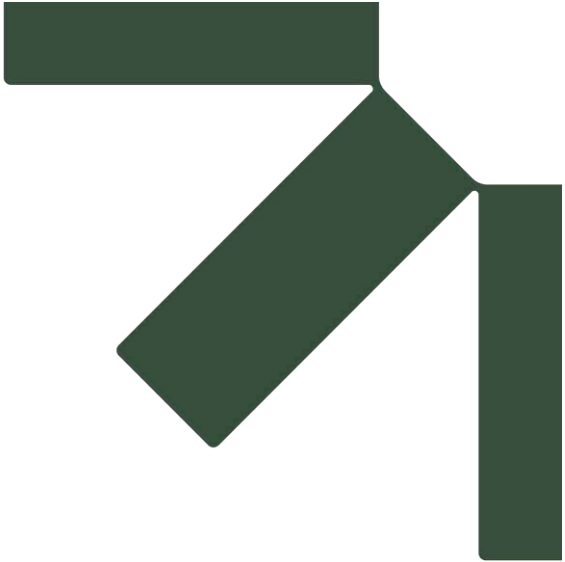
ANZECC Livestock Drinking Water Quality Guideline = 0.2 mg/L (out of range)



ANZG (2018) Aquatic Ecosystem Protection (no level defined) = 0.006 mg/L







Appendix D Water Quality Summary Statistics (Outliers Removed) and Limit Derivation

Groundwater Compliance 2024 Updated Limit and Trigger Development

New Lenton Coal Project

Lenton Joint Venture

SLR Project No.: 620.040927.00001

25 September 2024

Analyte	pH (Field)	Lab_EC	Calcium	NH3-N	SO4	Al (dias)	As (dias)	B (dias)	Cd (dias)	Co (dias)	Cr (dias)	Cu (dias)	Hg (dias)	Pb (dias)	Mn (dias)	Mo (dias)	Ni (dias)	Ag (dias)	Se (dias)	U (dias)	V (dias)	Zn (dias)
Unit	-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Default Guideline	6.5 - 8.5	720	1000	0.9*	25	0.055 ^a	0.013*	0.94*	0.0002	0.0014*	0.001**	0.0014*	0.00006 ^a	0.0034*	1.9*	0.034*	0.011*	0.00005*	0.005*	0.0005*	0.006*	0.008*
Bore	Statistics																					
GW06	Total Number	9	8	11	3	11	8	7	7	6	7	7	8	8	7	0	7	7	8	7	7	7
GW06	from	01-02-2014	20-02-2014	20-02-2014	01-03-2017	20-02-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	
GW09	to	23-03-2020	24-03-2020	24-03-2020	01-06-2018	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	03-12-2019	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	24-03-2020	
GW06	Min	6.8	2820	33	0.03	0.5	0.005	5.00E-04	0.05	5.00E-05	0.0005	5.00E-04	5.00E-05	5.00E-04	0.0005	N/A	0.0005	5.00E-04	0.005	0.0005	0.0025	
GW06	5th %ile	6.8	2834	34	0.031	0.5	0.005	6.50E-04	0.185	5.00E-05	5.00E-04	0.0005	5.00E-04	5.00E-05	5.00E-04	0.01565	N/A	0.0005	5.00E-04	0.005	0.00545	
GW06	20th %ile	7.0	3652	44	0.034	0.5	0.005	1.20E-03	0.514	0.00005	5.00E-04	0.0005	5.00E-05	5.00E-04	0.053	N/A	0.0006	5.00E-04	0.005	0.018	0.005	
GW06	Median	7.2	6105	68	0.04	1.4	0.005	2.00E-03	1.13	5.00E-05	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.076	N/A	0.002	5.00E-04	0.005	0.024	
GW06	80th %ile	7.4	12828	79	0.046	52	0.005	4.80E-03	1.526	0.00005	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	1.0364	N/A	0.0028	5.00E-04	0.005	0.029	
GW06	95th %ile	7.4	16115	316	0.049	128	0.005	0.0057	1.737	5.00E-05	5.00E-04	0.0005	0.00085	5.00E-05	5.00E-04	1.345	N/A	0.0005	0.0005	0.0307	0.005	
GW06	Max	7.4	16500	321	0.05	341	0.005	0.006	1.8	5.00E-05	5.00E-04	0.0005	0.001	5.00E-05	5.00E-04	1.39	N/A	0.008	0.0005	0.005	0.031	
GW06	Tau	0.25	0.93	0.49	0.04	1.05	0.20	0.33	1.00	1.00	1.00	0.18	1.00	1.00	0.71	N/A	0.45	1.00	1.00	0.24	1.00	
GW06	2-sided-p	0.40	0.00	0.04	N/A	0.08	1.00	0.65	0.37	1.00	1.00	0.80	1.00	1.00	0.04	N/A	0.22	1.00	1.00	0.55	1.00	
GW06	Trend	No	Upward	Upward	N/A	No	No	No	No	No	No	No	No	No	Upward	N/A	No	No	No	No	No	
GW06	Number of Obs Below LOR	0	0	0	0	5	8	1	0	7	6	7	6	8	8	1	0	2	7	8	1	
GW06	Percent Below LOR	0%	0%	0%	0%	45%	100%	14%	0%	100%	100%	100%	86%	100%	100%	14%	0%	29%	100%	100%	14%	
GW06	Limit Derivation Considerations																					
GW06	Limit development not possible due to insufficient number of samples				x				x	x	x	x				x	x	x	x		x	
GW06	Limit development not possible due to more than 15% of values <LOR																					
GW06	Limit development not possible due to trend		x	x		x																
GW06	Proposed Limits	8.5	TBD	TBD	0.9	TBD	0.055	0.013	TBD	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	
GW03	Total Number	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GW03	from	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	to	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	Min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	5th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	20th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	Median	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	80th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	95th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	Max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	Tau	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	2-sided-p	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	Trend	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	Number of Obs Below LOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	Percent Below LOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
GW03	Limit Derivation Considerations																					
GW03	Limit development not possible due to insufficient number of samples	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
GW03	Limit development not possible due to more than 15% of values <LOR																					
GW03	Limit development not possible due to trend																					
GW03	Proposed Limits	8.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006
GW09	Total Number	7	9	11	4	11	7	7	6	7	5	7	6	7	6	3	7	5	7	6	6	
GW09	from	01-02-2015	20-02-2014	20-02-2014	01-03-2017	20-02-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	29-10-2023	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	
GW09	to	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	08-12-2023	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	04-02-2024	
GW09	Min	6.8	875	46	0.04	14	0.0025	5.00E-04	0.14	2.50E-05	1.00E-04	0.0001	2.50E-05	5.00E-05	0.0707	1.00E-03	0.0005	5.00E-05	0.0001	0.00253	0.0005	
GW09	5th %ile	6.8	1077	47	0.040	19	0.0025	9.50E-04	0.16	2.50E-05	1.20E-04	0.0001	3.12E-04	2.00E-05	0.071295	1.00E-03	0.0005	5.00E-05	0.0001	0.004975	0.0005	
GW09	20th %ile	6.8	1518	48	0.064	25	0.0025	2.00E-03	0.22	0.000025	1.80E-04	0.00012	0.0005	2.00E-05	5.00E-05	0.0732	1.24E-03	0.0006	5.00E-05	0.0001	0.00292	
GW09	Median	6.9	2830	74	0.115	34	0.005	2.60E-03	0.2215	5.00E-05	5.00E-04	0.0005	0.0015	5.00E-05	5.00E-04	0.1765	1.60E-03	0.0015	5.00E-04	0.005	0.00325	
GW09	80th %ile	7.1	4382	101	0.574	36	0.005	2.98E-03	0.255	0.00005	5.00E-04	0.0005	0.0020	5.00E-05	5.00E-04	0.308	0.00196	0.00178	5.00E-04	0.005	0.005	
GW09	95th %ile	7.1	4586	107	1.051	42	0.005	6.0079	0.26025	1.55E-04	5.00E-04	0.0005	0.002075	5.00E-05	5.00E-04	0.344	0.00214	0.00264	0.0005	0.008	0.00875	
GW09	Max	7.2	4870	109	1.21	42	0.005	0.01	0.27	2.00E-04	5.00E-04	0.0005	0.003	5.00E-05	5.00E-04	0.356	0.0022	0.003	0.0005	0.009	0.01	
GW09	Tau	0.43	0.83	0.73	0.67	-0.46	-0.76	-0.29	0.69	-0.73	-0.84	-0.58	-0.07	-0.76	-0.76	-0.73	N/A	0.00	-0.77	-0.76	-0.33	
GW09	2-sided-p	0.23	0.00	0.00	0.31	0.06	0.05	0.45	0.09	0.05	0.10	0.13	1.00	0.05	0.05	0.06	N/A	1.00	0.15	0.05	0.45	
GW09	Trend	No	Upward	Upward	No	No	No	No	No	Downward	No	No	No	No	No	N/A	No	No	No	No	No	
GW09	Number of Obs Below LOR	0	0	0	0	0	7	1	0	6	3	6	2	7	7	0	0	2	5	0	2	
GW09	Percent Below LOR	0%	0%	0%	0%	0%	100%	14%	0%	86%	60%	86%	32%	100%	100%	0%	0%	29%	100%	100%	0%	
GW09	Limit Derivation Considerations																					
GW09	Limit development not possible due to insufficient number of samples	x			x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
GW09	Limit development not possible due to more than 15% of values <LOR																					
GW09	Limit development not possible due to trend		x	x																		
GW09	Proposed Limits	8.5	TBD	TBD	0.9	42	0.055	0.013	0.94	0.0002	0.0014	0.001	TBD	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	
GW19_37a	Total Number	11	11	7	6	11	9	11	10	11	10	10	10	11	10	11	8	11	10	11	7	
GW19_37a	from	17-12-2019	17-12-2019	17-12-2019	10-07-2023	24-03-2020	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	08-11-2022	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	
GW19_37a	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	
GW19_37a	Min	7.0	2110	42	0.23	3	0.0025	1.90E-03	0.19	2.50E-05	2.00E-04	0.0001	5.00E-04	2.00E-05	5.00E-05	0.208	8.00E-03	0.0005	5.00E-05	0.0001	0.0025	
GW19_37a	5th %ile	7.1																				

Analyte		pH (Field)	Lab_EC	Calcium	NH3-N	SO4	Al (dias)	As (dias)	B (dias)	Cd (dias)	Co (dias)	Cr (dias)	Cu (dias)	Hg (dias)	Pb (dias)	Mn (dias)	Mo (dias)	Ni (dias)	Ag (dias)	Se (dias)	U (dias)	V (dias)	Zn (dias)
Unit		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Default Guideline		6.5 - 8.5	720	1000	0.9*	25	0.055 ^A	0.013*	0.94*	0.0002	0.0014	0.001*	0.0014*	0.00006*	0.0034*	1.9*	0.034*	0.011*	0.00005*	0.005*	0.00054*	0.006*	0.008*
Bore	Statistics																						
	Total Number	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW08	from	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	to	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	Min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	5th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	20th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	Median	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	80th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	95th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	Max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	Tau	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	2-sided-p	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	Trend	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	Number of Obs Below LOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW08	Percent Below LOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limit Derivation Considerations																							
GW08	Limit development not possible due to insufficient number of samples	yes			yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
GW08	Limit development not possible due to more than 15% of values <LOR																						
GW08	Limit development not possible due to trend																						
GW08	Proposed Limits	6.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW07	Total Number	19	18	17	9	21	16	18	17	14	17	18	10	18	17	17	7	18	16	18	17	13	11
GW07	from	01-02-2014	20-02-2014	20-02-2014	01-03-2017	20-02-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	04-11-2014	01-05-2014	01-05-2014	08-11-2022	01-05-2014	01-05-2014	01-05-2014	01-05-2014	01-05-2014	04-11-2014	
GW07	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	27-04-2024	22-06-2024	22-06-2024	27-04-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	
GW07	Min	6.3	4590	148	0.03	8	0.0025	4.00E-04	0.2	2.50E-05	2.00E-03	0.0001	1.00E-03	2.00E-05	5.00E-05	0.278	7.00E-04	0.002	5.00E-05	0.0001	0.005	0.0005	0.012
GW07	5th %ile	6.3	4590	148.8	0.034	8	0.0025	4.00E-04	0.2	2.50E-05	2.00E-03	0.0001	1.00E-03	2.00E-05	5.00E-05	0.284	1.00E-03	0.002	5.00E-05	0.0001	0.005	0.00056	0.012
GW07	20th %ile	6.7	5360	194	0.046	22	0.0025	4.00E-04	0.228	0.00025	2.00E-03	0.00014	0.00124	2.00E-05	8.00E-05	0.4066	2.00E-03	0.00394	5.00E-05	0.00014	0.00061	0.00064	0.012
GW07	Median	6.9	5935	229	0.06	28	0.005	5.00E-04	0.3	5.00E-05	3.00E-03	0.0005	0.002	5.00E-05	5.00E-04	0.527	2.48E-03	0.0065	5.00E-04	0.005	0.008	0.005	0.014
GW07	80th %ile	7.2	7420	255.4	0.118	45	0.005	5.00E-04	0.4484	0.00005	3.00E-03	0.0005	0.0002	5.00E-05	5.00E-04	1.8919	0.0059	0.00346	5.00E-04	0.005	0.00392	0.005	0.029
GW07	95th %ile	7.4	8651	271	0.178	51	0.005	0.0005	0.564	5.00E-05	0.004	0.0005	0.0040	5.00E-05	5.00E-04	1.34	0.0024	0.021	0.0005	0.005	0.012	0.005	0.038
GW07	Max	7.8	9460	277	0.21	54	0.005	0.0005	0.58	5.00E-05	4.10E-03	0.0005	0.005	5.00E-05	5.00E-04	1.78	0.0092	0.0213	0.0005	0.005	0.012	0.005	0.039
GW07	Tau	0.39	0.16	-0.27	-0.08	0.30	-0.68	-0.65	0.31	-0.66	0.29	-0.67	-0.25	-0.65	0.13	-0.20	0.24	-0.63	-0.67	0.23	-0.76	0.11	
GW07	2-sided-p	0.02	0.36	0.15	0.83	0.07	0.00	0.00	0.09	0.01	0.14	0.00	0.37	0.00	0.00	0.48	0.65	0.19	0.00	0.00	0.23	0.00	0.69
GW07	Trend	Upward	No	No	No	No	Downward	Downward	No	Downward	No	Downward	No	Downward	No	No	No	Downward	Downward	No	Downward	No	No
GW07	Number of Obs Below LOR	0	0	0	0	0	16	13	0	14	0	17	0	18	16	0	0	0	16	17	0	8	0
GW07	Percent Below LOR	0%	0%	0%	0%	0%	100%	72%	0%	100%	0%	94%	0%	100%	94%	0%	0%	0%	100%	94%	0%	62%	0%
Limit Derivation Considerations																		yes					
GW07	Limit development not possible due to insufficient number of samples						x	x		x		x		x	x			yes		x	x		x
GW07	Limit development not possible due to more than 15% of values <LOR																						
GW07	Limit development not possible due to trend																						
GW07	Proposed Limits	6.5	9661	271	0.9	51	0.055	0.013	0.94	0.0002	0.004	0.001	0.0046	0.00006	0.0034	1.9	0.034	0.021	0.00005	0.005	0.012	0.006	0.038
GW26	Total Number	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GW26	from	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	to	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Min	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	5th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	20th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Median	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	80th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	95th %ile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Max	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Tau	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	2-sided-p	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Trend	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Number of Obs Below LOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GW26	Percent Below LOR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limit Derivation Considerations																							
GW26	Limit development not possible due to insufficient number of samples	yes			yes		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
GW26	Limit development not possible due to more than 15% of values <LOR																						
GW26	Limit development not possible due to trend																						
GW26	Proposed Limits	6.5	720	1000	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.008
GW19_33	Total Number	10	10	8	6	10	10	9	9	8	10	8	9	9	10	10	9	8	10	9	10	9	7
GW19_33	from	17-12-2019	17-12-2019	17-12-2019	10-07-2023	17-12-2019	17-12-2019	24-03-2020	14-05-2023	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	17-12-2019	
GW19_33	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	
GW19_33	Min	6.8	517	41	0.02	1	0.0025	4.00E-04	0.065	2.50E-05	2.00E-04	0.0001	5.00E-04	2.00E-05	5.00E-05	0.0029	4.00E-04	0.0021	5.00E-05	0.0001	0.00017	0.0003	0.0025
GW19_33	5th %ile	6.9	526.45	43.1	0.02	1.45	0.0025	4.00E-04	0.06745	2.50E-05	2.00E-04	0.0001											

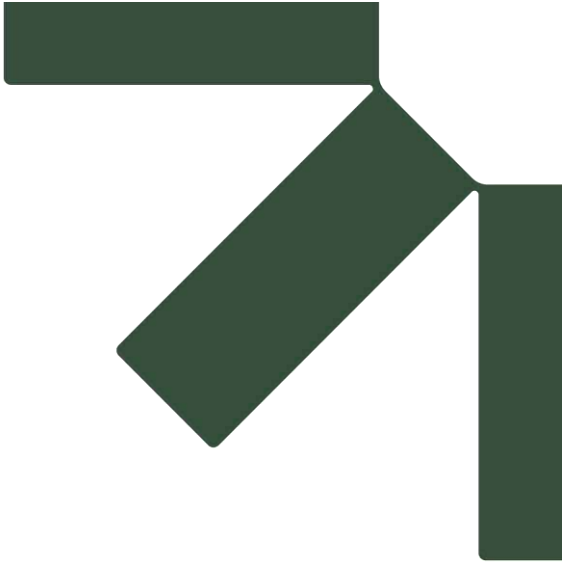
Analyte		pH	Lab_EC	Calcium	NH3-N	SO4	Al (dias)	As (dias)	B (dias)	Cd (dias)	Co (dias)	Cr (dias)	Cu (dias)	Hg (dias)	Pb (dias)	Mn (dias)	Mo (dias)	Ni (dias)	Ag (dias)	Se (dias)	U (dias)	V (dias)	Zn (dias)	
Unit		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Default Guideline		6.5 - 8.5	720	1000	0.9*	25	0.055 ^A	0.013*	0.94*	0.0002	0.0014*	0.001*	0.0014*	0.00006 ^B	0.0034*	1.9*	0.034*	0.011*	0.00005 ^C	0.005*	0.00054*	0.006*	0.008*	
Bore	Statistics																							
GW30c	Total Number	13	12	9	8	13	13	13	13	13	13	13	13	13	13	13	9	13	12	13	13	9	11	
GW30c	from	01-06-2018	09-05-2019	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	08-11-2022	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	
GW30c	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	
GW30c	Min	6.5	12300	167	0.04	25	0.0025	2.50E-04	0.28	2.50E-05	5.00E-05	0.0001	2.50E-04	2.00E-05	5.00E-05	0.0062	5.00E-05	0.00025	5.00E-05	0.0001	0.0004	0.0001	0.0005	
GW30c	5th %ile	6.6	12355	168.6	0.11	25.6	0.0025	2.50E-04	0.31	2.50E-05	8.00E-05	0.00019	2.50E-04	2.00E-05	5.00E-05	0.07048	1.50E-04	0.0004	5.00E-05	0.00022	0.00046	0.00016	0.00125	
GW30c	20th %ile	6.7	12600	178.8	0.276	32.4	0.0025	4.40E-04	0.3748	0.000035	1.00E-04	0.00035	2.00E-05	1.00E-04	0.0772	3.60E-04	0.0005	6.00E-05	0.00094	0.0005	0.00025	0.00025	0.0025	
GW30c	Median	6.9	14400	226	0.39	43	0.005	5.00E-04	0.4	5.00E-05	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.163	4.00E-04	0.001	5.00E-04	0.005	0.0005	0.0005	0.0025	
GW30c	80th %ile	7.0	15040	334	0.676	98.8	0.005	5.00E-04	0.6064	0.00005	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.2236	0.0005	0.00188	5.00E-04	0.005	0.000138	0.005	0.0025	
GW30c	95th %ile	7.5	15875	357	0.9175	185	0.015	0.00076	0.6596	1.00E-04	7.00E-04	0.0005	0.0007	5.00E-05	5.00E-04	0.3076	0.002	0.0024	0.0005	0.005	0.010308	0.005	0.00425	
GW30c	Max	7.9	16700	372	0.97	198	0.03	0.001	0.68	1.00E-04	1.00E-03	0.0005	0.001	5.00E-05	5.00E-04	0.31	0.003	0.003	0.0005	0.005	0.012	0.005	0.006	
GW30c	Tau	-0.25	-0.03	0.08	0.14	-0.01	-0.61	-0.47	0.89	0.07	0.74	0.55	0.49	-0.72	-0.57	-0.22	-0.85	0.04	-0.84	-0.80	-0.84	-0.85	-0.44	
GW30c	2-sided-p	0.27	0.95	0.83	0.71	1.00	0.01	0.05	0.71	0.83	0.90	0.02	0.05	0.90	0.62	0.33	0.90	0.90	0.01	0.01	0.90	0.93	0.11	
GW30c	Trend	No	No	No	No	No	Downward	Downward	No	Downward	Downward	Downward	Downward	Downward	Downward	No	Downward	No	Downward	Downward	No	Downward	No	
GW30c	Number of Obs Below LOR	0	0	0	0	0	12	9	0	13	10	11	12	13	13	0	4	6	12	11	6	7	9	
GW30c	Percent Below LOR	0%	0%	0%	0%	0%	92%	69%	0%	100%	77%	85%	92%	100%	100%	0%	44%	46%	100%	85%	46%	78%	82%	
GW30c	Limit Derivation Considerations																							
GW30c	Limit development not possible due to insufficient number of samples																							
GW30c	Limit development not possible due to more than 15% of values <LOR																							
GW30c	Limit development not possible due to trend																							
GW30c	Proposed Limits	6.5	15875	357	0.9	185	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	TBD	0.006	0.008	
GW31b	Total Number	13	12	9	7	13	13	13	13	13	13	13	12	13	13	13	9	13	12	13	13	9	13	
GW31b	from	01-06-2018	09-05-2019	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	08-11-2022	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	
GW31b	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	
GW31b	Min	6.6	2290	74	0.02	6	0.0025	1.00E-04	0.2	2.50E-05	5.00E-05	0.0001	2.50E-04	2.00E-05	5.00E-05	0.0013	4.00E-04	0.0005	5.00E-05	0.0001	0.00151	0.0004	0.0005	
GW31b	5th %ile	6.7	2339.5	74.4	0.035	8.4	0.0025	1.00E-04	0.2294	2.50E-05	5.00E-05	0.0001	2.50E-04	2.00E-05	5.00E-05	0.00232	4.40E-04	0.0005	5.00E-05	0.0001	0.001582	0.00044	0.0014	
GW31b	20th %ile	6.8	2454	75	0.076	11.4	0.0025	1.00E-04	0.252	0.000025	5.00E-05	0.0002	0.00025	2.00E-05	5.00E-05	0.009	5.00E-04	0.0005	5.00E-05	0.0001	0.001784	0.00056	0.0025	
GW31b	Median	6.9	2625	85	0.14	15	0.005	5.00E-04	0.27	5.00E-05	5.00E-04	0.0005	0.0005	5.00E-04	0.0005	5.00E-04	0.028	5.00E-04	0.0007	5.00E-04	0.005	0.002	0.0008	0.0025
GW31b	80th %ile	7.5	2638	88	0.248	15.6	0.005	5.00E-04	0.2692	0.00005	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.0462	0.00074	0.0014	5.00E-04	0.005	0.002	0.005	0.0086	
GW31b	95th %ile	7.8	2739	90	0.533	16.9	0.015	0.0005	0.31	7.00E-05	5.00E-04	0.0005	0.000725	5.00E-05	5.00E-04	0.06844	0.00272	0.0008	0.0005	0.005	0.002	0.005	0.01	
GW31b	Max	7.9	2860	92	0.85	18	0.03	0.0005	0.325	1.00E-04	5.00E-04	0.0005	0.001	5.00E-05	5.00E-04	0.0666	0.004	0.0028	0.0005	0.005	0.002	0.005	0.01	
GW31b	Tau	-0.40	0.66	0.29	0.52	-0.46	-0.61	-0.65	0.005	-0.55	-0.75	-0.62	-0.75	-0.72	-0.48	0.06	0.59	-0.70	-0.72	-0.61	-0.71	-0.20	-0.41	
GW31b	2-sided-p	0.07	0.00	0.34	0.13	0.04	0.01	0.01	0.71	0.03	0.00	0.01	0.00	0.00	0.00	0.03	0.91	0.01	0.01	0.01	0.01	0.02	0.41	
GW31b	Trend	No	Upward	No	No	Downward	Downward	Downward	No	Downward	Downward	Downward	Downward	Downward	Downward	Upward	No	Upward	Downward	Downward	Downward	Downward	No	
GW31b	Number of Obs Below LOR	0	0	0	0	0	12	12	0	12	12	10	13	13	13	0	3	6	12	13	0	4	6	
GW31b	Percent Below LOR	0%	0%	0%	0%	0%	92%	92%	0%	92%	92%	77%	92%	100%	100%	0%	33%	46%	100%	100%	0%	44%	46%	
GW31b	Limit Derivation Considerations																							
GW31b	Limit development not possible due to insufficient number of samples																							
GW31b	Limit development not possible due to more than 15% of values <LOR																							
GW31b	Limit development not possible due to trend																							
GW31b	Proposed Limits	6.5	2739	90	0.9	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.002	0.006	TBD	
GW30b	Total Number	13	12	9	8	11	13	10	12	13	12	13	13	13	13	13	9	11	12	13	13	9	13	
GW30b	from	01-06-2018	09-05-2019	01-06-2018	01-06-2018	03-12-2019	01-06-2018	01-06-2018	01-06-2018	09-05-2019	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	08-11-2022	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	01-06-2018	
GW30b	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	
GW30b	Min	6.5	16800	437	3.22	0.5	0.0025	2.50E-04	0.273	2.50E-05	1.00E-04	0.0002	2.50E-04	2.00E-05	5.00E-05	0.081	5.00E-05	0.0014	5.00E-05	0.0001	0.000025	0.0001	0.009	
GW30b	5th %ile	6.5	16800	448.2	3.227	0.5	0.0025	2.50E-04	0.27885	4.00E-05	1.00E-04	0.00023	4.00E-04	2.00E-05	8.00E-05	0.0876	2.50E-04	0.00145	5.00E-05	0.00084	0.00004	0.00015	0.0005	
GW30b	20th %ile	6.7	16800	589.4	3.284	0.5	0.0025	4.50E-04	0.3012	0.00005	2.00E-04	0.0005	0.0005	2.00E-05	1.00E-04	0.101	5.00E-04	0.0019	5.00E-05	0.001	0.00005	0.00025	0.011	
GW30b	Median	7.0	17200	552	3.48	4	0.005	9.50E-04	0.329	5.00E-05	5.00E-04	0.0005	0.0005	5.00E-05	5.00E-04	0.105	1.00E-03	0.002	5.00E-04	0.005	0.0005	0.00025	0.018	
GW30b	80th %ile	7.2	17560	617	3.604	5	0.01	1.20E-03	0.3568	0.0001	5.00E-04	0.0005	0.002	5.00E-05	5.00E-04	0.1136	0.00212	0.005	5.00E-04	0.005	0.0005	0.005	0.0236	
GW30b	95th %ile	7.6	18285	679	3.9	16.5	0.022	0.00255	0.3767	1.00E-04	5.00E-04	0.0005	0.003	7.00E-05	5.00E-04	0.1144	0.00302	0.007	0.0005	0.005	0.0005	0.005	0.029	
GW30b	Max	7.8	19000	705	4.01	18	0.04	0.003	0.38	1.00E-04	5.00E-04	0.0005	0.003	1.00E-04	5.00E-04	0.118	0.005	0.008	0.0005	0.005	0.005	0.005	0.036	
GW30b	Tau	-0.45	0.13	-0.44	0.07	-0.84	-0.44	-0.58	-0.14	0.44	-0.67	-0.65	-0.23	-0.38	-0.65	0.52	-0.37	-0.60	-0.70	-0.65	-0.65	-0.61	-0.13	
GW30b	2-sided-p	0.04	0.63	0.12	0.90	0.00	0.06	0.03	0.58	0.07	0.01	0.01	0.34	0.13	0.01	0.02	0.21	0.01	0.01	0.01	0.01	0.05	0.58	
GW30b	Trend	Downward	No	No	No	Downward	No	Downward	No	Downward	Downward	Downward	No	No	Downward	Upward	No	Downward	Downward	Downward	Downward	Downward	No	
GW30b	Number of Obs Below LOR	0	0	0	0	5	8	3	0	13	9	12	8	13	13	0	2	0	12	13	13	9	0	
GW30b	Percent Below LOR	0%	0%	0%	0%	45%	62%	30%	0%	100%	75%	92%	62%	100%	100%	0%	22%	0%	100%	100%	100%	100%	0	
GW30b	Limit Derivation Considerations																							
GW30b	Limit development not possible due to insufficient number of samples																							
GW30b	Limit development not possible due to more than 15% of values <LOR																							
GW																								

Yellow highlight indicates 80th Percentile is above relevant guideline	Notes:
DEHP (2011) Isaac River Sub Basin Surface Water WGO	N/A = Insufficient data for statistics
ANZE (2018) Aquatic ecosystem protection	p=1 = 95.3% Conservative value for AOTV used
ANZECC (2000) Stock Watering Guideline	95th species protection for slightly to moderately disturbed systems
Site specific (95th Percentile of bore specific dataset)	* No level of species protection defined
TBD = To be defined once sufficient data becomes available	** More conservative value for COV11 used
	# 99% level of protection as recommended for slightly to moderately disturbed systems (for bioaccumulating toxicants)

Analyte		pH (Field)	Lab_EC	Calcium	NH3-N	SO4	Al (diss)	As (diss)	B (diss)	Cd (diss)	Co (diss)	Cr (diss)	Cu (diss)	Hg (diss)	Pb (diss)	Mn (diss)	Mo (diss)	Ni (diss)	Ag (diss)	Se (diss)	U (diss)	V (diss)	Zn (diss)
Unit		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Default Guideline		6.5 - 8.5	720	1000	0.9*	25	0.055 [§]	0.013*	0.94*	0.0002	0.0014*	0.001*	0.0014*	0.00006*	0.0034*	1.9*	0.034*	0.011*	0.00005*	0.005*	0.0005^	0.006^	0.008*
Bore	Statistics																						
GW29a	Total Number	11	11	8	6	11	10	11	10	11	10	10	9	11	10	10	8	8	10	11	10	8	10
GW29a	from	09-05-2019	09-05-2019	09-05-2019	10-07-2023	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	14-05-2023	03-12-2019	09-05-2019	09-05-2019	09-05-2019	09-05-2019	
GW29a	to	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	22-06-2024	
GW29a	Min	7.1	8480	92	1.59	0.5	0.0025	6.00E-03	0.536	2.50E-05	5.00E-05	0.0001	2.50E-04	2.00E-05	5.00E-05	0.0288	5.00E-04	0.001	5.00E-05	0.0001	0.000025	0.0001	0.01
GW29a	5th %ile	7.1	8520	92.35	1.6125	0.5	0.0025	6.00E-03	0.5405	2.50E-05	5.00E-05	0.0001	2.50E-04	2.00E-05	5.00E-05	0.02934	1.38E-03	0.001	5.00E-05	0.0001	0.000025	0.0001	0.0109
GW29a	20th %ile	7.3	8650	97	1.68	0.5	0.0025	7.00E-03	0.5492	0.000025	9.00E-05	0.0001	0.0004	2.00E-05	5.00E-05	0.03	3.00E-03	0.00116	5.00E-05	0.0001	0.000025	0.0001	0.0128
GW29a	Median	7.5	9170	115	1.885	0.5	0.005	1.00E-02	0.5835	5.00E-05	3.50E-04	0.0003	0.0005	5.00E-05	2.75E-04	0.032	3.75E-03	0.00145	5.00E-04	0.005	0.0002625	0.0001	0.0145
GW29a	80th %ile	7.7	9530	123.6	1.92	2	0.0052	1.15E-02	0.612	0.00005	5.00E-04	0.0005	0.00068	5.00E-05	5.00E-04	0.03654	0.00404	0.00182	5.00E-04	0.005	0.0005	0.005	0.0184
GW29a	95th %ile	7.8	9870	140	1.92	3.5	0.0247	0.01555	0.6732	5.00E-05	5.00E-04	0.0005	0.00092	5.00E-05	5.00E-04	0.03991	0.004265	0.001965	0.0005	0.005	0.0005	0.005	0.02
GW29a	Max	7.9	10100	148	1.92	5	0.04	0.017	0.684	5.00E-05	5.00E-04	0.0005	0.001	5.00E-05	5.00E-04	0.0409	0.0043	0.002	0.0005	0.005	0.0005	0.005	0.02
GW29a	Tau	-0.43	-0.45	-0.36	-0.69	-0.26	-0.29	0.33	-0.04	-0.74	-0.75	-0.75	-0.22	-0.74	-0.75	0.22	0.59	0.30	-0.73	-0.60	-0.75	-0.73	0.30
GW29a	2-sided-p	0.08	0.06	0.27	0.09	0.36	0.34	0.18	0.93	0.01	0.01	0.01	0.51	0.01	0.01	0.42	0.06	0.38	0.01	0.03	0.01	0.04	0.28
GW29a	Trend	No	No	No	No	No	No	No	No	Downward	Downward	Downward	No	Downward	Downward	No	No	No	Downward	Downward	Downward	Downward	No
GW29a	Number of Obs Below LOR	0	0	0	0	8	8	0	0	11	7	10	6	11	10	0	1	0	10	10	10	8	0
GW29a	Percent Below LOR	0%	0%	0%	0%	73%	80%	0%	0%	100%	70%	100%	67%	100%	100%	0%	13%	0%	100%	91%	100%	100%	0%
GW29a	Limit Derivation Considerations																						
GW29a	Limit development not possible due to insufficient number of samples																						
GW29a	Limit development not possible due to more than 15% of values <LOR					x	x			x	x	x	x	x	x			x	x		x	x	
GW29a	Limit development not possible due to trend																						
GW29a	Proposed Limits	8.5	9870	140	TBD	25	0.055	0.013	0.94	0.0002	0.0014	0.001	0.0014	0.00006	0.0034	1.9	0.034	0.011	0.00005	0.005	0.0005	0.006	0.02

Yellow highlight indicates 80th Percentile is above relevant guideline
DEHP (2011) Isaac River Sub Basin Surface Water WQO
ANZG (2018) Aquatic ecosystem protection
ANZECC (2000) Stock Watering Guideline
Site specific (95th Percentile of bore specific dataset)
TBD = To be defined once sufficient data becomes available

Notes:
 N/A = insufficient data for statistics
 § pH >6.5 x Conservative value for As(V) used
 * 95% species protection for slightly to moderately disturbed systems
 ^ No level of species protection defined
 + More conservative value for Cr(VI) used
 # 99% level of protection as recommended for slightly to moderately disturbed systems (for bioaccumulating toxicants)



Appendix E Water Level Time Series and Level Threshold Testing

**Groundwater Compliance 2024 Updated Limit and Trigger
Development**

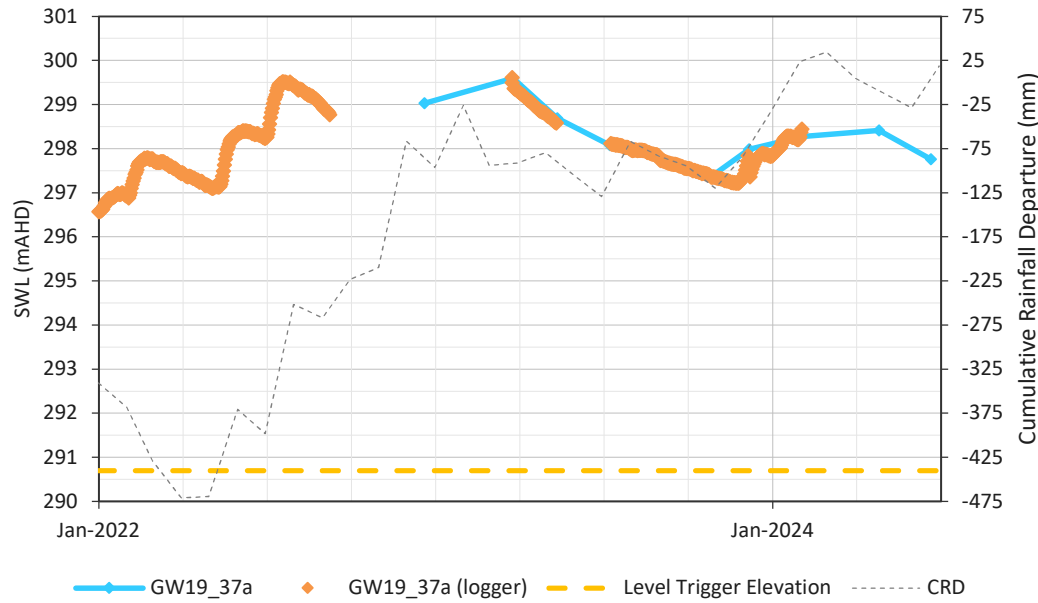
New Lenton Coal Project

Lenton Joint Venture

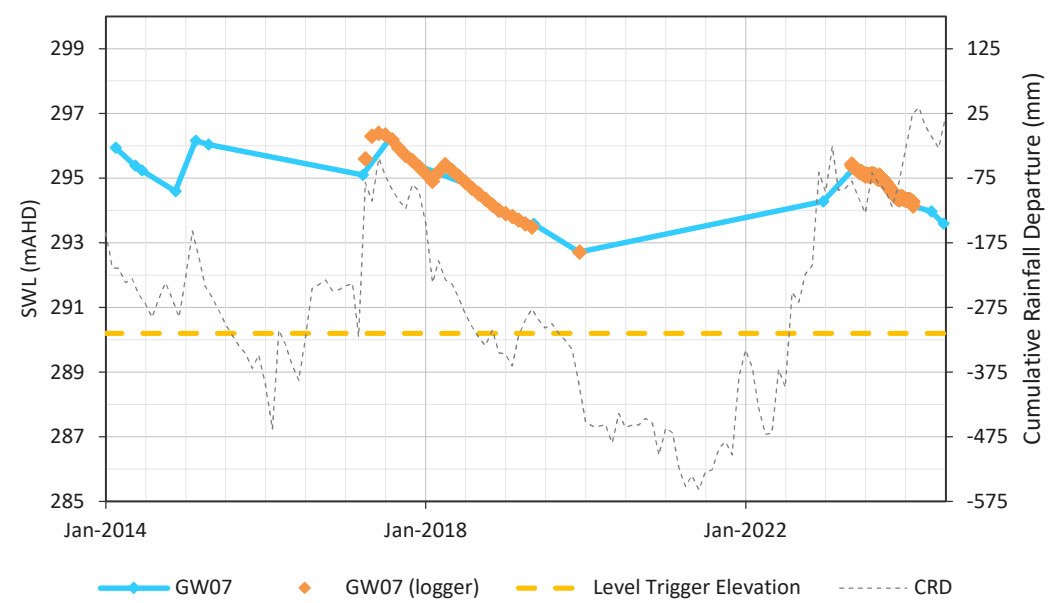
SLR Project No.: 620.040927.00001

25 September 2024

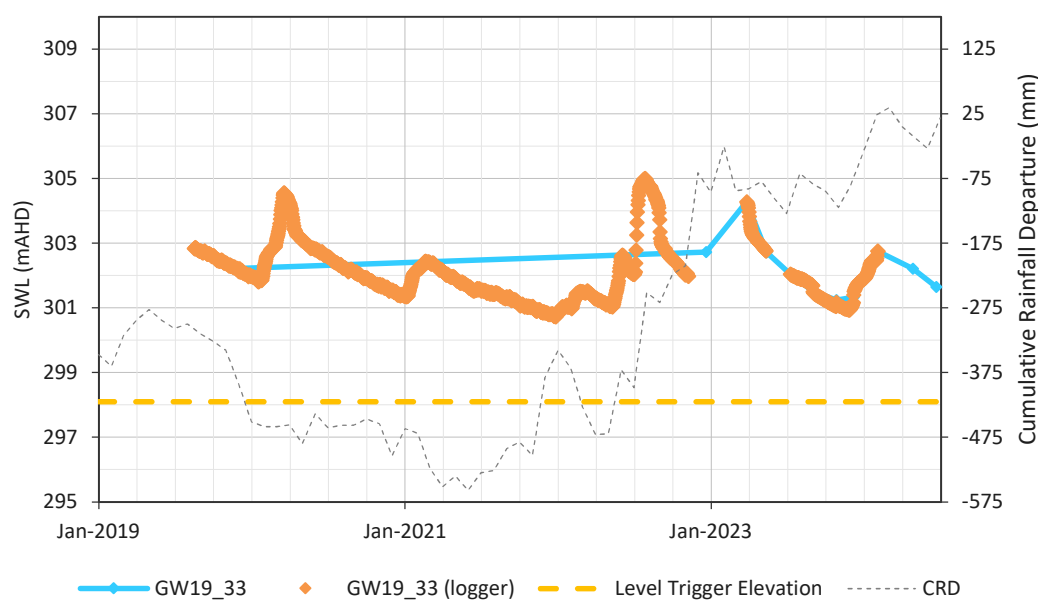
GW19_37a (Alluvium)



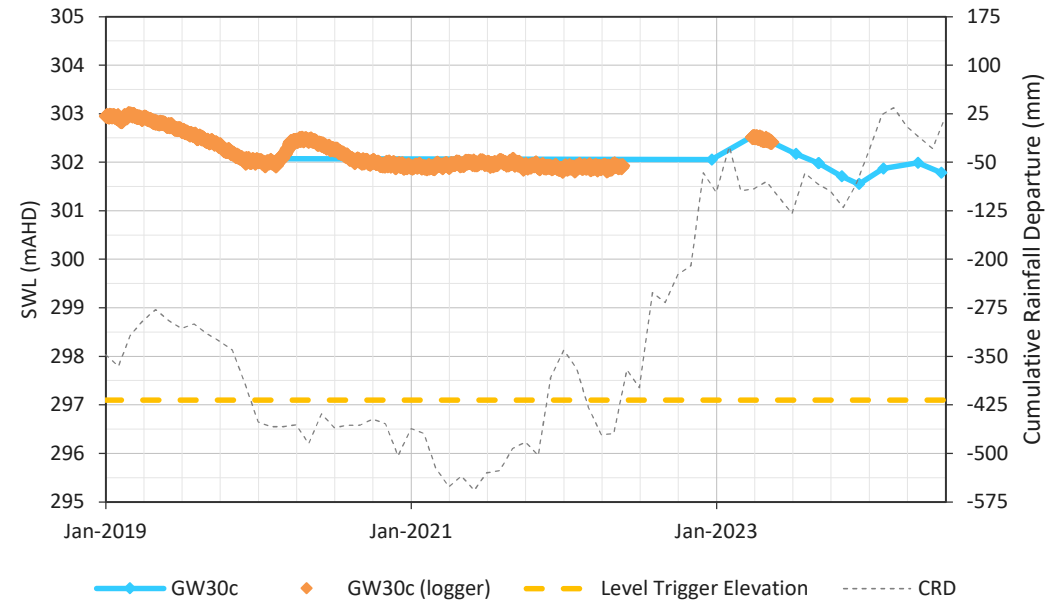
GW07 (Alluvium)



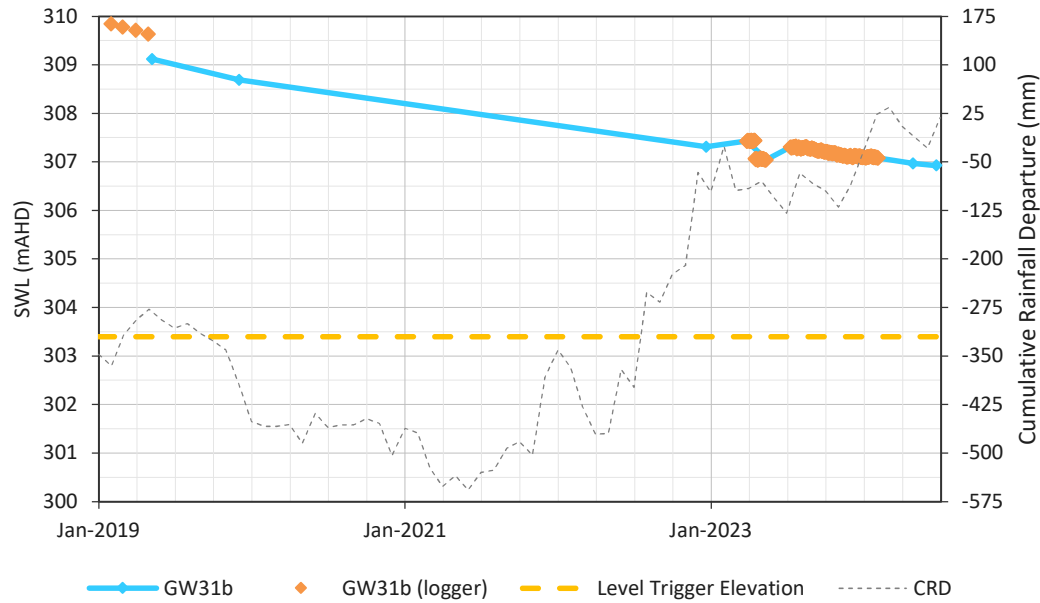
GW19_33 (Alluvium/Regolith)



GW30c (Regolith)



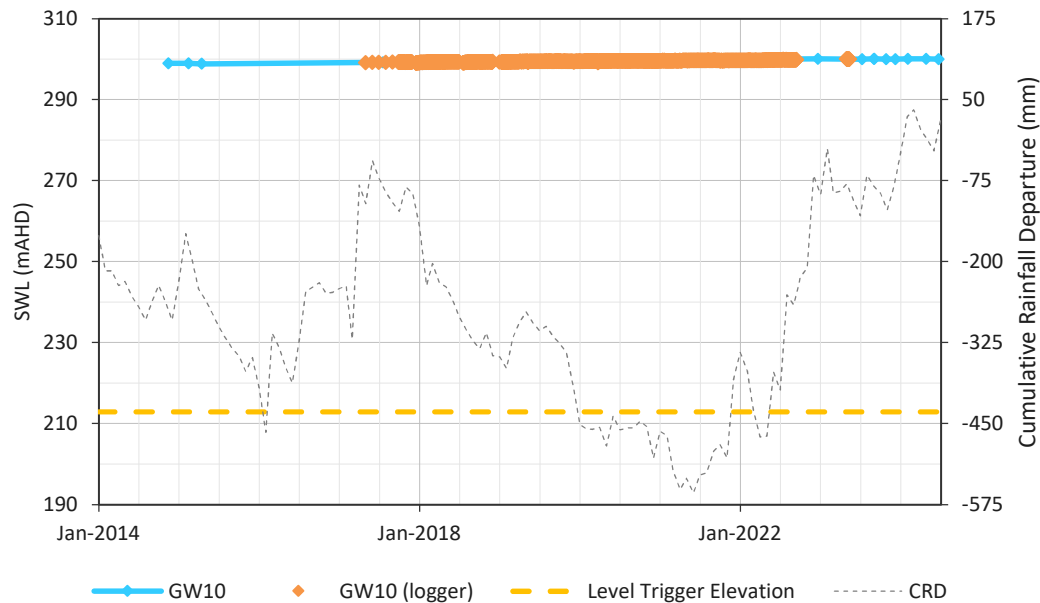
GW31b (Regolith)



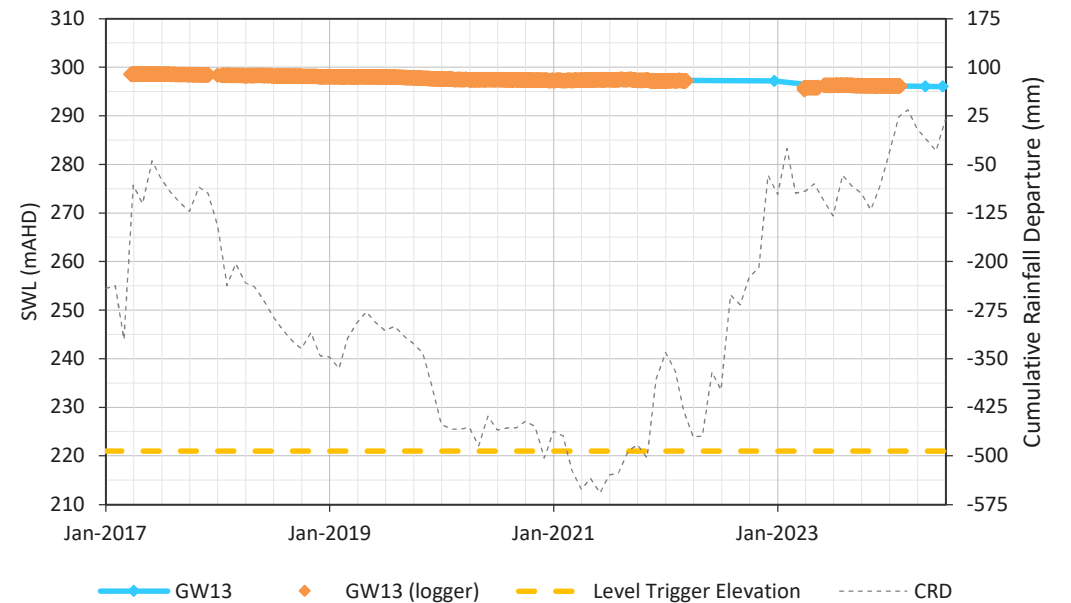
GW30b (Permian - Burton Seam)



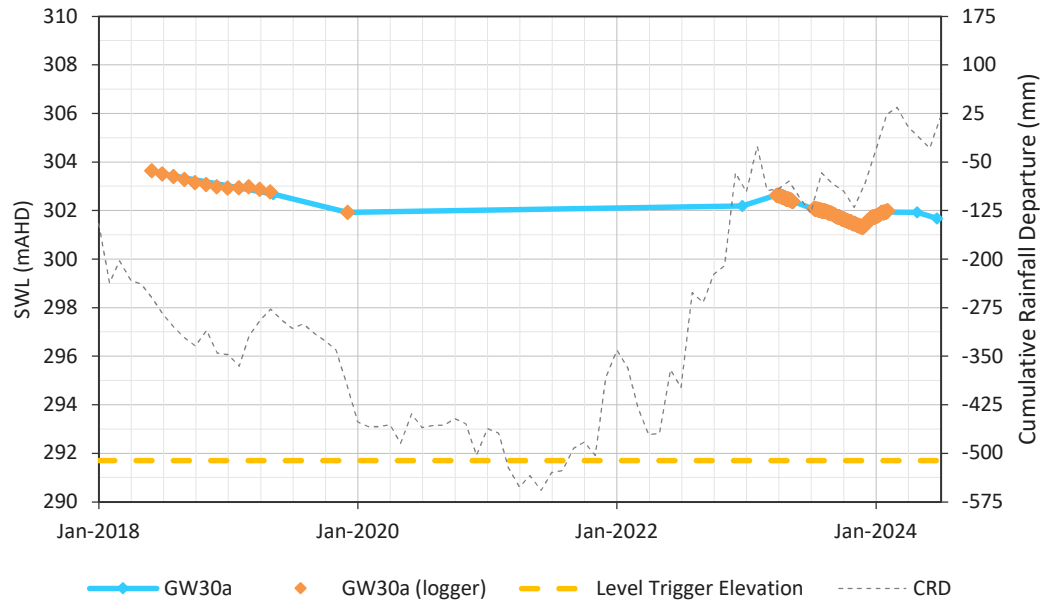
GW10 (Permian - Leichhardt/Vermont Seam)



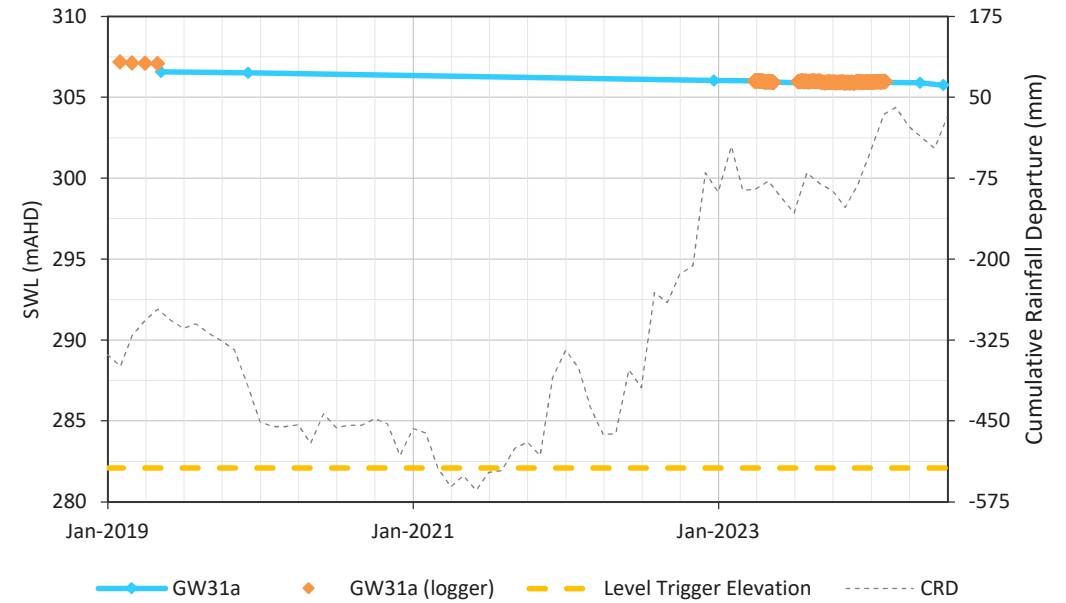
GW13 (Permian Leichhardt/Vermont Seam)



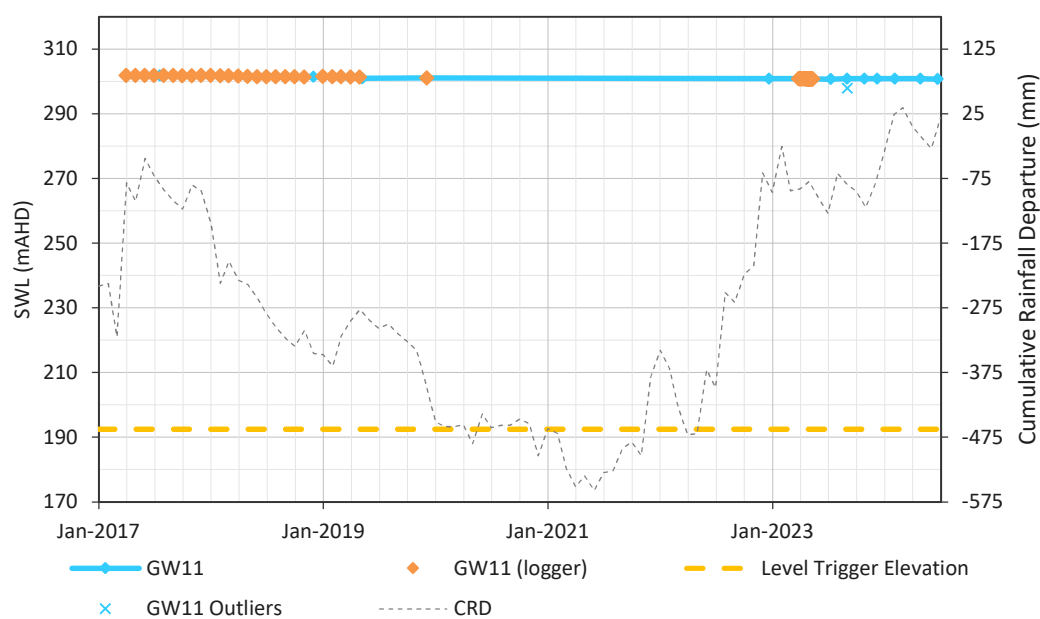
GW30a (Permian Leichhardt/Vermont Seam)



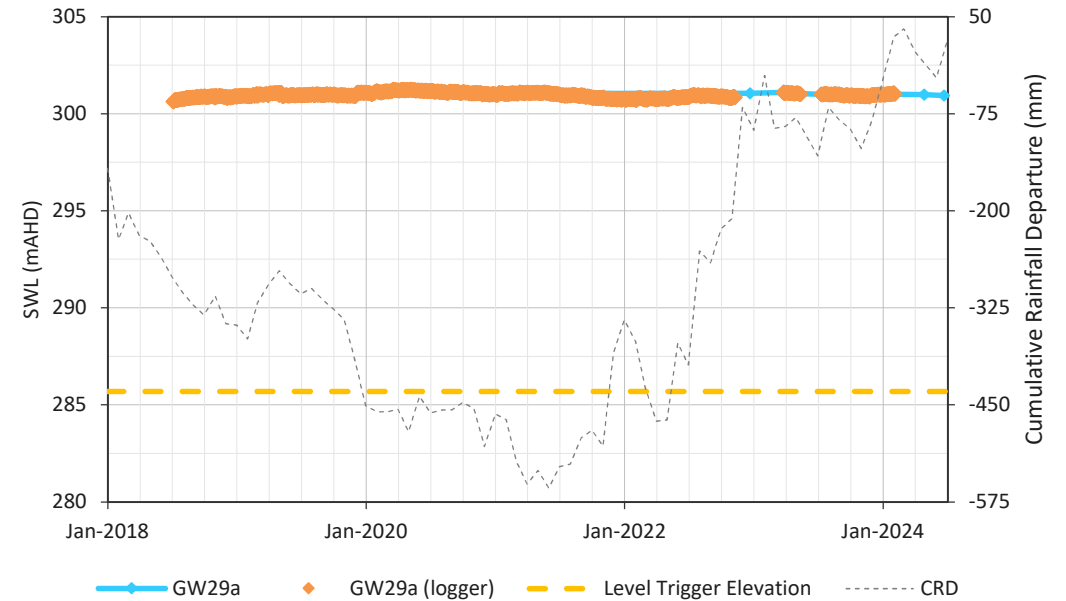
GW31a (Permian Leichhardt/Vermont Seam)

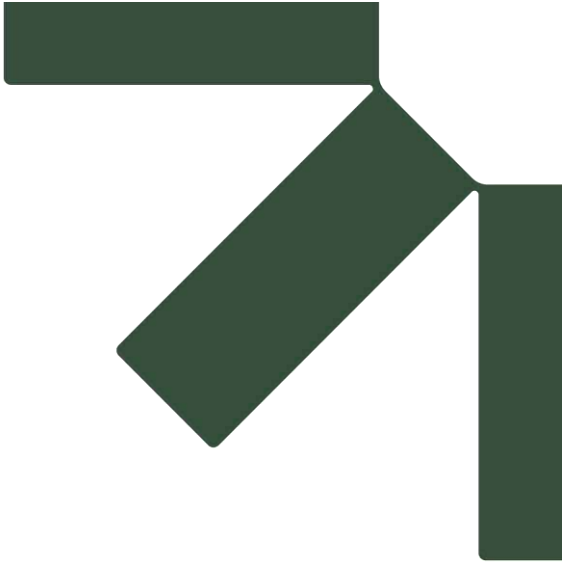


GW11 (Permian Leichhardt/Vermont Seam)



GW29a (Permian - Sandstone)





Appendix F Water Level Summary Statistics

Groundwater Compliance 2024 Updated Limit and Trigger Development

New Lenton Coal Project

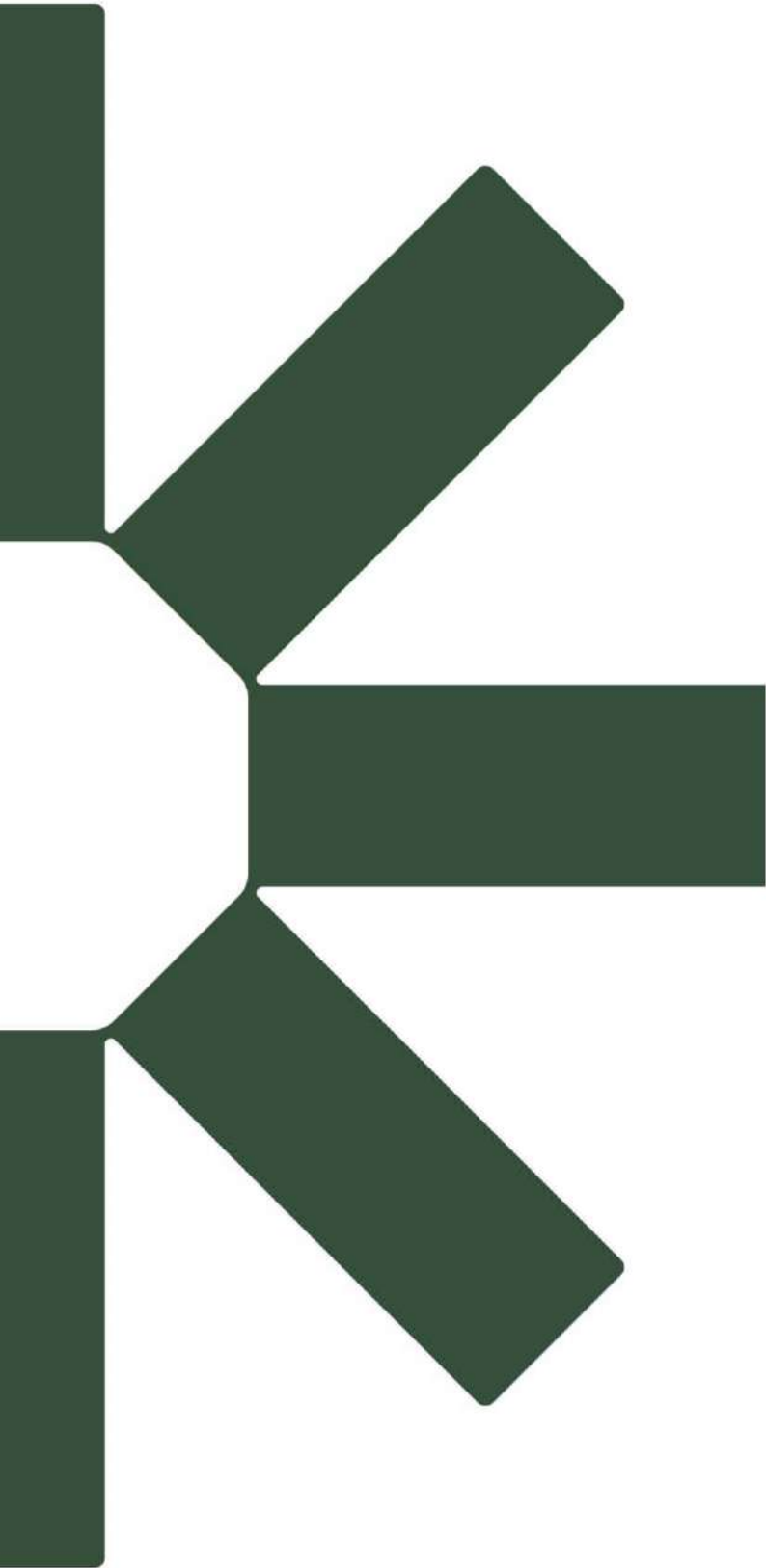
Lenton Joint Venture

SLR Project No.: 620.040927.00001

25 September 2024

Aquifer	Bore	Total Number	Statistical Outliers	from	to	Min	5th %ile	20th %ile	Median	80th %ile	95th %ile	Max	Tau	2-sided-p	Trend
Alluvium	GW06	12	1	15-02-2014	03-12-2019	302.1	302.3	302.5	302.9	303.0	303.0	303.0	-0.8	7.79E-04	Yes-Downward
Alluvium	GW03	0	0	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alluvium	GW09	16	0	15-02-2014	04-02-2024	284.2	284.6	284.9	292.1	297.1	297.5	297.8	-1.0	2.12E-07	Yes-Downward
Alluvium	GW19_37a	11	0	21-12-2022	22-06-2024	297.4	297.6	297.8	298.1	298.7	299.3	299.6	-0.3	0.2	No
Alluvium	GW08	1	0	09-05-2019	09-05-2019	295.2	295.2	295.2	295.2	295.2	295.2	295.2	na	na	na
Alluvium	GW07	23	0	15-02-2014	22-06-2024	292.7	293.6	294.0	294.8	295.4	296.1	296.2	-0.5	1.38E-03	Yes-Downward
Alluvium	GW26	0	0	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alluvium/Regolith	GW19_33	12	0	03-12-2019	22-06-2024	301.2	301.3	301.5	302.1	302.7	303.4	304.3	-0.3	0.2	No
Regolith	GW30c	13	1	09-05-2019	22-06-2024	301.6	301.6	301.8	302.0	302.3	302.6	302.8	-0.6	4.93E-03	Yes-Downward
Regolith	GW31b	13	2	09-05-2019	22-06-2024	306.9	307.0	307.1	307.3	307.4	308.9	309.1	-0.8	1.51E-04	Yes-Downward
Permian (Burton Seam)	GW30b	14	0	27-06-2018	22-06-2024	301.2	301.2	301.4	301.8	302.3	302.9	303.5	-0.4	4.25E-02	Yes-Downward
Permian (Leichhardt/Vermont Seam)	GW10	18	0	15-11-2014	22-06-2024	298.9	299.0	299.2	300.0	300.0	300.1	300.1	0.7	6.51E-05	Yes-Upward
Permian (Leichhardt/Vermont Seam)	GW13	16	0	19-07-2017	22-06-2024	296.0	296.1	296.1	296.3	298.1	298.5	298.5	-0.9	1.78E-06	Yes-Downward
Permian (Leichhardt/Vermont Seam)	GW30a	14	1	27-06-2018	22-06-2024	301.4	301.5	301.8	301.9	302.5	303.0	303.5	-0.6	4.30E-03	Yes-Downward
Permian (Leichhardt/Vermont Seam)	GW31a	13	2	09-05-2019	22-06-2024	305.8	305.8	305.9	305.9	306.0	306.5	306.6	-0.8	4.08E-04	Yes-Downward
Permian (Leichhardt/Vermont Seam)	GW11	15	3	19-07-2017	22-06-2024	300.7	300.7	300.8	300.9	301.1	301.6	301.8	-0.7	8.75E-04	Yes-Downward
Permian (sandstone)	GW29a	14	0	03-12-2018	22-06-2024	300.9	300.9	300.9	301.0	301.0	301.1	301.1	-0.2	0.4	No

N/A = Not Applicable, insufficient data to be statistically significant



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