Appendix H Isaac Downs Extension Groundwater Modelling Calibration and Prediction Report (SLR, 2026b)

Isaac Downs Extension

Groundwater Impact Assessment

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00001

28 May 2026

Isaac Downs Extension Project

Groundwater Modelling Calibration and Prediction Report

Stanmore ID Extension Pty Ltd

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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 Stanmore ID Extension Pty Ltd (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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Executive Summary

This hydrogeological assessment supports the Isaac Downs Extension (IDE) Project (the Project) for Stanmore ID Extension Pty Ltd (ID Extension), located in the Bowen Basin, Queensland. The study evaluates groundwater conditions at the end of mining and post-rehabilitation equilibrium. The assessment aligns with the Water—EIS information guideline (ESR/2020/5312) and the Applications for activities with impacts to water guideline (ESR/2015/1837) and is informed by the IESC Information Guidelines Explanatory Note – Using impact pathway diagrams based on ecohydrological conceptualisation in environmental impact assessment. The assessment integrates geological, climatic, hydrogeological, and groundwater modelling data.

Groundwater impacts associated with the Project were assessed using the latest version (2026) of the Central Bowen Basin regional numerical groundwater model, developed in MODFLOW-USG. The model incorporates an unstructured Voronoi grid with localised refinement around the Project and surrounding mining areas, allowing regional-scale cumulative impacts to be assessed while retaining sufficient resolution to represent pit dewatering, fault structures and hydrostratigraphic complexity at the Project. The model includes representation of Quaternary alluvium, regolith, Permian coal measures (including the Leichhardt and Vermont seams), interburden units and major structural features that influence groundwater connectivity and drawdown propagation.

Model calibration was undertaken using a Sequential Monte Carlo (SMC) approach, enabling robust conditioning of key hydraulic parameters while explicitly accounting for parameter uncertainty. Transient calibration covered the period 2008 to 2025 and incorporated groundwater level data from 52 monitoring locations within or proximal to the Project, providing 646 calibration targets. Calibration targeted both initial groundwater levels and changes in groundwater levels through time, ensuring the model reproduces both absolute heads and historical drawdown trends associated with existing mining. The resulting Most Likely Estimate (MLE) model demonstrates acceptable calibration performance, with mean residuals close to zero.

Predictive simulations were undertaken for three scenarios: a Null Run (no mining), an Approved scenario (approved and foreseeable regional mining), and a Proposed scenario (Approved plus the IDE Project). Mining was simulated from 2026 to 2043, followed by post-mining recovery to equilibrium. During operations, groundwater drawdown and depressurisation are predicted to be concentrated around the Project mine areas, with the largest impacts occurring within the mined coal seams. Peak incremental groundwater inflows to the IDE pit are predicted to occur in 2038 at approximately 152 ML/year. Impacts to the regolith are limited in extent, and no incremental drawdown exceeding 1 m is predicted in the alluvial aquifers.

The final landform includes a single residual void, which is predicted to persist as a long-term groundwater sink. Final void behaviour was assessed through iterative coupling of the groundwater model with a surface water balance model. Results indicate that groundwater inflows to the void will occur predominantly through backfilled spoil rather than surrounding intact geological units, with lake water levels remaining well below shallow aquifers and sufficient freeboard maintained to prevent groundwater discharge. Particle-tracking analysis confirms that groundwater flow paths are directed toward the void following mining and that water entering the void remains contained within it over the long term.

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1.0 Groundwater Modelling

1.1 Model Details

This hydrogeological modelling supports the Isaac Downs Extension (IDE) Project (the Project) for Stanmore ID Extension Pty Ltd (ID Extension), a wholly owned subsidiary of Stanmore Resources Ltd (Stanmore). The project will be integrated into Isaac Plains Complex (IOC) comprising Isaac Downs Mine (IDM) and Isaac Plains Mine (IPM).

The Central Bowen Basin regional numerical groundwater model was adopted for assessing the Project's impact on groundwater. This section provides a summary of the design and development of the numerical groundwater model (the model). Full details of the numerical groundwater model adopted in this hydrogeological assessment are included within SLR (2026a).

The model was deemed appropriate for the purposes of the Project for the following reasons:

- Adoption of the MODFLOW-USG code in the existing model allows for sufficient refinement of the model grid around the Project's proposed mining activities, such that the limitations of a regional model in terms of the grid design are mitigated;
- The model incorporates the Project's geologic model with model layer representation consistent with the geologic model;
- The stochastic model is calibrated using an extensive regional dataset, including data collected at IPC and other neighbouring mines. Calibration targets were selected from the regional dataset based on monitoring locations that are within or proximal to the Project, and the model realisation with the best fit to these targets was selected for the Project assessment;
- The model incorporates regional influences that may interact with the groundwater system (and model predictions) post-closure, including operations at the IDM and Poitrel Mine that are considered likely to interact with the Project voids given their proximity;
- The version of the model adopted for the Project is the latest update to the existing Central Bowen Basin regional numerical model that has been subject to multiple independent peer reviews, as well as State and Commonwealth regulator reviews.

1.1.1 Model Objectives

The objectives of the groundwater modelling are:

- Predict groundwater levels during the lifecycle of the Project (operation and closure) and the extent of groundwater drawdown/depressurisation due to mining at the Project and cumulatively with existing and proposed resource projects, including those at IPC.
- Predict changes in groundwater levels at identified groundwater receptors (i.e. registered bores, landholder bores, and groundwater dependent ecosystems [GDEs]), during operations and closure, due to mining at the Project and cumulatively with existing and proposed resource projects.
- Predict induced changes in water budgets including groundwater fluxes to and from alluvial sediments during Project mining operations and mine closure (via the use of zone budgets).

- Predict potential changes in surface water flow due to Project mining operations (i.e. the reduction in baseflow to or induced leakage from watercourses).
- Identify where groundwater impact mitigation/control measures may be required for the Project.
- Estimate direct water take (groundwater removed during mining) and final void inflows (groundwater fluxes to the final void post mining) of the Project.
- Estimate post-mining recovery conditions.

1.1.2 Model Design

The most recently updated (2026) version of the Central Bowen Basin regional numerical groundwater model, adopted for the Project, is designed primarily to predict regional scale mining impacts in a cumulative impact framework. That is, mines such as the Project are represented within the regional cumulative hydrogeological impact framework in which they sit.

MODFLOW-USG Transport was used as the model code (Panday, 2021). MODFLOW-USG is a version of industry standard MODFLOW code and is suitable for accomplishing the model objectives. MODFLOW-USG optimises the model grid and increases numerical stability by using unstructured, variably sized cells. Cells take any polygonal shape, with variable size allowing for refinement in areas of interest (e.g. geological or mining features).

Where previous MODFLOW versions restricted interlayer flow to vertical connectivity, MODFLOW-USG offers lateral connectivity between model layers. Lateral connectivity enables more accurate representations of hydrostratigraphic units, particularly those that pinch out, outcrop, or cross geological faults.

MODFLOW-USG is also able to simulate unsaturated conditions, allowing progressive mine dewatering and post mining rewetting to be represented by the model. For the current model, vadose zone properties have been excluded, and the unsaturated zone was simulated using the upstream-weighting method. Model layering is based on a simplified regional scale representation of the central Bowen Basin hydrogeological framework. The model layer structure is presented in **Table 1-1**.

Table 1-1 Model Layering

Model Layer	Geologic Formation	Hydrogeologic Unit	Present in Project area	Average Thickness (m)
1	Quaternary alluvium (Qa), Quaternary colluvium, Tertiary basalt (at outcrop)	Quaternary alluvium, surface cover	Yes	6.8
2	Tertiary sediments, Tertiary basalt	Tertiary sediments, weathered Permian (collectively 'regolith') Tertiary basalt	Yes	18.5
3	Rewan Group	Triassic	Yes (unit subcrops within pit area)	74.6
4	Rangal Coal Measures	Leichhardt overburden	Yes (unit subcrops within pit area)	36.2
5		Leichhardt seam	Yes (unit subcrops within pit area)	4.5
6		Interburden	Yes	34.5
7		Vermont seam	Yes	3.8
8		Vermont underburden	Yes	43.9
9	Fort Cooper Coal Measures	Fort Cooper overburden	Yes	182.3
10		Fort Cooper seams (combined)	Yes	58.1
11		Fort Cooper underburden	Yes	58.2
12	Moranbah Coal Measures	Q Seam	Yes	3.3
13		Interburden	Yes	34.8

Model Layer	Geologic Formation	Hydrogeologic Unit	Present in Project area	Average Thickness (m)
14		P Seam	Yes	2.8
15		Interburden	Yes	53.0
16		H Seam	Yes	5.4
17		Interburden	Yes	65.1
18		D Seam	Yes	8.1
19		Interburden	Yes	496.2

1.1.3 Model Discretisation, Layer Properties and Numerical Solution

The Central Bowen Basin regional groundwater model comprises 75 stress periods, including pre-mining, warm-up, steady-state and transient calibration phases. The transient calibration period spans January 2008 to December 2025 and is discretised into quarterly stress periods, consistent with the calibration dataset (SLR, 2026a).

During the calibration period, each stress period has a duration of approximately 91 days and is simulated using one time step per stress period. A maximum allowable time-step length of approximately 45 days was applied through the adaptive time-stepping configuration, with a minimum time step of 0.1 days. Adaptive time stepping was enabled to allow automatic reduction of time-step size where required for numerical stability.

The model is discretised vertically into 19 layers, and all layers are defined as convertible, allowing simulation of both confined and unconfined conditions (**Table 1-1**).

Hydraulic properties are assigned using the Layer Property Flow (LPF) formulation. Spatial variability in hydraulic parameters is represented using pilot points within defined hydrogeological zones. The LPF setup and parameterisation approach are described in the model build report (SLR, 2026a).

Groundwater flow is solved using the Sparse Matrix Solver (SMS) package in MODFLOW-USG, with the PCGU solver applied. Inner and outer convergence criteria of 0.005 and 0.05, respectively (SLR, 2026a).

1.2 Model Calibration

Model calibration was performed using a Sequential Monte Carlo (SMC) approach, which incrementally refines parameter distributions through a series of resampling and adjustment steps. This method begins with an ensemble of parameter realisations sampled from the prior distribution for each parameter, which is established on the basis of conceptual hydrogeological bounds. At each stage of calibration, the ensemble is updated by weighting realisations according to their likelihood that they result in acceptable calibration statistics with respect to the groundwater level observation dataset, followed by weighted parameter resampling. To enhance the accuracy of the posterior parameter estimates, Laplace approximations to the likelihood function were employed, allowing for more precise characterisation of parameter uncertainty around high-likelihood regions. This approach enables a more flexible and robust assimilation of groundwater level data, particularly in the presence of nonlinearity and multimodality in the parameter space.

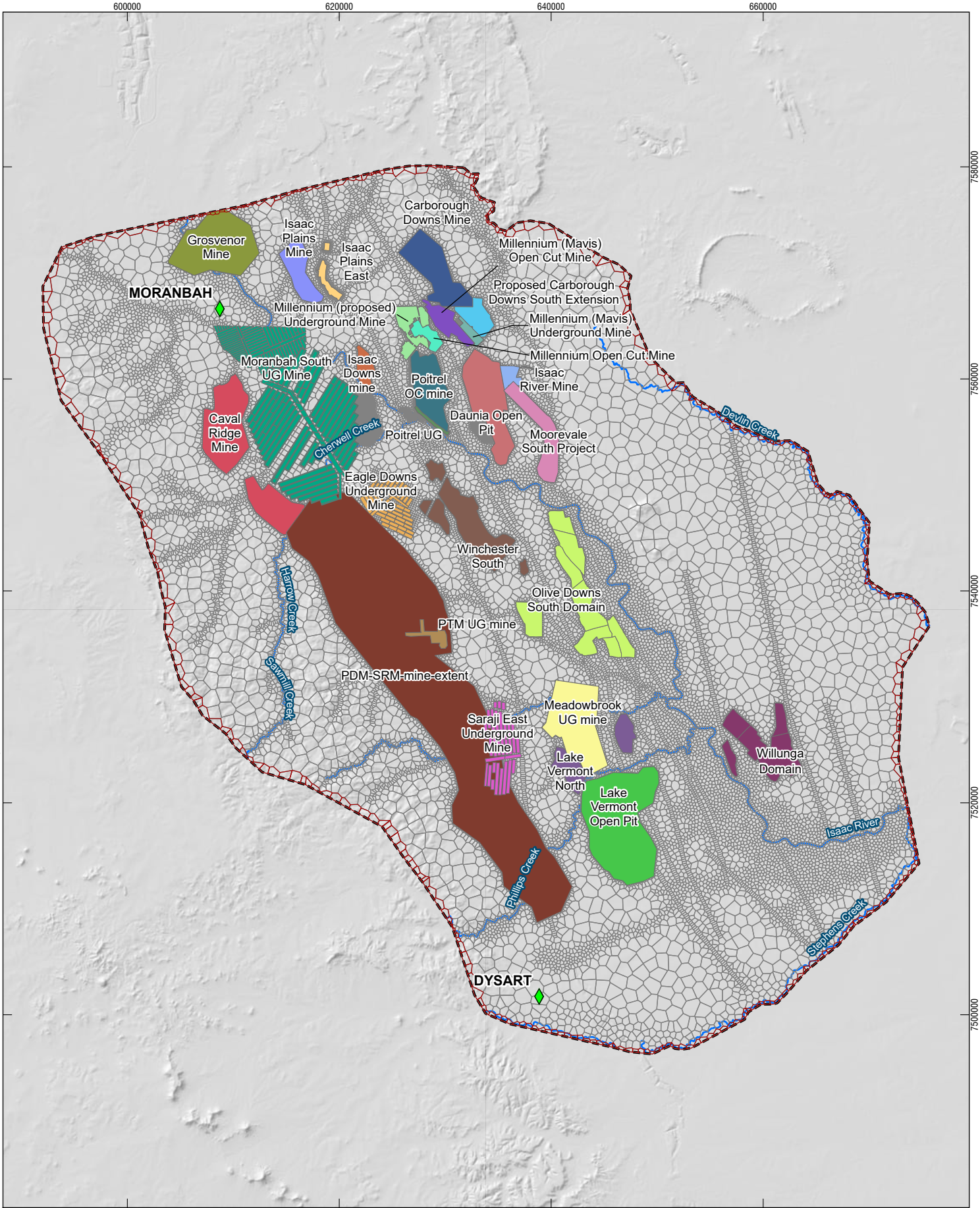
A detailed description of the calibration procedure for the most recent version of the Central Bowen Basin regional groundwater model is provided in SLR (2026a).

1.2.1 Calibration Targets

Transient calibration was undertaken for the period 2008 to 2025 and includes representation of historical mining at Daunia, Caval Ridge, Peak Downs, Saraji, Lake Vermont, Poitrel, Millennium, IPM, Olive Downs, Eagle Downs, Winchester South, IDM, Moorvale South, and Meadowbrook mines (**Figure 1-1**).

For the Project specifically, calibration targets were selected from the regional dataset on the basis of monitoring locations that are within or proximal to the Project. The resulting calibration target locations included all monitoring locations in the Project monitoring network. In all, calibration used 646 target heads for 52 monitoring locations within or near the Project with available groundwater level data (**Figure 1-2**).

The selected datasets were separated into two separate target datasets: (i) initial water level elevations (52 targets), and (ii) change in water level elevations (594 targets). The initial water level elevations are the first (i.e. earliest) groundwater level readings at each selected calibration location. The change in water level elevations are all subsequent water levels readings minus the initial water level elevation, this providing a dataset on the variability of the water levels with time. By calibrating to both datasets, the objective of calibration is to provide a balanced approach to calibration whereby the model is calibrated to both water level elevations, and the magnitude and timing of changes in water levels.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.041537
Date:	20-Apr-2026
Drawn by:	RB

- Town
- Major Drainage System
- Model Boundary
- Model Grid
- General Head Boundary

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MODEL MESH, BOUNDARY CONDITIONS AND APPROVED OPERATIONS

SLR

FIGURE 1-1

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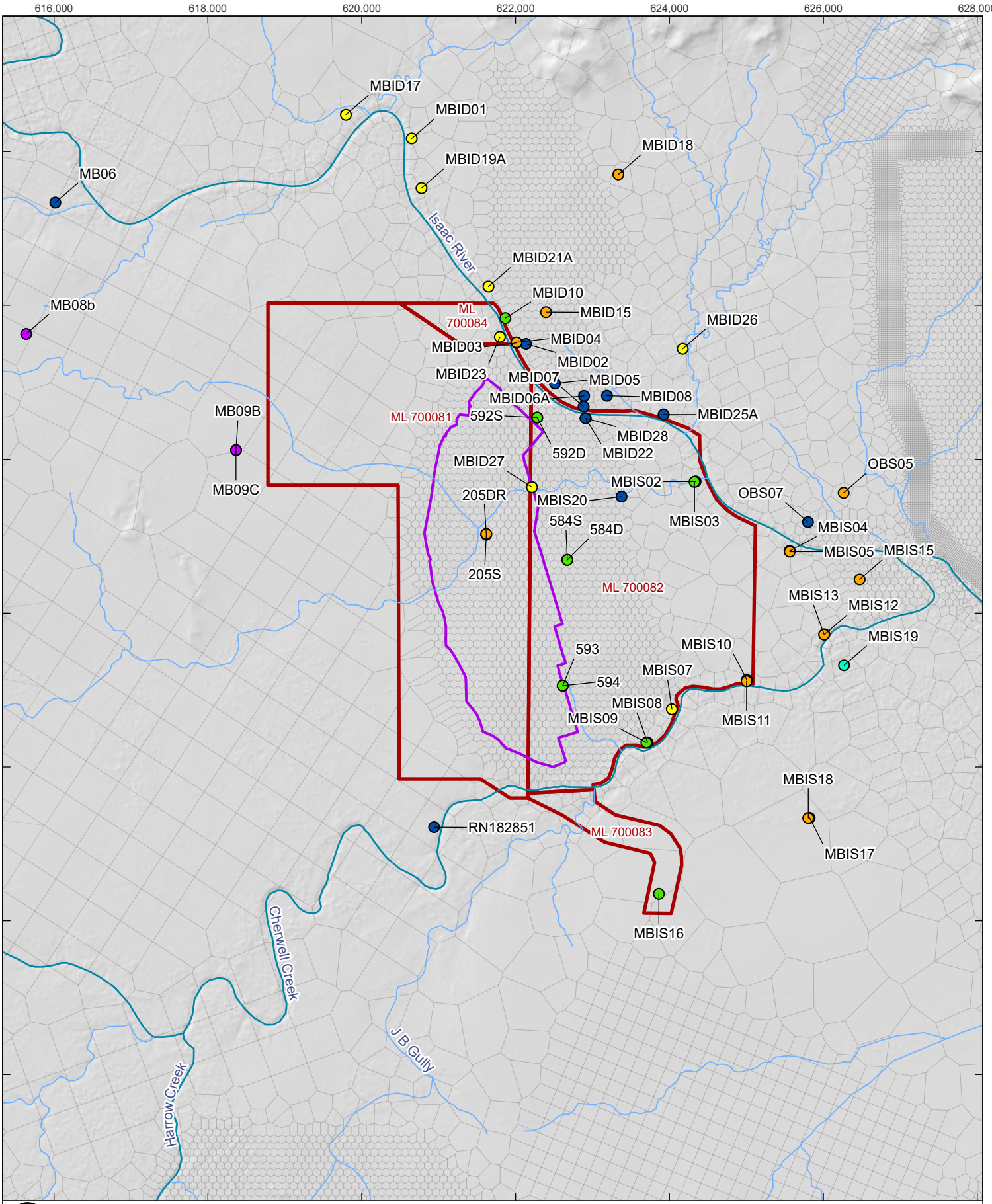

0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:65,000 at A4
Project Number:	620.041537
Date Drawn:	27-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Model Grid

Calibration Data Points (Geological Unit)

- Alluvium
- Regolith
- Leichhardt overburden
- Leichhardt seam
- Vermont seam
- Fort Cooper seams (combined)

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CALIBRATION DATA POINTS

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FIGURE 1-2

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F01-02_Calibration Data Points

1.2.2 Calibration Performance

1.2.2.1 Evaluation Process

Calibration performance is assessed throughout the calibration process by tracking the following statistics for each of the calibration datasets:

- Mean (average) residual
- Median residual
- Standard deviation residual
- Lower Quartile Range (LQR)

A likelihood value is calculated for each of the realisations using each of the above-mentioned statistics for each of the calibration target datasets, resulting in 8 different likelihood values for each realisation. These eight likelihood values for each realisation are then combined (i.e. multiplied by each other) to establish an overall likelihood for the realisation based upon the combined calibration performance.

The Most Likely Estimate (MLE) model realisation (i.e. the parameter set that results in the highest likelihood, also otherwise known as the best calibrated model realisation) has been adopted for model predictions. **Sections 1.2.2.2** and **1.2.2.3** provide a summary of calibration performance for the MLE realisation and the calibrated ensemble.

1.2.2.2 Initial Water Level Elevations

Calibration statistics for the MLE using the initial water level elevation dataset are provided in **Table 1-2**. **Table 1-2** also presents a summary of the calibration statistics for the calibrated ensemble. The four statistics used for the selection of the MLE are provided in **BOLD**, with other commonly reported calibration statistics provided for transparency.

Table 1-2 Initial Water Level Elevation Calibration Statistics

Statistics	Minimum	Median	Maximum	MLE
Mean Residual (m)	**-6.3**	**-2.0**	**2.5**	**-1.1**
Median Residual (m)	**-6.0**	**-2.4**	**2.0**	**-1.3**
Standard Deviation (m)	**3.7**	**5.0**	**7.7**	**5.6**
Lower Quartile Range (m)	**2.1**	**3.2**	**5.4**	**2.1**
Mean Absolute Residual (m)	2.7	3.8	6.7	3.4
Sum of Squares (m2)	757.7	1730.6	3465.2	1703.3
Root Mean Square Error (RMS) (m)	3.8	5.8	8.2	5.7
Minimum Residual (m)	-46.5	-20.8	-4.9	-27.1
Maximum Residual (m)	14.6	18.9	22.6	16.9
Number of Observations	52.0	52.0	52.0	52
Range in Observations (m)	42.1	42.1	42.1	42.1
Scaled Standard Deviation (%)	8.9	12.0	18.5	13.5
Scaled Absolute Mean (%)	6.4	9.1	15.9	8.0
Scaled RMS (SRMS) (%)	9.1	13.7	19.4	13.6

Figure 1-3 presents the observed and simulated groundwater levels graphically as a scattergram for the initial water level elevations dataset for the Project bores included in the calibration. **Figure 1-3** shows that the majority of data points fall close to the line of equality, indicating that the model generally performs well in reproducing observed groundwater levels.

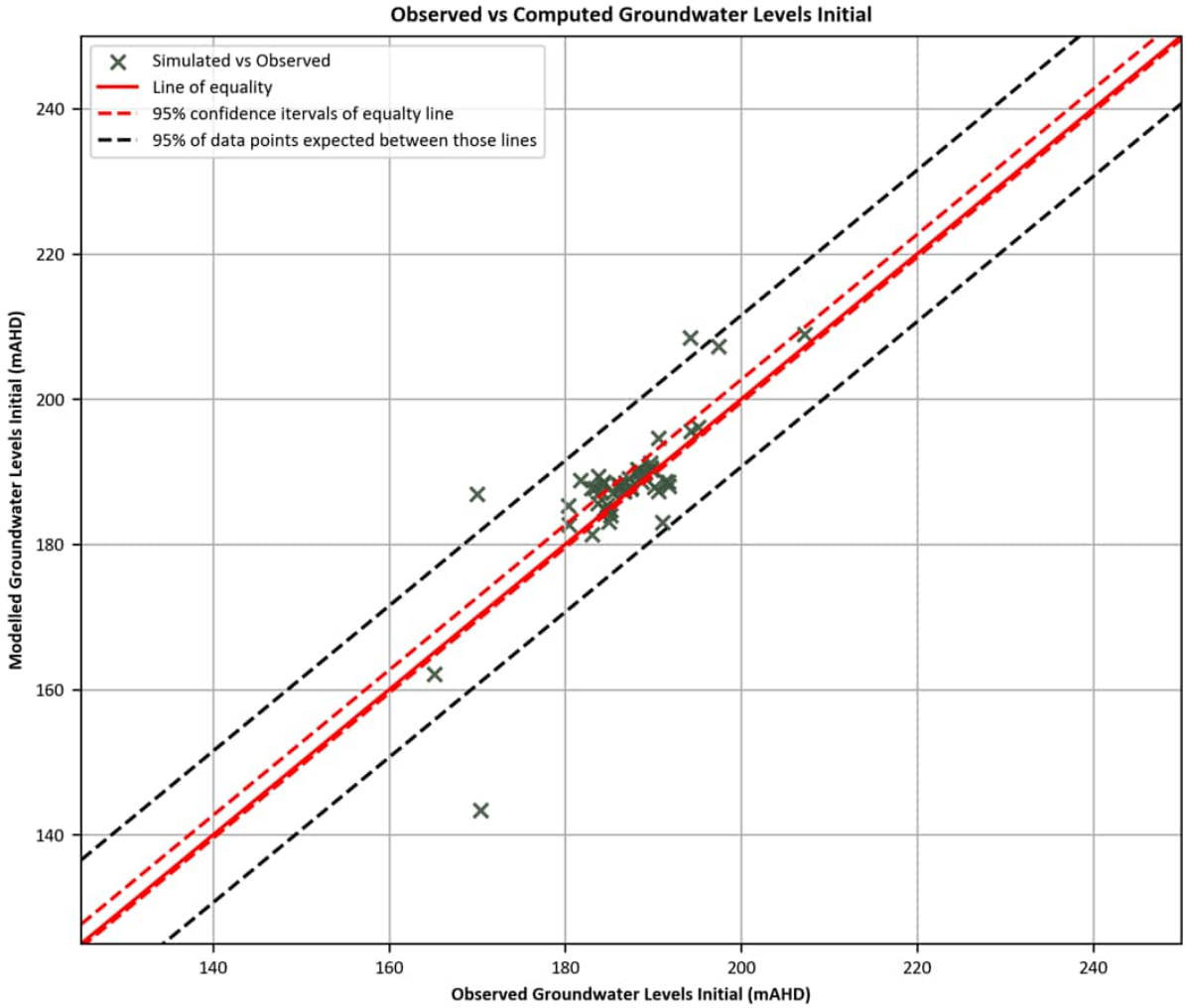


Figure 1-3 Calibration Scattergram – Modelled vs Observed Groundwater Levels (Initial Water Levels)

Figure 1-4 shows the distribution of calibration residuals for the initial groundwater level elevation dataset at the Project bores included in the calibration. The histogram shows that the residuals are generally well centred around zero, indicating a balanced model performance with no strong bias toward either overprediction or underprediction of groundwater levels. Most residuals fall within the ±10 m range, suggesting a good overall fit to the measured data. Residuals in the shallow groundwater levels within the potential area of impact are generally within ±5 m, further supporting the suitability of the base model realisation.

Figure 1-5 is a map depicting the spatial distribution of residuals for the initial water level elevations target dataset.

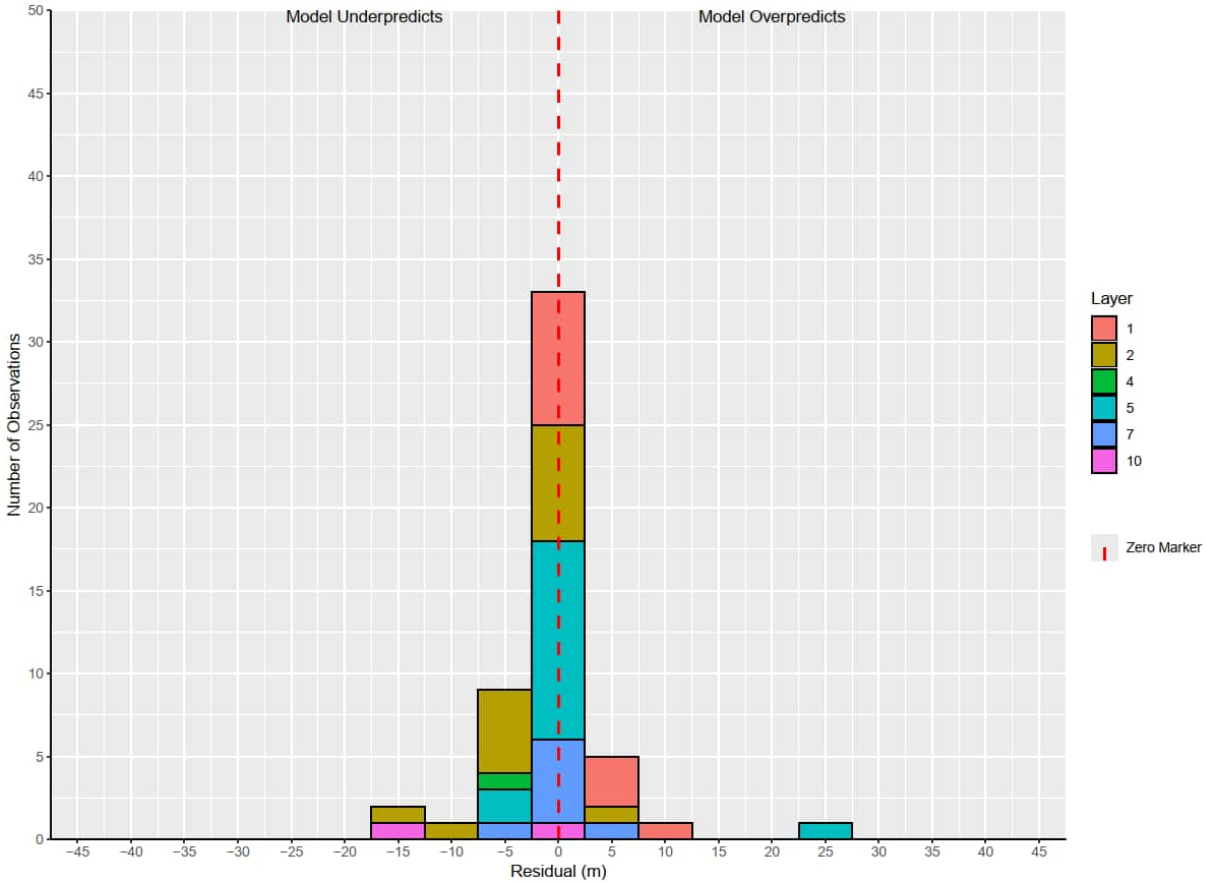
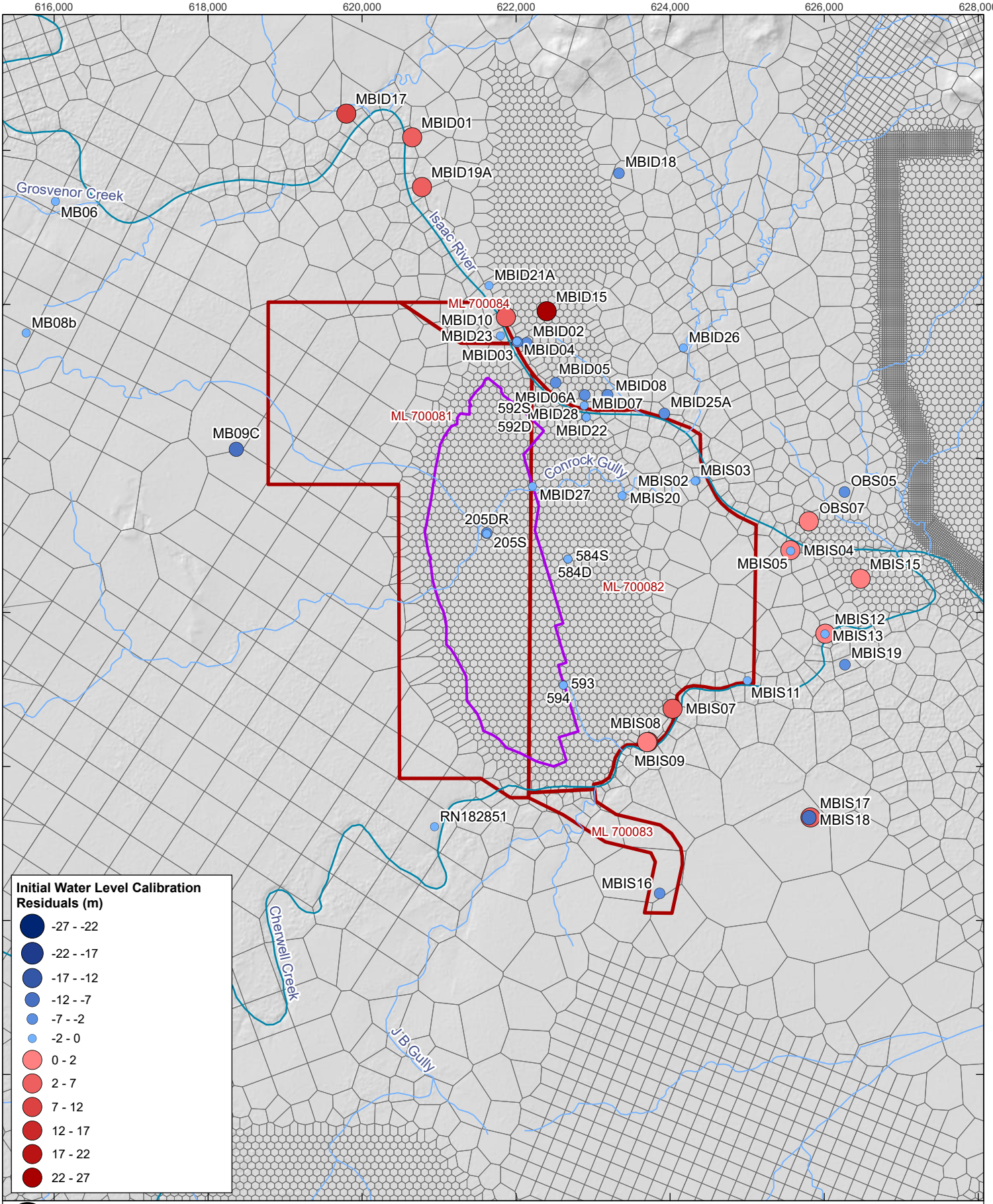


Figure 1-4 Calibration Residual Histogram (Initial Water Levels)



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:65,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING
TECHNICAL REPORT

INITIAL WATER LEVEL CALIBRATION RESIDUALS (M)

SLR

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FIGURE 1-5

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F01-05_Initial Water Level Calibration Residuals (m)

1.2.2.3 Change in Water Level Elevations

Calibration statistics for the change in water level elevation dataset used in selecting the MLE are provided in **Table 1-3**. The statistics used to select the MLE are calculated on the average residual at each bore.

Additional commonly reported calibration statistics are shown on **Table 1-3**. The statistics provided on **Table 1-3** are calculated based on all measurements (i.e. using all datapoints rather than the average at each bore).

Table 1-3 Change in Water Level Elevation Calibration Statistics - MLE Selection

Statistics	Minimum	Median	Maximum	MLE
Mean Residual (m)	-0.1	0.2	0.6	0.4
Median Residual (m)	-0.01	0.03	0.2	0.04
Standard Deviation (m)	0.7	1.2	2.5	1.4
Lower Quartile Range (m)	0.4	0.6	1.0	0.6

Table 1-4 Change in Water Level Elevation Calibration Statistics - Unweighted

Statistics	Minimum	Median	Maximum	MLE
Mean Residual (m)	-0.8	-0.4	-0.2	-0.6
Mean Absolute Residual (m)	0.7	0.8	1.1	0.9
Standard Deviation (m)	1.1	1.5	2.2	2.1
Sum of Squares (m2)	717.6	1490.6	3216.2	2822.0
Root Mean Square Error (RMS) (m)	1.1	1.6	2.3	2.2
Minimum Residual (m)	-20.1	-8.7	-3.7	-20.1
Maximum Residual (m)	2.7	11.2	15.8	7.0
Number of Observations	594.0	594.0	594.0	594.0
Range in Observations (m)	24.3	24.3	24.3	24.3
Scaled Standard Deviation (%)	4.5	6.3	9.0	8.6
Scaled Absolute Mean (%)	2.7	3.4	4.5	3.8
Scaled RMS (SRMS) (%)	4.5	6.5	9.6	9.0

Figure 1-6 presents the observed and simulated change in water level elevations graphically as a scattergram for the Project bores included in the calibration. **Figure 1-6** shows that the majority of data points fall close to the line of equality, with most lying within the expected confidence interval, indicating that the model generally performs well in reproducing observed changes in groundwater levels. Most of the apparent misfit in the transient calibration is associated with two monitoring bores, MBDI04 and MBDI18, which are screened within the Leichhardt Seam and located in close proximity to the ID mine area. In these locations, the model simulates drawdown effects associated with mining activities, whereas the measured water levels do not reflect the same degree of influence, leading to an apparent divergence between observed and simulated trends. This reflects a slight delay in the simulated timing of drawdown associated with the representation of mining stresses in the model, rather than an issue with the simulated magnitude of drawdown.

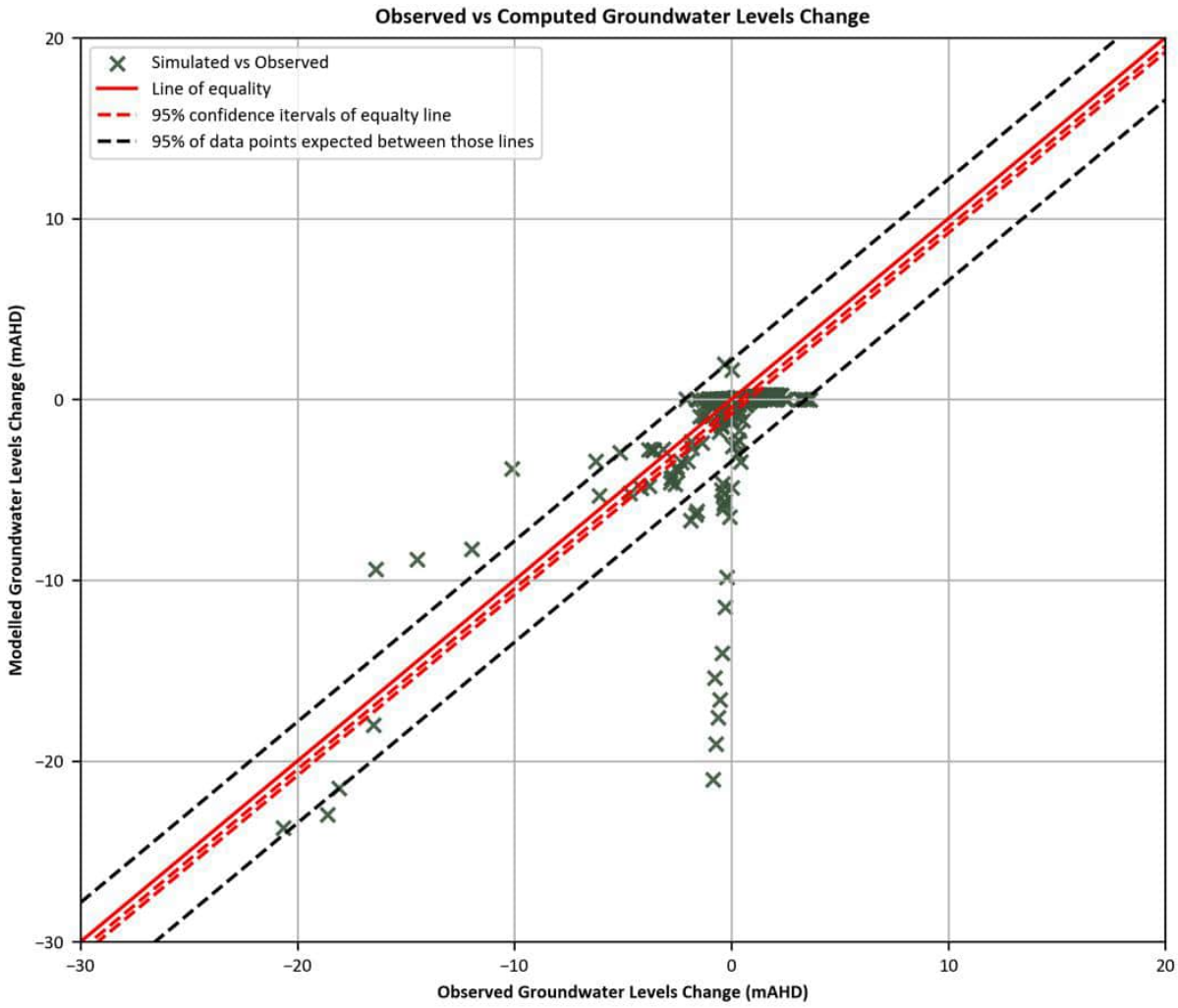


Figure 1-6 Calibration Scattergram – Modelled vs Observed Groundwater Levels (Change in Water Levels)

Figure 1-7 shows the distribution of calibration residuals for the change in groundwater level elevation dataset at the Project bores included in the calibration. The histogram shows that the residuals are generally well centred around zero, indicating a balanced model performance. There is a small bias toward underprediction of change in groundwater levels. However, most residuals fall within the ±10 m range, suggesting a good overall fit to the measured data.

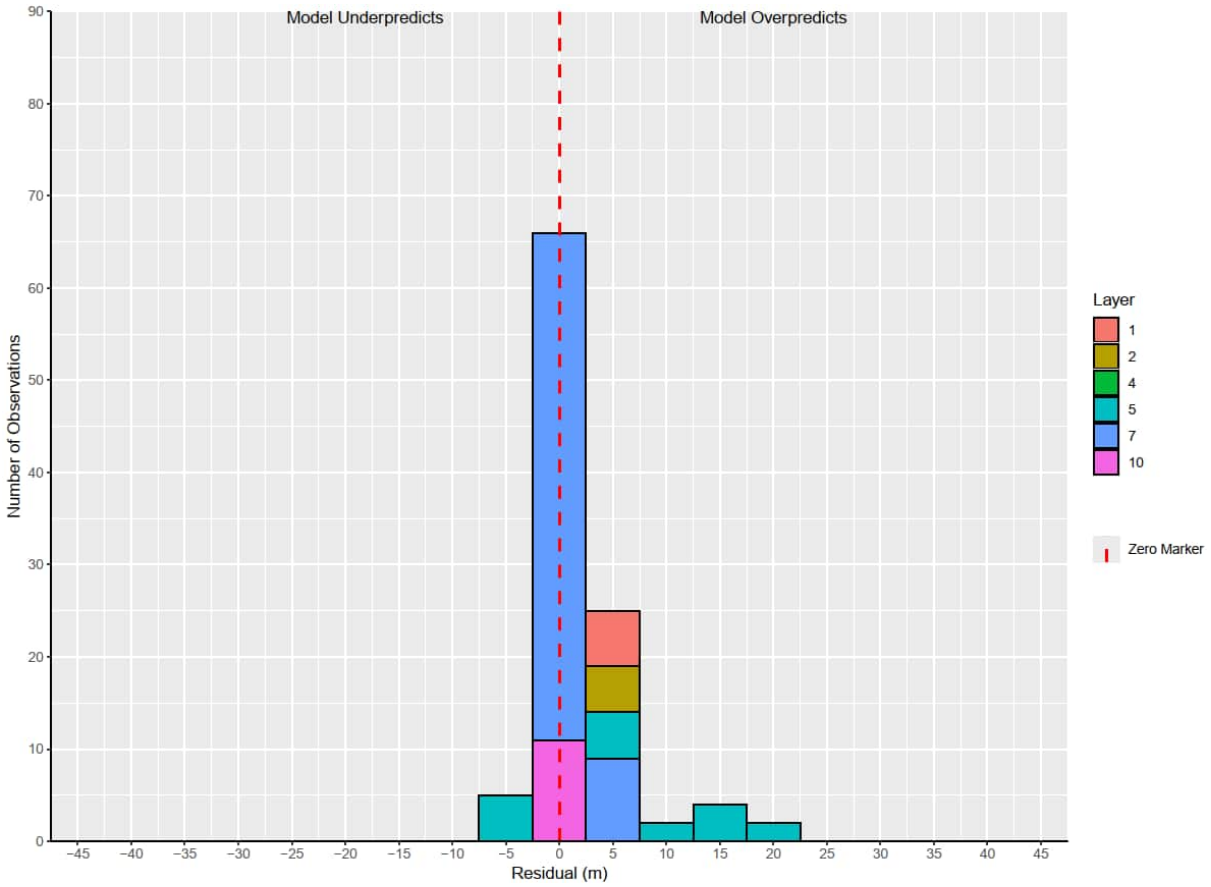
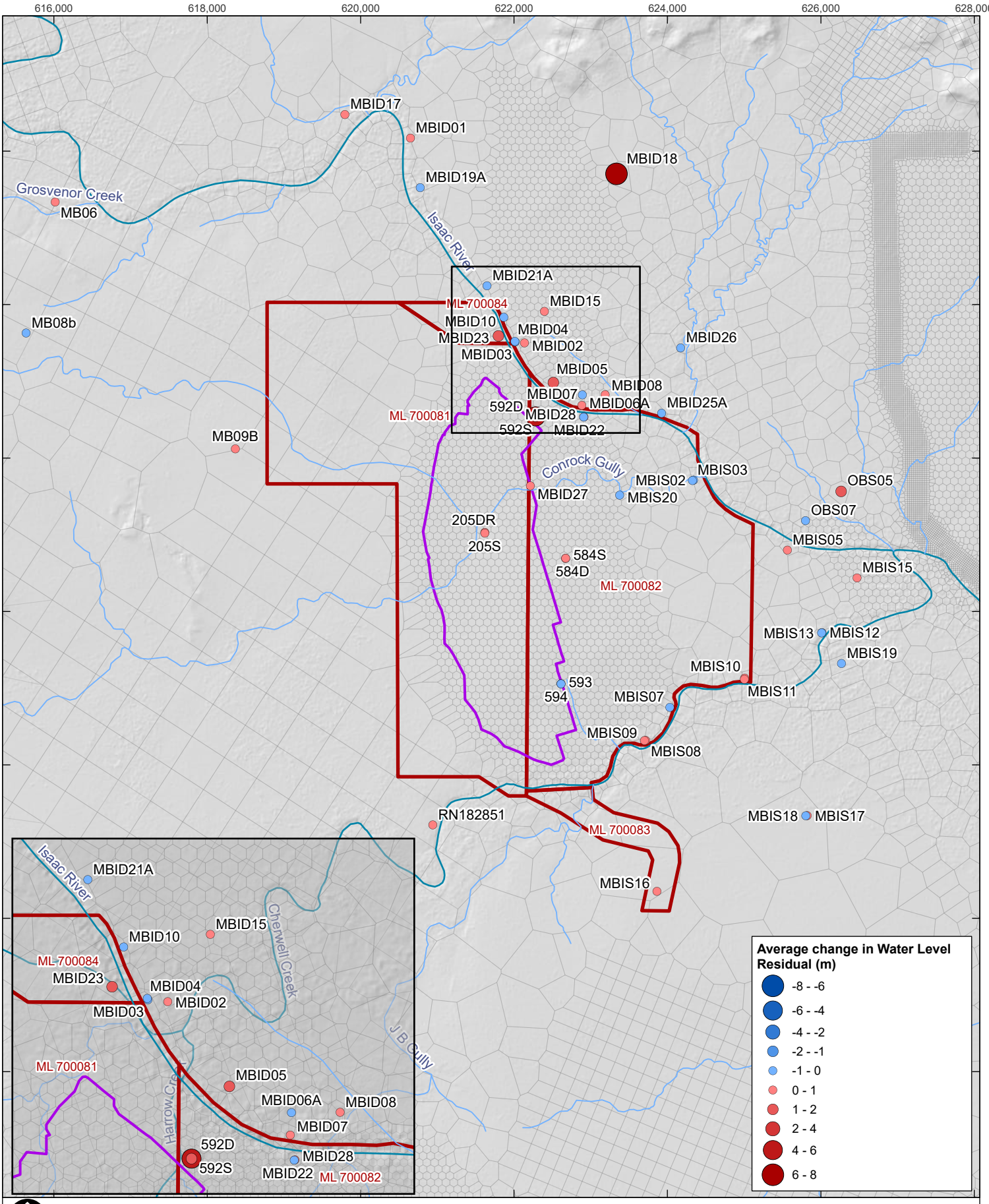


Figure 1-7 Calibration Residual Histogram (Change in Water Levels)

Figure 1-8 is a map depicting the spatial distribution of average residuals at each location for the change in water level elevations target dataset. Residuals are generally low across most of the model domain, indicating consistent model performance.



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:65,000 at A4
Project Number:	620.041537
Date Drawn:	11-May-2026
Drawn by:	RB

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING
TECHNICAL REPORT

AVERAGE CHANGE IN WATER LEVEL CALIBRATION RESIDUALS (M)

SLR

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FIGURE 1-8

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F01-08_Average Change in Water Level Calibration Residuals (m)

1.2.3 Calibration Hydrographs

This section discusses the model to measurement fit at the Project observation sites, for the MLE realisation (selected from a total of 109 realisations). Example calibration hydrographs for a selection of monitoring bores at IDE are provided in **Figure 1-10** to **Figure 1-11**. The hydrographs for the full calibration data set (52 locations), comparing the observed data with simulated outputs from the MLE realisation at IDE, are included as **Appendix A**. Overall, the model demonstrates reasonable performance across the range of hydrographs, with areas of both relatively strong and relatively weak agreement as is typical in modelling.

1.2.3.1 Layer 1 (Quaternary alluvium, Surface cover)

Figure 1-9 shows the calibration hydrographs for Project bores MBIS12, MBID21A, MBID28, and MBID26. As seen in the hydrographs, the model generally reproduces observed groundwater behaviour across the alluvium monitoring network. At MBIS12, measured water levels are relatively stable, and the model follows this trend with only minor offsets of around 1–2 m. For MBID21A, simulated levels align well with observations for most of the record, although the model shows a late-period decline that is not present in the measurements; earlier in the record, differences remain small. At MBID28, the model captures the long-term mean but does not reproduce the sharper rise observed in recent measurements, with model observation differences typically within 1–3 m before diverging in the later period. Localised areas of spikes in water levels in the alluvium are likely associated with flow events and are not shared across all alluvium bores. They are small in duration and cannot be reproduced using recharge (which is uniform over the Isaac River alluvium and averaged over quarterly stress periods). Considering the model size, run time and predictive timing setup (yearly), priority is given to capturing medium to long term trends over localised and short duration events.

Bore MBID26 exhibits very stable groundwater conditions throughout, and the model reflects this behaviour closely, with consistently small absolute differences. Overall, the model provides a reasonable representation of groundwater levels at these sites, capturing dominant trends and magnitudes with some localised discrepancies.

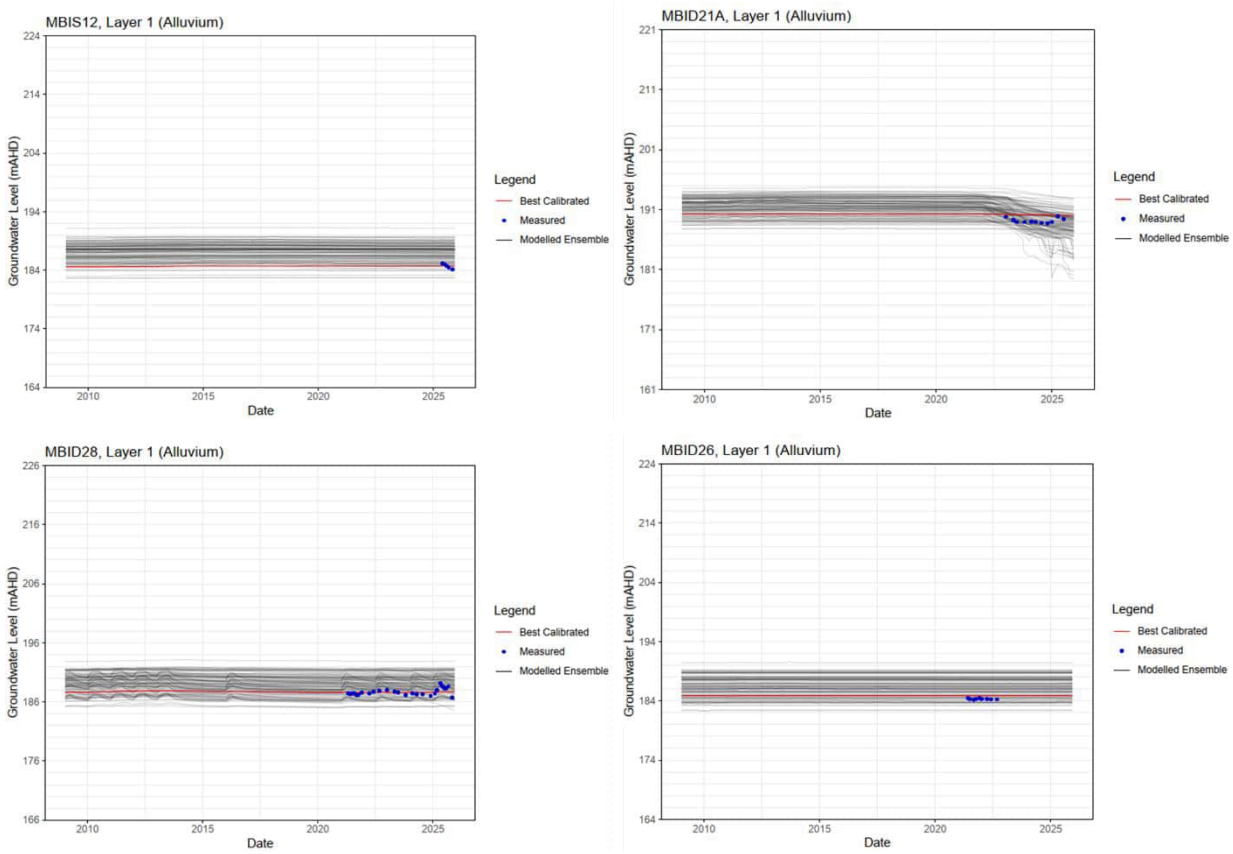


Figure 1-9 Calibration Fit – Layer 1 – Bores MBIS12, MBID21A, MBID28, and MBID26 (MLE Realisation)

1.2.3.2 Layer 2 (Tertiary-Quaternary alluvium, Tertiary sediments, weathered Permian, and Tertiary basalt)

Figure 1-10 shows the calibration hydrographs for IDE bores OBS07, MBID07, MBID22, and MB06. At OBS07, observed levels remain steady over the monitoring period, and the model follows this flat trend with a small but consistent offset. MBID07 also exhibits stable water levels, and the model accurately reproduces this pattern, maintaining proximity to the measured values with only minor discrepancies. At MBID22, both the observations and the model exhibit a gentle downward trend, with the simulated line closely tracking the measured pattern, apart from small point-to-point variations. In MB06, groundwater levels are highly stable, and the modelled estimates align almost directly with the measured data, showing excellent agreement. Overall, the comparison across these four bores demonstrates that the model captures the key trends and magnitudes of regolith groundwater levels with good consistency.

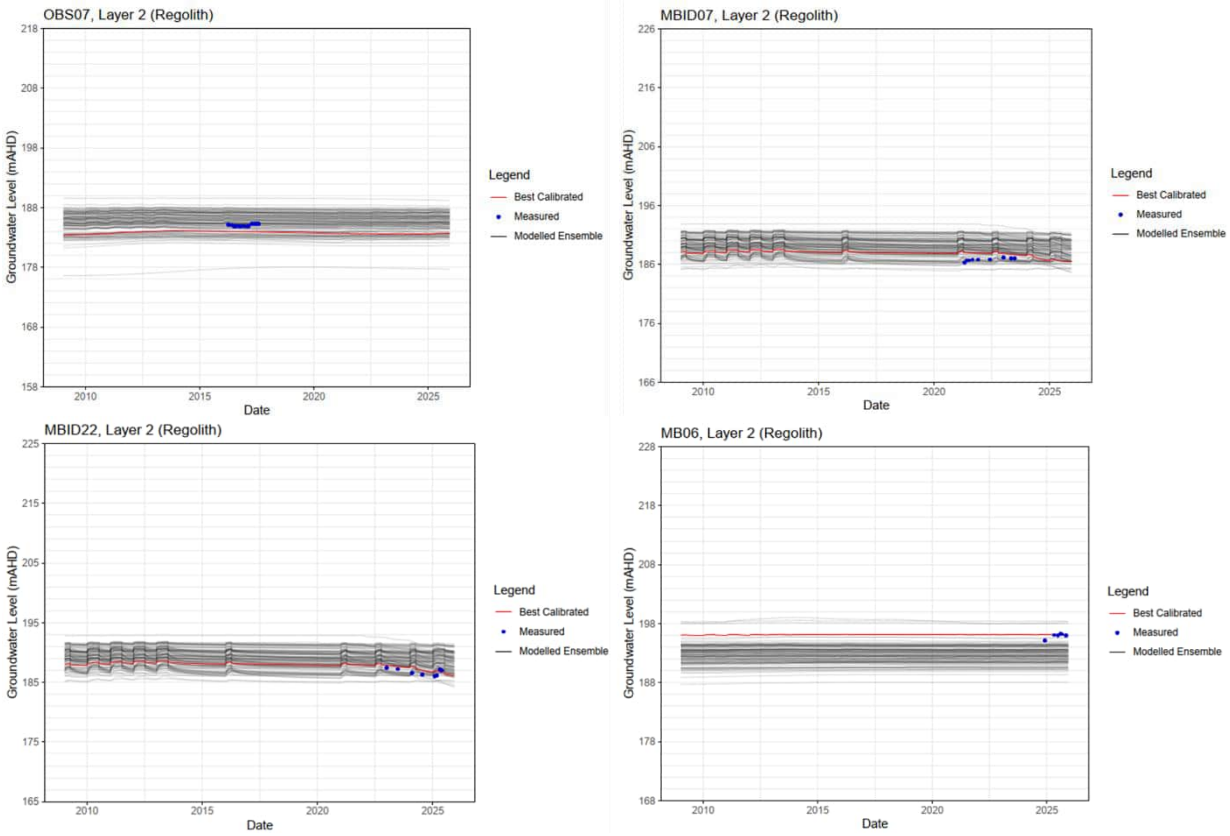


Figure 1-10 Calibration Fit – Layer 2 – Bores OBS07, MBID07, MBID22, and MB06 (MLE Realisation)

1.2.3.3 Layers 5 and 7 (Rangal Coal Measures)

Example hydrographs for selected Rangal Coal Measures bores are shown in **Figure 1-11** and **Figure 1-12**.

The hydrographs for MBID04, Bore 594, Bore 592S, and MBIS02 (**Figure 1-11**) show that the model generally captures groundwater behaviour within the Leichhardt Seam across a range of observed conditions. At MBID04, a substantial decline in groundwater levels is recorded, and the model reproduces both the timing and magnitude of this major drop with only minor differences at individual measurements. In contrast, bore 594 exhibits very stable groundwater levels, and the model closely matches this flat trend with small, consistent offsets. Bore 592S shows a gradual downward trend, the model follows this decline well, tracking the general pattern and staying close to the observed data throughout most of the record. At MBIS02, groundwater levels remain highly stable, and the model reproduces this behaviour accurately, with simulated levels aligning closely with measured values. Overall, the model performs well across these bores, capturing both sharp declines and stable long-term conditions within the Leichhardt Seam.

The hydrographs for MBID10, 584D, MBIS03, and MBIS09 (**Figure 1-12**) show that the model captures groundwater behaviour within the Vermont Seam across a range of observed conditions. At MBID10, groundwater levels gradually decline, and the model reproduces this downward trend, following the measured data with only minor offsets. In contrast, bore 584D exhibits highly stable groundwater levels, and the model aligns closely with this flat trend, matching the observed values throughout the period of record. MBIS03 also displays stable conditions and the model accurately reflects this behaviour, remaining close to the measured record. At MBIS09, groundwater levels remain steady and the model similarly represents this stability, tracking the observed hydrograph well. Overall, the model

performs consistently across these Vermont Seam bores, capturing both the gradual decline observed at MBID10 and the stable long-term conditions recorded at the other sites.

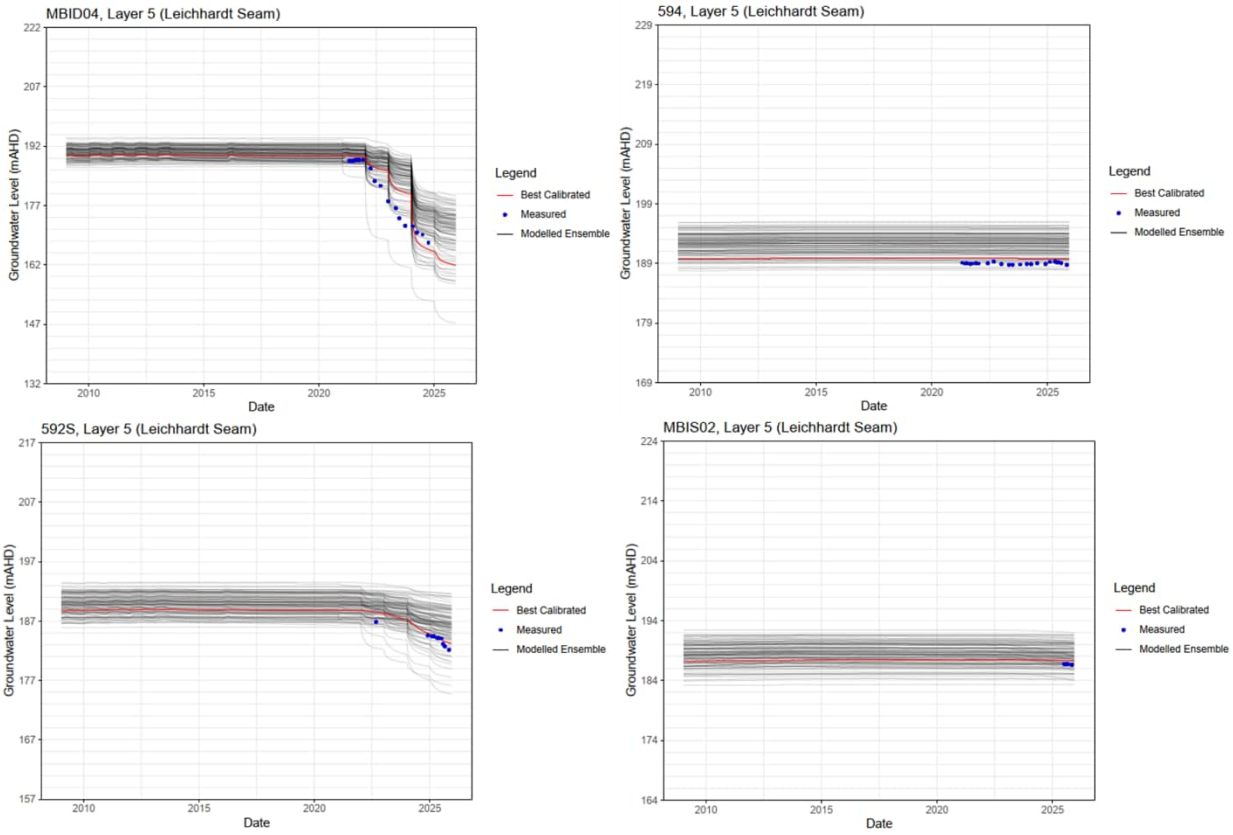


Figure 1-11 Calibration Fit – Layer 5 (Leichhardt Seam) – Bores MBID04, Bore 594, 5925, and MBIS02 (MLE Realisation)

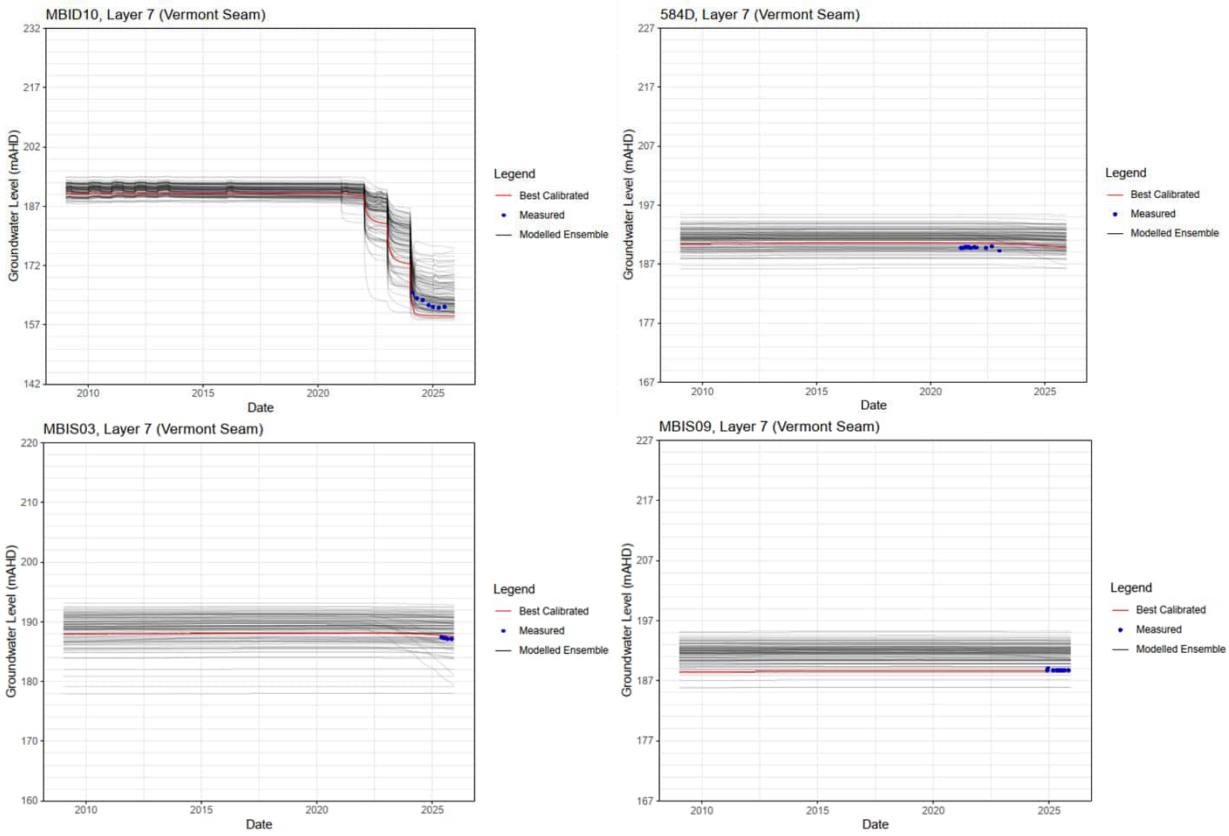


Figure 1-12 Calibration Fit – Layer 7 (Vermont Seam) – Bores MBID10, 584D, MBIS03, and MBIS09 (MLE Realisation)

1.2.4 Model Water Balance

1.2.4.1 Steady State

The steady state water balance for the MLE realisation of the model is shown in **Table 1-5**. The water balance for the steady-state model indicates that regional groundwater inflow was the largest net inflow contributor to the steady state model (28.3 ML/d), followed by recharge (6.4 ML/d). Groundwater outflow is dominated by evapotranspiration (22.4 ML/d outflow) and regional groundwater outflow (11.9 ML/d) where the water table is within a few metres of the land surface. The mass balance error for the steady state calibration is less than 0.1%, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Table 1-5 Steady-State Water Balance

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/d)	Percent of Total Outflow (%)
Recharge (RCH)	6.4	19%	-	-
ET (from GW) (EVT)	-	-	22.4	65%
Rivers (RIV)	-	-	0.4	1%
Regional GW Flow (GHB)	28.3	81%	11.9	34%
Total	**34.7**	100%	**34.7**	100%

1.2.4.2 Transient Calibration Period

The model water balance for the MLE realisation in the transient calibration, averaged over the duration of the calibration period, is presented in **Table 1-6**.

The water balance for the MLE realisation in the transient calibration period indicates that recharge to the groundwater system within the model averages 9.7 ML/day. Approximately 22.4 ML/day is lost to evapotranspiration in areas where the water table is within a few metres of the land surface.

The net flux from the general head boundary (GHB) component is 16.5 ML/day, indicating that groundwater enters the model domain through this boundary. 7.0 ML/day is removed from the model by the Drain boundary condition that represents mining in the model. River inflow and outflow are 0.3 and 0.4 ML/d, respectively, indicating a net outflow of approximately 0.1 ML/d. The mass balance error for the transient calibration is less than 0.1%, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Table 1-6 Transient Calibration Period Water Balance

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/d)	Percent of Total Outflow (%)
Recharge (RCH)	9.7	21%	-	-
ET (from GW) (EVT)	-	-	22.4	49%
River (RIV)	0.3	1%	0.4	1%
Regional GW Flow (GHB)	28.3	62%	11.8	26%
Drains (DRN)	-	-	7.0	15%
Storage	7.1	16%	3.9	9%
Total	**45.5**	100%	**45.5**	100%

The transient water balance is presented on **Figure 1-13**. General head boundary (GHB In) and Evapotranspiration (ET Out) stand out as the largest components of inflow and outflow, respectively.

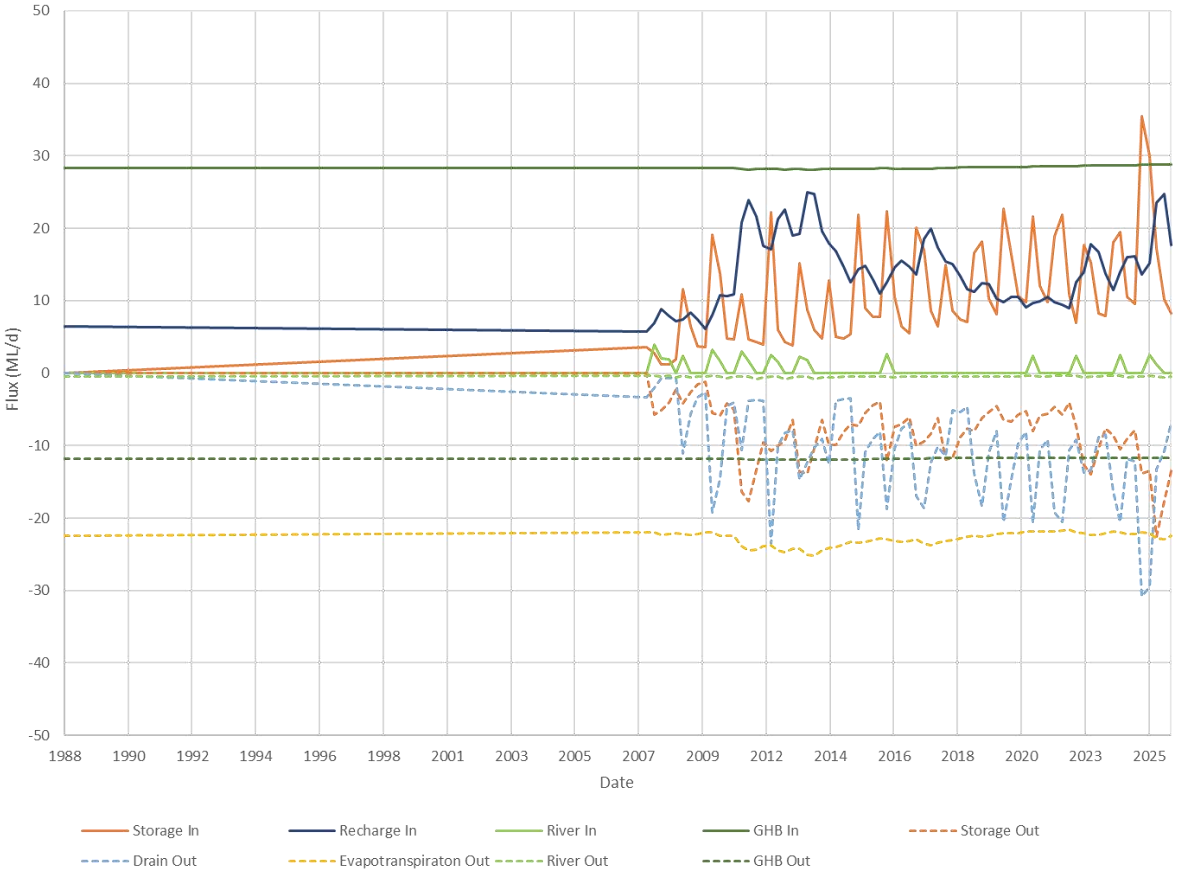


Figure 1-13 Transient Calibration Period Water Balance

1.2.5 Calibrated Hydraulic Parameters

Table 1-7 and **Table 1-8** summarise the calibrated parameter values for the MLE realisation, including horizontal hydraulic conductivity (Kx) and vertical to horizontal hydraulic conductivity ratio (Kz/Kx), Specific Storage (Ss) and Specific Yield (Sy). A depth dependence equation for the coal measures was used in the numerical groundwater model as described in detail in SLR (2026a), and therefore the calibrated hydraulic conductivity values vary across the model domain. Maximum depths used for the depth dependence equation for each unit as well as hydraulic parameters for the fault zones are shown on **Appendix B**.

The prior versus posterior distribution plot is shown in **Appendix C**.

Pilot points were used to model the spatial variability of horizontal and vertical hydraulic conductivity parameters (and specific yield, in the case of the Isaac River Alluvium) in some modelled geologic units, as described in detail in SLR (2026a). Pilot points were placed in the Isaac Alluvium and weathered formations, as well as any coal bearing formation, or formation with at least ten observation bores in the calibration observation database.

Table 1-7 Calibrated Hydraulic Parameters (Hydraulic Conductivity) – MLE Realisation

Geology Unit	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/d)
Alluvium [1]	Surface Cover	1	6.3X10-02	6.3X10-02	6.3X10-02	4.2X10-04	4.2X10-04	4.2X10-04
Isaac River Alluvium [2]	Isaac River Alluvium	1	1.1X10-03	3.8X10+00	1.1X10-01	8.5X10-07	9.1X10-02	5.2X10-04
Regolith [1]	Surface Cover	1	1.5X10-03	1.9X10+00	5.7X10-02	6.9X10-07	2.7X10-02	3.1X10-04
Weathered Permian [1]	Surface Cover	1 & 2	1.6X10-01	1.6X10-01	1.6X10-01	2.4X10-03	2.4X10-03	2.4X10-03
Duaringa [1]	Surface Cover	1 & 2	5.2X10-02	5.2X10-02	5.2X10-02	1.3X10-03	1.3X10-03	1.3X10-03
Tertiary Basalt [1]	Tertiary Basalt	1 & 2	2.1X10-02	2.1X10-02	2.1X10-02	2.4X10-04	2.4X10-04	2.4X10-04
Regolith [2]	Surface Cover	2	1.5X10-03	1.2X10+00	4.9X10-02	6.9X10-07	1.3X10-02	2.3X10-04
Rewan [2]	Triassic	3	1.5X10-04	1.7X10+01	9.6X10-02	6.4X10-08	4.0X10-02	1.9X10-04
Rangal Coal Measures [1]	Interburden	4	4.6X10-06	3.4X10-03	4.9X10-04	3.2X10-08	2.4X10-05	3.4X10-06
Rangal Coal Measures [2]	Leichhardt Seam	5	2.0X10-05	1.6X10+00	1.5X10-02	1.8X10-08	1.1X10-02	4.3X10-05
Rangal Coal Measures [1]	Interburden	6	3.3X10-05	1.7X10-03	1.9X10-04	4.9X10-07	2.6X10-05	2.8X10-06
Rangal Coal Measures [2]	Vermont Seam	7	1.5X10-06	6.3X10+00	2.4X10-02	3.8X10-10	6.1X10-02	2.3X10-04
Rangal Coal Measures [1]	Interburden	8	1.0X10-03	3.6X10-03	1.1X10-03	1.5X10-05	5.4X10-05	1.6X10-05
Fort Cooper Coal Measures [2]	Interburden	9	1.6X10-05	1.9X10-01	2.6X10-03	3.6X10-09	4.9X10-03	1.5X10-05
Fort Cooper Coal Measures [2]	Fort Cooper Seams	10	3.1X10-06	1.3X10+00	1.7X10-03	9.9X10-10	4.5X10-03	1.6X10-05

Geology Unit	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/d)
Fort Cooper Coal Measures [1]	Interburden	11	2.0X10-04	3.8X10-03	2.2X10-04	2.4X10-06	4.8X10-05	2.7X10-06
Moranbah Coal Measures [2]	Q Seam	12	1.9X10-06	2.3X10+00	4.0X10-03	1.1X10-09	1.2X10-01	2.2X10-05
Moranbah Coal Measures [1]	Interburden	13	1.4X10-08	3.1X10-03	1.0X10-04	3.4X10-09	7.4X10-04	2.5X10-05
Moranbah Coal Measures [2]	P Seam	14	3.1X10-06	1.1X10+01	2.8X10-03	3.9X10-09	6.3X10-03	1.1X10-05
Moranbah Coal Measures [1]	Interburden	15	1.4X10-07	5.8X10-04	1.8X10-05	1.3X10-09	5.2X10-06	1.7X10-07
Moranbah Coal Measures [2]	H Seam	16	1.2X10-05	3.2X10+00	1.7X10-02	3.0X10-08	8.6X10-03	4.3X10-05
Moranbah Coal Measures [1]	Interburden	17	1.4X10-05	9.9X10-03	3.9X10-04	5.0X10-07	3.4X10-04	1.3X10-05
Moranbah Coal Measures [2]	D Seam	18	5.1X10-06	9.8X10-01	2.8X10-03	1.7X10-09	1.2X10-01	1.6X10-04
Moranbah Coal Measures [1]	Interburden	19	6.2X10-05	5.0X10-04	7.4X10-05	2.5X10-06	2.0X10-05	3.0X10-06
Igneous Zone	Igneous	1 to19	1.5X10-06	1.5X10-06	1.5X10-06	7.9X10-09	7.9X10-09	7.9X10-09

1 Pilot Points are not included
2 Pilot Points are included

Table 1-8 Calibrated Hydraulic Parameters (Storage) – MLE Realisation

Geology Unit	Unit	Layer	Min Ss (d^{-1})	Max Ss (d^{-1})	Average Ss (d^{-1})	Min Sy (-)	Max Sy (-)	Average Sy (-)
Alluvium	Surface Cover	1	4.1X10-07	4.1X10-07	4.1X10-07	1.7X10-02	1.7X10-02	1.7X10-02
Isaac River Alluvium *	Isaac River Alluvium	1	9.0X10-07	9.0X10-07	9.0X10-07	1.3X10-03	1.6X10-01	2.1X10-02
Regolith	Surface Cover	1	4.9X10-07	4.9X10-07	4.9X10-07	1.4X10-02	1.4X10-02	1.4X10-02
Weathered Permian	Surface Cover	1 & 2	2.4X10-07	2.4X10-07	2.4X10-07	3.5X10-03	3.5X10-03	3.5X10-03
Duaringa	Surface Cover	1 & 2	5.8X10-07	5.8X10-07	5.8X10-07	9.2X10-03	9.2X10-03	9.2X10-03
Tertiary Basalt	Tertiary Basalt	1 & 2	1.5X10-07	1.5X10-07	1.5X10-07	5.6X10-03	5.6X10-03	5.6X10-03
Regolith	Surface Cover	2	1.5X10-06	1.5X10-06	1.5X10-06	6.4X10-03	6.4X10-03	6.4X10-03
Rewan	Triassic	3	9.3X10-06	9.3X10-06	9.3X10-06	2.2X10-03	2.2X10-03	2.2X10-03
Rangal Coal Measures	Interburden	4	1.1X10-06	1.1X10-06	1.1X10-06	1.0X10-03	1.0X10-03	1.0X10-03
Rangal Coal Measures	Leichhardt Seam	5	2.9X10-07	2.9X10-07	2.9X10-07	7.1X10-04	7.1X10-04	7.1X10-04
Rangal Coal Measures	Interburden	6	3.8X10-07	3.8X10-07	3.8X10-07	1.8X10-03	1.8X10-03	1.8X10-03
Rangal Coal Measures	Vermont Seam	7	1.4X10-06	1.4X10-06	1.4X10-06	7.9X10-04	7.9X10-04	7.9X10-04
Rangal Coal Measures	Interburden	8	5.8X10-07	5.8X10-07	5.8X10-07	5.2X10-04	5.2X10-04	5.2X10-04
Fort Cooper Coal Measures	Interburden	9	5.7X10-07	5.7X10-07	5.7X10-07	3.6X10-03	3.6X10-03	3.6X10-03
Fort Cooper Coal Measures	Fort Cooper Seams	10	1.5X10-06	1.5X10-06	1.5X10-06	1.0X10-03	1.0X10-03	1.0X10-03
Fort Cooper Coal Measures	Interburden	11	5.6X10-07	5.6X10-07	5.6X10-07	7.5X10-04	7.5X10-04	7.5X10-04
Moranbah Coal Measures	Q Seam	12	1.3X10-06	1.3X10-06	1.3X10-06	7.7X10-04	7.7X10-04	7.7X10-04
Moranbah Coal Measures	Interburden	13	1.0X10-06	1.0X10-06	1.0X10-06	4.7X10-03	4.7X10-03	4.7X10-03
Moranbah Coal Measures	P Seam	14	5.9X10-07	5.9X10-07	5.9X10-07	5.1X10-04	5.1X10-04	5.1X10-04
Moranbah Coal Measures	Interburden	15	2.8X10-06	2.8X10-06	2.8X10-06	5.3X10-04	5.3X10-04	5.3X10-04
Moranbah Coal Measures	H Seam	16	4.9X10-07	4.9X10-07	4.9X10-07	9.3X10-04	9.3X10-04	9.3X10-04

Geology Unit	Unit	Layer	Min Ss (d^{-1})	Max Ss (d^{-1})	Average Ss (d^{-1})	Min Sy (-)	Max Sy (-)	Average Sy (-)
Moranbah Coal Measures	Interburden	17	1.9X10-06	1.9X10-06	1.9X10-06	3.6X10-03	3.6X10-03	3.6X10-03
Moranbah Coal Measures	D Seam	18	7.6X10-07	7.6X10-07	7.6X10-07	3.8X10-04	3.8X10-04	3.8X10-04
Moranbah Coal Measures	Interburden	19	6.3X10-07	6.3X10-07	6.3X10-07	6.1X10-04	6.1X10-04	6.1X10-04
Igneous Zone	Igneous	1 to19	7.2X10-07	7.2X10-07	7.2X10-07	3.9X10-03	3.9X10-03	3.9X10-03

* Pilot points are included only for the Sy of Isaac River Alluvium

The properties of Project's spoil emplacement simulated using the Time-Variant Material package (TVM package) were adjusted during the calibration process. The spoil parameter values for the MLE realisation are shown in **Table 1-9.**

Table 1-9 Calibrated Spoil Hydraulic Parameters – MLE Realisation

Parameter	Value
Horizontal hydraulic conductivity (m/day)	0.36
Vertical hydraulic conductivity (m/day)	0.11
Specific Yield (%)	0.01
Specific Storage (1/m)	3.8 x10-06

1.2.6 Calibrated Recharge

Table 1-10 presents the calibrated recharge rates for each recharge zone (geological unit outcrop area) in the model. These calibrated recharge rates have been adopted into the predictive model. The mean annual rainfall was assumed to be 566 mm/year consistent with SILO grid point data**.**

Table 1-10 Calibrated Rainfall Recharge – MLE Realisation

Model Recharge Zone	% of Rainfall	Long-term Average Rainfall Recharge (mm/yr)
Alluvium Isaac River Channel	0.03%	0.1
Alluvium Isaac River	0.1%	0.7
Alluvium (rest of the model)	0.05%	0.3
Regolith	0.003%	0.02
Weathered Permian	0.2%	0.8
Duaringa Formation (Tertiary)	0.1%	0.8
Tertiary Basalts	0.6%	3.5
Spoil	4.7%	25.5

1.2.7 Calibrated Evapotranspiration (EVT)

Table 1-11 presents the calibrated EVT extinction depth for each zone in the model. The EVT rate was not calibrated and was applied as per the model design described in SLR (2026a).

Table 1-11 Calibrated EVT Extinction Depth – MLE Realisation

Model EVT Zone	Extinction Depth (m)
Alluvium	11.7
Regolith	2.2
Weathered Permian	4.2
Duaringa Formation	1.8
Tertiary Basalts	0.8
Permian Outcrop	0.8
Spoil	5.1

1.2.8 Other Calibrated Boundary Conditions

Calibrated parameters for general head boundary and riverbed vertical conductivity are provided for each zone in **Appendix B**.

2.0 Model Predictions

2.1 Predictive Setup

2.1.1 Timing

The predictive modelling presented herein was conducted to assess the potential groundwater impacts of the Project. As such, transient predictive modelling was used to simulate the Project as well as mining at other approved and foreseeable mines within the model domain.

The predictive model has been set up to simulate mining activities from the end of calibration (2025) through to the end of 2043, after which the post-mining period begins. The predictive recovery starts from the end of mining up to 2519 (**Table 2-1**). Note that the stress period setup also accounts for predictive simulations at other mine voids within the model domain (i.e. is not designed only for the simulation at the Project).

Transient predictive models have been developed for three model scenarios:

- **Null Run** – no mining within the region.
- **Approved** - all approved and foreseeable mining operations within the model domain are likely to have model prediction effects.
- **Proposed** – all approved and foreseeable mining with the addition of the proposed Project.

Table 2-1 Models Timing – Predictive

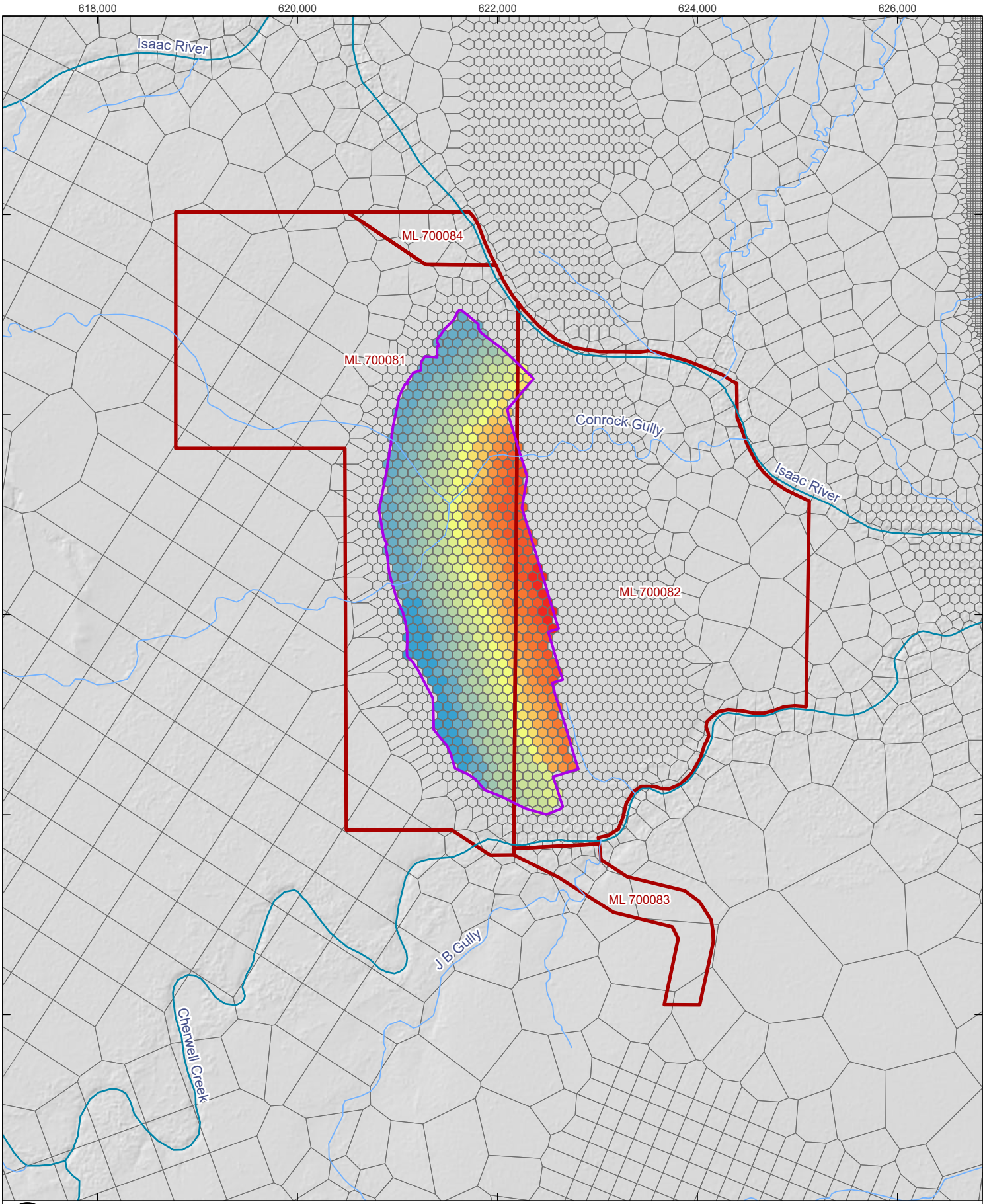
Stress Period	Date Start	Date End	Mining Period	Max Stress Period Length (day)	Max Time Step Length (day)
76 - 93	Jan 2026	Dec 2043	Predictive - Mining	365	186
94 - 216	Jan 2044	Jan 2519	Predictive - Recovery	18,262	9,131

2.1.2 Model Stresses and Boundary Conditions

Recharge rates for the prediction period were derived from historical deep drainage data, with each stress period assigned an average value corresponding to its duration (e.g. annual stress periods use annual averages, while multi-year stress periods use averages over the equivalent period length). A long-term average value was applied for the later prediction and recovery periods.

River stage for the prediction period was derived from historical data using median values for each stress period, consistent with the calibration period. For the prediction and recovery periods, median values were calculated based on stress period length and repeated accordingly. These values represent typical stage conditions, including both zero and positive stages.

The Proposed open cut mine progression at the Project is presented **Figure 2-1**. Although the assessment considers regional-scale mining, including other mine areas, only the Project mine progression is shown.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Model Grid

Mining Progression Open Cut

2029	2034	2039
2030	2035	2040
2031	2036	2041
2032	2037	2042
2033	2038	2043

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PROPOSED OPEN CUT MINE PROGRESSION

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FIGURE 2-1

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-01_Proposed Open Cut Mine Progression

2.1.2.1 Final Landform

The proposed Project final landform was replicated in the model, including areas of waste rock emplacement within mined out pits, and the proposed final void.

The final landform was simulated by changing the surface (height) at which EVT is applied over the backfilled spoil (EVT rate of 1.6 mm/d and extinction depth of 5.1 m).

IDE Final Void

Recharge and evapotranspiration were not applied to the area of lake formation in the final residual void in the groundwater model, since the water balance model (HydroBalance, 2026) used iteratively with the groundwater model accounts for these boundary conditions on the void lake.

The final void would accumulate water over time due to rainfall, surface water runoff and groundwater inflows from recovered groundwater levels. 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 (HydroBalance, 2026).

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

- Step 1: The pit lake recovery levels vs time were simulated by the HydroBalance (2026) surface water model, which incorporated both groundwater and surface water fluxes and processes.
- Step 2: To refine the groundwater model prediction of groundwater inflow during recovery, the residual void water elevations derived from the HydroBalance (2026) surface water balance modelling were then replicated within the numerical groundwater model using a time variant constant head boundary (CHD) condition.
- Step 3: The simulated groundwater inflows (using the residual void water elevation from step 2) were then provided to the surface water consultant (HydroBalance) to check for consistency with the surface water model inputs.
- Step 4: Three iterations were performed between the groundwater and surface water models until convergence was reached. The lake elevation from the final iteration, in which both models were consistent, was then selected for the analysis.

2.2 Water Balance

2.2.1 Active Mining

The transient water balance is shown as time-series (averaged per stress period) for all components for the Proposed scenario (**Figure 2-2**), the Approved scenario ((**Figure 2-3**) and the Null Run scenario (**Figure 2-4**).

For all scenarios, variations in river leakage (River Leakage In and River Leakage Out) are reflective of the model set-up, alternating between periods of river flow and periods without flow.

Water going into and out of storage (Storage In and Storage Out) shows limited variability, with minor peaks associated with small recharge fluctuations. The difference in total recharge flux between the null and the two mining scenarios is noticeable. This is due to spoil recharge applied over the entire model domain. Contributions from regional boundary flow (Head Dep Bounds In and Out) and constant heads (Constant Head In and Out) remain small overall during the operational period.

For the Approved and Proposed scenarios, mine dewatering (Drains Out) is observed to first increase in peak inflow and overall volumes before reducing overtime. A slight increase (i.e. decrease on water coming out of storage [Storage In] shows peak associated with mine dewatering peaks).

The average mass balance error for all simulations is less than 0.1%, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Figure 2-2 Predictive Water Balance – Proposed Scenario – MLE Model

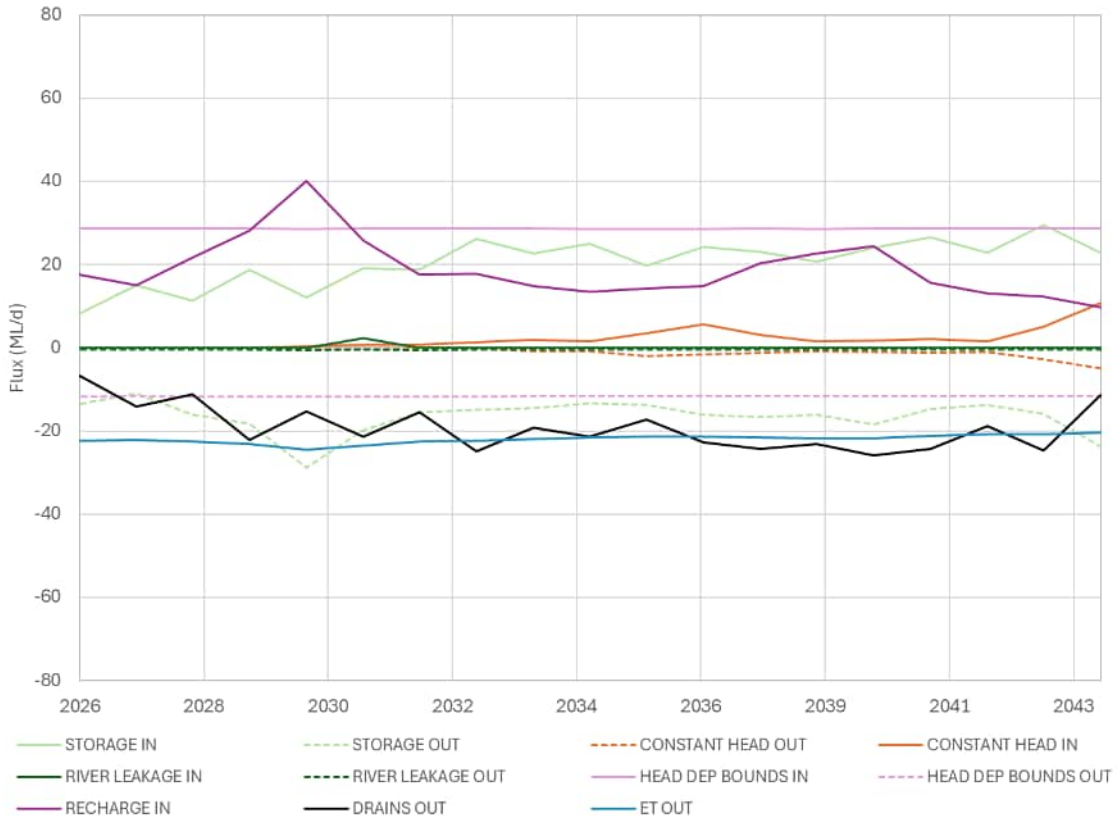


Figure 2-3 Predictive Water Balance – Approved Scenario – MLE Model

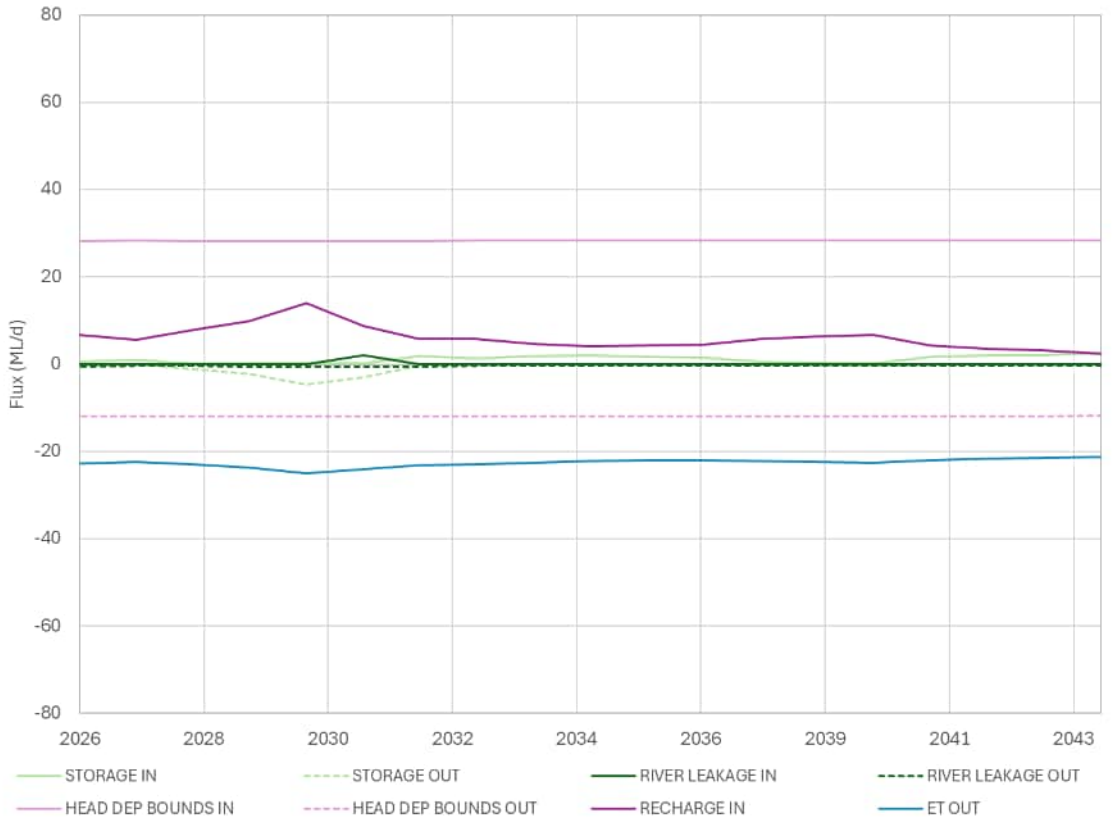


Figure 2-4 Predictive Water Balance – Null Run – MLE Model

2.2.2 Post-Mining

The transient water balance is shown as time series for all components for the MLE model for the Proposed scenario (**Figure 2-5**), the Approved scenario (**Figure 2-6**) and the Null run (**Figure 2-7**).

During the recovery period, most boundary conditions are set at a constant value and as such, there are limited variations in the water balance overtime. The only boundary condition that is transient is the Constant Head, simulating all final void lakes in the model domain.

The spike in Constant Head In and Storage Out (**Figure 2-5** and **Figure 2-6**) occurs because the Peak Downs Mine (PDM) voids are large/deep, and the increase in the constant-head lake is not fully progressive. This causes the constant-head cells at PDM to temporarily draw in a large volume of water to maintain the fixed head, while the aquifer simultaneously releases stored water. The spike is associated with the PDM mine and is unrelated to the Project.

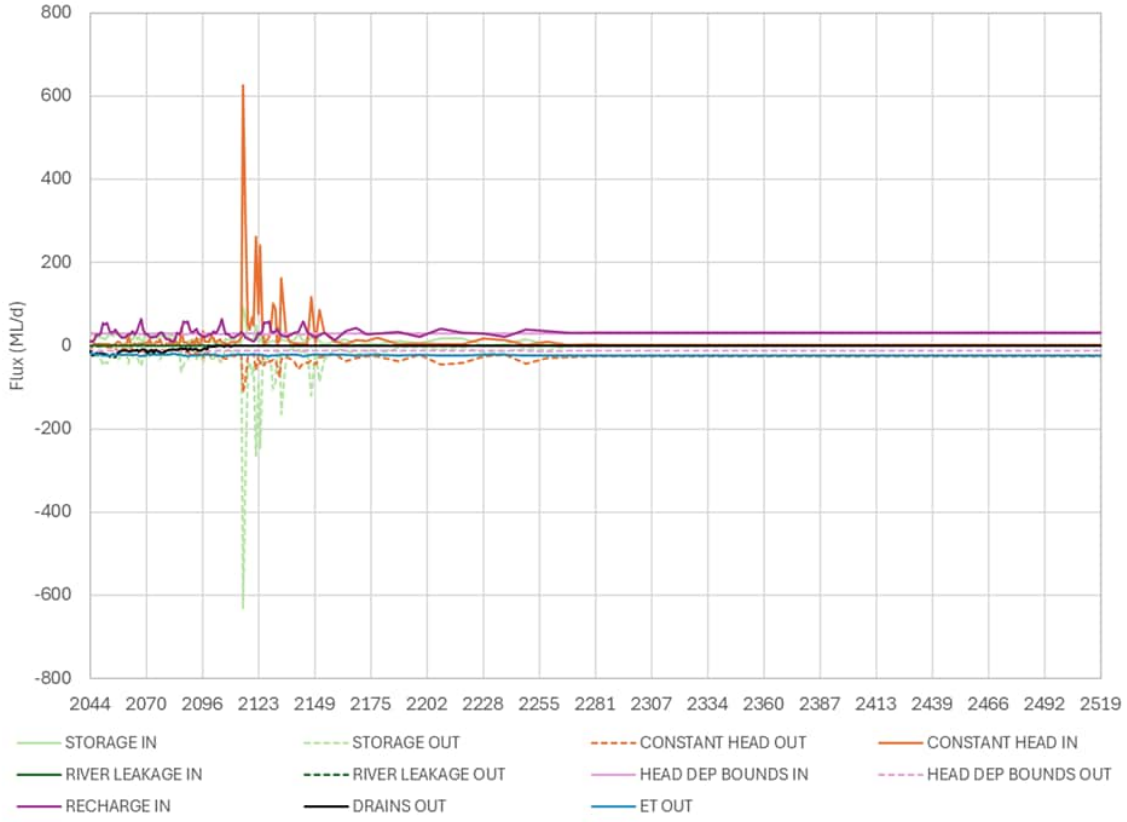


Figure 2-5 Post-Mining Water Balance – Proposed Scenario – MLE Model

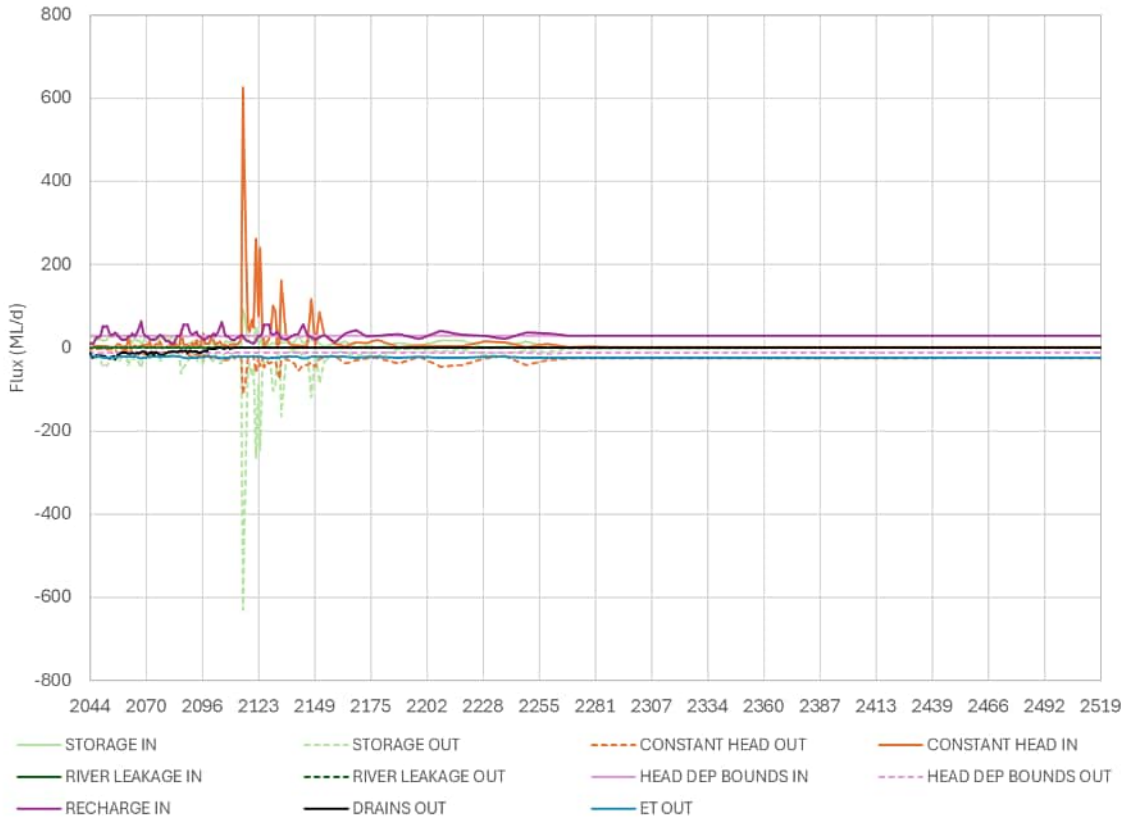


Figure 2-6 Post-mining Water Balance – Approved Scenario – MLE Model

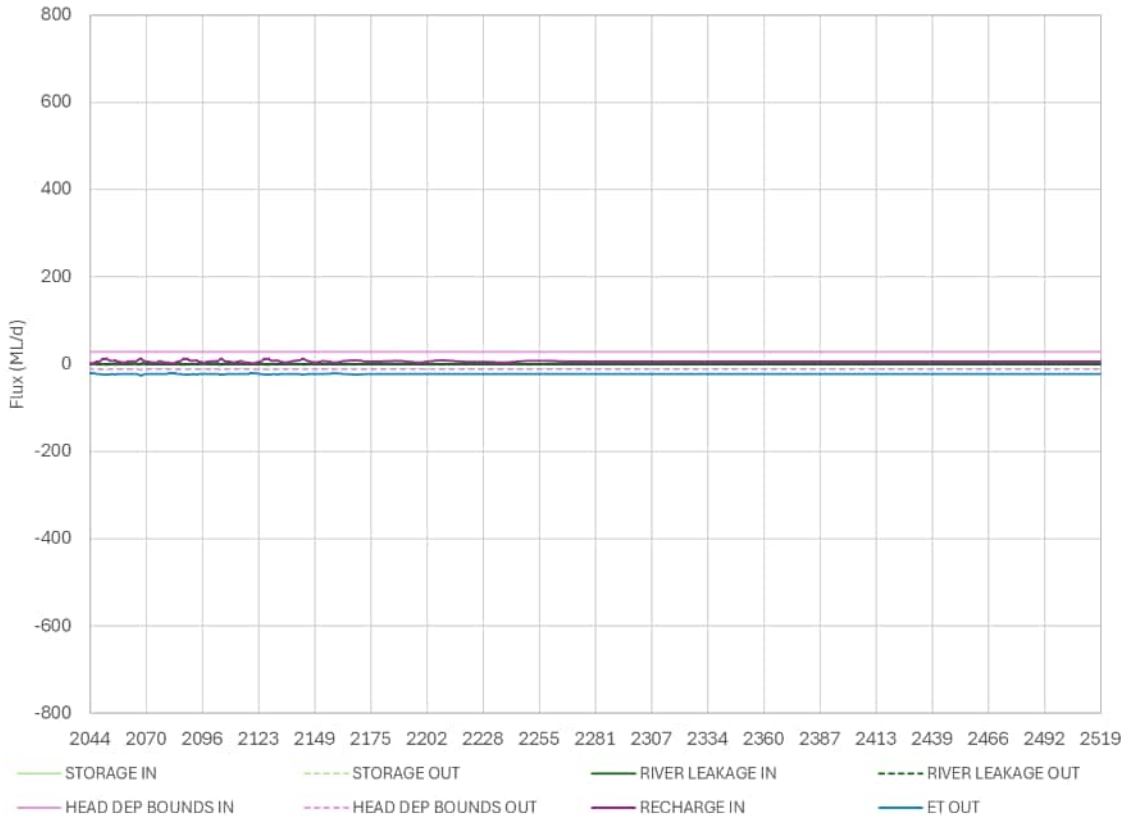


Figure 2-7 Post-mining Water Balance – Null Scenario – MLE Model

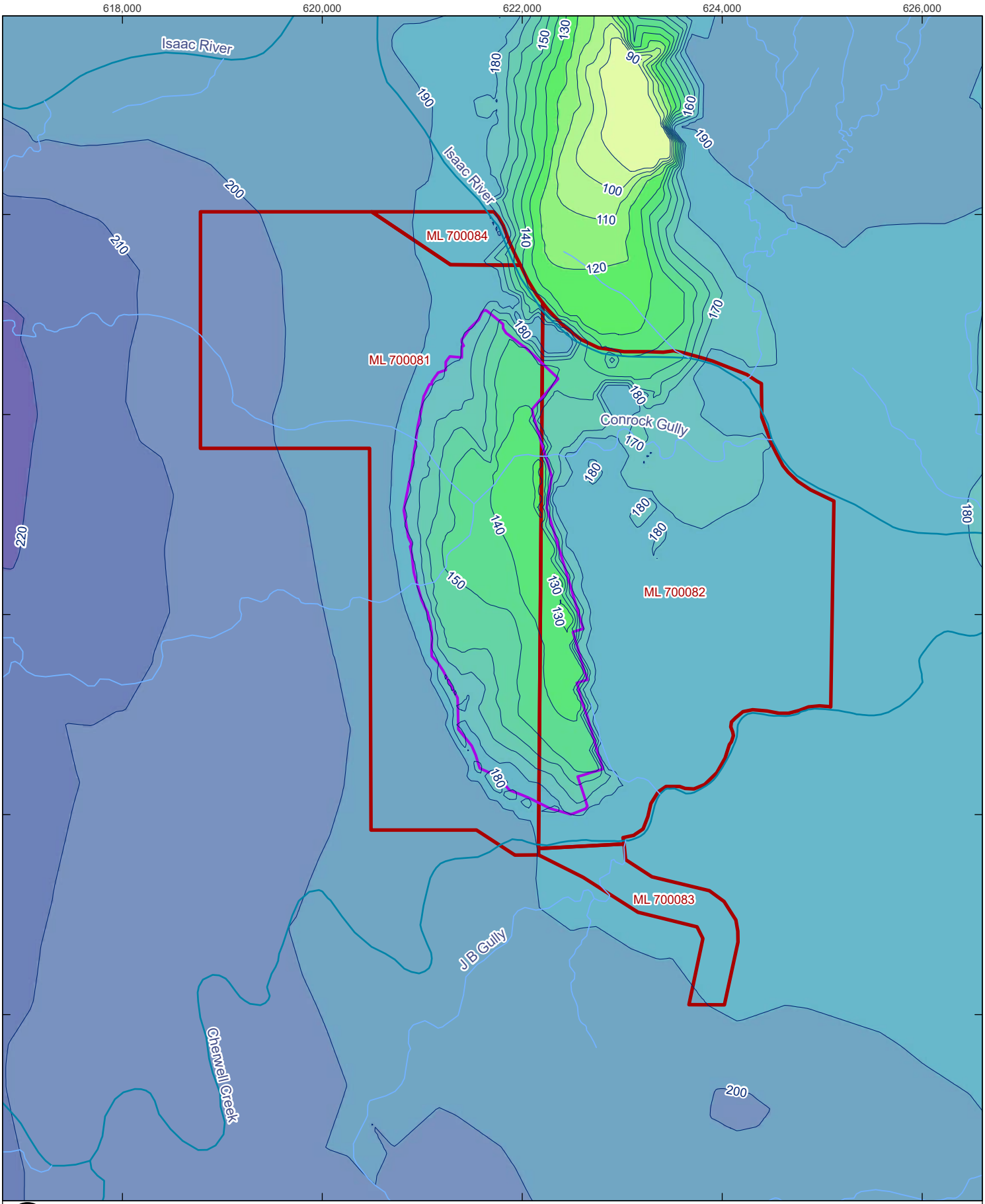
2.3 Predicted Groundwater Levels

Predicted groundwater levels at the end of Project mining operations for the proposed model scenario are provided in **Figure 2-8** to **Figure 2-12**, showing the groundwater table, and groundwater levels within the alluvium (Layer 1), regolith (Layer 2), Leichhardt Seam (Layer 5), and Vermont Seam (Layer 7), respectively. The gaps in the water level grids represent unsaturated areas (i.e. where the simulated water level elevation is below the base of cell).

Figure 2-10 shows predicted groundwater levels in the regolith at the end of mining for the proposed model scenario. Dewatering of the regolith caused by mining at the Project and surrounding mines can be seen by slightly larger unsaturated zones within the sites of mining (**Figure 2-10**).

Figure 2-11 and **Figure 2-12** show the predicted water levels in the Rangal Coal Measures for the Leichardt Seam (Layer 5) and the Vermont Seam (Layer 7), respectively. A regional south-easterly hydraulic gradient can be observed consistent with the conceptualisation, reflecting the downstream flow gradient of the Isaac River. Zones of depressurisation at the Project and surrounding mines are shown to cause localised interruptions to the regional flow gradient, again consistent with the conceptualisation.

Predicted groundwater levels for post mining at the Project for the proposed model scenario are provided in **Figure 2-13** to **Figure 2-17**, showing the groundwater table, and groundwater levels within the alluvium (Layer 1), regolith (Layer 2), Leichhardt Seam (Layer 5), and Vermont Seam (Layer 7), respectively. The gaps in the water level grids represent unsaturated areas (i.e. where the simulated water level elevation is below the base of cell). The depressed groundwater levels to the south-west of the project area are likely influenced by the drawdown associated with the Moranbah South underground mine.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Groundwater Level (mAHD)

80 - 90	160 - 170
90 - 100	170 - 180
100 - 110	180 - 190
110 - 120	190 - 200
120 - 130	200 - 210
130 - 140	210 - 220
140 - 150	220 - 230
150 - 160	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER TABLE ELEVATION – END OF MINING

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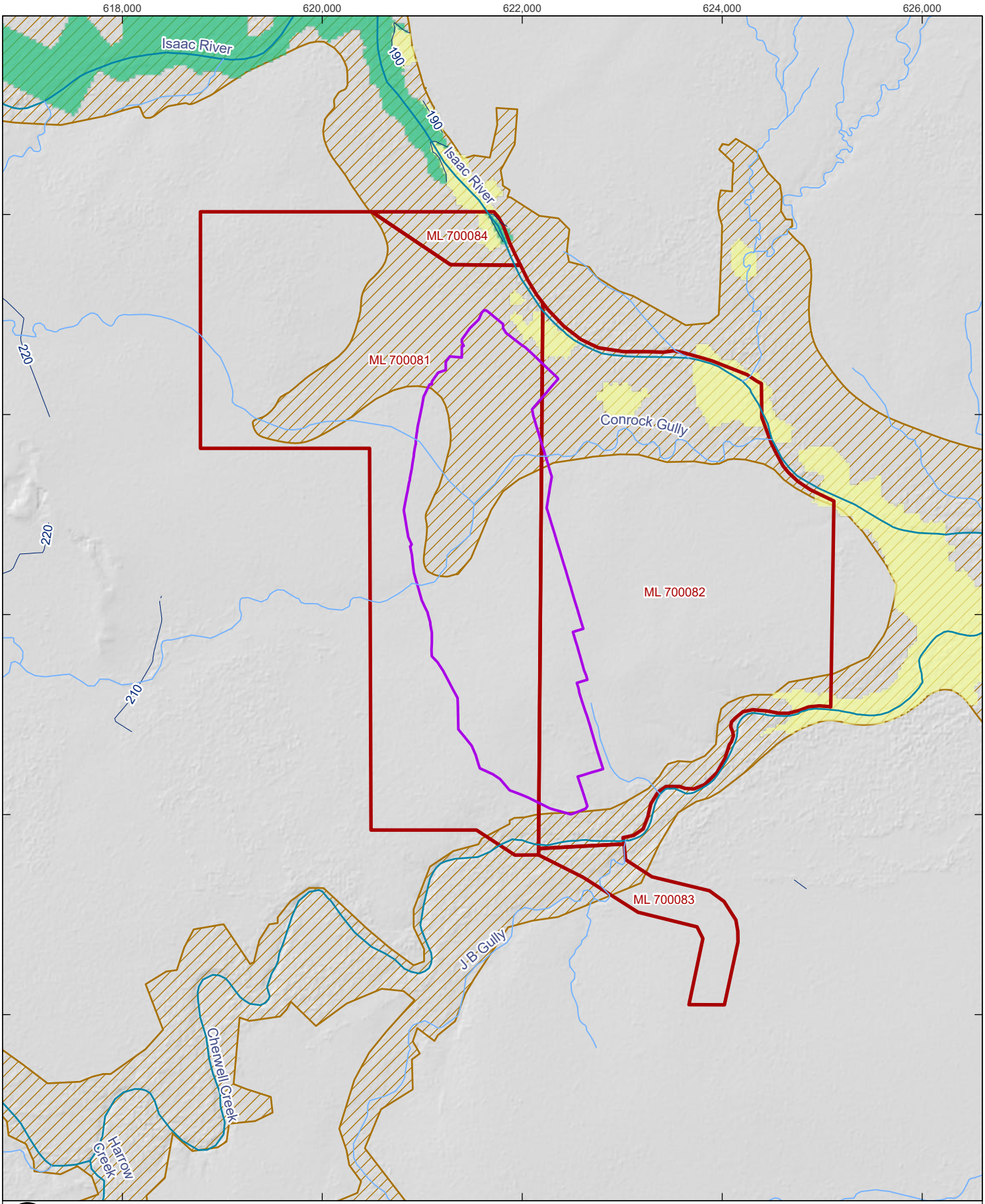
FIGURE 2-8

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-08_Predicted Groundwater Table Elevation – End of Mining



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Alluvium Extent

Groundwater Level (mAHD)

- 180 - 190
- 190 - 200

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS WITHIN ALLUVIUM (LAYER 1) – END OF MINING

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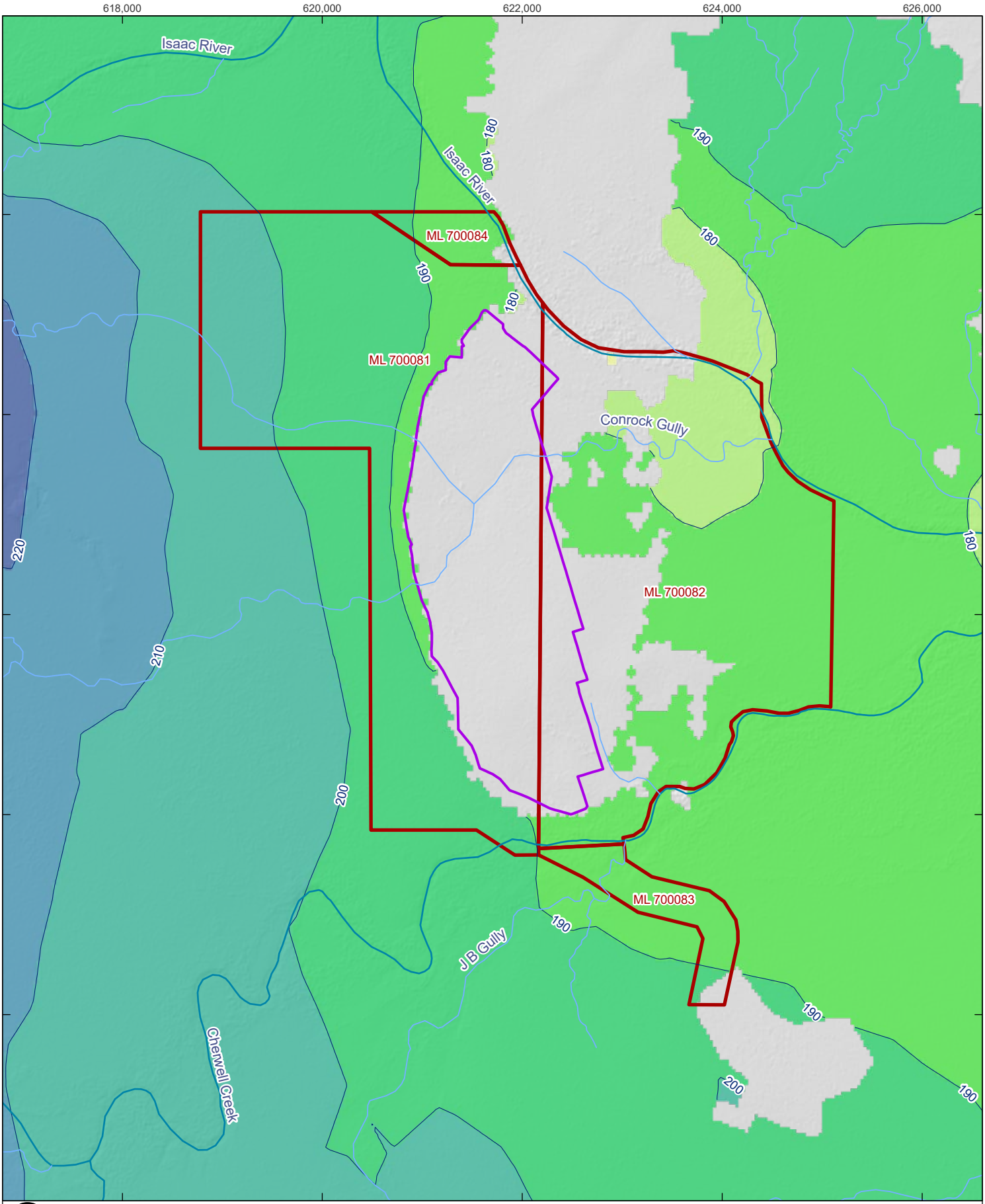
FIGURE 2-9

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-09_Predicted Groundwater Levels Within Alluvium (Layer 1) – End of Mining



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Groundwater Level (mAHD)

- 160 - 170
- 170 - 180
- 180 - 190
- 190 - 200
- 200 - 210
- 210 - 220
- 220 - 230

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PREDICTED GROUNDWATER LEVELS WITHIN REGOLITH (LAYER 2) – END OF MINING

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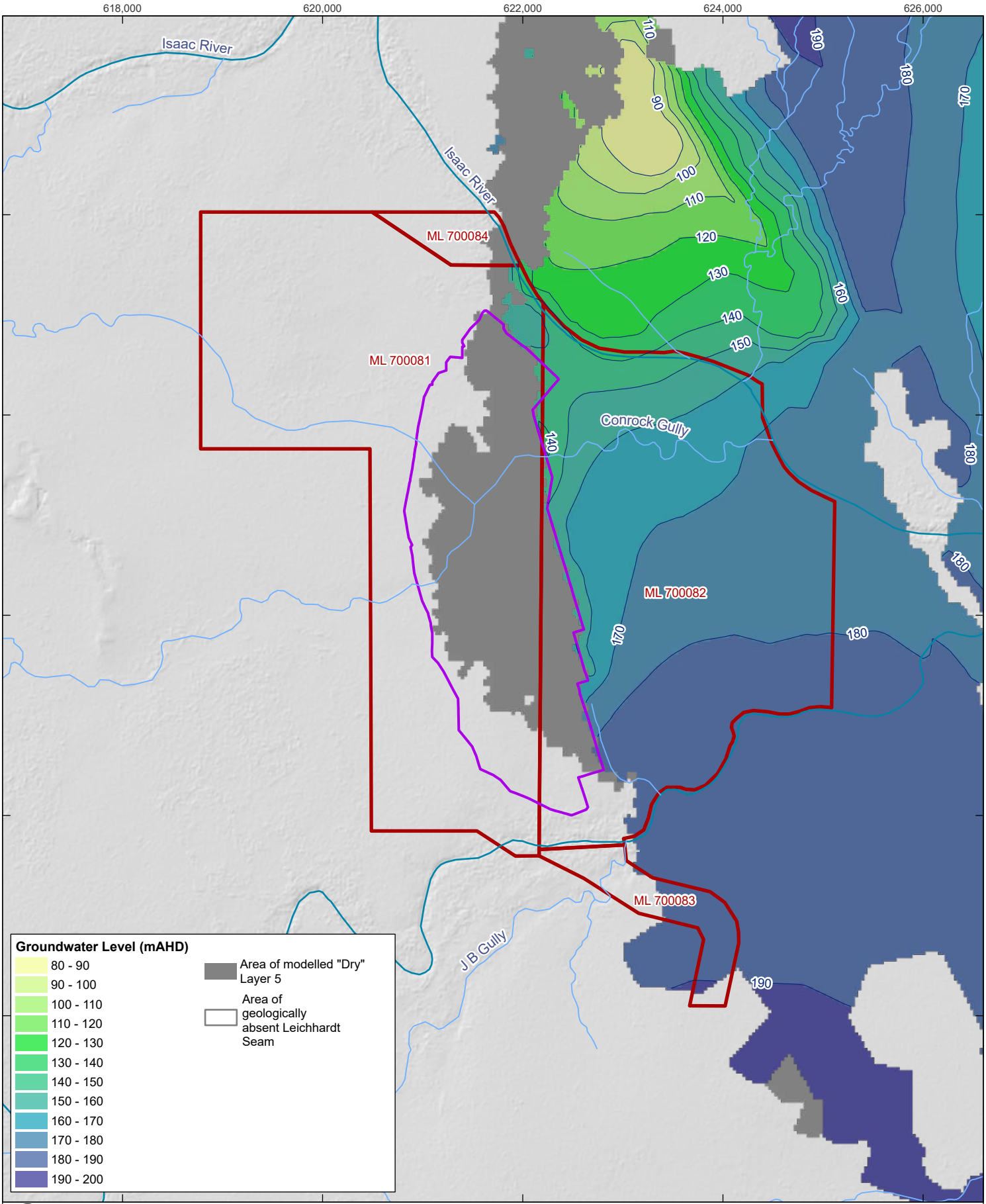
FIGURE 2-10

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-10_Predicted Groundwater Levels Within Regolith (Layer 2) – End of Mining



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS WITHIN LEICHHARDT SEAM (LAYER 5) – END OF MINING

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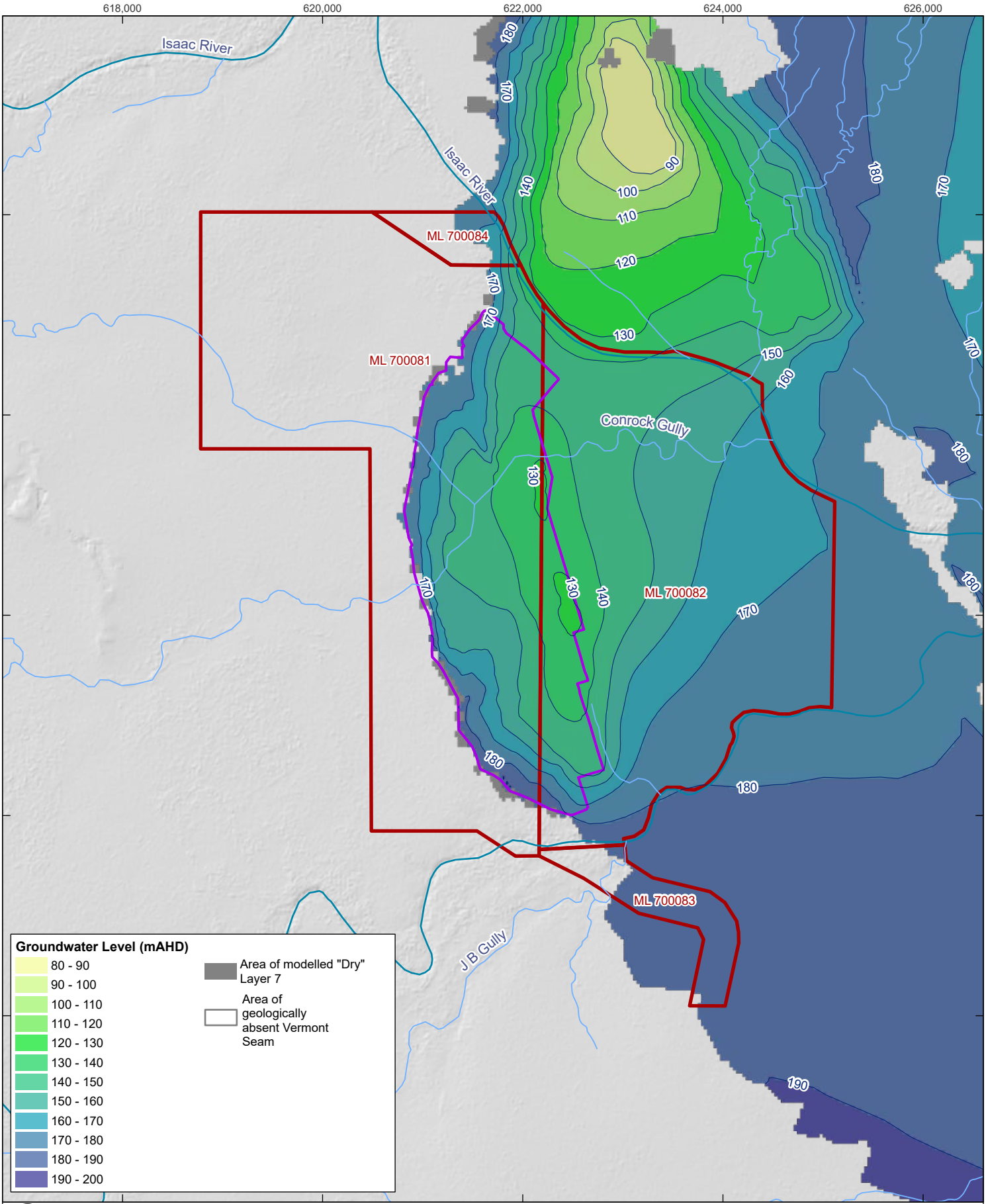
FIGURE 2-11

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-11_Predicted Groundwater Levels Within Leichhardt Seam (Layer 5) – End of Mining



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	21-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS WITHIN VERMONT SEAM (LAYER 7) – END OF MINING

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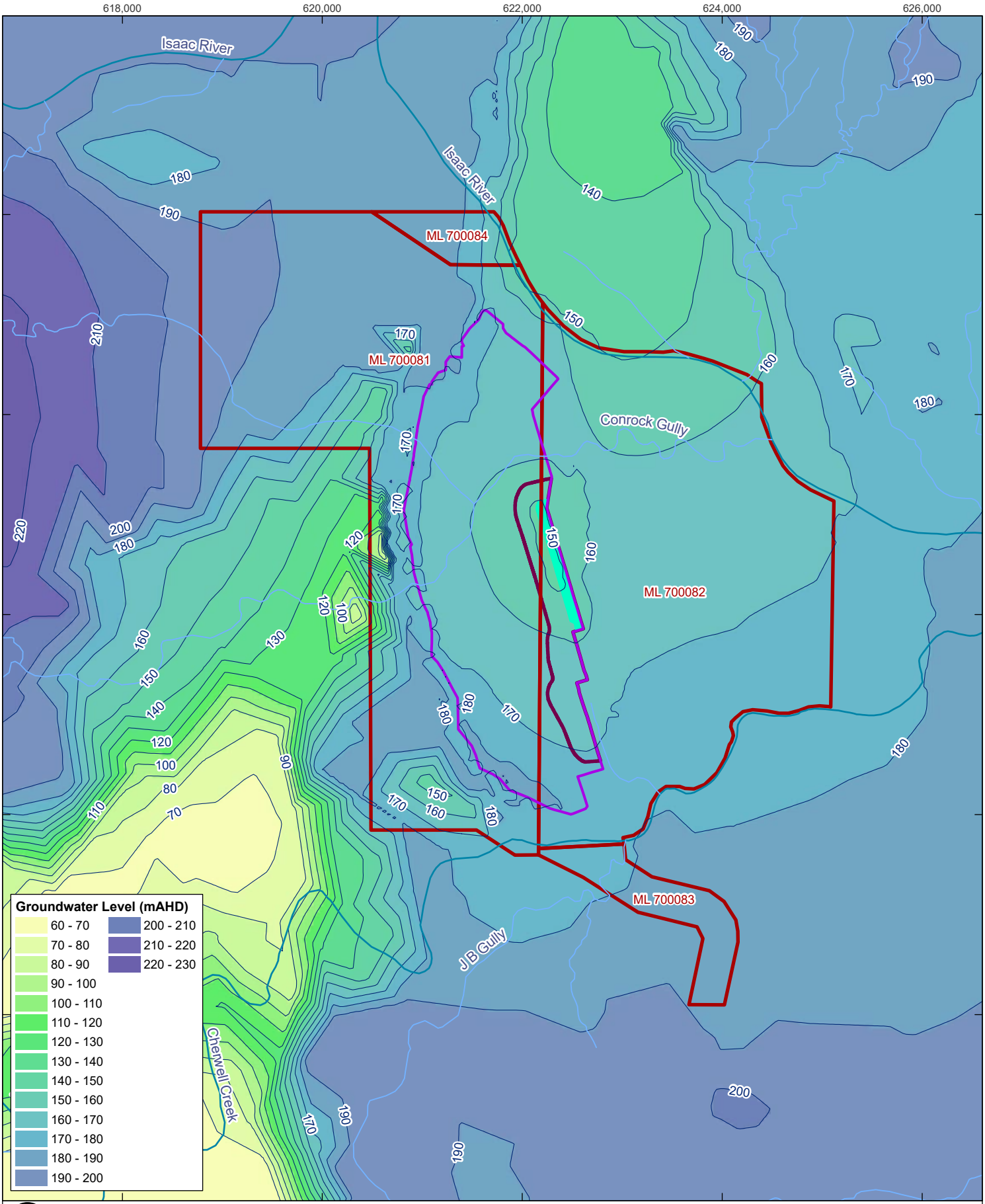
FIGURE 2-12

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-12_Predicted Groundwater Levels Within Vermont Seam (Layer 7) – End of Mining



LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Void Extent
- Void Lake

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER TABLE ELEVATION – POST-MINING EQUILIBRIUM

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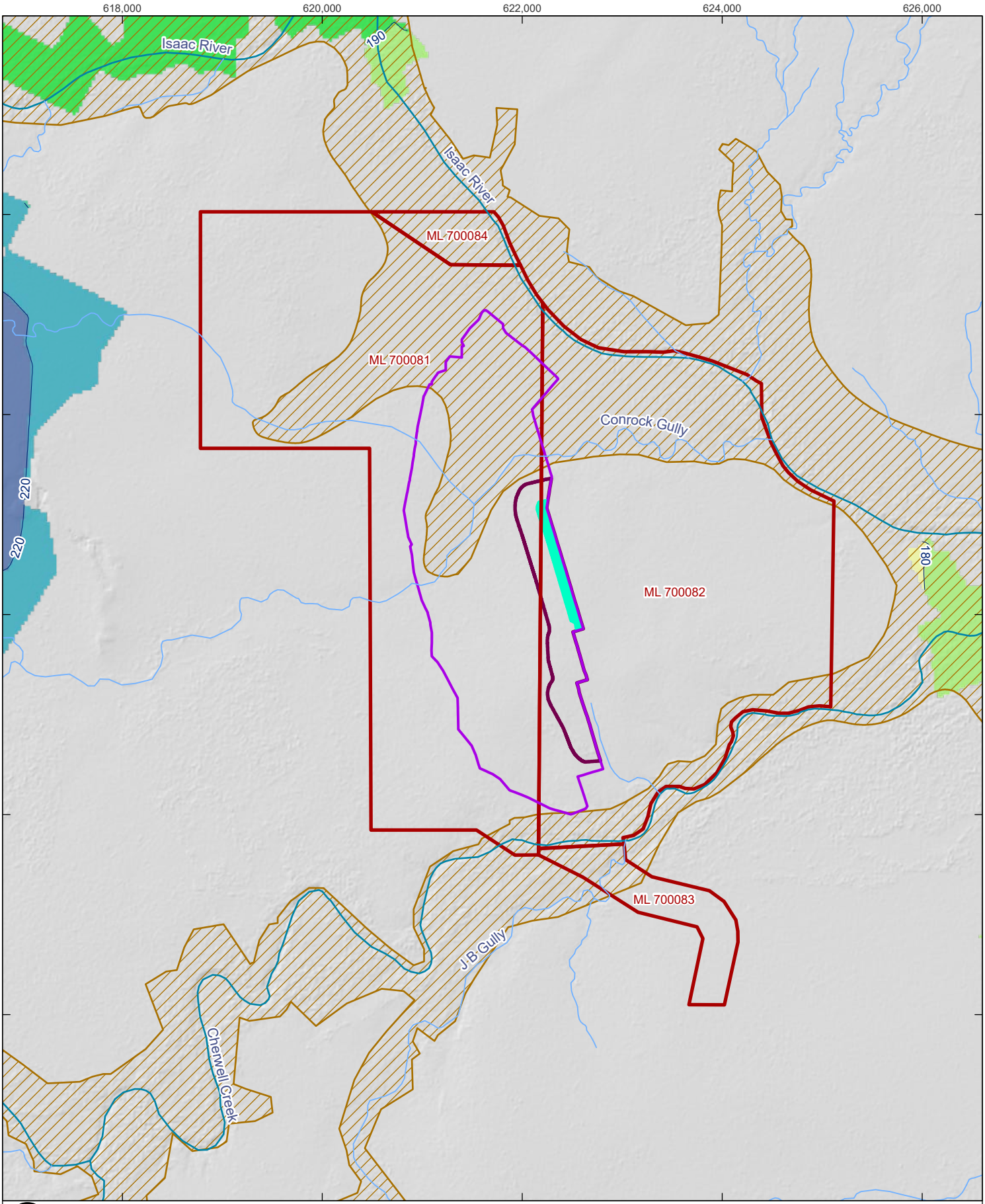
FIGURE 2-13

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-13_Predicted Groundwater Table Elevation – Post-Mining Equilibrium



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Void Extent
- Void Lake
- Alluvium Extent

Groundwater Level (mAHD)

- 170 - 180
- 180 - 190
- 190 - 200
- 200 - 210
- 210 - 220
- 220 - 230

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS WITHIN ALLUVIUM (LAYER 1) – POST-MINING EQUILIBRIUM

SLR

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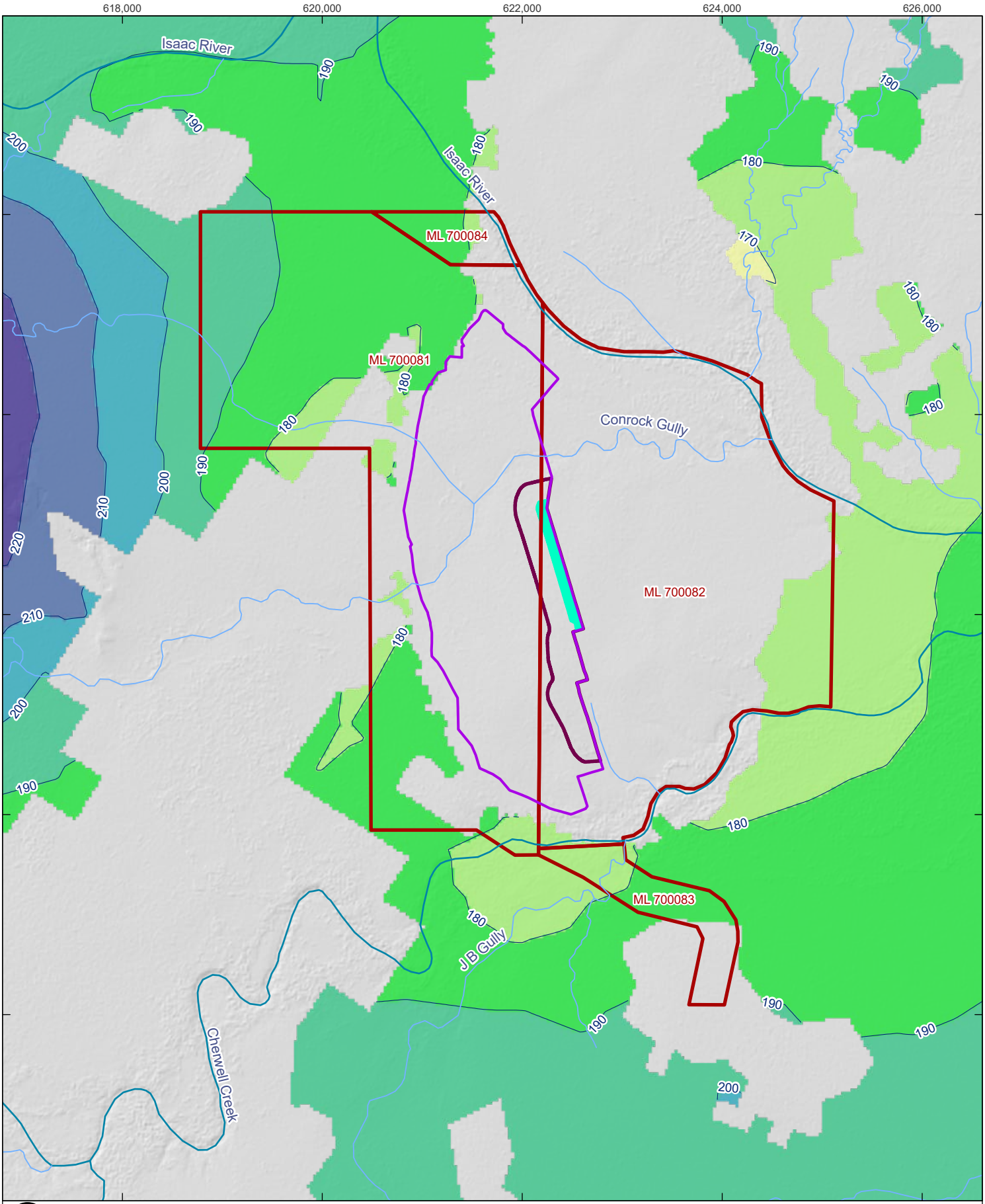
FIGURE 2-14

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-14_Predicted Groundwater Levels Within Alluvium (Layer 1) – Post-Mining Equilibrium



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Void Extent
- Void Lake

Groundwater Level (mAHD)

- 160 - 170
- 170 - 180
- 180 - 190
- 190 - 200
- 200 - 210
- 210 - 220
- 220 - 230

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS WITHIN REGOLITH (LAYER 2) – POST-MINING EQUILIBRIUM

SLR

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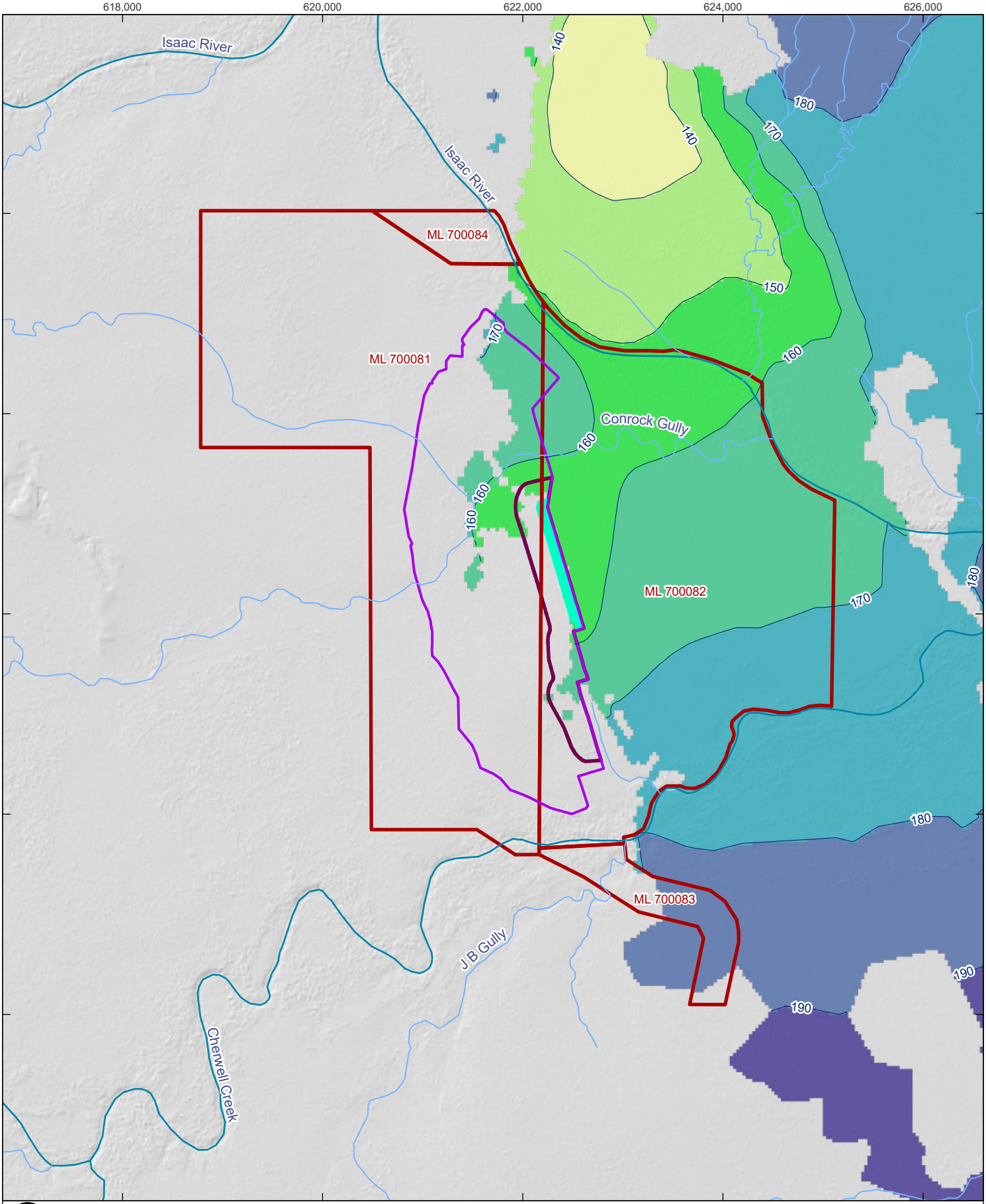
FIGURE 2-15

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-15_Predicted Groundwater Levels Within Regolith (Layer 2) – Post-Mining Equilibrium



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Void Extent
- Void Lake

Groundwater Level (mAHD)

- 130 - 140
- 140 - 150
- 150 - 160
- 160 - 170
- 170 - 180
- 180 - 190
- 190 - 200

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS WITHIN LEICHHARDT SEAM (LAYER 5) – POST-MINING EQUILIBRIUM

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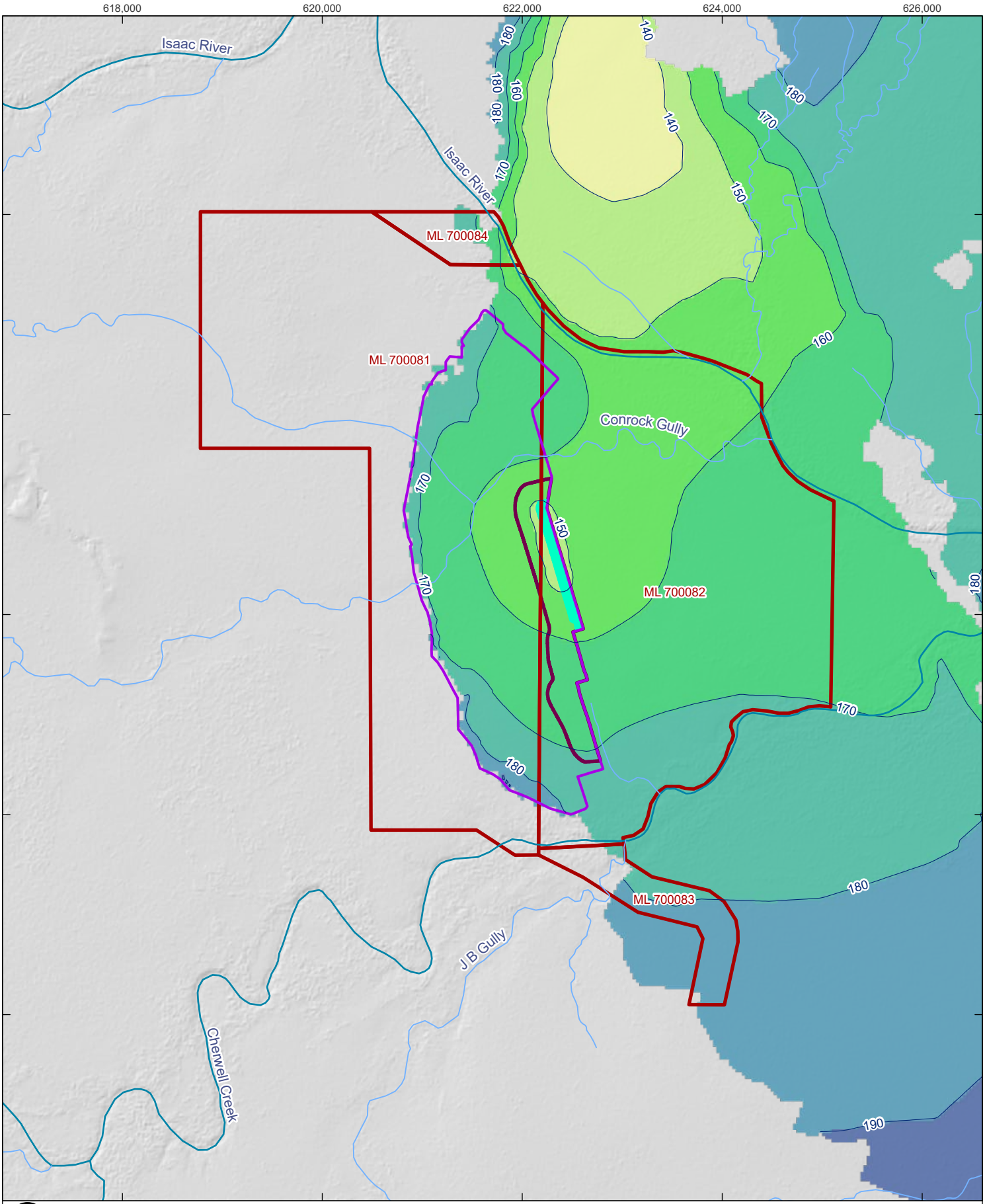
FIGURE 2-16

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-16_Predicted Groundwater Levels Within Leichhardt Seam (Layer 5) – Post-Mining Equilibrium



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Contour (mAHD)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Void Extent
- Void Lake

Groundwater Level (mAHD)

- 130 - 140
- 140 - 150
- 150 - 160
- 160 - 170
- 170 - 180
- 180 - 190
- 190 - 200

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED GROUNDWATER LEVELS WITHIN VERMONT SEAM (LAYER 7) – POST-MINING EQUILIBRIUM

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FIGURE 2-17

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-17_Predicted Groundwater Levels Within Vermont Seam (Layer 7) – Post-Mining Equilibrium

2.4 Predicted Maximum Drawdown

The process of mining reduces groundwater levels and pressures in surrounding geological 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 unconfined aquifers, including the water table (i.e. the upper surface of the saturated zone where pore water pressure equals atmospheric pressure).

Depressurisation and drawdown are greatest at the working coal-face and reduce with distance from the Project. The predicted drawdowns due to the Project only (incremental or Project only effects were calculated as the difference between the Proposed scenario and Approved scenario). The predicted drawdowns due to the Project and all the neighbouring mining operations (the 'Cumulative' mining effects) were calculated as the difference between the Proposed scenario and the Null scenario. Incremental and cumulative depressurisation and drawdown are discussed in the following sections.

2.4.1 Post Mining

2.4.1.1 Predicted Maximum Drawdown (Incremental)

The maximum drawdown represents the maximum drawdown recorded at each model cell at any time over the model simulation duration time from the start of the calibration period (1960) to the end of recovery (2519). Predicted maximum drawdown (incremental) is the component of maximum drawdown that is associated with the addition of the proposed action.

Predicted drawdown figures (**Figure 2-18** to **Figure 2-22**) show where maximum drawdown impacts are predicted to exceed 1 m.

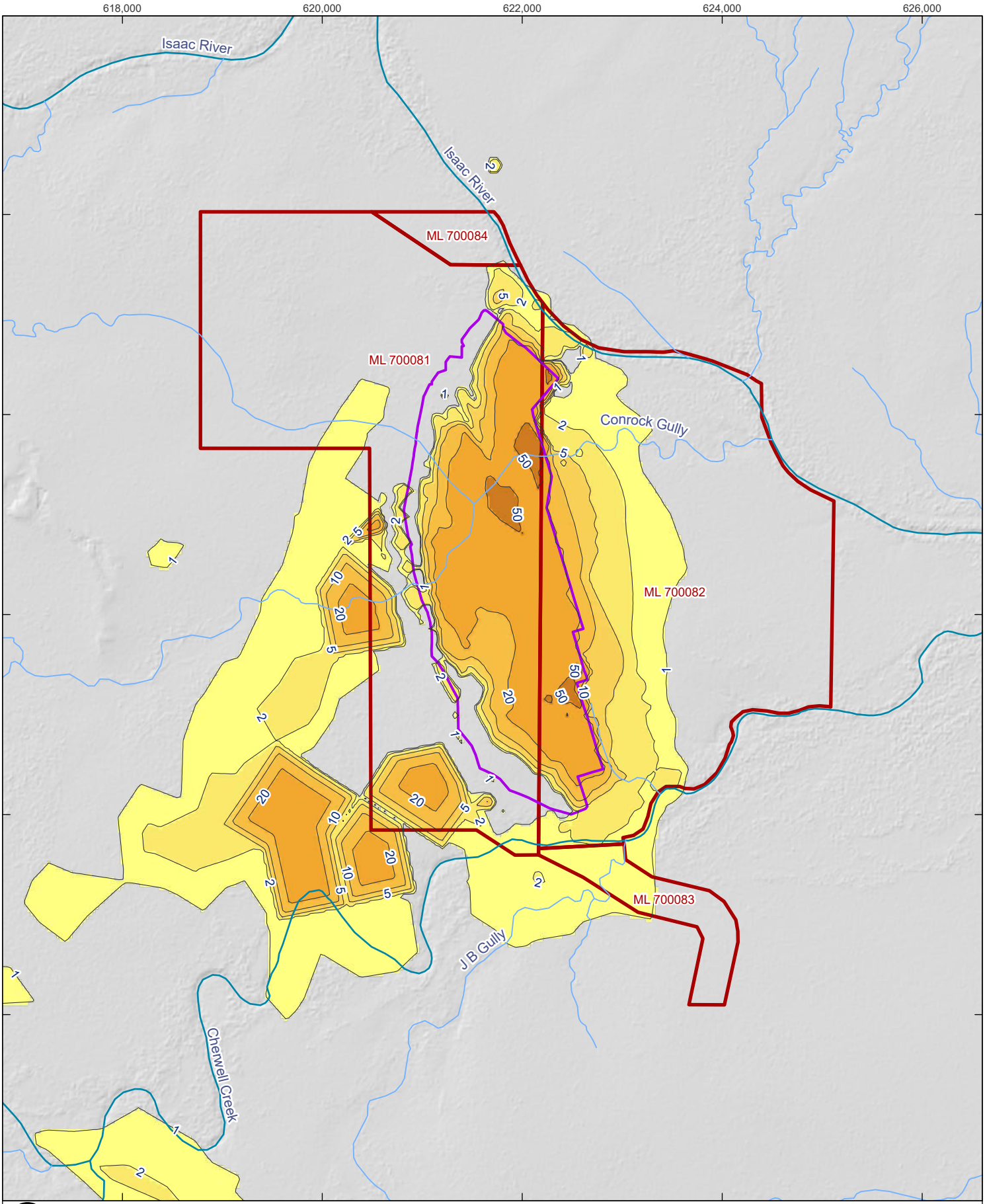
No incremental drawdown impacts exceeding 1 m are predicted for the Quaternary alluvium as a result of the Project (**Figure 2-19**).

Figure 2-18 shows that the predicted maximum water table drawdown (incremental) is concentrated around the Project mining area. The small areas of drawdown shown outside the Project area are the result of numerical effects within the model and do not represent any physical depressurisation beyond the Project.

The predicted maximum drawdowns (incremental) exceeding 1 m associated with the Project within the regolith are shown in **Figure 2-20**. The incremental drawdown extent within the regolith (Layer 2) is confined to a small area directly south of the Project area (i.e. the Project MLAs).

The coal seams of the Rangal Coal Measures are the primary groundwater bearing strata targeted by mining at the Project and experience drawdowns as a direct result of mining. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents.

Figure 2-21 and **Figure 2-22** show the predicted maximum drawdown (incremental) for the Leichhardt and Vermont seams in the Rangal Coal Measures. The predicted maximum drawdowns (incremental) occur along the western margin of the Project pit area in both seams, with the Leichhardt seam exhibiting the highest magnitudes adjacent to the mined areas (**Figure 2-21**). In the Vermont seam (**Figure 2-22**), the footprint of drawdown extends further north and south relative to the Leichhardt seam.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

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PREDICTED MAXIMUM WATER TABLE DRAWDOWN (INCREMENTAL)

SLR

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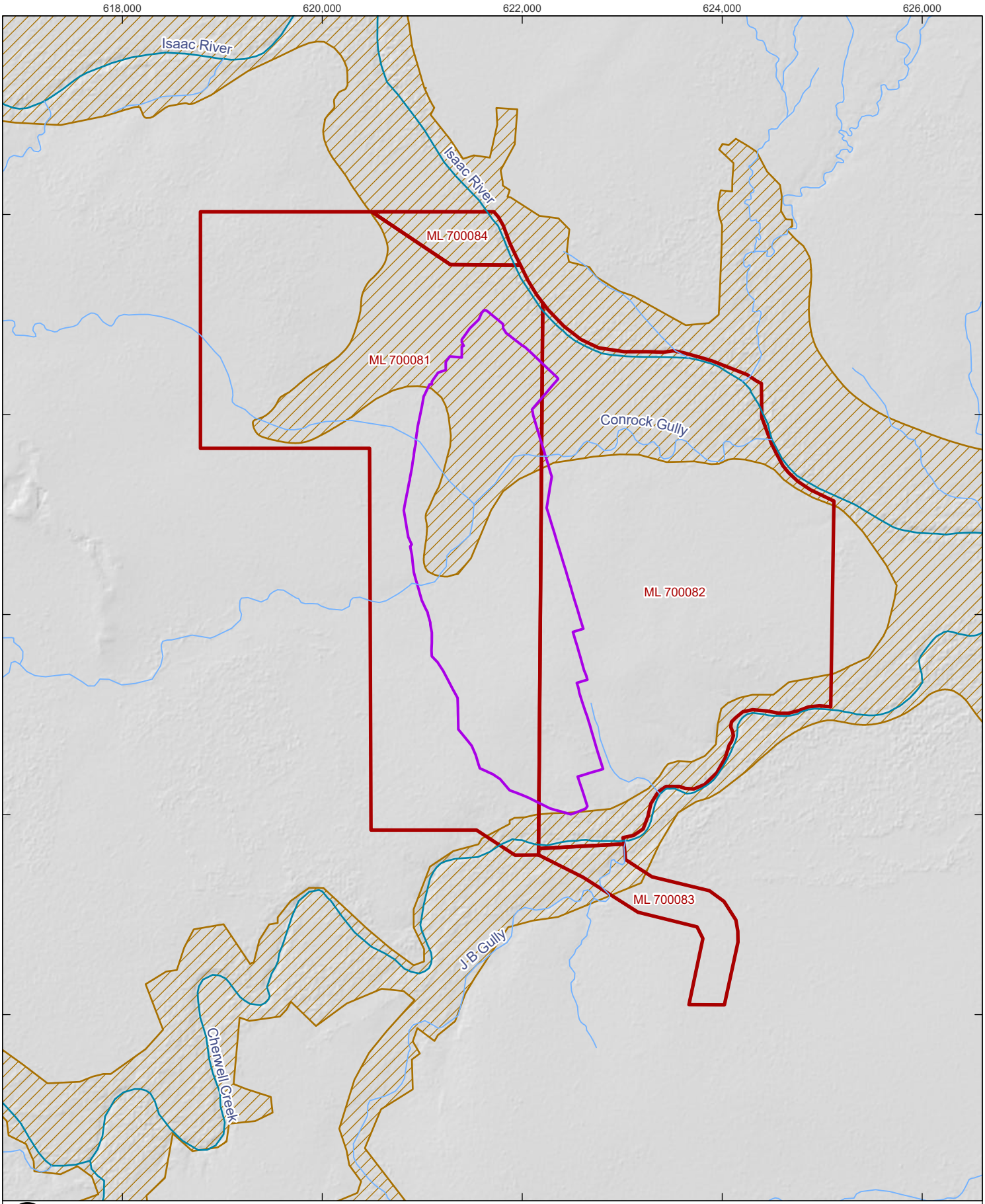
FIGURE 2-18

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-18_Predicted Maximum Water Table Drawdown (Incremental)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	21-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Alluvium Extent

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM DRAWDOWN (INCREMENTAL) – ALLUVIUM (LAYER 1)

SLR

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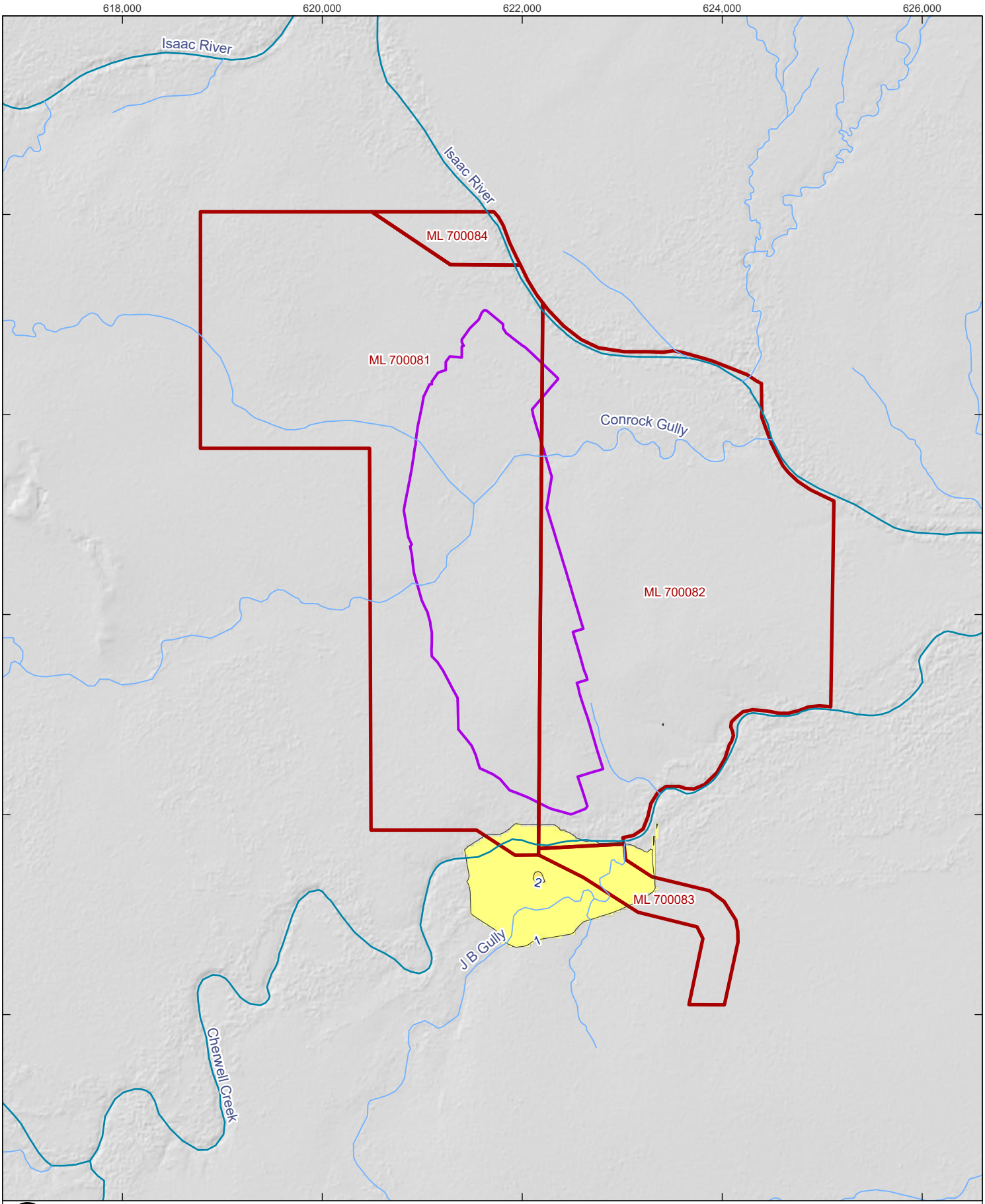
FIGURE 2-19

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-19_Predicted Maximum Drawdown (Incremental) – Alluvium (Layer 1)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	21-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 1 - 2
- 2- 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 500
- > 500

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM DRAWDOWN (INCREMENTAL) – REGOLITH (LAYER 2)

SLR

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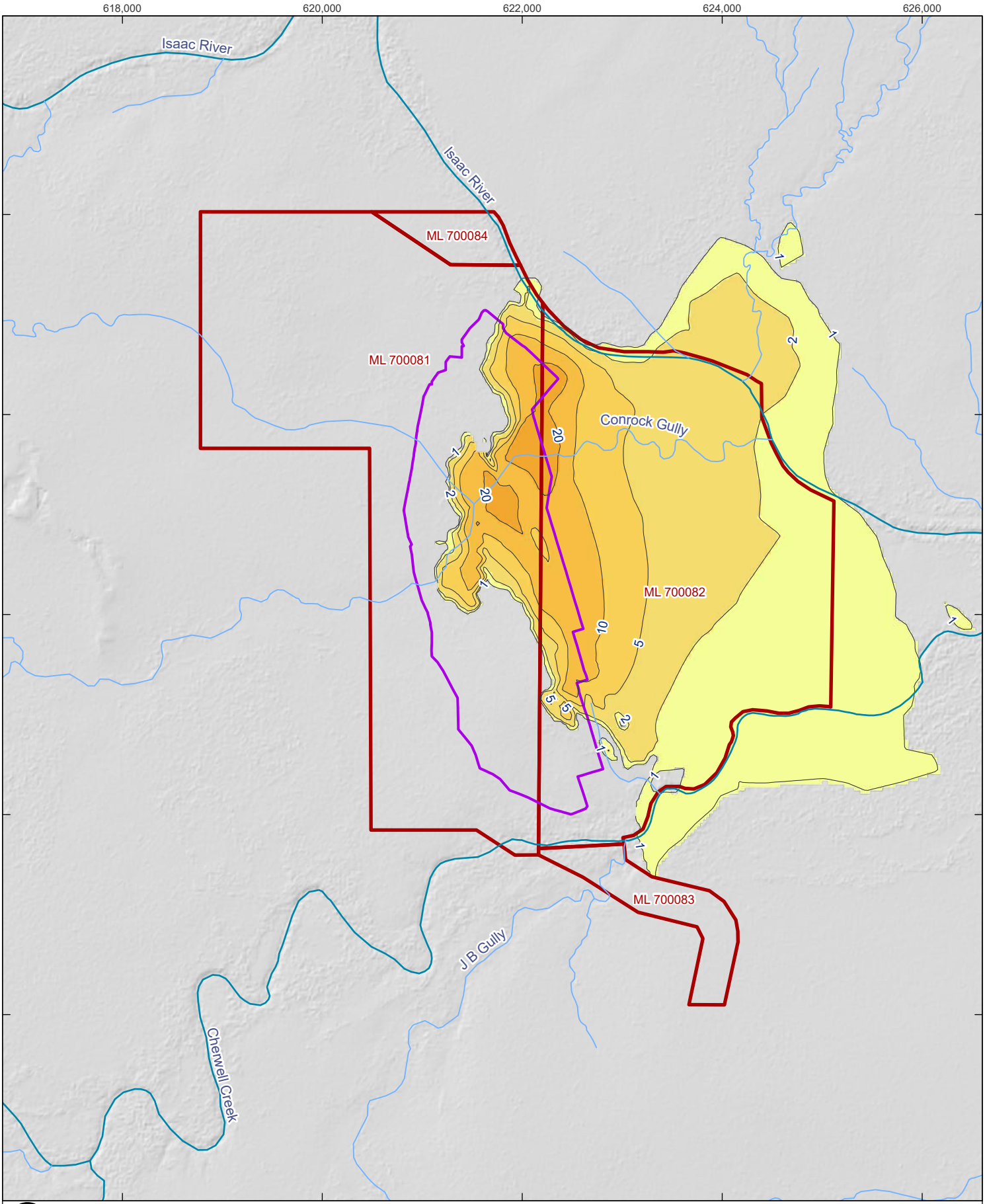
FIGURE 2-20

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-20_Predicted Maximum Drawdown (Incremental) – Regolith (Layer 2)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	04-Jun-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM DRAWDOWN (INCREMENTAL) – LEICHHARDT SEAM (LAYER 5)

SLR

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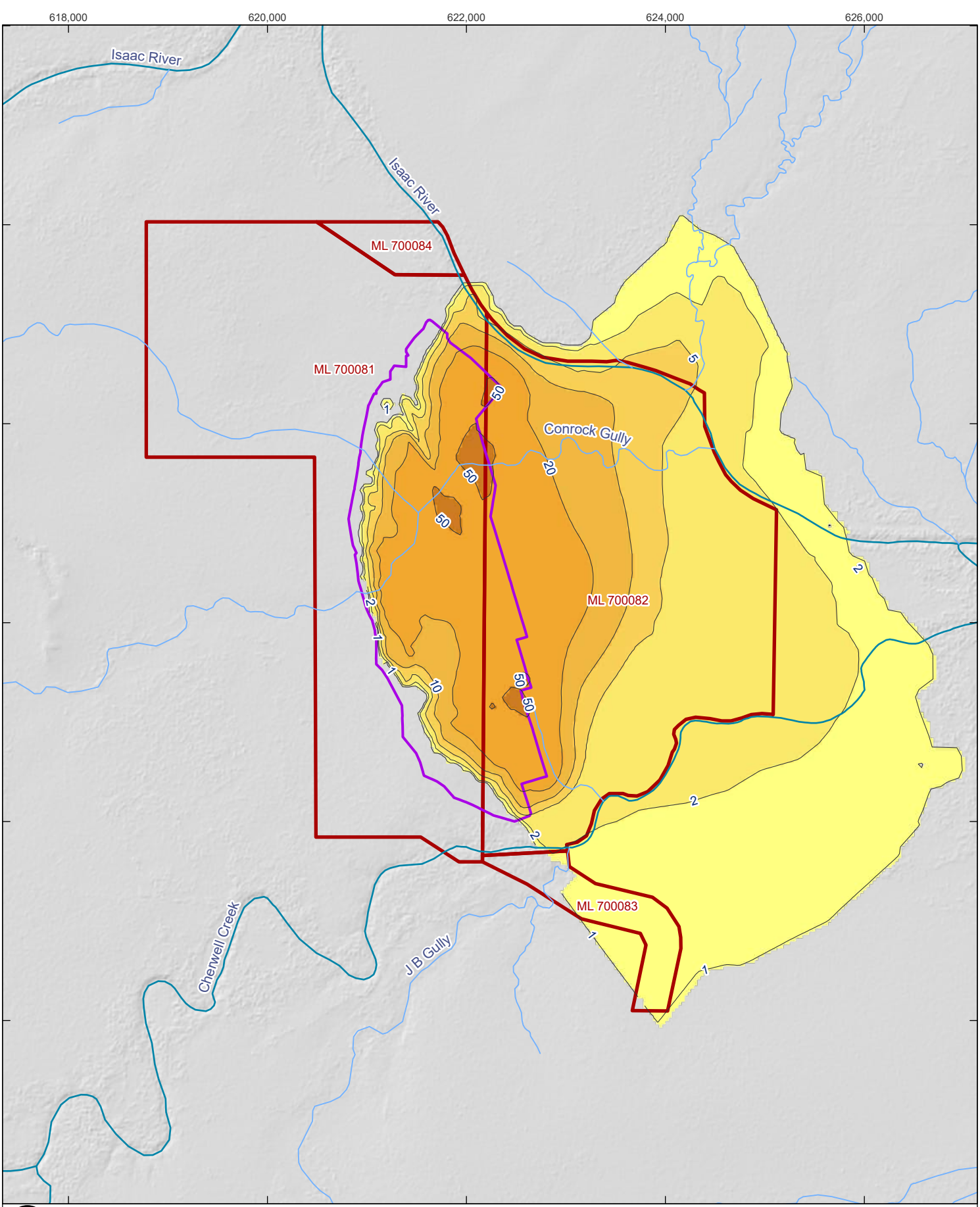
FIGURE 2-21

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-21_Predicted Maximum Drawdown (Incremental) – Leichhardt Seam (Layer 5)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	21-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM DRAWDOWN (INCREMENTAL) – VERMONT SEAM (LAYER 7)

SLR

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FIGURE 2-22

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-22_Predicted Maximum Drawdown (Incremental) – Vermont Seam (Layer 7)

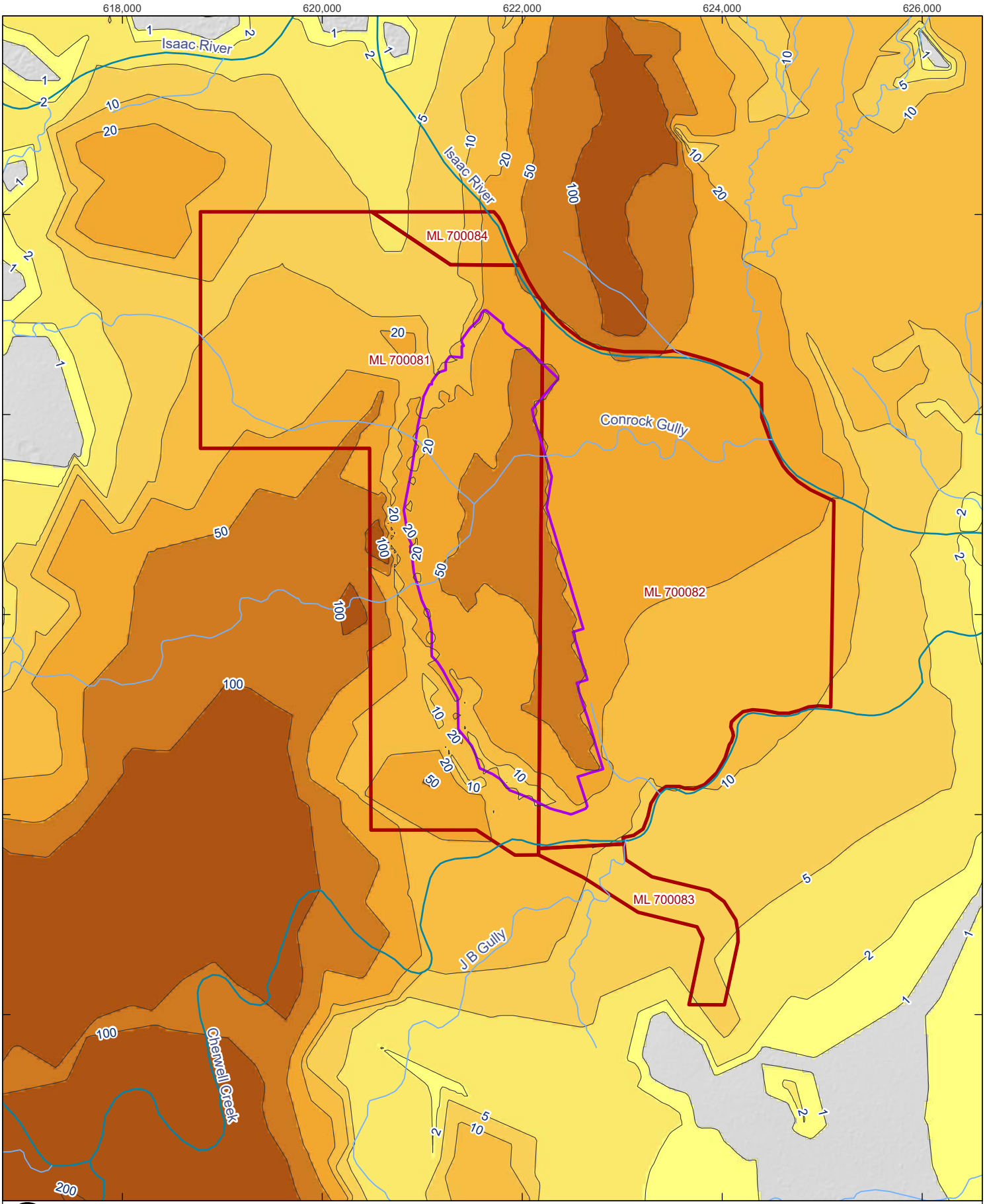
2.4.1.2 Cumulative Drawdown

The predicted maximum drawdowns (cumulative) are obtained by calculating the maximum difference in heads between the Proposed scenario and null run at each cell at any time, from the start of the calibration period (1960) to the end of recovery (2519). **Figure 2-23** to **Figure 2-30** show the predicted maximum drawdowns (cumulative) for the water table, alluvium (layer 1), regolith (layer 2), Leichhardt Seam (layer 5) and Vermont Seam (layer 7), respectively.

The results indicate that cumulative drawdown increases with depth, with the most pronounced depressurisation occurring within the mined coal seams, particularly the Vermont Seam. Shallower units exhibit broader but lower-magnitude drawdown patterns.

The spatial extent of cumulative drawdown reflects the combined influence of long-term mining activities within the Project area and neighbouring operations, including the proposed Moranbah South UG mine.

As shown in **Figure 2-30**, the greatest cumulative depressurisation occurs in the Vermont Seam that is mined at the mining areas. In the deeper coal seams, drawdown extends beyond the Immediate Project footprint, indicating cumulative hydraulic interaction between adjacent mining areas.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-Mar-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM WATER TABLE DRAWDOWN (CUMULATIVE)

SLR

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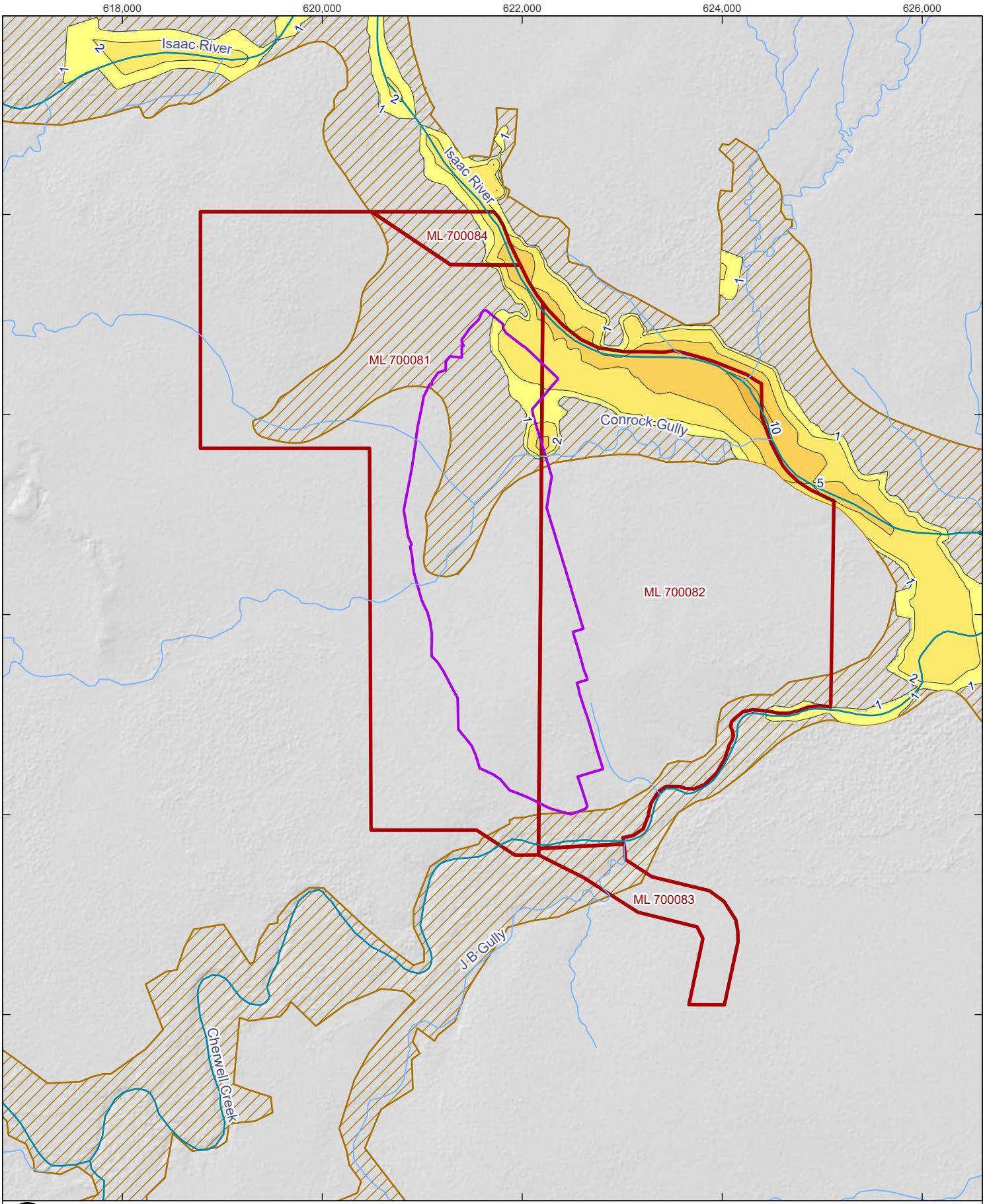
FIGURE 2-23

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-23_Predicted Maximum Cumulative Water Table Drawdown



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-May-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Alluvium Extent

Maximum Drawdown (m)

- 1 - 2
- 2- 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 500
- > 500

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM CUMULATIVE DRAWDOWN – ALLUVIUM (LAYER 1)

SLR

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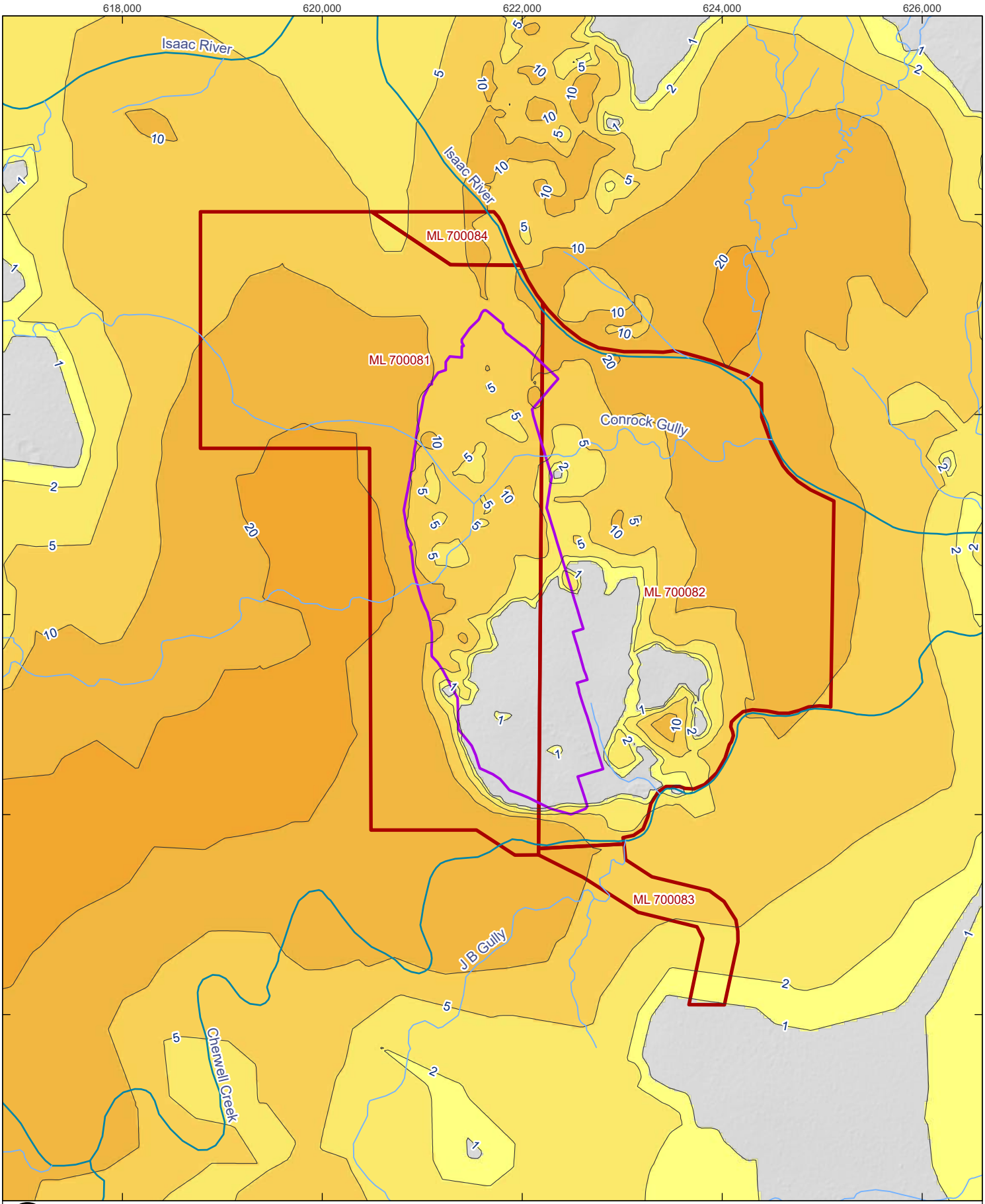
FIGURE 2-24

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-24_Predicted Maximum Cumulative Drawdown – Alluvium (Layer 1)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-Mar-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM DRAWDOWN (CUMULATIVE) – REGOLITH (LAYER 2)

SLR

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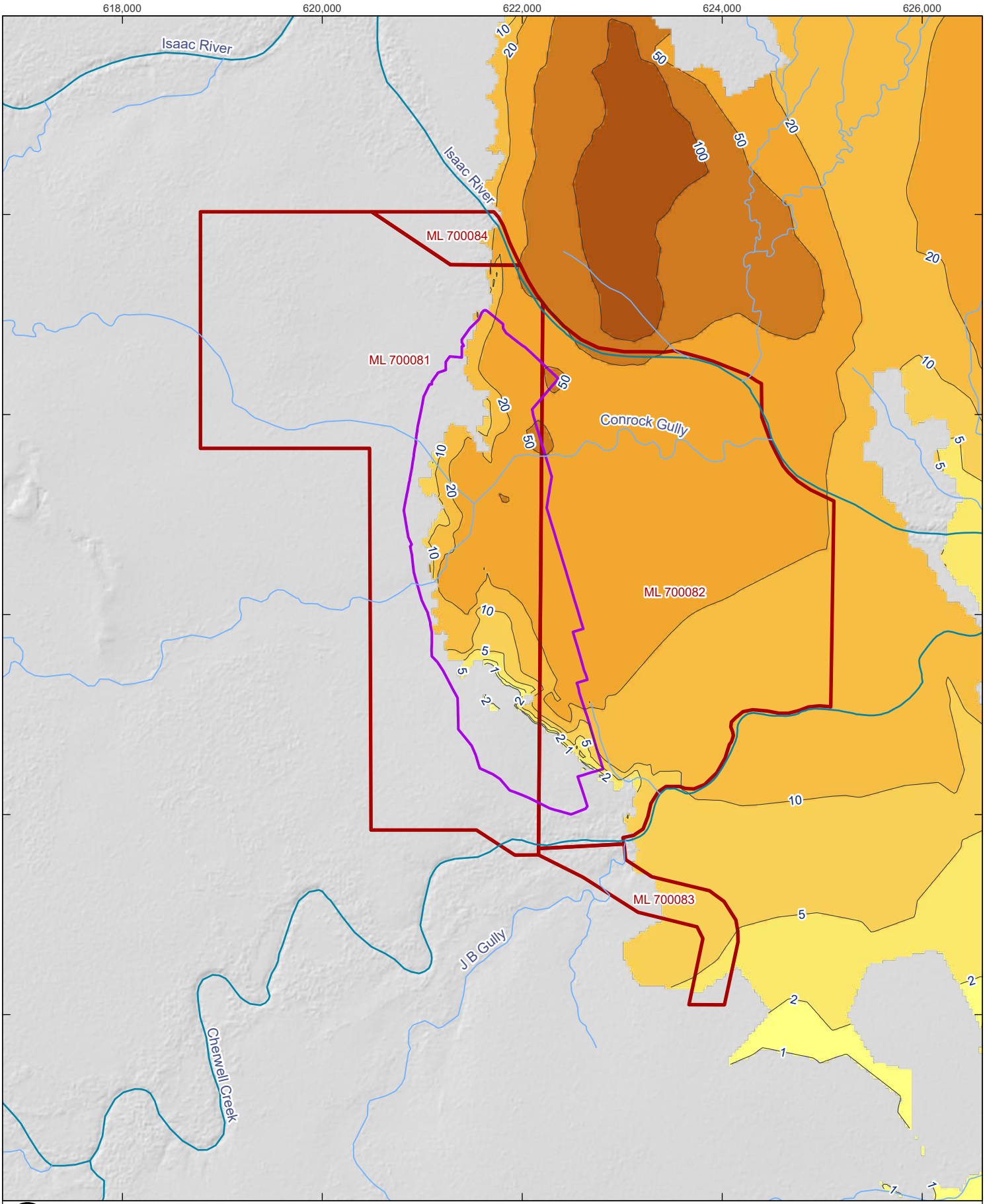
FIGURE 2-25

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-25_Predicted Maximum Cumulative Drawdown – Regolith (Layer 2)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-Mar-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 1 - 2
- 2- 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 500
- > 500

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM DRAWDOWN (CUMULATIVE) – LEICHHARDT SEAM (LAYER 5)

SLR

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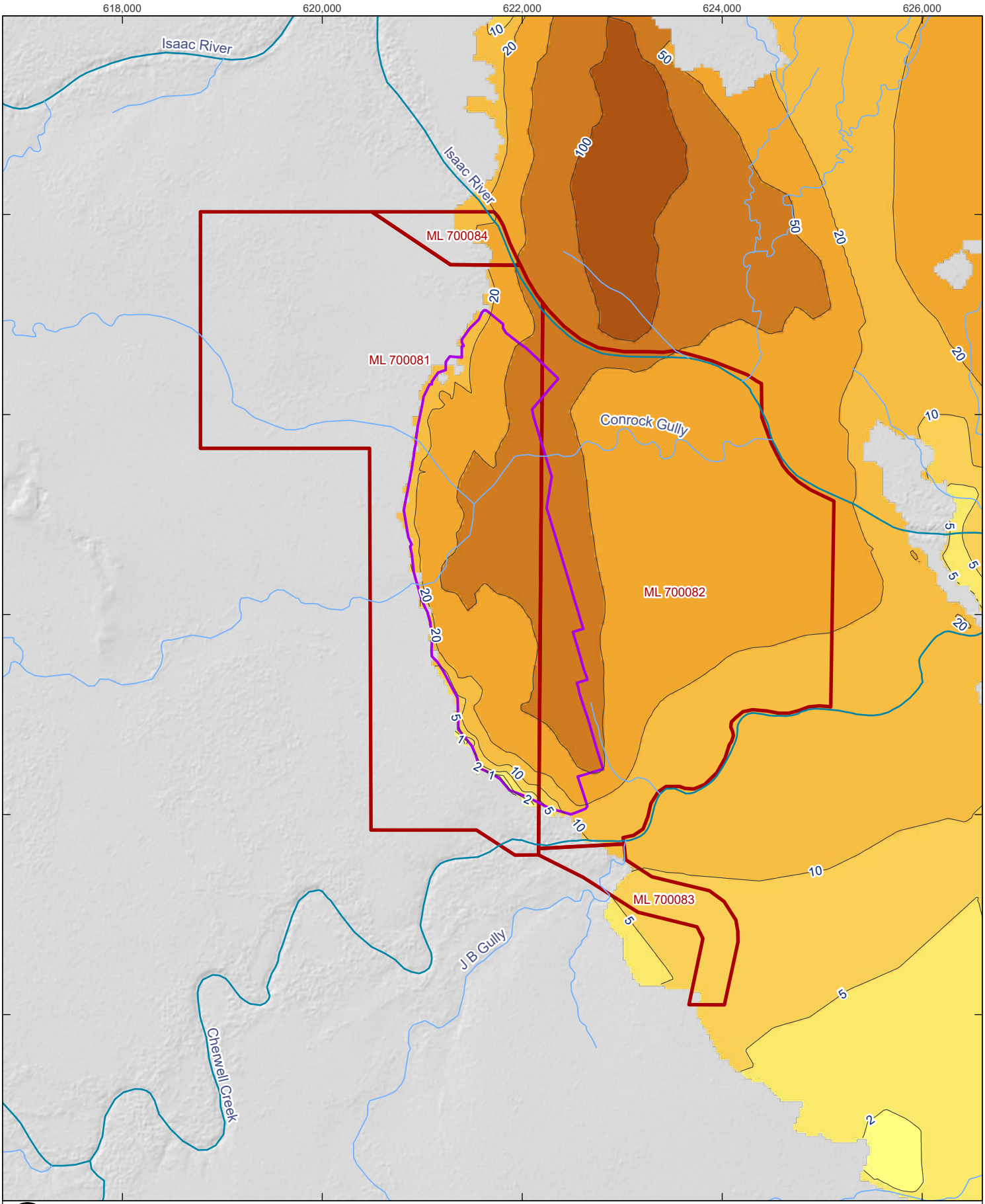
FIGURE 2-26

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-26_Predicted Maximum Cumulative Drawdown – Leichhardt Seam (Layer 5)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-Mar-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MAXIMUM DRAWDOWN (CUMULATIVE) – VERMONT SEAM (LAYER 7)

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FIGURE 2-27

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-27_Predicted Maximum Cumulative Drawdown – Vermont Seam (Layer 7)

2.4.2 Residual Drawdown (Post Recovery)

2.4.2.1 Residual Drawdown (Incremental)

The residual drawdown (incremental or Project only) is the drawdown at the end of the recovery period, due to the Project. It is calculated as the difference between the Proposed scenario and the Approved scenario for the last stress period of the simulation (i.e. at post mining equilibrium).

The residual drawdown (incremental) figures (**Figure 2-28** to **Figure 2-32**) show where maximum drawdown impacts are predicted to exceed 1 m. **Figure 2-28** to **Figure 2-32** show the residual water table drawdown (incremental), residual drawdown (incremental) within Alluvium (layer 1), Regolith (layer 2), Leichhardt seam (layer 5), and Vermont seam (layer 7), respectively.

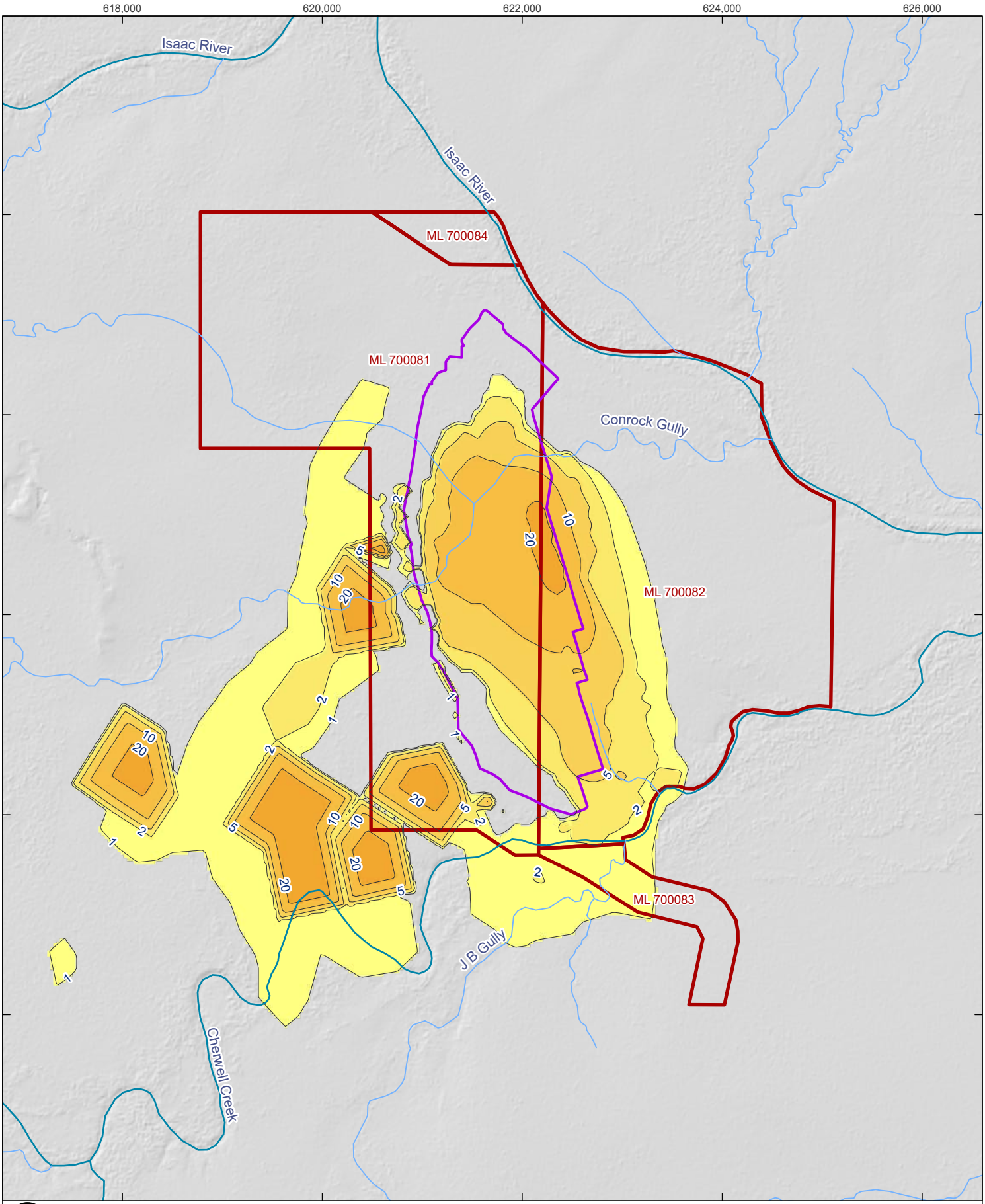
Figure 2-28 shows that the residual water table drawdown (incremental) remains within approximately 3 km of the Project mining area. The small areas of drawdown shown outside the Project area are the result of numerical effects within the model and do not represent any physical depressurisation beyond the Project.

No incremental drawdown impacts exceeding 1 m are predicted for the Quaternary alluvium as a result of the Project (**Figure 2-29**). **Figure 2-30** shows that residual drawdown within the regolith (Layer 2) is limited in extent and confined to areas immediately to the south of the Project mining footprint at post-recovery indicating minimal long-term impacts to the regolith following recovery.

Figure 2-28 to **Figure 2-32** show that impacts are strongly concentrated around the Project mining area, with the largest magnitudes occurring in the Leichhardt and Vermont seams.

Comparison of the maximum drawdown (incremental) and residual drawdown (incremental) results indicates that drawdown magnitudes are substantially reduced by the end of the recovery period. Maximum drawdown occurs during active mining and represents the peak Project-related response across the model period, whereas residual drawdown represents the remaining incremental change at post-mining equilibrium and is lower in magnitude and more spatially confined.

For the Project, residual drawdown (incremental) is largely confined to areas immediately surrounding the mining footprint, with no widespread drawdown persisting beyond the Project area at post-recovery. This indicates a high degree of groundwater recovery following cessation of mining, with only small residual drawdown remaining within the deeper mined seams.



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-Mar-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

RESIDUAL WATER TABLE DRAWDOWN (INCREMENTAL)

SLR

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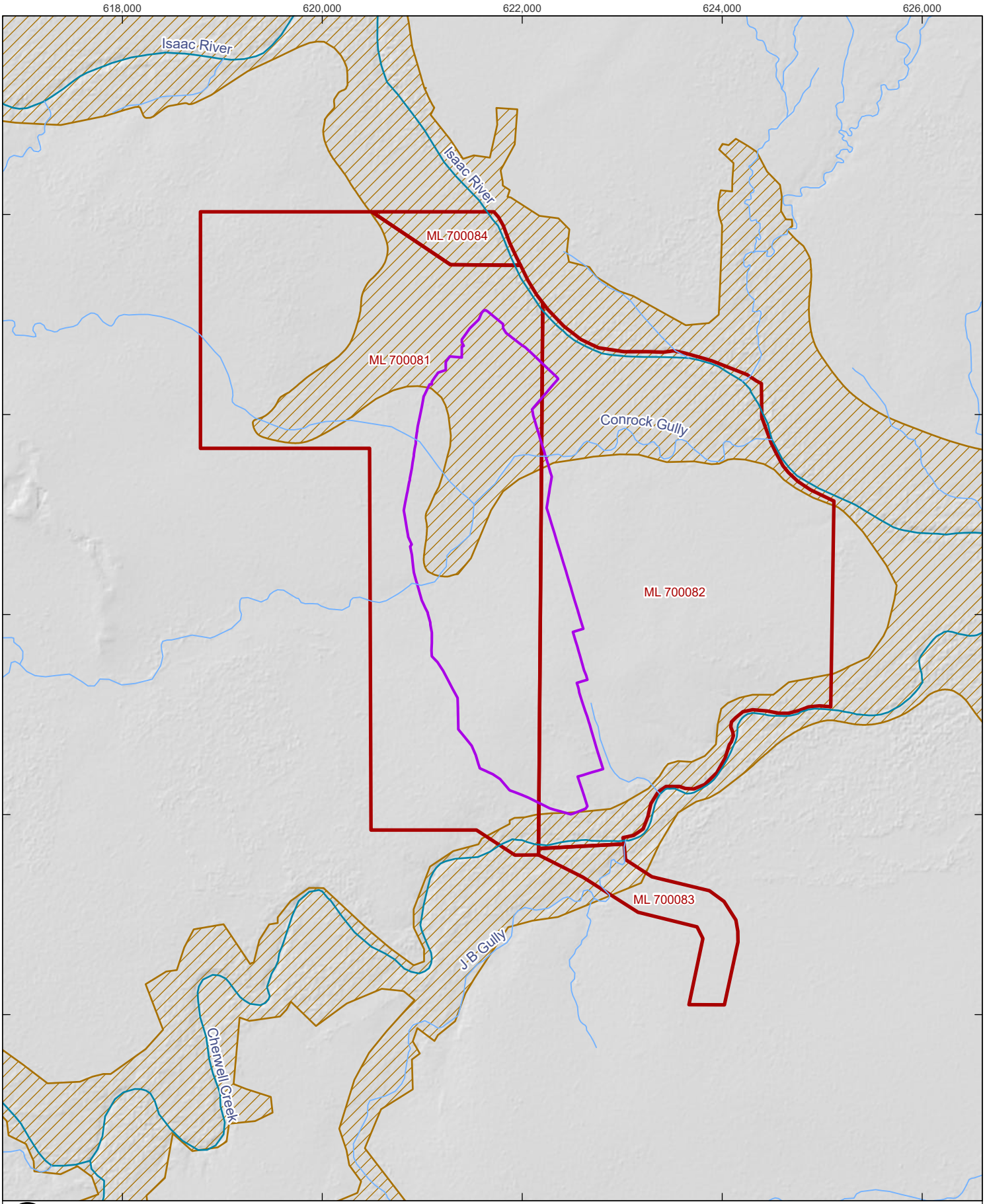
FIGURE 2-28

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-28_Residual Incremental Water Table Drawdown



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	21-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Alluvium Extent

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

RESIDUAL DRAWDOWN (INCREMENTAL) – ALLUVIUM (LAYER 1)

SLR

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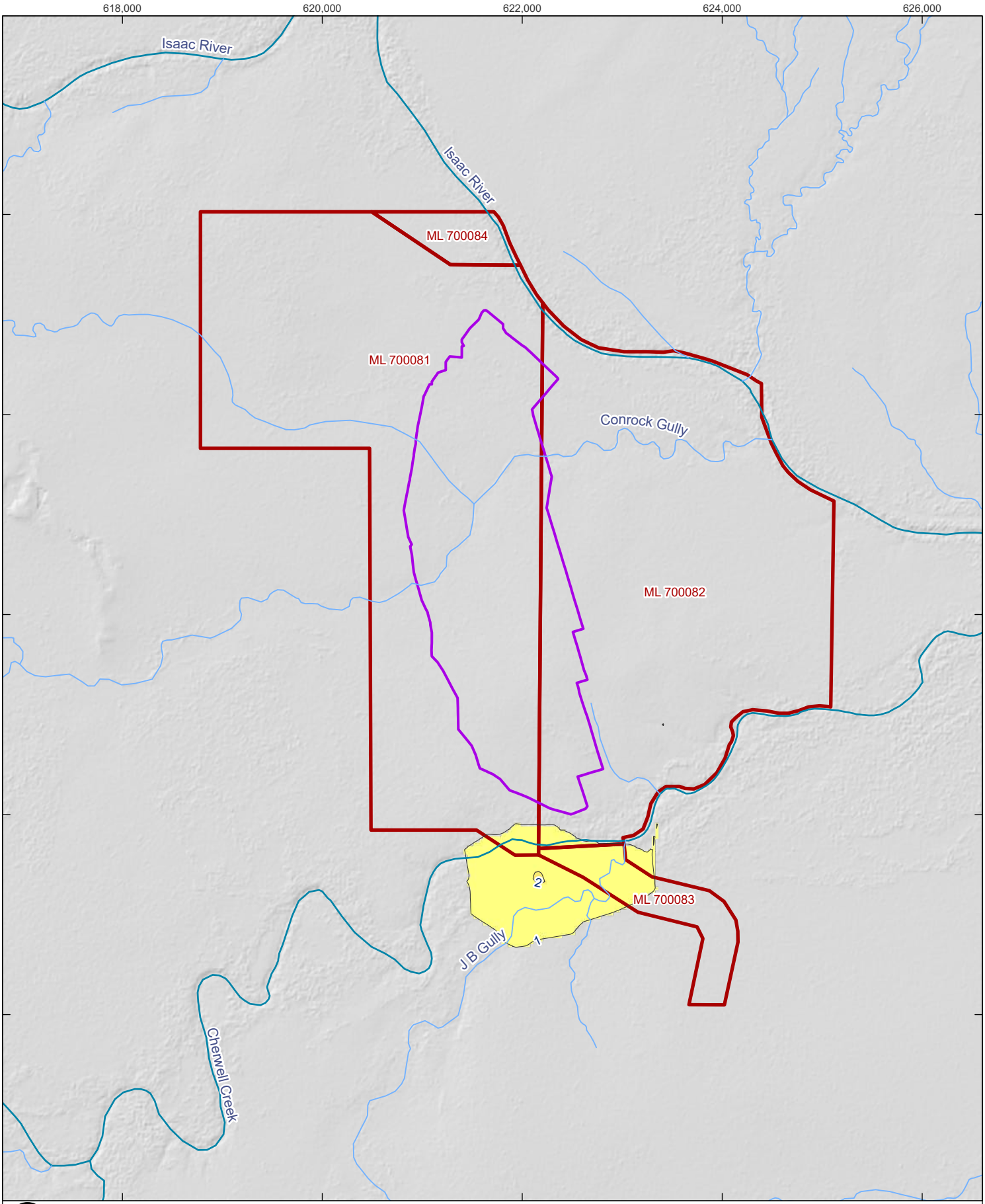
FIGURE 2-29

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-29_Residual Drawdown (Incremental) – Alluvium (Layer 1)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	21-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

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RESIDUAL DRAWDOWN (INCREMENTAL) – REGOLITH (LAYER 2)

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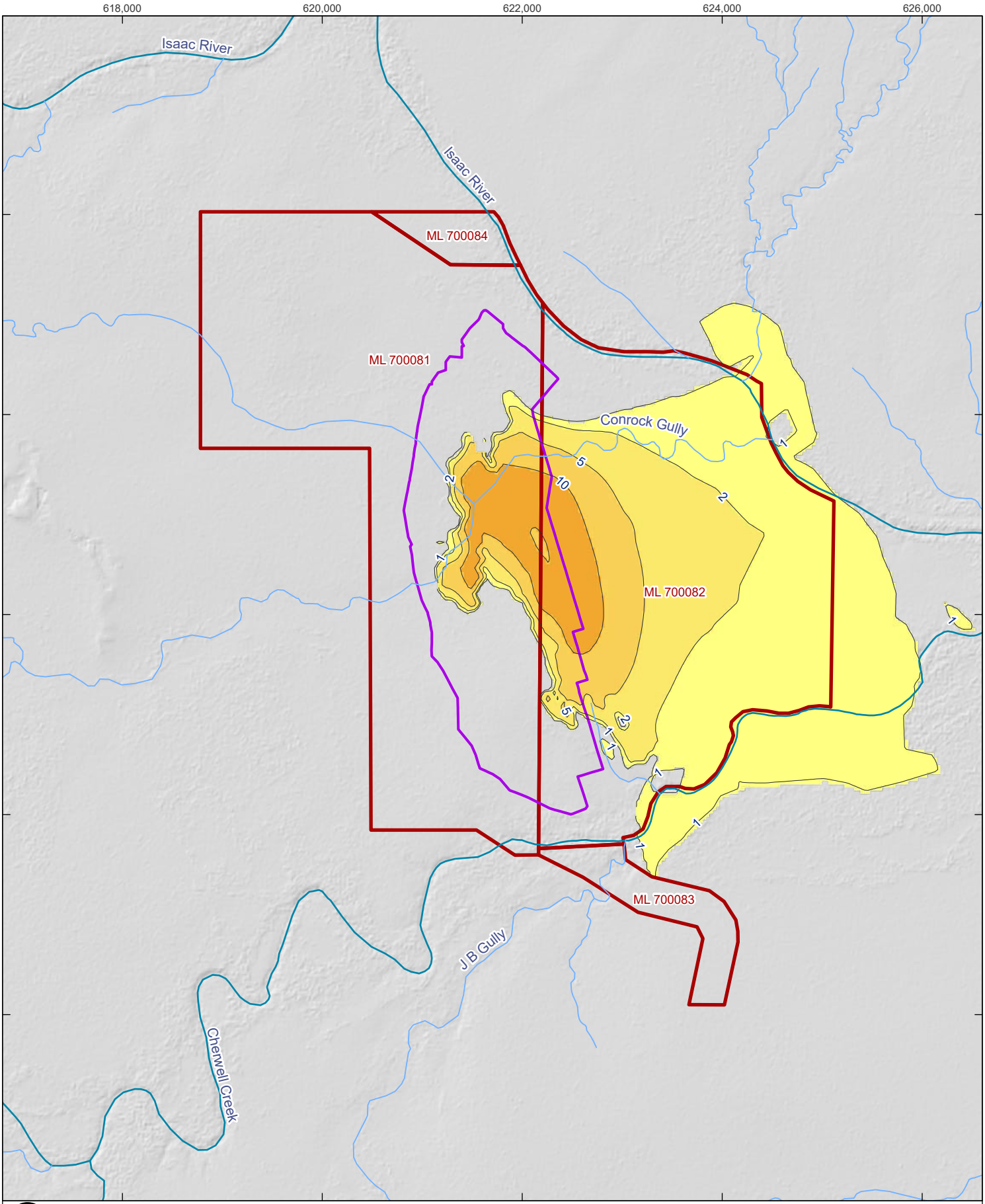
FIGURE 2-30

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-30_Residual Drawdown (Incremental) – Regolith (Layer 2)



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

RESIDUAL DRAWDOWN (INCREMENTAL) – LEICHHARDT SEAM (LAYER 5)

SLR

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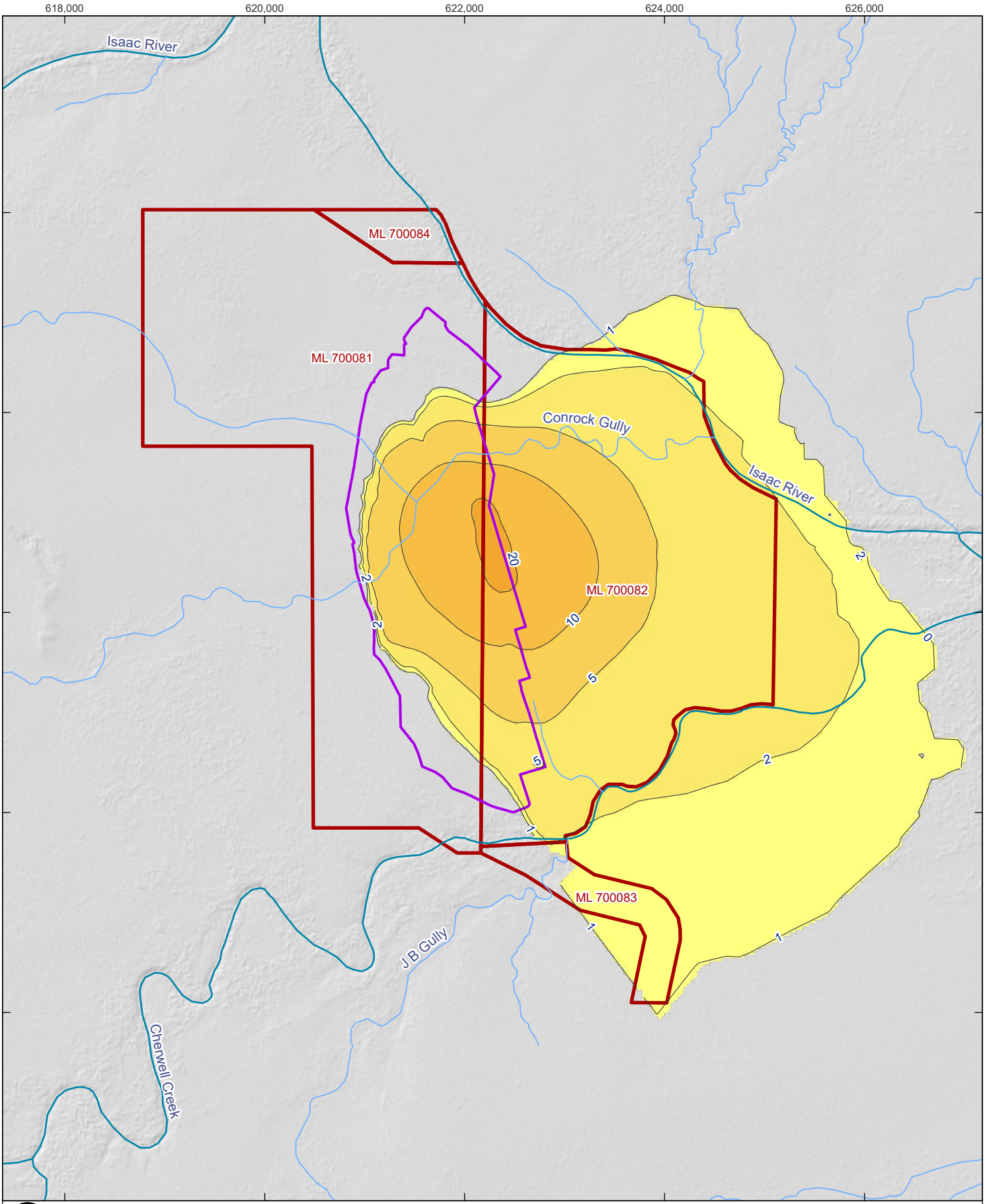
FIGURE 2-31

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-31_Residual Drawdown (Incremental) – Leichhardt Seam (Layer 5)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	21-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

RESIDUAL DRAWDOWN (INCREMENTAL) – VERMONT SEAM (LAYER 7)

SLR

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FIGURE 2-32

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-32_Residual Drawdown (Incremental) – Vermont Seam (Layer 7)

2.4.2.2 Residual Drawdown (Cumulative)

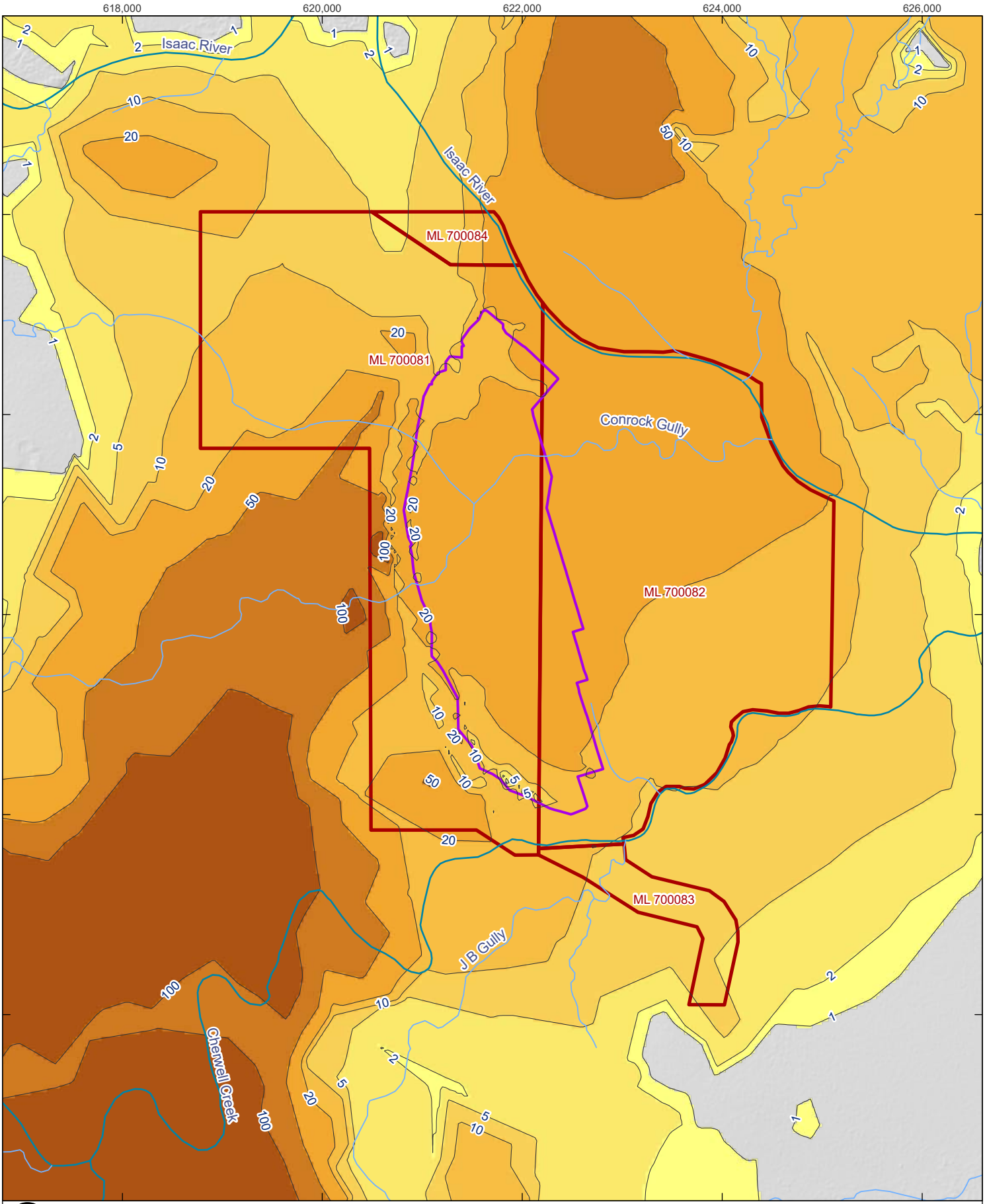
The residual drawdown (cumulative) is calculated as the difference between the Proposed scenario and the Null run, for the last stress period of the simulation, representing post-mining equilibrium conditions.

The residual drawdown (cumulative) figures (**Figure 2-33** to **Figure 2-37**) show where maximum drawdown impacts are predicted to exceed 1 m, for the last stress period of the simulation. **Figure 2-33** to **Figure 2-37** show the residual water table drawdown (cumulative), residual drawdown (cumulative) within Alluvium (layer 1), Regolith (layer 2), Leichhardt seam (layer 5), and Vermont seam (layer 7), respectively. These results represent the combined effects of the Project and other existing and foreseeable mining operations across the model domain.

The residual drawdown (cumulative) map for the alluvium indicates that all drawdown within this layer arises from other existing and foreseeable mining operations rather than from the Project. This is consistent with the residual drawdown (incremental) results, which show no Project-only drawdown impacts exceeding 1 m in the alluvium. Accordingly, cumulative drawdown patterns within the alluvium predominantly reflect regional groundwater conditions and post-mining equilibrium responses associated with neighbouring mines, rather than Project-related effects.

Residual drawdown (cumulative) is shown across the water table, alluvium, regolith, and coal measures, with spatial patterns influenced by the location and extent of multiple mining operations. While drawdown magnitudes generally decrease with distance from the Project mining area, cumulative drawdown increases or persists in some areas further away, corresponding to the presence of other active or historical mines within the region.

In the deeper coal measures, particularly the Leichhardt and Vermont seams, cumulative drawdown reflects long-term groundwater responses to mining activities that extend beyond individual mine boundaries. These patterns indicate hydraulic interaction between mining areas and represent post-mining equilibrium conditions shaped by the combined influence of the Project and neighbouring operations.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

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RESIDUAL WATER TABLE DRAWDOWN (CUMULATIVE)

SLR

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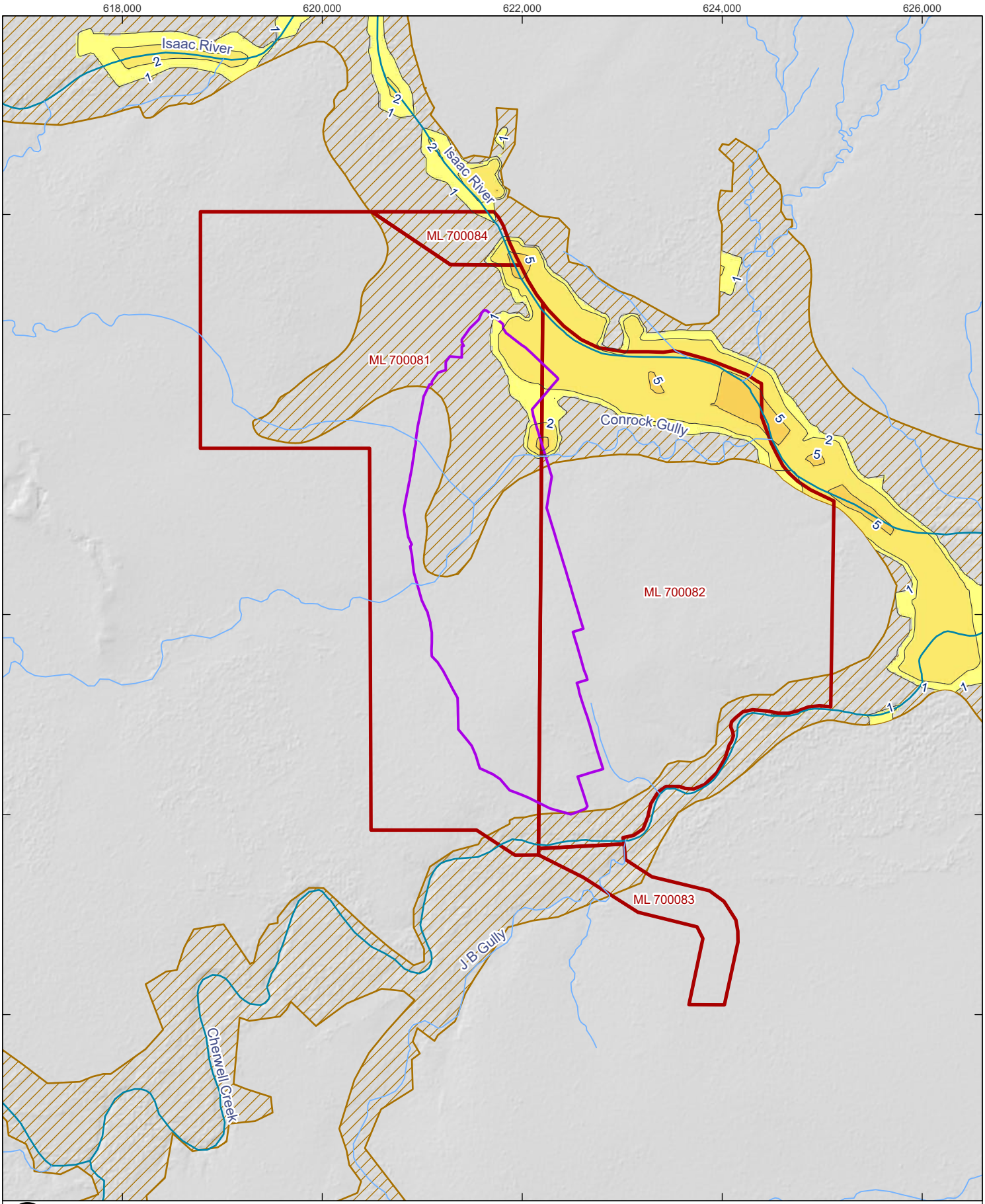
FIGURE 2-33

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-33_Residual Water Table Drawdown (Cumulative)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-May-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Alluvium Extent

Maximum Drawdown (m)

- 1 - 2
- 2- 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 500
- > 500

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

RESIDUAL DRAWDOWN (CUMULATIVE) – ALLUVIUM (LAYER 1)

SLR

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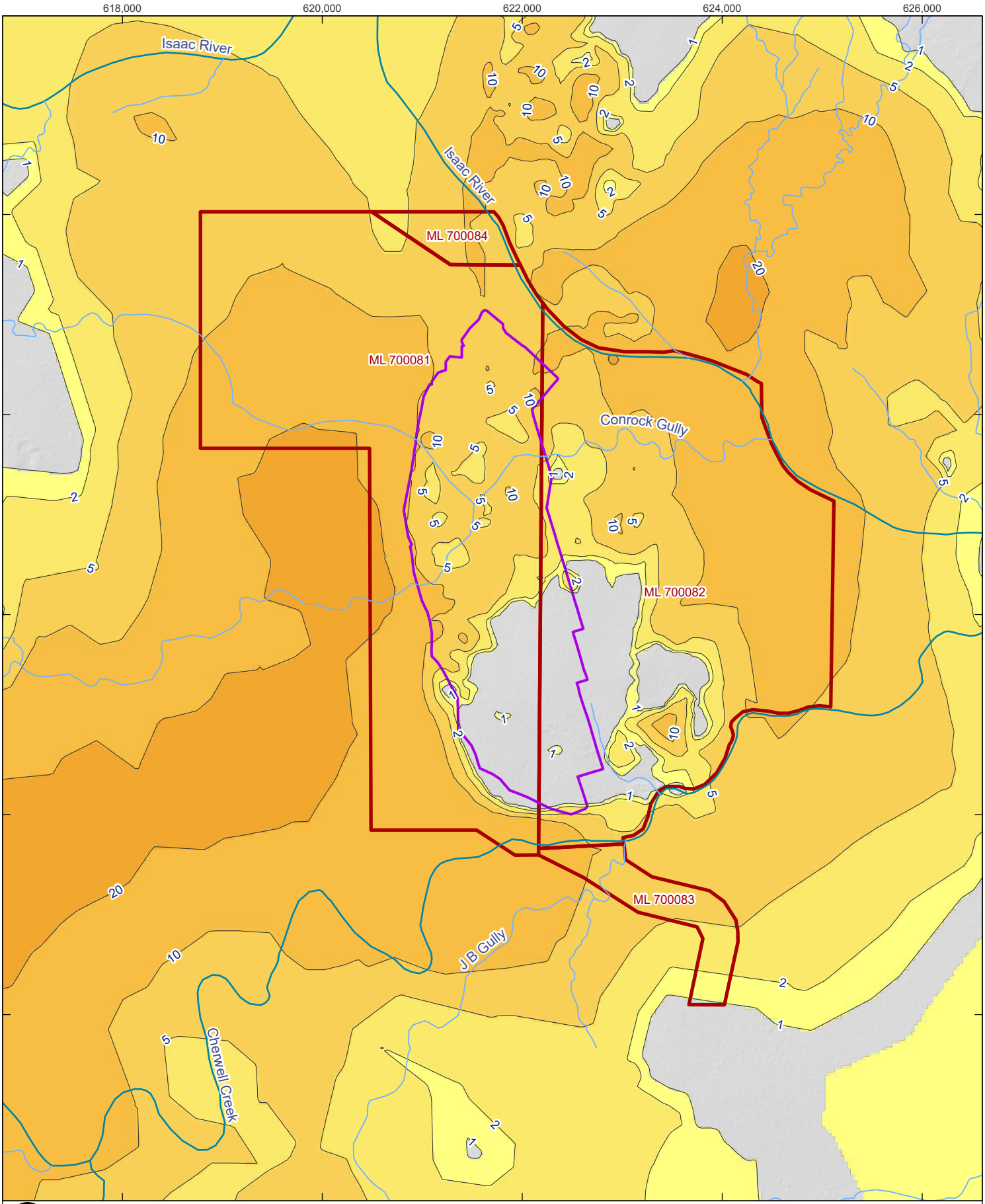
FIGURE 2-34

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-34_Residual Drawdown (Cumulative) – Alluvium (Layer 1)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

RESIDUAL DRAWDOWN (CUMULATIVE) – REGOLITH (LAYER 2)

SLR

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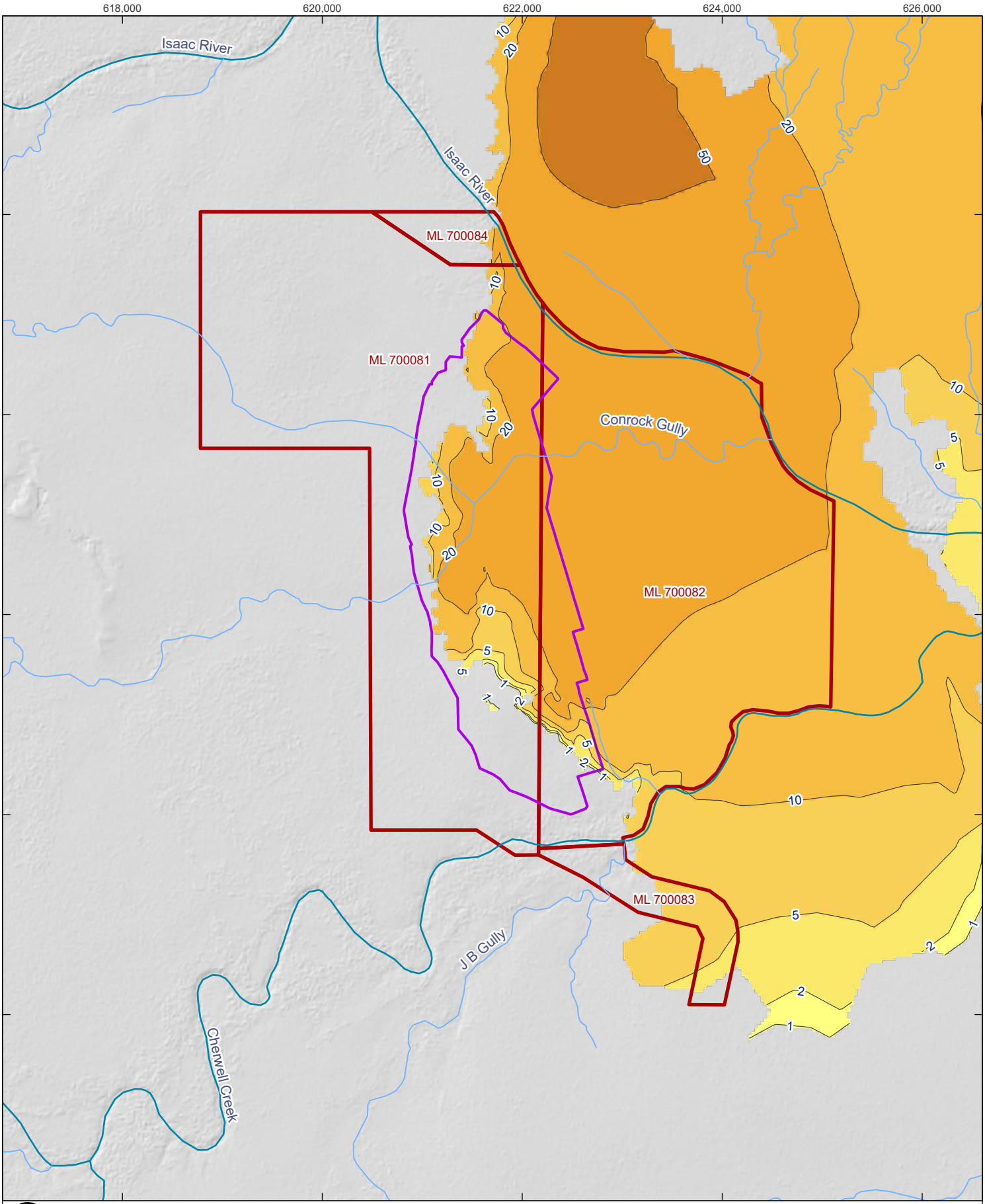
FIGURE 2-35

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-35_Residual Drawdown (Cumulative) – Regolith (Layer 2)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

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RESIDUAL DRAWDOWN (CUMULATIVE) – LEICHHARDT SEAM (LAYER 5)

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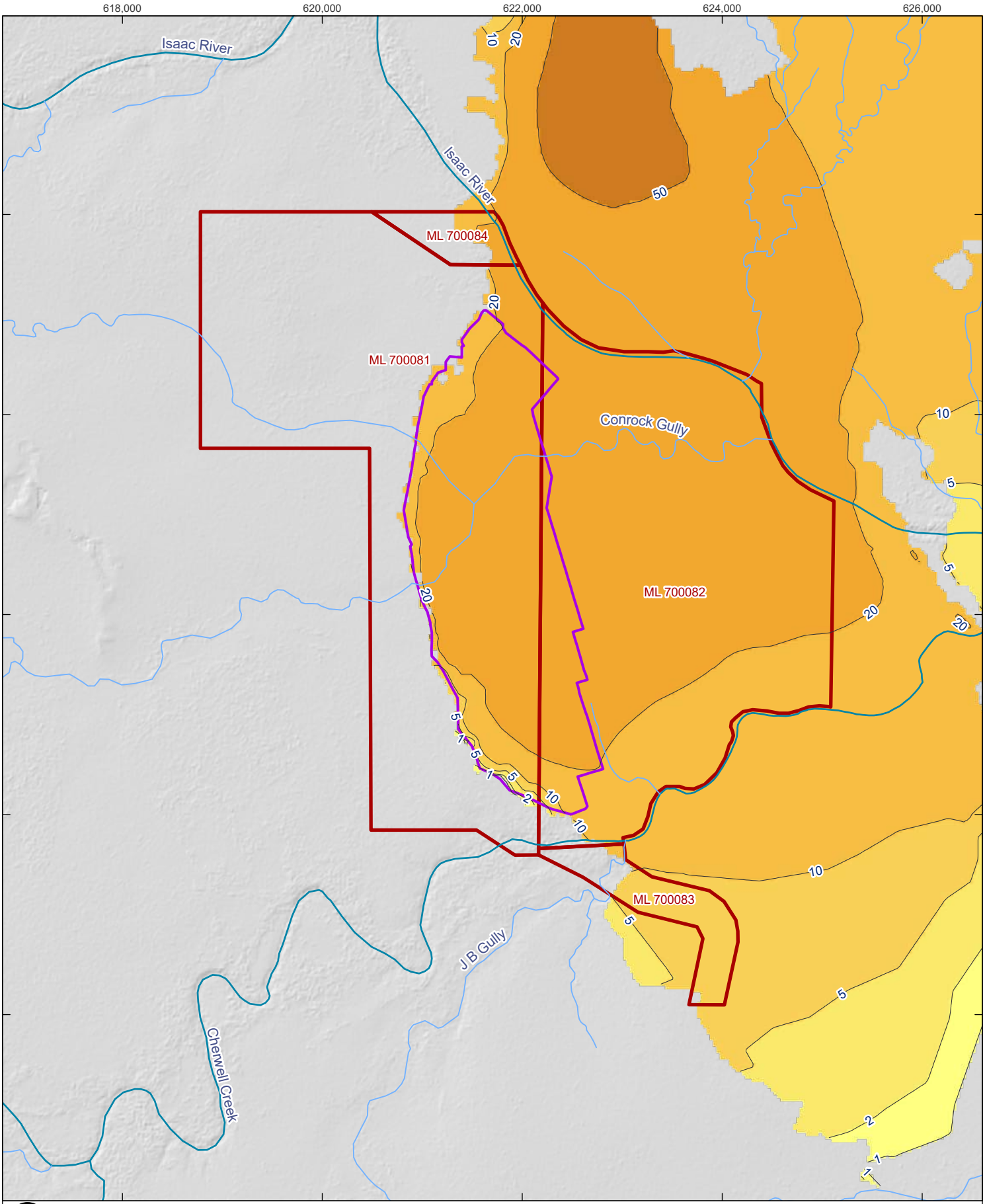
FIGURE 2-36

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-36_Residual Drawdown (Cumulative) – Leichhardt Seam (Layer 5)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Drawdown Contour (m)
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

1 - 2	50 - 100
2- 5	100 - 200
5 - 10	200 - 500
10 - 20	> 500
20 - 50	

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

RESIDUAL DRAWDOWN (CUMULATIVE) – VERMONT SEAM (LAYER 7)

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FIGURE 2-37

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-37_Residual Drawdown (Cumulative) – Vermont Seam (Layer 7)

2.5 Predicted Groundwater Interception

2.5.1 Mine Groundwater Inflows – Active Mining

The predicted incremental mine groundwater inflows are presented on **Figure 2-38** and **Table 2-2**.

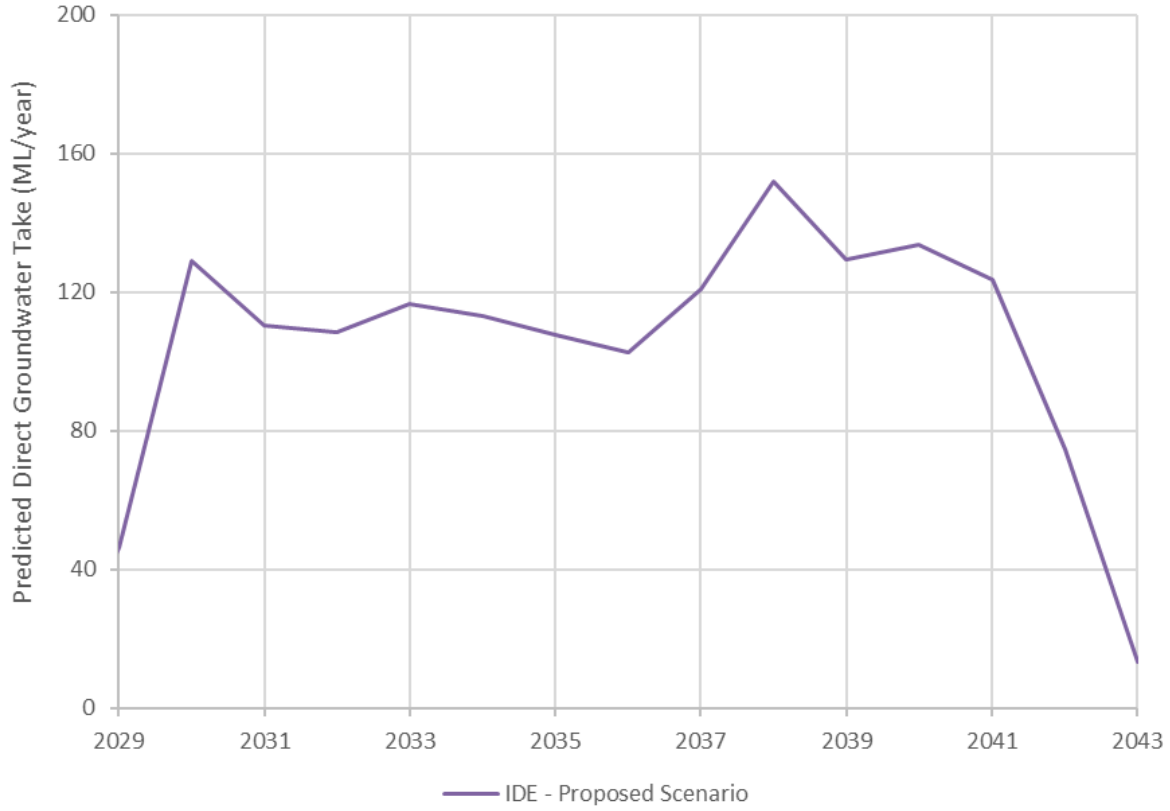


Figure 2-38 Predictive Incremental Mine Groundwater Inflows during Active Mining

The predicted pit inflows resulting from the Project are summarised in **Table 2-2**. The peak incremental mine groundwater inflows would occur in the year 2038 at 152 ML/year (**Table 2-2**).

Table 2-2 Predicted Cumulative Mine Groundwater Inflows from the Proposed

Year	Groundwater Inflows (ML/year)
2029	46
2030	129
2031	110
2032	108
2033	117
2034	113
2035	108
2036	103
2037	121
2038	152

Year	Groundwater Inflows (ML/year)
2039	129
2040	134
2041	124
2042	75
2043	13

2.5.2 Final Void Inflows

The final predicted groundwater inflows to the residual void from the groundwater model is shown on **Figure 2-39**, with inflows partitioned between that which flows into the residual void through spoil, and that which flows into the residual void through surrounding natural geological formations. This shows that almost all inflows are through spoil. Spoil materials are significantly more permeable and loosely compacted than the natural geological formations, providing preferential pathways for groundwater movement. As a result, groundwater is expected to enter the void predominantly through spoil. The final void geometry and elevation are illustrated in the particle-tracking maps presented later in **Section 0 (Figure 2-48).**

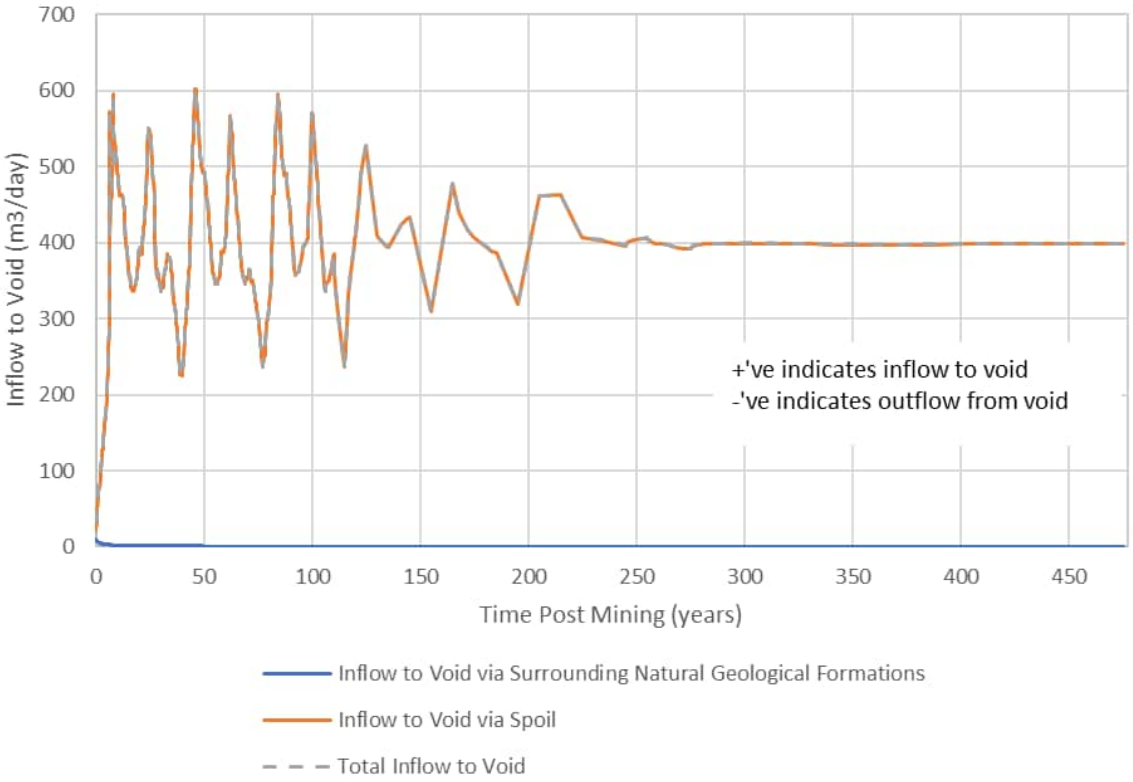


Figure 2-39 Predicted Residual Void Groundwater Inflows – Project Void

2.6 Incidental Water Impacts

2.6.1 Alluvium Water Take

The predicted change in the alluvial aquifer take due to the Project (incremental) was calculated as the difference between the net alluvium fluxes in the Proposed Scenario and the Approved Scenario. The predicted change in alluvium net flux for the Project calculated in this manner is shown on **Figure 2-40**. This shows that between the commencement of Project mining in 2029 and the end of mining in 2043, there is a predicted overall loss of water from the alluvial aquifers that is attributable to the Project of between approximately 0 and 34.5 ML/year. This represents a negligible reduction in the context of regional surface water flows; for example, compared to the mean daily flow of 430 ML/d in the Isaac River at Deverill, this equates to approximately 0.02% of annual flow.

The predicted cumulative alluvium net flux is shown in **Figure 2-41**. This shows that between 2029 and the end of mining in 2043, there is a predicted overall cumulative loss of water from the alluvium of between approximately 470 and 700 ML/year. This represents the net water flux associated with the alluvium across the entire regional-scale numerical model extent. As this is a cumulative prediction, the general trends in increasing and decreasing rates of loss of water from the alluvium are shown on **Figure 2-41** cannot be attributed to only the Project but to all mining operations represented in the model.

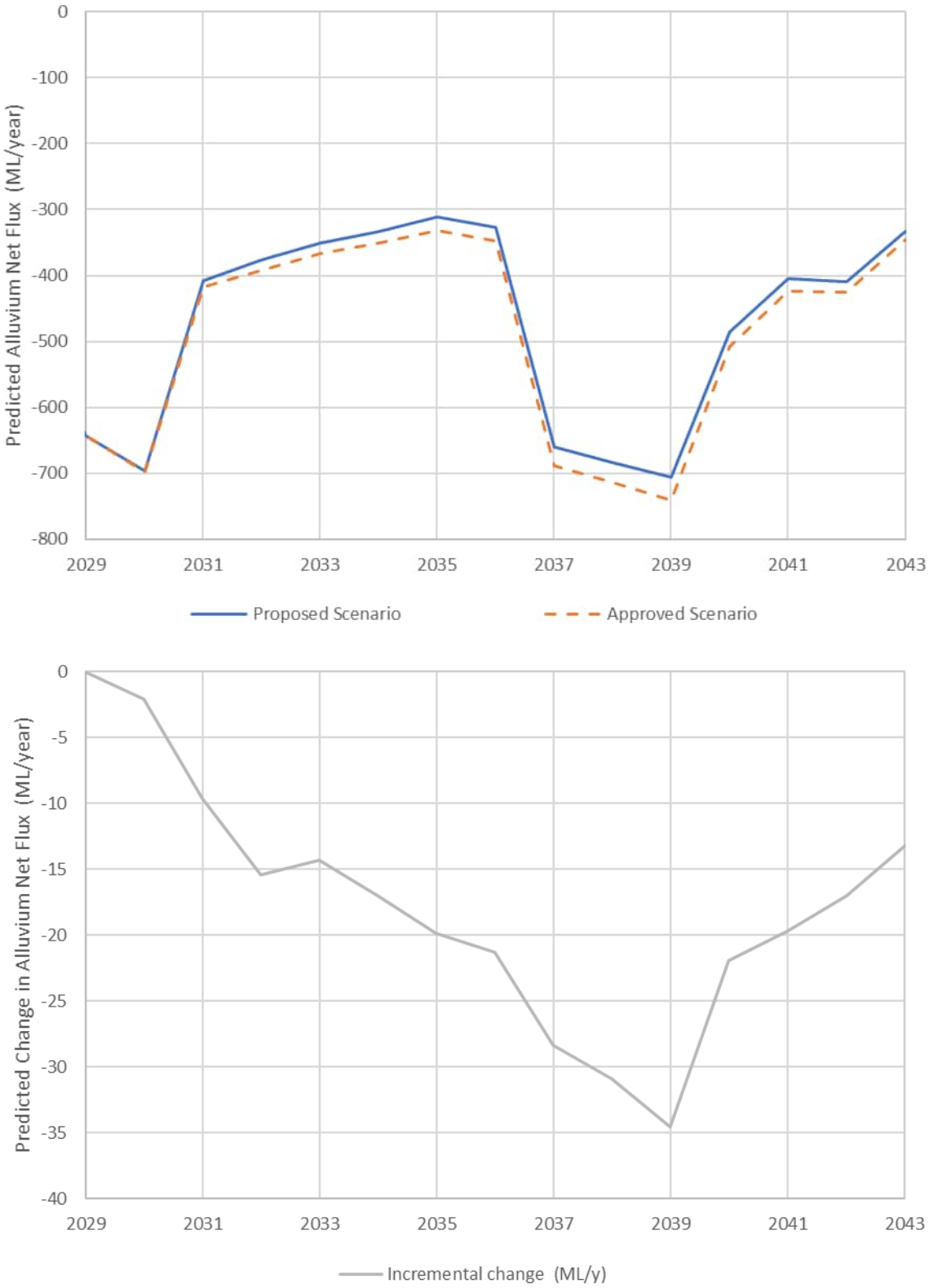


Figure 2-40 Predicted Alluvium Net Flux (top) and Change in Alluvium Net Flux (bottom)

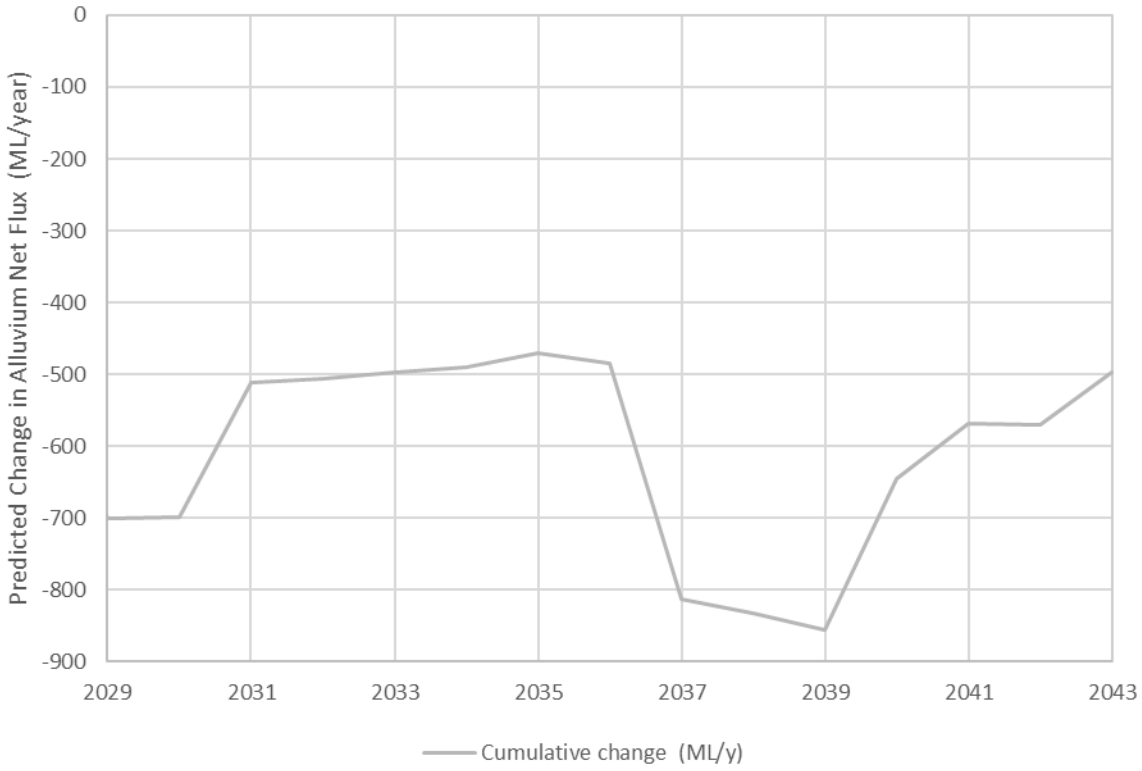


Figure 2-41 Predicted Alluvium Net Flux –Cumulative

2.6.1.1 Post Mining

The predicted change in alluvium net flux and the predicted cumulative alluvium net flux for the post-mining period are shown on **Figure 2-42** and **Figure 2-41**.

The incremental net flux time series shows that post-mining variations are minor and do not exhibit any sustained increase in alluvium water loss attributable to the Project. Overall, the post-mining results demonstrate that Project-related impacts on alluvium water take are short-term, with no ongoing Project-specific increase in alluvium loss following mine closure.

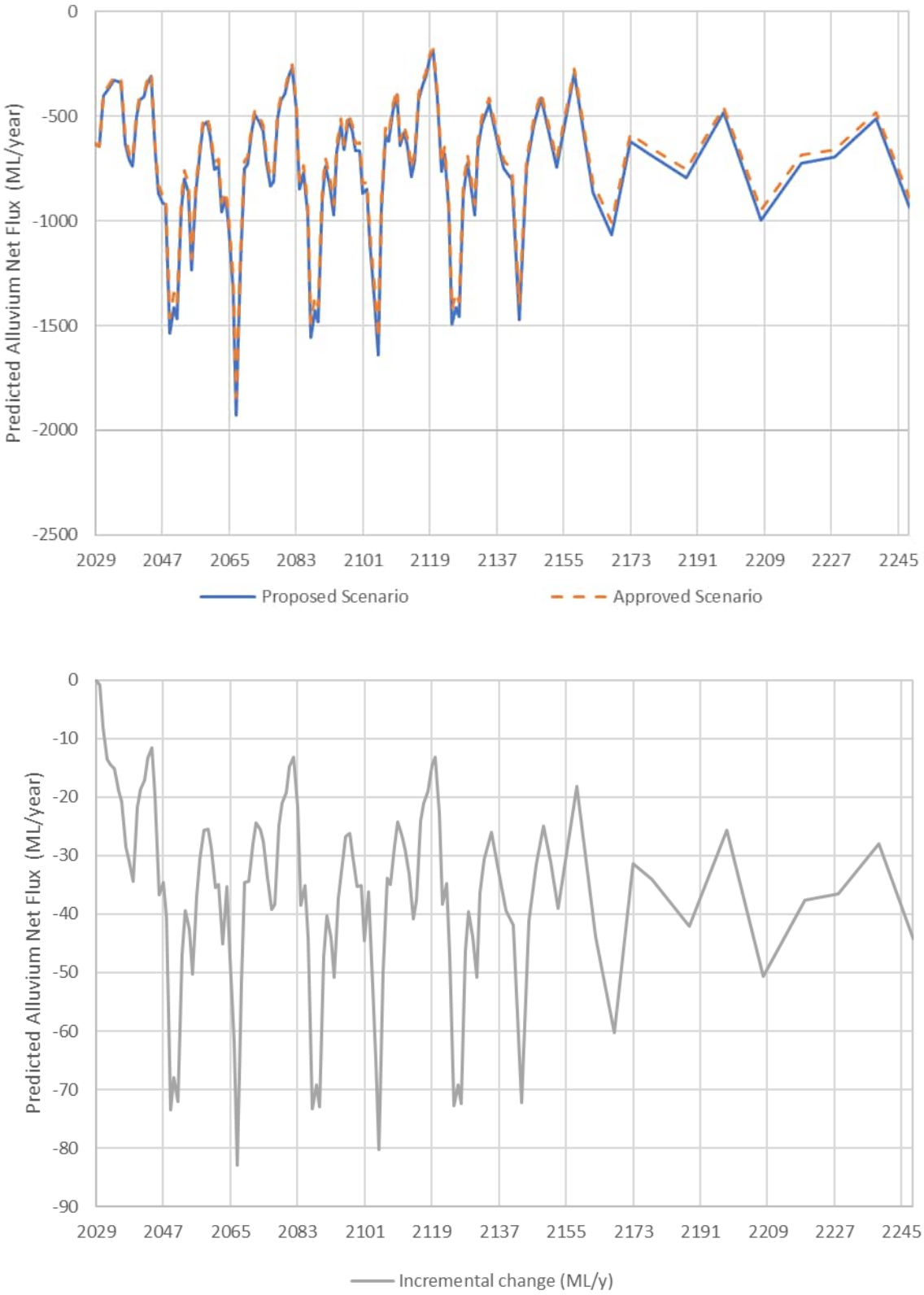


Figure 2-42 Predicted Alluvium Net Flux (top) and Change in Alluvium Net Flux (bottom) – Post Mining

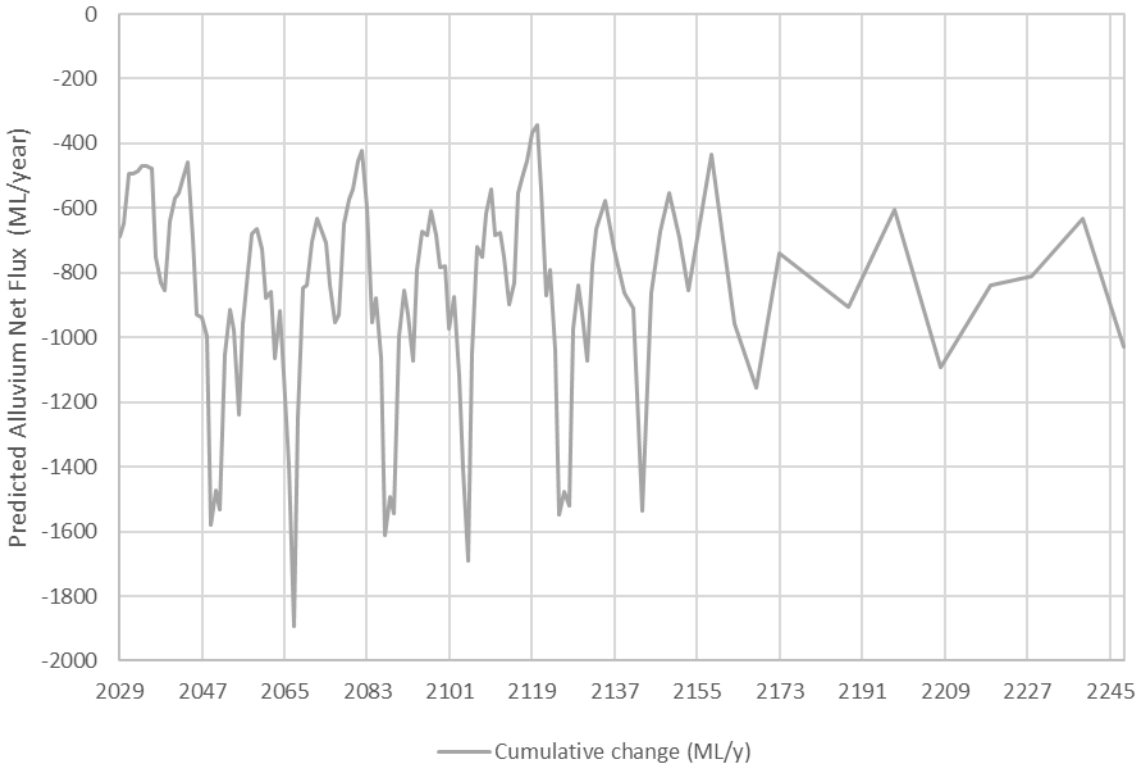


Figure 2-43 Predicted Alluvium Net Flux –Cumulative – Post Mining

2.6.2 Loss of Flow in Stream

Mining activities can result in a change in gradient from the aquifer into the watercourse, thereby reducing the rate at which baseflow occurs.

The predicted incremental (Project only) change in net flux and the predicted cumulative net flux of water moving in or out of the Isaac River are shown in **Figure 2-44**.

This shows that between 2029 and the end of IDE mining in 2043, there is no net flux in water moving in or out of the Isaac River that is attributable to the Project. The maximum cumulative net loss of water from the river is approximately 84 ML/year under a simulated future flow condition in 2030. This represents the net water flux associated with the River across the entire regional scale numerical model extent. As the Project does not result in a net flux of water to/from the River all fluxes are attributed all other mining operations represented in the model.

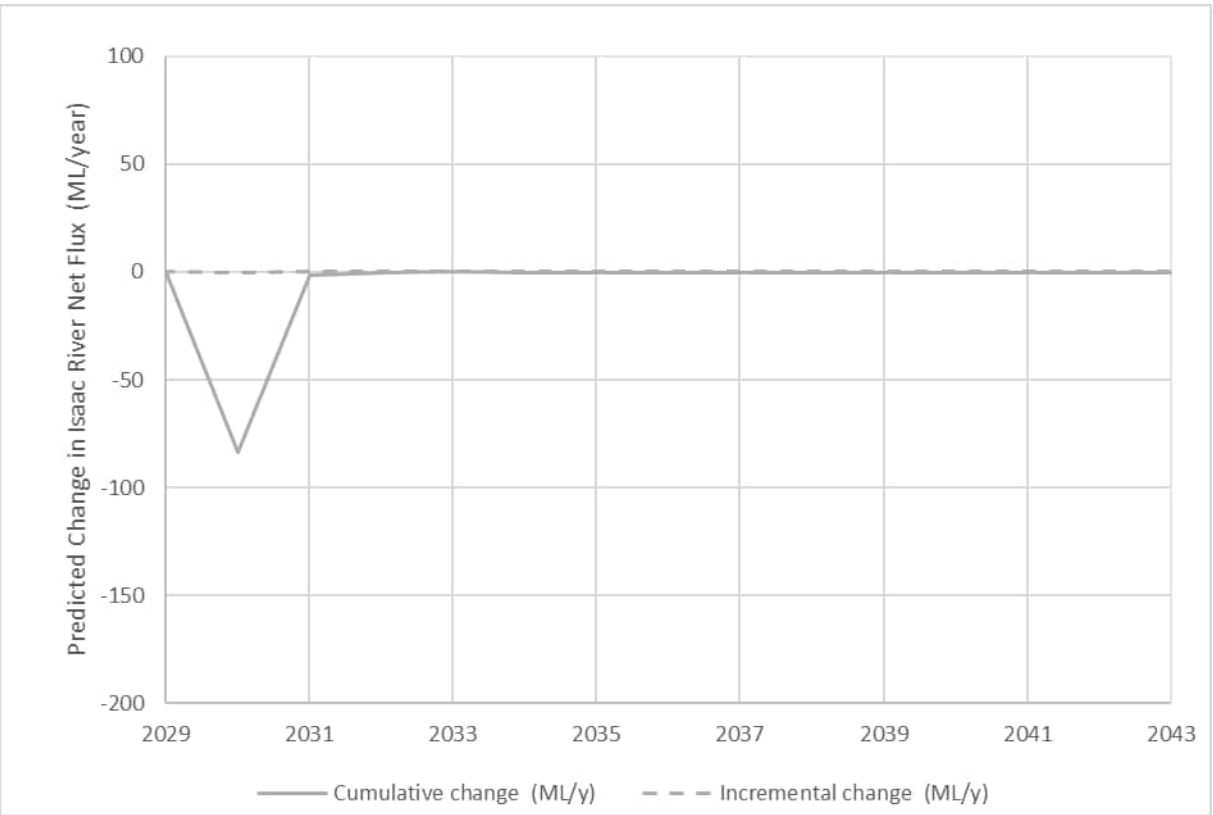


Figure 2-44 Predicted Reduction in River Baseflow (Incremental and Cumulative)

2.6.2.1 Post Mining

The predicted incremental (Project only) change in net flux and the predicted cumulative net flux of water moving in or out of the Isaac River for the post mining period are shown in **Figure 2-45**.

Figure 2-45 shows that both incremental and cumulative net fluxes to the Isaac River stabilise, with no ongoing Project-specific loss of river baseflow predicted during the post-mining period. **Figure 2-45** shows that the Project has no impact on river flux.

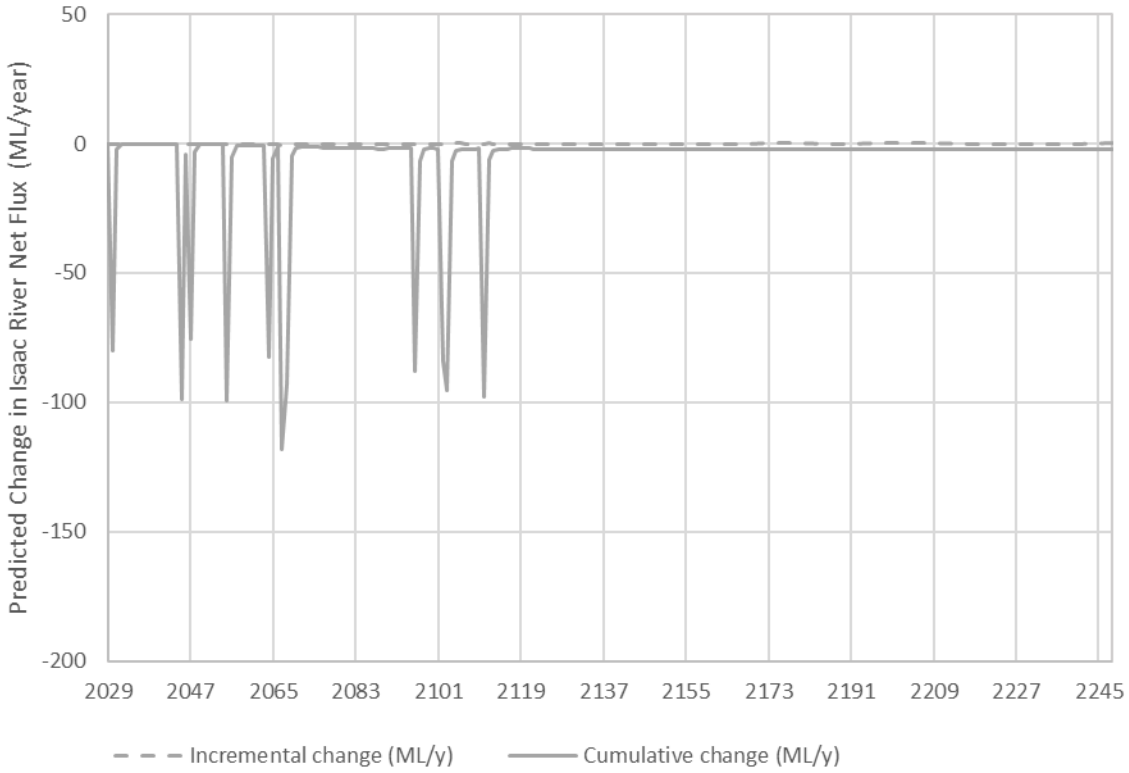
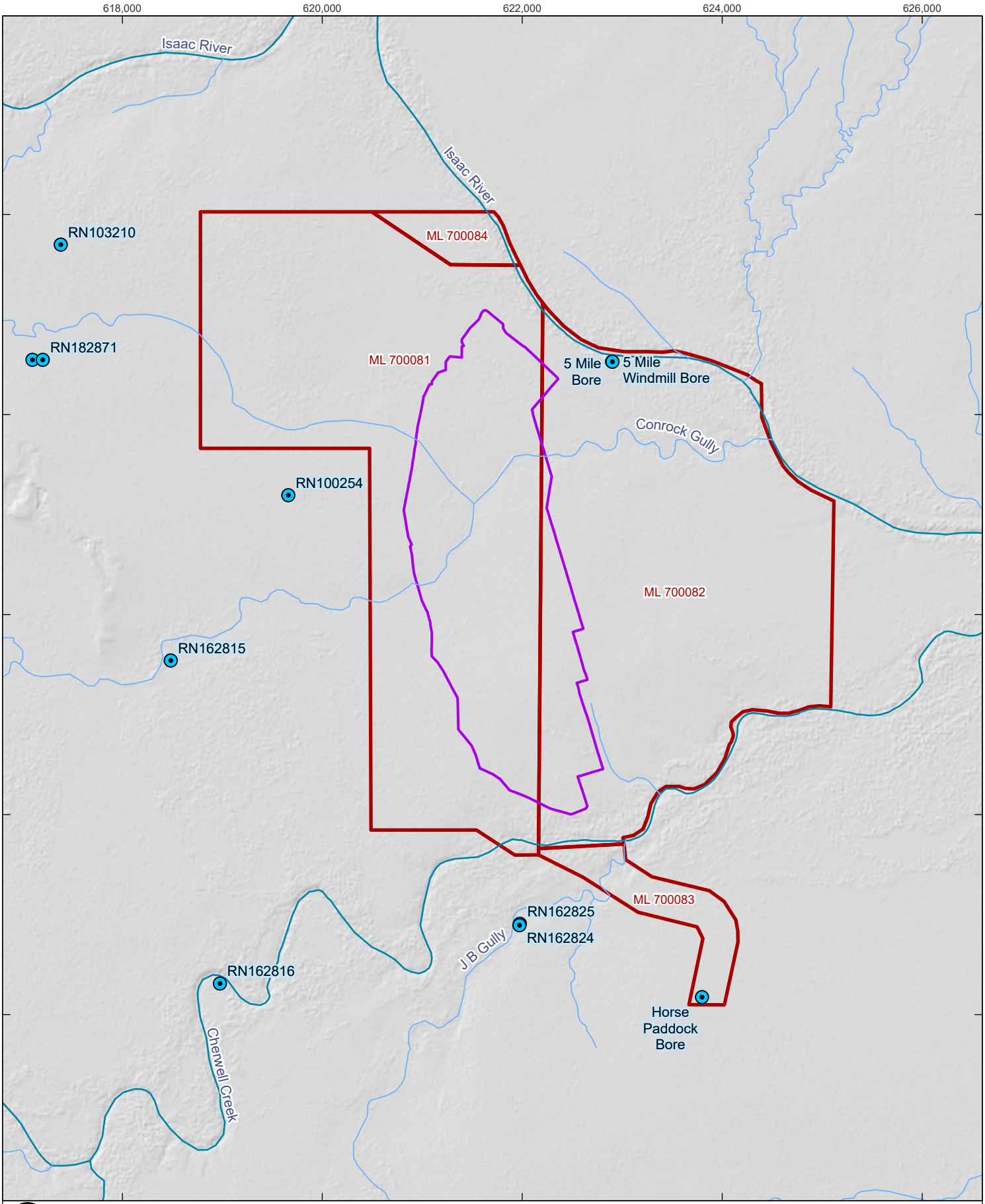


Figure 2-45 Predicted Reduction in River Baseflow (Incremental and Cumulative) – Post Mining

2.7 Impact to Potential Receptors

2.7.1 Privately Owned Bores

Landholder bore's locations are represented on **Figure 2-46**. Maximum incremental and cumulative drawdown at landholder bores is represented on **Table 2-3**. Predicted maximum incremental drawdown at the assessed landholder bores is low, generally less than 1.5m, indicating limited Project-related groundwater impacts. Predicted cumulative drawdown is higher at some bores and reflects the combined effects of the Project together with other existing and foreseeable mining activities influencing regional groundwater conditions.



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	17-Mar-2026
Drawn by:	RB

LEGEND

- Landholder Bore
- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

LANDHOLDER BORE LOCATIONS

SLR

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FIGURE 2-46

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-42_Landholder Bore Locations

Table 2-3 Maximum Incremental and Cumulative Drawdown at Landholder Bores

Registered RN (ID)	Assumed Formation[1]	Maximum Incremental Drawdown (m)	Maximum Cumulative Drawdown (m)[2]
5 Mile Bore RN162817	Regolith	< 0.1	22.18
5 Mile Windmill Bore RN162818	Regolith	< 0.1	22.18
Horse Paddock Bore RN162459	Vermont Underburden	0.59	63.27
RN100254	Fort Cooper Underburden	0.35	50.38
RN103210	Fort Cooper Overburden	0.36	49.68
RN162815	Fort Cooper Seams	1.04	7.08
RN162816	Fort Cooper Seams	0.23	39.89
RN162824	Regolith	0.91	61.30
RN162825	Fort Cooper Seams	1.43	20.01
RN182871	Fort Cooper Overburden	0.29	80.21
RN182872	Fort Cooper Overburden	1.27	13.74

1 Bores assigned to definitive geological unit and model layers based on known geology bore depth

2 Model-estimated cumulative drawdown may exceed the bore depth, indicating a risk that the bore could run dry.

2.7.2 Flow Path Simulation

An analysis of the water movement within the final landform was undertaken to simulate and assess the movement and fate of water particles through the groundwater system post mining. A number of particles were placed on the final landform and within the Project's residual void in the recovery groundwater model and the mod-PATH3DU code (S.S. Papadopulos & Associates, Inc., 2018) was used to simulate particle pathways along the groundwater flow field during recovery (i.e. 475 years). To run the mod-PATH3DU code, the transient head outputs from the groundwater flow model were used by mod-PATH3DU to simulate particle flowpath lines.

Particle tracking is limited to advection (i.e. no retardation or dispersion). Effective porosity was set at 0.1 (10%) for the unconsolidated sediments (Layer 1 and 2) and 0.01 (1%) for the consolidated units (Layer 3 to 19).

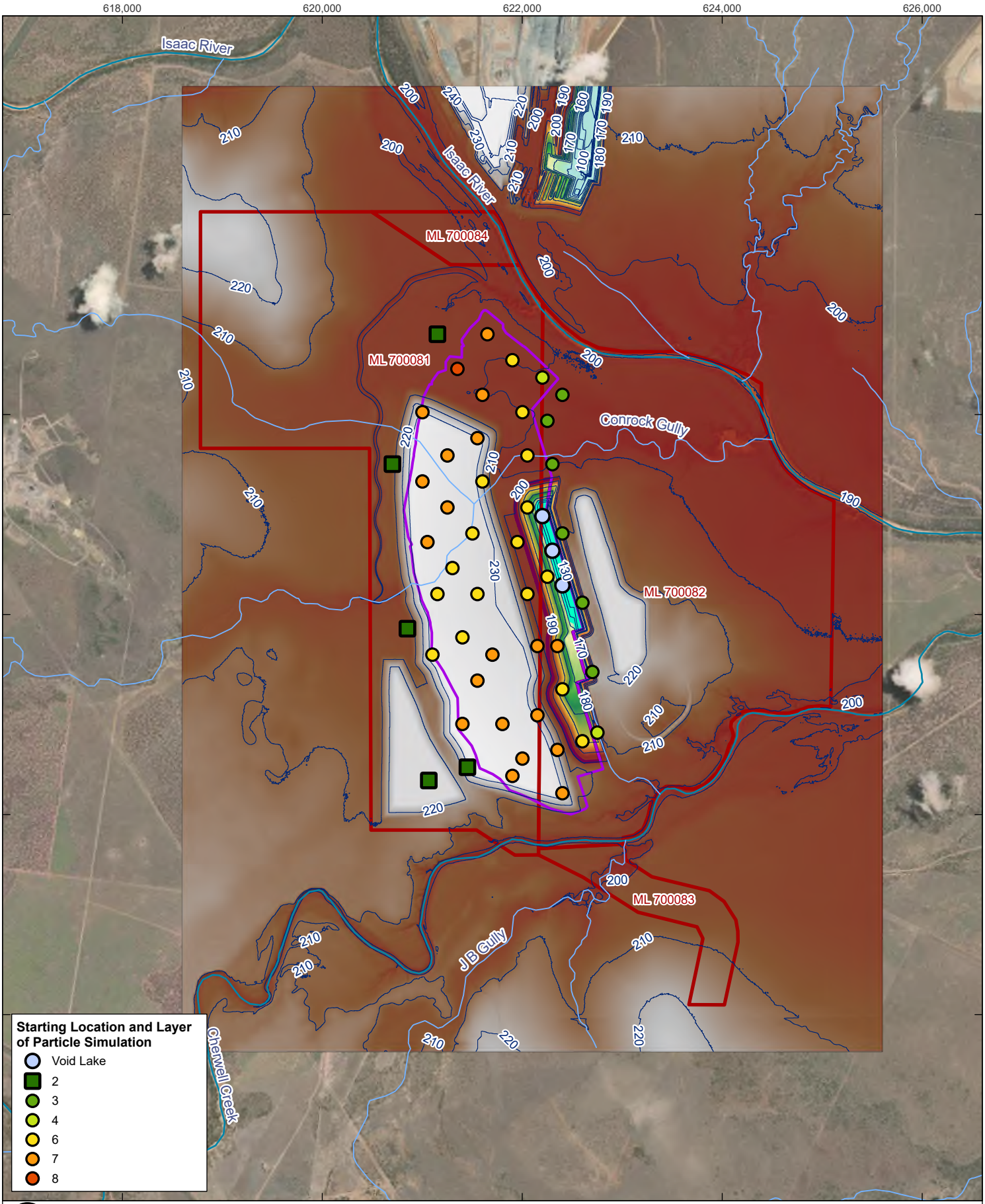
Figure 2-47 shows the initial location of particles on the final landform. The particles were placed at the surface of the model and released at the start of the post-mining simulation, with the movement of the particles then recorded during the post-mining simulation. It should be noted that the mod-PATH3DU code automatically moves the particle from the model surface to the shallowest saturated layer at the commencement of the simulation; as shown on **Figure 2-47** for many of the particles, this represents the RCM (Rangal Coal Measures) layers as the shallow layers (Layers 1 and 2) are unsaturated across much of the Project at the commencement of the post-mining simulation.

Figure 2-48shows the predicted movement of water particles in the 475-year recovery simulation of the final landform. The colours along the predicted particle flow paths provides

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 colour changes along the paths on **Figure 2-48** indicate that particles situated within the shallower saturated layers at the beginning of the post-mining simulation generally move progressively toward deeper layers over the post-mining period. The flow path analysis indicates the particles generally move toward the void lake, with many of the particles terminating in the void. Particles that move into the void during the post-mining simulation remain within the void for the duration of the simulation. Particles starting in the void themselves remain within the void for the duration of the simulation.

A series of particles are noted to travel outside the Project MLAs, to the northeast. Particle tracking results indicate that migration is confined to the Rangal Coal Measures, and the flux direction is likely attributable to nearby mining operations (i.e. IDM) controlling drawdown and flow direction within the Rangal Coal Measures and terminates in the adjacent void. The migration terminates in adjacent voids with no loss to regional groundwater.


618,000
620,000
622,000
624,000
626,000
7,560,000
7,558,000
7,556,000
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7,552,000
Isaac River
Isaac River
Isaac River
ML 700084
ML 700081
ML 700082
ML 700083
Conrock Gully
JB Gully
Cherwell Creek
Starting Location and Layer of Particle Simulation
Void Lake
2
3
4
6
7
8
0
0.5
1
km
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:50,000 at A4
Project Number: 620.041537
Date Drawn: 27-Apr-2026
Drawn by: RB
LEGEND
Major Watercourse
Minor Watercourse
Pit Extent
IDE Project MLAs
Void Extent
Void Lake
Final Landform Elevation (mAHD)
259.953
78.824
ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING
TECHNICAL REPORT
STARTING LOCATION OF PARTICLES
SLR
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 2-47
Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_F02-47_Starting Location of Particles

3.0 Sensitivity and Uncertainty Analysis

3.1 Sensitivity Analysis

3.1.1 Purpose

Quantifying the sensitivity of both calibration performance and model predictions to input parameters provides critical insight into model behaviour and uncertainty. The combined sensitivity analysis presented in this section supports two primary objectives:

1 **Assessing parameter conditioning through calibration sensitivity**: Parameters that have a strong influence on calibration performance metrics are more likely to be conditioned by the calibration process. In contrast, parameters with low sensitivity to calibration performance are less likely to be conditioned by the calibration process, meaning that their posterior distributions will likely remain broad regardless of the amount or quality of calibration data.

2 **Understanding prediction sensitivity to parameter uncertainty**: When model predictions are highly sensitive to specific parameters, it indicates that uncertainties in those parameters have a strong influence on predictive outcomes. Conversely, if predictions are insensitive to a given parameter, then uncertainty in that parameter has limited influence on the modelled forecast.

Comparing calibration and prediction sensitivity allows for distinguishing between parameters that are constrained during calibration, and parameters that drive predictive uncertainty, which may or may not overlap. Such insights support decision-making in model refinement, data collection prioritisation, and risk-based scenario analysis.

3.1.2 Methodology

To evaluate how variations in model parameters affect calibration and prediction outcomes, SLR employed two complementary global sensitivity analysis methods:

- Spearman rank correlation.
- Standardised linear regression coefficients.

These two methods assess different aspects of the input–output relationship and are well-suited to the often non-linear and complex behaviour of hydrogeological systems. They are commonly used in hydrological and environmental modelling due to their simplicity, interpretability, and relatively low computational demand (Saltelli et al., 2008; Pianosi et al., 2016).

3.1.2.1 Data Aggregation and Standardisation

Parameter and observation data were pre-processed and standardised. Parameters using a log normal distribution were converted to log 10 values.

Calibration performance was represented by two metrics (median residuals for initial and change in water level). For predictive sensitivity, predictive data included three groups: total alluvium take, total area with drawdown > 1 m and mine groundwater inflow (active mining). Except for mine inflow, which is specific to the Project, alluvium take, drawdown and Isaac River take are assessed as cumulative.

Parameter values (one group), calibration data (two groups) and prediction data (three groups) were standardised (zero mean, unit variance) independently (i.e. per group) to enable consistent comparison across variables and groups.

3.1.2.2 Spearman Rank Correlation Coefficient

Spearman rank correlation measures the monotonic relationship between input parameters and model outputs. It identifies whether changes in a parameter consistently increase or decrease a model output, regardless of the exact functional form of the relationship. This is especially useful in groundwater models where non-linearities are common due to boundary conditions, storage terms, or non-linear recharge responses (van Griensven et al., 2006).

Given a parameter vector X and a model response vector Y, Spearman's rank correlation coefficient ρ is calculated as:

$$\rho = 1 - \frac{6\sum_{i=1}^{n}(R_i - S_i)^2}{n(n^2-1)}$$

Where:

- R_i is the rank of parameter X for sample *i*.
- S_i is the rank of the corresponding model output Y.
- n is the number of realisations.

3.1.2.3 Linear Regression Sensitivity Coefficient

Linear regression sensitivity quantifies how much the output changes *on average* with a unit change in a parameter, assuming a linear relationship. It describes the *magnitude* of influence a parameter has on model outputs under the assumption of a linear relationship.

The relationship is represented as:

$$Y = X\beta + \epsilon$$

Where:

- Y is the model output.
- X is a matrix of standardized parameter values.
- β is the vector of estimated sensitivity coefficients.
- ϵ is the model error.

The coefficient β represents the average change in model output (Y) for a one standard deviation change in model parameter (X) and is interpreted as a direct measure of sensitivity magnitude, specifically how the variance of the parameter uncertainty contributes to the variance of the predictive or calibration uncertainty. This method assumes linearity and additivity but remains useful as a first-order sensitivity metric (Helton et al., 2006).

3.1.2.4 Interpretation

There is no single universally accepted threshold for Spearman or regression coefficients in sensitivity analysis. However, some thresholds are often used as pragmatic benchmarks based on the practical significance of parameter influence rather than strict statistical cutoffs. For this analysis, moderate sensitivity was selected for an absolute ρ score greater than 0.2 and for an absolute β value greater than 0.1.

This dual-method framework supports robust sensitivity diagnostics by capturing both the consistency and strength of parameter influence. The combined use of both metrics enables us to distinguish between parameters that:

- Have a strong and consistent effect;
- Have an effect only in a narrow range (local sensitivity); or
- Behave non-monotonically and inconsistently.

A comparison of the interpretive value of each method is provided in **Table 3-1**:

Table 3-1 Comparison of Spearman and Regression in Sensitivity Analysis

Sensitivity Scenario	Impact of Parameter Changes on Model Outcome	Spearman	Regression	Interpretation
S1	Strong, consistent linear effect	>0.2	>0.1	Parameter is influential and predictable
S2	Consistent but nonlinear effect	>0.2	<0.1	Parameter is influential but not well described by linear models
S3	Local or inconsistent effect	<0.2	>0.1	Large effect in a narrow range
S4	Limited influence	<0.2	<0.1	Parameter has limited to minimal influence

3.1.3 Results

The results are presented as bar charts in **Appendix D** and discussed in **Section 3.1.3.1** and **Section 3.1.3.2**.

3.1.3.1 Calibration Sensitivity (Parameter Conditioning)

Parameter with a ρ score greater than 0.2 and/or a β value greater than 0.1 (scenarios S1, S2 or S3 in **Table 3-1**) are likely to be conditioned through the calibration process.

As presented on **Appendix D** the calibration process is likely to be conditioning:

- Kx of the regional alluvium (z01), Isaac River alluvium (z29), regolith (z06), Rewan (z08) RCM inteburden (z11), FCM interburden (z16), D seam (z23), Igneous rock (z69) and of several fault zones (z31, z35, z40, z48, z49, z52, Z54, z56, z62, z66).
- Kz of the MCM interburden (z18), spoil (spl_kz_z01) and of several fault zones (z26, z28, z30, z31, z46, z50, z60, z62, z63, z64, z67)
- Sy of the Isaac River alluvium (z29), regolith (z02, z06), weathered Permain (z03), Rewan (z08), RCM Leichardt seam (z10), FCM interburden (z14, z15) and fault zone (z25)
- Ss of the Duaringa formation (z04), Tertiary basalt (z05), MCM interburden (z13) FCM interburden (z16), Igneous rock (z69) and fault zone (z07)
- Recharge of the Duaringa formation (z05) and Isaac River alluvium (z07)
- Evapotranspiration (depth) for the alluvium (z01), Duaringa formation (z04) and basalt (z05)
- Riverbed Kz (Riv_vk) of the Izaac River zone associated with IDE (z02) and Ripstone Creek (z06)
- General head boundary (head multiplier)

3.1.3.2 Type I-IV Analysis

The Murray Darling Basin Modelling Guidelines (Murray Darling Basin Commission [MDBC], 2000) recommends classifying sensitivity by the resultant changes (or contribution) to the model calibration and predictions. According to this process models can be classified as one of the four main types:

- Type I: Insignificant changes to calibration (low calibration sensitivity) and prediction (low predictive sensitivity);
- Type II: Significant changes to calibration (high calibration sensitivity) – insignificant changes to predictions (low predictive sensitivity);
- Type III: Significant changes to calibration (high calibration sensitivity) –significant changes to predictions (high predictive sensitivity);
- Type IV: Insignificant changes to calibration (low calibration sensitivity) –significant changes to predictions (high predictive sensitivity).

Most parameters are Types I-III parameters that have an insignificant impact on model predictions or conditioned by calibration. Type IV are significant to the predictive uncertainty as non-uniqueness in a model input might allow a range of valid calibrations but the choice of value impacts significantly on a prediction (MDBC, 2000).

To classify the sensitivity contribution to the model calibration and predictions for each model parameter, the calibration and prediction sensitivities were compared against each other for each parameter.

To allow comparing calibration and prediction sensitivity in one graph, a combined sensitivity value was calculated for each sensitivity group as:

$$\text{Combined}_{(i,g)} = 0.5 * |\beta_{(i,g)}| + 0.5 * |\rho_{(i,g)}|$$

where:

- $\beta_{(i,g)}$ is the standardised regression coefficient for parameter *i* and group *g*.
- $\rho_{(i,g)}$ is the Spearman rank correlation coefficient between parameter *i* and group *g*.

For the calibration sensitivity, the highest sensitivity was selected between the two Phi parameter (i.e. Max of initial Water Level [WL] phi and change in WL Phi). For this analysis, the threshold value for a sensitive parameter was set at 0.15, as the average of the threshold for *β and ρ* (see **Section 3.1.2.4**).

Comparison plots are presented for the alluvium take (**Figure 3-1**), drawdown (**Figure 3-2**) and mine groundwater inflow (active mining) (**Figure 3-3**). Type IV parameters are summarised in **Table 3-2.**

It should be noted that most Type IV parameters summarised in **Table 3-2** are “weak” type IV, meaning that prediction sensitivity remains relatively low overall (less than 0.3 for the combined metric, as shown on **Figure 3-1** to **Figure 3-3**). Noticeable type IV parameters are:

- **Alluvium take**: Hydraulic conductivity of the P seam (Kx_z19) and recharge to the spoil (spl_rchf_z01)
- **Isaac River baseflow loss:** Evapotranspiration depth (expd_z01)
- **Mine inflows (IDE):** RCM Interburden (Sy_z11)

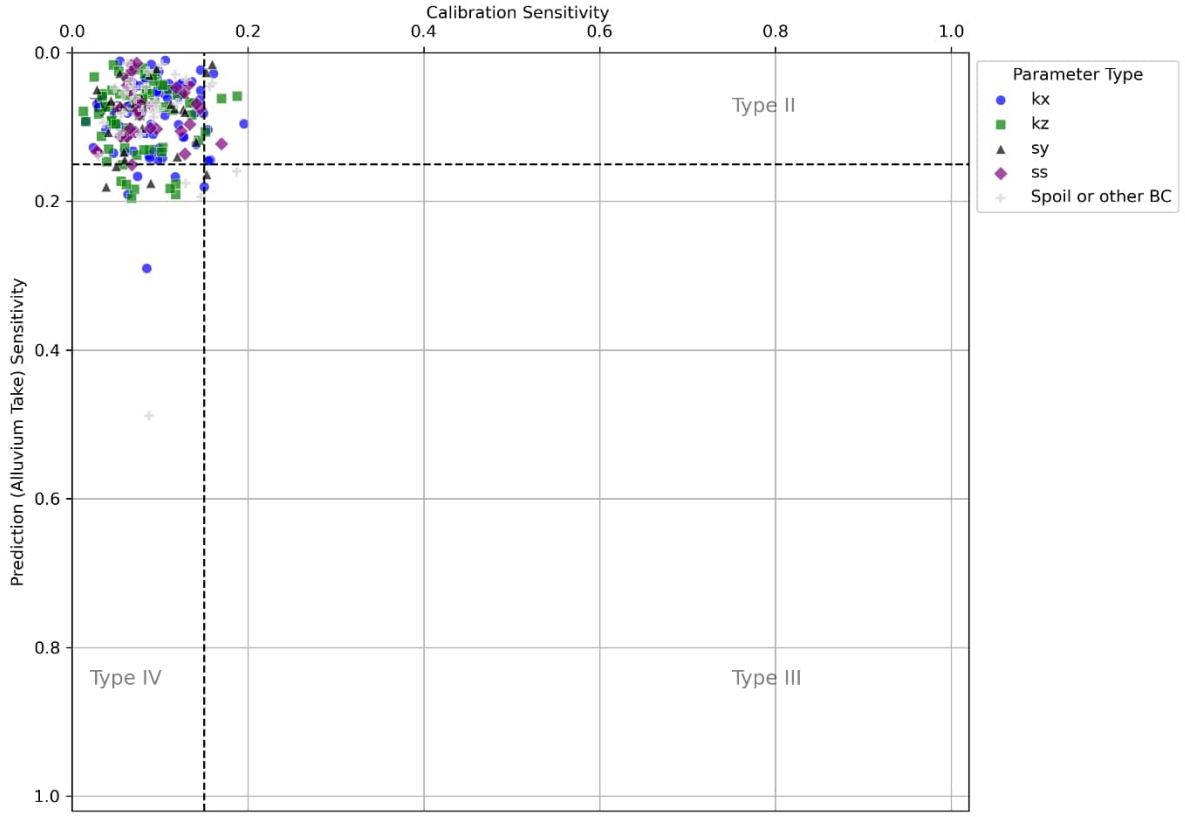


Figure 3-1 Predictive Sensitivity (Alluvium Take) Versus Calibration Sensitivity

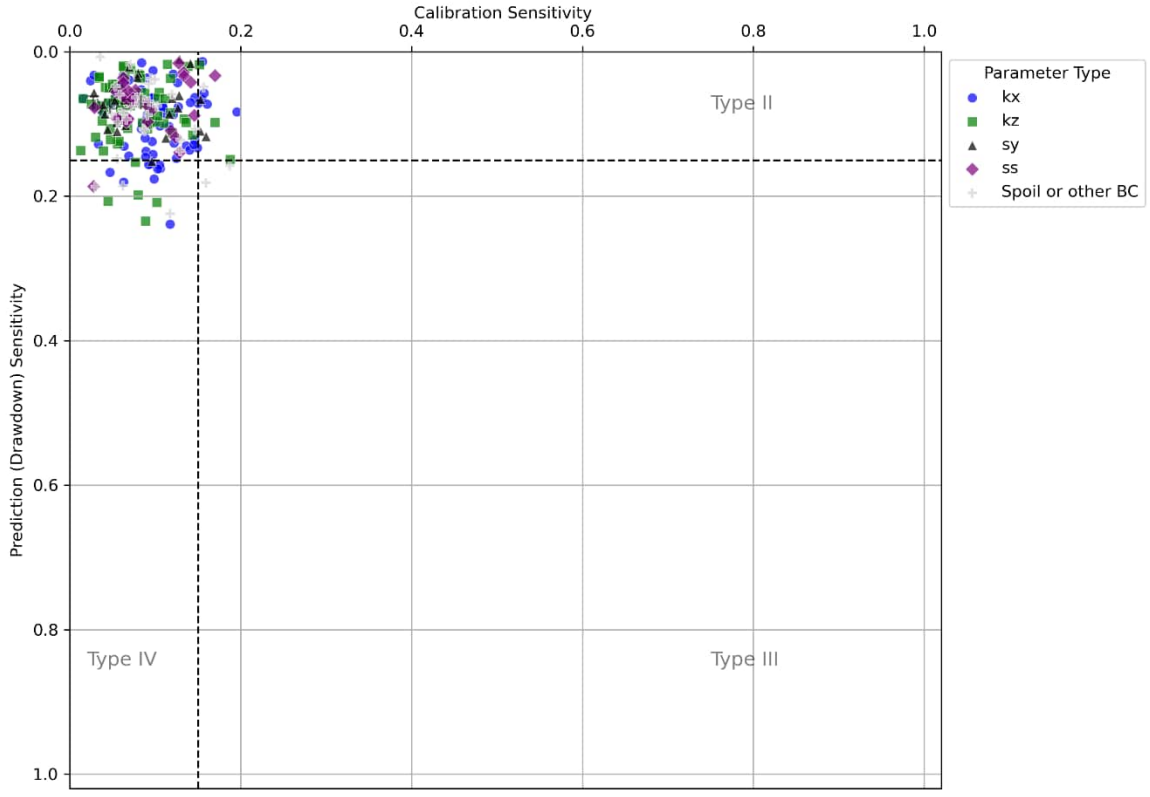


Figure 3-2 Predictive Sensitivity (Drawdown) Versus Calibration Sensitivity

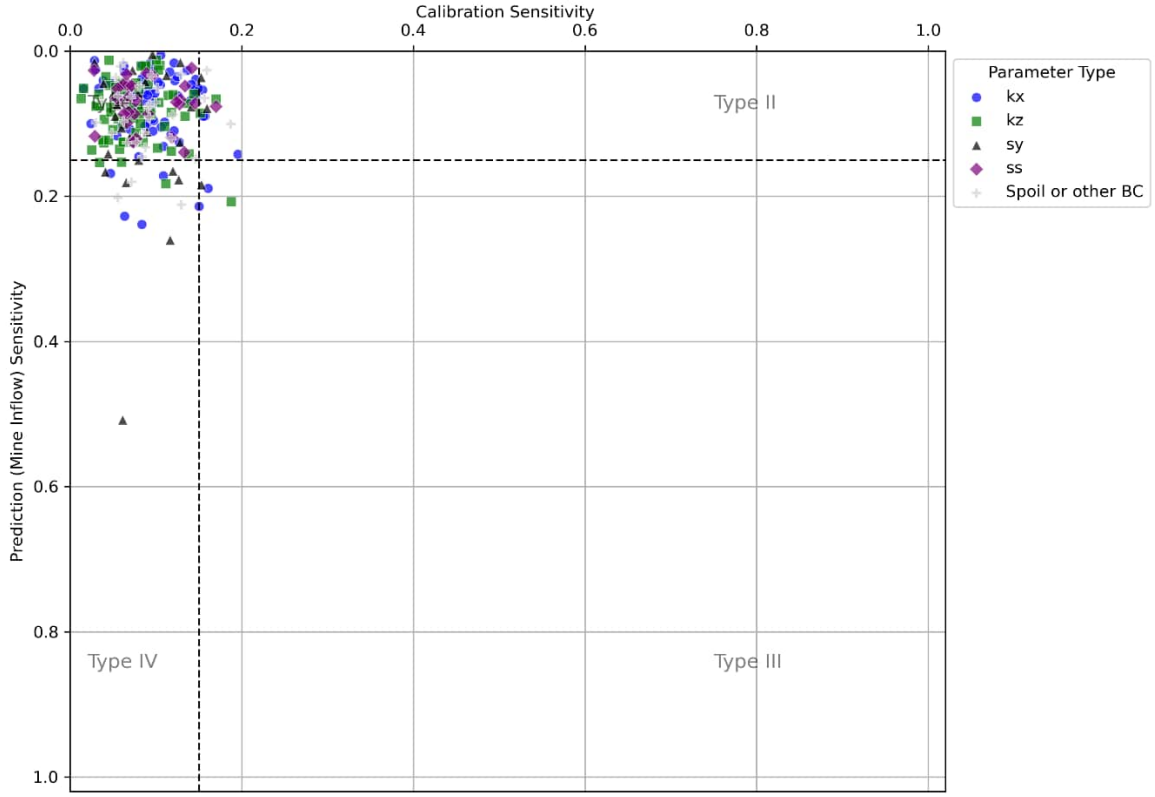


Figure 3-3 Predictive Sensitivity (Mine Groundwater Inflow) Versus Calibration Sensitivity

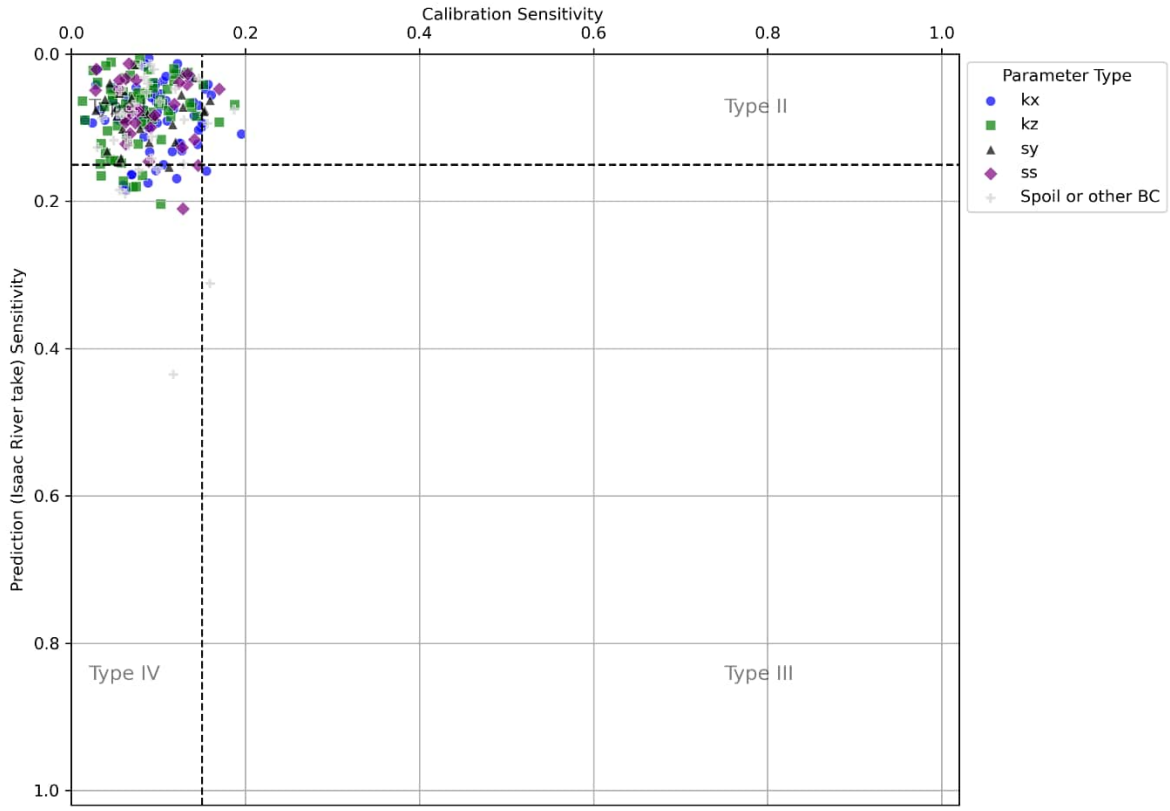


Figure 3-4 Predictive Sensitivity (Isaac River Take) Versus Calibration Sensitivity

Table 3-2 Type IV Parameters

Parameter	Definition	Associated Prediction
exdp z01	Alluvium	Drawdown, Isaac River take
exdp z02	Regolith	Alluvium Take
ghbc f all	GHB conductance factor	Isaac River Take
kx (multiple zones)	Faults	Alluvium Take, Drawdown, Isaac River Take, Mine Inflow
kx z04	Duaringa Surface Cover layers 1 and 2	Drawdown, Isaac River Take
kx z08	Rewan Triassic	Alluvium Take, Drawdown
kx z12	Moranbah Coal Measures Vermont Seam	Isaac River Take
kx z13	Rangal Coal Measures 1 Interburden	Isaac River Take
kx z15	Fort Cooper Coal Measures Interburden	Alluvium Take, Mine Inflow
kx z19	Moranbah Coal Measures P Seam	Alluvium Take
kx z24	Moranbah Coal Measures 1 Interburden	Alluvium Take
kzf z06	Regolith Surface Cover	Alluvium Take
kzf z09	Rangal Coal Measures 1 Interburden	Isaac River Take
kzf z11	Rangal Coal Measures 1 Interburden	Mine Inflow
kzf z14	Fort Cooper Coal Measures Interburden	Drawdown
kzf z23	Moranbah Coal Measures D Seam	Alluvium Take
kzf z29	Isaac River Alluvium	Isaac River Take, Mine Inflow
rchf z02	Regolith	Drawdown
rchf z03	Weathered Permian	Drawdown, Isaac River Take
rchf z05	Duaringa Formation (Tu)	Mine Inflow
rivk z01	Isaac River Goonyella	Isaac River Take, Mine Inflow
rivk z11	North Creek	Isaac River Take
spl kx z01	spoil	Mine Inflow
spl kz z01	spoil	Alluvium Take
spl rchf z01	spoil	Alluvium Take
ss z02	Regolith Surface Cover	Alluvium Take
ss z04	Duaringa Tertiary Basalt	Isaac River take
ss z23	Moranbah Coal Measures D Seam	Drawdown
sy z06	Regolith Surface Cover	Mine Inflow
sy z08	Rewan Triassic	Mine Inflow
sy z09	Rangal Coal Measures Interburden	Mine Inflow
sy z11	Rangal Coal Measures Interburden	Mine Inflow
sy z13	Moranbah Coal Measures Interburden	Alluvium Take
sy z19	Moranbah Coal Measures P Seam	Alluvium Take
sy z20	Moranbah Coal Measures Interburden	Alluvium Take

Parameter	Definition	Associated Prediction
sy z21	Moranbah Coal Measures H Seam	Drawdown
sy z23	Moranbah Coal Measures D Seam	Mine Inflow

3.1.4 Conclusion

The sensitivity analysis highlighted several parameters that contribute to predictive uncertainty and that are likely to be poorly conditioned by the calibration process (Type IV parameters). A distinction was made between “weak” and “strong” type IV parameters, with strong type IV likely to be key contributors of prediction uncertainty. Prediction uncertainty was quantified for the quantities of interest in the following section (**Section 3.2**)

3.2 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 using the calibrated realisations presented in **Section 1.1.3**, executing the model independently for each realisation, and then aggregating the results for statistical analysis.

As described in **Section 1.1.3**, calibrated realisations have been assigned a likelihood value as part of the SMC calibration. As such, the quantities of interest (i.e. drawdown, mine groundwater inflow (active mining), alluvium take and river baseflow loss) are weighted for each realisation based on the normalised likelihood (i.e. sum of likelihood for the ensemble are equal to 1) for this realisation. The statistical analysis is therefore performed on weighted predictions where realisations with a greater likelihood are given a higher weight. Results are presented as weighted percentiles for each quantity of interest.

The 109 calibrated realisations with the highest likelihood were selected for this uncertainty analysis. The predictions included in the uncertainty analysis were:

- Maximum Drawdown.
- Mine Inflows (active mining).
- Alluvium Water Take.
- Loss of Stream Flow.

Due to the long model run times and the number of realisations required for the uncertainty analysis, the assessment was limited to 200 years of post-mining conditions, by which time the Project’s final void lake level is expected to have reached equilibrium.

3.2.1 Uncertainty Convergence

Statistical analyses of predictive results were conducted to assess if additional realisations were likely to provide results that would significantly change reported results. The 5th and 95th percent confidence interval for the main predictive results (drawdown, mine groundwater inflow (active mining) and alluvium take) was calculated using the Bootstrap method (Efron & Tibshirani, 1993).

The confidence intervals are calculated sequentially as more realisations are added, creating a sequential progression of confidence intervals; for example, the confidence interval of the mine groundwater inflow (active mining) rates was calculated using the results from 10 realisations, 20 realisations, sequentially, up to the total number of realisations (i.e. 109 realisations).

3.2.1.1 Methodology

Given a dataset of values $X = \{x_1, x_2, \ldots, x_n\}$ and corresponding non-negative weights $\omega = \{\omega_1, \omega_2, \ldots, \omega_n\}$ we compute percentile confidence intervals as follows:

1. **Data Preprocessing**

The input dataset consists of model realisations with two key attributes:

- Prediction (X): the metric of interest (e.g., total area impacted by drawdown > 1 m),
- Likelihood (ω) : a normalized probability weight associated with each realisation.

The prediction data ($X = \{x_1, x_2, \ldots, x_n\}$) is sorted in descending order of likelihood ($\omega = \{\omega_1, \omega_2, \ldots, \omega_n\}$) to prioritise more probable realisations.

2. **Sequential Calculations (Convergence Check)**

For each incrementally increasing subset of realisations (in steps of 10), we calculated:

- **Weighted Percentile:** we calculated the weighted 5th, 50th, and 95th percentiles of the prediction values. These percentiles were computed using the realisations' associated likelihoods as weights, ensuring that more probable realisations contributed more heavily to the statistic. Specifically, the weighted P-th percentile was defined as the smallest prediction value such that the cumulative sum of weights up to that value was at least **P%**.
- **Bootstraping**
  - We perform 500 bootstrap iterations. In each iteration b = 1, ... , 500, we draw a sample with replacement from the data, where the probability of selecting each x_i is proportional to its normalized weight:

$$\tilde{w}_i = \frac{w_i}{\sum_{j=1}^{n} w_j}$$

  - The weighted percentiles are recalculated for each bootstrap sample
  - The 95th confidence interval is estimated using the 2.5th and 97.5th percentiles of the bootstrap estimates.

Confidence intervals represent uncertainty in the quantile estimator and may not bracket the empirical percentile, particularly for tail quantiles under likelihood weighting. The uncertainty bands (CI) describe how much the calculated percentile might change if we repeated the analysis with similar data. They are not guaranteed to sit above and below the reported percentile value, especially near the extreme ends of the distribution (95th and 5th percentiles), where estimates depend on fewer data points and are more sensitive to weighting.

This method allows for non-parametric estimation of confidence intervals on weighted percentiles, accounting for sampling variability and the influence of differing observation weights.

3.2.1.2 Results

Figure 3-5, **Figure 3-6**, **Figure 3-7** and **Figure 3-8**. shows weighted (i.e. by likelihood) percentile for the 5th, median and 95th as well as the 5th and 95th confidence intervals as more realisations are added, for mine groundwater inflows, drawdown, alluvium take, and loss of stream flow in Isaac River, respectively. As indicated in **Figure 3-5**, **Figure 3-6**,

Figure 3-7 and **Figure 3-8**, additional realisations are unlikely to significantly increase or decrease the confidence intervals of predictions. This conclusion is drawn based upon the combination of two factors:

- The rate of change per additional realisation is small.
- The magnitudes of the confidence interval are small and well below reasonable expectation of the predictive ability of a numerical model.

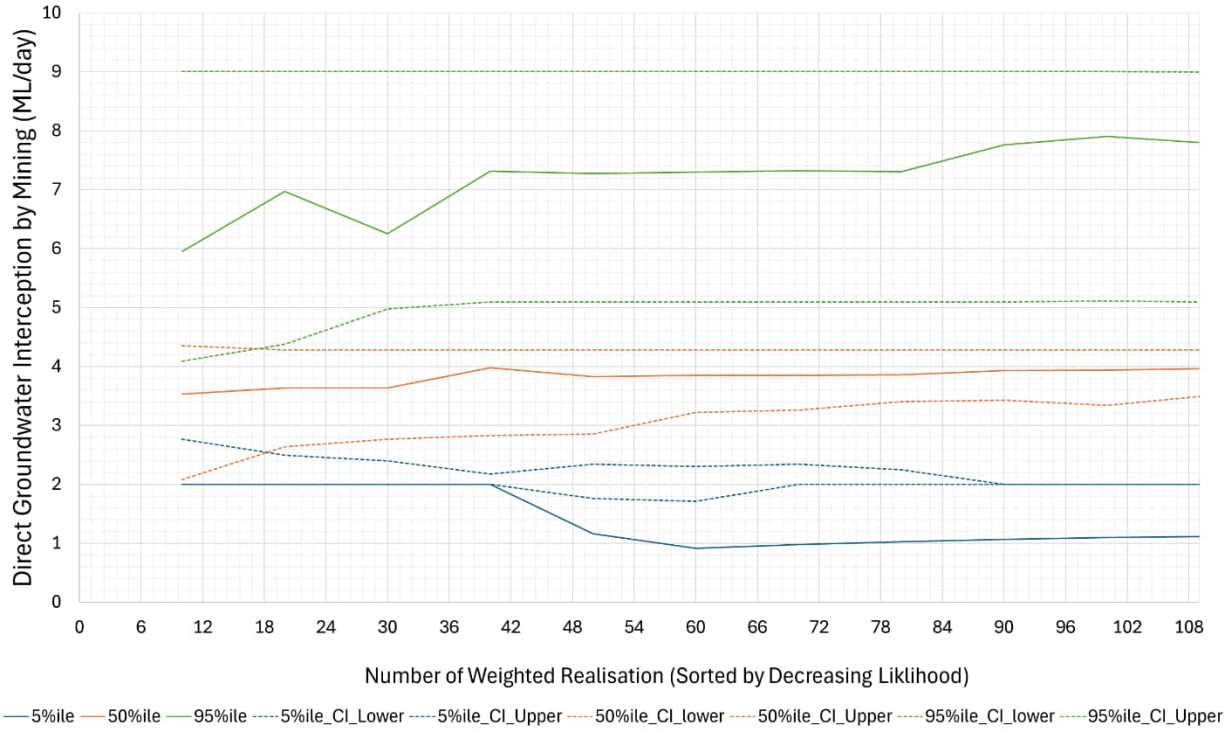
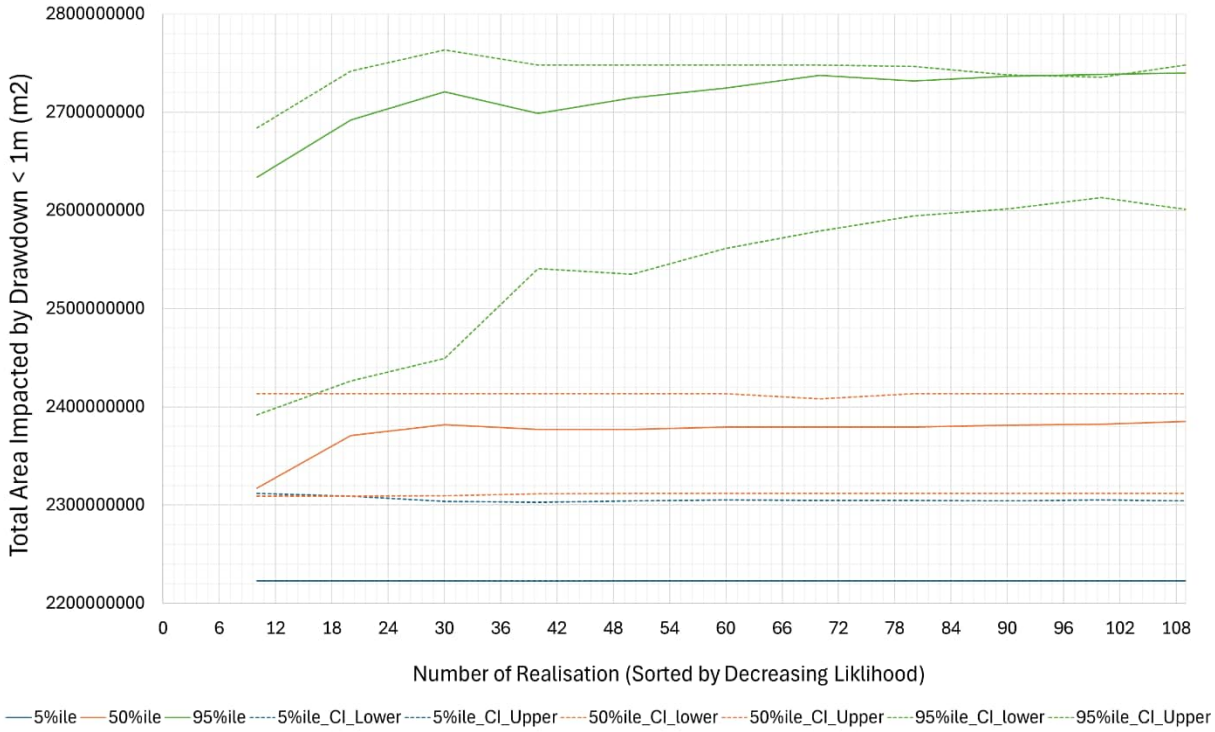


Figure 3-5 Predictive Uncertainty Convergence – Mine Groundwater Inflows (Active Mining)



Note: m^2 = square metres

Figure 3-6 Predictive Uncertainty Convergence – Drawdown

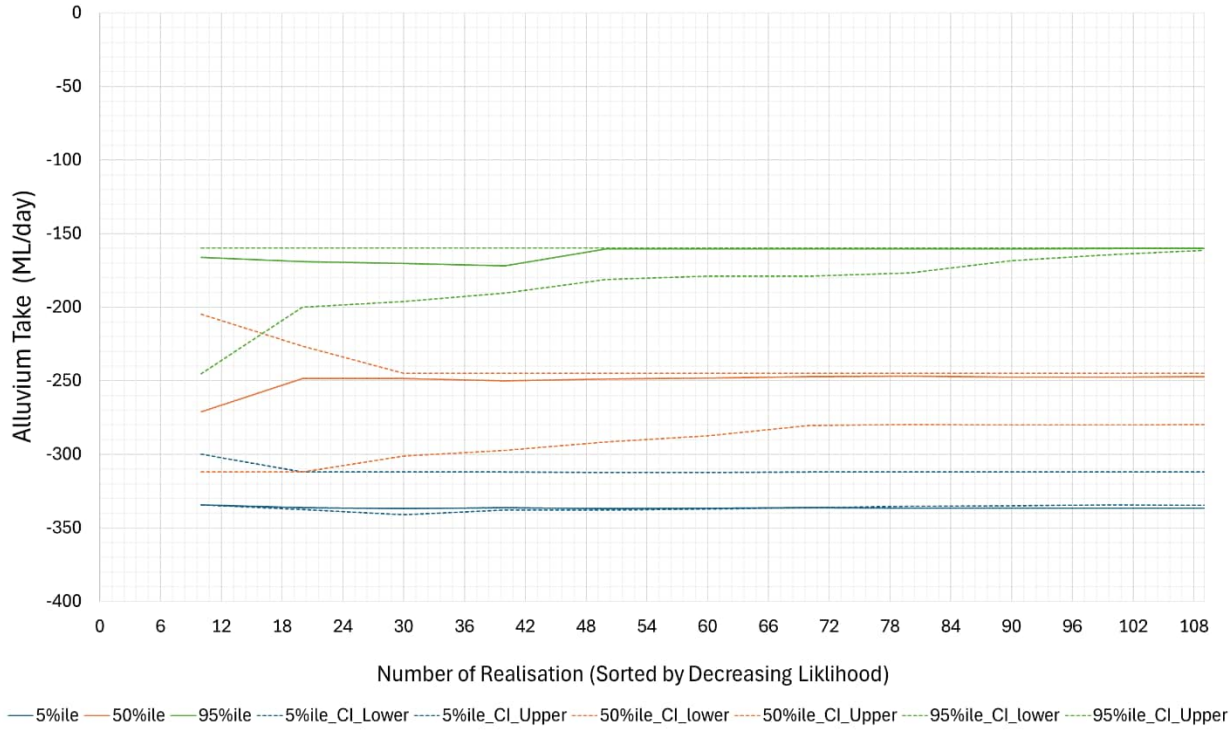


Figure 3-7 Predictive Uncertainty Convergence – Alluvium Take

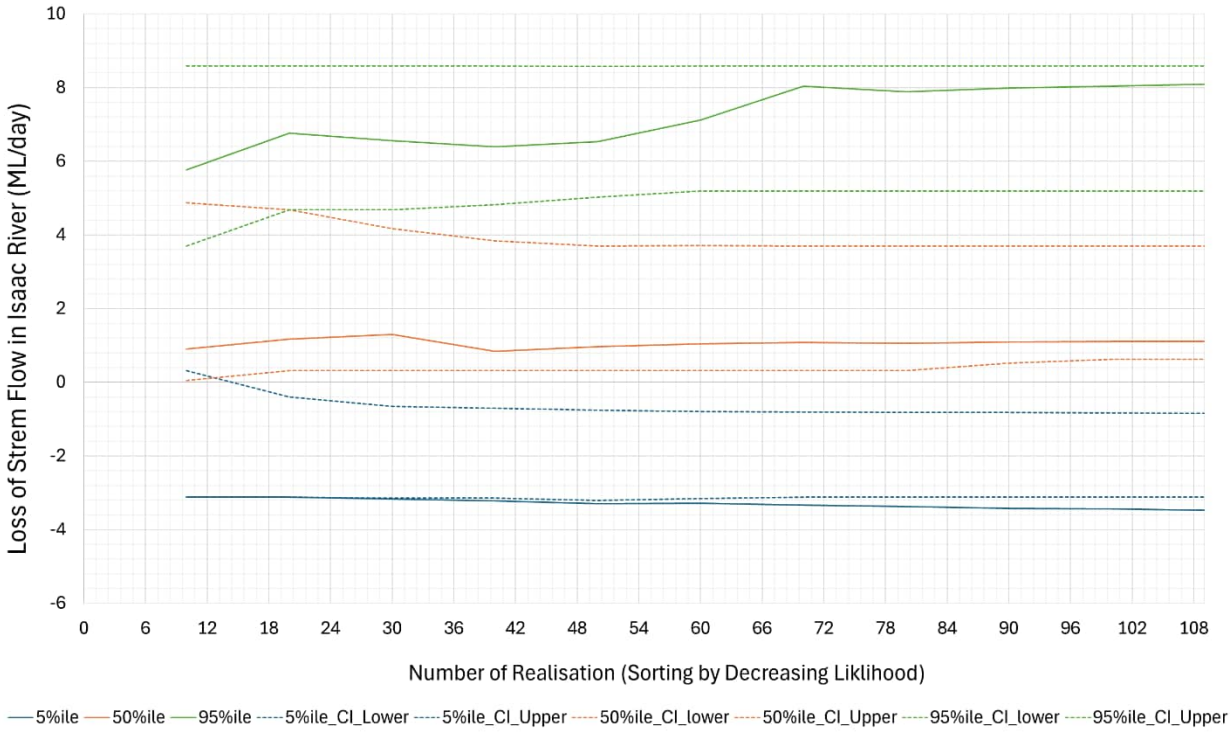


Figure 3-8 Predictive Uncertainty Convergence – Loss of Stream Flow in Isaac River

3.2.2 Uncertainty of Drawdown

To illustrate the level of uncertainty in the extent of predicted mine induced drawdown (1 m contours), the calibrated prediction model maximum drawdown (incremental and cumulative) and the 50th percentile maximum drawdown extent were compared to the maximum drawdown extent for the 5th and 95th percentiles (**Appendix E**). In addition, residual drawdown (incremental and cumulative) was assessed in **Appendix E**.

Overall, the results indicate that the MLE 1 m contour fits in between the median and the 95th percentile of the ensemble for the Regolith (Layer 2), the Leichhardt seam (Layer 5) and the Vermont seam (Layer 7). As mentioned in **Section 2.4.1.1**, no incremental drawdown exceeding 1 m is predicted for the MLE in the alluvium (Layer 1) as a result of the Project. The MLE results presented in **Section 2.4** are thus unlikely to underestimate drawdown.

3.2.3 Uncertainty of Mine Groundwater Inflows

The uncertainty of mine groundwater inflow (active mining) into the Project pit (active take) from the start of Project mining (2029) to the end of mining (2043), is shown for the incremental scenario in **Figure 3-9**. The figures show the predicted mine groundwater inflows (active mining) for the MLE model and different weighted percentiles prediction ranges. These represent:

- 5th – 33th indicates it is likely that the outcome is larger than this range.
- Median indicates it is as likely as not that the outcome is larger or smaller than this value.
- 33th – 67th indicates it is likely that the outcome is within that range.

- 67th – 95th indicates it is unlikely that the outcome is larger than this range.

The predicted uncertainty in mine groundwater inflows (active mining) is up to 0.45 ML/d deviation from the median for the incremental scenario. Overall, the results indicate that the MLE model is representative of the 33th – 67th percentile range from 2029 to 2036 and the 67th – 95th percentile range from 2036 to 2043 for the estimated mine groundwater inflows (active mining) (**Figure 3-9**). The MLE results presented in **Section 2.5.1** are thus unlikely to underestimate mine inflows.

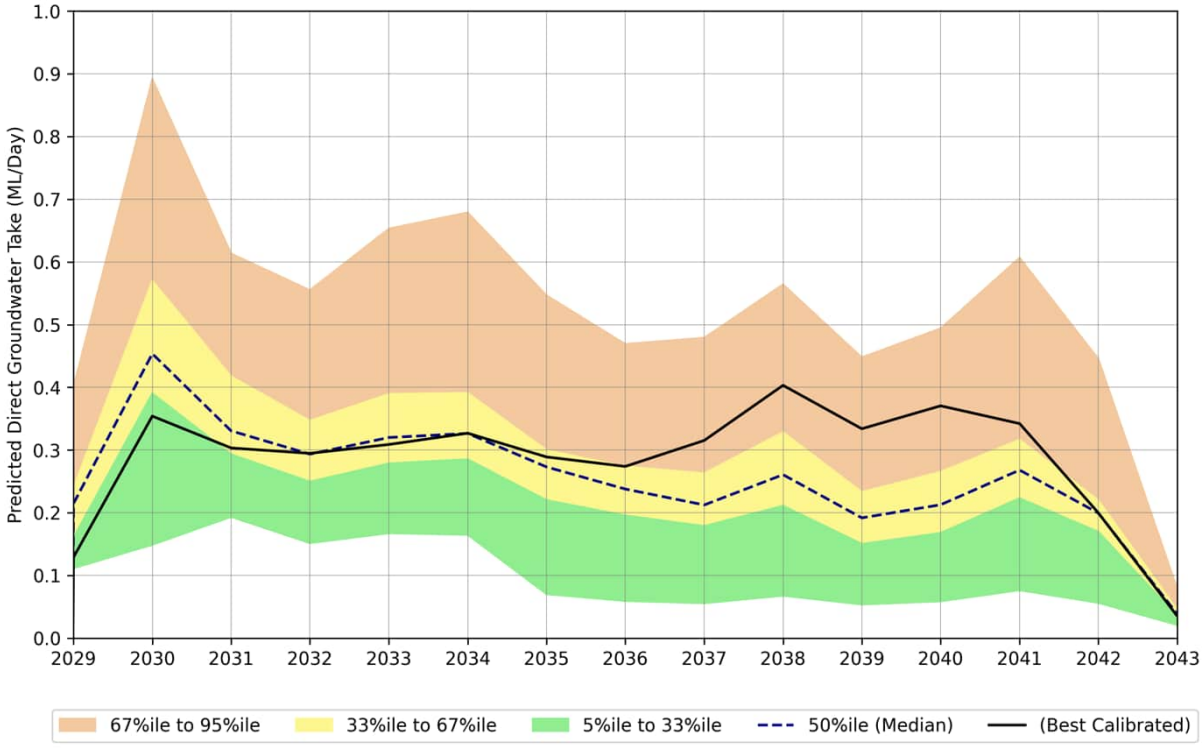


Figure 3-9 Uncertainty in Incremental Mine Groundwater Inflows (Active Mining)

3.2.4 Uncertainty in Alluvium Water Take

The uncertainty in alluvium water take from the start of the predictive model (2029) to post-mining equilibrium (2249), is shown for the incremental scenario (**Figure 3-10**) and the cumulative scenario (**Figure 3-11**). The figures show the predicted alluvium take for the MLE model and different weighted percentiles prediction ranges.

Negative values for the incremental and cumulative take indicate an increase in alluvium take, while positive values indicate a reduction in alluvium take. The MLE model is representative of the 5th percentile to 33rd percentile for the incremental and cumulative alluvium take. The MLE results presented in **Section 2.6.1** are thus unlikely to underestimate alluvium take.

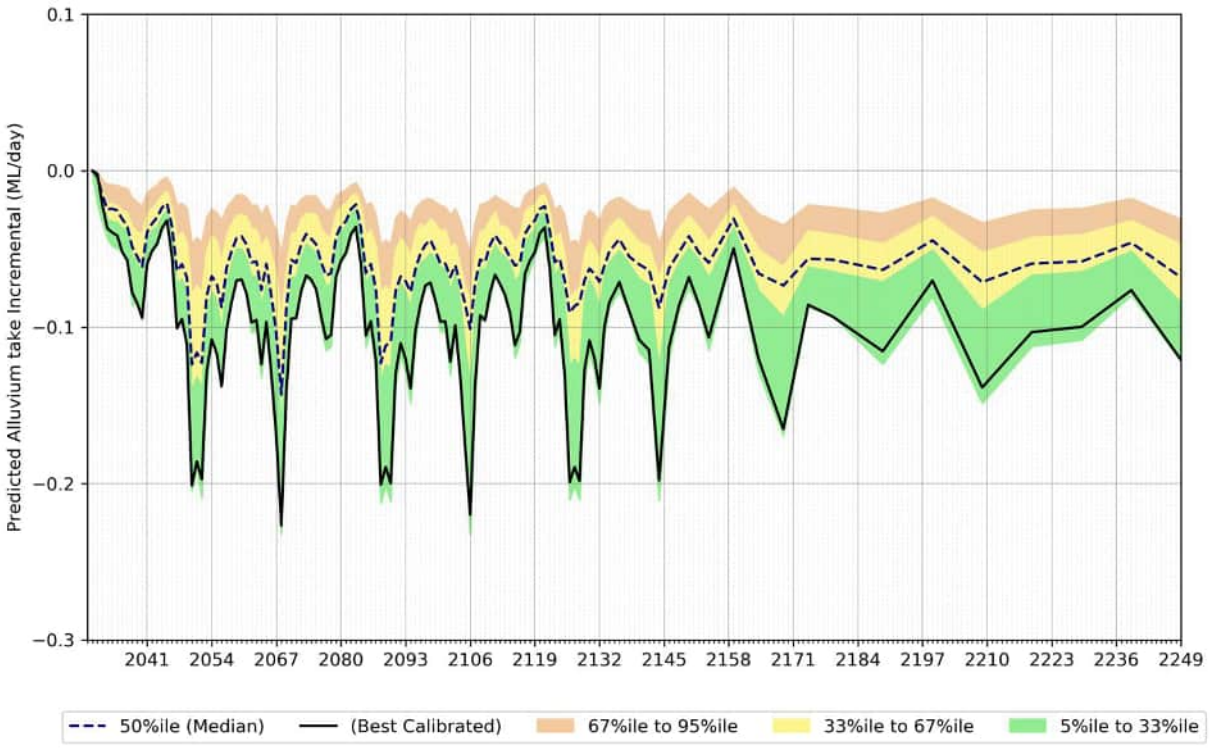


Figure 3-10 Uncertainty in Incremental Alluvium Take

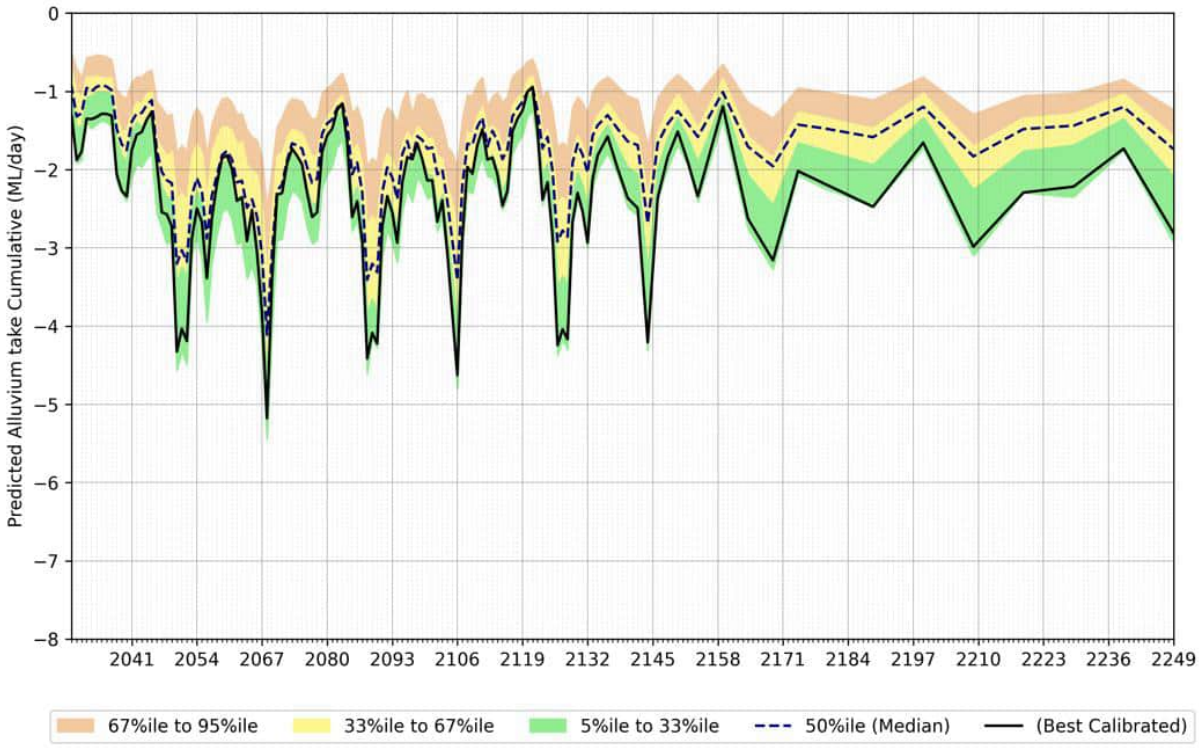


Figure 3-11 Uncertainty in Cumulative Alluvium Take

3.2.5 Uncertainty in River Baseflow Loss

The uncertainty of stream baseflow loss from the start of the predictive model (2029) to post-mining equilibrium (2249), is shown for the incremental scenario (**Figure 3-12**) and the cumulative scenario (**Figure 3-13**). The figures show the predicted stream baseflow loss for the MLE model and different weighted percentiles prediction ranges. Overall, the MLE model is representative of the median for the active mining period and of the 5th percentile to 33rd percentile for the post-mining period. The MLE results presented in **Section 2.6.2** are thus unlikely to underestimate river baseflow loss.

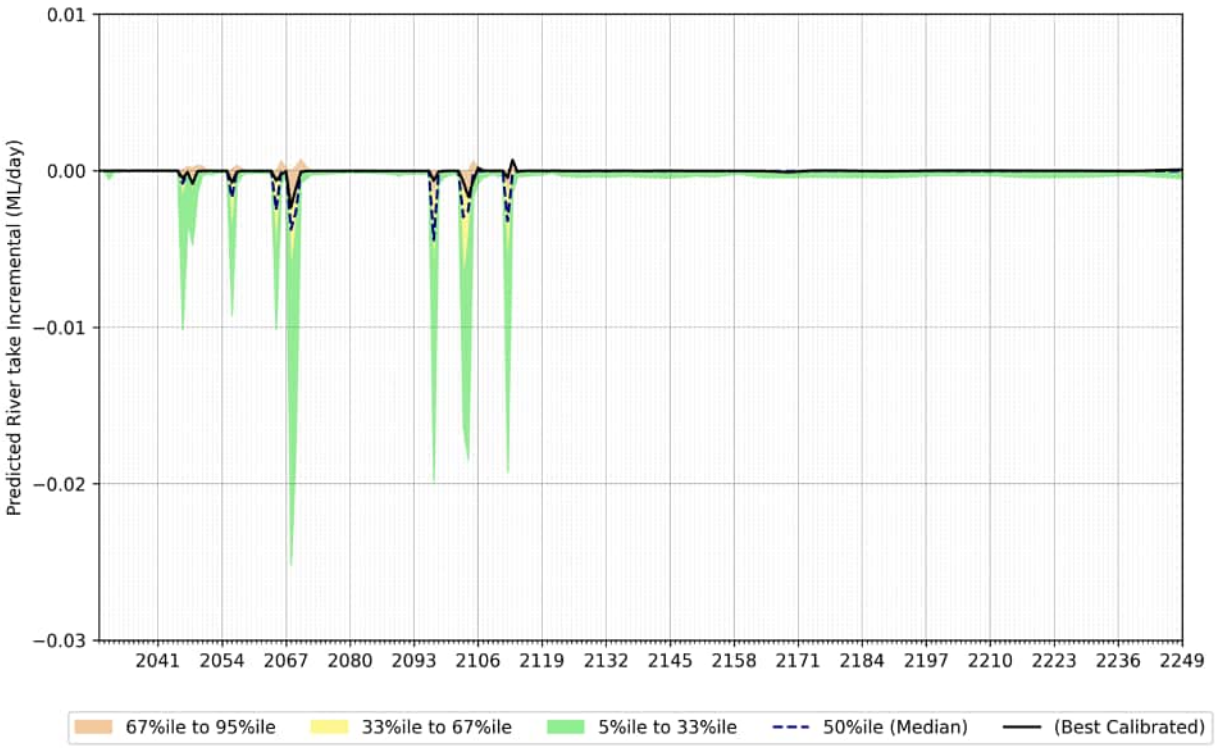


Figure 3-12 Uncertainty in Incremental Stream Baseflow Loss

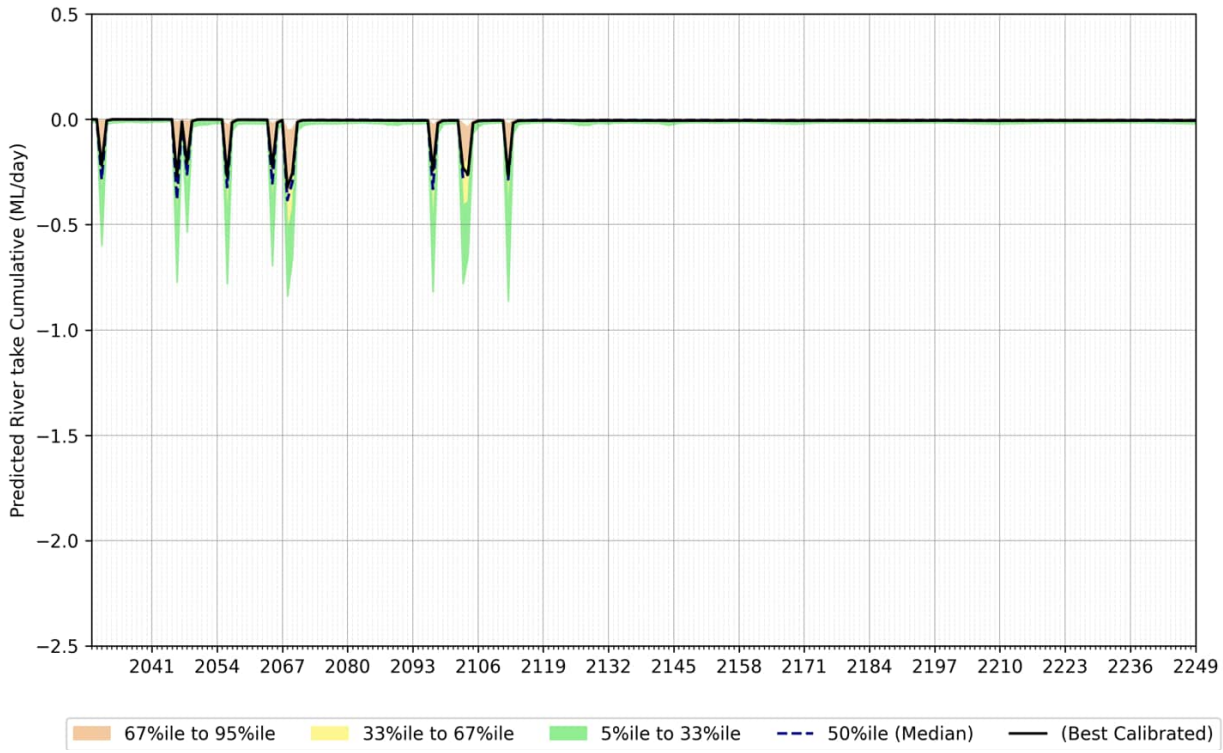


Figure 3-13 Uncertainty in Cumulative Stream Baseflow Loss

4.0 Model Performance and Limitations

The groundwater modelling was conducted in accordance with the *Australian groundwater modelling guideline* (Barnett et al. 2012) and the MDBC Groundwater Flow Modelling Guideline (MDBC, 2001). These are mostly generic guides and do not include specific guidelines on special applications, such as open cut mine modelling.

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 groundwater 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 include mine inflows, alluvium take, river take, and change in groundwater levels;
- 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 are not underestimated. The calibration performance was deemed acceptable. Although uncertainty analysis was part of the scope of work, uncertainties are reviewed qualitatively in **Table 4-1**; and

- Feasible – Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the project. This groundwater model was built to predict groundwater inflows to the mine, changes in groundwater levels during operation and post-closure, fluxes to groundwater receptors, impacts on water budgets and surface water, and to support the assessment of mitigation measures and post-mining recovery conditions. The model complexity and calibration process is deemed commensurate with long term risk associated with the post mining landform.

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 **Table 4-1**.

Table 4-1 Groundwater Model and Data Limitations and Potential Recommended Updates

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose.	The groundwater model has an unstructured Voronoi grid that includes detailed cell refinement around the mining area, mapped geological structures and along drainage features. The groundwater model extent was designed to prevent boundary influence on modelled drawdown/mounding.
	Layers and Geological Structure	Fit for purpose	Top of Layer 1 uses detailed Digital Elevation Model (DEM) data. **Unconsolidated geology:** Regionally, representation of alluvium and regolith is based on publicly available mapped geology and Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2015) regolith mapping. At the Project, representation of the alluvium was based on detailed surface geology mapping by the Queensland Government and was further refined using drill data, ERI survey interpretations, and groundwater investigations from IDM and PTM, as discussed in SLR (2026b) **Consolidated Geology:** Regionally, solid geology is based on geological models and publicly available data, as discussed in SLR (2026a). At IDE, the local structure of the geology is well defined through both resource exploration and groundwater drilling, at and near to the Project Area, supported by regional geological interpretation outside the site. The main regional fault (Isaac Thrust Fault) has been defined and characterised through exploration drilling, as discussed in SLR (2026b). Model vertical resolution is sufficient to represent relevant geological units, and unstructured grid allows layer pinch out where units not present.
	Conceptualisation – GDEs	Fit for purpose	Project specific local assessments have been considered when updating the model mesh to ensure sufficient discretisation in GDE areas. A GDE conceptualisation is provided in SLR (2026b).
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose.	The groundwater -surface water interactions are conceptualised as limited. Due to the surface water features being classified as ephemeral (SLR, 2026b), no long-term baseflow contribution from the groundwater is expected. Rather, surface water is expected to recharge the groundwater and that the alluvial aquifer is hydraulically disconnected from the riverbed.

Type	Part	Status	Comment
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose.	Several monitoring bores for the regional area are present in the Alluvium and Regolith and monitored regularly were used to inform saturated extent of alluvium locally at site and for calibration targets.
Parameterisation	Hydraulic Conductivity – Shallow layers	Fit for purpose	Spatial variability of hydraulic parameters in the Alluvium and Regolith has been incorporated in this model version by adding pilot points in both layer 1 and 2. This enhancement has allowed representing the heterogeneity in the alluvial system, improving the model's ability to replicate water level measurements in these units.
	Hydraulic Conductivity – Depth Dependence	Fit for purpose	Field testing of hydraulic conductivity (horizontal) has been conducted in the area. 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	No site-specific spoil data is available, as mining has not yet commenced and spoil materials are therefore not able to be measured. Spoil properties were adopted using previous studies.
	Rivers	Fit for purpose. Improvements possible.	Major rivers and creeks were represented using the RIV package with smoothed riverbed elevations. Stage data from regional gauging stations were adjusted to reflect the seasonal nature of the Isaac River. Local stage data collection would improve future assessments.
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and regional site conceptualisation
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	Publicly available private bore data were incorporated in the model calibration across the model domain.
	Temporal spread	Fit for purpose. Future improvements possible.	Timeseries water level data with varying resolution has been used in the model calibration.

Type	Part	Status	Comment
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose. Future improvement possible.	A transient calibration model was run and calibrated to observed groundwater levels using sequential Monte Carlo analysis. The model calibration could be further refined as more data is collected in the Project area and surrounds.
	Predictive	Fit for purpose.	Model captures open cut mining progression and timing at the Project based on data provided by Stanmore. The surrounding mines' plans have been included based on the data sharing agreement (i.e. most recent mine plans).
	Sensitivity Analysis	Fit for purpose.	A global sensitivity analysis was used to assess model sensitivity to both calibration and predictions. While most parameters are Type I to III, it highlighted several parameters that contribute to predictive uncertainty and that are likely to be poorly conditioned by the calibration process (Type IV).
	Uncertainty Analysis	Fit for purpose.	A Type 3 Monte Carlo uncertainty analysis was undertaken to estimate the uncertainty in the future impacts predicted by the model. While most parameters are Type I to III, some Type IV parameters were identified as part of the sensitivity analysis were included in the uncertainty analysis.

5.0 References

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Appendix A Calibration Hydrographs

Isaac Downs Extension Project

Groundwater Modelling Calibration and Prediction Report

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00006

29 May 2026

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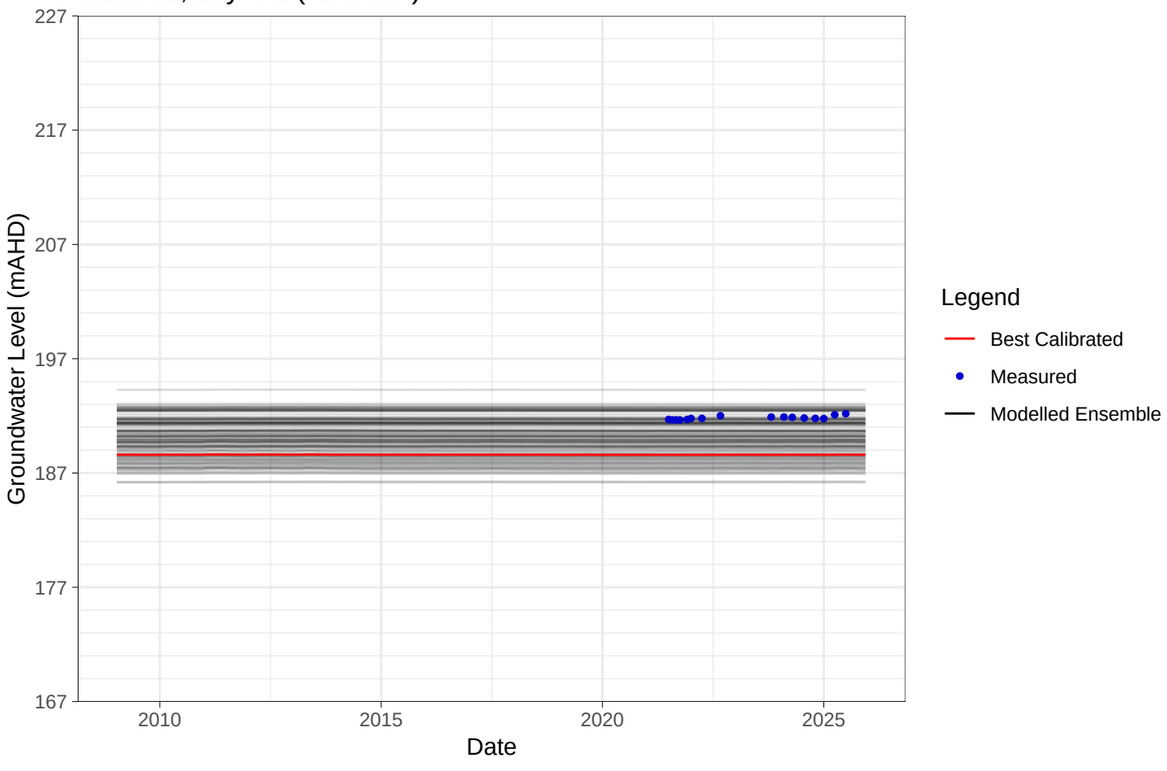

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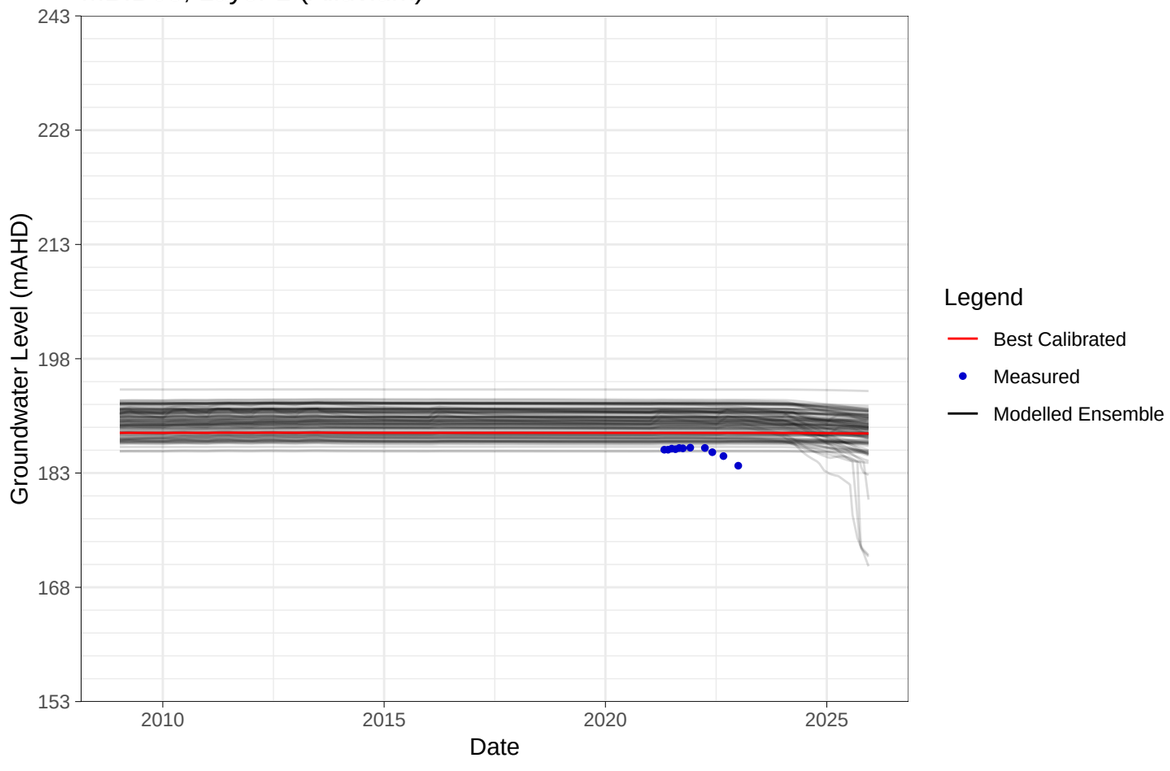

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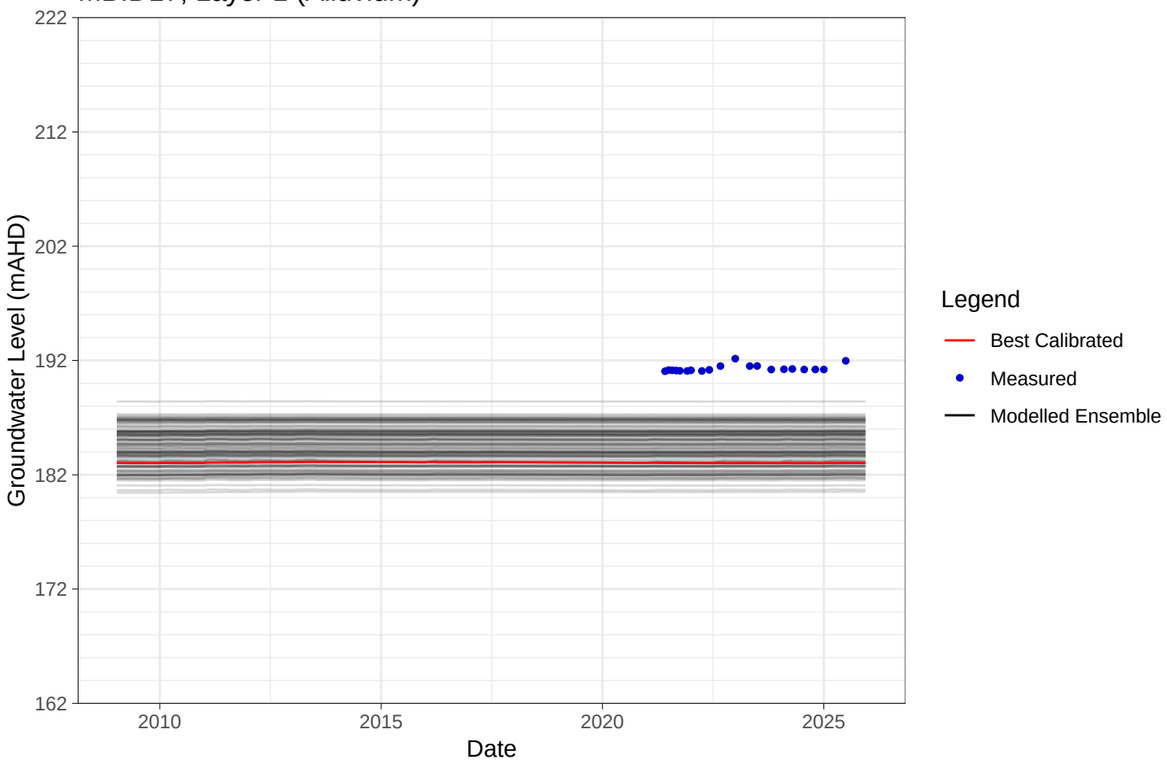

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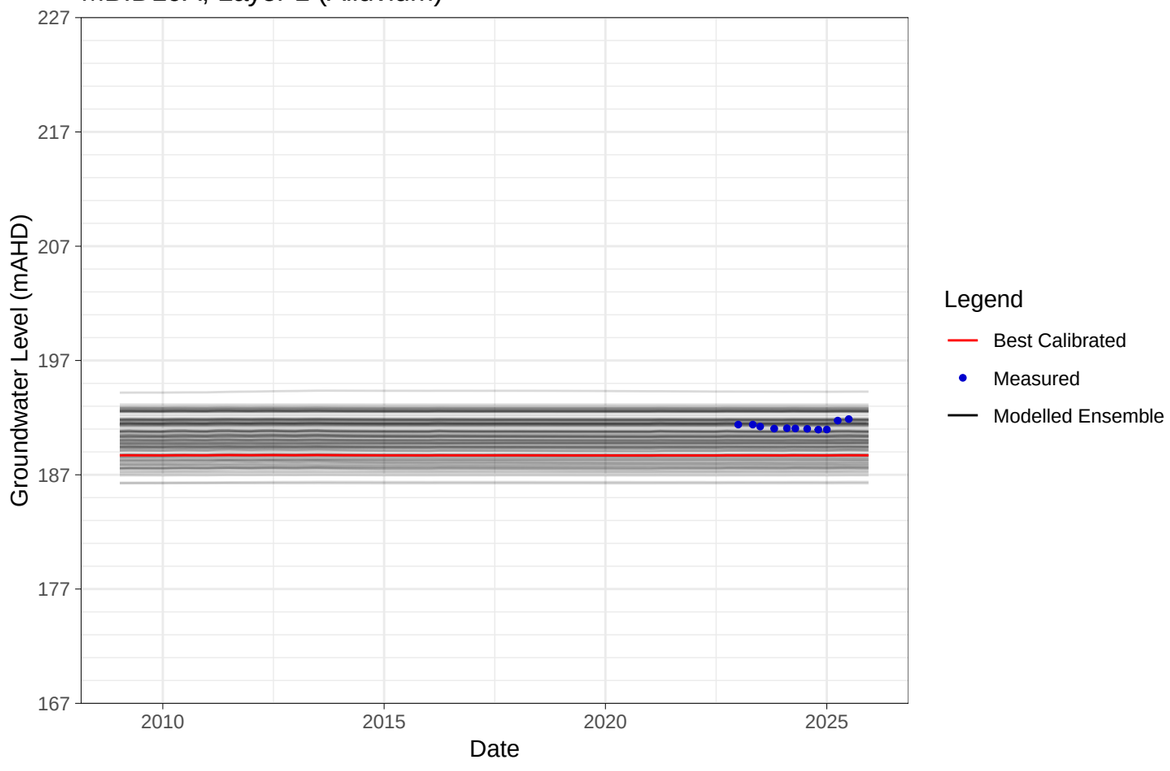

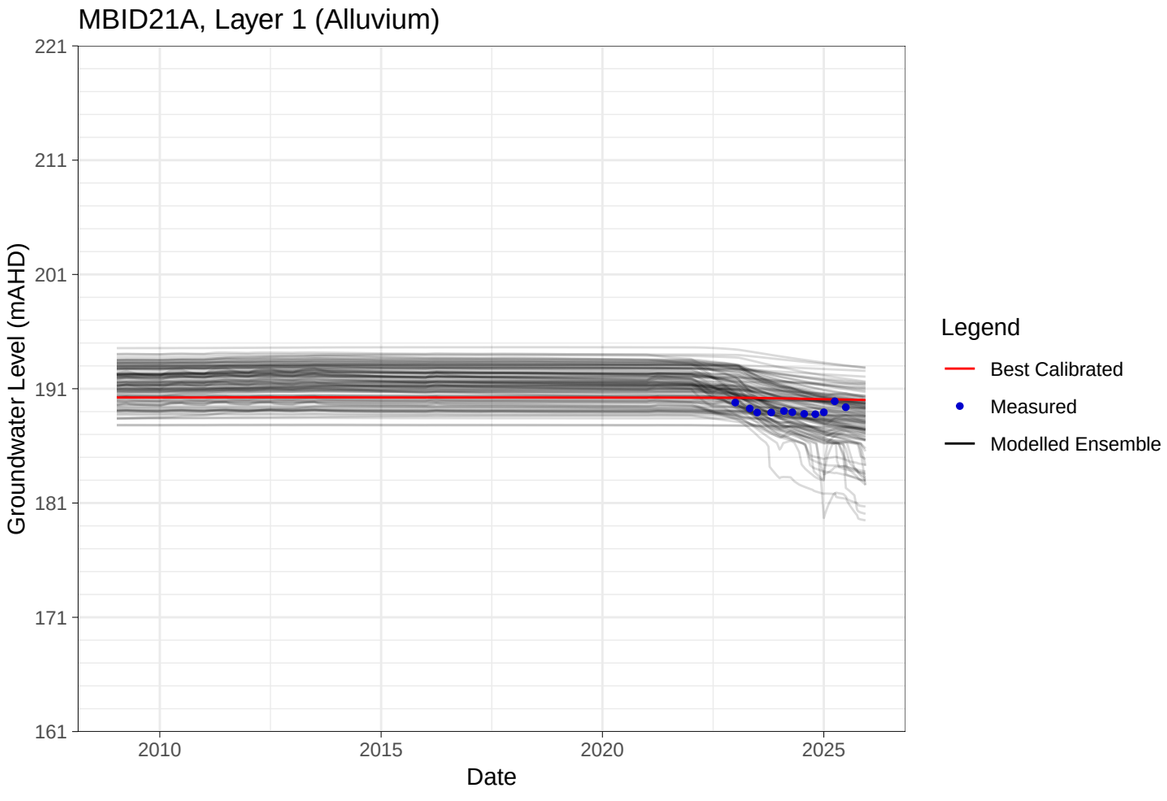
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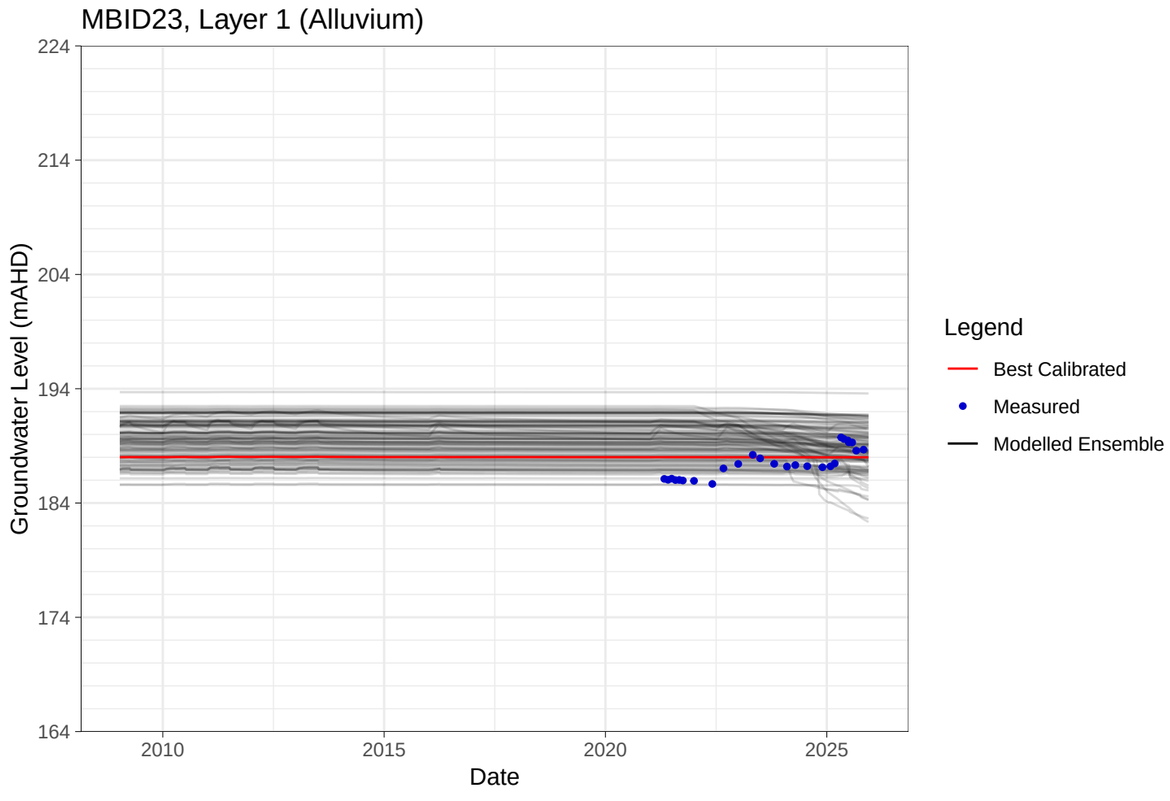
201
191
181
171
161
2010
2015
2020
2025
Date
Legend
Best Calibrated
Measured
Modelled Ensemble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2015
2020
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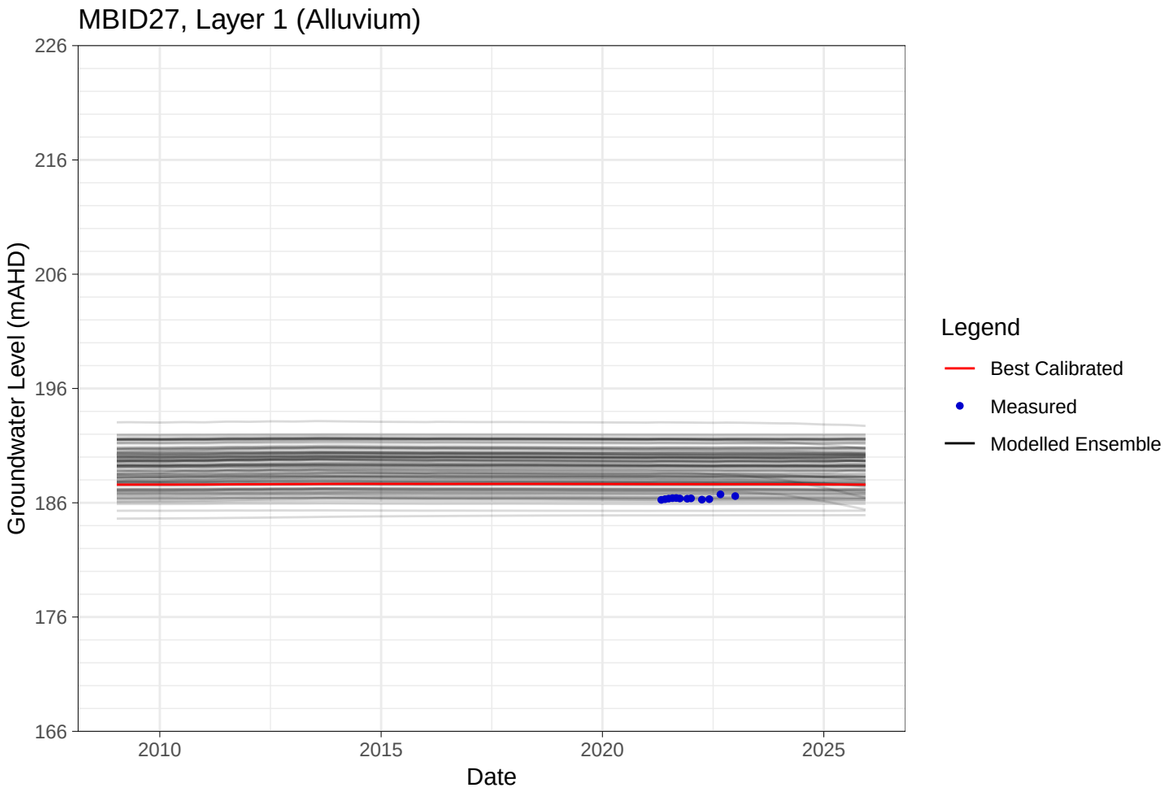
Date
Legend
Best Calibrated
Measured
Modelled Ensemble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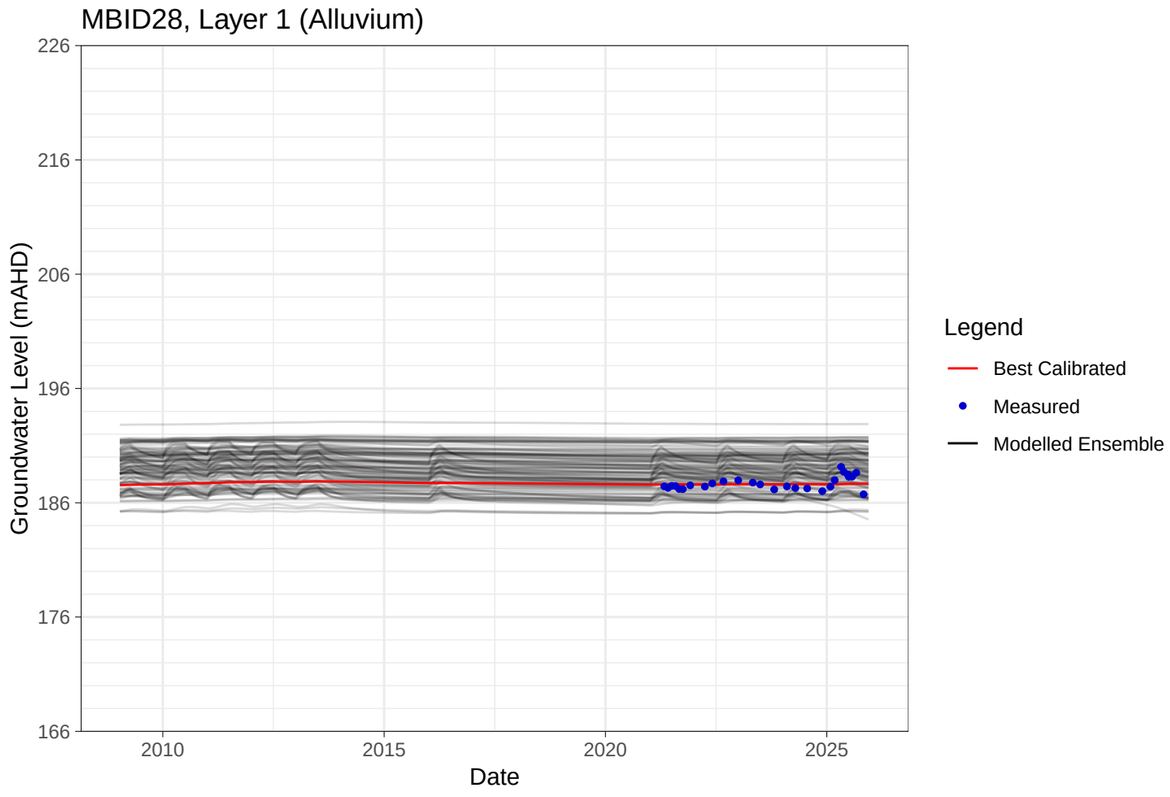
Modelled Ensemble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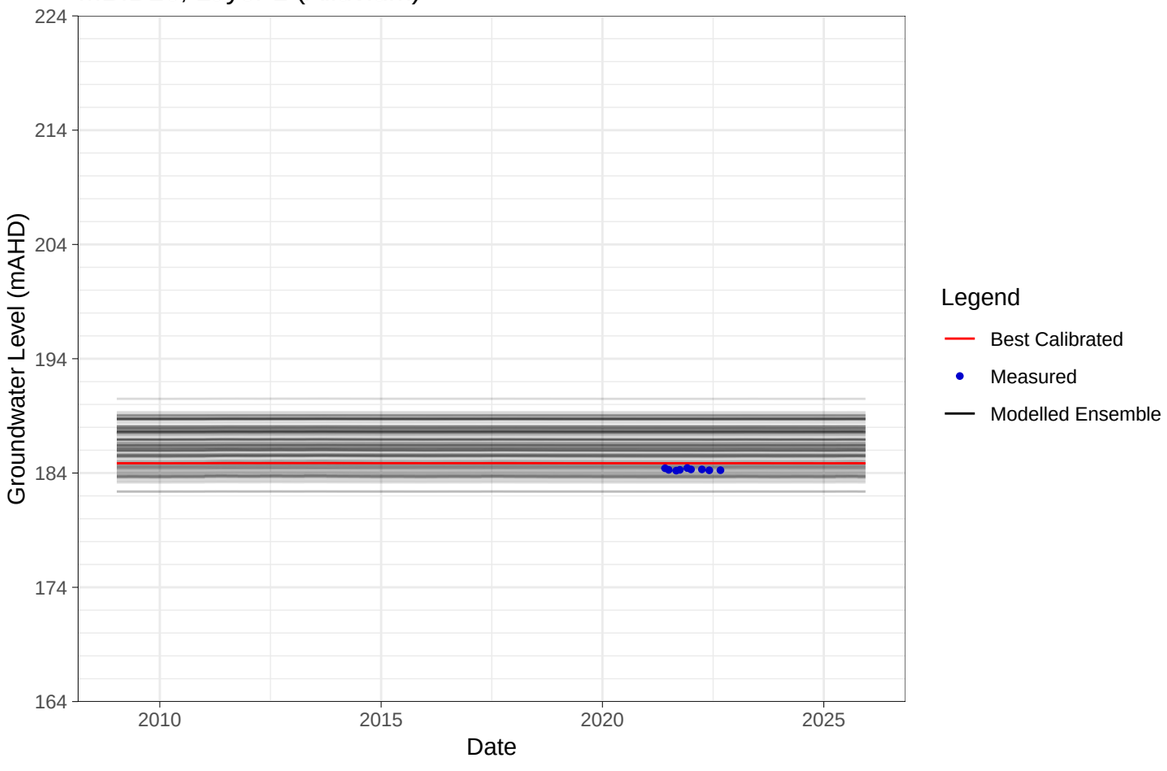

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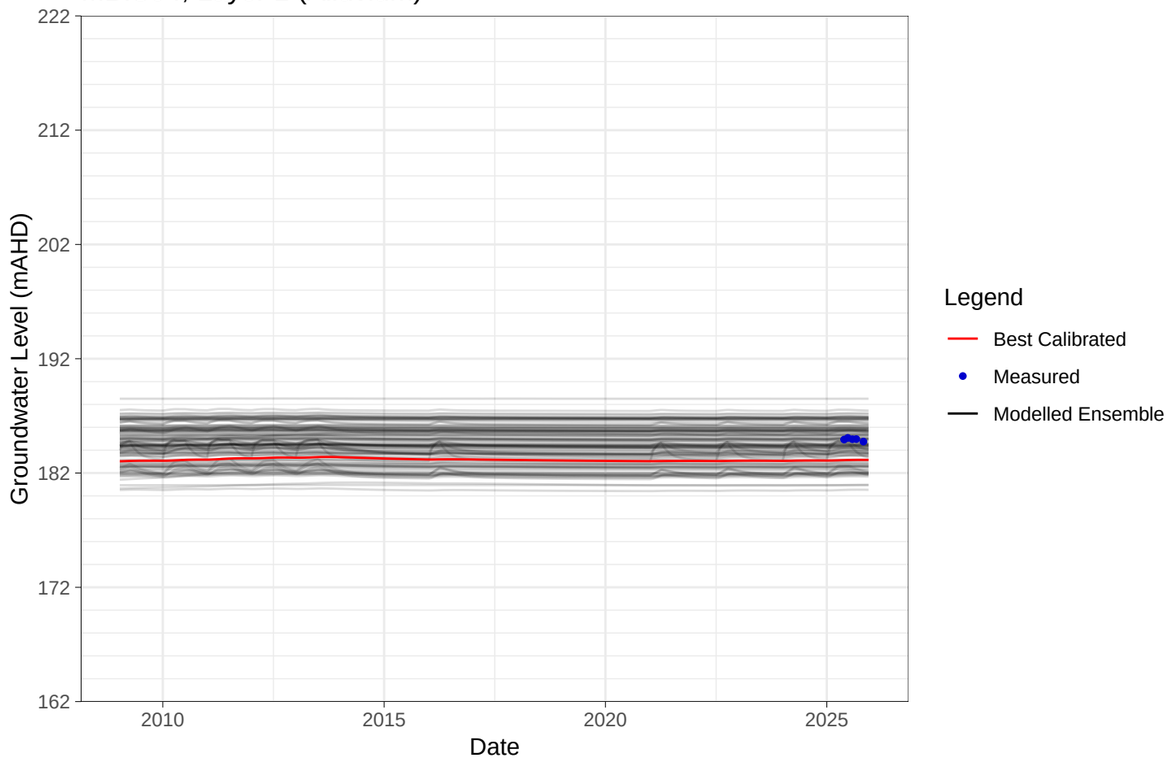

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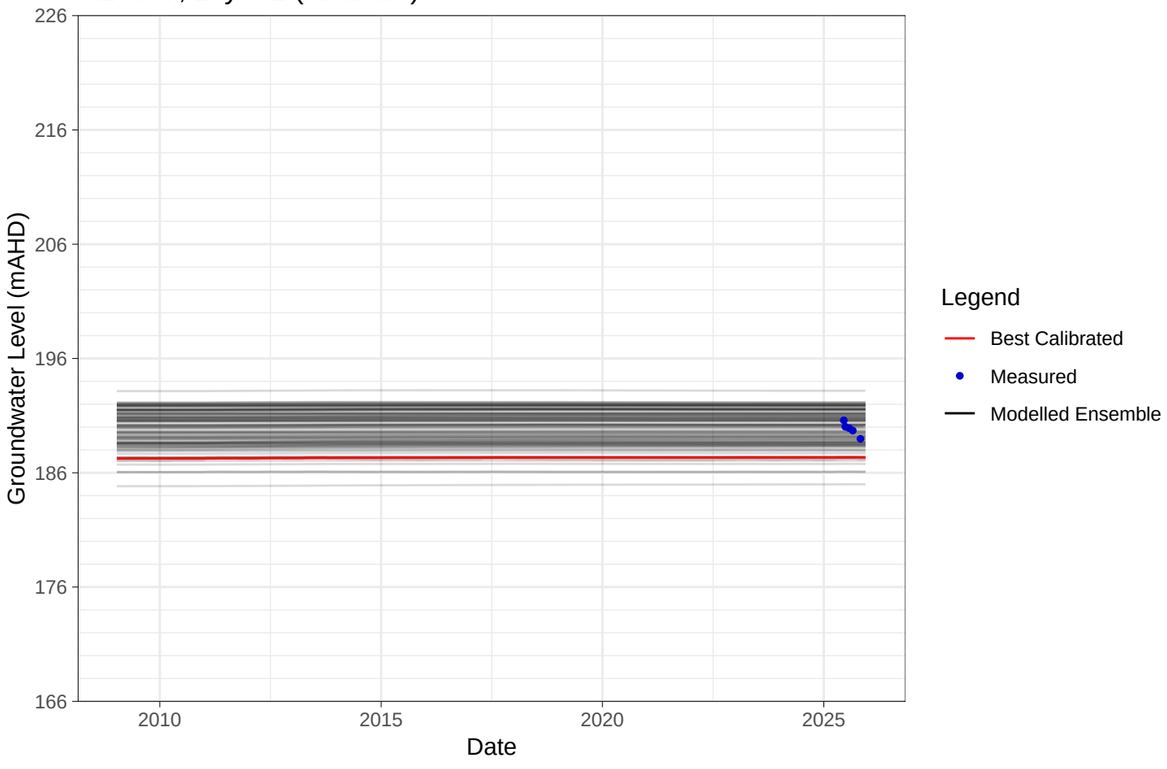

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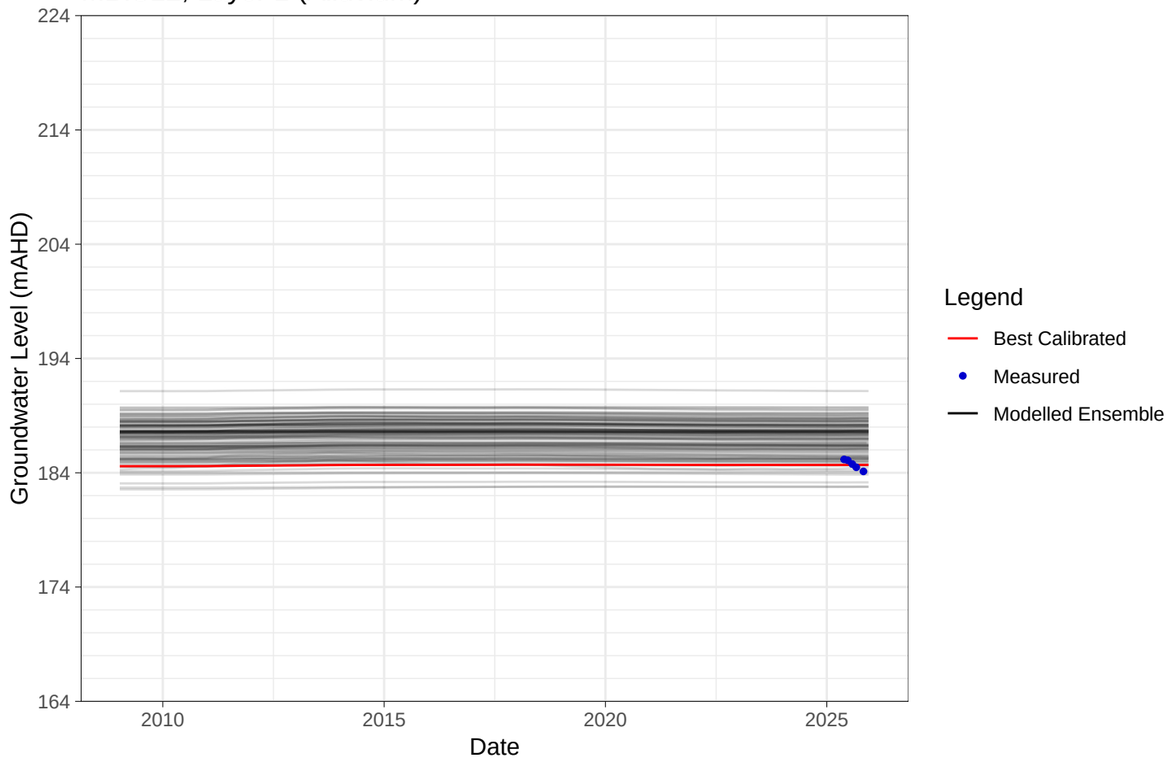

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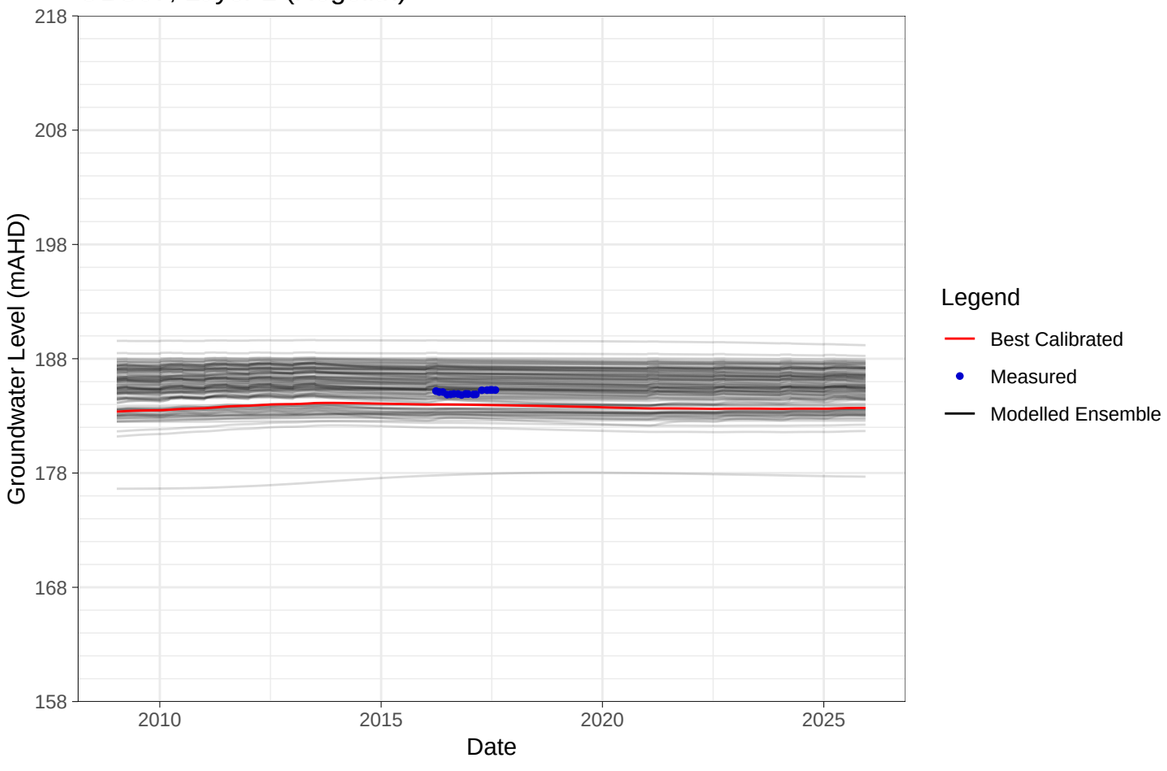

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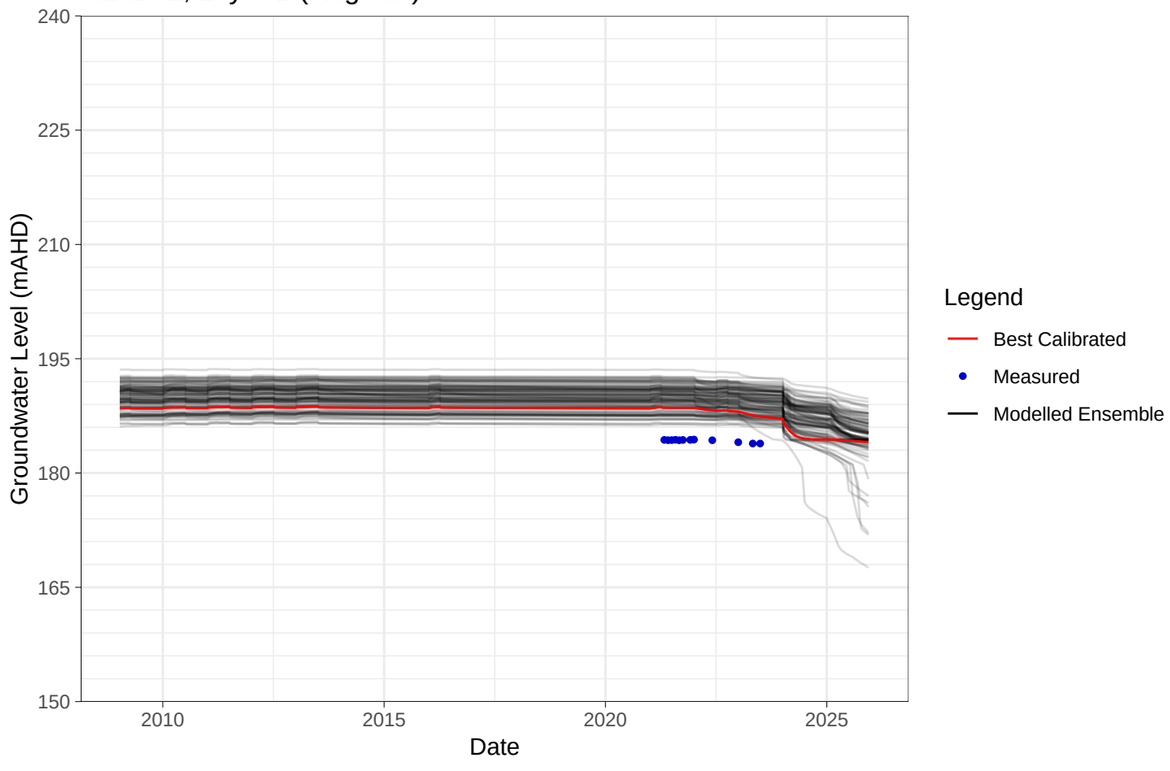

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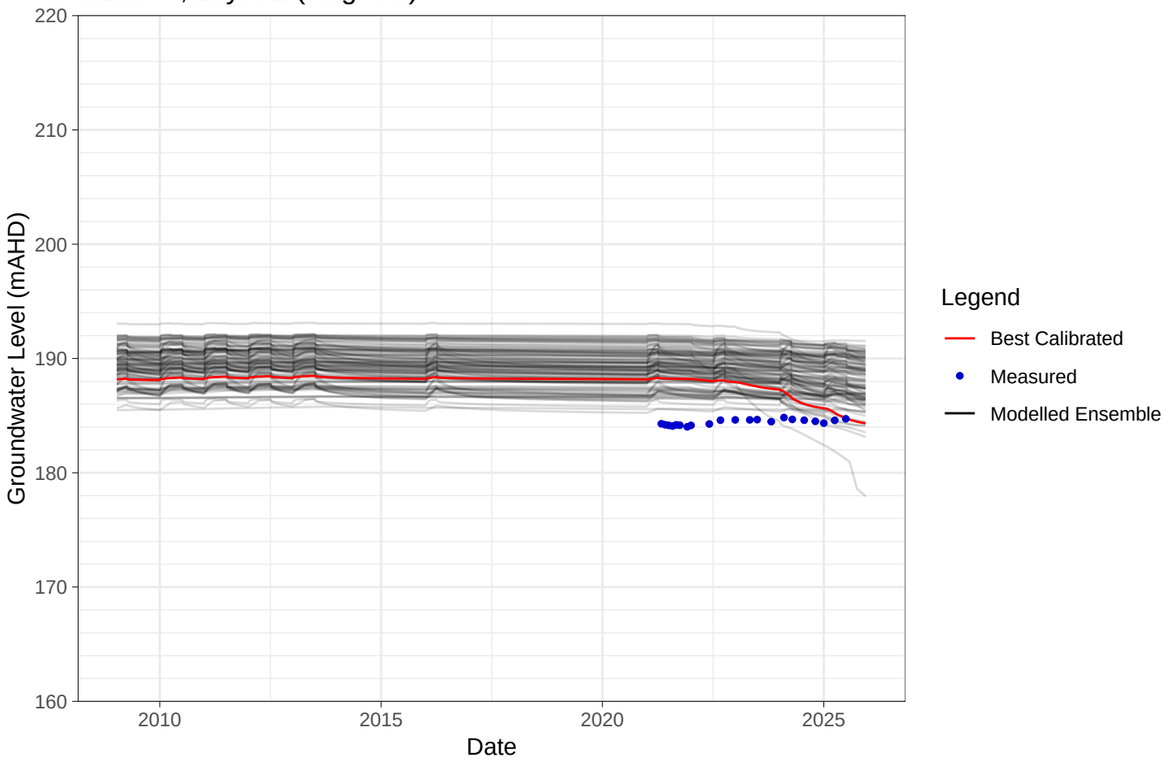

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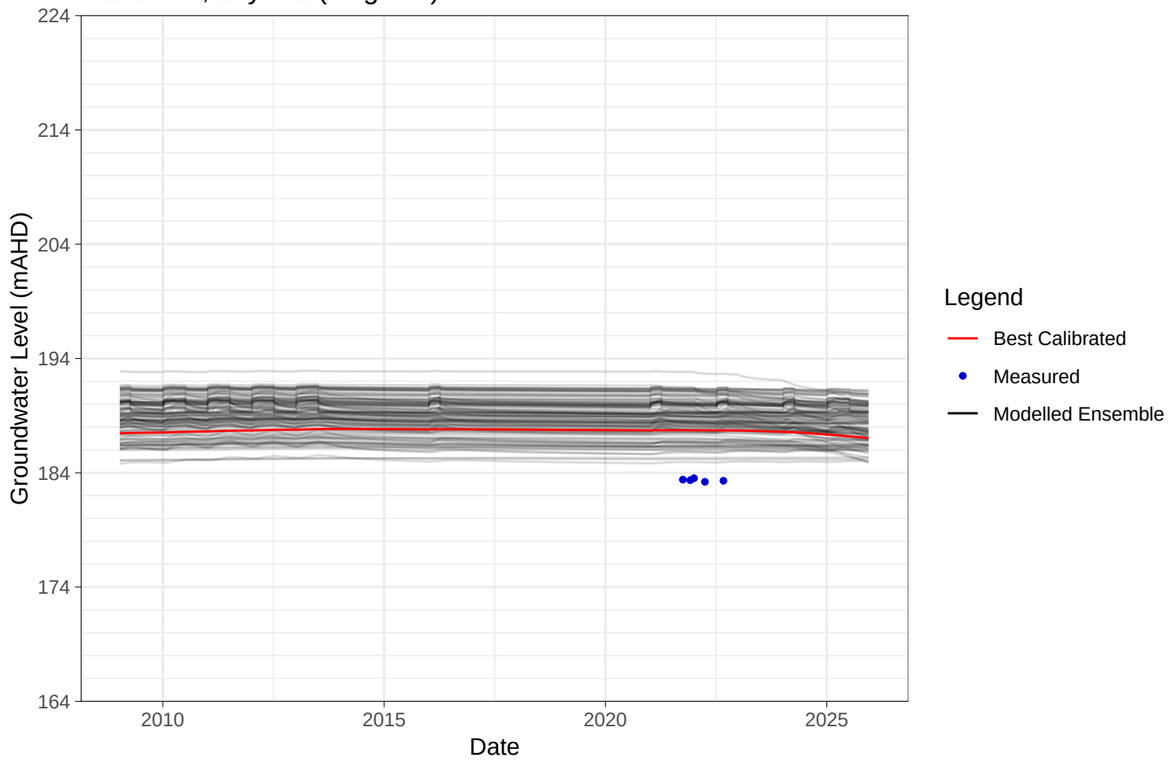

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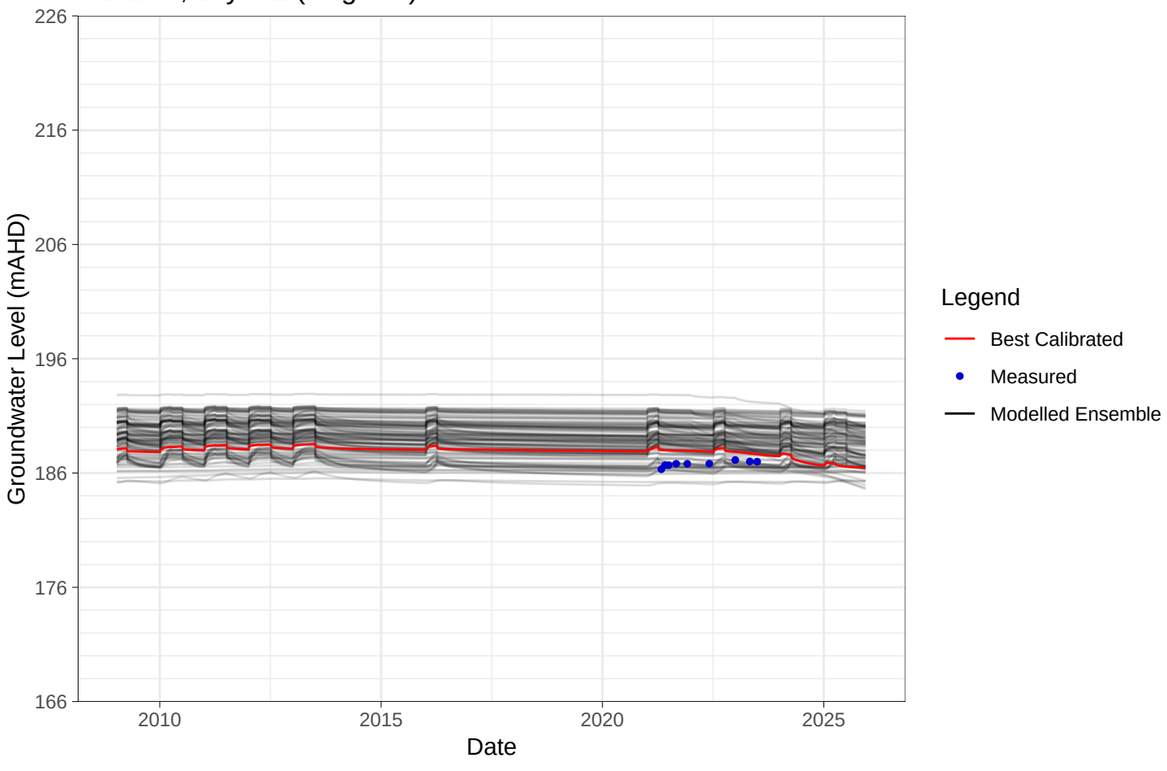

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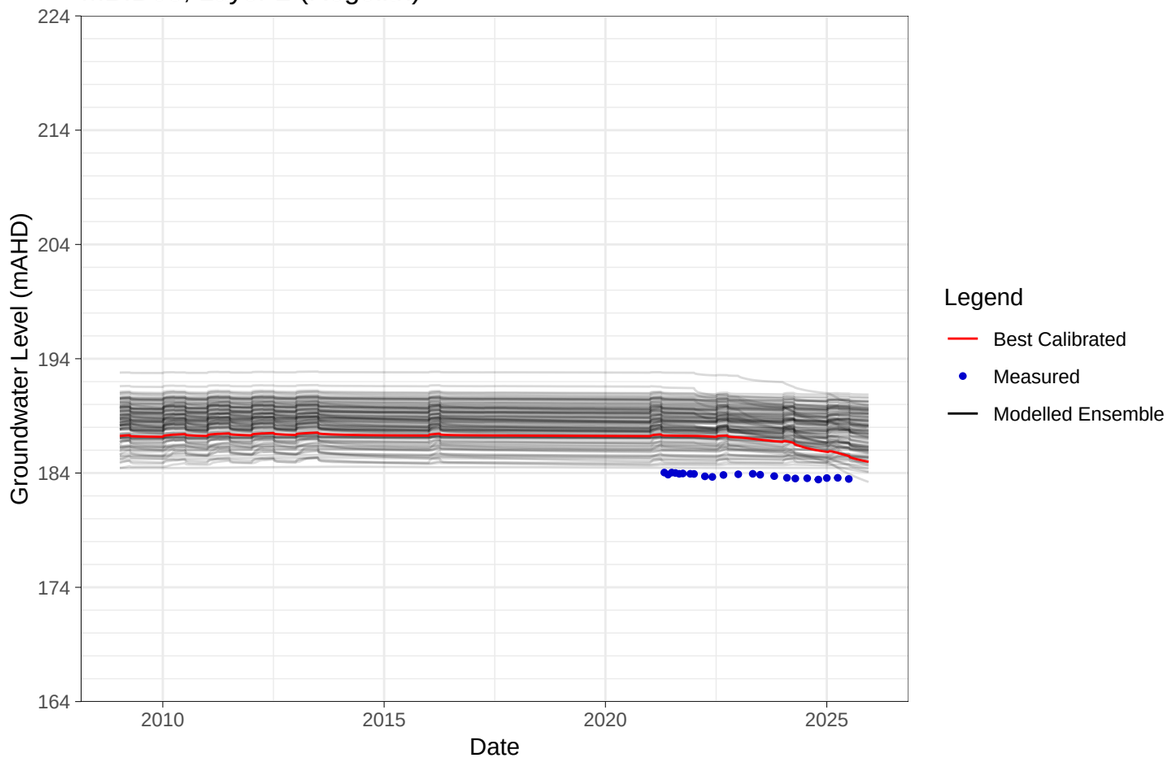

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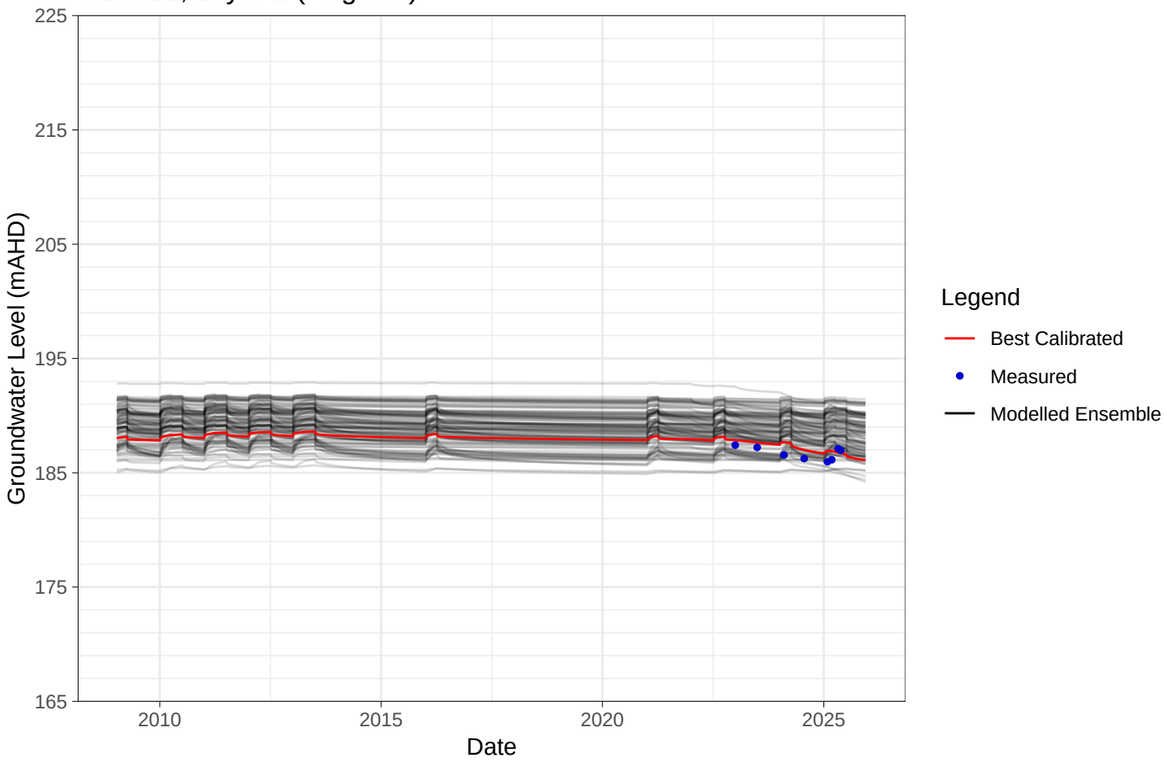

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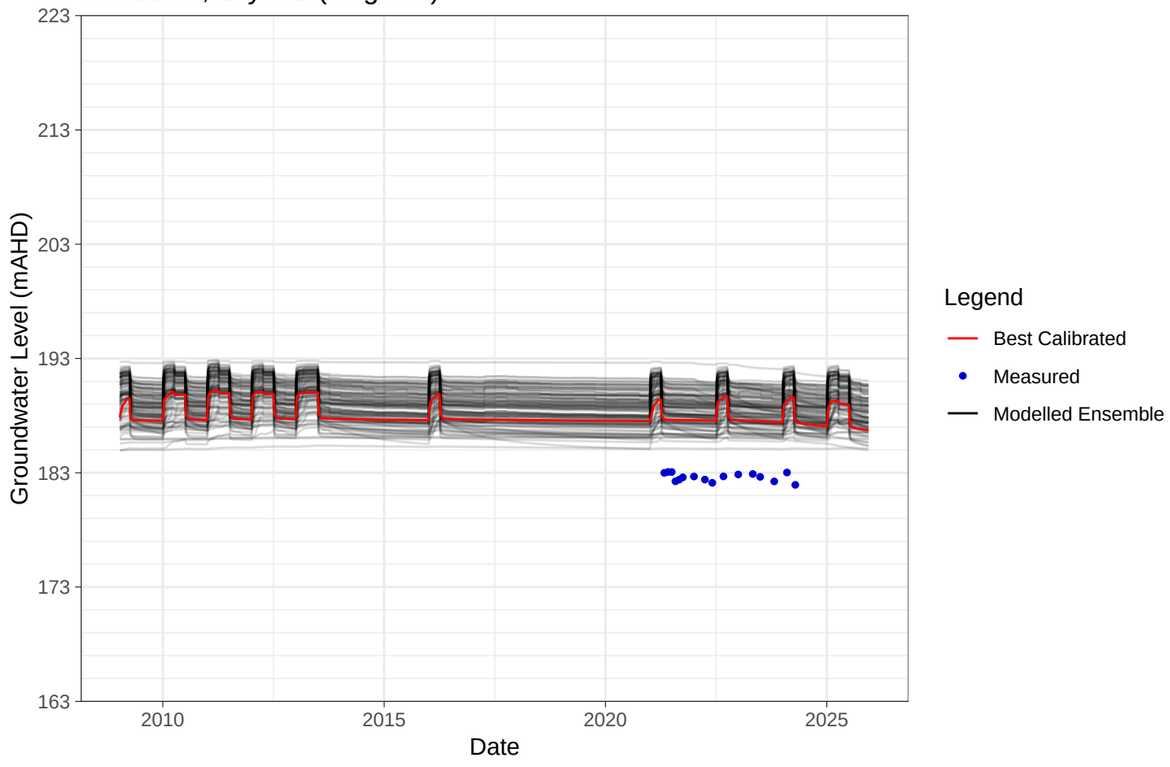

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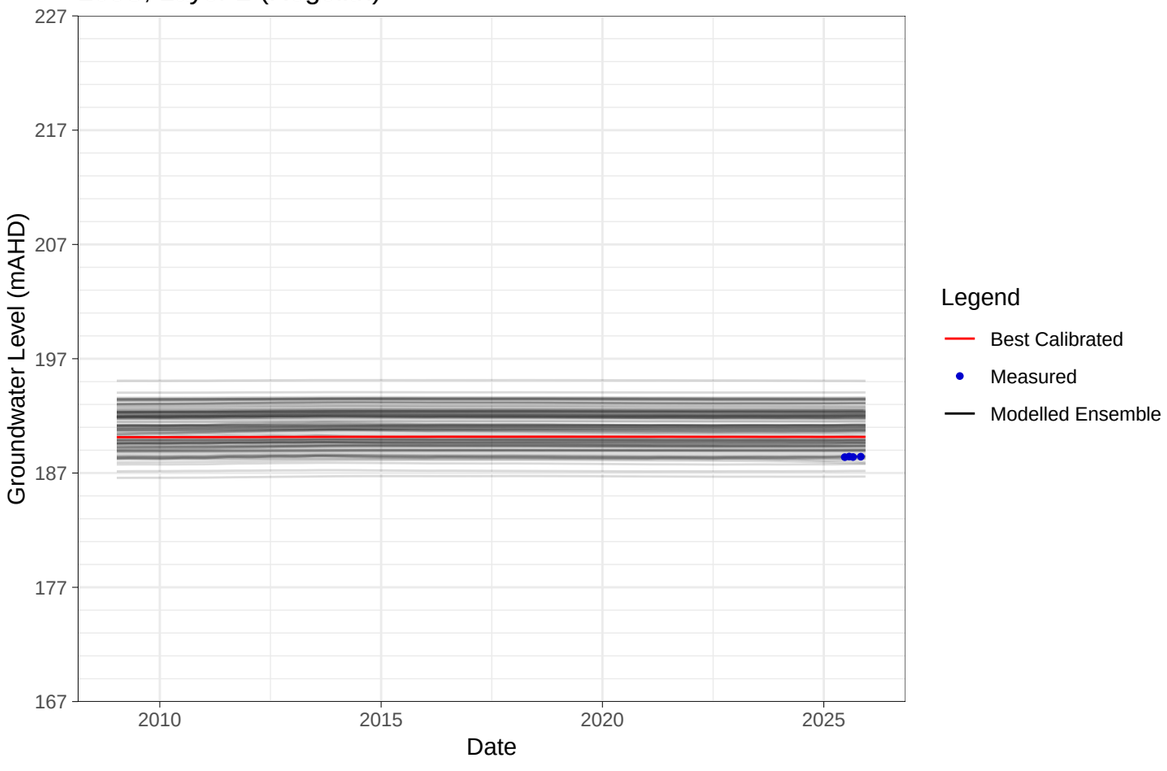

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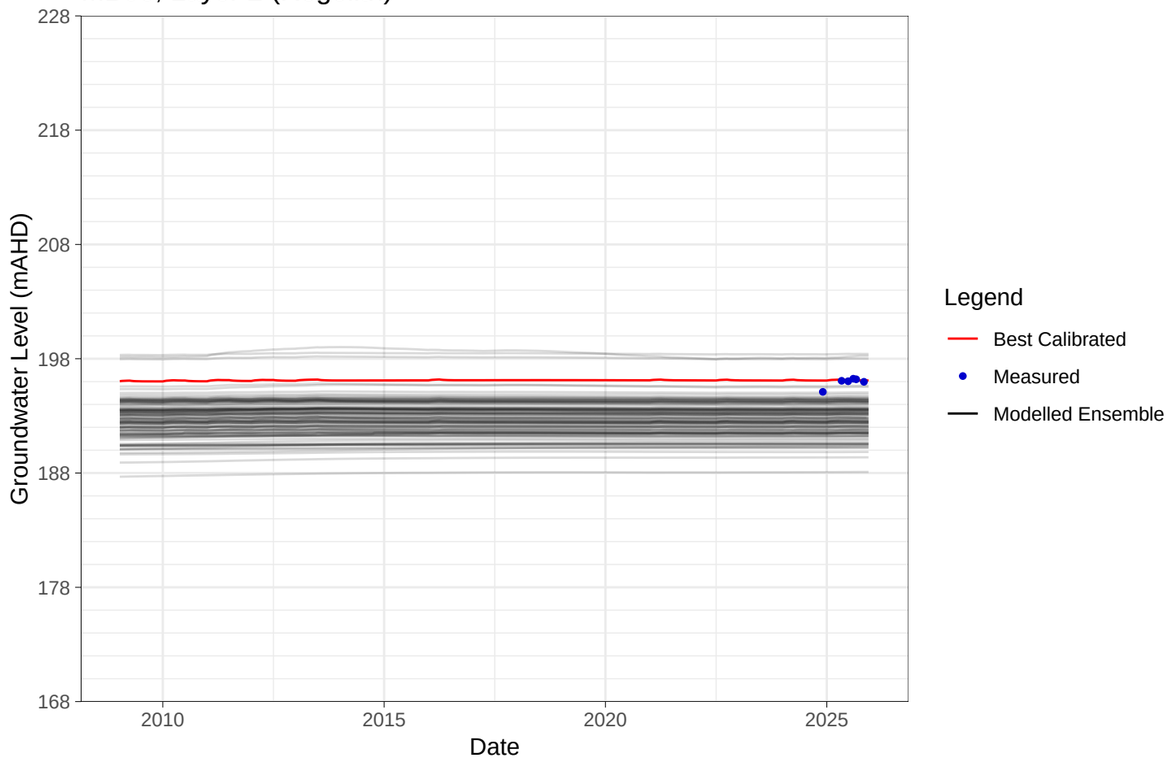

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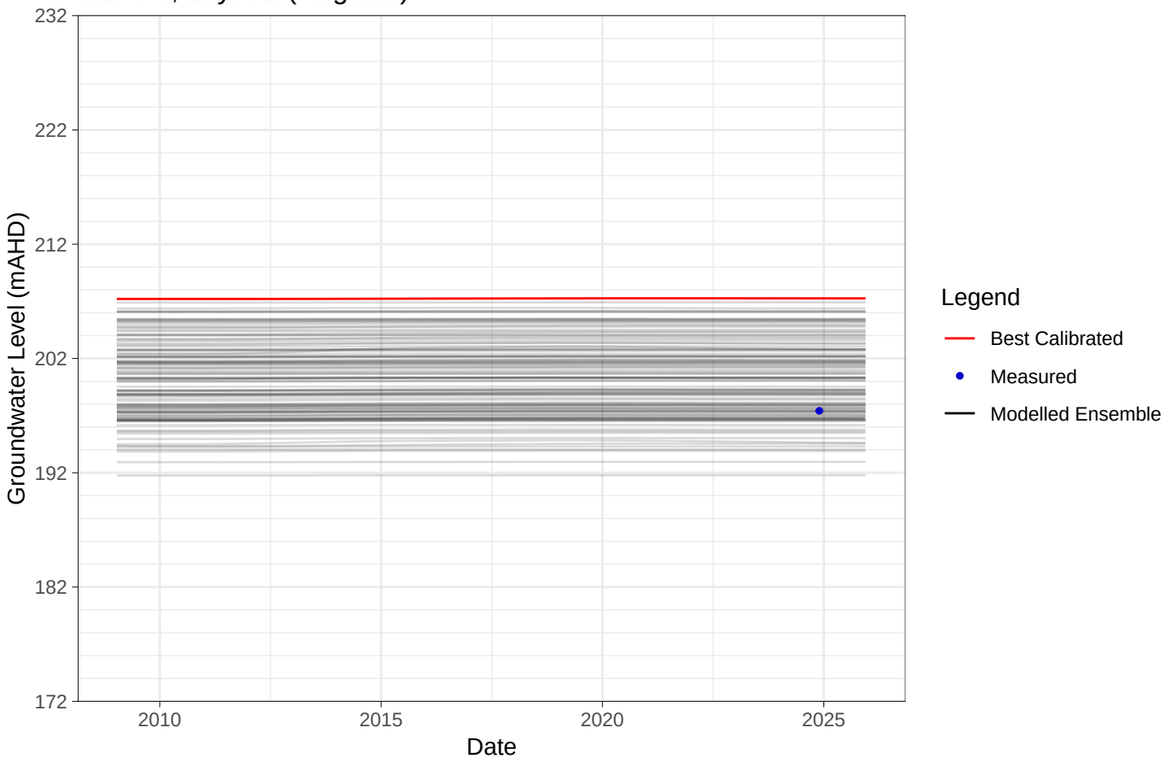

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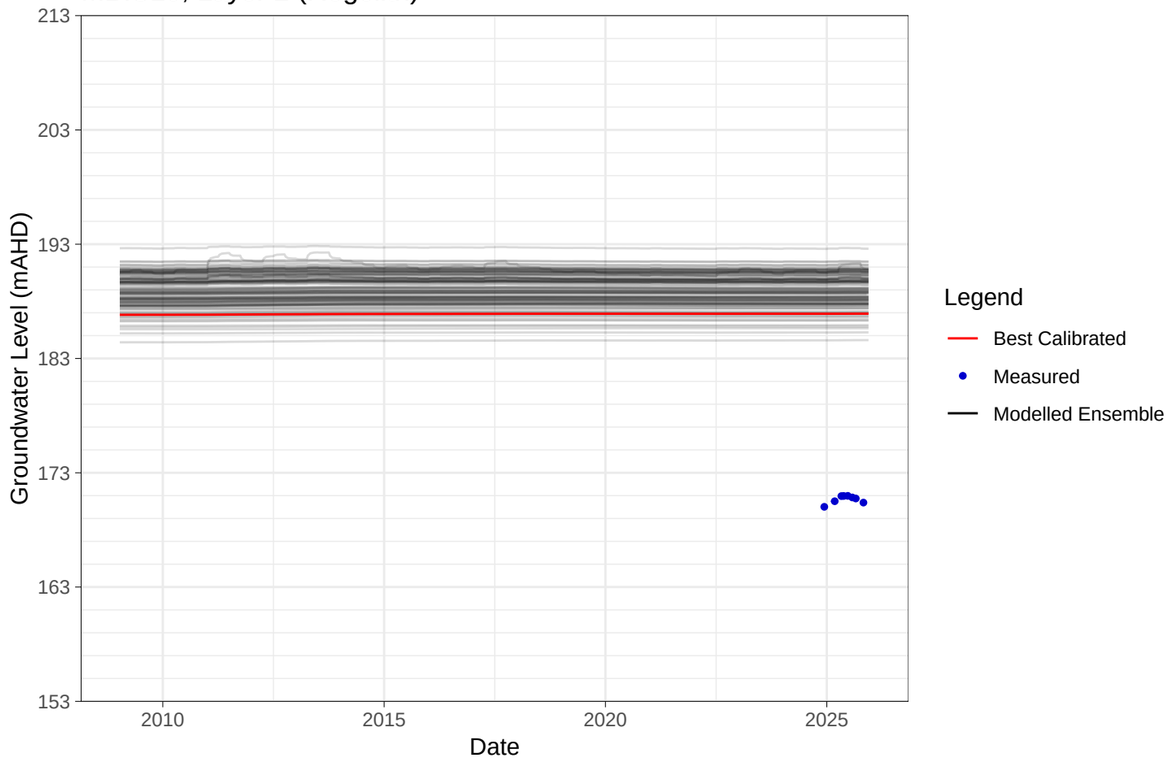

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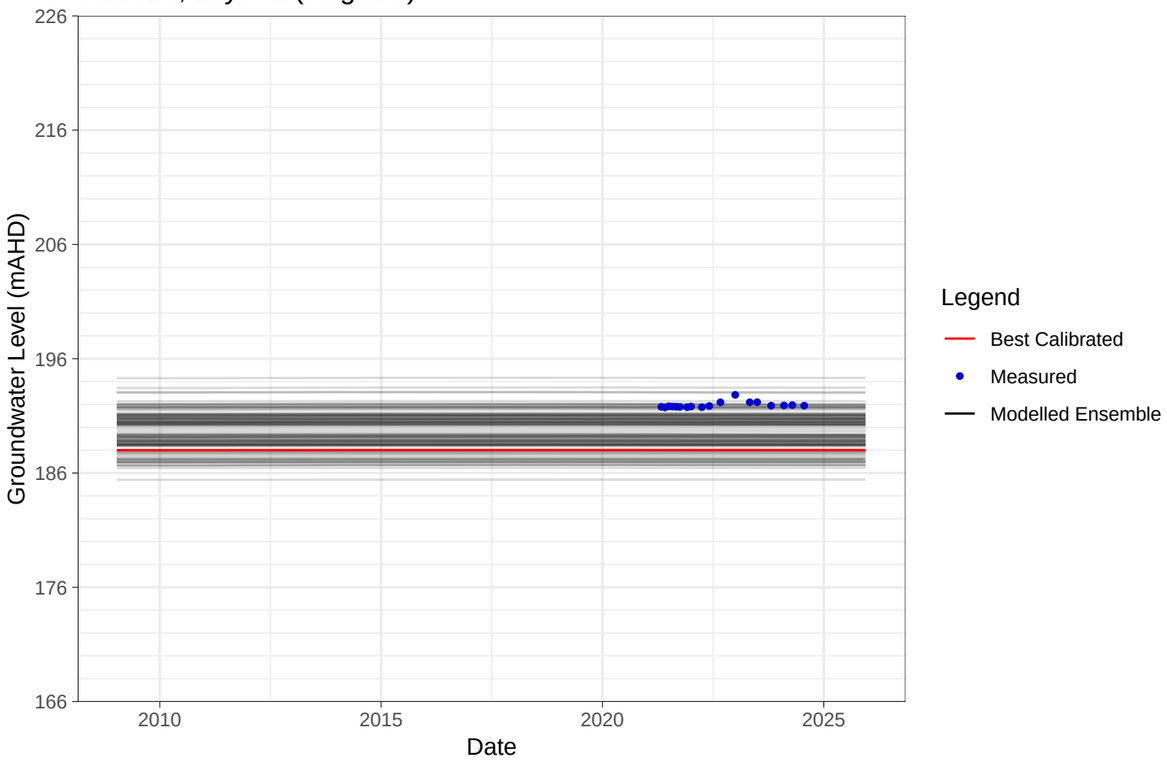

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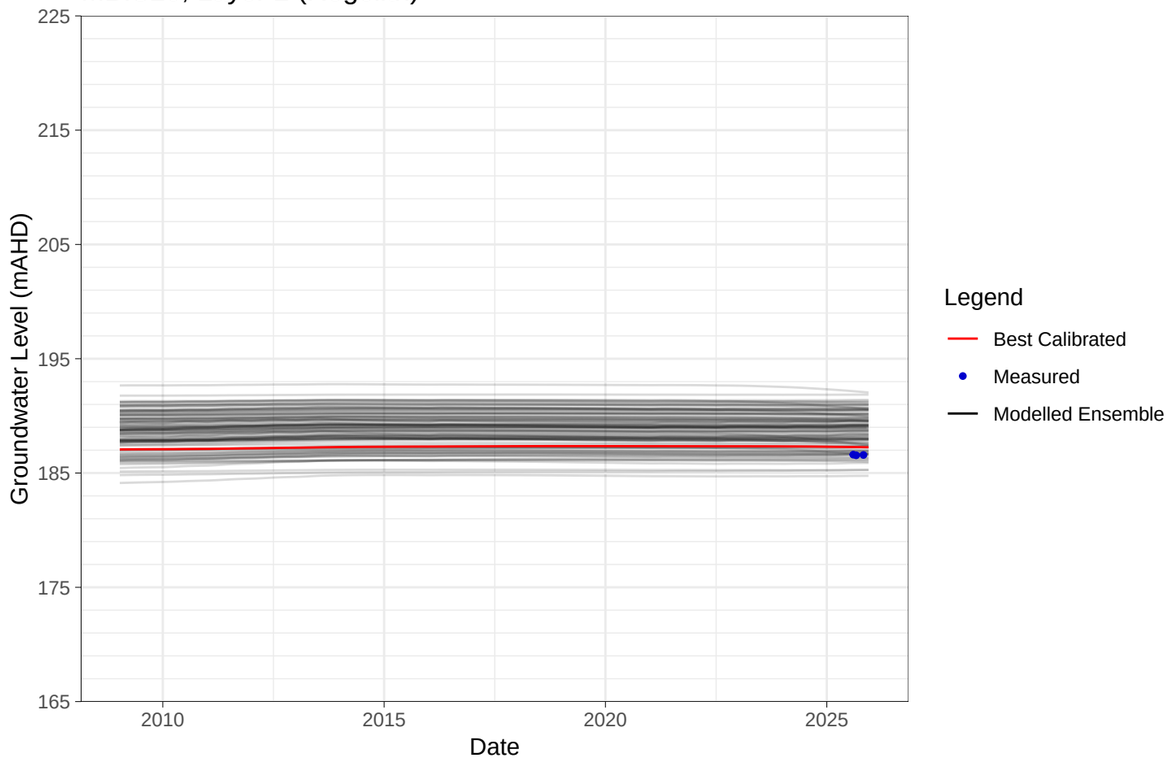

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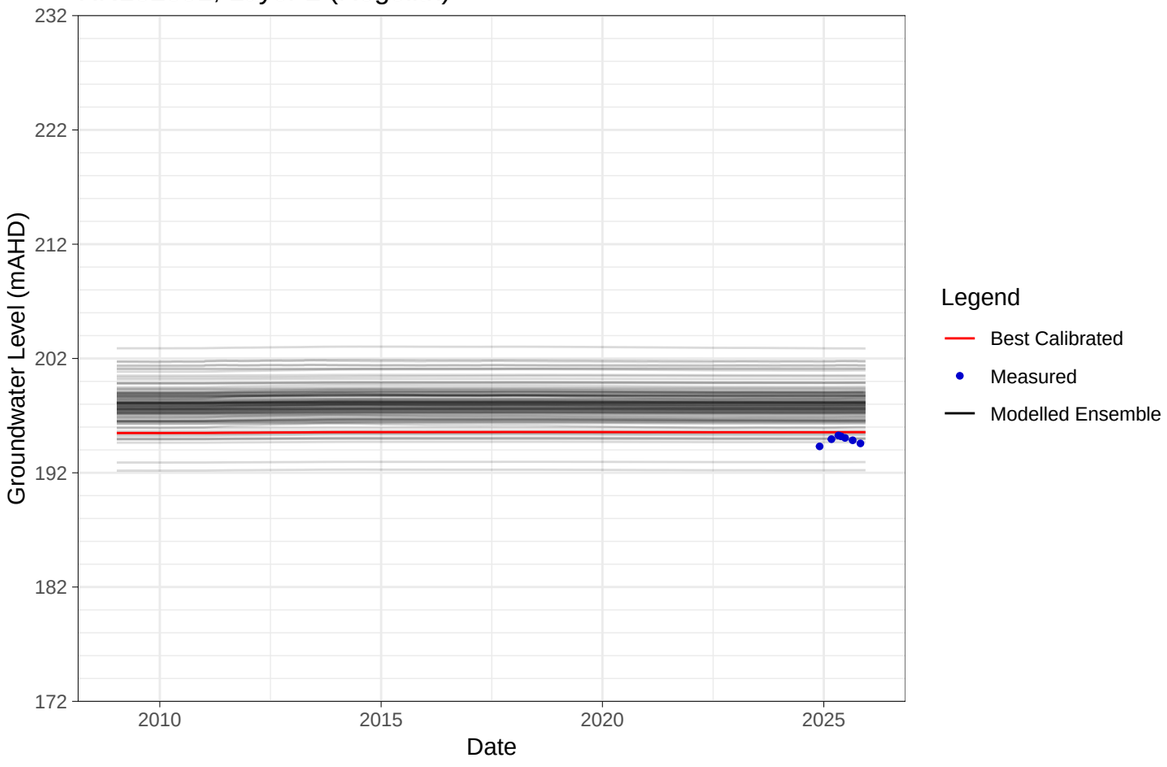

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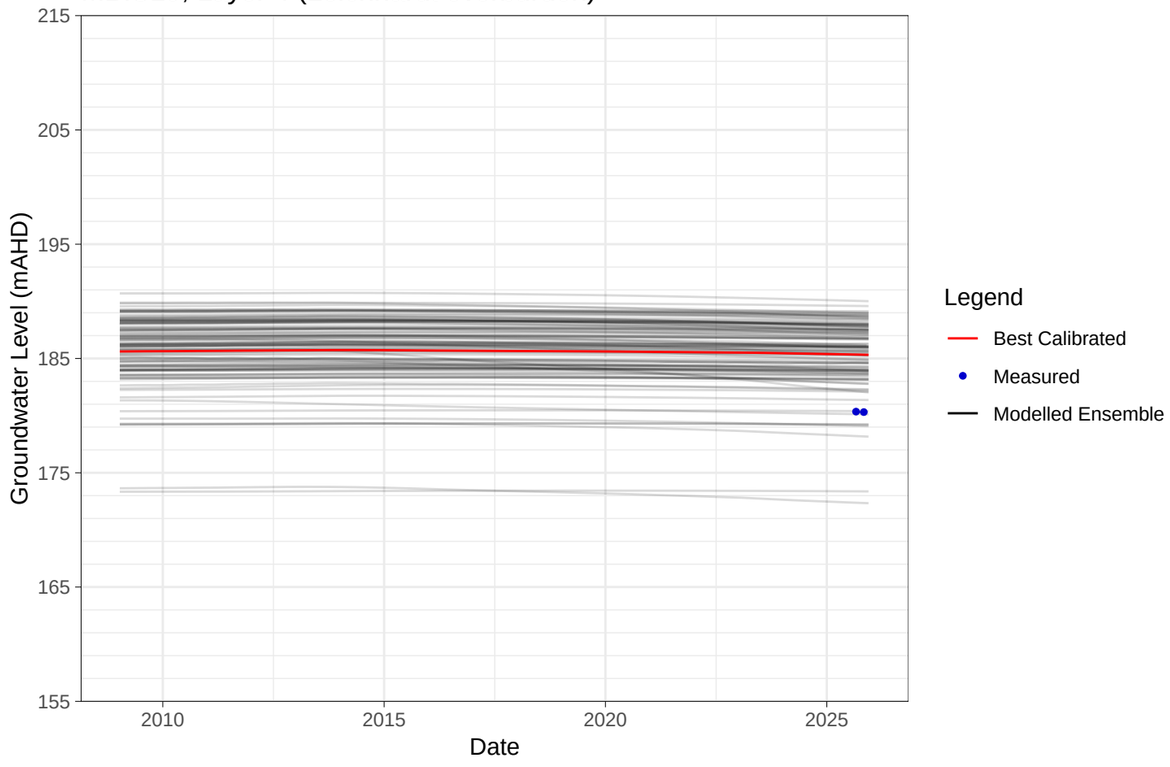
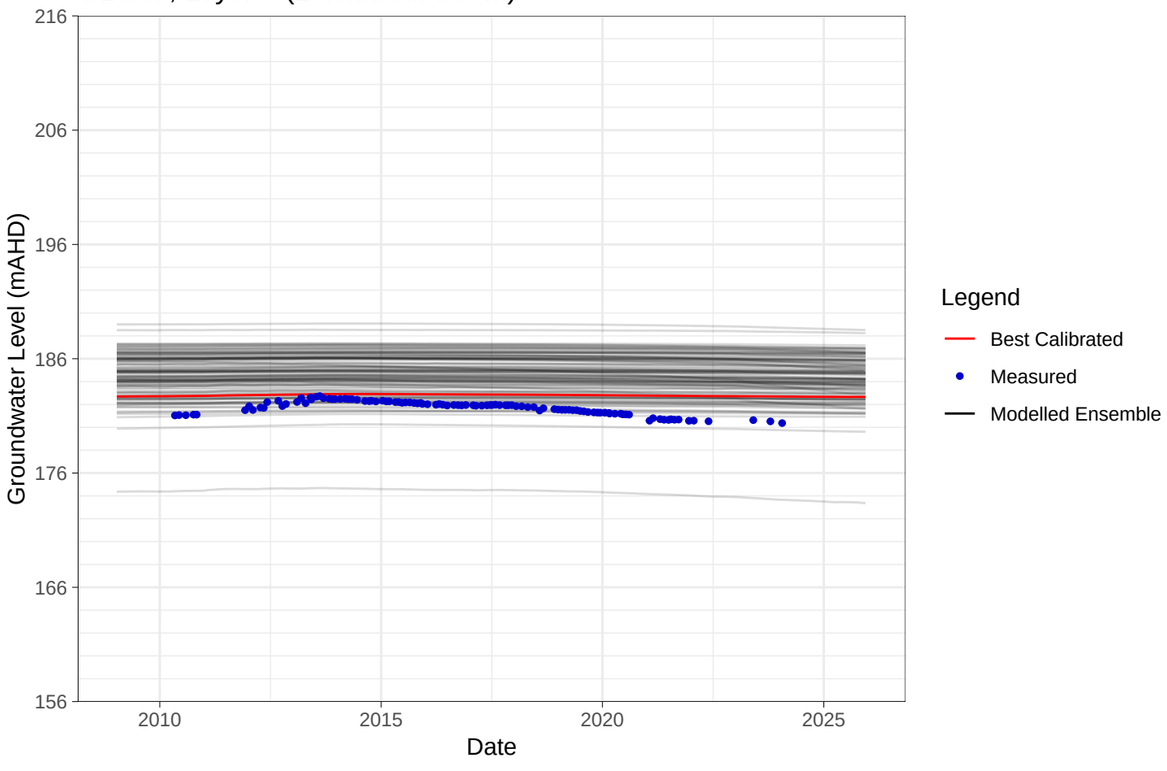
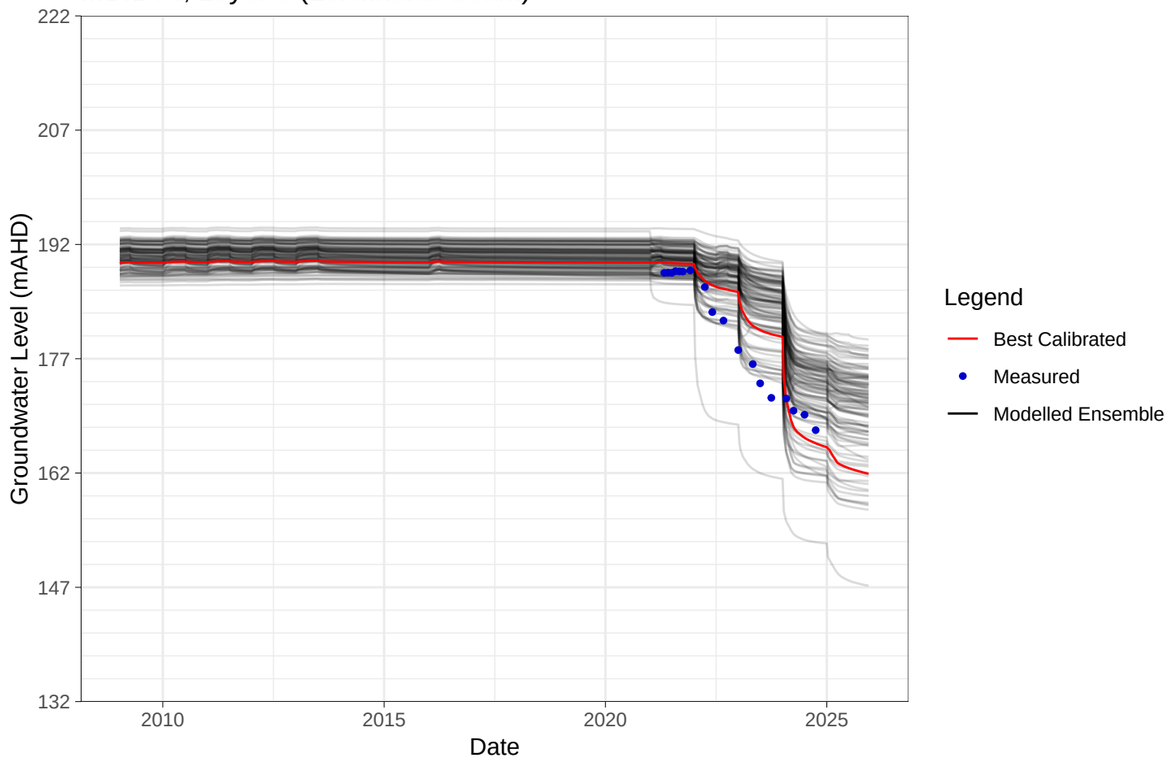


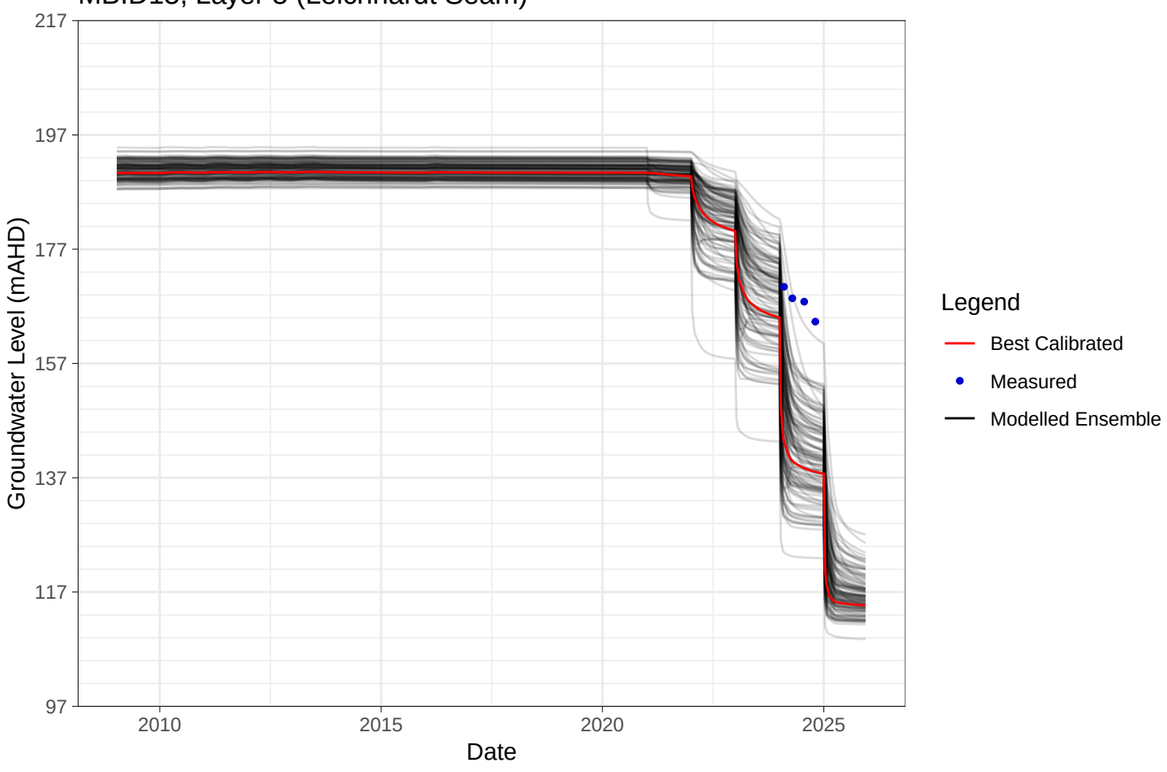
OBS05, Layer 5 (Leichhardt Seam)



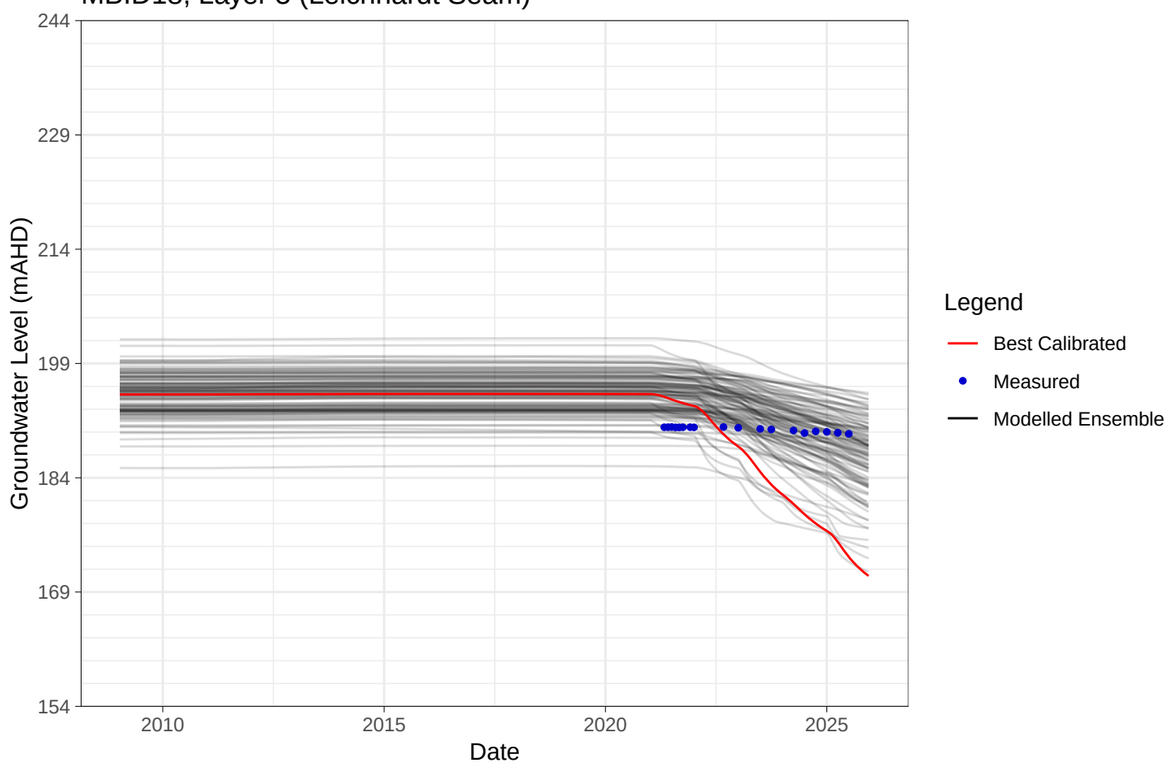
MBID04, Layer 5 (Leichhardt Seam)



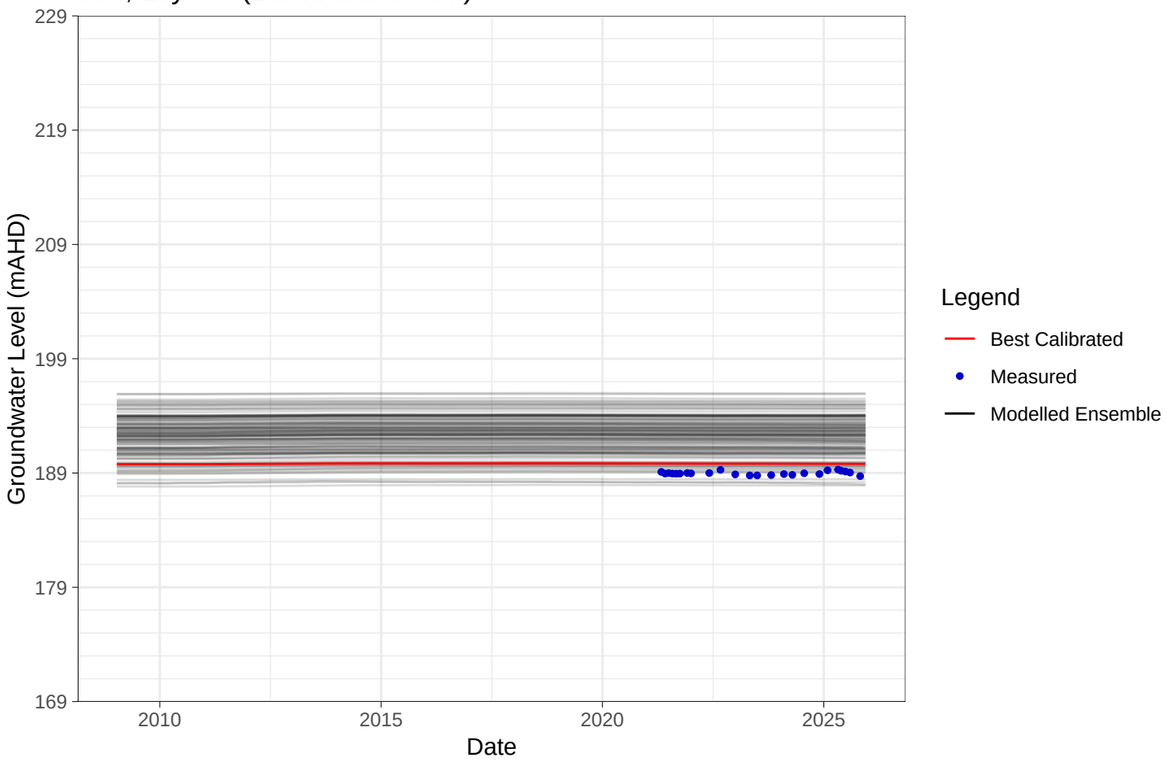
MBID15, Layer 5 (Leichhardt Seam)



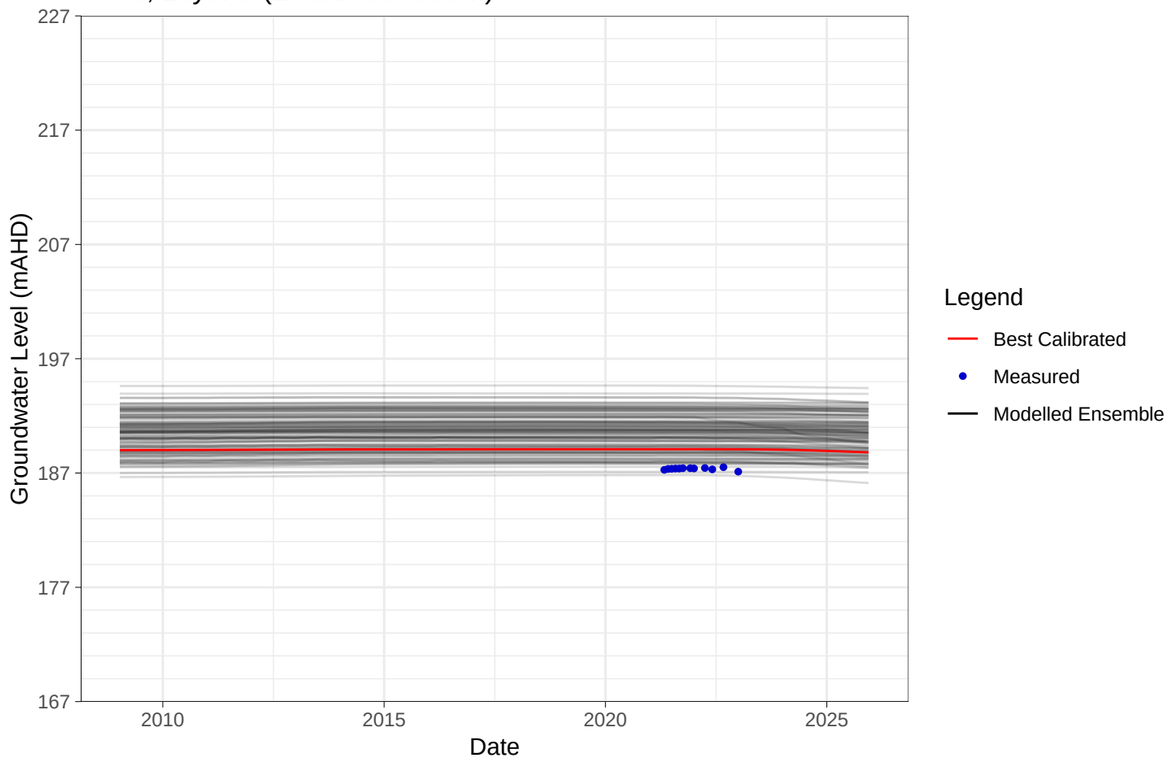
MBID18, Layer 5 (Leichhardt Seam)



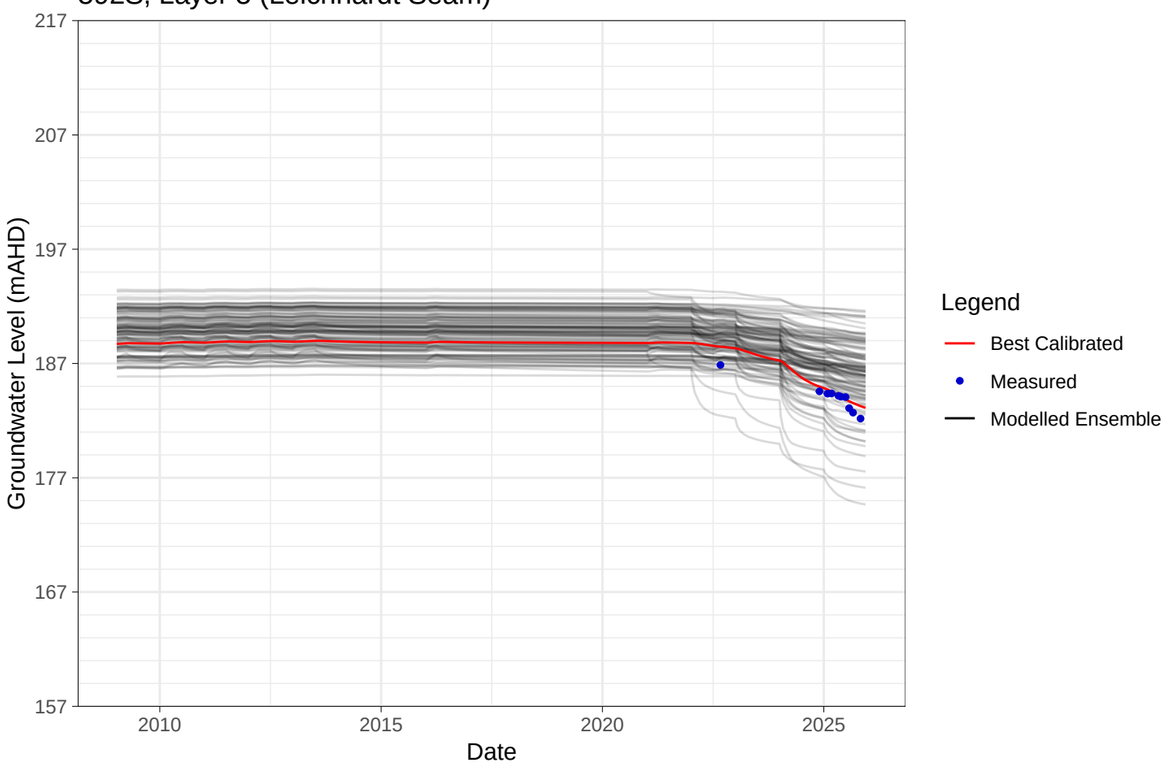
594, Layer 5 (Leichhardt Seam)



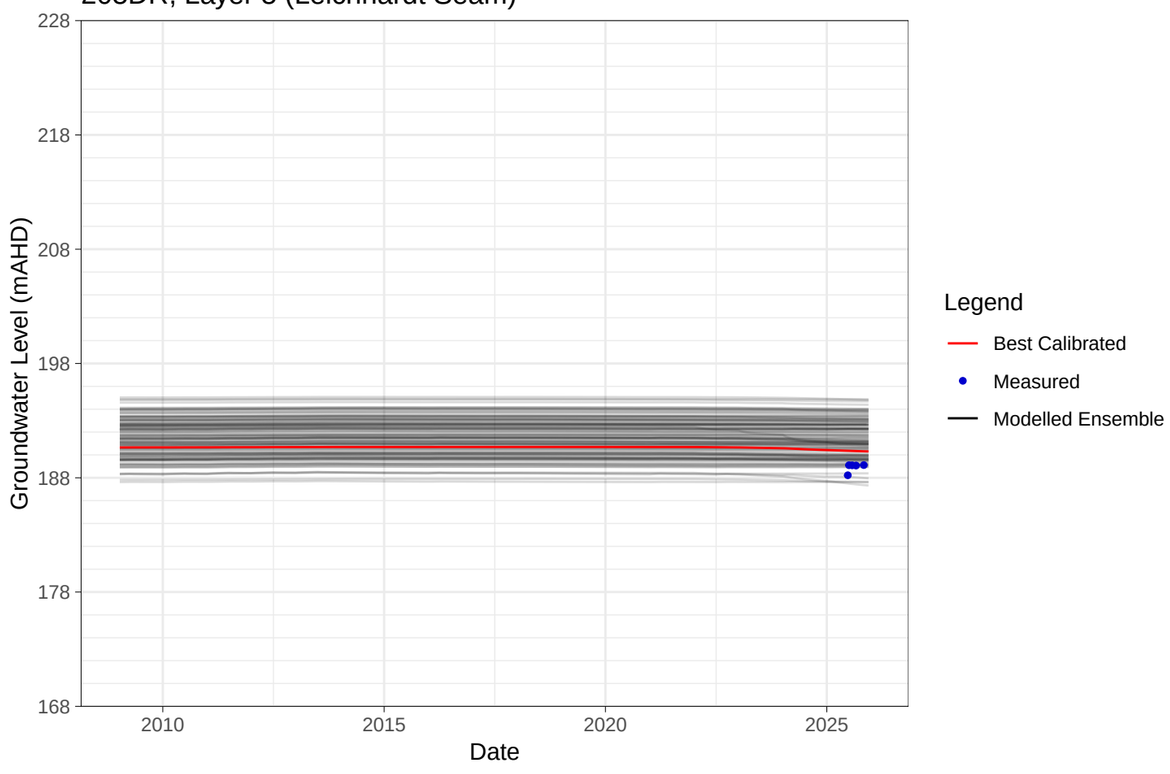
584S, Layer 5 (Leichhardt Seam)



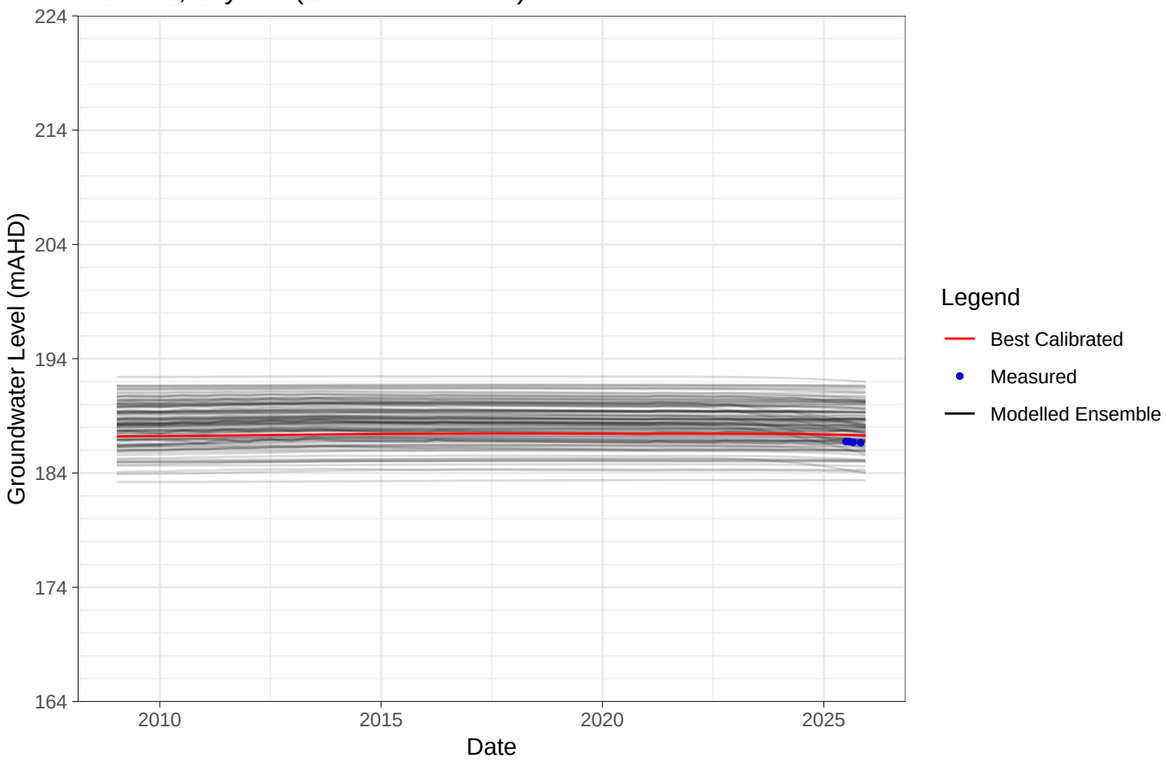
592S, Layer 5 (Leichhardt Seam)



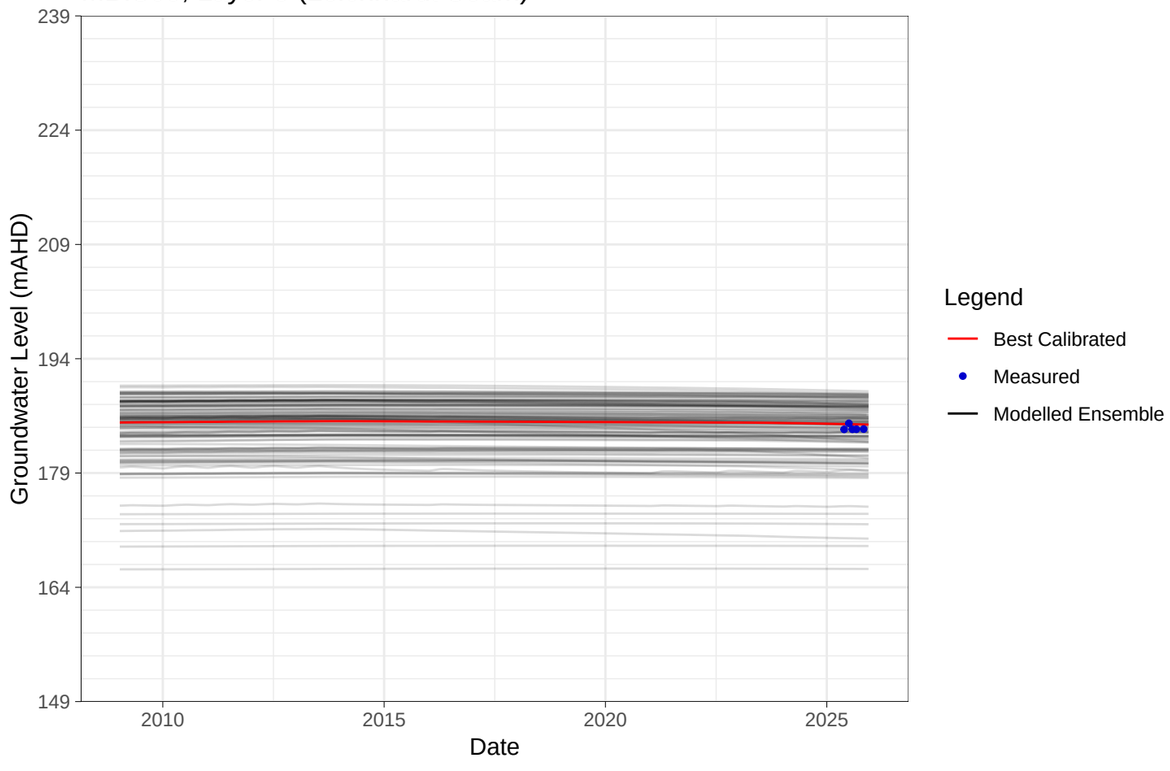
205DR, Layer 5 (Leichhardt Seam)



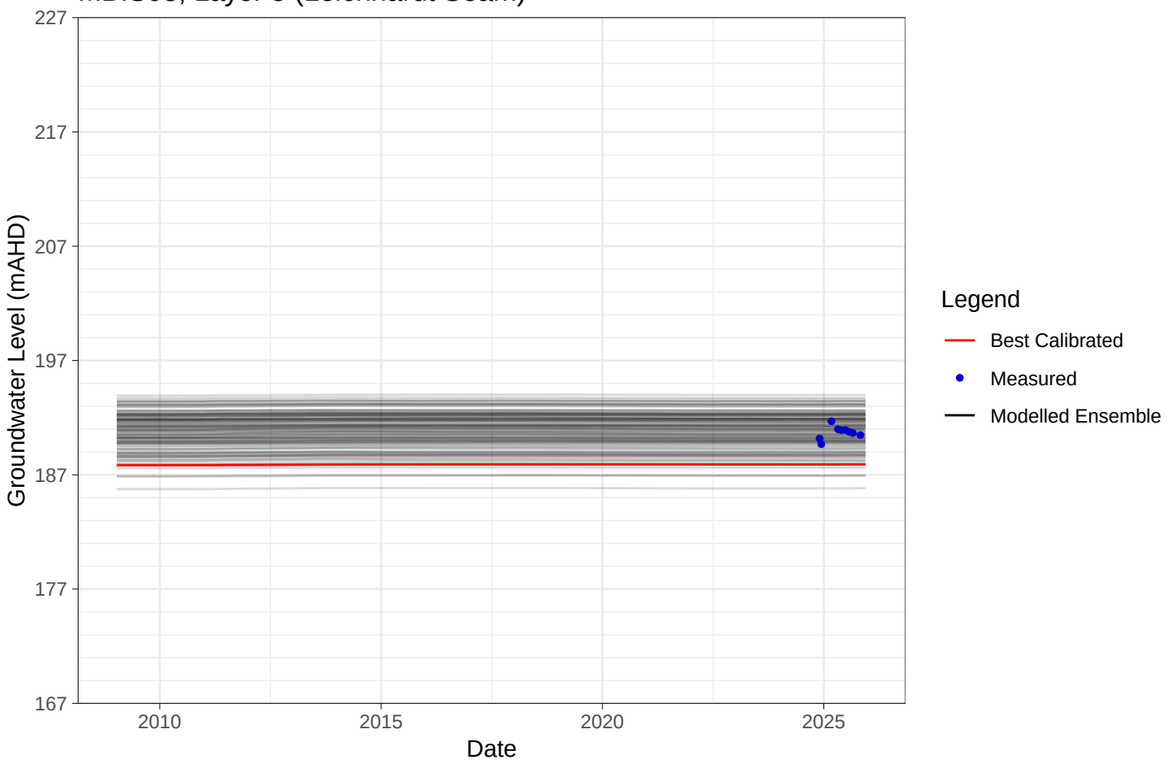
MBIS02, Layer 5 (Leichhardt Seam)



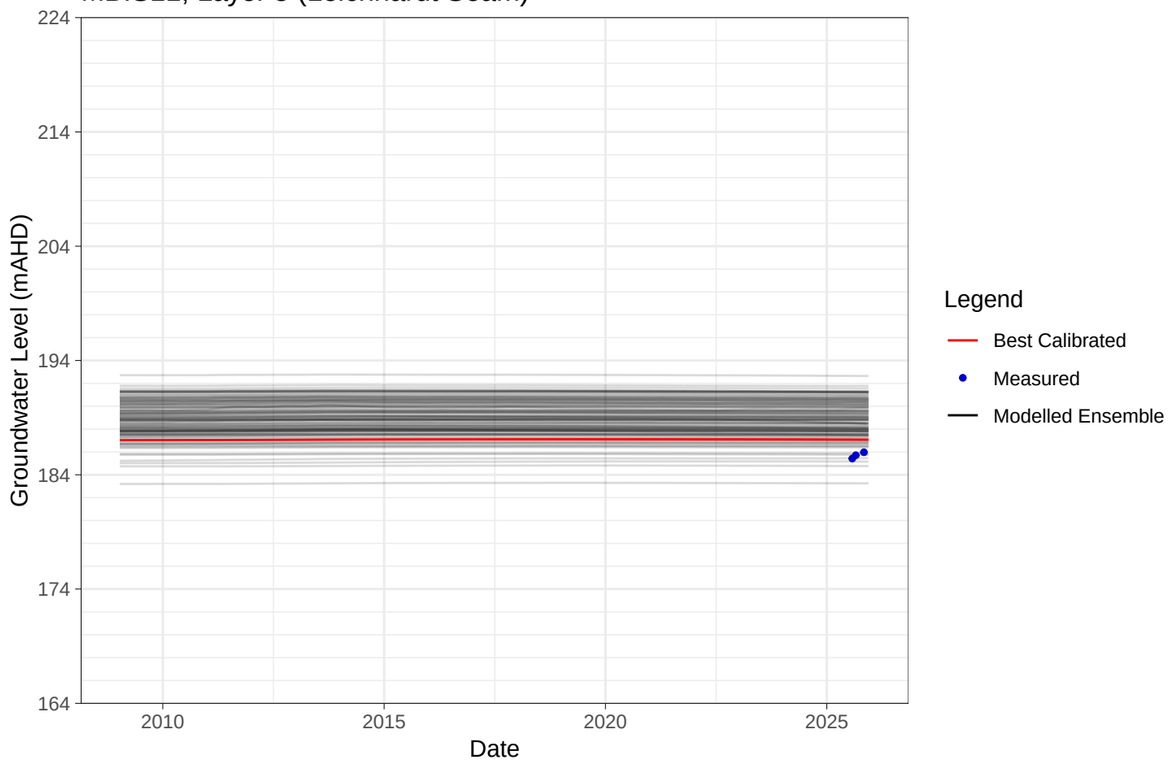
MBIS05, Layer 5 (Leichhardt Seam)



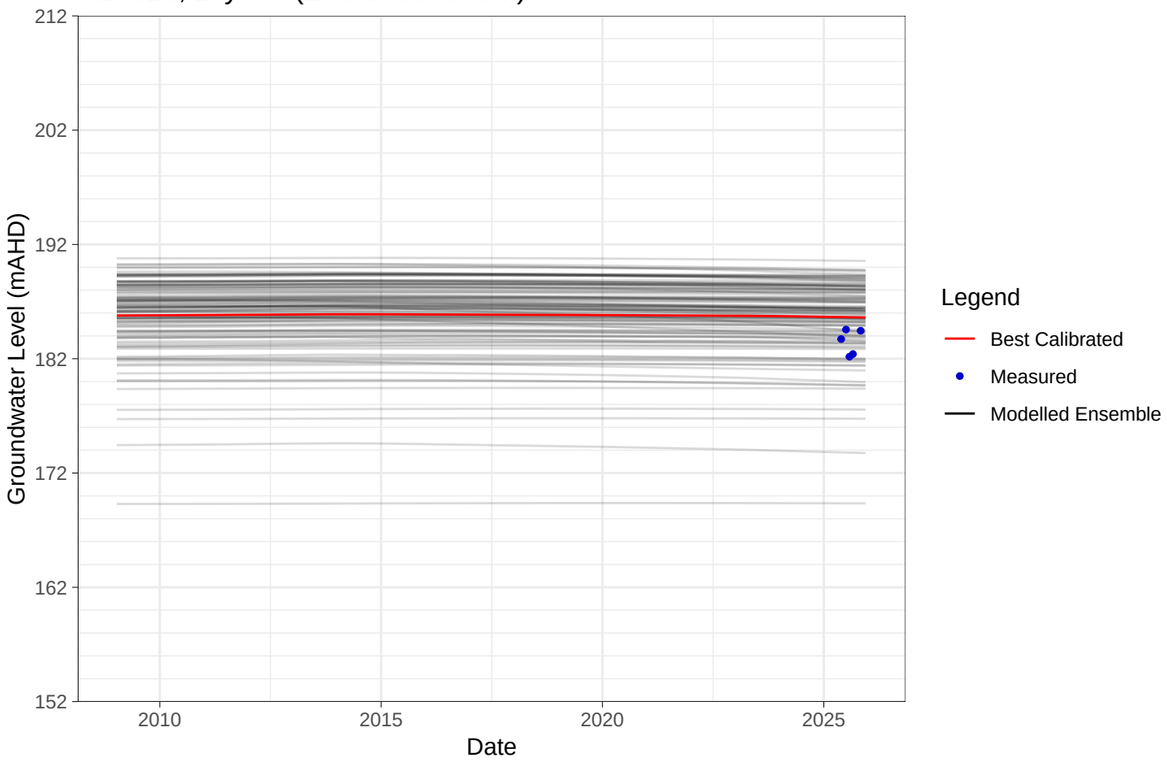
MBIS08, Layer 5 (Leichhardt Seam)



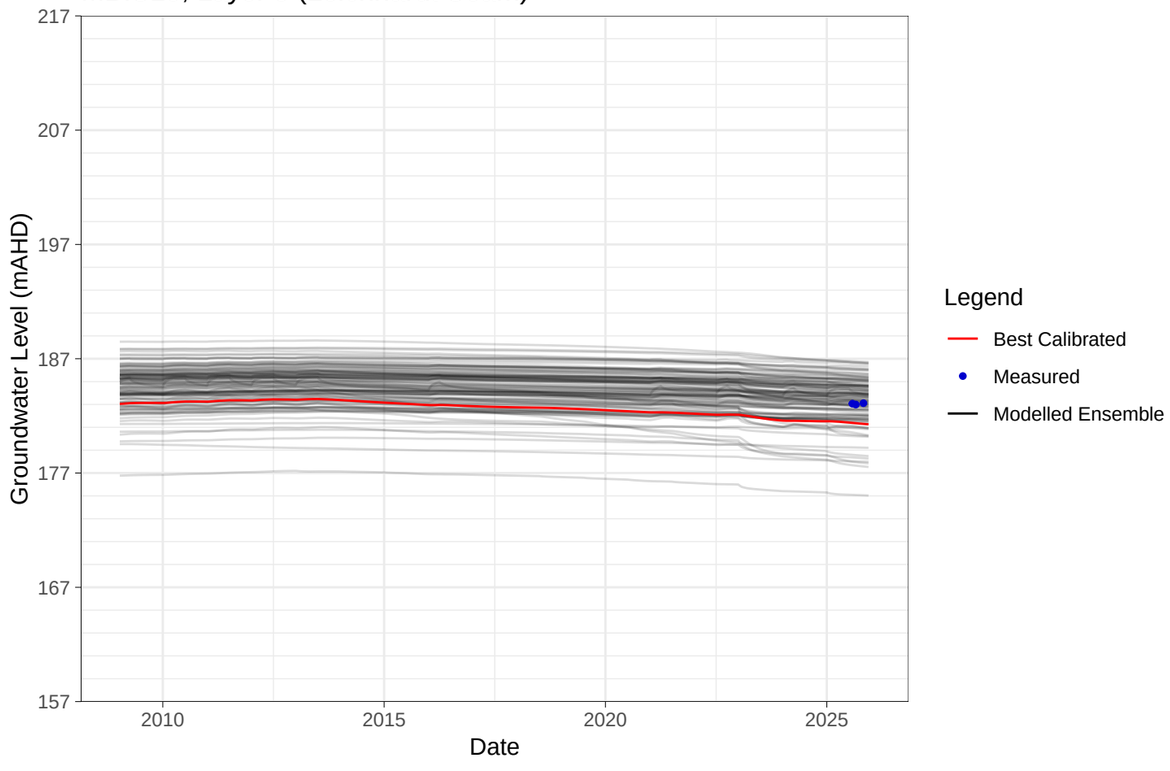
MBIS11, Layer 5 (Leichhardt Seam)



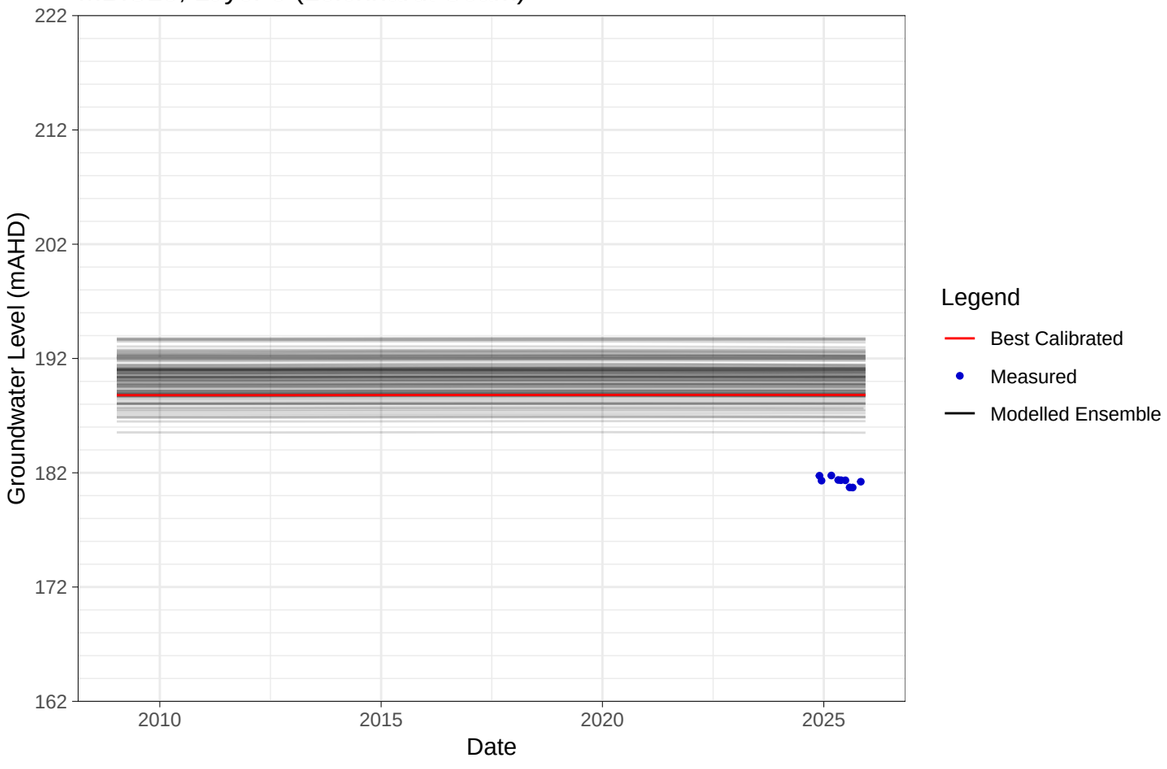
MBIS13, Layer 5 (Leichhardt Seam)



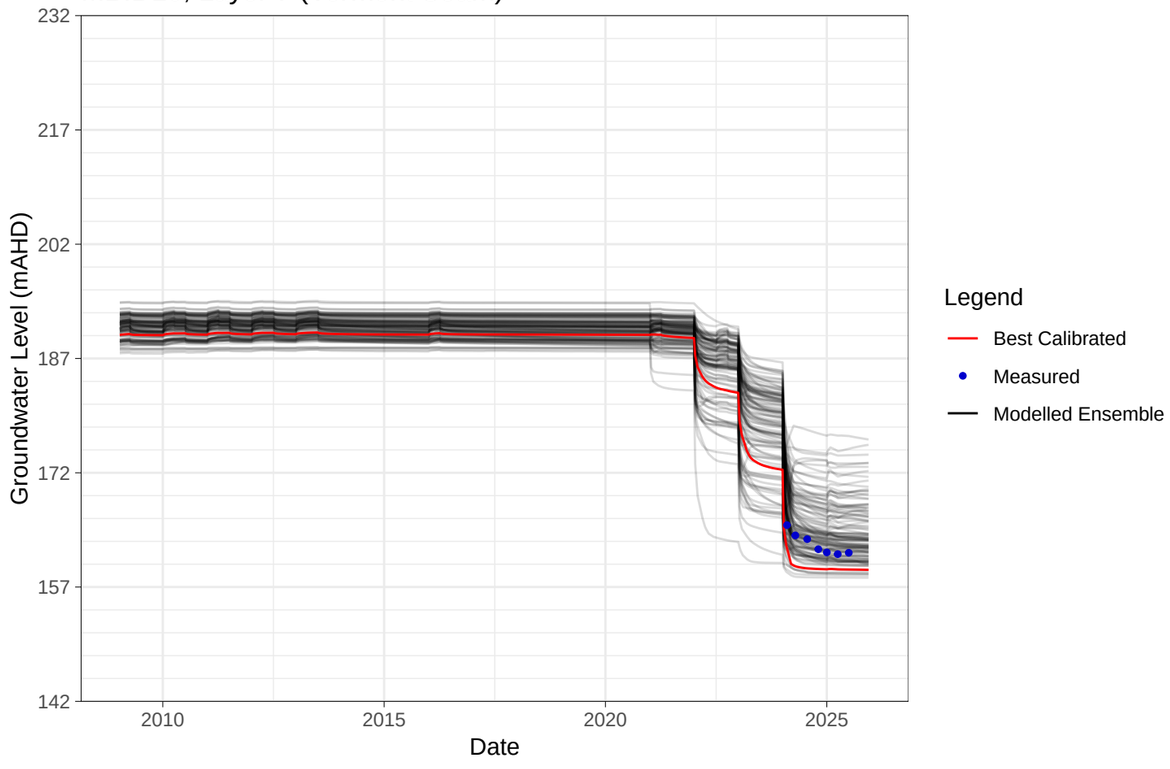
MBIS15, Layer 5 (Leichhardt Seam)



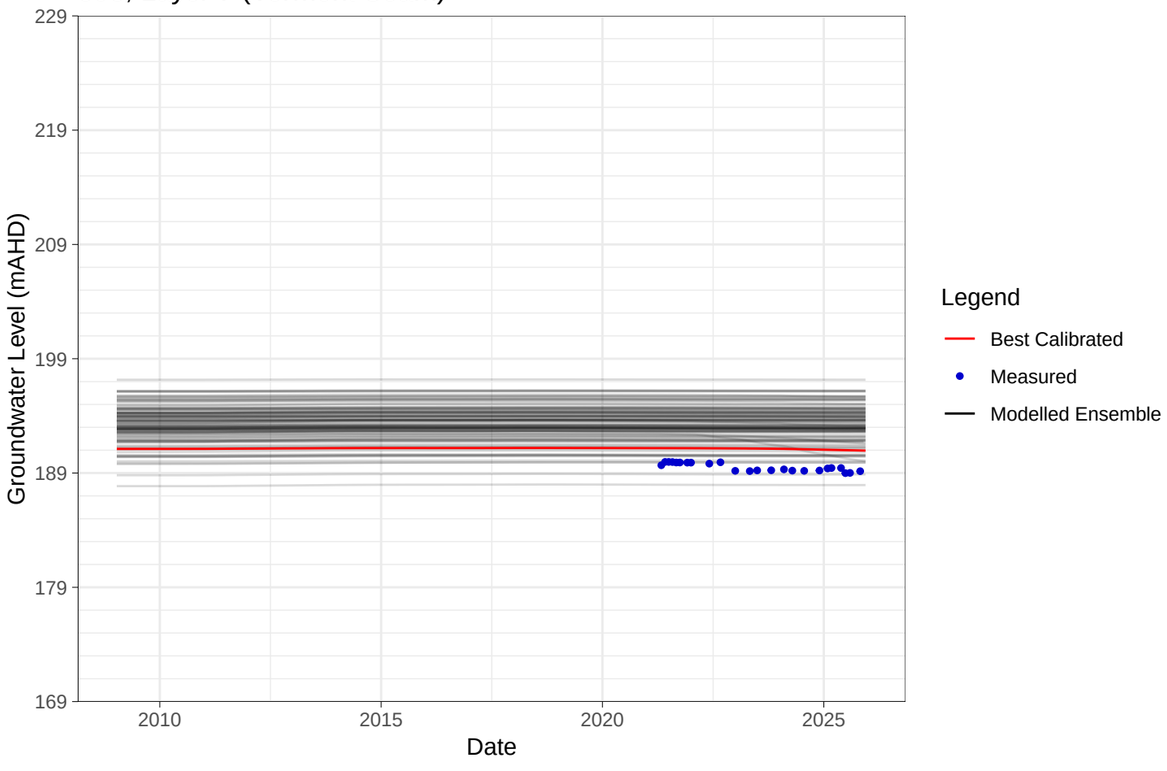
MBIS18, Layer 5 (Leichhardt Seam)



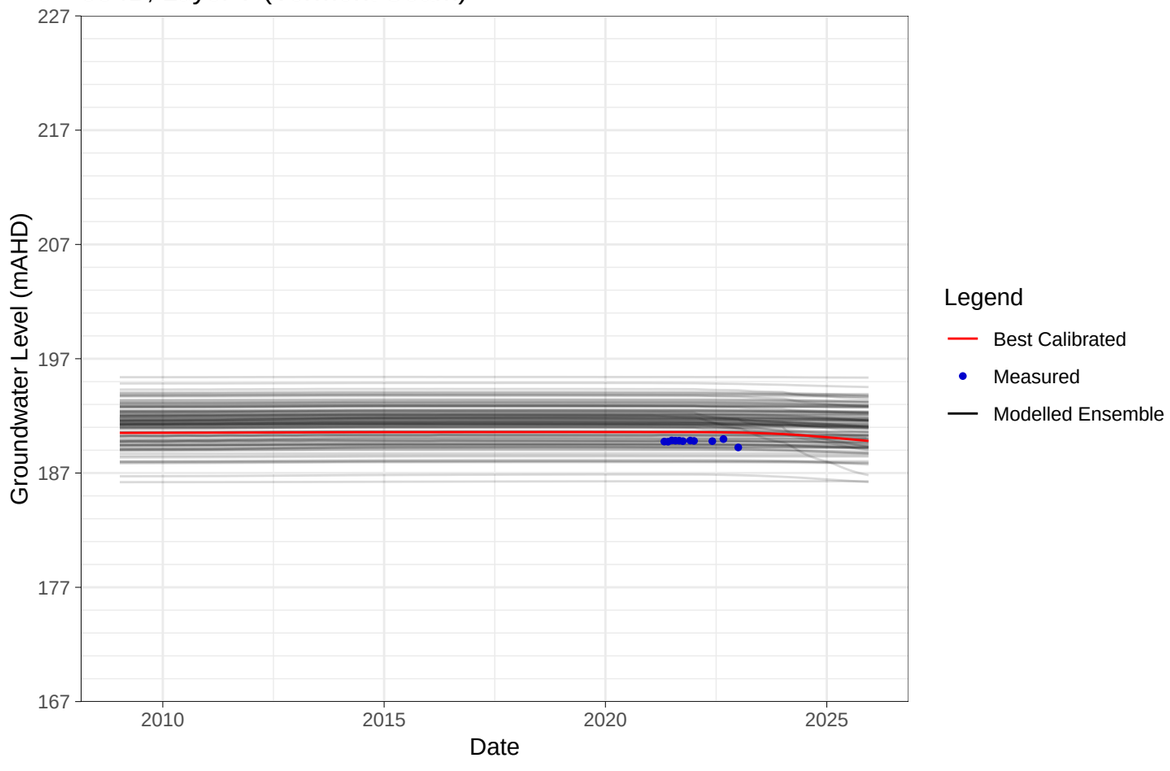
MBID10, Layer 7 (Vermont Seam)



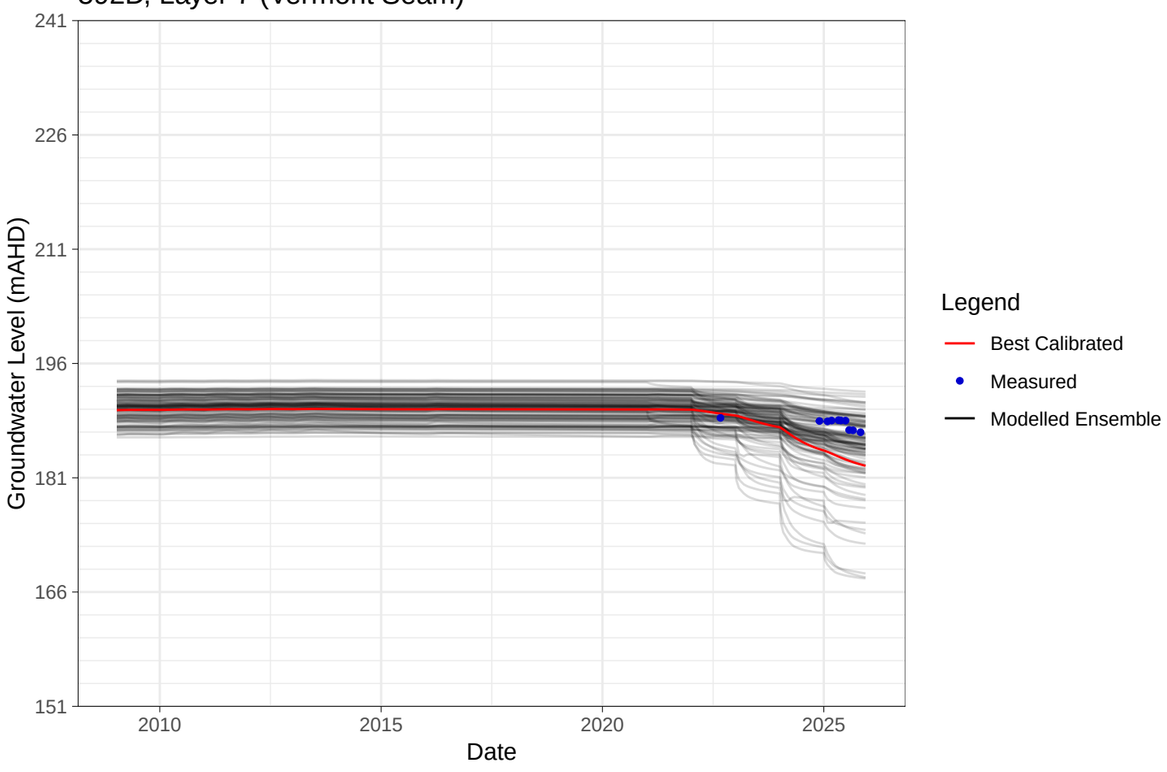
593, Layer 7 (Vermont Seam)



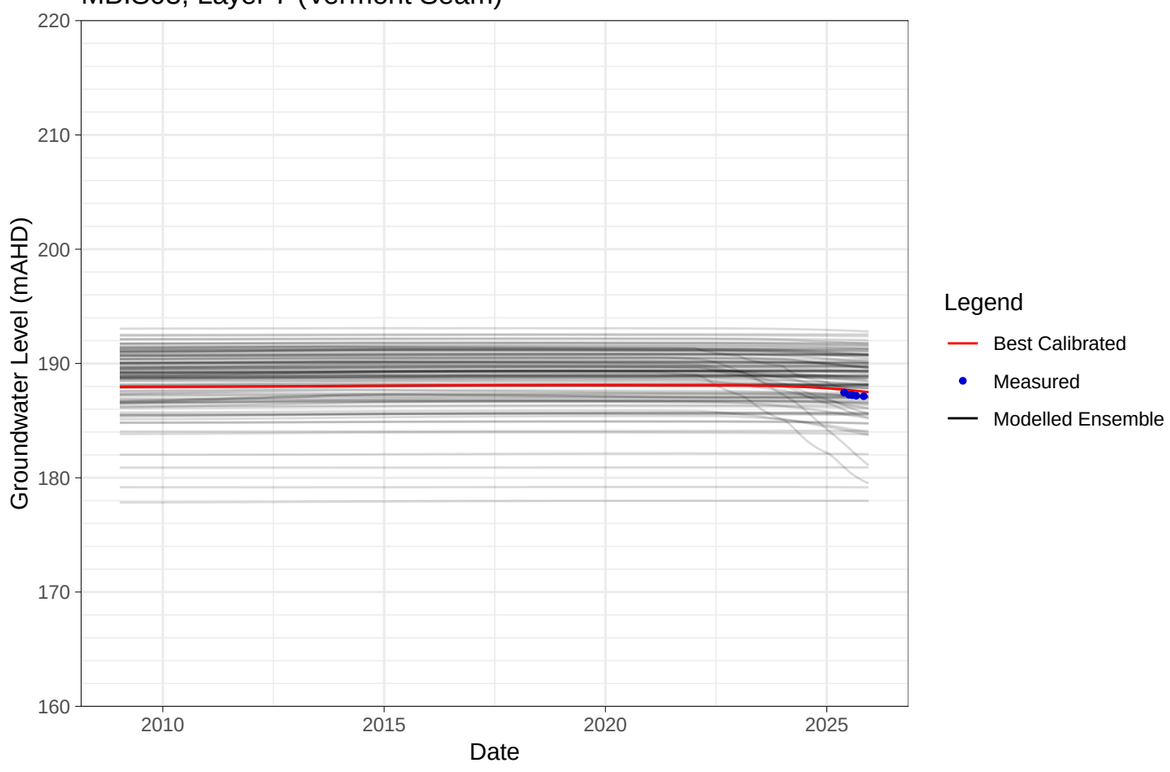
584D, Layer 7 (Vermont Seam)



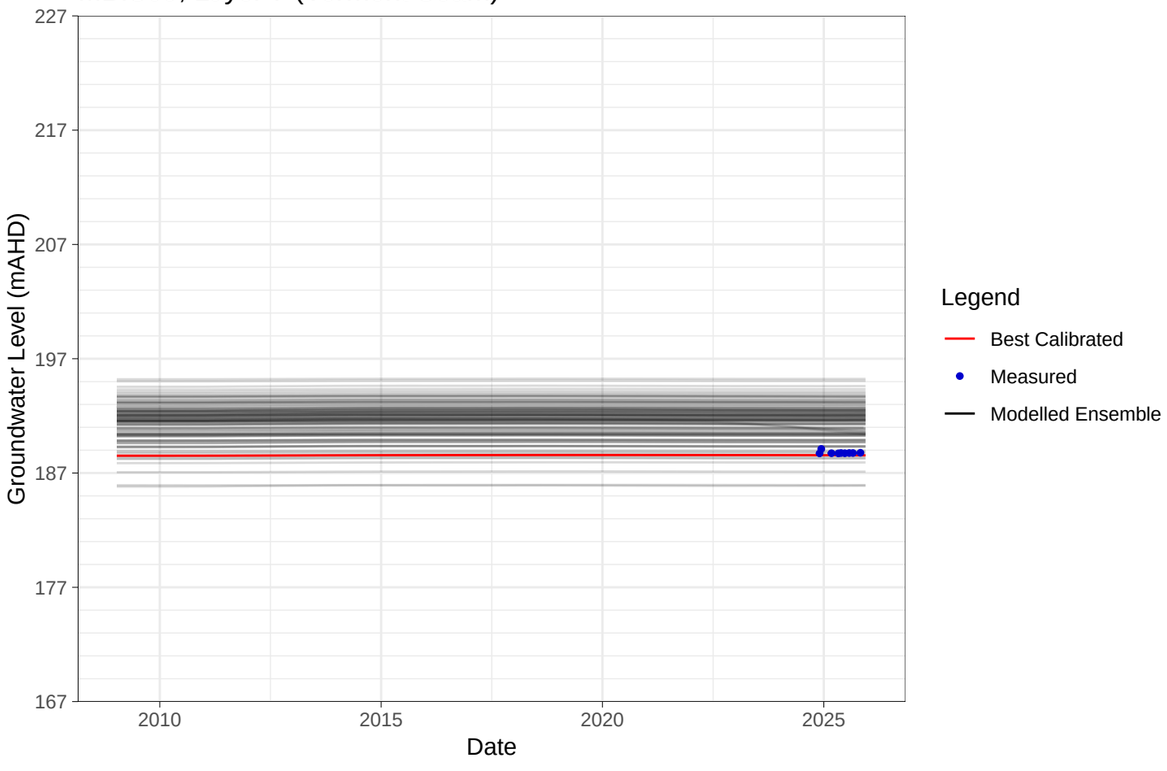
592D, Layer 7 (Vermont Seam)



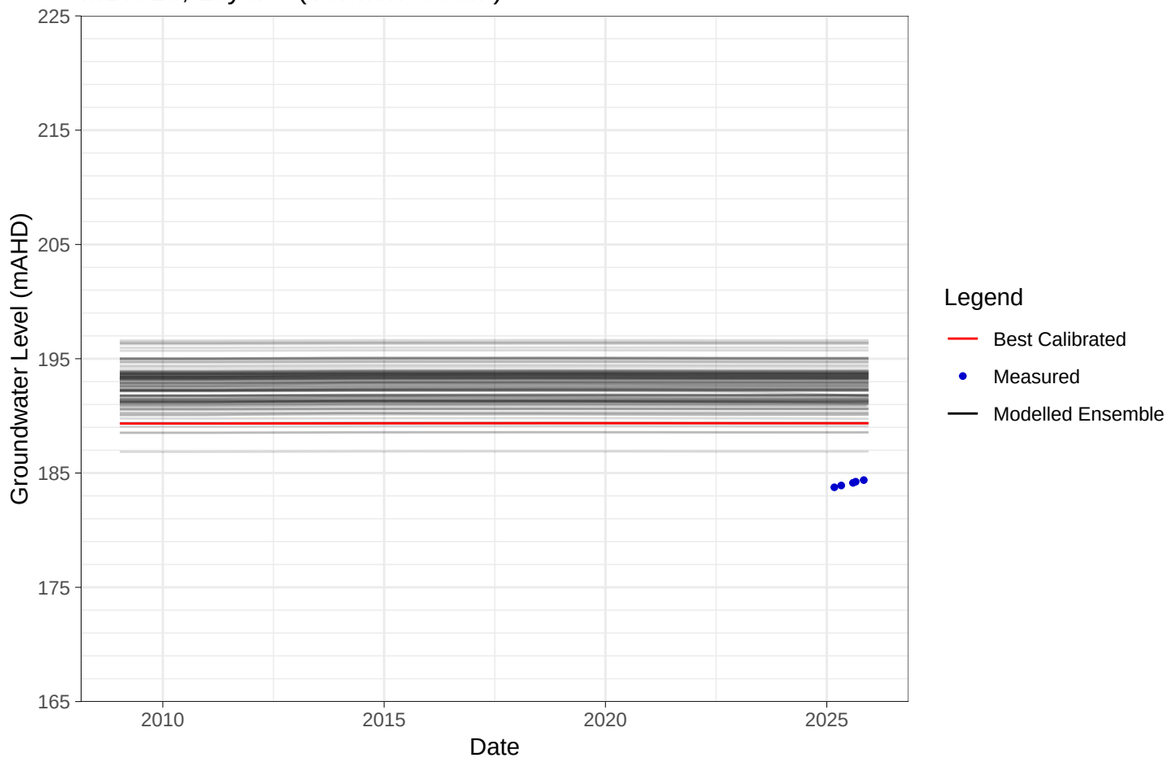
MBIS03, Layer 7 (Vermont Seam)



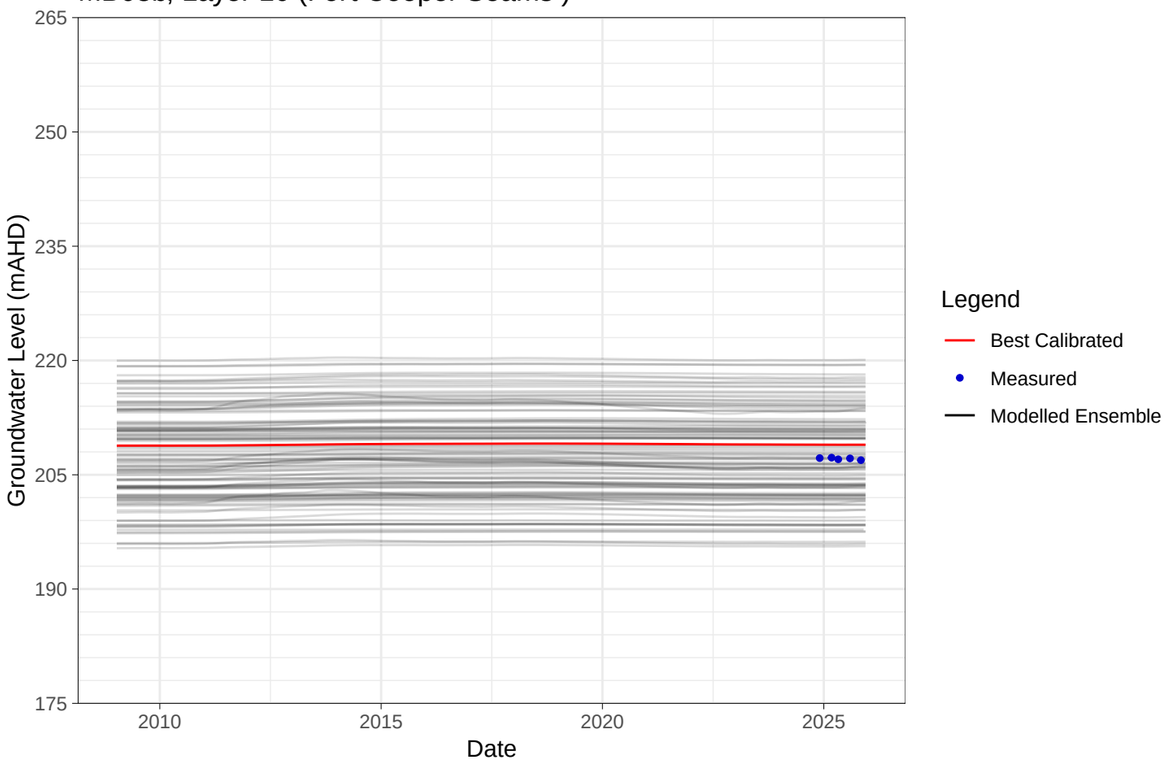
MBIS09, Layer 7 (Vermont Seam)



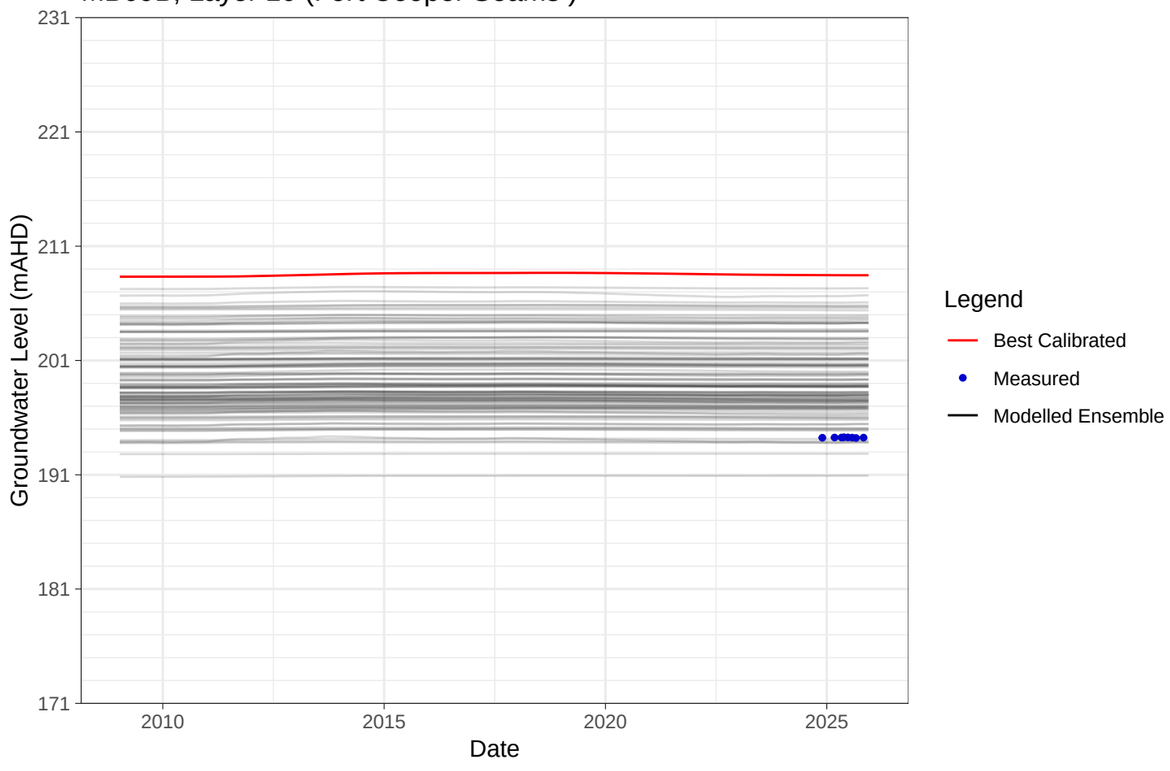
MBIS16, Layer 7 (Vermont Seam)



MB08b, Layer 10 (Fort Cooper Seams)



MB09B, Layer 10 (Fort Cooper Seams)



Appendix B Calibrated Parameters

Isaac Downs Extension Project

Groundwater Modelling Calibration and Prediction Report

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00006

29 May 2026

Calibrated Hydraulic Parameters

Table B1 Calibrated Hydraulic Parameters (Hydraulic Conductivity) – MLE Realisation

Geology Unit	Unit	Layer	Min Kx (m/day)	Max Kx (m/day)	Average Kx (m/day)	Min Kz (m/day)	Max Kz (m/day)	Average Kz (m/day)	Maximum Depth for Depth Dependence Correction(m)
Alluvium [1]	Surface Cover	1	6.3X10-02	6.3X10-02	6.3X10-02	4.2X10-04	4.2X10-04	4.2X10-04	-
Isaac River Alluvium [2]	Isaac River Alluvium	1	1.1X10-03	3.8X10+00	1.1X10-01	8.5X10-07	9.1X10-02	5.2X10-04	-
Regolith [1]	Surface Cover	1	1.5X10-03	1.9X10+00	5.7X10-02	6.9X10-07	2.7X10-02	3.1X10-04	-
Weathered Permian [1]	Surface Cover	1 & 2	1.6X10-01	1.6X10-01	1.6X10-01	2.4X10-03	2.4X10-03	2.4X10-03	-
Duaringa [1]	Surface Cover	1 & 2	5.2X10-02	5.2X10-02	5.2X10-02	1.3X10-03	1.3X10-03	1.3X10-03	-
Tertiary Basalt [1]	Tertiary Basalt	1 & 2	2.1X10-02	2.1X10-02	2.1X10-02	2.4X10-04	2.4X10-04	2.4X10-04	-
Regolith [2]	Surface Cover	2	1.5X10-03	1.2X10+00	4.9X10-02	6.9X10-07	1.3X10-02	2.3X10-04	-
Rewan [2]	Triassic	3	1.5X10-04	1.7X10+01	9.6X10-02	6.4X10-08	4.0X10-02	1.9X10-04	108.8
Rangal Coal Measures [1]	Interburden	4	4.6X10-06	3.4X10-03	4.9X10-04	3.2X10-08	2.4X10-05	3.4X10-06	174.5
Rangal Coal Measures [2]	Leichhardt Seam	5	2.0X10-05	1.6X10+00	1.5X10-02	1.8X10-08	1.1X10-02	4.3X10-05	125.2
Rangal Coal Measures [1]	Interburden	6	3.3X10-05	1.7X10-03	1.9X10-04	4.9X10-07	2.6X10-05	2.8X10-06	113.5
Rangal Coal Measures [2]	Vermont Seam	7	1.5X10-06	6.3X10+00	2.4X10-02	3.8X10-10	6.1X10-02	2.3X10-04	188.6
Rangal Coal Measures [1]	Interburden	8	1.0X10-03	3.6X10-03	1.1X10-03	1.5X10-05	5.4X10-05	1.6X10-05	43.7
Fort Cooper Coal Measures [2]	Interburden	9	1.6X10-05	1.9X10-01	2.6X10-03	3.6X10-09	4.9X10-03	1.5X10-05	58.5

Geology Unit	Unit	Layer	Min Kx (m/day)	Max Kx (m/day)	Average Kx (m/day)	Min Kz (m/day)	Max Kz (m/day)	Average Kz (m/day)	Maximum Depth for Depth Dependence Correction(m)
Fort Cooper Coal Measures [2]	Fort Cooper Seams	10	3.1X10-06	1.3X10+00	1.7X10-03	9.9X10-10	4.5X10-03	1.6X10-05	165.2
Fort Cooper Coal Measures [1]	Interburden	11	2.0X10-04	3.8X10-03	2.2X10-04	2.4X10-06	4.8X10-05	2.7X10-06	96.9
Moranbah Coal Measures [2]	Q Seam	12	1.9X10-06	2.3X10+00	4.0X10-03	1.1X10-09	1.2X10-01	2.2X10-05	177.0
Moranbah Coal Measures [1]	Interburden	13	1.4X10-08	3.1X10-03	1.0X10-04	3.4X10-09	7.4X10-04	2.5X10-05	323.0
Moranbah Coal Measures [2]	P Seam	14	3.1X10-06	1.1X10+01	2.8X10-03	3.9X10-09	6.3X10-03	1.1X10-05	173.0
Moranbah Coal Measures [1]	Interburden	15	1.4X10-07	5.8X10-04	1.8X10-05	1.3X10-09	5.2X10-06	1.7X10-07	216.5
Moranbah Coal Measures [2]	H Seam	16	1.2X10-05	3.2X10+00	1.7X10-02	3.0X10-08	8.6X10-03	4.3X10-05	127.6
Moranbah Coal Measures [1]	Interburden	17	1.4X10-05	9.9X10-03	3.9X10-04	5.0X10-07	3.4X10-04	1.3X10-05	168.6
Moranbah Coal Measures [2]	D Seam	18	5.1X10-06	9.8X10-01	2.8X10-03	1.7X10-09	1.2X10-01	1.6X10-04	147.6
Moranbah Coal Measures [1]	Interburden	19	6.2X10-05	5.0X10-04	7.4X10-05	2.5X10-06	2.0X10-05	3.0X10-06	106.2
Igneous Zone	Igneous	1 to19	1.5X10-06	1.5X10-06	1.5X10-06	7.9X10-09	7.9X10-09	7.9X10-09	-
Structure	Faults [1]	4 to 13	3.2X10-03	2.4X10-01	7.4X10-03	1.4X10-05	1.0X10-03	3.2X10-05	128.9
Structure	Faults [1]	4 to 13	5.2X10-05	1.9X10+00	1.1X10-01	5.4X10-07	1.9X10-02	1.2X10-03	275.9
Structure	Faults [1]	4 to 13	1.0X10-06	6.4X10-04	2.2X10-05	1.5X10-08	9.7X10-06	3.4X10-07	175.1
Structure	Faults [1]	4 to 13	1.4X10-03	2.5X10-03	1.4X10-03	8.3X10-06	1.5X10-05	8.4X10-06	37.3

Geology Unit	Unit	Layer	Min Kx (m/day)	Max Kx (m/day)	Average Kx (m/day)	Min Kz (m/day)	Max Kz (m/day)	Average Kz (m/day)	Maximum Depth for Depth Dependence Correction(m)
Structure	Faults [1]	4 to 6	7.0X10-05	2.2X10-03	7.6X10-04	2.8X10-07	8.8X10-06	3.1X10-06	212.2
Structure	Faults [2]	3	1.9X10-05	1.8X10-02	3.4X10-03	8.0X10-10	3.0X10-06	2.8X10-07	215.7
Structure	Faults [2]	5	1.3X10-09	2.6X10-04	2.9X10-05	1.0X10-10	1.1X10-06	5.9X10-08	285.1
Structure	Faults [2]	7	7.2X10-08	2.2X10-03	8.9X10-05	1.0X10-10	2.5X10-05	1.2X10-06	97.7
Structure	Faults [2]	9	1.9X10-08	3.7X10-04	6.3X10-06	1.0X10-10	2.8X10-07	4.6X10-09	151.8
Structure	Faults [2]	10	6.2X10-07	1.5X10-04	7.2X10-06	1.0X10-10	1.6X10-07	6.8X10-09	109.8
Structure	Faults [2]	12	3.9X10-06	8.1X10-04	2.6X10-05	1.0X10-10	1.9X10-08	1.5X10-09	117.3
Structure	Faults [2]	14	2.7X10-07	3.6X10-06	1.2X10-06	1.0X10-10	1.0X10-10	1.0X10-10	160.0
Structure	Faults [2]	16	1.3X10-08	4.6X10-05	9.0X10-07	1.0X10-10	2.1X10-08	5.3X10-10	250.1
Structure	Faults [2]	18	3.3X10-08	2.0X10-06	3.8X10-07	1.0X10-10	5.0X10-10	1.1X10-10	191.0
Structure	Faults [2]	3	2.1X10-04	1.7X10-02	6.5X10-03	4.3X10-09	7.5X10-06	1.5X10-06	199.0
Structure	Faults [2]	5	4.8X10-05	5.0X10-02	2.5X10-03	5.2X10-09	1.3X10-05	4.6X10-07	48.9
Structure	Faults [2]	7	2.5X10-06	1.8X10-02	4.9X10-04	1.0X10-10	1.2X10-05	2.0X10-07	166.9
Structure	Faults [2]	9	5.1X10-07	1.4X10-03	1.2X10-04	1.0X10-10	1.5X10-07	5.1X10-09	129.1
Structure	Faults [2]	10	2.9X10-07	9.5X10-05	2.8X10-06	1.0X10-10	3.4X10-08	1.3X10-09	91.8
Structure	Faults [2]	12	9.7X10-07	3.3X10-02	1.4X10-03	1.0X10-10	1.9X10-06	8.7X10-08	199.1
Structure	Faults [2]	14	4.5X10-07	6.4X10-04	7.3X10-06	1.0X10-10	8.1X10-07	7.4X10-09	146.9
Structure	Faults [2]	16	1.1X10-05	3.8X10-03	5.6X10-04	1.1X10-08	1.2X10-05	1.4X10-06	84.0
Structure	Faults [2]	18	8.4X10-07	3.0X10-04	2.4X10-05	1.0X10-10	1.6X10-07	1.5X10-08	88.7
Structure	Faults [2]	3	6.9X10-07	5.6X10-04	3.0X10-05	4.4X10-10	3.7X10-07	3.1X10-08	95.3
Structure	Faults [2]	5	2.5X10-07	6.6X10-03	4.0X10-04	1.2X10-09	8.2X10-05	4.9X10-06	196.2

Geology Unit	Unit	Layer	Min Kx (m/day)	Max Kx (m/day)	Average Kx (m/day)	Min Kz (m/day)	Max Kz (m/day)	Average Kz (m/day)	Maximum Depth for Depth Dependence Correction(m)
Structure	Faults [2]	7	1.6X10-05	6.0X10-03	1.9X10-03	2.5X10-08	2.5X10-06	7.9X10-07	41.7
Structure	Faults [2]	9	6.9X10-10	4.0X10-05	6.4X10-06	1.0X10-10	2.9X10-07	6.1X10-08	248.2
Structure	Faults [2]	10	8.9X10-08	2.4X10-05	2.1X10-06	1.0X10-10	9.2X10-08	6.3X10-09	135.0
Structure	Faults [2]	12	1.8X10-05	6.9X10-02	6.4X10-03	1.0X10-07	4.4X10-03	2.1X10-04	106.5
Structure	Faults [2]	14	2.0X10-07	3.3X10-06	1.4X10-06	1.0X10-10	1.5X10-10	1.0X10-10	141.6
Structure	Faults [2]	16	4.3X10-06	5.7X10-05	2.2X10-05	1.8X10-09	2.0X10-08	9.7X10-09	118.5
Structure	Faults [2]	18	9.0X10-09	1.9X10-06	2.1X10-07	1.0X10-10	1.0X10-10	1.0X10-10	248.6
Structure	Faults [2]	3	5.6X10-05	3.7X10-01	9.4X10-03	4.7X10-07	3.1X10-03	7.1X10-05	202.5
Structure	Faults [2]	5	3.3X10-06	4.4X10-03	2.2X10-04	7.6X10-10	9.5X10-06	2.8X10-07	140.9
Structure	Faults [2]	7	1.3X10-07	2.8X10-02	7.1X10-04	1.0X10-10	1.1X10-04	2.6X10-06	280.5
Structure	Faults [2]	9	6.3X10-08	8.9X10-05	6.6X10-06	1.0X10-10	3.7X10-08	8.3X10-10	166.1
Structure	Faults [2]	10	1.6X10-08	3.5X10-06	2.6X10-07	1.0X10-10	7.9X10-10	1.1X10-10	196.0
Structure	Faults [2]	12	2.4X10-03	4.4X10-02	8.8X10-03	3.7X10-08	5.6X10-06	1.3X10-06	43.1
Structure	Faults [2]	14	2.6X10-05	4.0X10-04	7.7X10-05	3.1X10-09	2.7X10-07	7.5X10-08	115.1
Structure	Faults [2]	16	1.9X10-04	6.8X10-03	1.2X10-03	4.1X10-09	1.1X10-06	1.1X10-07	69.9
Structure	Faults [2]	18	5.5X10-07	6.8X10-05	2.0X10-05	1.0X10-10	1.2X10-09	3.6X10-10	90.1
Structure	Faults [2]	3	1.3X10-03	4.1X10-01	5.6X10-02	2.8X10-08	2.1X10-05	2.0X10-06	145.0
Structure	Faults [2]	5	6.8X10-06	1.2X10-03	1.1X10-04	4.8X10-10	1.8X10-07	2.0X10-08	156.7
Structure	Faults [2]	7	6.9X10-03	6.8X10-01	8.9X10-02	3.6X10-08	1.6X10-05	1.5X10-06	75.5

1 Pilot Points are not included
2 Pilot Points are included

Table B2 Calibrated Hydraulic Parameters (Storage) – MLE Realisation

Geology Unit	Unit	Layer	Min Ss (d^{-1})	Max Ss (d^{-1})	Average Ss (d^{-1})	Min Sy (-)	Max Sy (-)	Average Sy (-)
Alluvium	Surface Cover	1	4.1X10-07	4.1X10-07	4.1X10-07	1.7X10-02	1.7X10-02	1.7X10-02
Isaac River Alluvium *	Isaac River Alluvium	1	9.0X10-07	9.0X10-07	9.0X10-07	1.3X10-03	1.6X10-01	2.1X10-02
Regolith	Surface Cover	1	4.9X10-07	4.9X10-07	4.9X10-07	1.4X10-02	1.4X10-02	1.4X10-02
Weathered Permian	Surface Cover	1 & 2	2.4X10-07	2.4X10-07	2.4X10-07	3.5X10-03	3.5X10-03	3.5X10-03
Duaringa	Surface Cover	1 & 2	5.8X10-07	5.8X10-07	5.8X10-07	9.2X10-03	9.2X10-03	9.2X10-03
Tertiary Basalt	Tertiary Basalt	1 & 2	1.5X10-07	1.5X10-07	1.5X10-07	5.6X10-03	5.6X10-03	5.6X10-03
Regolith	Surface Cover	2	1.5X10-06	1.5X10-06	1.5X10-06	6.4X10-03	6.4X10-03	6.4X10-03
Rewan	Triassic	3	9.3X10-06	9.3X10-06	9.3X10-06	2.2X10-03	2.2X10-03	2.2X10-03
Rangal Coal Measures	Interburden	4	1.1X10-06	1.1X10-06	1.1X10-06	1.0X10-03	1.0X10-03	1.0X10-03
Rangal Coal Measures	Leichhardt Seam	5	2.9X10-07	2.9X10-07	2.9X10-07	7.1X10-04	7.1X10-04	7.1X10-04
Rangal Coal Measures	Interburden	6	3.8X10-07	3.8X10-07	3.8X10-07	1.8X10-03	1.8X10-03	1.8X10-03
Rangal Coal Measures	Vermont Seam	7	1.4X10-06	1.4X10-06	1.4X10-06	7.9X10-04	7.9X10-04	7.9X10-04
Rangal Coal Measures	Interburden	8	5.8X10-07	5.8X10-07	5.8X10-07	5.2X10-04	5.2X10-04	5.2X10-04
Fort Cooper Coal Measures	Interburden	9	5.7X10-07	5.7X10-07	5.7X10-07	3.6X10-03	3.6X10-03	3.6X10-03
Fort Cooper Coal Measures	Fort Cooper Seams	10	1.5X10-06	1.5X10-06	1.5X10-06	1.0X10-03	1.0X10-03	1.0X10-03

Geology Unit	Unit	Layer	Min Ss (d^{-1})	Max Ss (d^{-1})	Average Ss (d^{-1})	Min Sy (-)	Max Sy (-)	Average Sy (-)
Fort Cooper Coal Measures	Interburden	11	5.6X10-07	5.6X10-07	5.6X10-07	7.5X10-04	7.5X10-04	7.5X10-04
Moranbah Coal Measures	Q Seam	12	1.3X10-06	1.3X10-06	1.3X10-06	7.7X10-04	7.7X10-04	7.7X10-04
Moranbah Coal Measures	Interburden	13	1.0X10-06	1.0X10-06	1.0X10-06	4.7X10-03	4.7X10-03	4.7X10-03
Moranbah Coal Measures	P Seam	14	5.9X10-07	5.9X10-07	5.9X10-07	5.1X10-04	5.1X10-04	5.1X10-04
Moranbah Coal Measures	Interburden	15	2.8X10-06	2.8X10-06	2.8X10-06	5.3X10-04	5.3X10-04	5.3X10-04
Moranbah Coal Measures	H Seam	16	4.9X10-07	4.9X10-07	4.9X10-07	9.3X10-04	9.3X10-04	9.3X10-04
Moranbah Coal Measures	Interburden	17	1.9X10-06	1.9X10-06	1.9X10-06	3.6X10-03	3.6X10-03	3.6X10-03
Moranbah Coal Measures	D Seam	18	7.6X10-07	7.6X10-07	7.6X10-07	3.8X10-04	3.8X10-04	3.8X10-04
Moranbah Coal Measures	Interburden	19	6.3X10-07	6.3X10-07	6.3X10-07	6.1X10-04	6.1X10-04	6.1X10-04
Igneous Zone	Igneous Zone	1 to 19	7.2X10-07	7.2X10-07	7.2X10-07	3.9X10-03	3.9X10-03	3.9X10-03
Structure	Faults	4 to 13	5.2X10-07	5.2X10-07	5.2X10-07	8.9X10-04	8.9X10-04	8.9X10-04
Structure	Faults	4 to 13	7.2X10-07	7.2X10-07	7.2X10-07	2.7X10-03	2.7X10-03	2.7X10-03
Structure	Faults	4 to 13	2.2X10-06	2.2X10-06	2.2X10-06	8.8X10-04	8.8X10-04	8.8X10-04
Structure	Faults	4 to 13	6.2X10-07	6.2X10-07	6.2X10-07	1.5X10-04	1.5X10-04	1.5X10-04
Structure	Faults	4 to 6	2.7X10-07	2.7X10-07	2.7X10-07	2.0X10-03	2.0X10-03	2.0X10-03
Structure	Faults	3	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02

Geology Unit	Unit	Layer	Min Ss (d^{-1})	Max Ss (d^{-1})	Average Ss (d^{-1})	Min Sy (-)	Max Sy (-)	Average Sy (-)
Structure	Faults	5	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	7	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	9	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	10	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	12	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	14	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	16	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	18	3.2X10-06	3.2X10-06	3.2X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	3	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	5	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	7	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	9	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	10	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	12	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	14	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	16	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	18	8.6X10-07	8.6X10-07	8.6X10-07	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	3	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02
Structure	Faults	5	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02
Structure	Faults	7	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02
Structure	Faults	9	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02
Structure	Faults	10	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02

Geology Unit	Unit	Layer	Min Ss (d^{-1})	Max Ss (d^{-1})	Average Ss (d^{-1})	Min Sy (-)	Max Sy (-)	Average Sy (-)
Structure	Faults	12	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02
Structure	Faults	14	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02
Structure	Faults	16	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02
Structure	Faults	18	4.2X10-06	4.2X10-06	4.2X10-06	2.5X10-02	2.5X10-02	2.5X10-02
Structure	Faults	3	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	5	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	7	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	9	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	10	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	12	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	14	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	16	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	18	6.4X10-06	6.4X10-06	6.4X10-06	1.8X10-02	1.8X10-02	1.8X10-02
Structure	Faults	3	2.0X10-06	2.0X10-06	2.0X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	5	2.0X10-06	2.0X10-06	2.0X10-06	1.3X10-02	1.3X10-02	1.3X10-02
Structure	Faults	7	2.0X10-06	2.0X10-06	1.9X10-06	1.3X10-02	1.3X10-02	1.3X10-02

* Pilot points are included only for the Sy of Isaac River Alluvium

Table B3 Calibrated Spoil Hydraulic Parameters – MLE Realisation

Parameter	Value
Horizontal hydraulic conductivity (m/day)	0.36
Vertical hydraulic conductivity (m/day)	0.11
Specific Yield (%)	0.01
Specific Storage (1/m)	3.8x10-06

Calibrated Recharge

Table B4 Calibrated Rainfall Recharge – MLE Realisation

Model Recharge Zone	% of Rainfall	Long-term Average Rainfall Recharge (mm/yr)
Alluvium Isaac River Channel	0.03%	0.1
Alluvium Isaac River	0.1%	0.7
Alluvium (rest of the model)	0.05%	0.3
Regolith	0.003%	0.02
Weathered Permian	0.2%	0.8
Duaringa Formation (Tertiary)	0.1%	0.8
Tertiary Basalts	0.6%	3.5
Spoil	4.7%	25.5

Calibrated Evapotranspiration (EVT)

Table B5 Calibrated EVT Extinction Depth – MLE Realisation

Model EVT Zone	Extinction Depth (m)
Alluvium	11.7
Regolith	2.2
Weathered Permian	4.2
Duaringa Formation	1.8
Tertiary Basalts	0.8
Permian Outcrop	0.8
Spoil	5.1

Calibrated General Head Boundary

Table B6 Calibrated General Head Boundary (GHB) Properties – MLE Realisation

Layer	Zone	GHB Head (m)	GHB Conductance Factor
1	1	39.8	3.21
1	2	44.1	4.44
1	3	38.9	43.01
2	4	30.3	4.13
2	5	22.1	8.81
2	6	39.1	0.06
3	7	38.1	47.42
3	8	26.3	0.01
3	9	49.5	19.26
4	10	51.6	51.98
4	11	62.8	42.08
4	12	12.6	12.48
4	13	38.9	0.14
5	14	61.7	1.10
5	15	25.2	0.01
5	16	36.6	0.01
5	17	11.8	64.23
6	18	34.6	43.61
6	19	27.2	0.01
6	20	25.3	0.13
6	21	23.1	0.04
7	22	39.0	0.07
7	23	9.3	0.12
7	24	13.6	5.78
7	25	30.7	0.19
8	26	27.0	16.93
8	27	49.9	0.00
8	28	30.7	0.38
8	29	22.3	1.13
9	30	48.2	0.01
9	31	22.7	0.16
9	32	60.5	0.47
9	33	19.8	4.17
10	34	46.4	1.07

Layer	Zone	GHB Head (m)	GHB Conductance Factor
10	35	45.9	4.65
10	36	32.5	7.48
10	37	33.4	0.02
11	38	32.7	0.45
11	39	7.4	0.03
11	40	48.3	2.94
11	41	36.0	14.06
12	42	49.9	29.23
12	43	30.0	0.03
12	44	30.3	0.48
12	45	39.1	0.02
13	46	28.5	0.46
13	47	15.5	49.39
13	48	24.1	0.40
13	49	26.5	0.02
14	50	57.2	0.19
14	51	36.4	2.17
14	52	45.0	0.72
14	53	23.6	0.47
15	54	43.6	11.12
15	55	19.8	6.33
15	56	37.2	0.08
15	57	25.0	0.15
16	58	47.9	0.03
16	59	27.4	0.49
16	60	56.8	0.83
16	61	43.4	6.99
17	62	14.7	0.15
17	63	26.7	0.19
17	64	49.5	92.00
17	65	32.4	0.02
18	66	50.6	8.62
18	67	17.2	65.50
18	68	63.2	0.19
18	69	59.7	2.60
19	70	45.3	0.02
19	71	26.5	0.04

Layer	Zone	GHB Head (m)	GHB Conductance Factor
19	72	35.0	46.22
19	73	24.5	0.51

Calibrated Riverbed Vertical Conductivity

Table B7 Calibrated Riverbed Vertical Conductivity – MLE Realisation

Model River Zone	Riverbed Vertical Conductivity (m/day)
Isaac River_Goonyella	9.8X10-04
Isaac River_Deverill	1.1X10-04
Grosvenor Creek	1.8X10-03
Conrock Gully	9.8X10-05
Cherwell Creek	2.2X10-04
Ripstone	6.1X10-05
Phillips Creek	5.0X10-03
Smoky Creek	4.2X10-04
Billy’s Gully	2.5X10-04
New Chum Creek	2.1X10-04
North Creek	5.0X10-04

Appendix C Parameter Distribution Plots

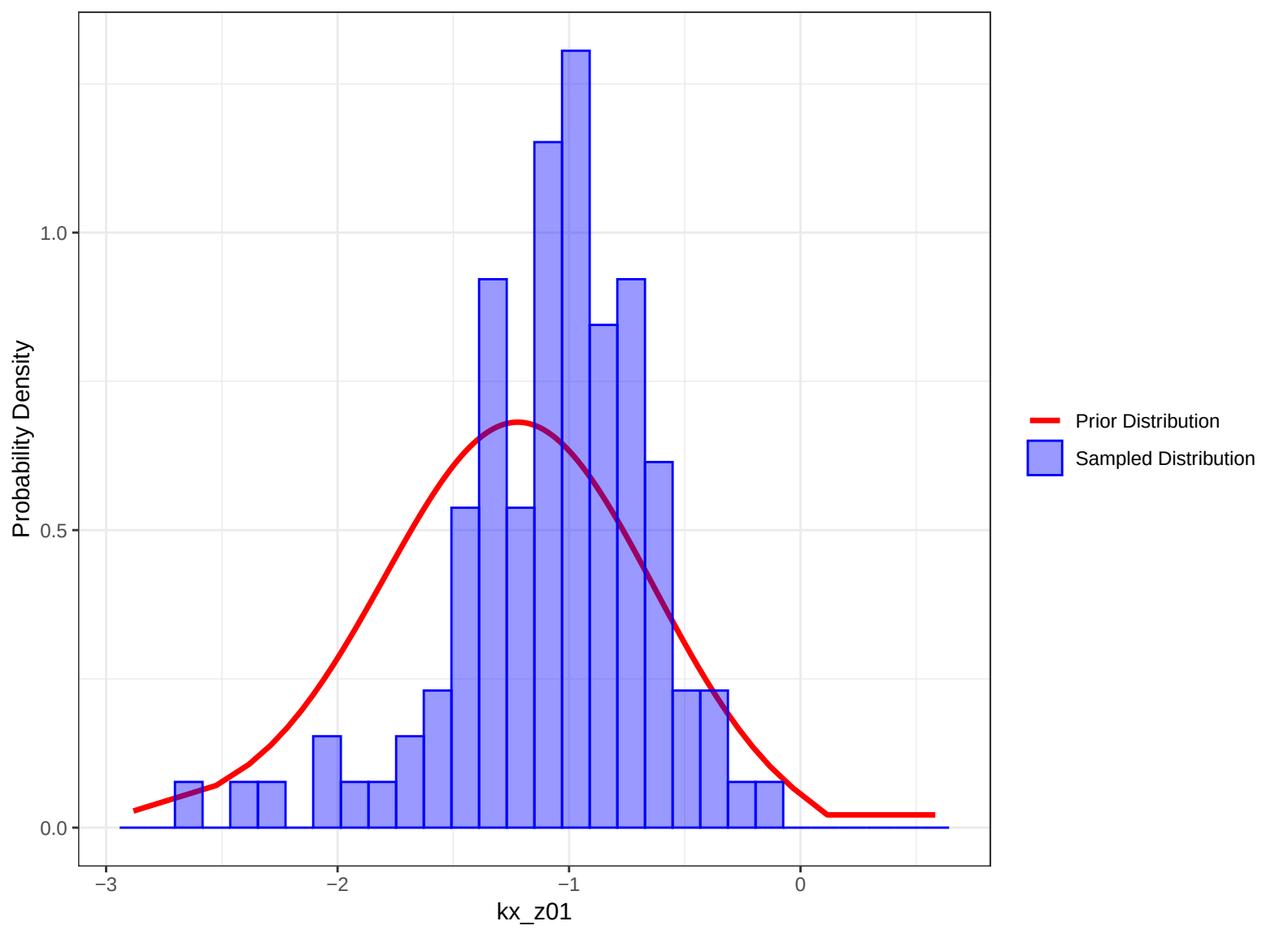
Isaac Downs Extension Project

Groundwater Modelling Calibration and Prediction Report

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00006

29 May 2026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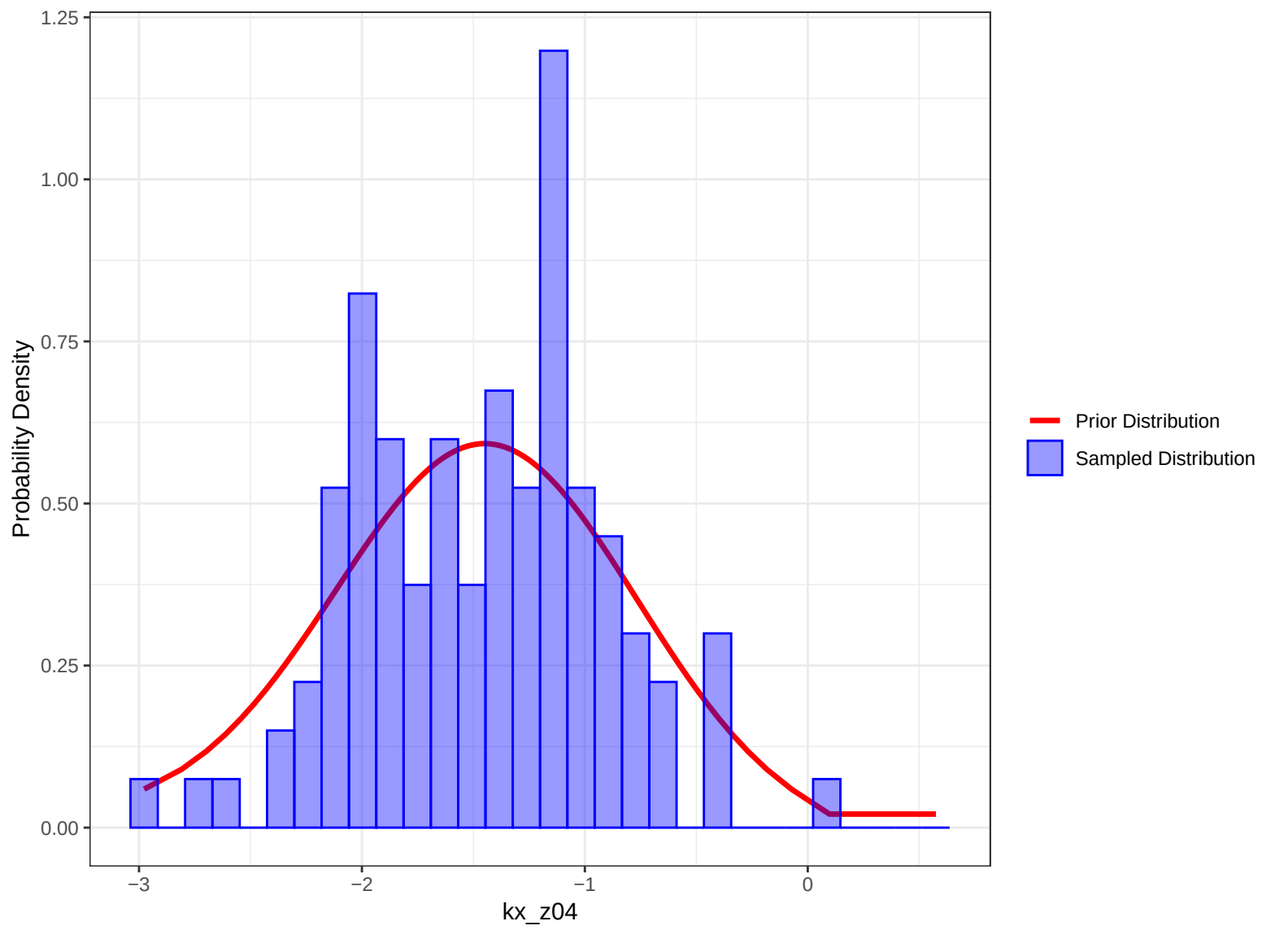
Prior Distribution
Sampled Distribution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Prior Distribution
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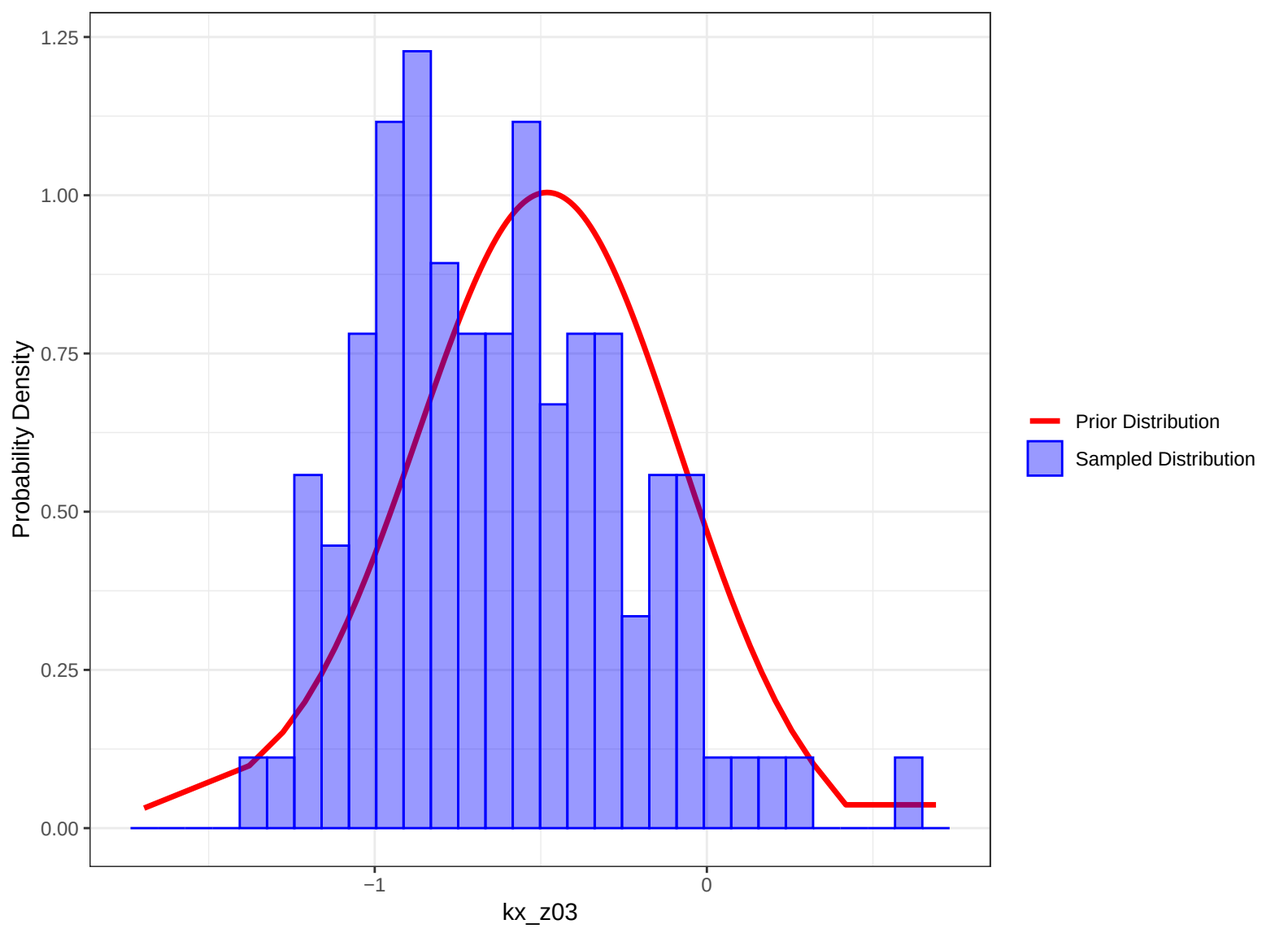
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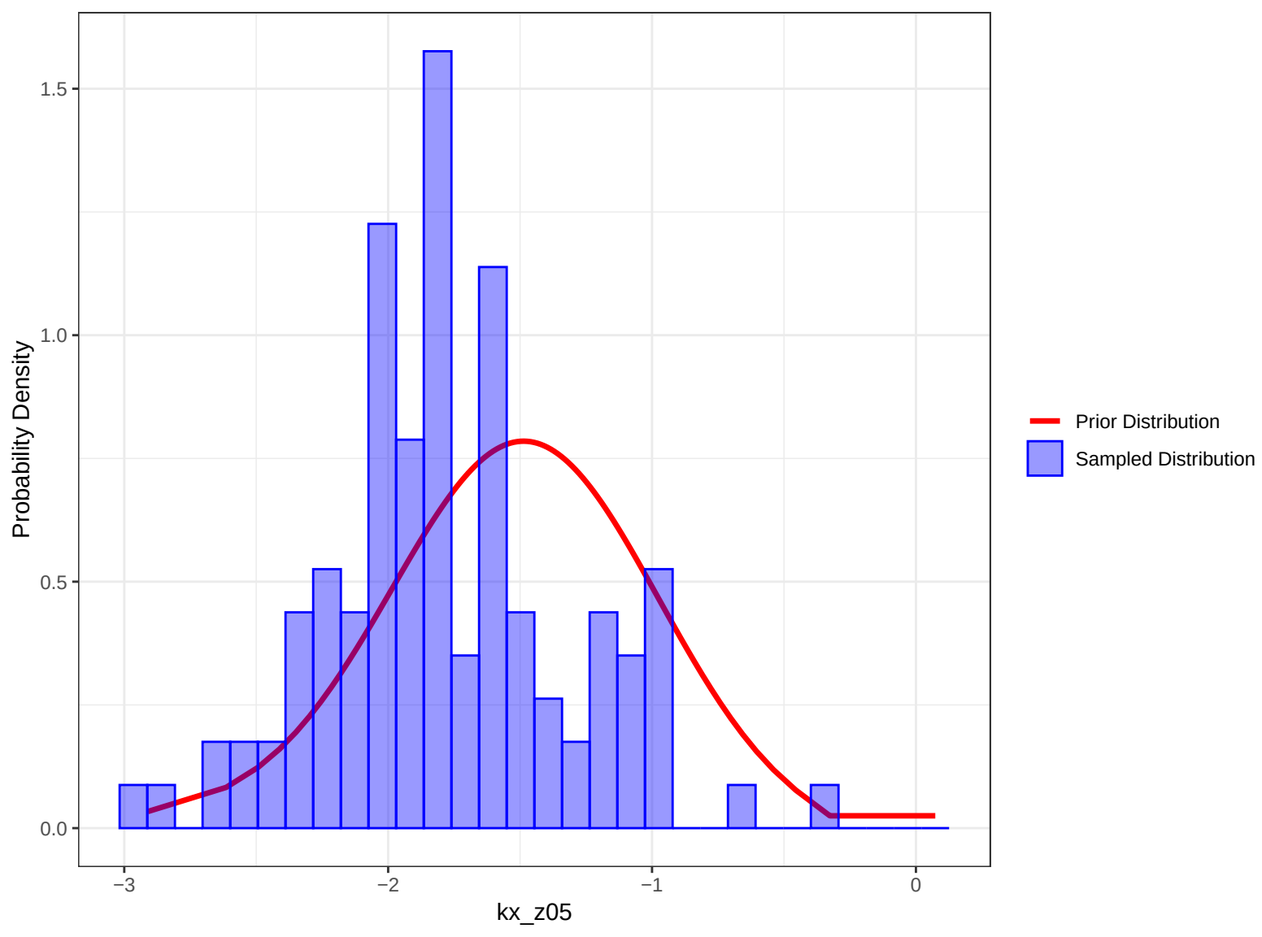
Prior Distribution
Sampled Distribution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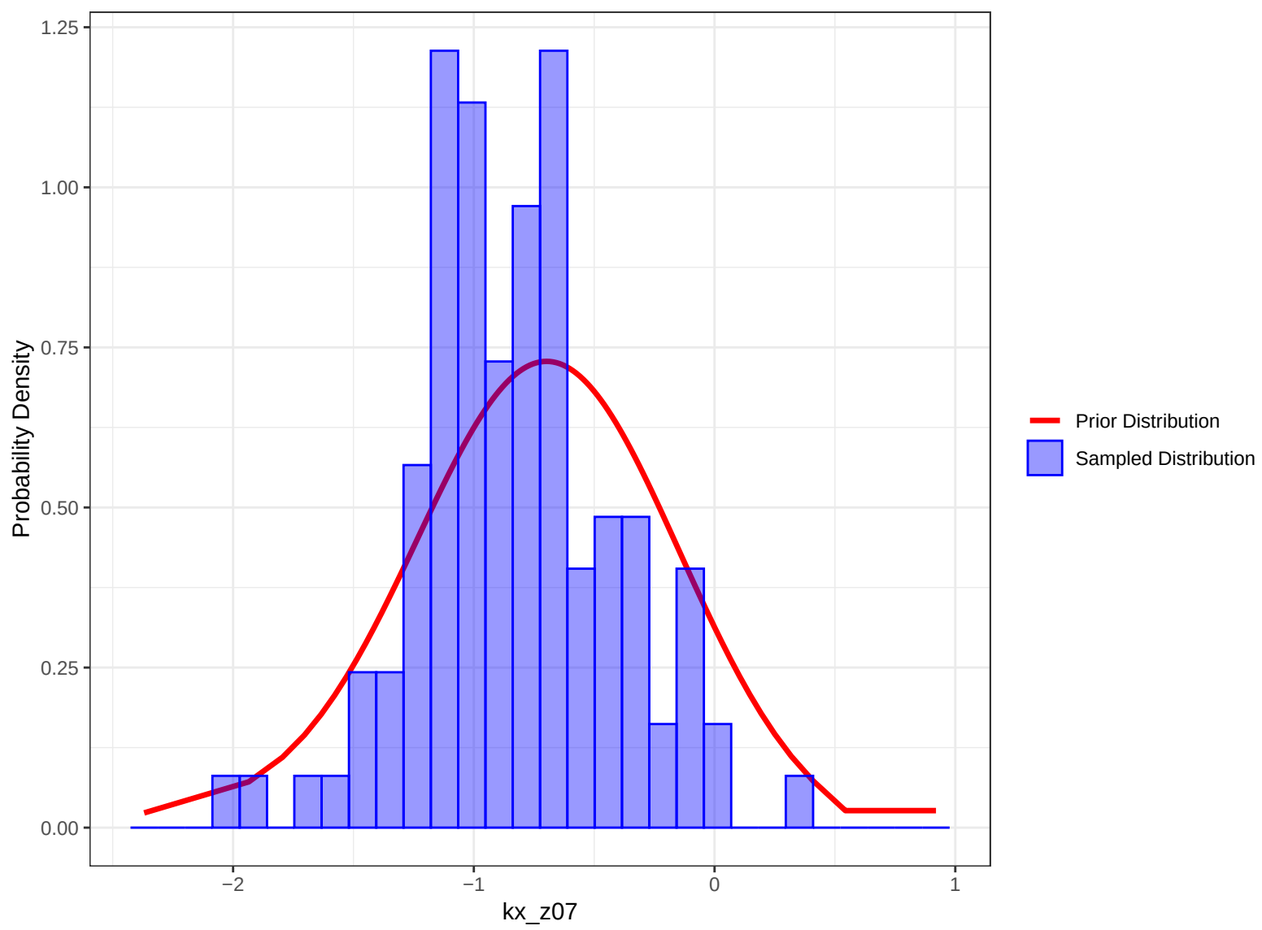
Prior Distribution
Sampled Distribution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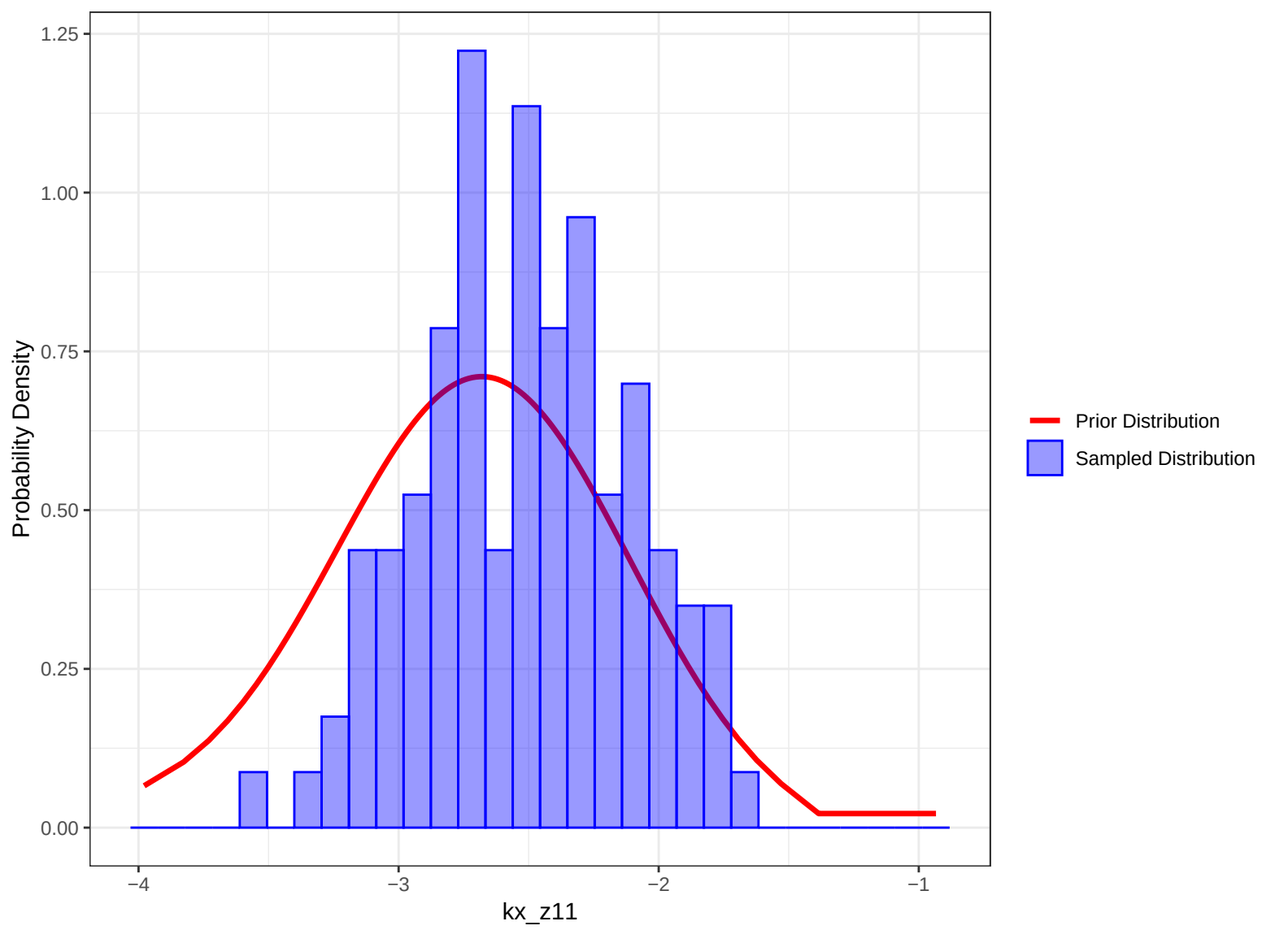
Prior Distribution
Sampled Distribution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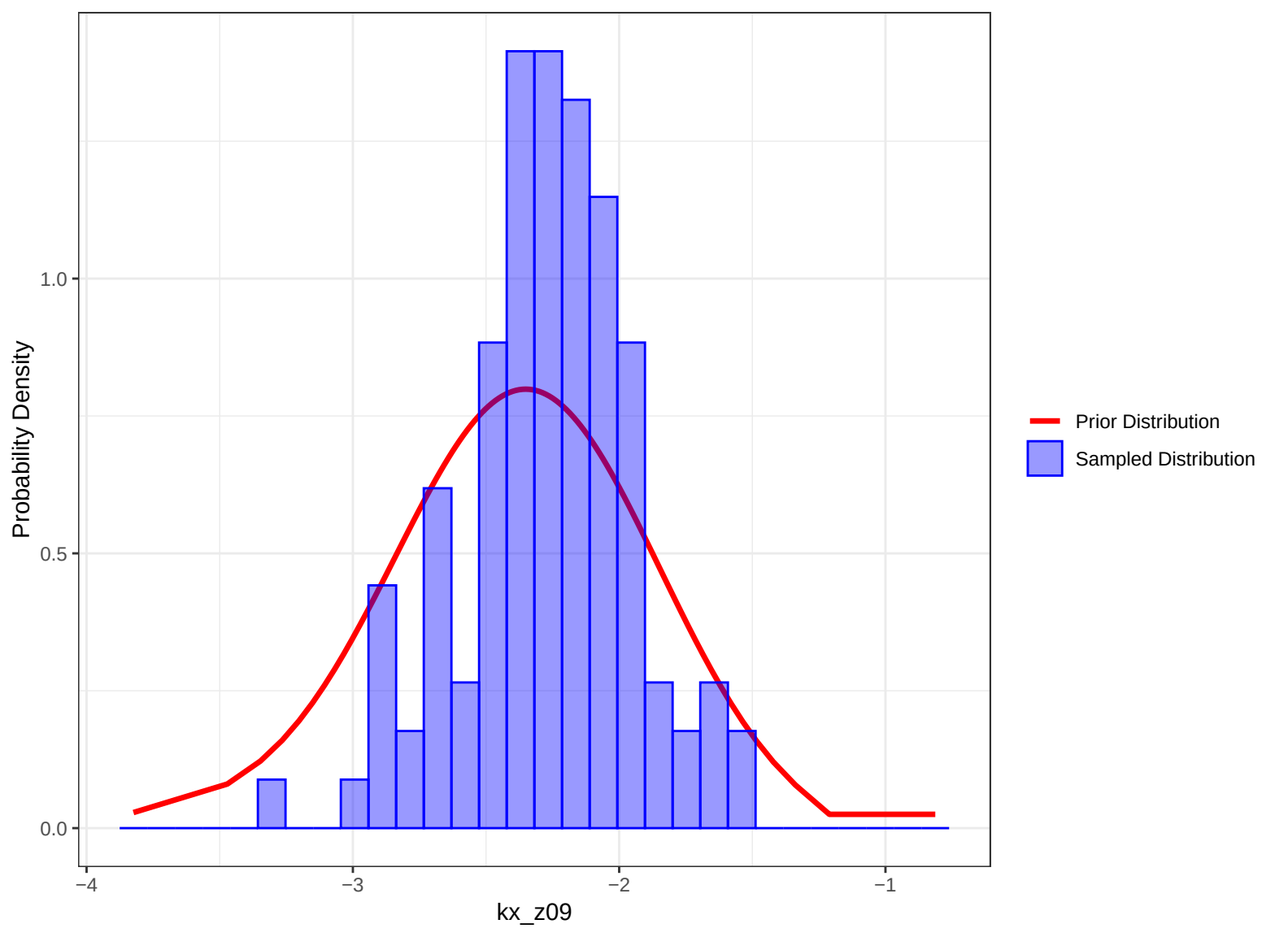
Prior Distribution
Sampled Distribution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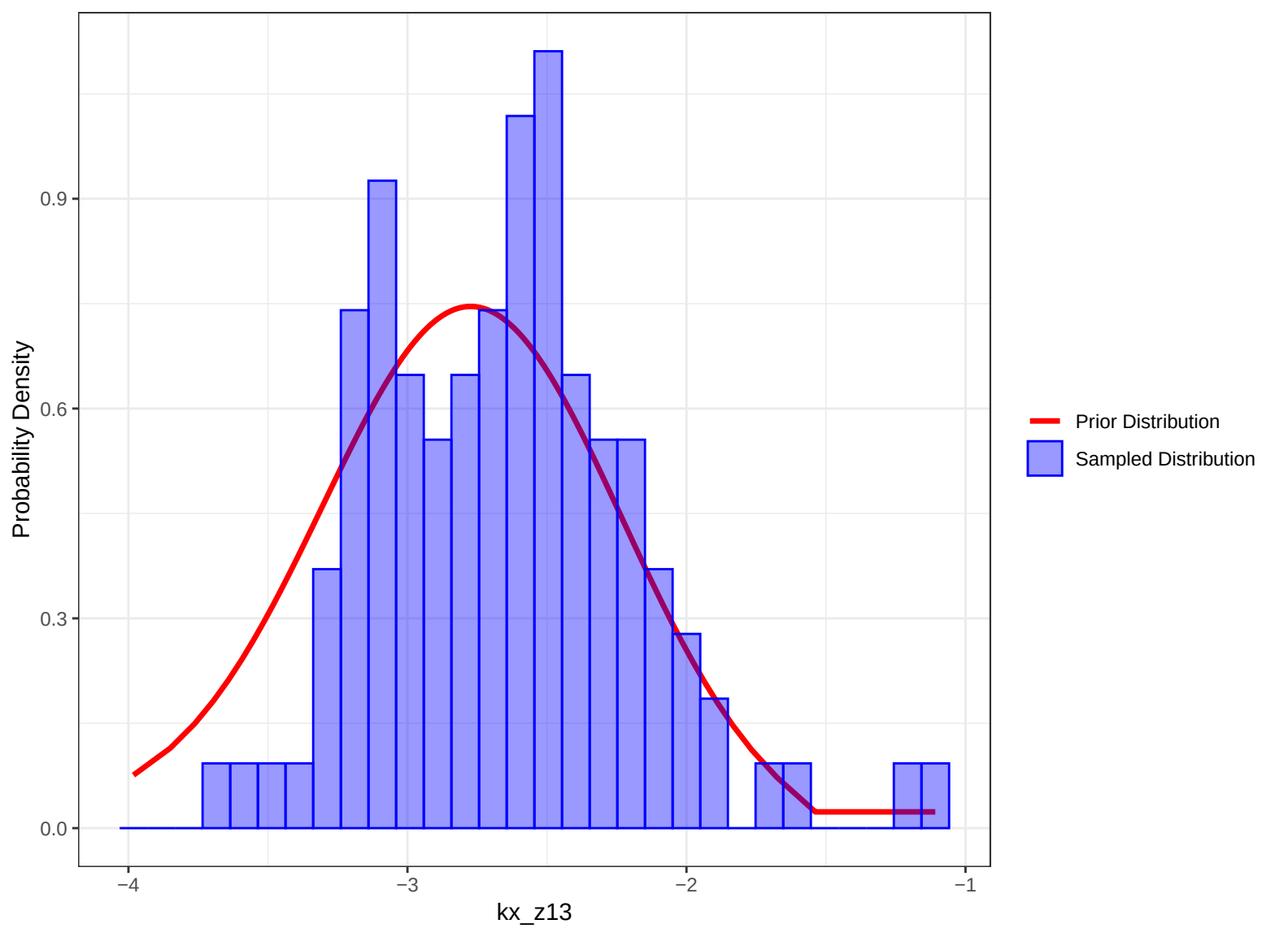
Prior Distribution
Sampled Distribution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0.0
Probability Density
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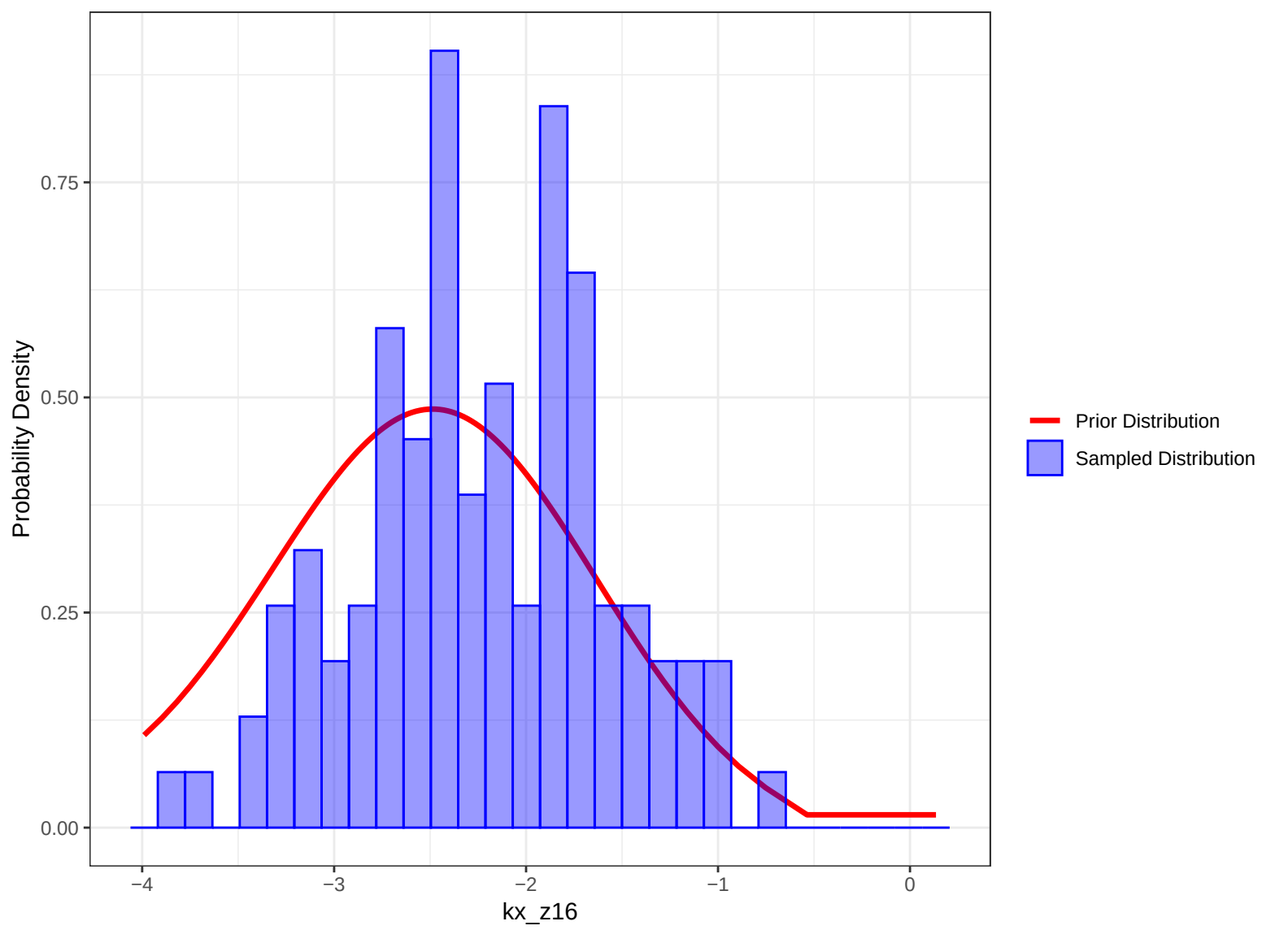
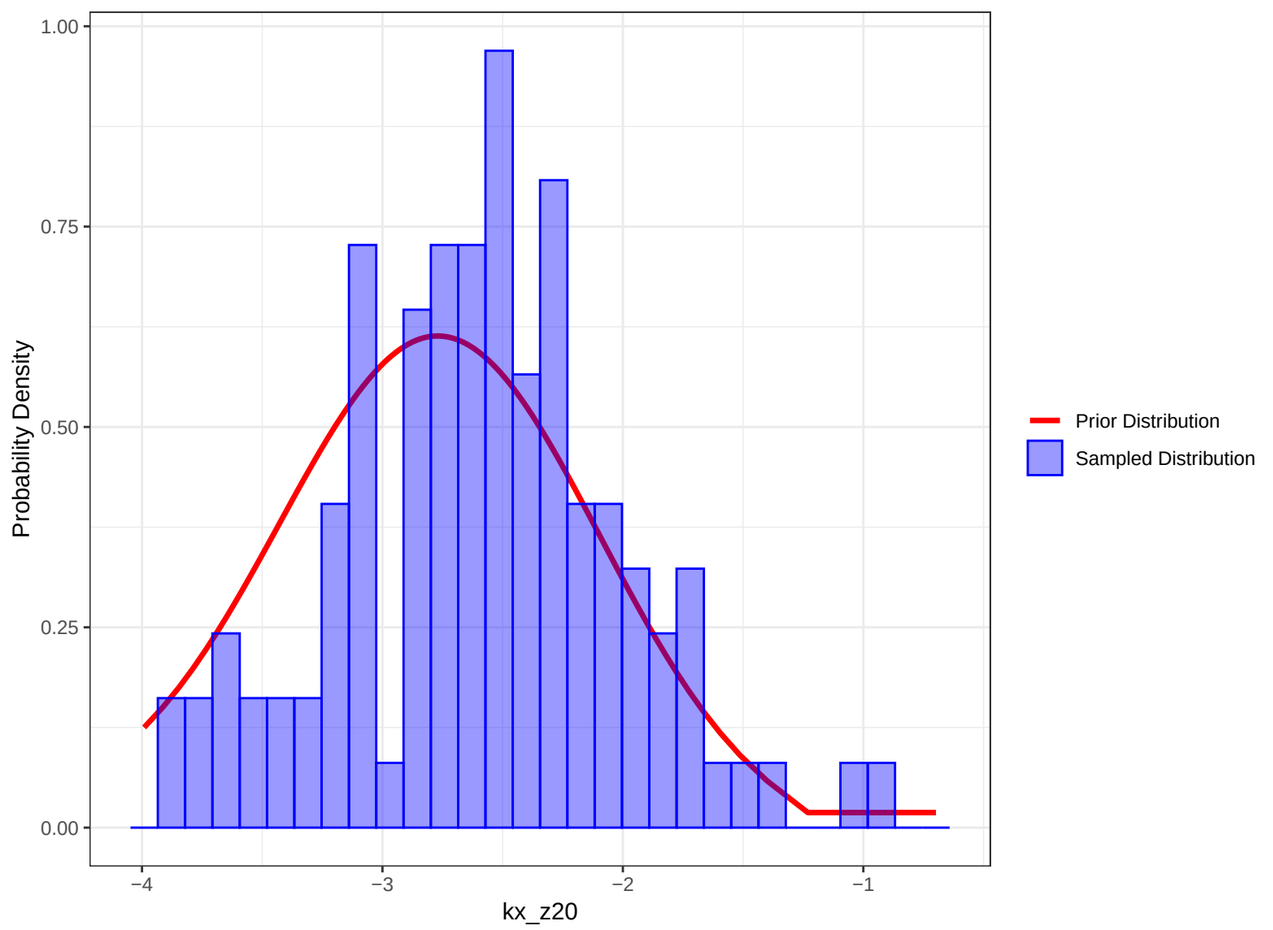
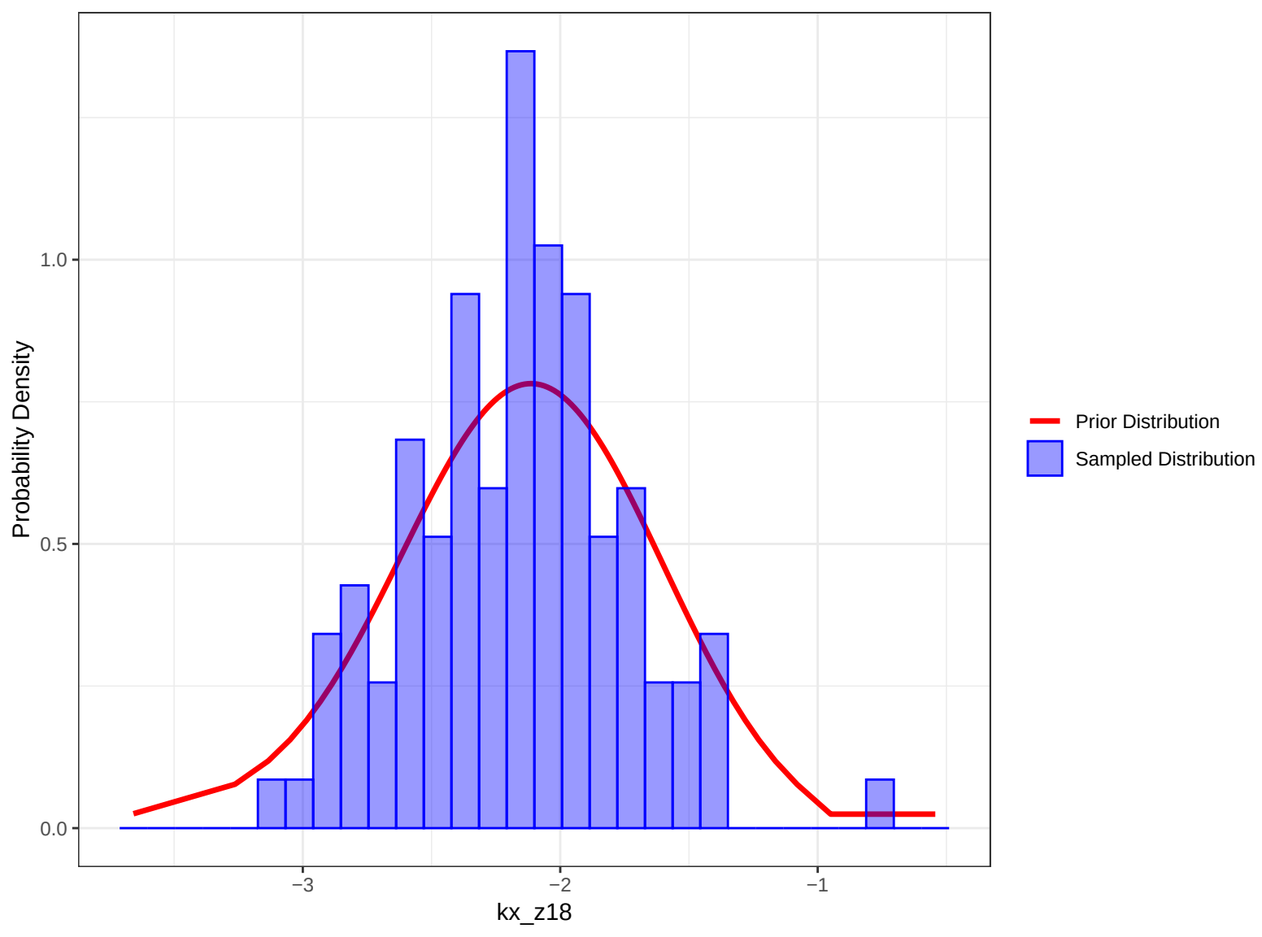
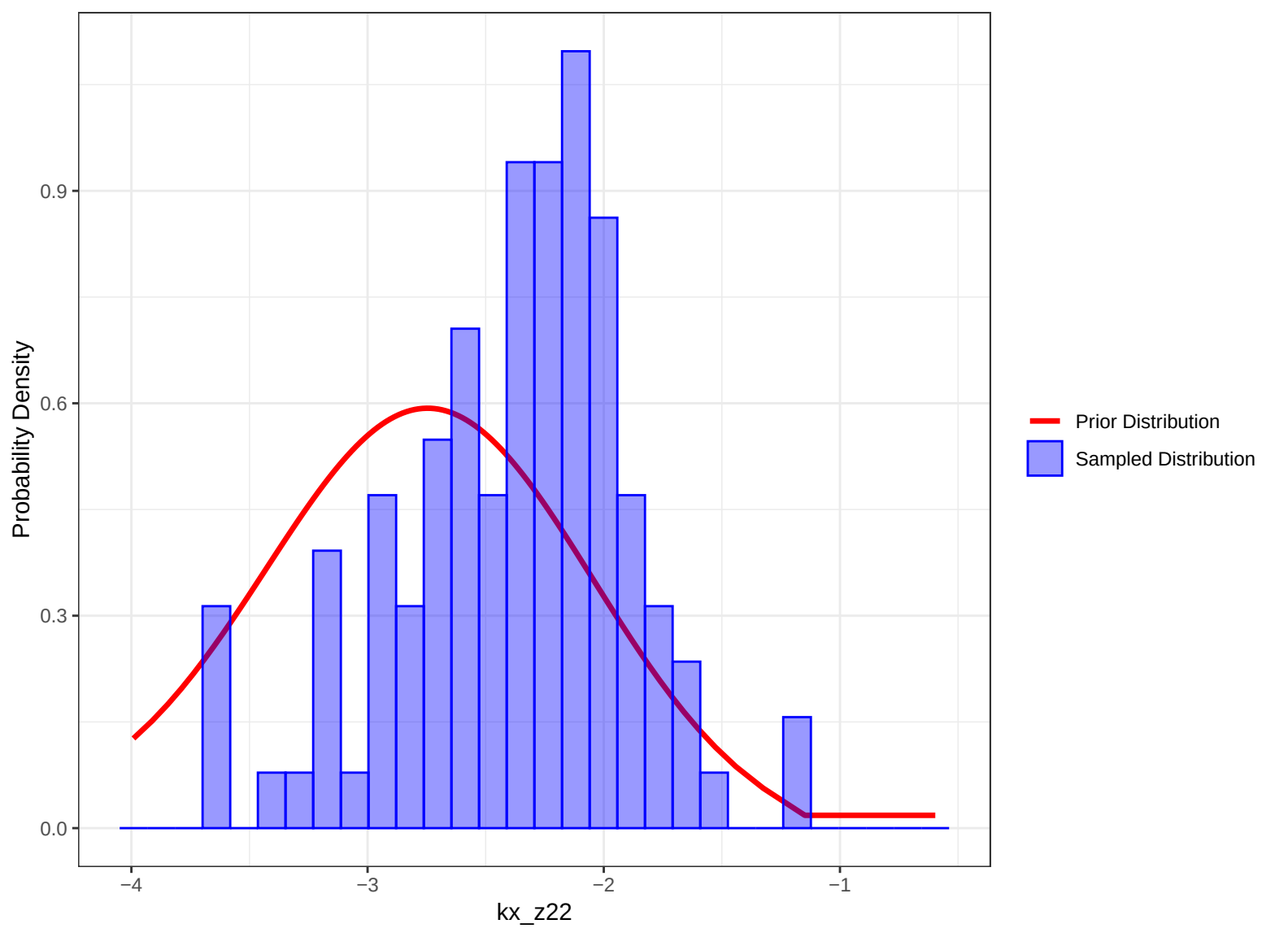
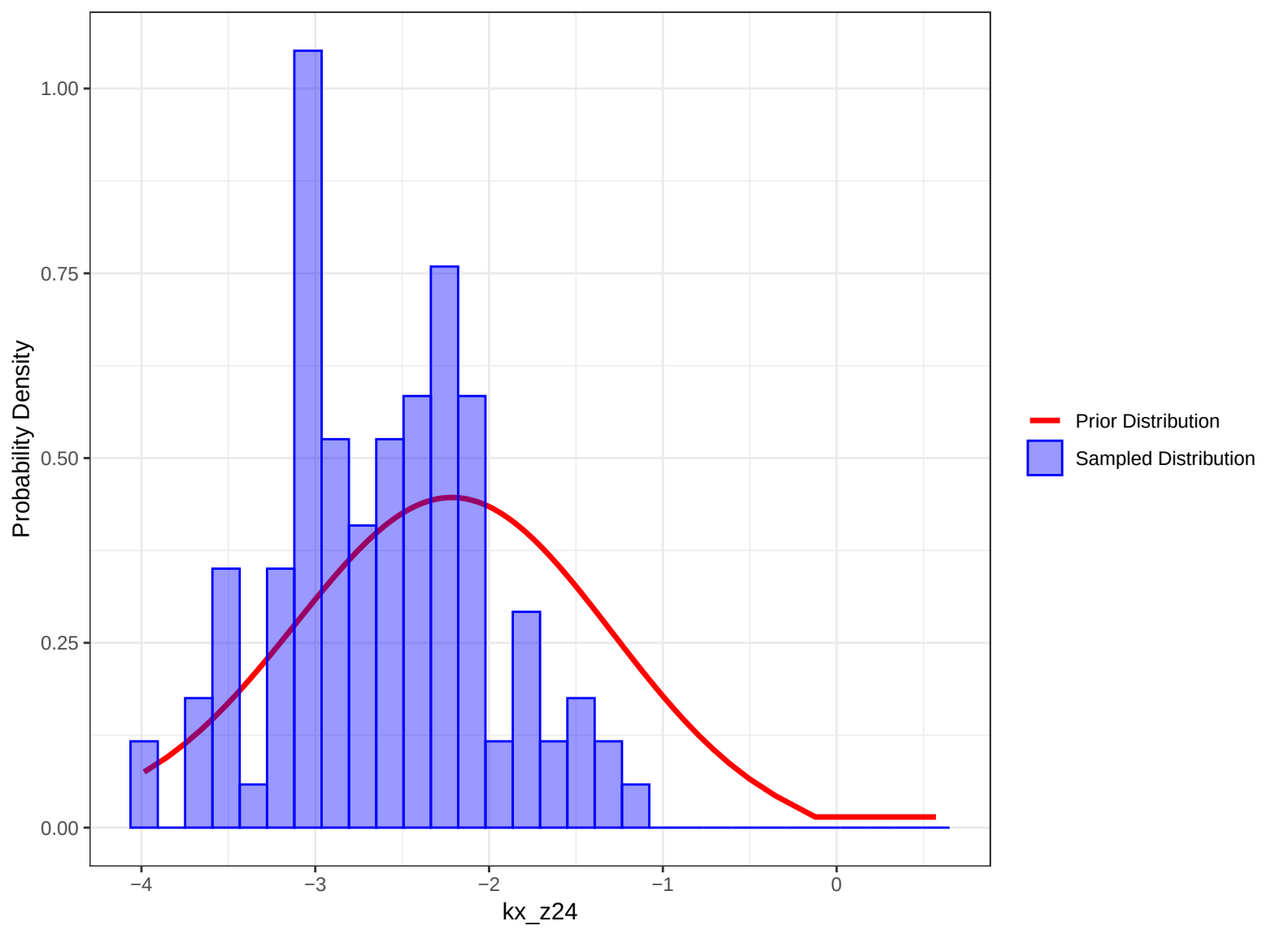
−2
−1
kx_z13
Prior Distribution
Sampled Distribution

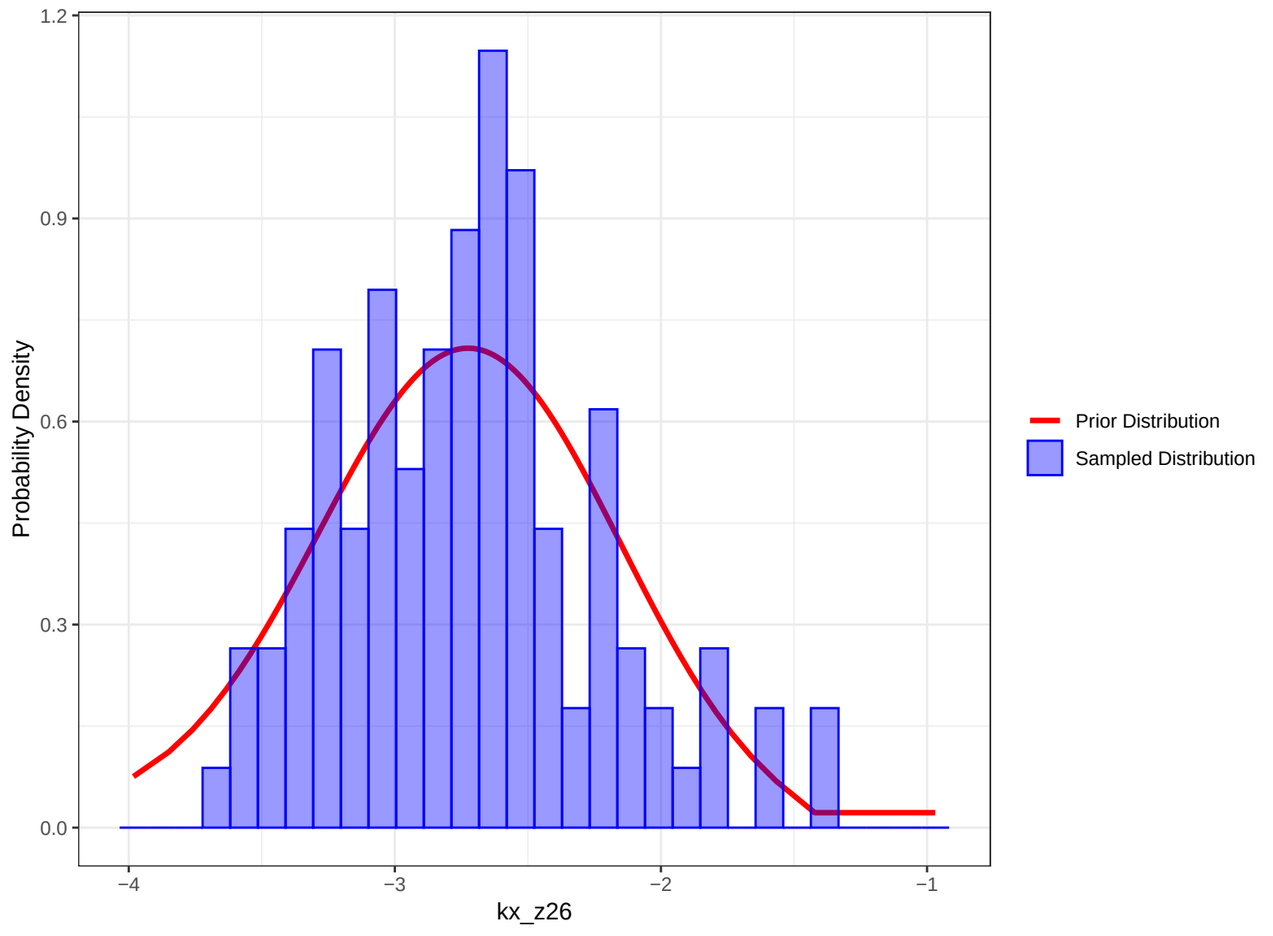

Probability Density
0.00
0.25
0.50
0.75
−4
−3
−2
−1
0
kx_z16
Prior Distribution
Sampled Distribution

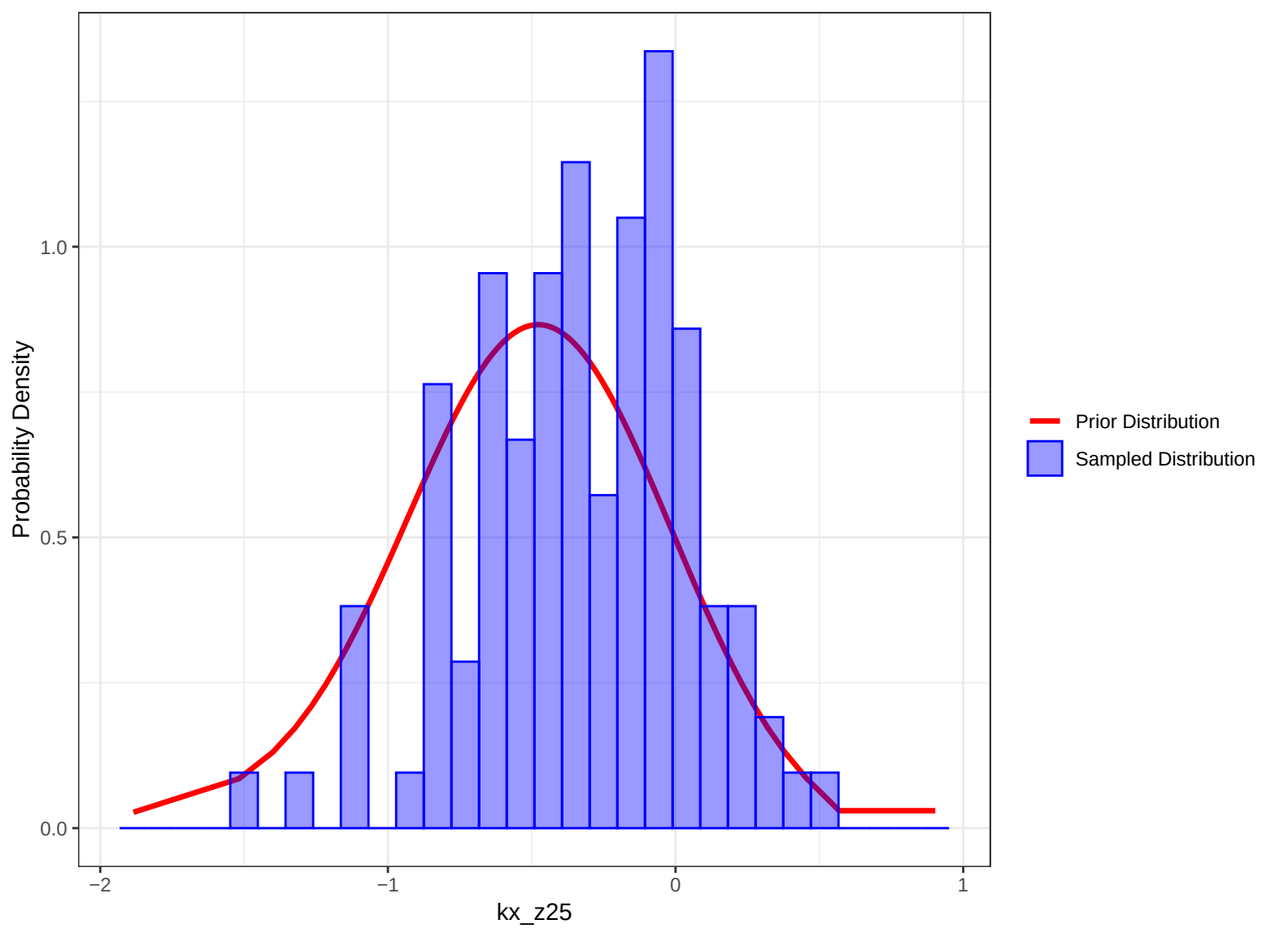

Probability Density
0.00
0.25
0.50
0.75
1.00
−4
−3
−2
−1
kx_z20
Prior Distribution
Sampled Distribution

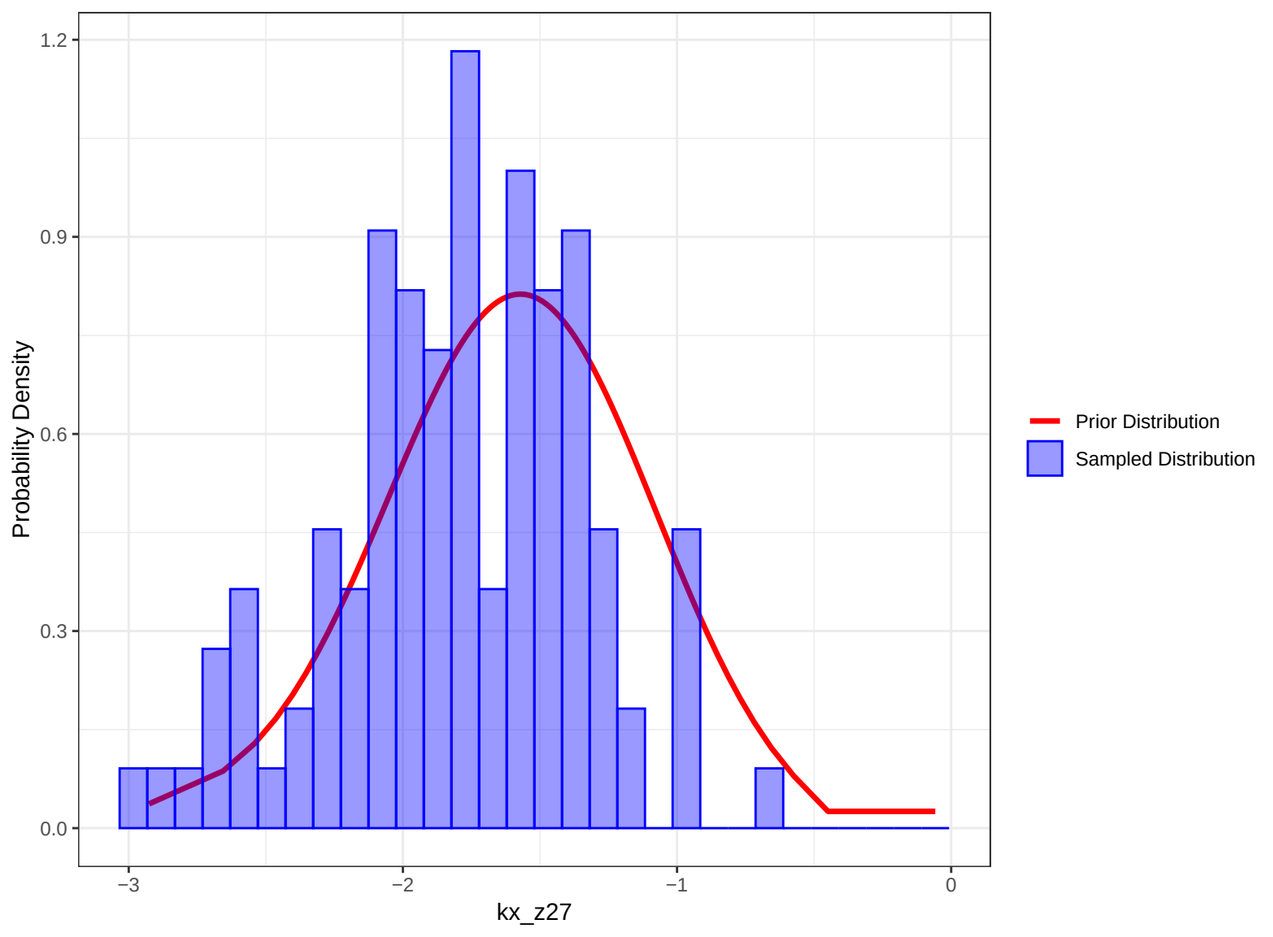

Probability Density
0.0
0.5
1.0
−3
−2
−1
kx_z18
Prior Distribution
Sampled Distribution

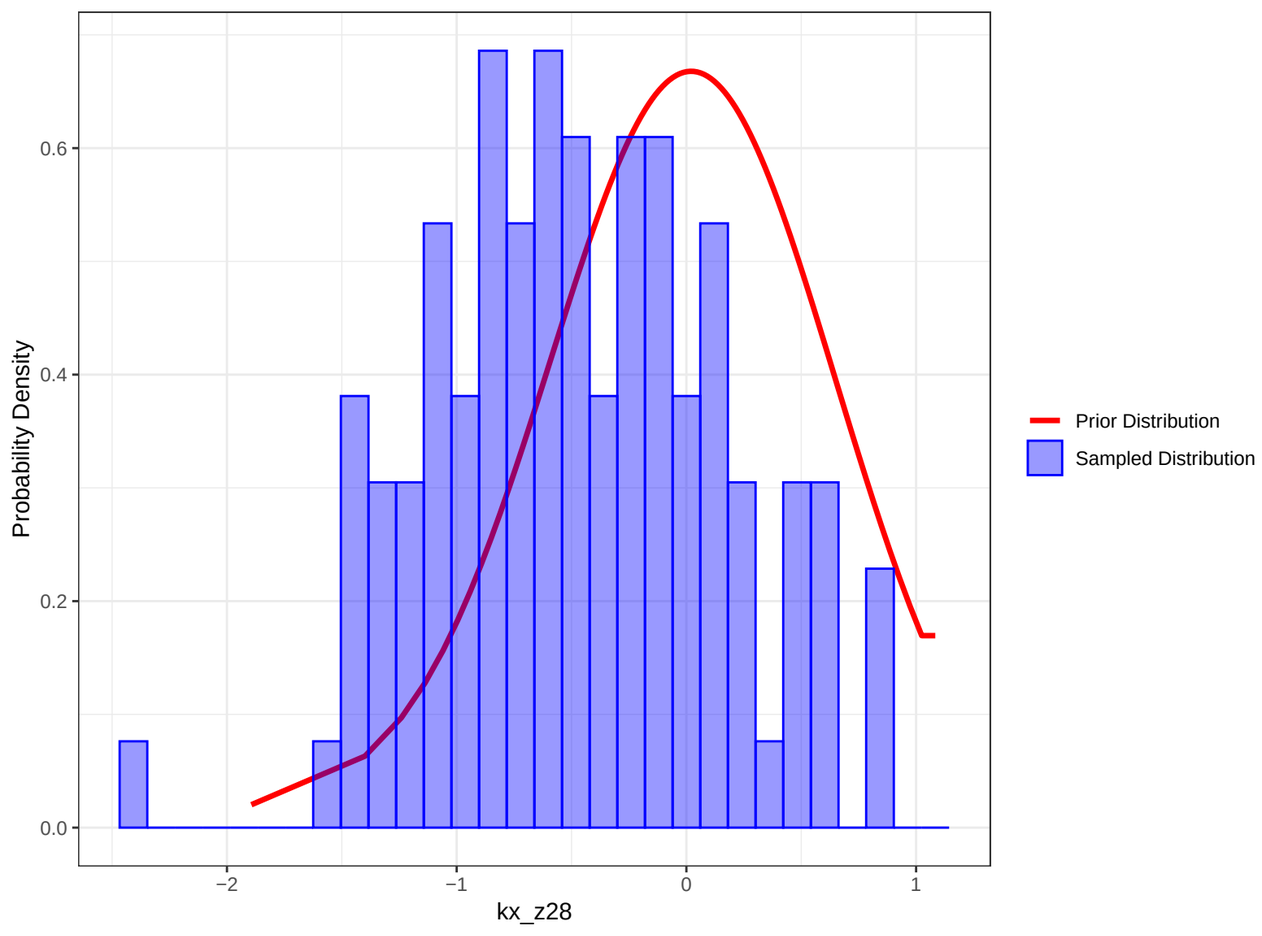

Probability Density
0.0
0.3
0.6
0.9
−4
−3
−2
−1
kx_z22
Prior Distribution
Sampled Distribution

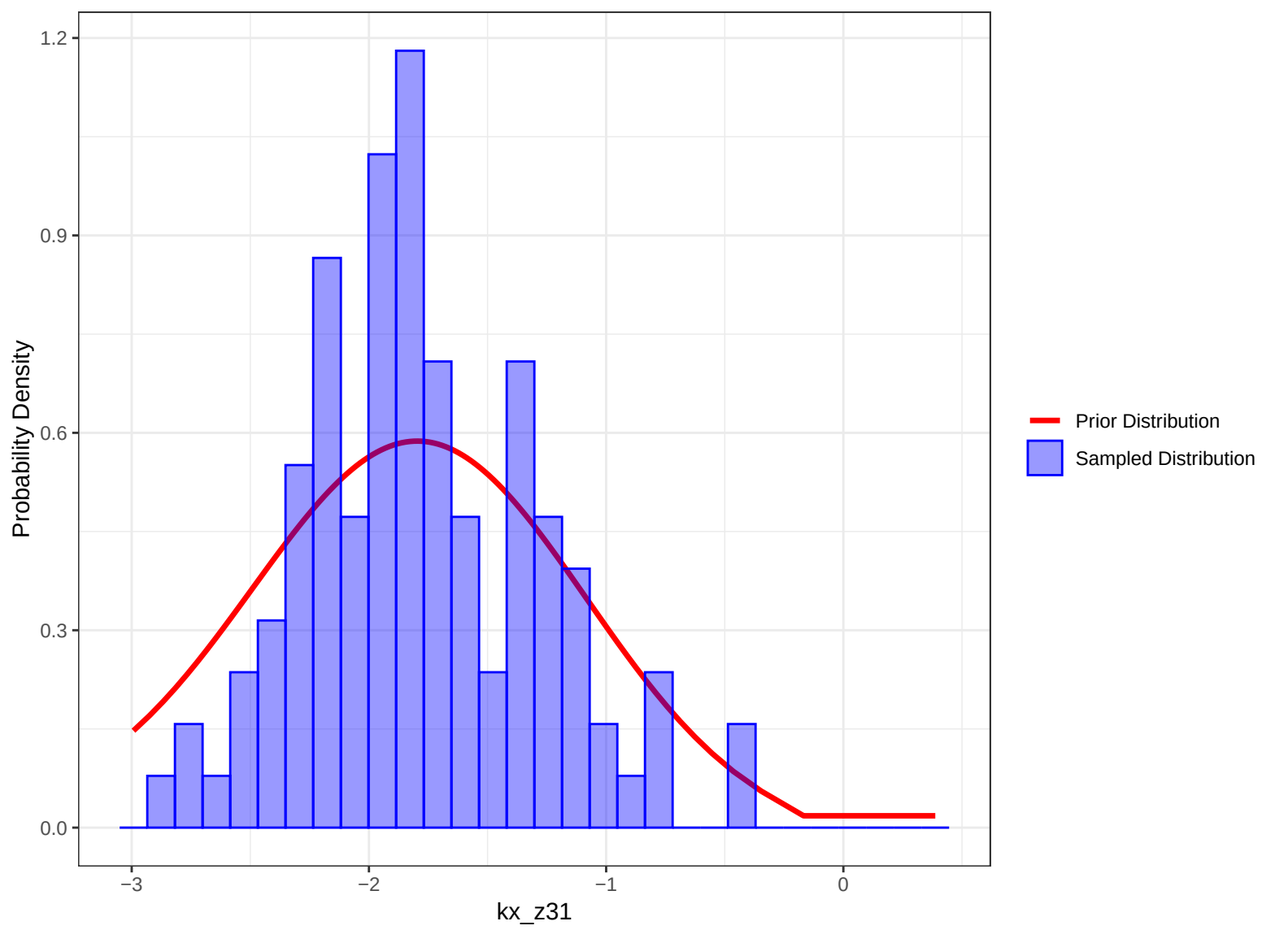

Probability Density
1.00
0.75
0.50
0.25
0.00
−4
−3
−2
−1
0
kx_z24
Prior Distribution
Sampled Distribution

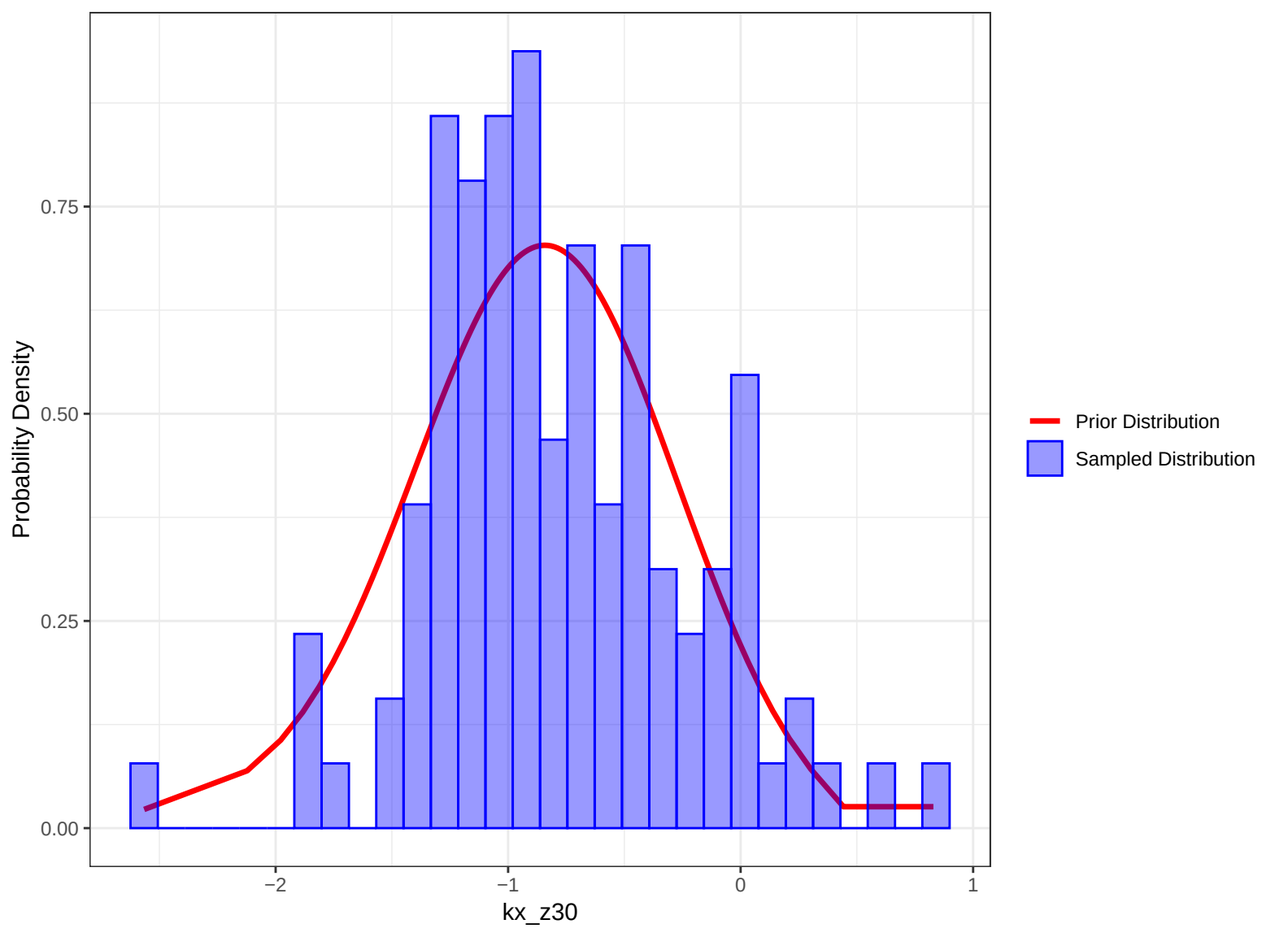

Probability Density
1.2
0.9
0.6
0.3
0.0
−4
−3
−2
−1
kx_z26
Prior Distribution
Sampled Distribution

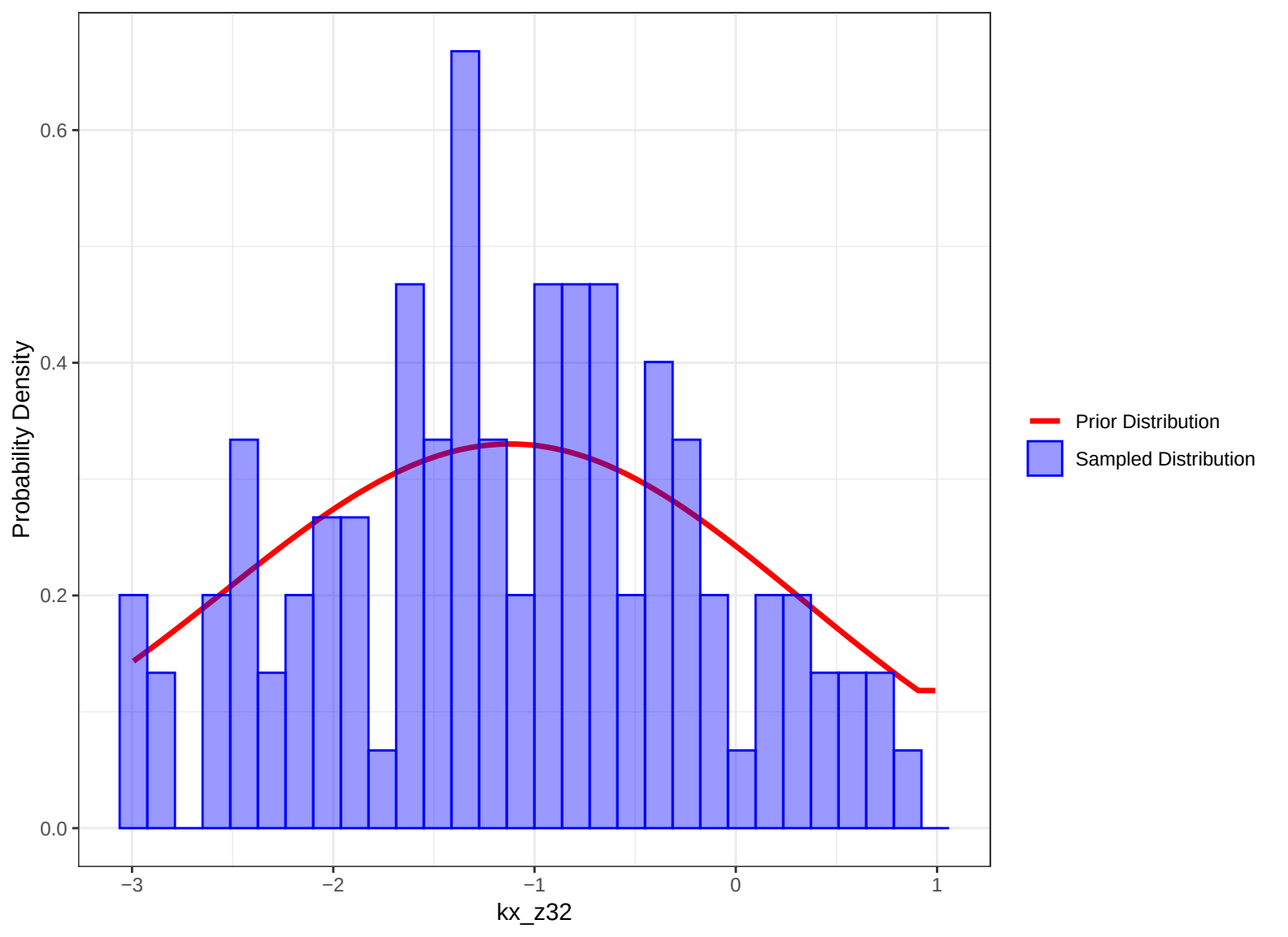

Probability Density
1.0
0.5
0.0
−2
−1
0
1
kx_z25
Prior Distribution
Sampled Distribution

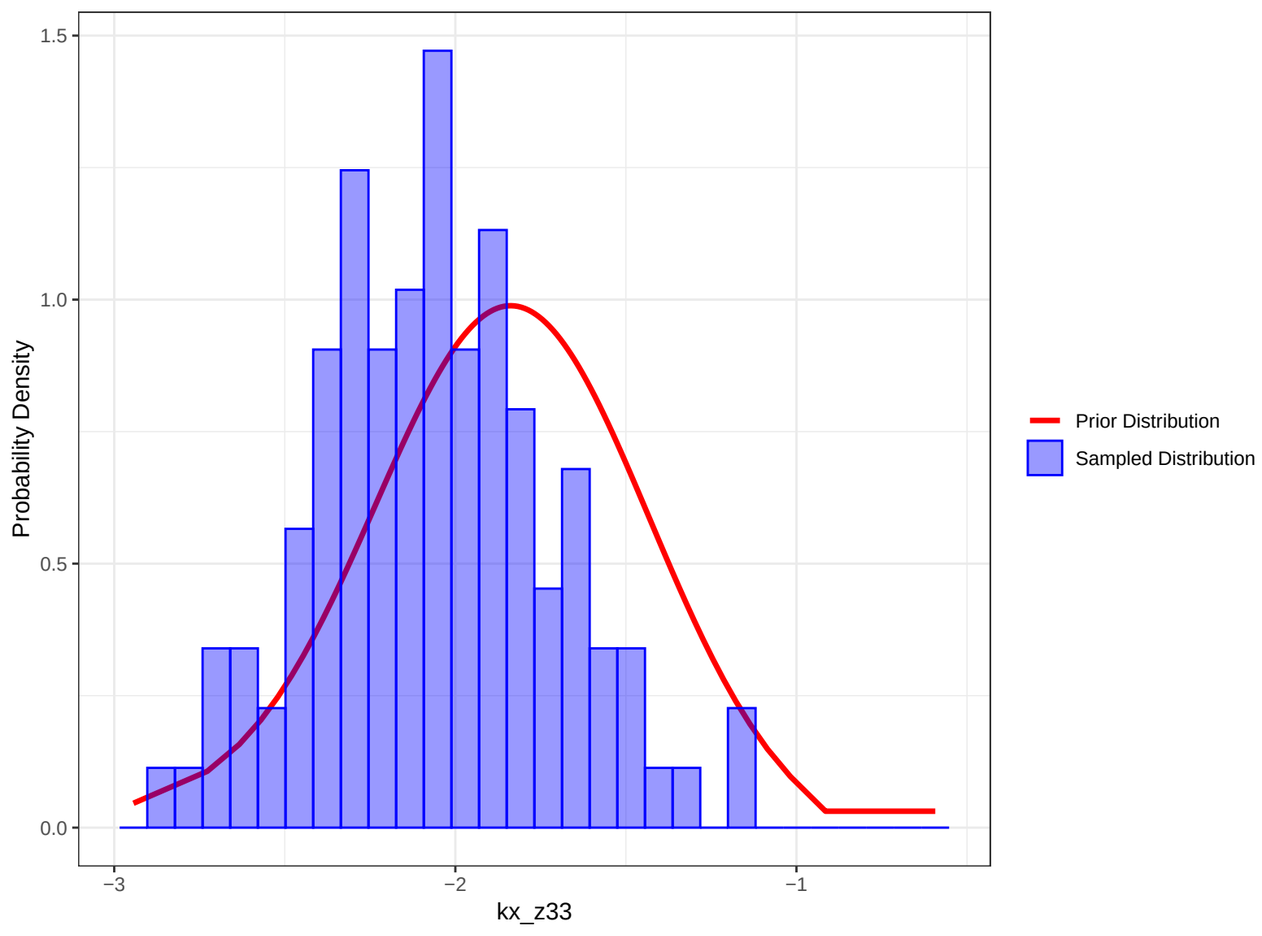

Probability Density
1.2
0.9
0.6
0.3
0.0
−3
−2
−1
0
kx_z27
Prior Distribution
Sampled Distribution

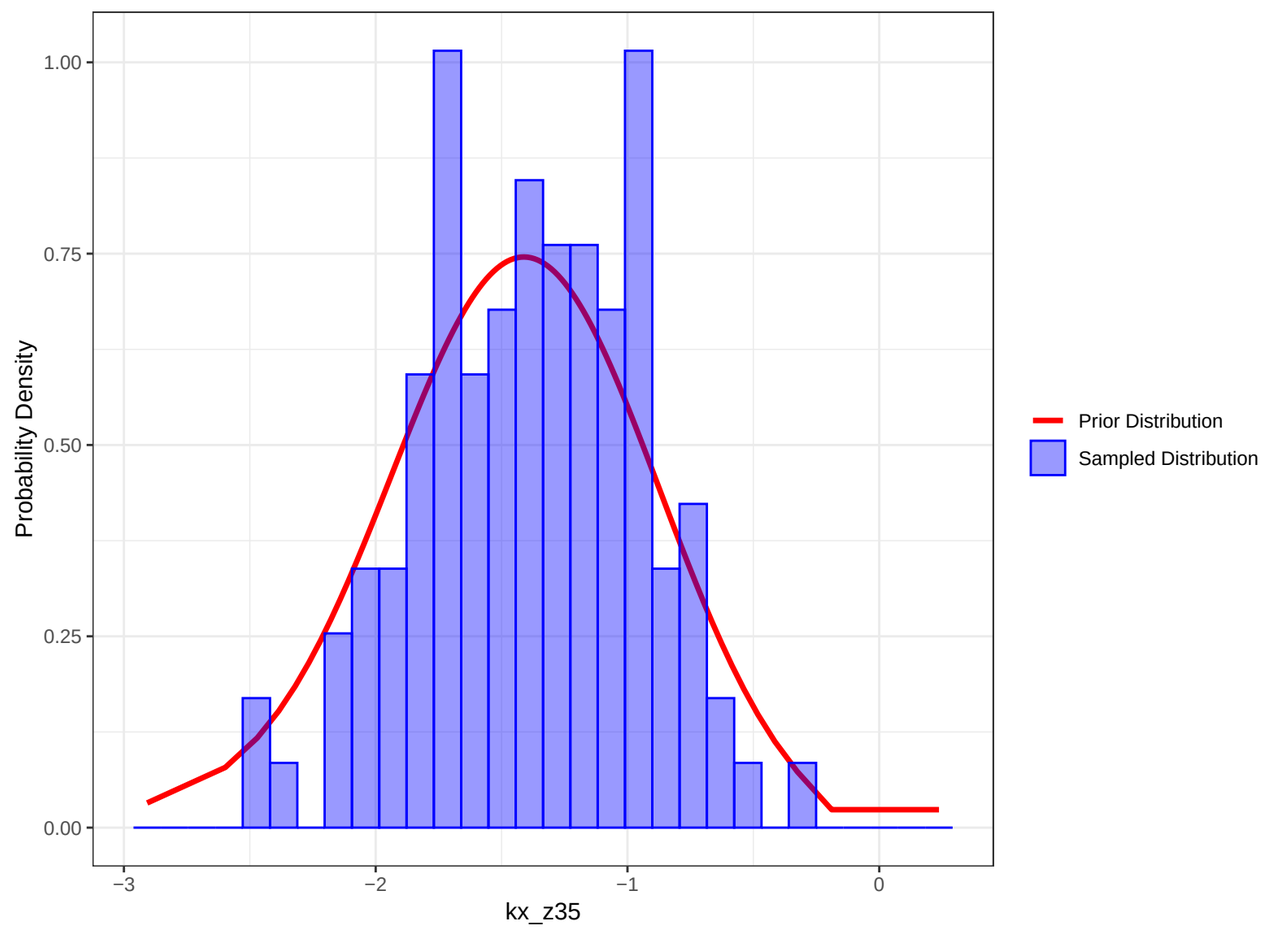

Probability Density
0.0
0.2
0.4
0.6
−2
−1
0
1
kx_z28
Prior Distribution
Sampled Distribution

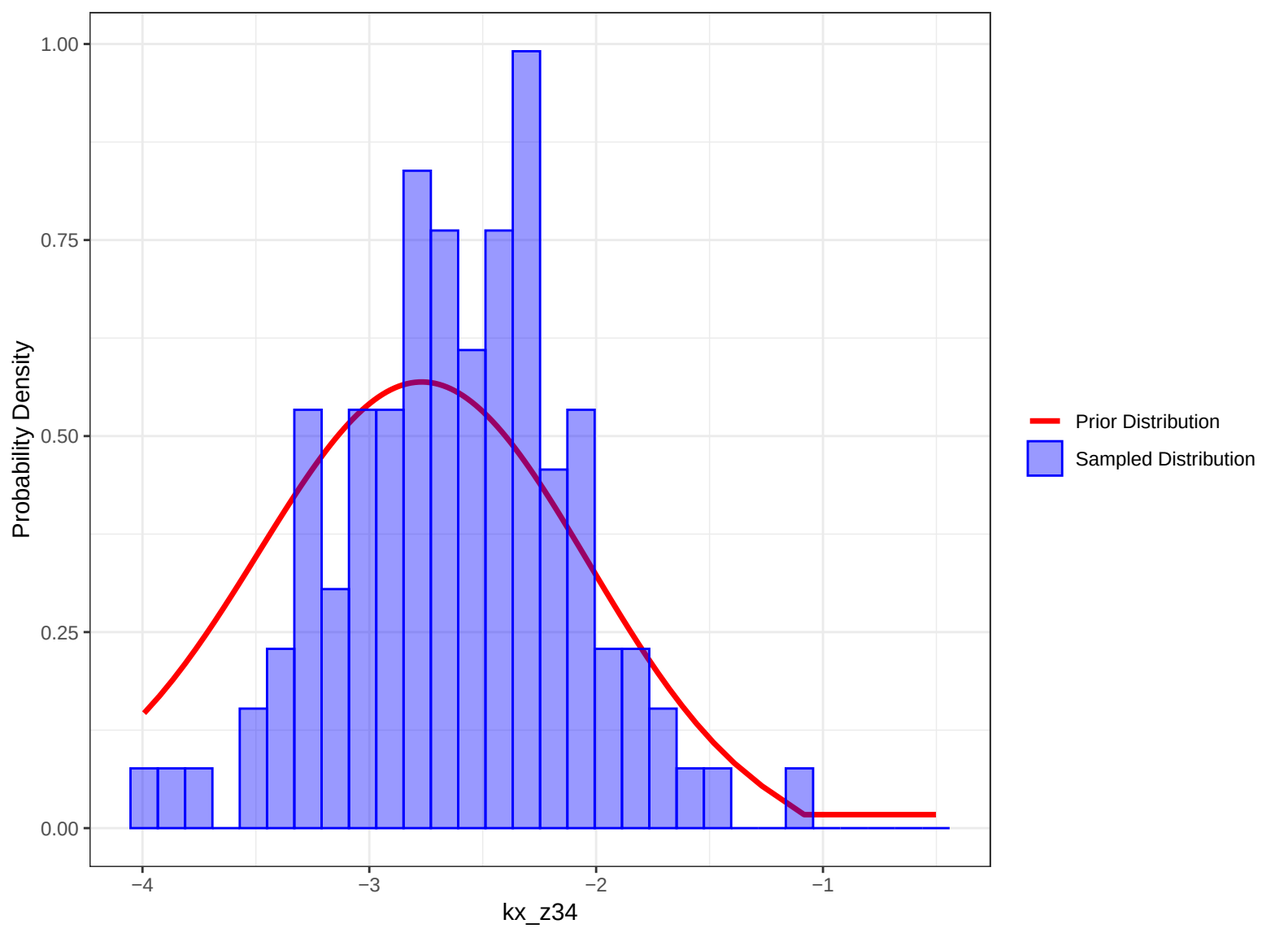

Probability Density
0.0
0.3
0.6
0.9
1.2
−3
−2
−1
0
kx_z31
Prior Distribution
Sampled Distribution

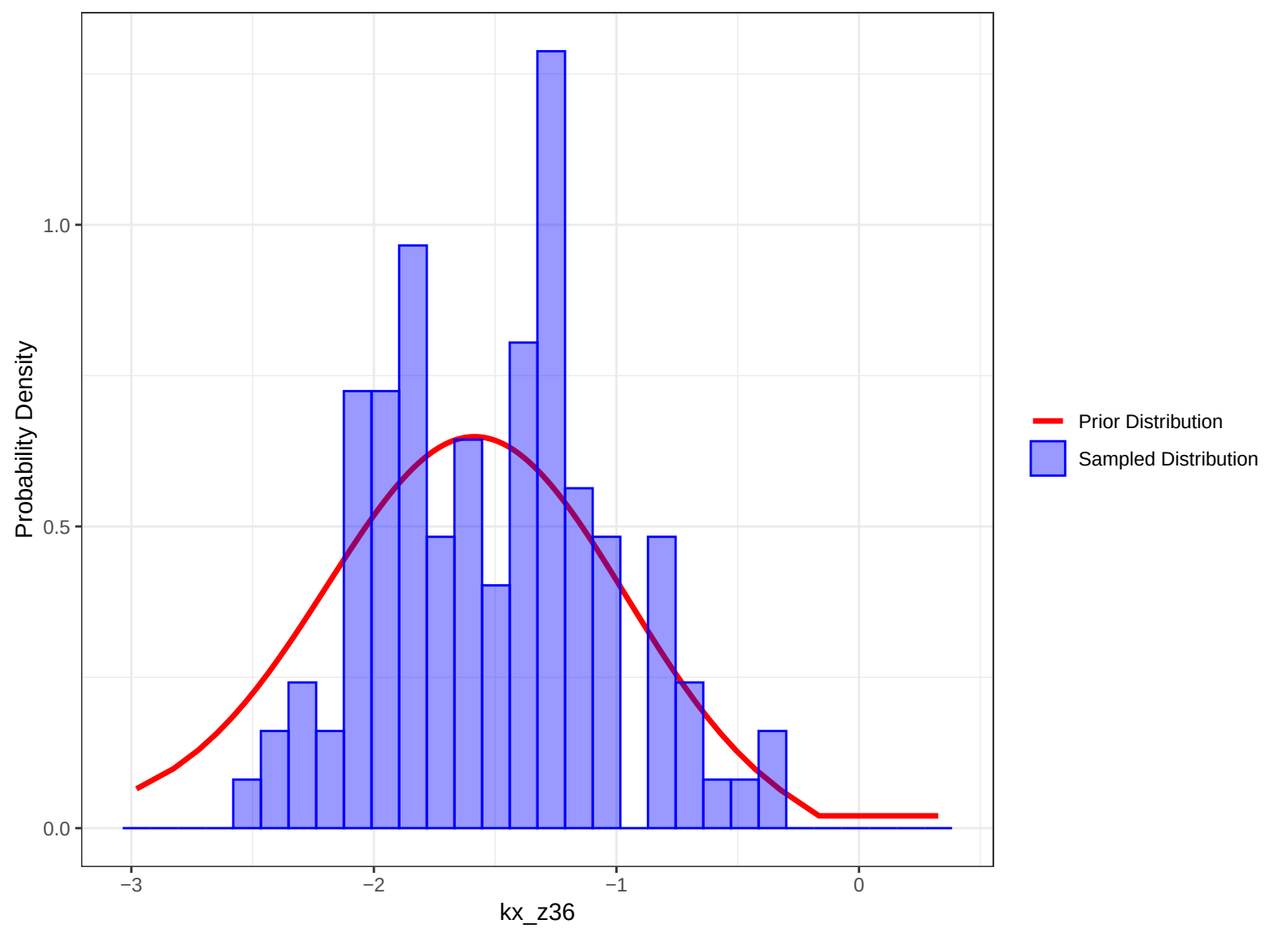

Probability Density
0.00
0.25
0.50
0.75
−2
−1
0
1
kx_z30
Prior Distribution
Sampled Distribution

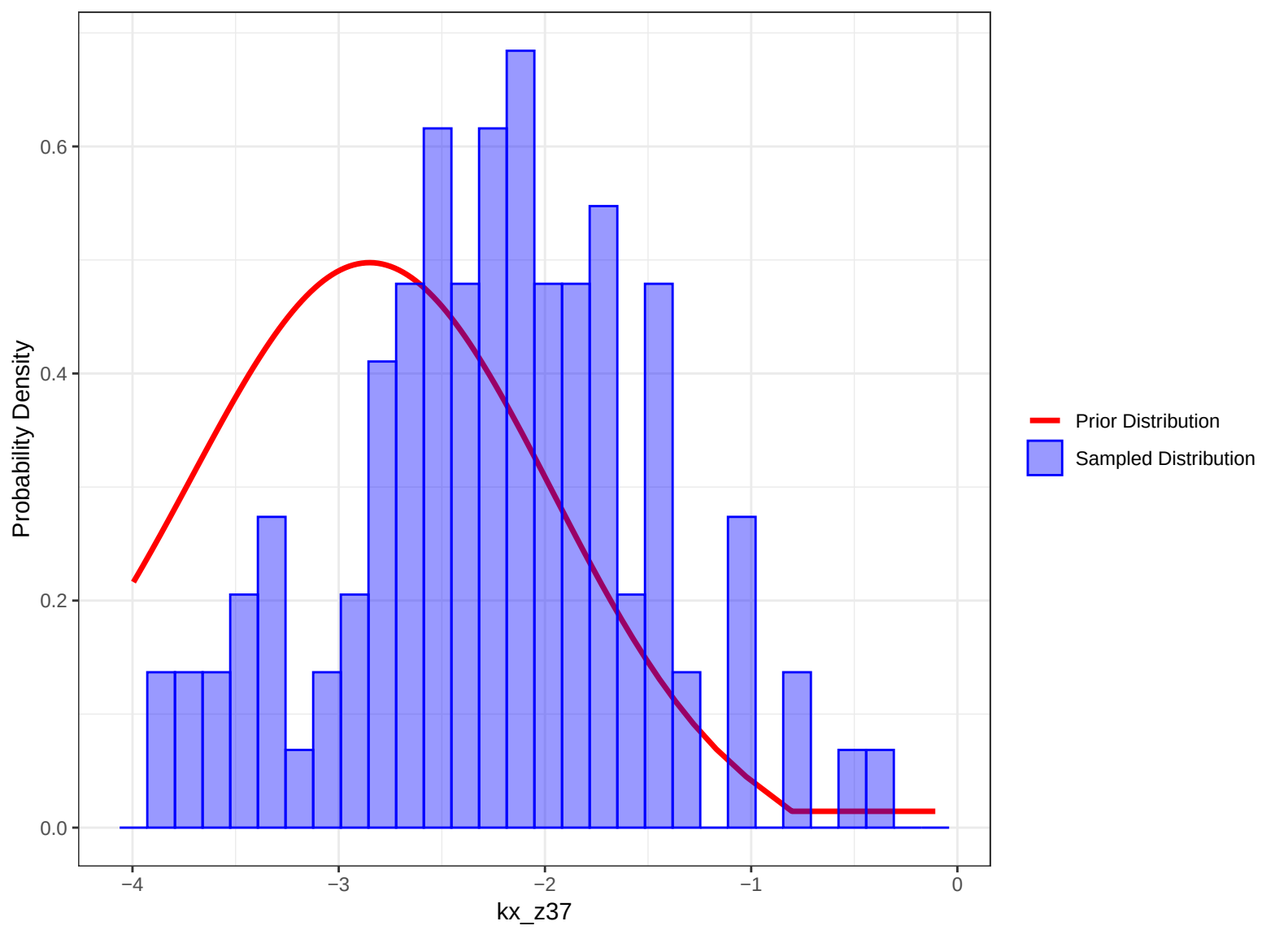

Probability Density
0.0
0.2
0.4
0.6
−3
−2
−1
0
1
kx_z32
Prior Distribution
Sampled Distribution

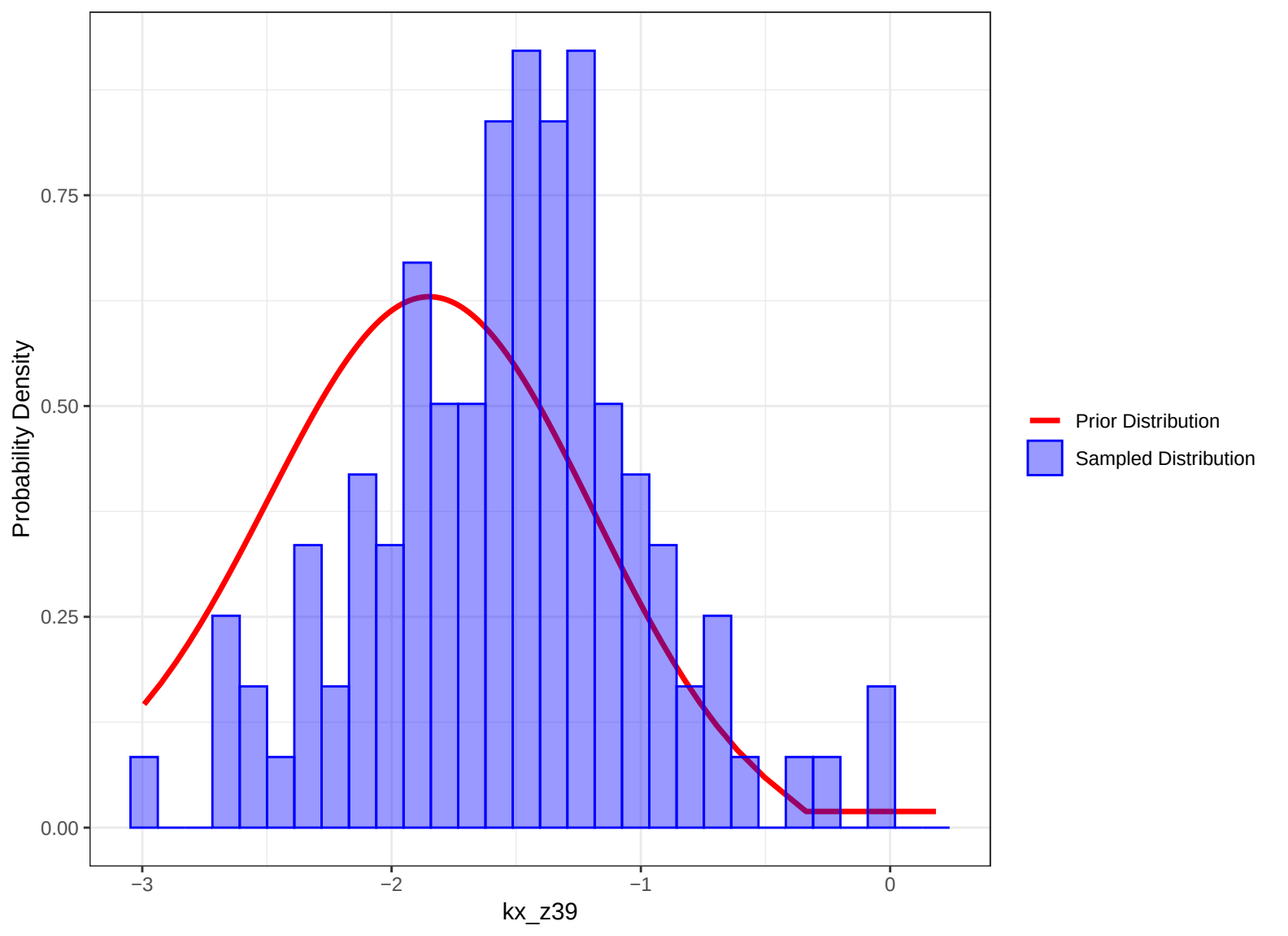

Probability Density
1.5
1.0
0.5
0.0
−3
−2
−1
kx_z33
Prior Distribution
Sampled Distribution

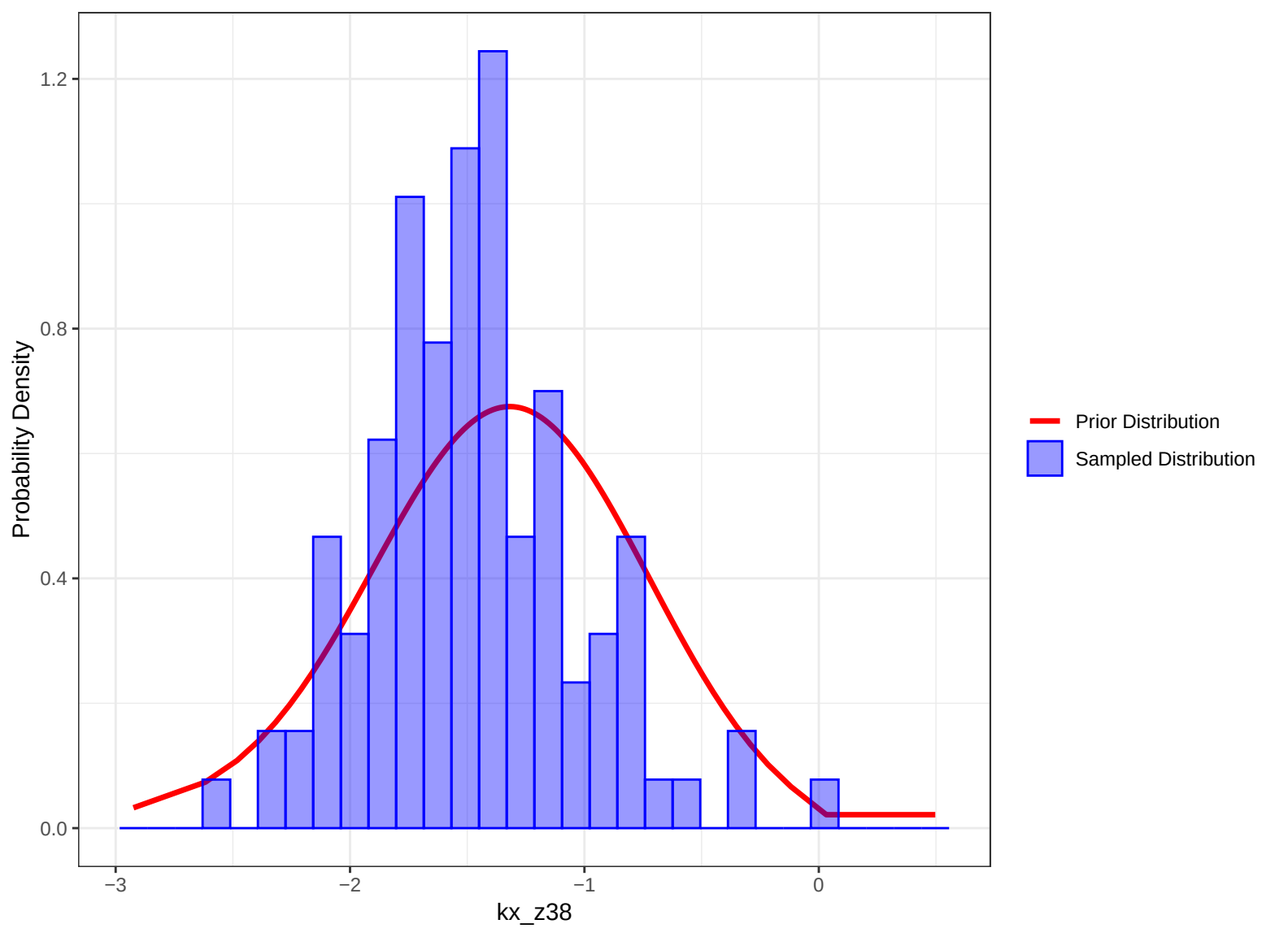

Probability Density
1.00
0.75
0.50
0.25
0.00
−3
−2
−1
0
kx_z35
Prior Distribution
Sampled Distribution

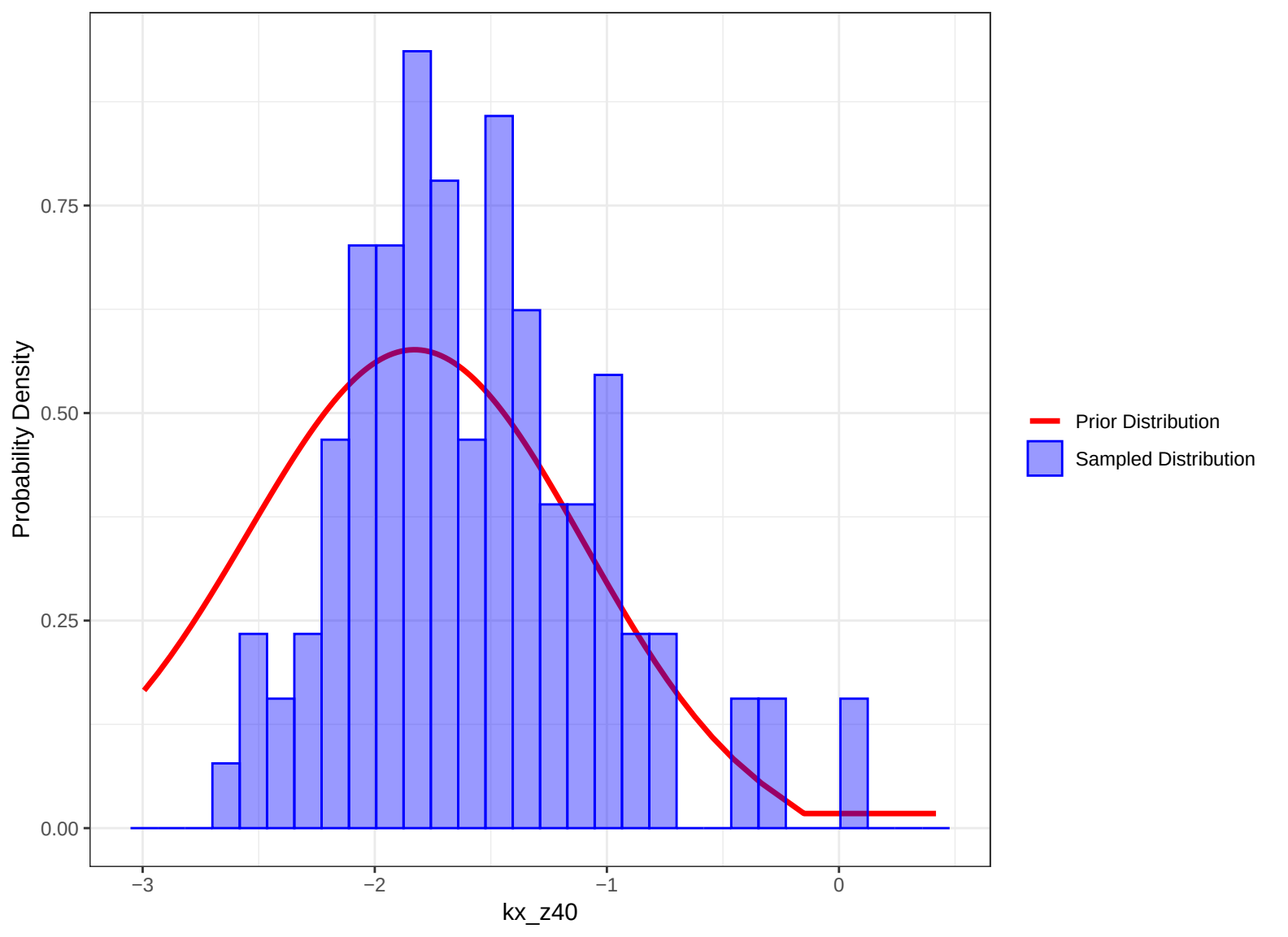

Probability Density
1.00
0.75
0.50
0.25
0.00
−4
−3
−2
−1
kx_z34
Prior Distribution
Sampled Distribution

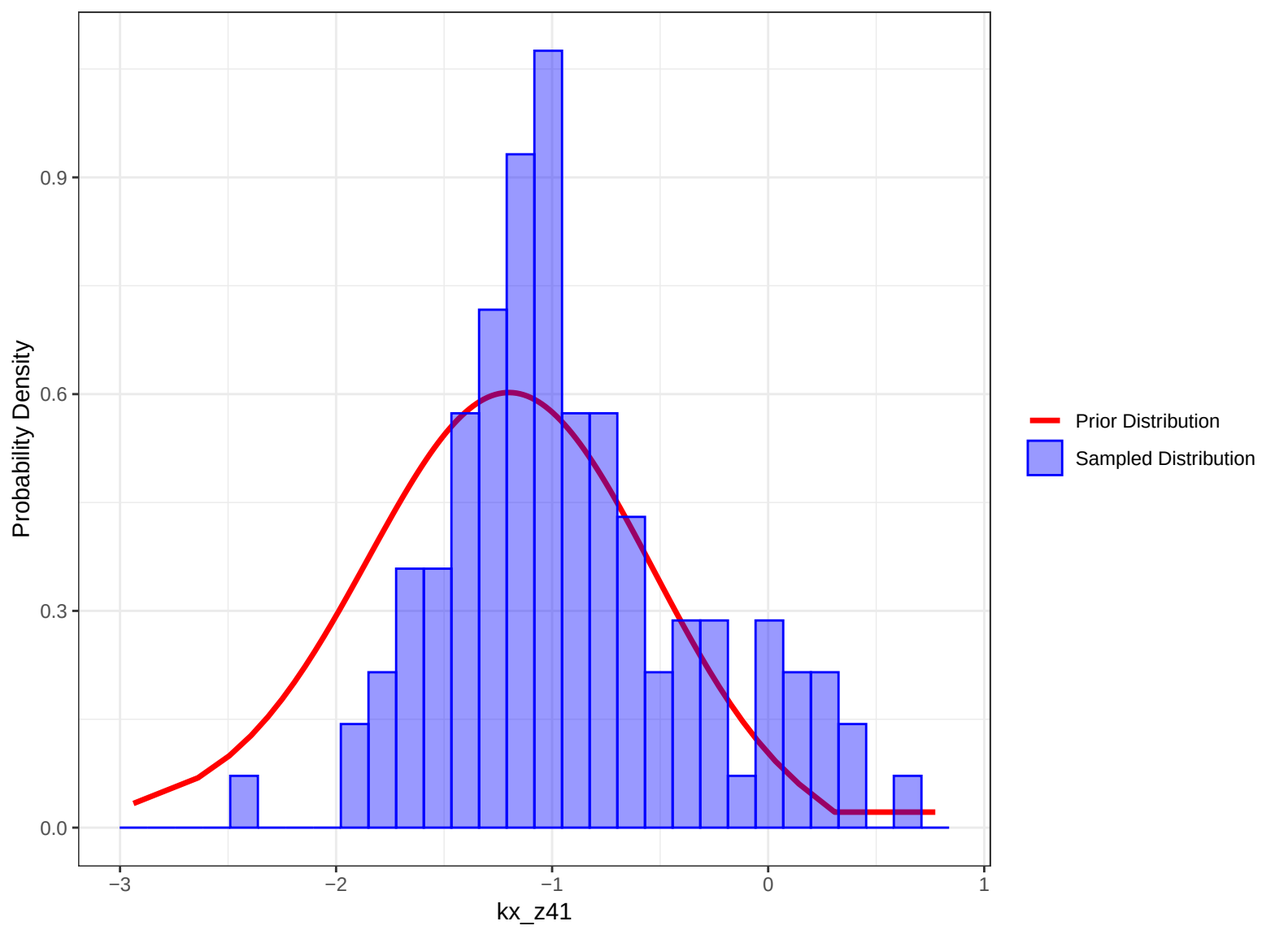

Probability Density
1.0
0.5
0.0
−3
−2
−1
0
kx_z36
Prior Distribution
Sampled Distribution

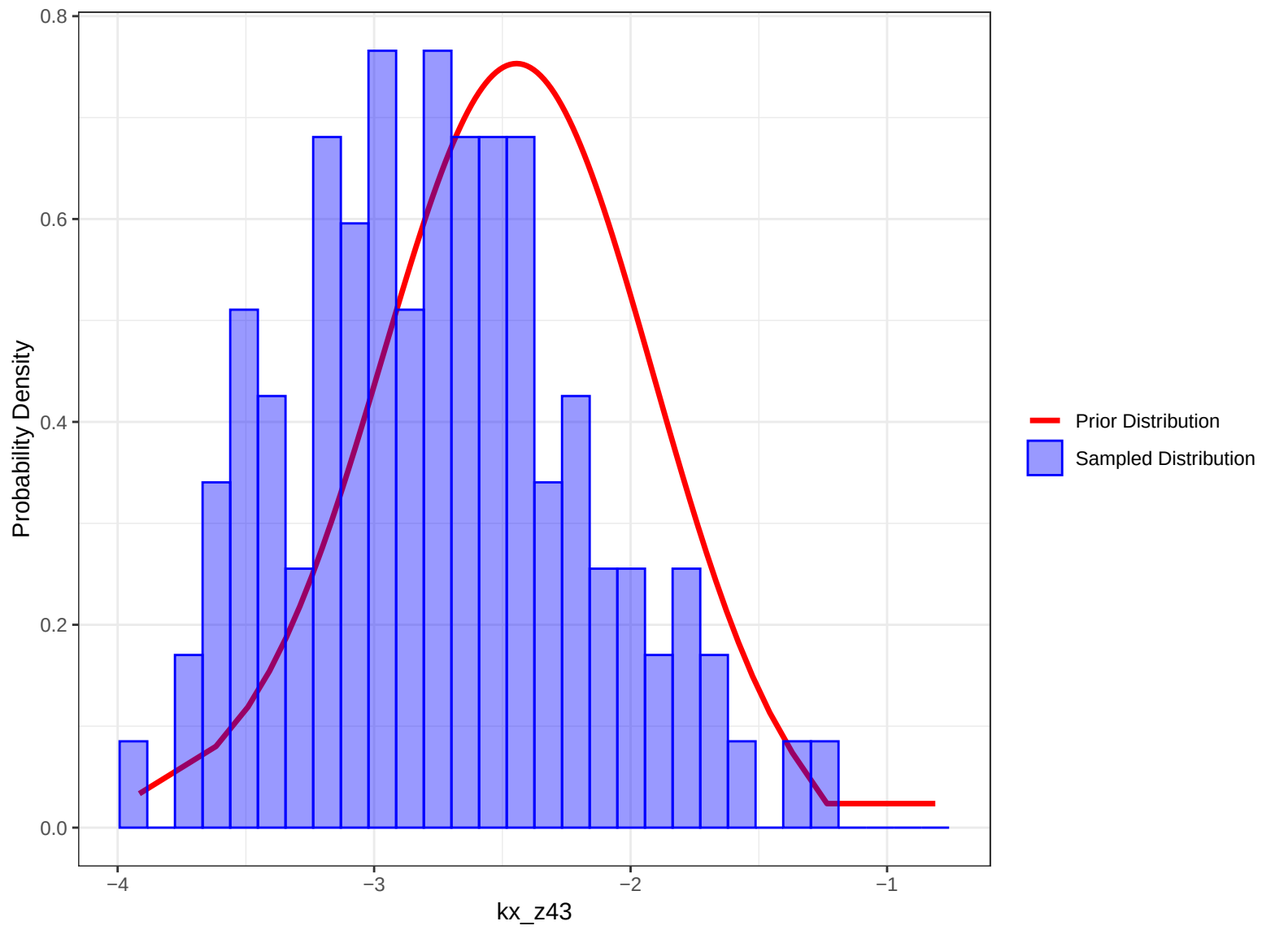

Probability Density
0.0
0.2
0.4
0.6
−4
−3
−2
−1
0
kx_z37
Prior Distribution
Sampled Distribution

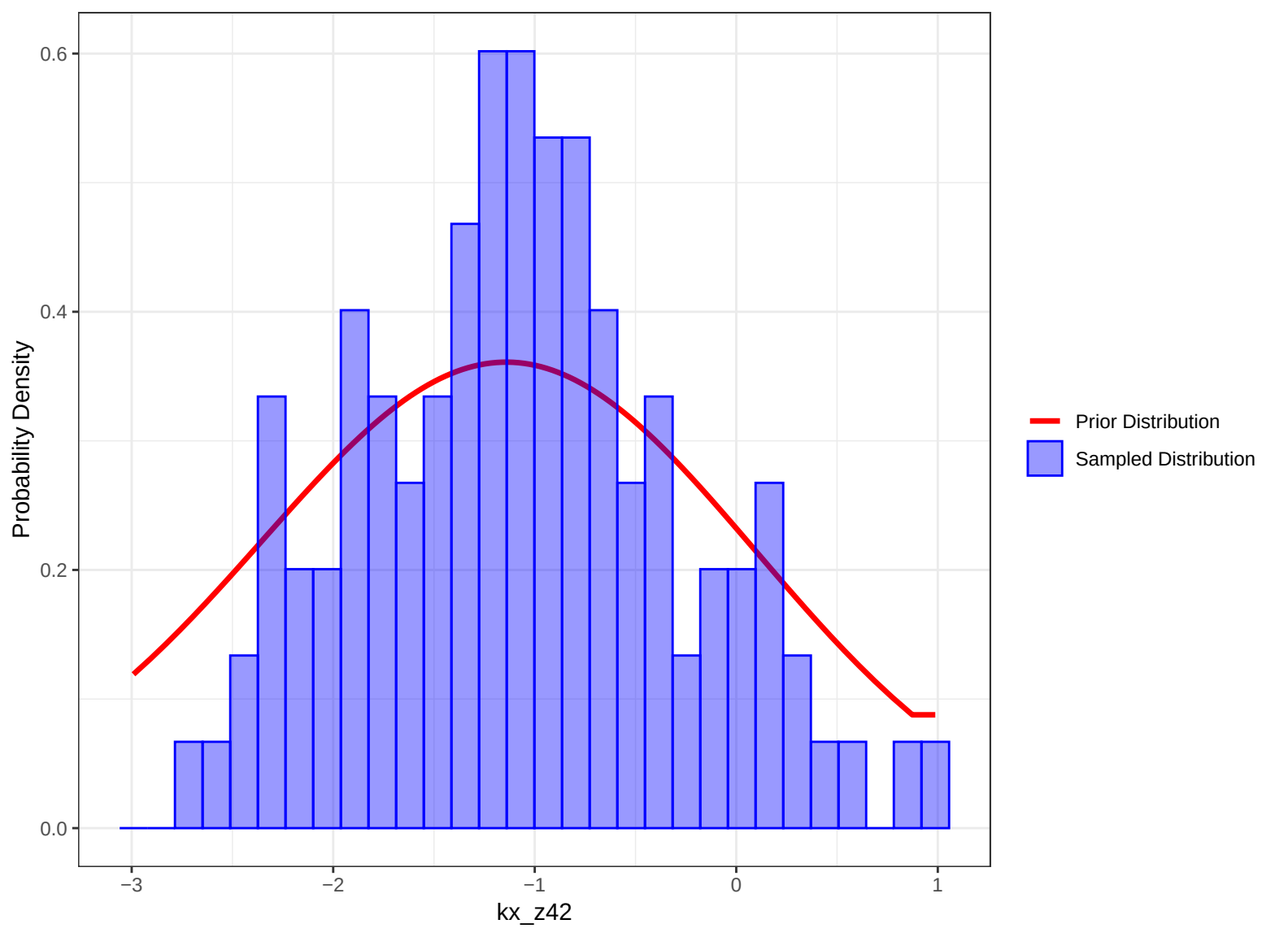

Probability Density
0.00
0.25
0.50
0.75
−3
−2
−1
0
kx_z39
Prior Distribution
Sampled Distribution

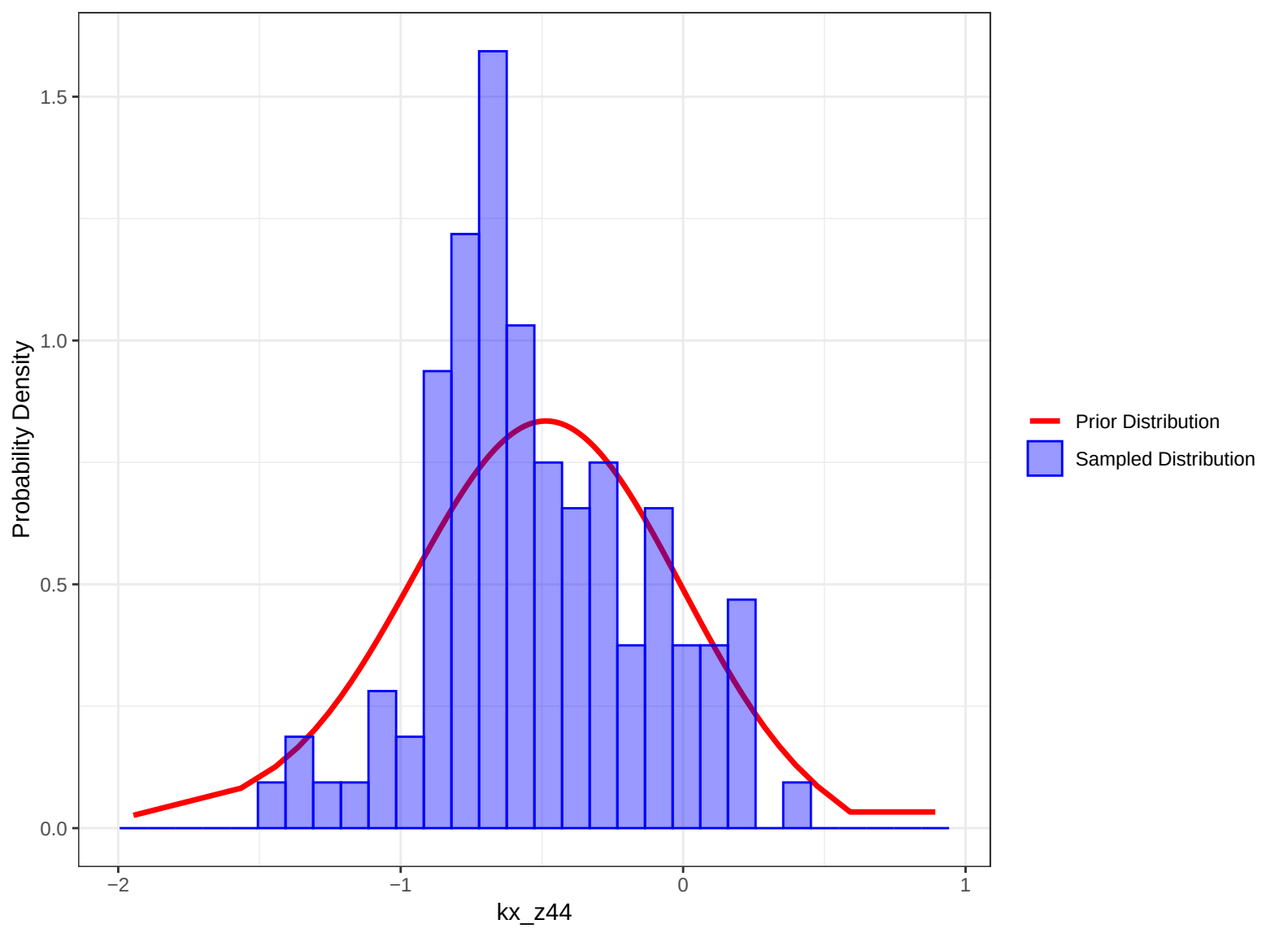

Probability Density
0.0
0.4
0.8
1.2
−3
−2
−1
0
kx_z38
Prior Distribution
Sampled Distribution

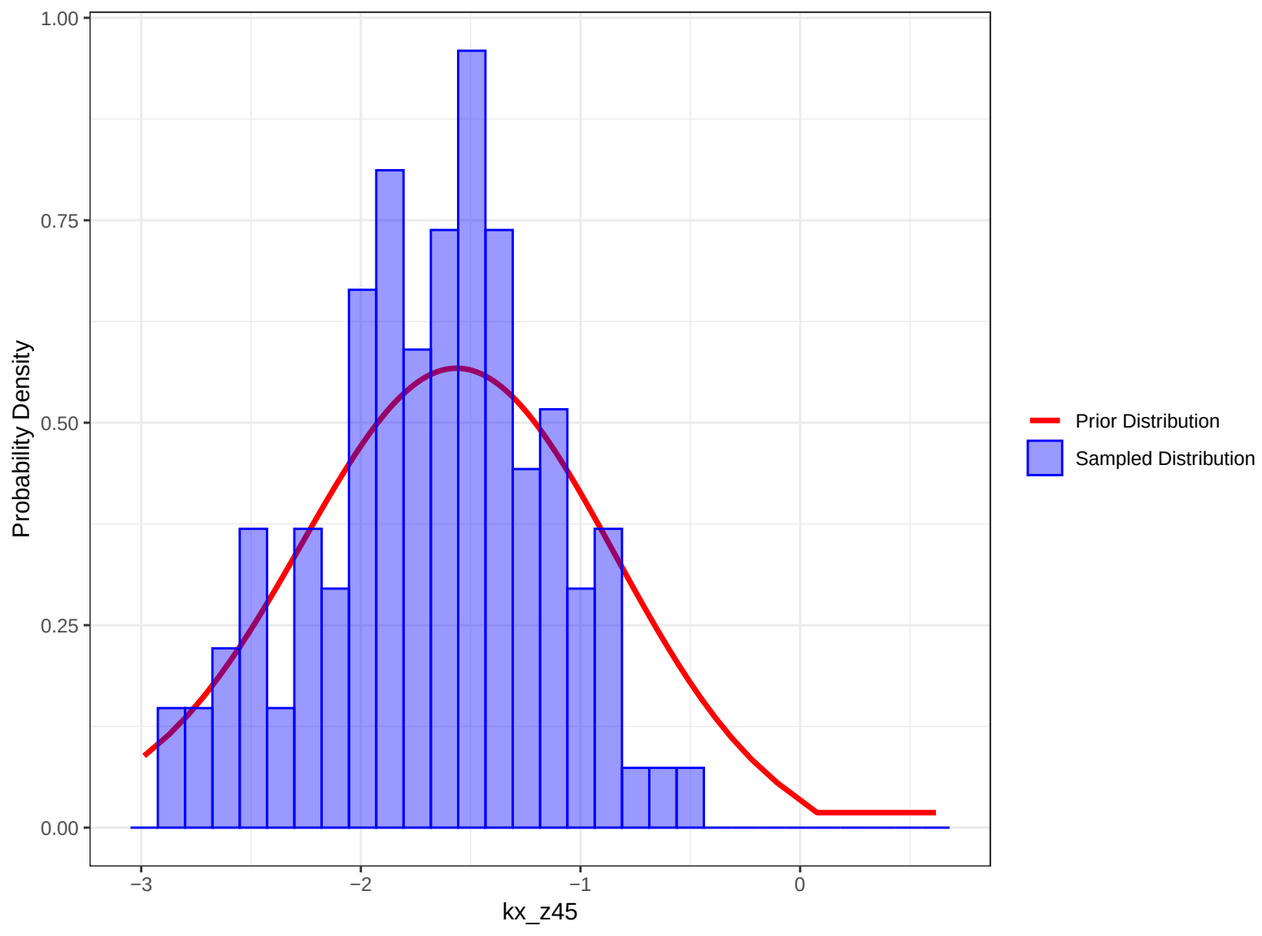

Probability Density
0.00
0.25
0.50
0.75
−3
−2
−1
0
kx_z40
Prior Distribution
Sampled Distribution

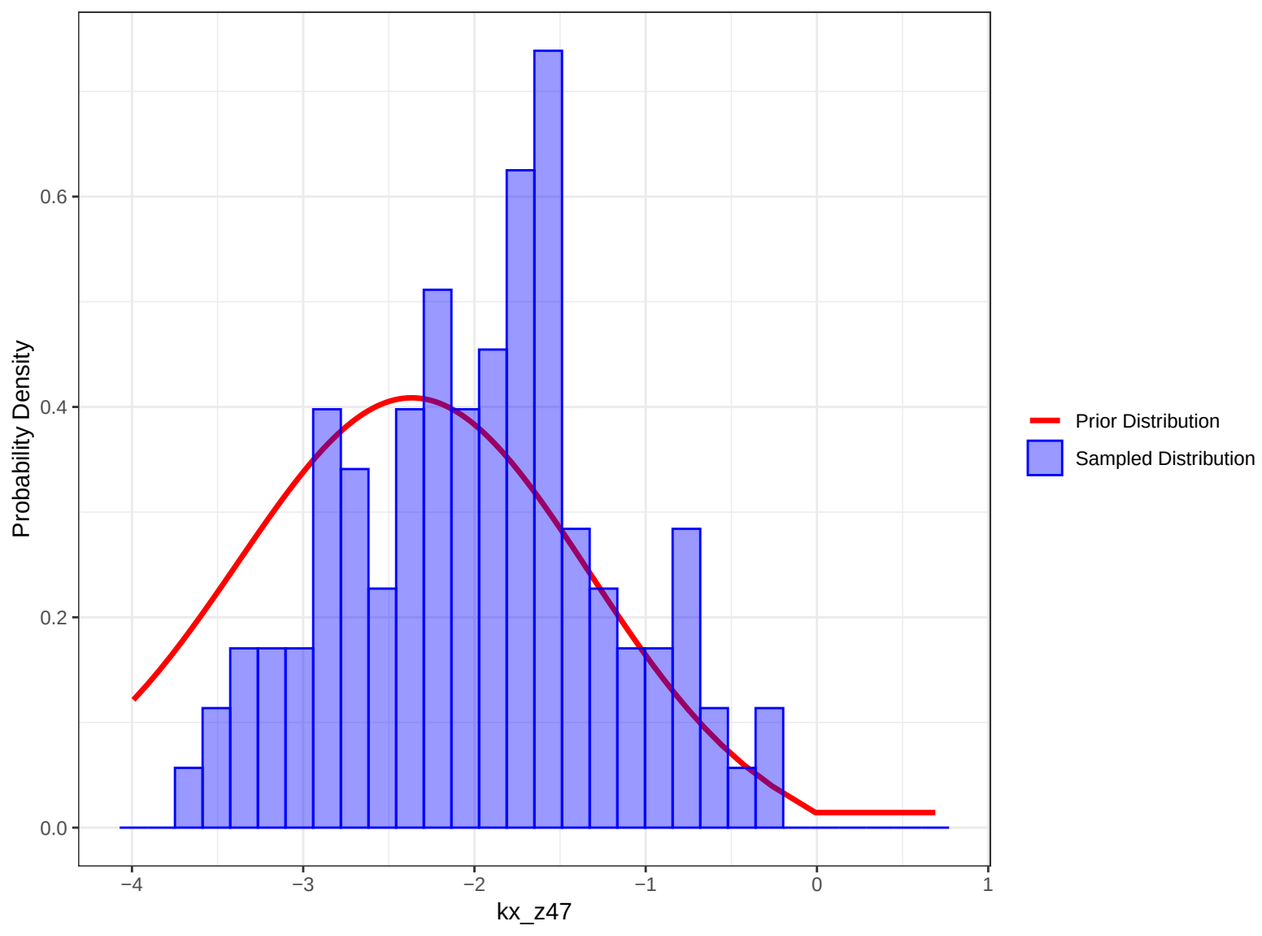

Probability Density
0.0
0.3
0.6
0.9
−3
−2
−1
0
1
kx_z41
Prior Distribution
Sampled Distribution

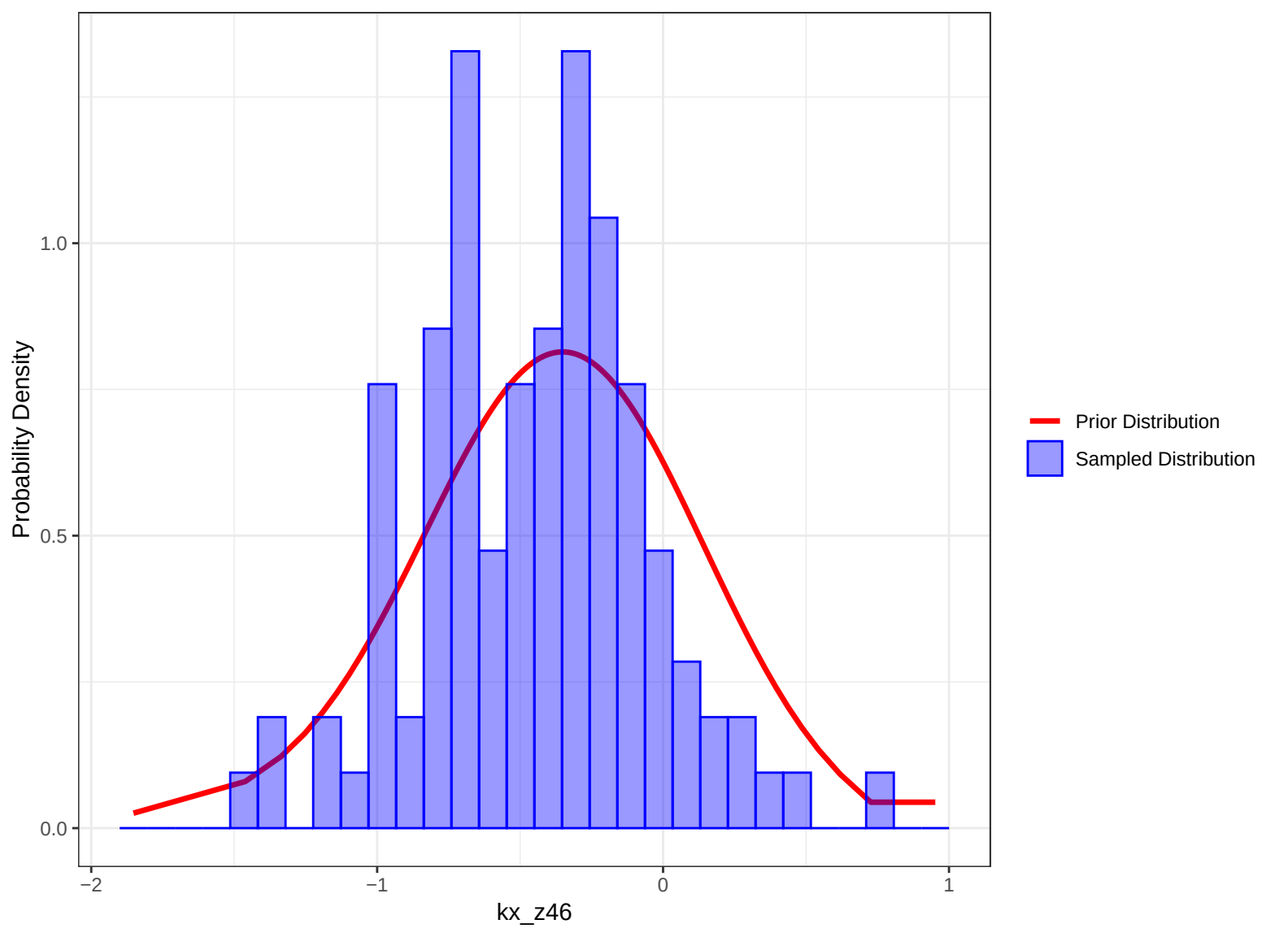

Probability Density
0.0
0.2
0.4
0.6
0.8
−4
−3
−2
−1
kx_z43
Prior Distribution
Sampled Distribution

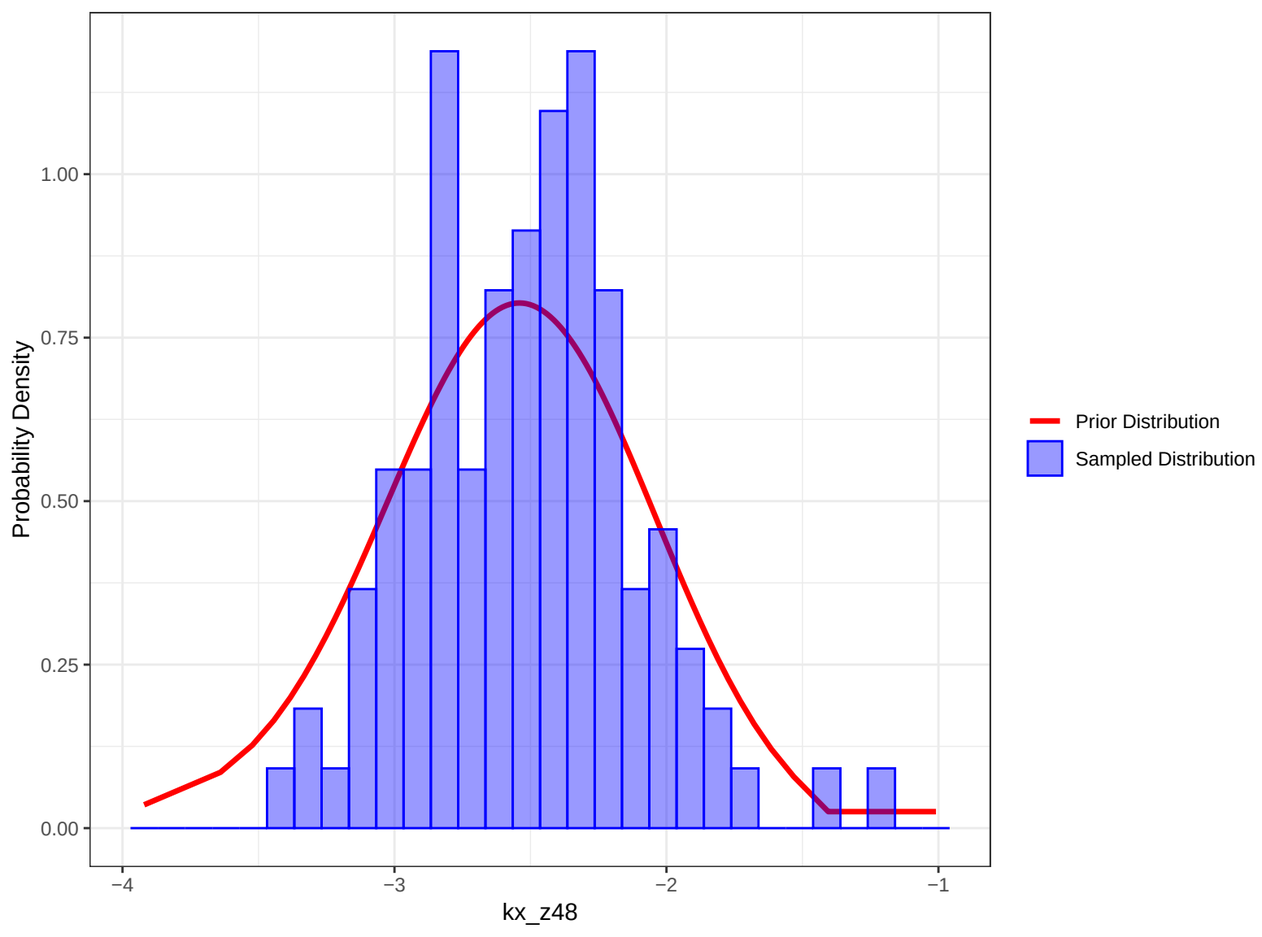

Probability Density
0.0
0.2
0.4
0.6
−3
−2
−1
0
1
kx_z42
Prior Distribution
Sampled Distribution

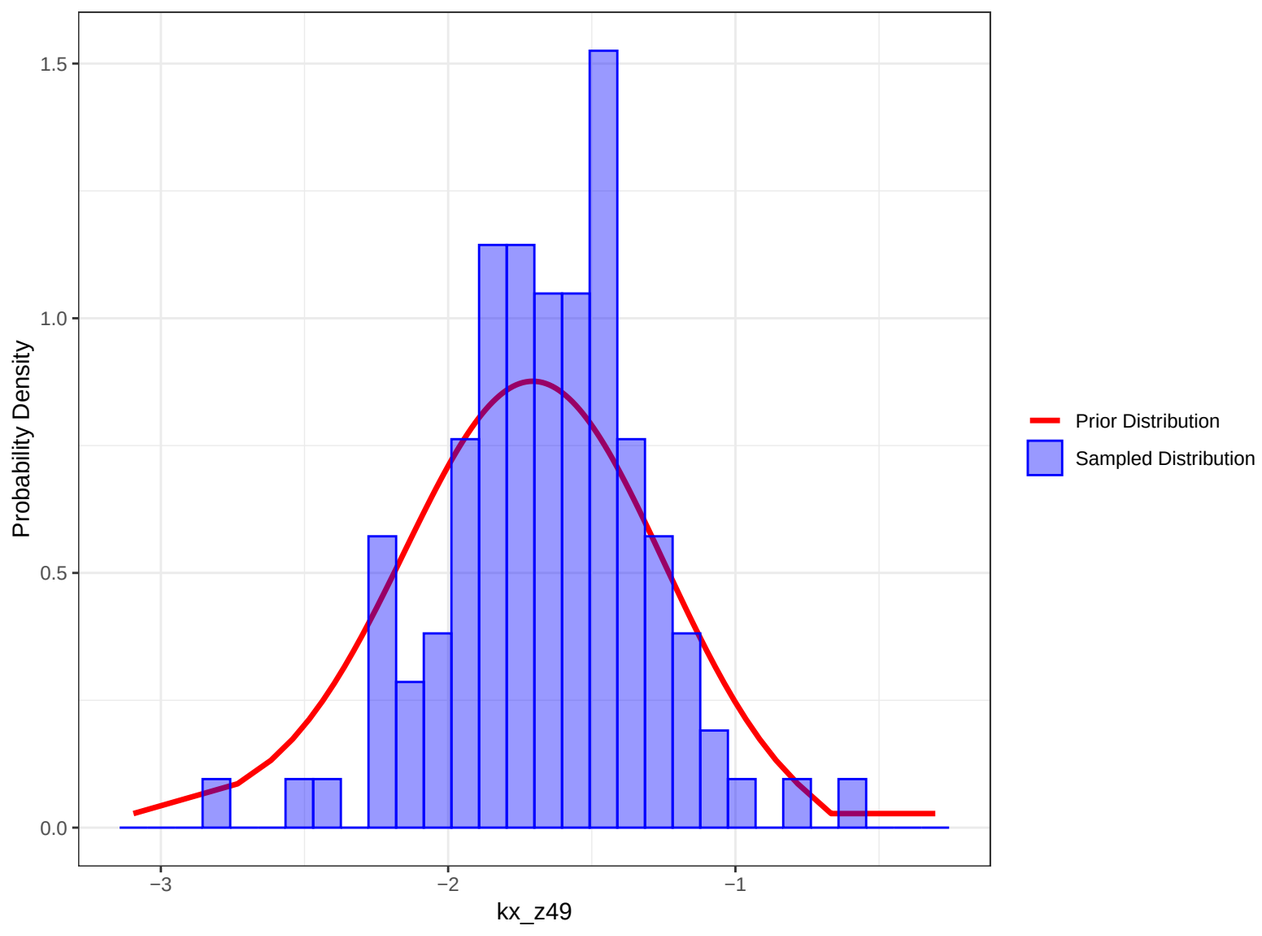

Probability Density
0.0
0.5
1.0
1.5
−2
−1
0
1
kx_z44
Prior Distribution
Sampled Distribution

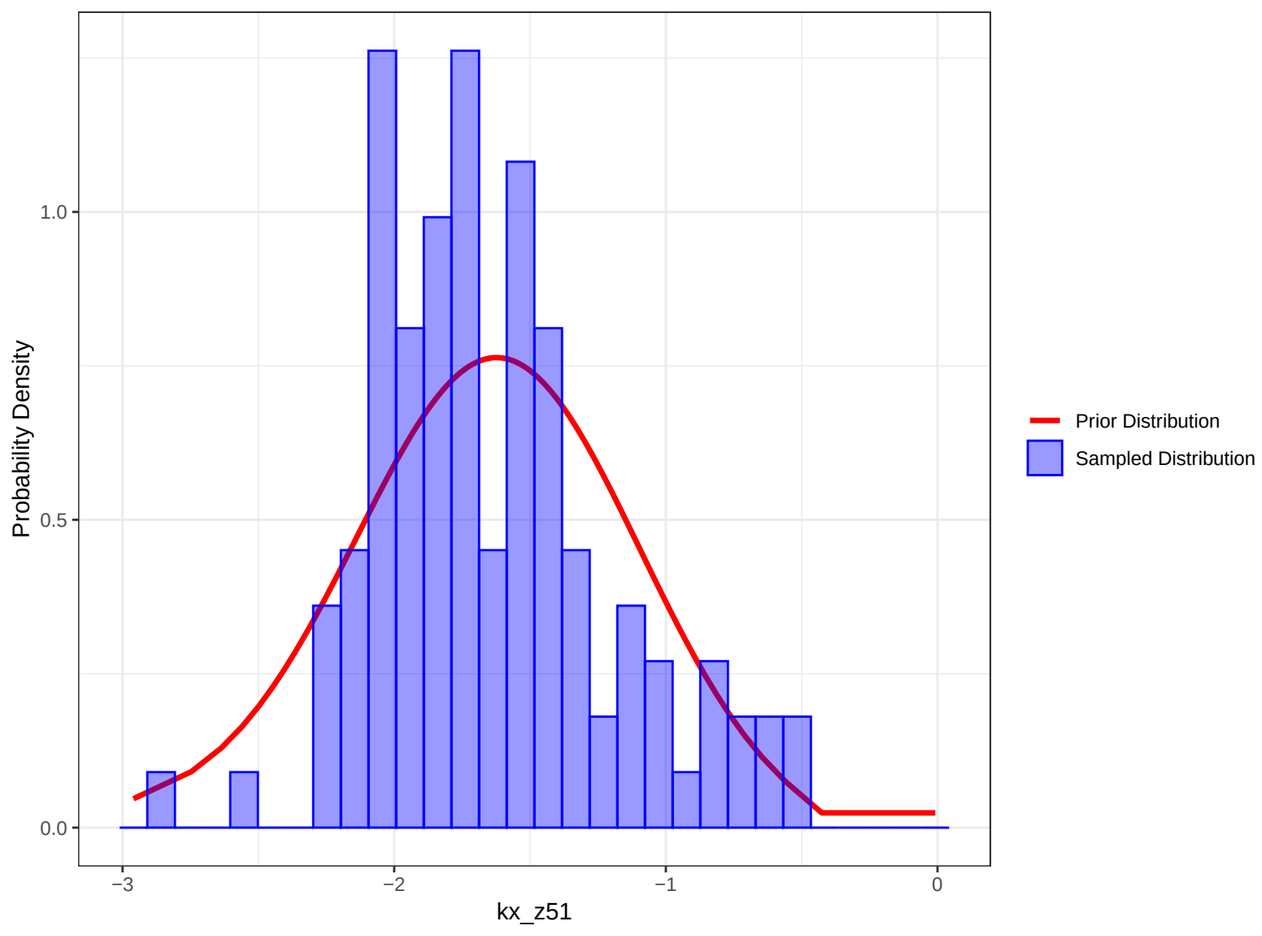

Probability Density
1.00
0.75
0.50
0.25
0.00
−3
−2
−1
0
kx_z45
Prior Distribution
Sampled Distribution

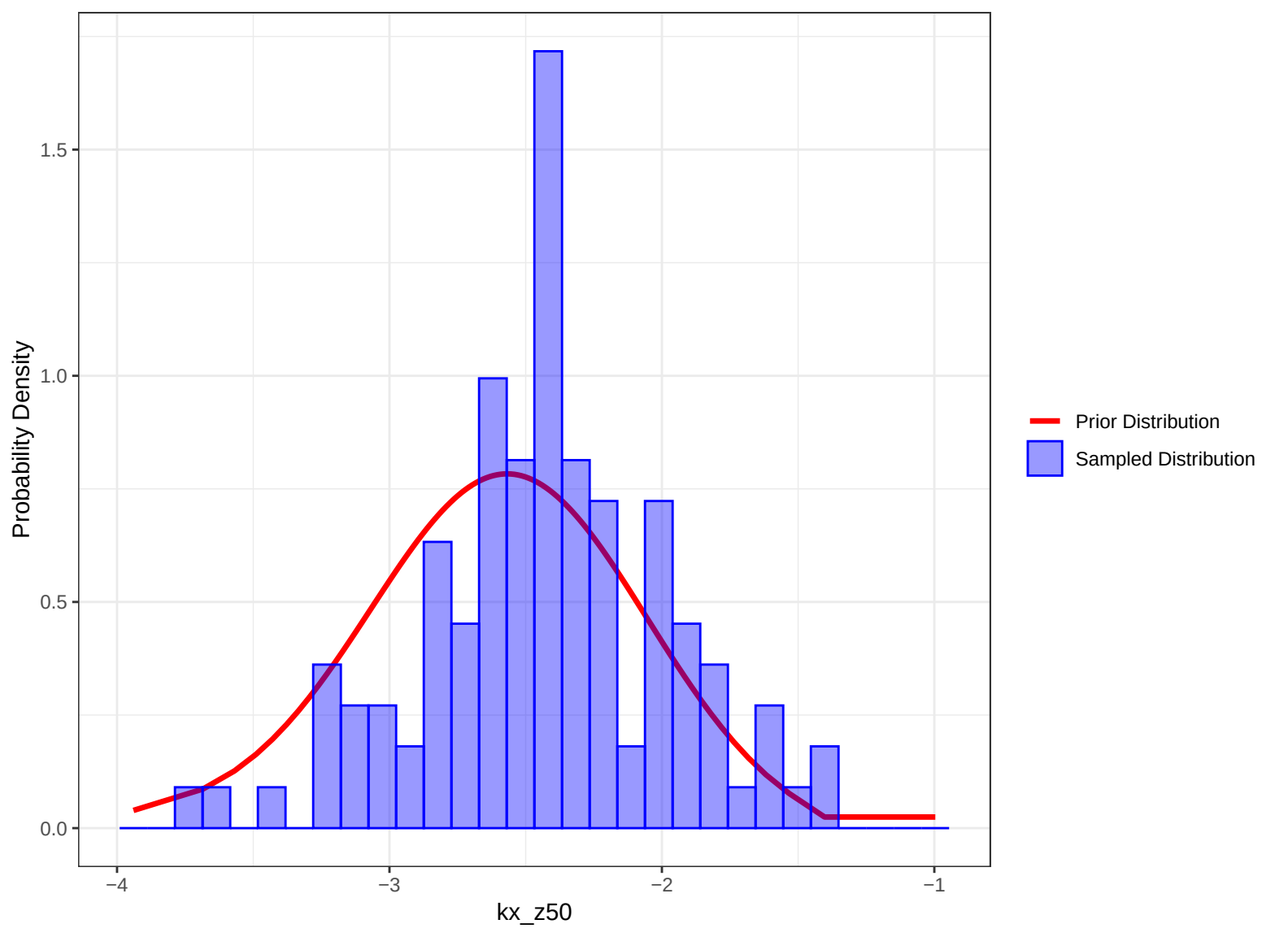

Probability Density
0.6
0.4
0.2
0.0
−4
−3
−2
−1
0
1
kx_z47
Prior Distribution
Sampled Distribution

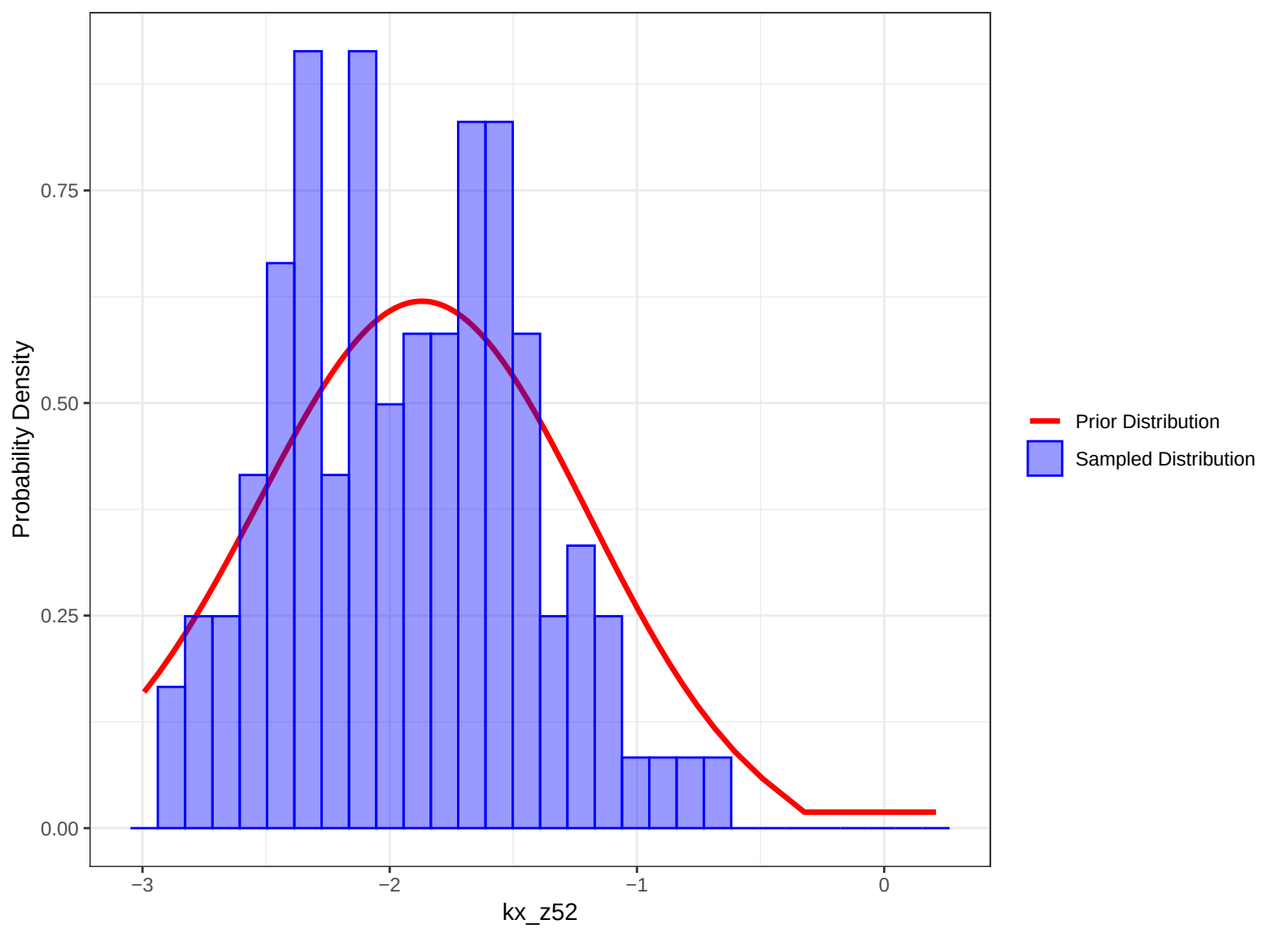

Probability Density
1.0
0.5
0.0
−2
−1
0
1
kx_z46
Prior Distribution
Sampled Distribution

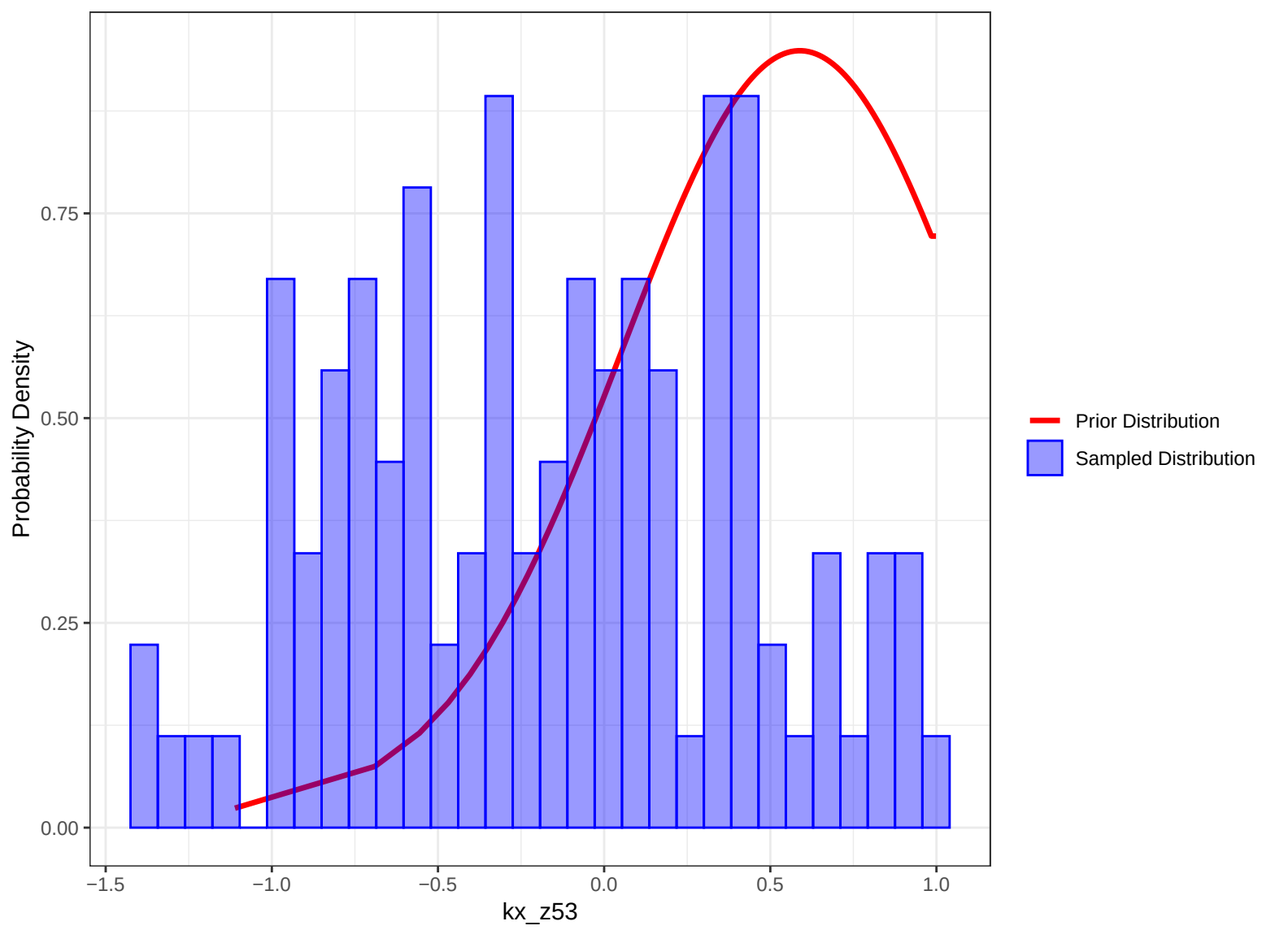

Probability Density
1.00
0.75
0.50
0.25
0.00
−4
−3
−2
−1
kx_z48
Prior Distribution
Sampled Distribution

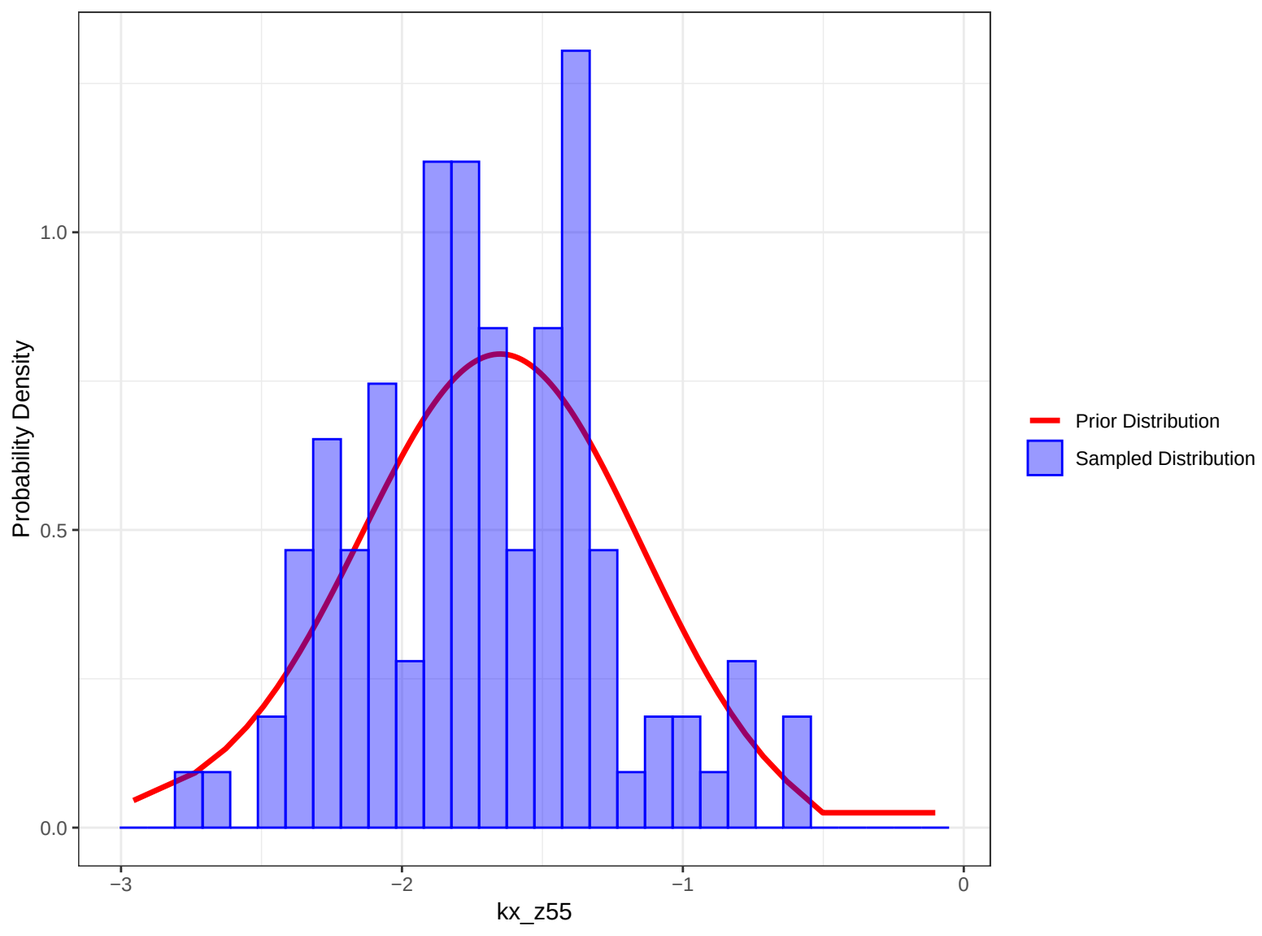

Probability Density
1.5
1.0
0.5
0.0
−3
−2
−1
kx_z49
Prior Distribution
Sampled Distribution

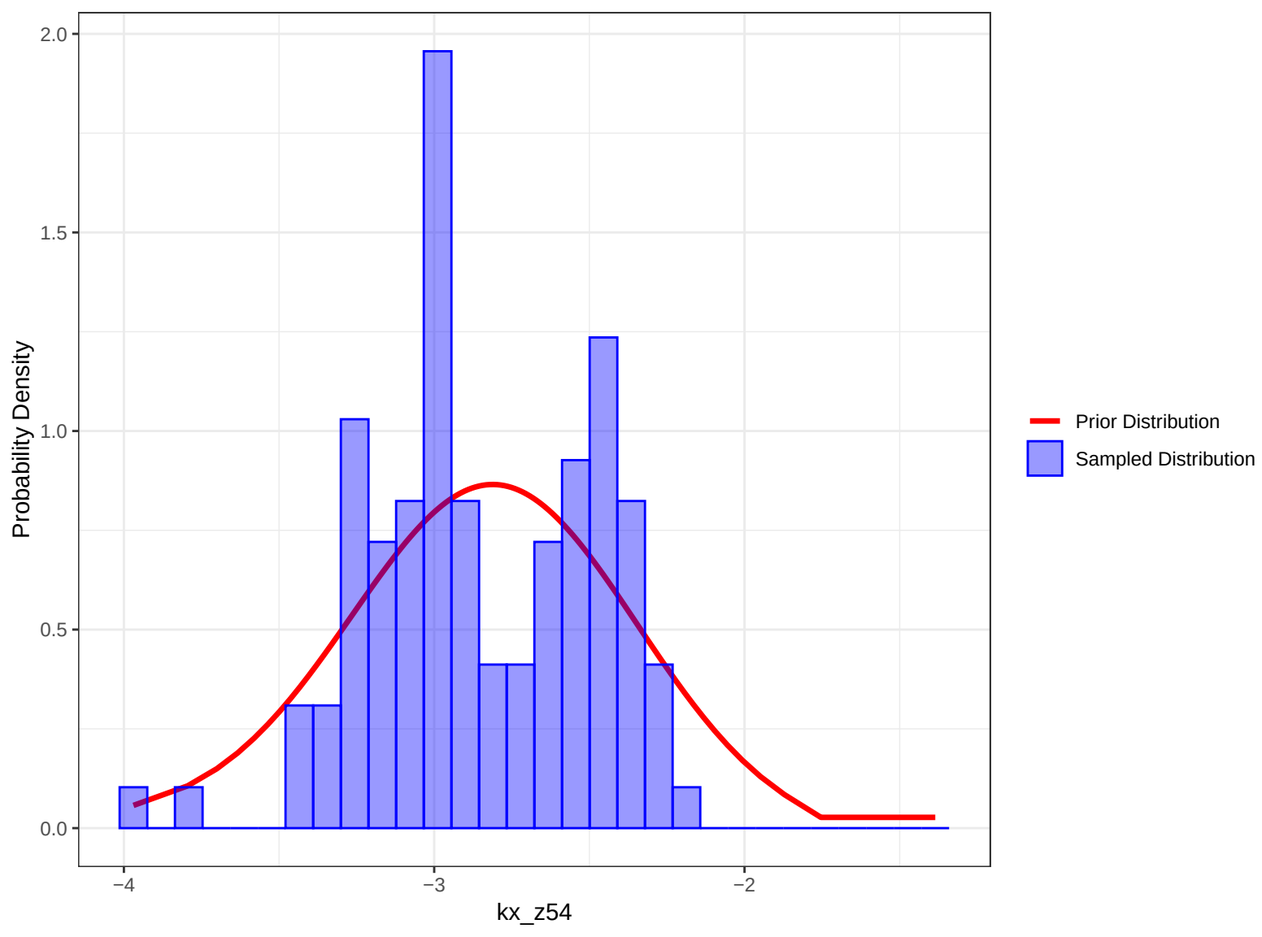

Probability Density
1.0
0.5
0.0
−3
−2
−1
0
kx_z51
Prior Distribution
Sampled Distribution

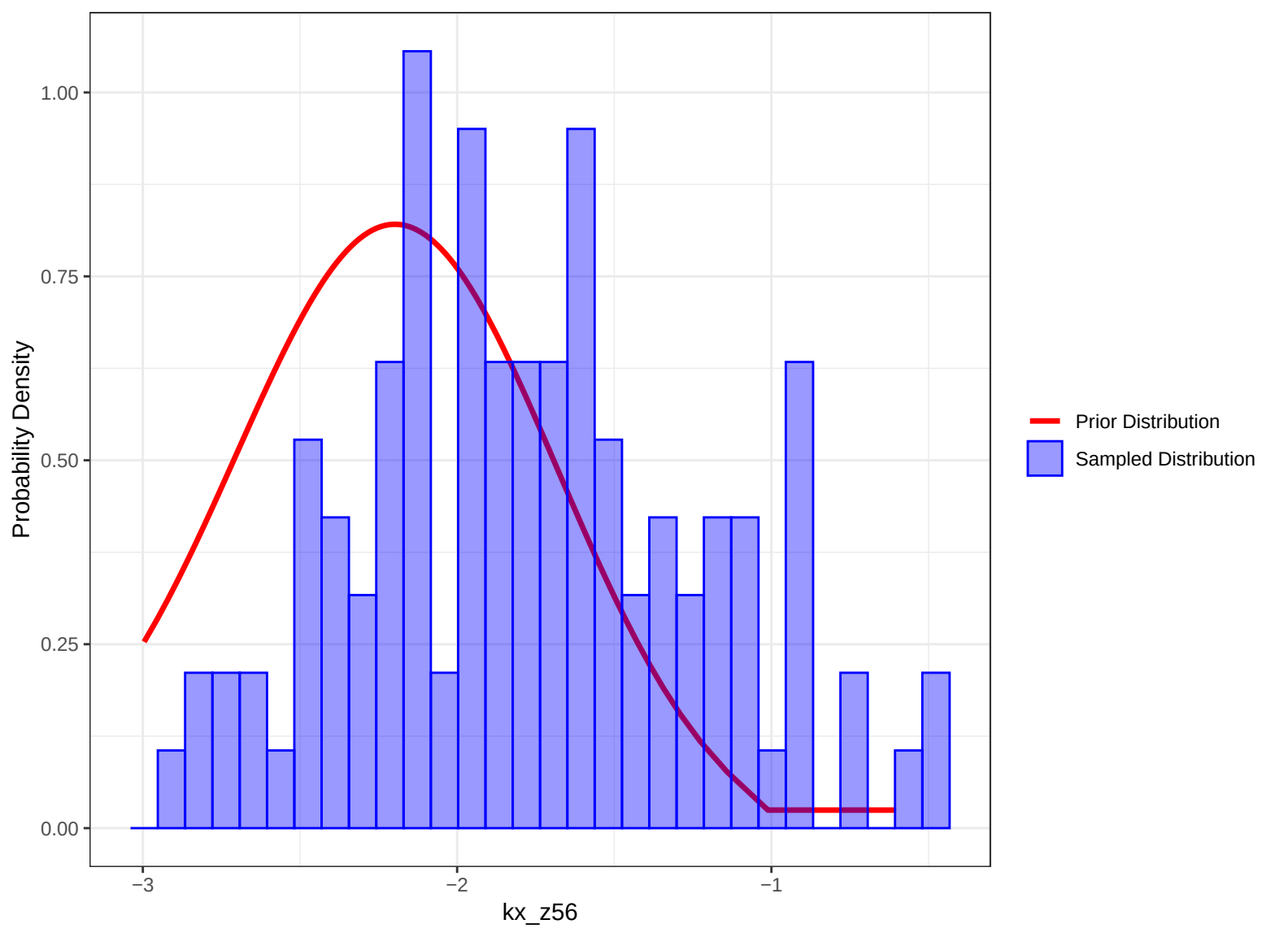

Probability Density
1.5
1.0
0.5
0.0
−4
−3
−2
−1
kx_z50
Prior Distribution
Sampled Distribution

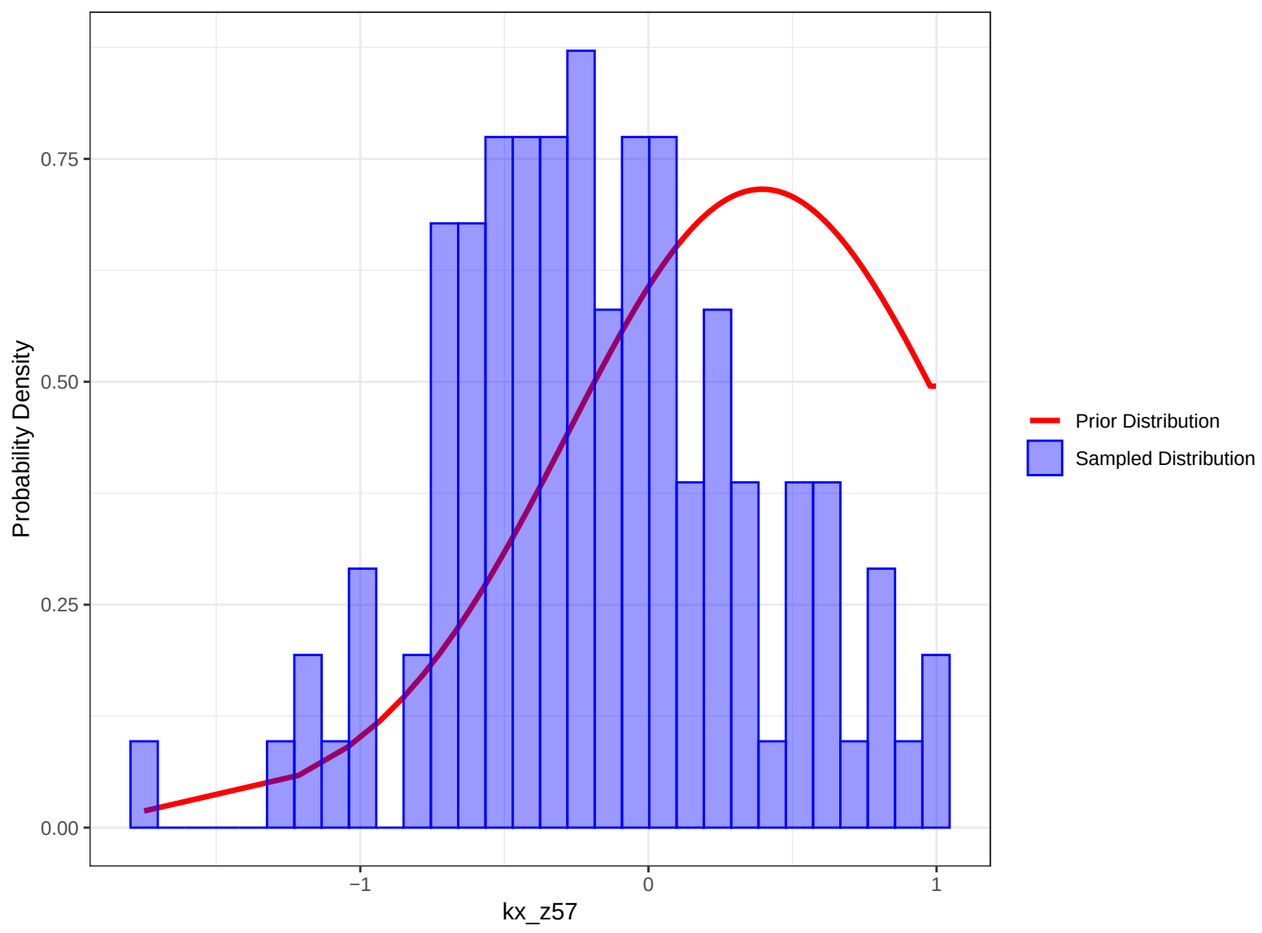

Probability Density
0.75
0.50
0.25
0.00
−3
−2
−1
0
kx_z52
Prior Distribution
Sampled Distribution

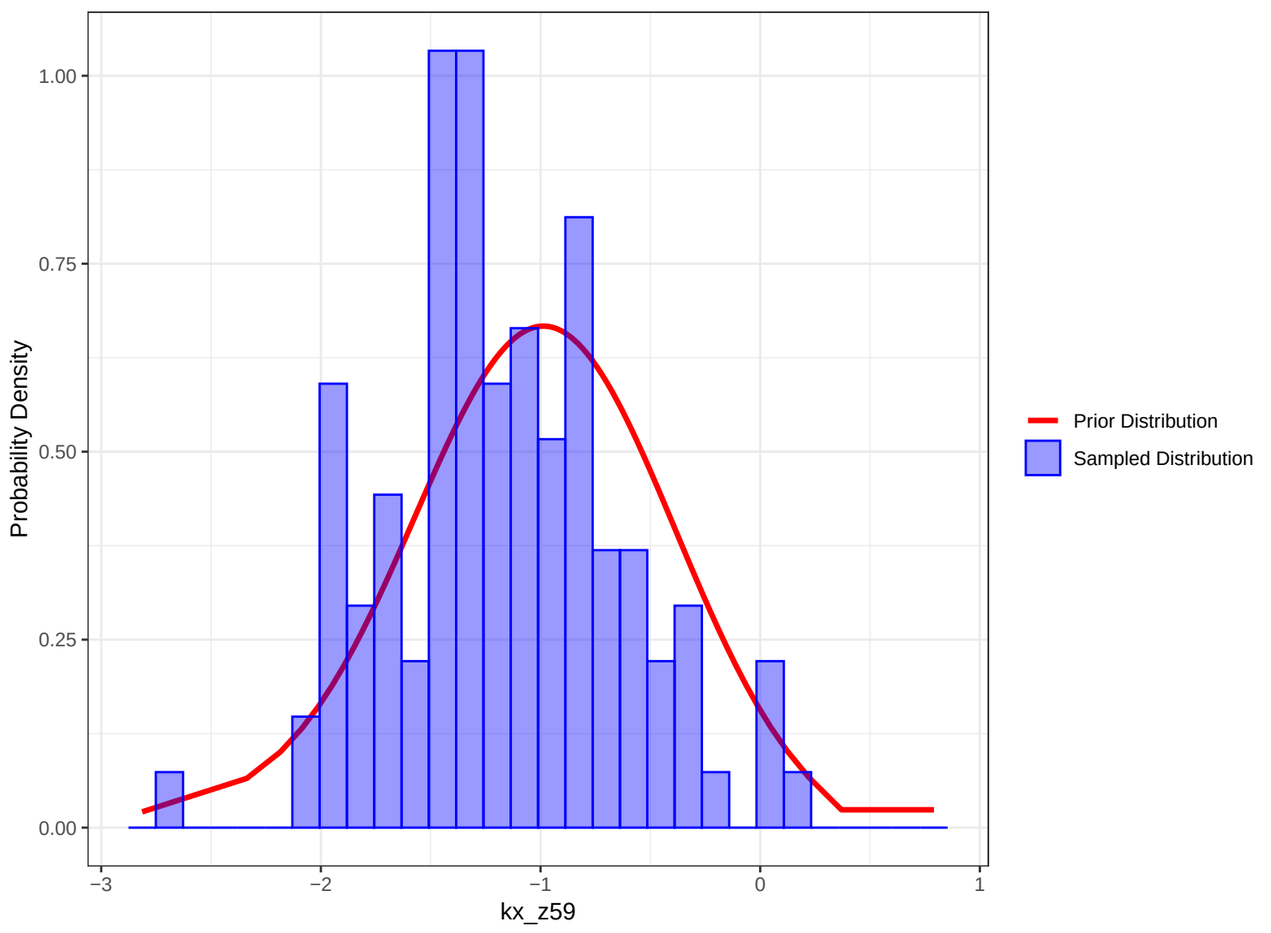

Probability Density
0.00
0.25
0.50
0.75
−1.5
−1.0
−0.5
0.0
0.5
1.0
kx_z53
Prior Distribution
Sampled Distribution

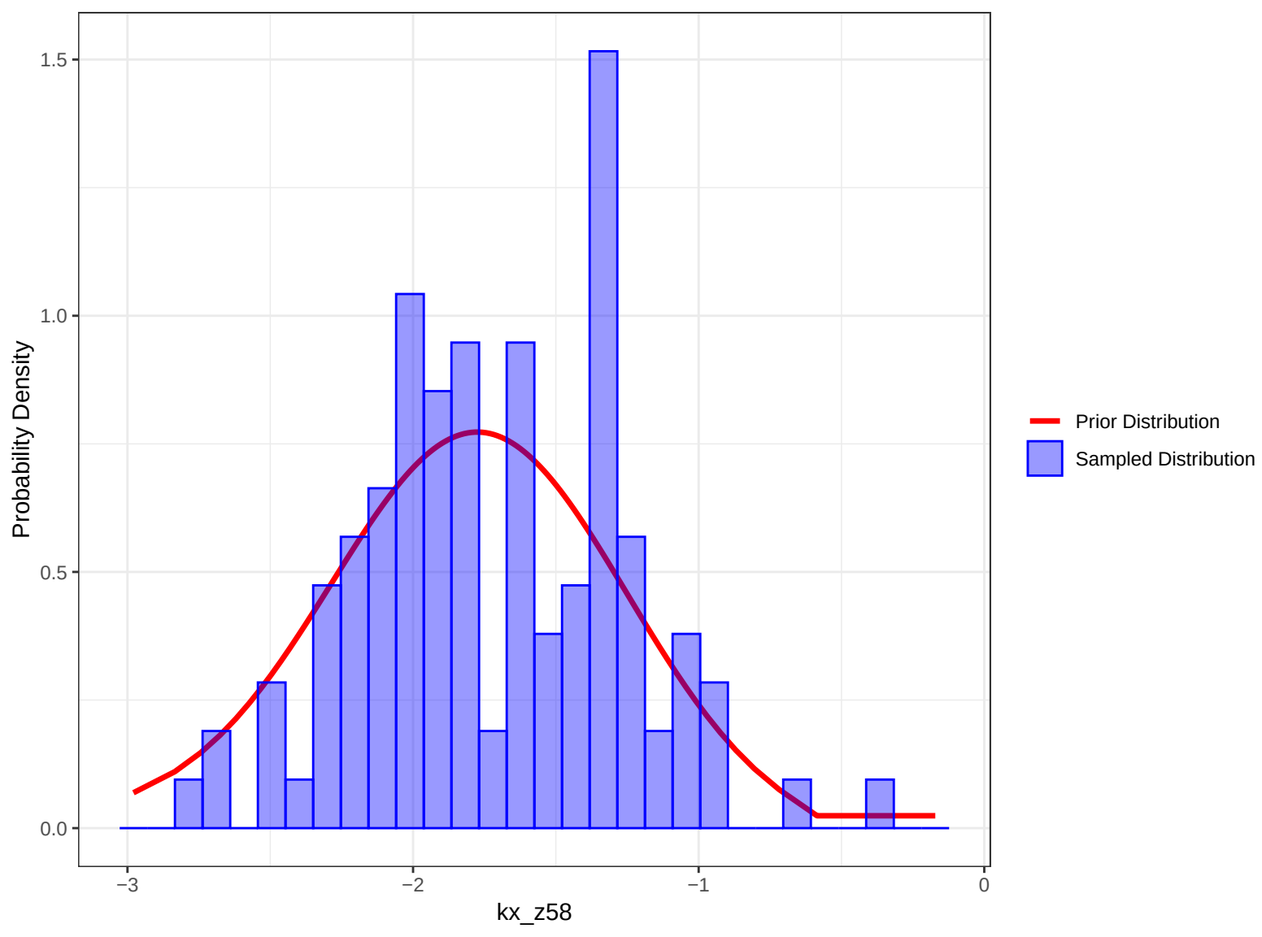

Probability Density
0.0
0.5
1.0
−3
−2
−1
0
kx_z55
Prior Distribution
Sampled Distribution

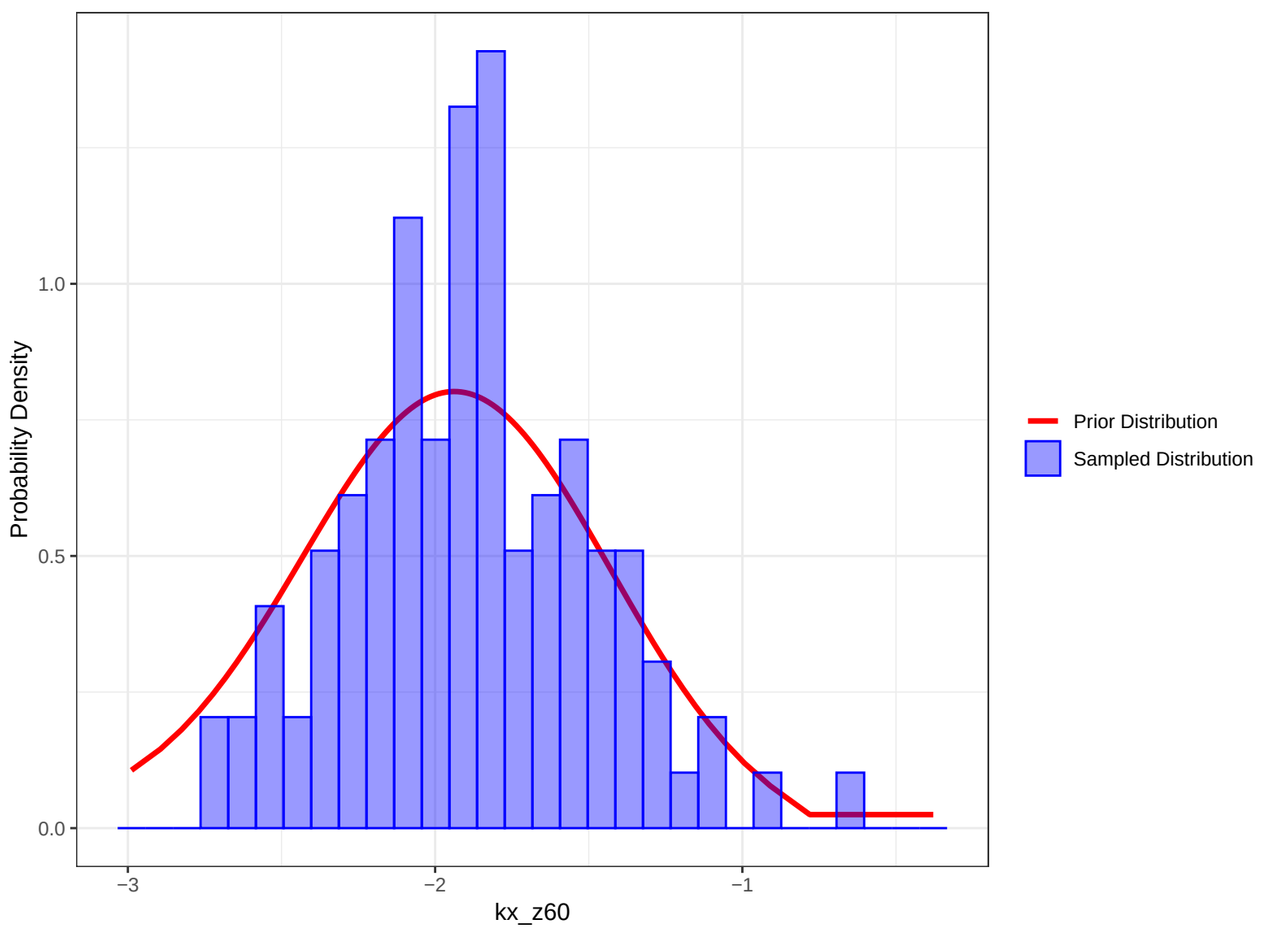

Probability Density
0.0
0.5
1.0
1.5
2.0
−4
−3
−2
kx_z54
Prior Distribution
Sampled Distribution

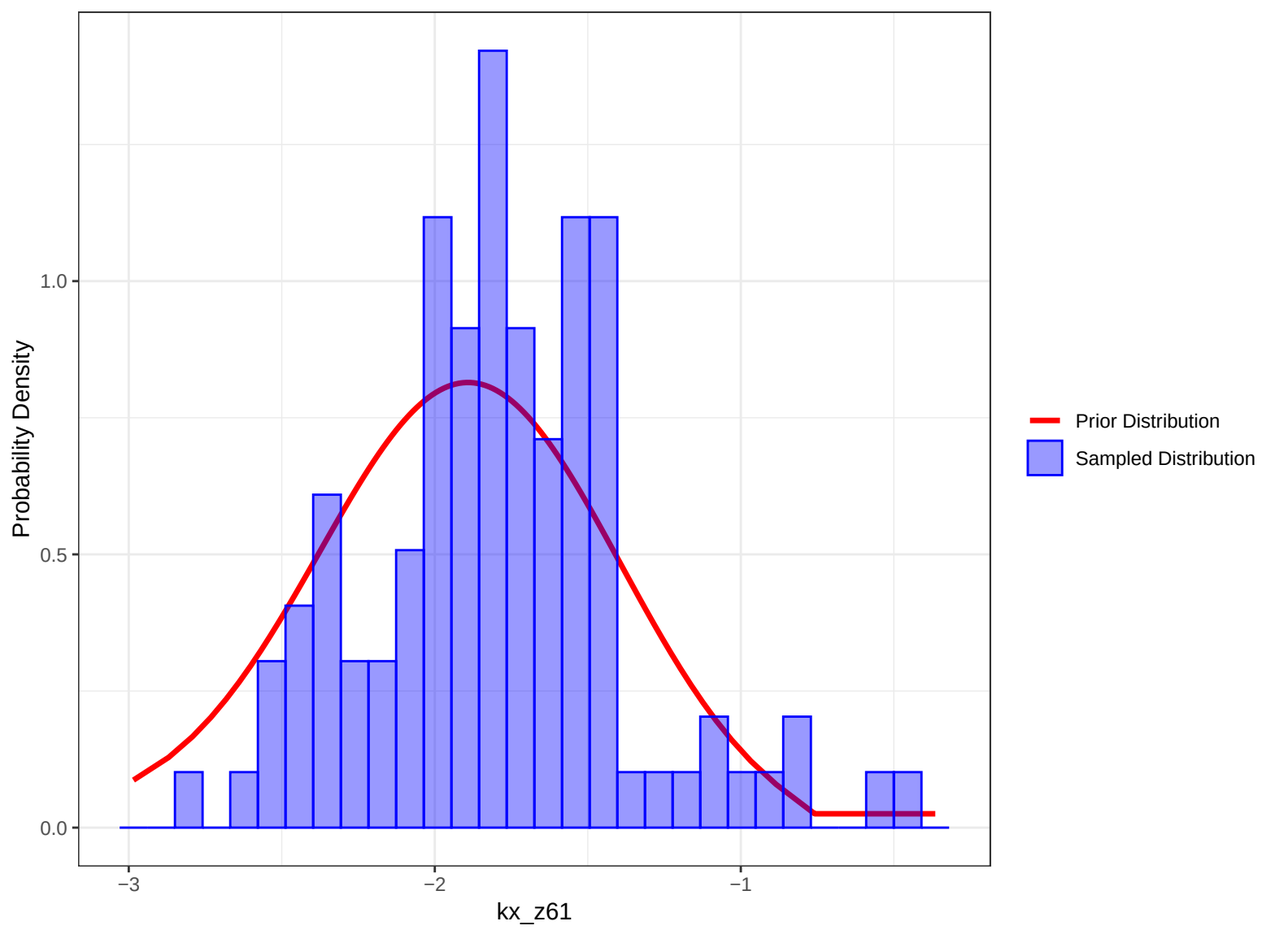

Probability Density
0.00
0.25
0.50
0.75
1.00
−3
−2
−1
kx_z56
Prior Distribution
Sampled Distribution

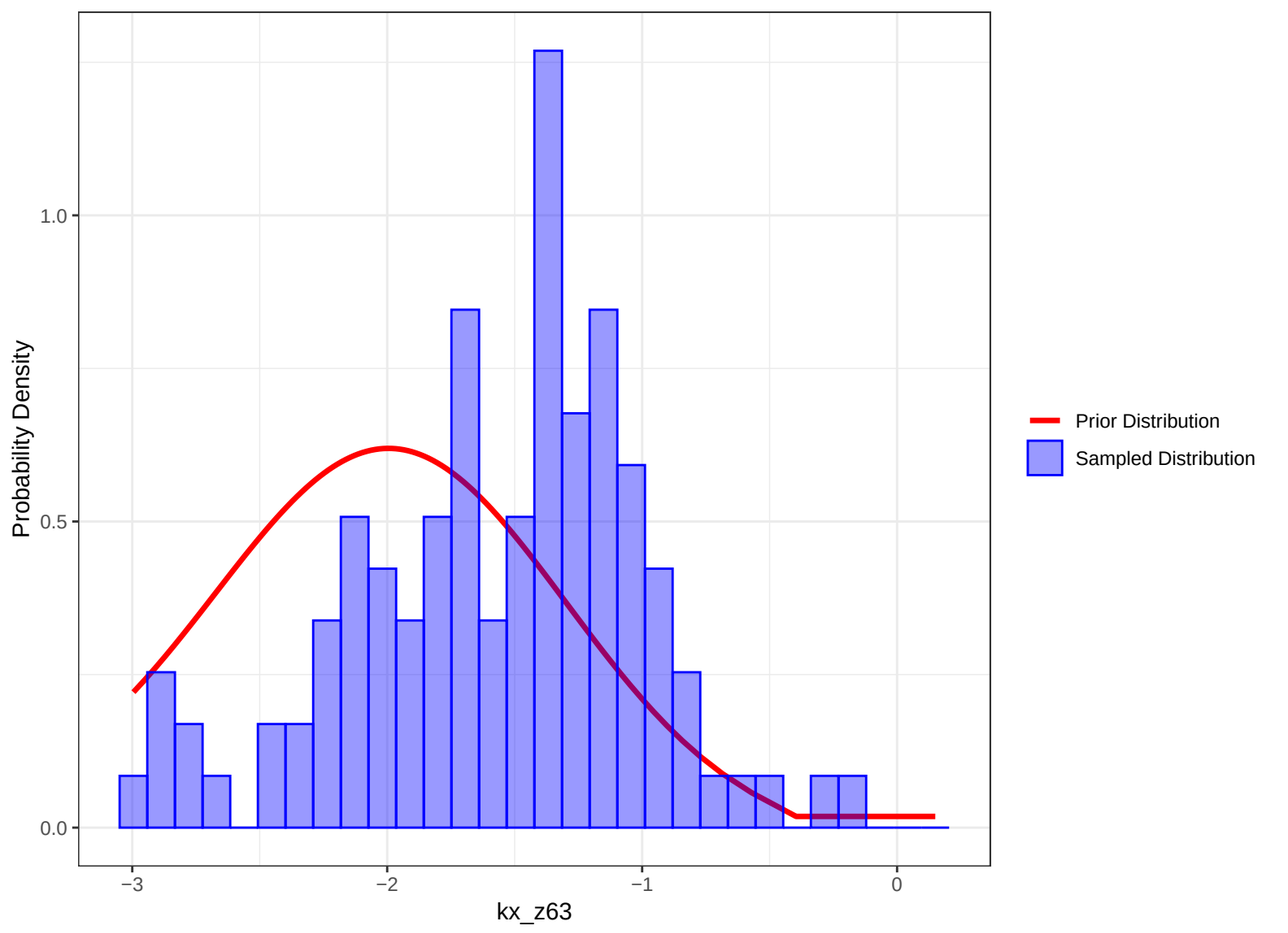

Probability Density
0.00
0.25
0.50
0.75
−1
0
1
kx_z57
Prior Distribution
Sampled Distribution

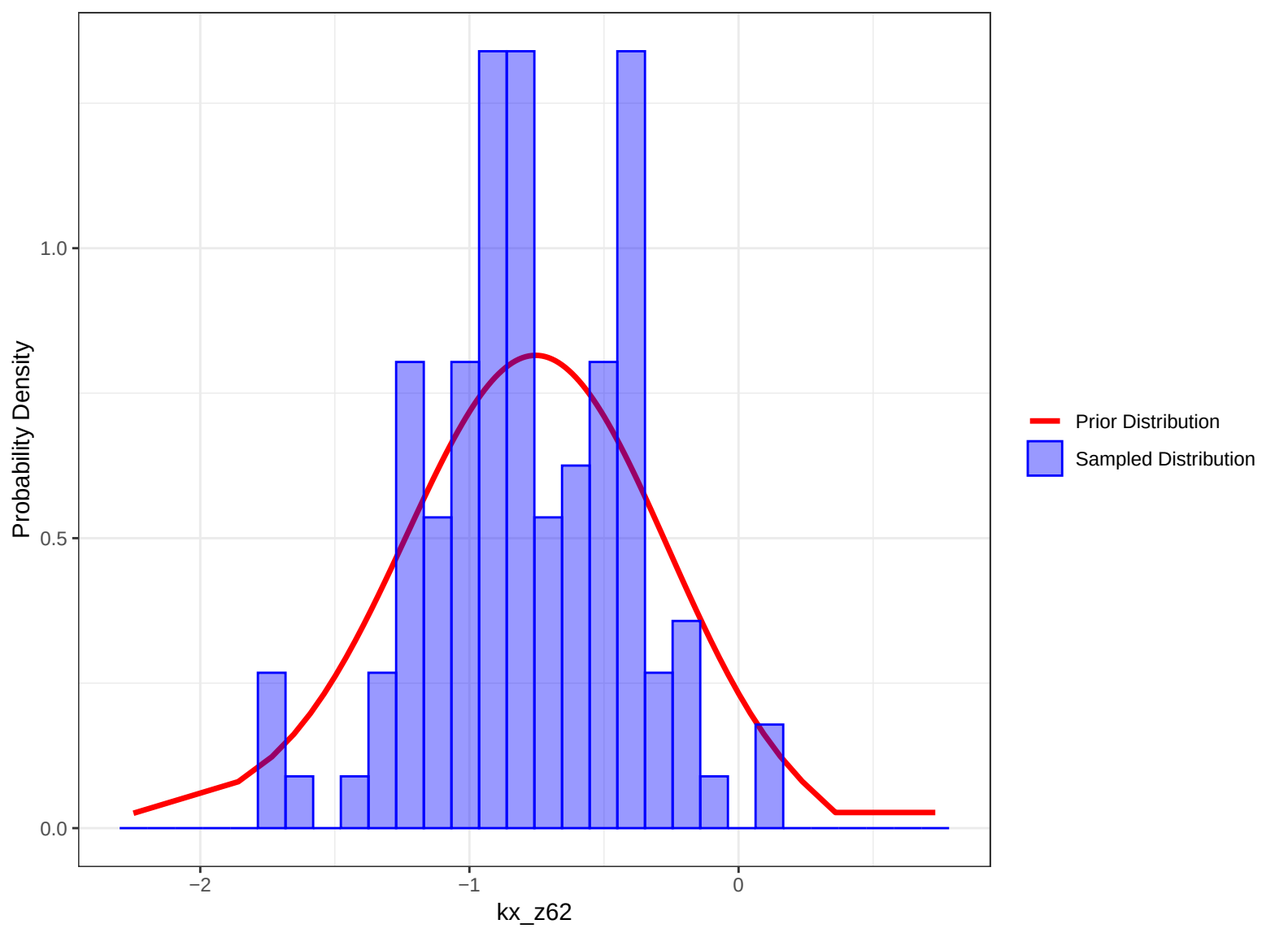

Probability Density
0.00
0.25
0.50
0.75
1.00
−3
−2
−1
0
1
kx_z59
Prior Distribution
Sampled Distribution

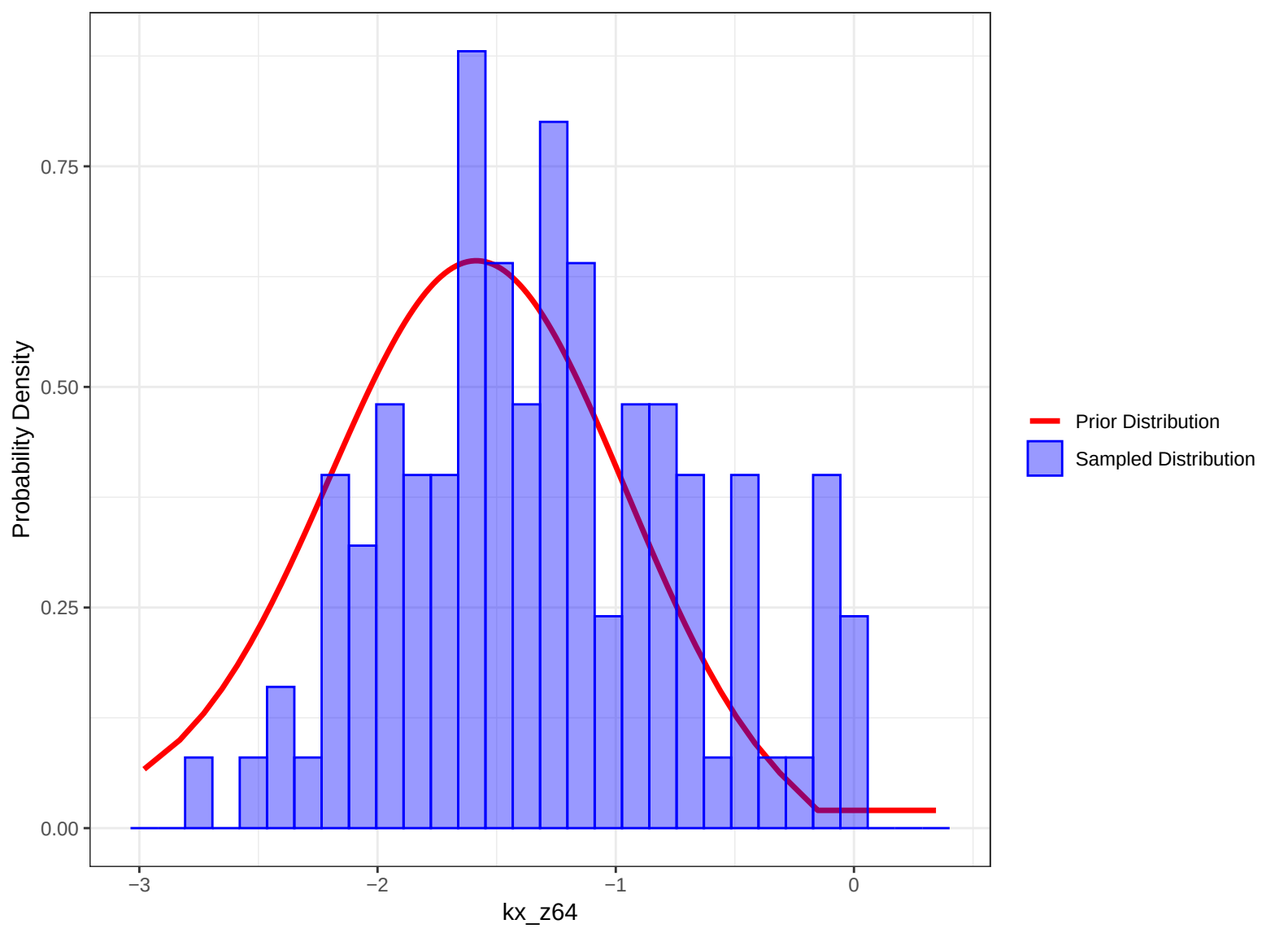

Probability Density
0.0
0.5
1.0
1.5
−3
−2
−1
0
kx_z58
Prior Distribution
Sampled Distribution

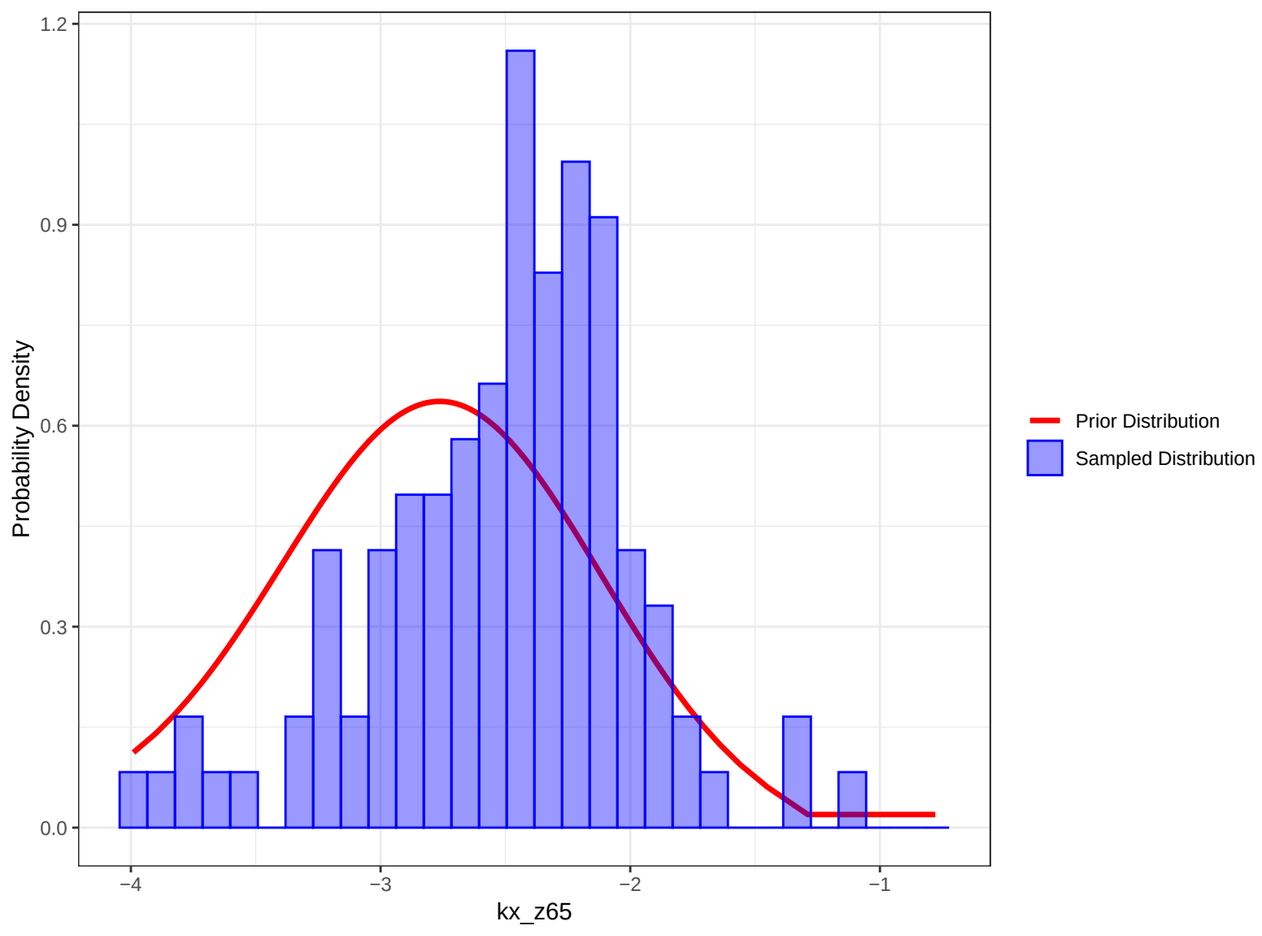

Probability Density
0.0
0.5
1.0
−3
−2
−1
kx_z60
Prior Distribution
Sampled Distribution

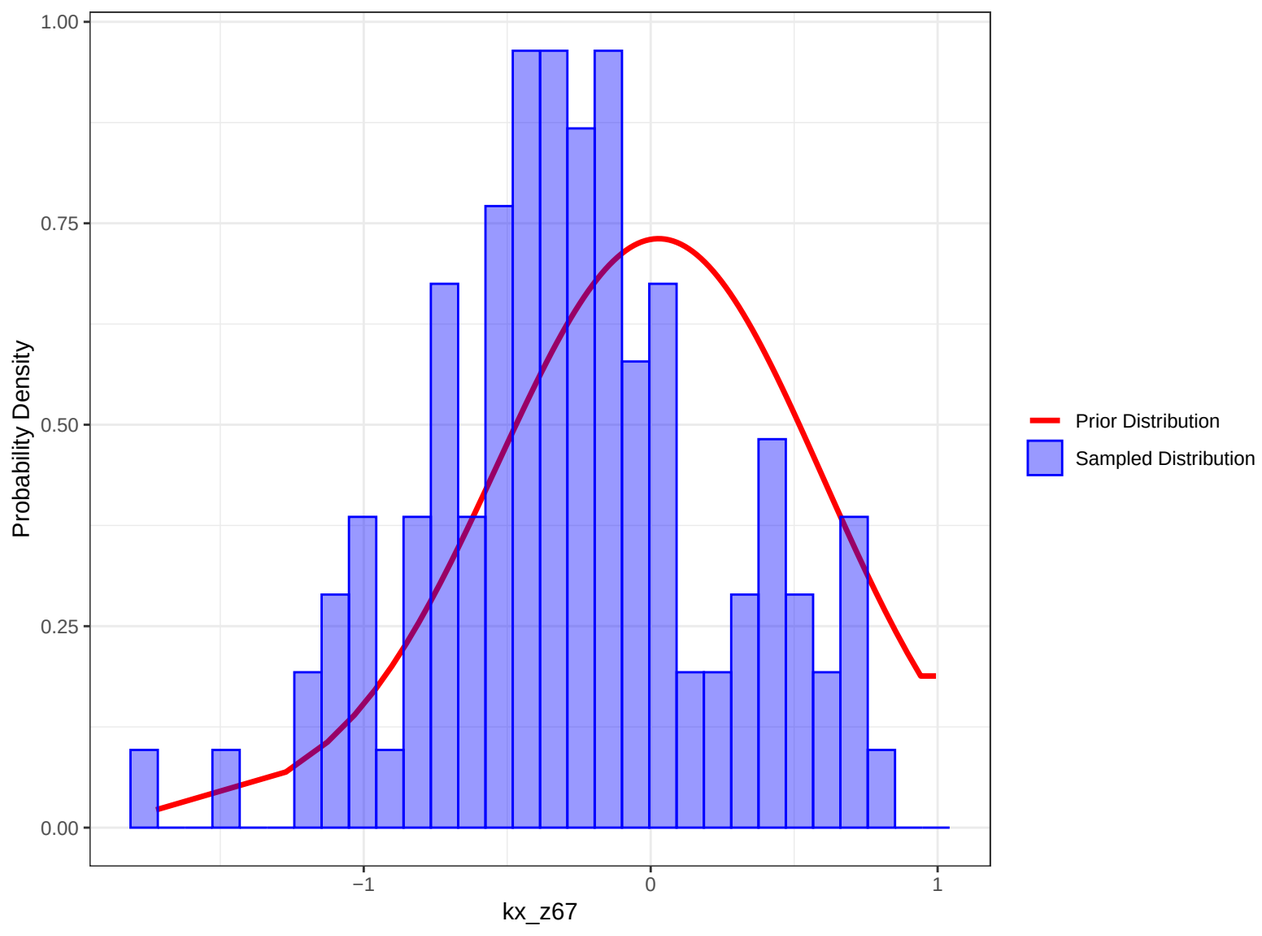

Probability Density
1.0
0.5
0.0
−3
−2
−1
kx_z61
Prior Distribution
Sampled Distribution

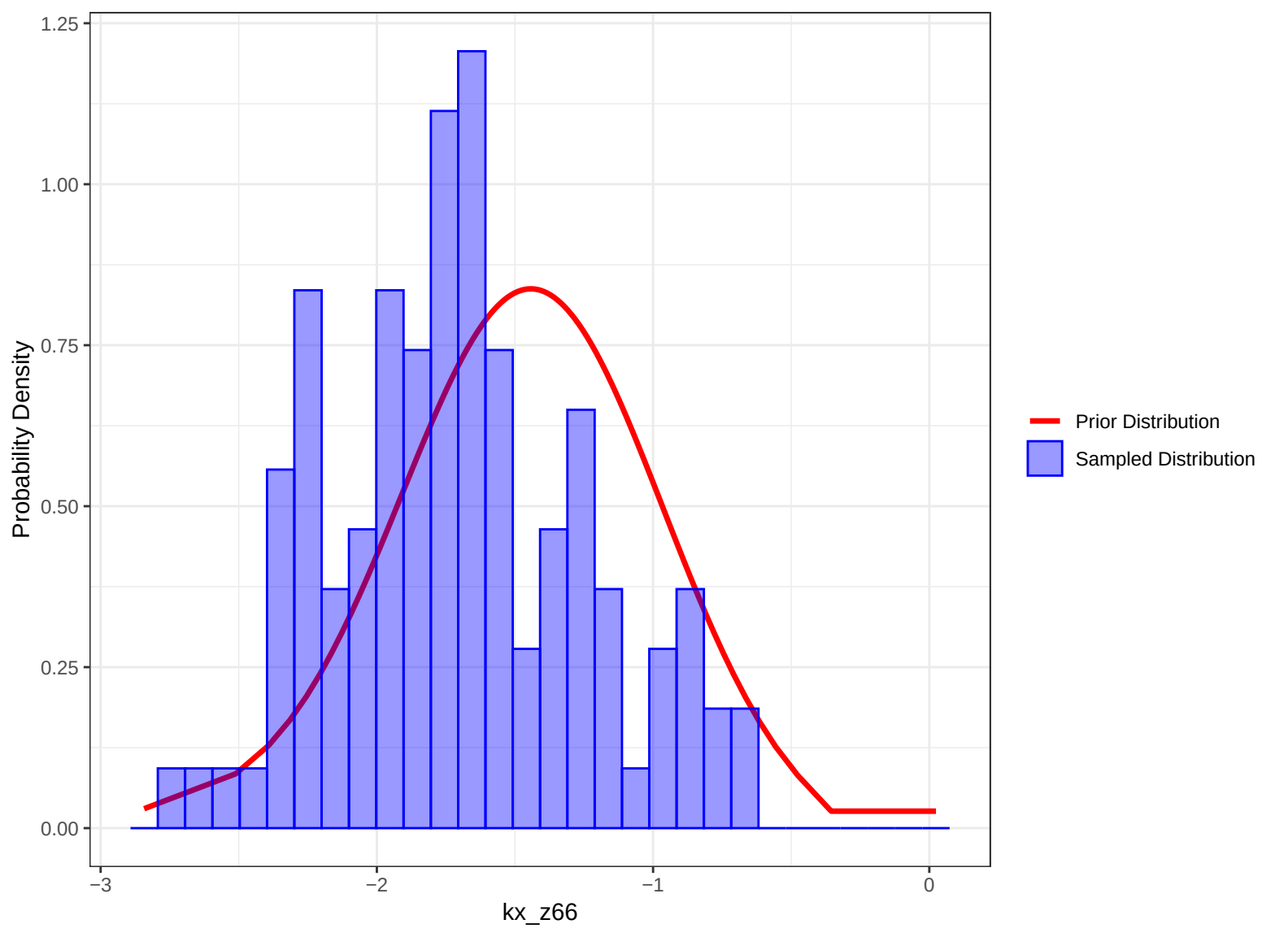

Probability Density
1.0
0.5
0.0
−3
−2
−1
0
kx_z63
Prior Distribution
Sampled Distribution

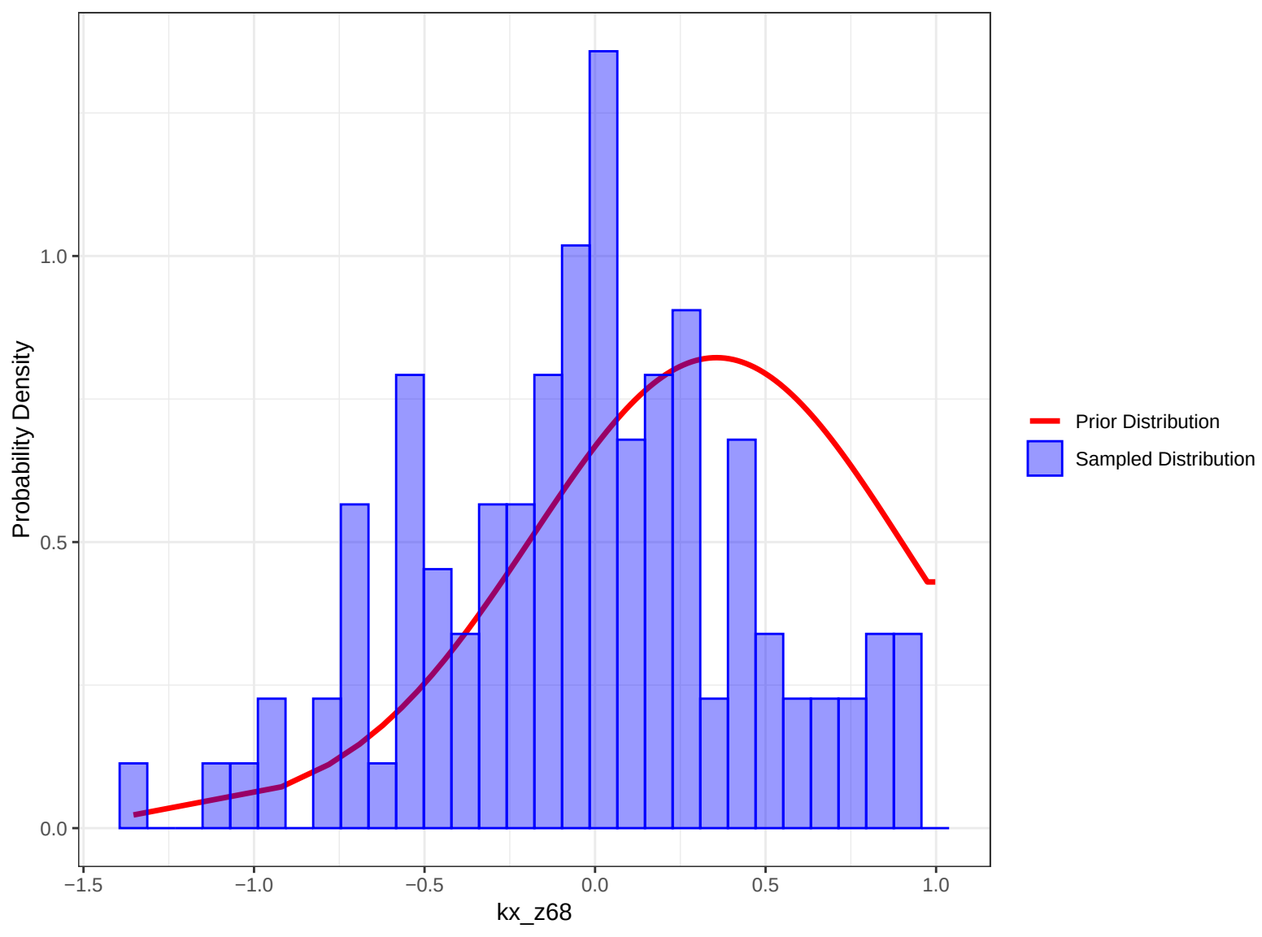

Probability Density
1.0
0.5
0.0
−2
−1
0
kx_z62
Prior Distribution
Sampled Distribution

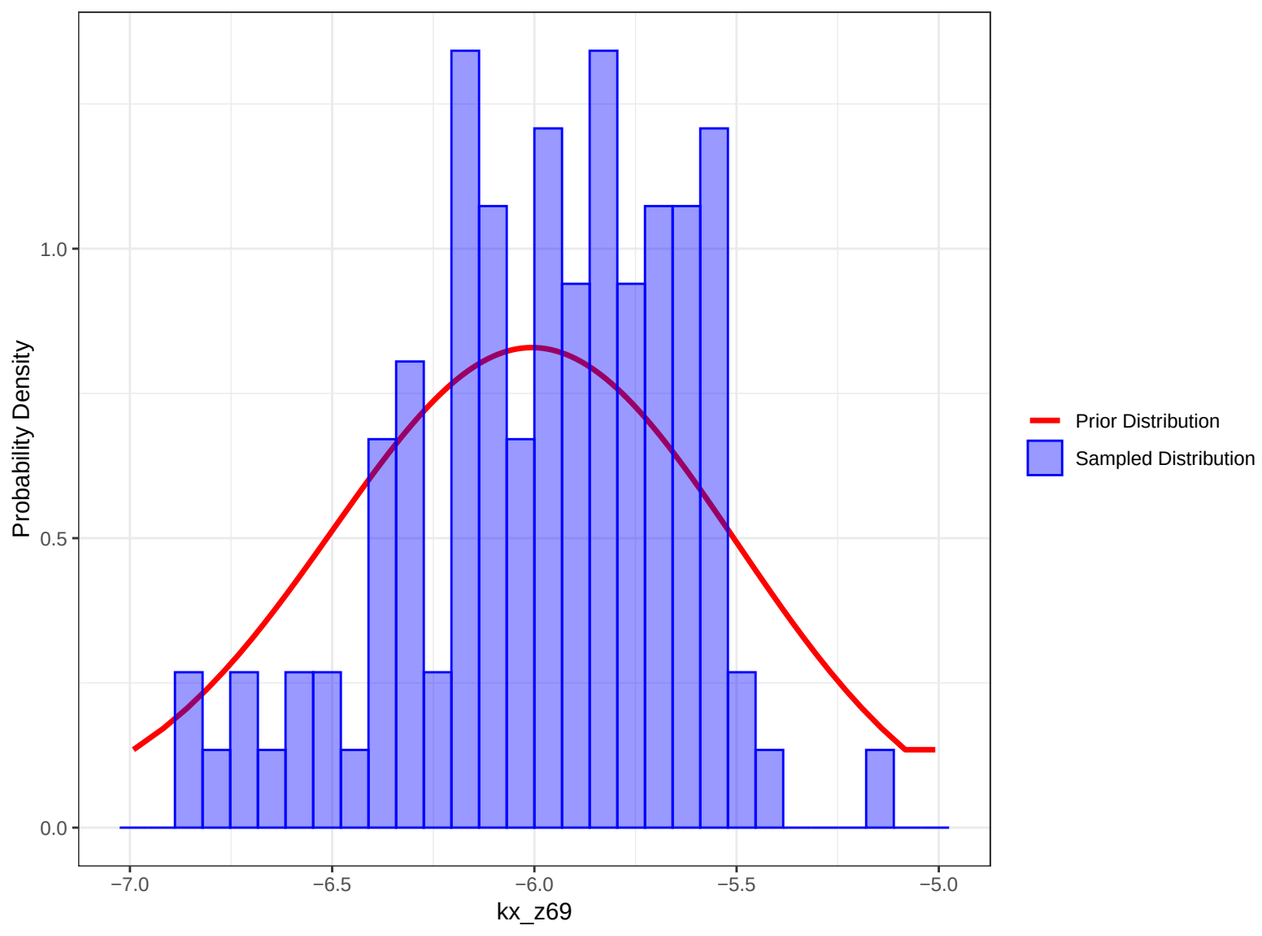

Probability Density
0.75
0.50
0.25
0.00
−3
−2
−1
0
kx_z64
Prior Distribution
Sampled Distribution

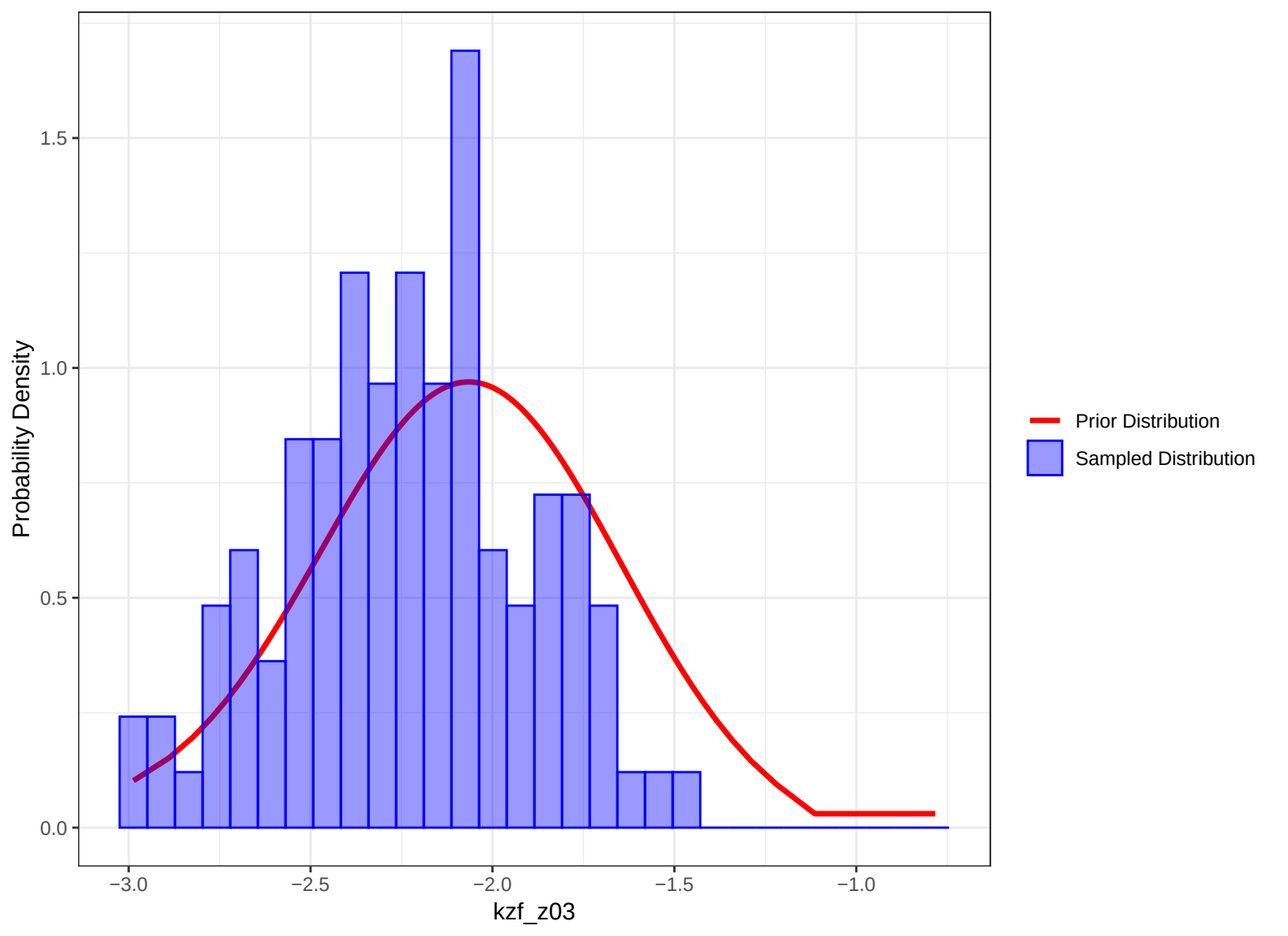

1.2
0.9
0.6
0.3
0.0
Probability Density
−4
−3
−2
−1
kx_z65
Prior Distribution
Sampled Distribution

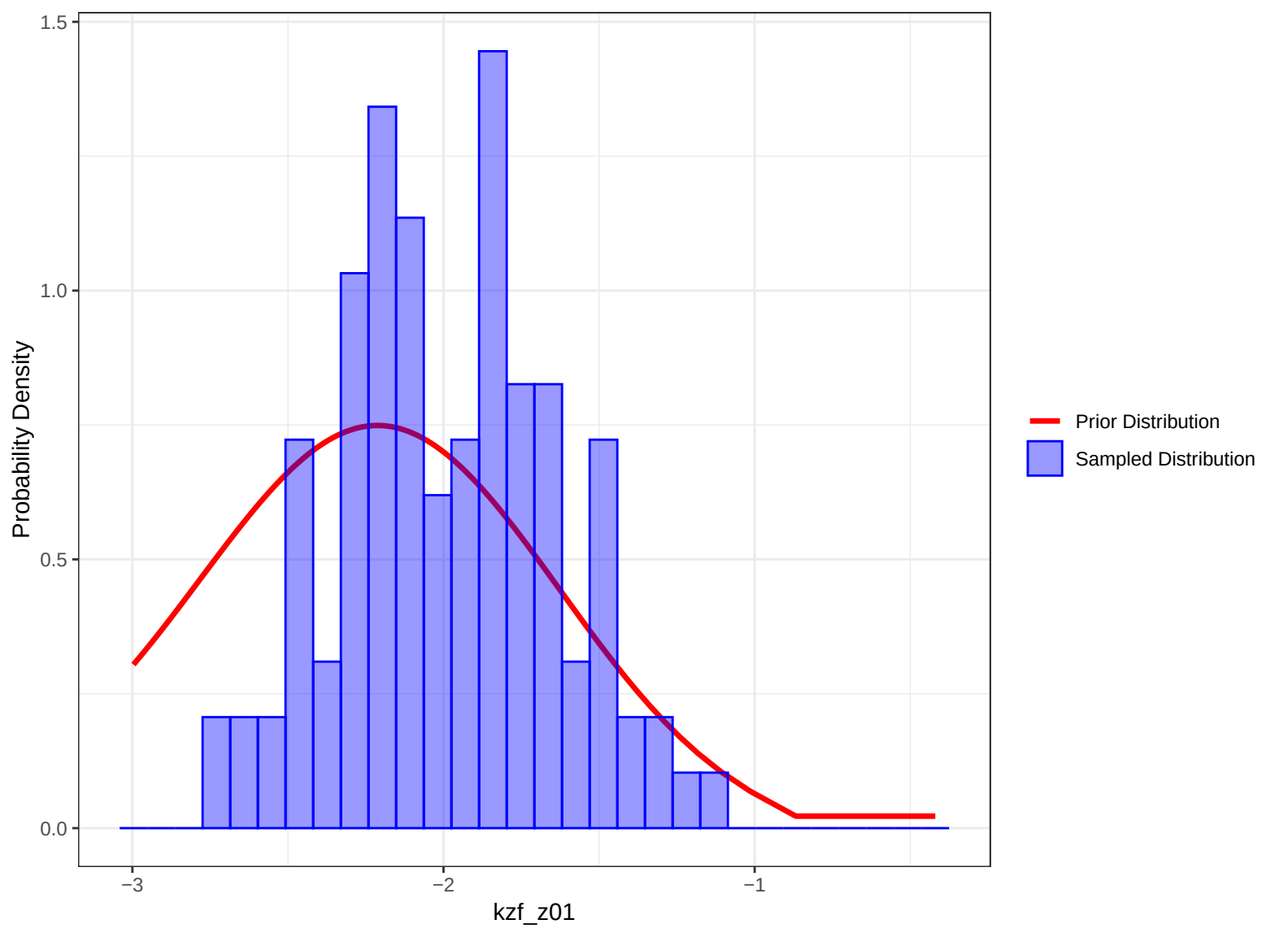

1.00
0.75
0.50
0.25
0.00
Probability Density
−1
0
1
kx_z67
Prior Distribution
Sampled Distribution

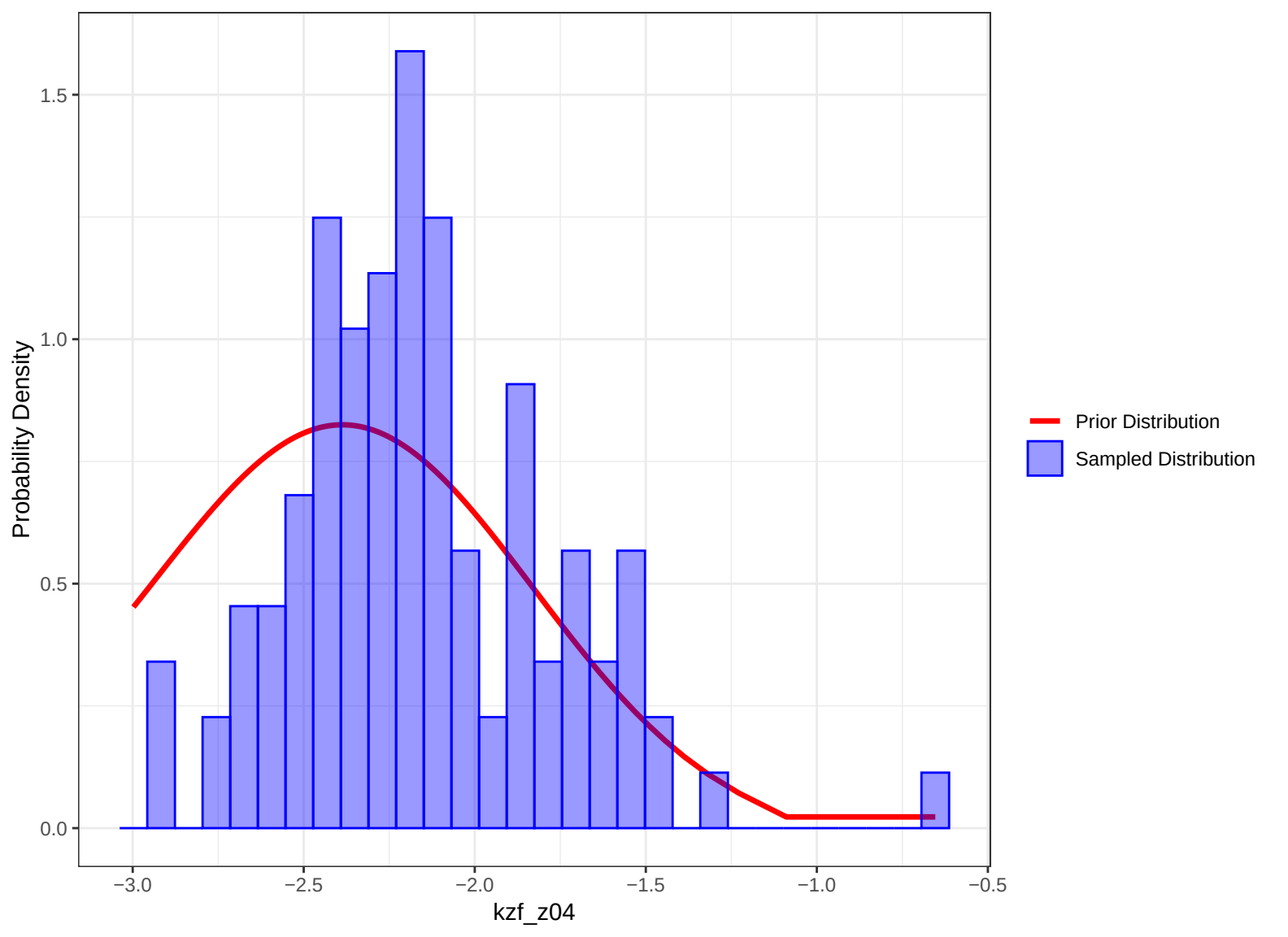

1.25
1.00
0.75
0.50
0.25
0.00
Probability Density
−3
−2
−1
0
kx_z66
Prior Distribution
Sampled Distribution

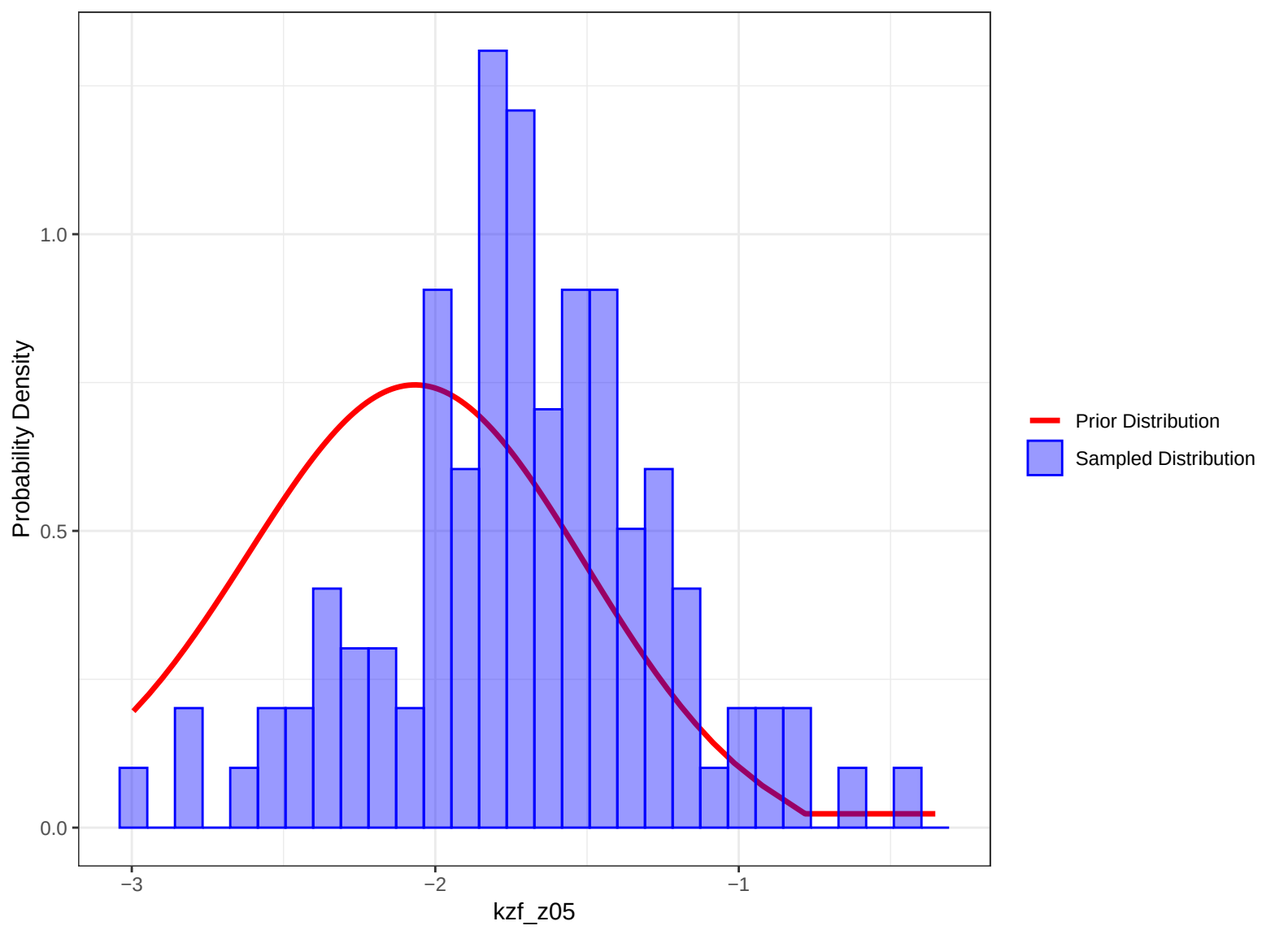

1.0
0.5
0.0
Probability Density
−1.5
−1.0
−0.5
0.0
0.5
1.0
kx_z68
Prior Distribution
Sampled Distribution

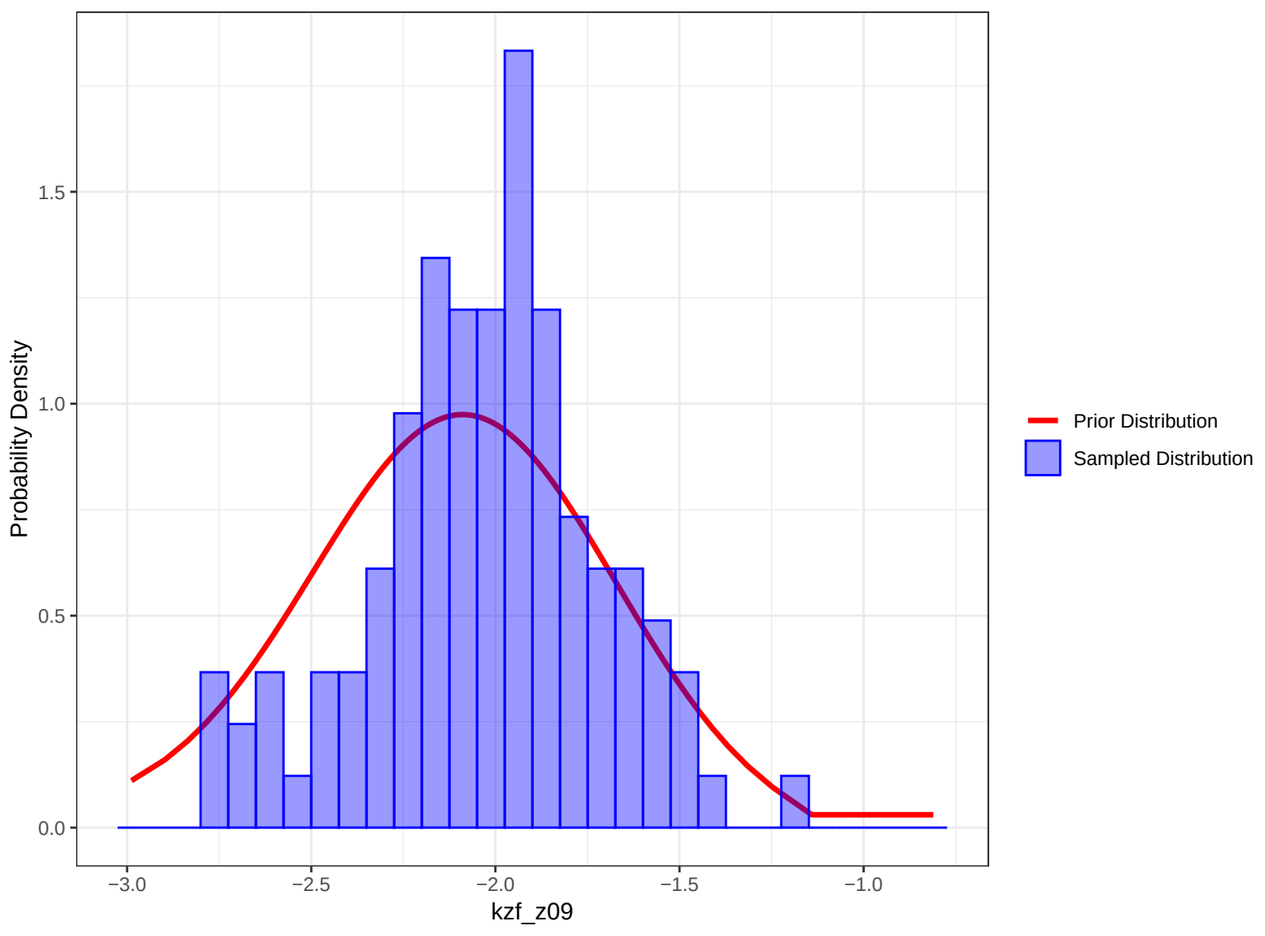

Probability Density
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
kx_z69
Prior Distribution
Sampled Distribution

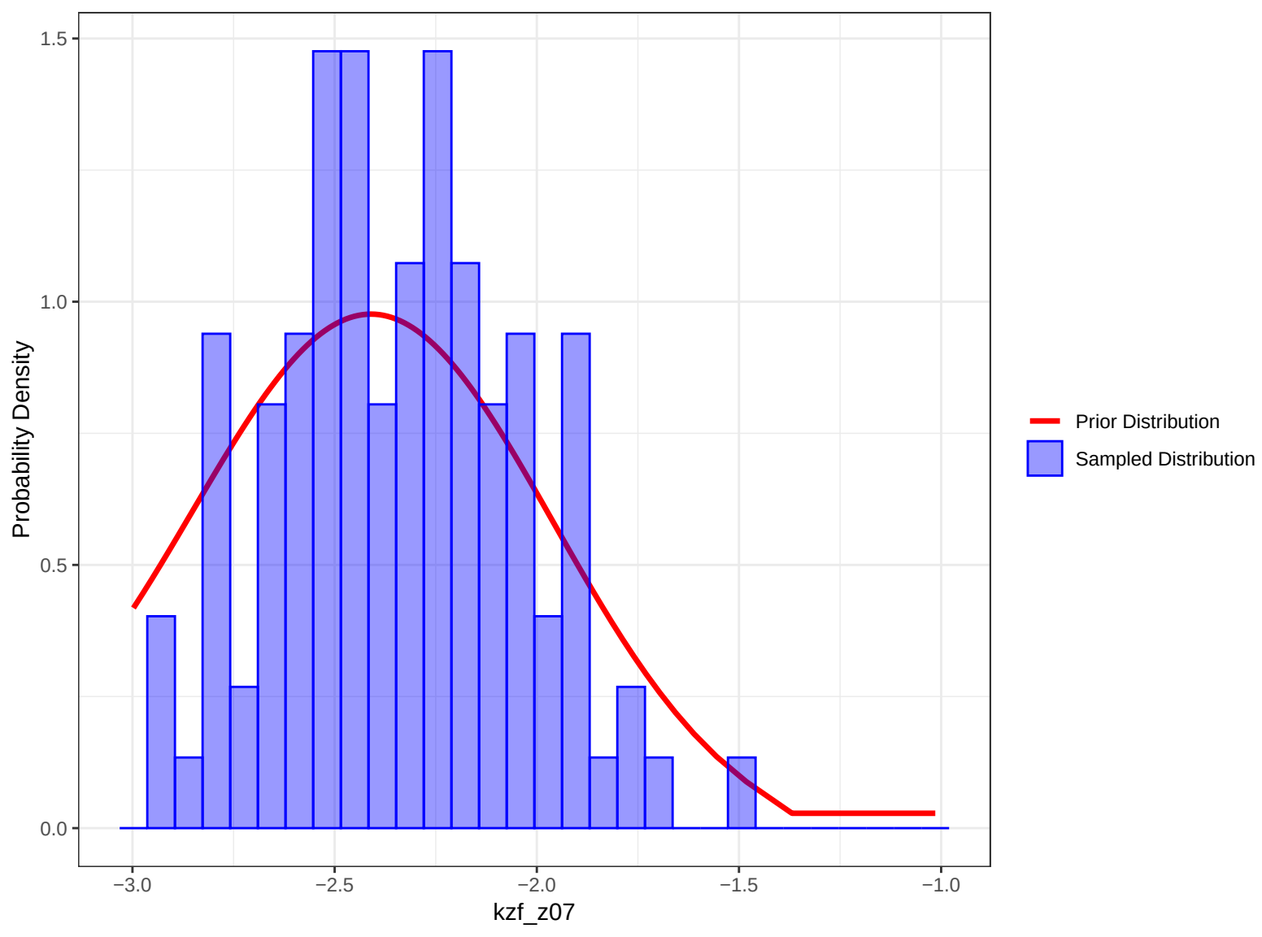

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z03
Prior Distribution
Sampled Distribution

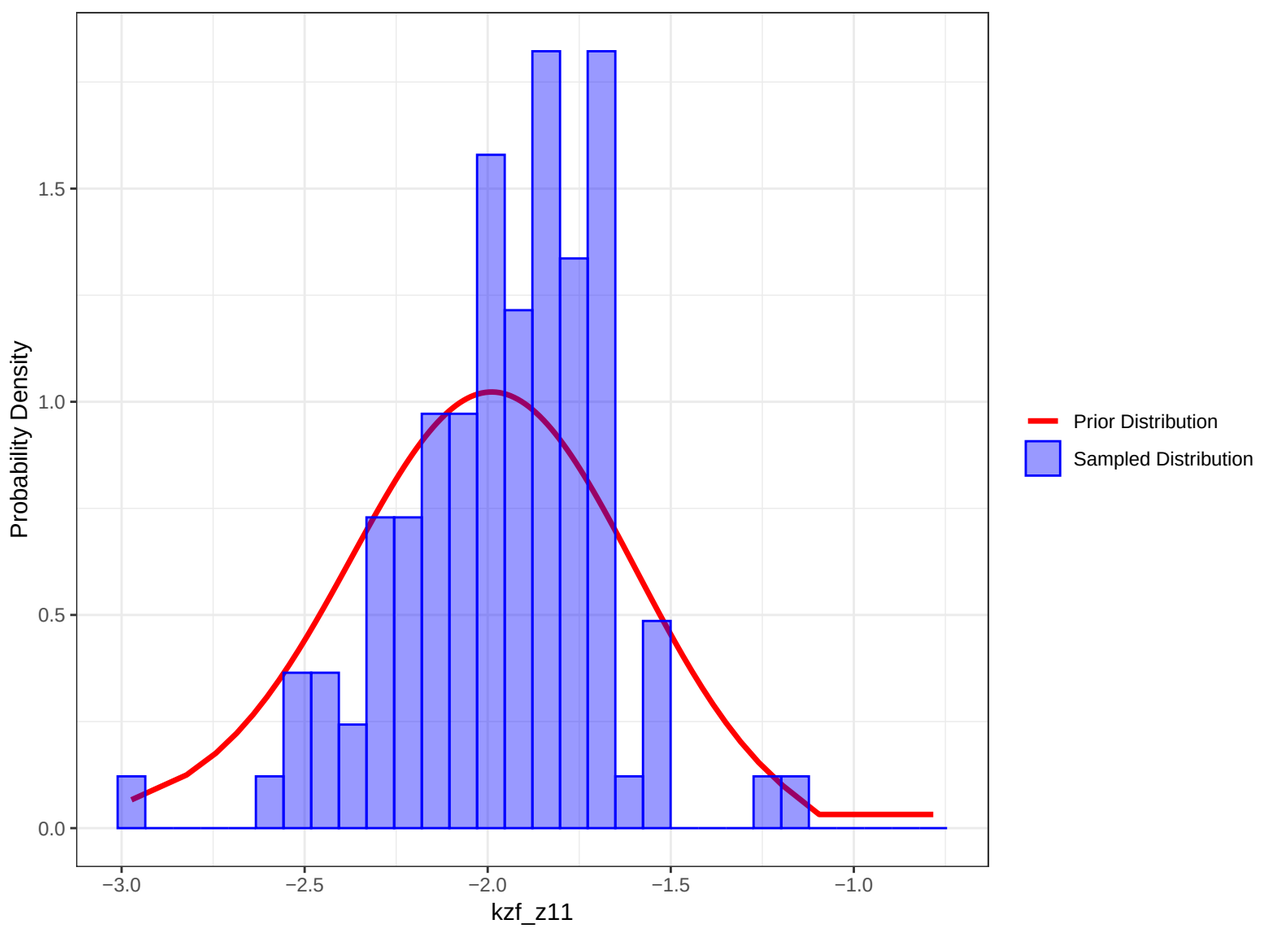

Probability Density
1.5
1.0
0.5
0.0
−3
−2
−1
kzf_z01
Prior Distribution
Sampled Distribution

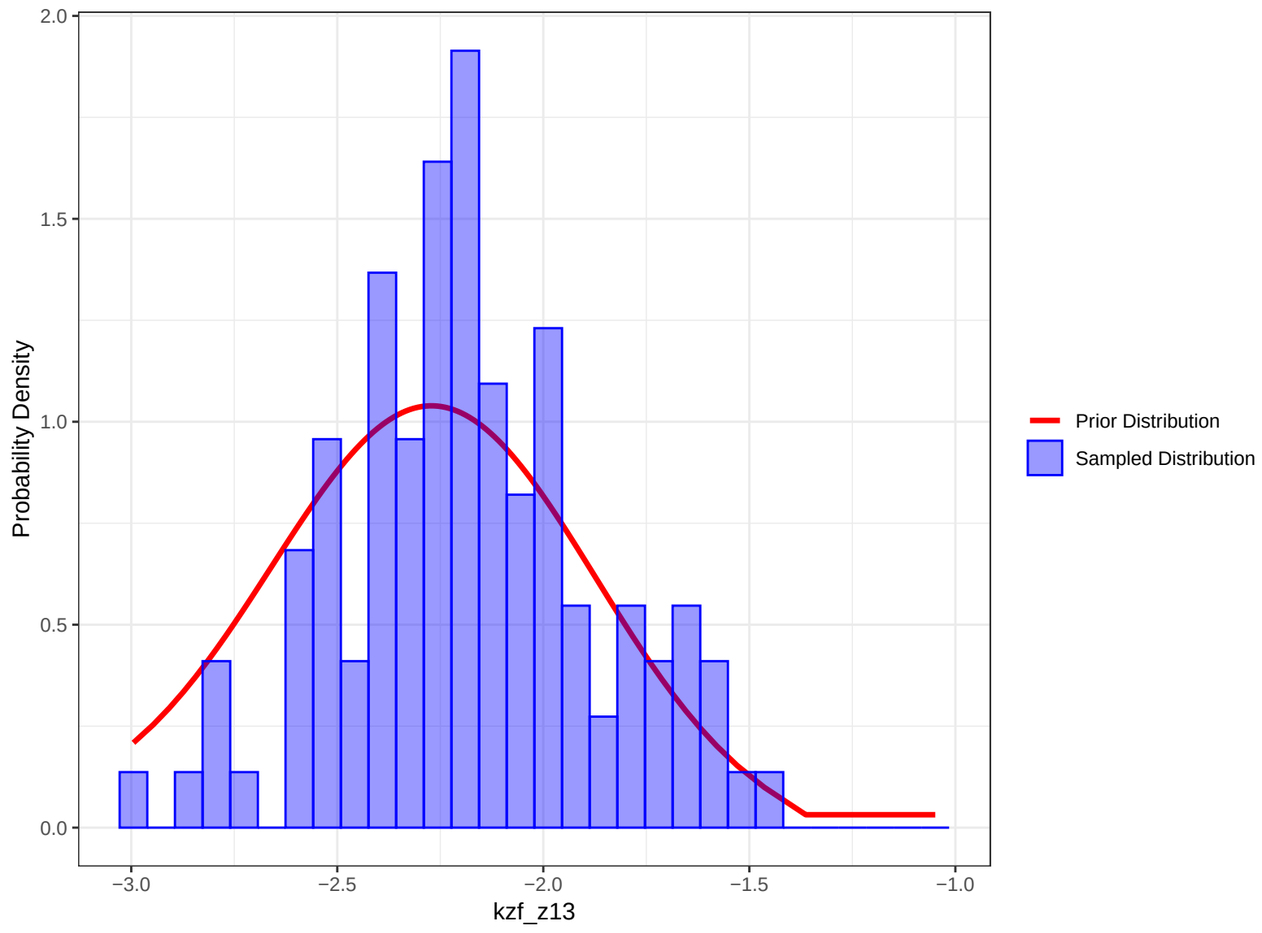

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
−0.5
kzf_z04
Prior Distribution
Sampled Distribution

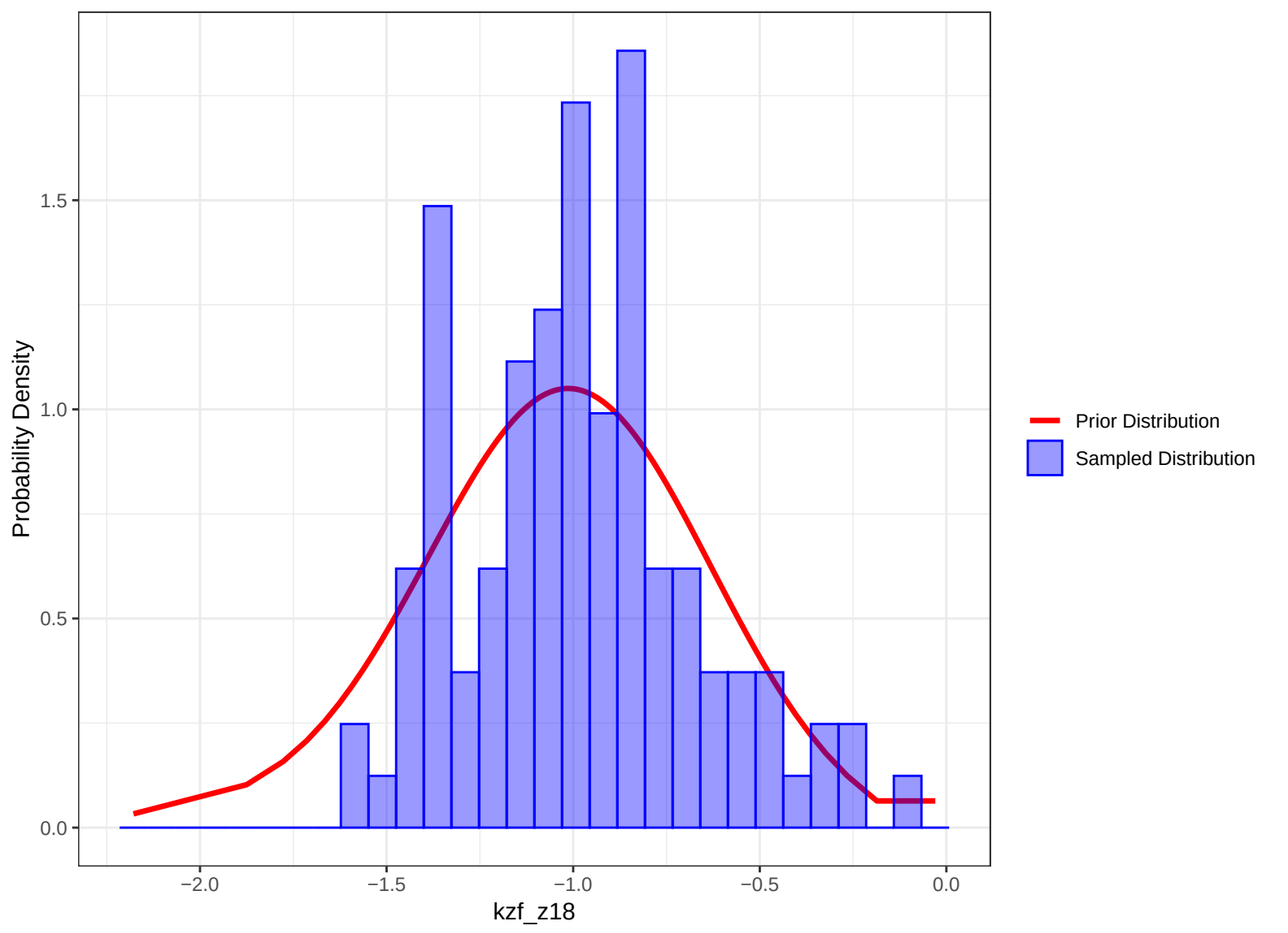

Probability Density
1.0
0.5
0.0
−3
−2
−1
kzf_z05
Prior Distribution
Sampled Distribution

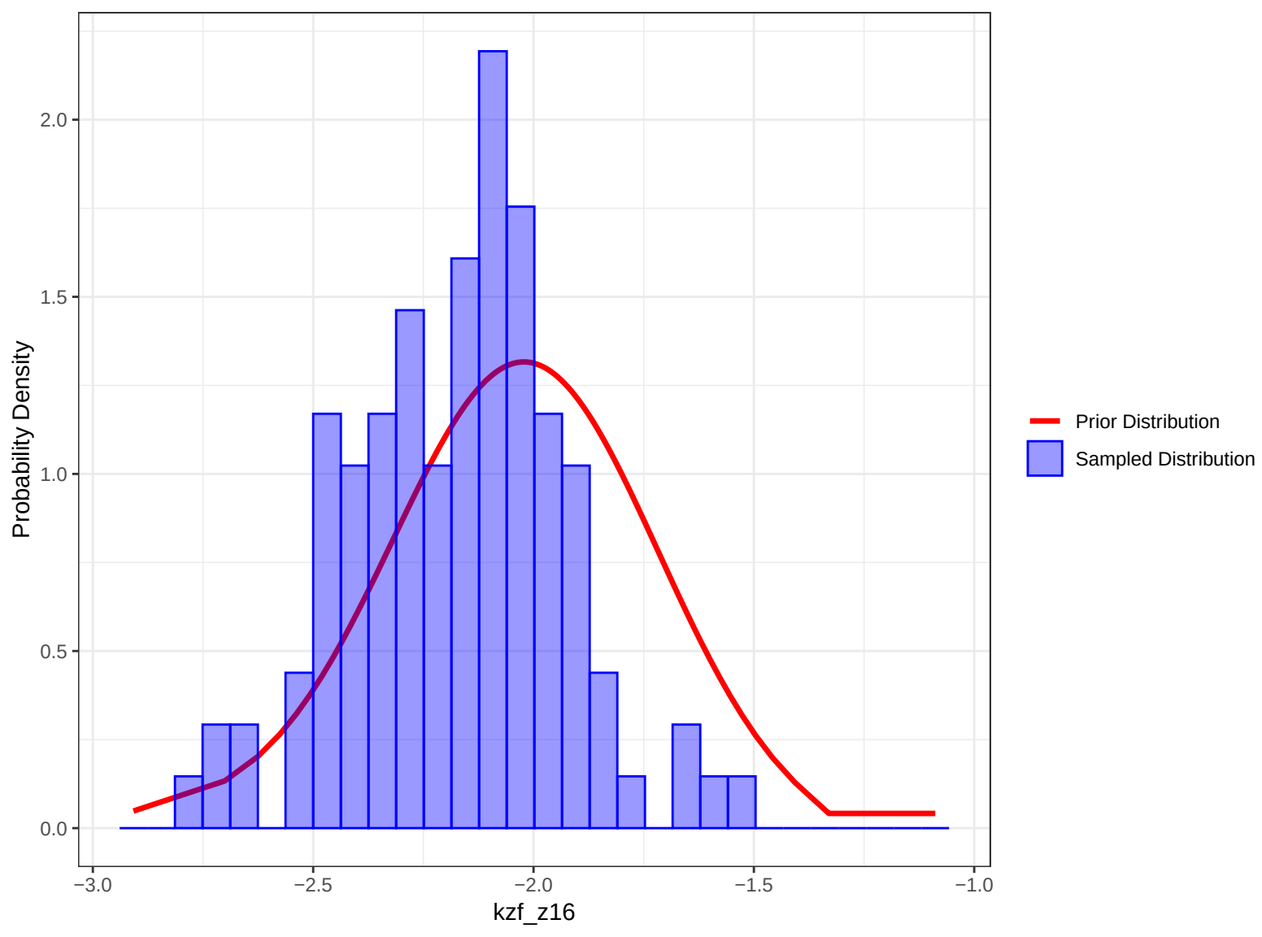

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z09
Prior Distribution
Sampled Distribution

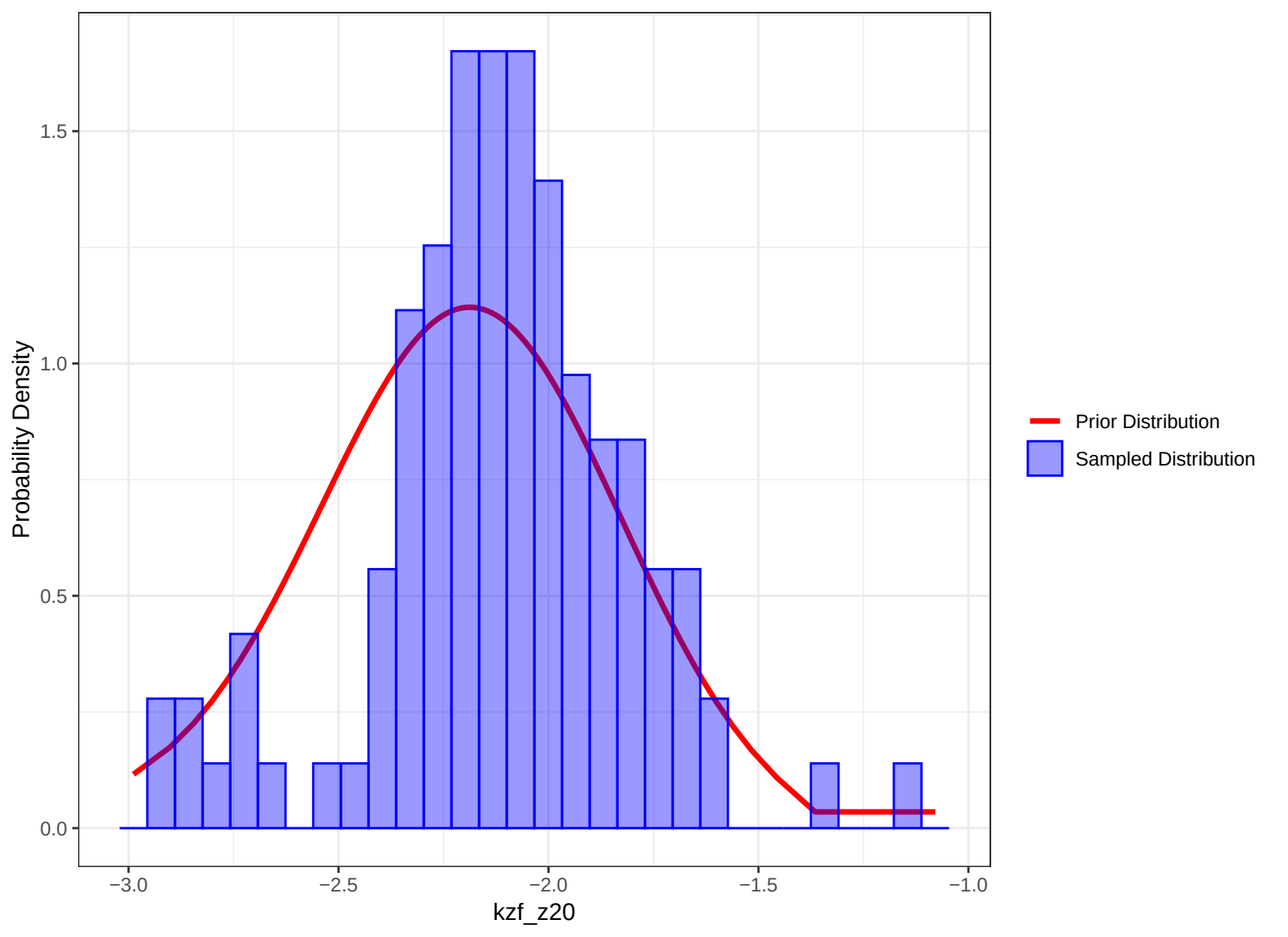

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z07
Prior Distribution
Sampled Distribution

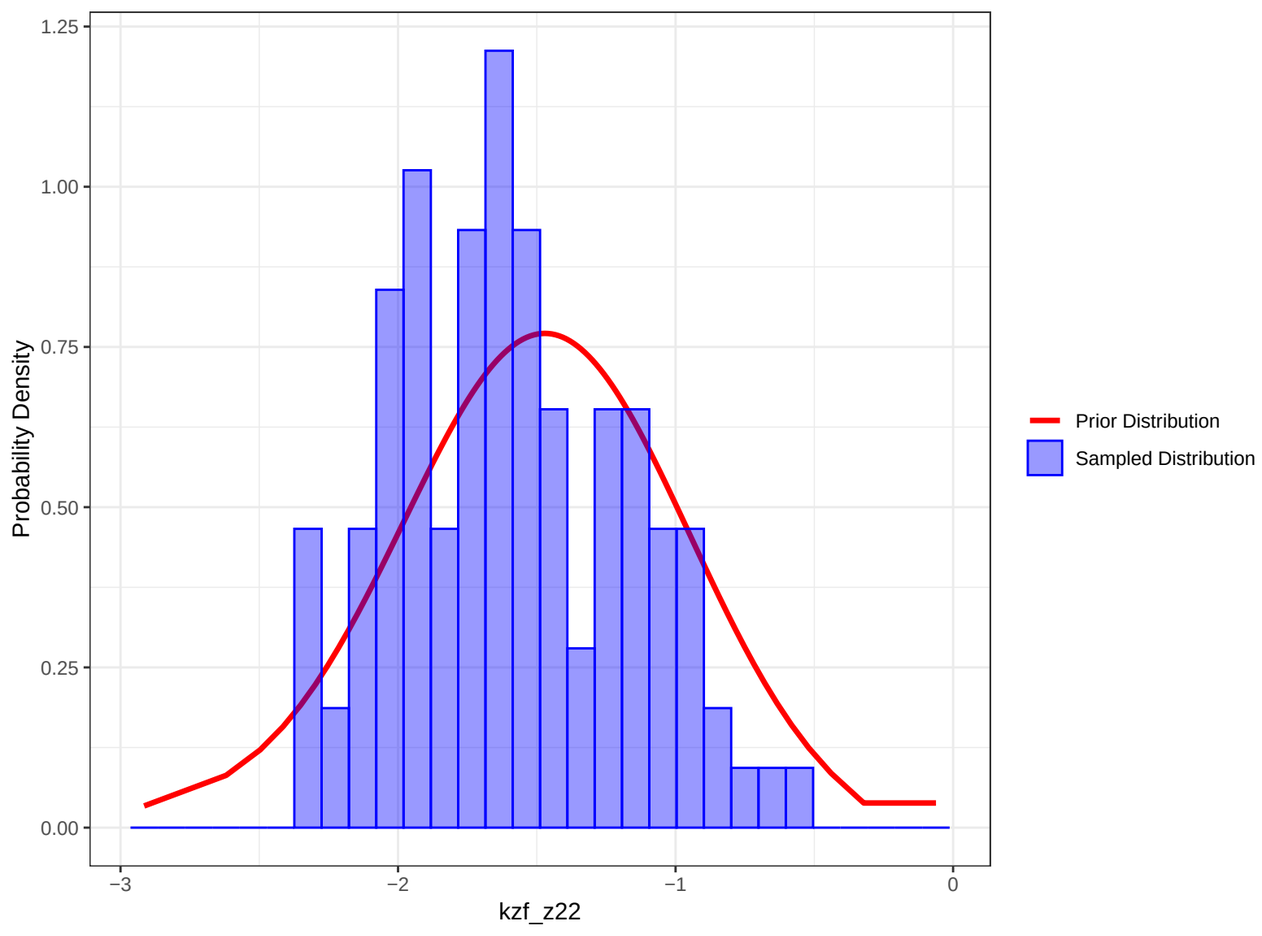

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z11
Prior Distribution
Sampled Distribution

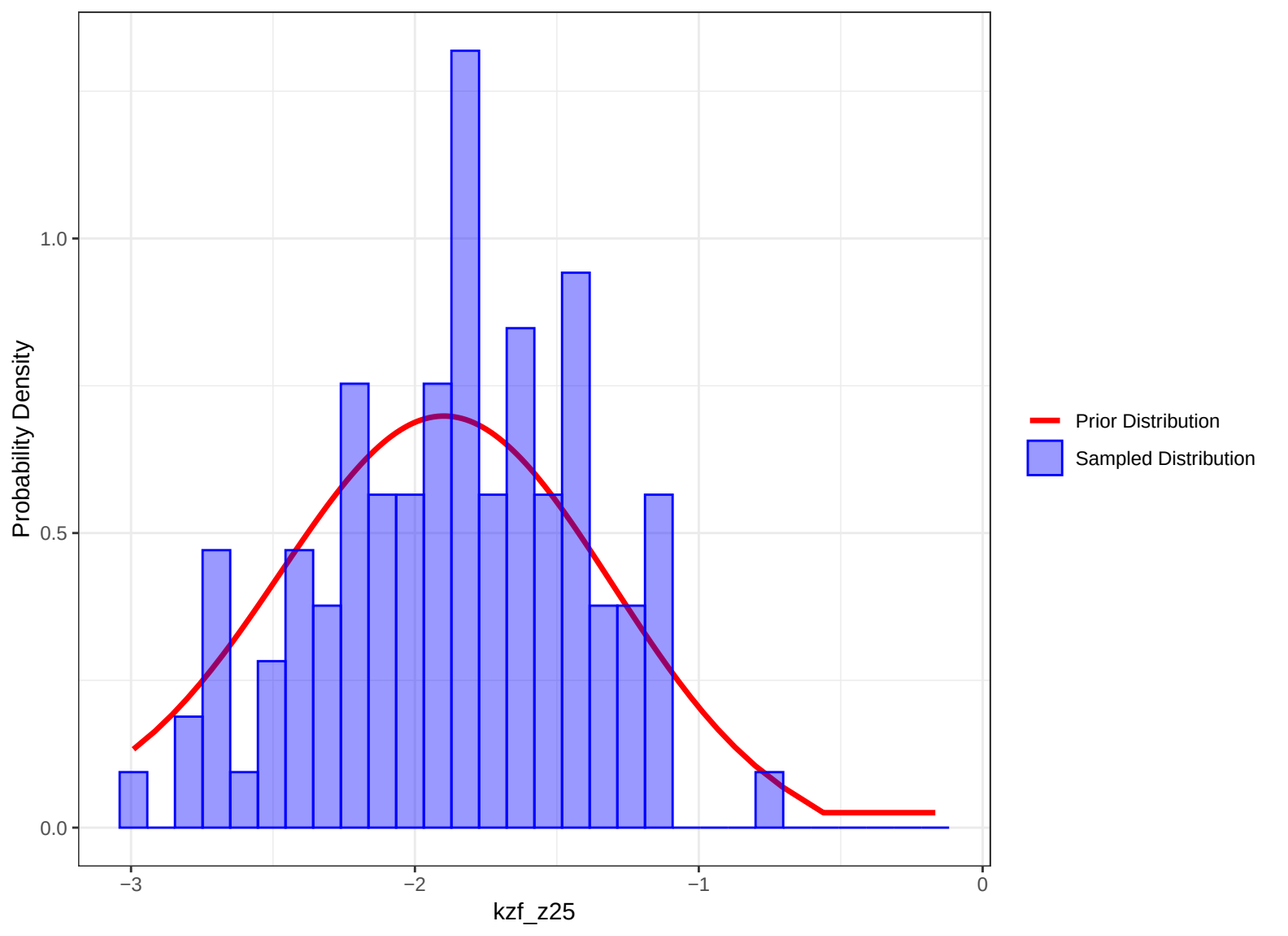

Probability Density
2.0
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z13
Prior Distribution
Sampled Distribution

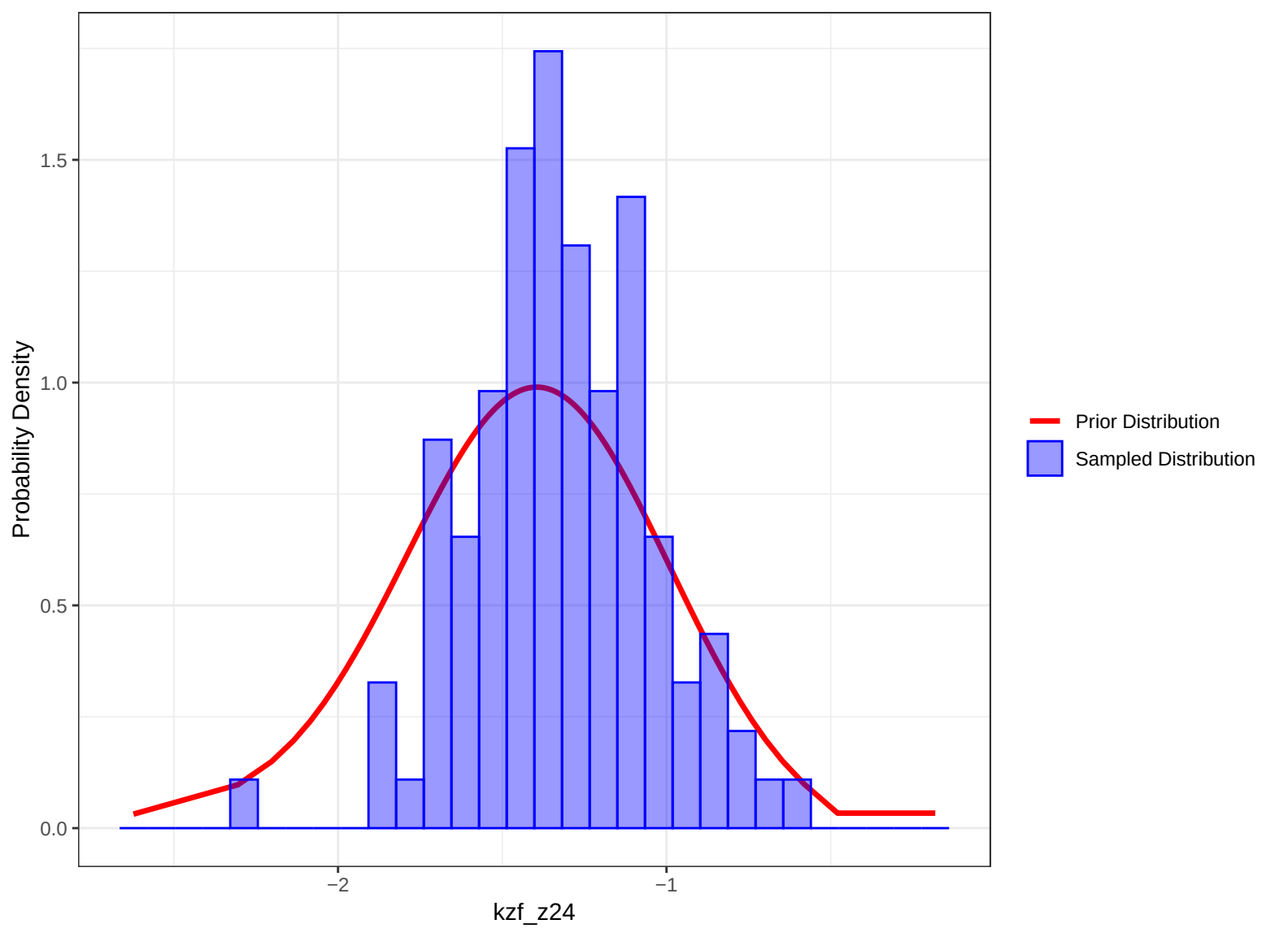

Probability Density
1.5
1.0
0.5
0.0
−2.0
−1.5
−1.0
−0.5
0.0
kzf_z18
Prior Distribution
Sampled Distribution

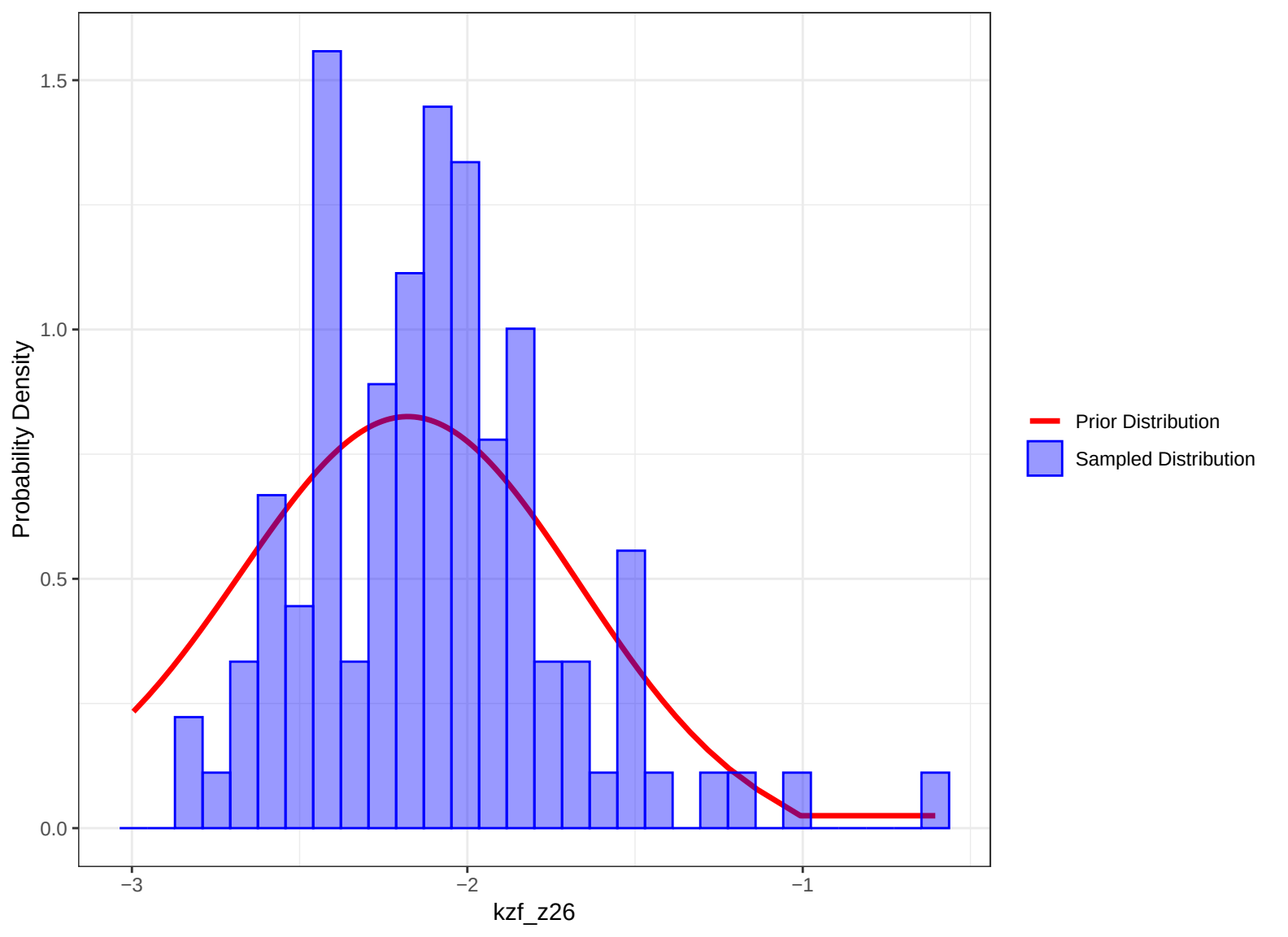

Probability Density
2.0
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z16
Prior Distribution
Sampled Distribution

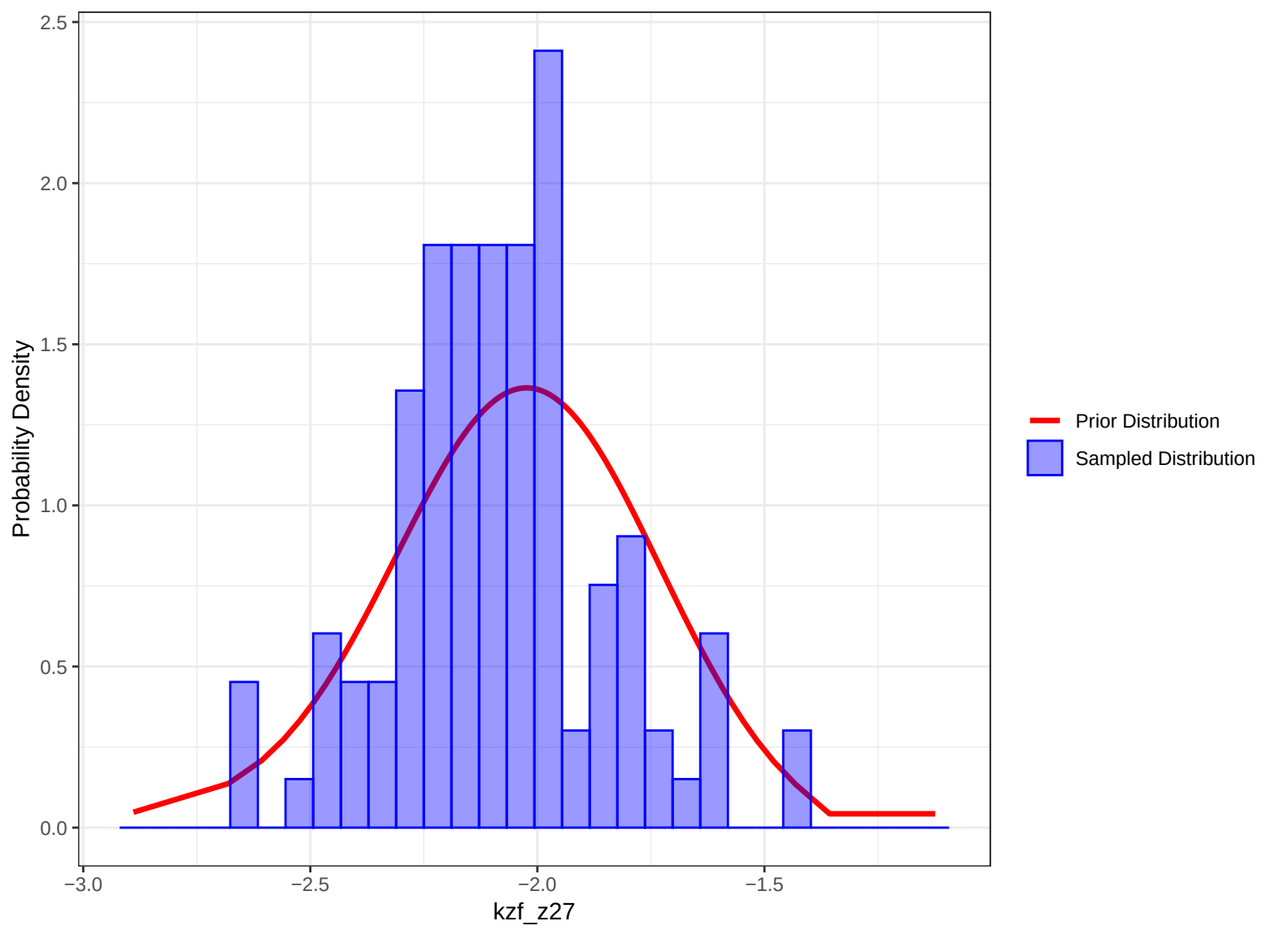

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z20
Prior Distribution
Sampled Distribution

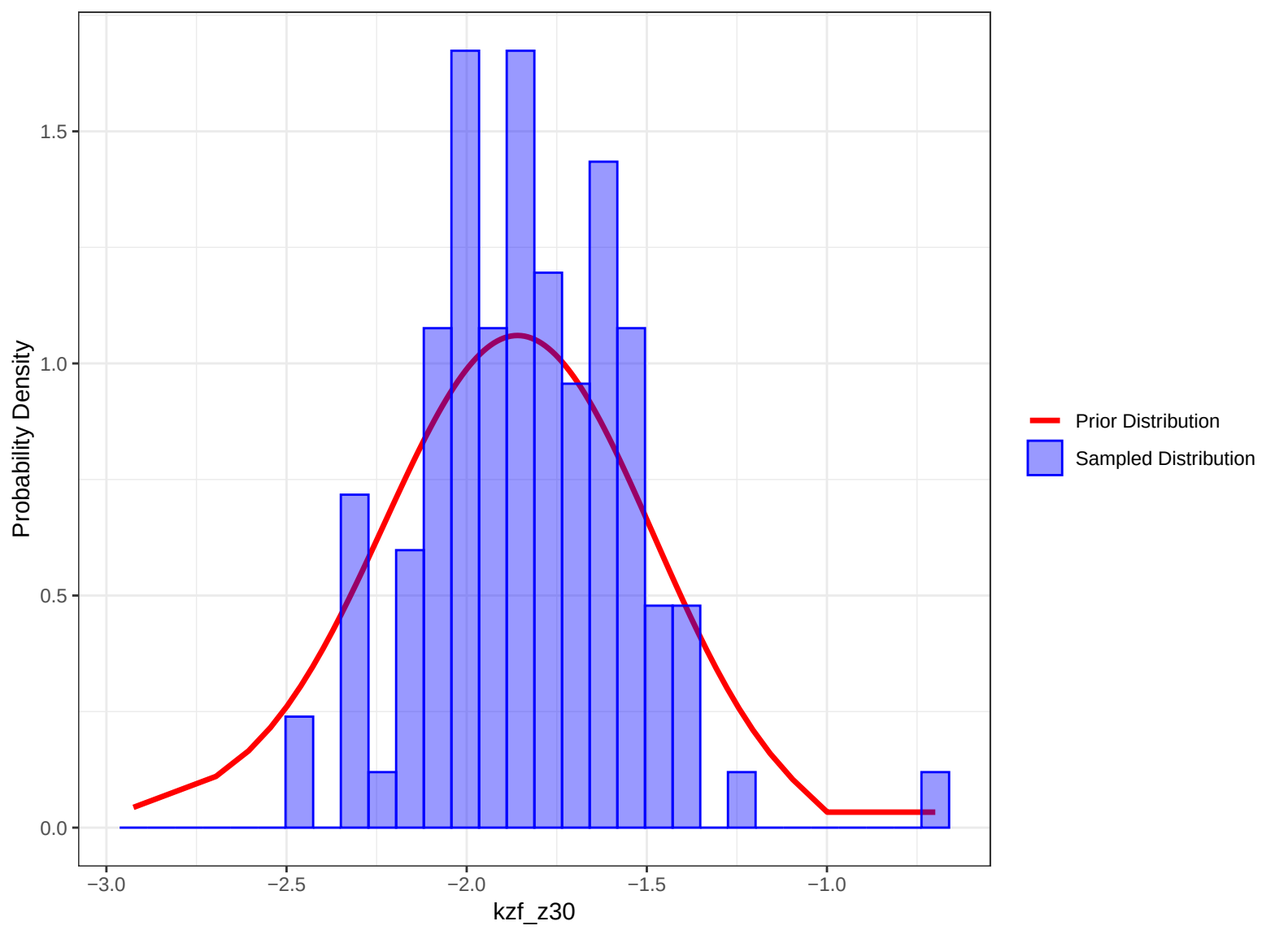

1.25
1.00
0.75
0.50
0.25
0.00
Probability Density
−3
−2
−1
0
kzf_z22
Prior Distribution
Sampled Distribution

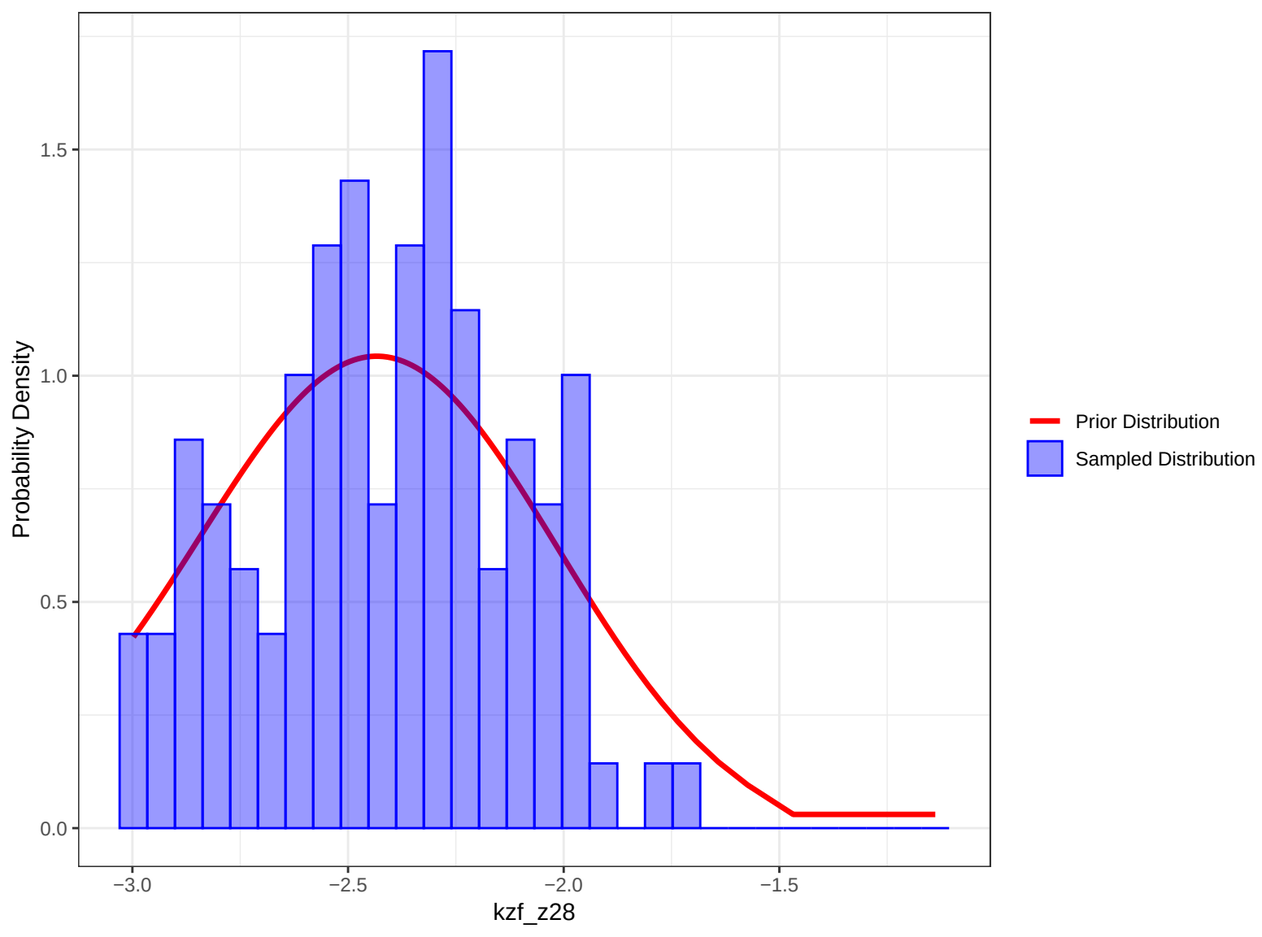

1.0
0.5
0.0
Probability Density
−3
−2
−1
0
kzf_z25
Prior Distribution
Sampled Distribution

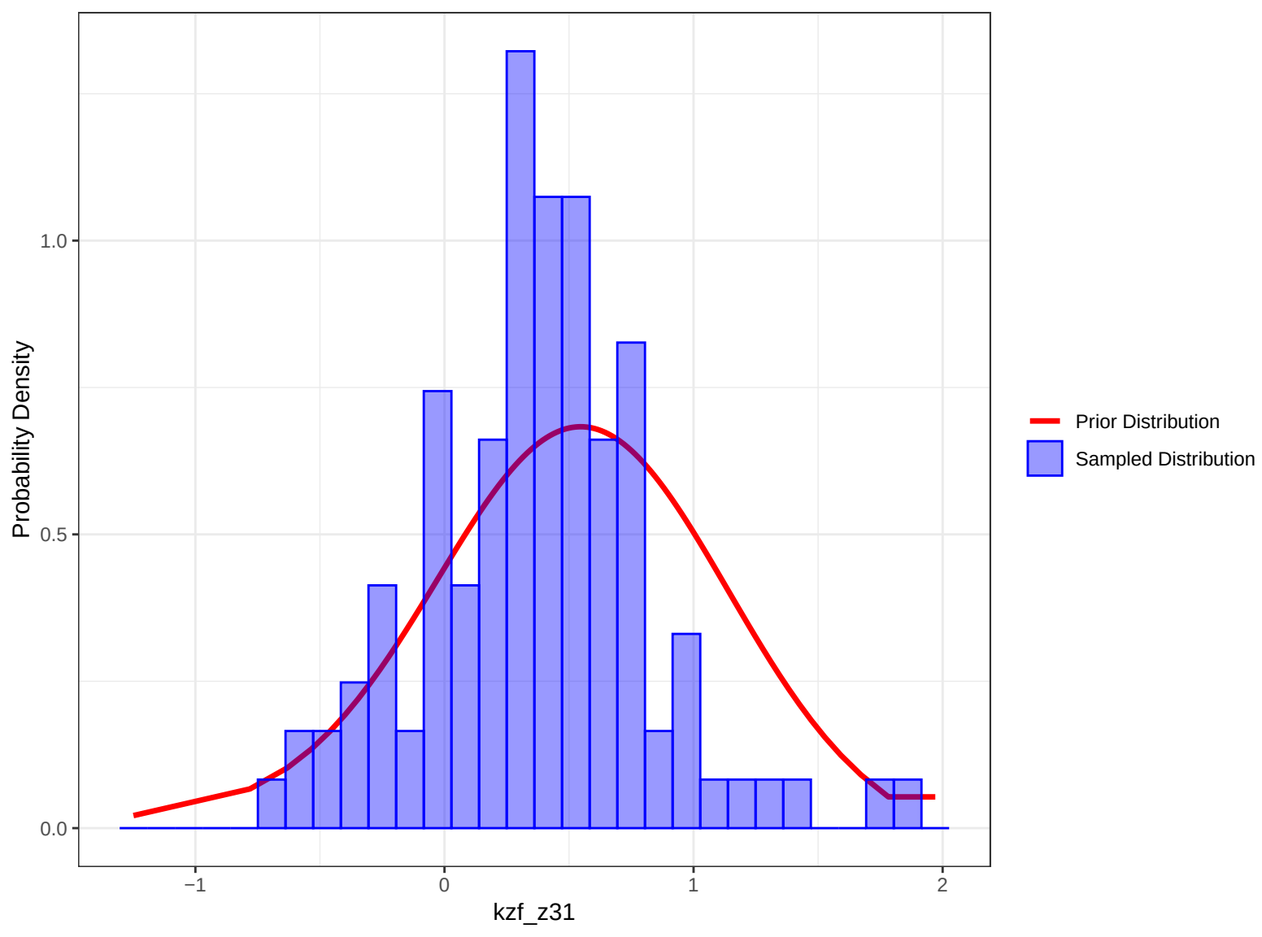

1.5
1.0
0.5
0.0
Probability Density
−2
−1
kzf_z24
Prior Distribution
Sampled Distribution

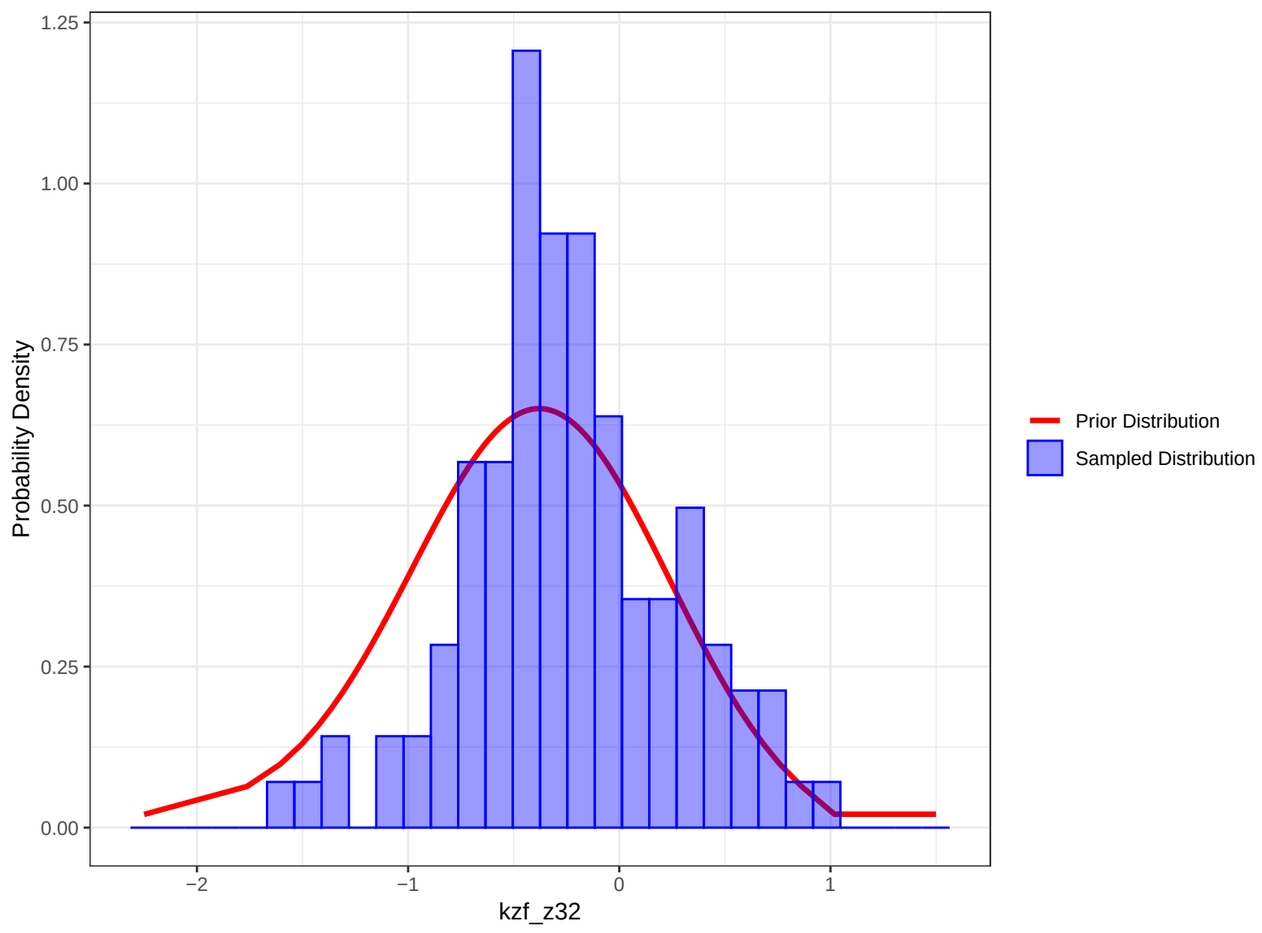

1.5
1.0
0.5
0.0
Probability Density
−3
−2
−1
kzf_z26
Prior Distribution
Sampled Distribution

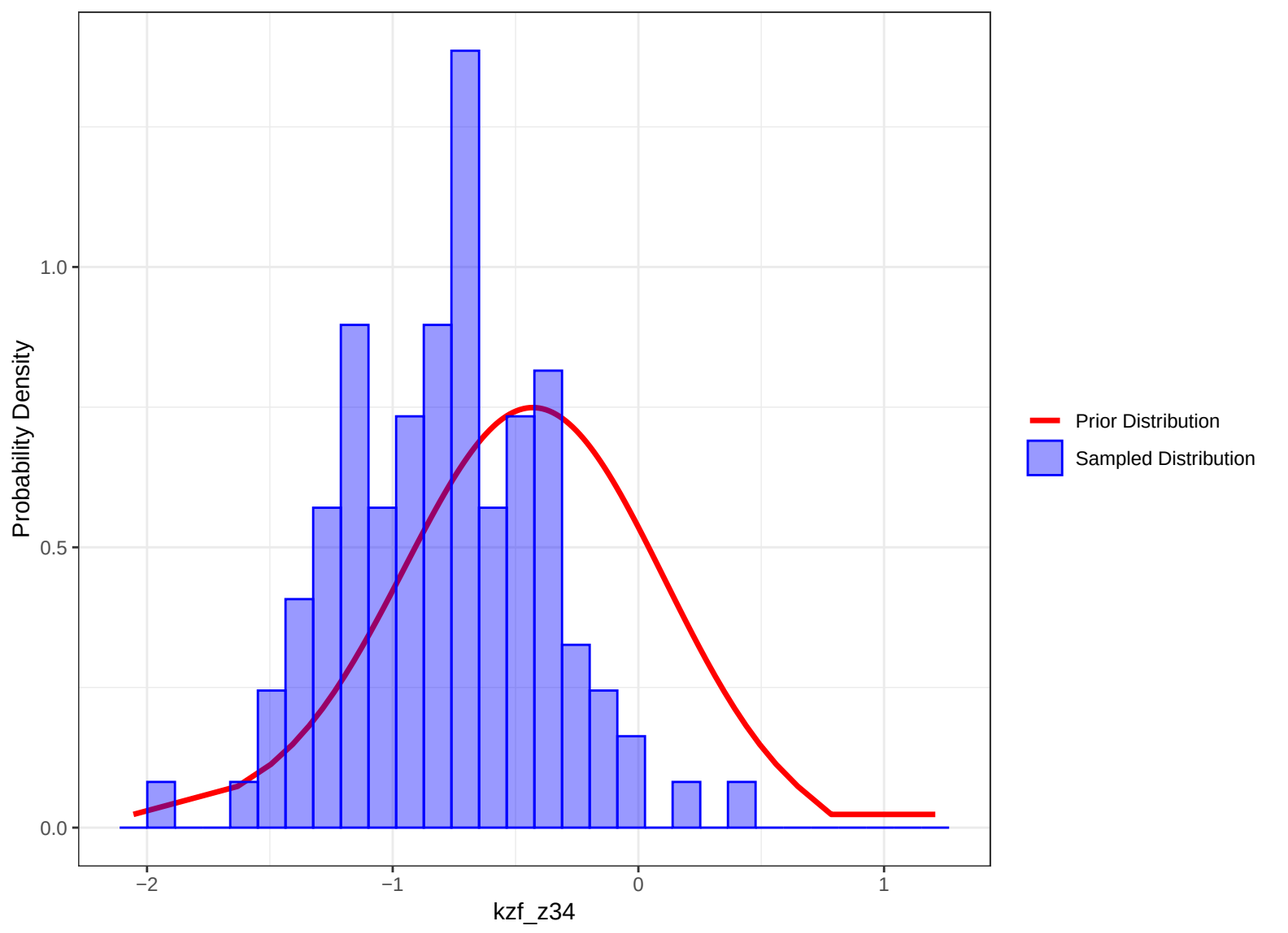

Probability Density
2.5
2.0
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
kzf_z27
Prior Distribution
Sampled Distribution

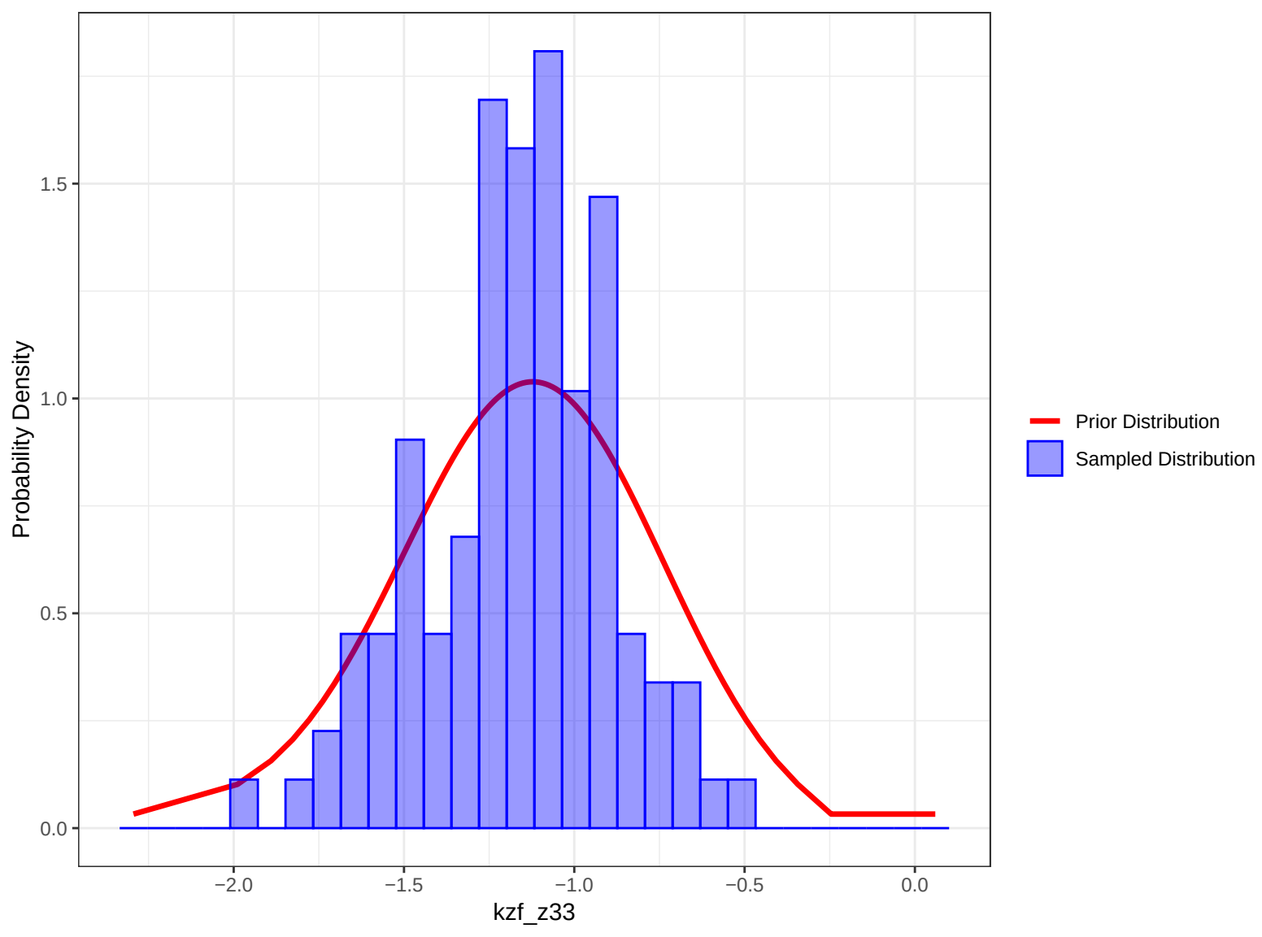

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z30
Prior Distribution
Sampled Distribution

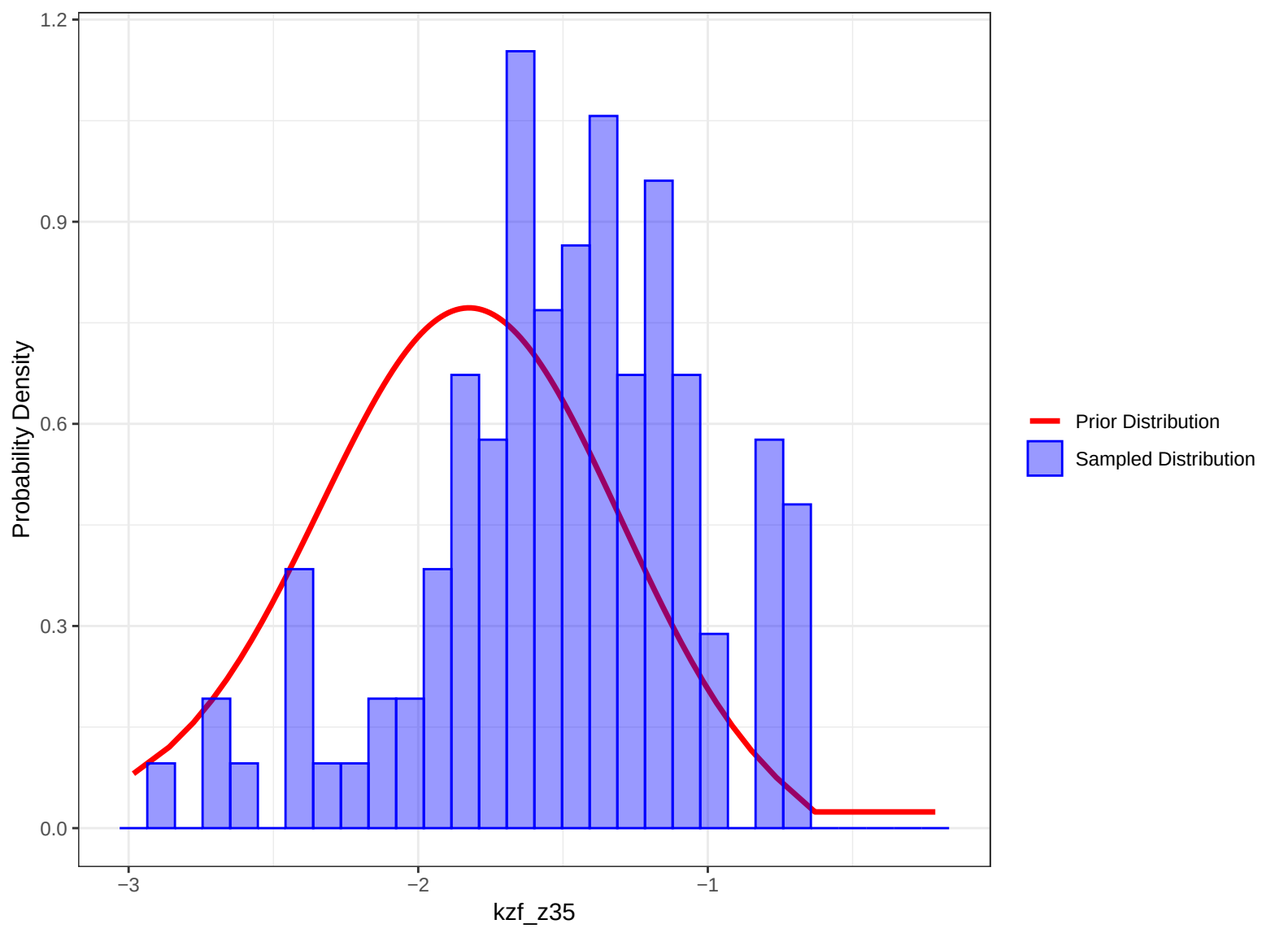

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
kzf_z28
Prior Distribution
Sampled Distribution

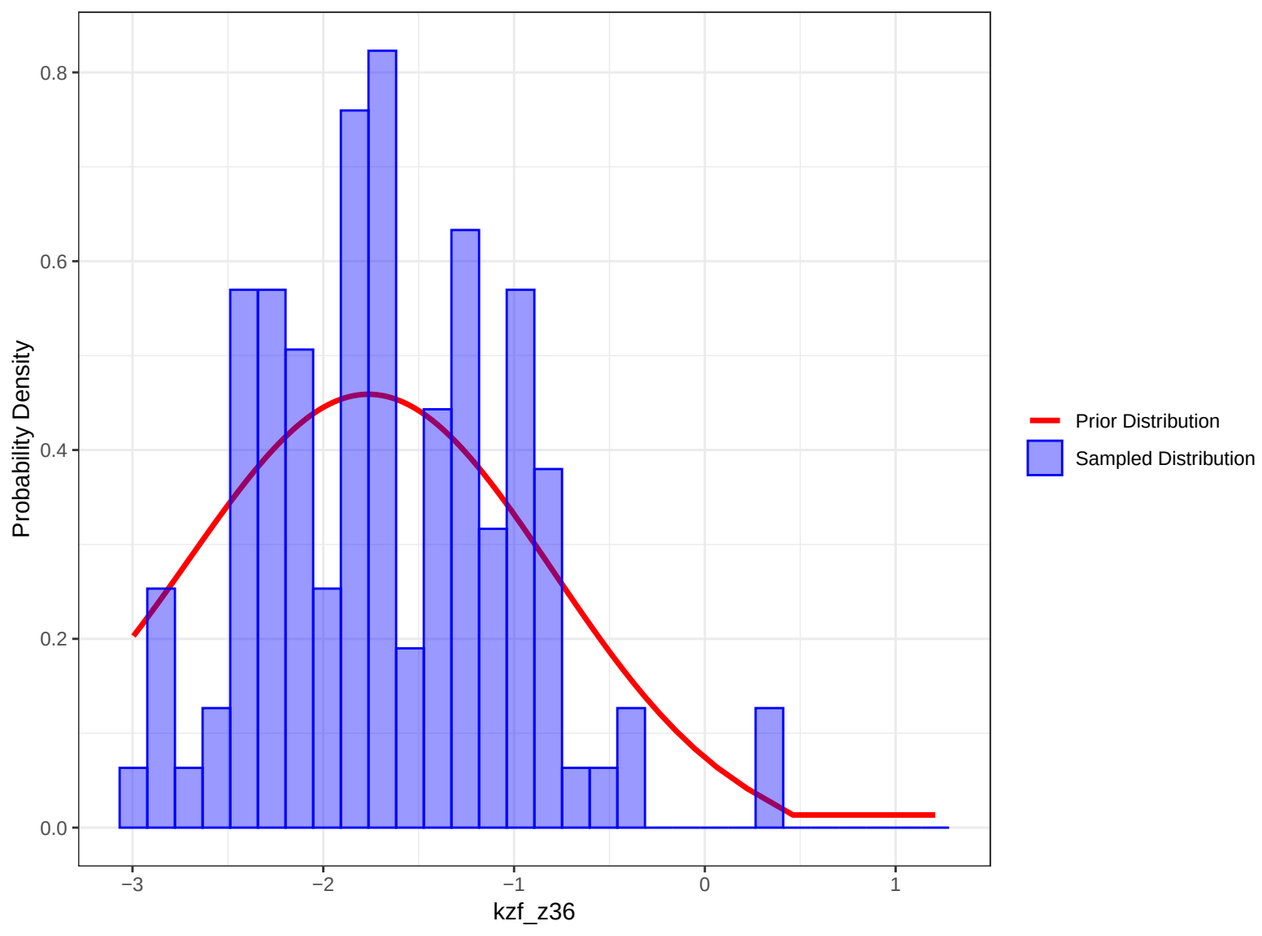

Probability Density
1.0
0.5
0.0
−1
0
1
2
kzf_z31
Prior Distribution
Sampled Distribution

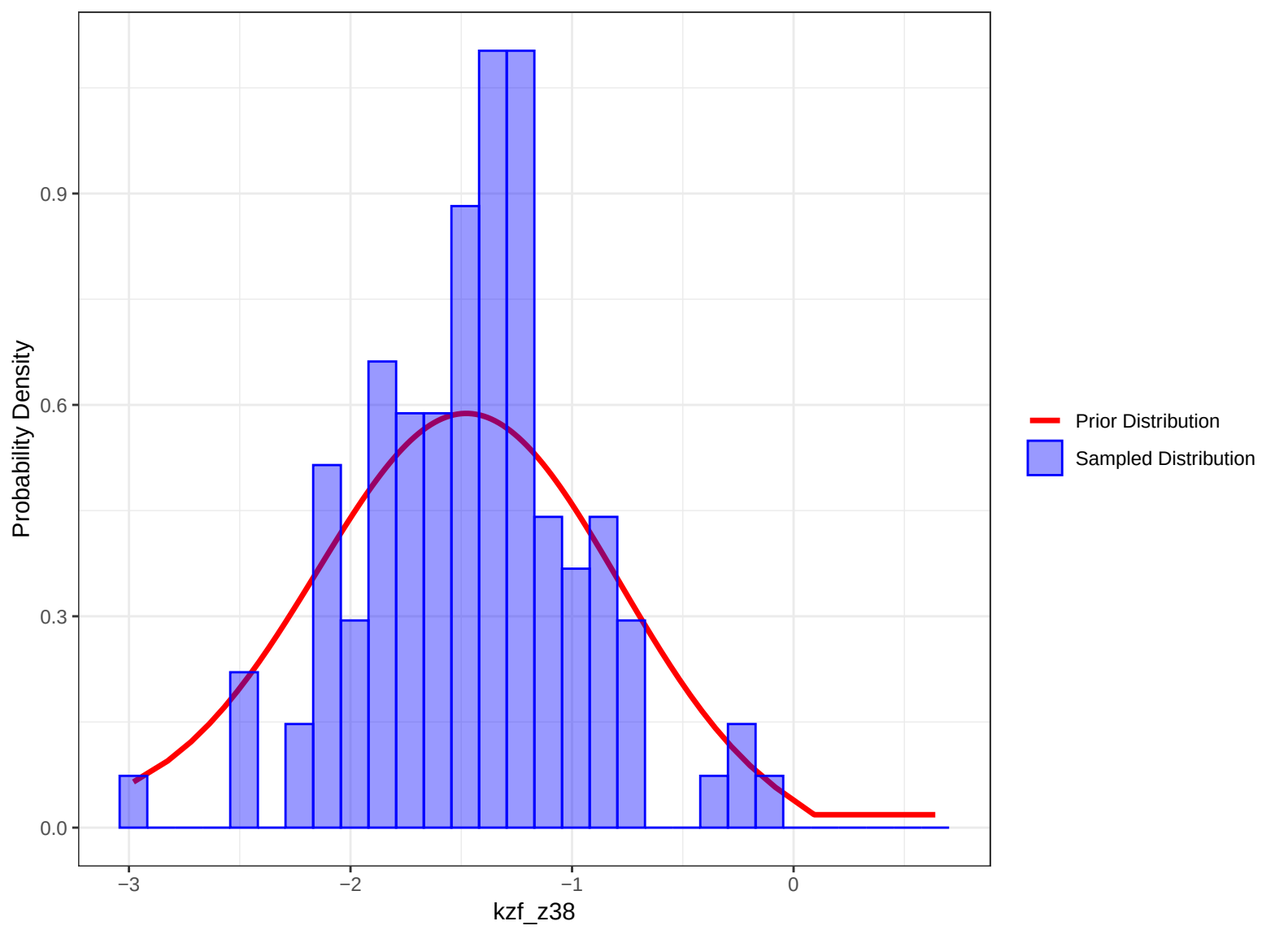

Probability Density
1.25
1.00
0.75
0.50
0.25
0.00
−2
−1
0
1
kzf_z32
Prior Distribution
Sampled Distribution

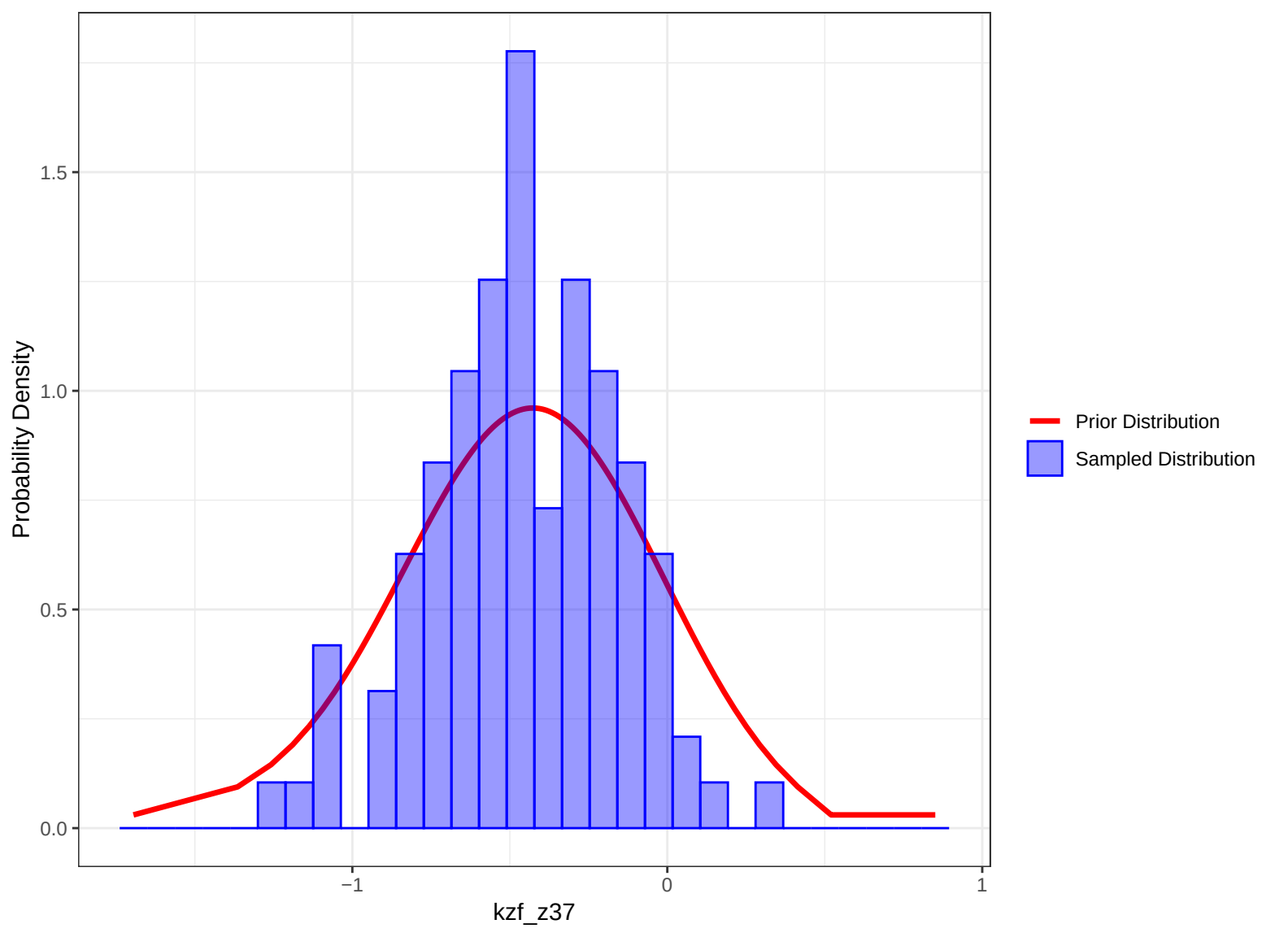

Probability Density
1.0
0.5
0.0
−2
−1
0
1
kzf_z34
Prior Distribution
Sampled Distribution

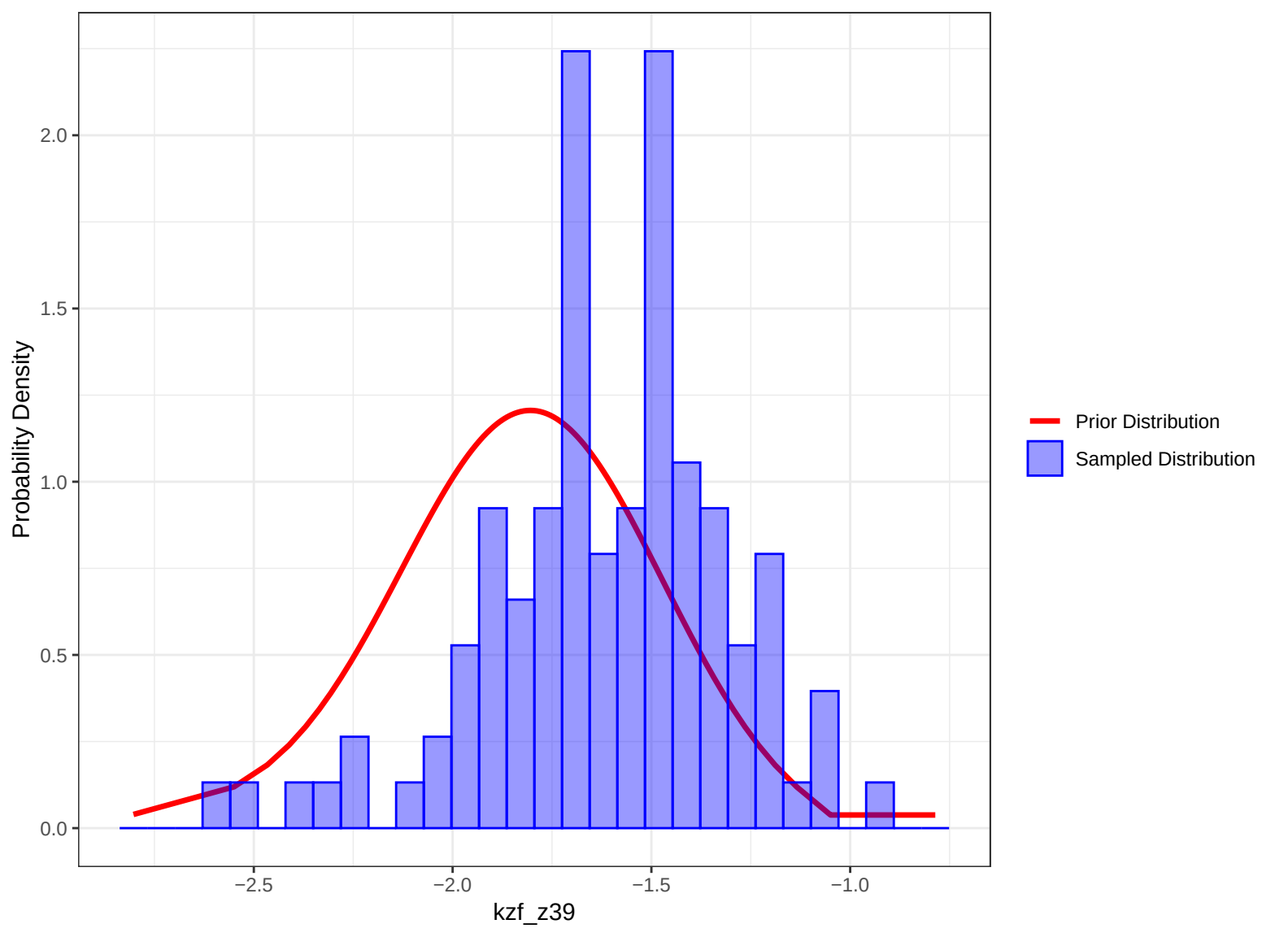

Probability Density
1.5
1.0
0.5
0.0
−2.0
−1.5
−1.0
−0.5
0.0
kzf_z33
Prior Distribution
Sampled Distribution

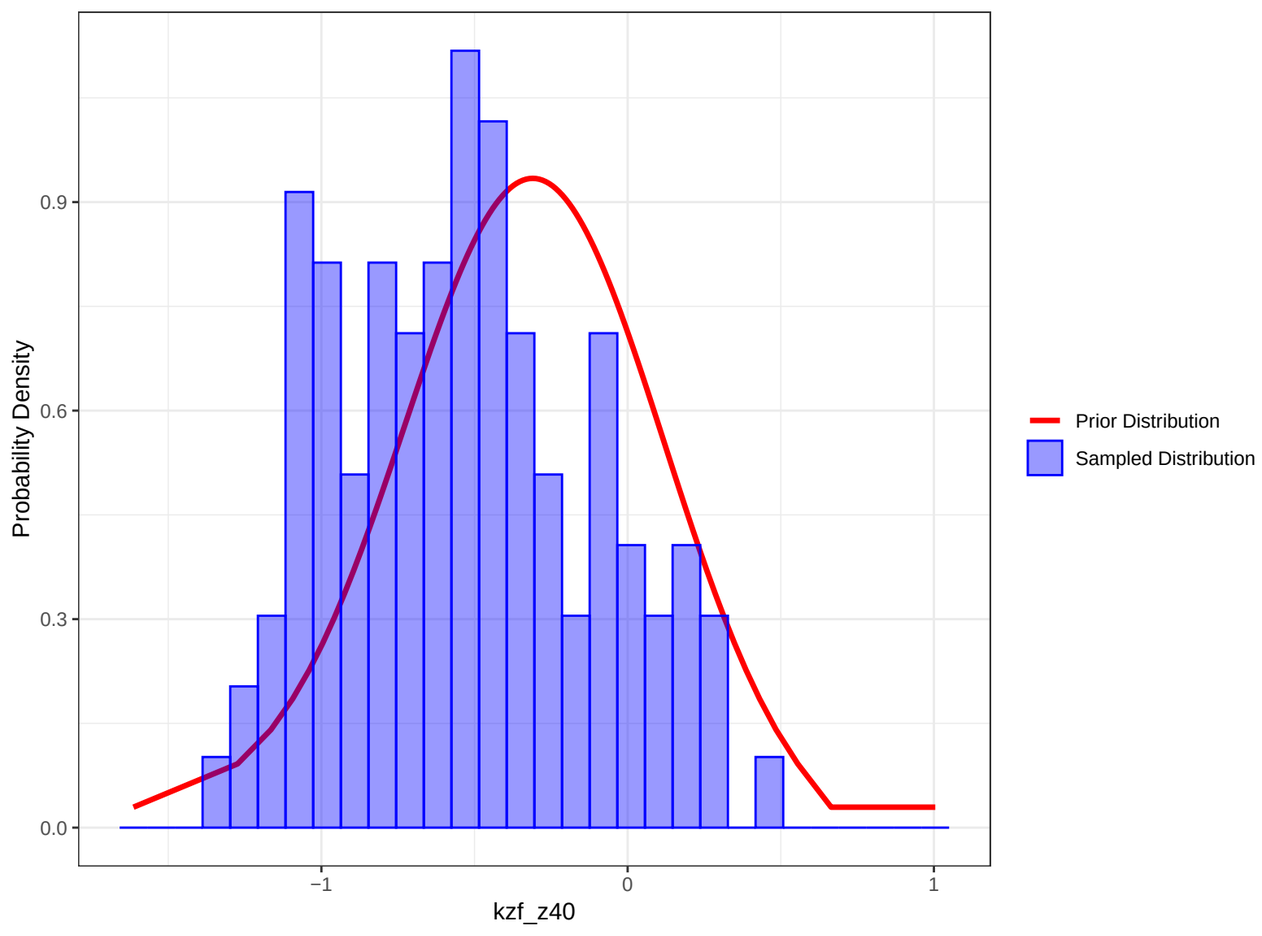

Probability Density
1.2
0.9
0.6
0.3
0.0
−3
−2
−1
kzf_z35
Prior Distribution
Sampled Distribution

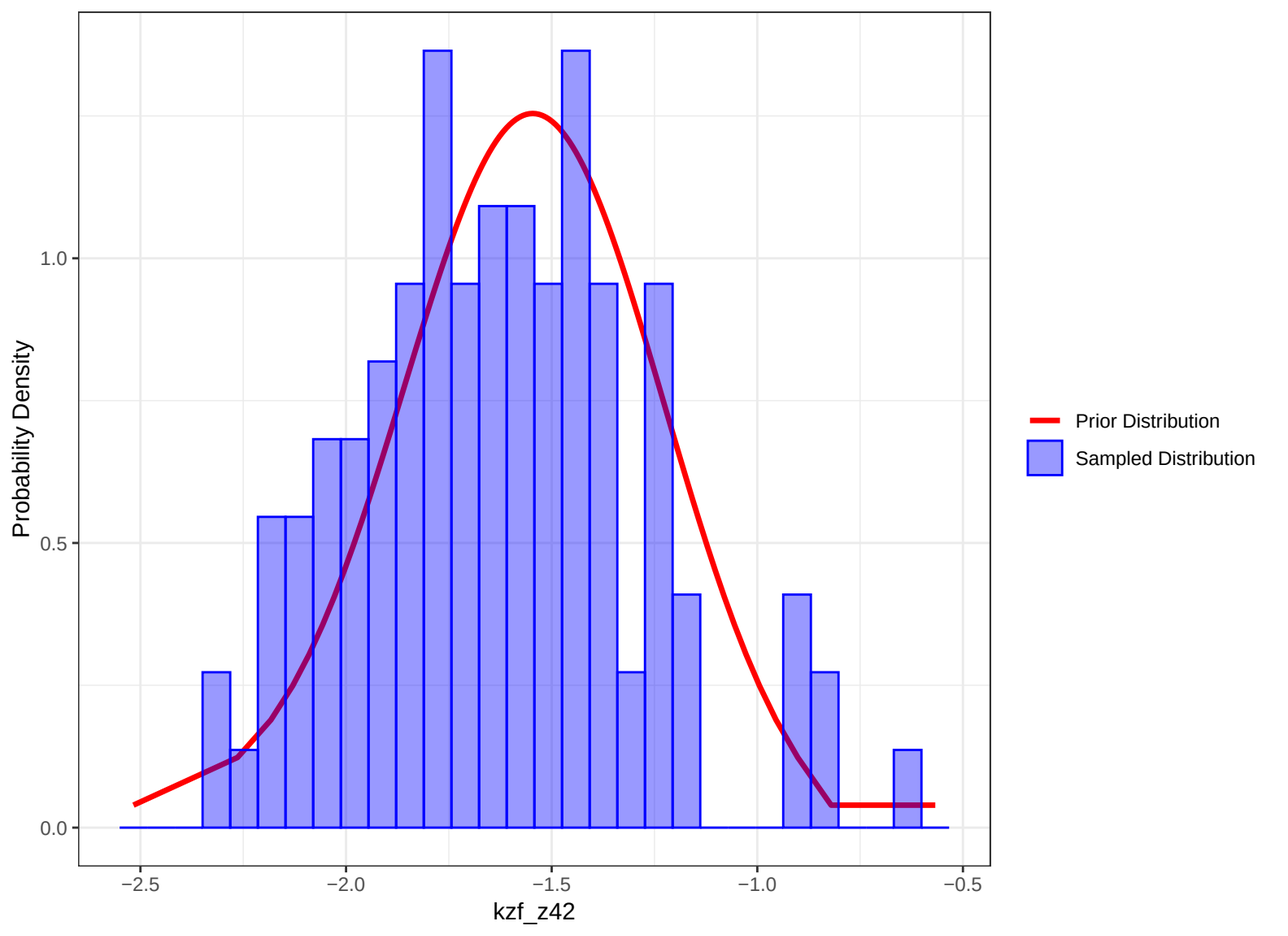

Probability Density
0.0
0.2
0.4
0.6
0.8
−3
−2
−1
0
1
kzf_z36
Prior Distribution
Sampled Distribution

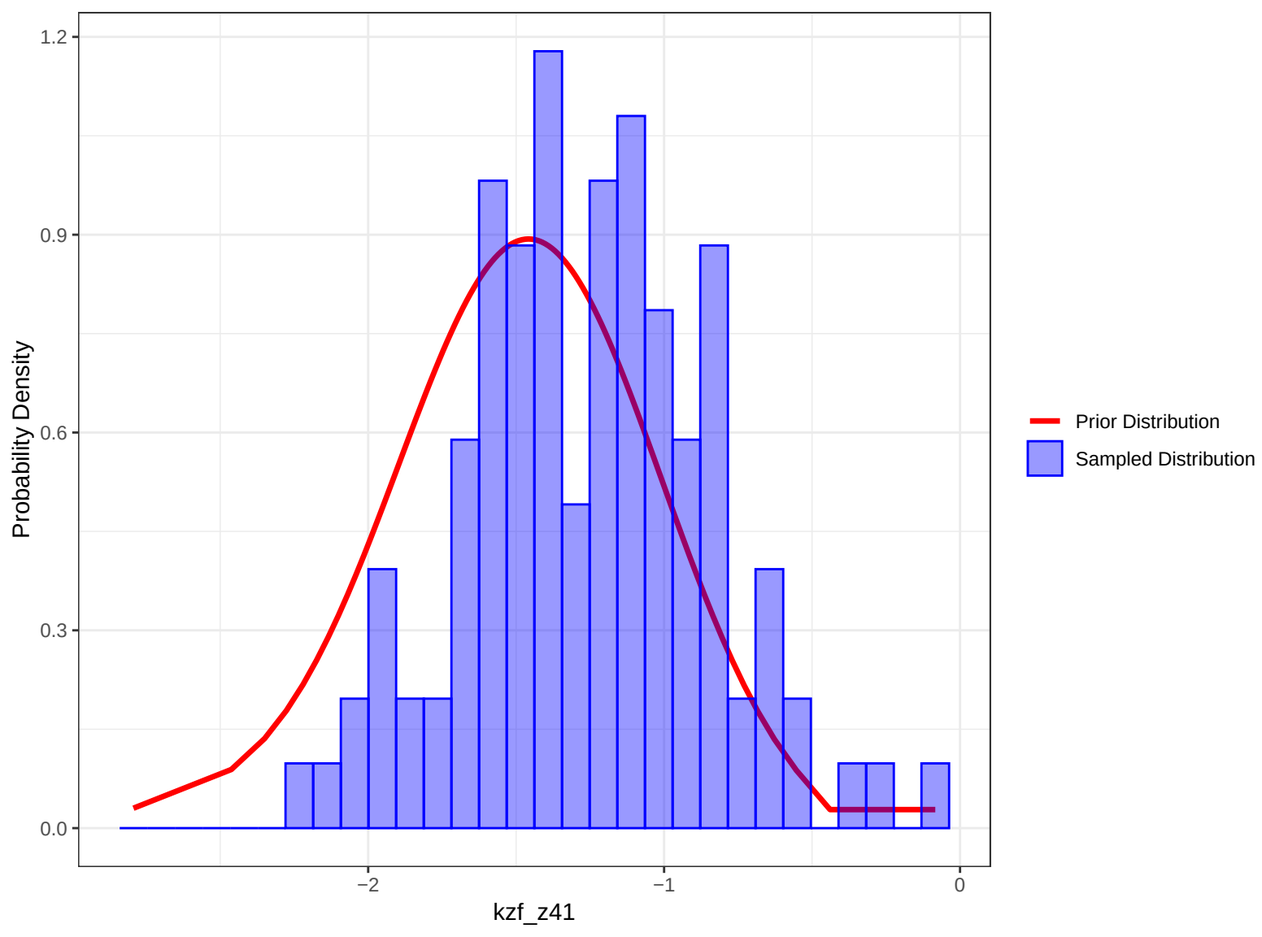

Probability Density
0.0
0.3
0.6
0.9
−3
−2
−1
0
kzf_z38
Prior Distribution
Sampled Distribution

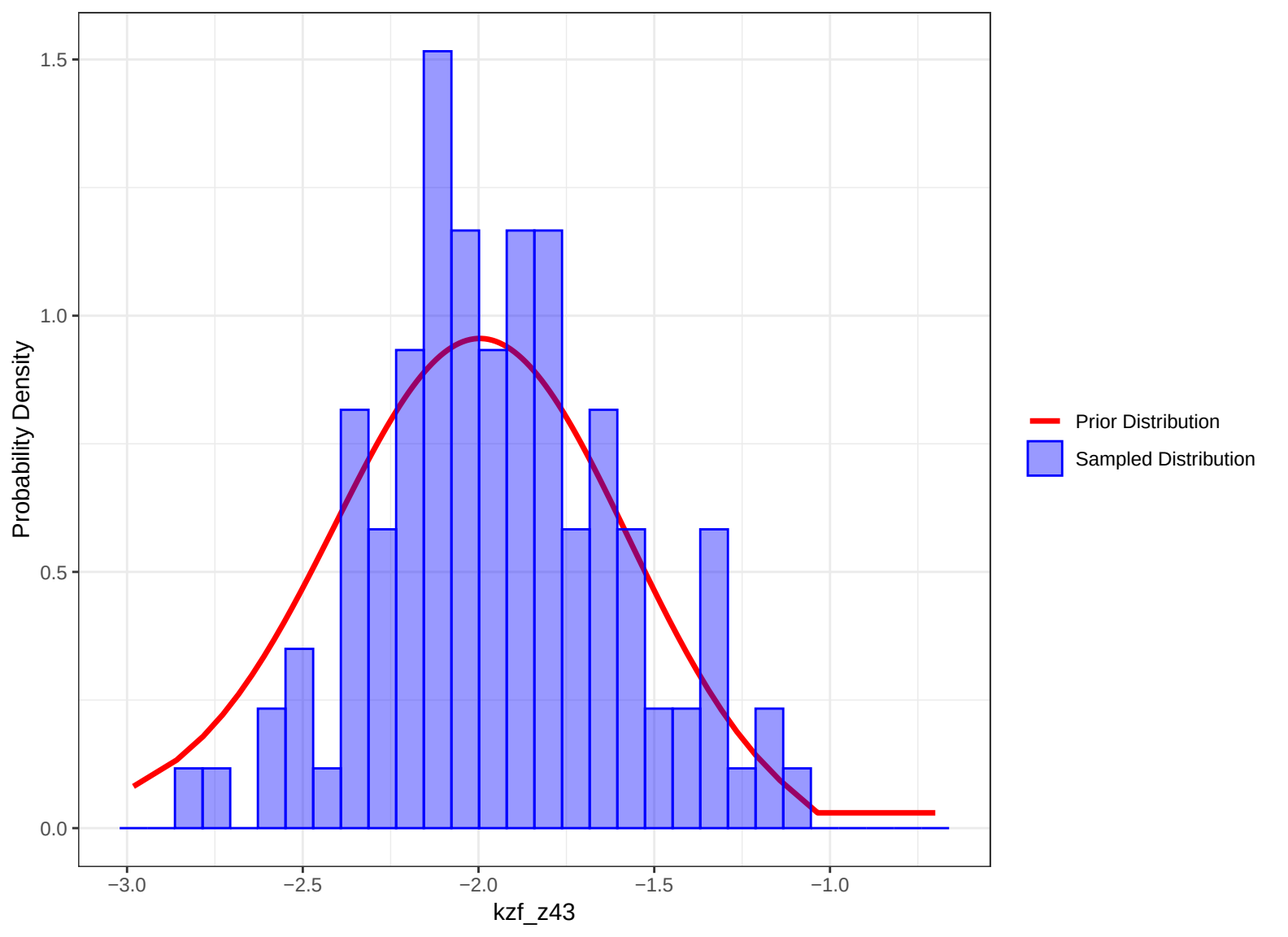

Probability Density
0.0
0.5
1.0
1.5
−1
0
1
kzf_z37
Prior Distribution
Sampled Distribution

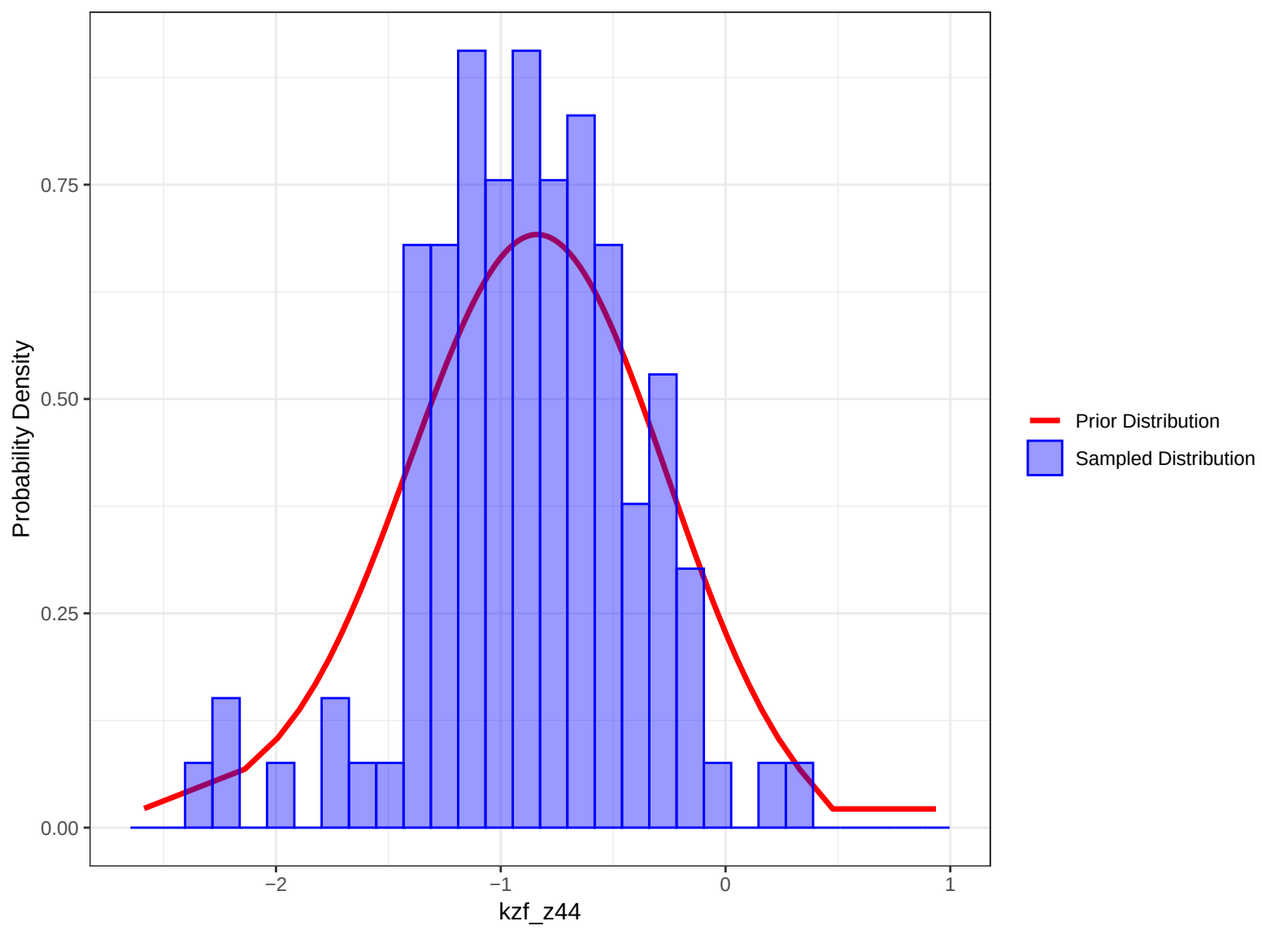

Probability Density
0.0
0.5
1.0
1.5
2.0
−2.5
−2.0
−1.5
−1.0
kzf_z39
Prior Distribution
Sampled Distribution

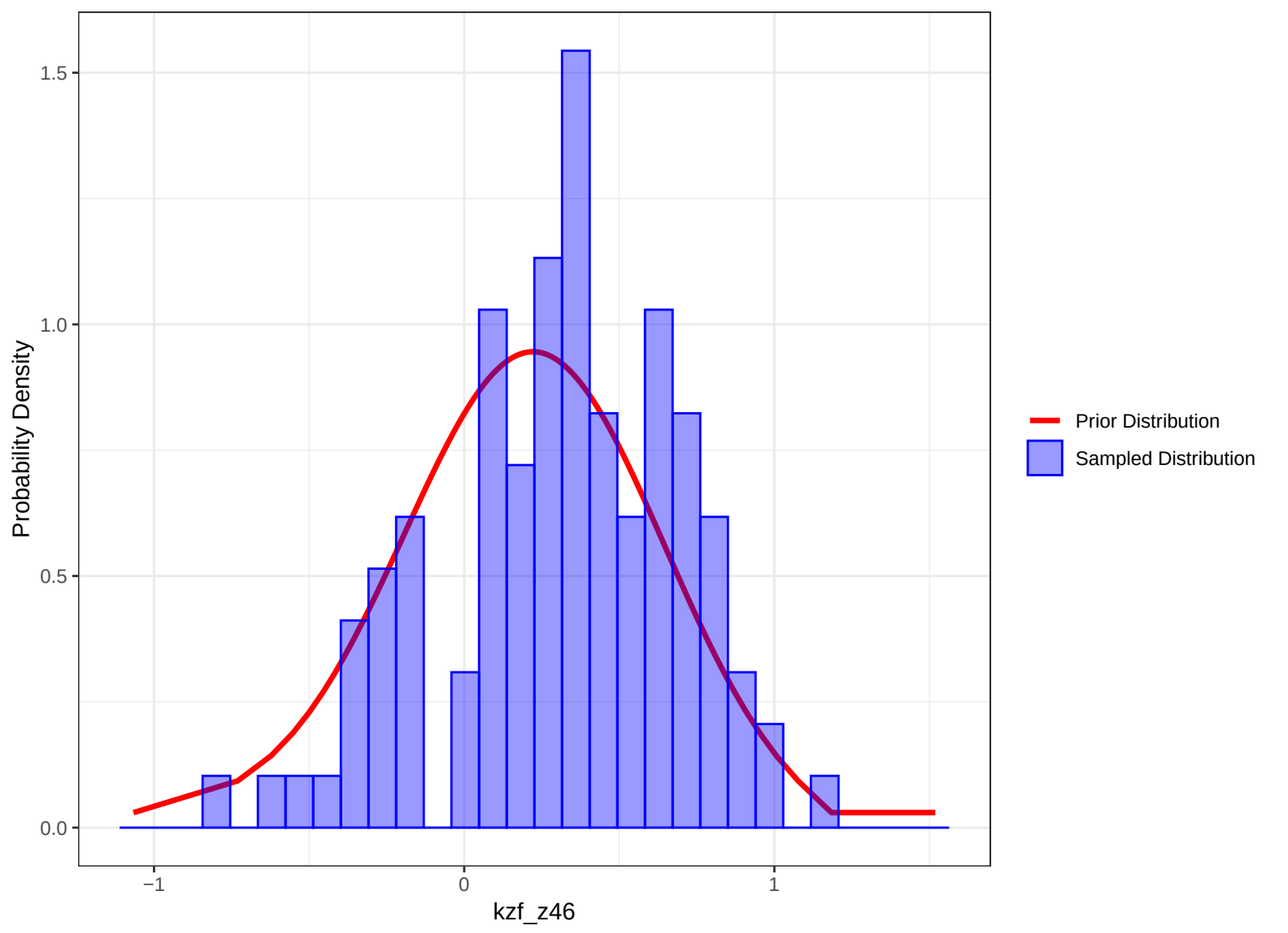

Probability Density
0.0
0.3
0.6
0.9
−1
0
1
kzf_z40
Prior Distribution
Sampled Distribution

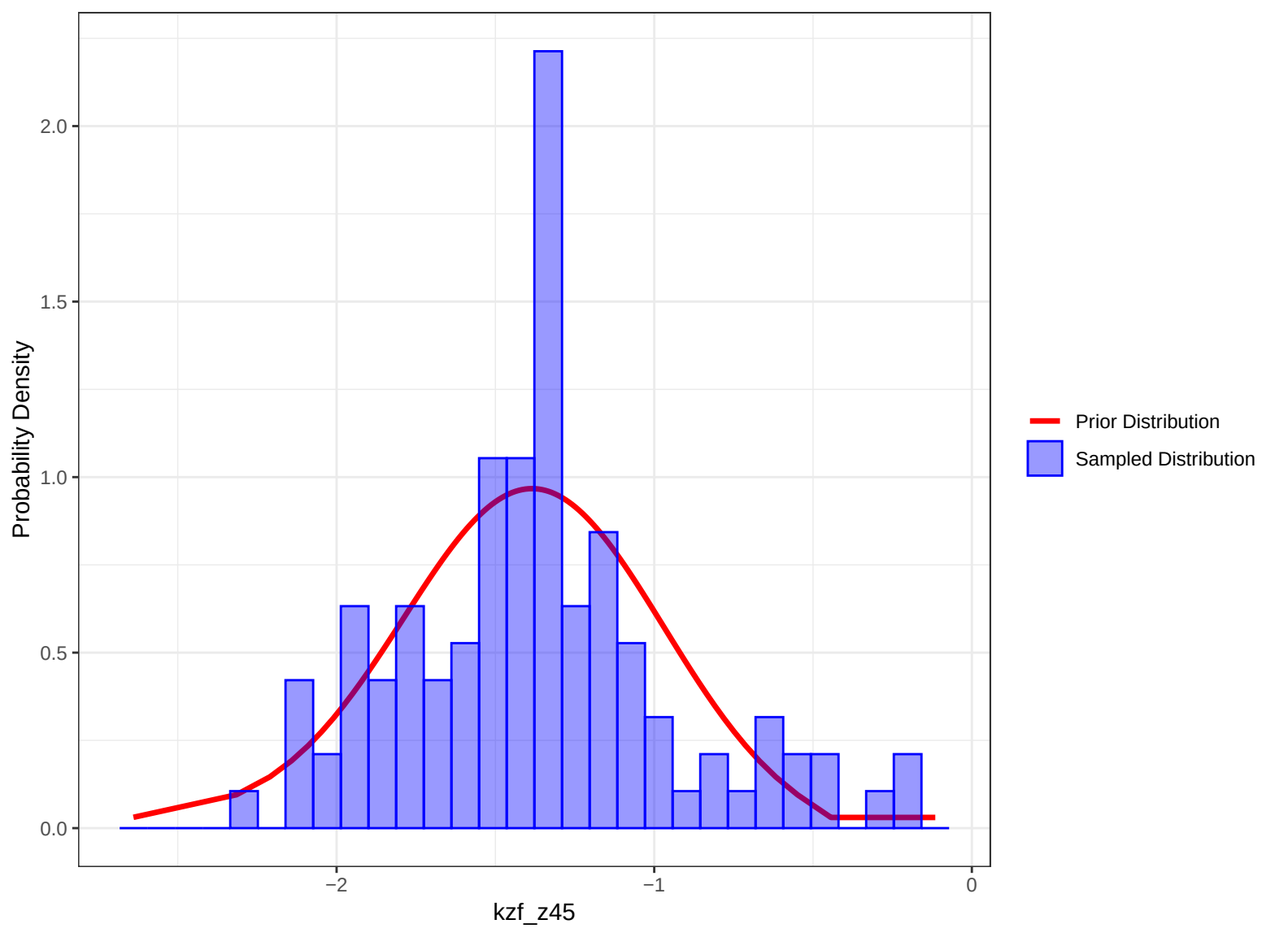

Probability Density
0.0
0.5
1.0
−2.5
−2.0
−1.5
−1.0
−0.5
kzf_z42
Prior Distribution
Sampled Distribution

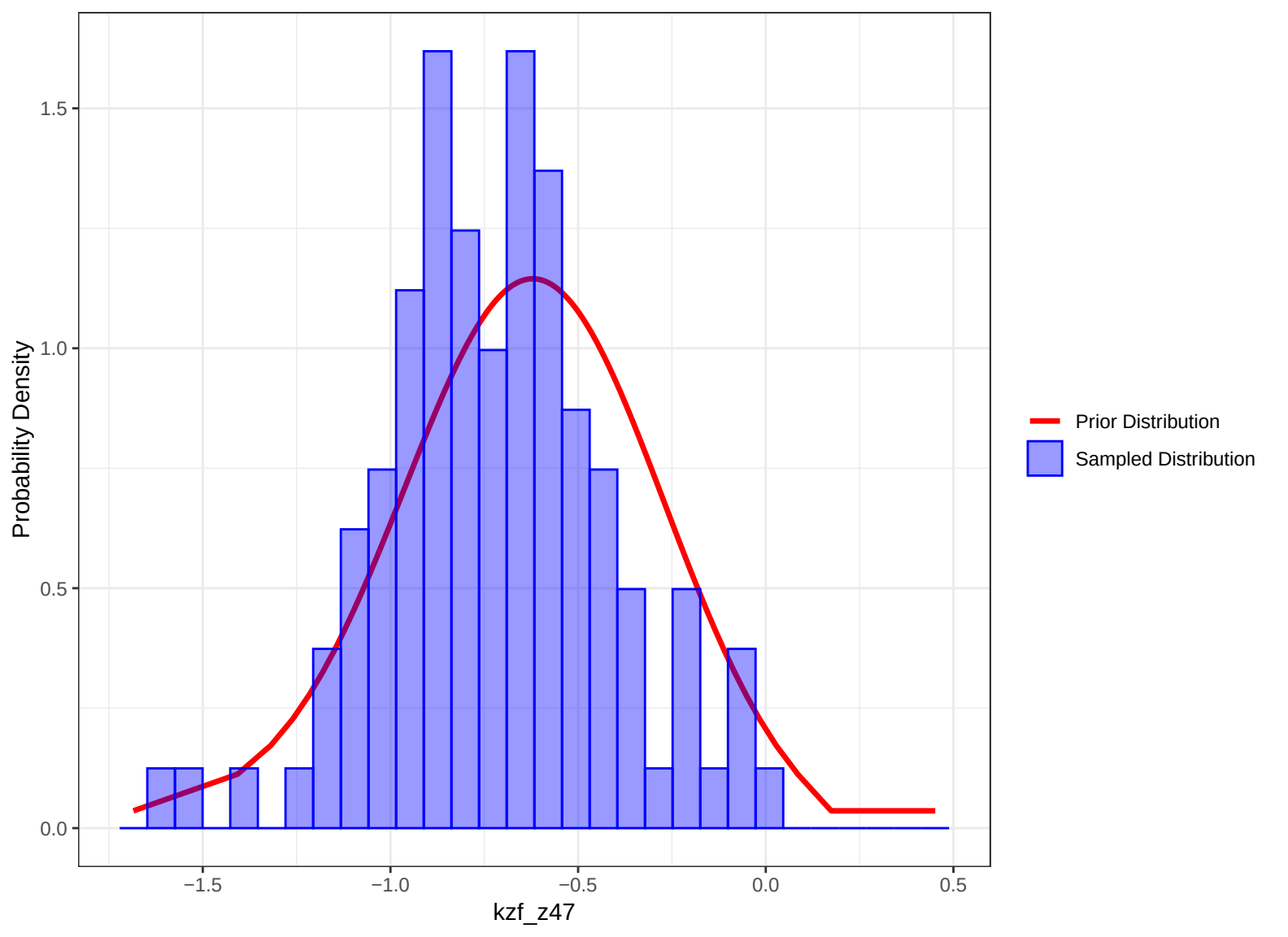

Probability Density
0.0
0.3
0.6
0.9
1.2
−2
−1
0
kzf_z41
Prior Distribution
Sampled Distribution

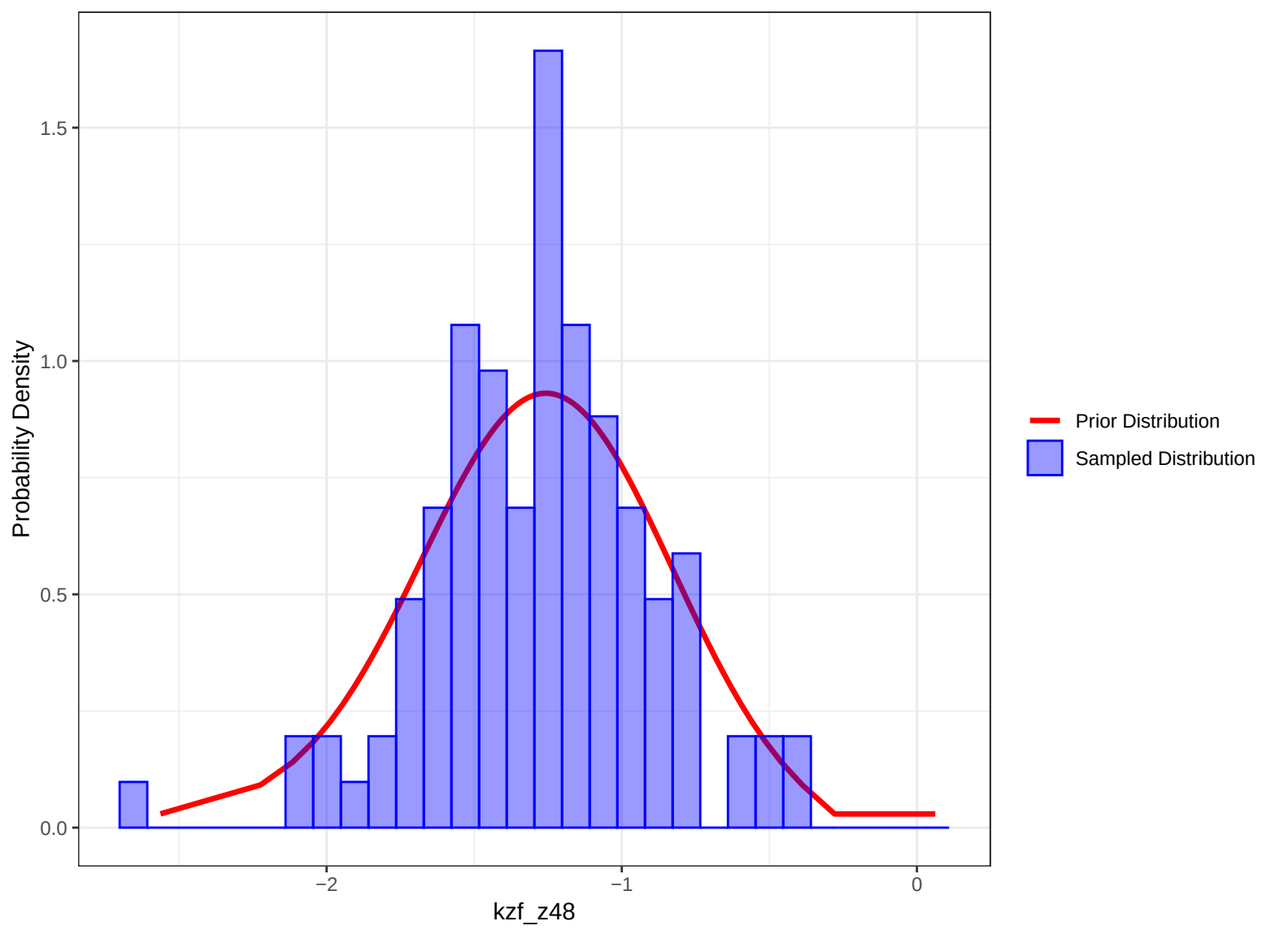

Probability Density
0.0
0.5
1.0
1.5
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z43
Prior Distribution
Sampled Distribution

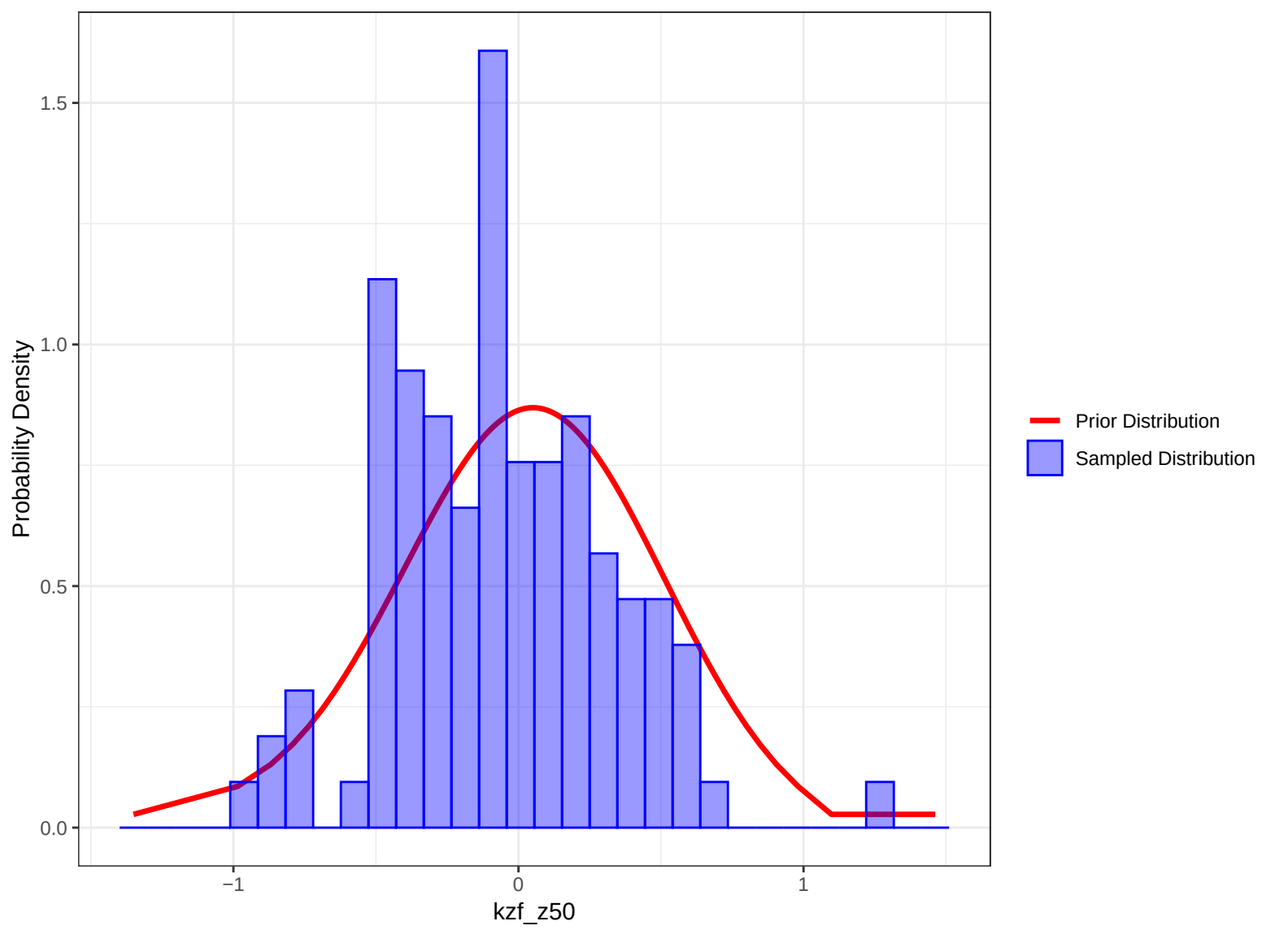

Probability Density
0.00
0.25
0.50
0.75
−2
−1
0
1
kzf_z44
Prior Distribution
Sampled Distribution

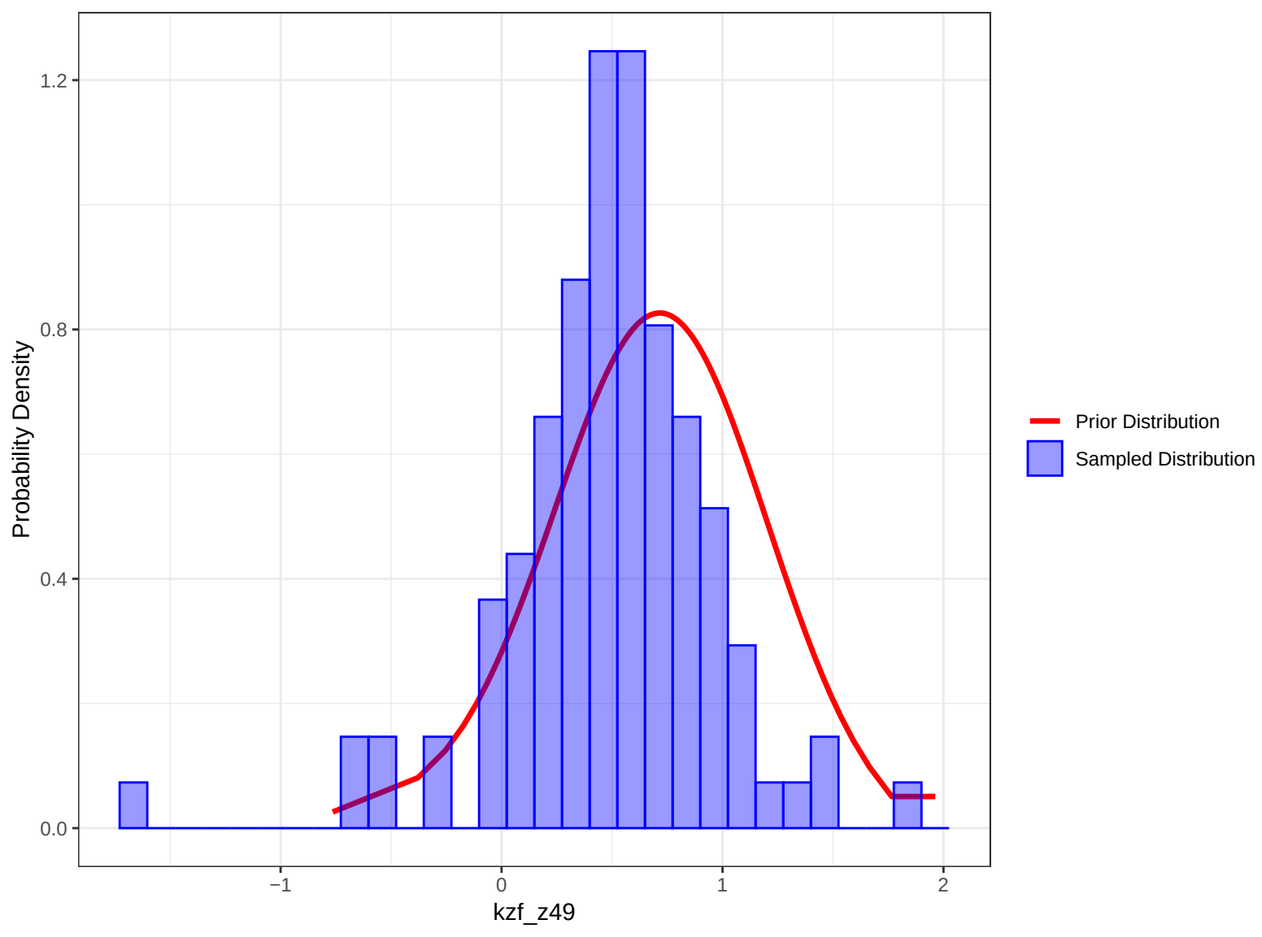

Probability Density
0.0
0.5
1.0
1.5
−1
0
1
kzf_z46
Prior Distribution
Sampled Distribution

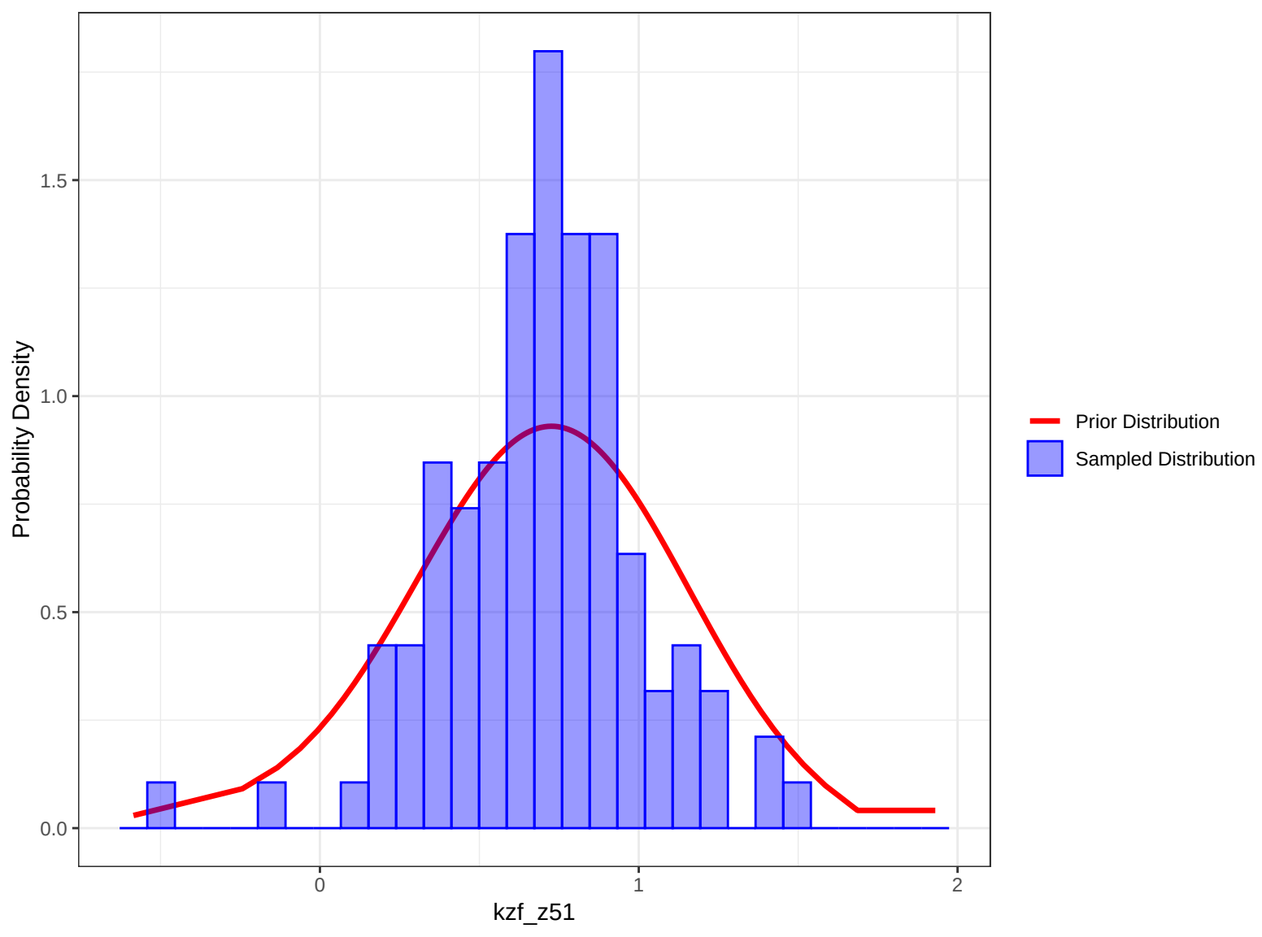

Probability Density
0.0
0.5
1.0
1.5
2.0
−2
−1
0
kzf_z45
Prior Distribution
Sampled Distribution

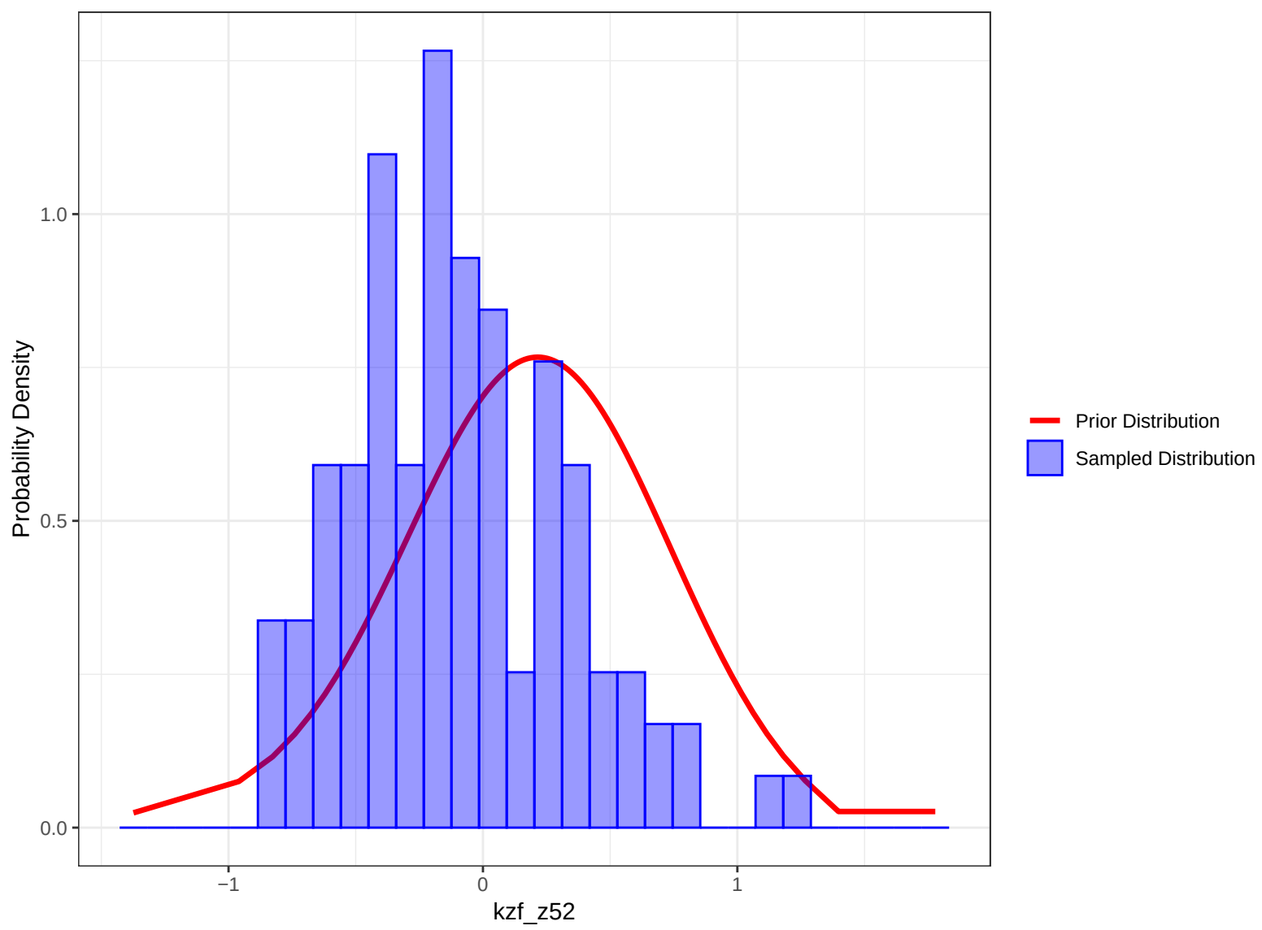

Probability Density
0.0
0.5
1.0
1.5
−1.5
−1.0
−0.5
0.0
0.5
kzf_z47
Prior Distribution
Sampled Distribution

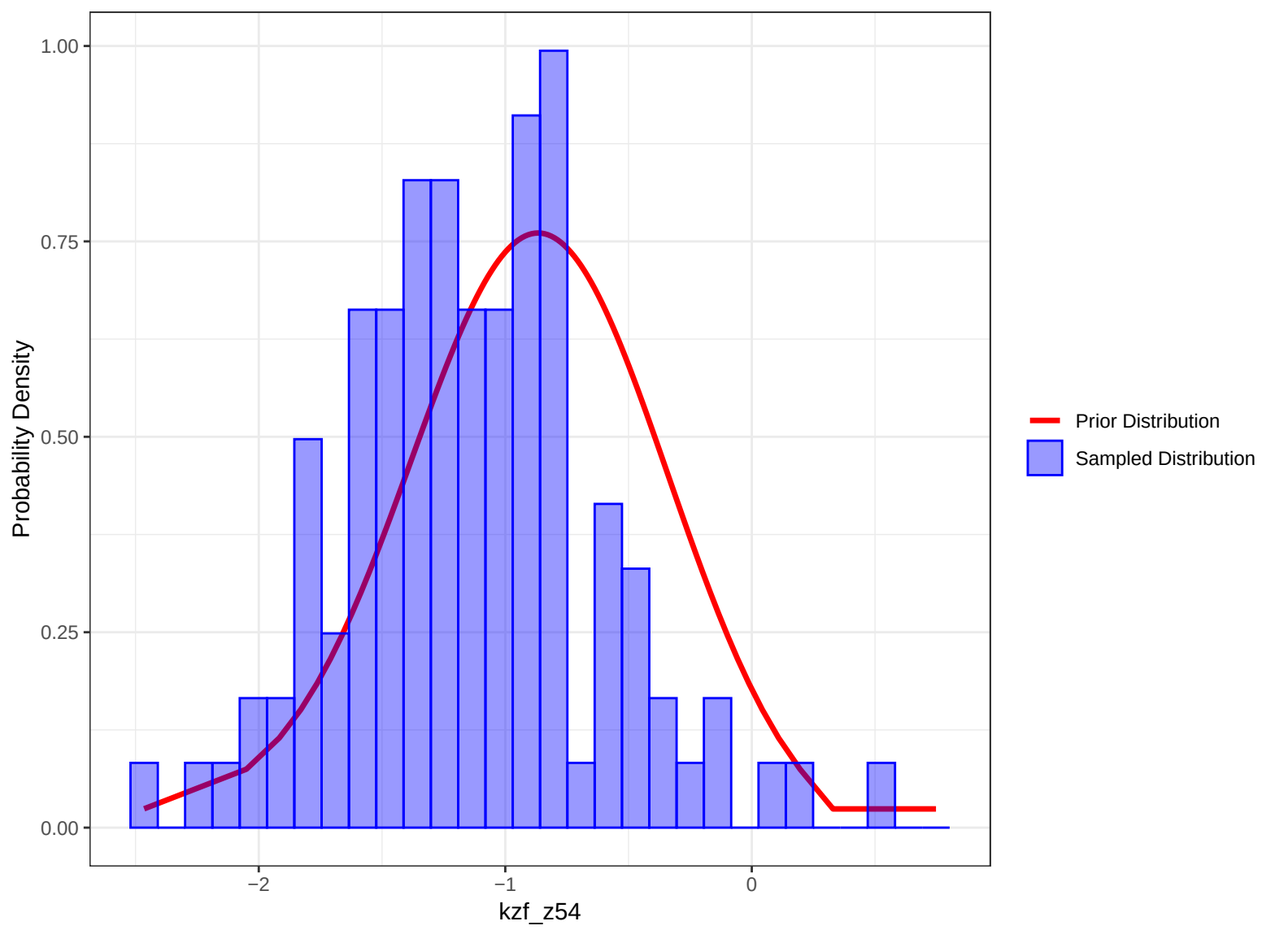

Probability Density
1.5
1.0
0.5
0.0
−2
−1
0
kzf_z48
Prior Distribution
Sampled Distribution

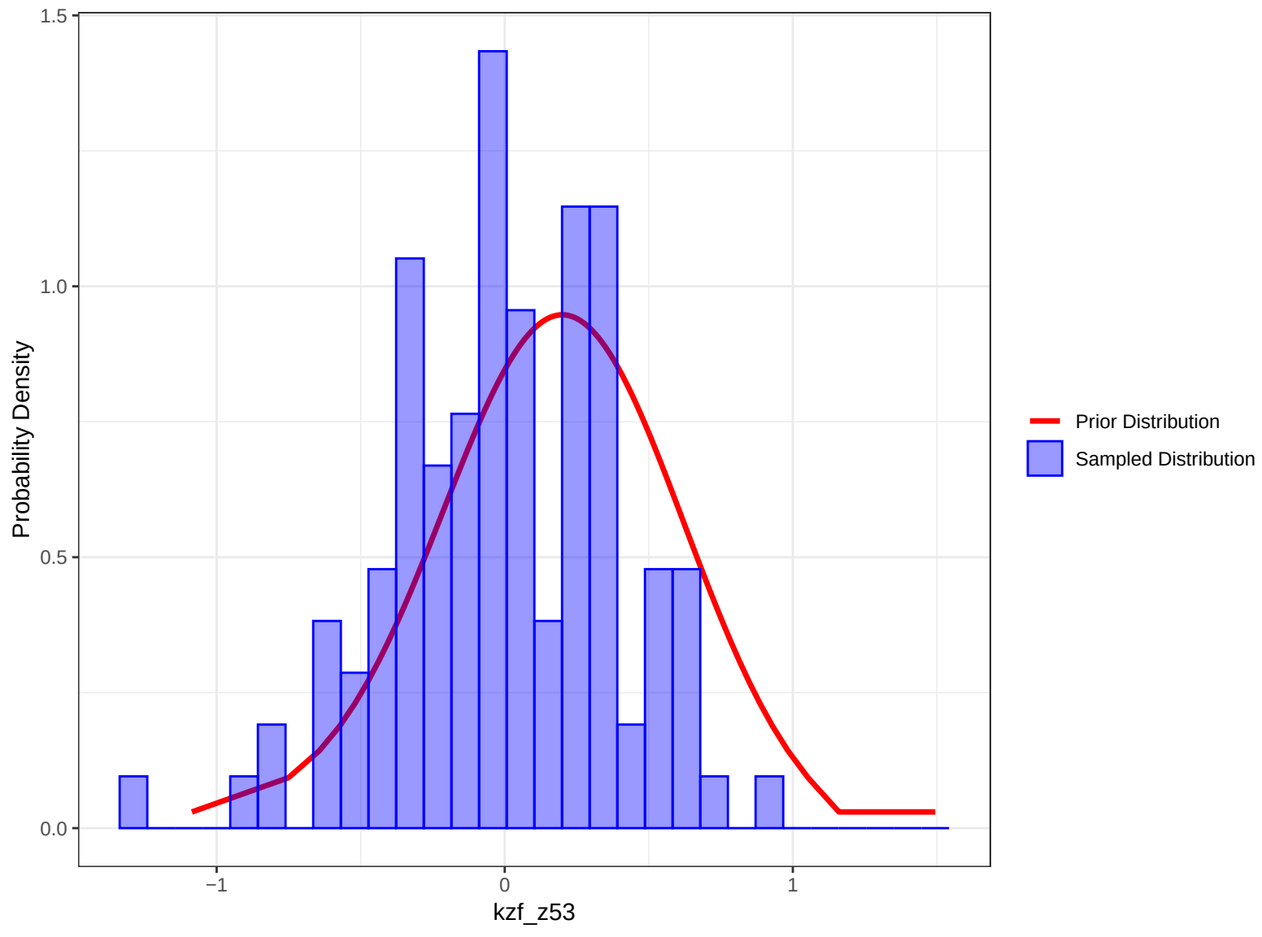

Probability Density
1.5
1.0
0.5
0.0
−1
0
1
kzf_z50
Prior Distribution
Sampled Distribution

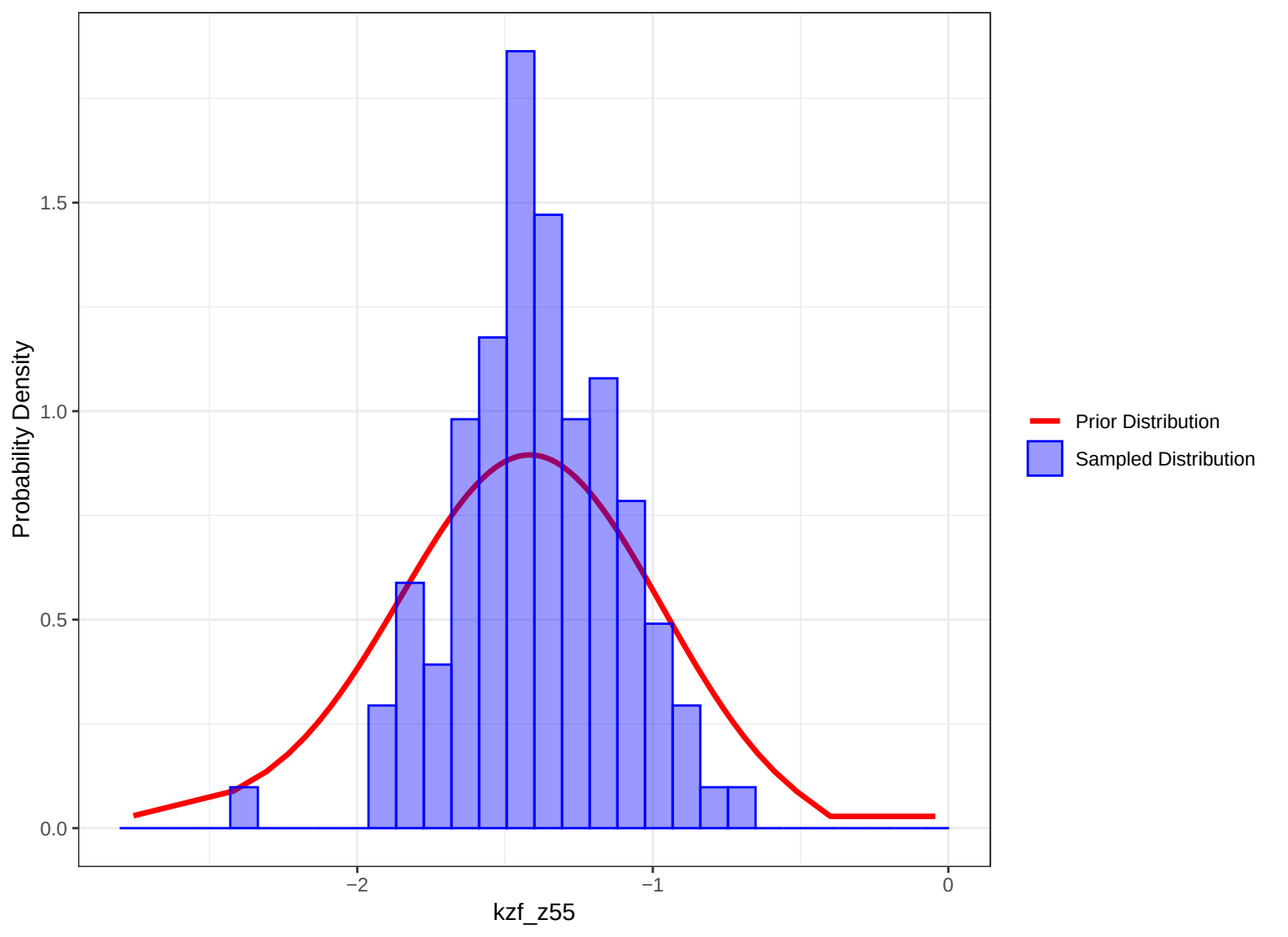

Probability Density
1.2
0.8
0.4
0.0
−1
0
1
2
kzf_z49
Prior Distribution
Sampled Distribution

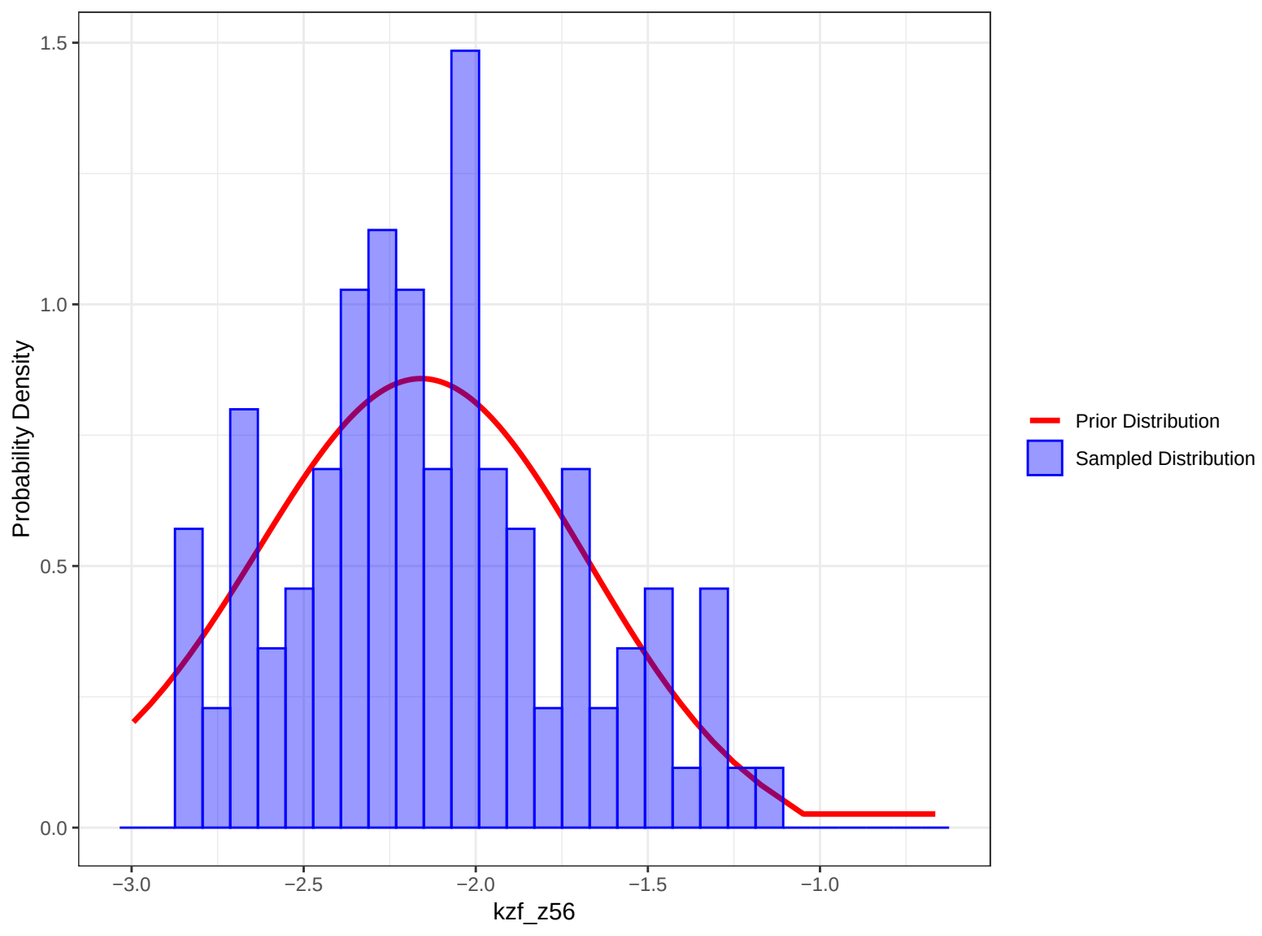

Probability Density
1.5
1.0
0.5
0.0
0
1
2
kzf_z51
Prior Distribution
Sampled Distribution

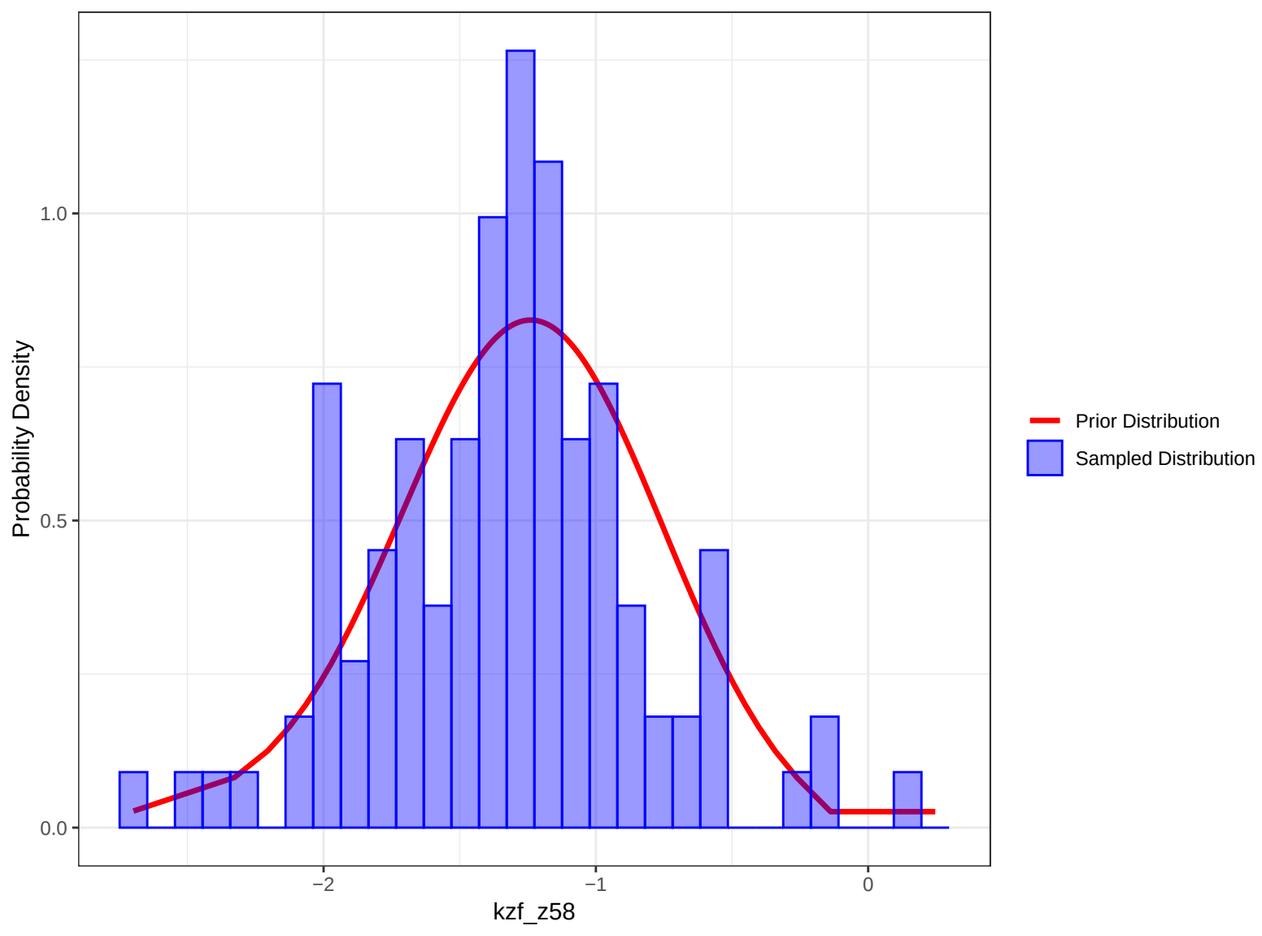

Probability Density
1.0
0.5
0.0
−1
0
1
kzf_z52
Prior Distribution
Sampled Distribution

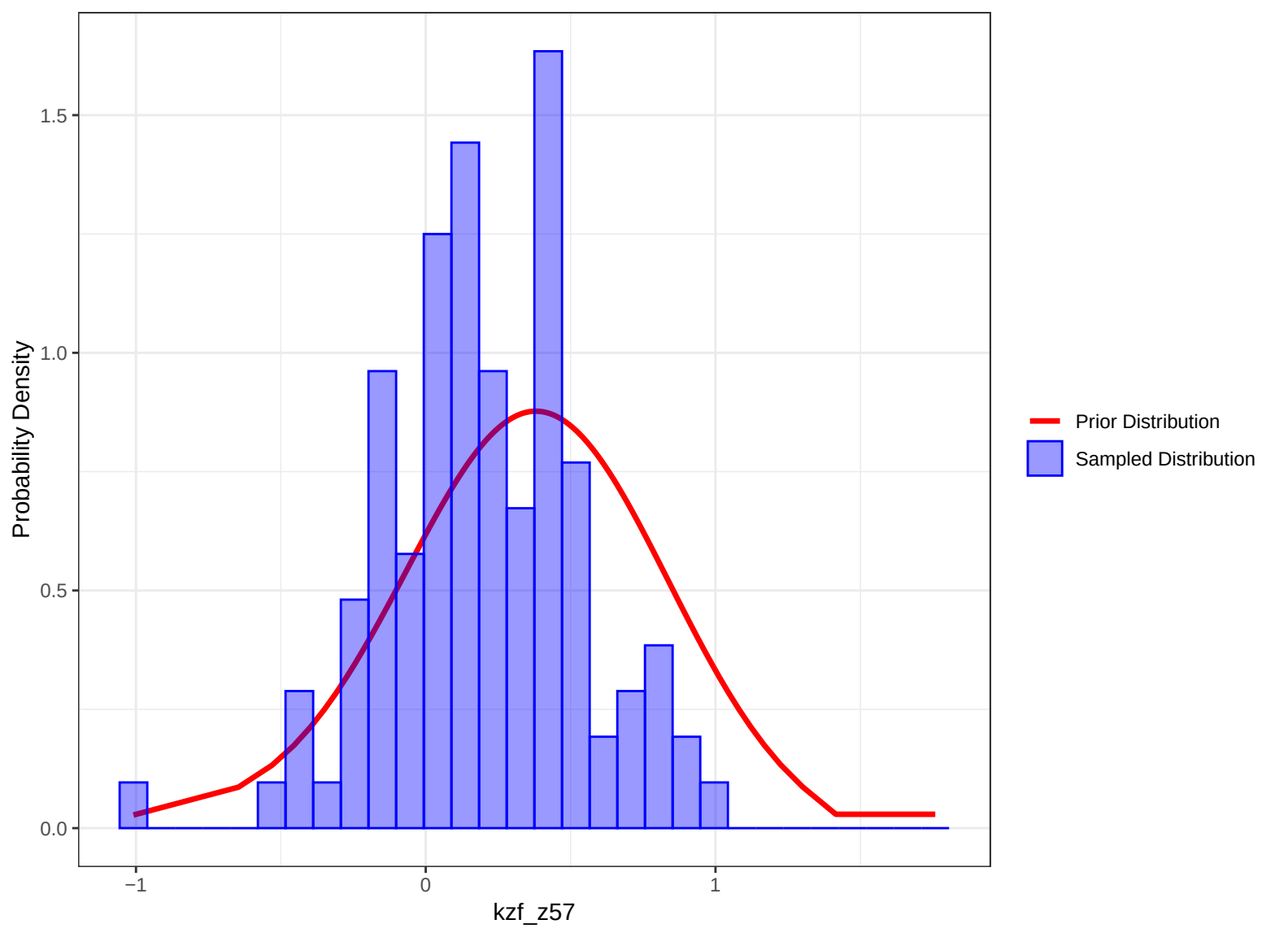

Probability Density
1.00
0.75
0.50
0.25
0.00
−2
−1
0
kzf_z54
Prior Distribution
Sampled Distribution

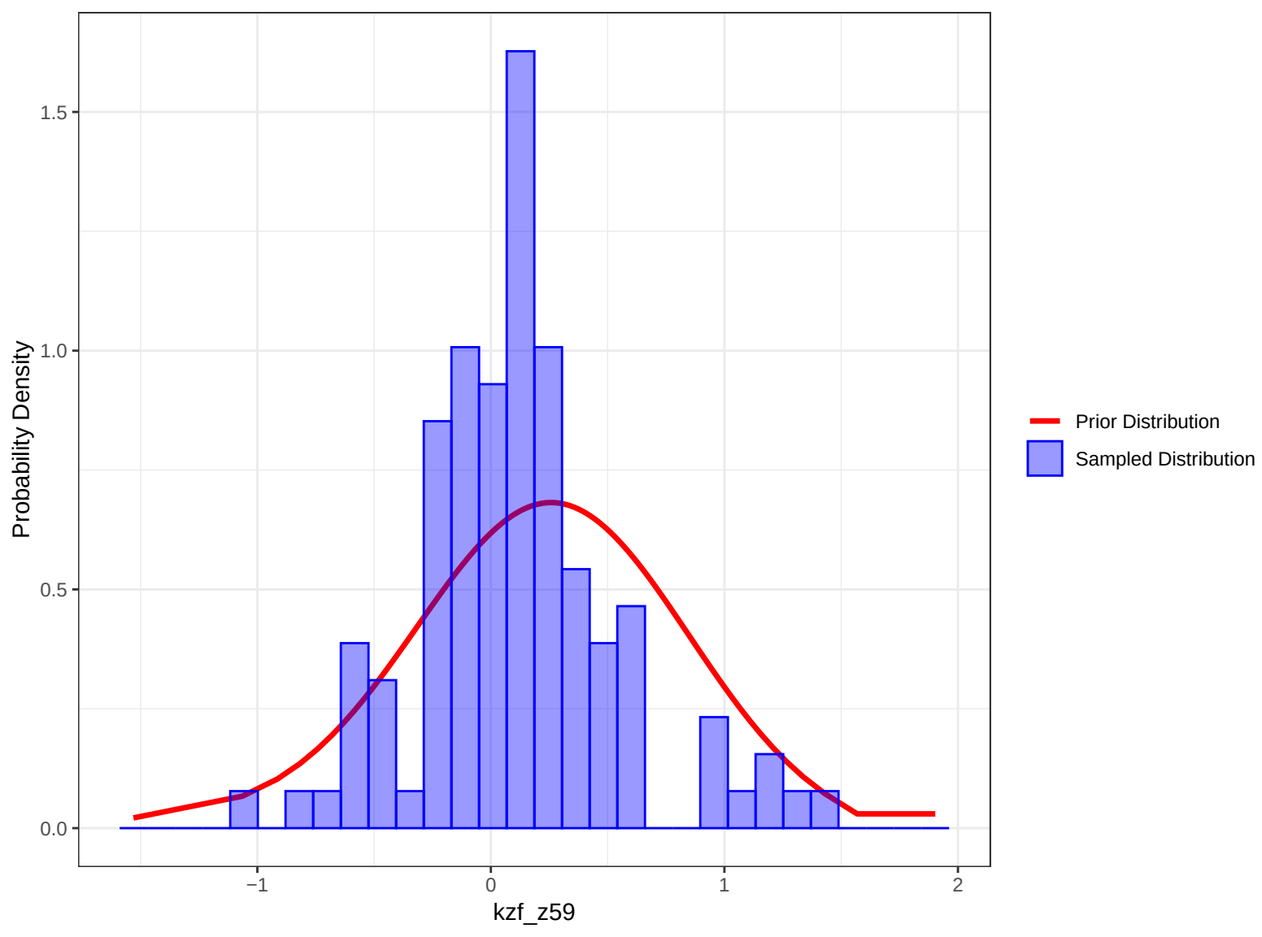

Probability Density
1.5
1.0
0.5
0.0
−1
0
1
kzf_z53
Prior Distribution
Sampled Distribution

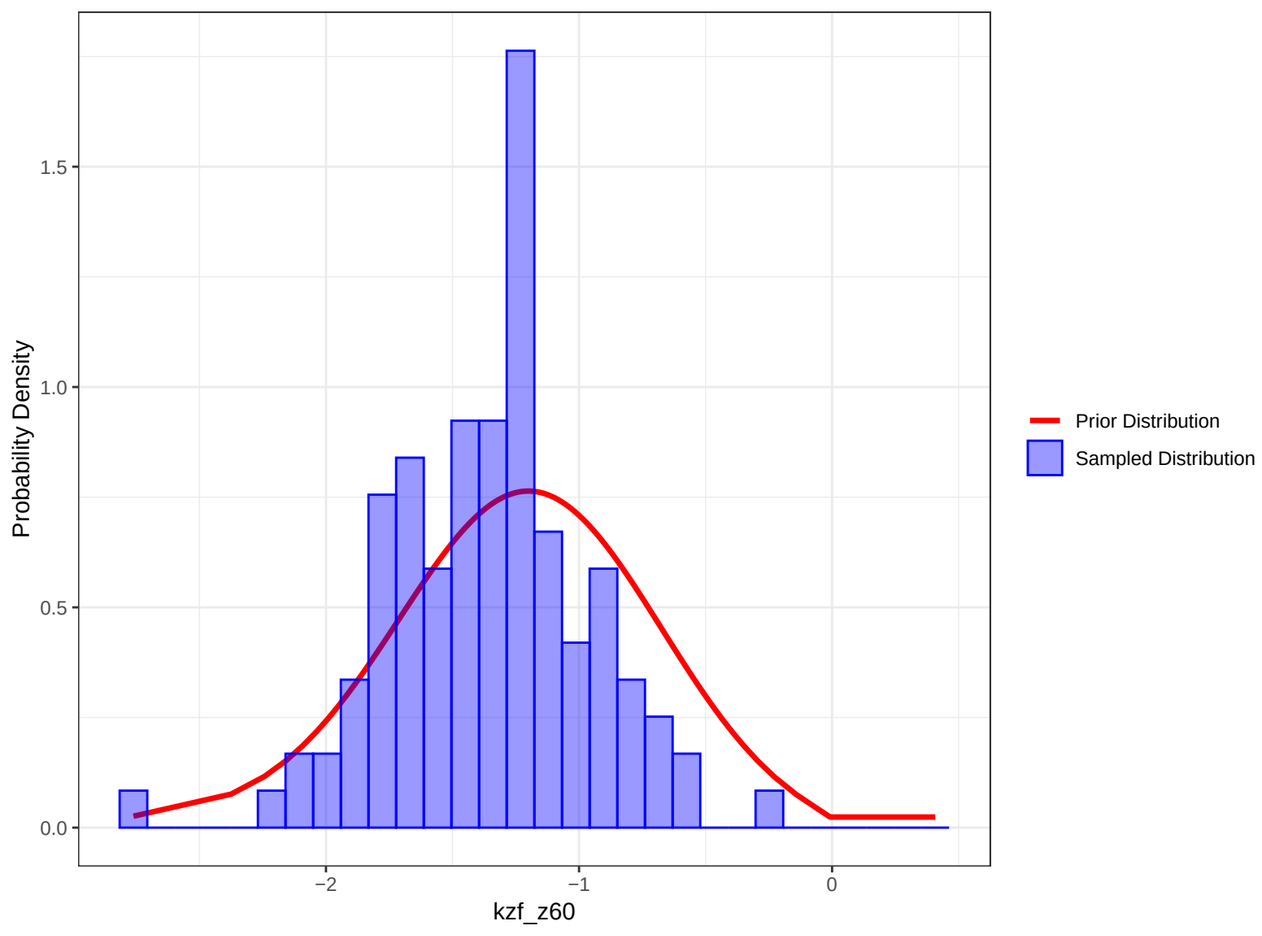

Probability Density
1.5
1.0
0.5
0.0
−2
−1
0
kzf_z55
Prior Distribution
Sampled Distribution

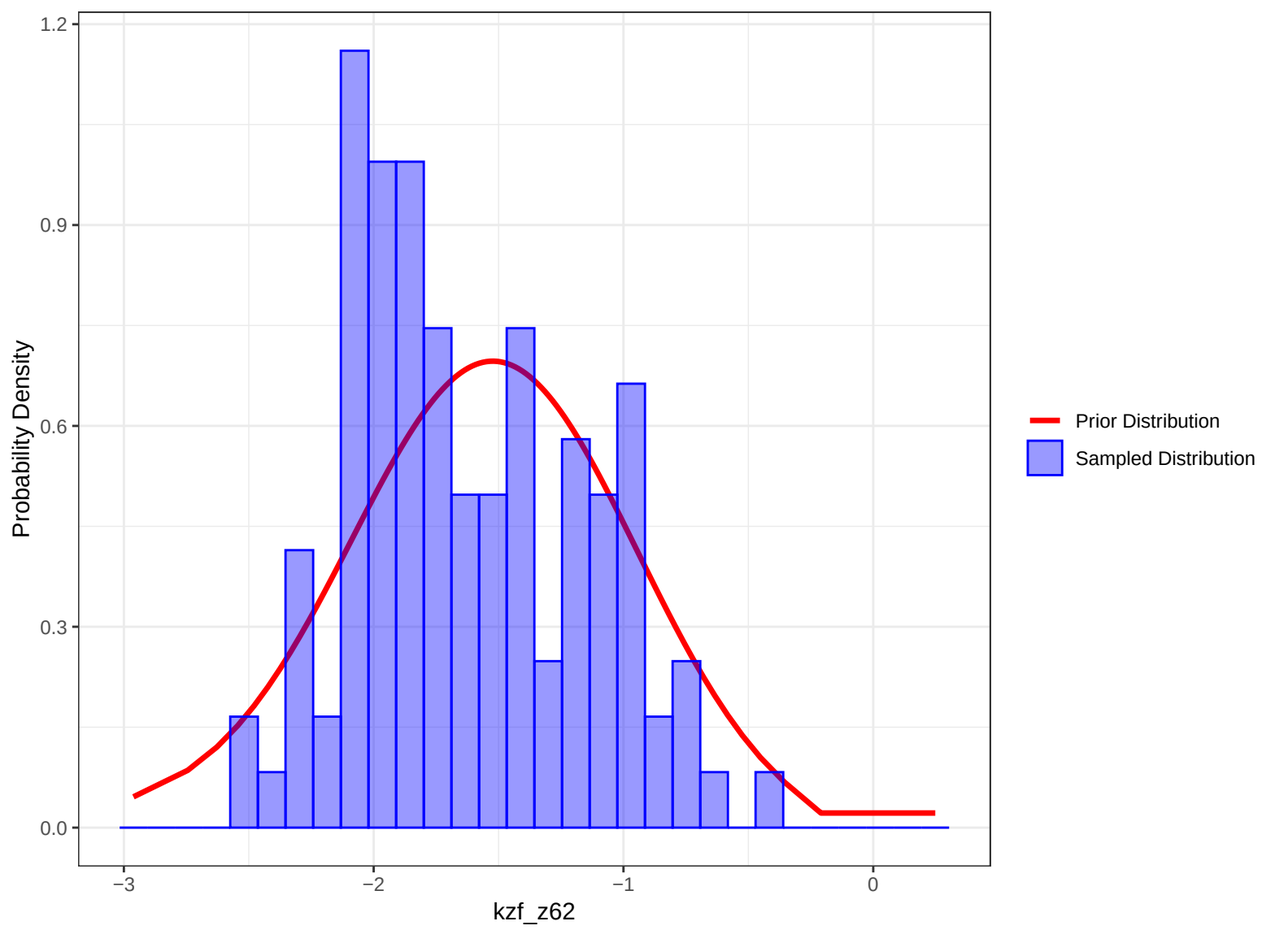

Probability Density
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z56
Prior Distribution
Sampled Distribution

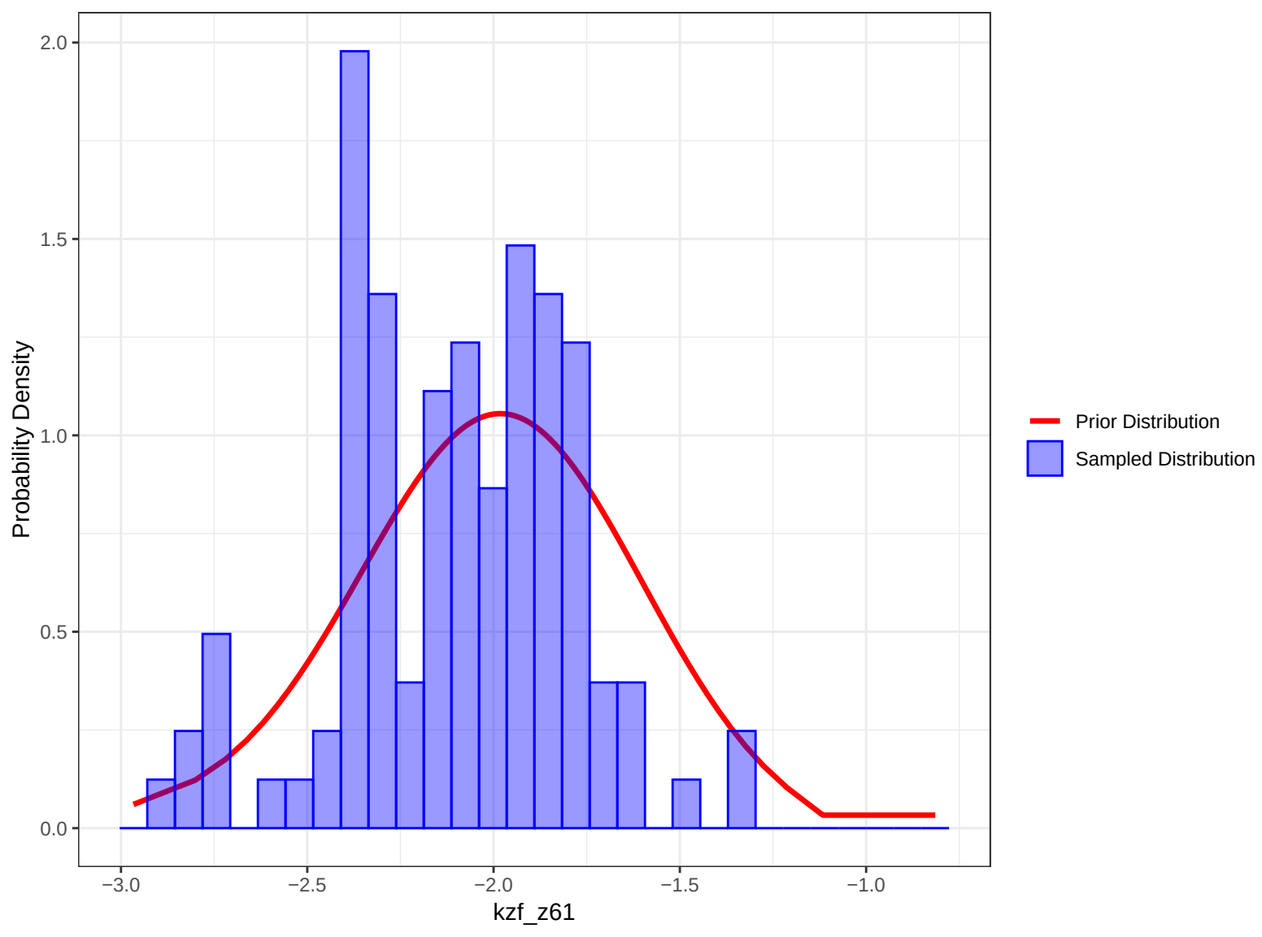

Probability Density
1.0
0.5
0.0
−2
−1
0
kzf_z58
Prior Distribution
Sampled Distribution

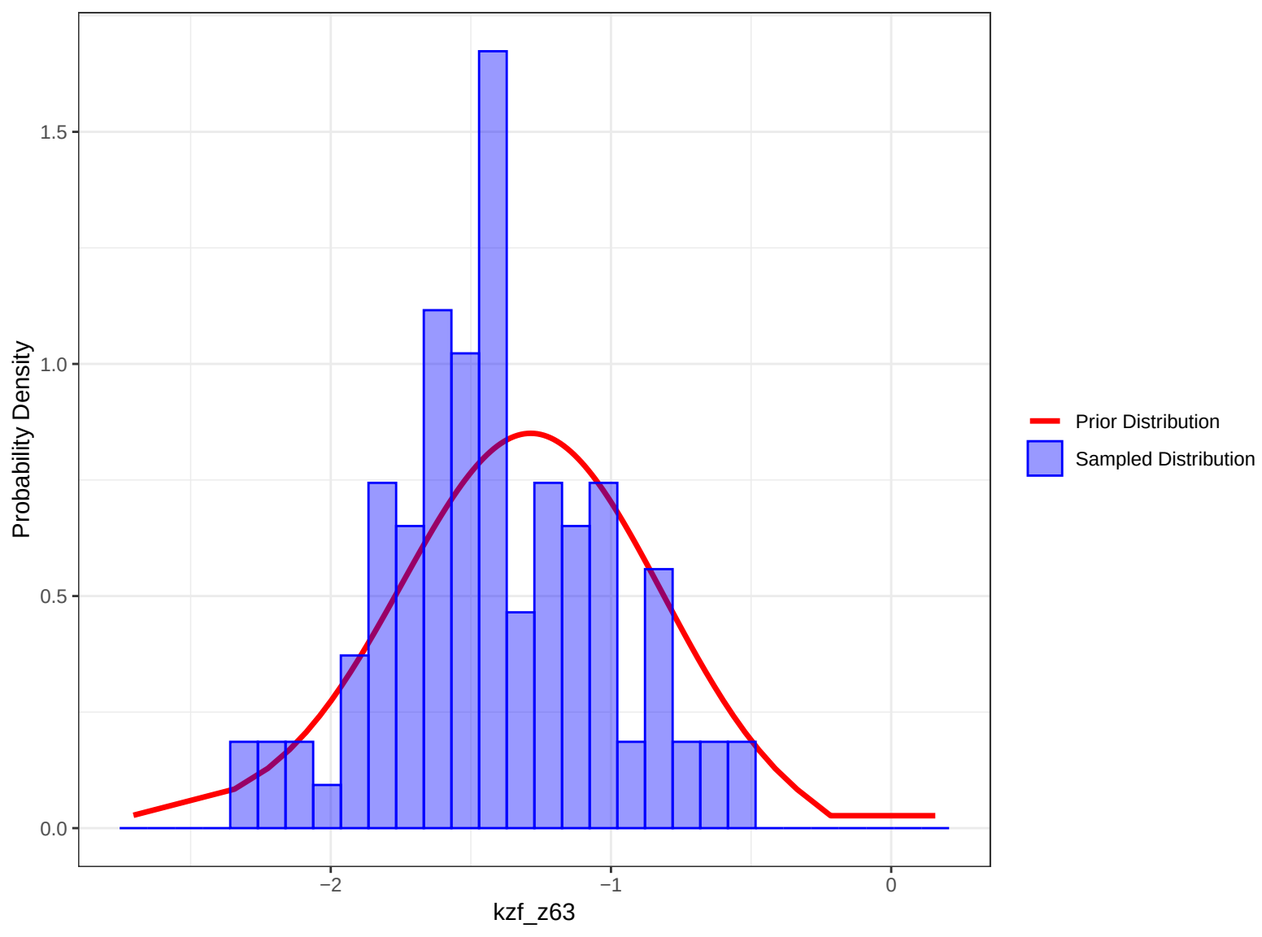

Probability Density
1.5
1.0
0.5
0.0
−1
0
1
kzf_z57
Prior Distribution
Sampled Distribution

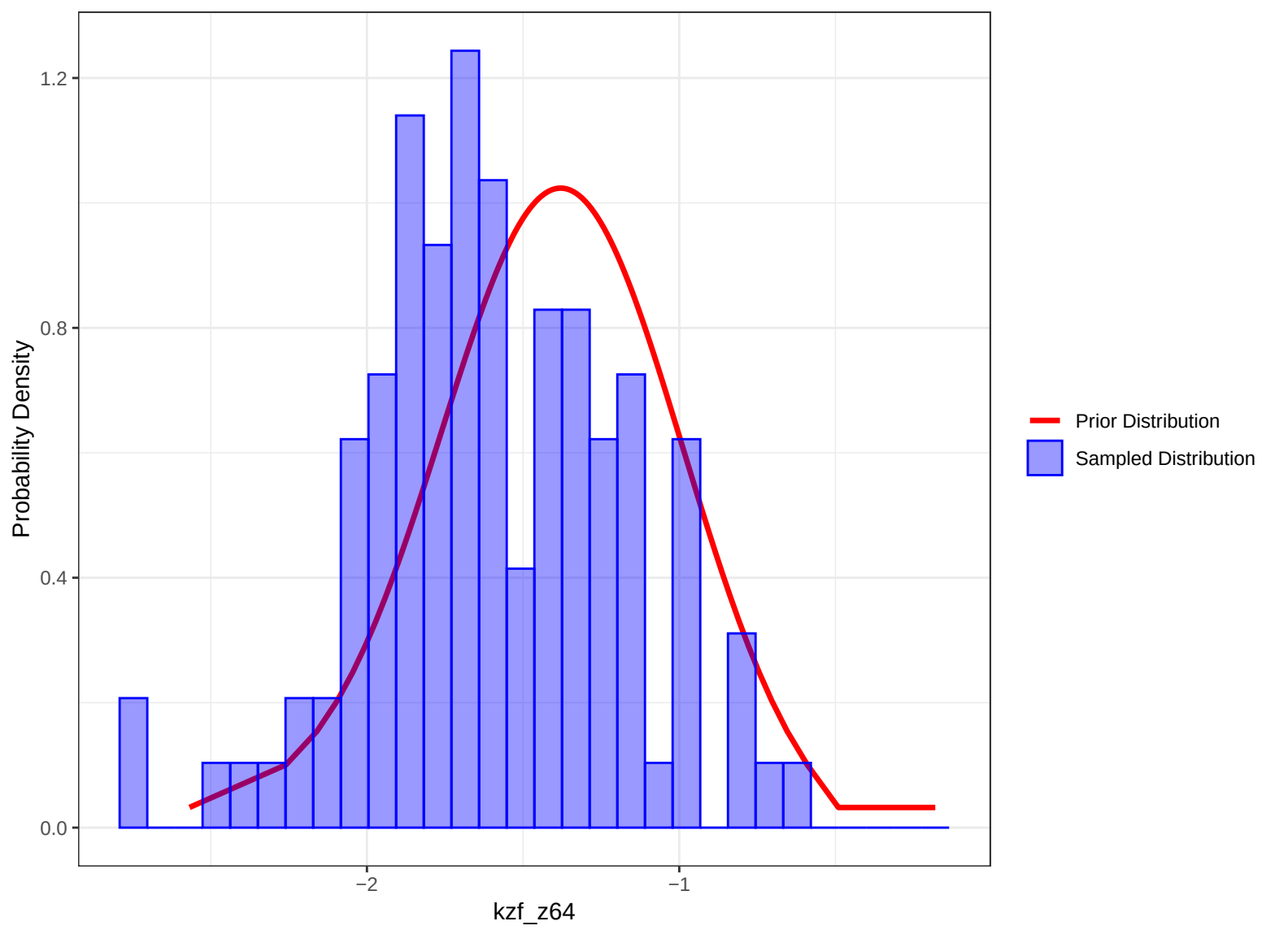

Probability Density
1.5
1.0
0.5
0.0
−1
0
1
2
kzf_z59
Prior Distribution
Sampled Distribution

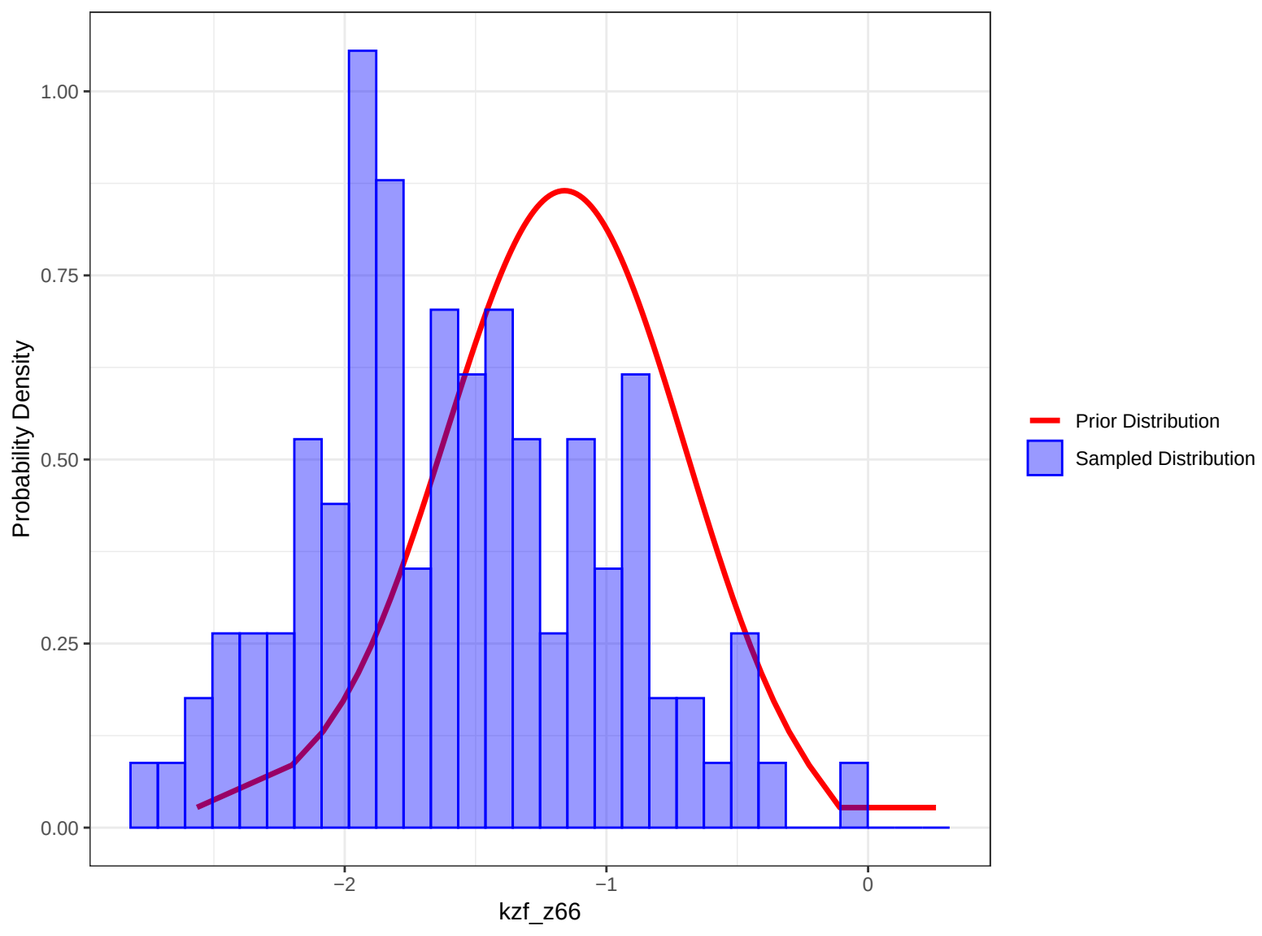

Probability Density
1.5
1.0
0.5
0.0
−2
−1
0
kzf_z60
Prior Distribution
Sampled Distribution

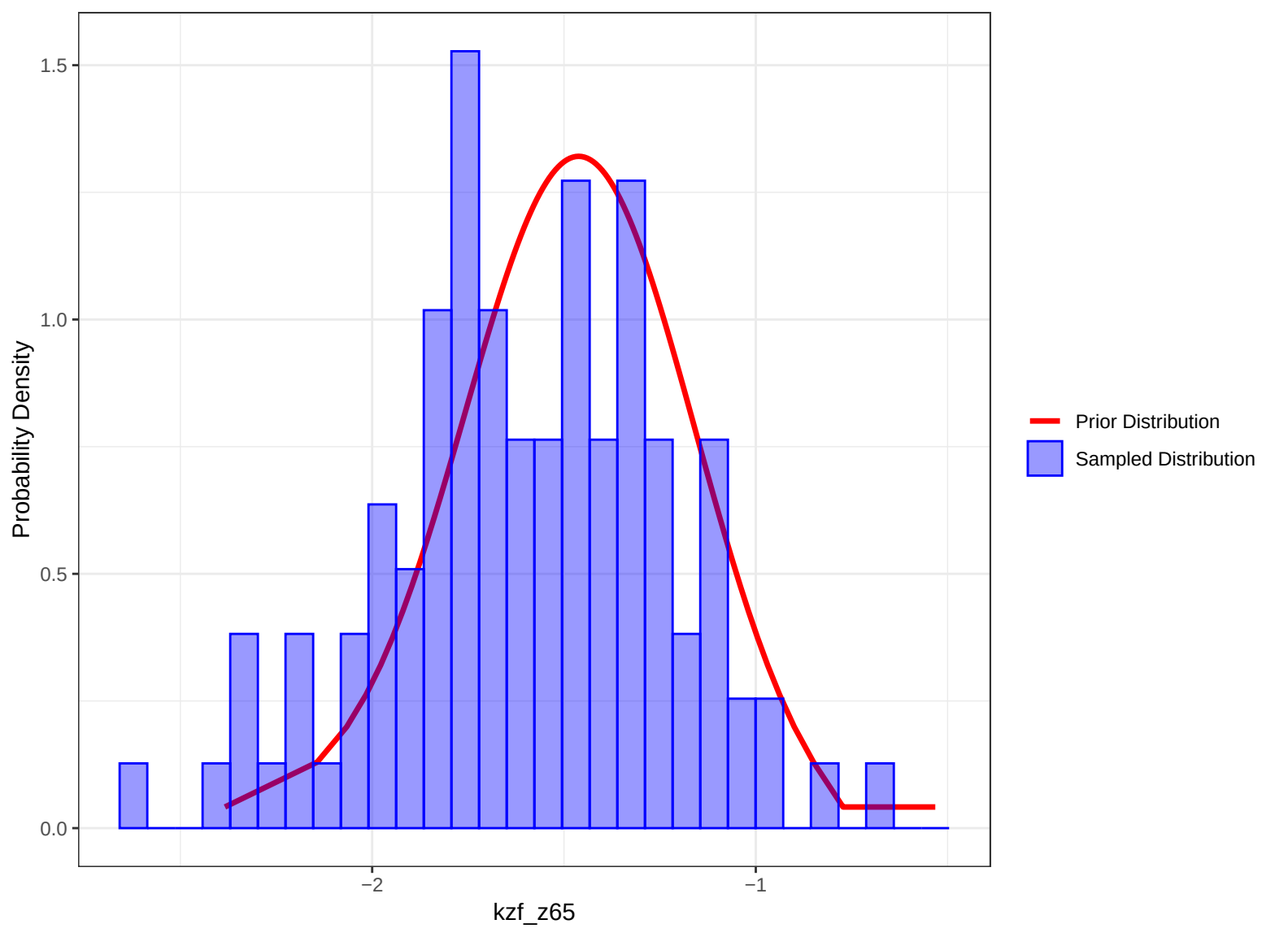

Probability Density
1.2
0.9
0.6
0.3
0.0
−3
−2
−1
0
kzf_z62
Prior Distribution
Sampled Distribution

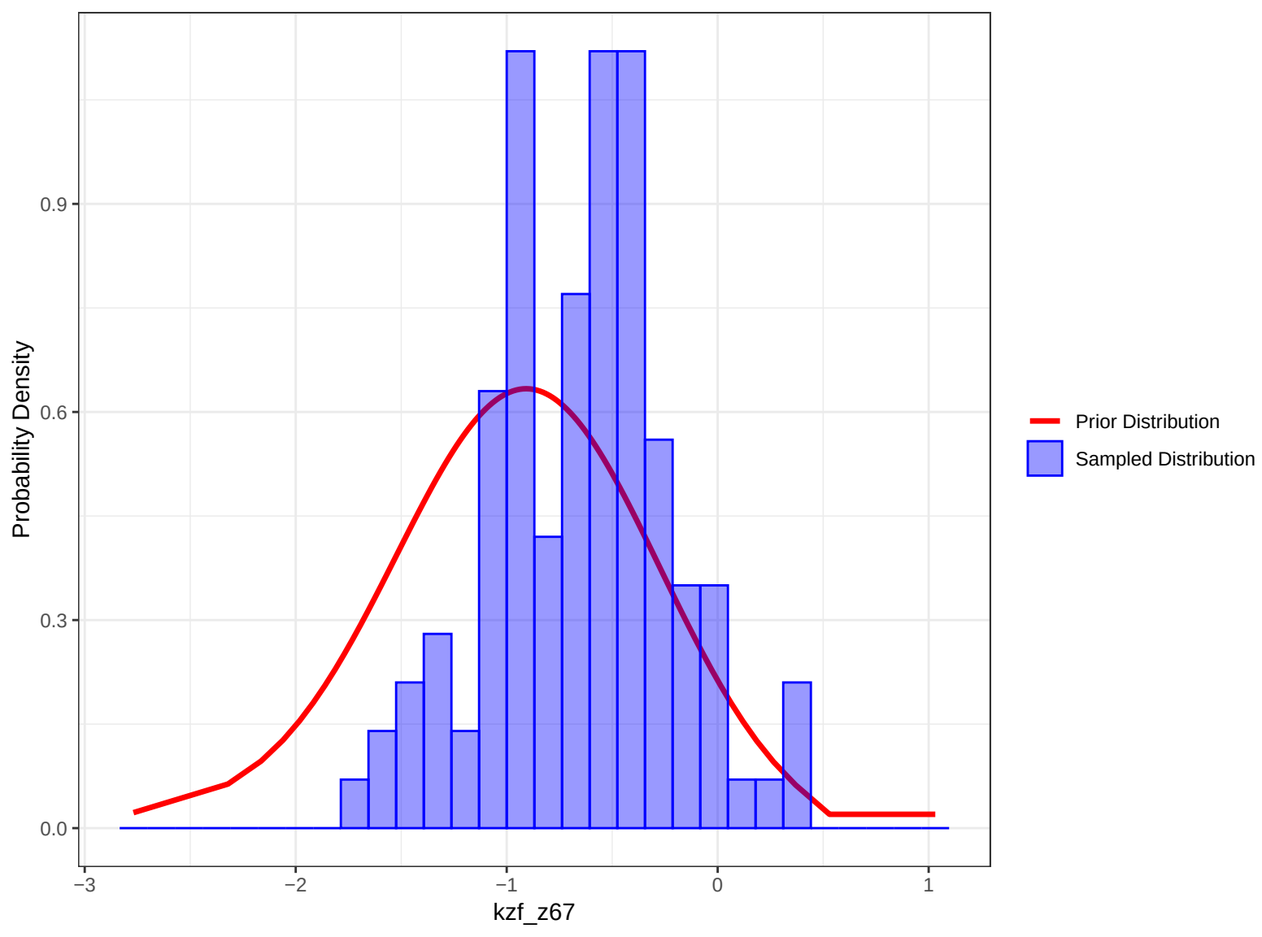

Probability Density
2.0
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
−1.0
kzf_z61
Prior Distribution
Sampled Distribution

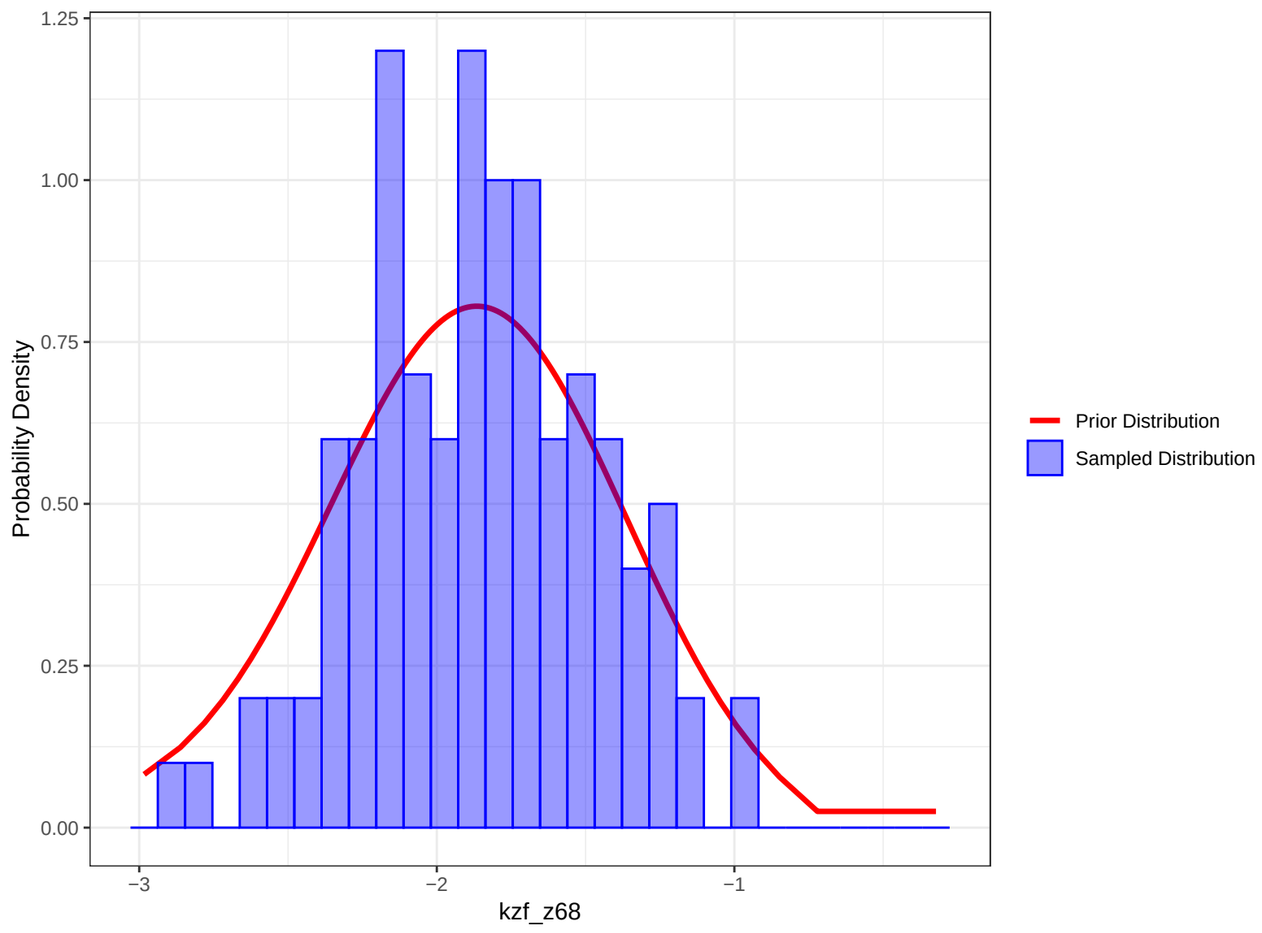

Probability Density
1.5
1.0
0.5
0.0
−2
−1
0
kzf_z63
Prior Distribution
Sampled Distribution

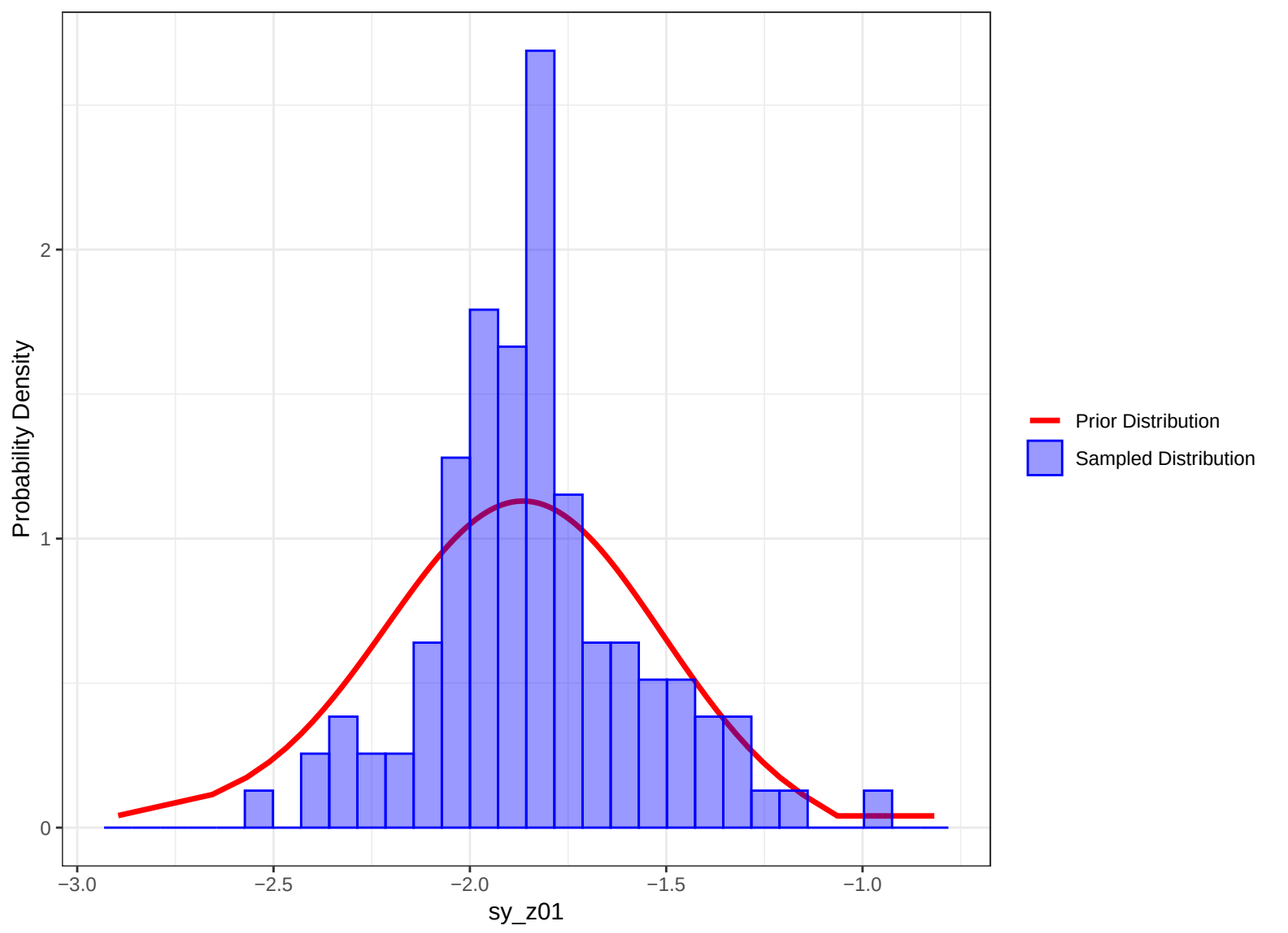

Probability Density
1.2
0.8
0.4
0.0
−2
−1
kzf_z64
Prior Distribution
Sampled Distribution

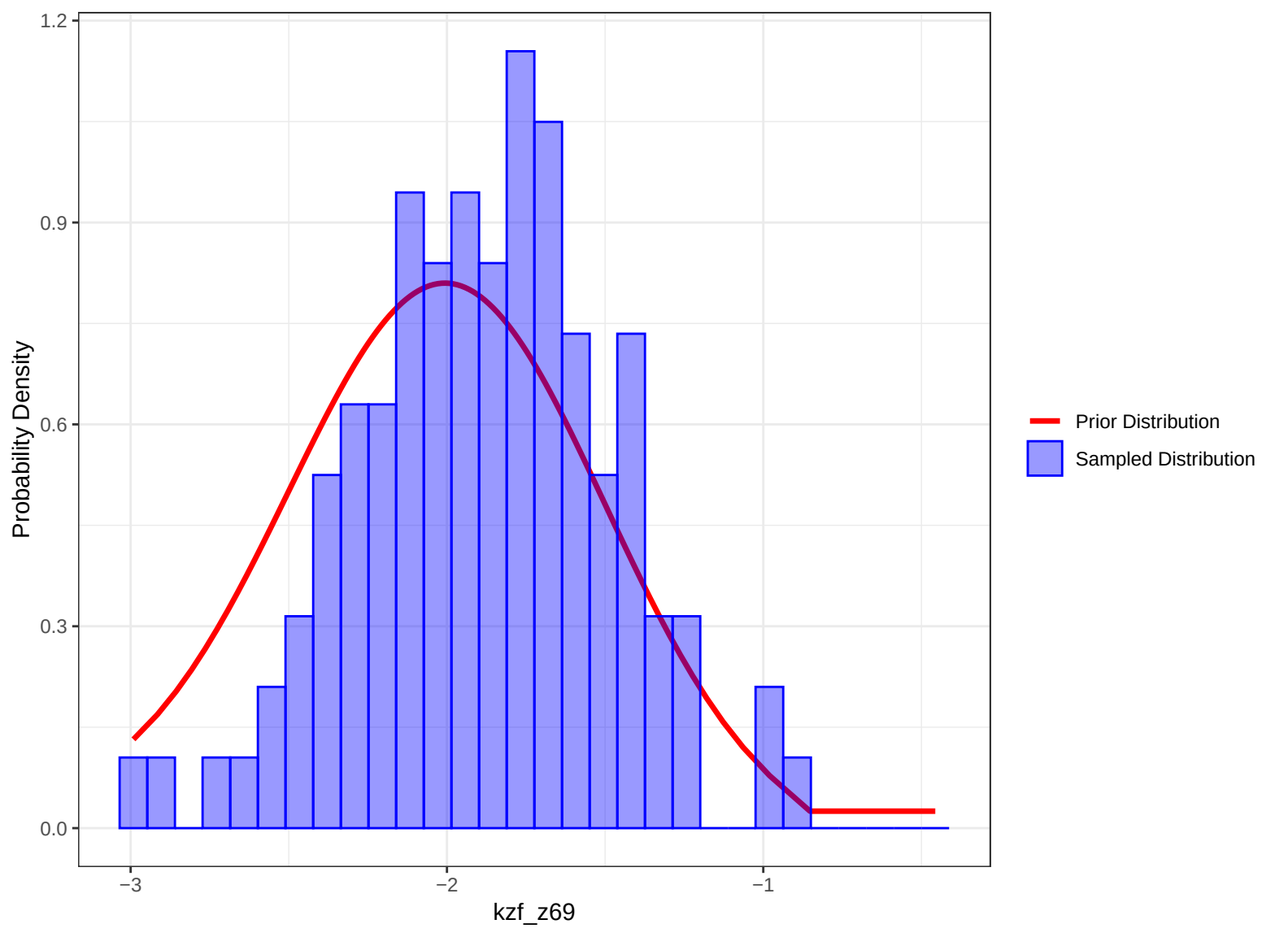

Probability Density
1.00
0.75
0.50
0.25
0.00
−2
−1
0
kzf_z66
Prior Distribution
Sampled Distribution

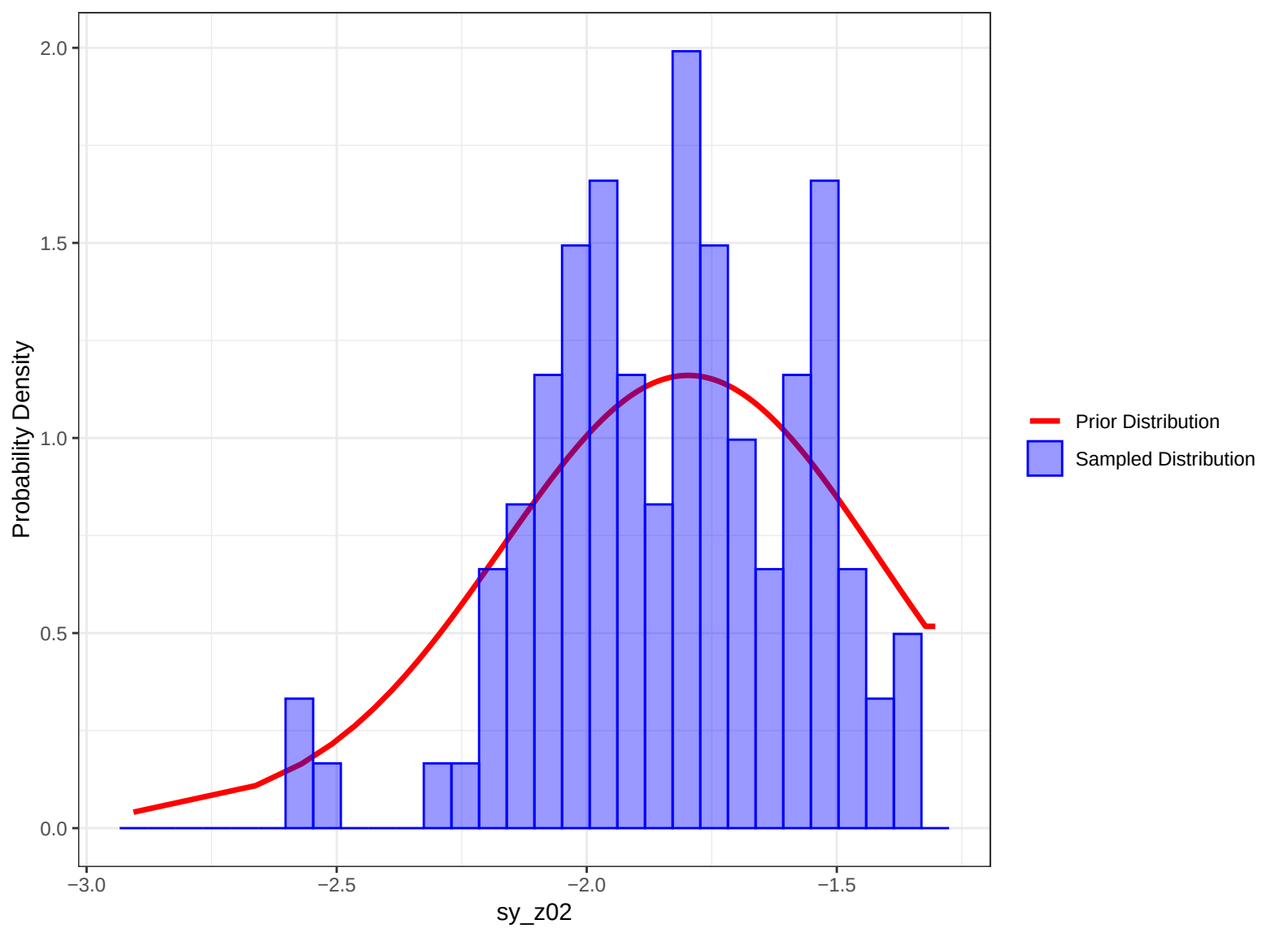

Probability Density
1.5
1.0
0.5
0.0
−2
−1
kzf_z65
Prior Distribution
Sampled Distribution

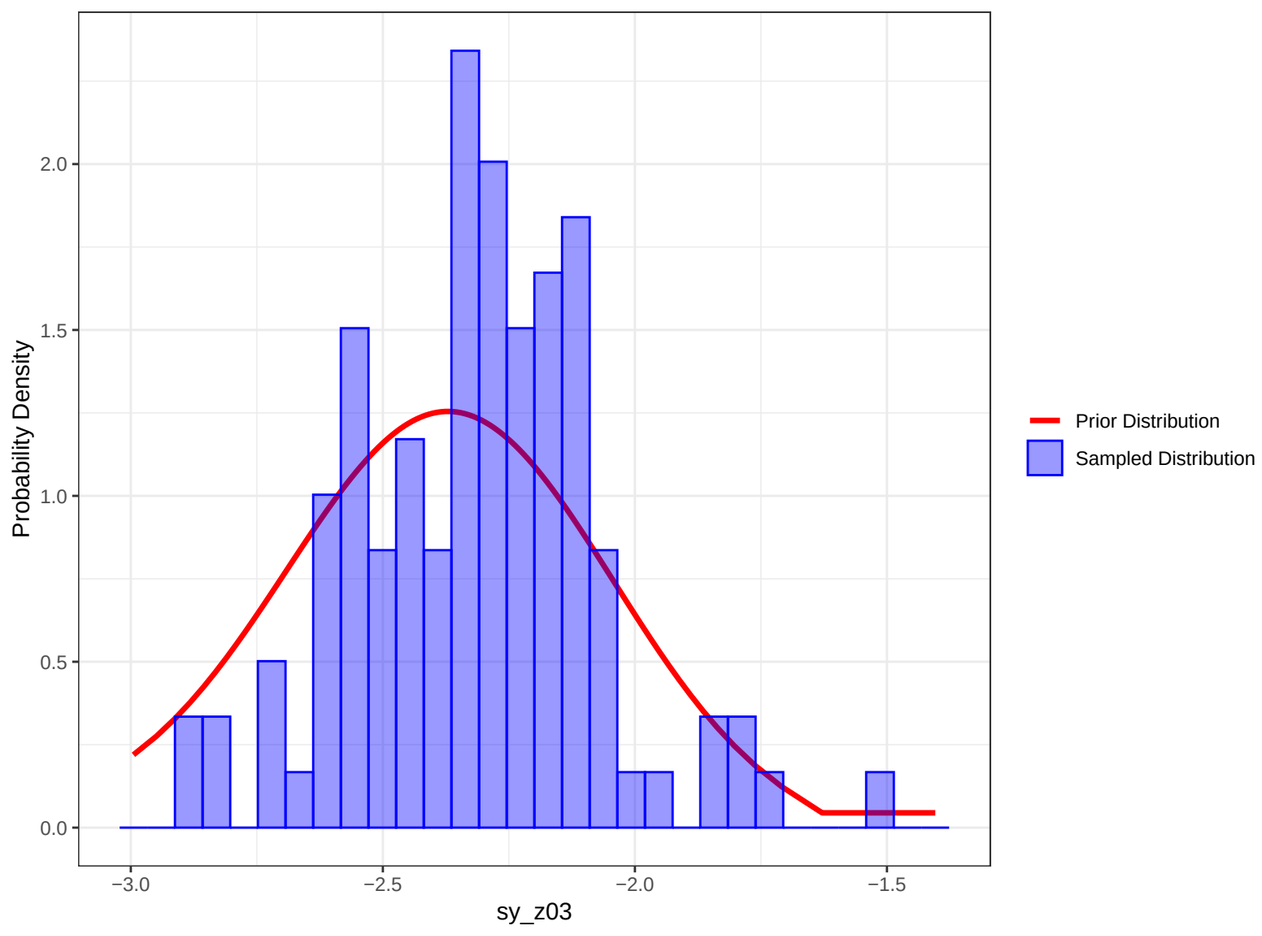

Probability Density
0.9
0.6
0.3
0.0
−3
−2
−1
0
1
kzf_z67
Prior Distribution
Sampled Distribution

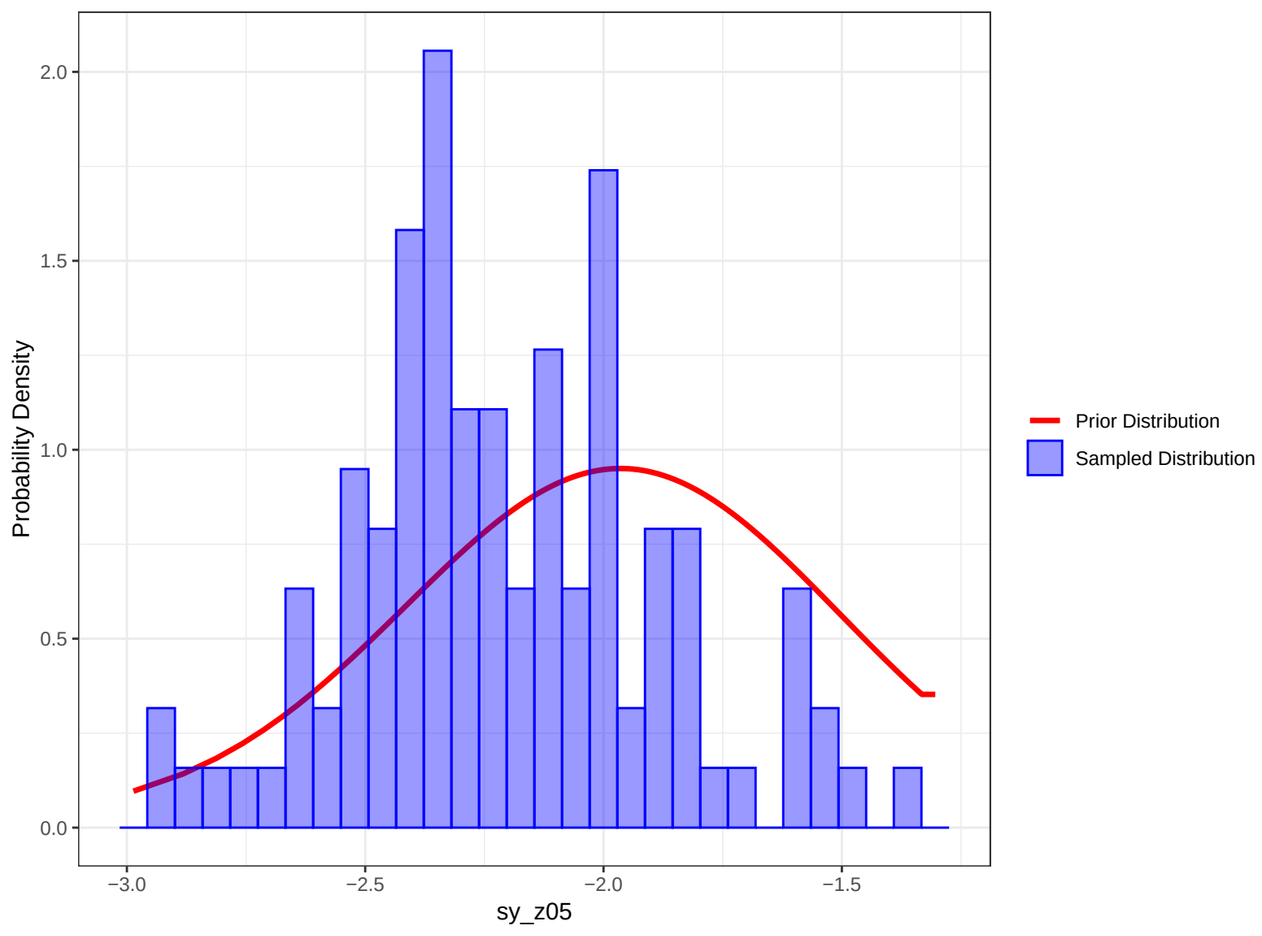

Probability Density
1.25
1.00
0.75
0.50
0.25
0.00
−3
−2
−1
kzf_z68
Prior Distribution
Sampled Distribution

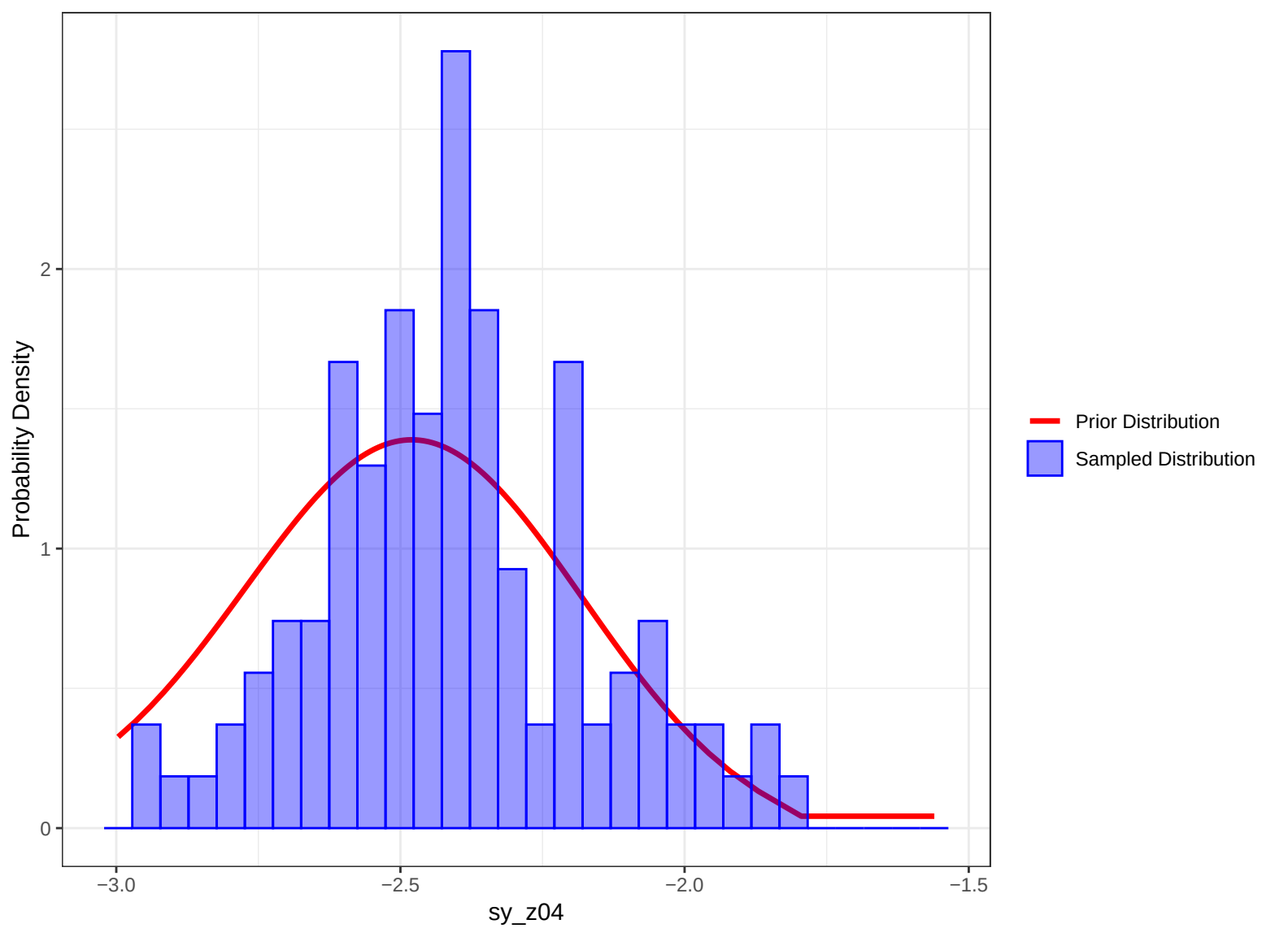

Probability Density
2
1
0
−3.0
−2.5
−2.0
−1.5
−1.0
sy_z01
Prior Distribution
Sampled Distribution

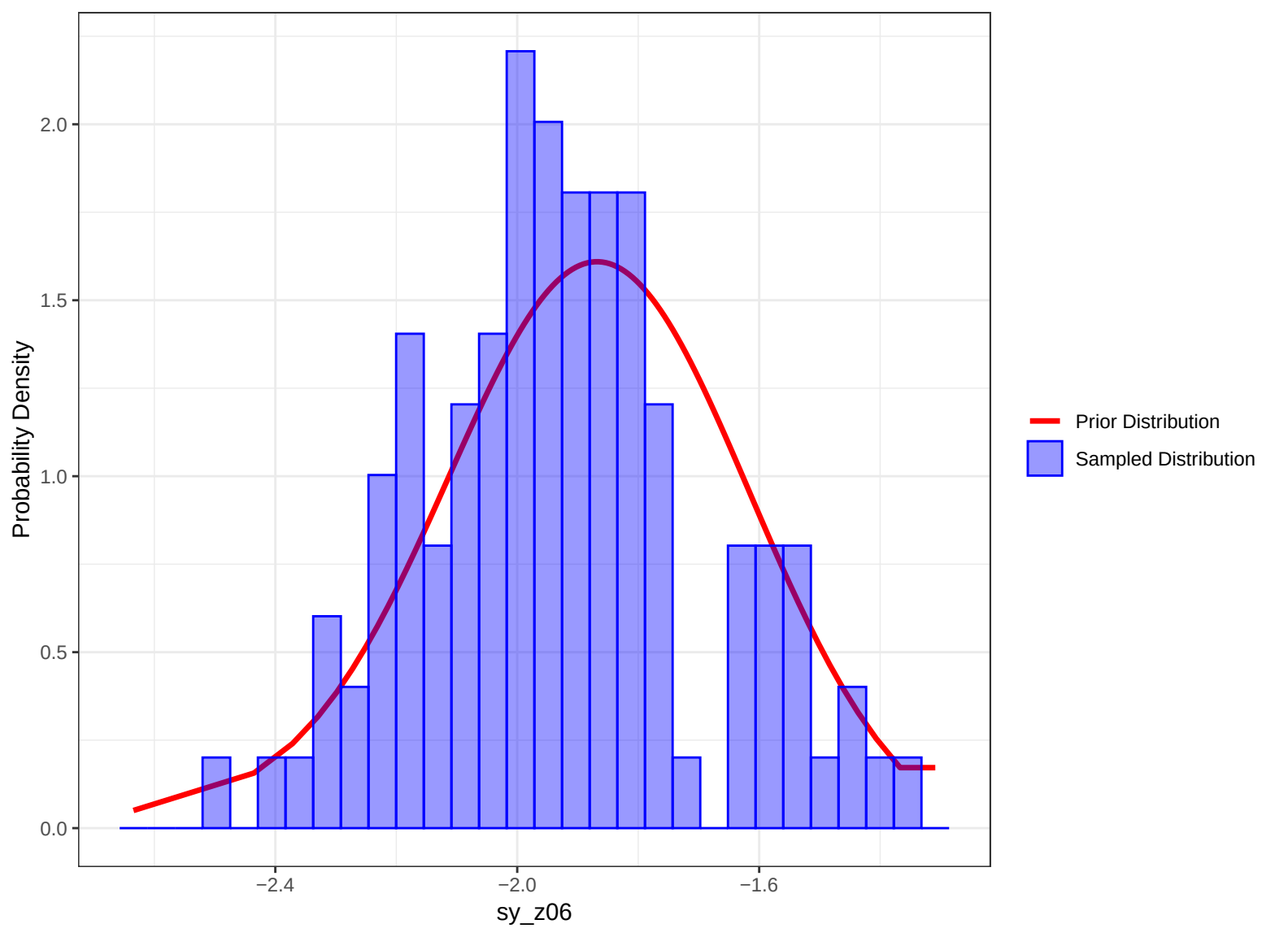

Probability Density
1.2
0.9
0.6
0.3
0.0
−3
−2
−1
kzf_z69
Prior Distribution
Sampled Distribution

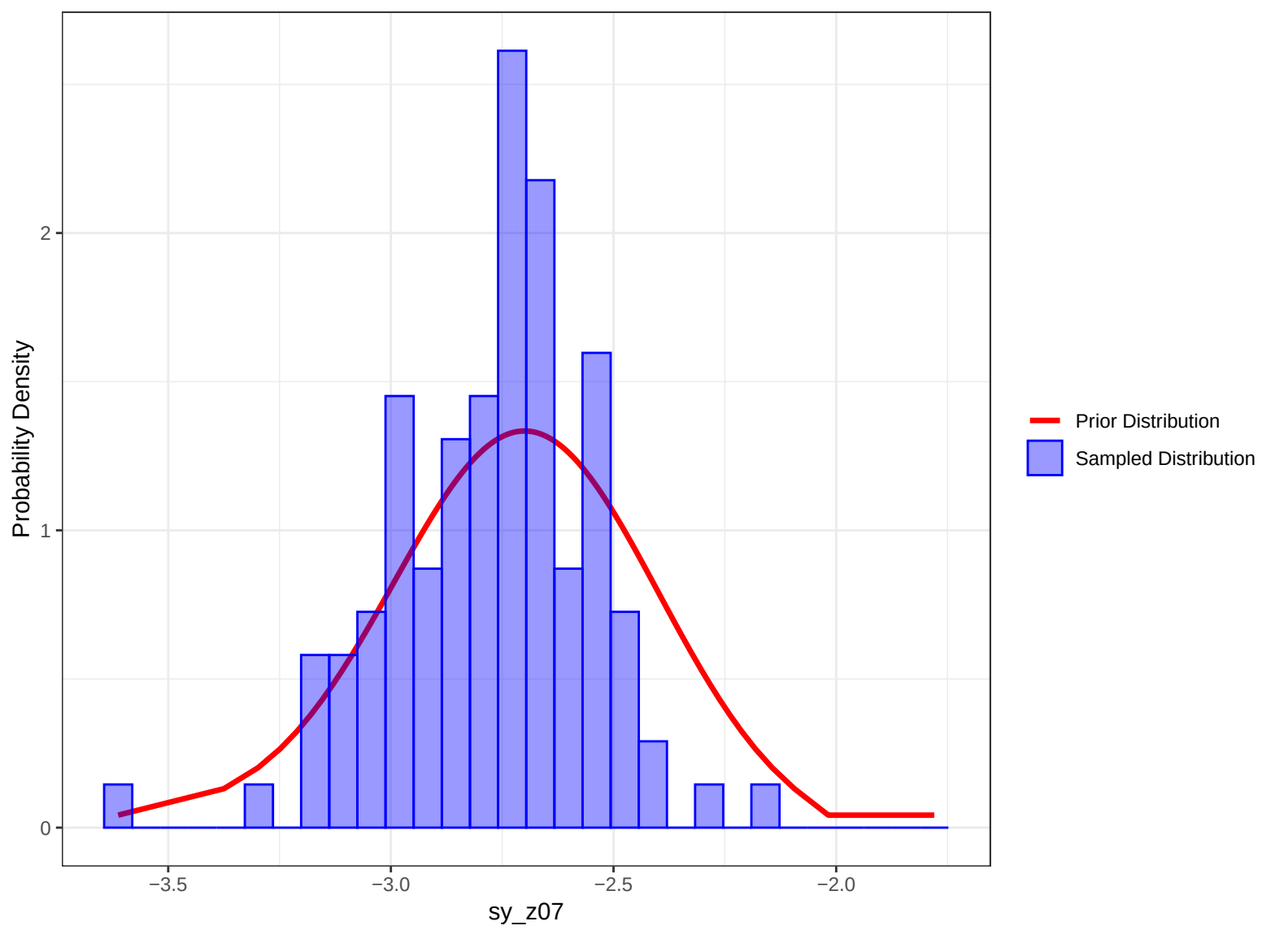

Probability Density
2.0
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
sy_z02
Prior Distribution
Sampled Distribution

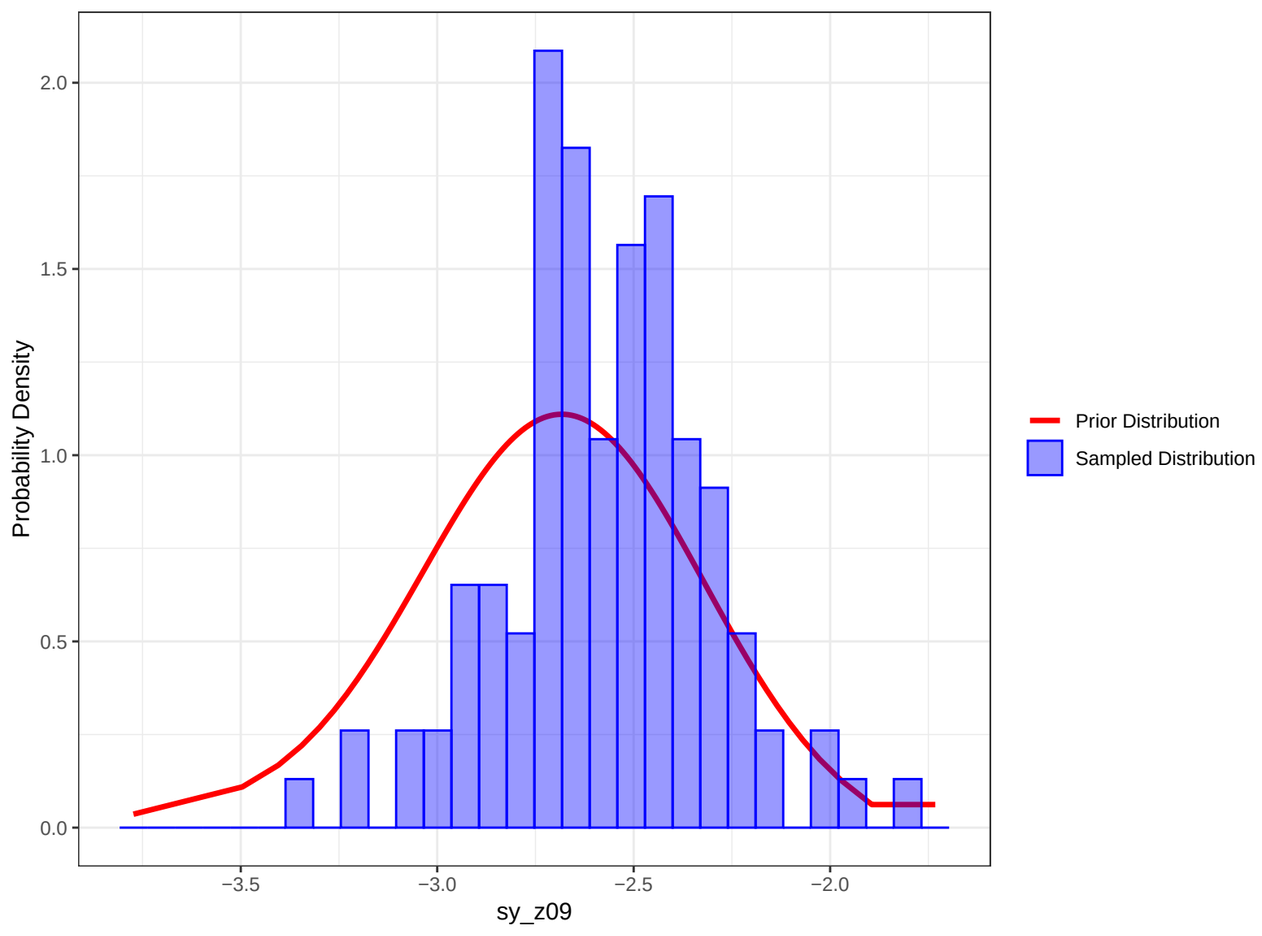

Probability Density
2.0
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
sy_z03
Prior Distribution
Sampled Distribution

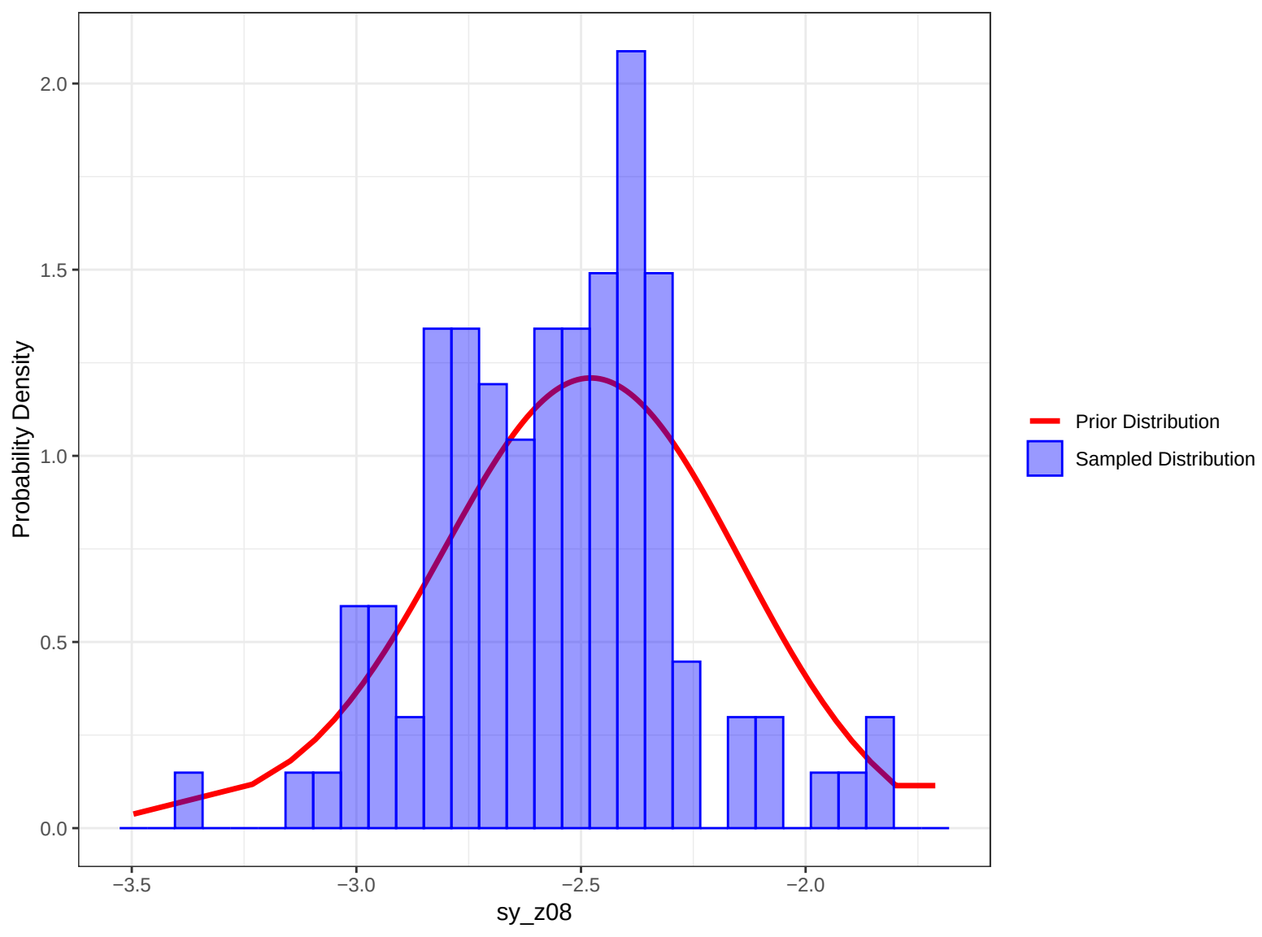

Probability Density
2.0
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
−1.5
sy_z05
Prior Distribution
Sampled Distribution

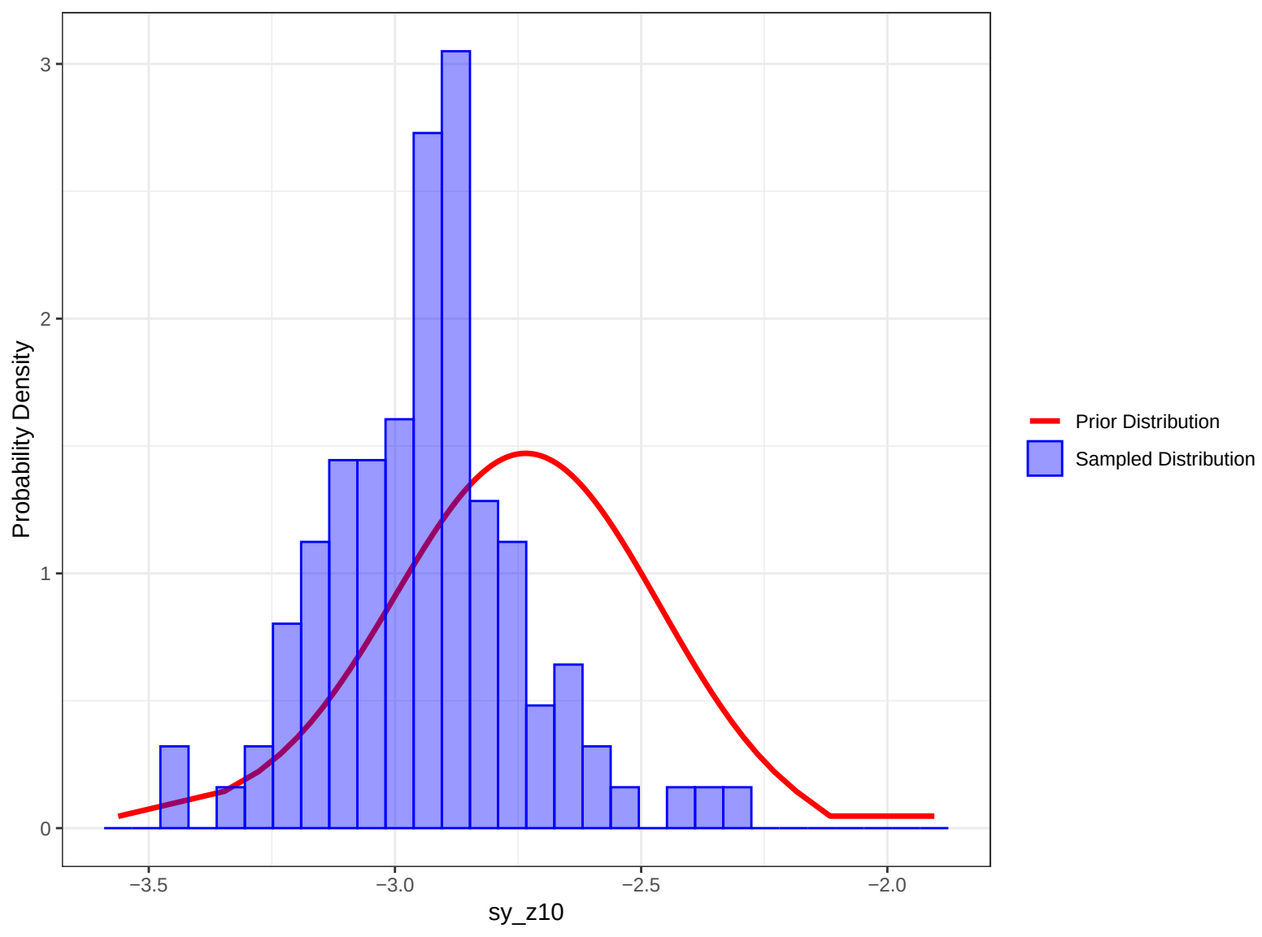

Probability Density
2
1
0
−3.0
−2.5
−2.0
−1.5
sy_z04
Prior Distribution
Sampled Distribution

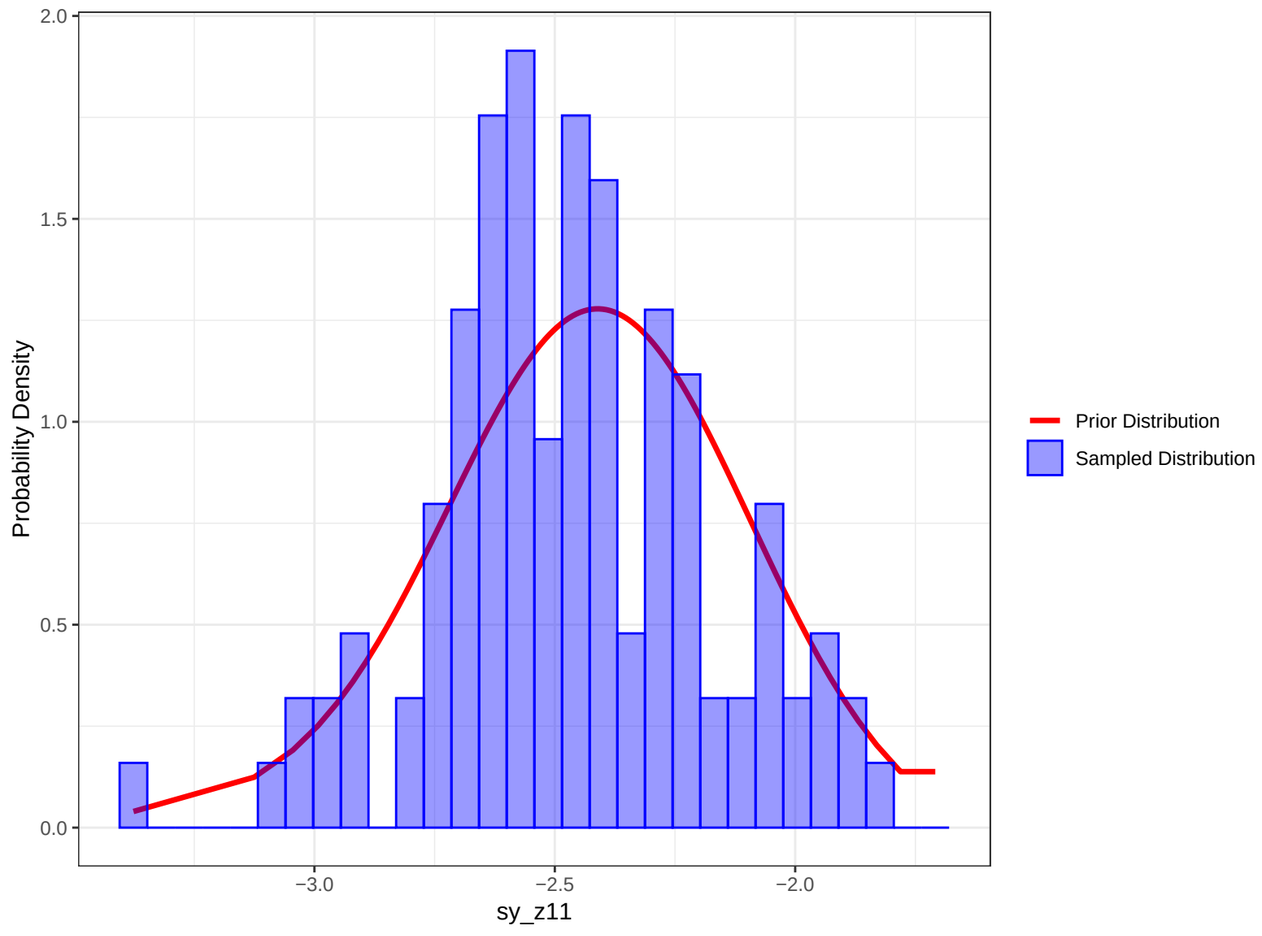

Probability Density
2.0
1.5
1.0
0.5
0.0
−2.4
−2.0
−1.6
sy_z06
Prior Distribution
Sampled Distribution

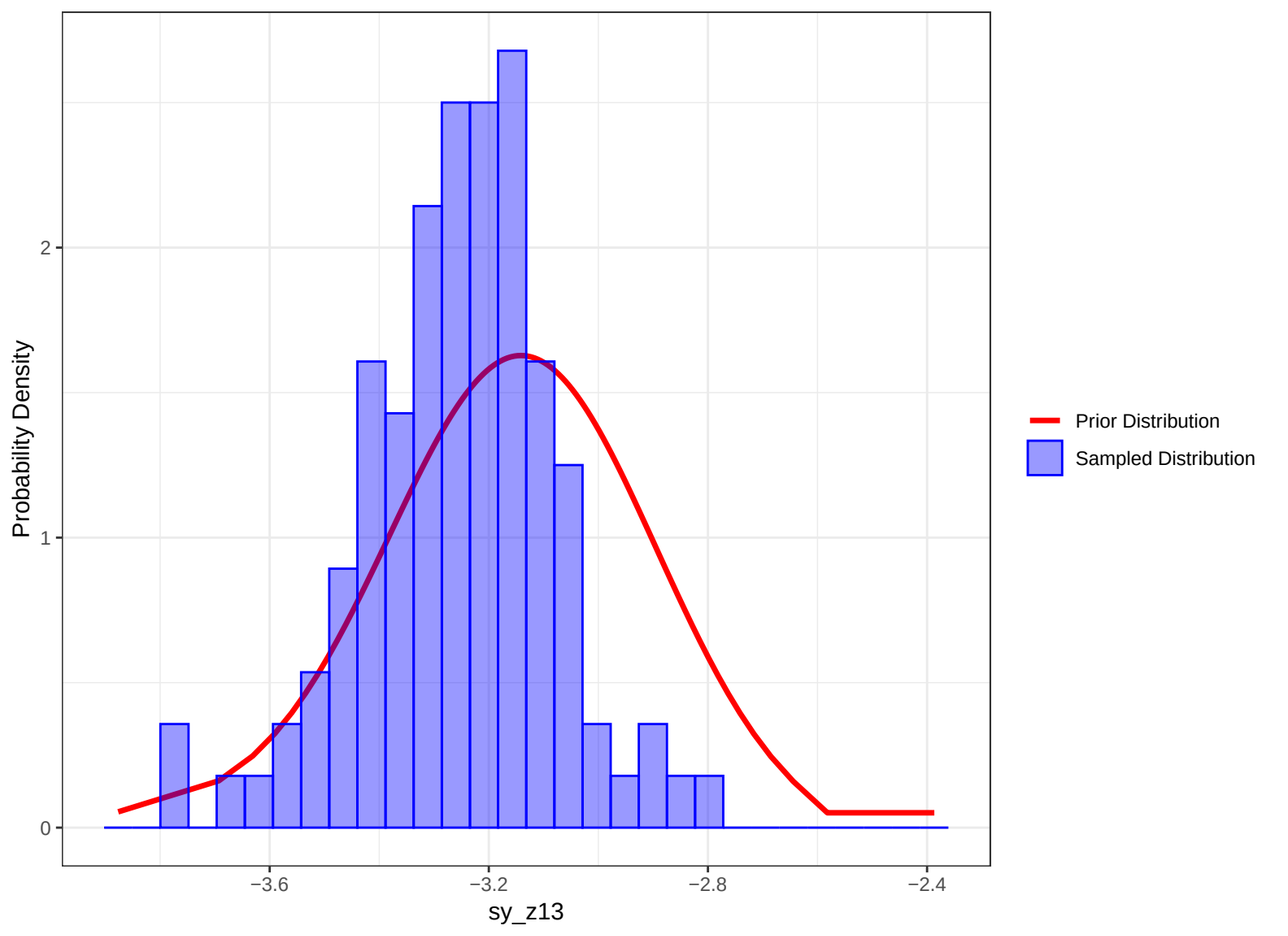

Probability Density
0
1
2
−3.5
−3.0
−2.5
−2.0
sy_z07
Prior Distribution
Sampled Distribution

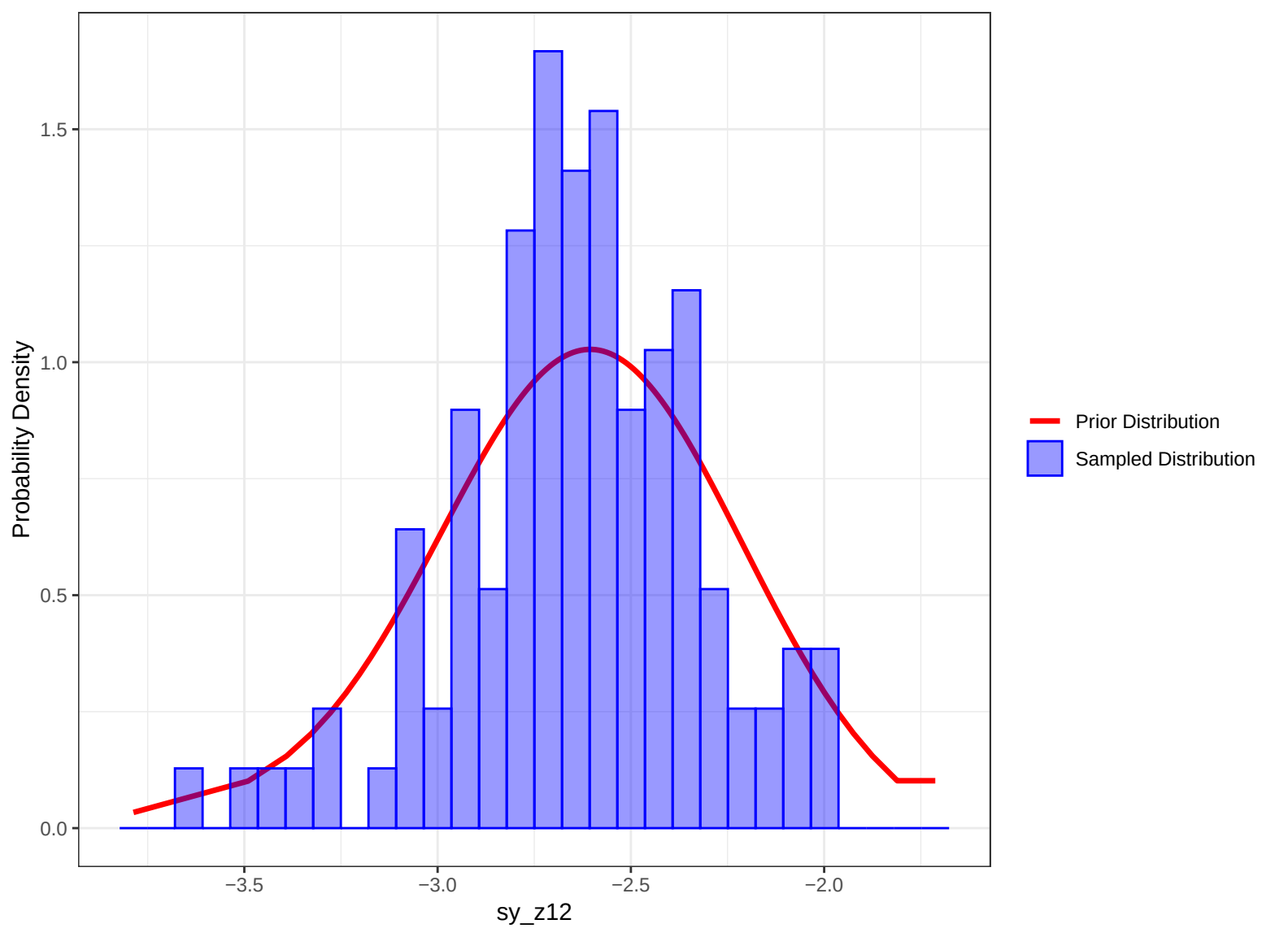

Probability Density
0.0
0.5
1.0
1.5
2.0
−3.5
−3.0
−2.5
−2.0
sy_z09
Prior Distribution
Sampled Distribution

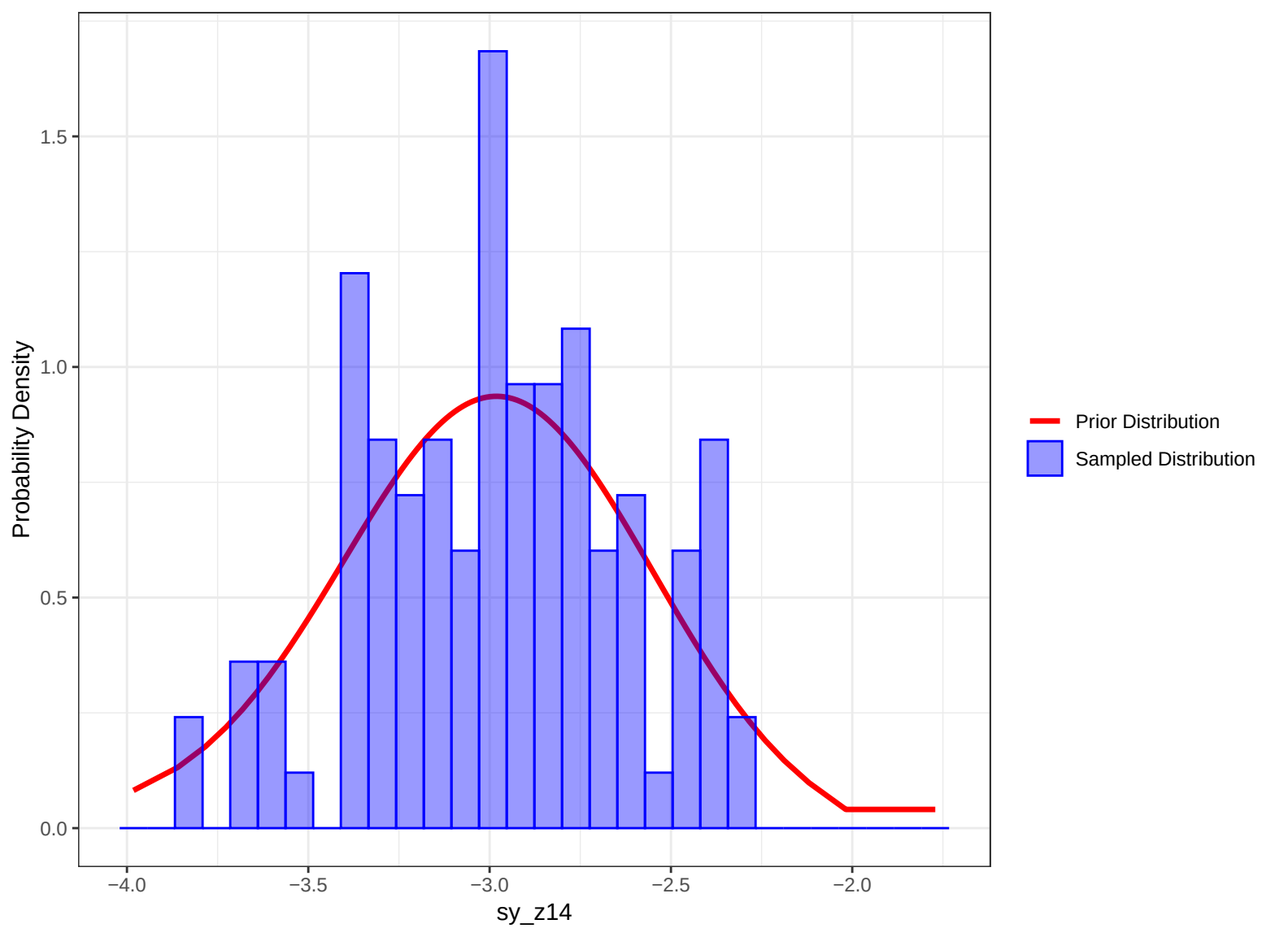

Probability Density
0.0
0.5
1.0
1.5
2.0
−3.5
−3.0
−2.5
−2.0
sy_z08
Prior Distribution
Sampled Distribution

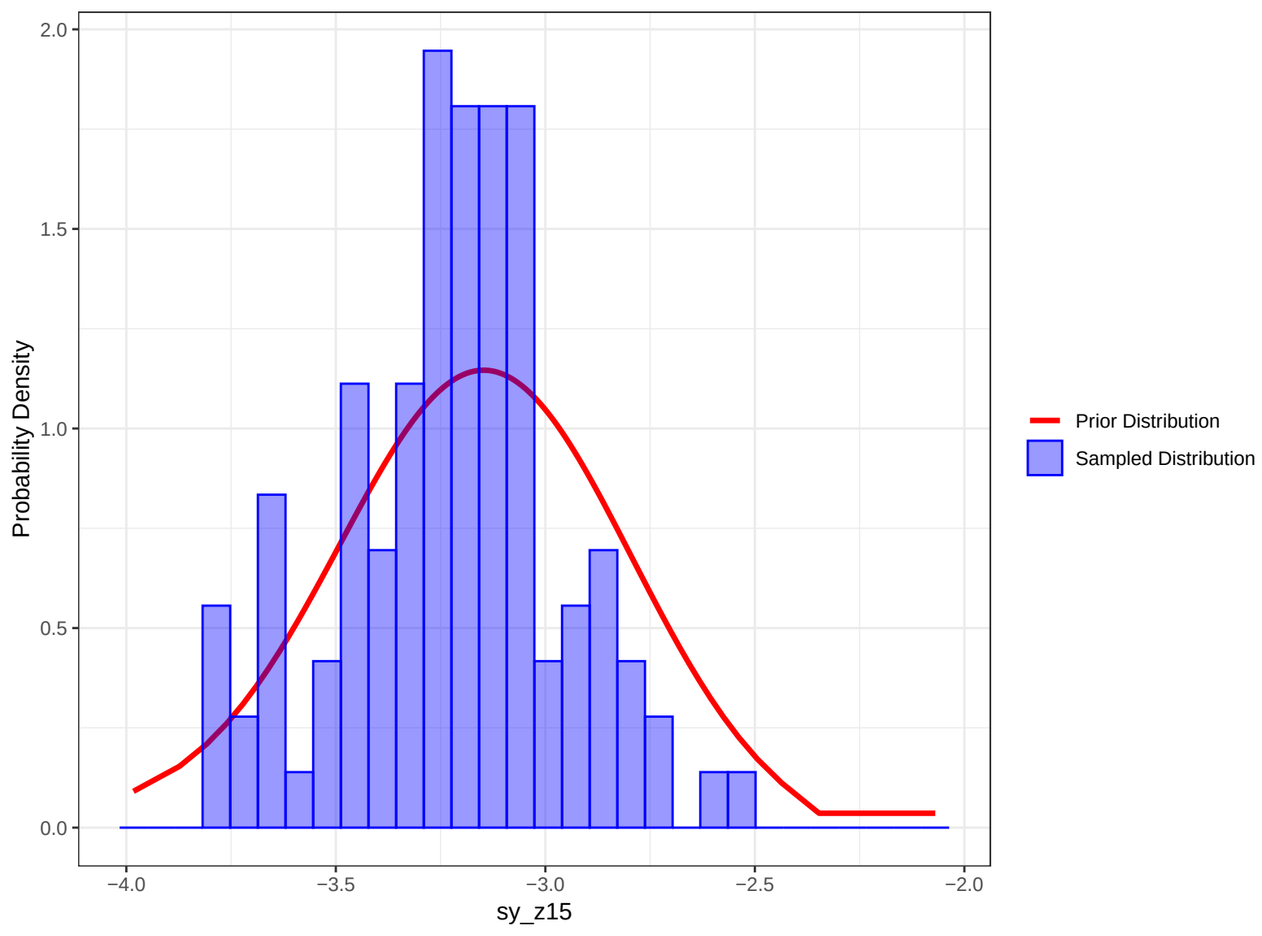

Probability Density
0
1
2
3
−3.5
−3.0
−2.5
−2.0
sy_z10
Prior Distribution
Sampled Distribution

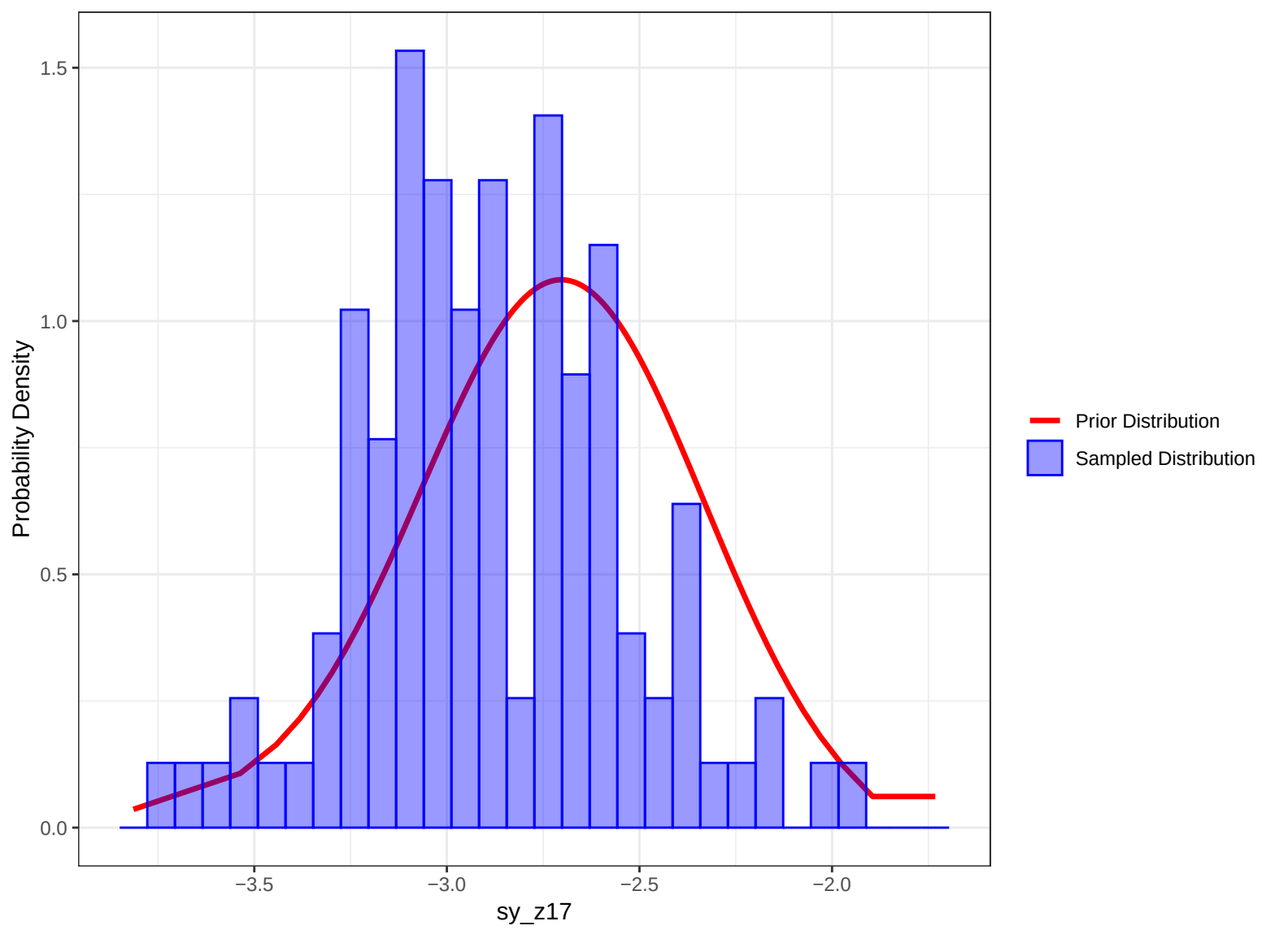

Probability Density
2.0
1.5
1.0
0.5
0.0
−3.0
−2.5
−2.0
sy_z11
Prior Distribution
Sampled Distribution

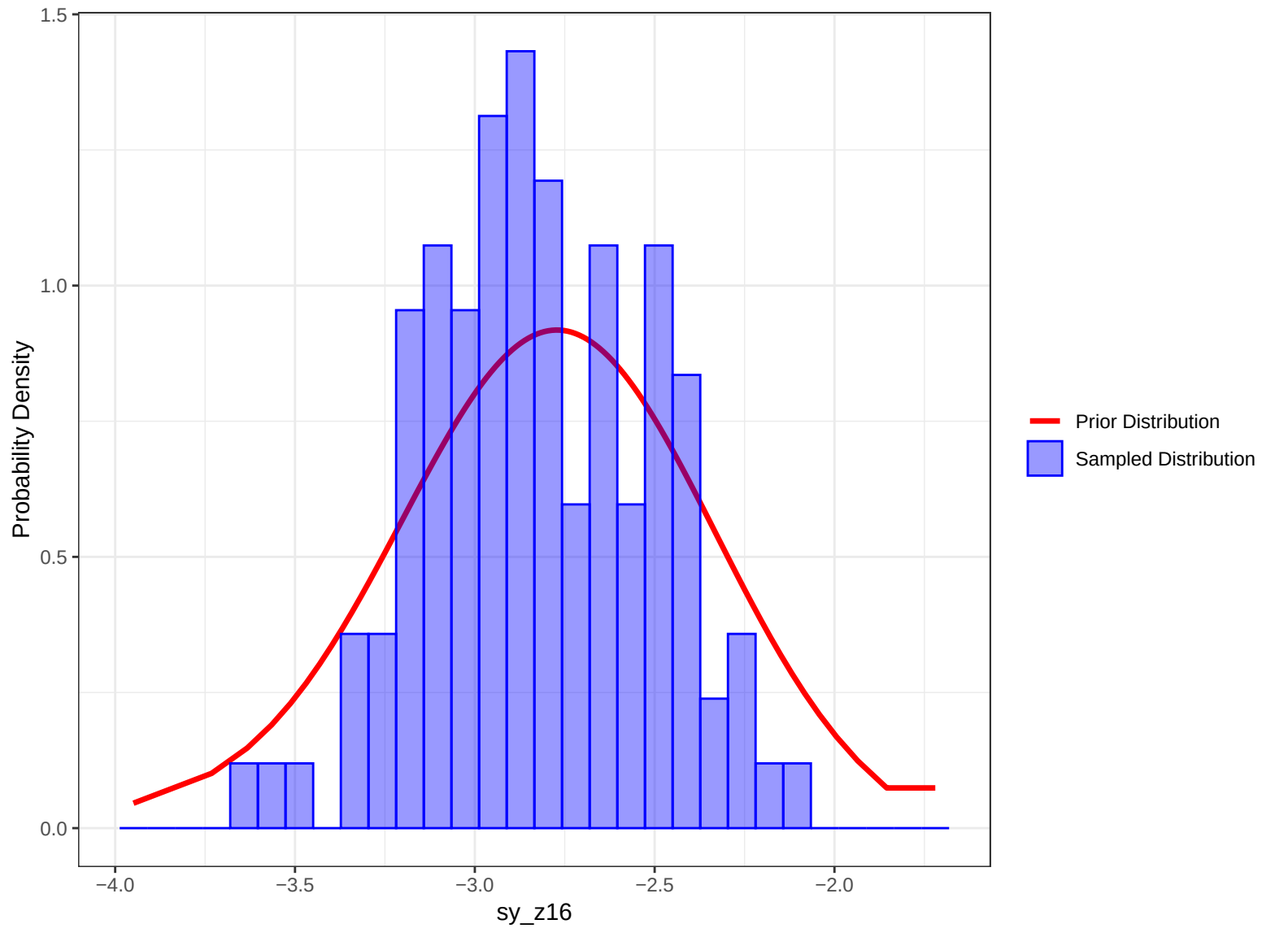

Probability Density
2
1
0
−3.6
−3.2
−2.8
−2.4
sy_z13
Prior Distribution
Sampled Distribution

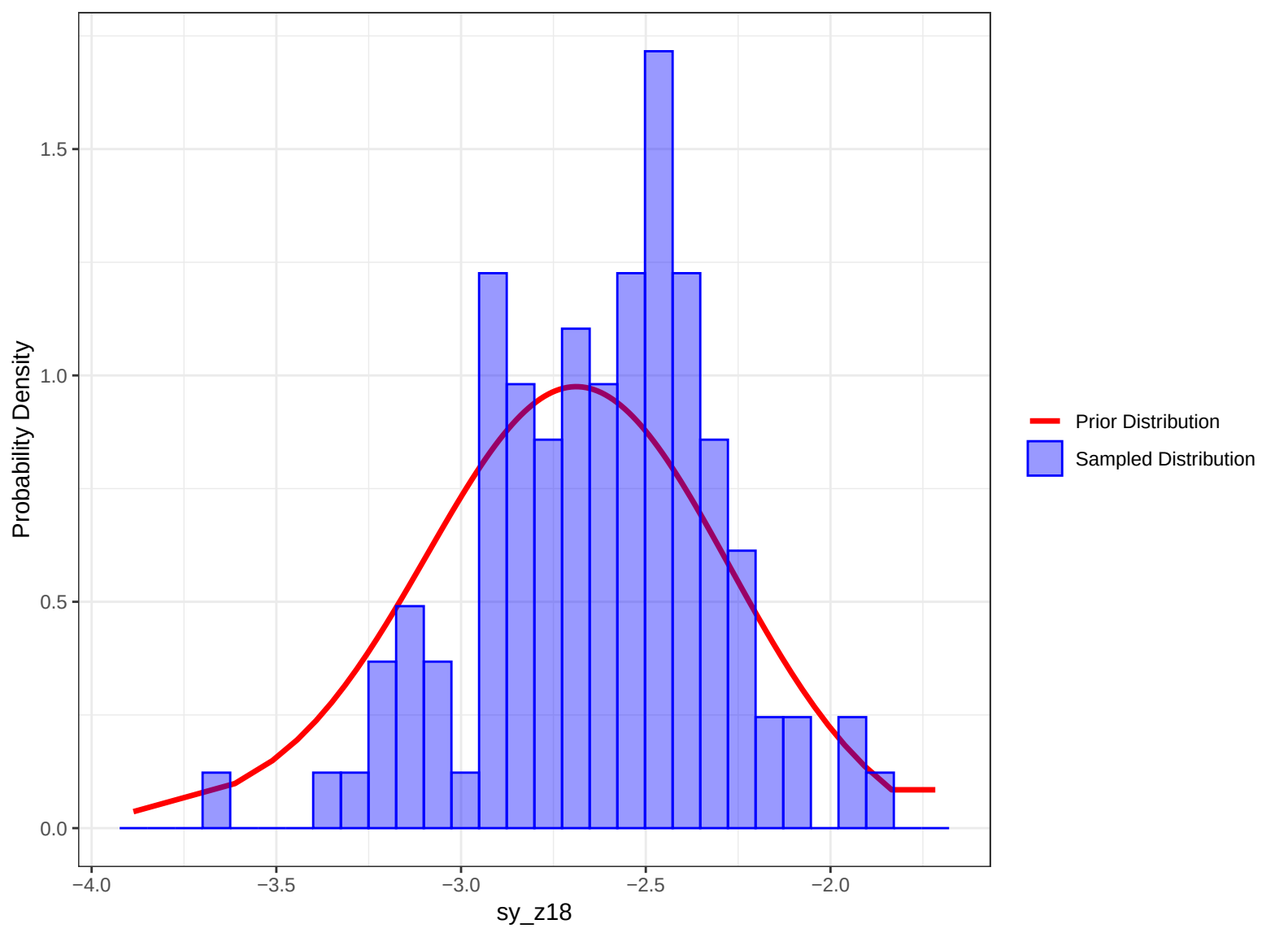

Probability Density
1.5
1.0
0.5
0.0
−3.5
−3.0
−2.5
−2.0
sy_z12
Prior Distribution
Sampled Distribution

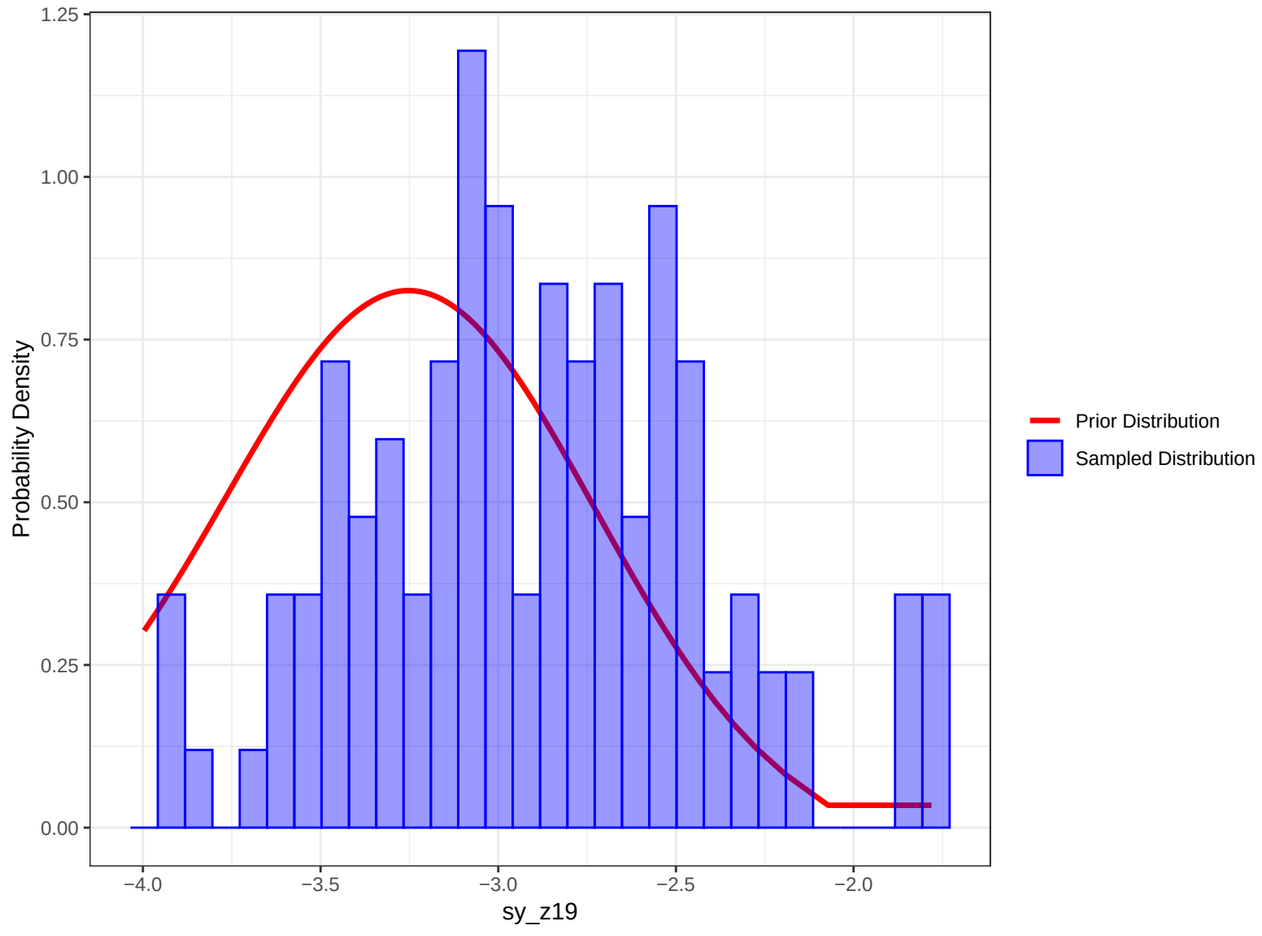

Probability Density
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z14
Prior Distribution
Sampled Distribution

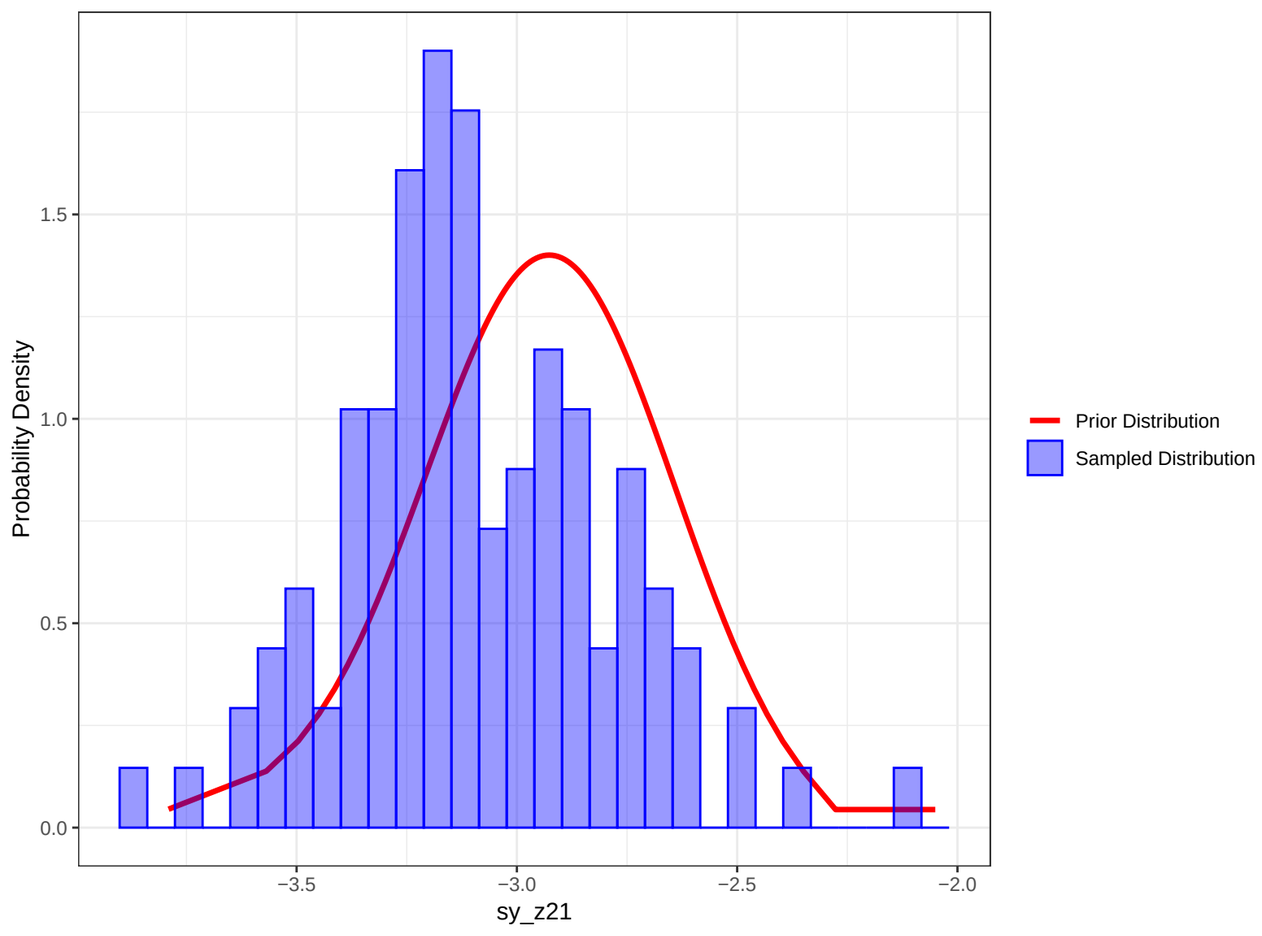

Probability Density
2.0
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z15
Prior Distribution
Sampled Distribution

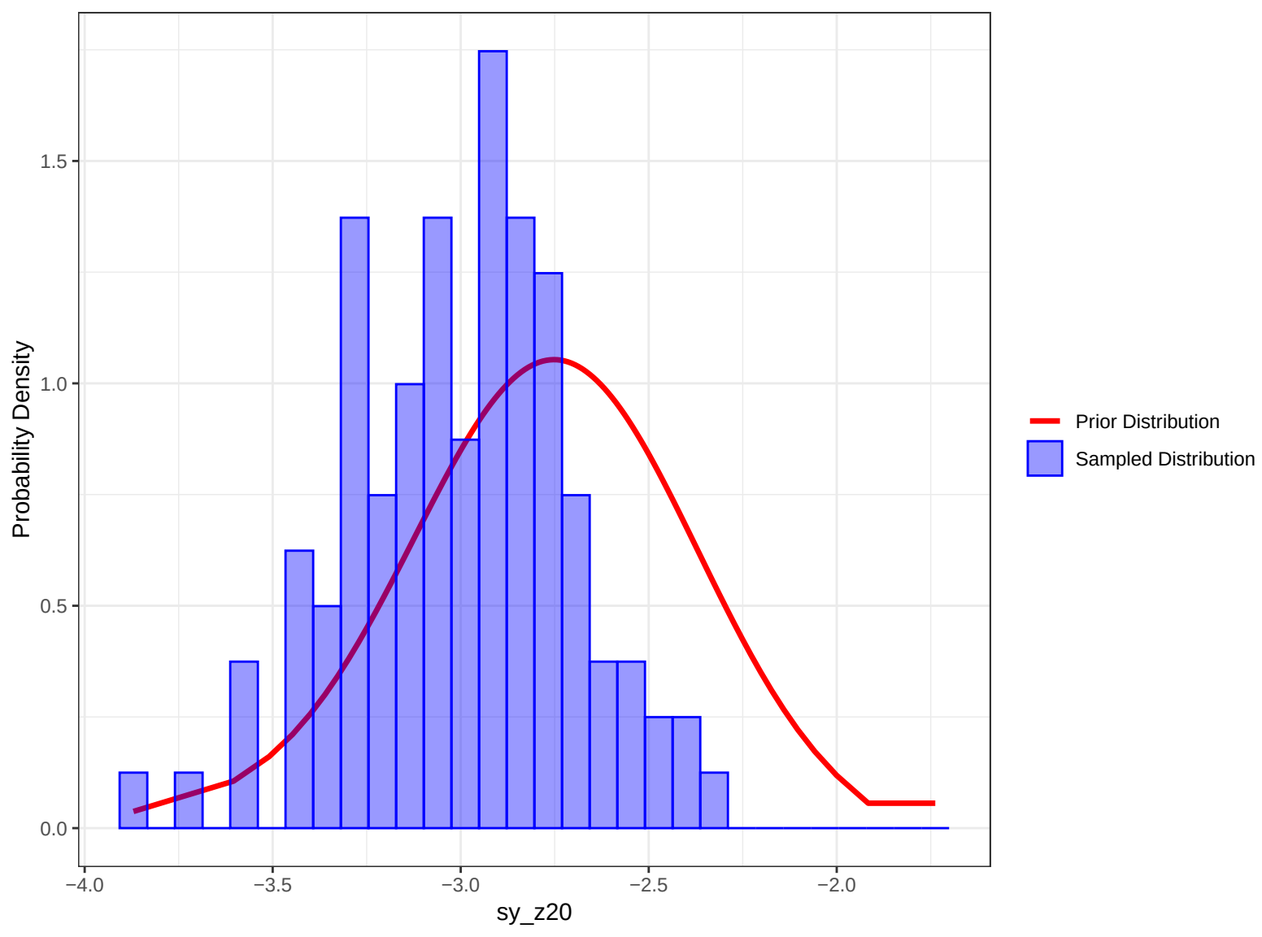

Probability Density
1.5
1.0
0.5
0.0
−3.5
−3.0
−2.5
−2.0
sy_z17
Prior Distribution
Sampled Distribution

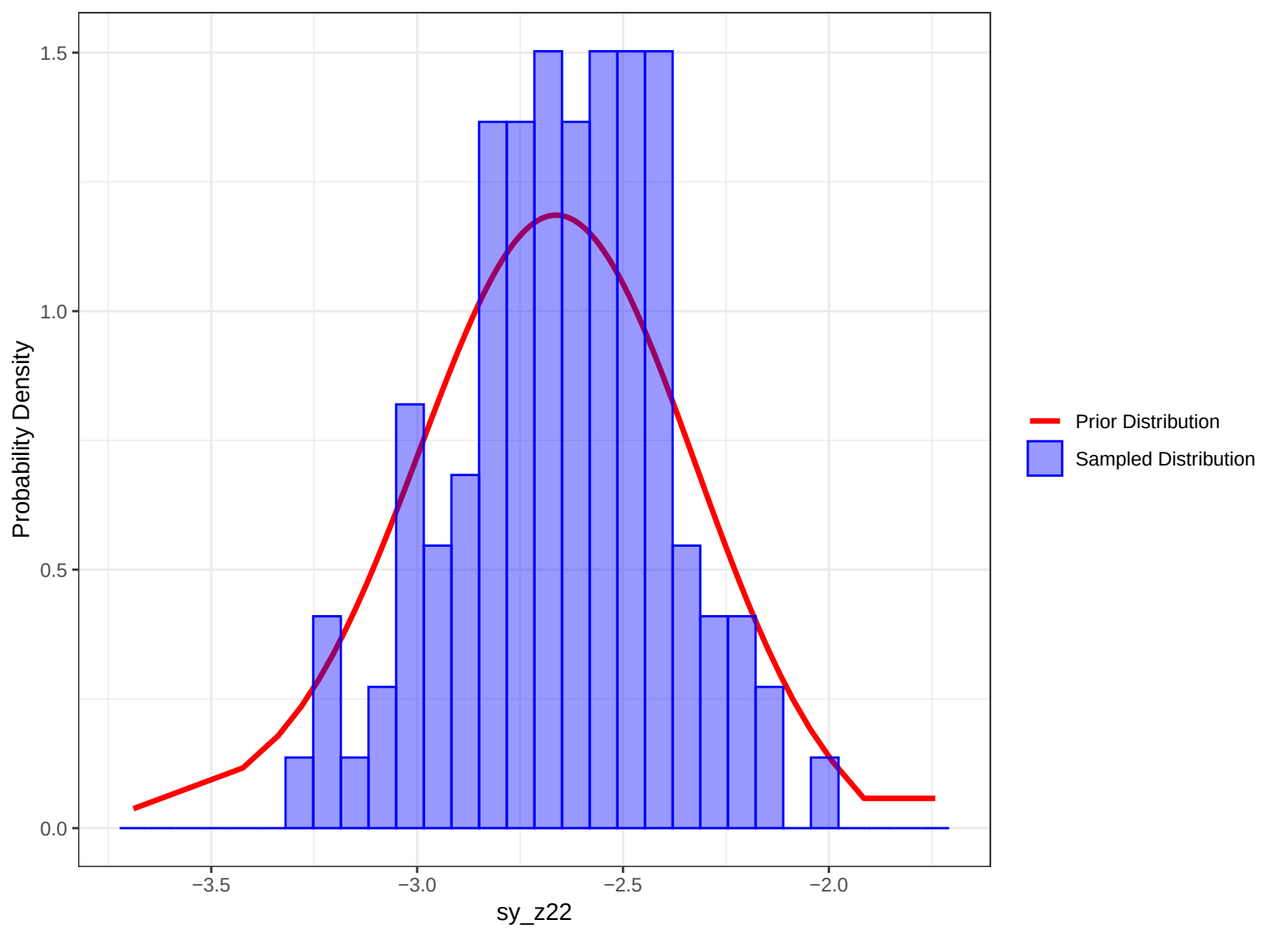

Probability Density
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z16
Prior Distribution
Sampled Distribution

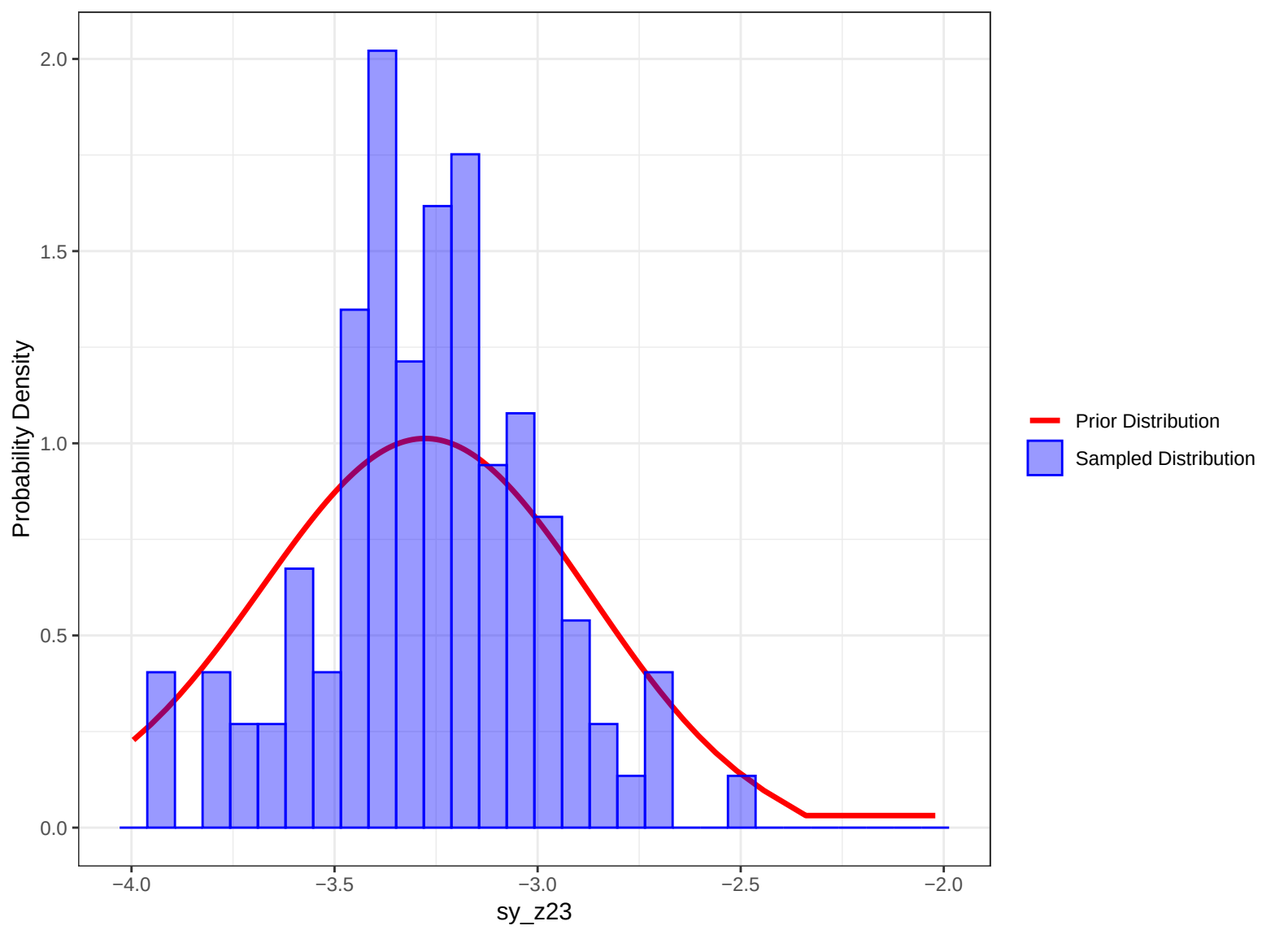

Probability Density
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z18
Prior Distribution
Sampled Distribution

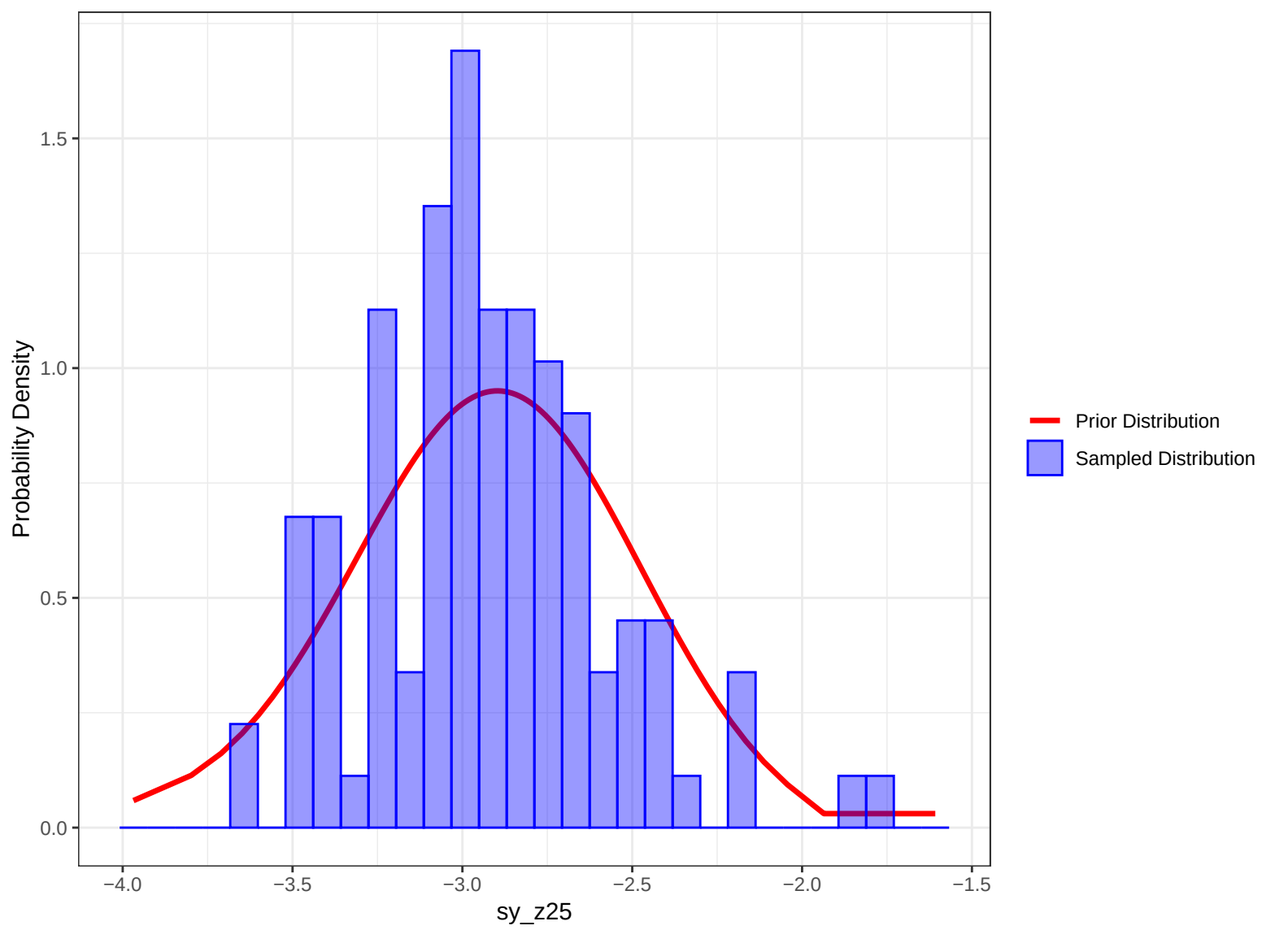

Probability Density
1.25
1.00
0.75
0.50
0.25
0.00
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z19
Prior Distribution
Sampled Distribution

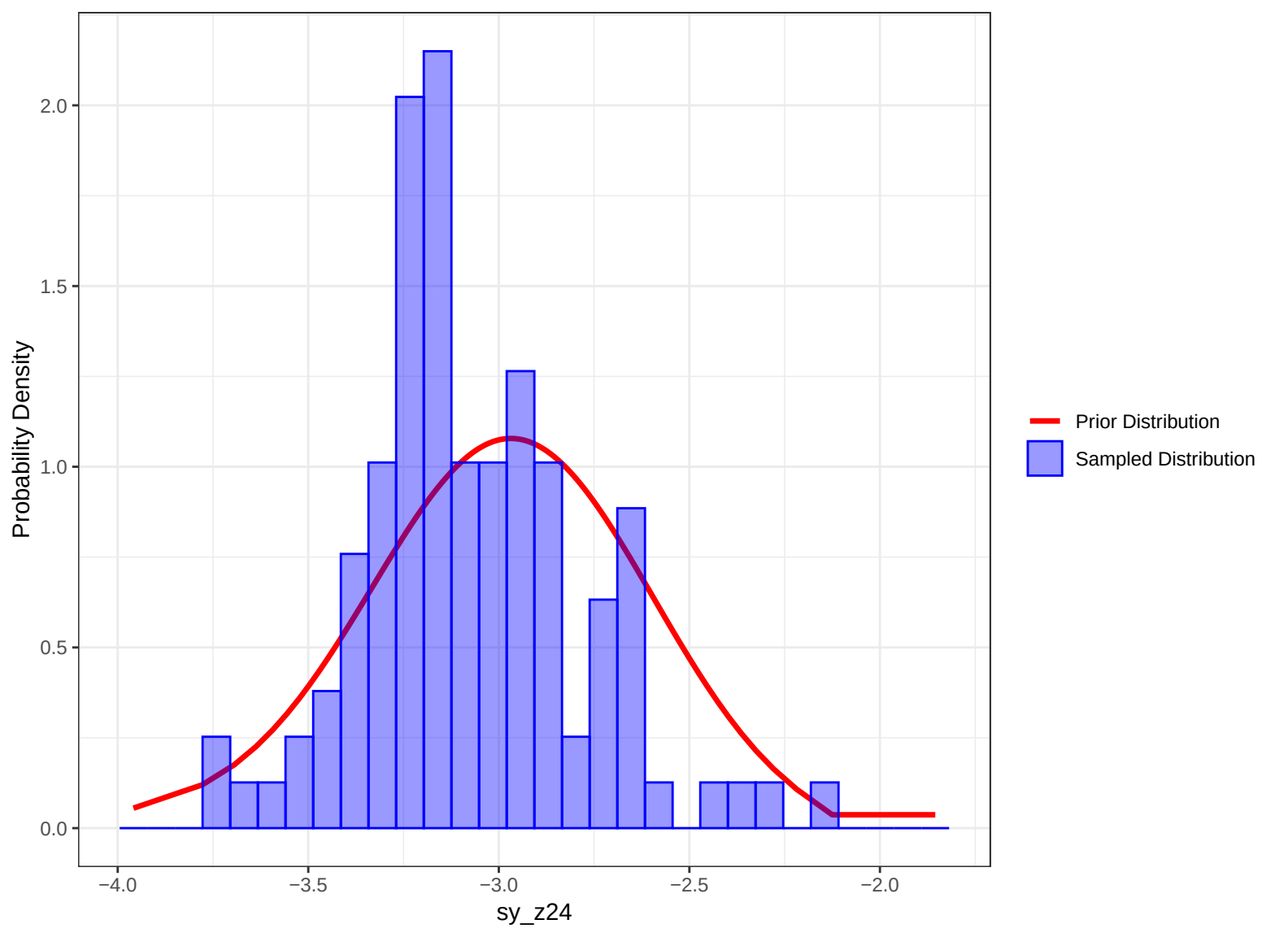

Probability Density
1.5
1.0
0.5
0.0
−3.5
−3.0
−2.5
−2.0
sy_z21
Prior Distribution
Sampled Distribution

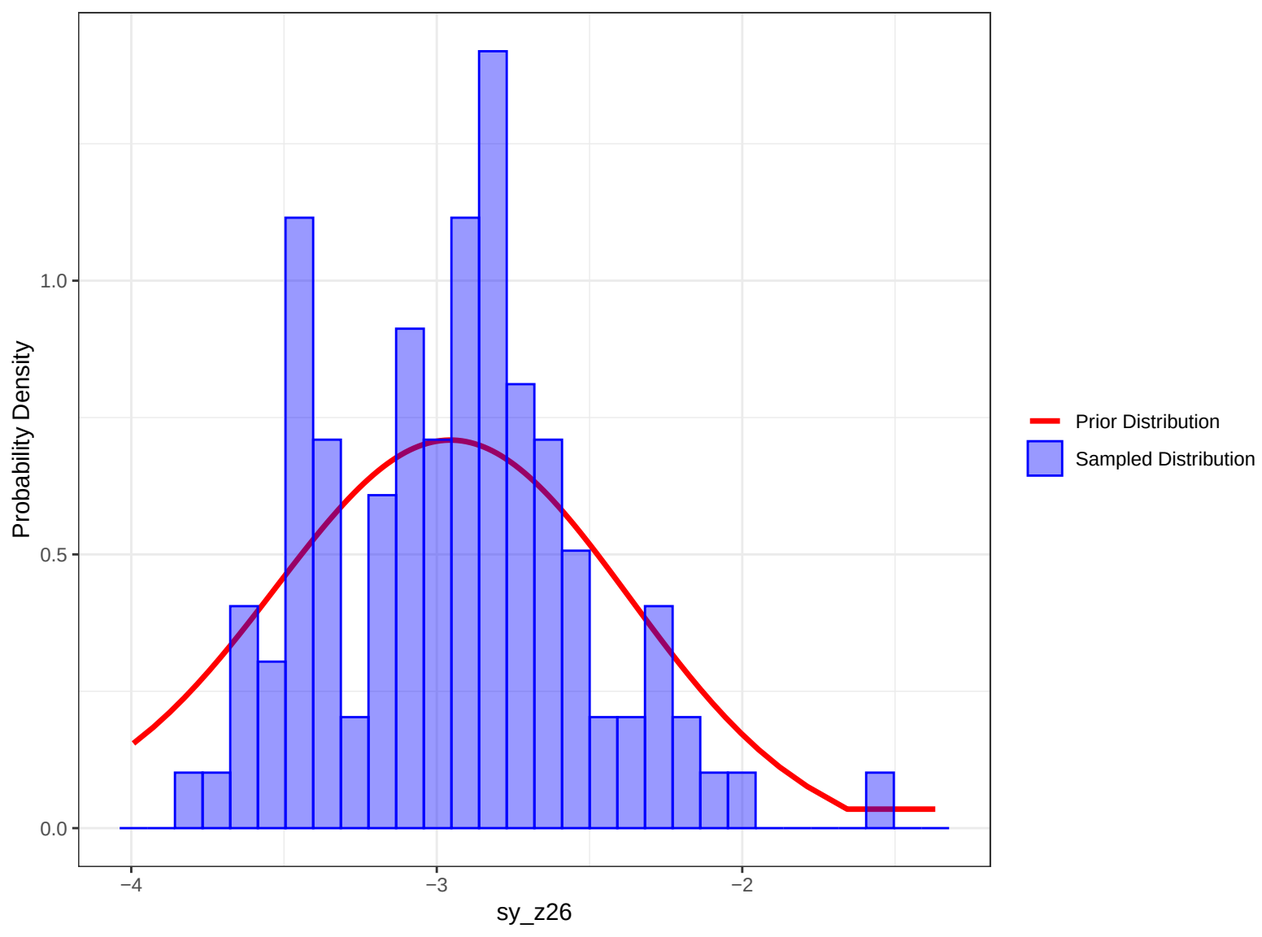

Probability Density
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z20
Prior Distribution
Sampled Distribution

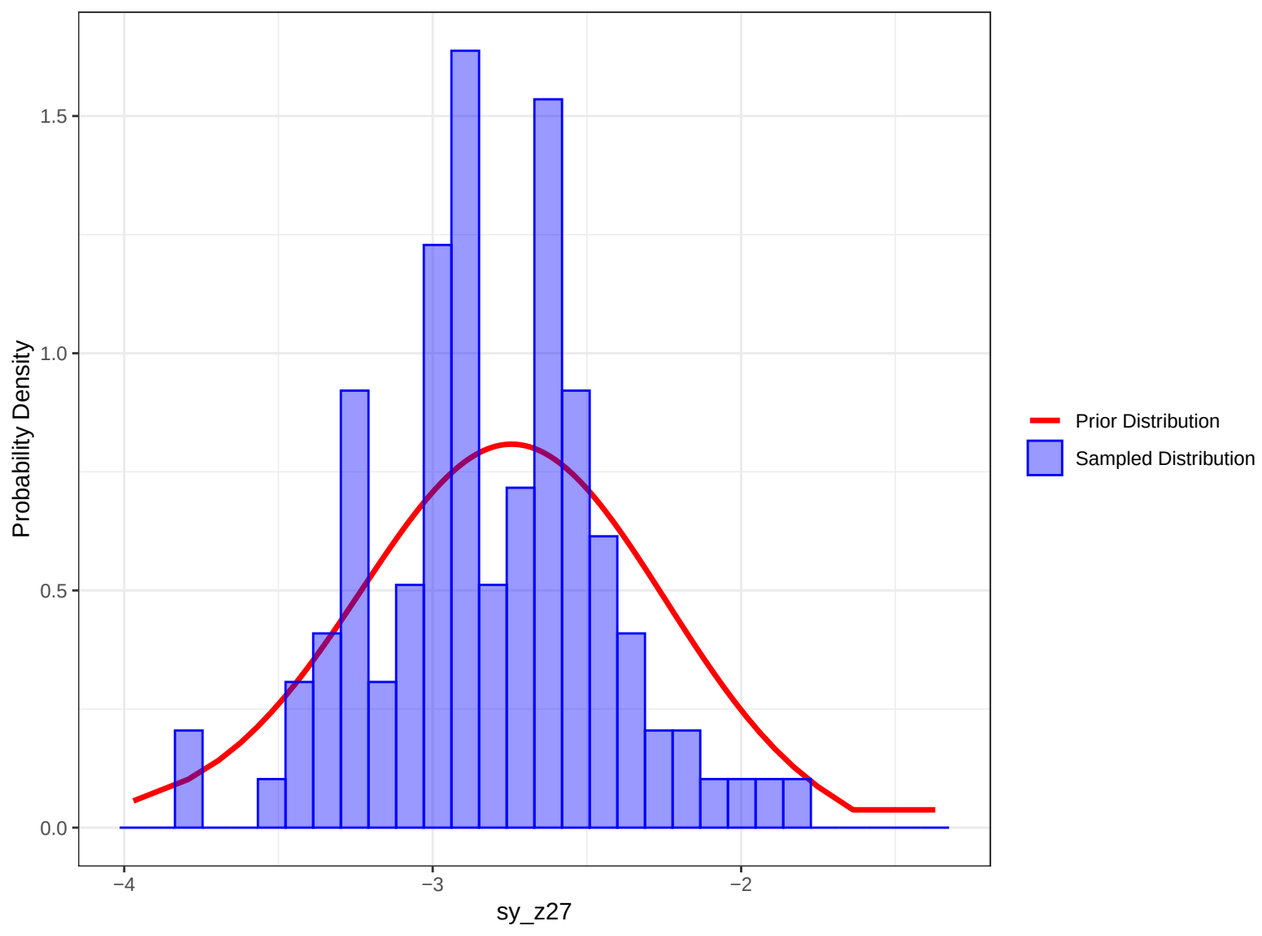

Probability Density
1.5
1.0
0.5
0.0
−3.5
−3.0
−2.5
−2.0
sy_z22
Prior Distribution
Sampled Distribution

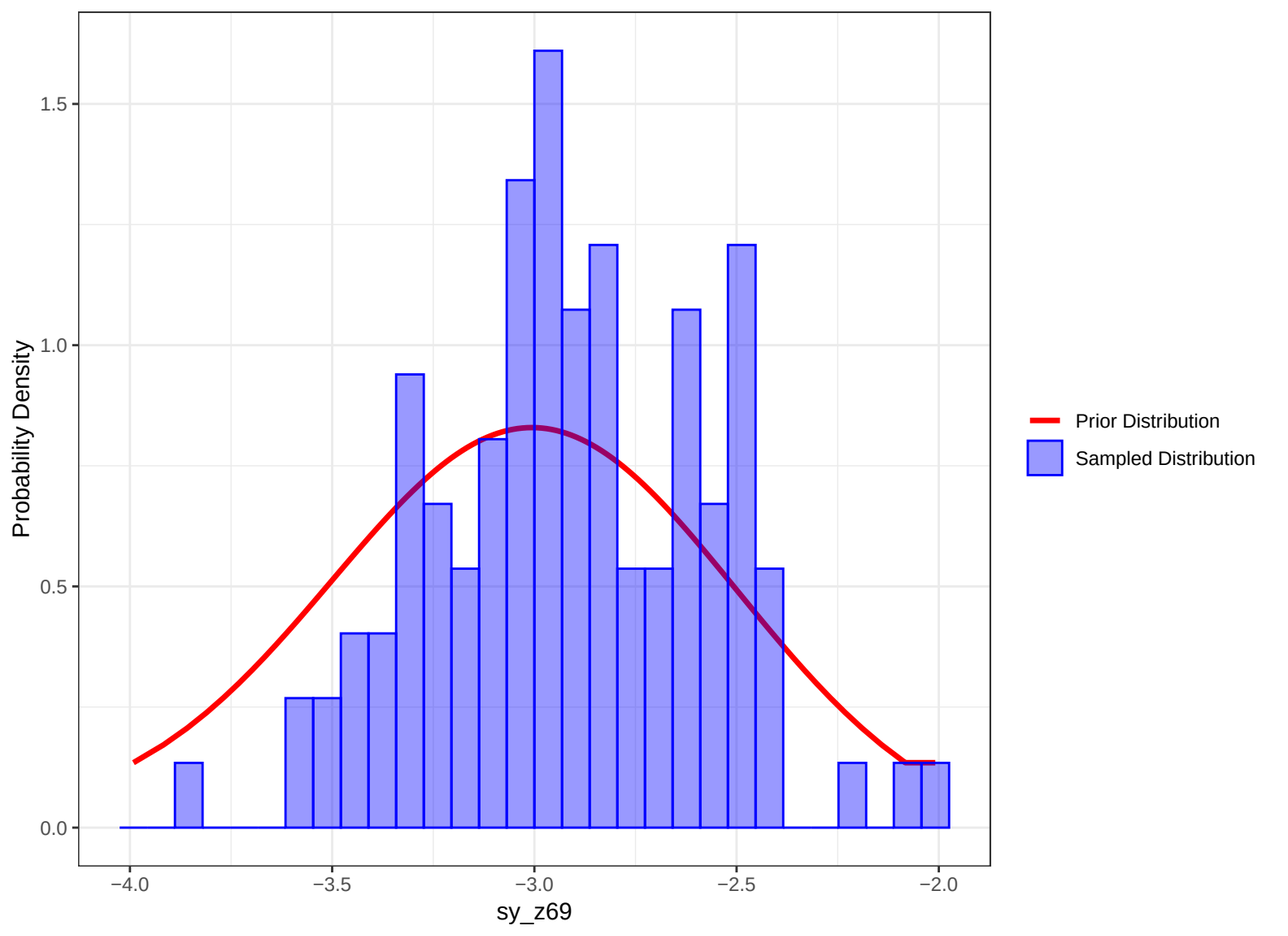

Probability Density
2.0
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z23
Prior Distribution
Sampled Distribution

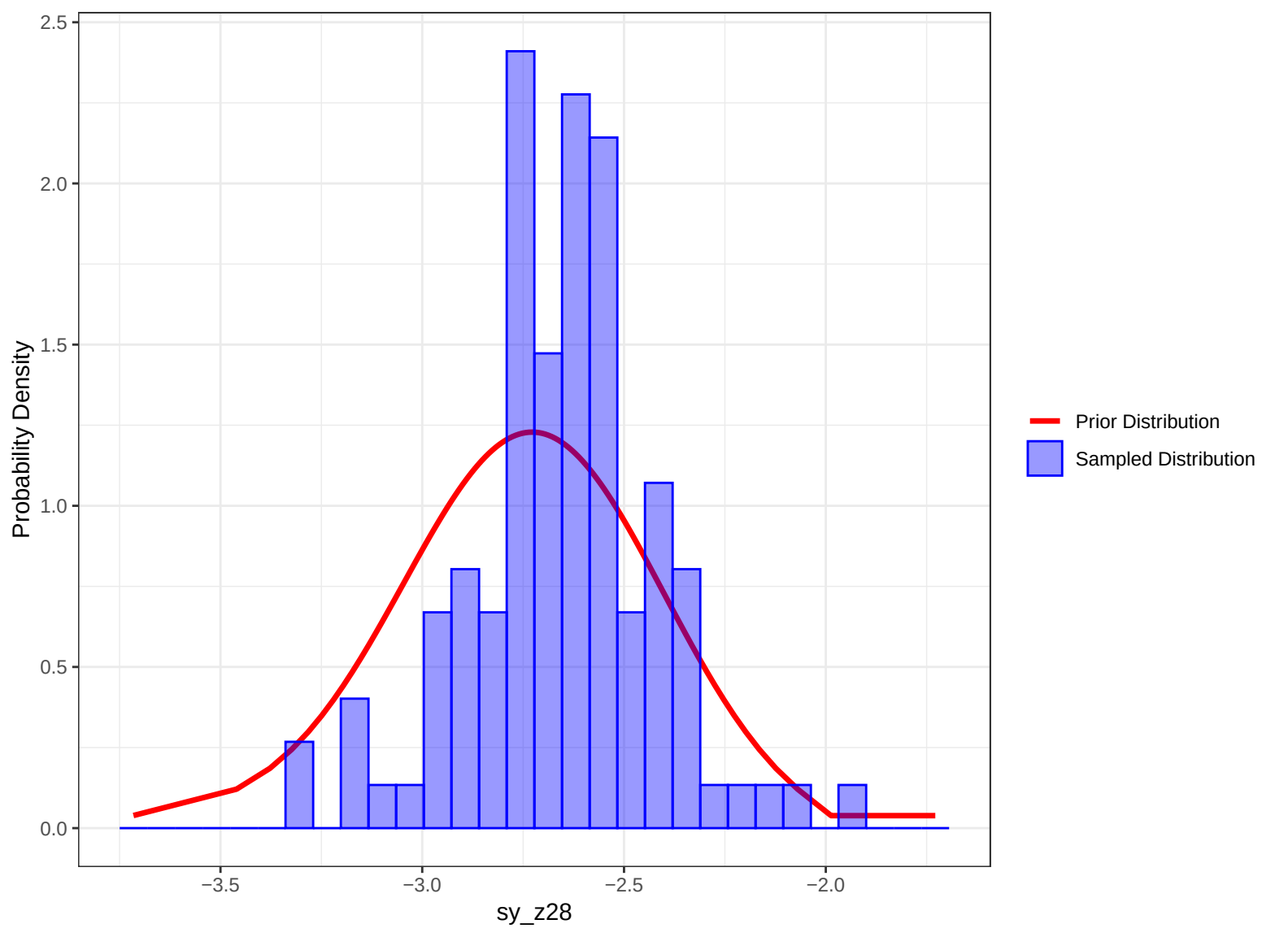

Probability Density
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
−1.5
sy_z25
Prior Distribution
Sampled Distribution

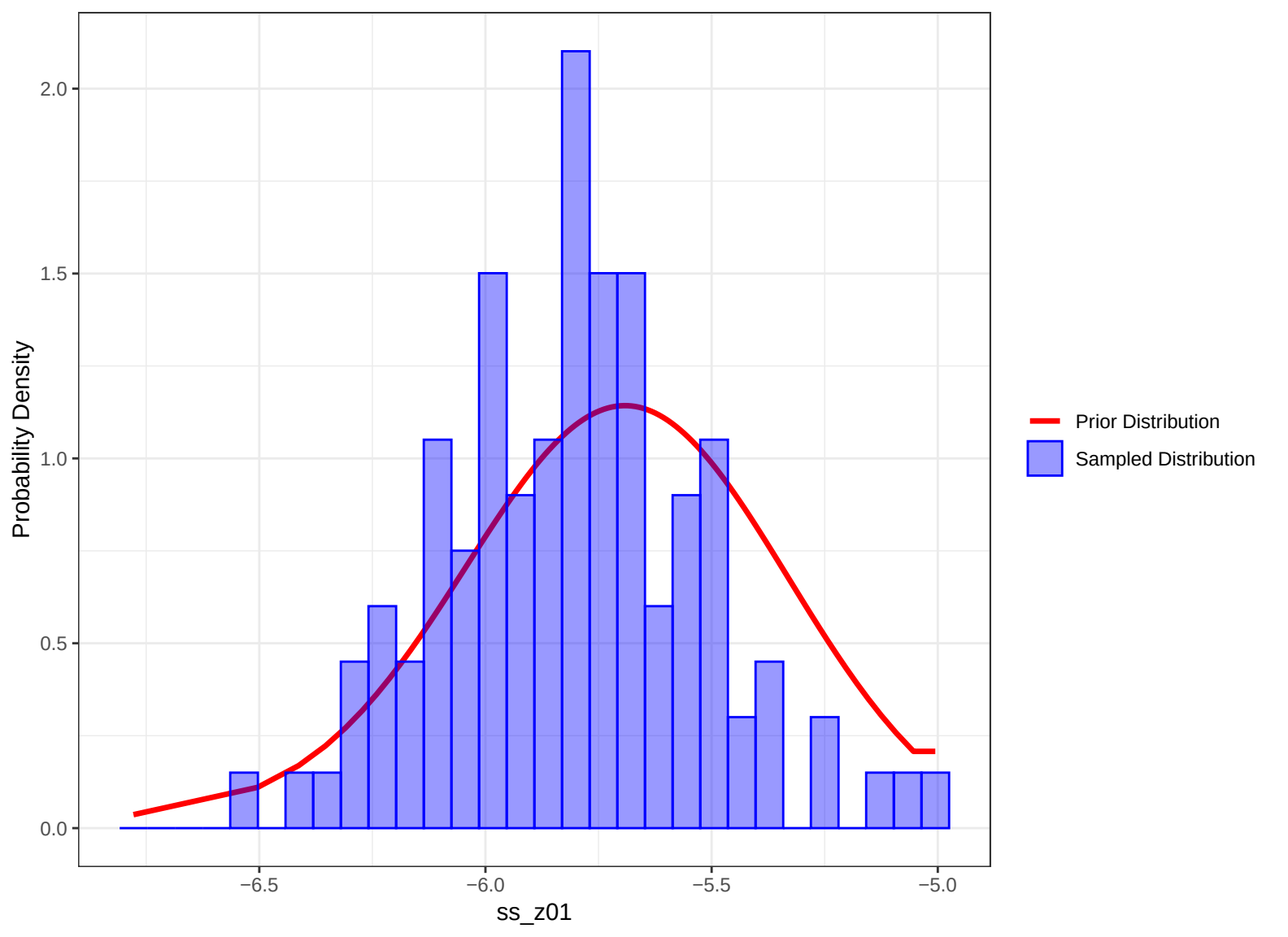

Probability Density
2.0
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z24
Prior Distribution
Sampled Distribution

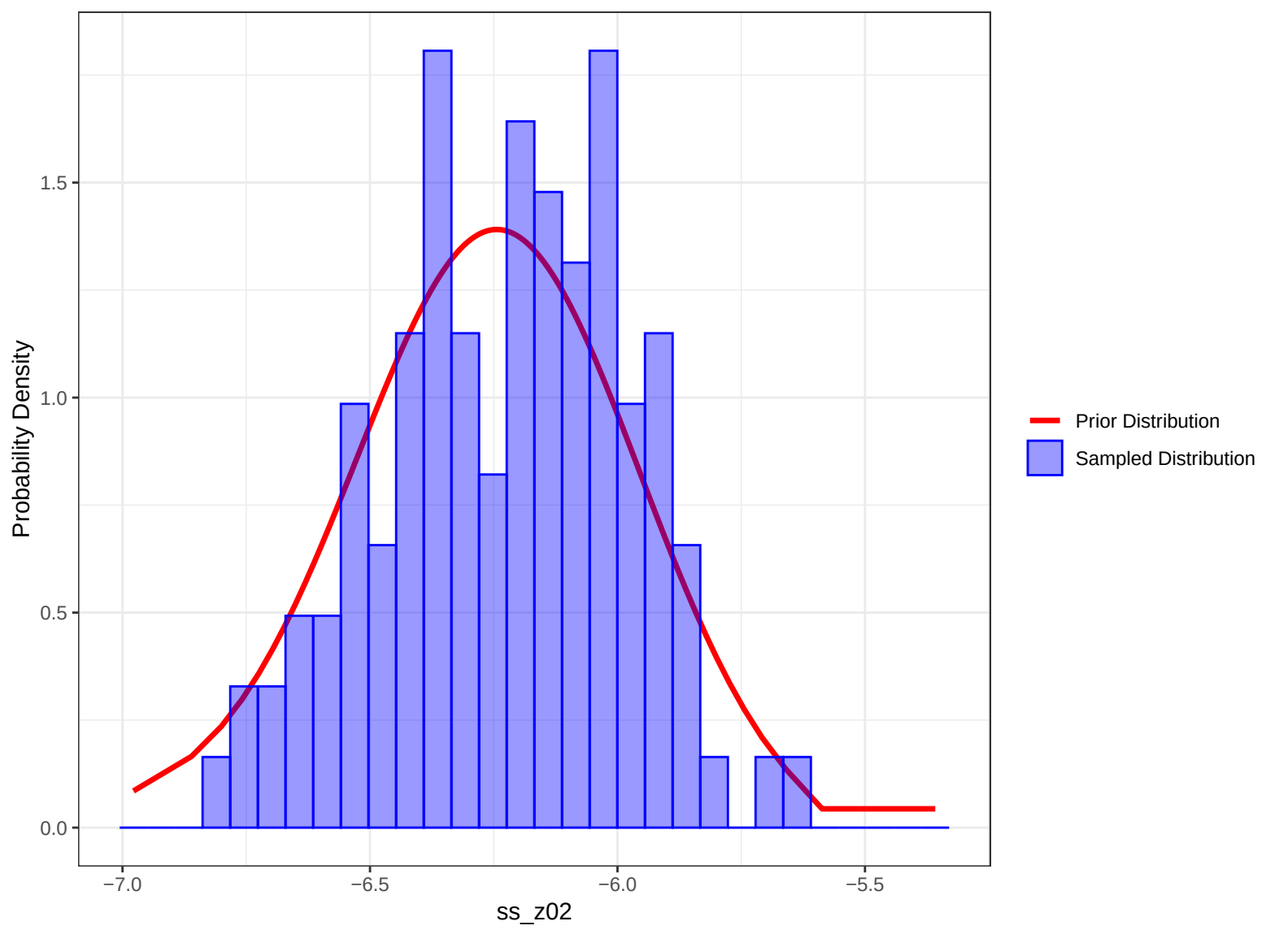

Probability Density
1.0
0.5
0.0
−4
−3
−2
sy_z26
Prior Distribution
Sampled Distribution

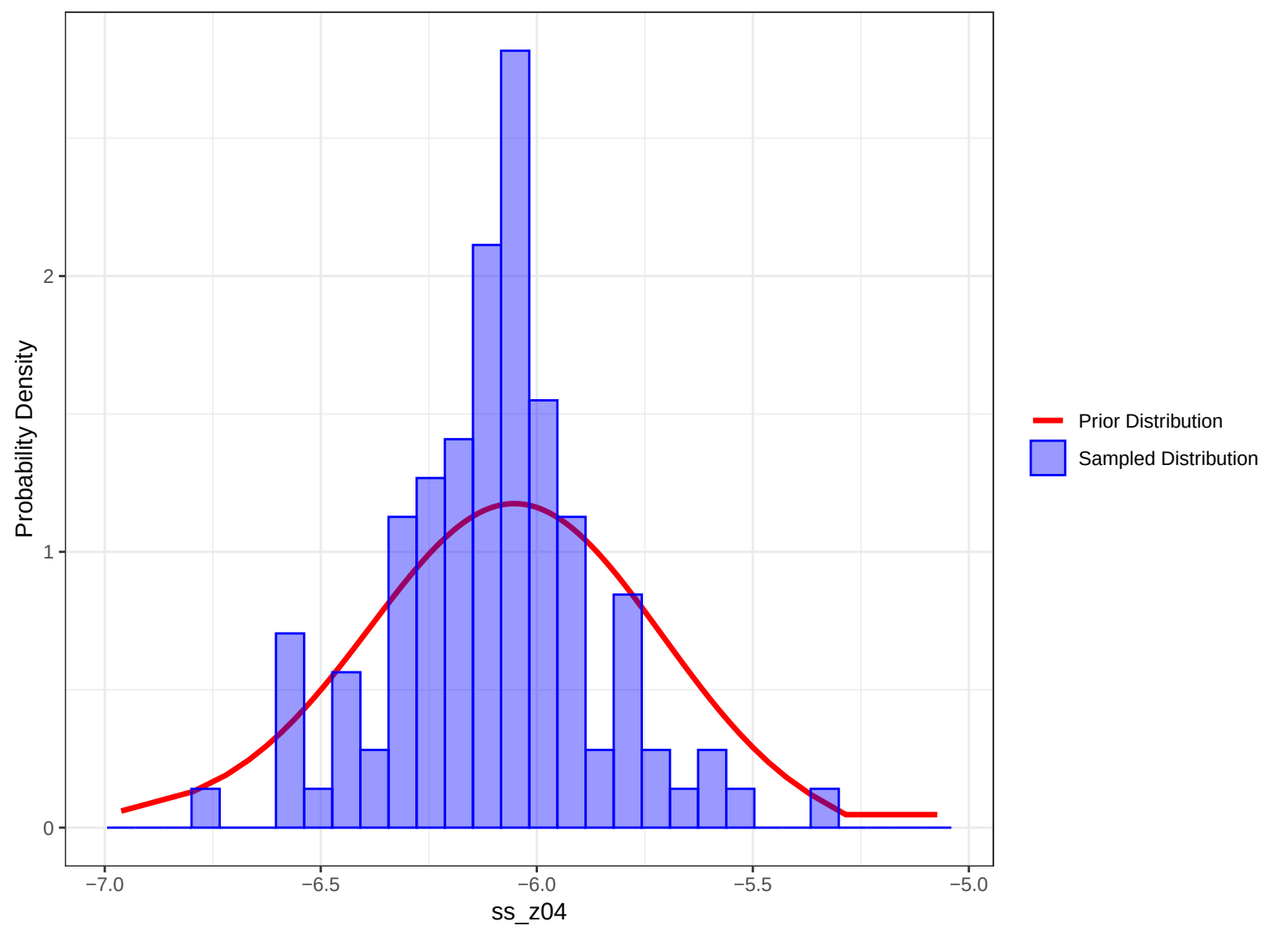

Probability Density
1.5
1.0
0.5
0.0
−4
−3
−2
sy_z27
Prior Distribution
Sampled Distribution

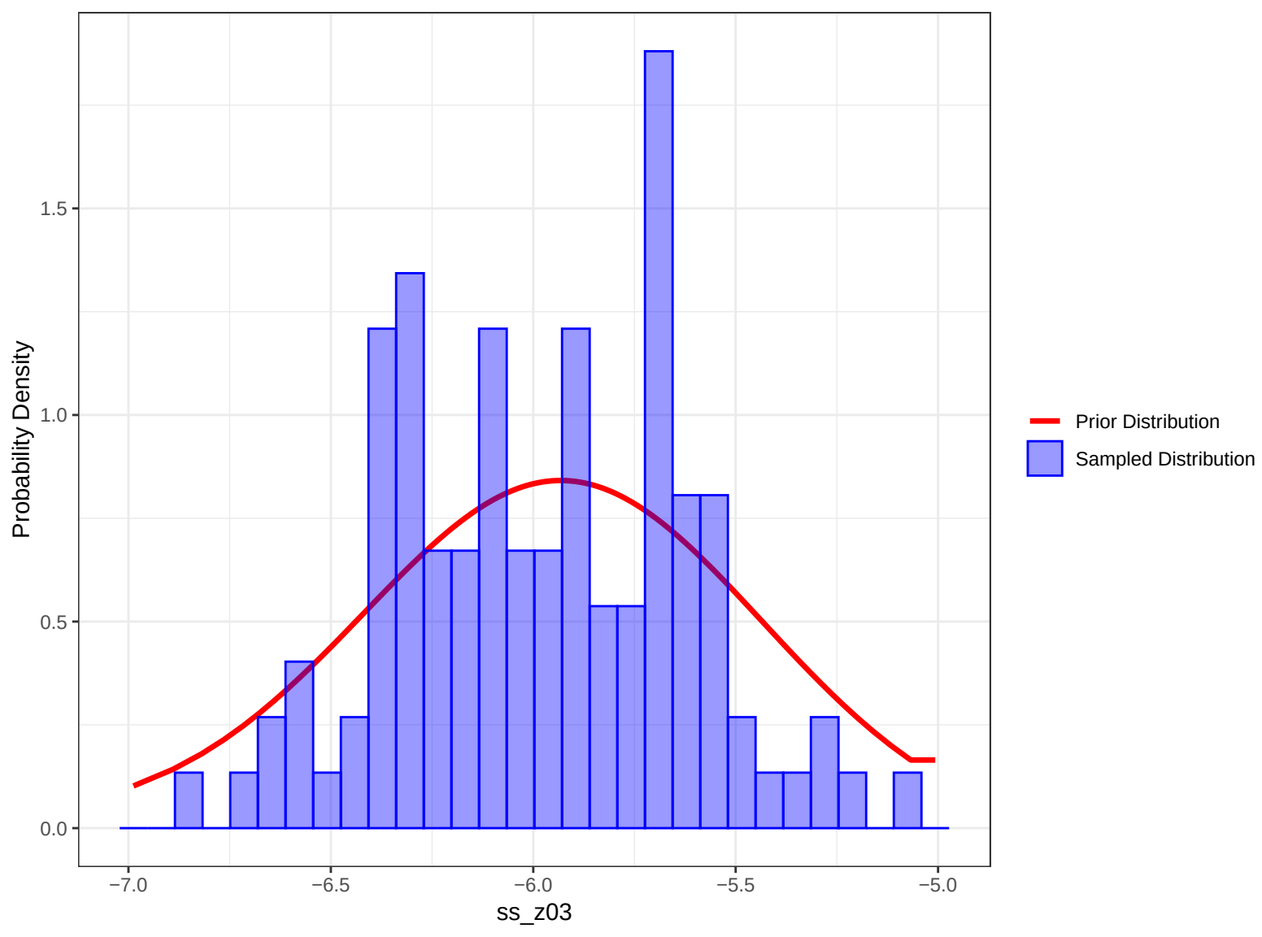

Probability Density
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
sy_z69
Prior Distribution
Sampled Distribution

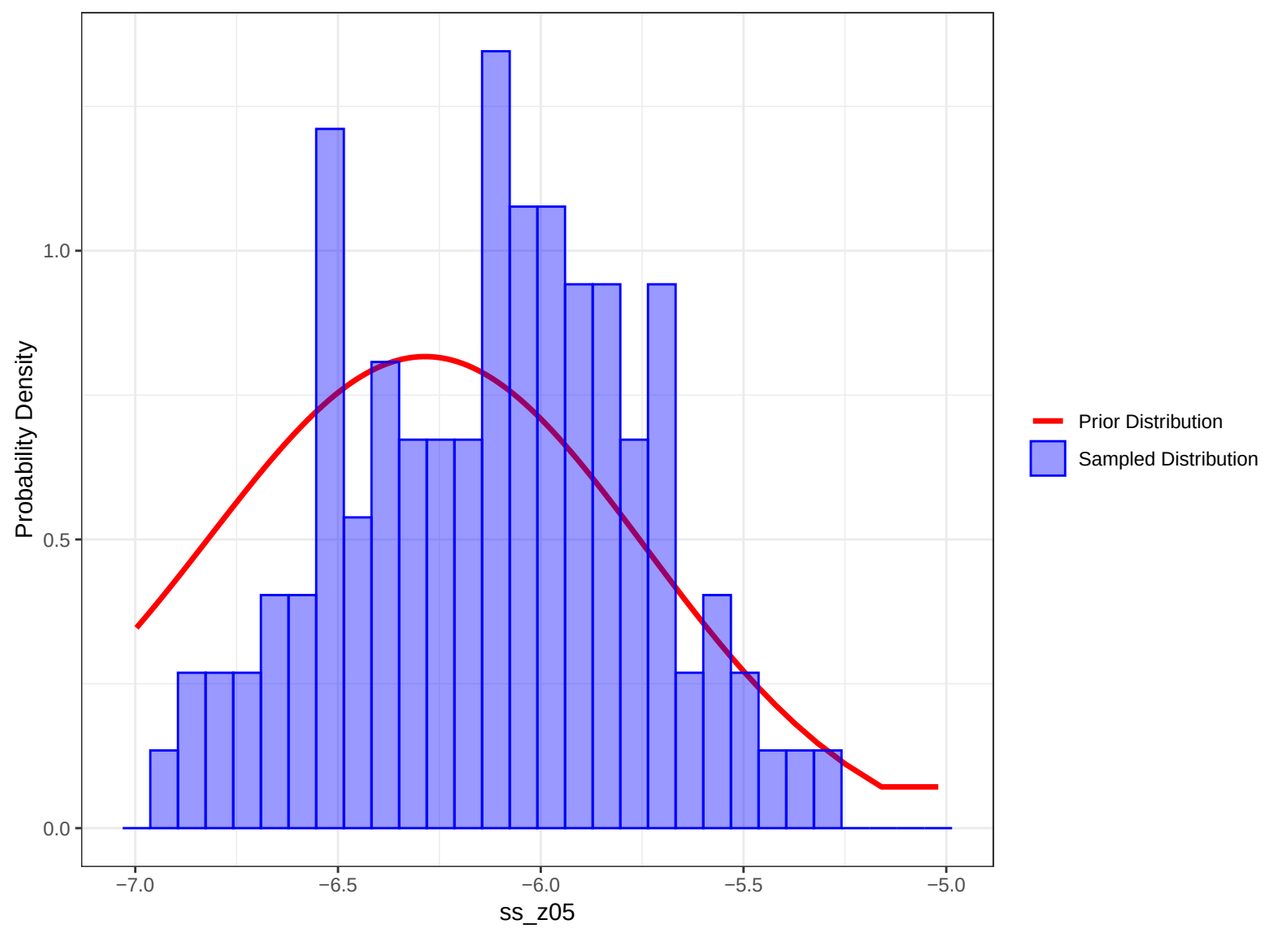

Probability Density
2.5
2.0
1.5
1.0
0.5
0.0
−3.5
−3.0
−2.5
−2.0
sy_z28
Prior Distribution
Sampled Distribution

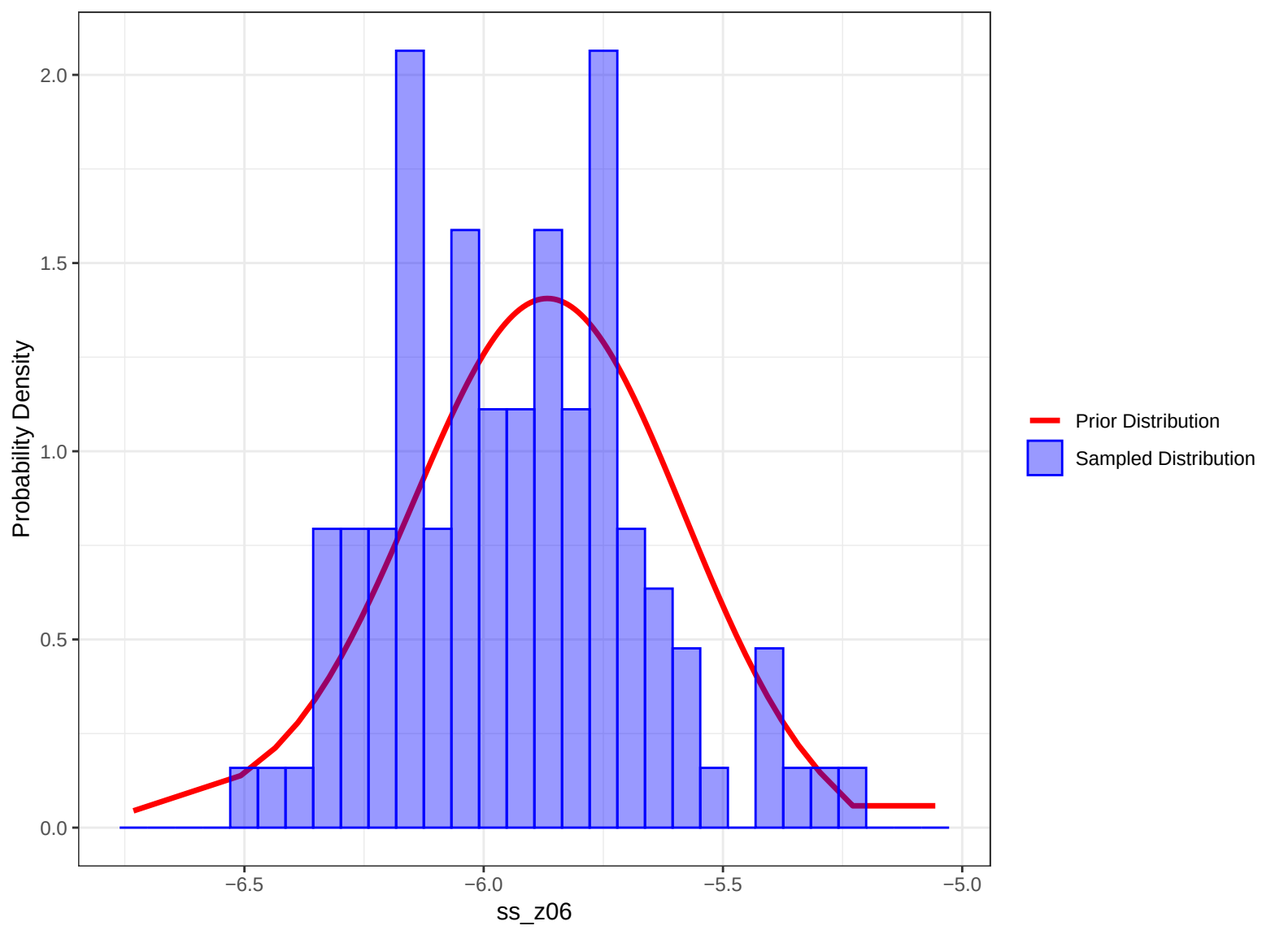

Probability Density
2.0
1.5
1.0
0.5
0.0
−6.5
−6.0
−5.5
−5.0
ss_z01
Prior Distribution
Sampled Distribution

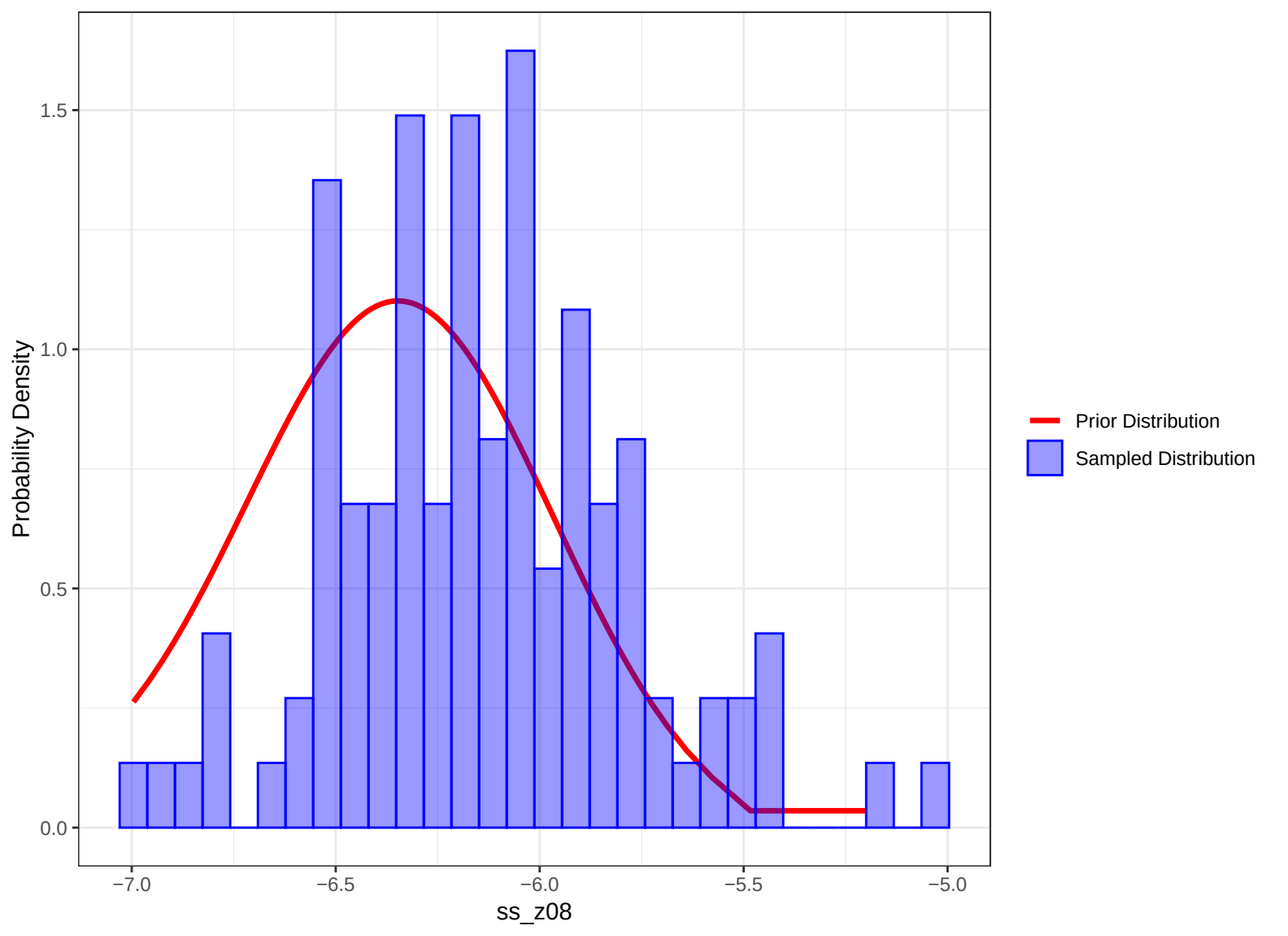

Probability Density
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z02
Prior Distribution
Sampled Distribution

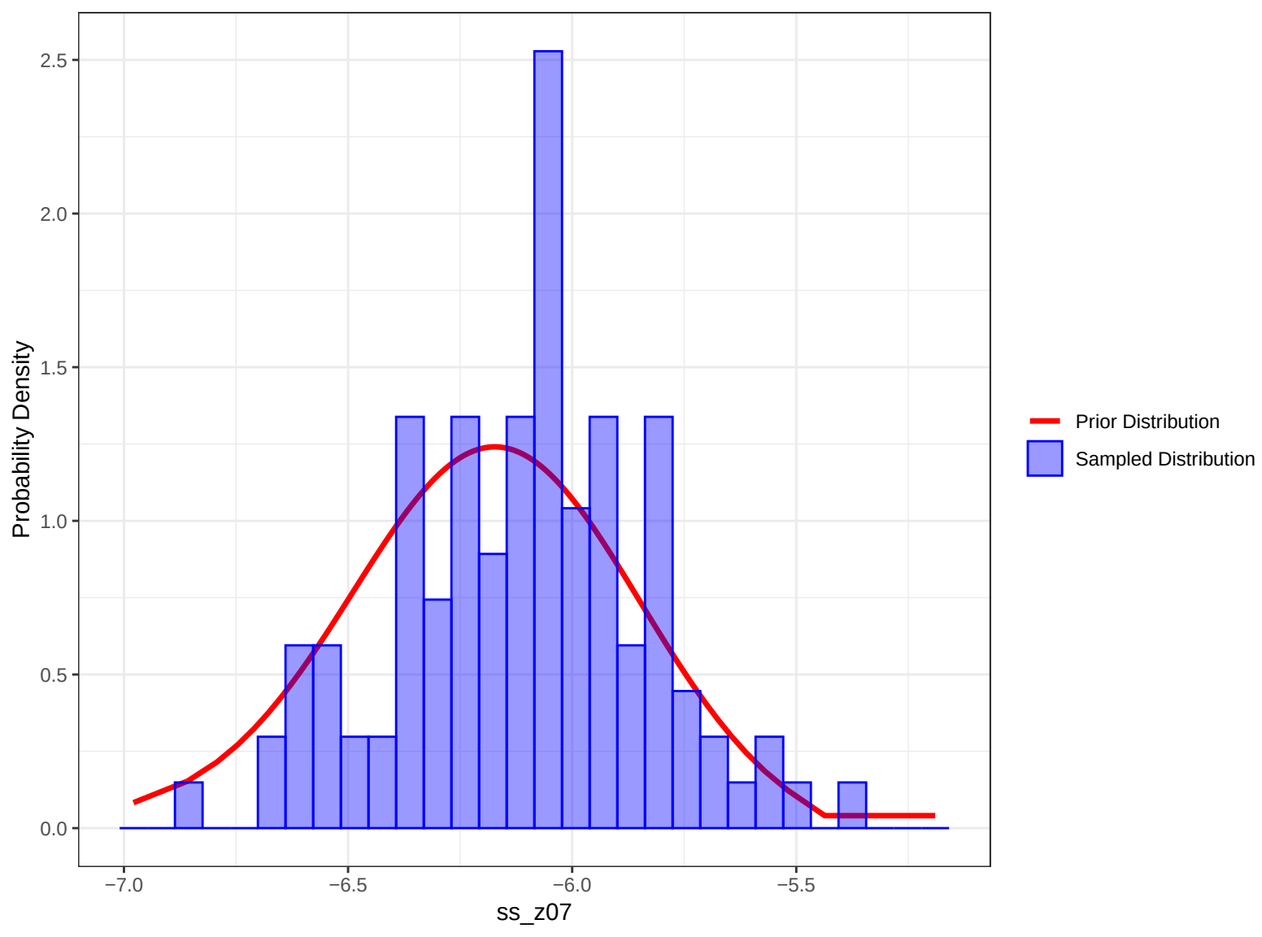

Probability Density
2
1
0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z04
Prior Distribution
Sampled Distribution

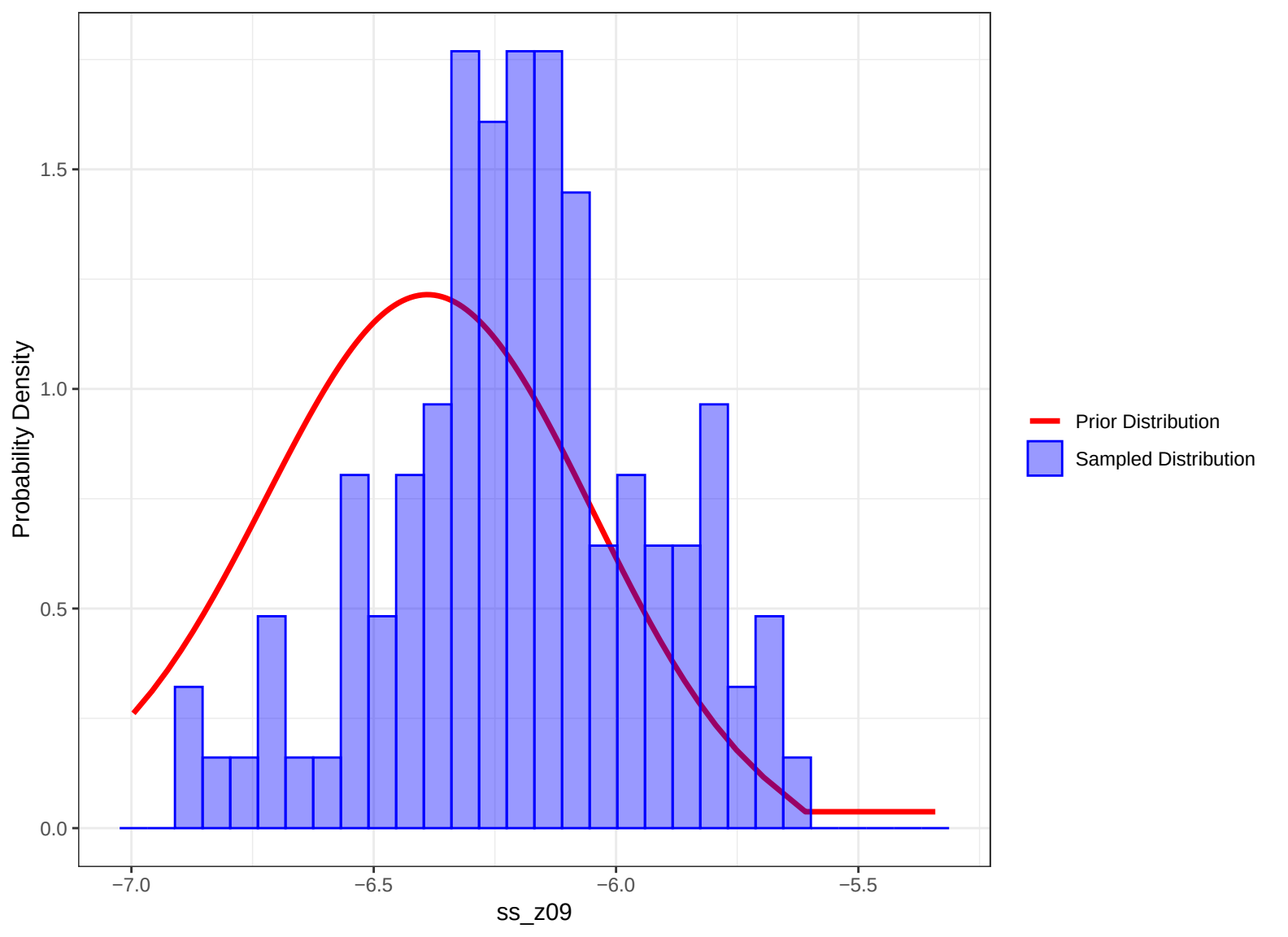

Probability Density
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z03
Prior Distribution
Sampled Distribution

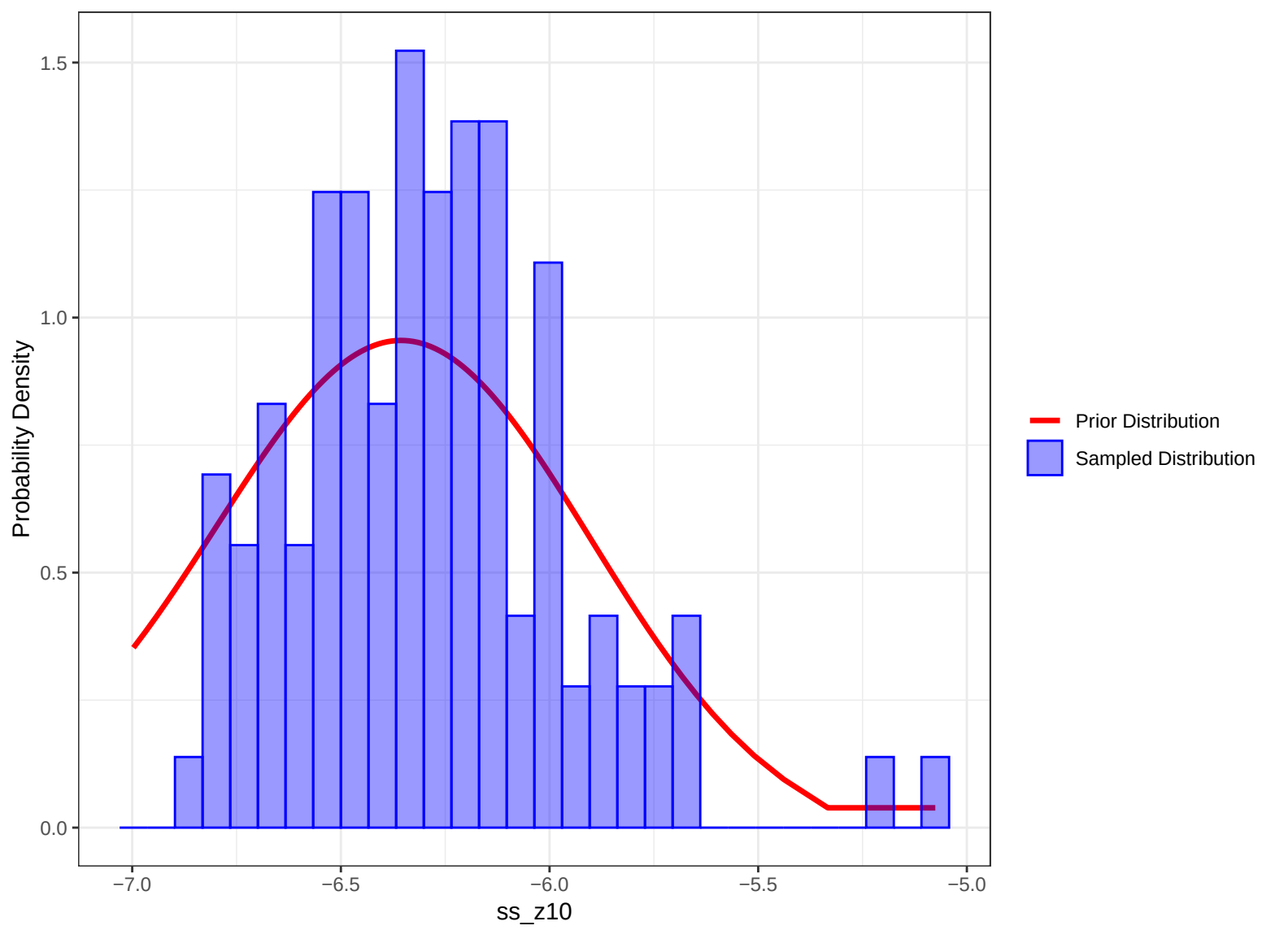

Probability Density
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z05
Prior Distribution
Sampled Distribution

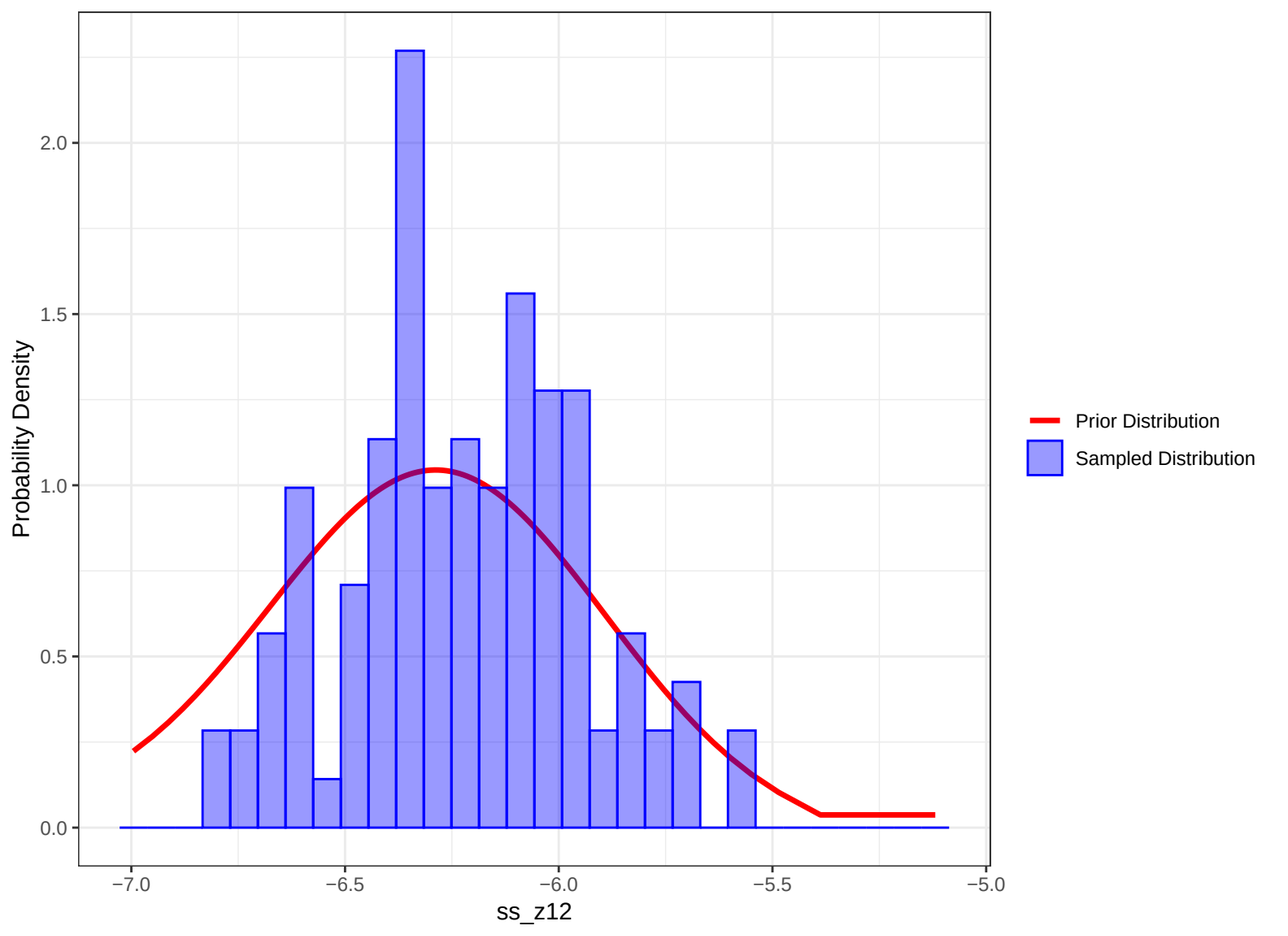

Probability Density
2.0
1.5
1.0
0.5
0.0
−6.5
−6.0
−5.5
−5.0
ss_z06
Prior Distribution
Sampled Distribution

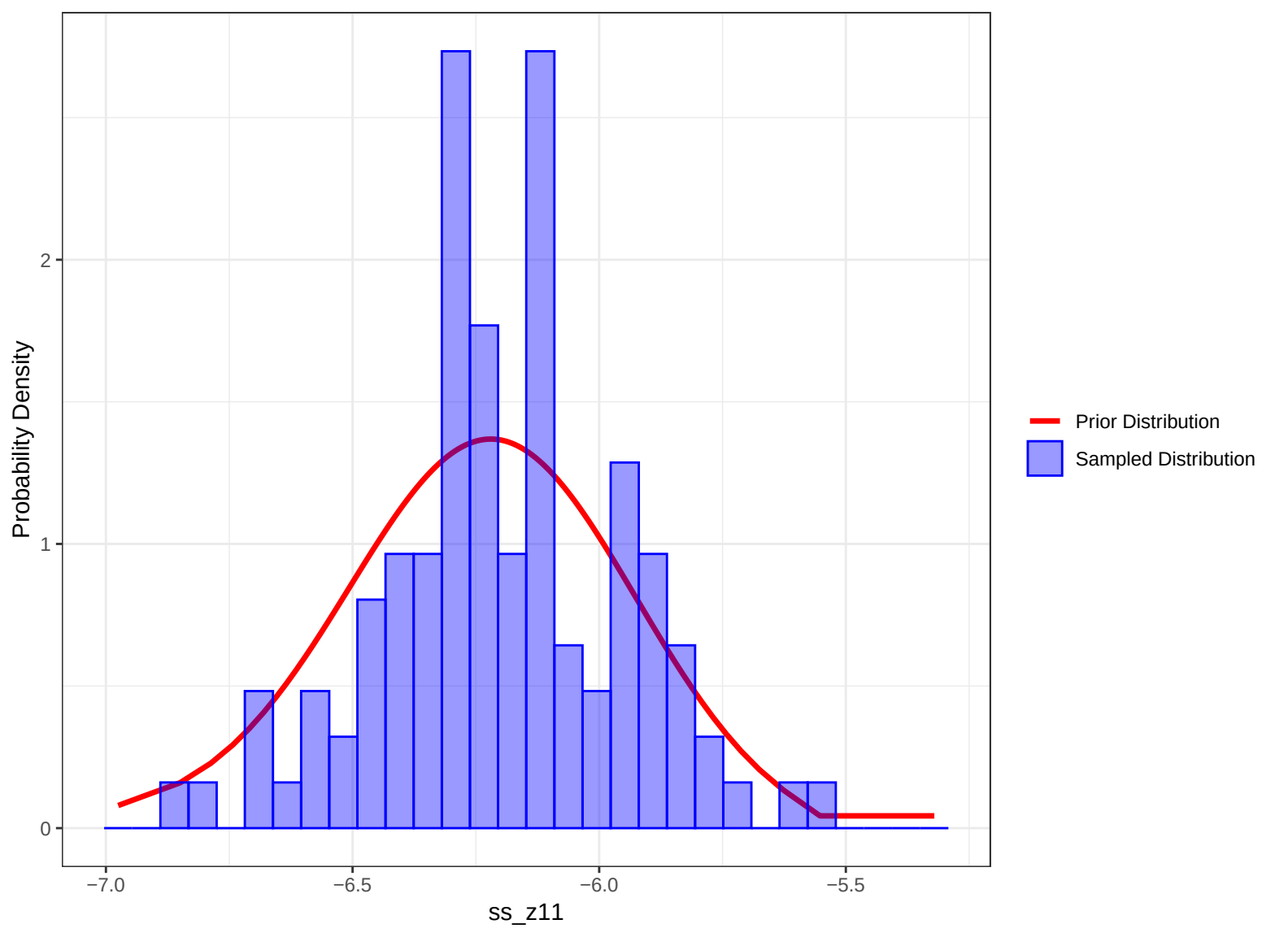

Probability Density
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z08
Prior Distribution
Sampled Distribution

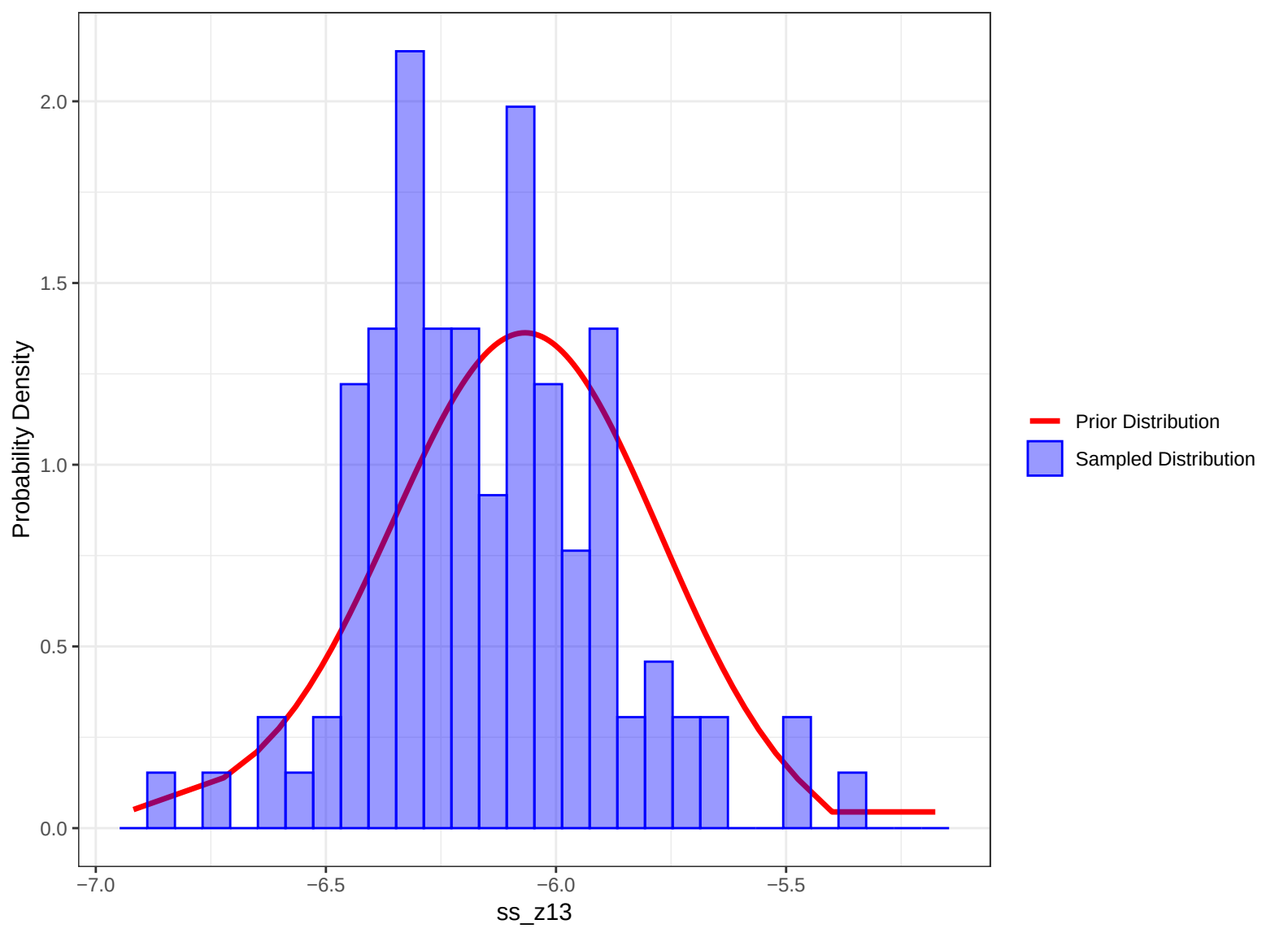

Probability Density
2.5
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z07
Prior Distribution
Sampled Distribution

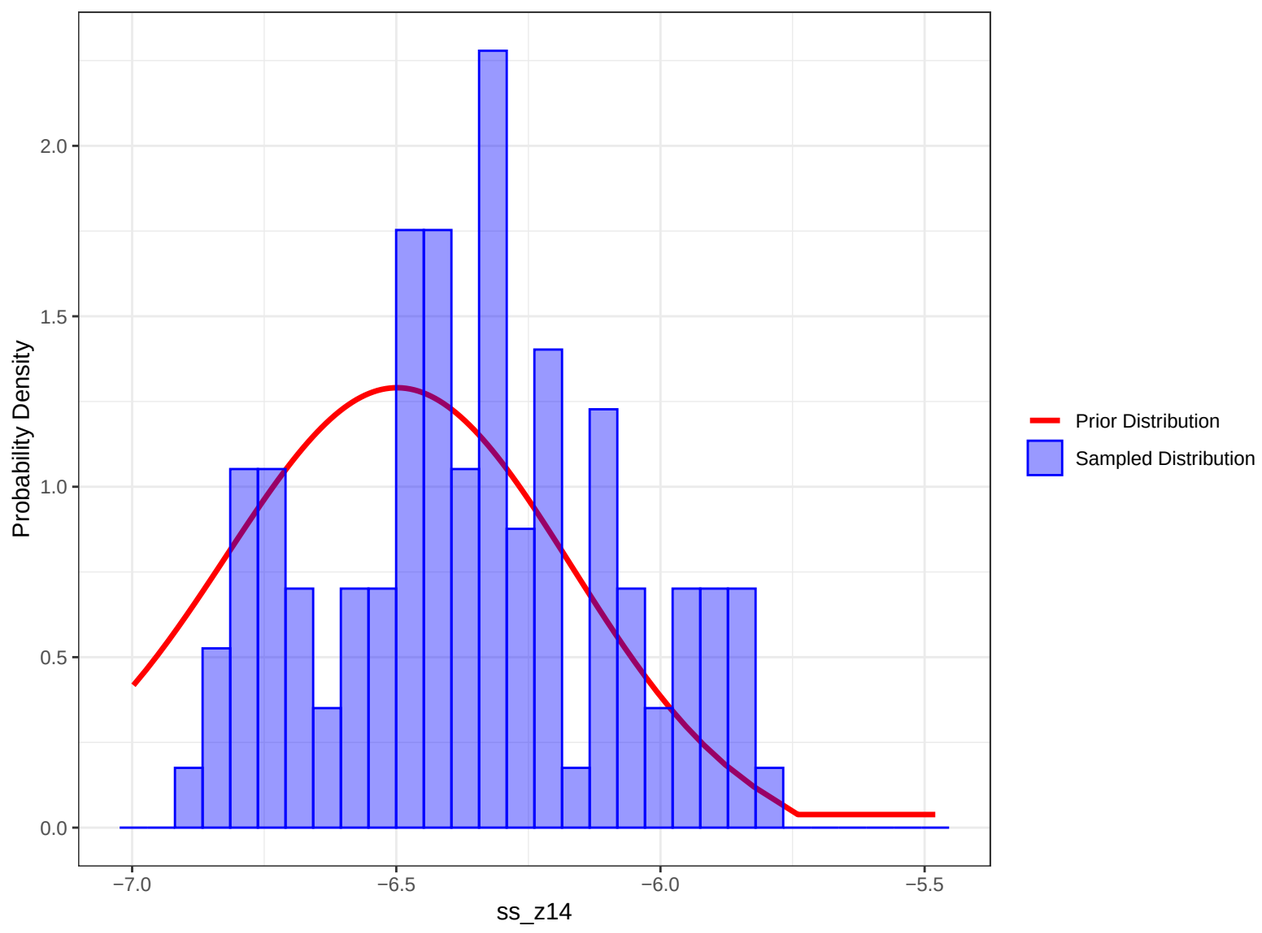

Probability Density
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z09
Prior Distribution
Sampled Distribution

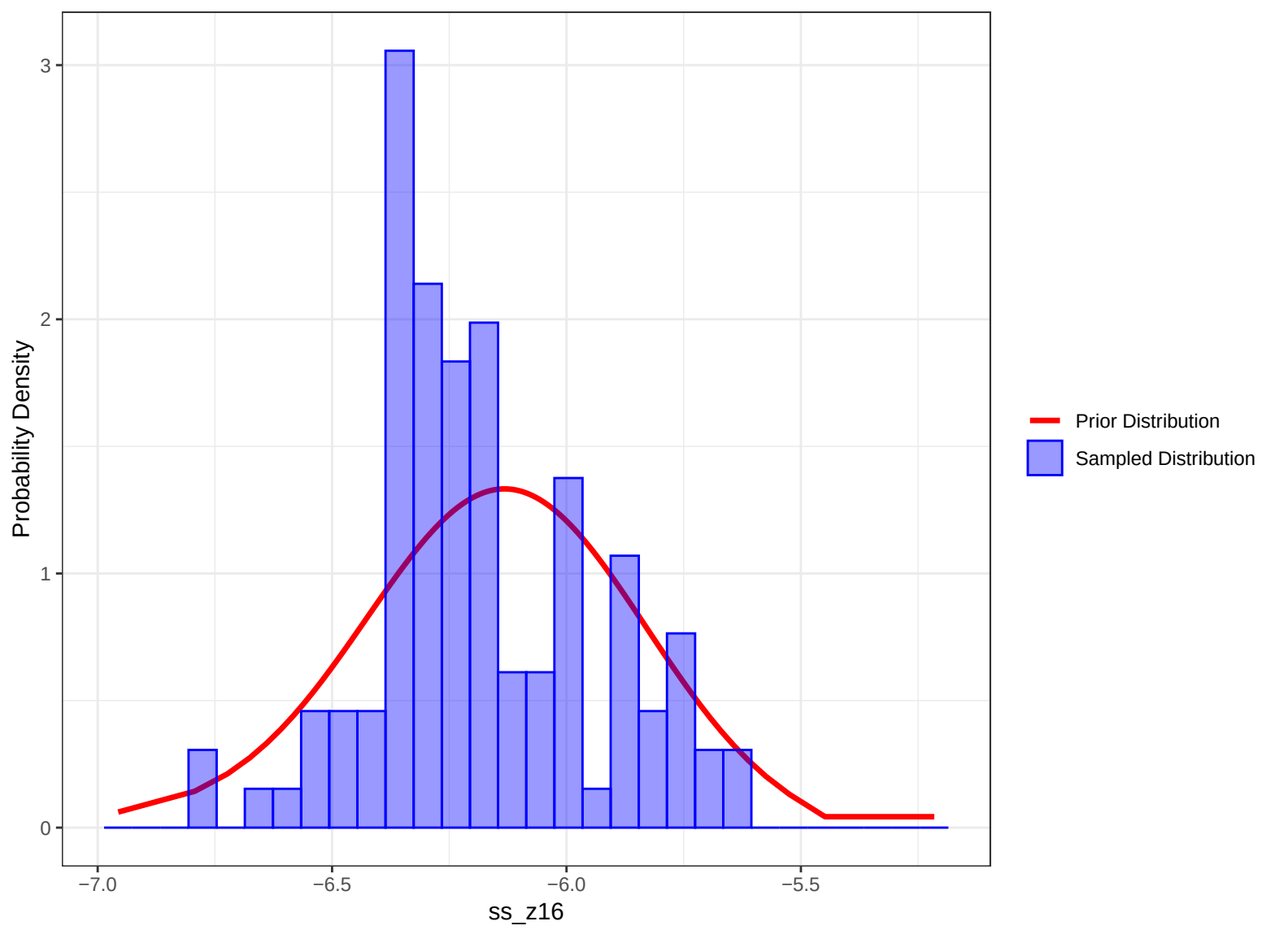

Probability Density
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z10
Prior Distribution
Sampled Distribution

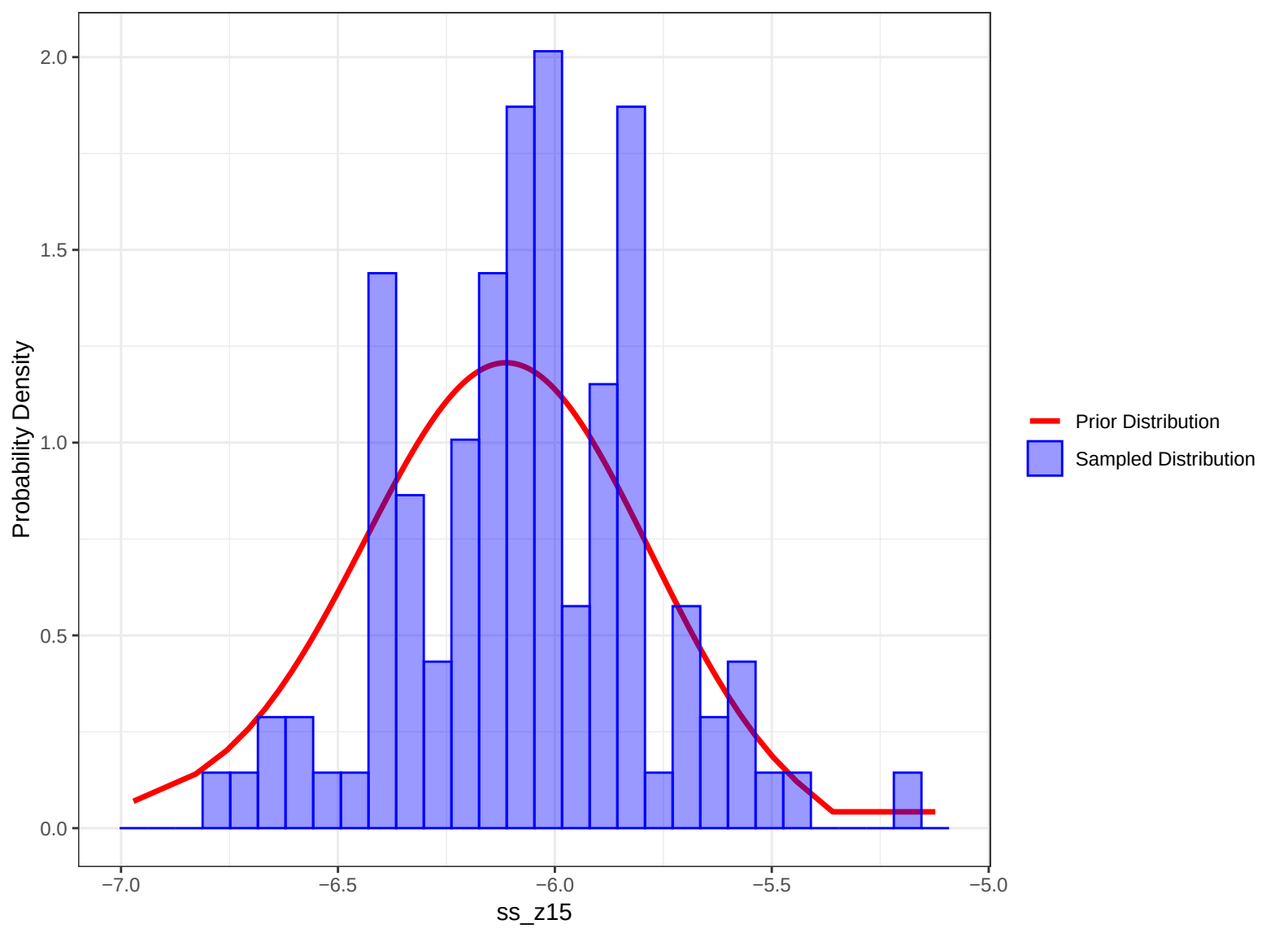

Probability Density
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z12
Prior Distribution
Sampled Distribution

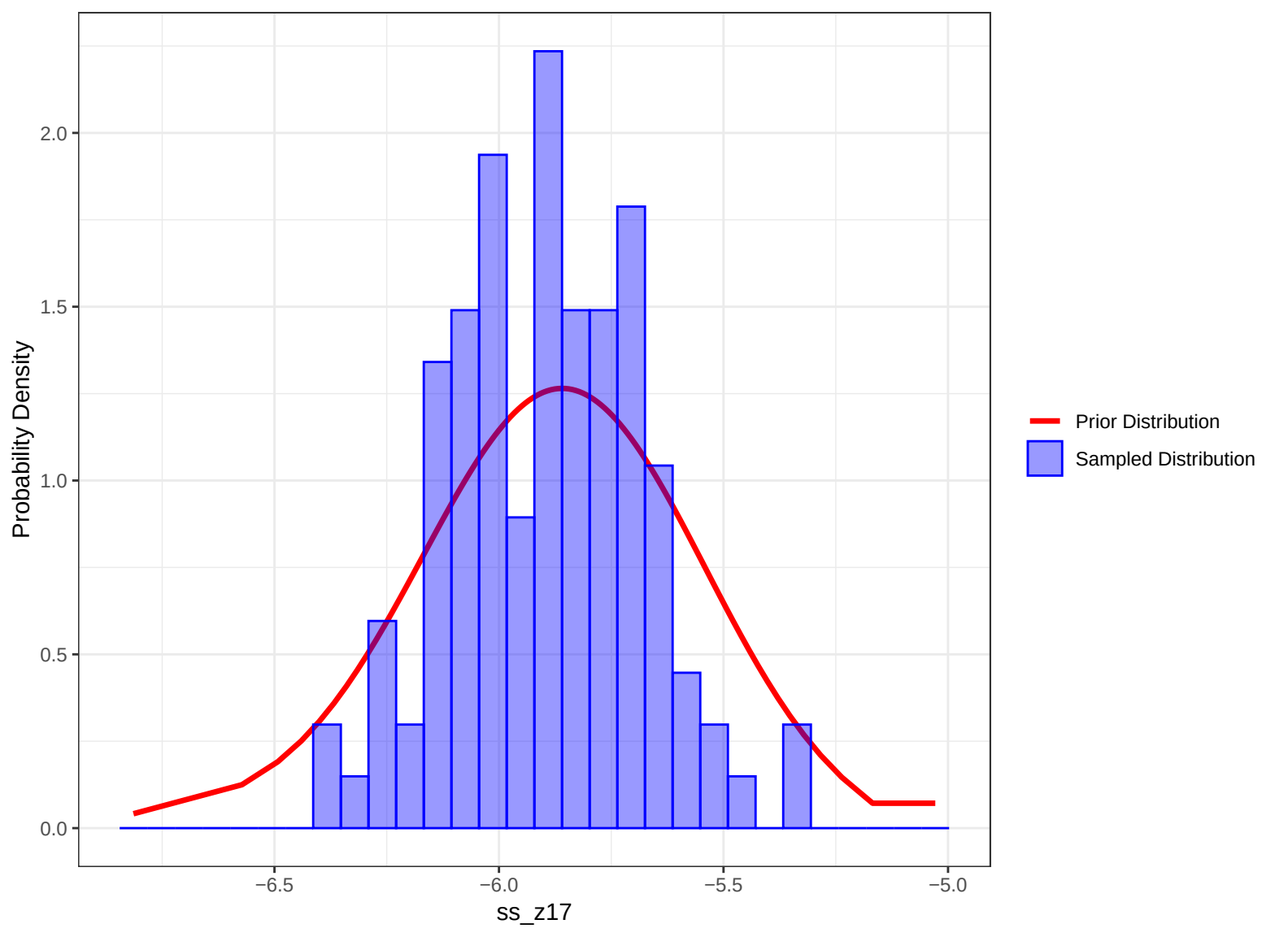

Probability Density
2
1
0
−7.0
−6.5
−6.0
−5.5
ss_z11
Prior Distribution
Sampled Distribution

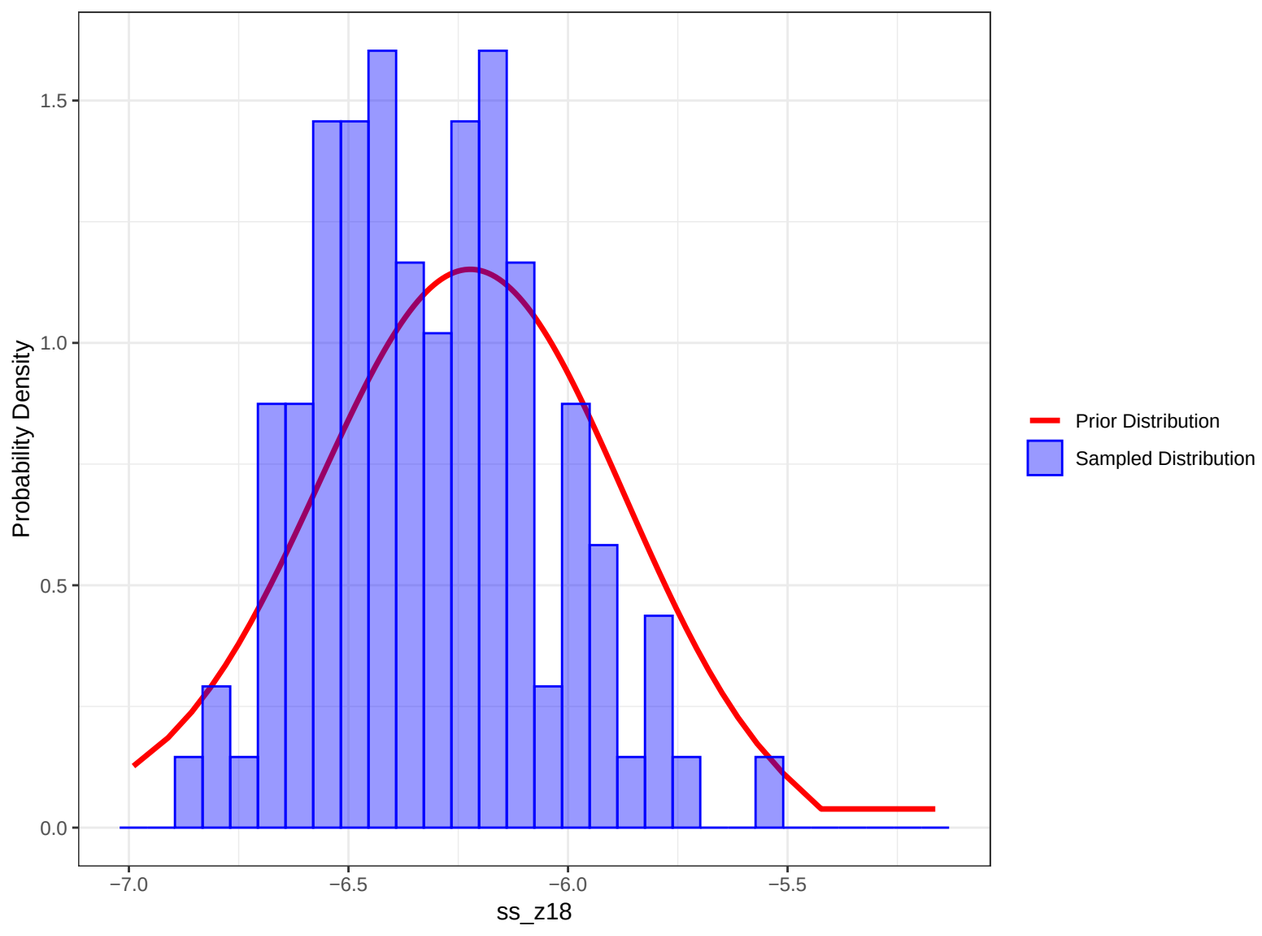

Probability Density
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z13
Prior Distribution
Sampled Distribution

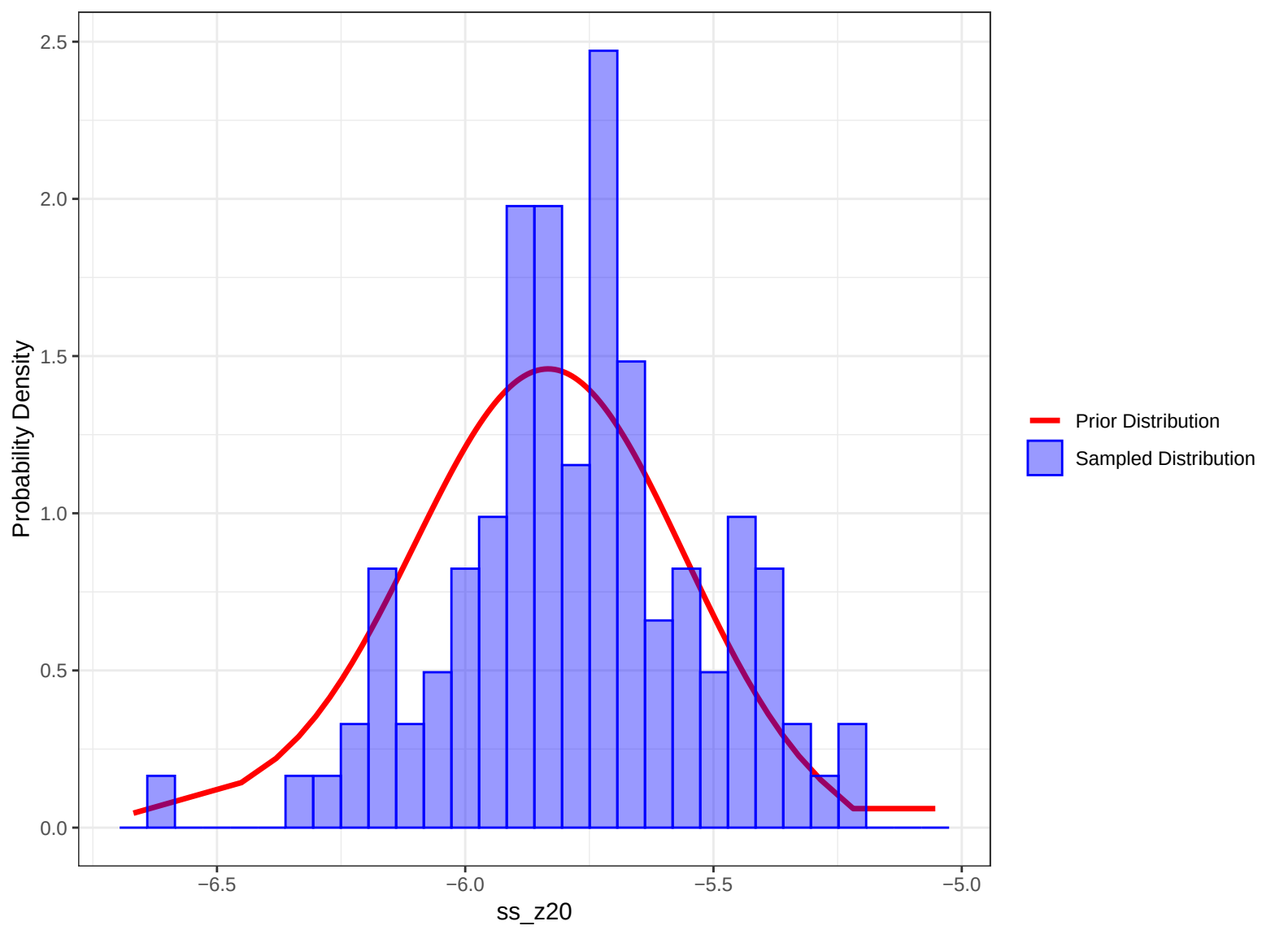

Probability Density
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z14
Prior Distribution
Sampled Distribution

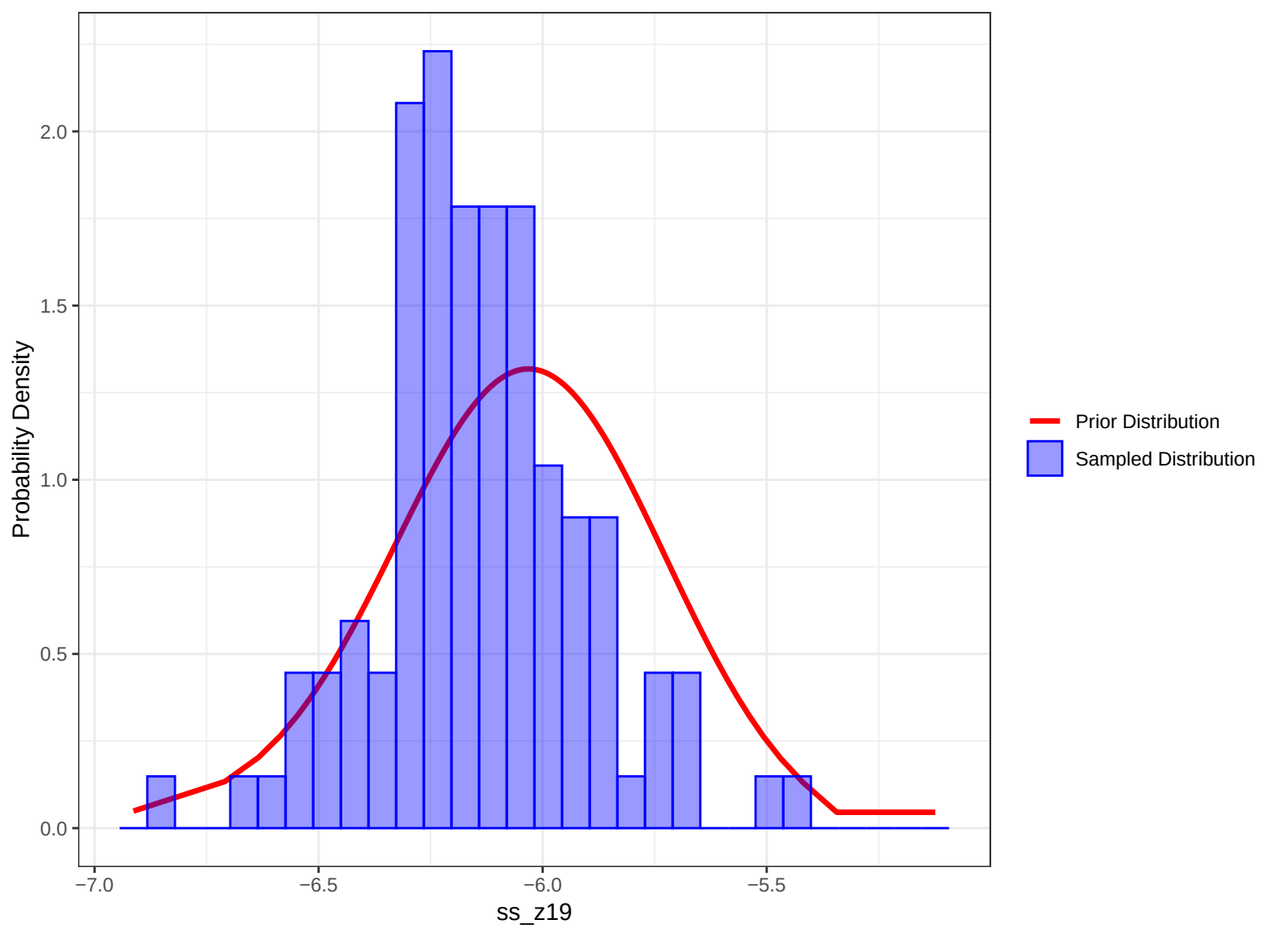

Probability Density
3
2
1
0
−7.0
−6.5
−6.0
−5.5
ss_z16
Prior Distribution
Sampled Distribution

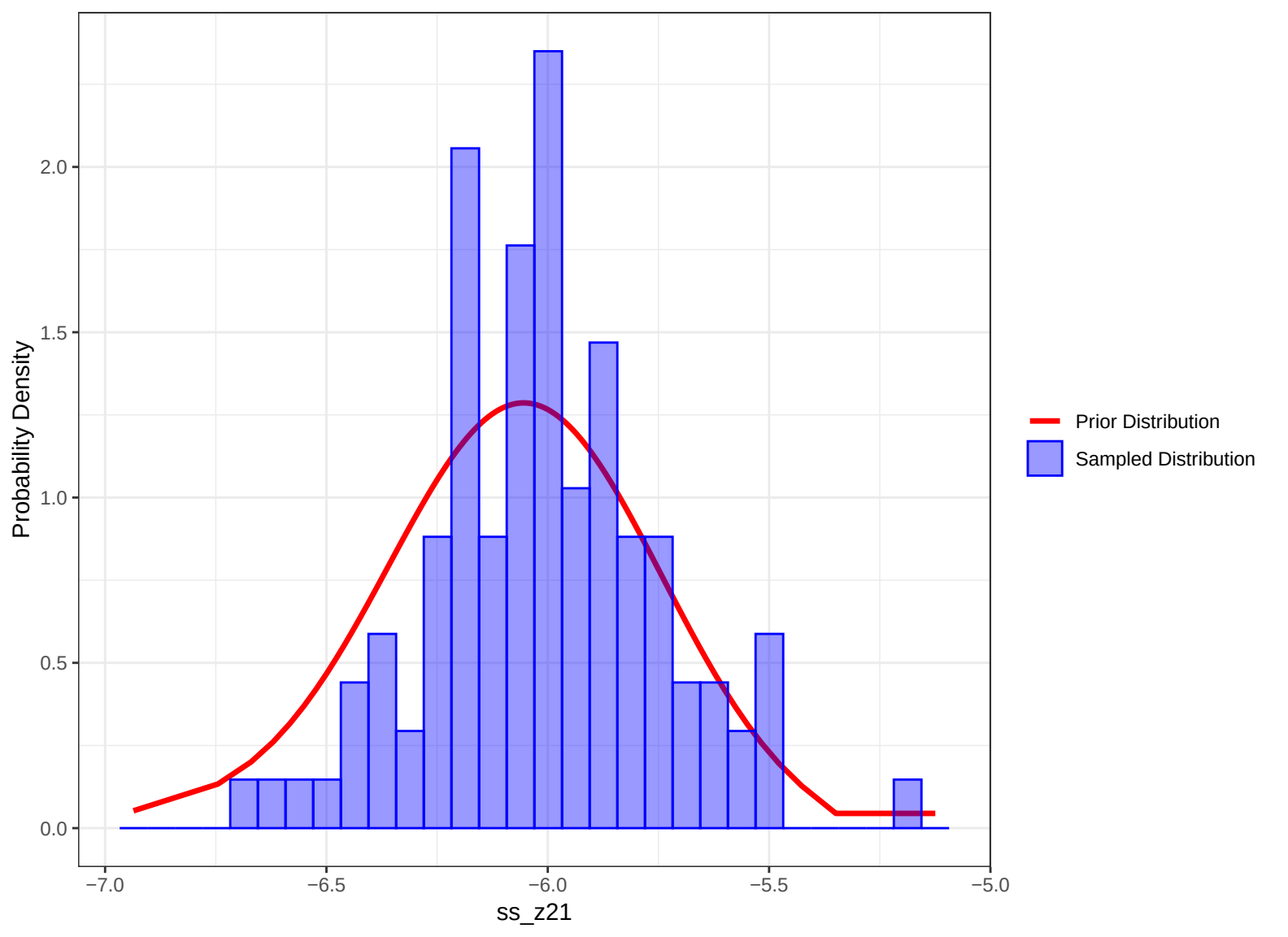

Probability Density
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z15
Prior Distribution
Sampled Distribution

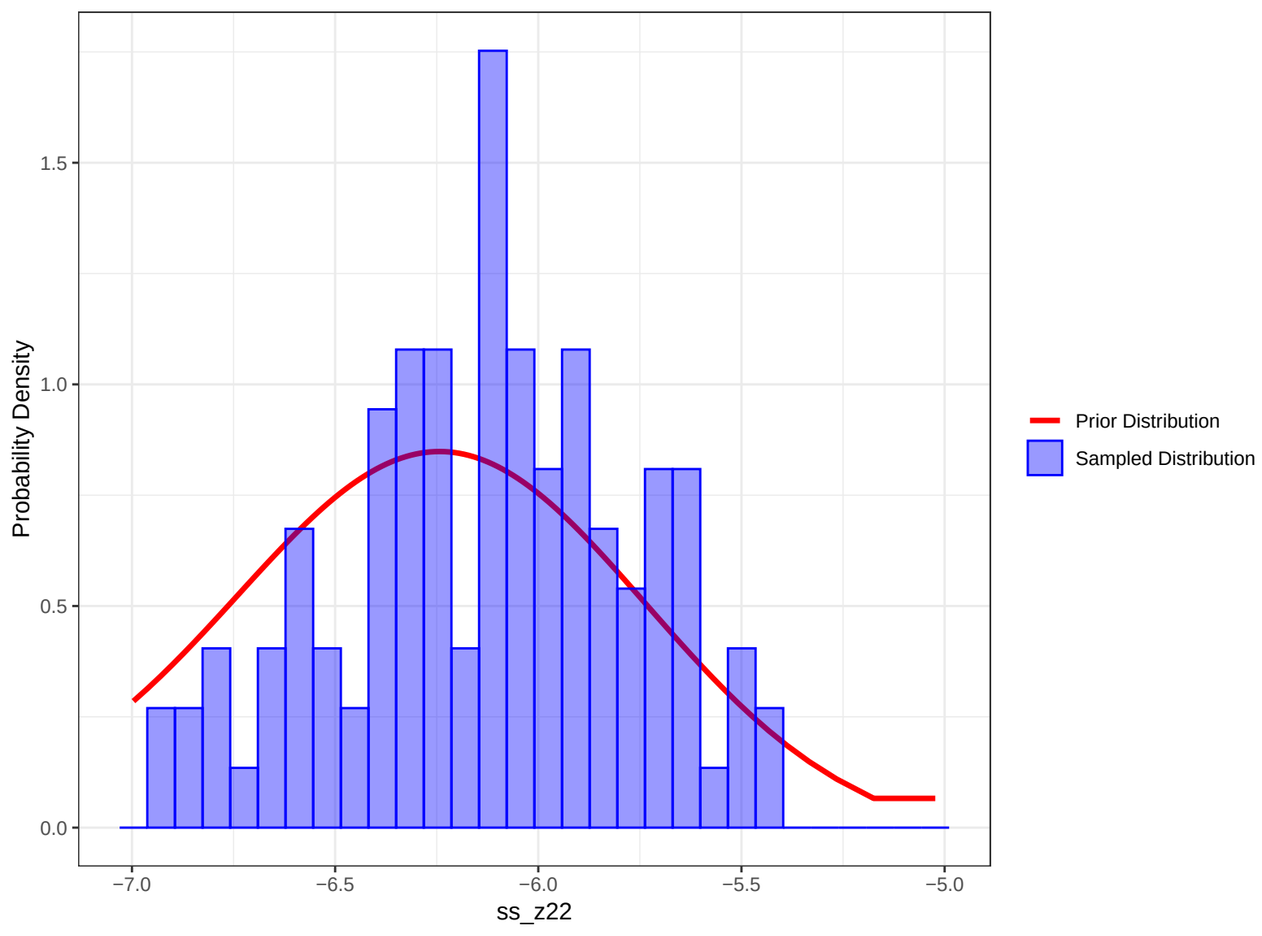

Probability Density
2.0
1.5
1.0
0.5
0.0
−6.5
−6.0
−5.5
−5.0
ss_z17
Prior Distribution
Sampled Distribution

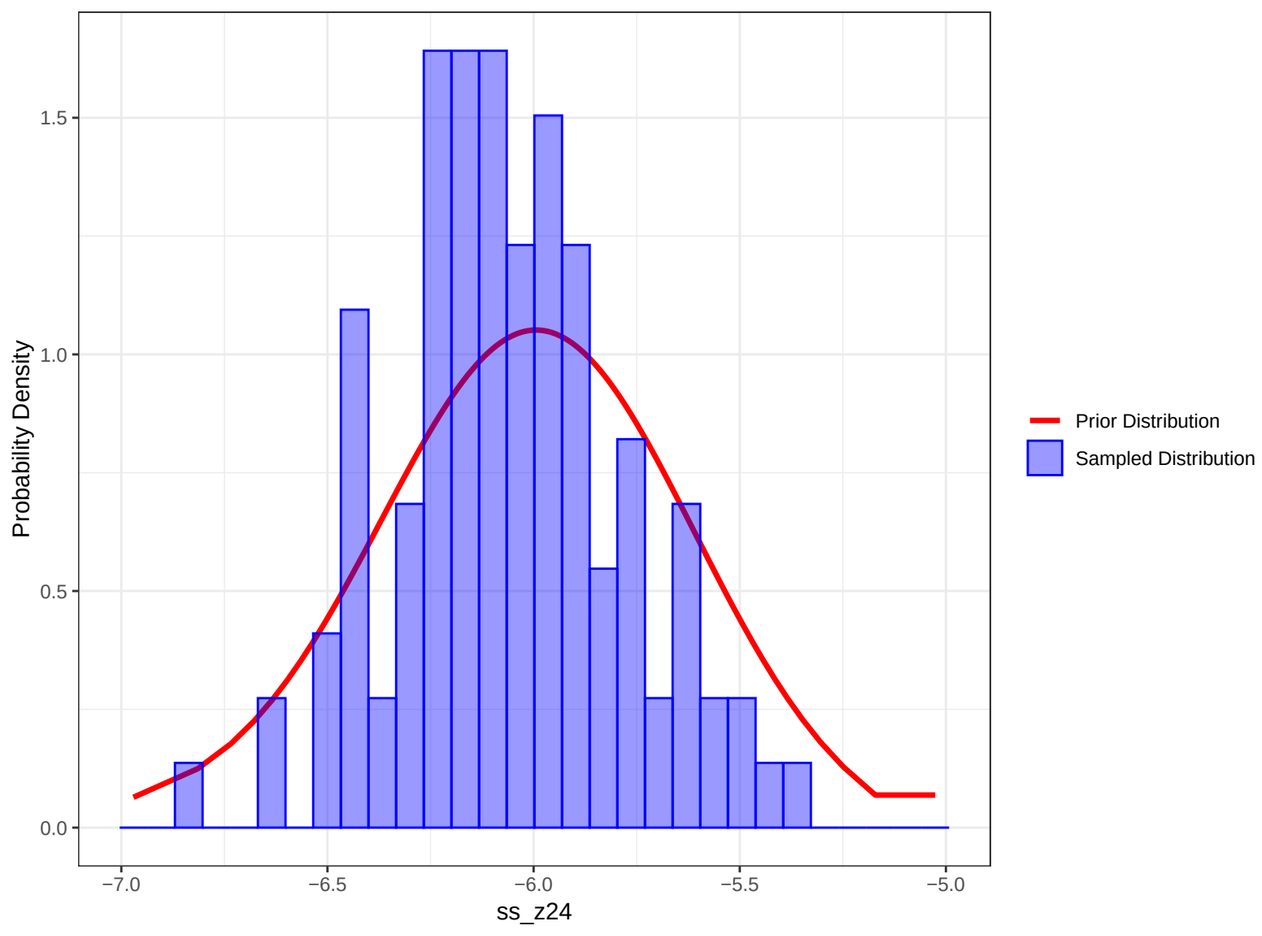

Probability Density
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z18
Prior Distribution
Sampled Distribution

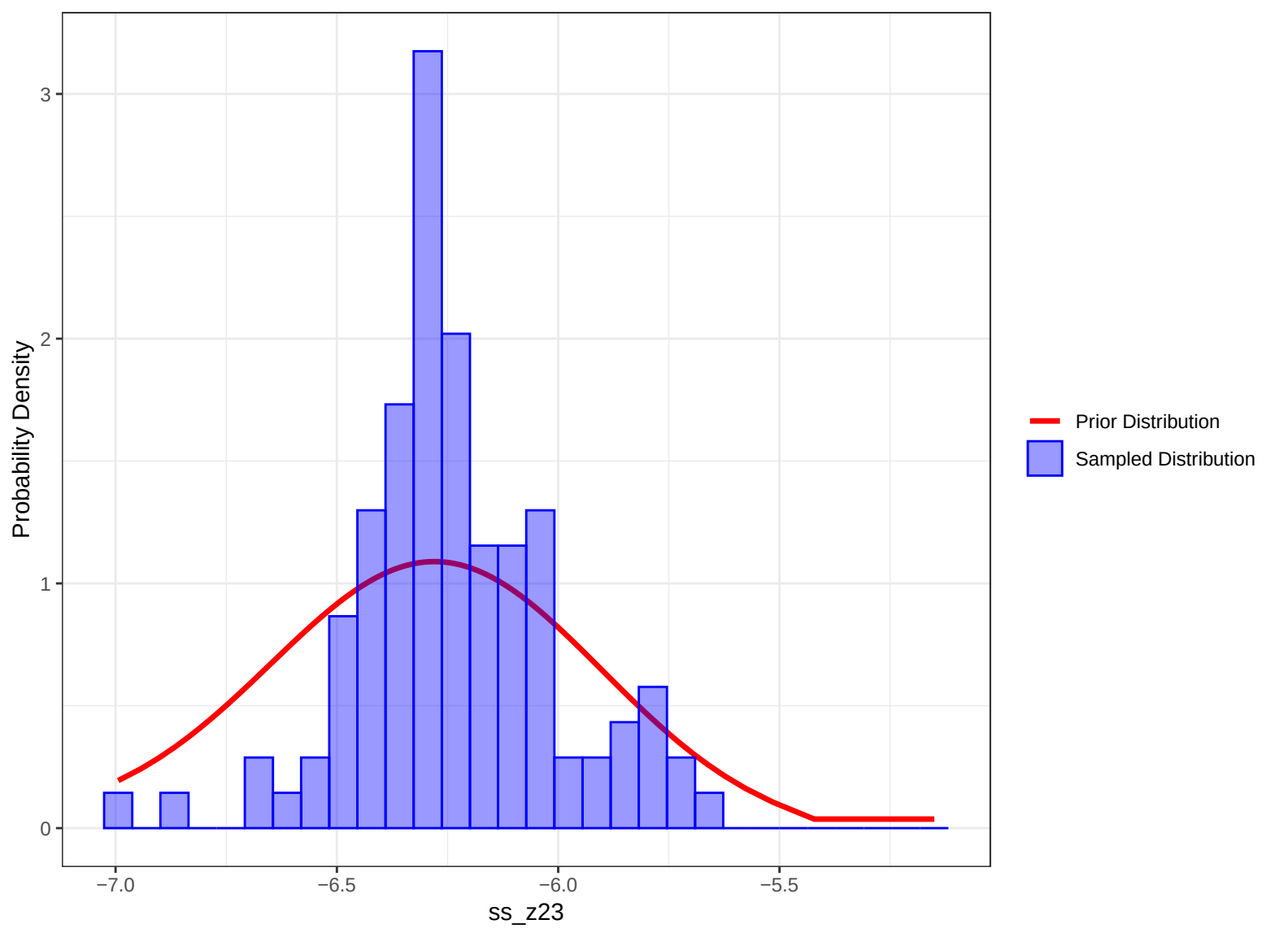

Probability Density
2.5
2.0
1.5
1.0
0.5
0.0
−6.5
−6.0
−5.5
−5.0
ss_z20
Prior Distribution
Sampled Distribution

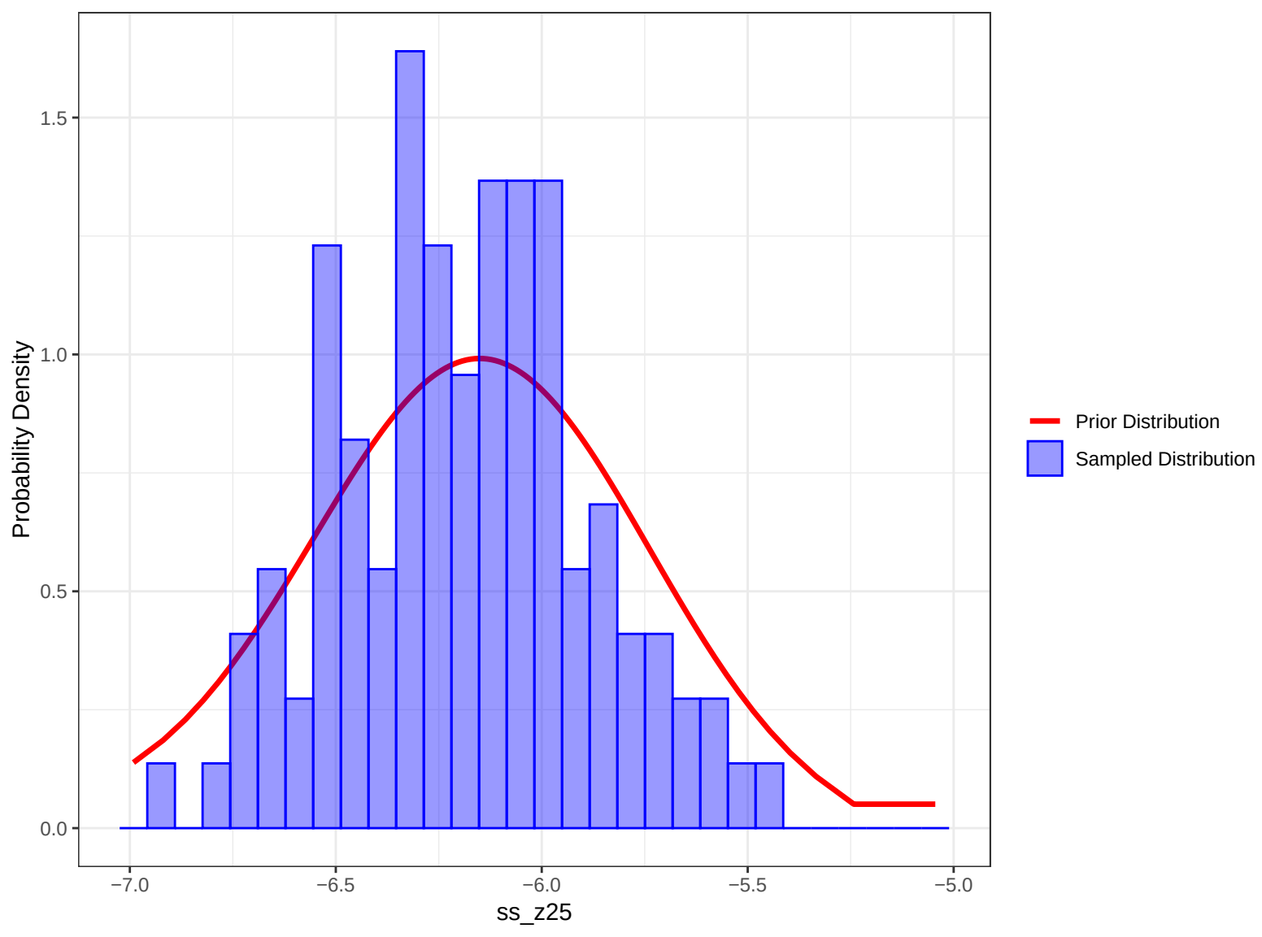

Probability Density
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z19
Prior Distribution
Sampled Distribution

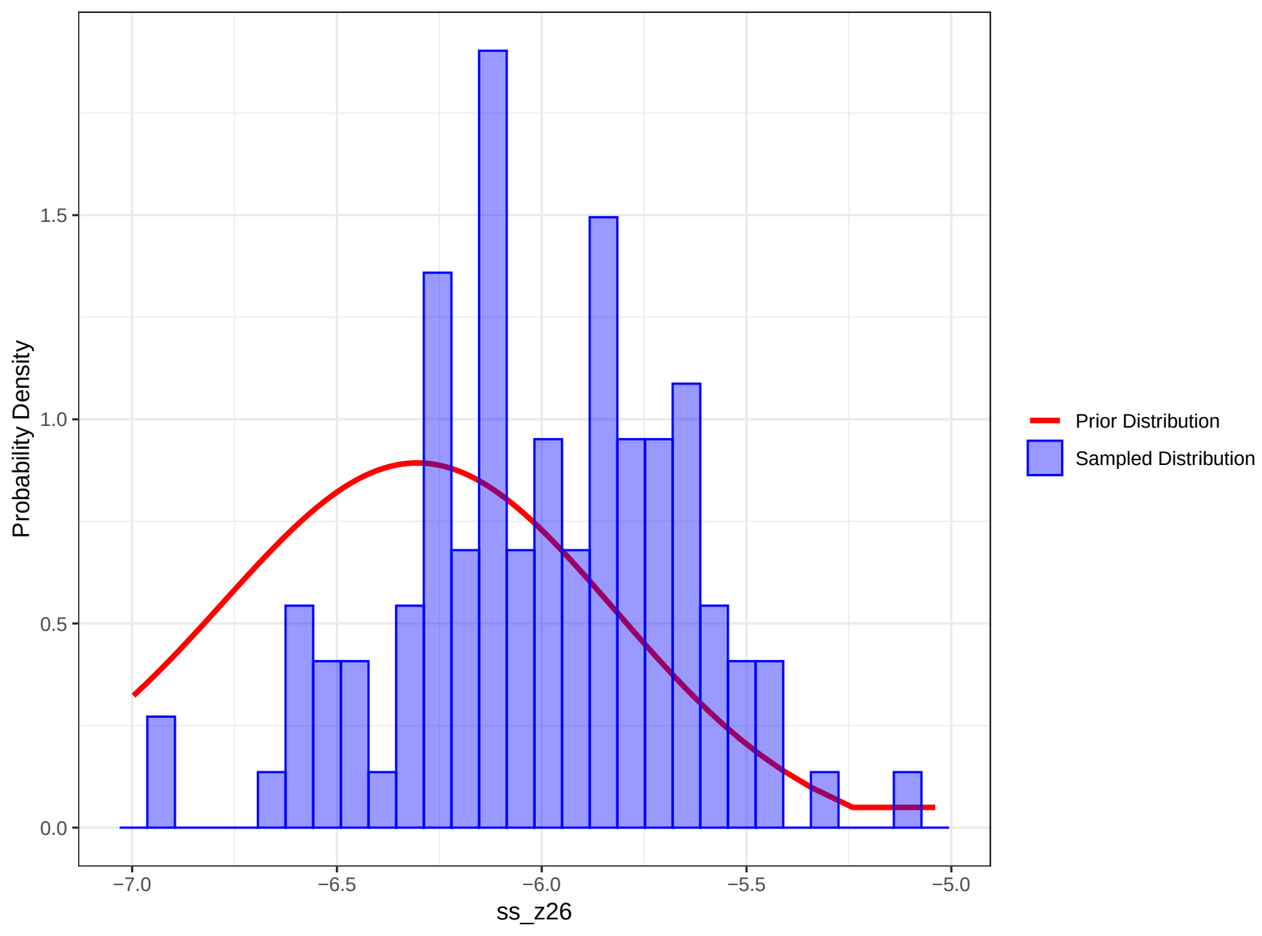

Probability Density
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z21
Prior Distribution
Sampled Distribution

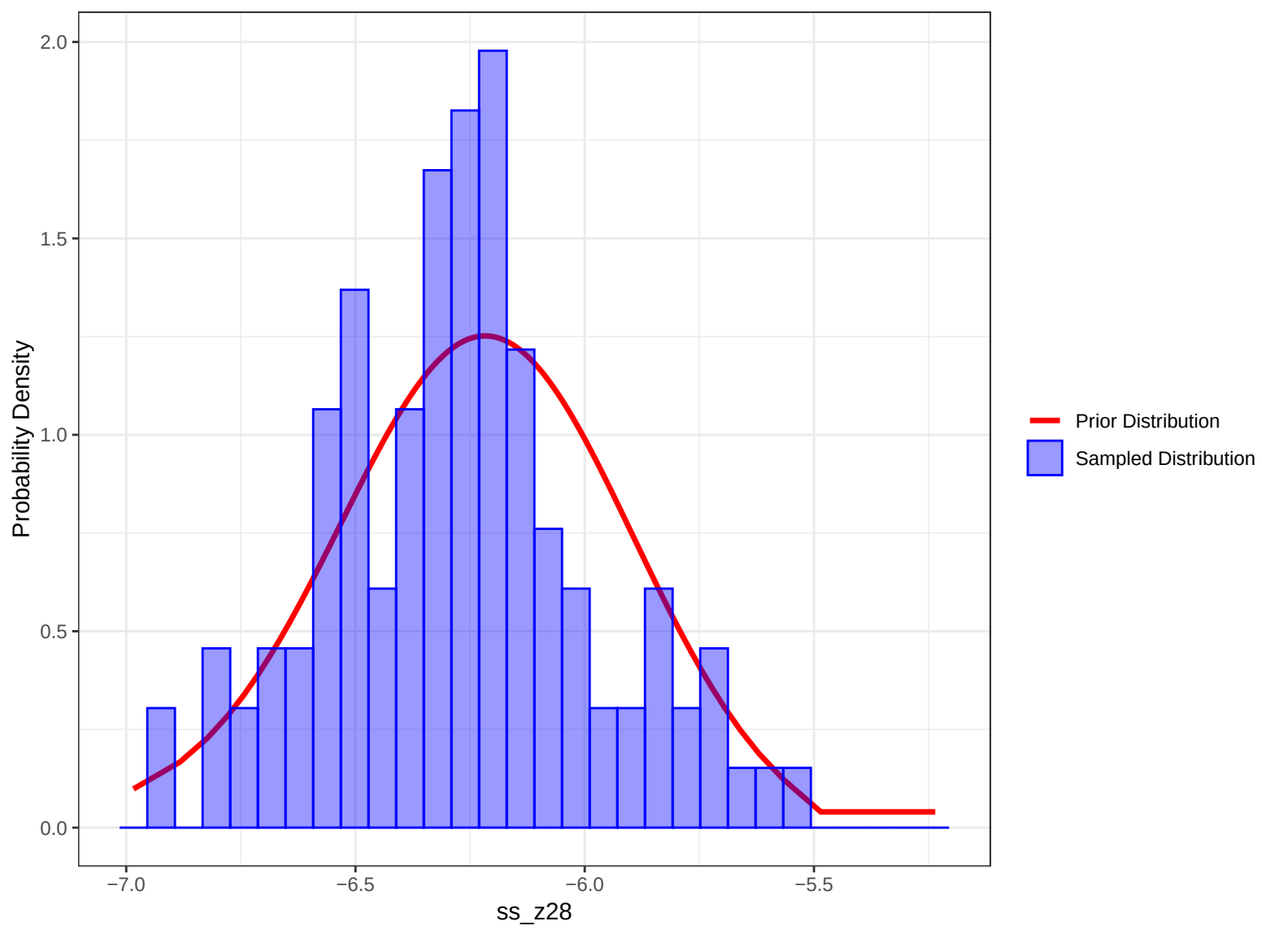

Probability Density
0.0
0.5
1.0
1.5
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z22
Prior Distribution
Sampled Distribution

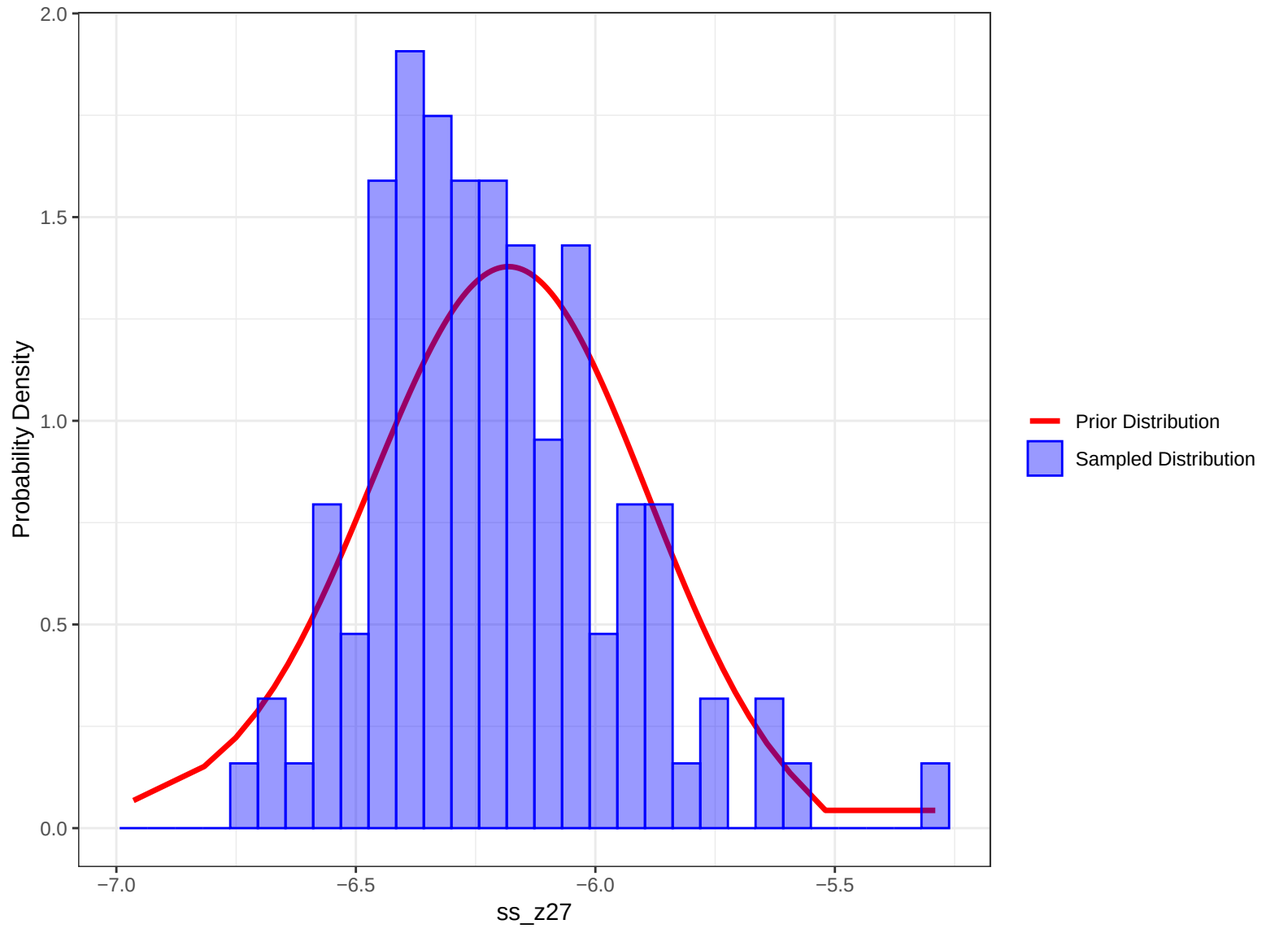

Probability Density
0.0
0.5
1.0
1.5
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z24
Prior Distribution
Sampled Distribution

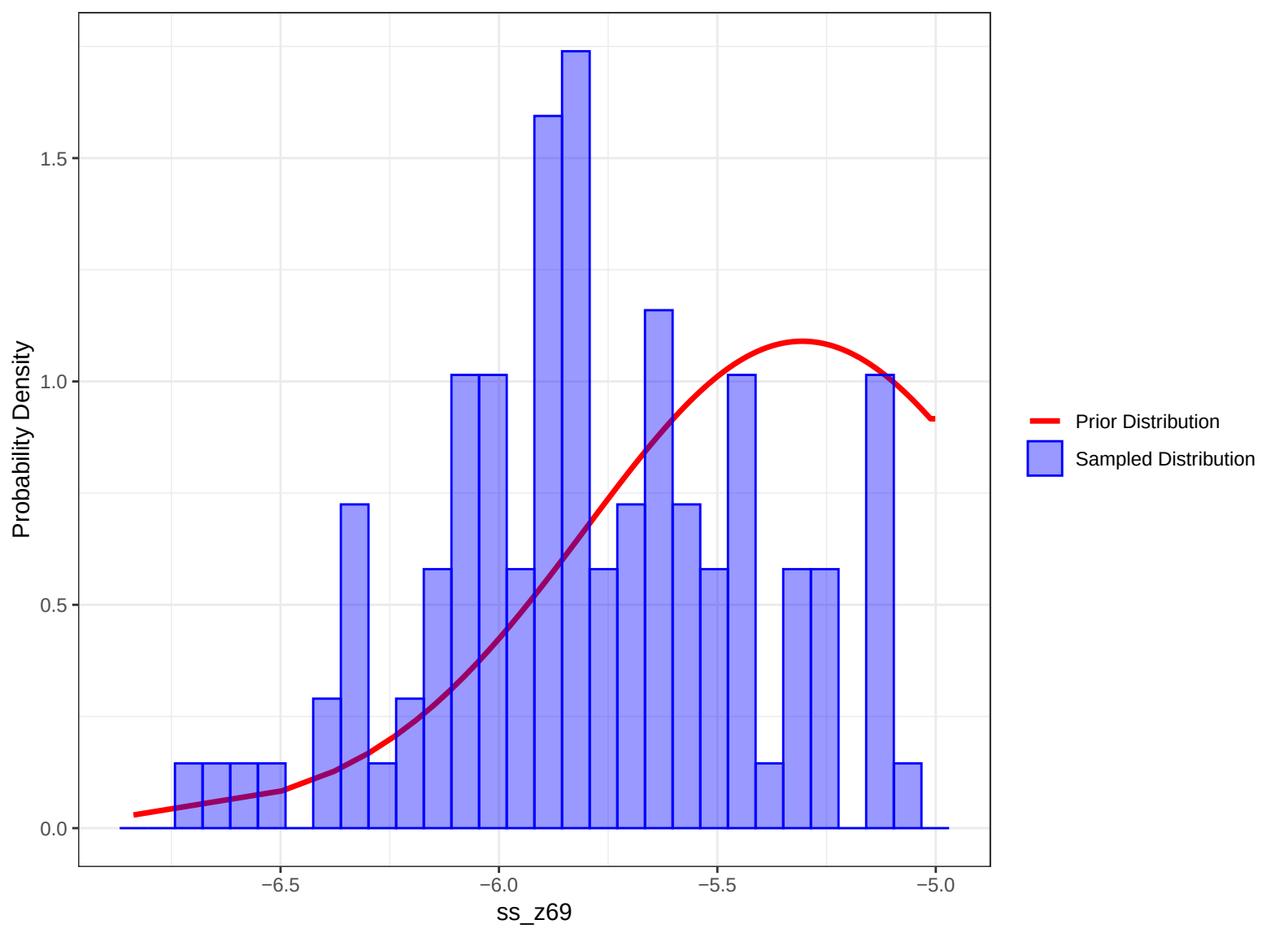

Probability Density
0
1
2
3
−7.0
−6.5
−6.0
−5.5
ss_z23
Prior Distribution
Sampled Distribution

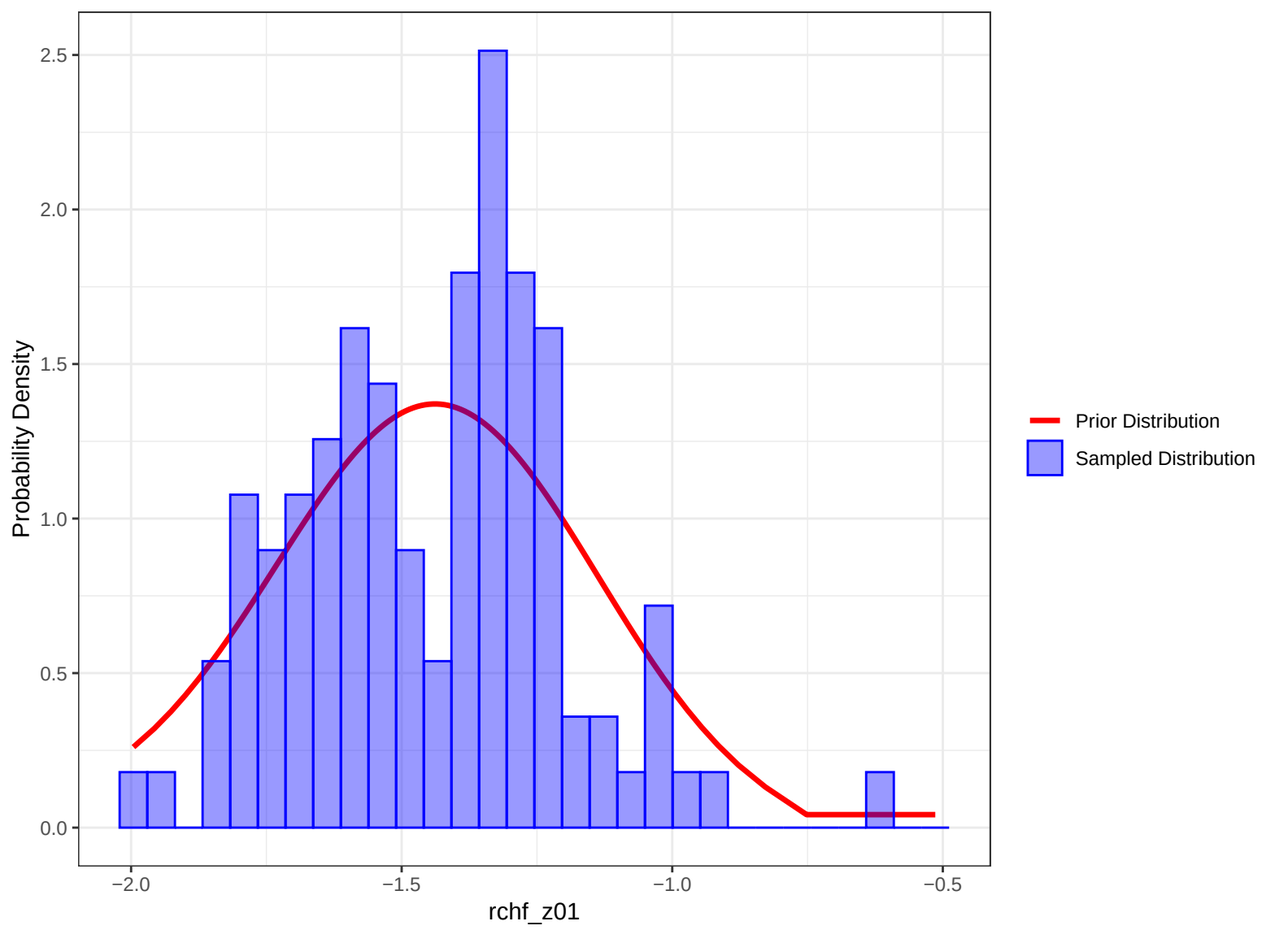

Probability Density
0.0
0.5
1.0
1.5
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z25
Prior Distribution
Sampled Distribution

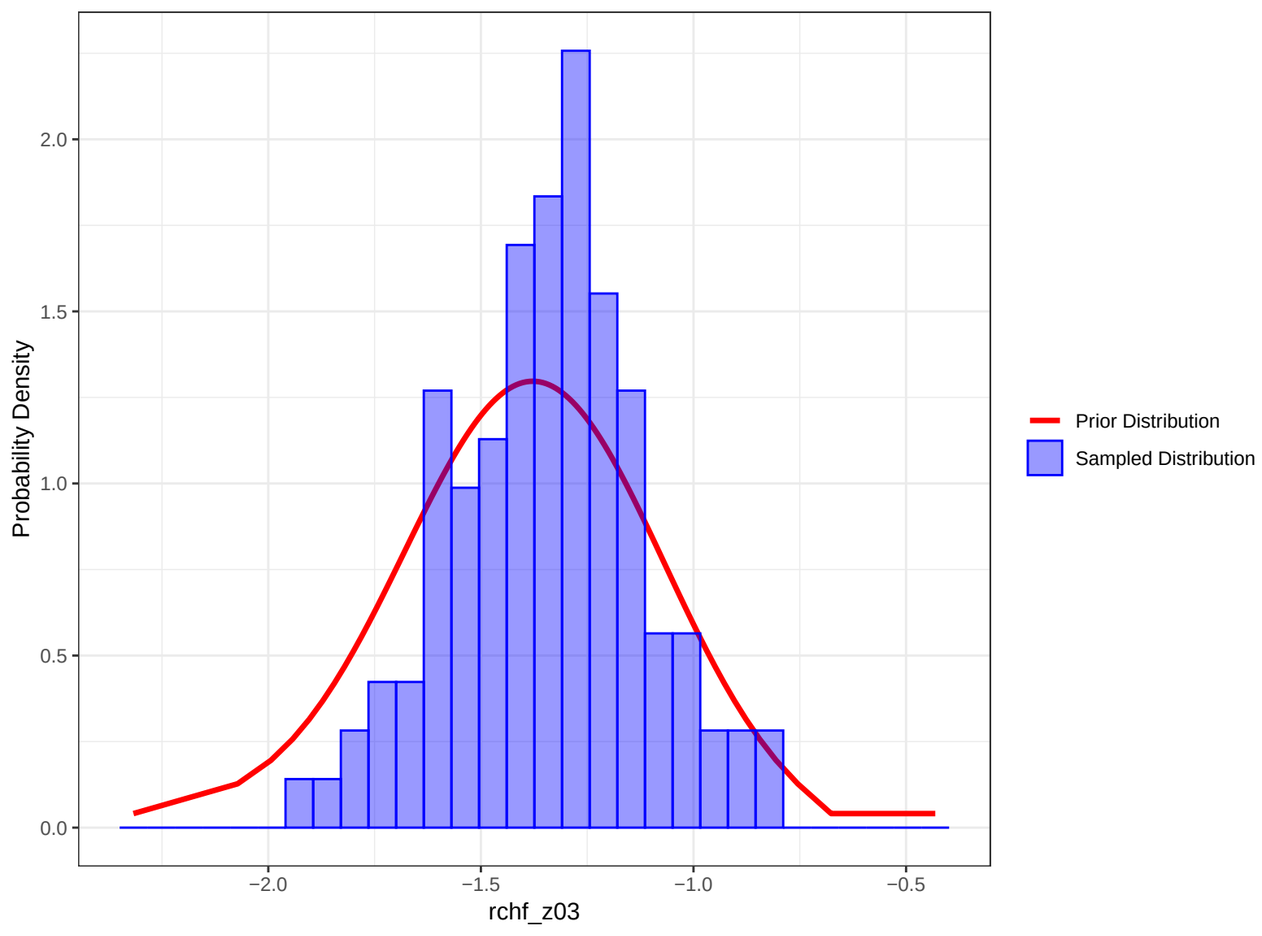

Probability Density
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
−5.0
ss_z26
Prior Distribution
Sampled Distribution

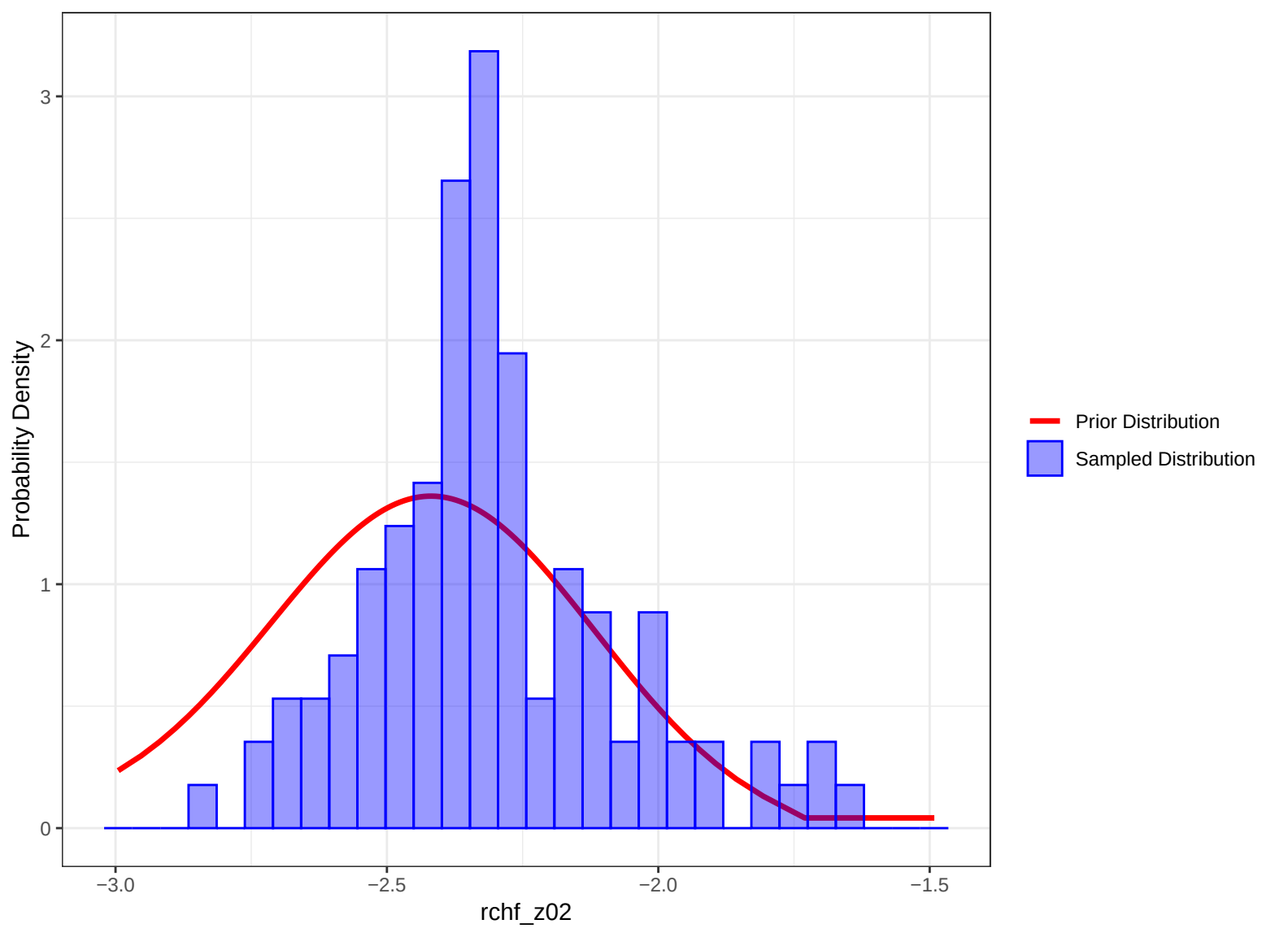

Probability Density
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z28
Prior Distribution
Sampled Distribution

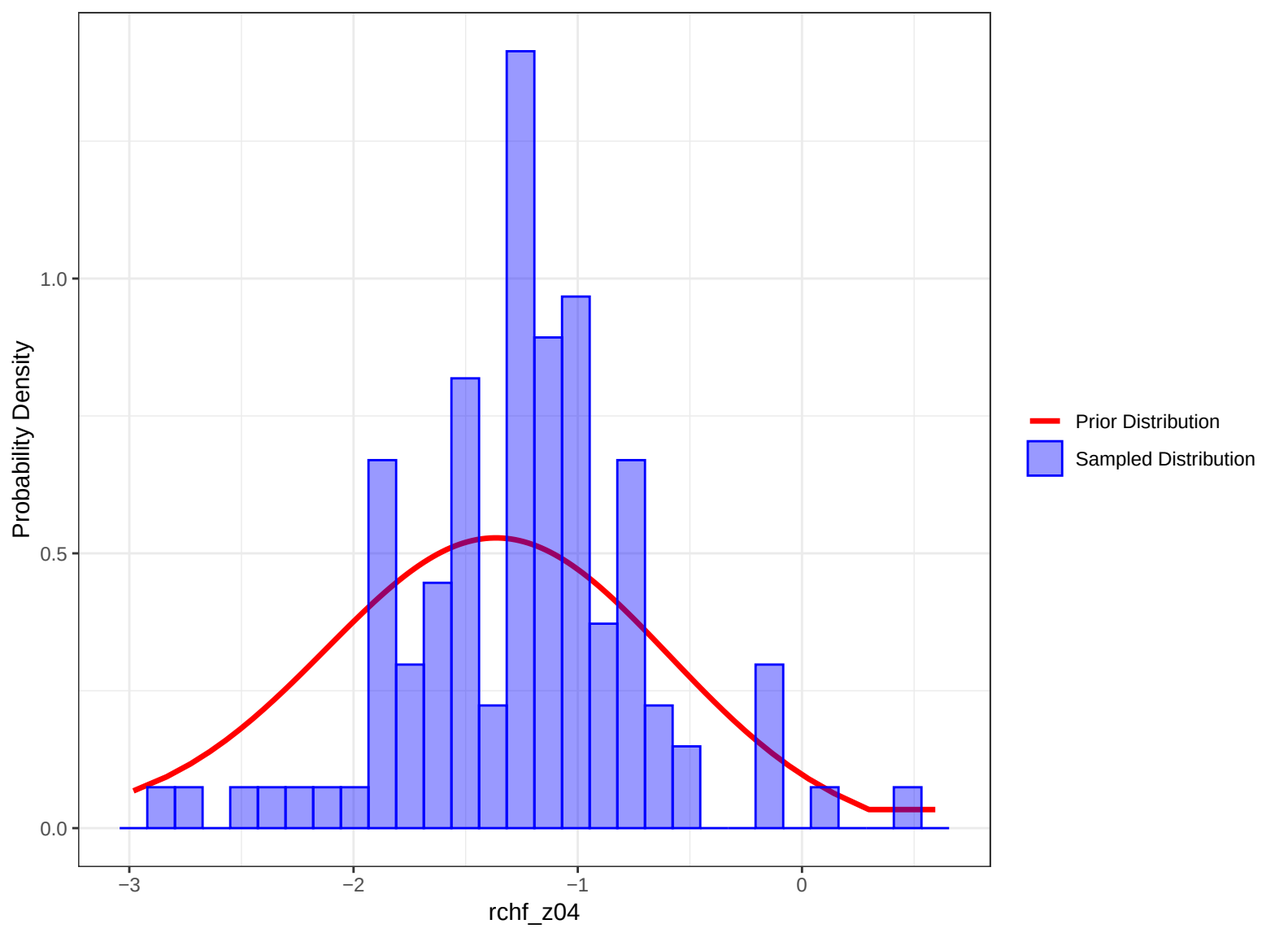

Probability Density
2.0
1.5
1.0
0.5
0.0
−7.0
−6.5
−6.0
−5.5
ss_z27
Prior Distribution
Sampled Distribution

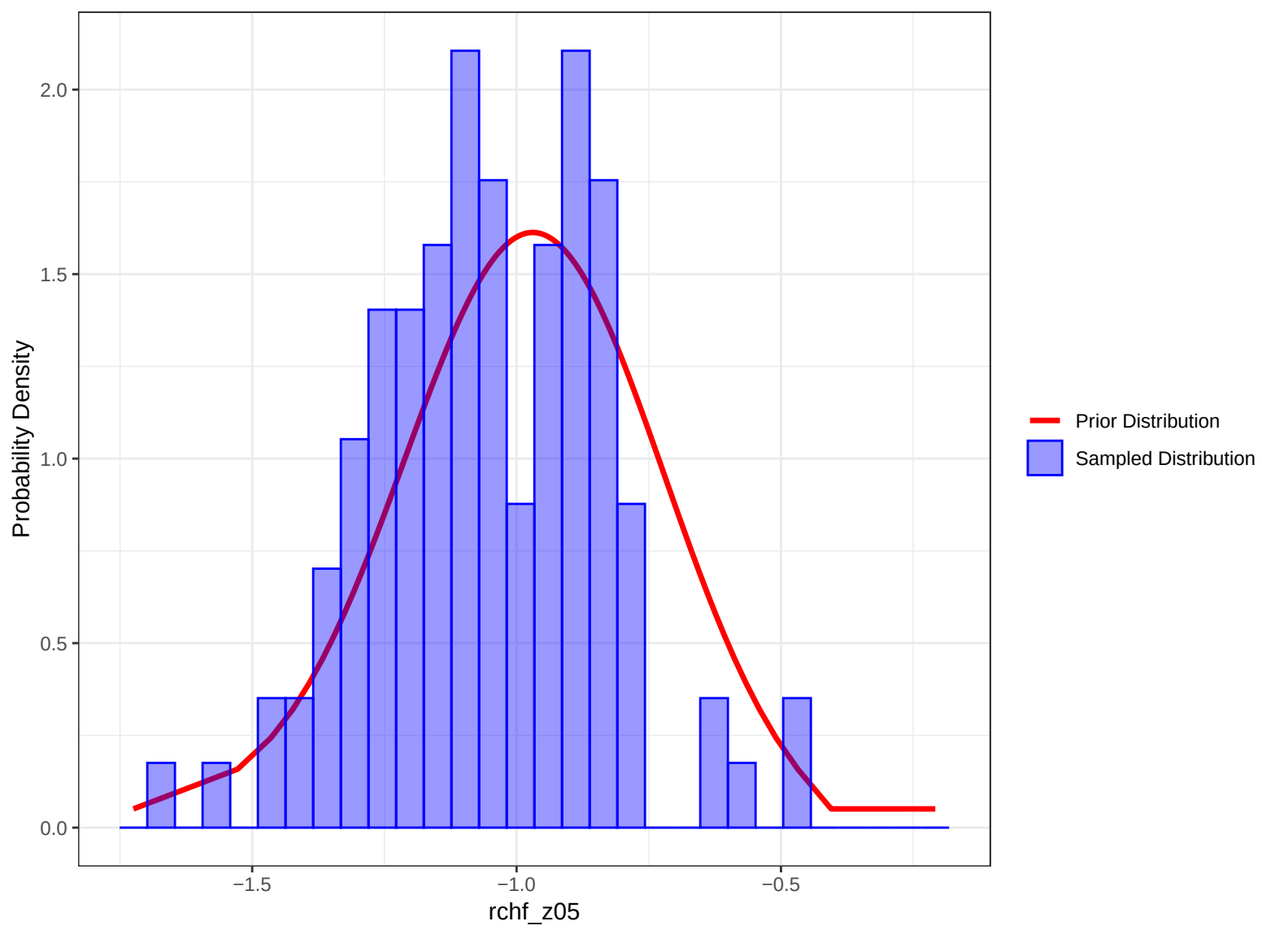

Probability Density
1.5
1.0
0.5
0.0
−6.5
−6.0
−5.5
−5.0
ss_z69
Prior Distribution
Sampled Distribution

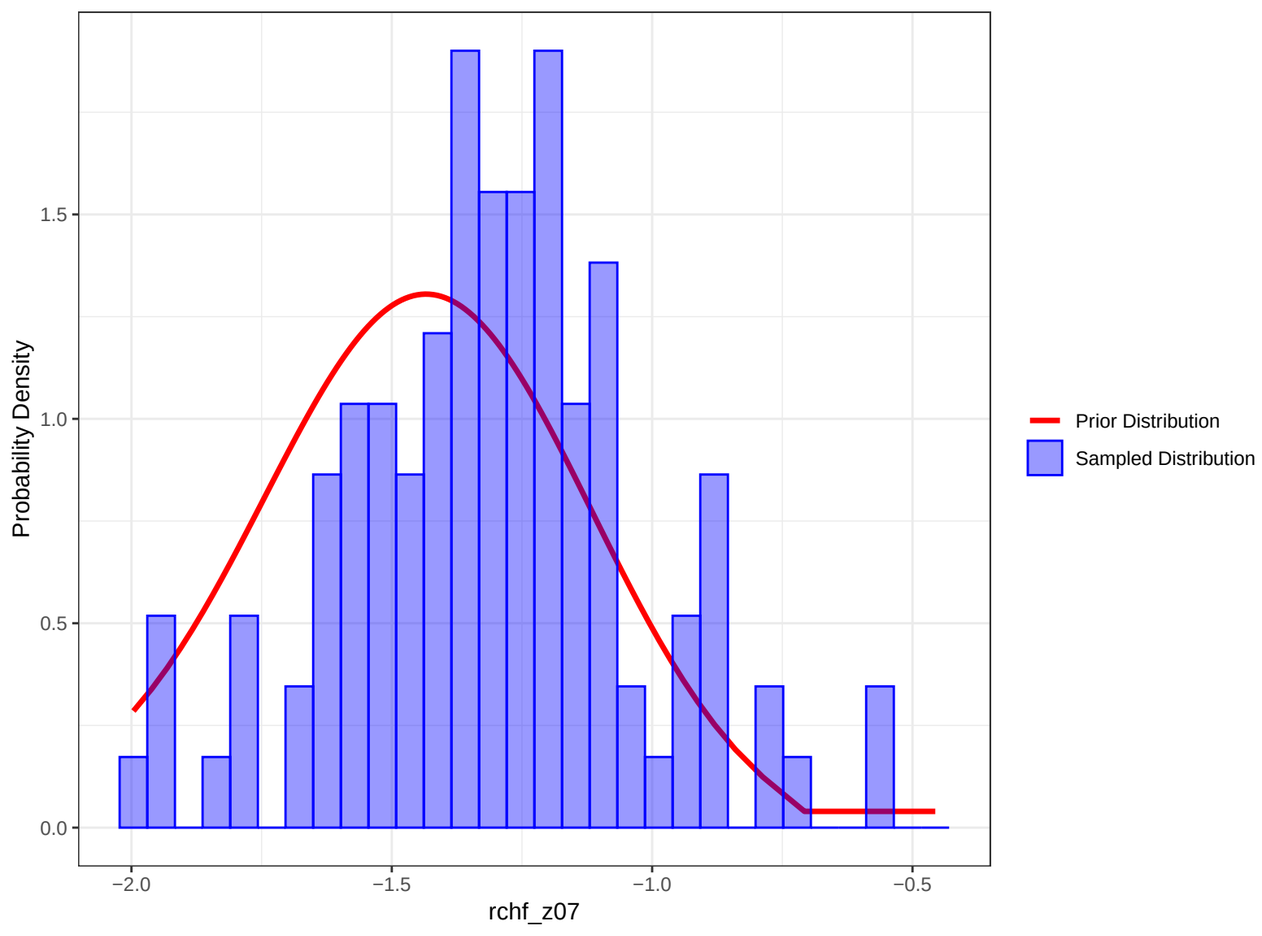

Probability Density
2.5
2.0
1.5
1.0
0.5
0.0
−2.0
−1.5
−1.0
−0.5
rchf_z01
Prior Distribution
Sampled Distribution

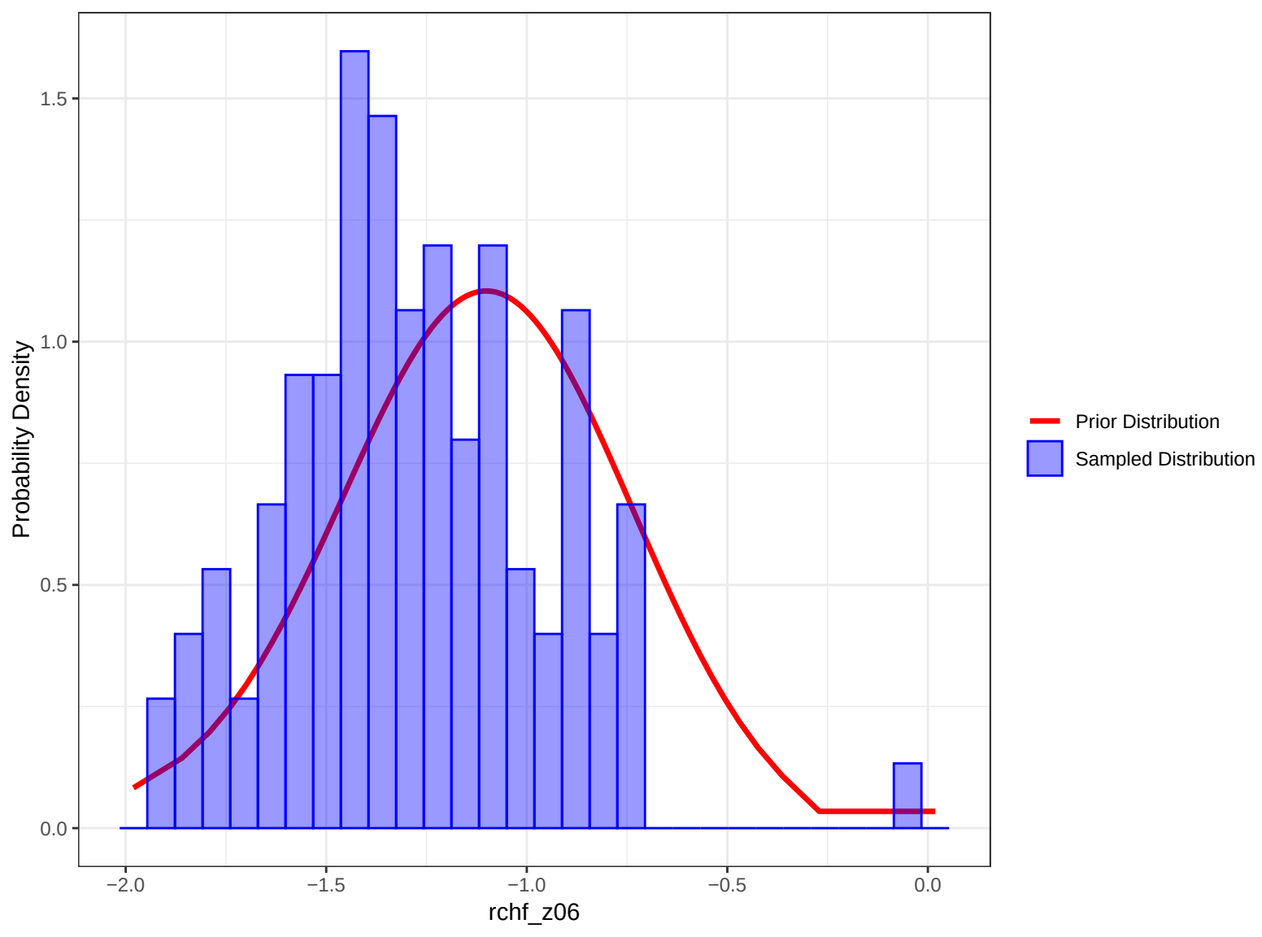

Probability Density
2.0
1.5
1.0
0.5
0.0
−2.0
−1.5
−1.0
−0.5
rchf_z03
Prior Distribution
Sampled Distribution

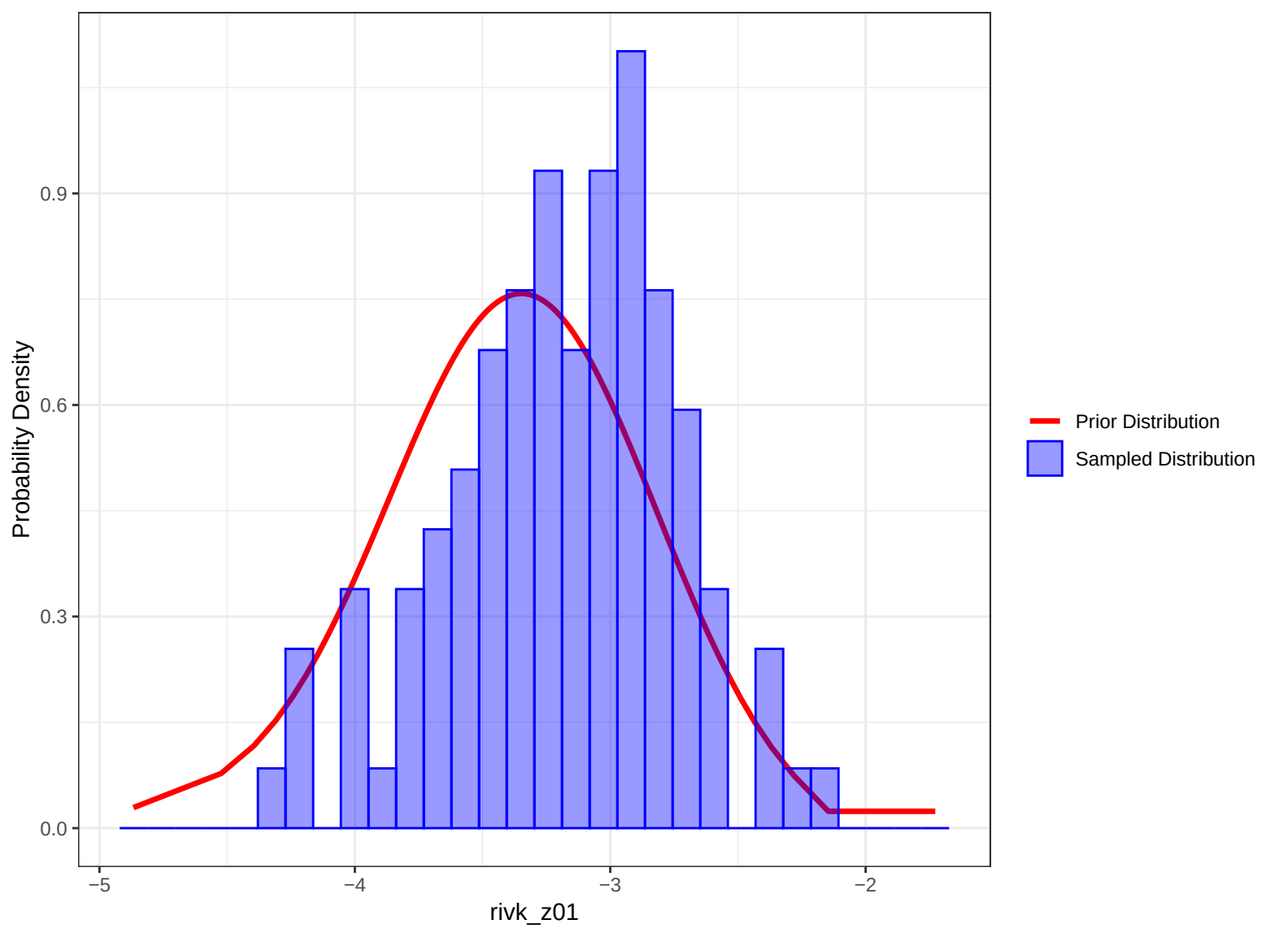

Probability Density
3
2
1
0
−3.0
−2.5
−2.0
−1.5
rchf_z02
Prior Distribution
Sampled Distribution

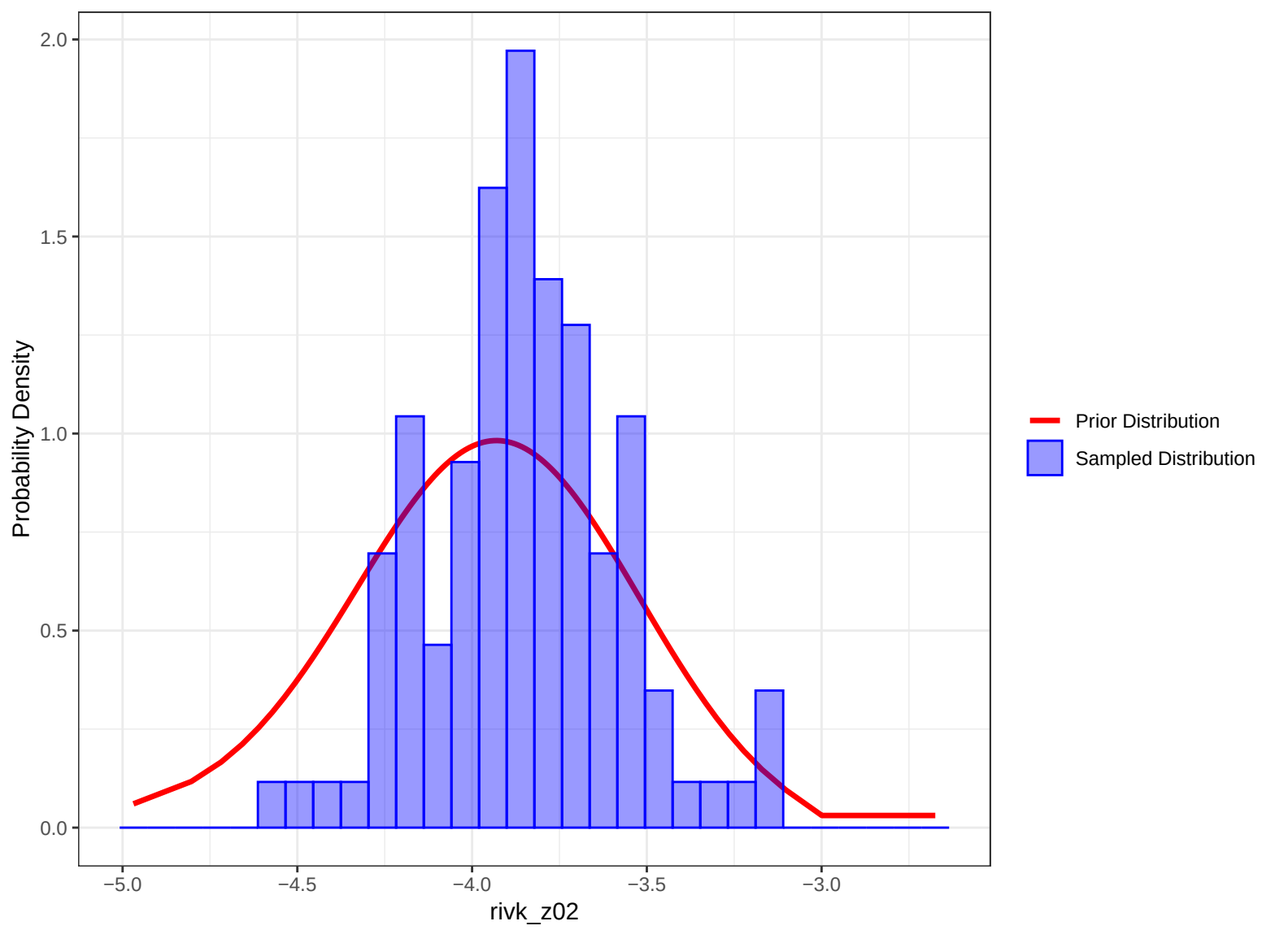

Probability Density
1.0
0.5
0.0
−3
−2
−1
0
rchf_z04
Prior Distribution
Sampled Distribution

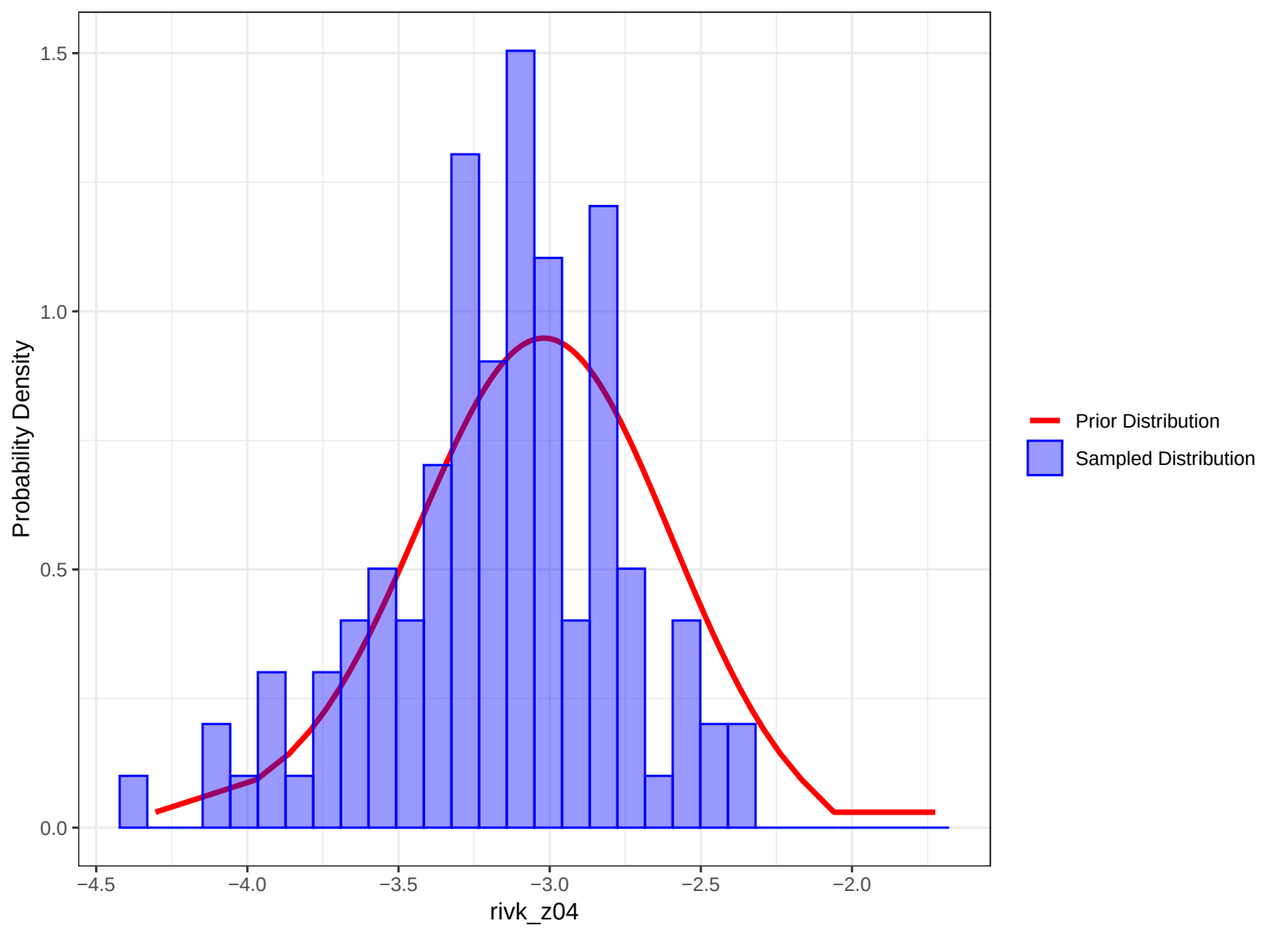

Probability Density
2.0
1.5
1.0
0.5
0.0
−1.5
−1.0
−0.5
rchf_z05
Prior Distribution
Sampled Distribution

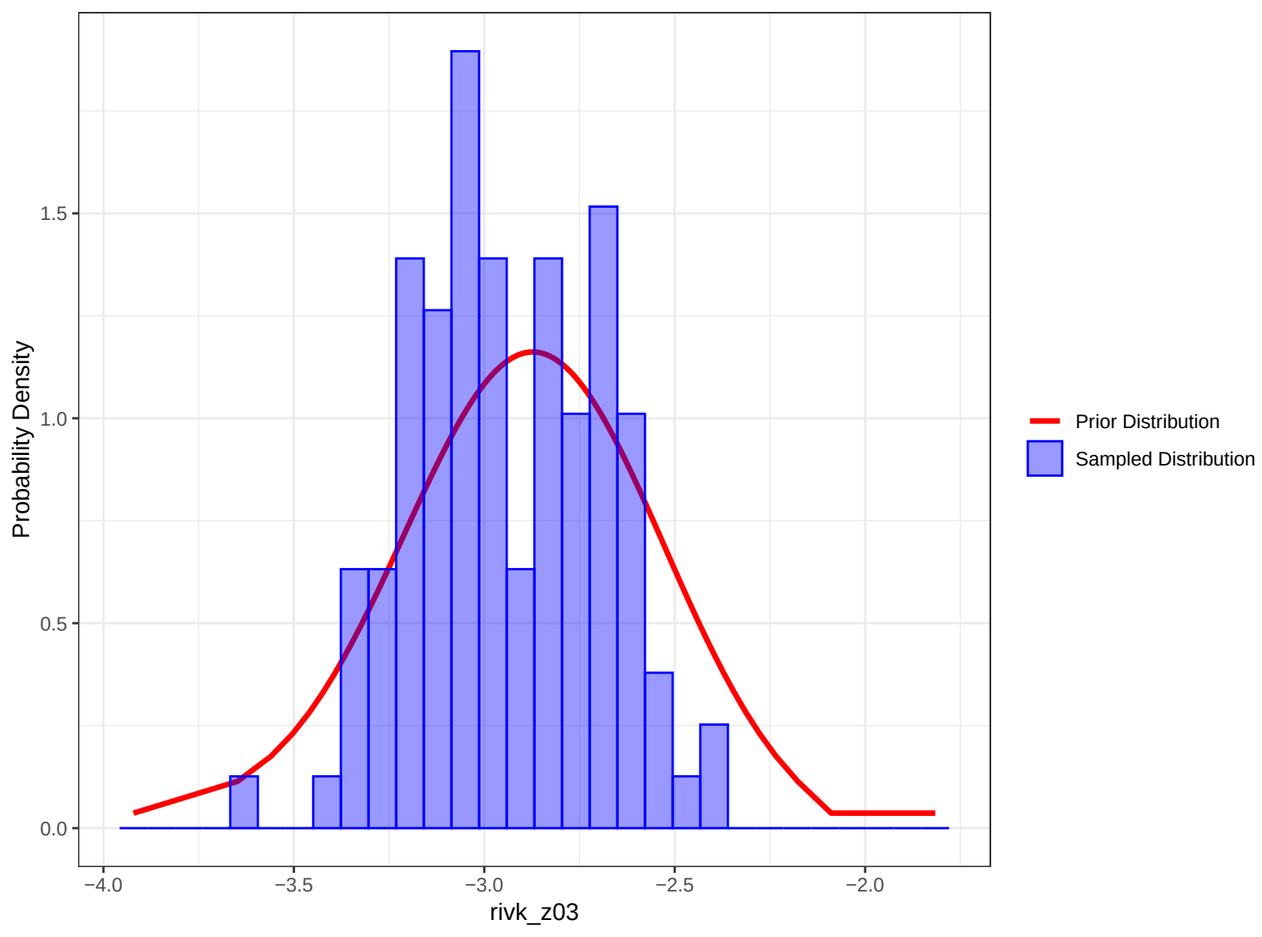

Probability Density
1.5
1.0
0.5
0.0
−2.0
−1.5
−1.0
−0.5
rchf_z07
Prior Distribution
Sampled Distribution

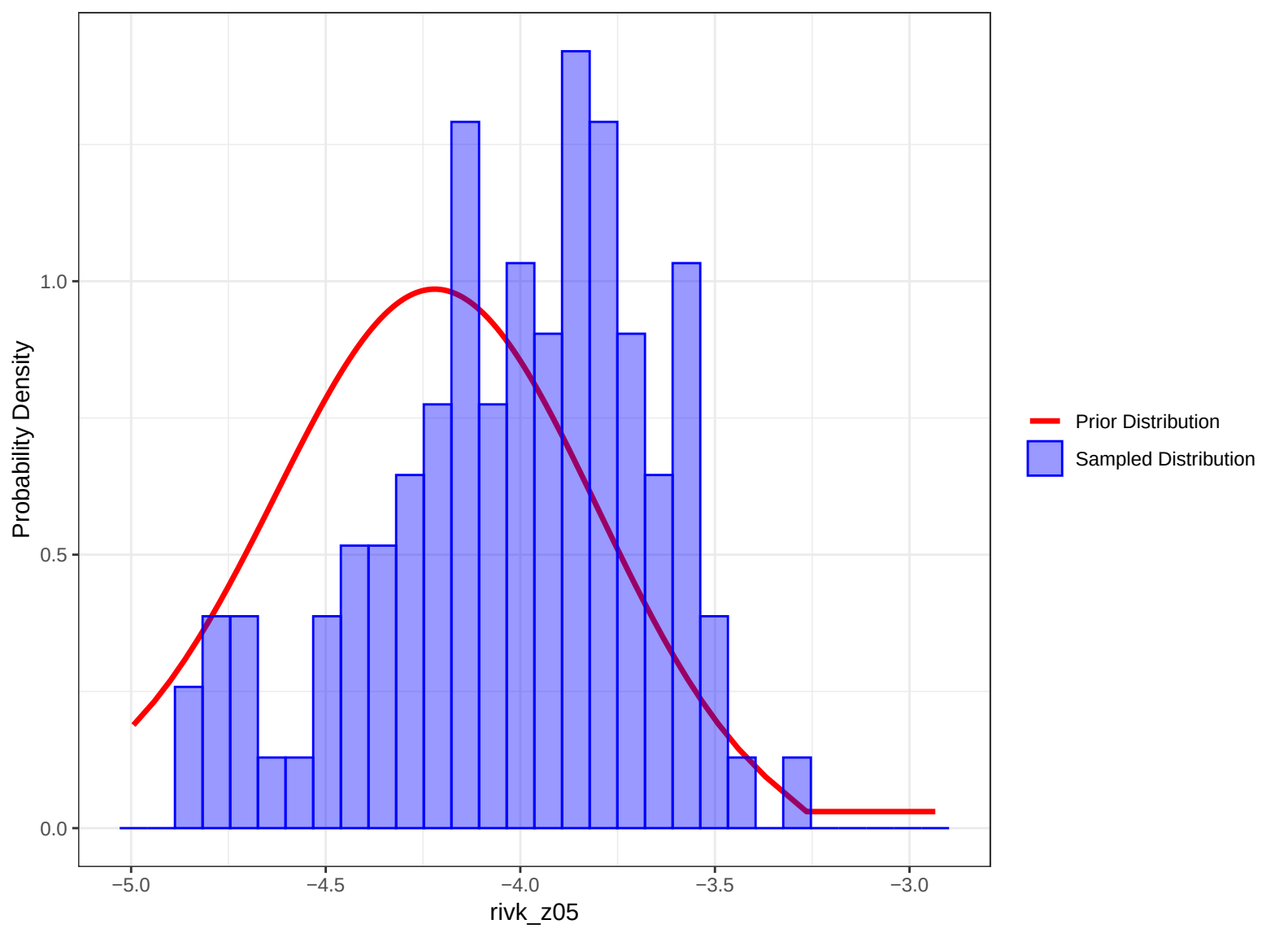

Probability Density
1.5
1.0
0.5
0.0
−2.0
−1.5
−1.0
−0.5
0.0
rchf_z06
Prior Distribution
Sampled Distribution

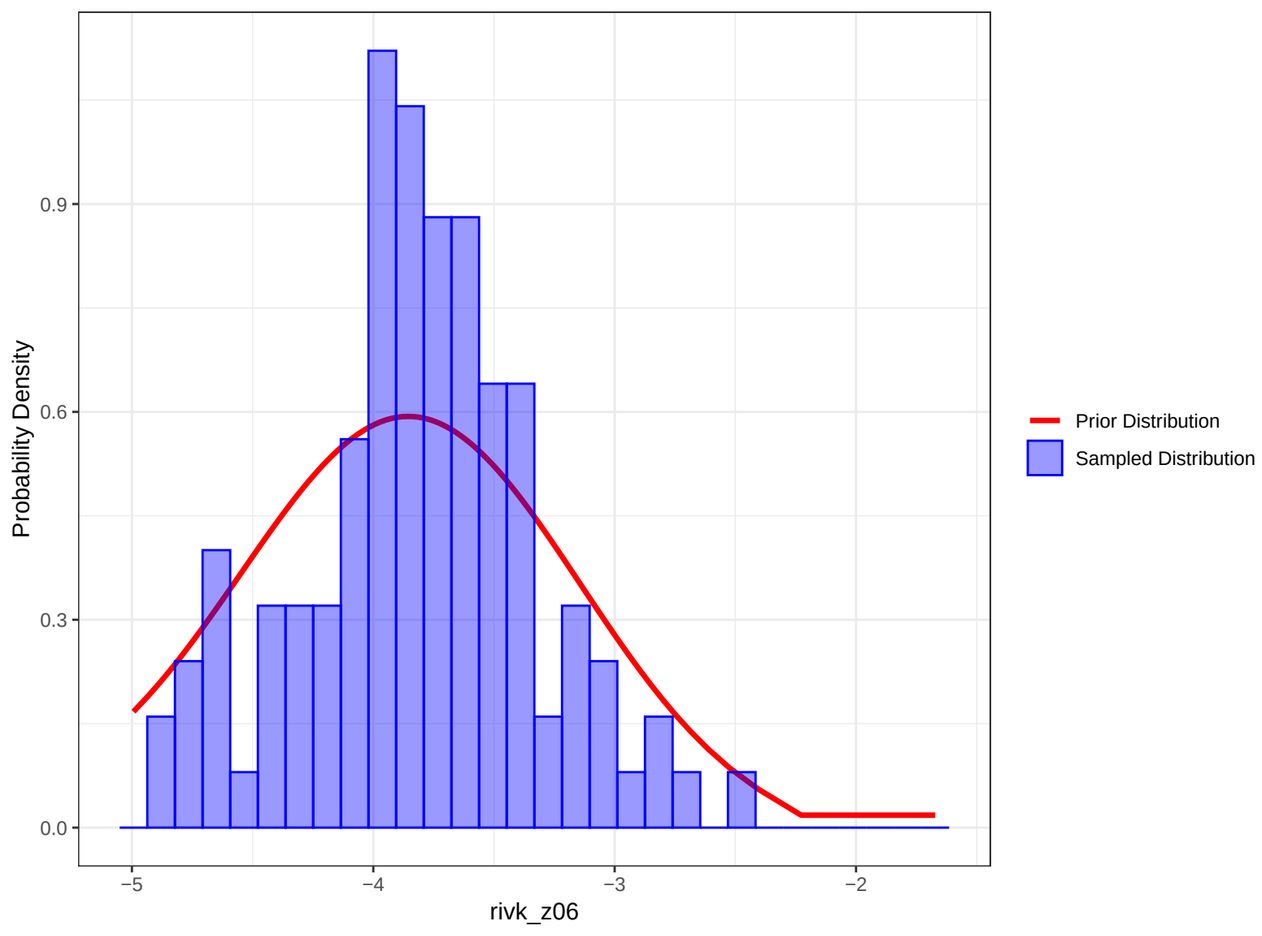

Probability Density
0.9
0.6
0.3
0.0
−5
−4
−3
−2
rivk_z01
Prior Distribution
Sampled Distribution

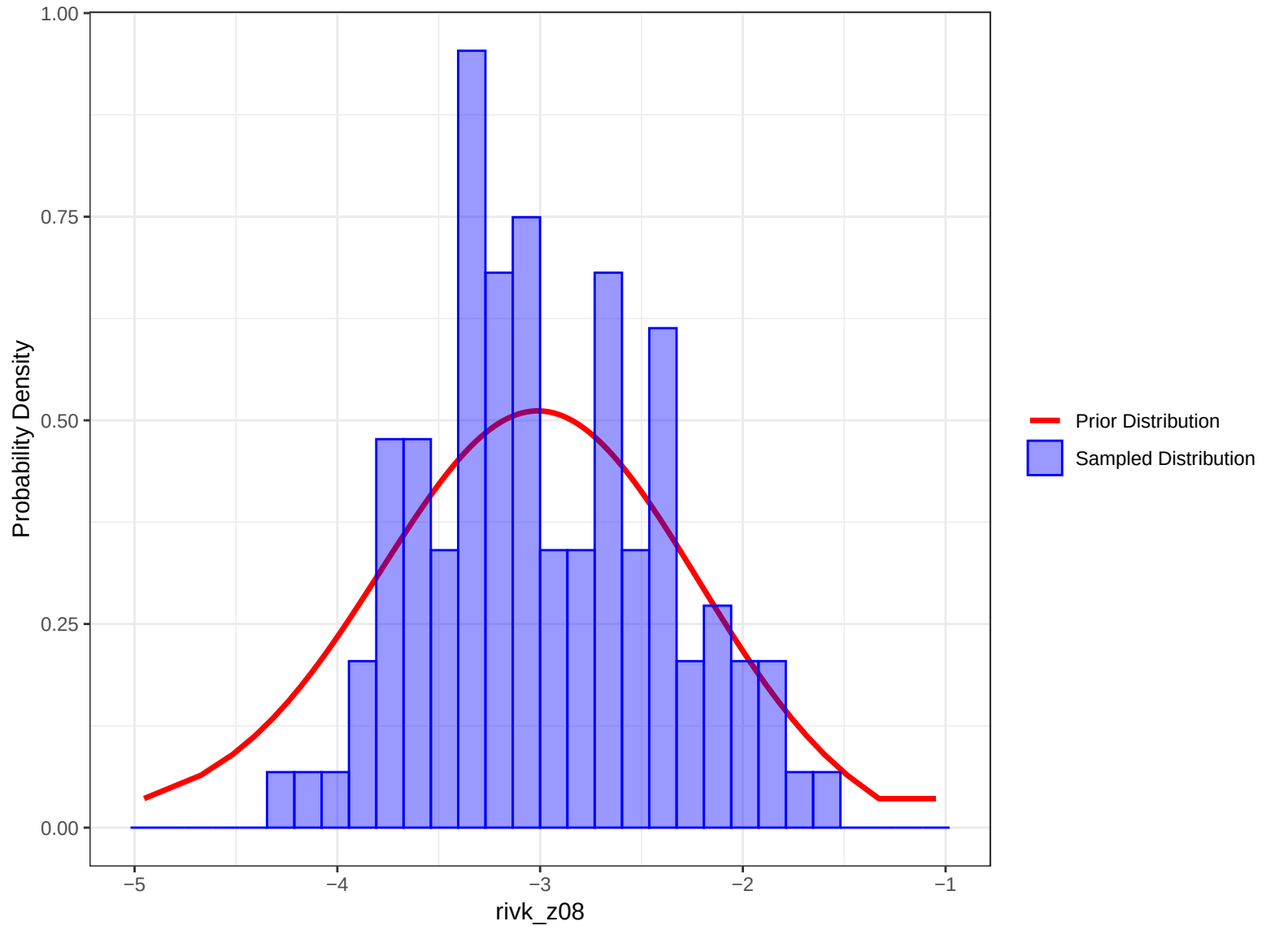

Probability Density
2.0
1.5
1.0
0.5
0.0
−5.0
−4.5
−4.0
−3.5
−3.0
rivk_z02
Prior Distribution
Sampled Distribution

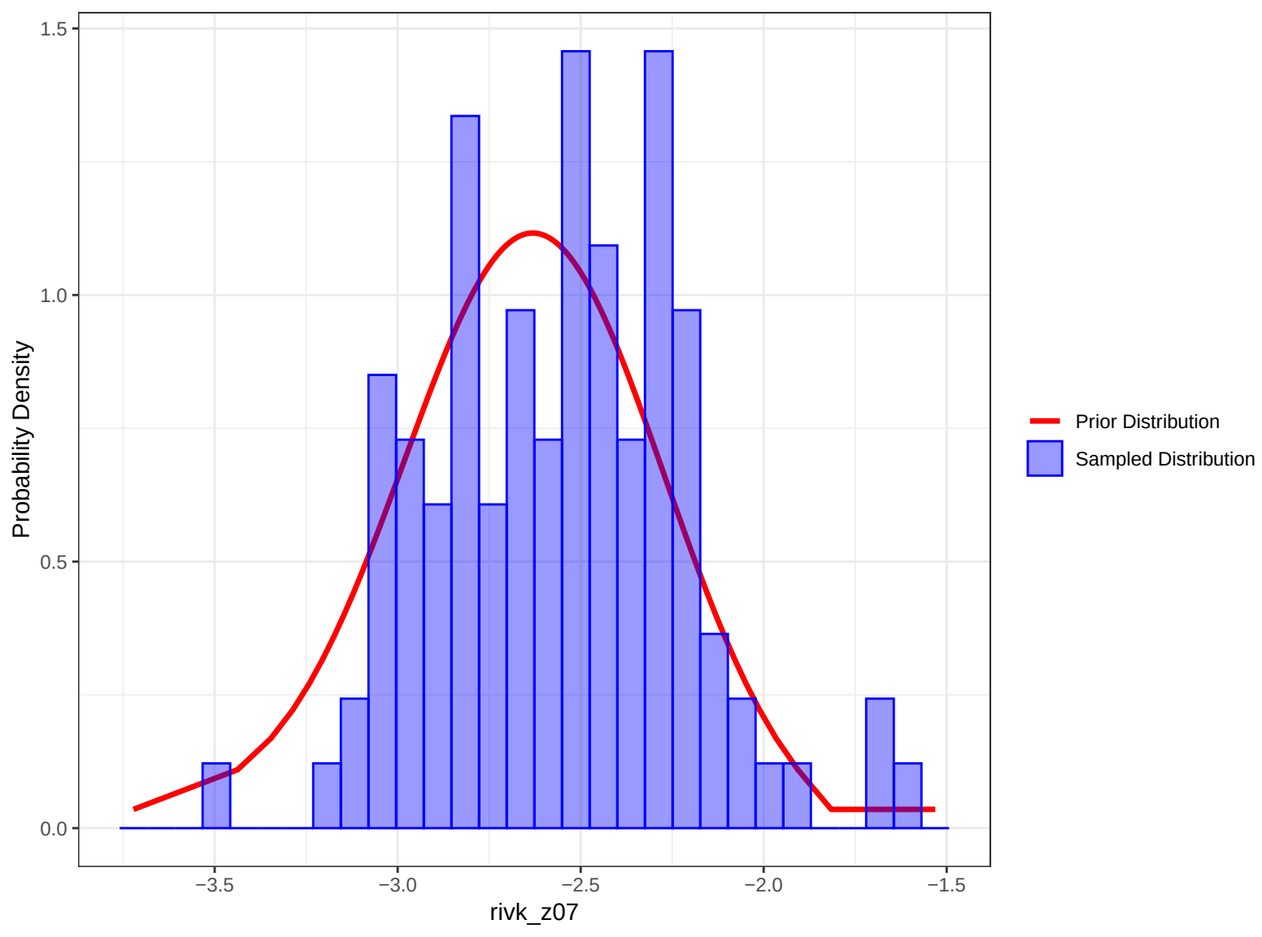

Probability Density
1.5
1.0
0.5
0.0
−4.5
−4.0
−3.5
−3.0
−2.5
−2.0
rivk_z04
Prior Distribution
Sampled Distribution

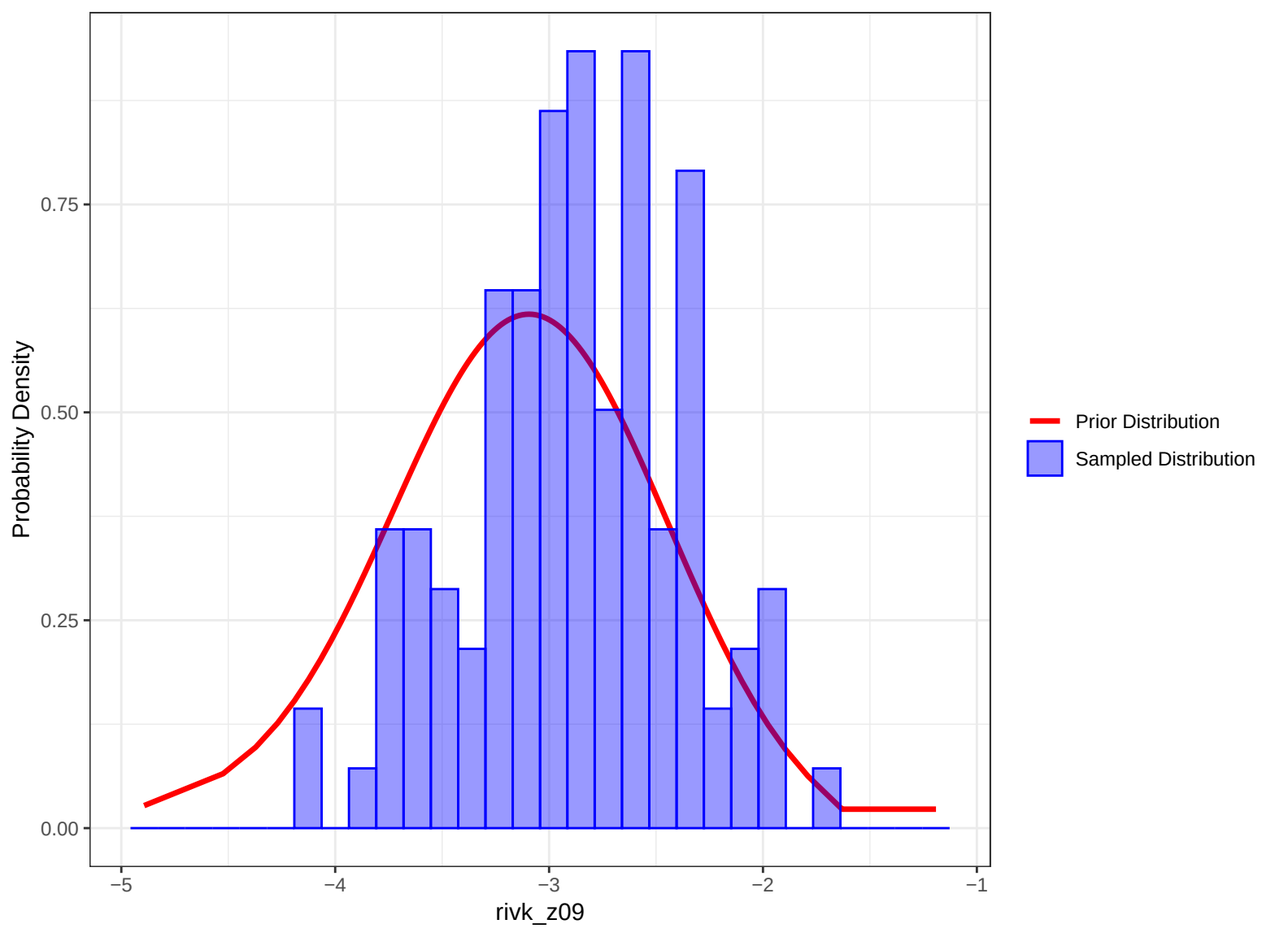

Probability Density
1.5
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
rivk_z03
Prior Distribution
Sampled Distribution

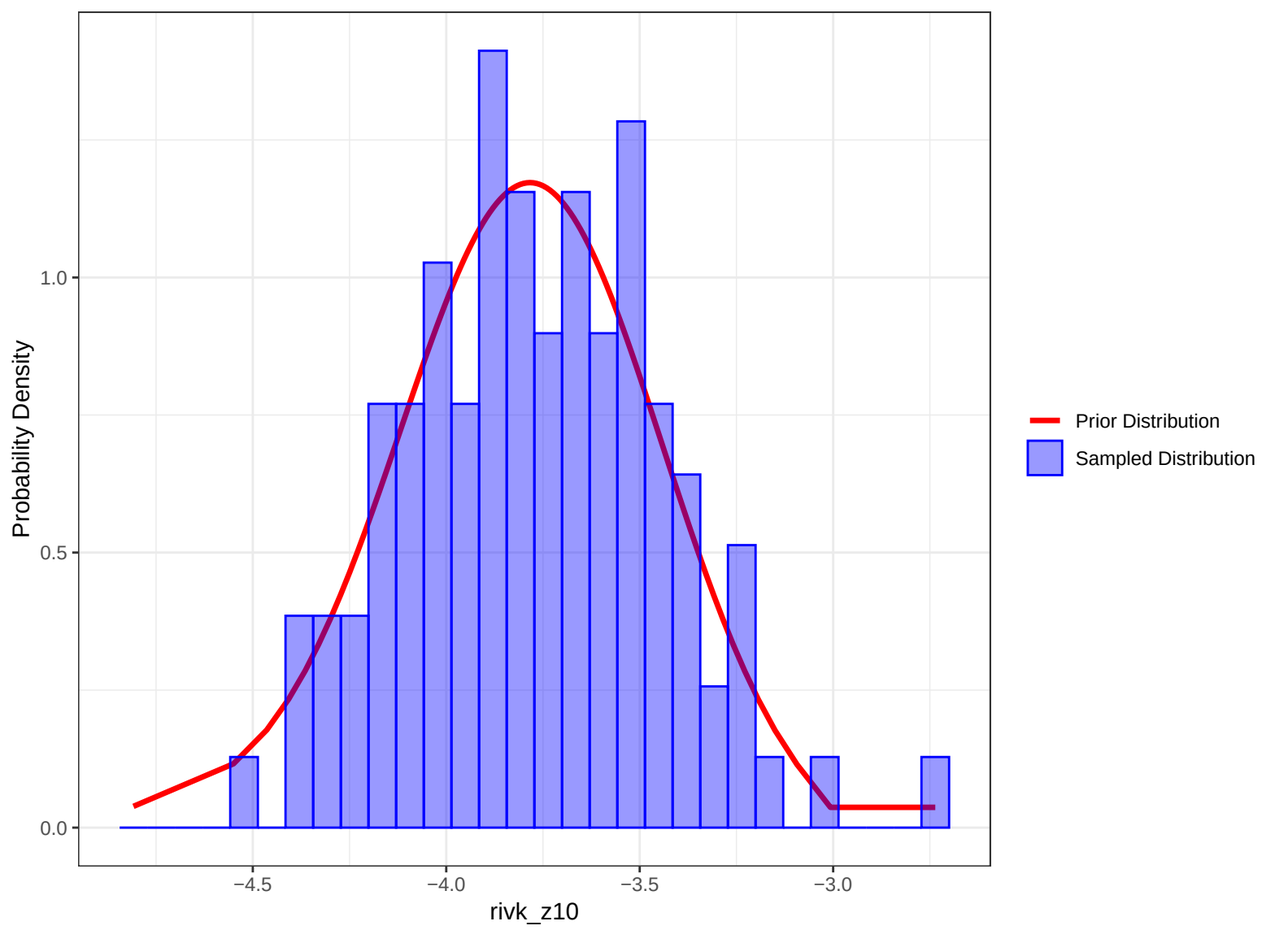

Probability Density
1.0
0.5
0.0
−5.0
−4.5
−4.0
−3.5
−3.0
rivk_z05
Prior Distribution
Sampled Distribution

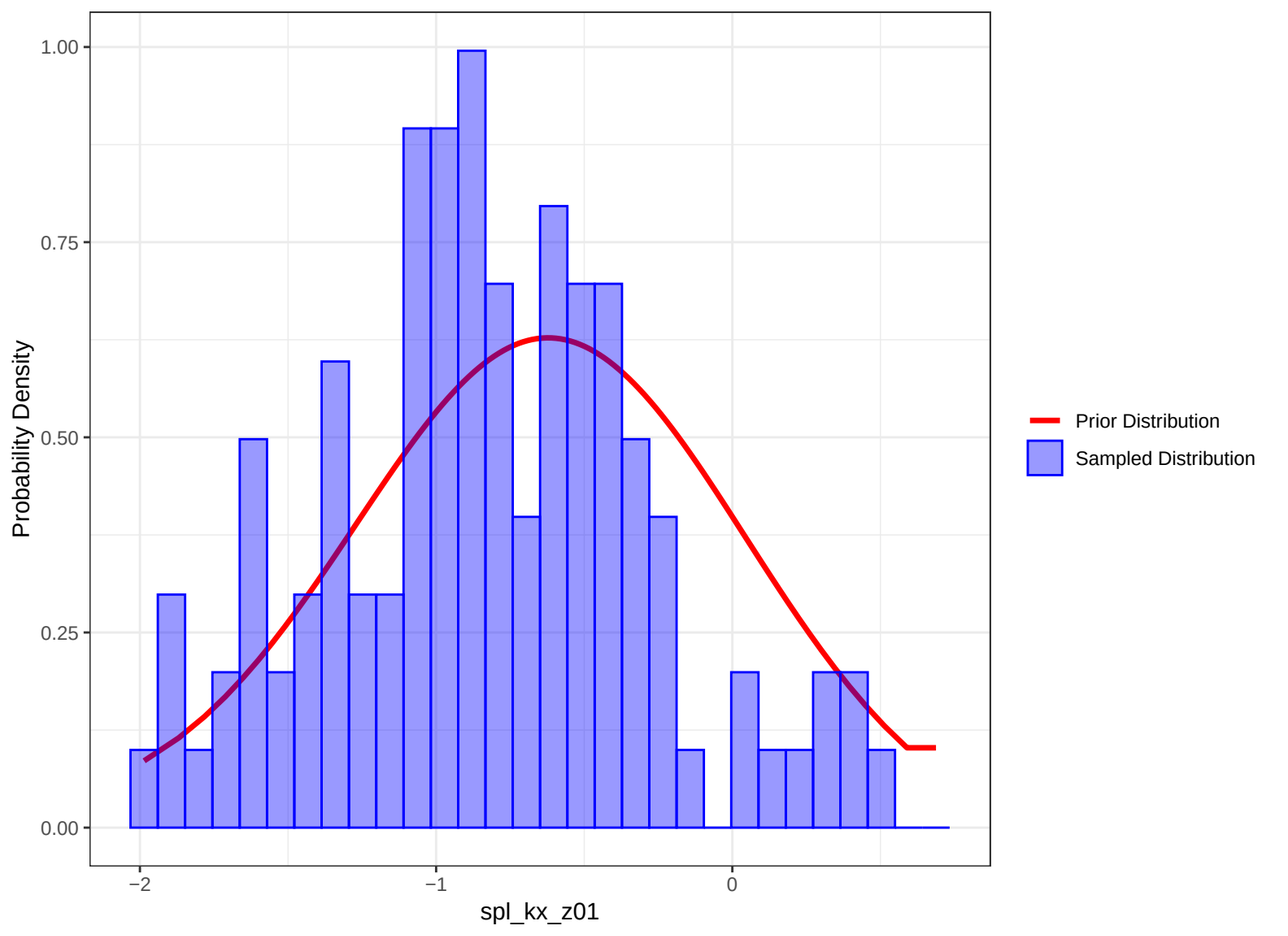

Probability Density
0.0
0.3
0.6
0.9
−5
−4
−3
−2
rivk_z06
Prior Distribution
Sampled Distribution

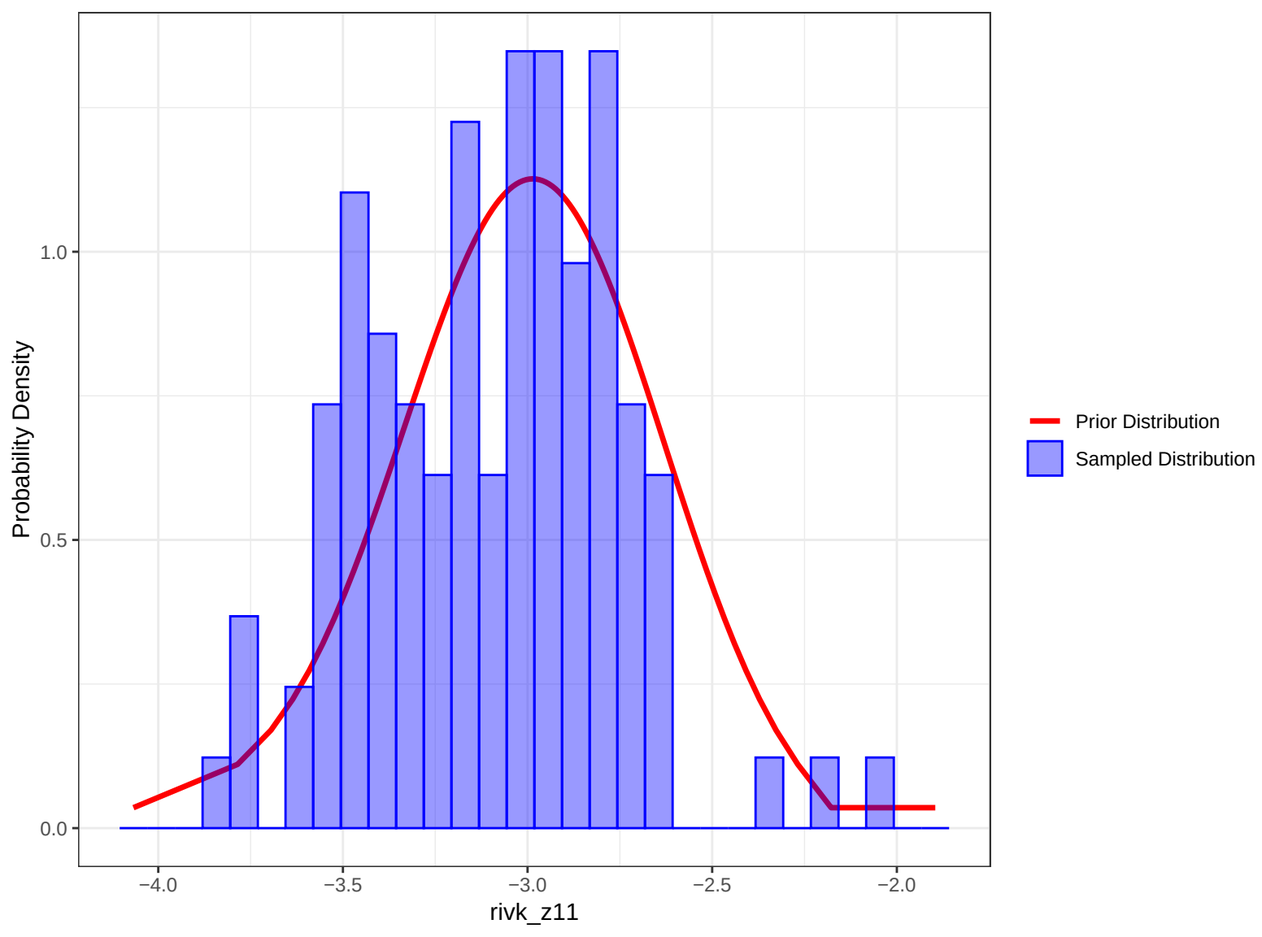

Probability Density
0.00
0.25
0.50
0.75
1.00
−5
−4
−3
−2
−1
rivk_z08
Prior Distribution
Sampled Distribution

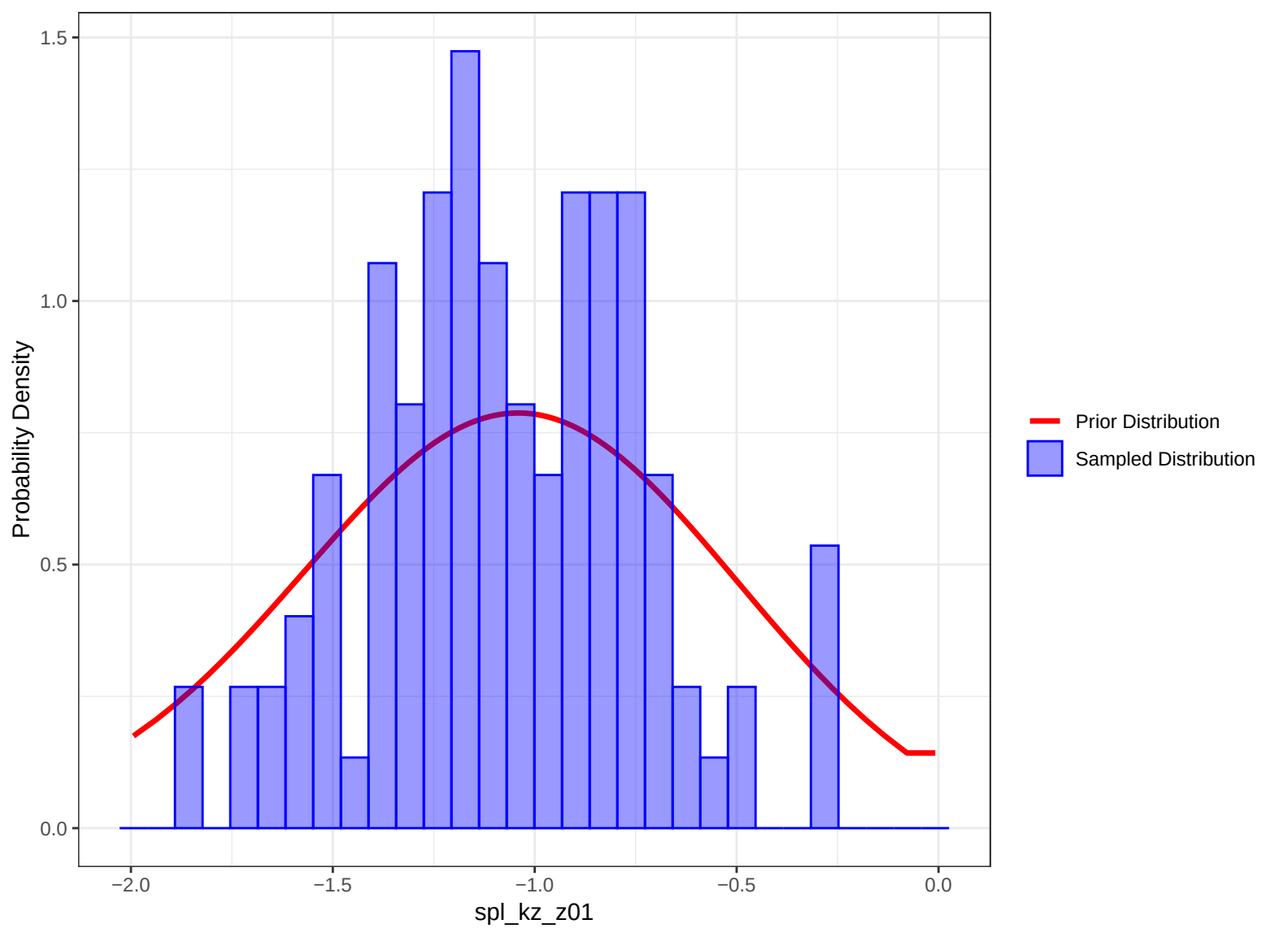

Probability Density
0.0
0.5
1.0
1.5
−3.5
−3.0
−2.5
−2.0
−1.5
rivk_z07
Prior Distribution
Sampled Distribution

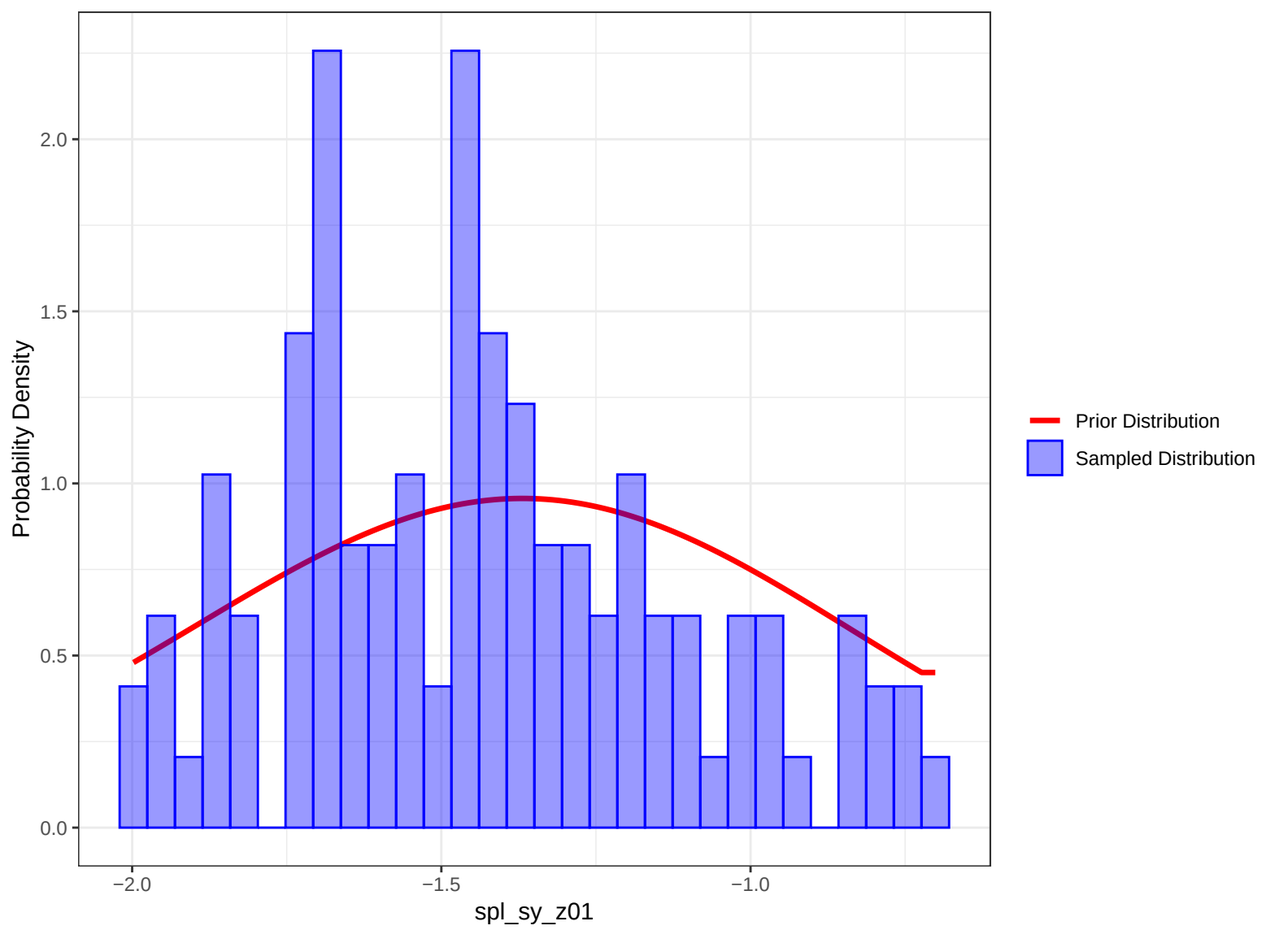

Probability Density
0.00
0.25
0.50
0.75
−5
−4
−3
−2
−1
rivk_z09
Prior Distribution
Sampled Distribution

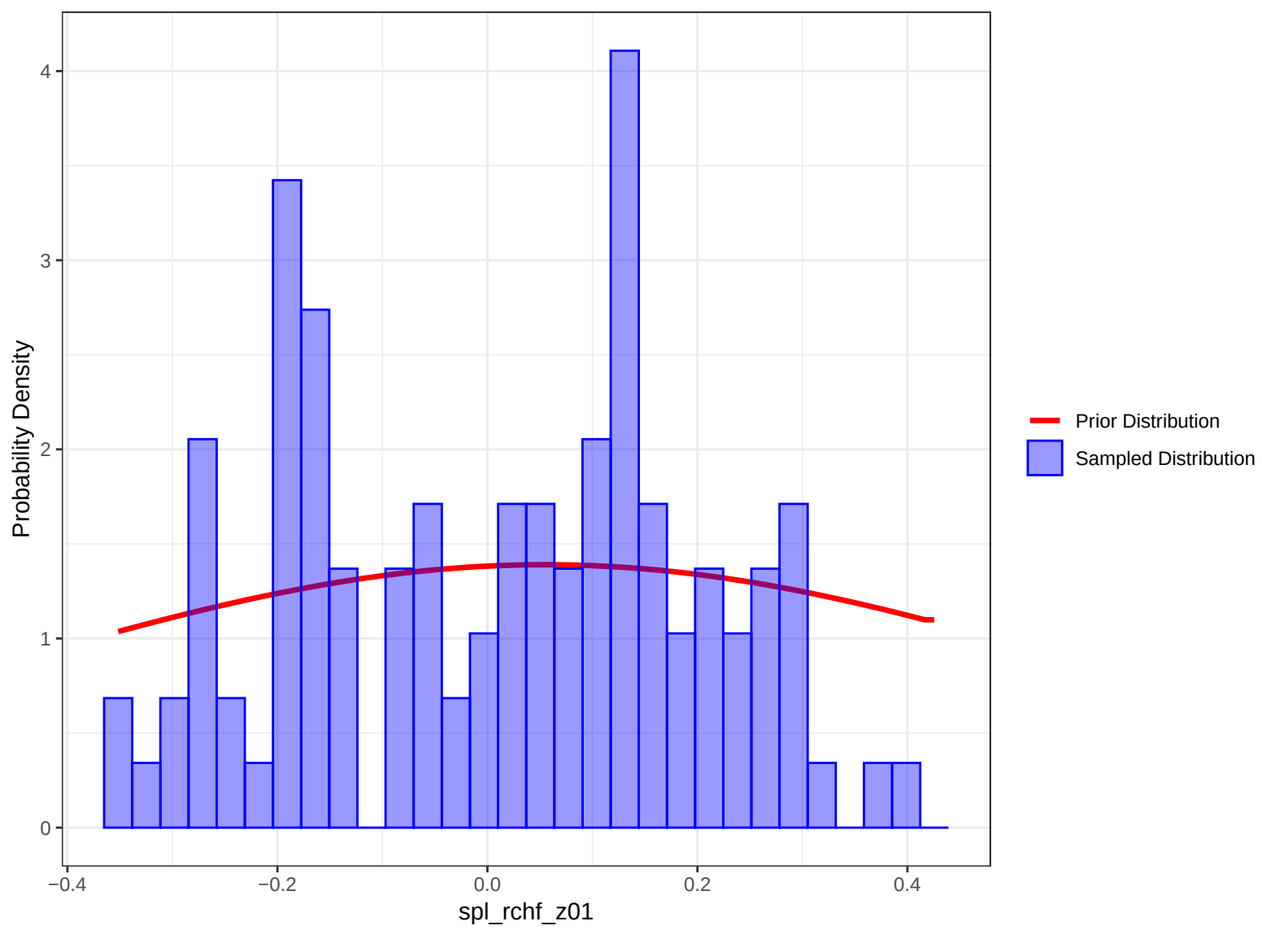

Probability Density
1.0
0.5
0.0
−4.5
−4.0
−3.5
−3.0
rivk_z10
Prior Distribution
Sampled Distribution

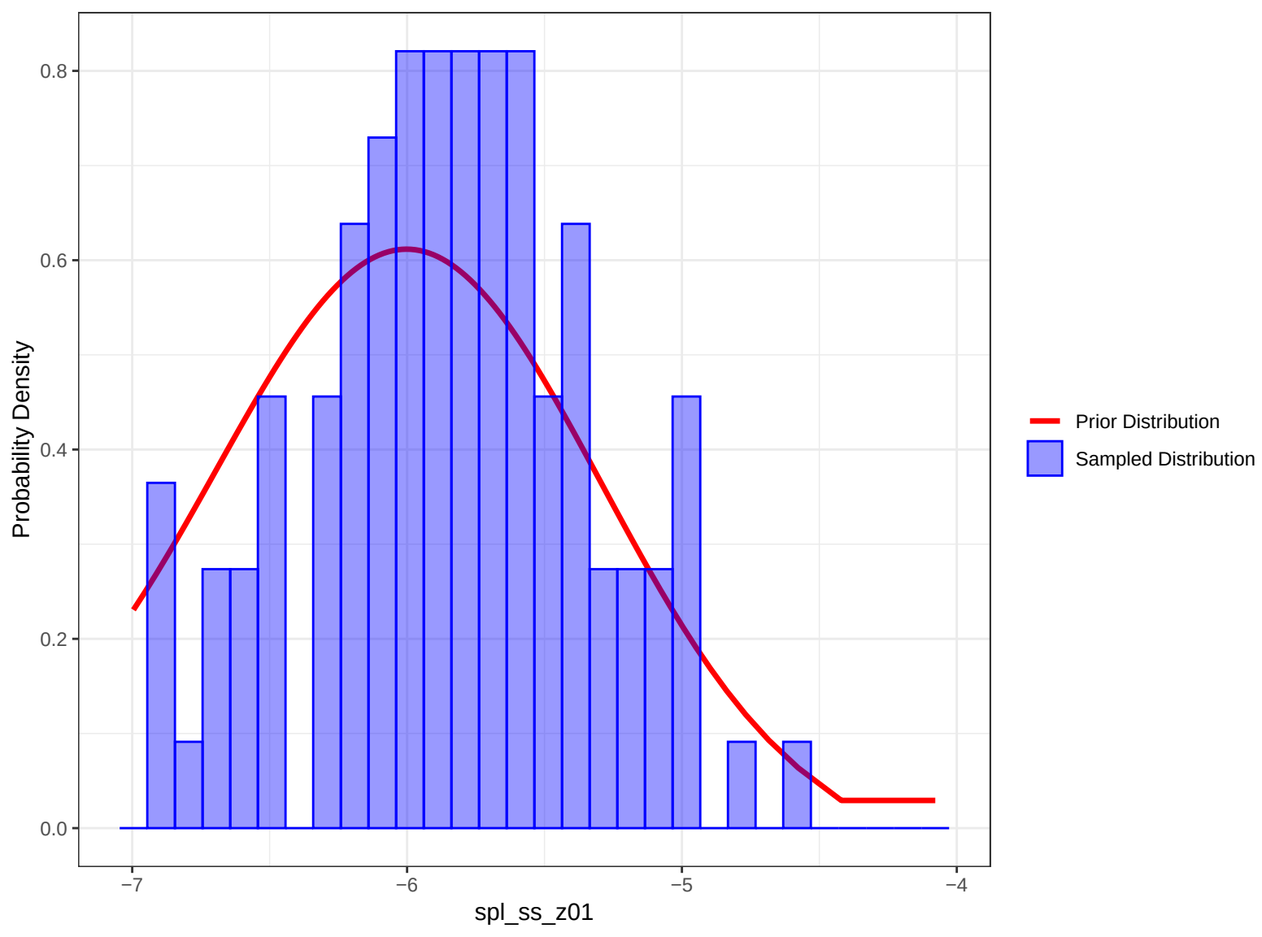

Probability Density
1.00
0.75
0.50
0.25
0.00
−2
−1
0
spl_kx_z01
Prior Distribution
Sampled Distribution

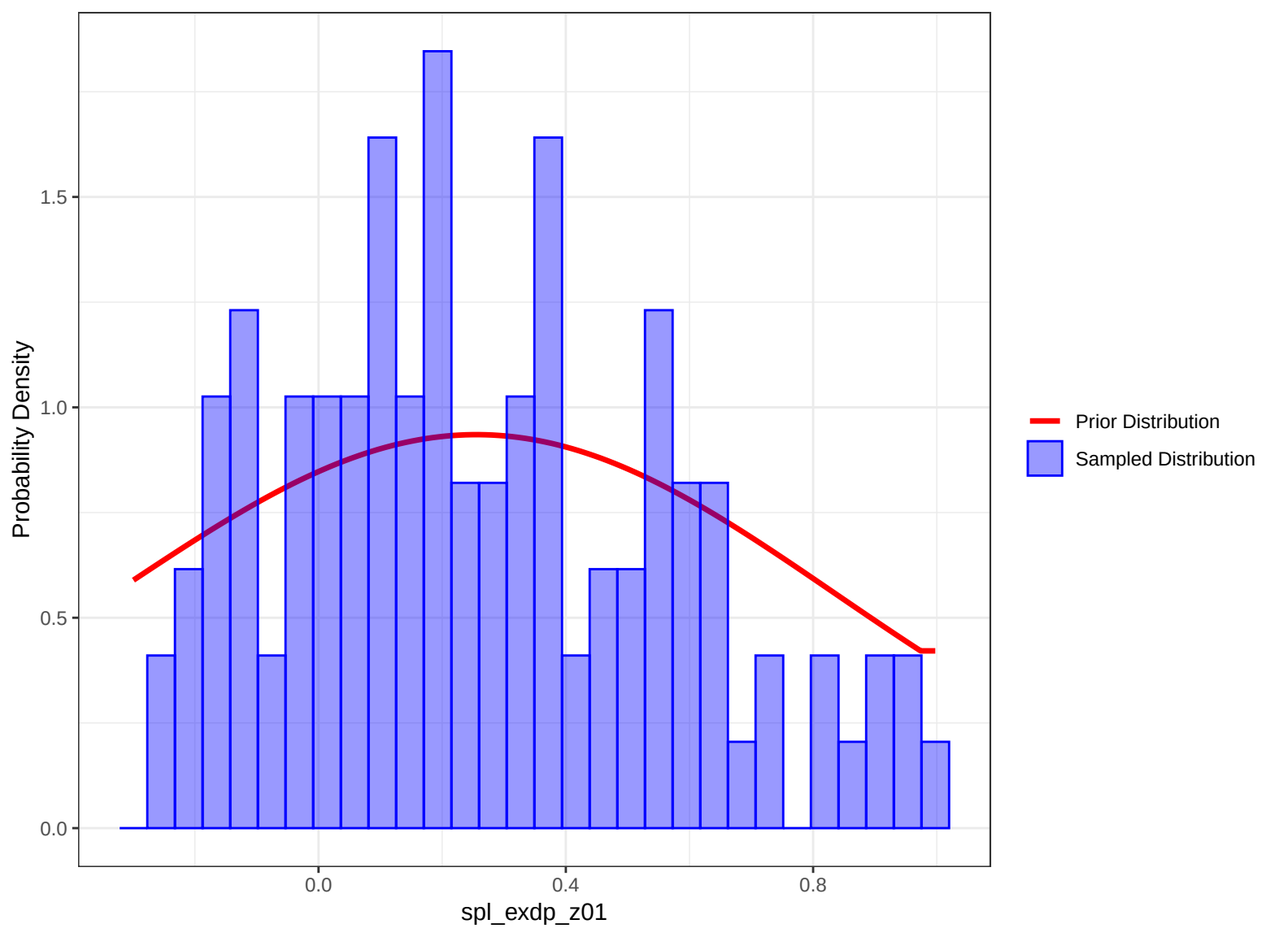

Probability Density
1.0
0.5
0.0
−4.0
−3.5
−3.0
−2.5
−2.0
rivk_z11
Prior Distribution
Sampled Distribution

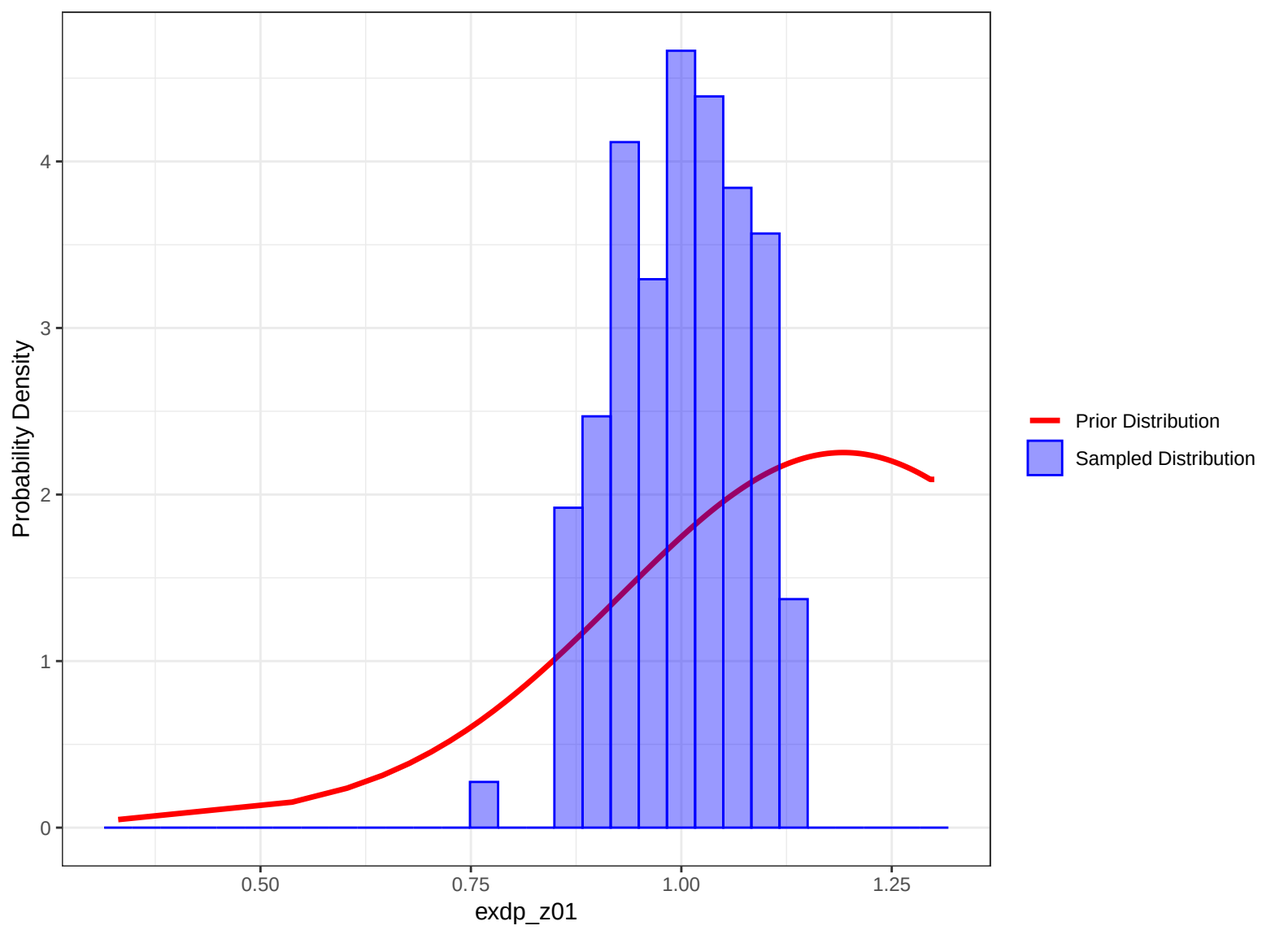

Probability Density
1.5
1.0
0.5
0.0
−2.0
−1.5
−1.0
−0.5
0.0
spl_kz_z01
Prior Distribution
Sampled Distribution

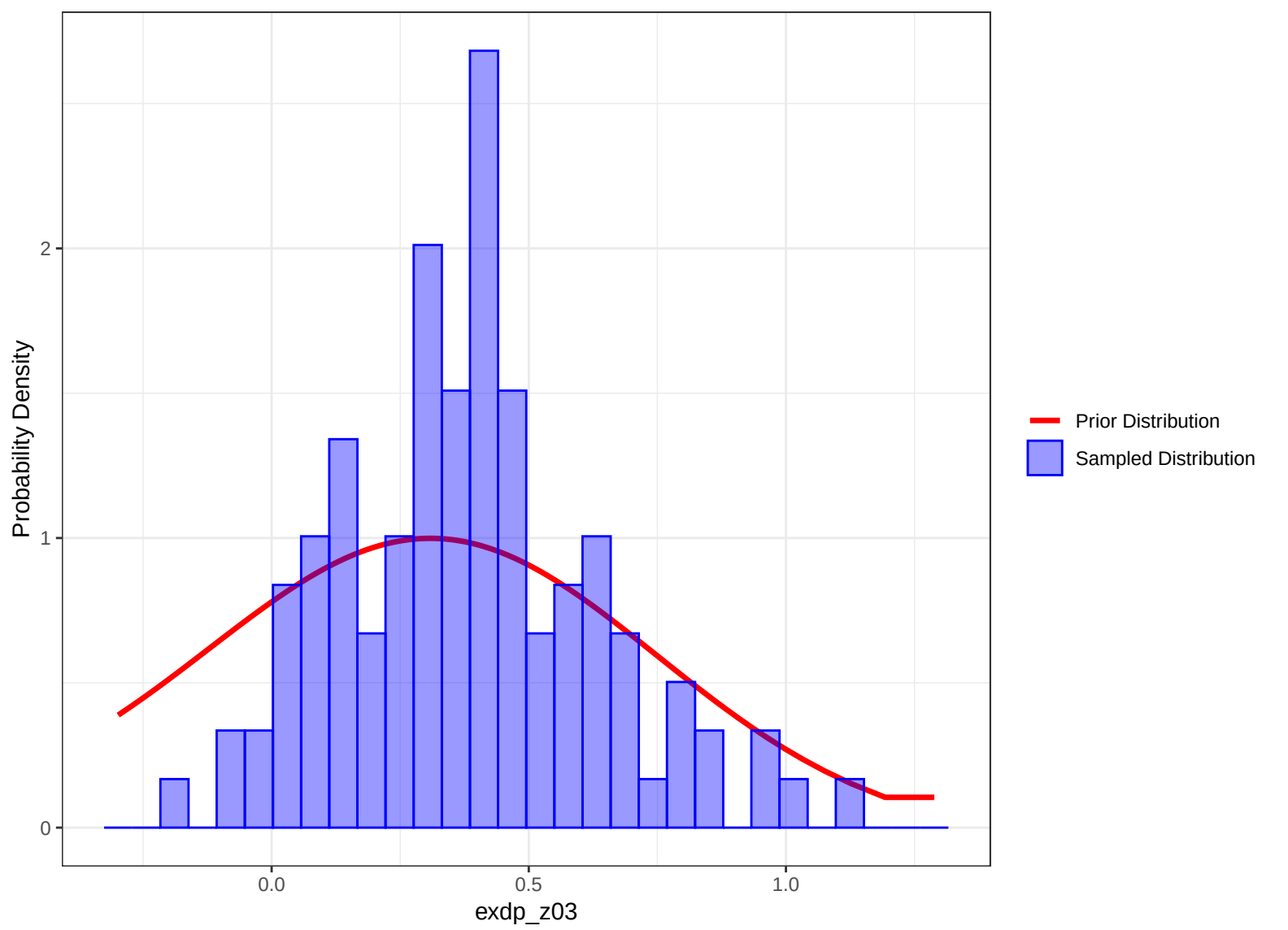

Probability Density
0.0
0.5
1.0
1.5
2.0
−2.0
−1.5
−1.0
spl_sy_z01
Prior Distribution
Sampled Distribution

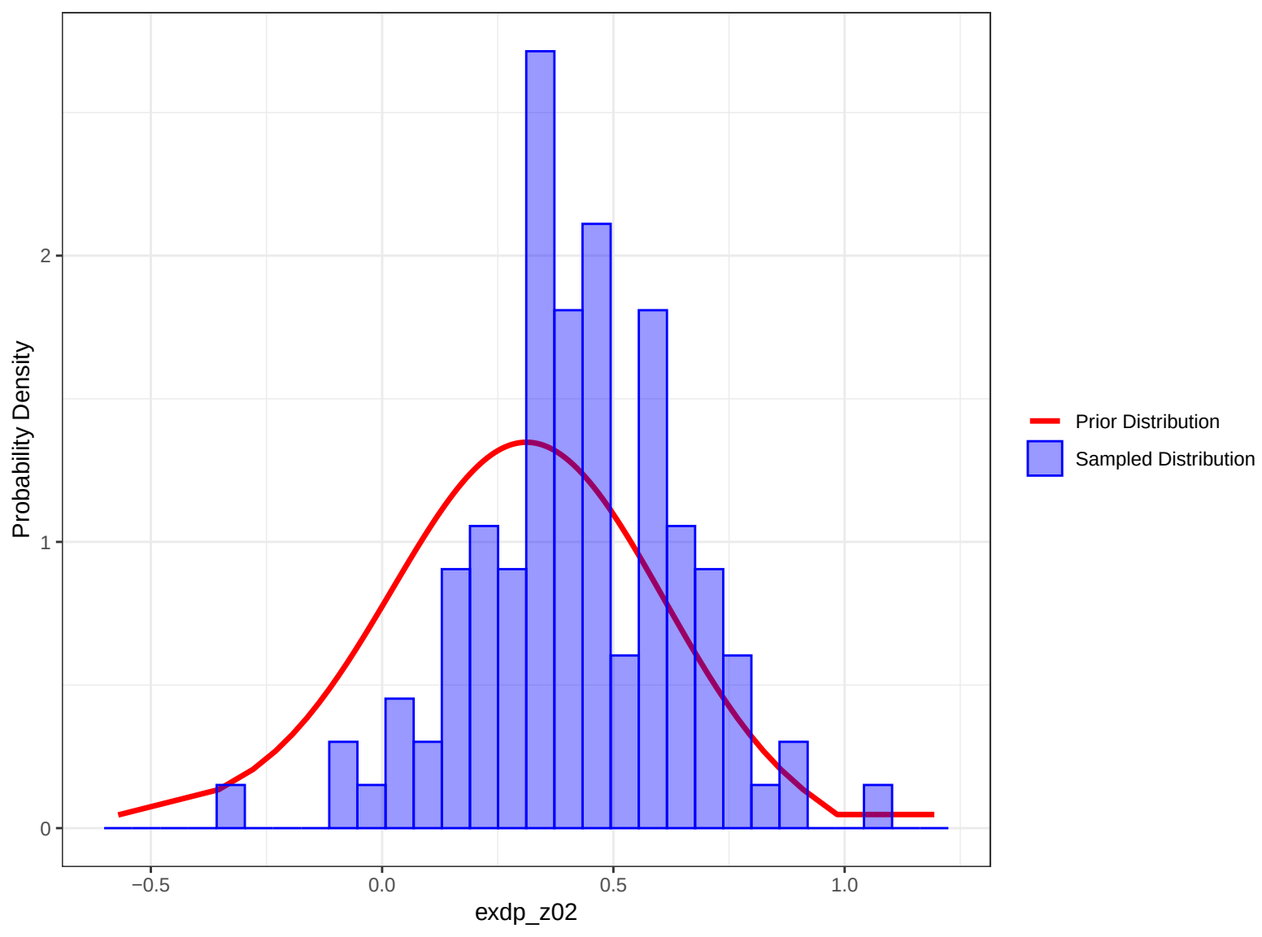

Probability Density
0
1
2
3
4
−0.4
−0.2
0.0
0.2
0.4
spl_rchf_z01
Prior Distribution
Sampled Distribution

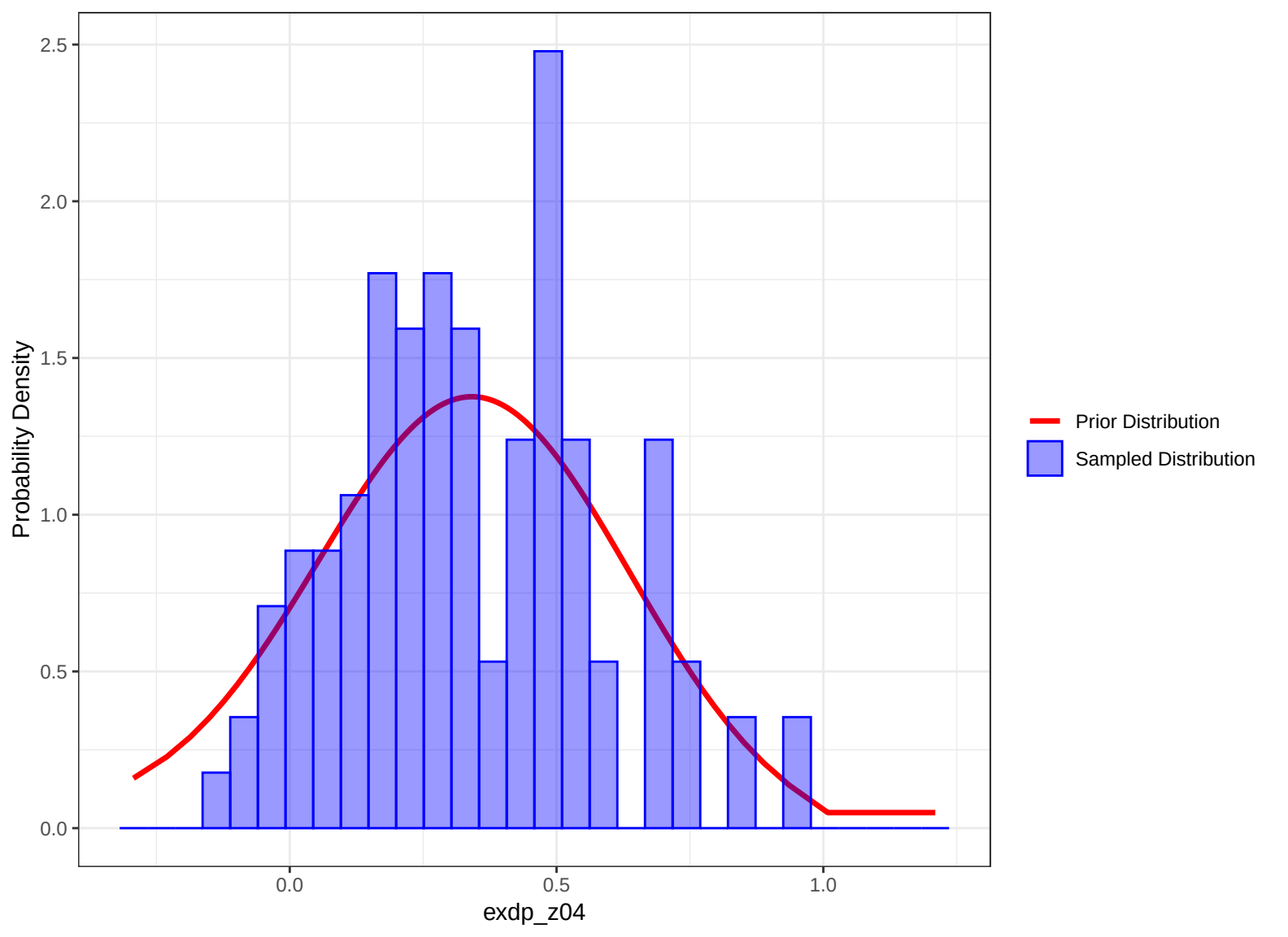

Probability Density
0.0
0.2
0.4
0.6
0.8
−7
−6
−5
−4
spl_ss_z01
Prior Distribution
Sampled Distribution

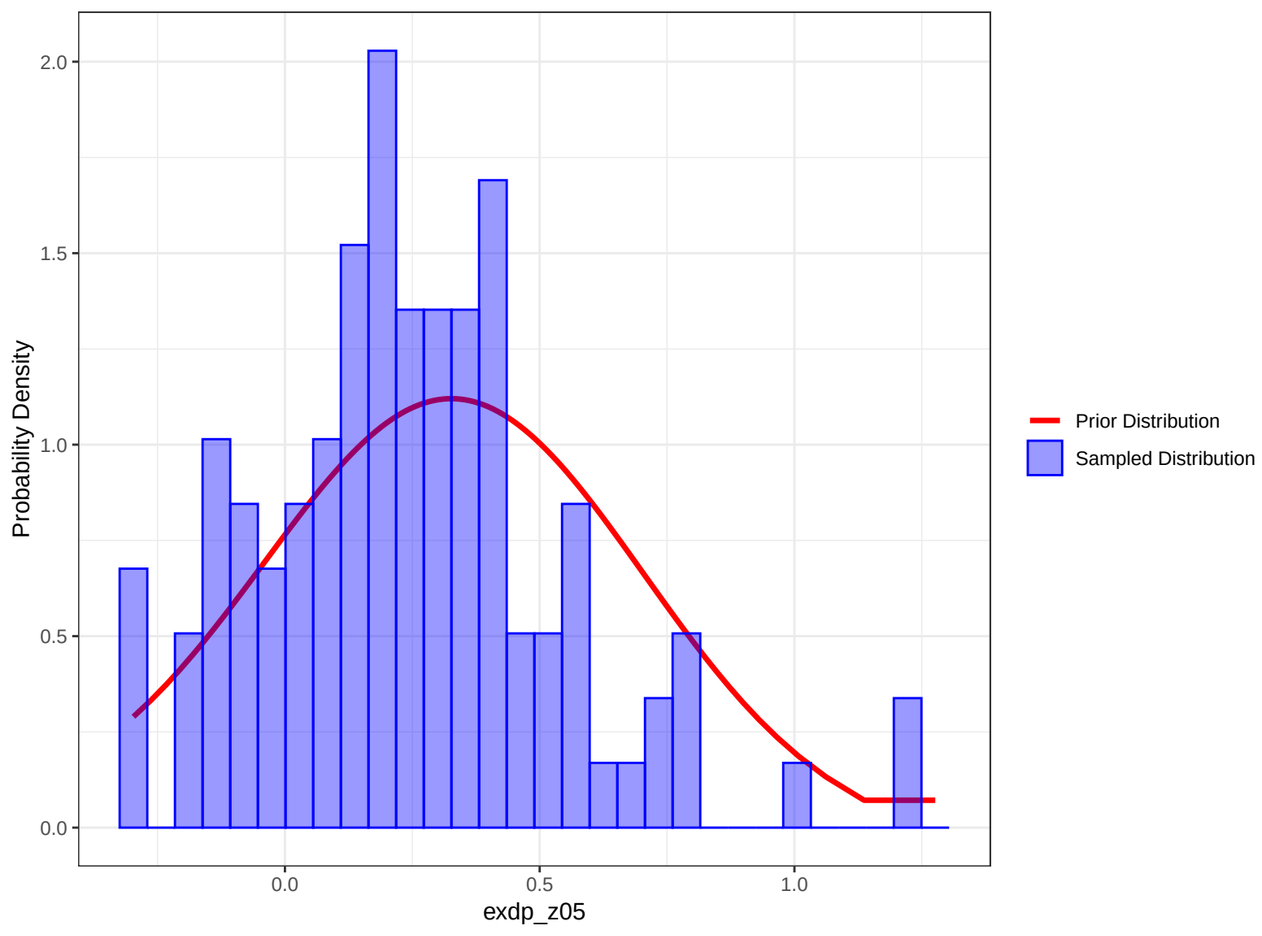

Probability Density
0.0
0.5
1.0
1.5
0.0
0.4
0.8
spl_exdp_z01
Prior Distribution
Sampled Distribution

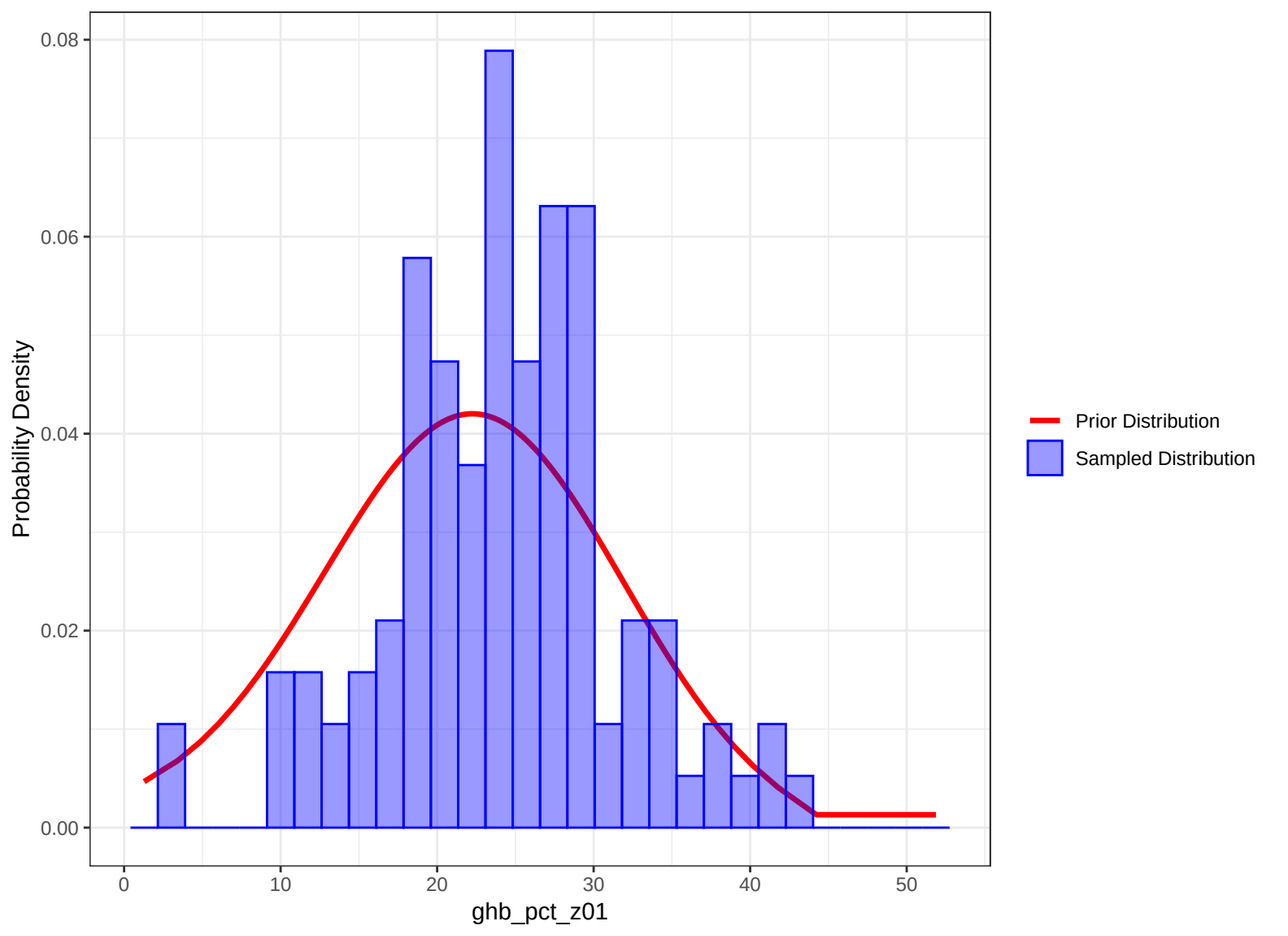

Probability Density
0
1
2
3
4
0.50
0.75
1.00
1.25
exdp_z01
Prior Distribution
Sampled Distribution

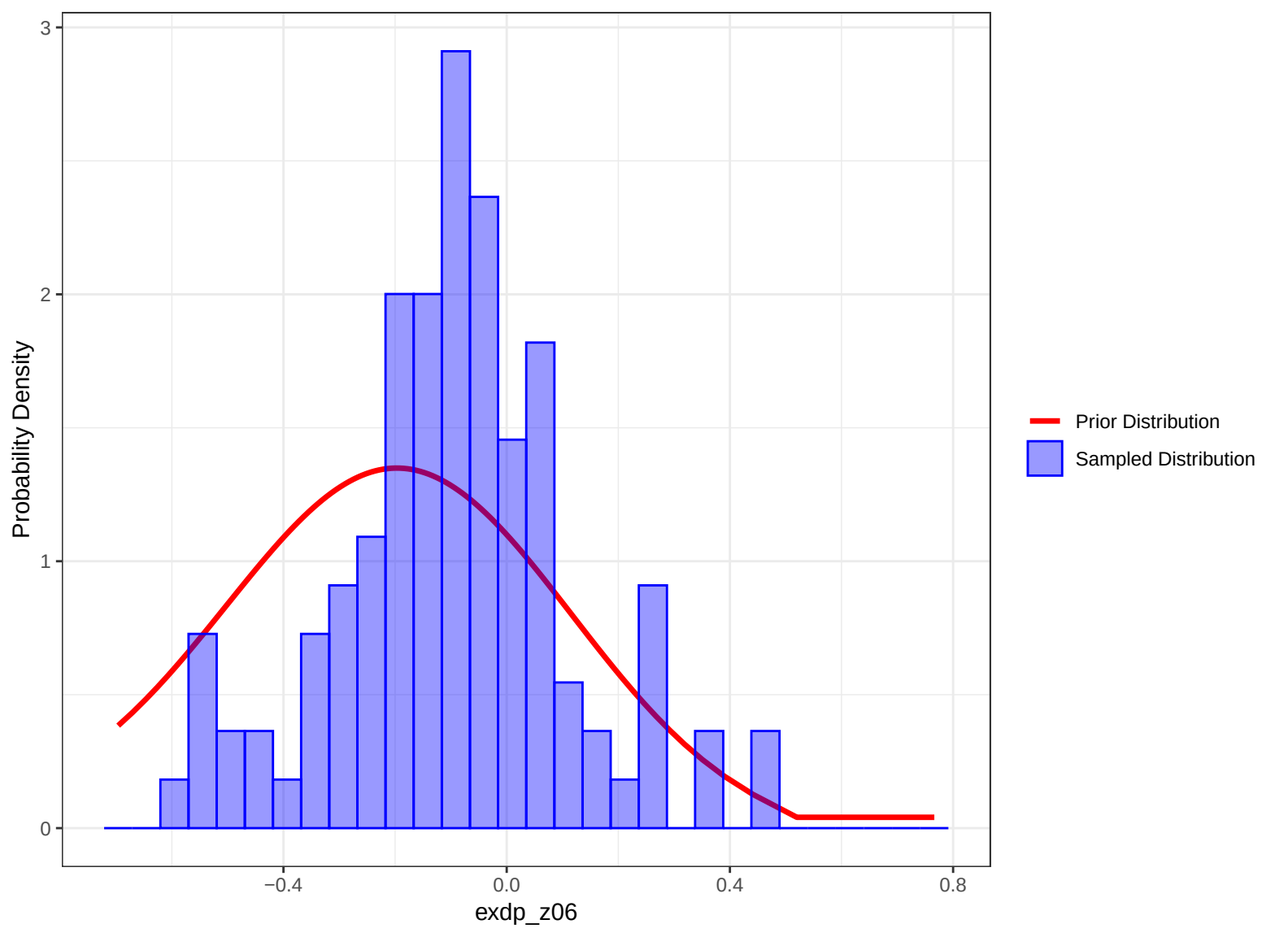

Probability Density
0
1
2
0.0
0.5
1.0
exdp_z03
Prior Distribution
Sampled Distribution

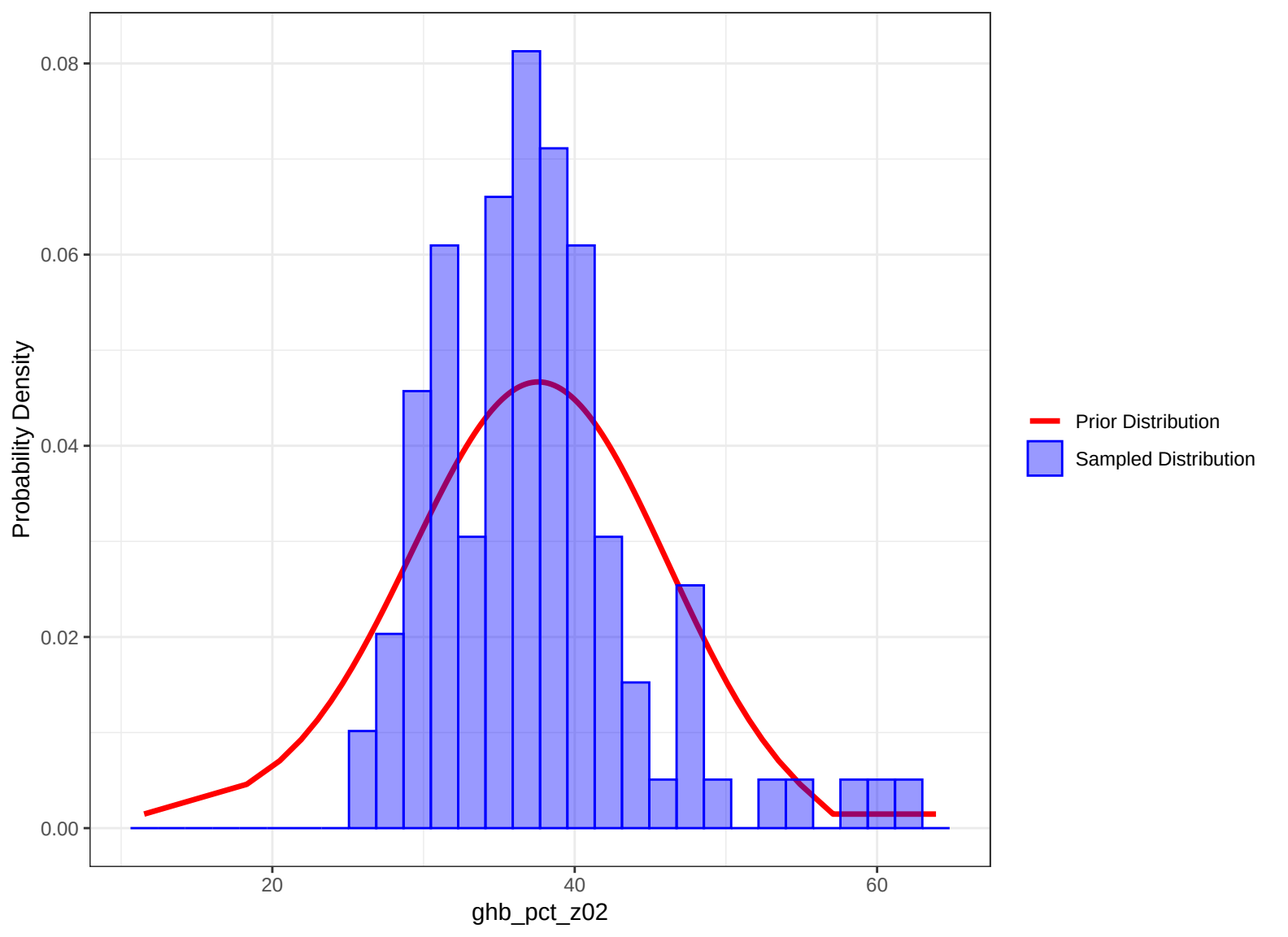

Probability Density
0
1
2
−0.5
0.0
0.5
1.0
exdp_z02
Prior Distribution
Sampled Distribution

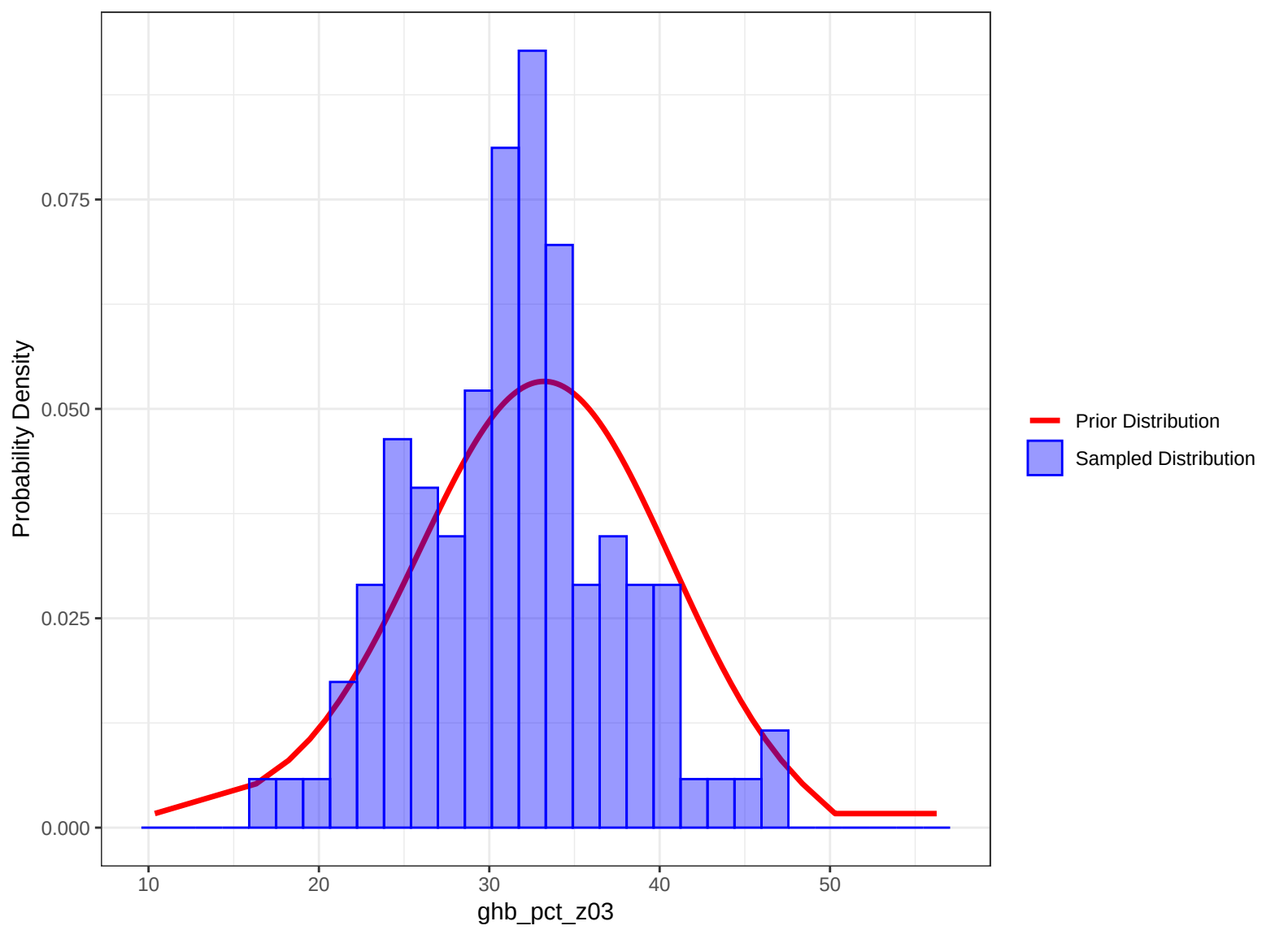

Probability Density
0.0
0.5
1.0
1.5
2.0
2.5
0.0
0.5
1.0
exdp_z04
Prior Distribution
Sampled Distribution

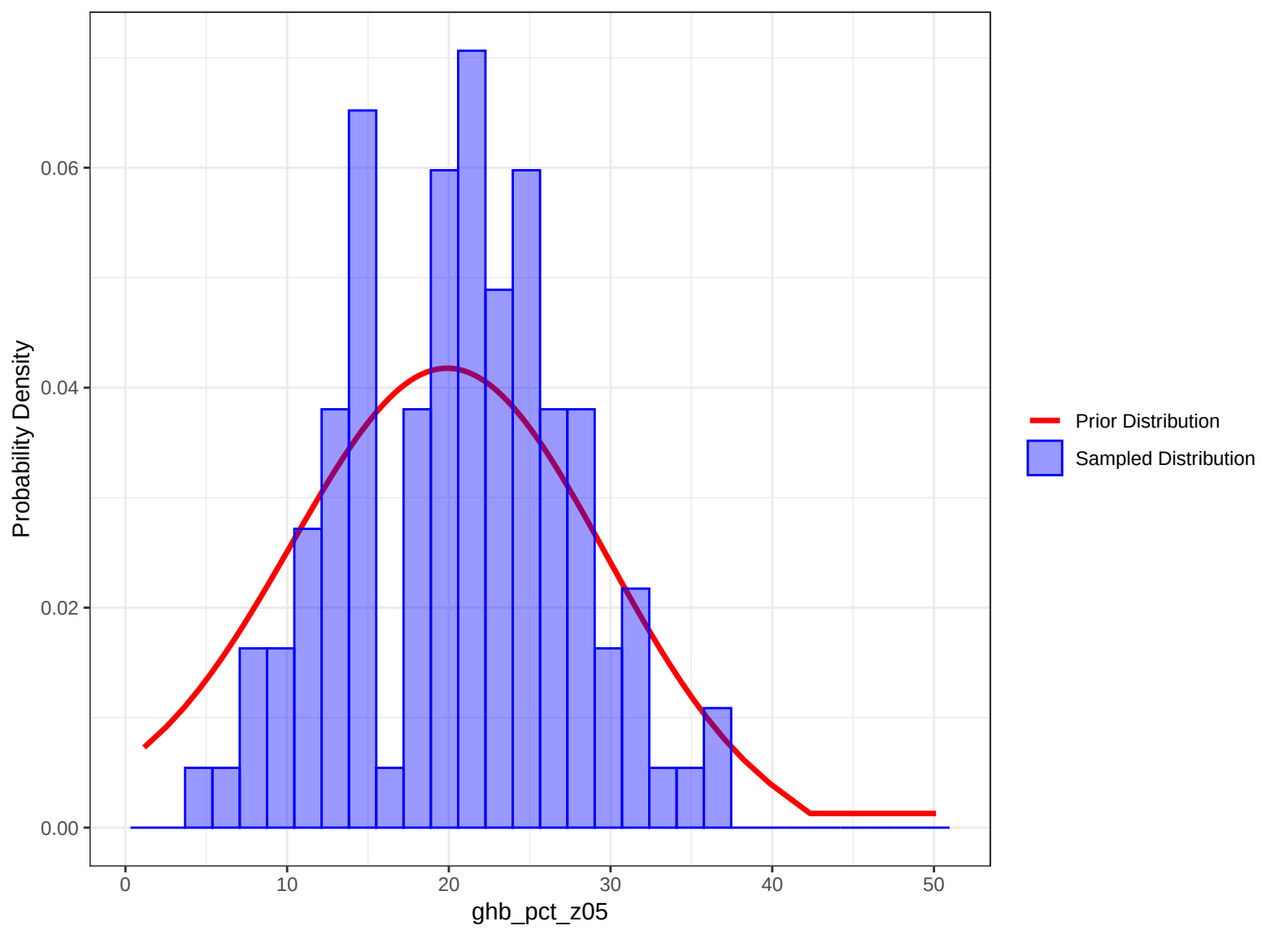

Probability Density
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
exdp_z05
Prior Distribution
Sampled Distribution

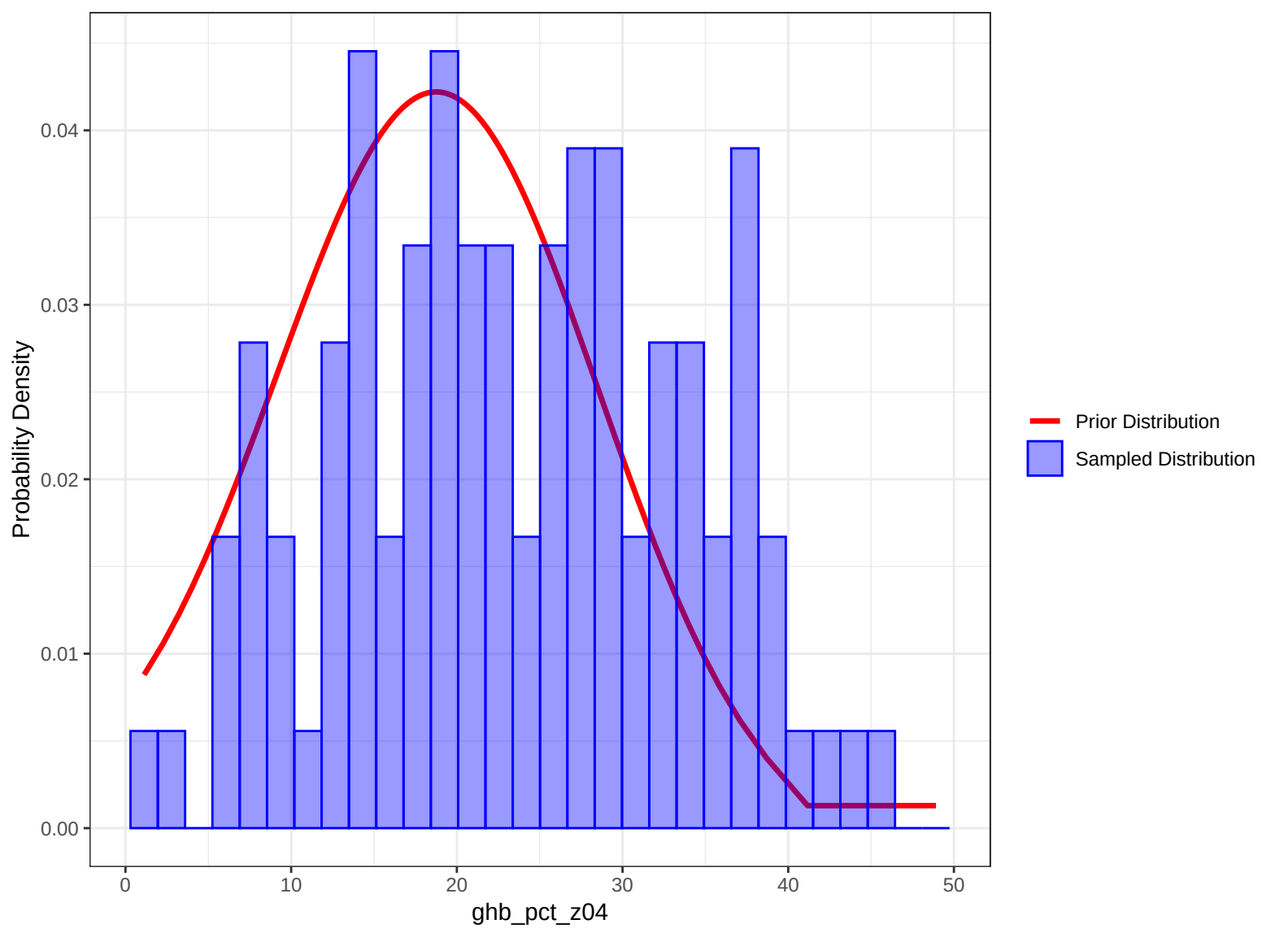

Probability Density
0.08
0.06
0.04
0.02
0.00
0
10
20
30
40
50
ghb_pct_z01
Prior Distribution
Sampled Distribution

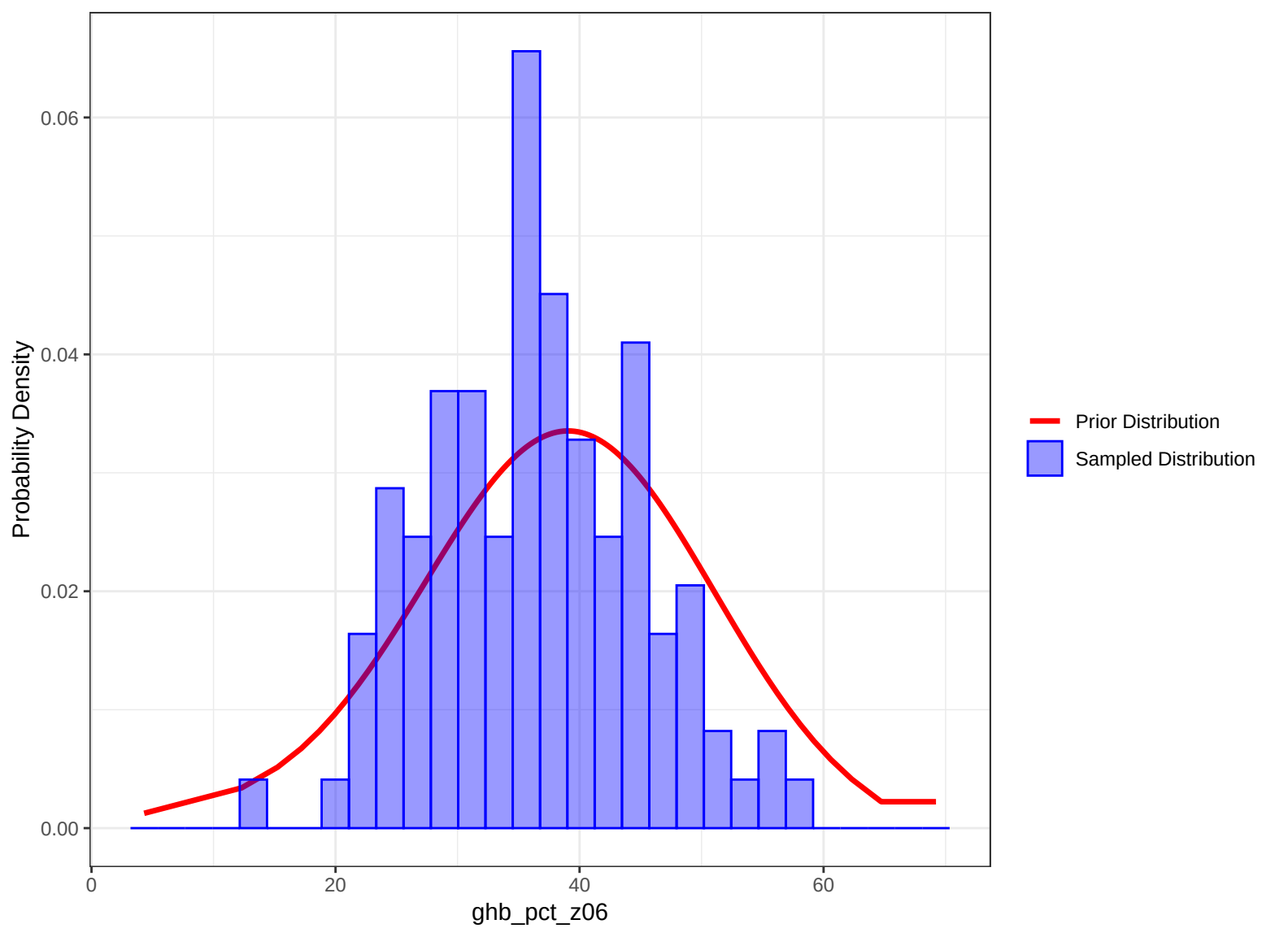

Probability Density
3
2
1
0
−0.4
0.0
0.4
0.8
exdp_z06
Prior Distribution
Sampled Distribution

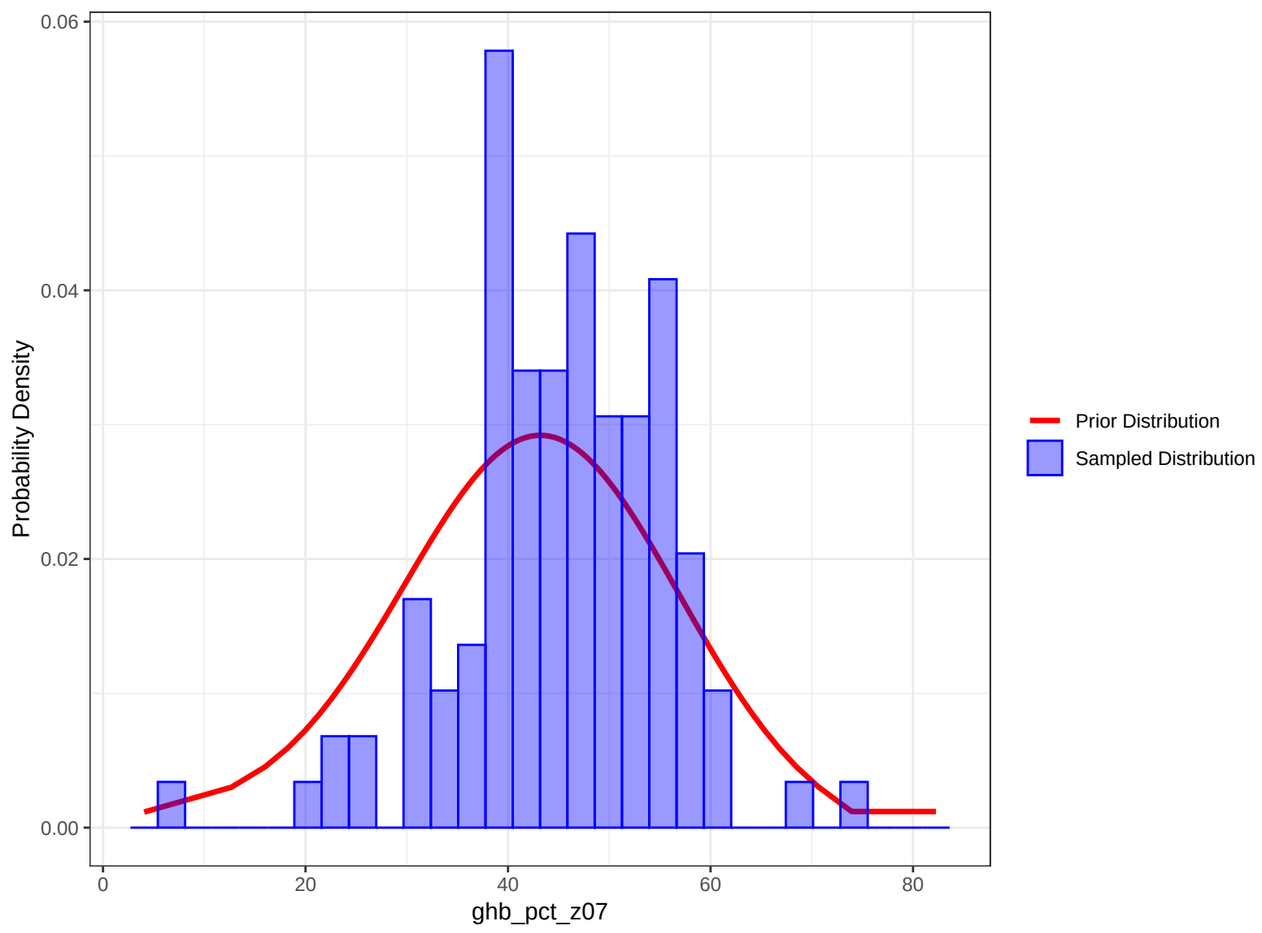

Probability Density
0.08
0.06
0.04
0.02
0.00
20
40
60
ghb_pct_z02
Prior Distribution
Sampled Distribution

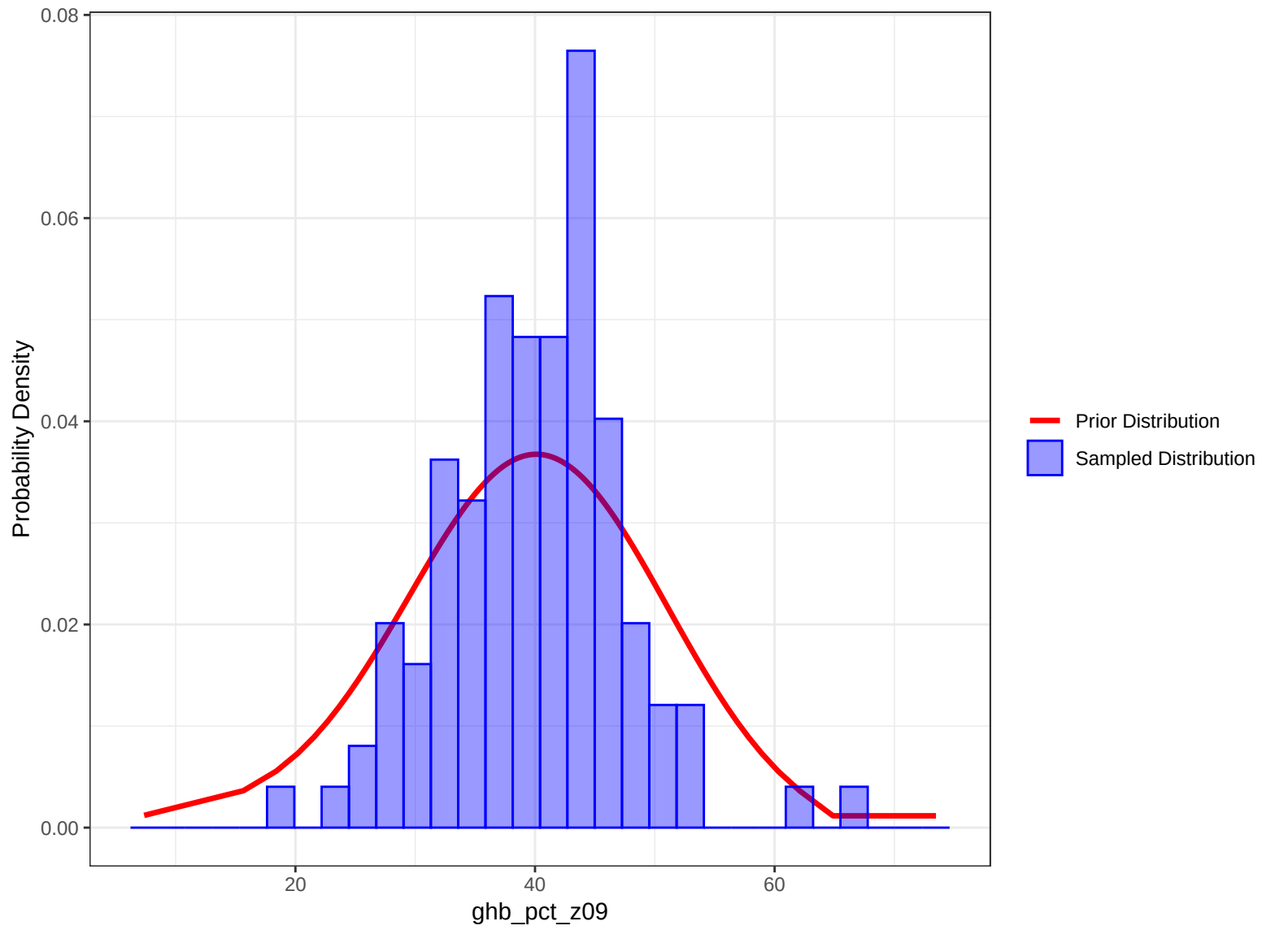

Probability Density
0.075
0.050
0.025
0.000
10
20
30
40
50
ghb_pct_z03
Prior Distribution
Sampled Distribution

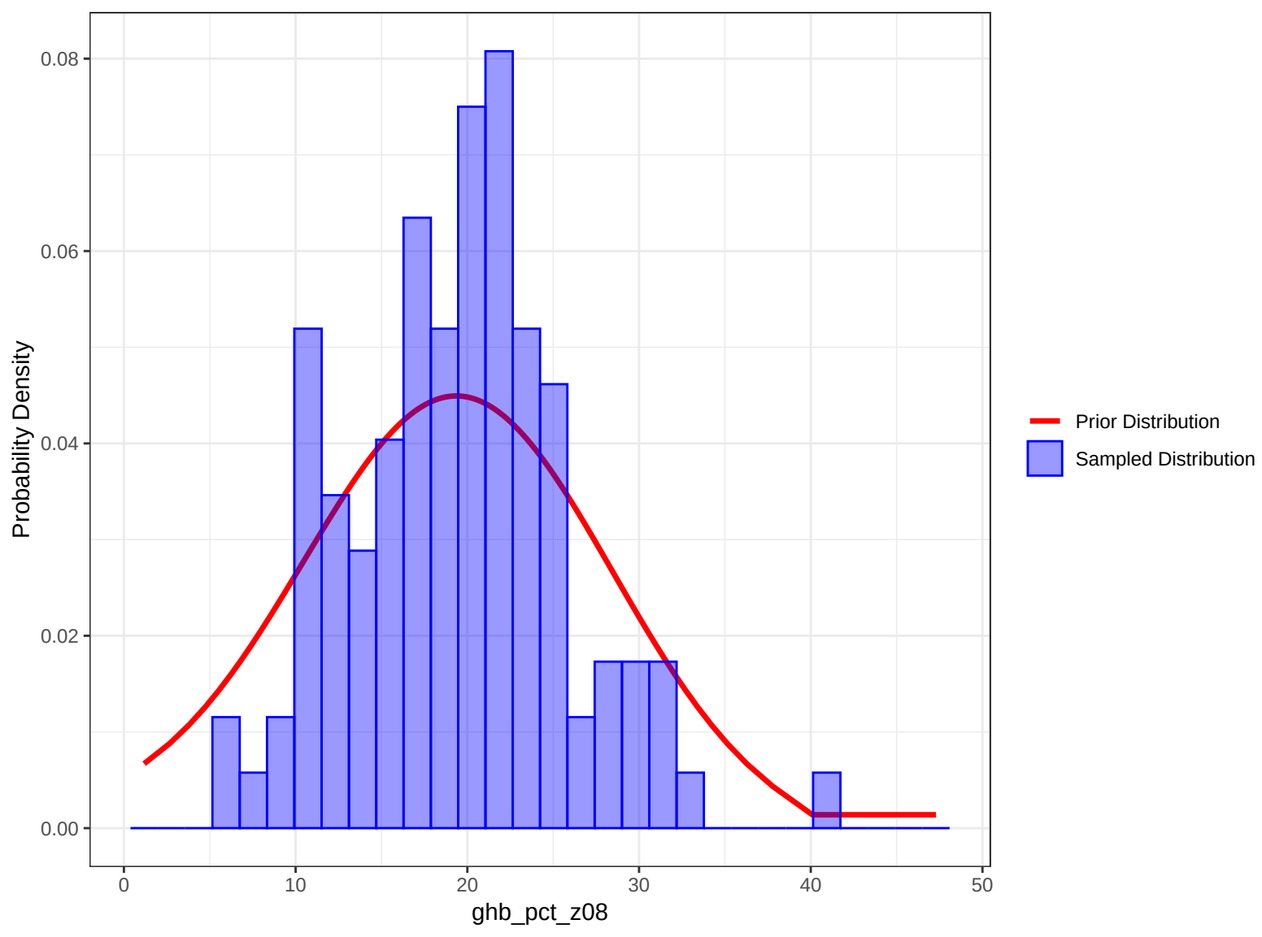

Probability Density
0.06
0.04
0.02
0.00
0
10
20
30
40
50
ghb_pct_z05
Prior Distribution
Sampled Distribution

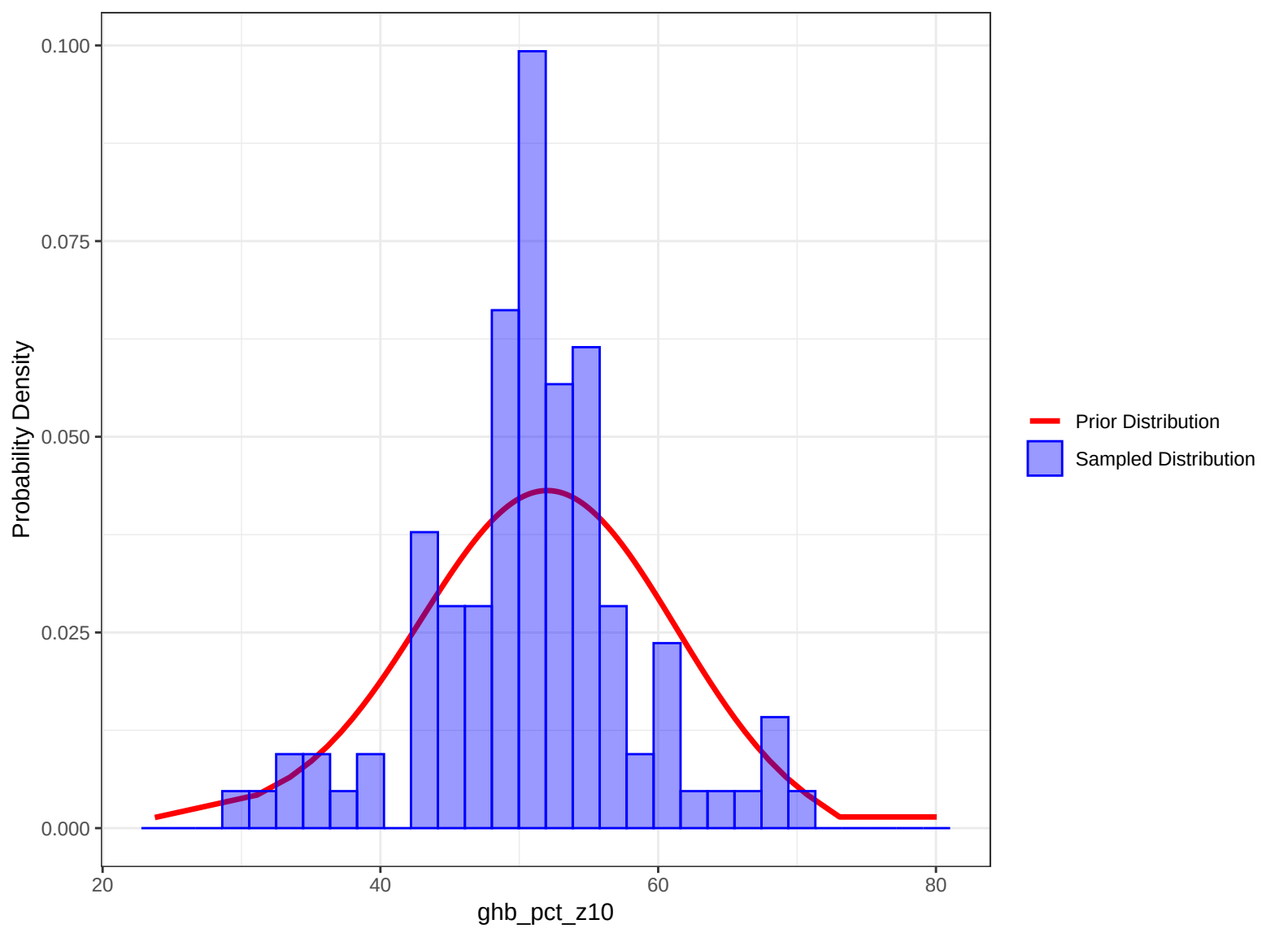

Probability Density
0.04
0.03
0.02
0.01
0.00
0
10
20
30
40
50
ghb_pct_z04
Prior Distribution
Sampled Distribution

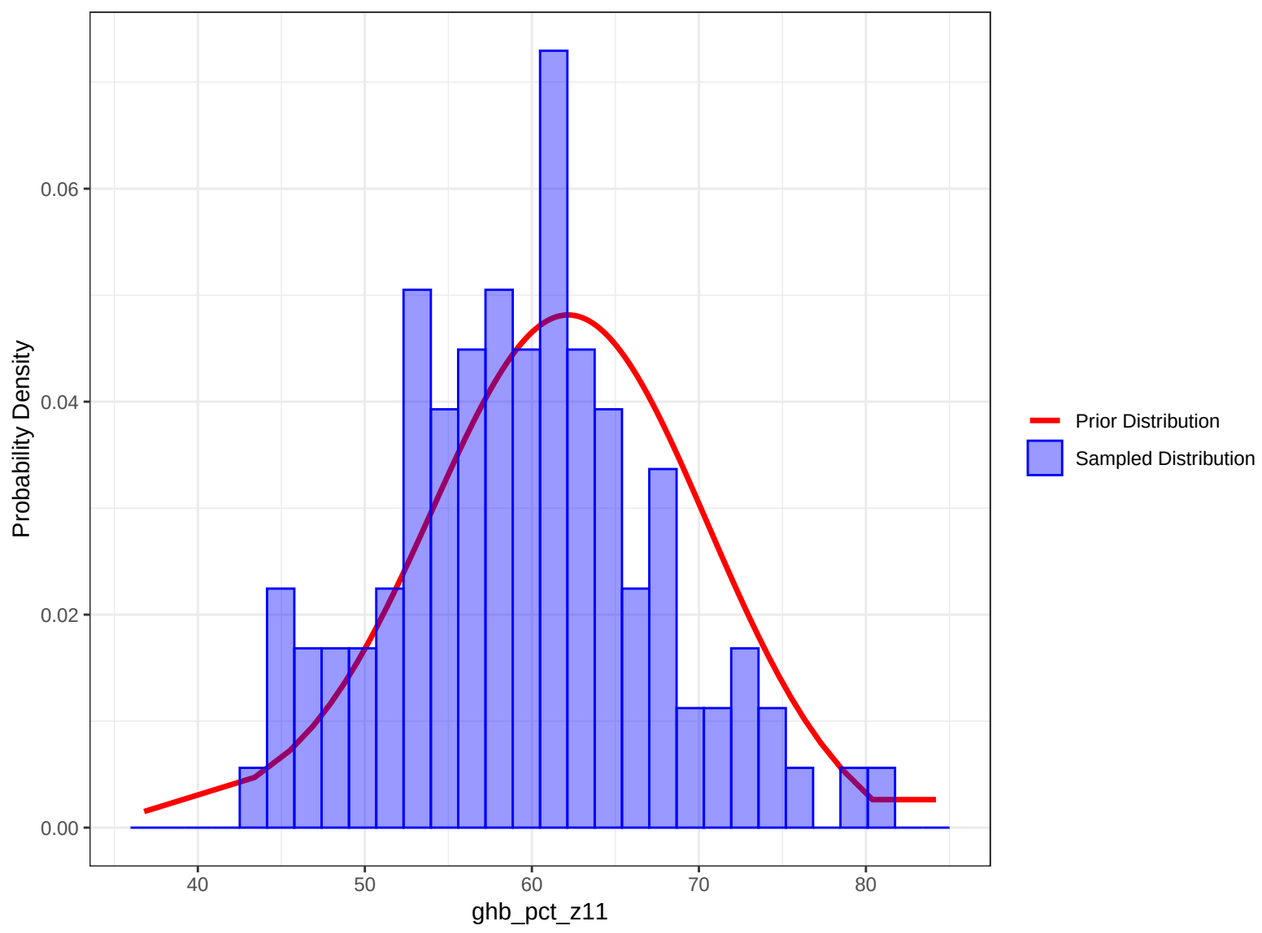

Probability Density
0.06
0.04
0.02
0.00
0
20
40
60
ghb_pct_z06
Prior Distribution
Sampled Distribution

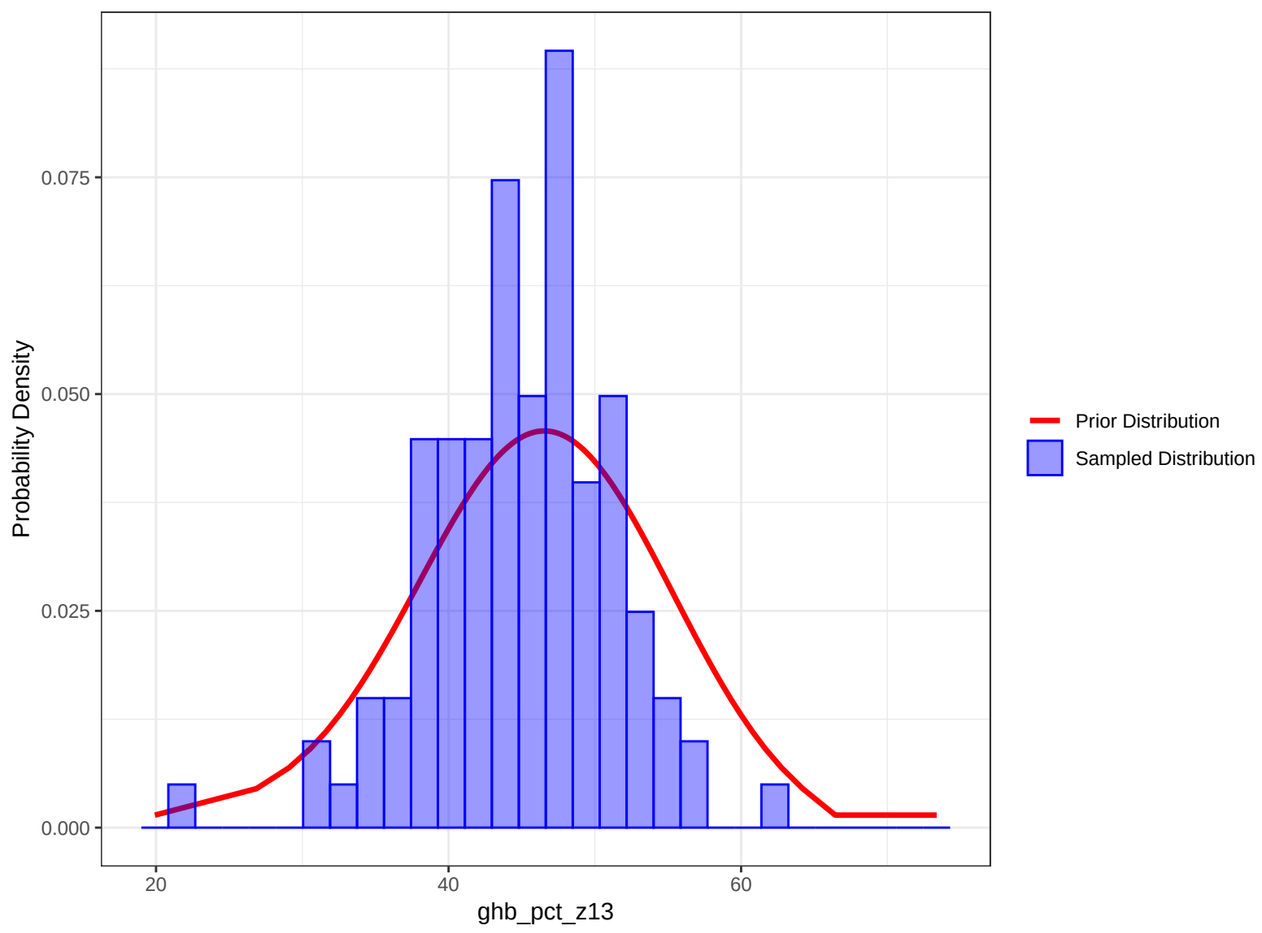

0.06
0.04
0.02
0.00
Probability Density
0
20
40
60
80
ghb_pct_z07
Prior Distribution
Sampled Distribution

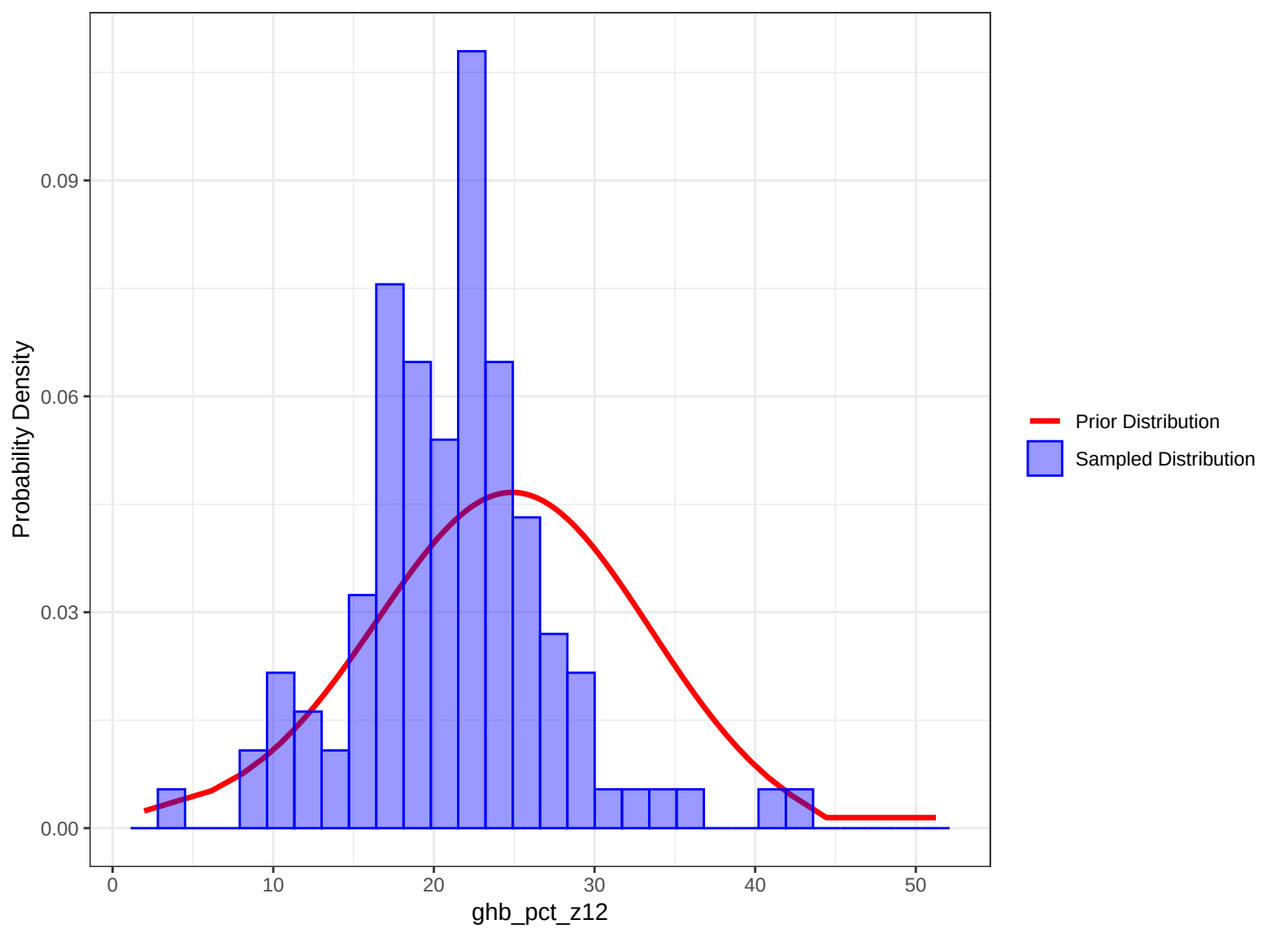

0.08
0.06
0.04
0.02
0.00
Probability Density
20
40
60
ghb_pct_z09
Prior Distribution
Sampled Distribution

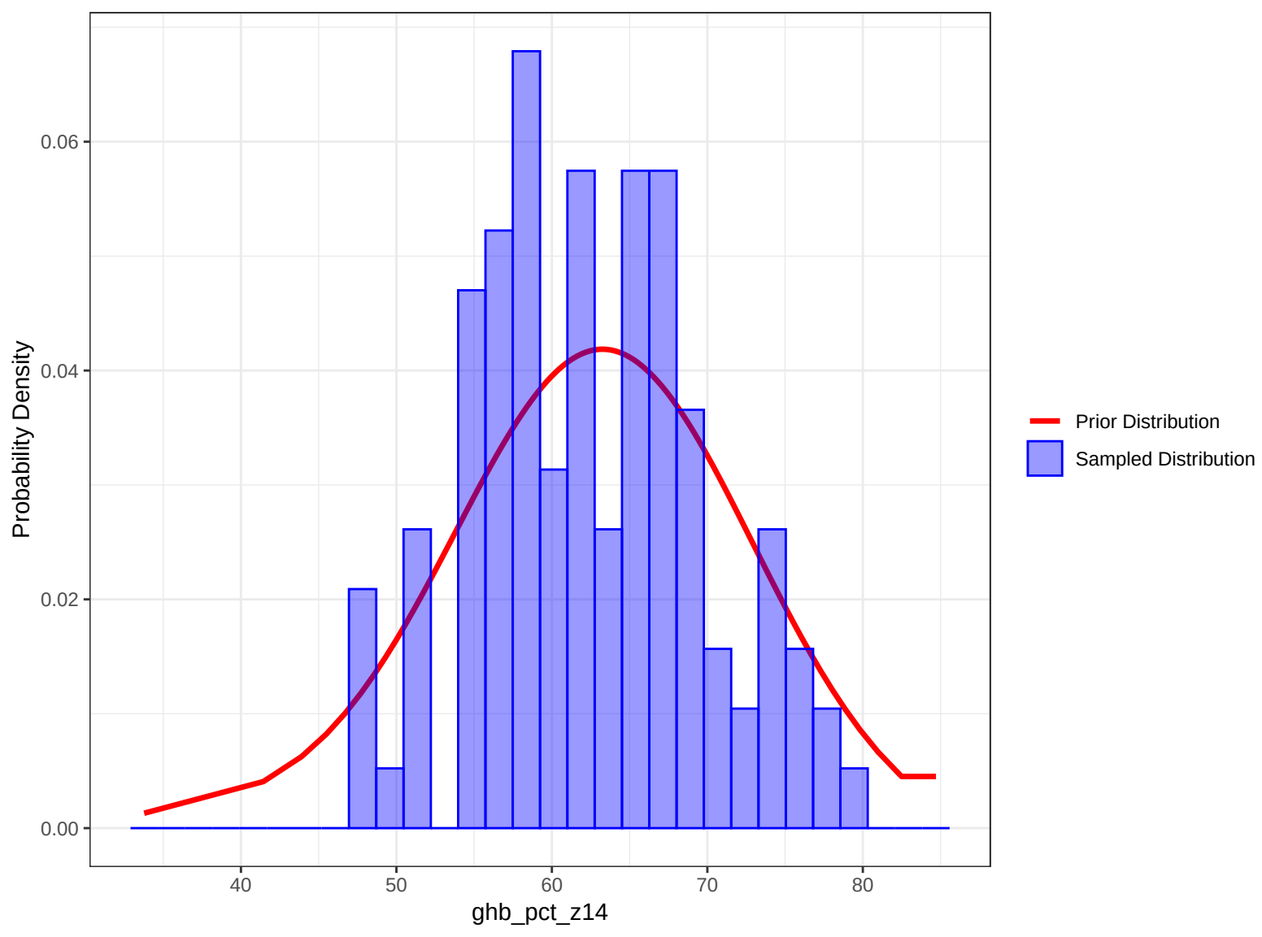

0.08
0.06
0.04
0.02
0.00
Probability Density
0
10
20
30
40
50
ghb_pct_z08
Prior Distribution
Sampled Distribution

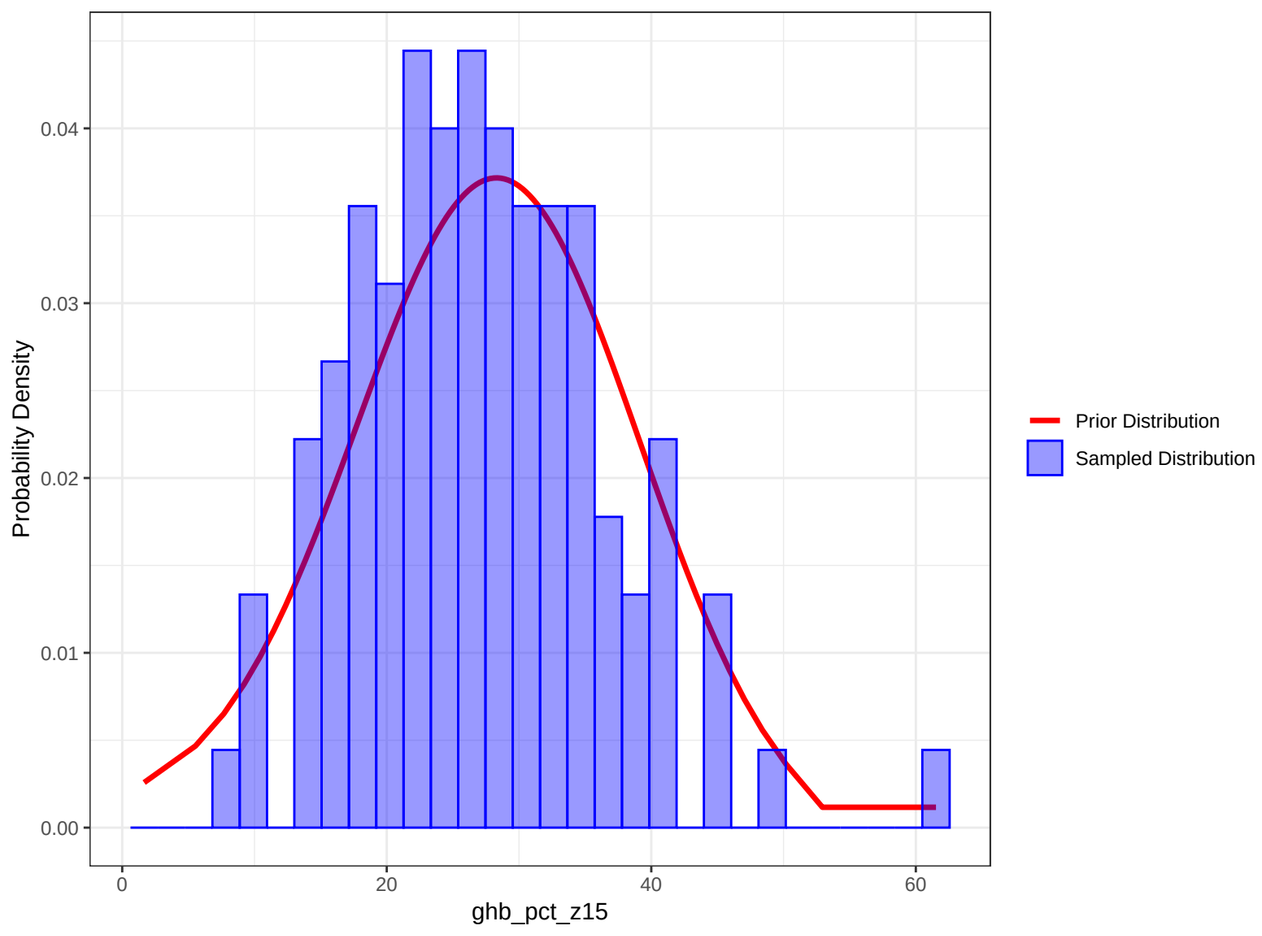

0.100
0.075
0.050
0.025
0.000
Probability Density
20
40
60
80
ghb_pct_z10
Prior Distribution
Sampled Distribution

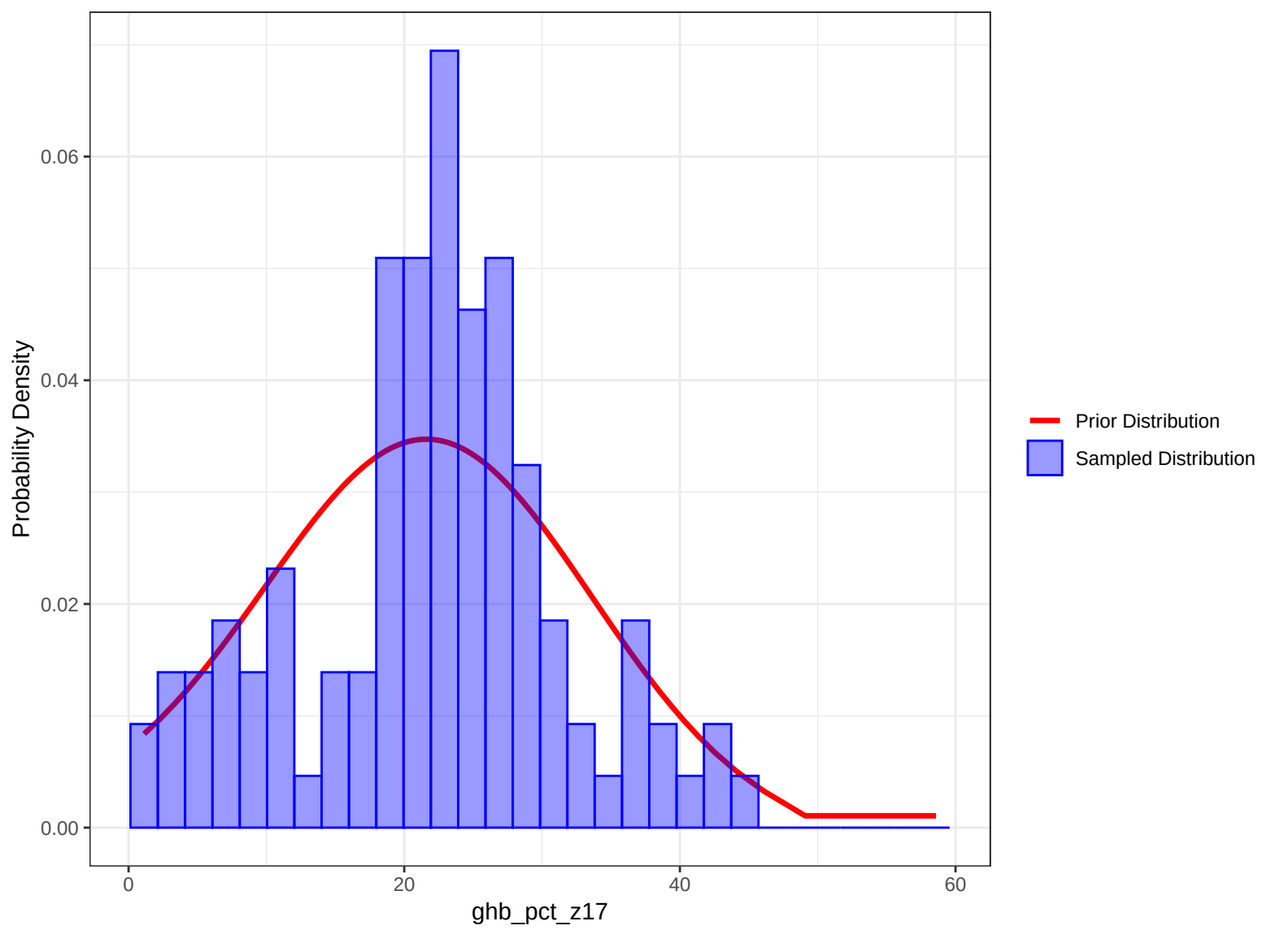

Probability Density
0.06
0.04
0.02
0.00
40
50
60
70
80
ghb_pct_z11
Prior Distribution
Sampled Distribution

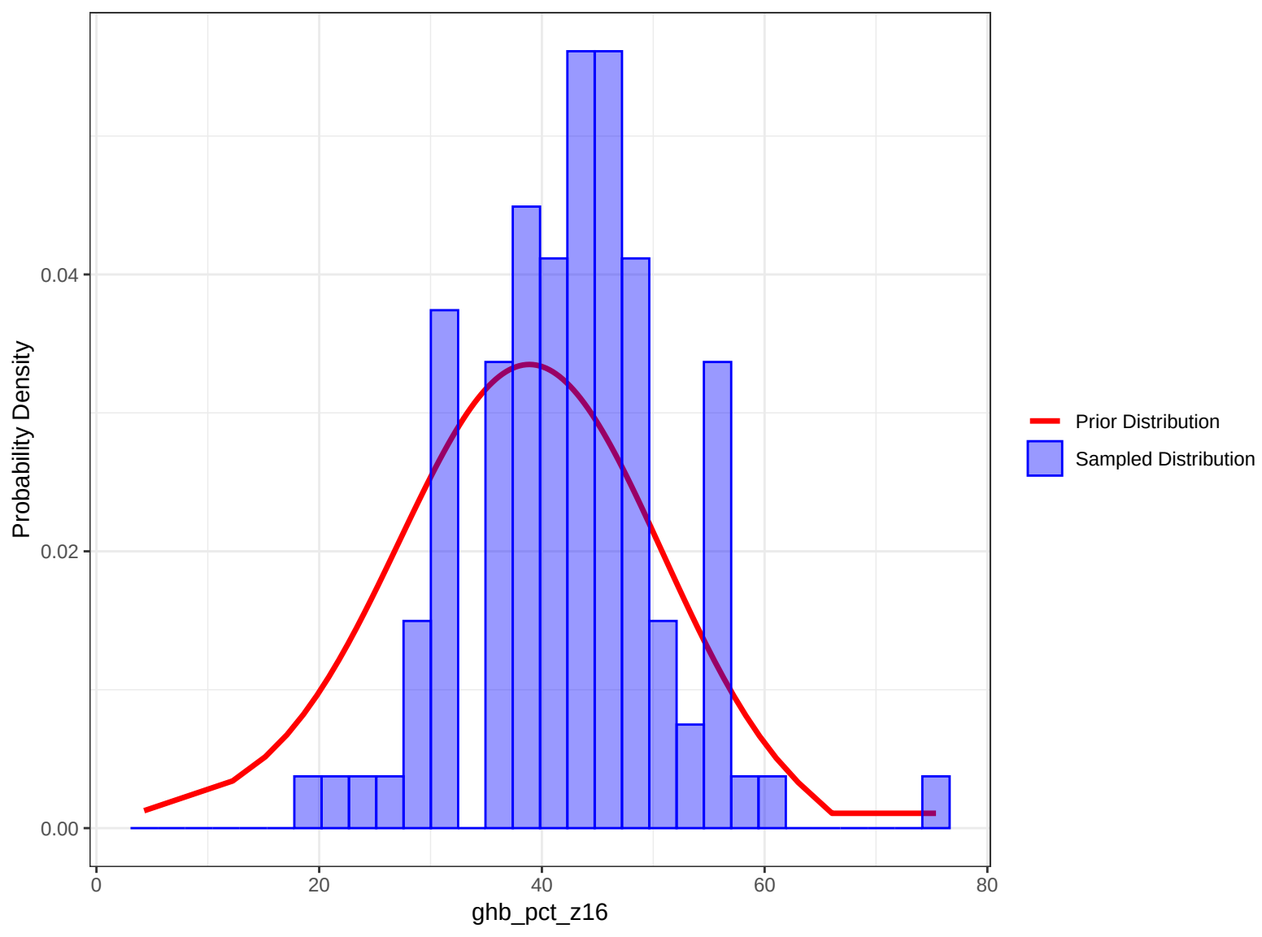

Probability Density
0.075
0.050
0.025
0.000
20
40
60
ghb_pct_z13
Prior Distribution
Sampled Distribution

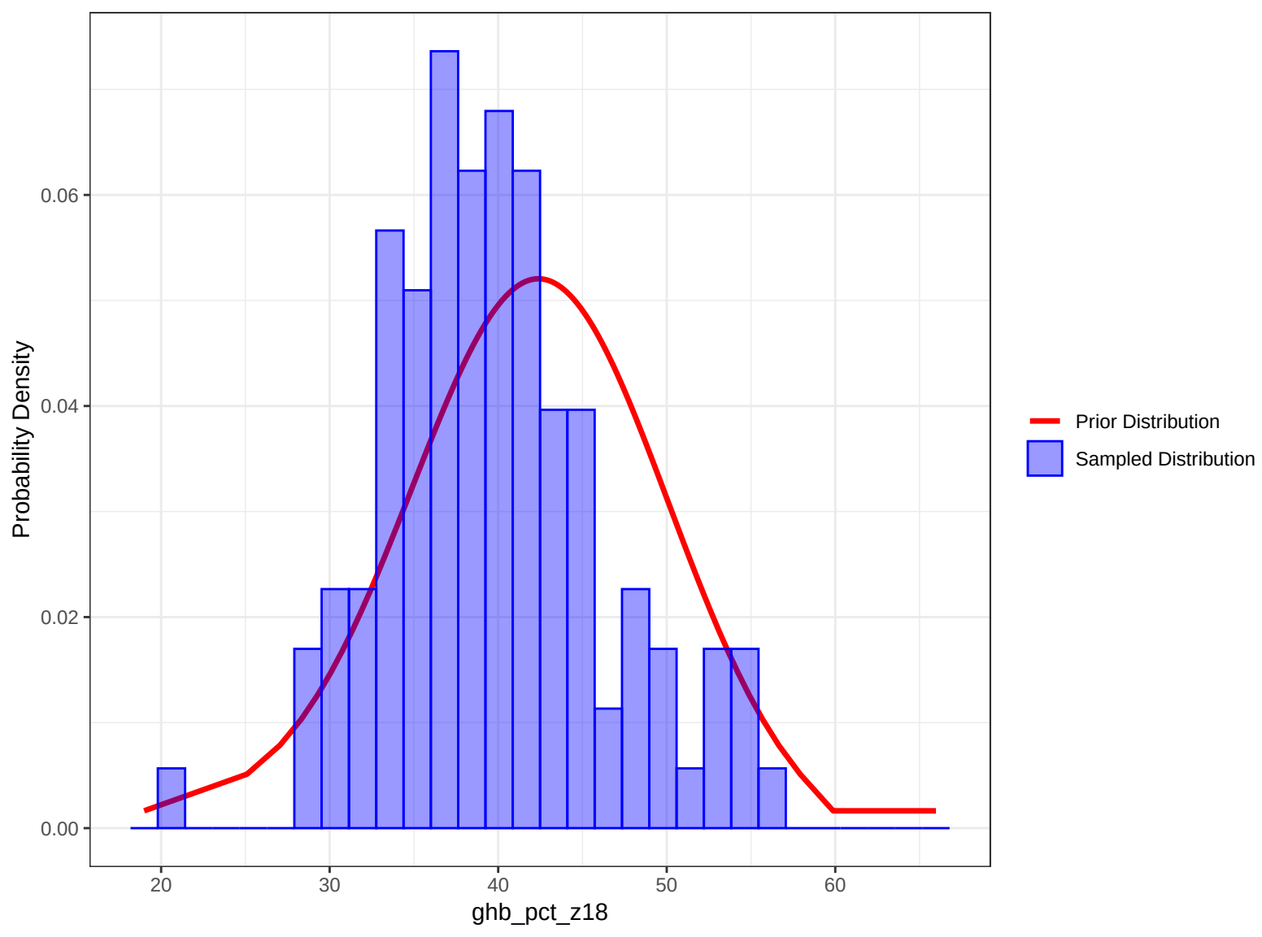

Probability Density
0.09
0.06
0.03
0.00
0
10
20
30
40
50
ghb_pct_z12
Prior Distribution
Sampled Distribution

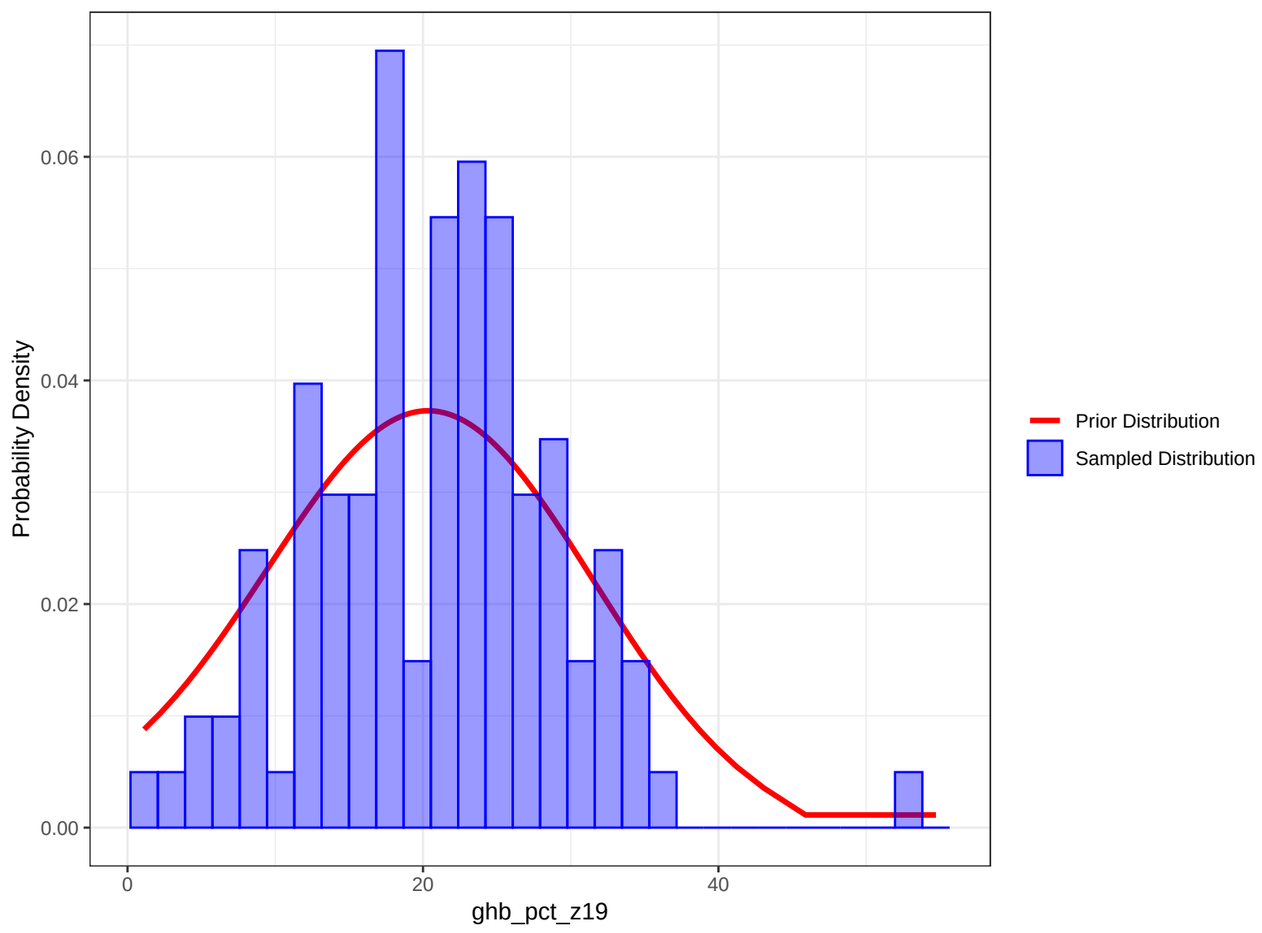

Probability Density
0.06
0.04
0.02
0.00
40
50
60
70
80
ghb_pct_z14
Prior Distribution
Sampled Distribution

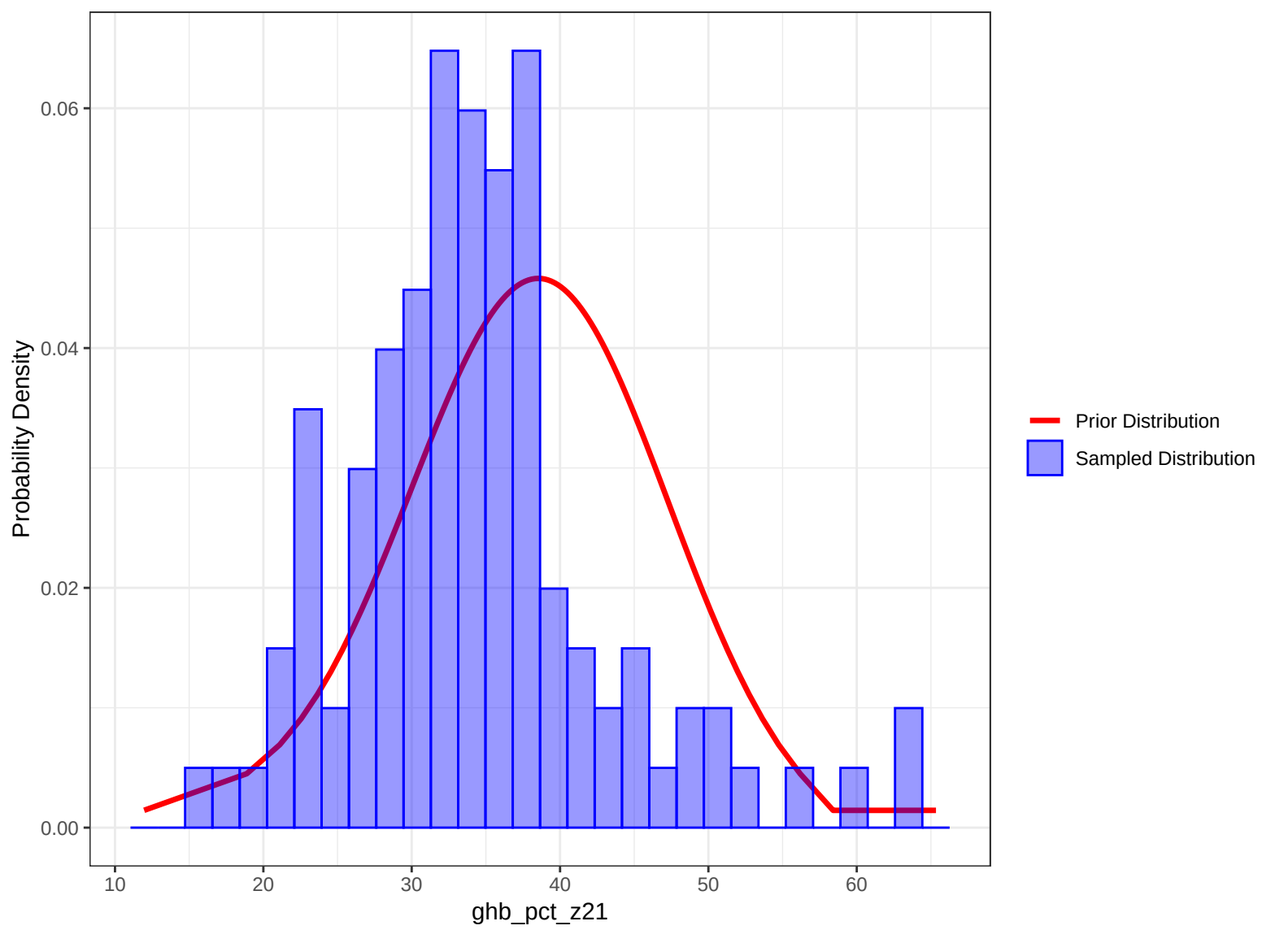

Probability Density
0.00
0.01
0.02
0.03
0.04
0
20
40
60
ghb_pct_z15
Prior Distribution
Sampled Distribution

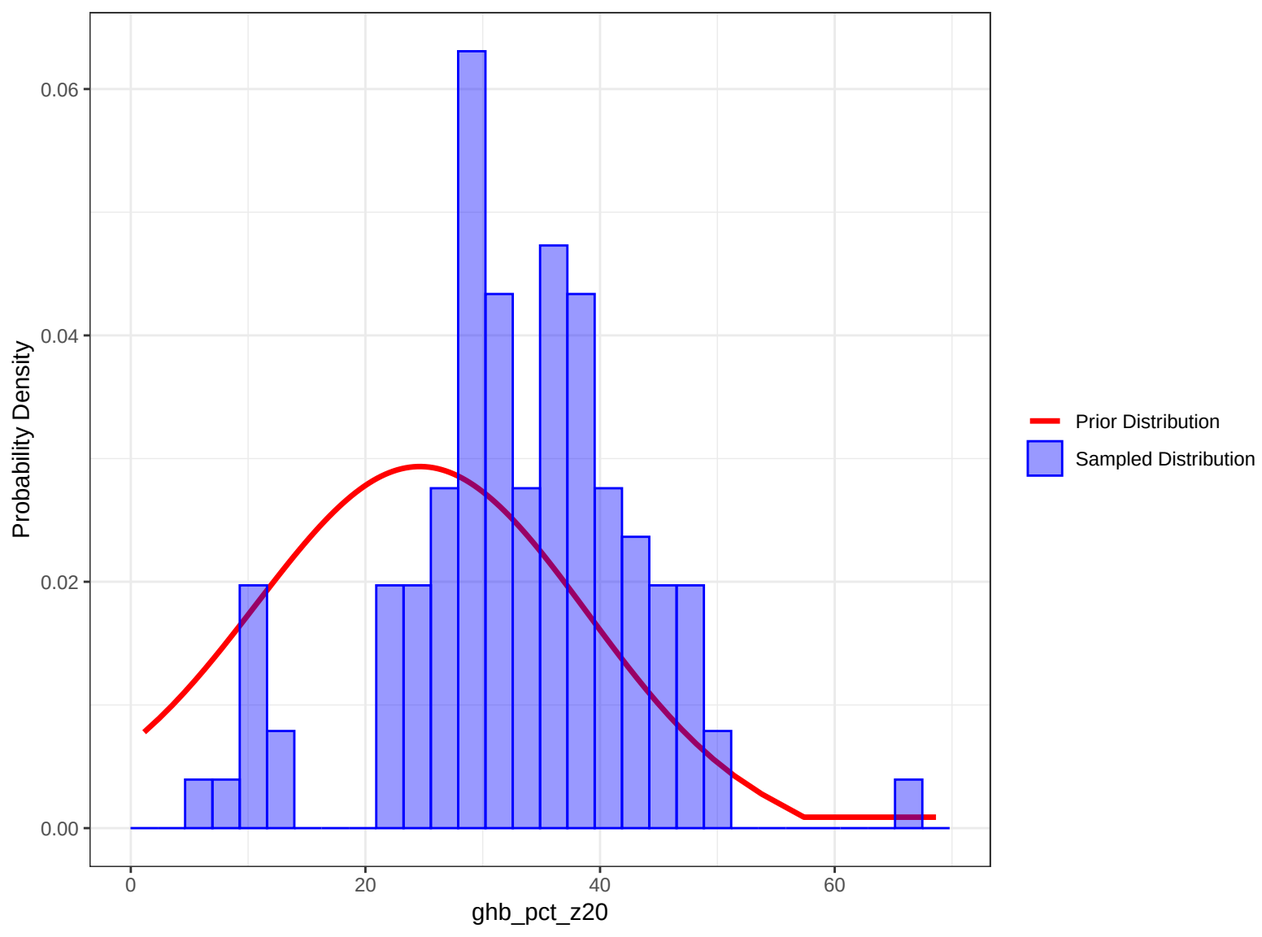

Probability Density
0.00
0.02
0.04
0.06
0
20
40
60
ghb_pct_z17
Prior Distribution
Sampled Distribution

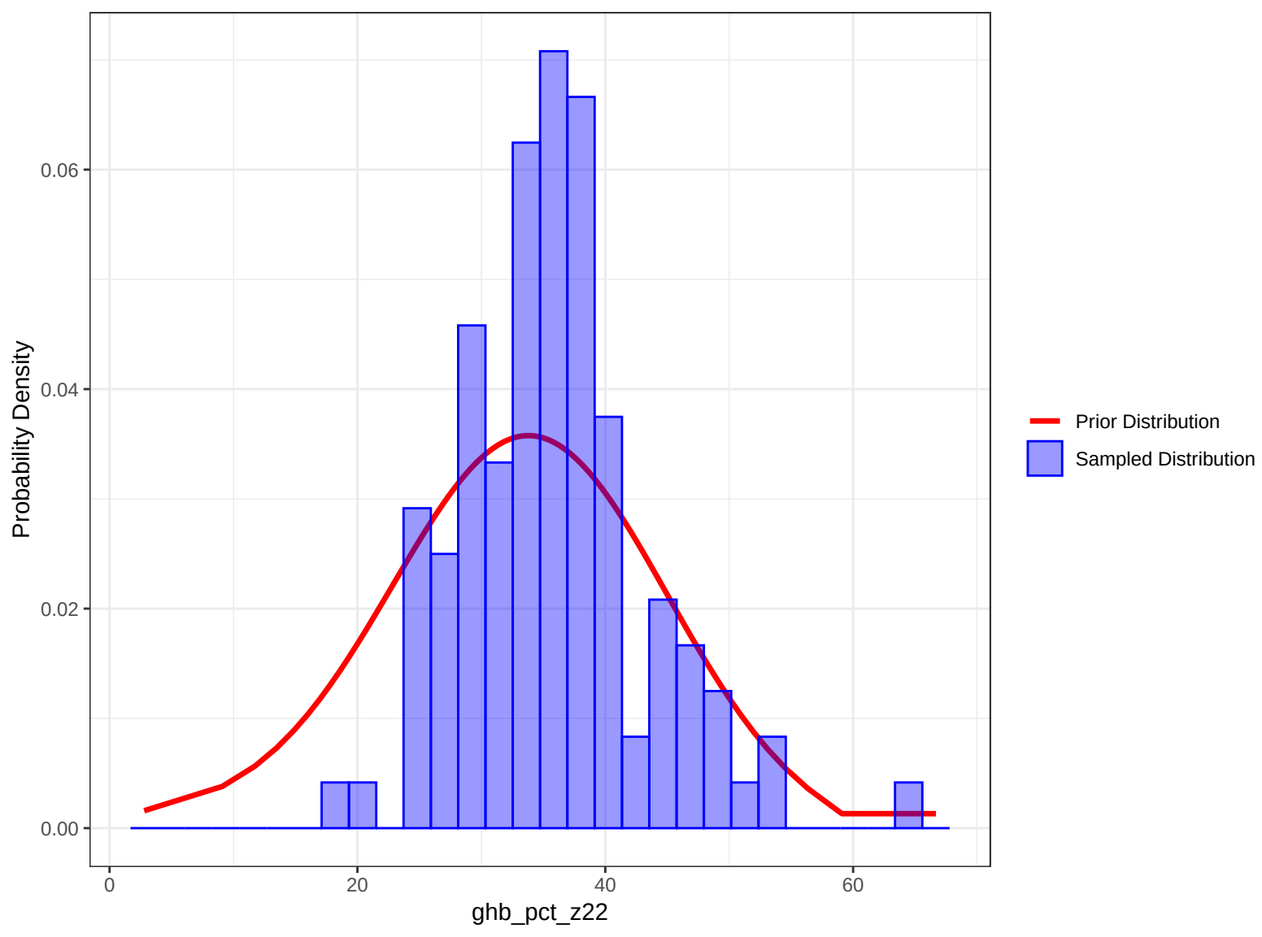

Probability Density
0.00
0.02
0.04
0
20
40
60
80
ghb_pct_z16
Prior Distribution
Sampled Distribution

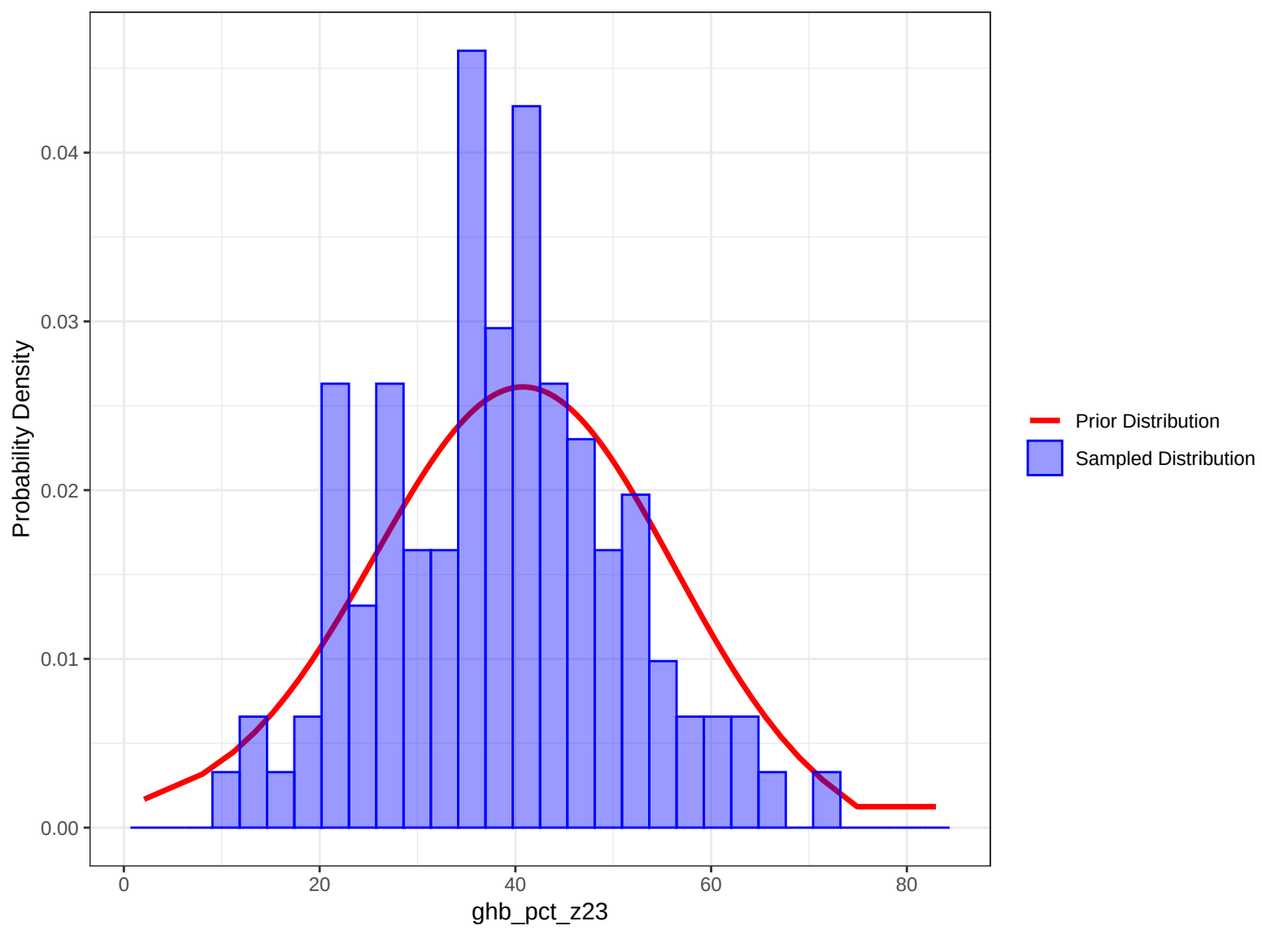

Probability Density
0.00
0.02
0.04
0.06
20
30
40
50
60
ghb_pct_z18
Prior Distribution
Sampled Distribution

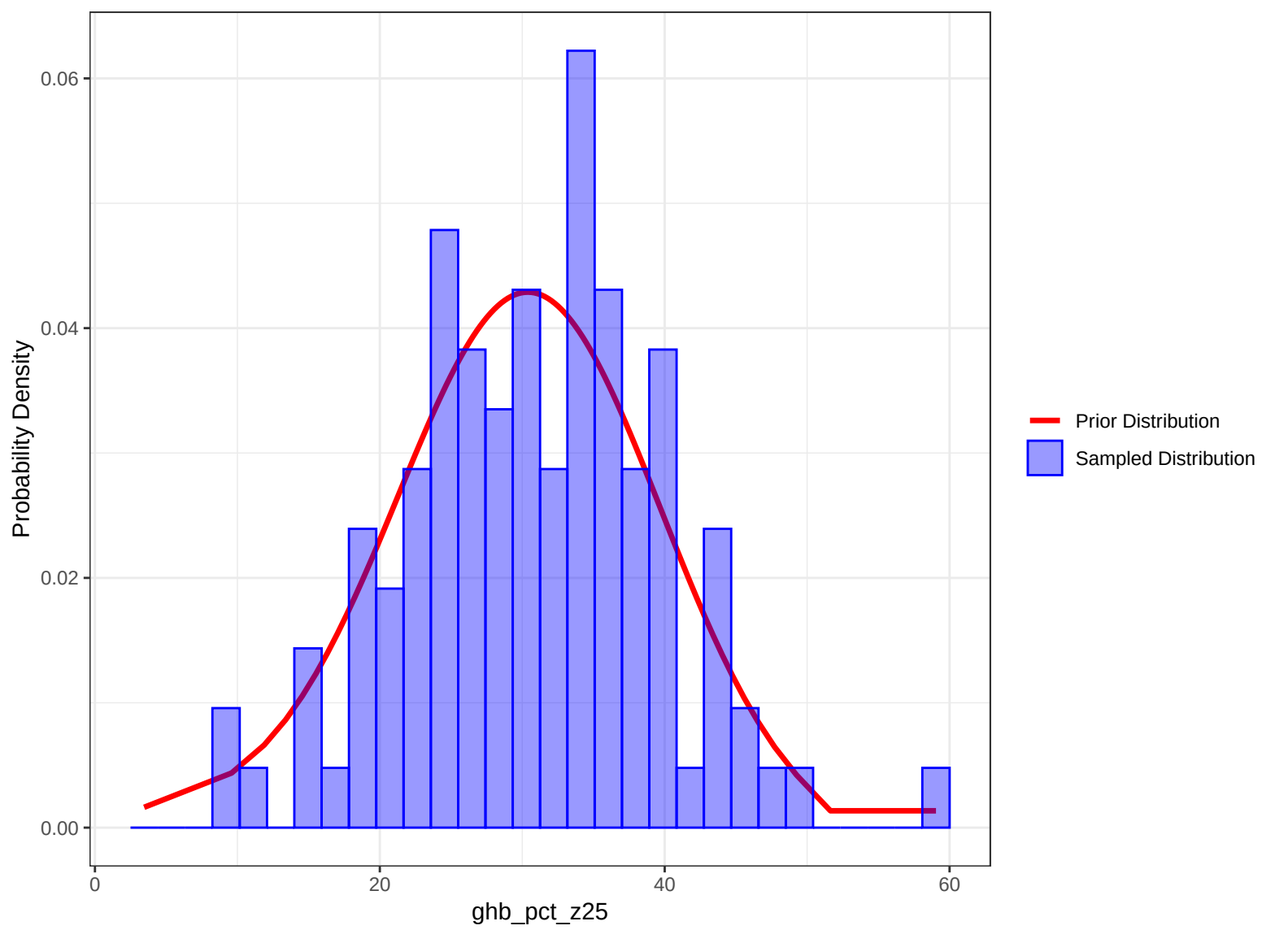

Probability Density
0.06
0.04
0.02
0.00
0
20
40
ghb_pct_z19
Prior Distribution
Sampled Distribution

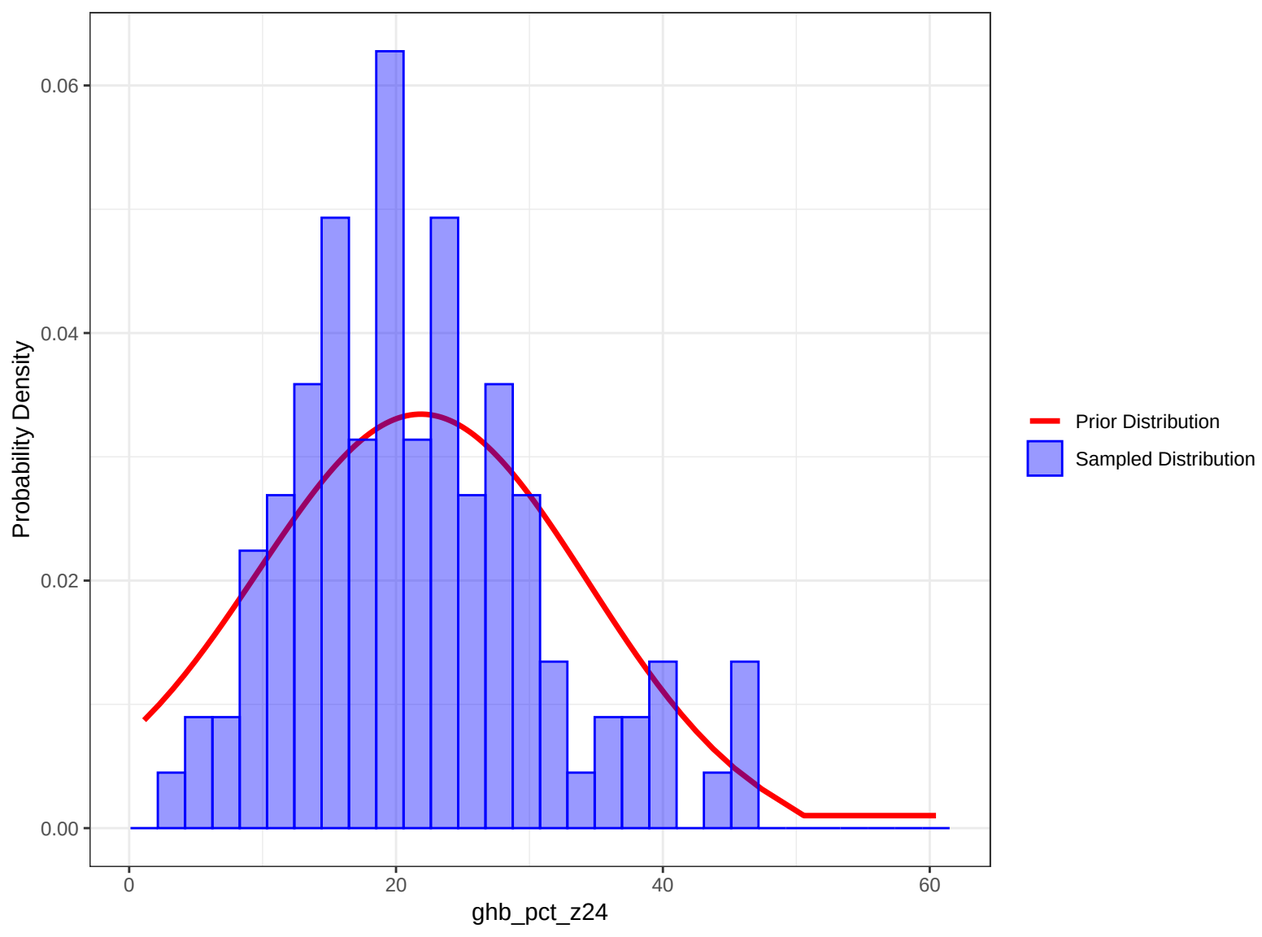

Probability Density
0.06
0.04
0.02
0.00
10
20
30
40
50
60
ghb_pct_z21
Prior Distribution
Sampled Distribution

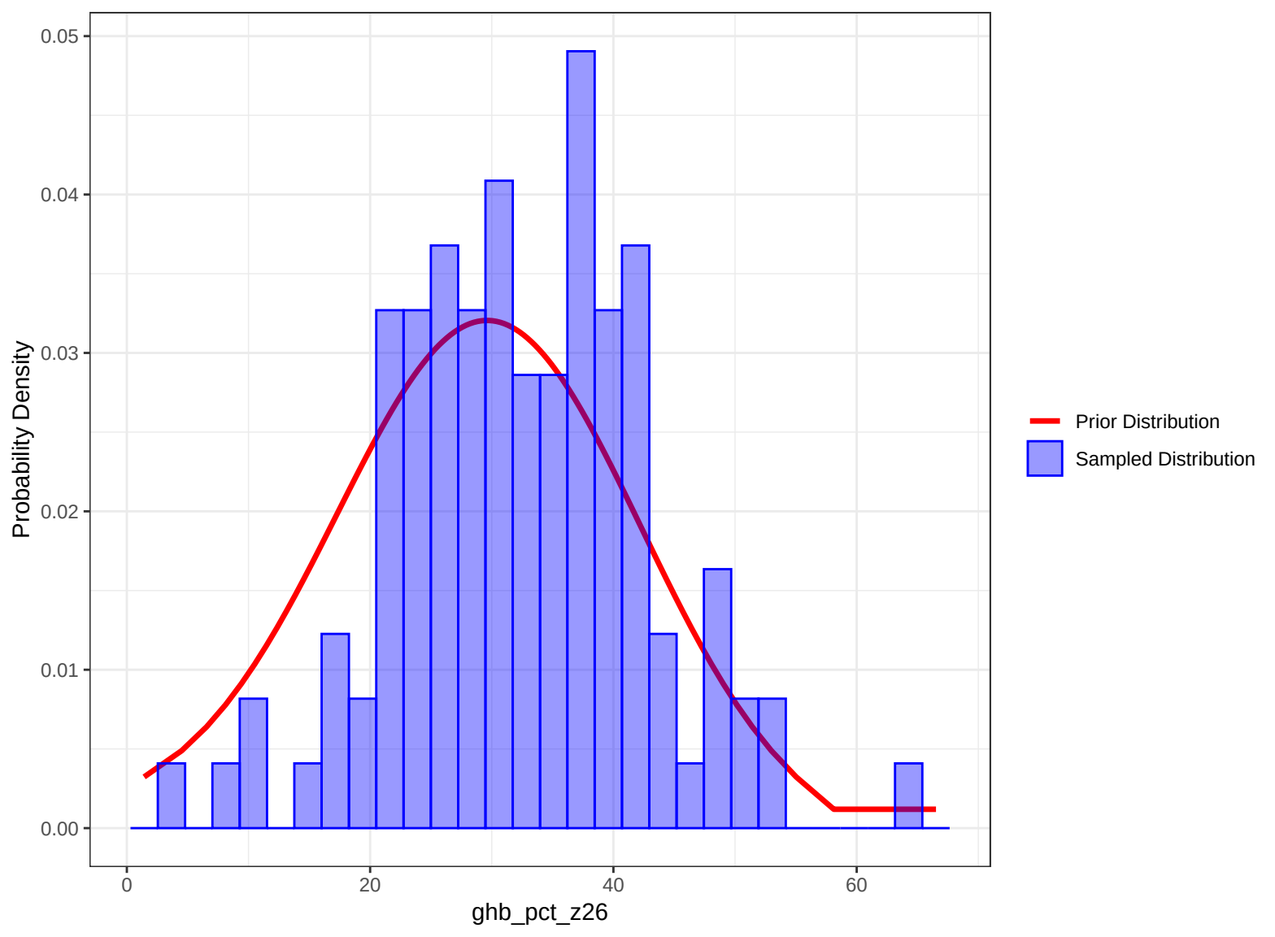

Probability Density
0.06
0.04
0.02
0.00
0
20
40
60
ghb_pct_z20
Prior Distribution
Sampled Distribution


Probability Density
0.06
0.04
0.02
0.00
0
20
40
60
ghb_pct_z22
Prior Distribution
Sampled Distribution


Probability Density
0.00
0.01
0.02
0.03
0.04
0
20
40
60
80
ghb_pct_z23
Prior Distribution
Sampled Distribution


Probability Density
0.00
0.02
0.04
0.06
0
20
40
60
ghb_pct_z25
Prior Distribution
Sampled Distribution


Probability Density
0.00
0.02
0.04
0.06
0
20
40
60
ghb_pct_z24
Prior Distribution
Sampled Distribution


Probability Density
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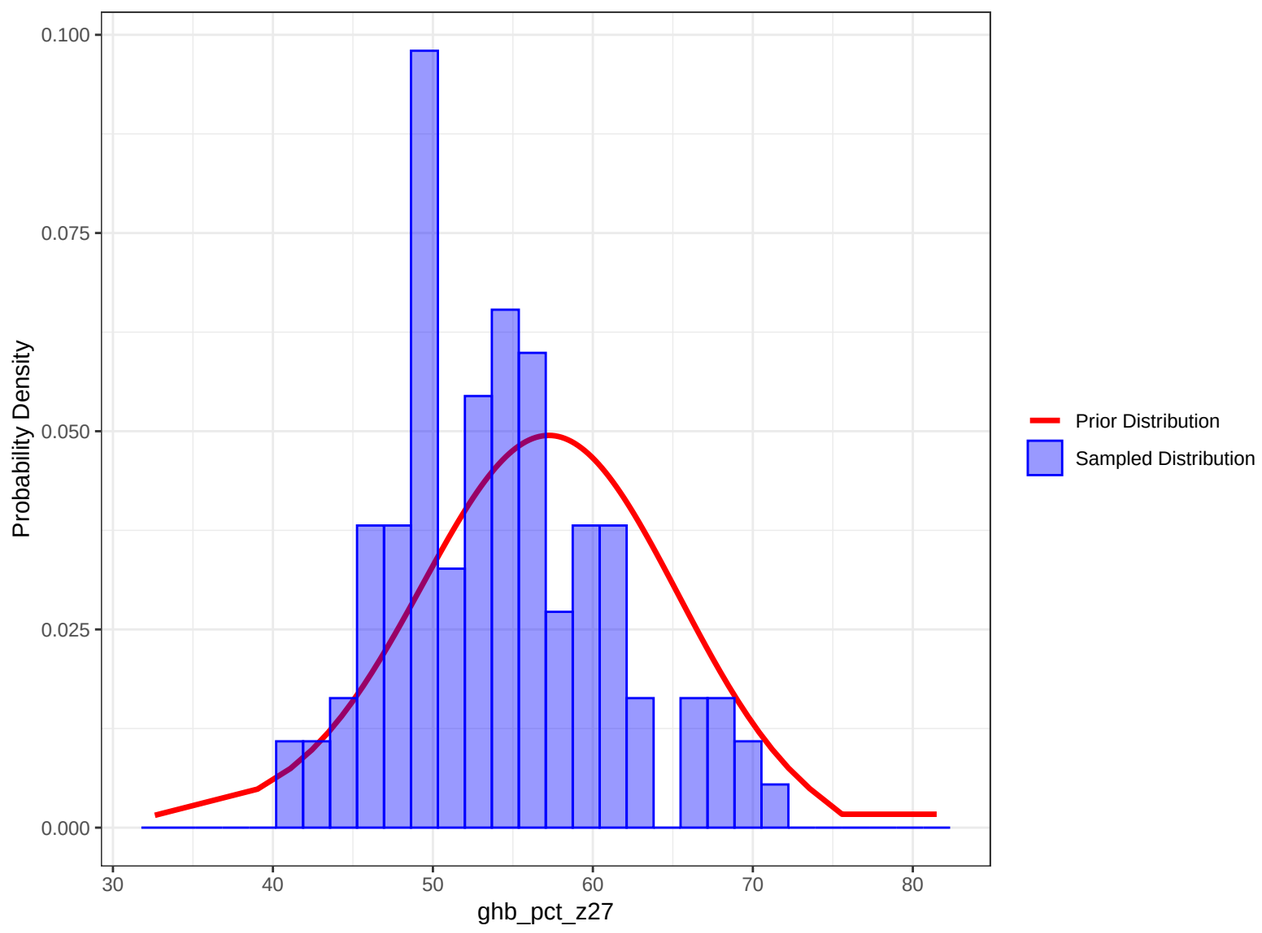
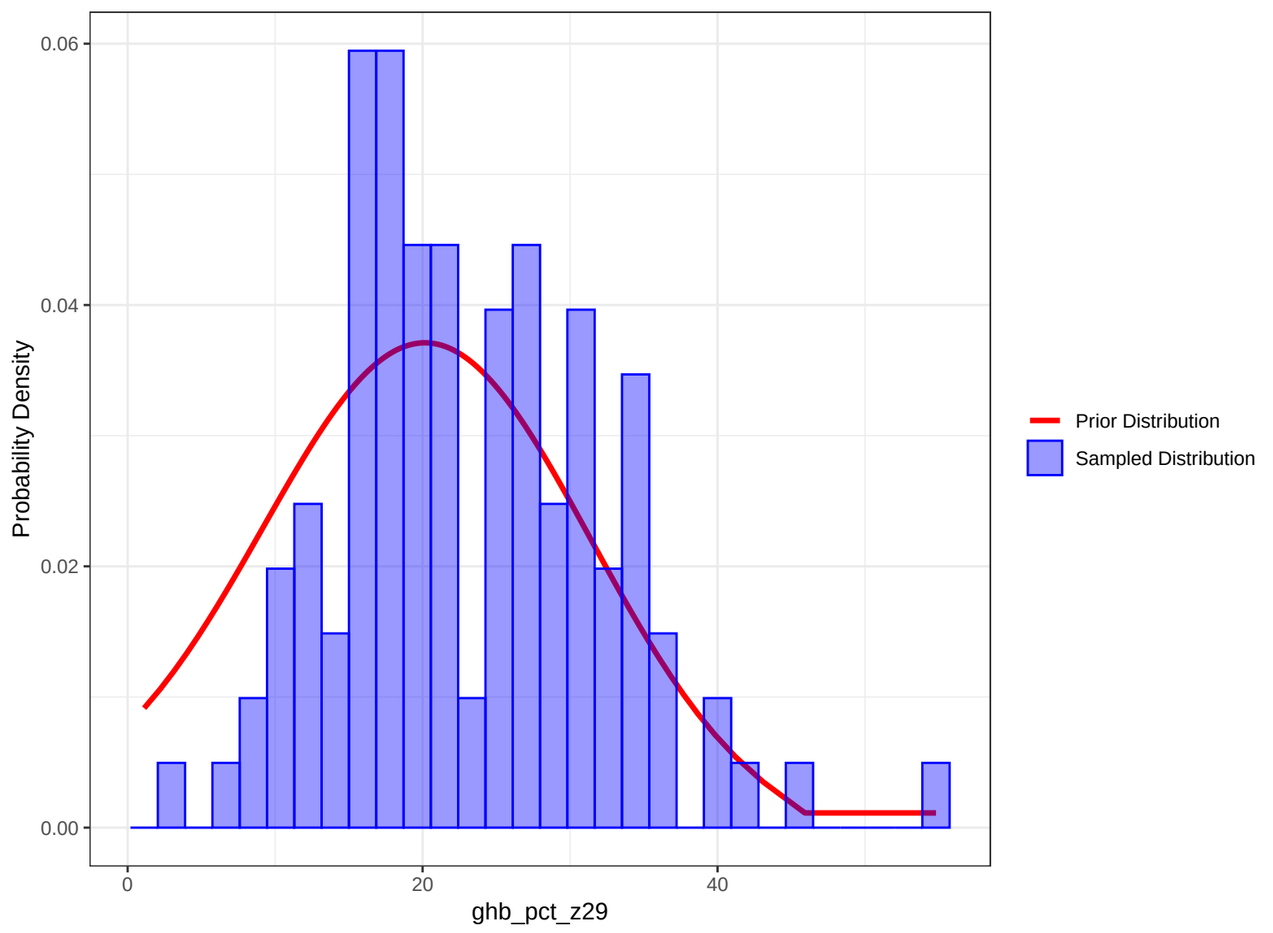
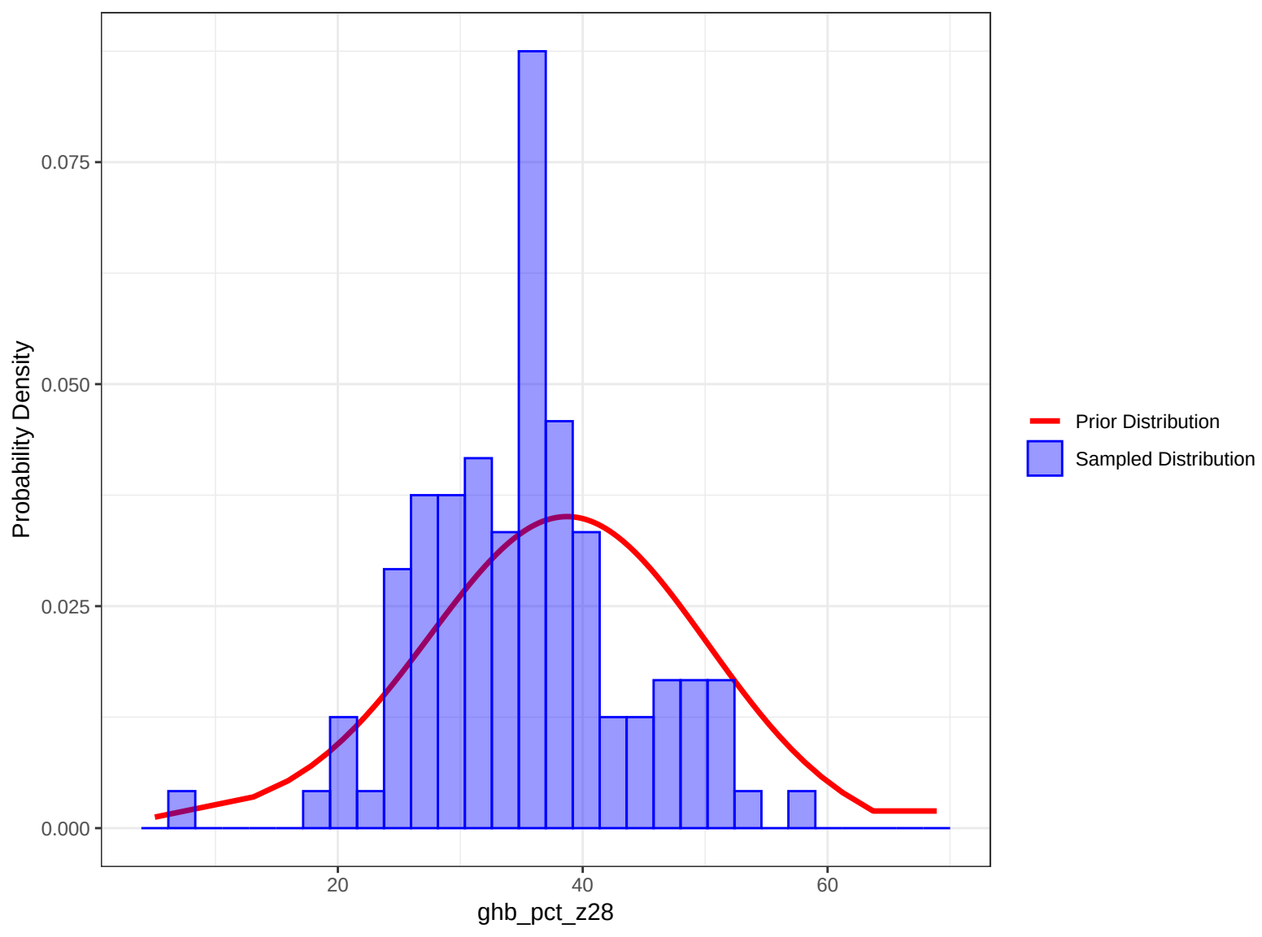
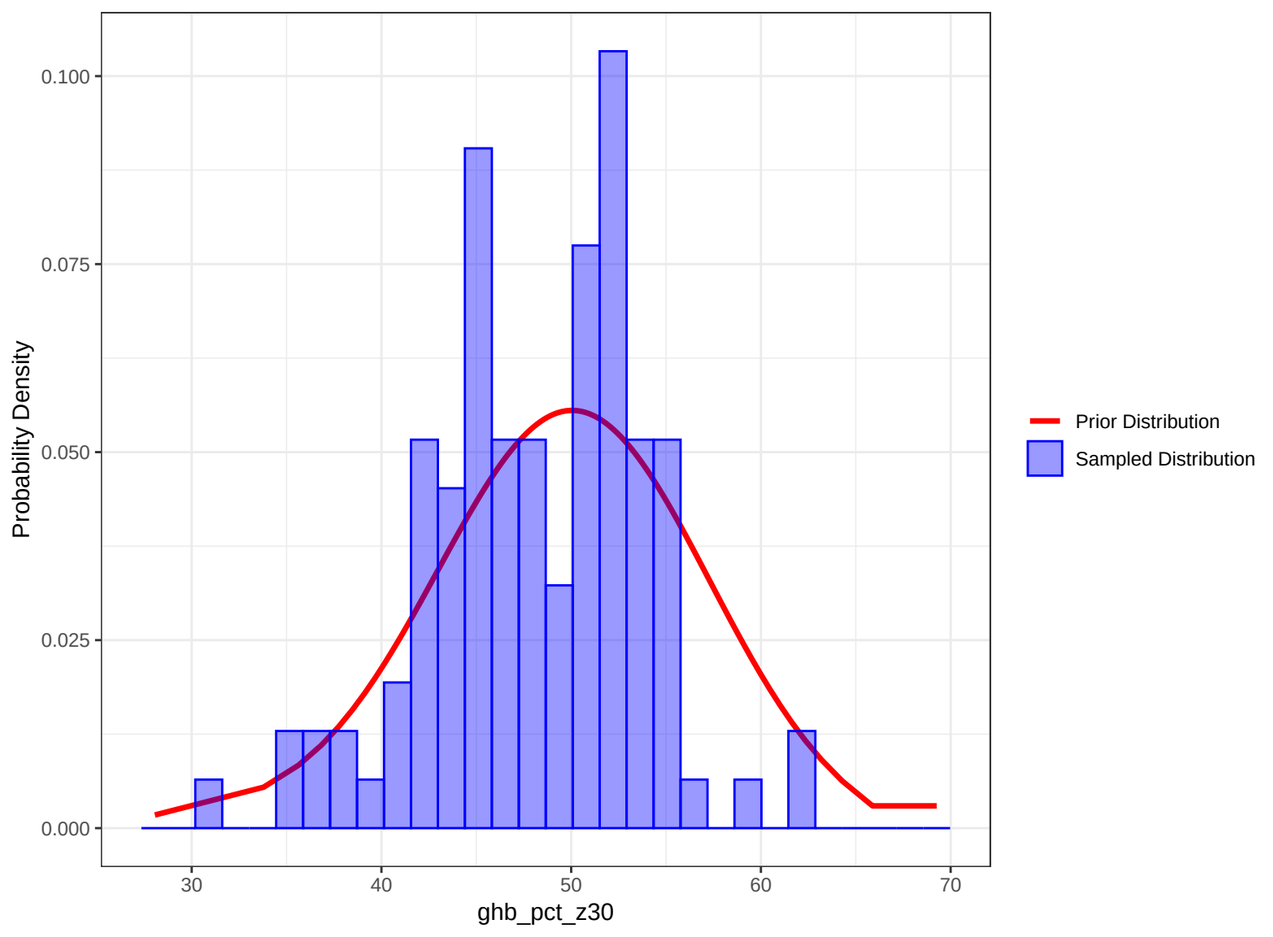
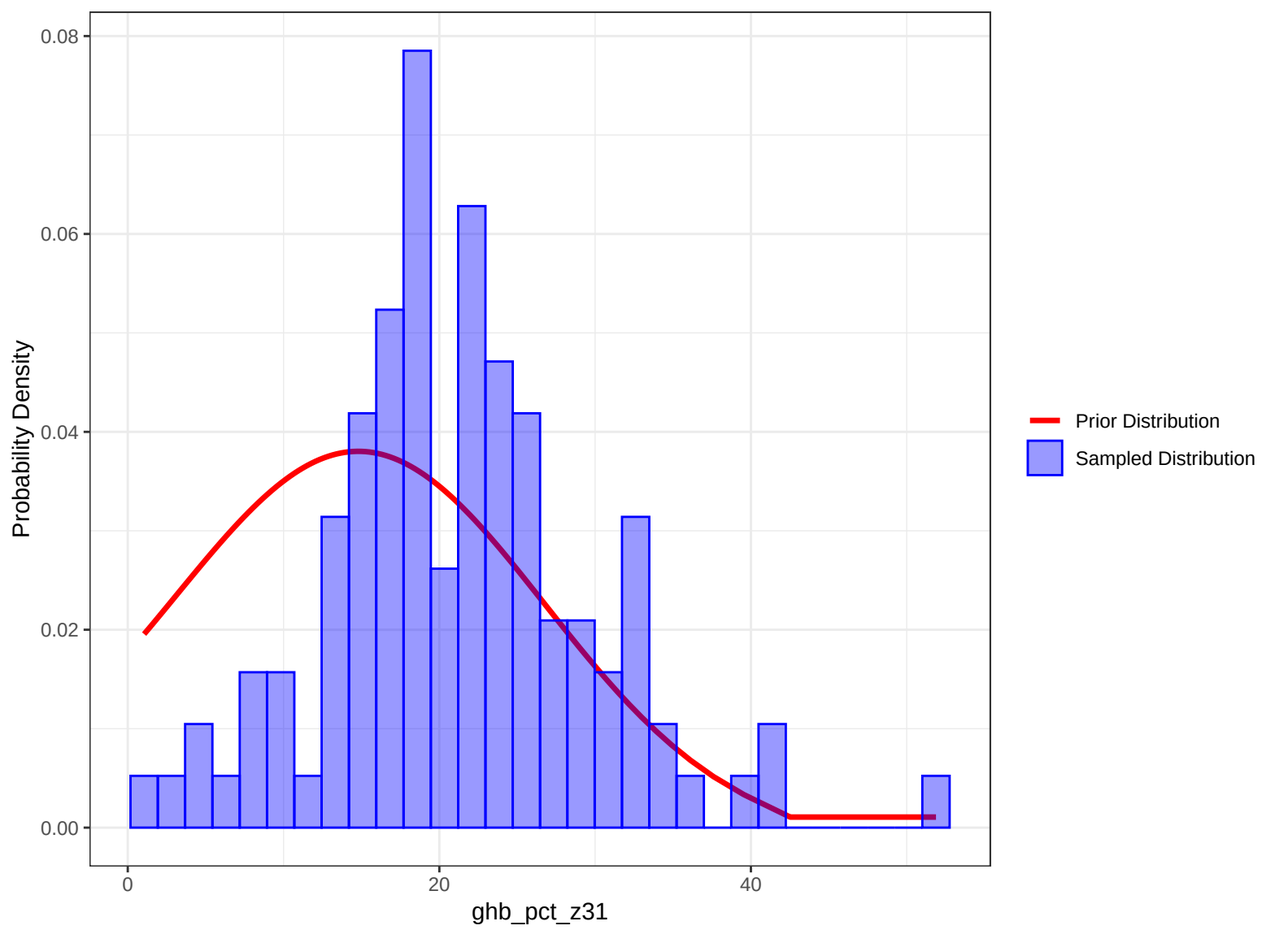
0.01
0.02
0.03
0.04
0.05
0
20
40
60
ghb_pct_z26
Prior Distribution
Sampled Distribution

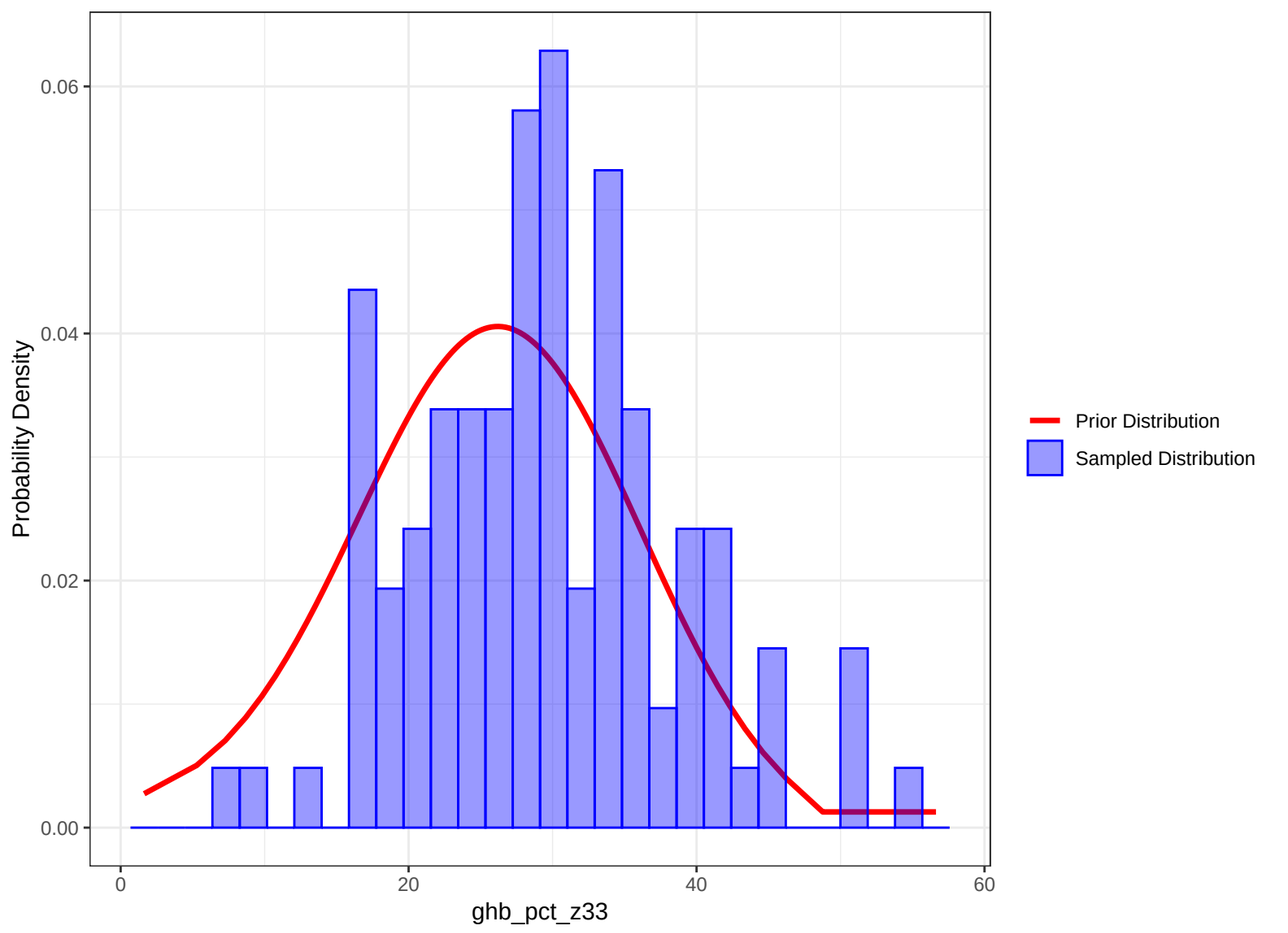

0.100
0.075
0.050
0.025
0.000
Probability Density
30
40
50
60
70
80
ghb_pct_z27
Prior Distribution
Sampled Distribution

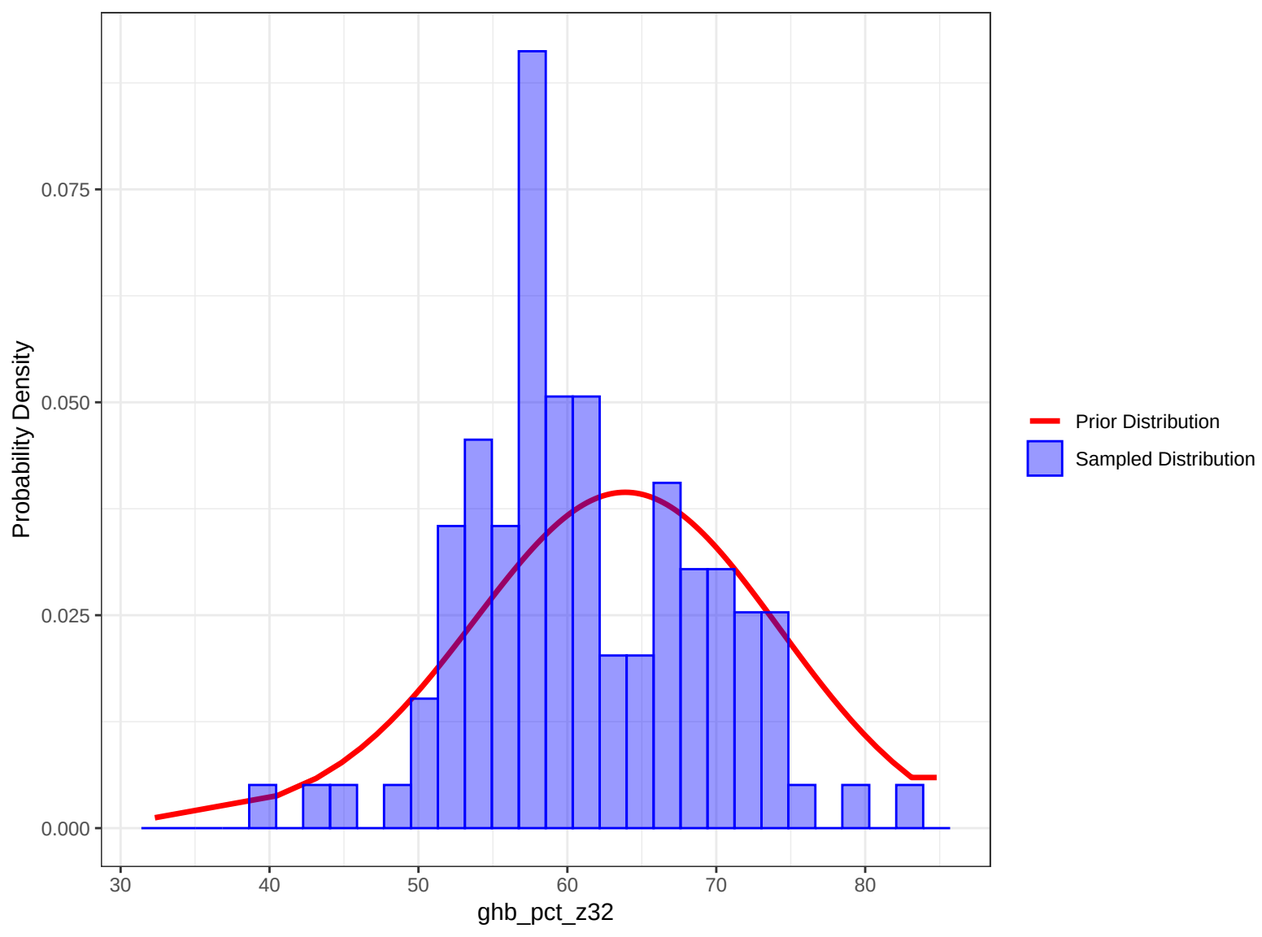

0.06
0.04
0.02
0.00
Probability Density
0
20
40
ghb_pct_z29
Prior Distribution
Sampled Distribution


0.075
0.050
0.025
0.000
Probability Density
20
40
60
ghb_pct_z28
Prior Distribution
Sampled Distribution


0.100
0.075
0.050
0.025
0.000
Probability Density
30
40
50
60
70
ghb_pct_z30
Prior Distribution
Sampled Distribution


0.08
0.06
0.04
0.02
0.00
Probability Density
0
20
40
ghb_pct_z31
Prior Distribution
Sampled Distribution


0.06
0.04
0.02
0.00
Probability Density
0
20
40
60
ghb_pct_z33
Prior Distribution
Sampled Distribution


0.075
0.050
0.025
0.000
Probability Density
30
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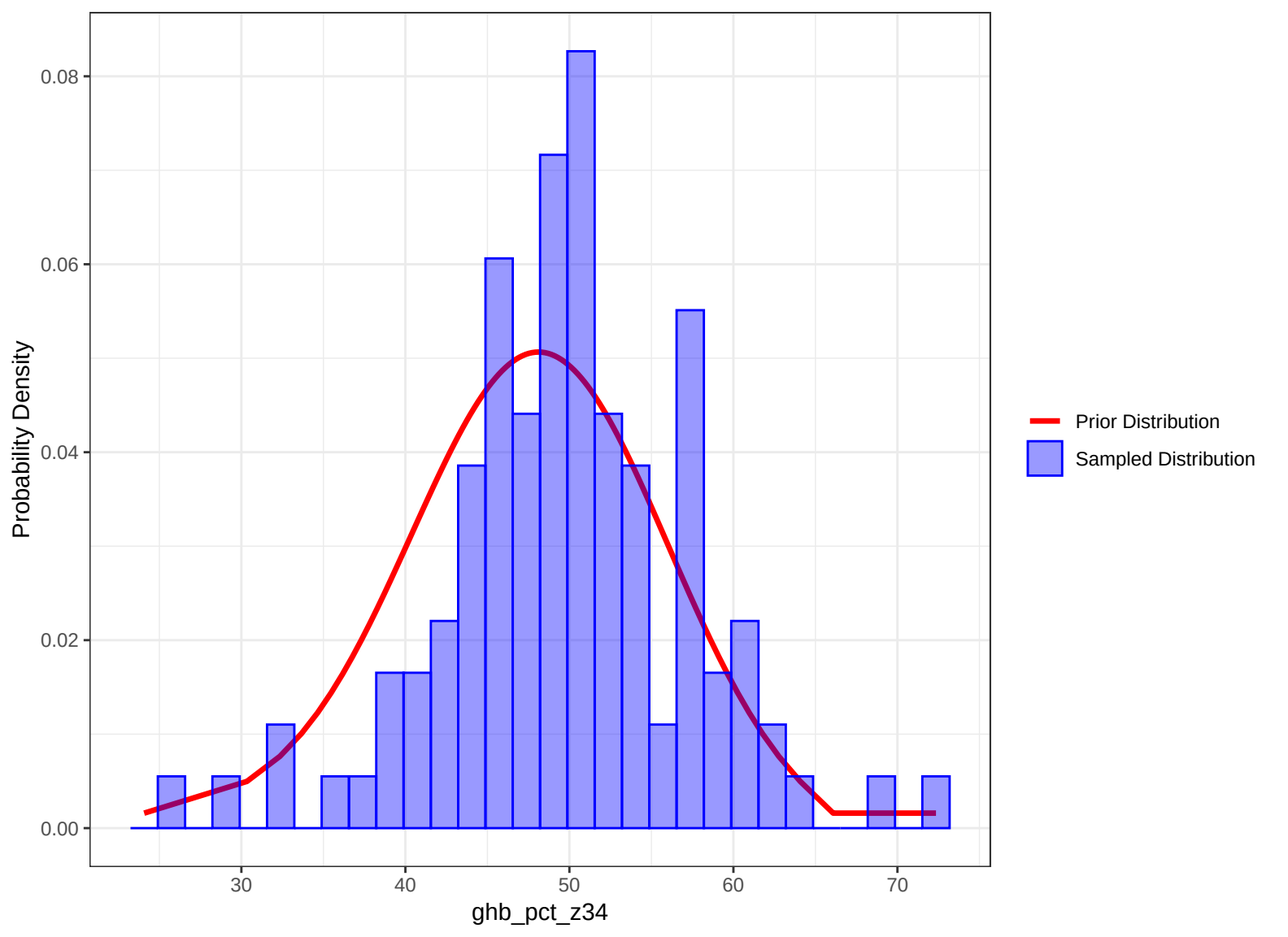
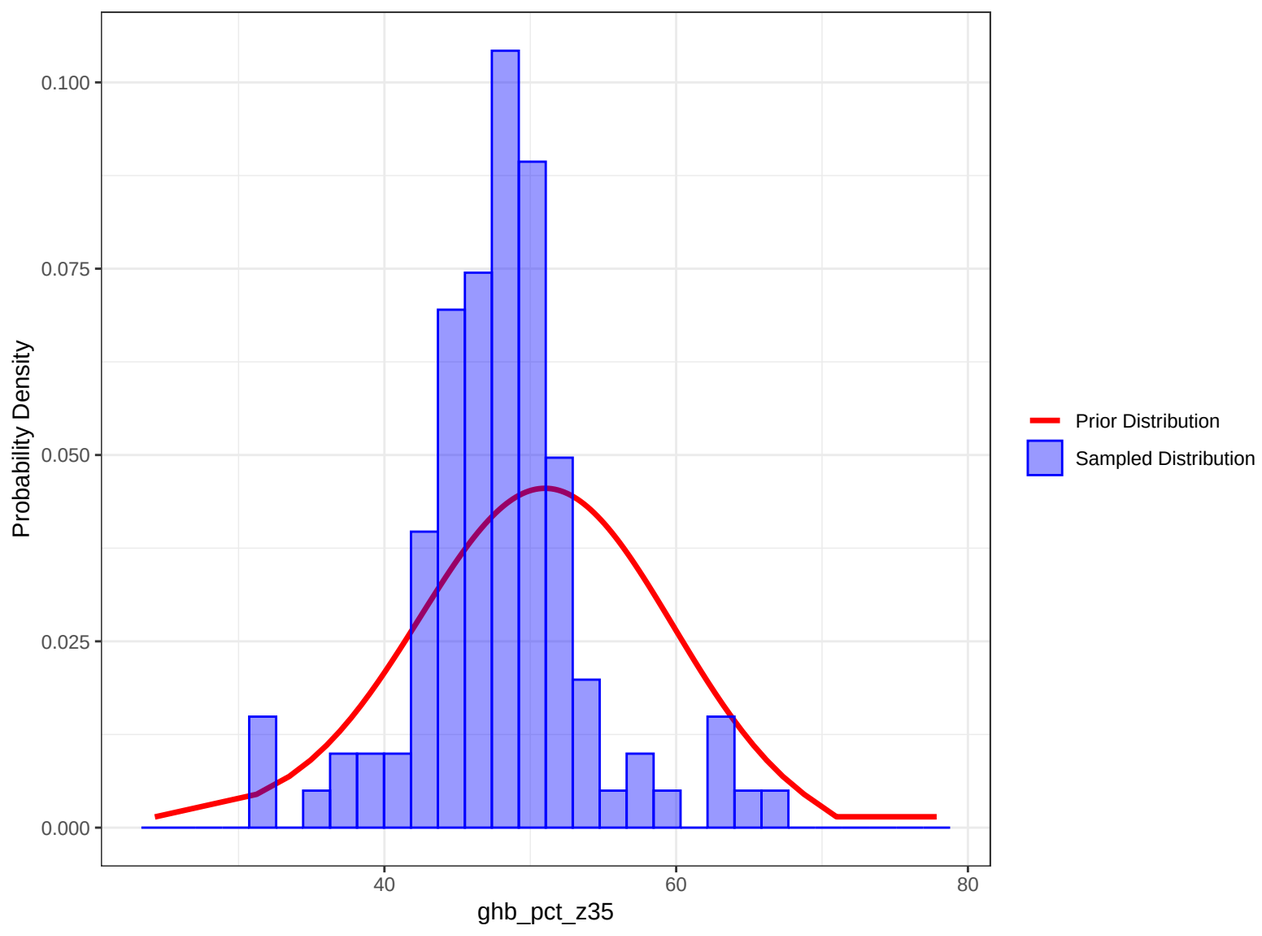
50
60
70
80
ghb_pct_z32
Prior Distribution
Sampled Distribution


0.08
0.06
0.04
0.02
0.00
Probability Density
30
40
50
60
70
ghb_pct_z34
Prior Distribution
Sampled Distribution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0.075
0.050
0.025
0.000
Probability Density
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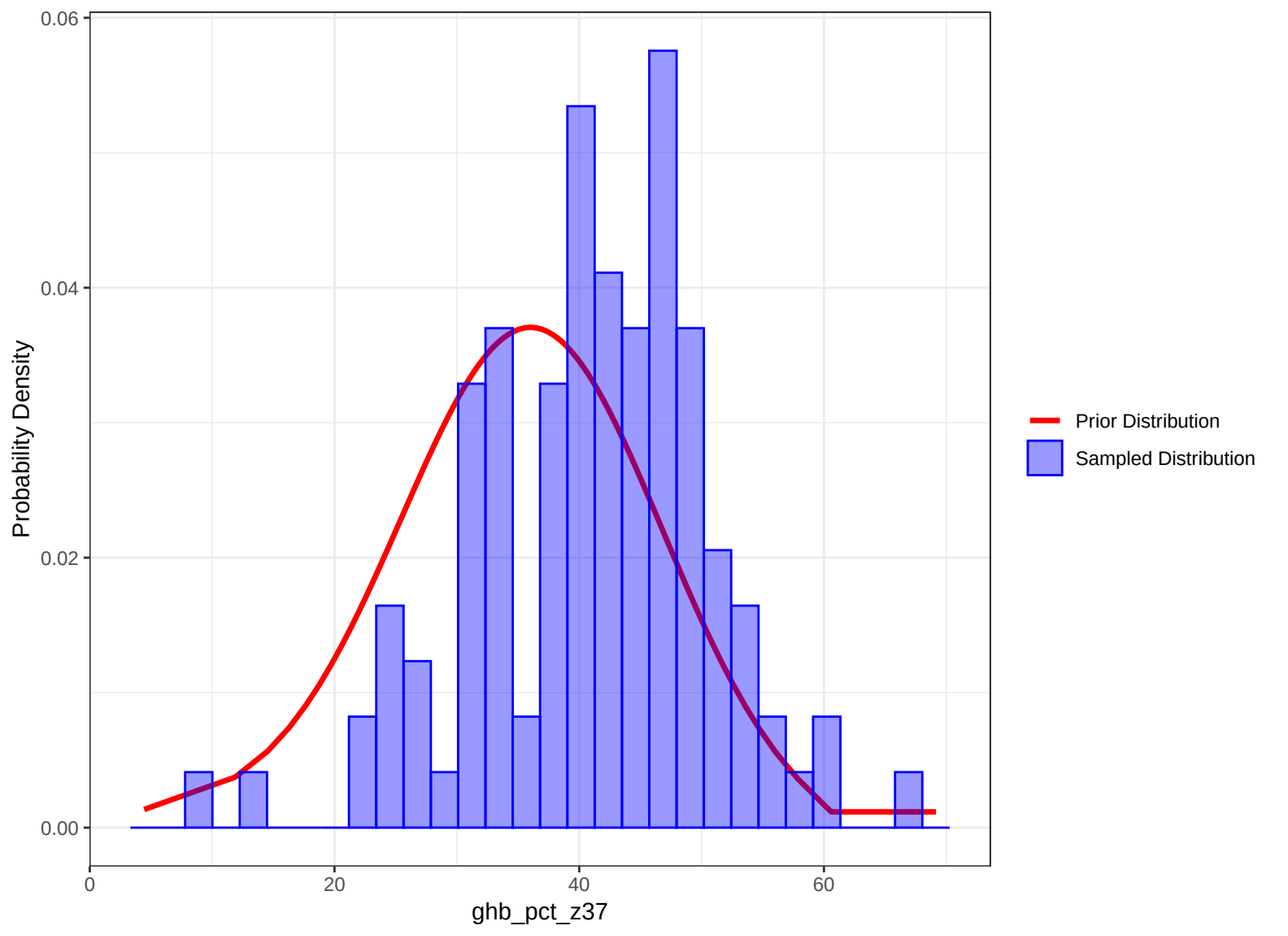
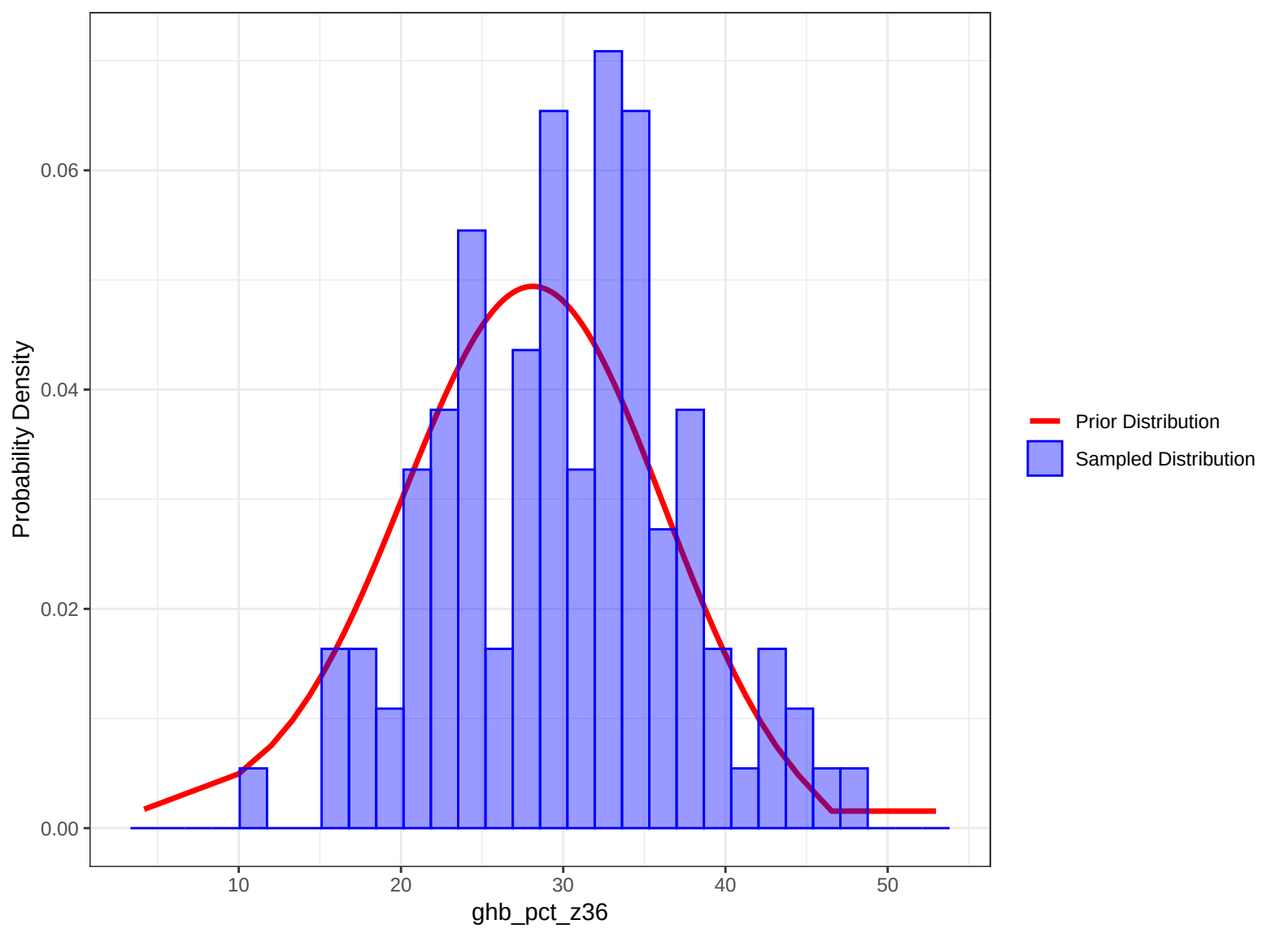
60
80
ghb_pct_z35
Prior Distribution
Sampled Distribution


0.06
0.04
0.02
0.00
Probability Density
0
20
40
60
ghb_pct_z37
Prior Distribution
Sampled Distribution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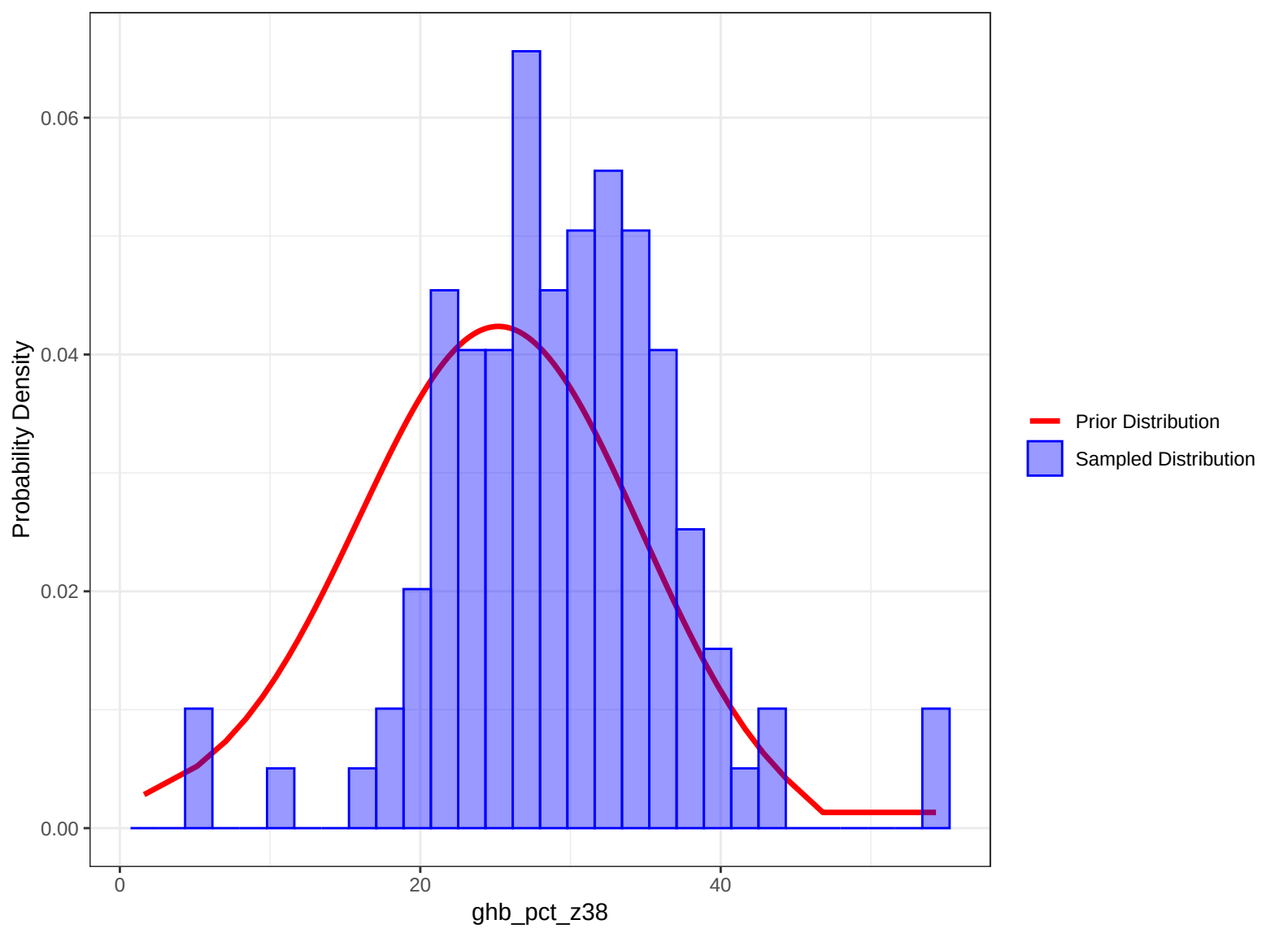
0.04
0.02
0.00
Probability Density
10
20
30
40
50
ghb_pct_z36
Prior Distribution
Sampled Distribution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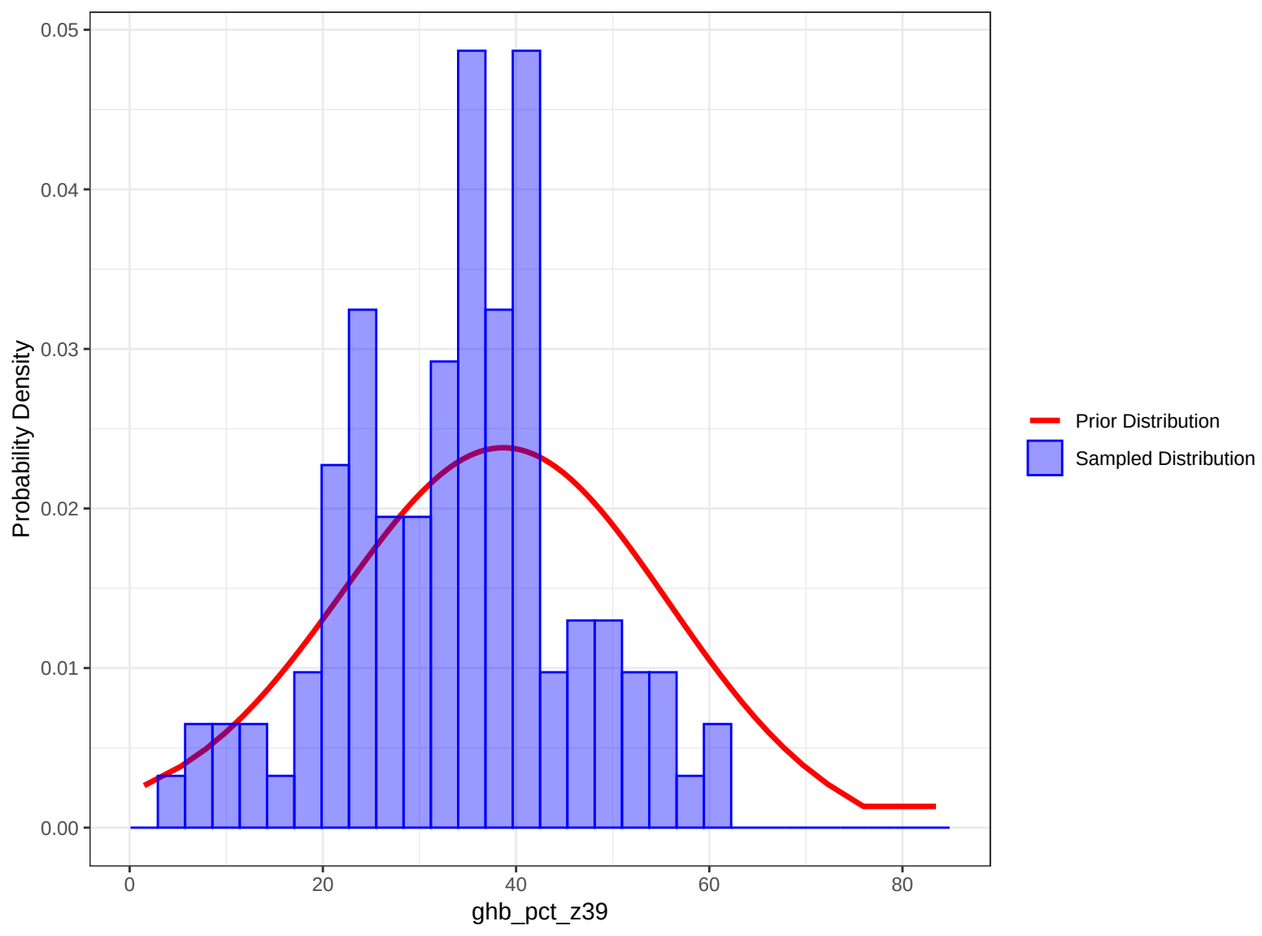
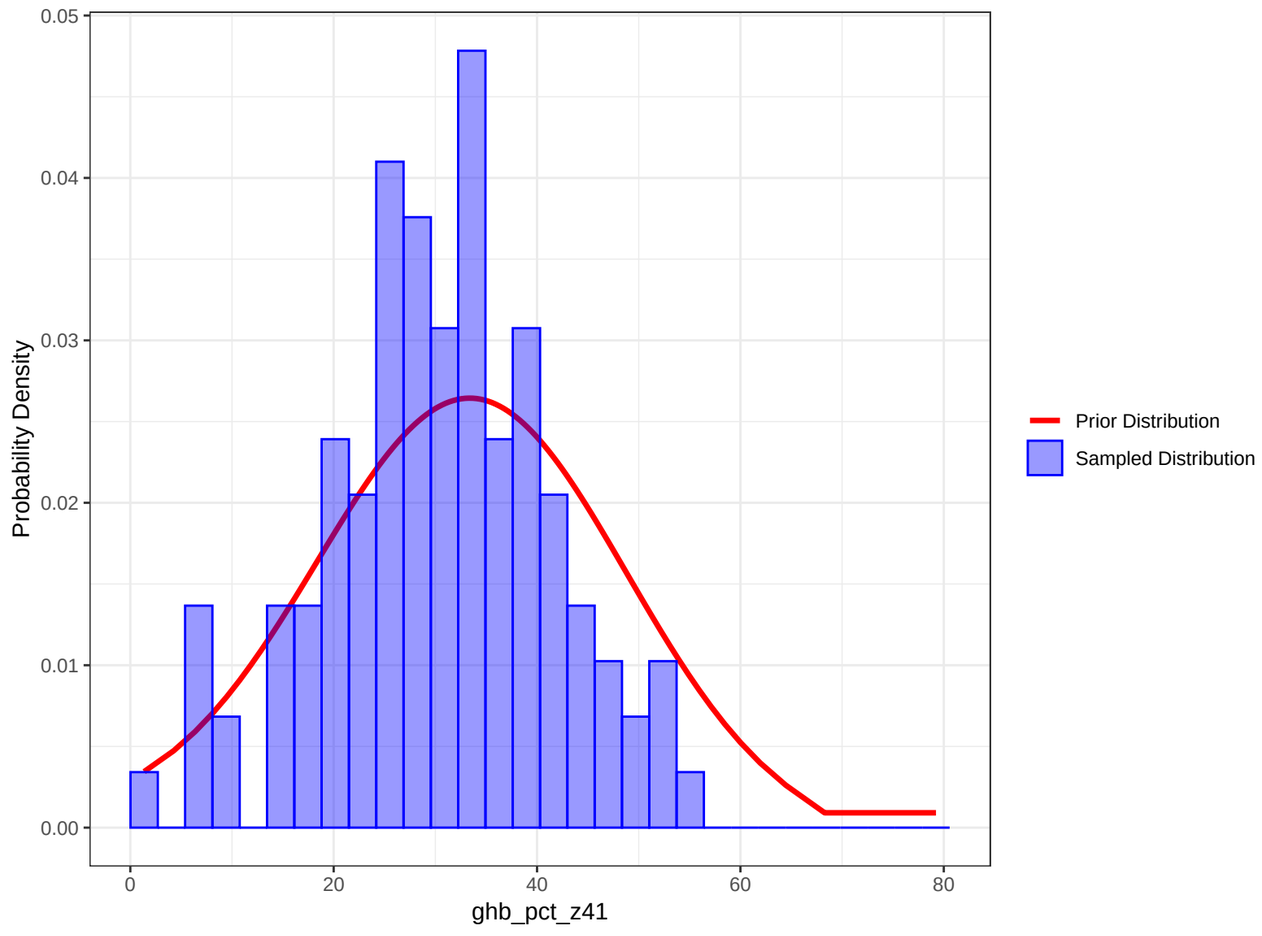
0.04
0.02
0.00
Probability Density
0
20
40
ghb_pct_z38
Prior Distribution
Sampled Distribution


0.05
0.04
0.03
0.02
0.01
0.00
Probability Density
0
20
40
60
80
ghb_pct_z39
Prior Distribution
Sampled Distribution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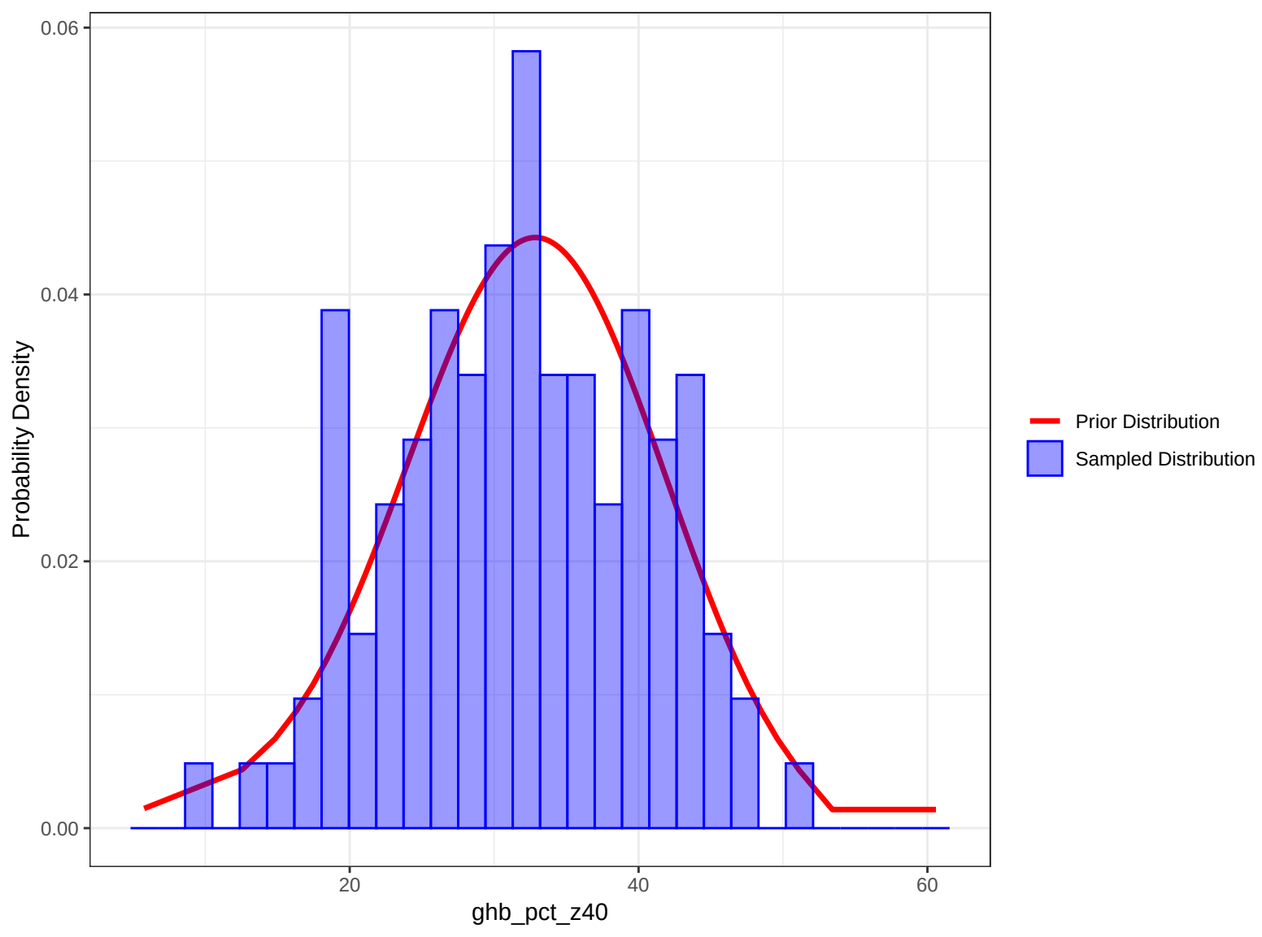
0.04
0.03
0.02
0.01
0.00
Probability Density
0
20
40
60
80
ghb_pct_z41
Prior Distribution
Sampled Distribution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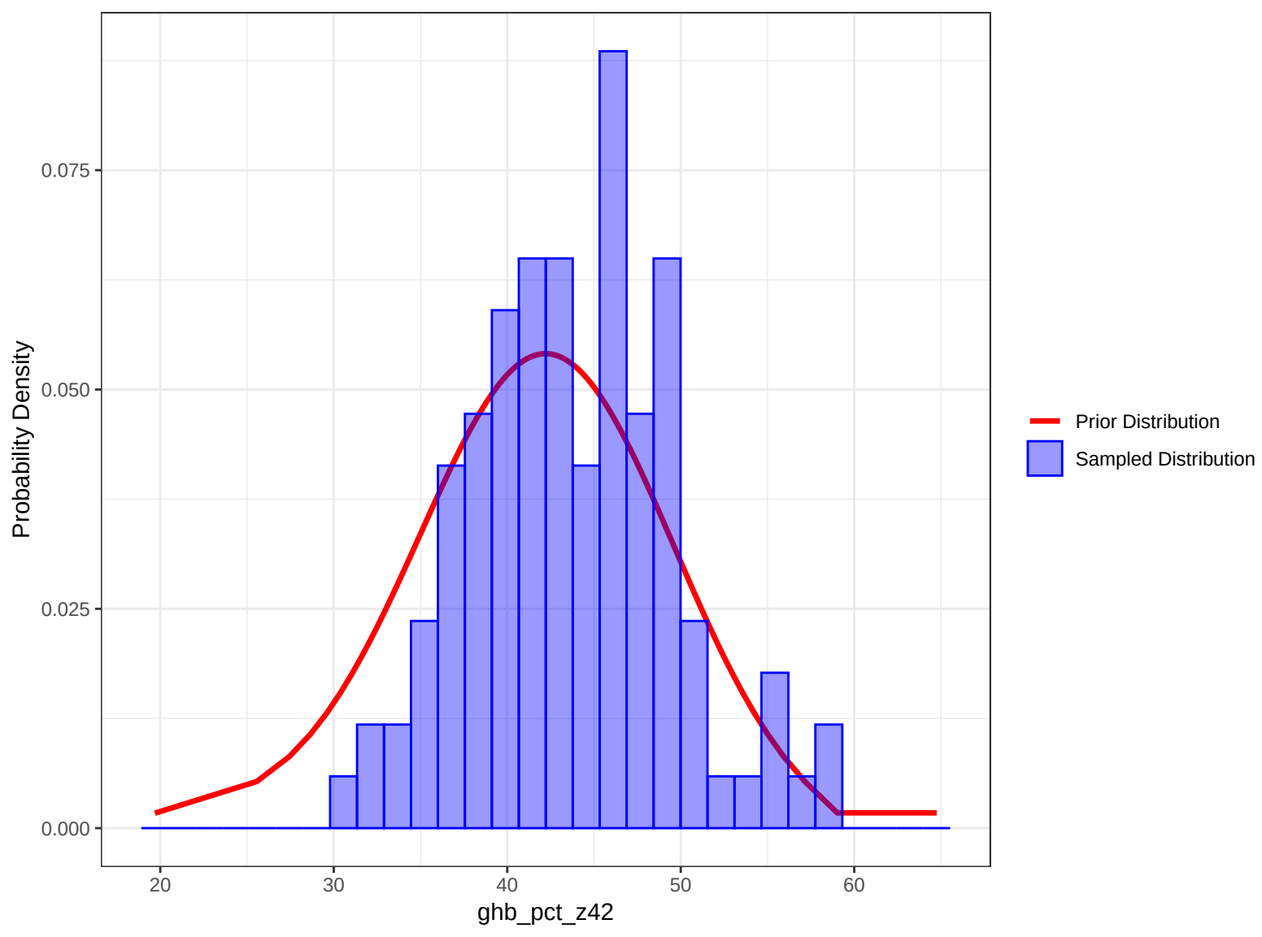
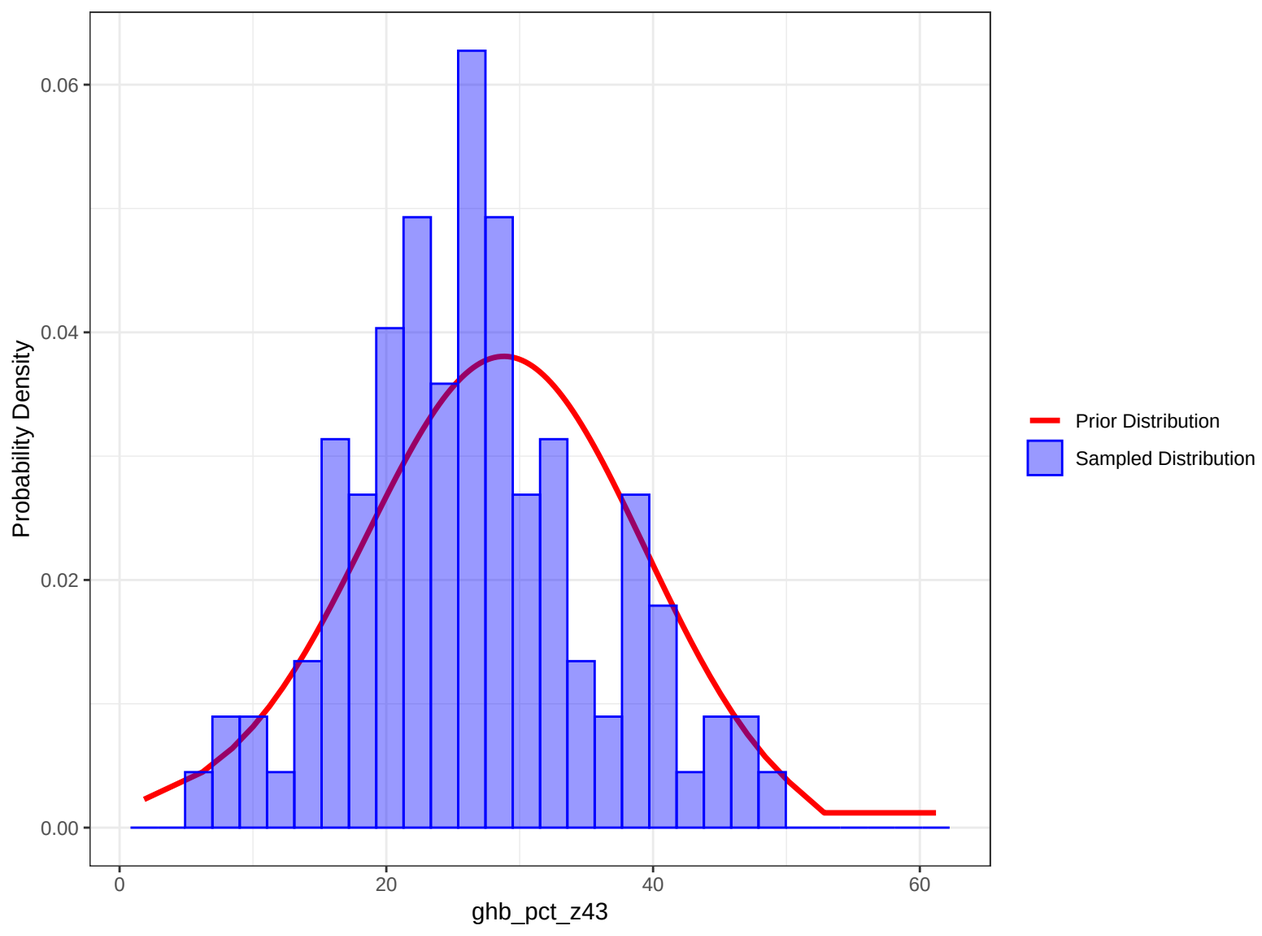
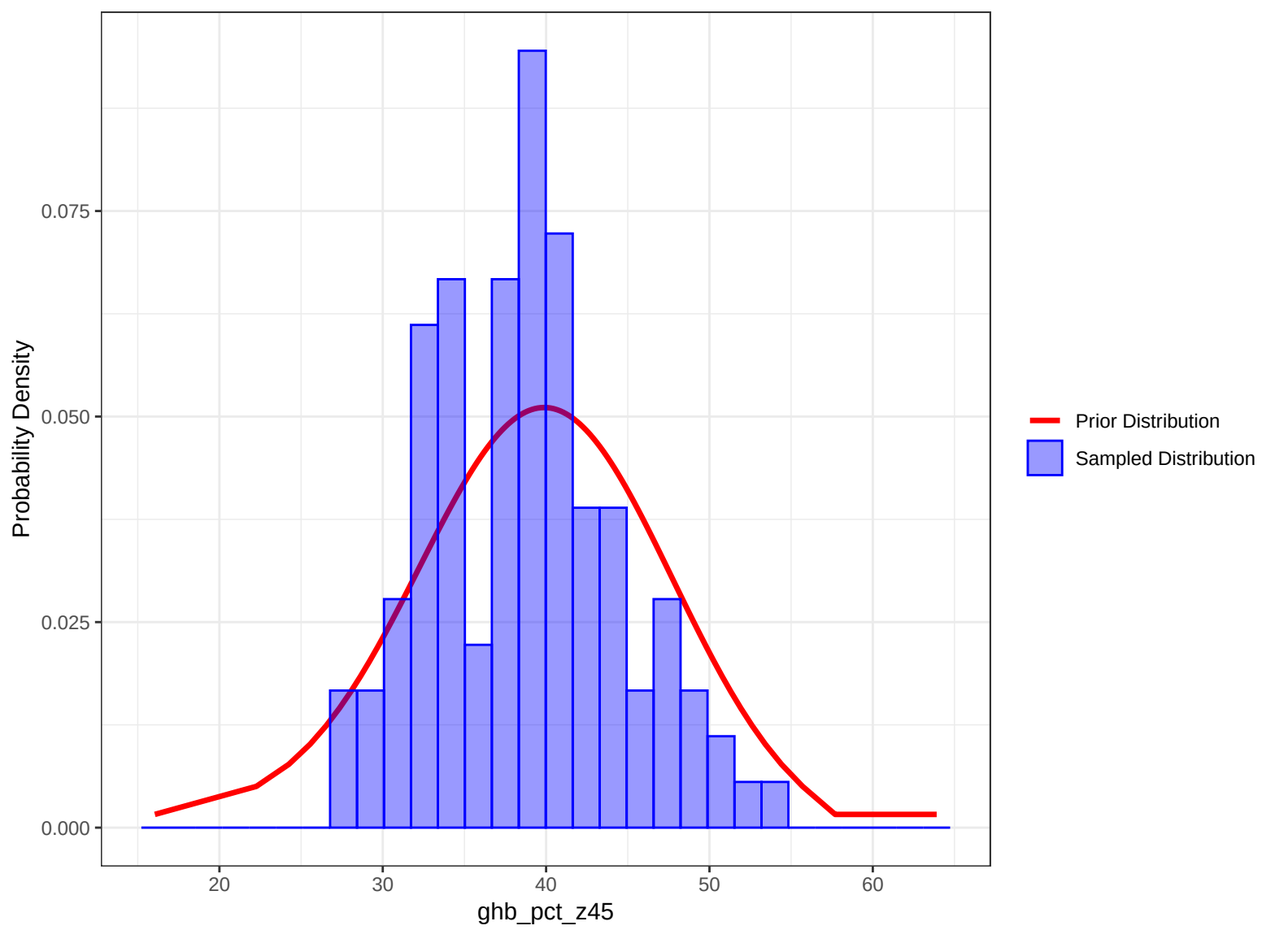
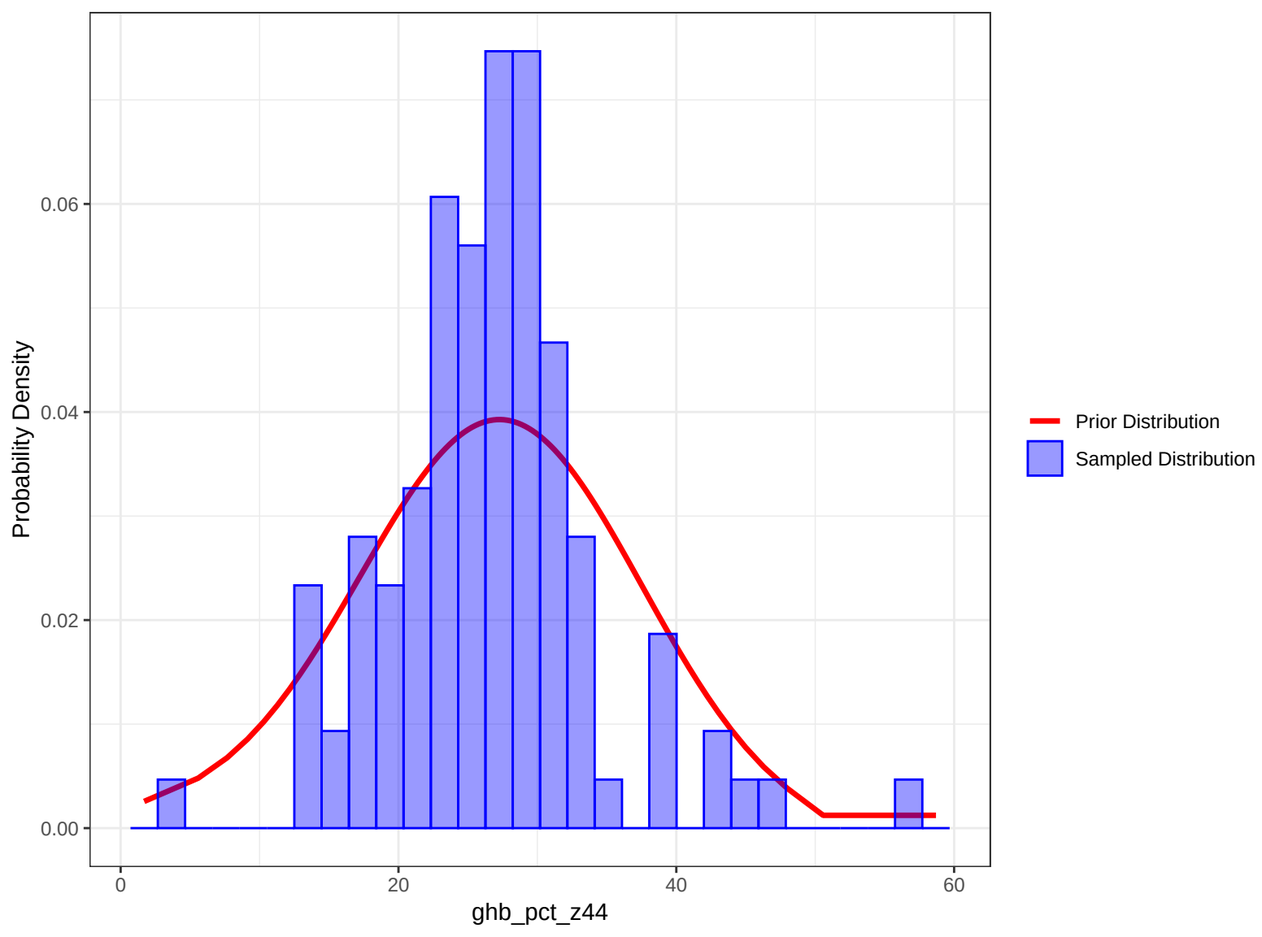
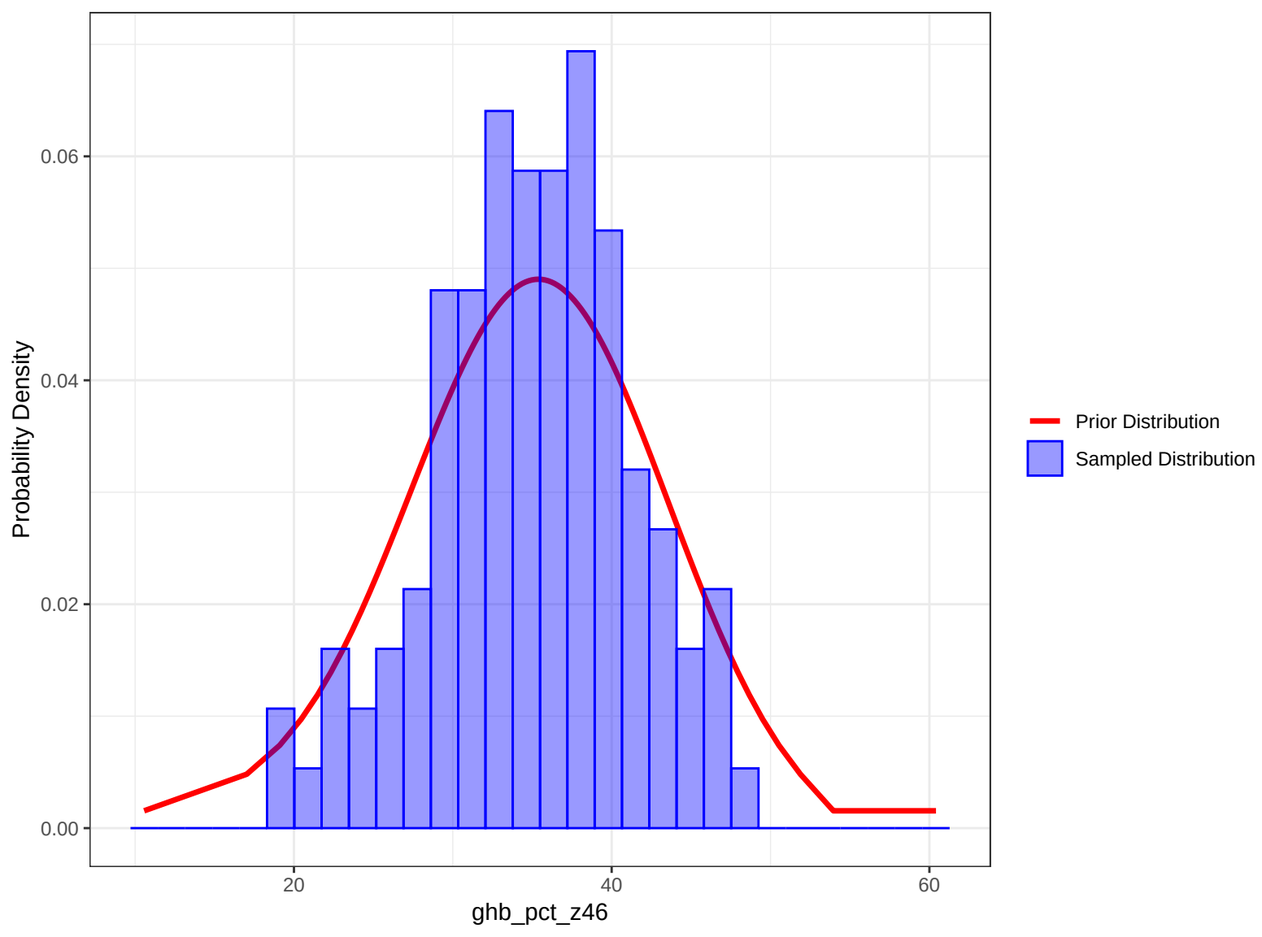
0.04
0.02
0.00
Probability Density
20
40
60
ghb_pct_z40
Prior Distribution
Sampled Distribution

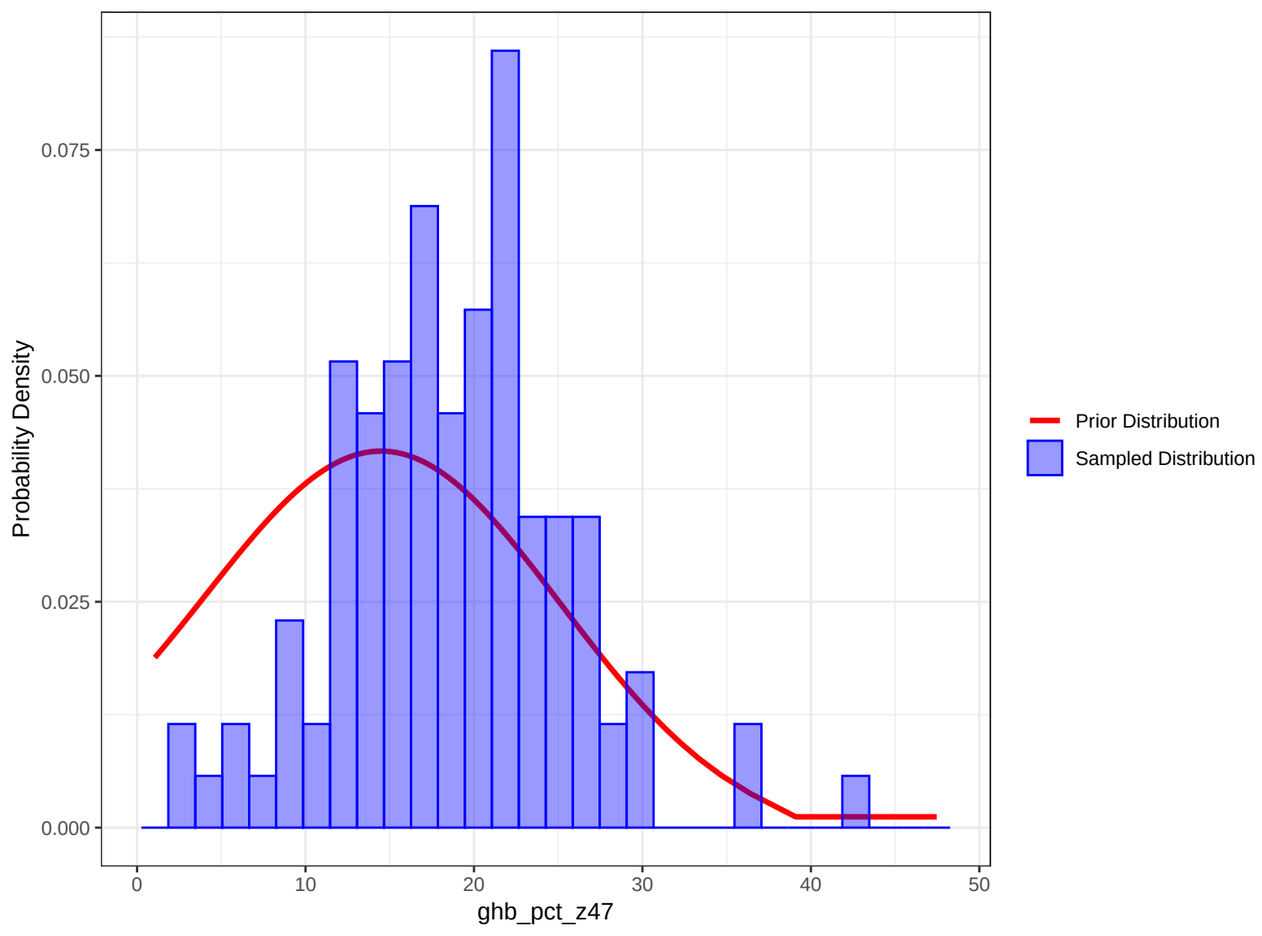

0.075
0.050
0.025
0.000
Probability Density
20
30
40
50
60
ghb_pct_z42
Prior Distribution
Sampled Distribution

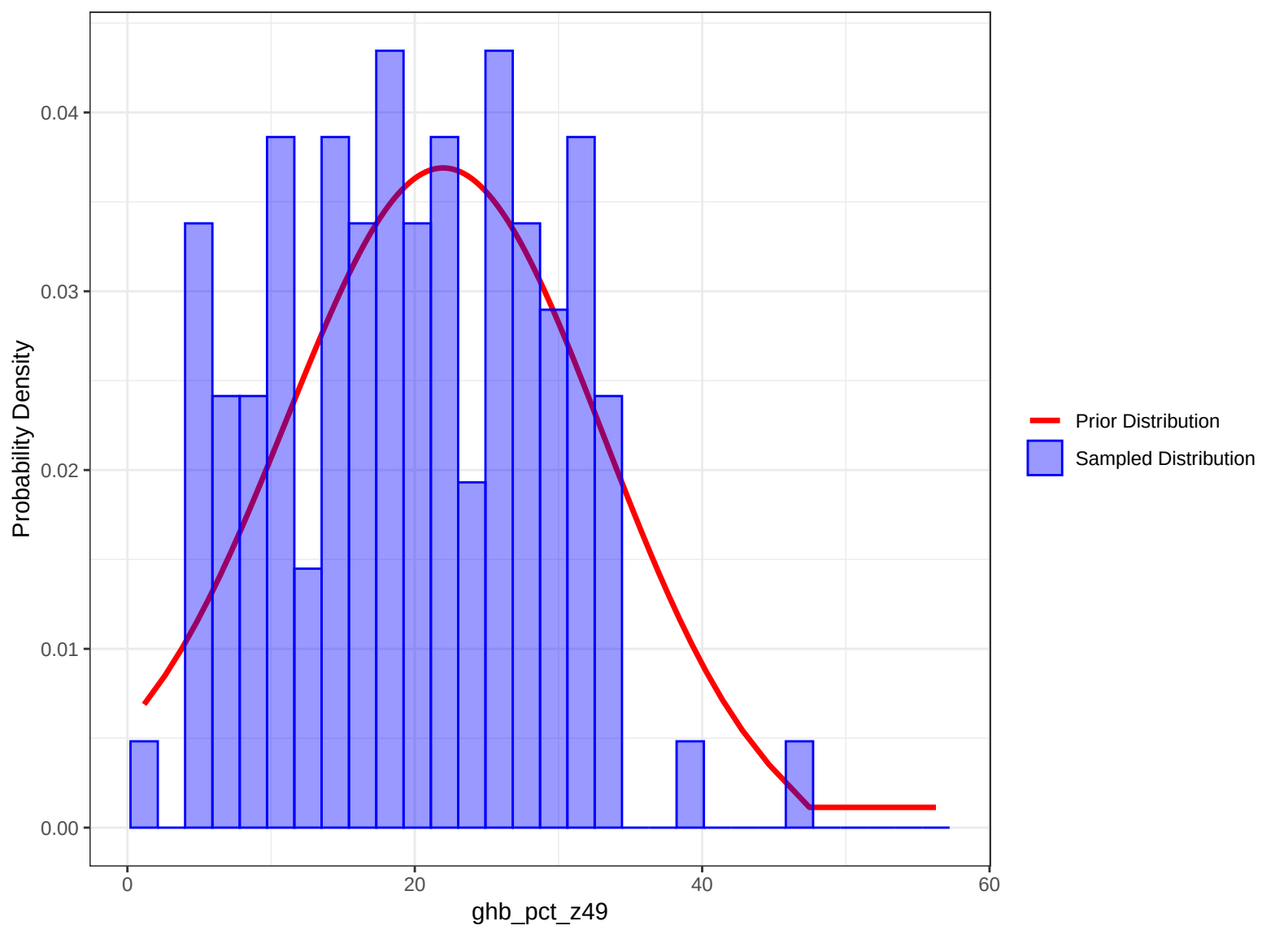

Probability Density
0.06
0.04
0.02
0.00
0
20
40
60
ghb_pct_z43
Prior Distribution
Sampled Distribution


Probability Density
0.075
0.050
0.025
0.000
20
30
40
50
60
ghb_pct_z45
Prior Distribution
Sampled Distribution


Probability Density
0.06
0.04
0.02
0.00
0
20
40
60
ghb_pct_z44
Prior Distribution
Sampled Distribution


Probability Density
0.06
0.04
0.02
0.00
20
40
60
ghb_pct_z46
Prior Distribution
Sampled Distribution


Probability Density
0.075
0.050
0.025
0.000
0
10
20
30
40
50
ghb_pct_z47
Prior Distribution
Sampled Distribution


Probability Density
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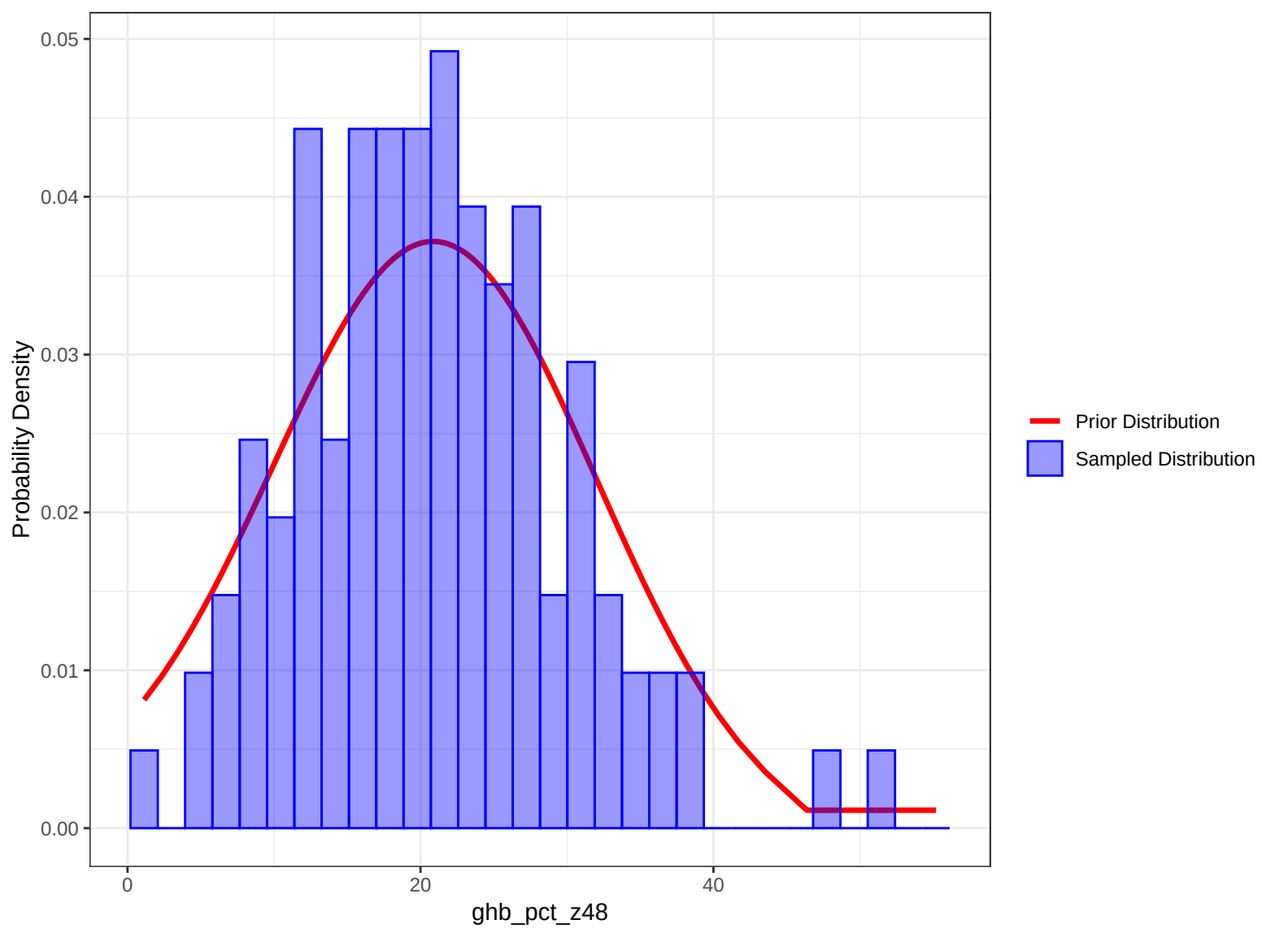
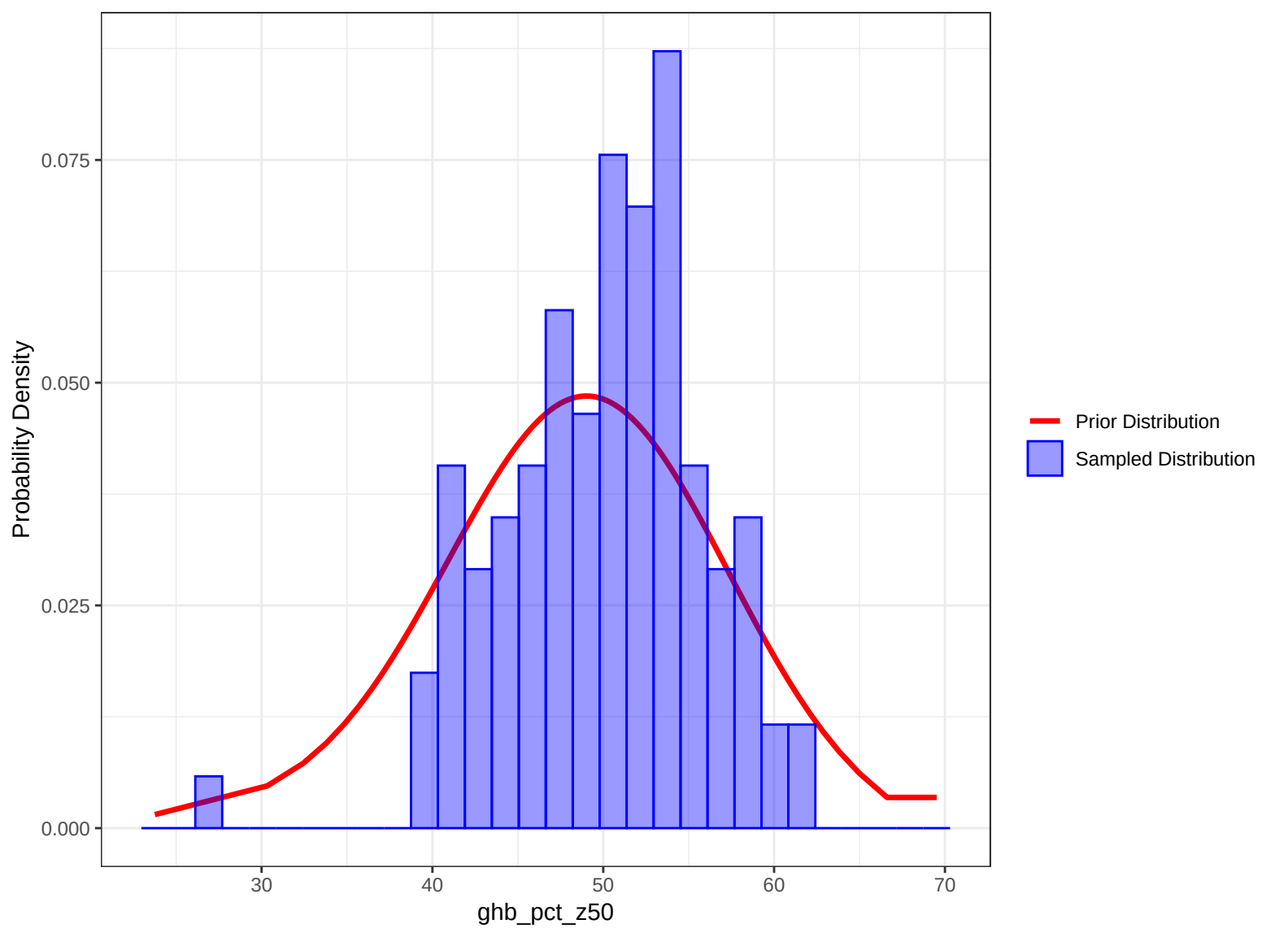
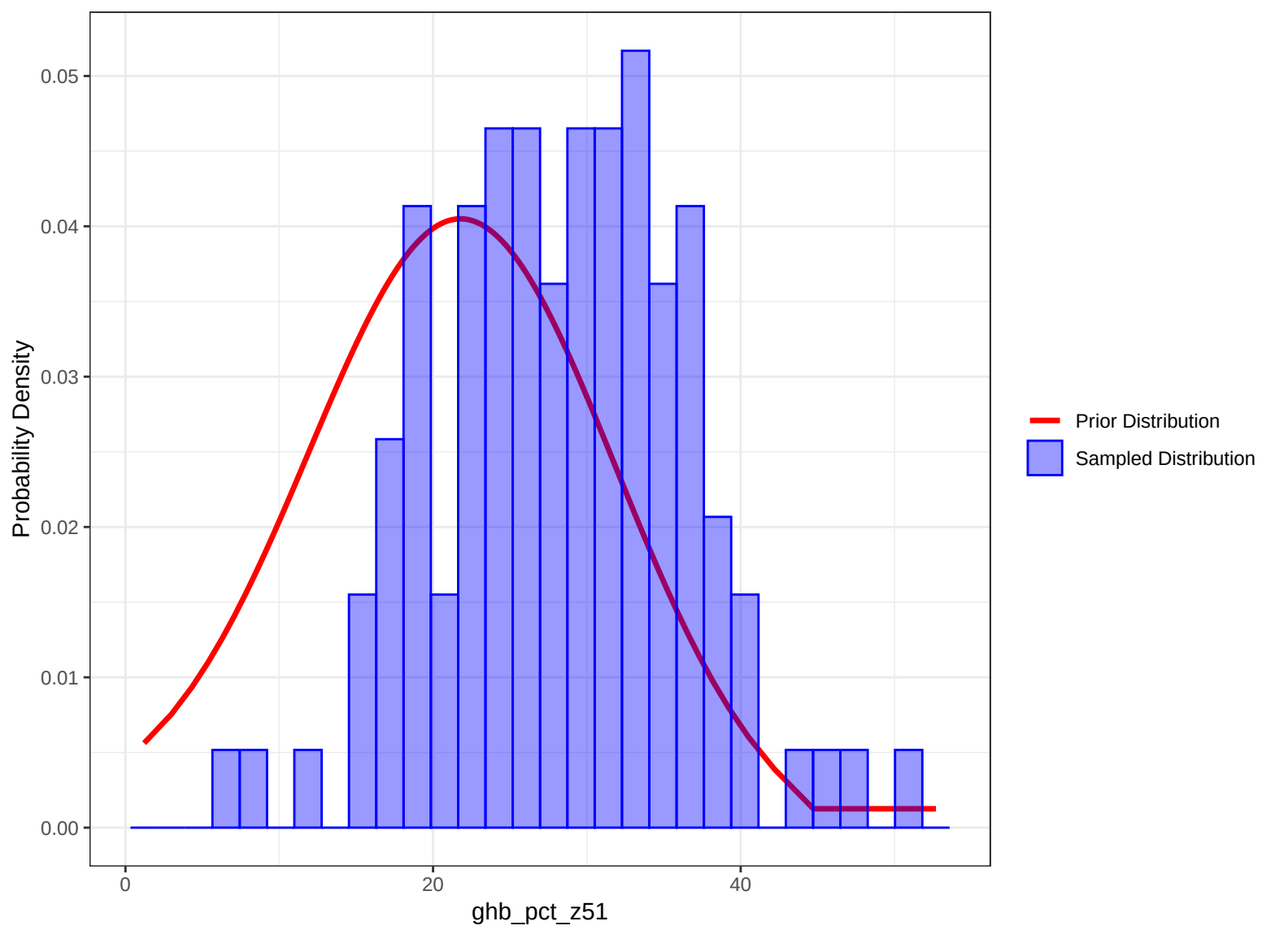
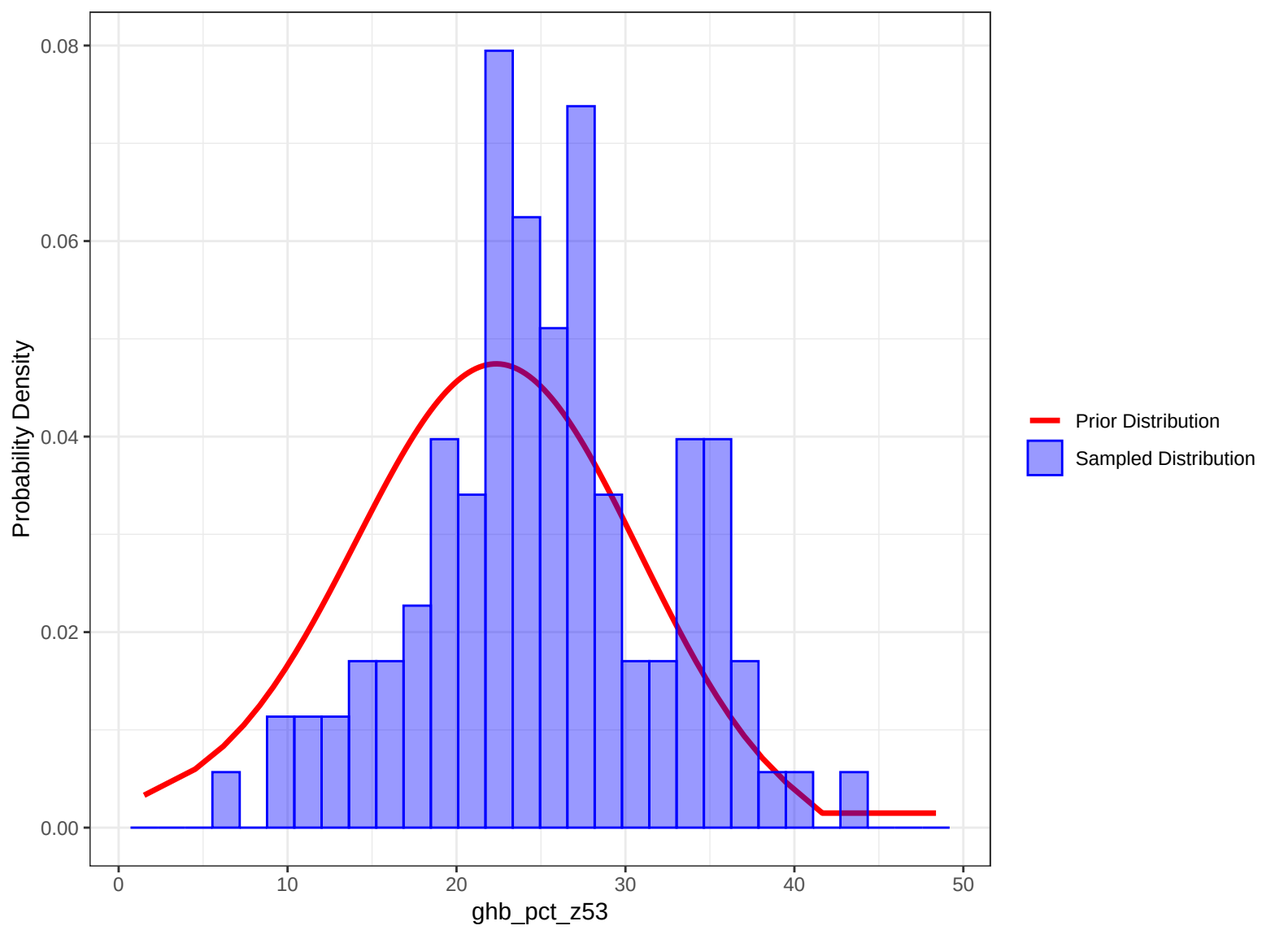
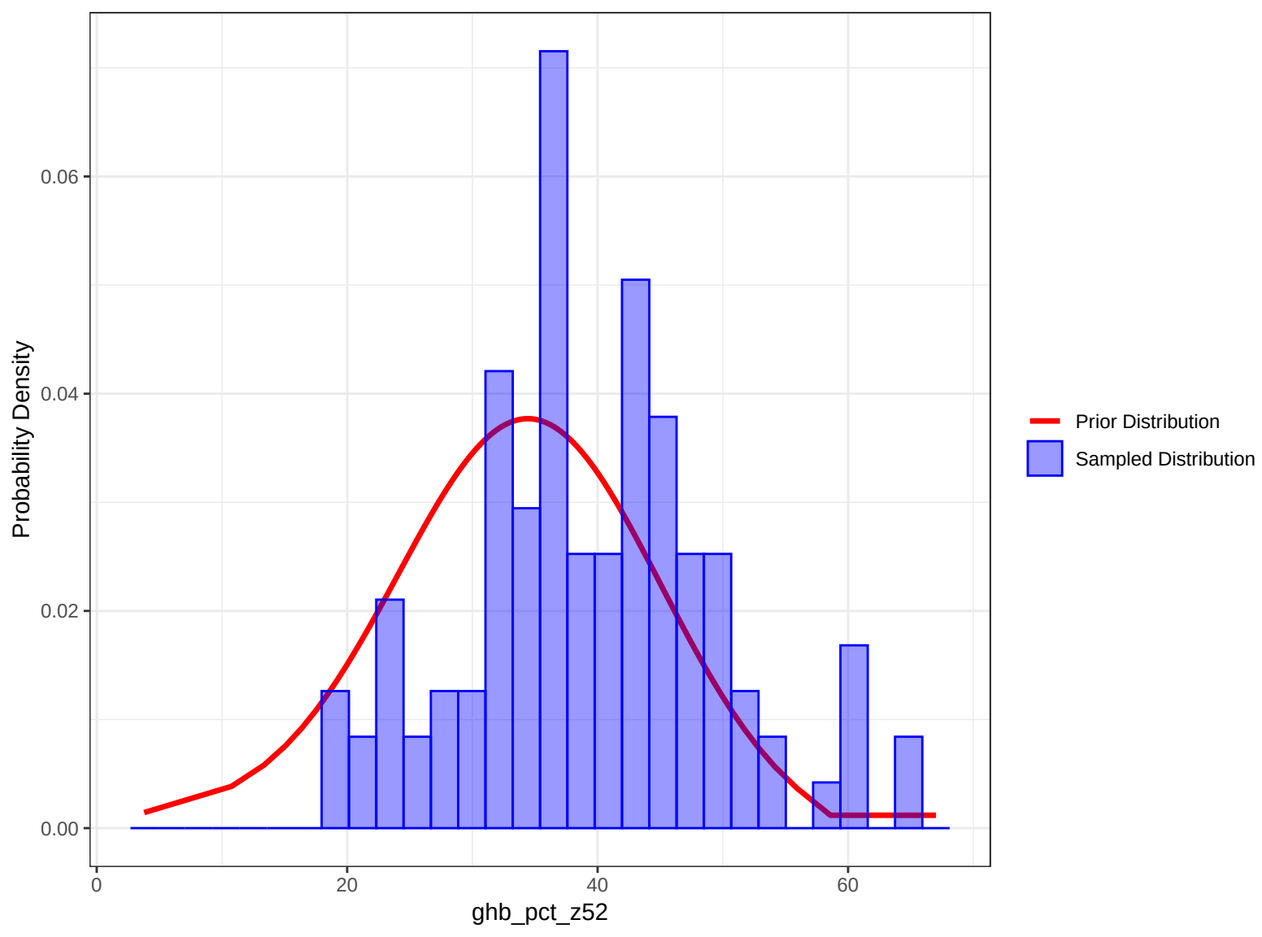
0.03
0.02
0.01
0.00
0
20
40
60
ghb_pct_z49
Prior Distribution
Sampled Distribution

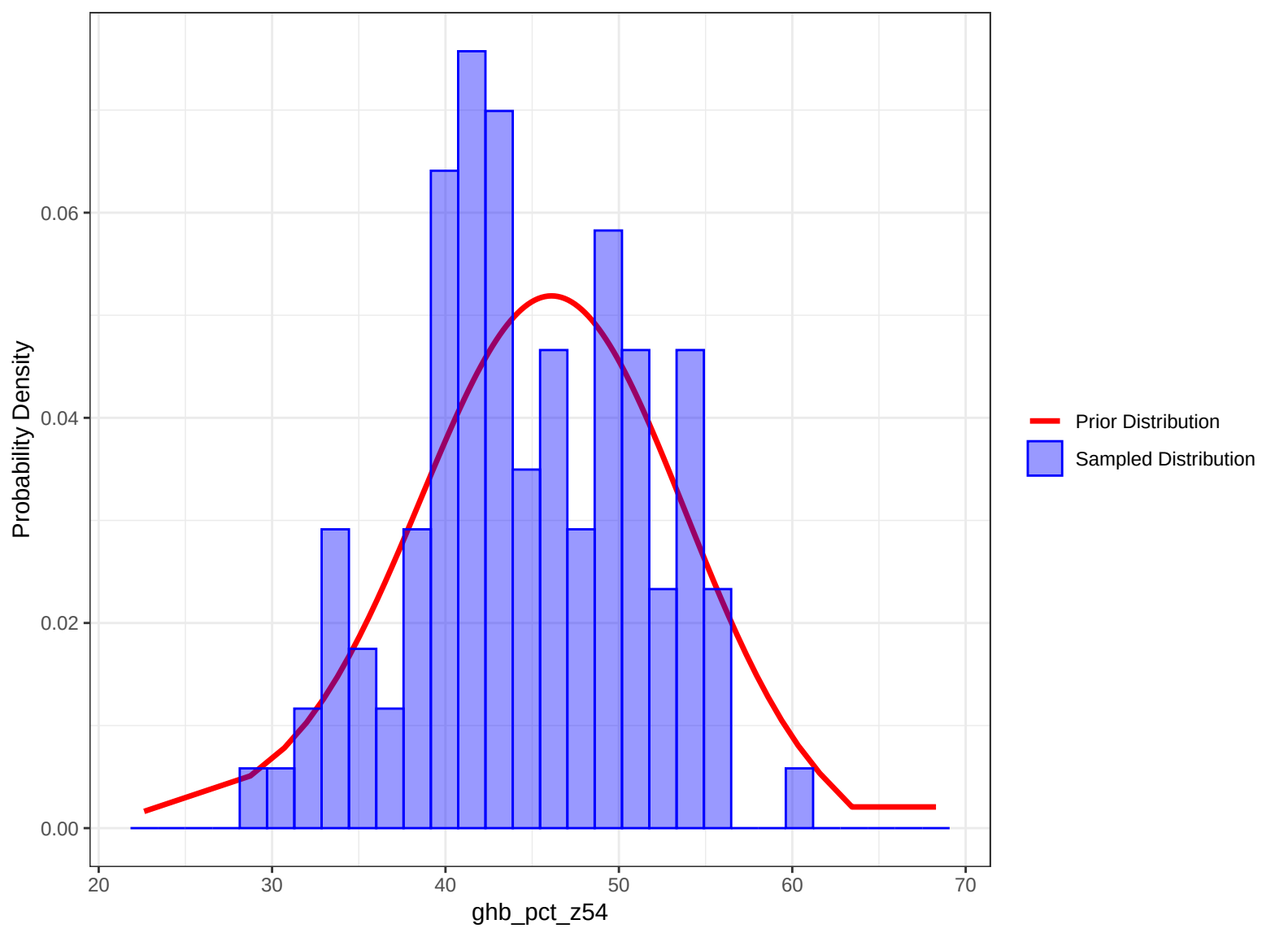

Probability Density
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
ghb_pct_z48
Prior Distribution
Sampled Distribution

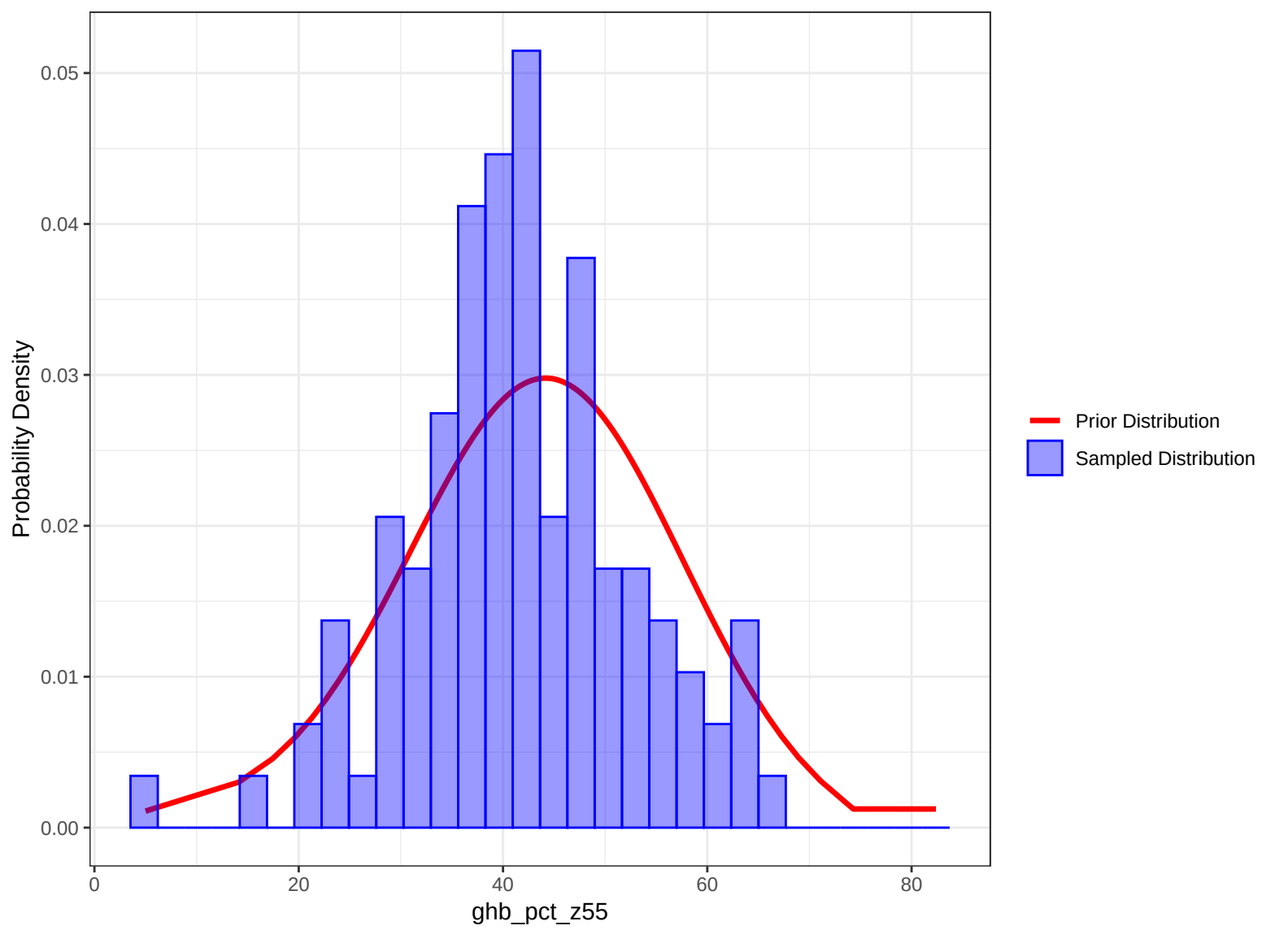

Probability Density
0.075
0.050
0.025
0.000
30
40
50
60
70
ghb_pct_z50
Prior Distribution
Sampled Distribution

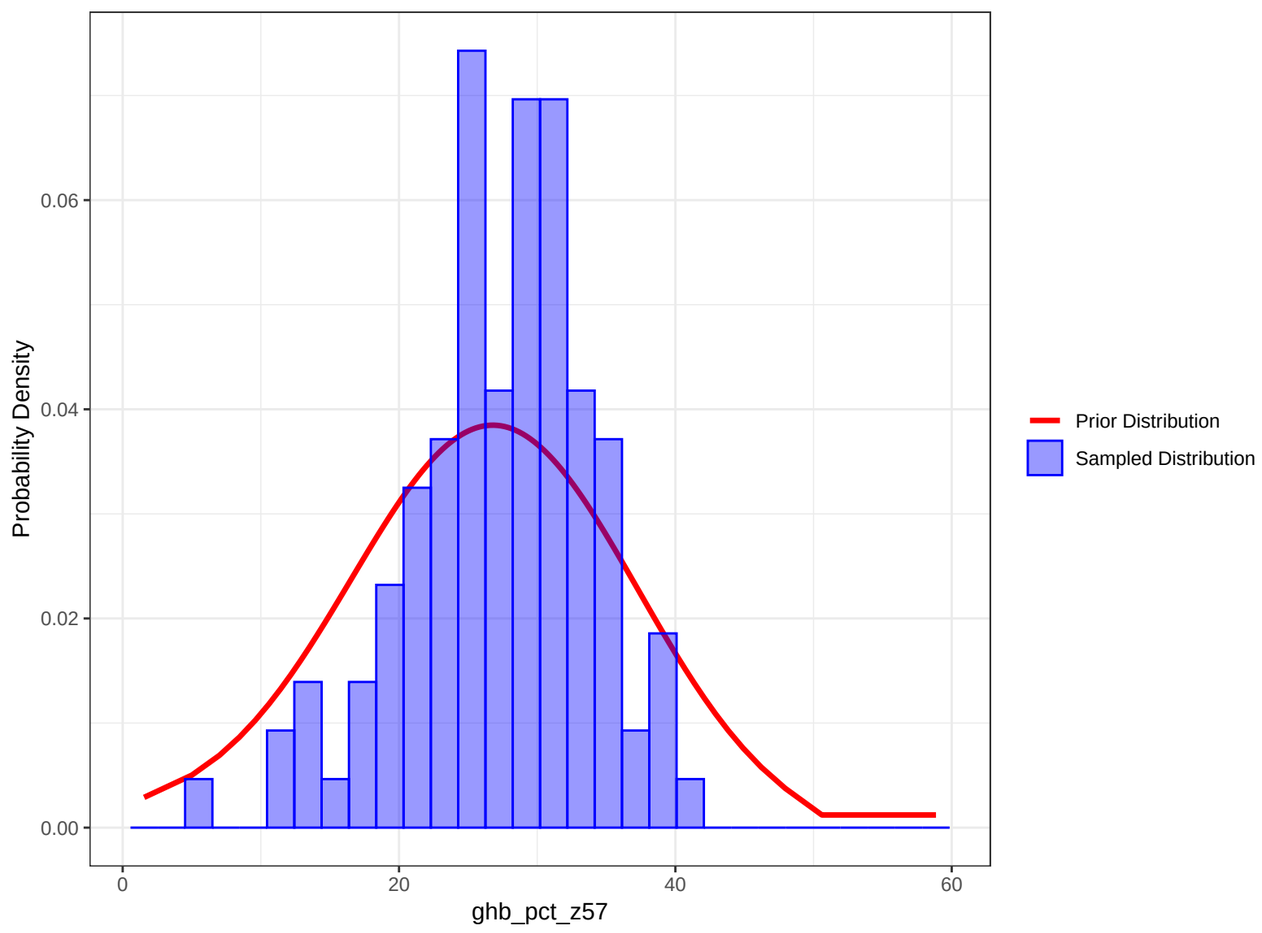

Probability Density
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
ghb_pct_z51
Prior Distribution
Sampled Distribution

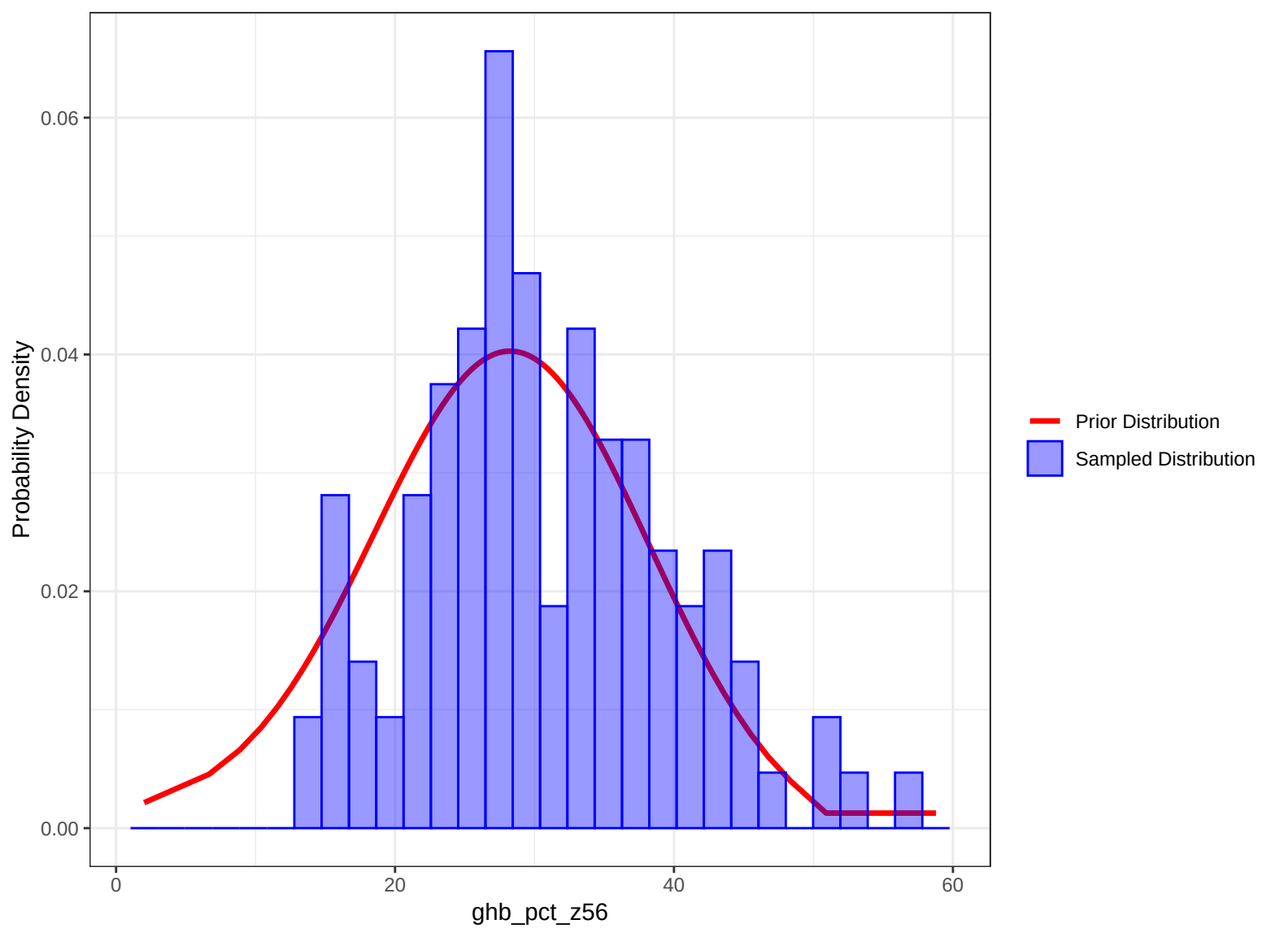

Probability Density
0.08
0.06
0.04
0.02
0.00
0
10
20
30
40
50
ghb_pct_z53
Prior Distribution
Sampled Distribution

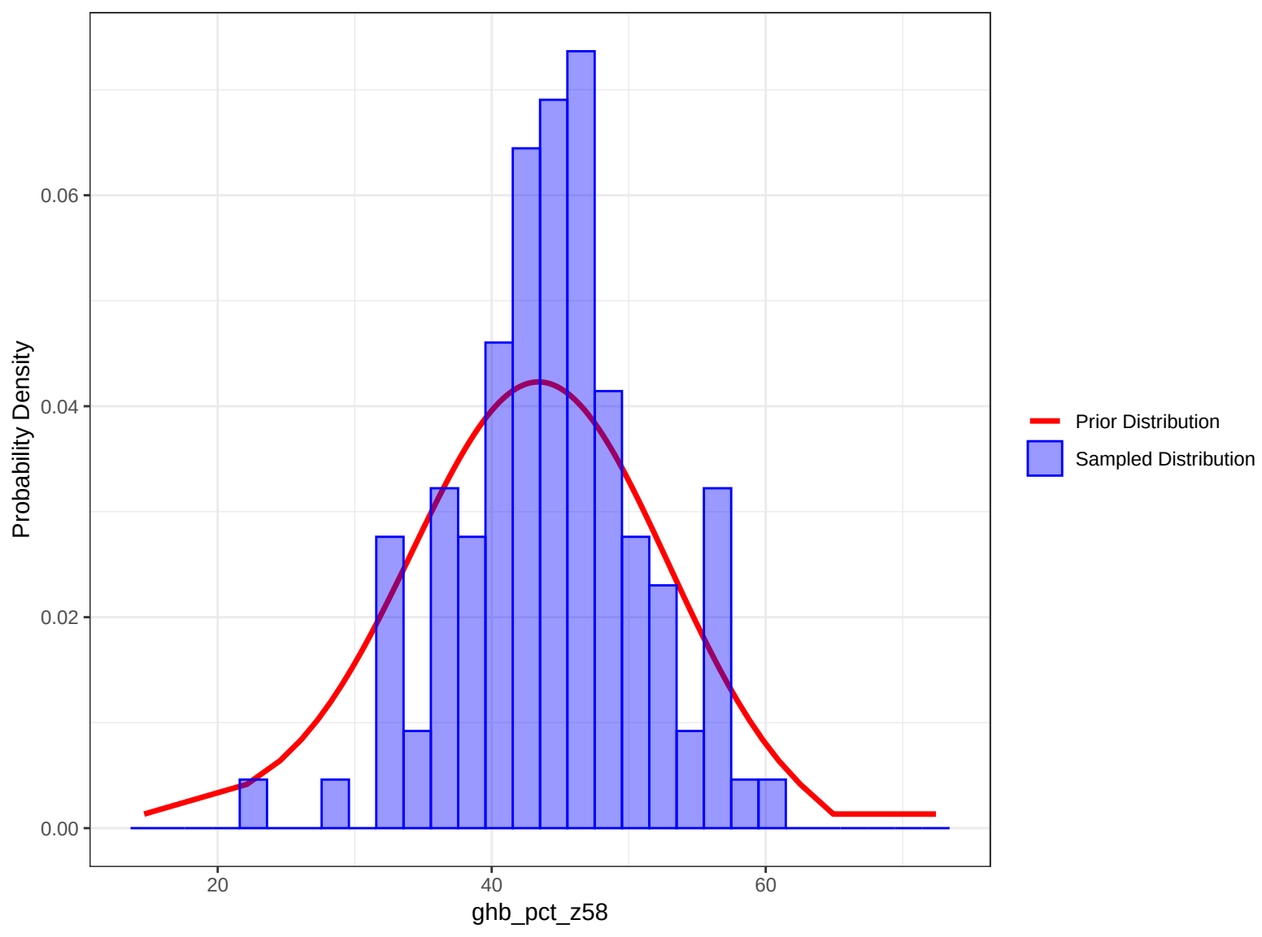

Probability Density
0.06
0.04
0.02
0.00
0
20
40
60
ghb_pct_z52
Prior Distribution
Sampled Distribution

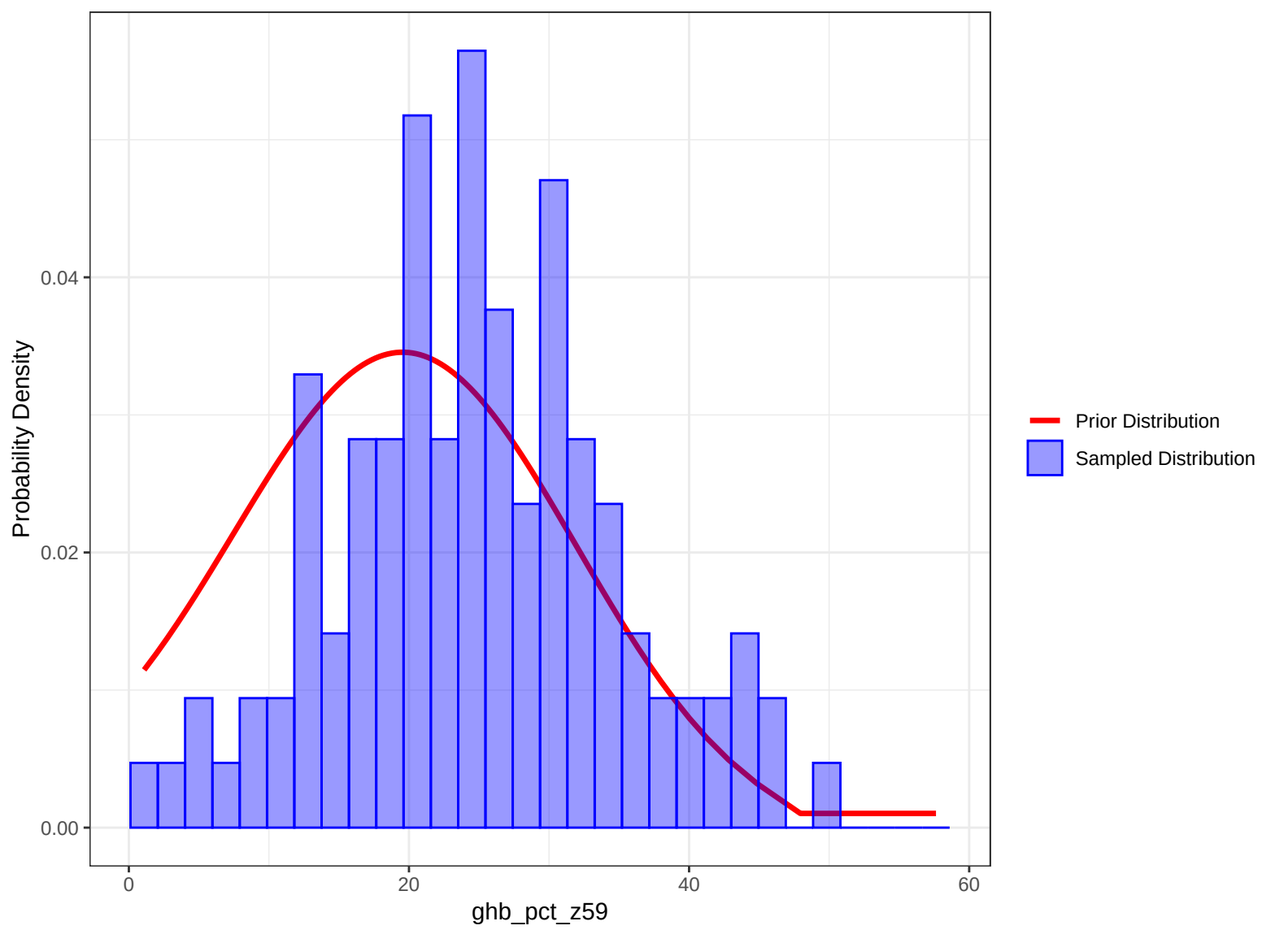

Probability Density
0.06
0.04
0.02
0.00
20
30
40
50
60
70
ghb_pct_z54
Prior Distribution
Sampled Distribution

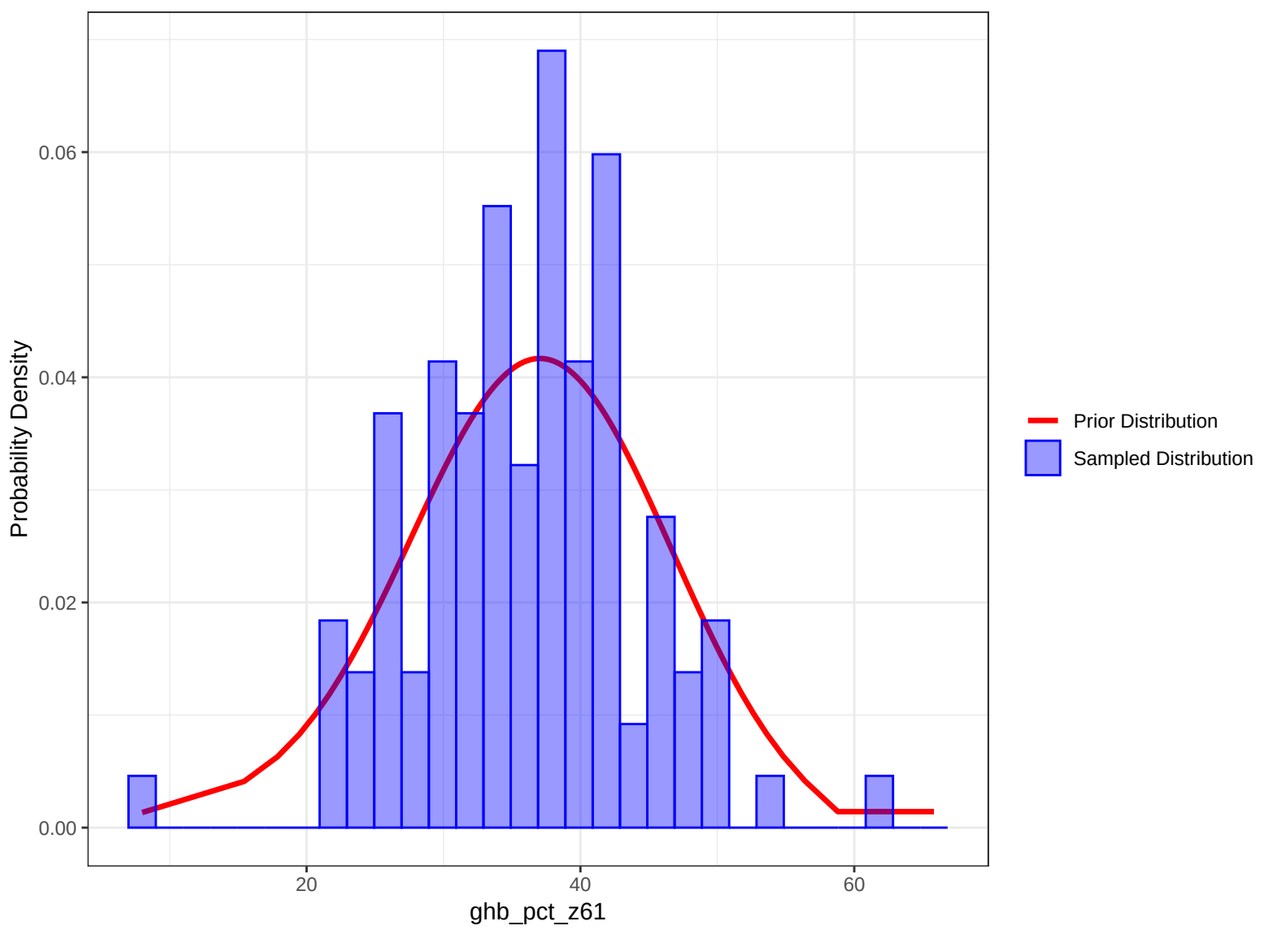

Probability Density
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
ghb_pct_z55
Prior Distribution
Sampled Distribution

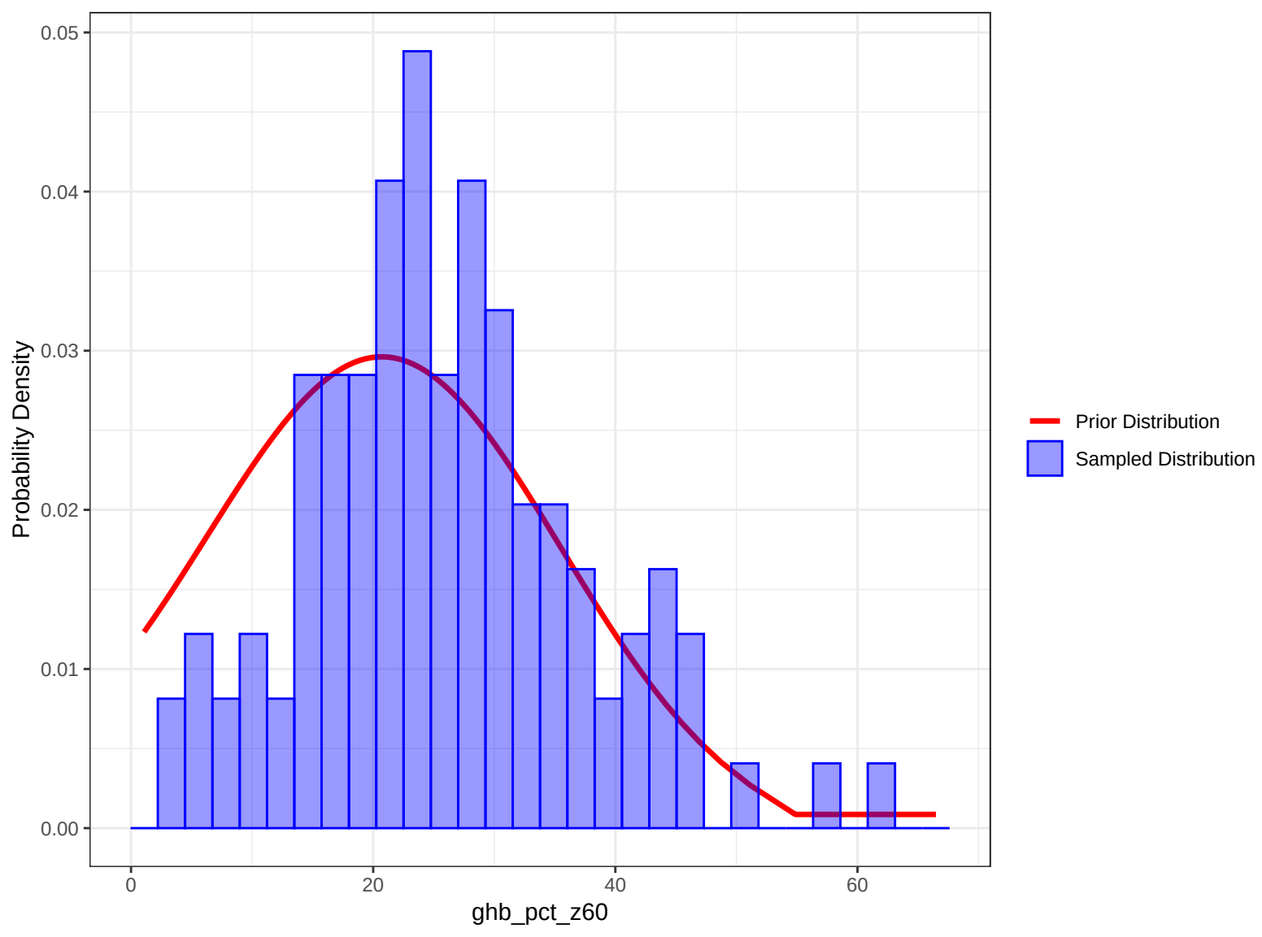

Probability Density
0.06
0.04
0.02
0.00
0
20
40
60
ghb_pct_z57
Prior Distribution
Sampled Distribution

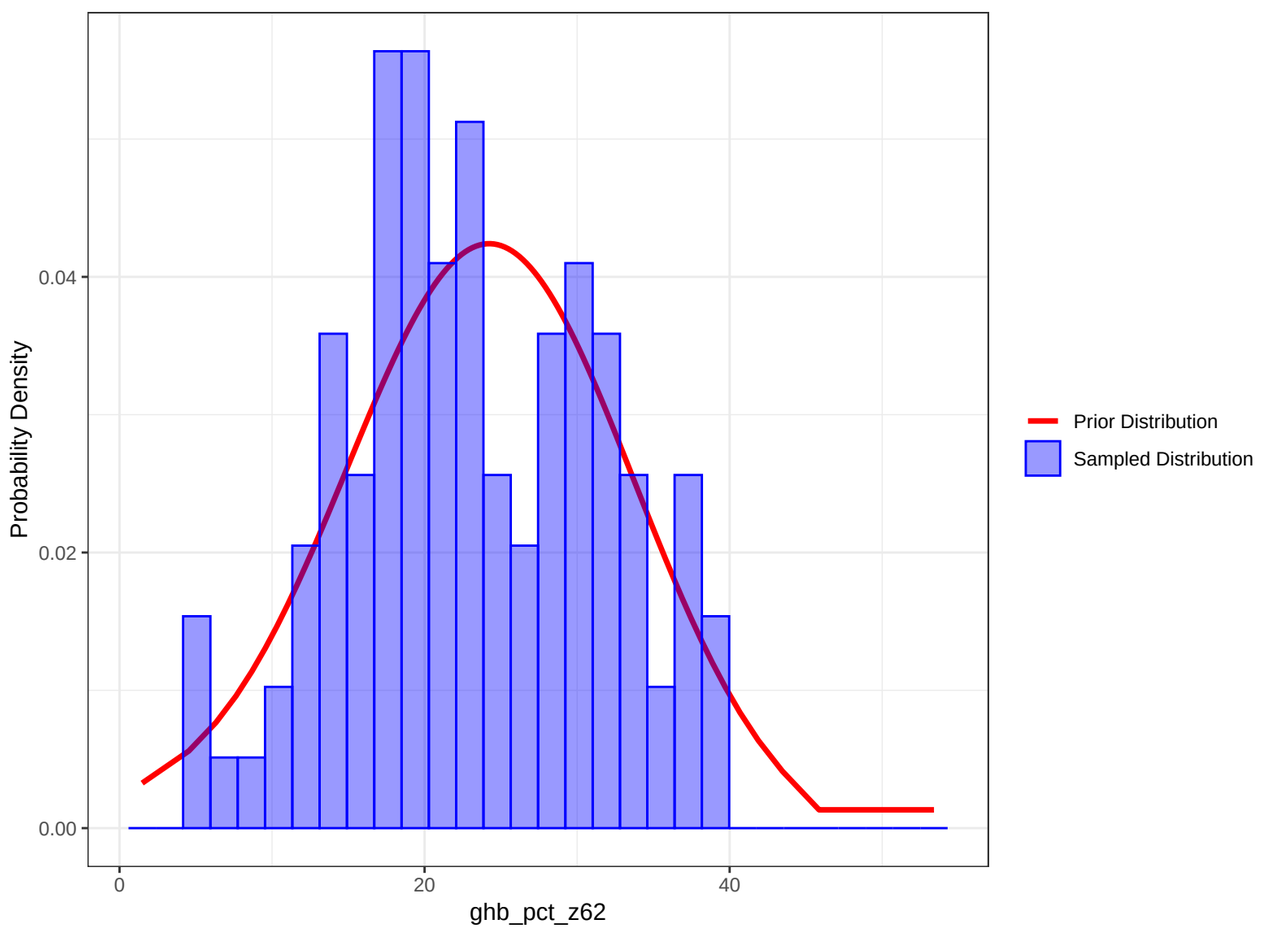

Probability Density
0.06
0.04
0.02
0.00
0
20
40
60
ghb_pct_z56
Prior Distribution
Sampled Distribution

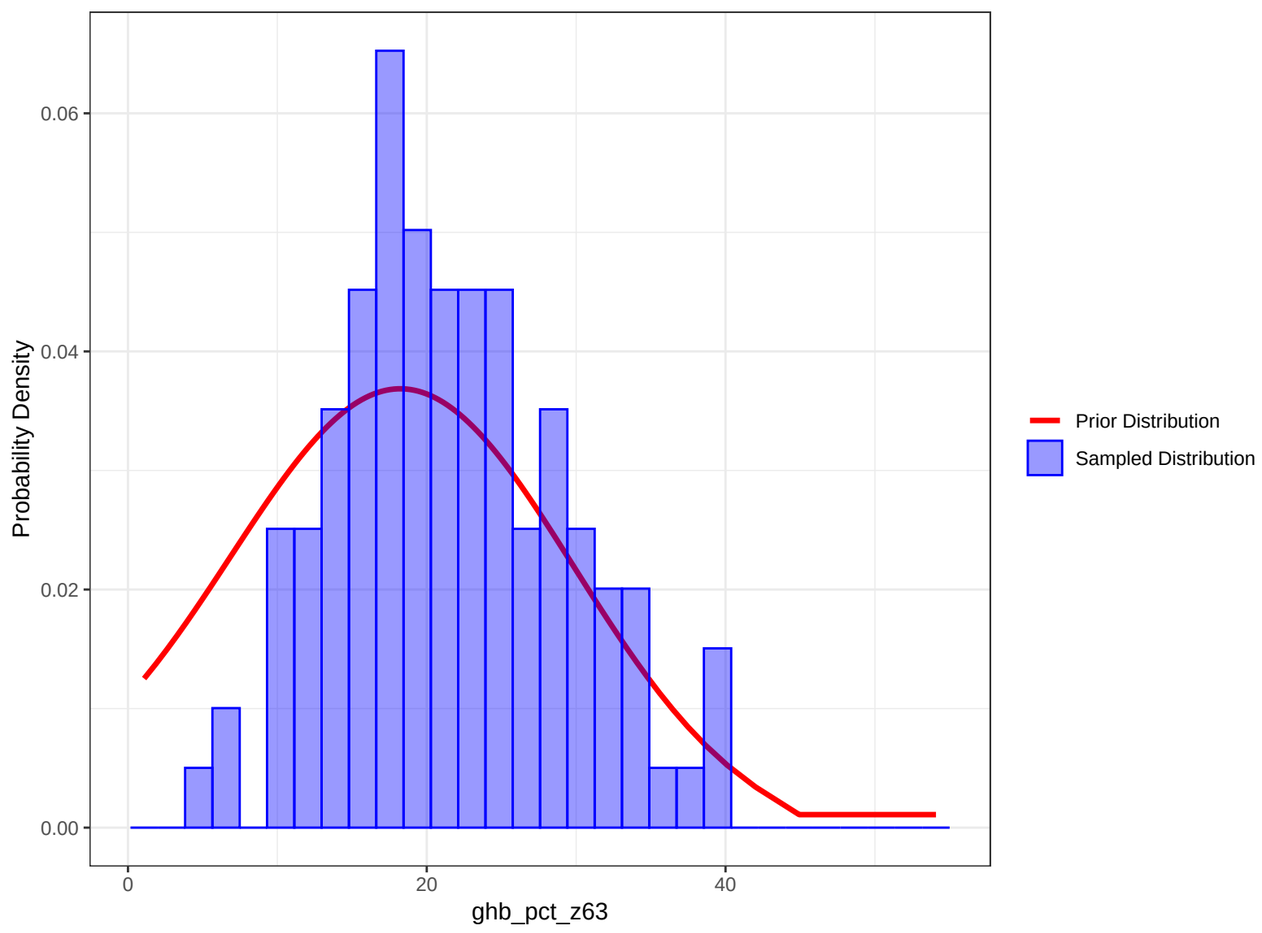

Probability Density
0.06
0.04
0.02
0.00
20
40
60
ghb_pct_z58
Prior Distribution
Sampled Distribution

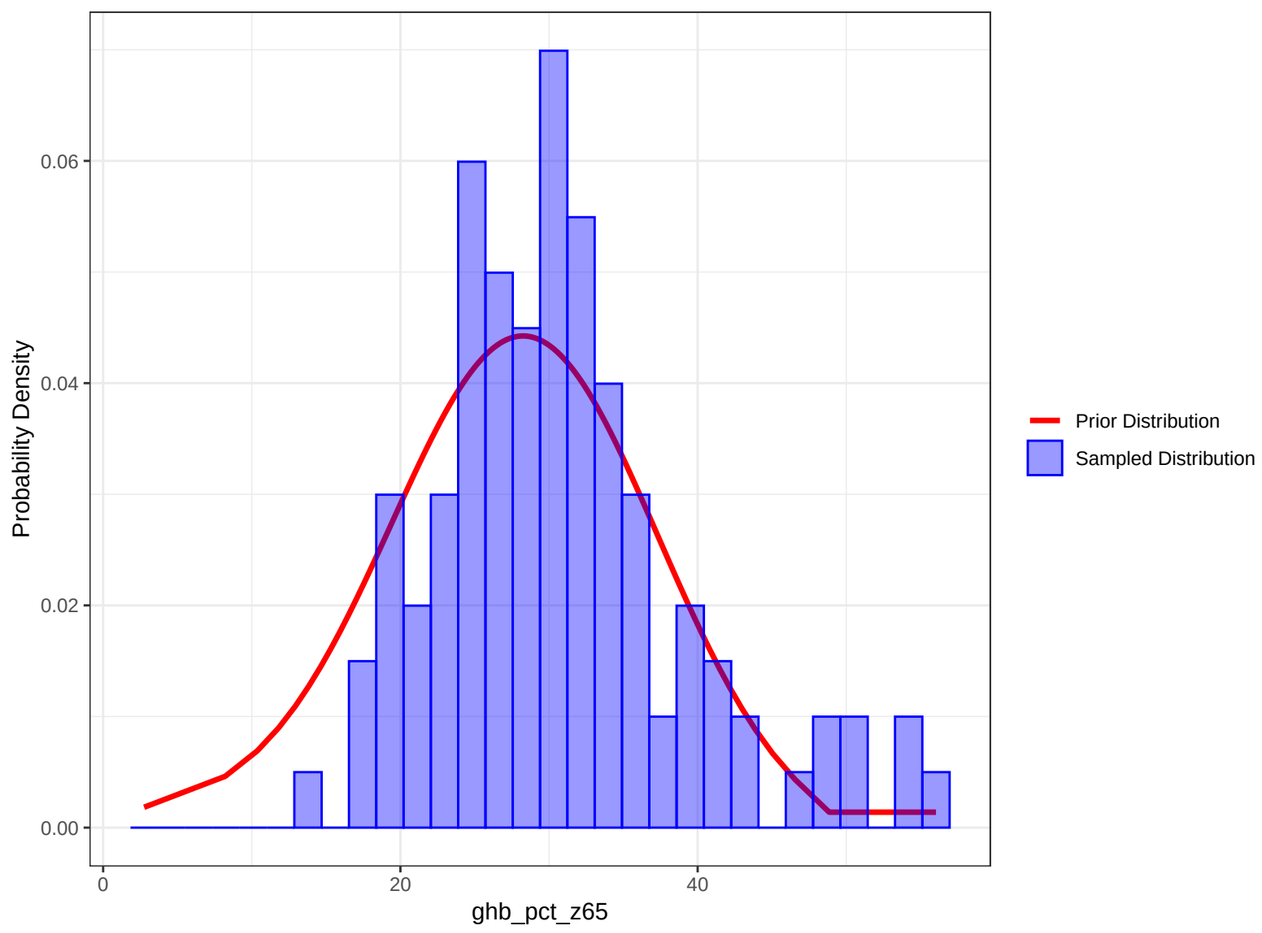

Probability Density
0.00
0.02
0.04
0
20
40
60
ghb_pct_z59
Prior Distribution
Sampled Distribution

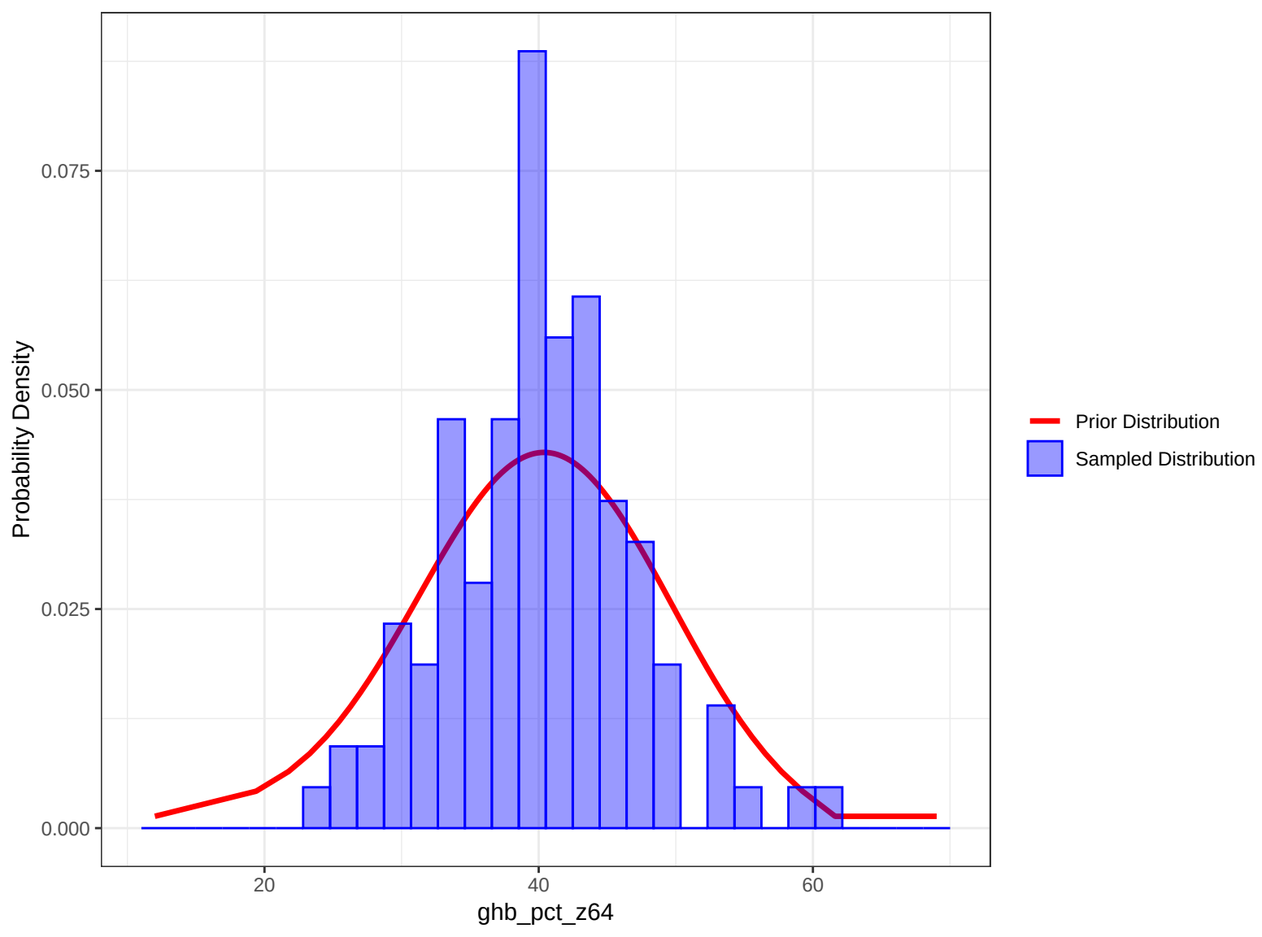

Probability Density
0.00
0.02
0.04
0.06
20
40
60
ghb_pct_z61
Prior Distribution
Sampled Distribution

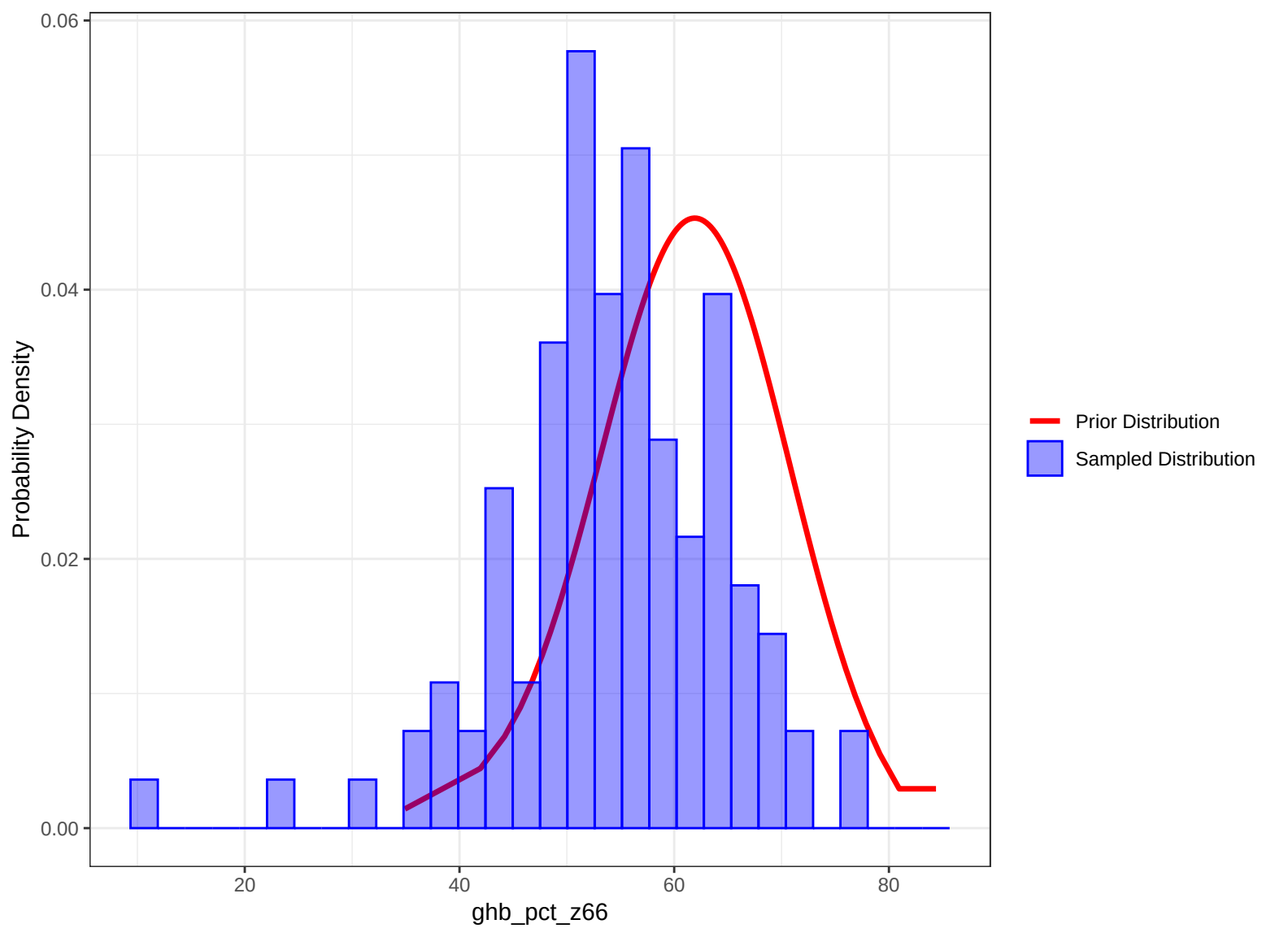

Probability Density
0.00
0.01
0.02
0.03
0.04
0.05
0
20
40
60
ghb_pct_z60
Prior Distribution
Sampled Distribution

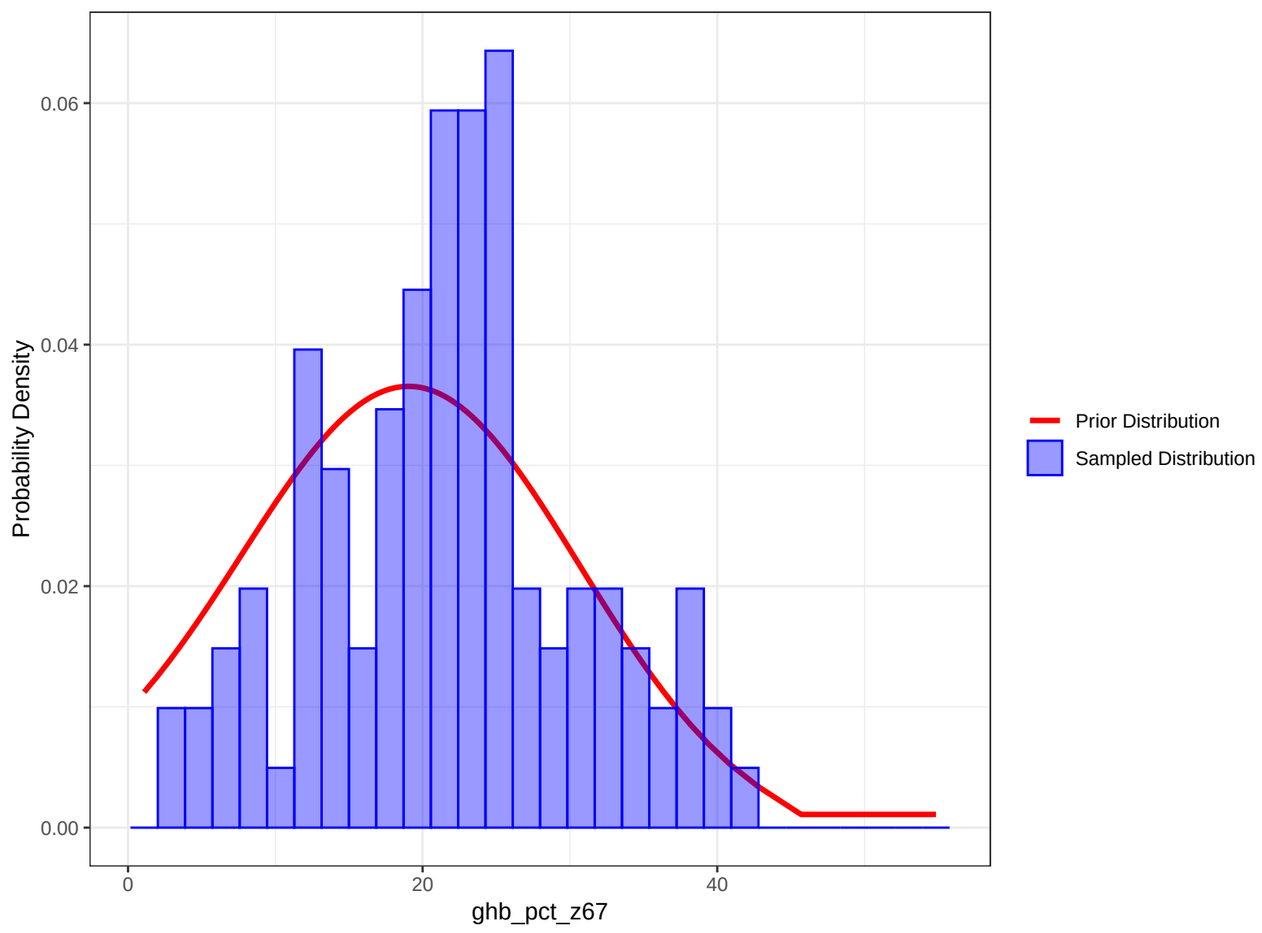

Probability Density
0.00
0.02
0.04
0
20
40
ghb_pct_z62
Prior Distribution
Sampled Distribution

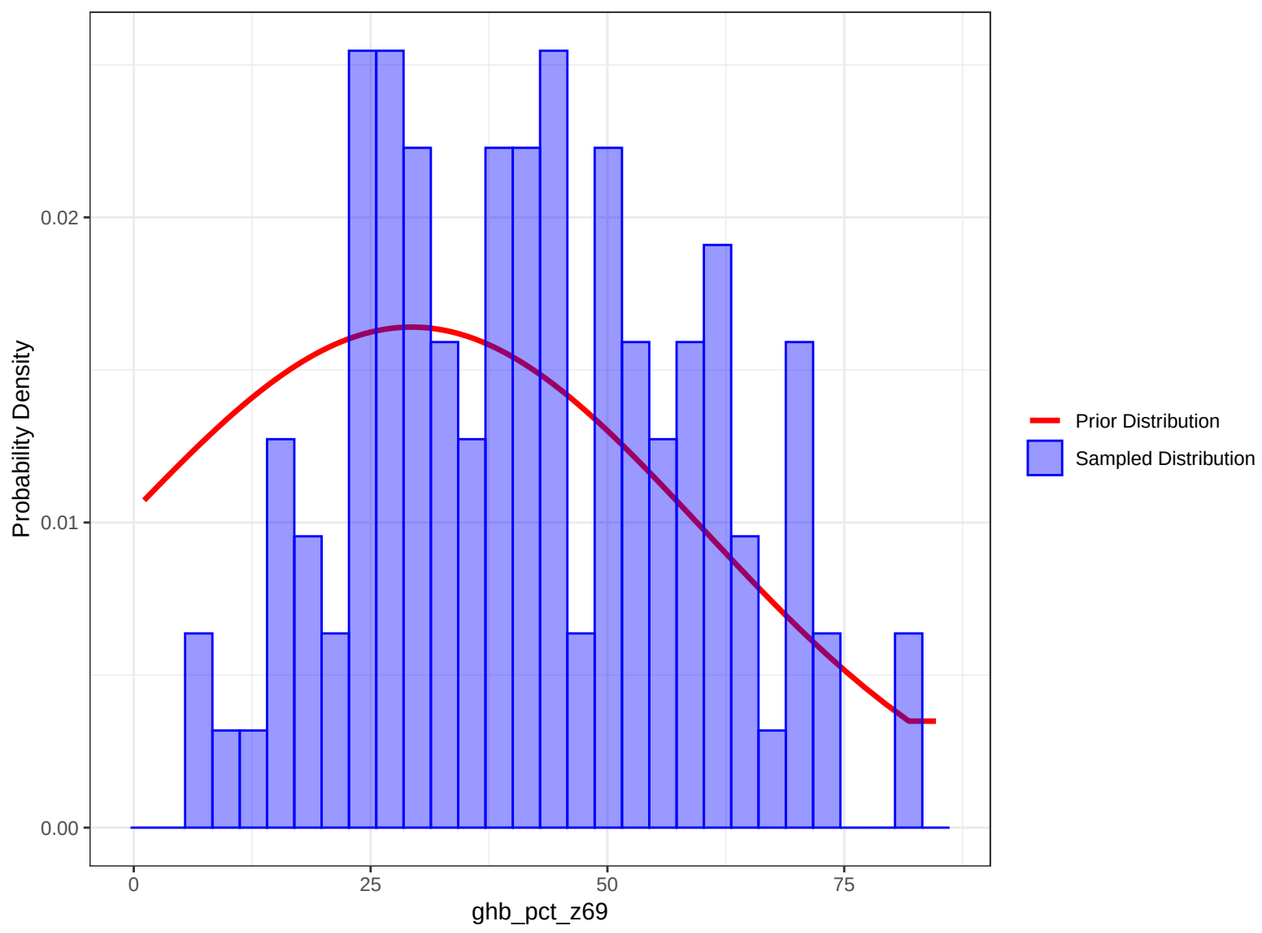

Probability Density
0.06
0.04
0.02
0.00
0
20
40
ghb_pct_z63
Prior Distribution
Sampled Distribution

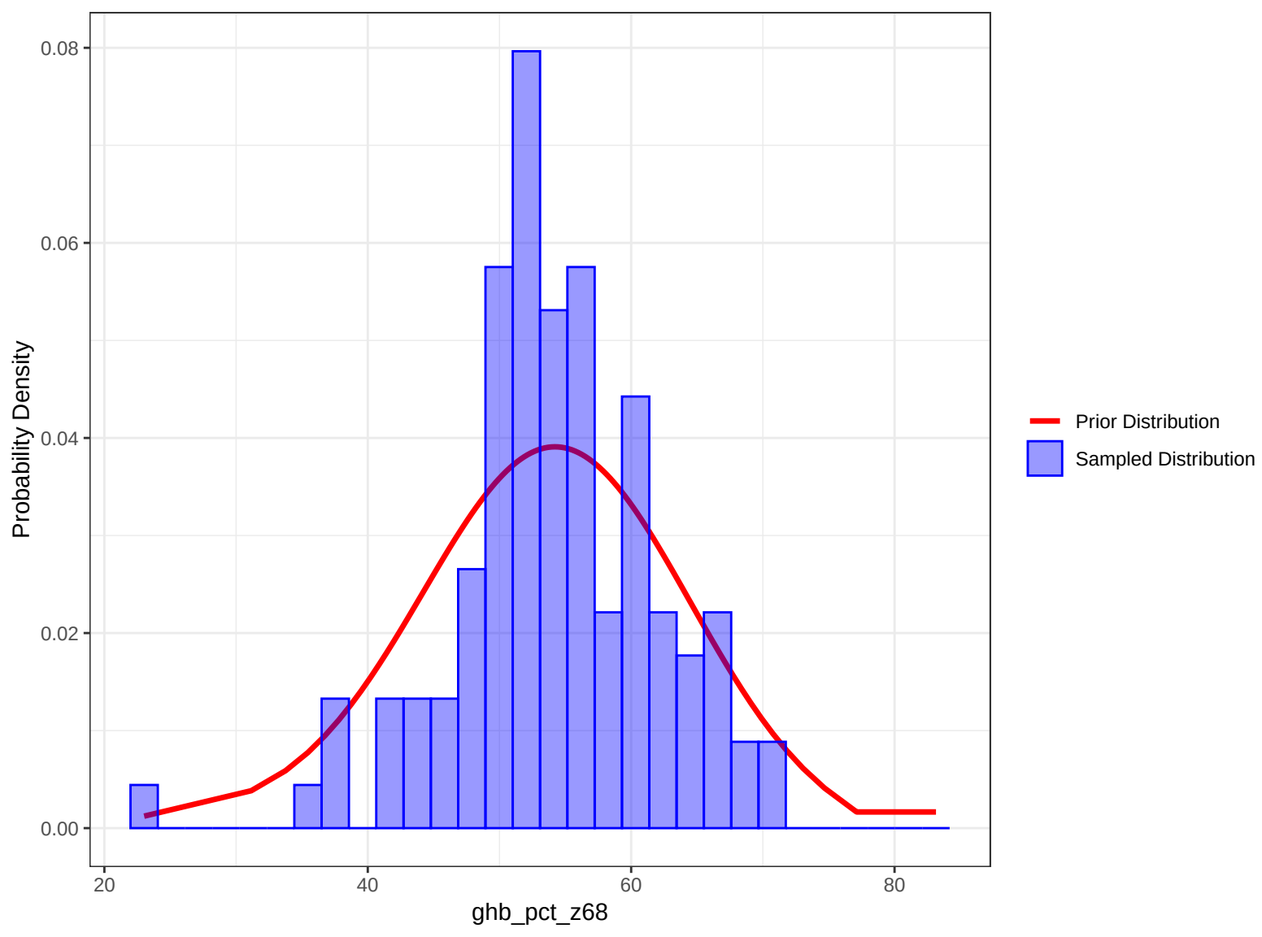

Probability Density
0.06
0.04
0.02
0.00
0
20
40
ghb_pct_z65
Prior Distribution
Sampled Distribution

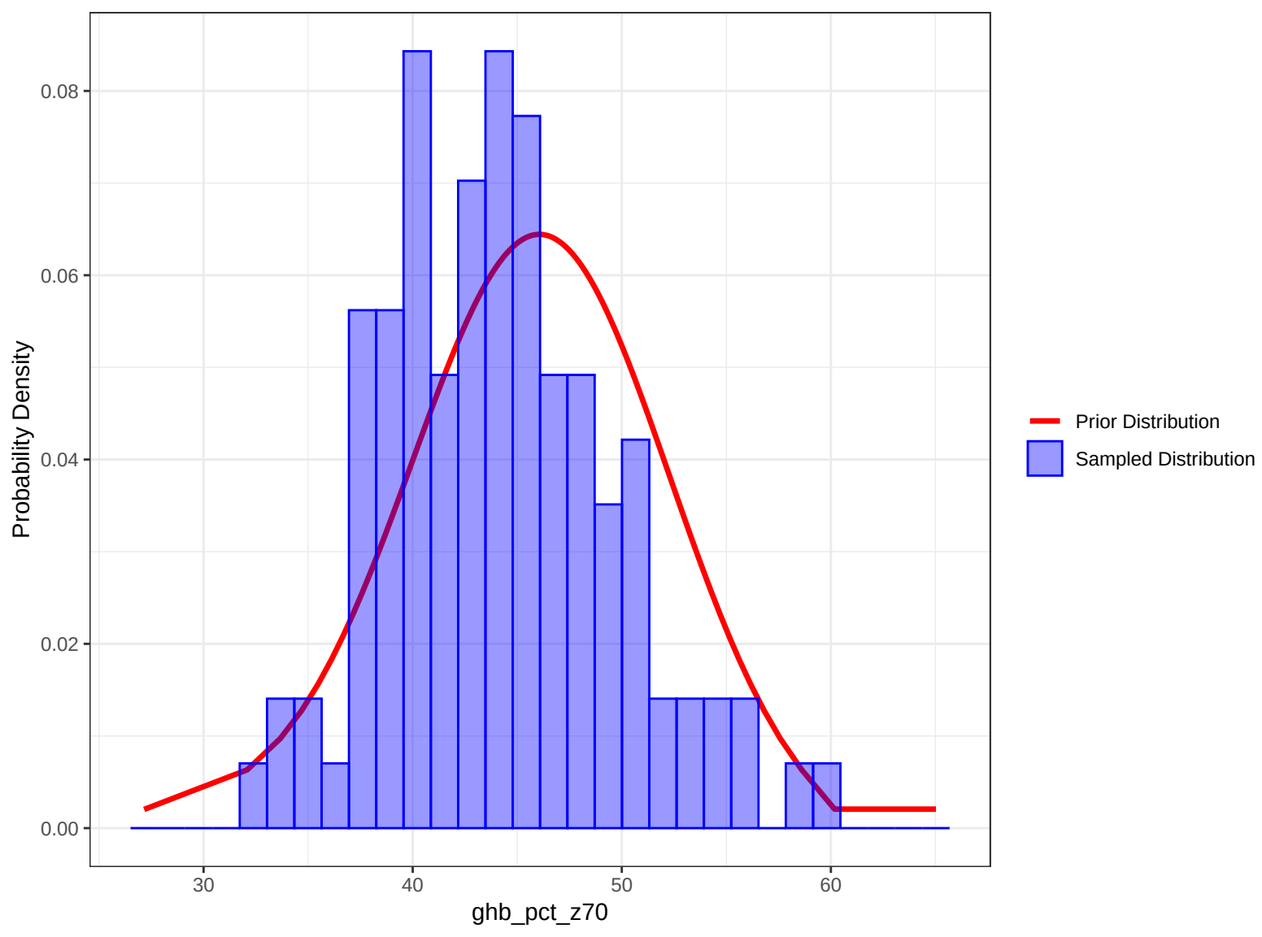

Probability Density
0.075
0.050
0.025
0.000
20
40
60
ghb_pct_z64
Prior Distribution
Sampled Distribution

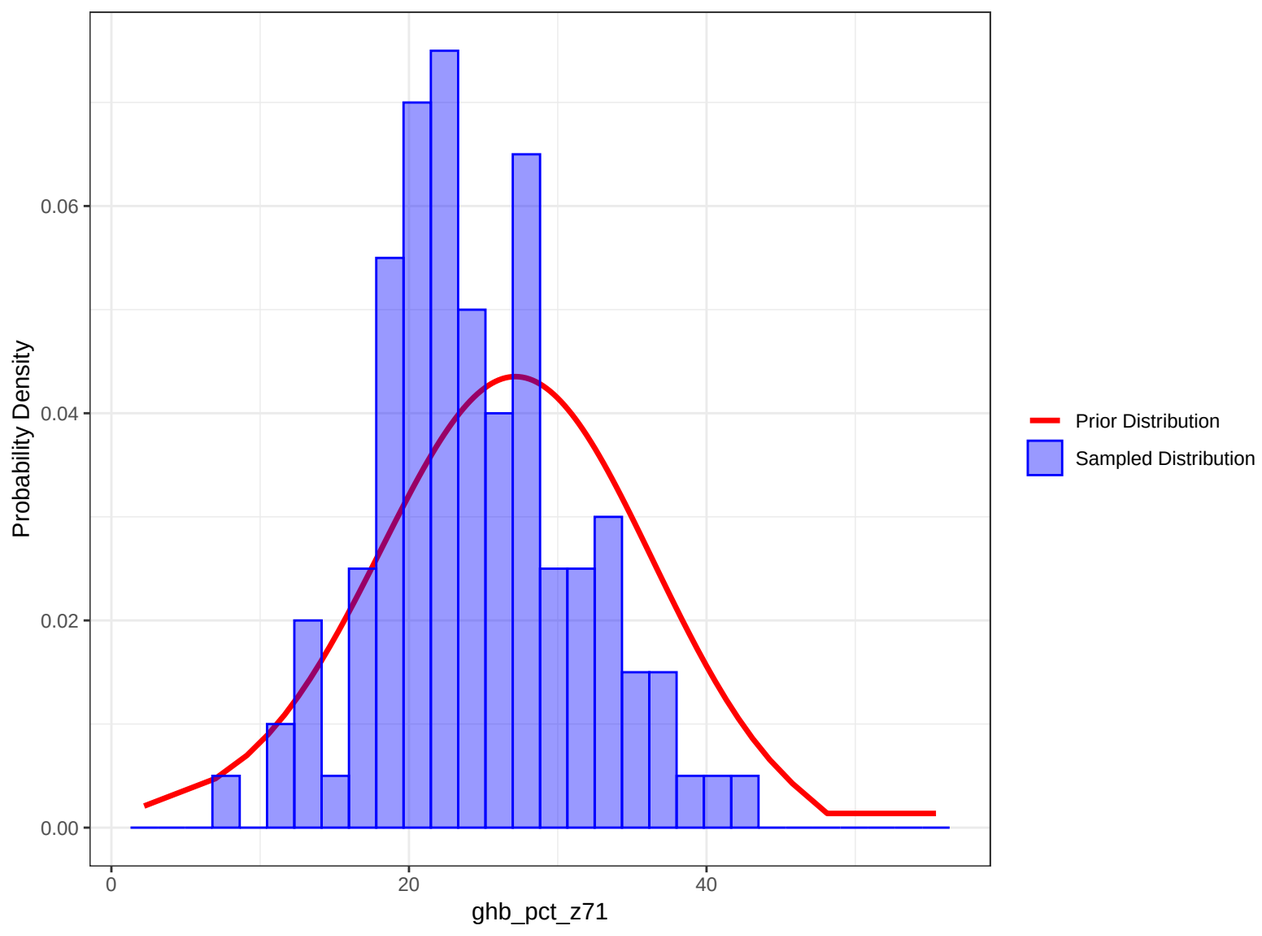

Probability Density
0.06
0.04
0.02
0.00
20
40
60
80
ghb_pct_z66
Prior Distribution
Sampled Distribution

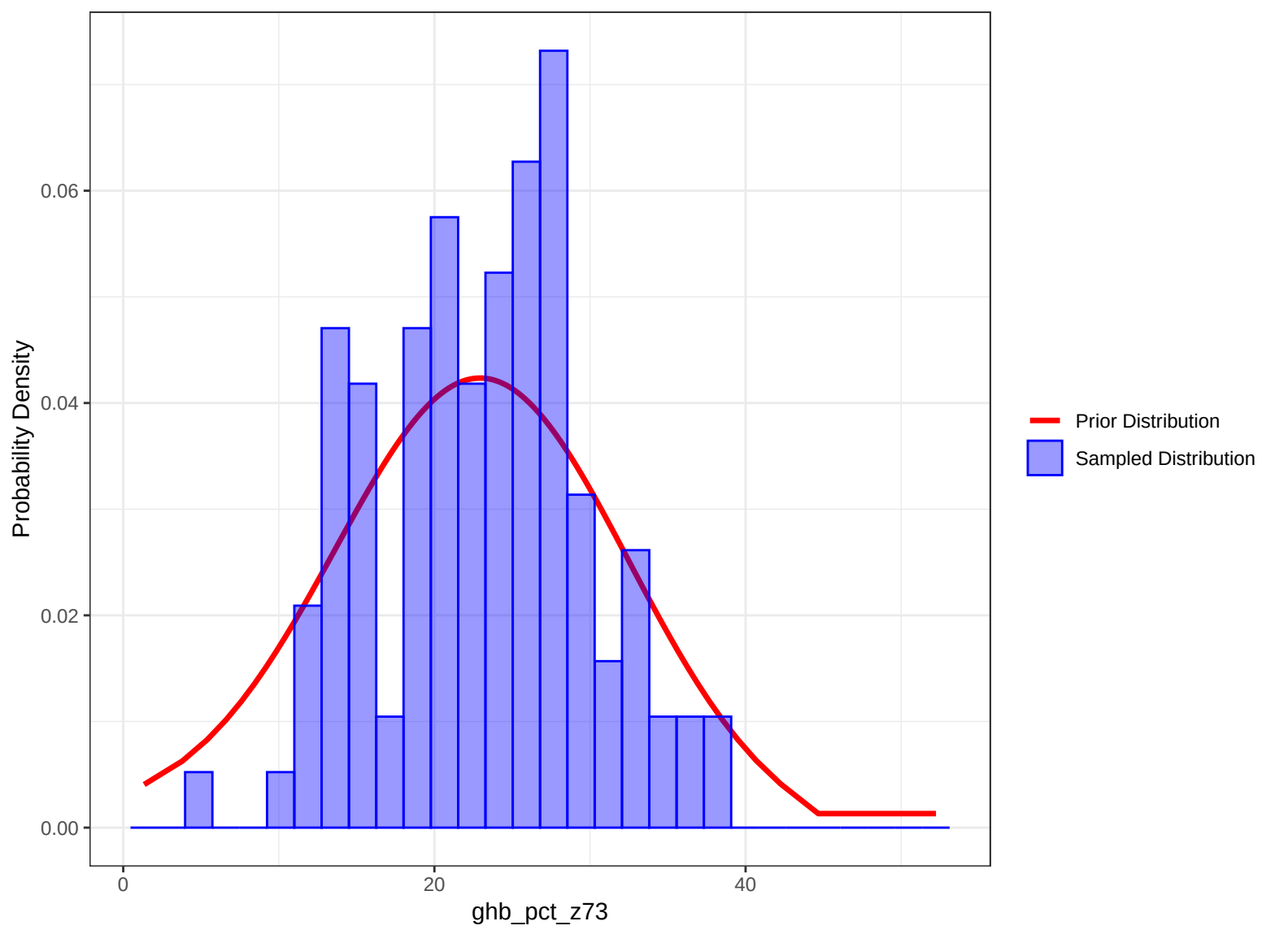

Probability Density
0.06
0.04
0.02
0.00
0
20
40
ghb_pct_z67
Prior Distribution
Sampled Distribution

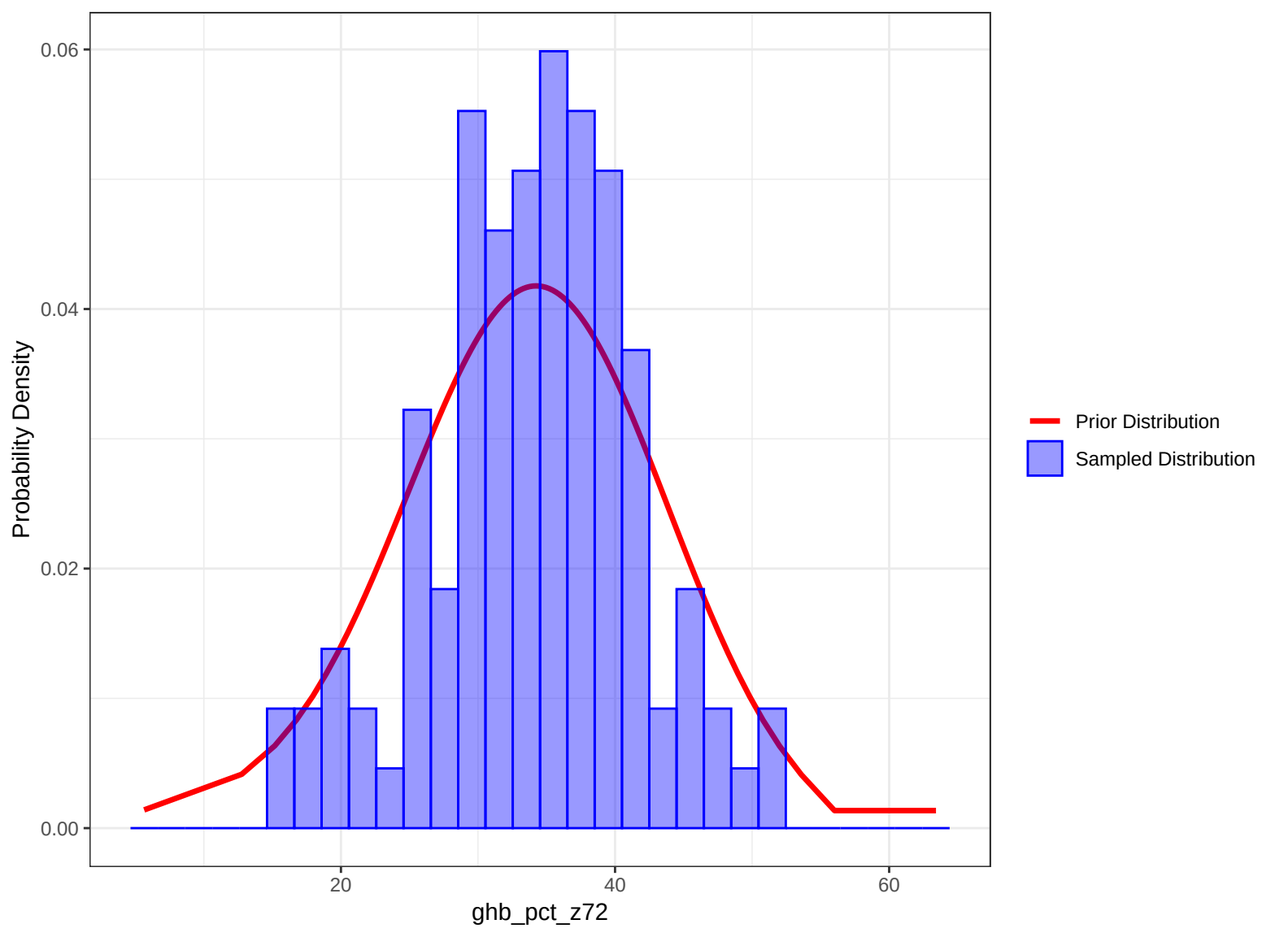

Probability Density
0.02
0.01
0.00
0
25
50
75
ghb_pct_z69
Prior Distribution
Sampled Distribution

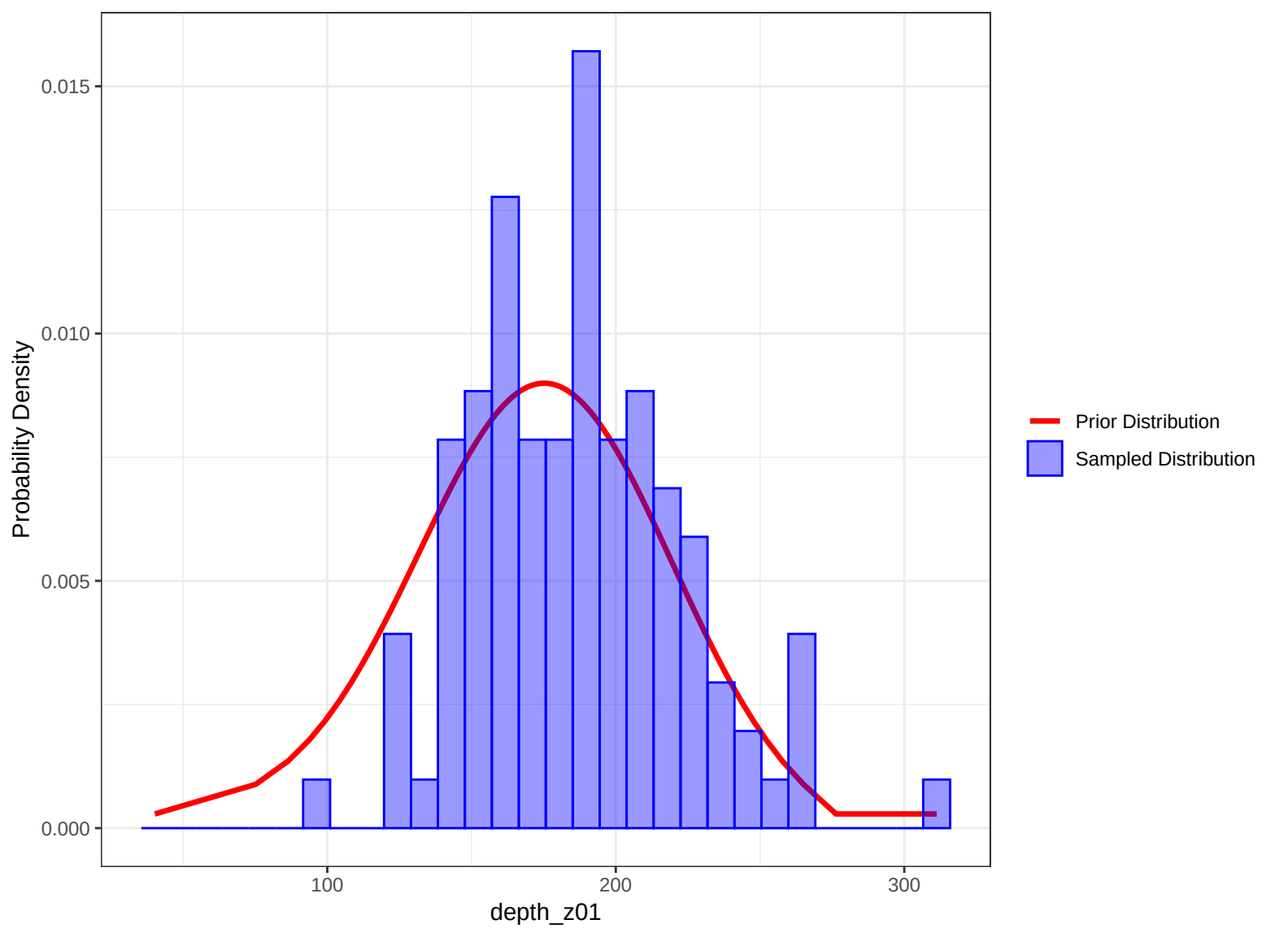

Probability Density
0.08
0.06
0.04
0.02
0.00
20
40
60
80
ghb_pct_z68
Prior Distribution
Sampled Distribution

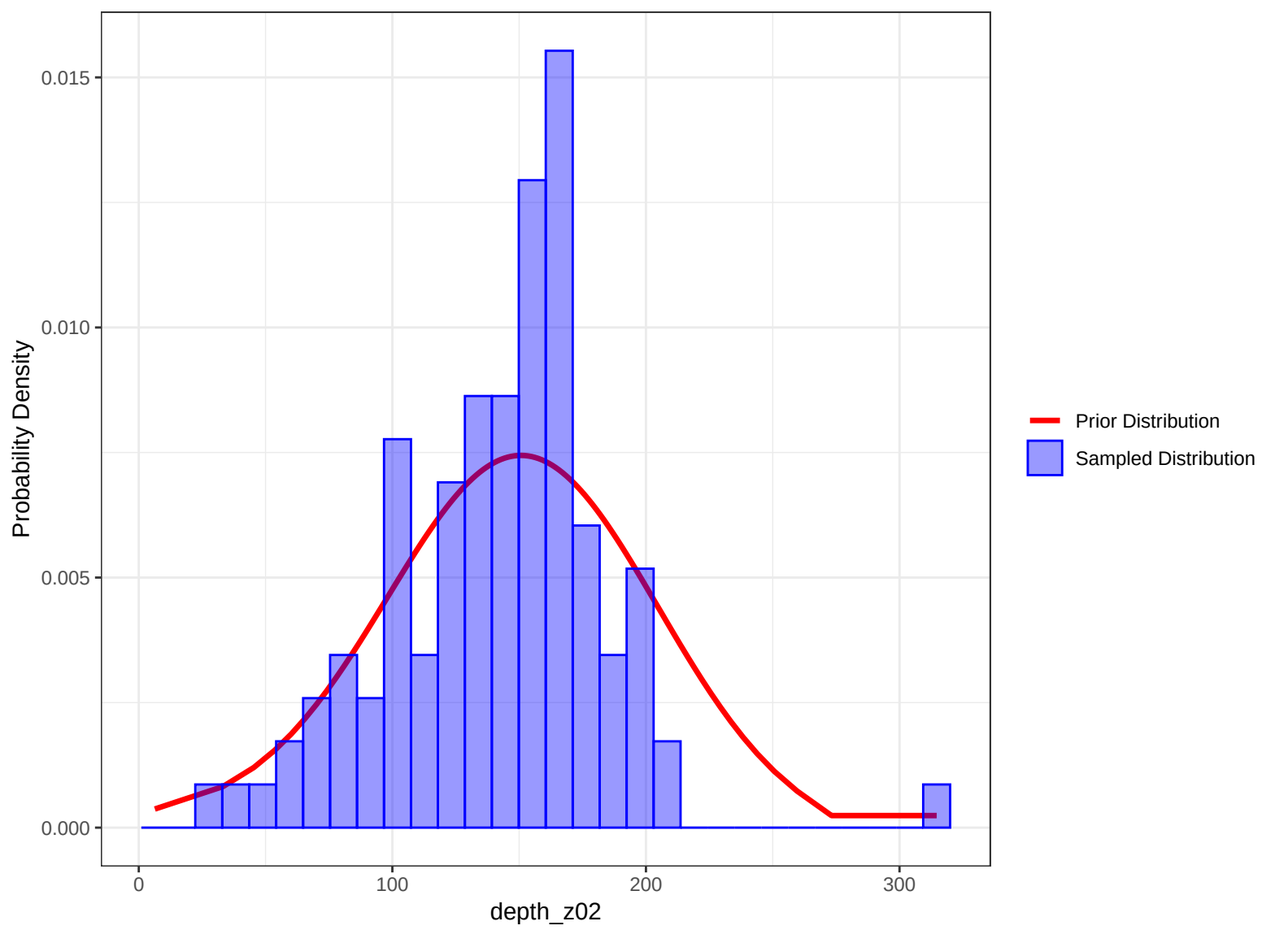

Probability Density
0.08
0.06
0.04
0.02
0.00
30
40
50
60
ghb_pct_z70
Prior Distribution
Sampled Distribution

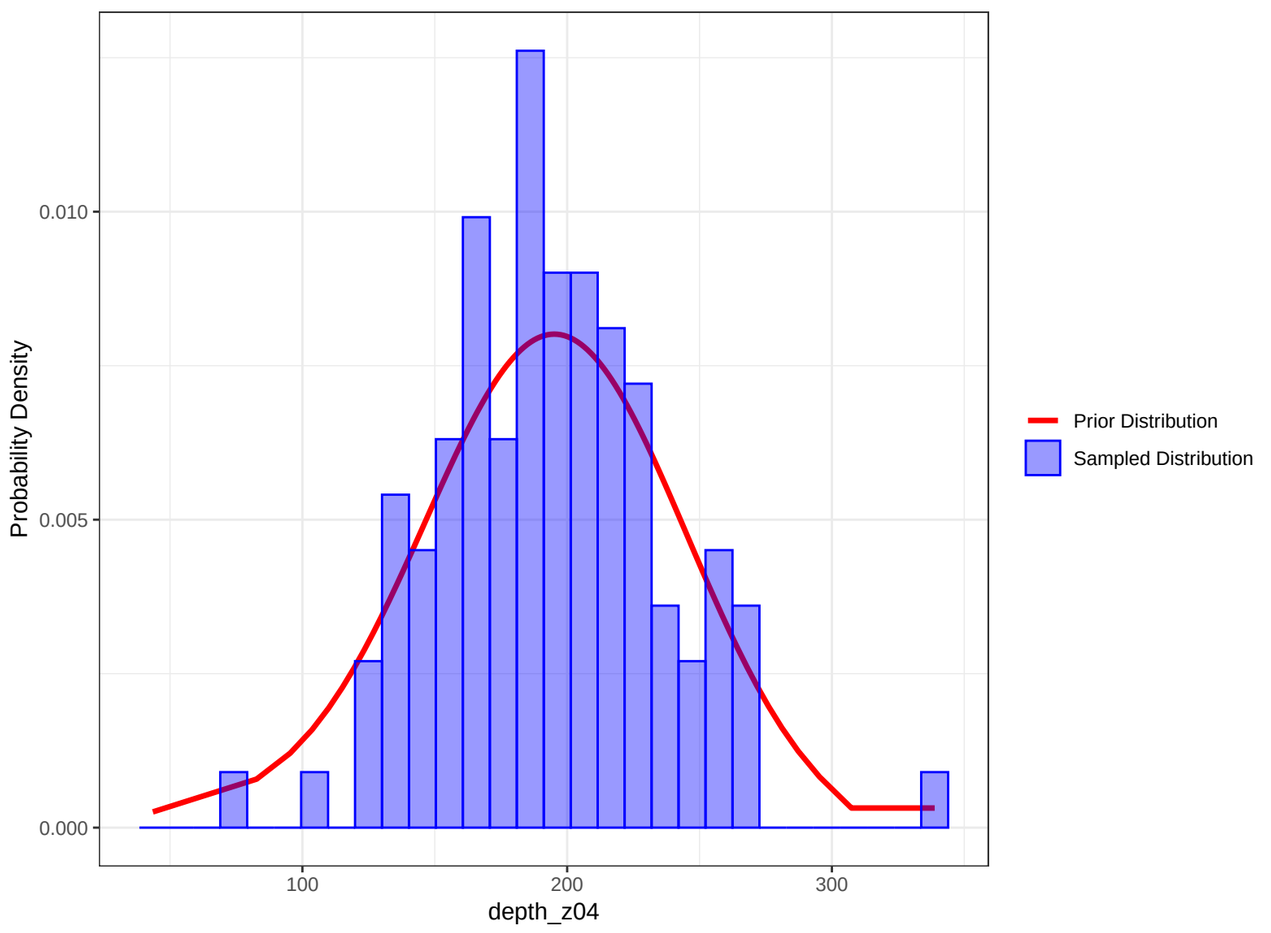

Probability Density
0.06
0.04
0.02
0.00
0
20
40
ghb_pct_z71
Prior Distribution
Sampled Distribution

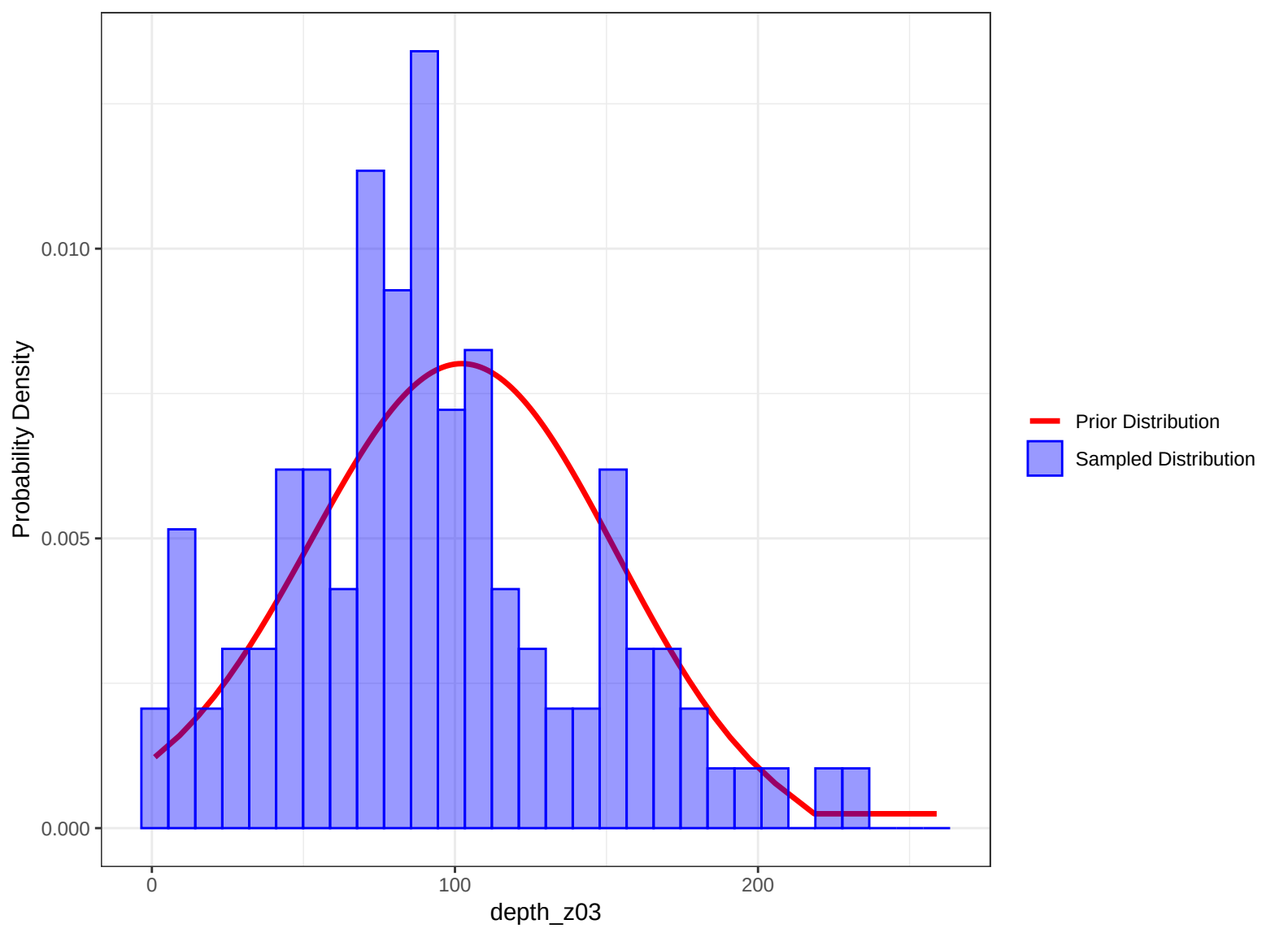

Probability Density
0.06
0.04
0.02
0.00
0
20
40
ghb_pct_z73
Prior Distribution
Sampled Distribution

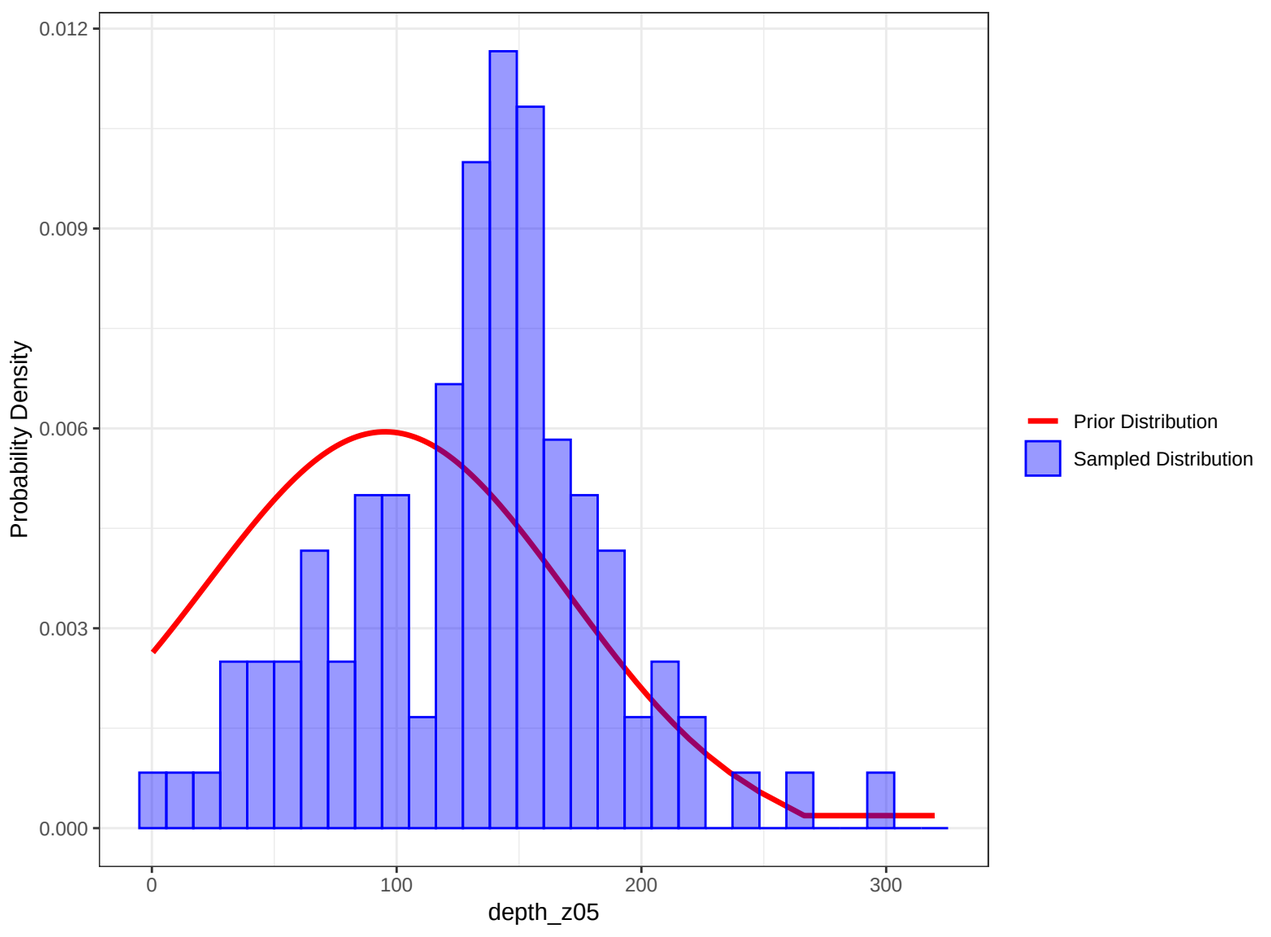

Probability Density
0.06
0.04
0.02
0.00
20
40
60
ghb_pct_z72
Prior Distribution
Sampled Distribution

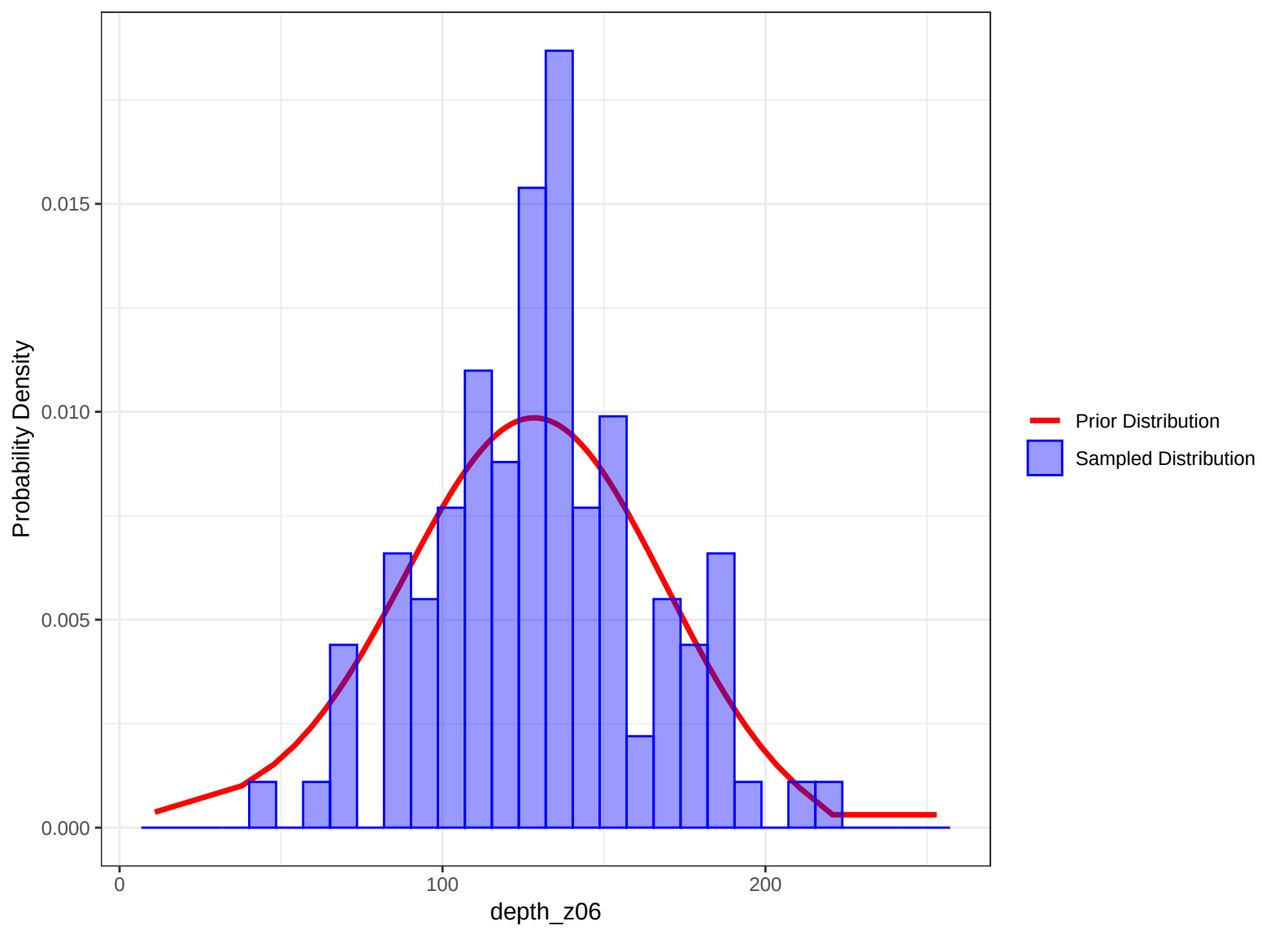

Probability Density
0.015
0.010
0.005
0.000
100
200
300
depth_z01
Prior Distribution
Sampled Distribution

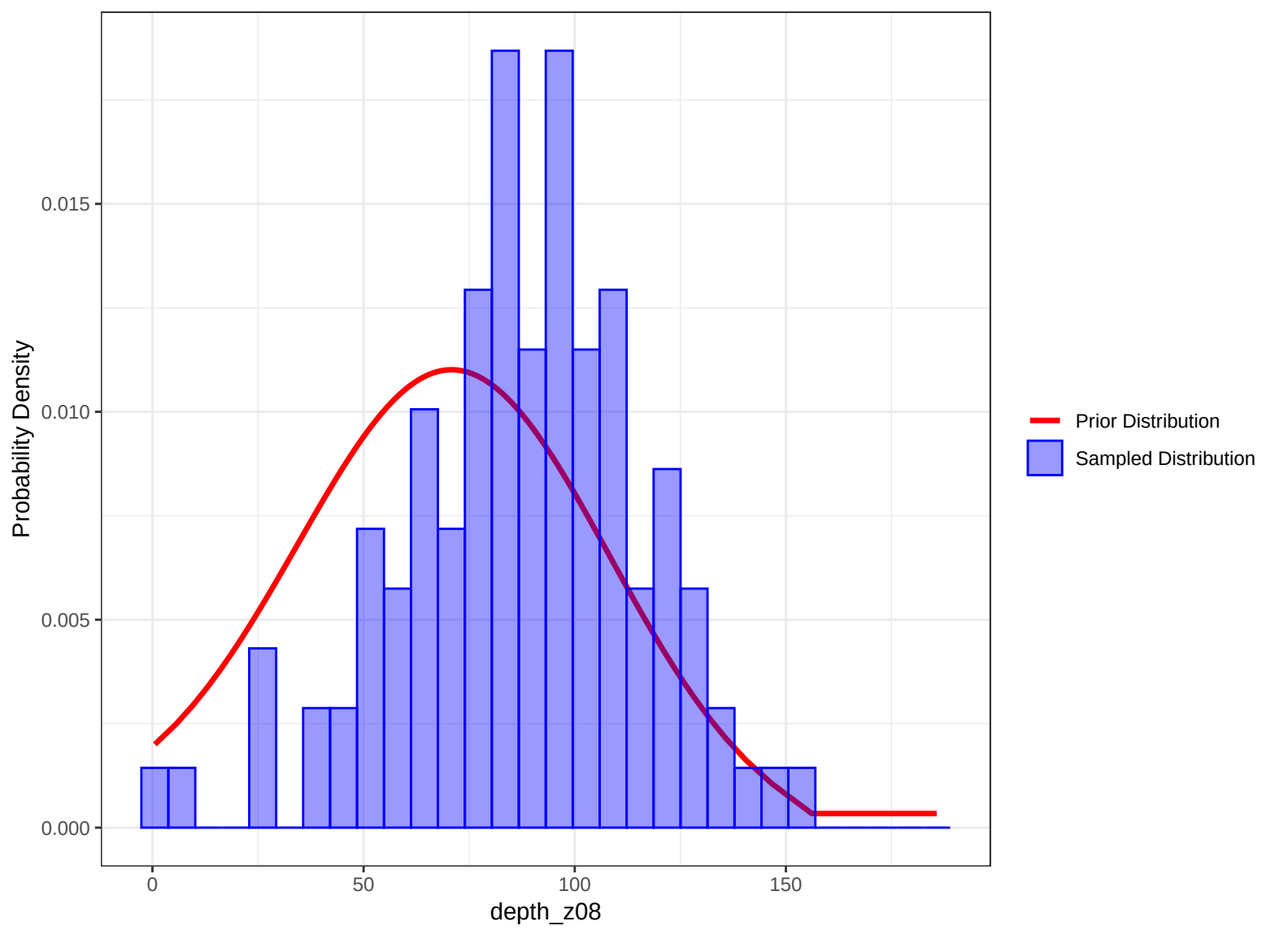

Probability Density
0.015
0.010
0.005
0.000
0
100
200
300
depth_z02
Prior Distribution
Sampled Distribution

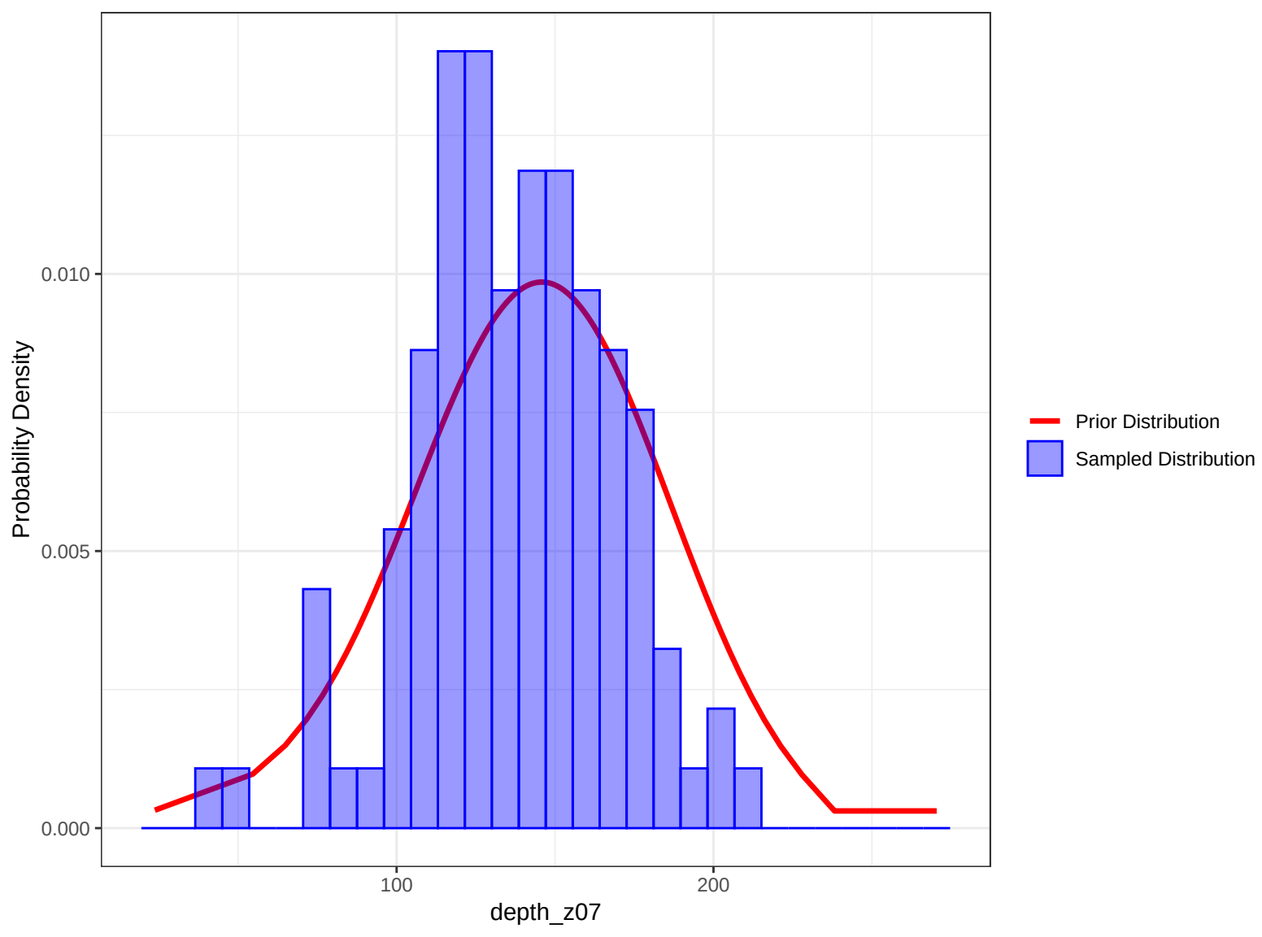

Probability Density
0.010
0.005
0.000
100
200
300
depth_z04
Prior Distribution
Sampled Distribution

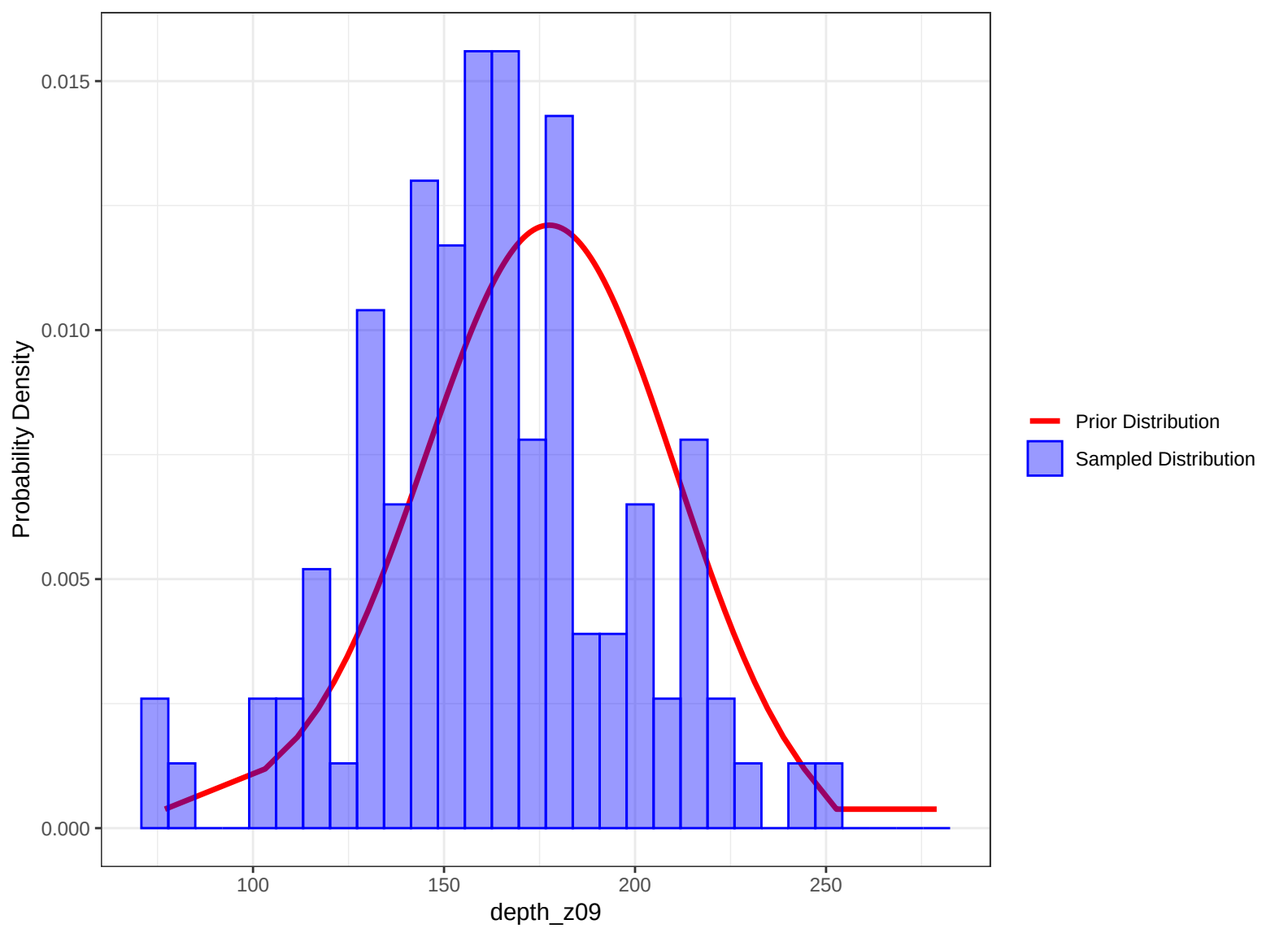

Probability Density
0.010
0.005
0.000
0
100
200
depth_z03
Prior Distribution
Sampled Distribution

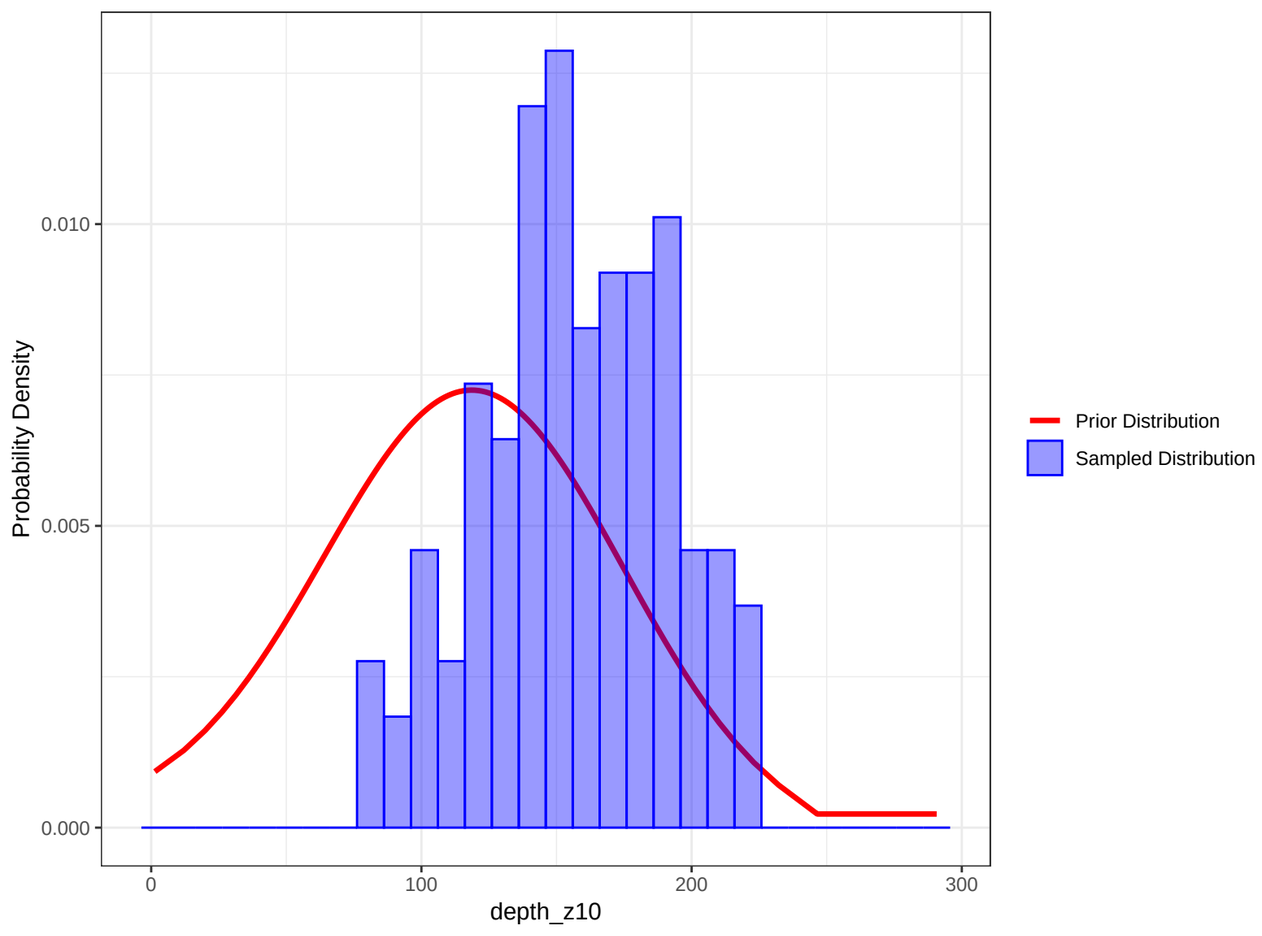

Probability Density
0.012
0.009
0.006
0.003
0.000
0
100
200
300
depth_z05
Prior Distribution
Sampled Distribution

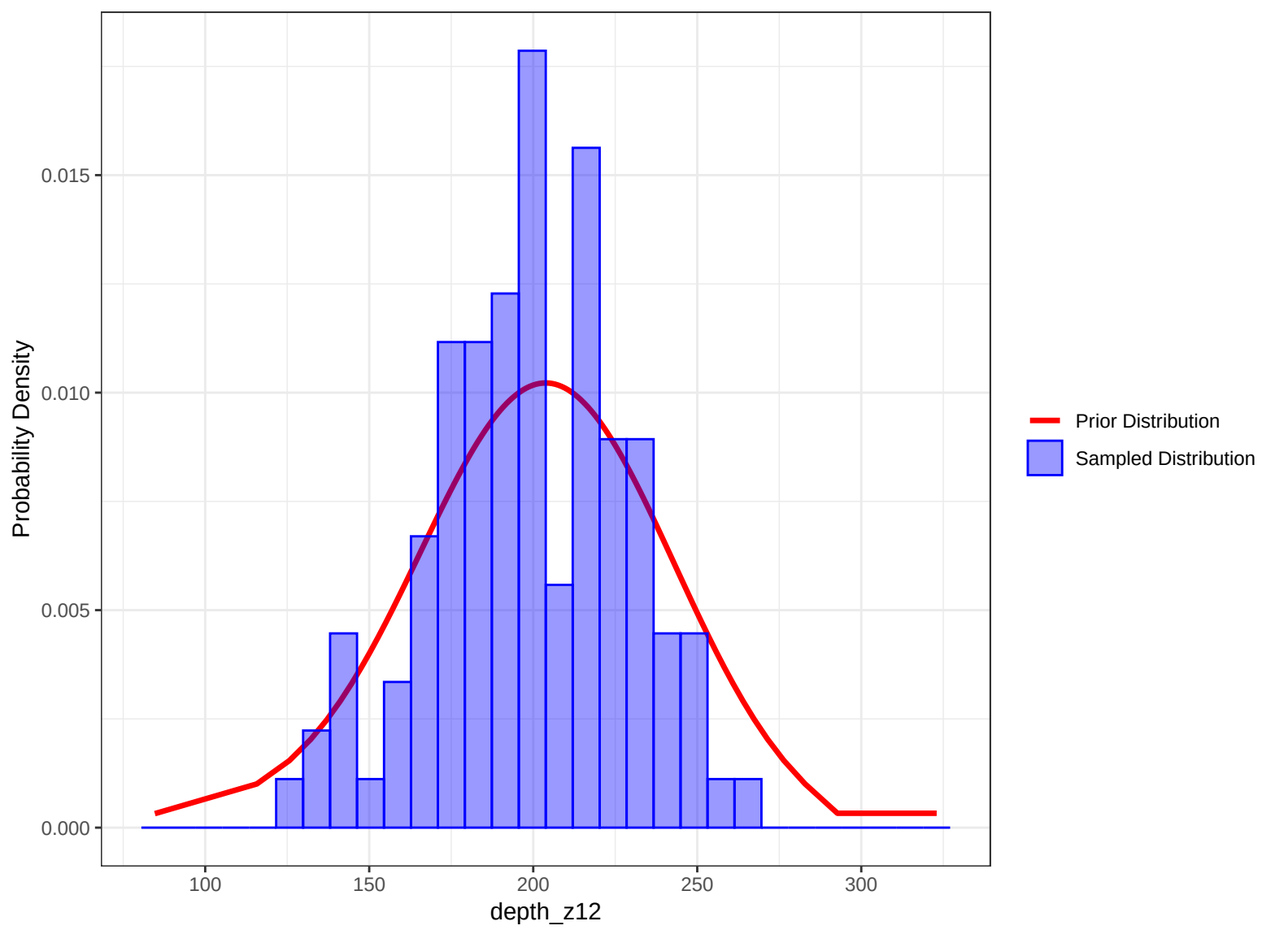

Probability Density
0.015
0.010
0.005
0.000
0
100
200
depth_z06
Prior Distribution
Sampled Distribution

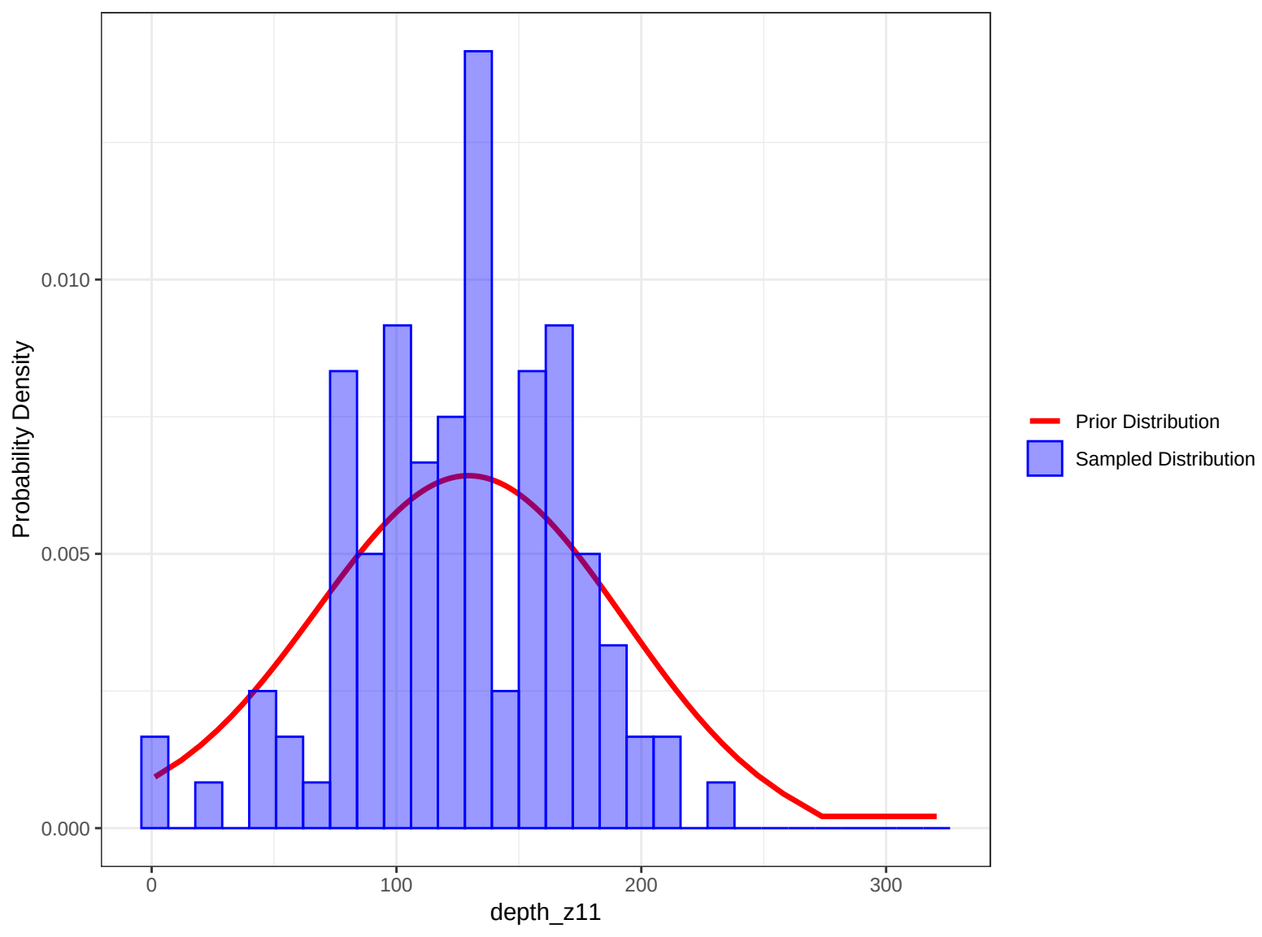

Probability Density
0.015
0.010
0.005
0.000
0
50
100
150
depth_z08
Prior Distribution
Sampled Distribution

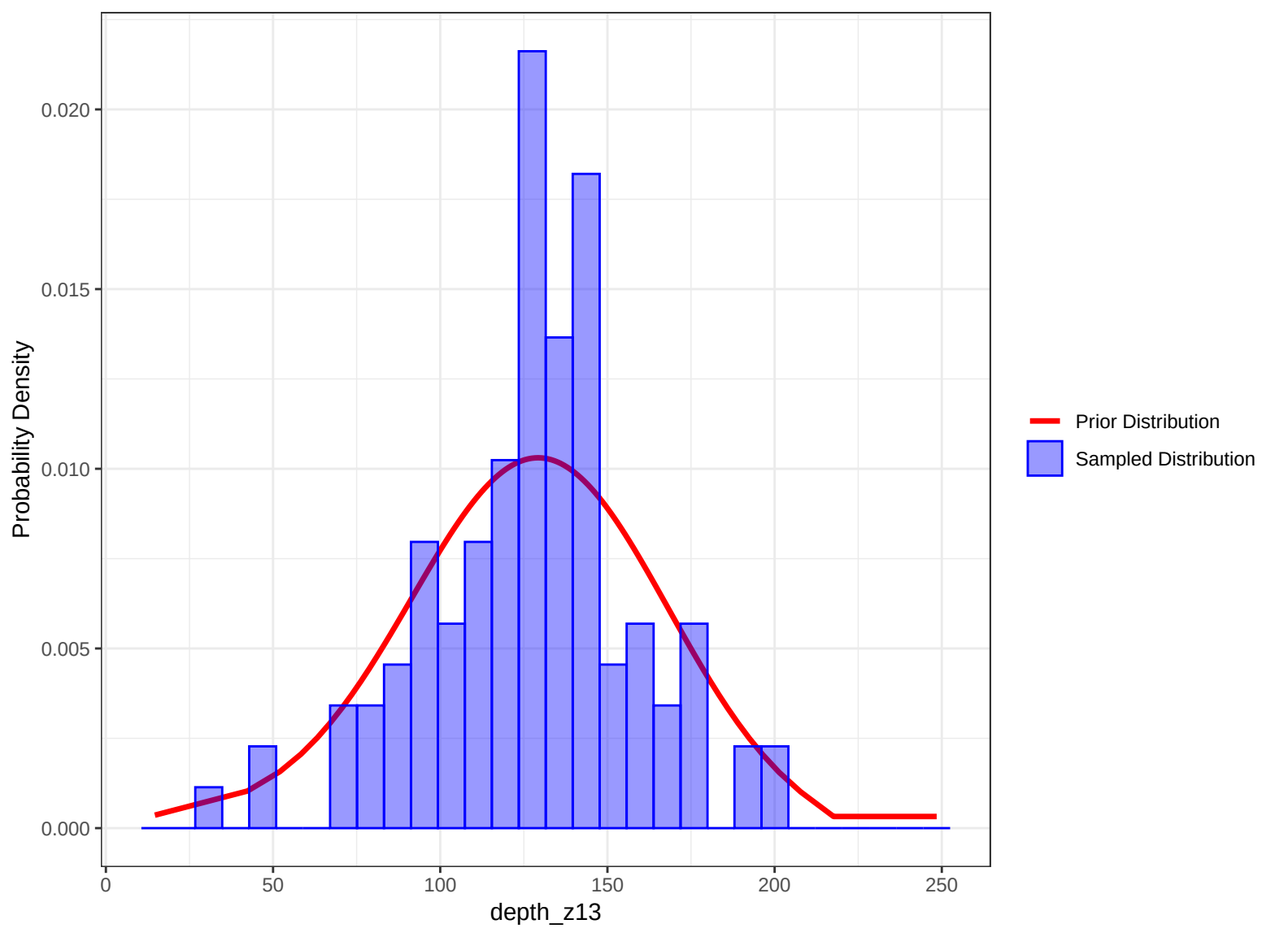

Probability Density
0.010
0.005
0.000
100
200
depth_z07
Prior Distribution
Sampled Distribution

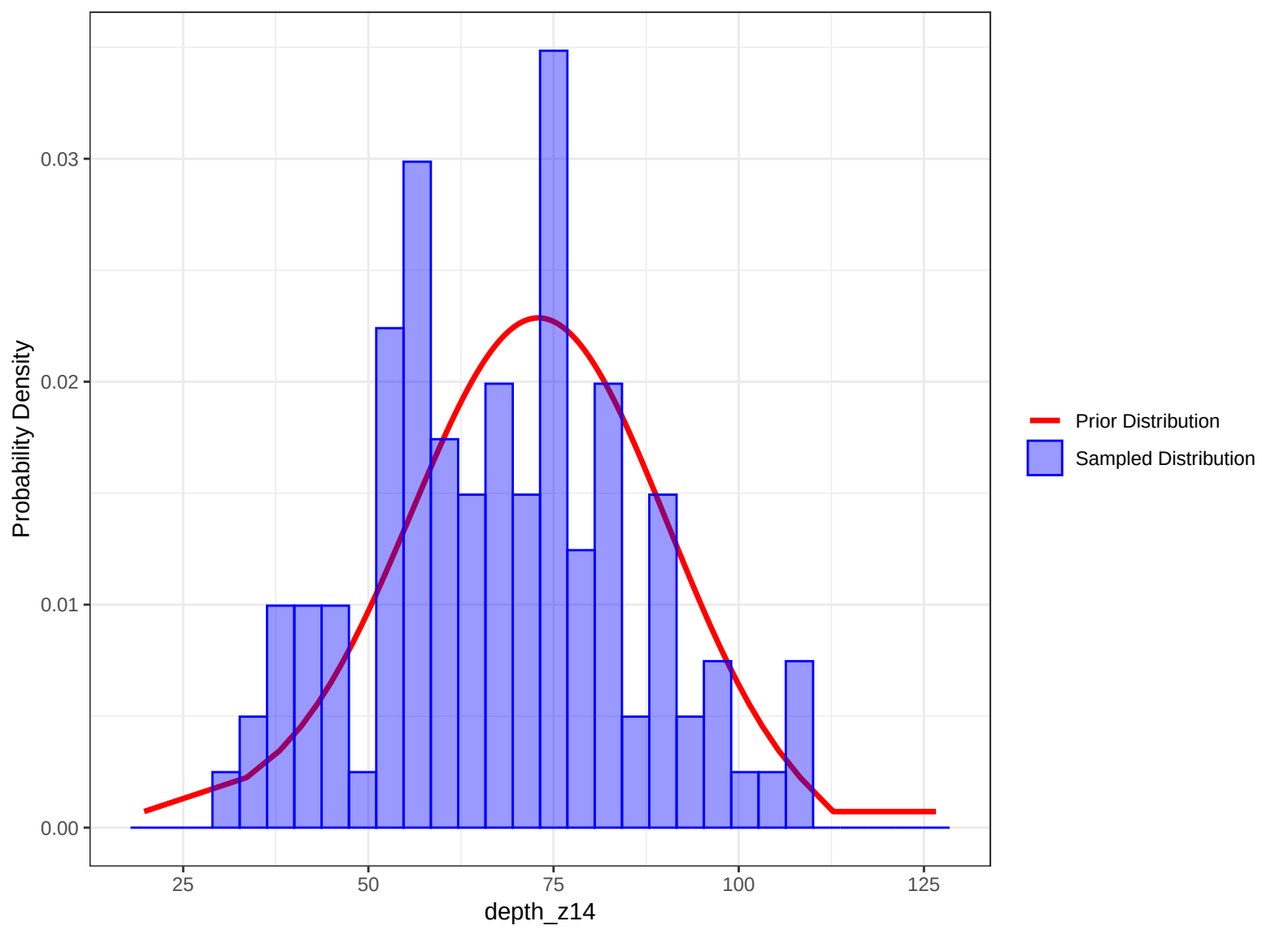

Probability Density
0.015
0.010
0.005
0.000
100
150
200
250
depth_z09
Prior Distribution
Sampled Distribution

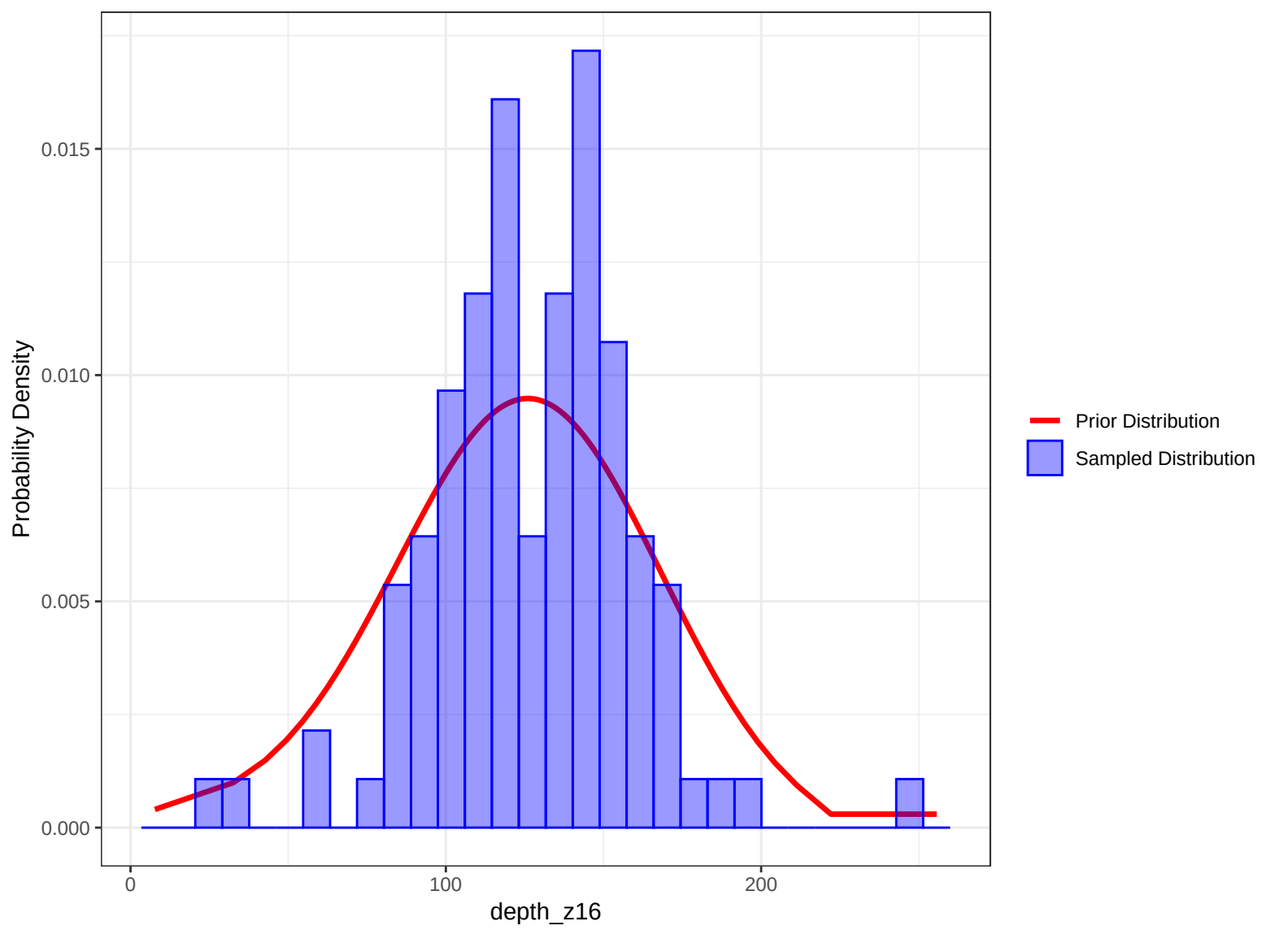

Probability Density
0.010
0.005
0.000
0
100
200
300
depth_z10
Prior Distribution
Sampled Distribution

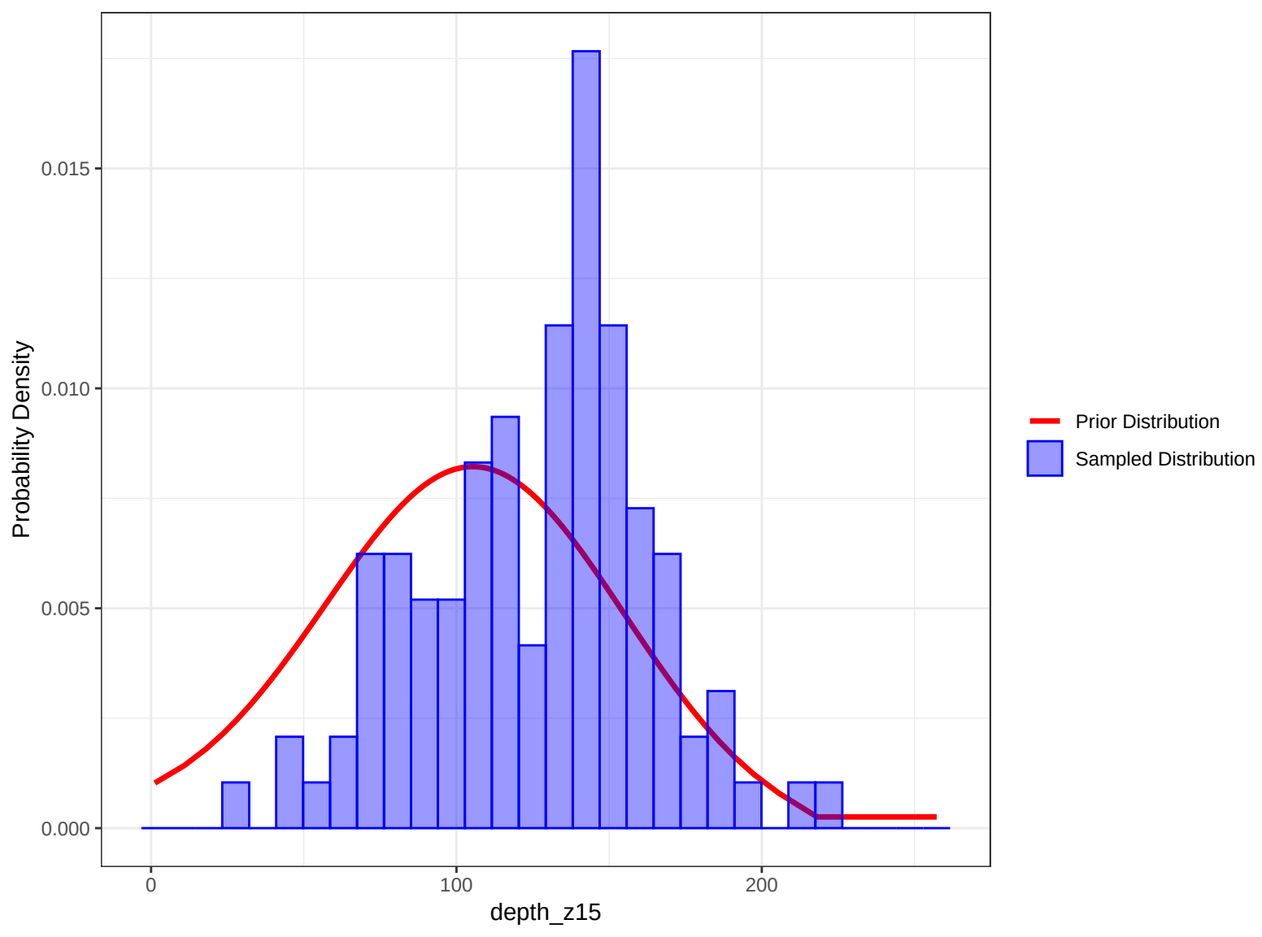

Probability Density
0.015
0.010
0.005
0.000
100
150
200
250
300
depth_z12
Prior Distribution
Sampled Distribution

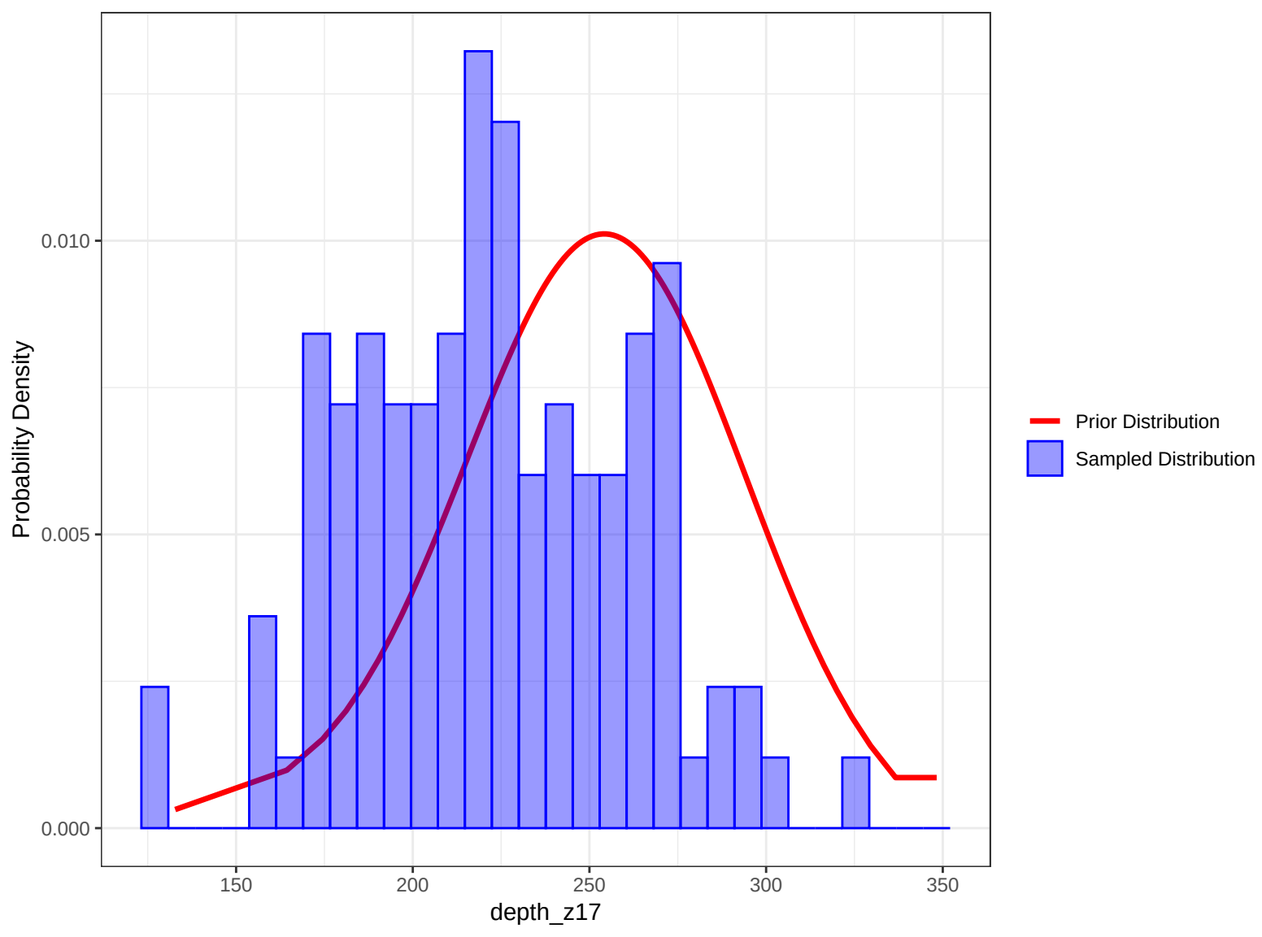

Probability Density
0.010
0.005
0.000
0
100
200
300
depth_z11
Prior Distribution
Sampled Distribution

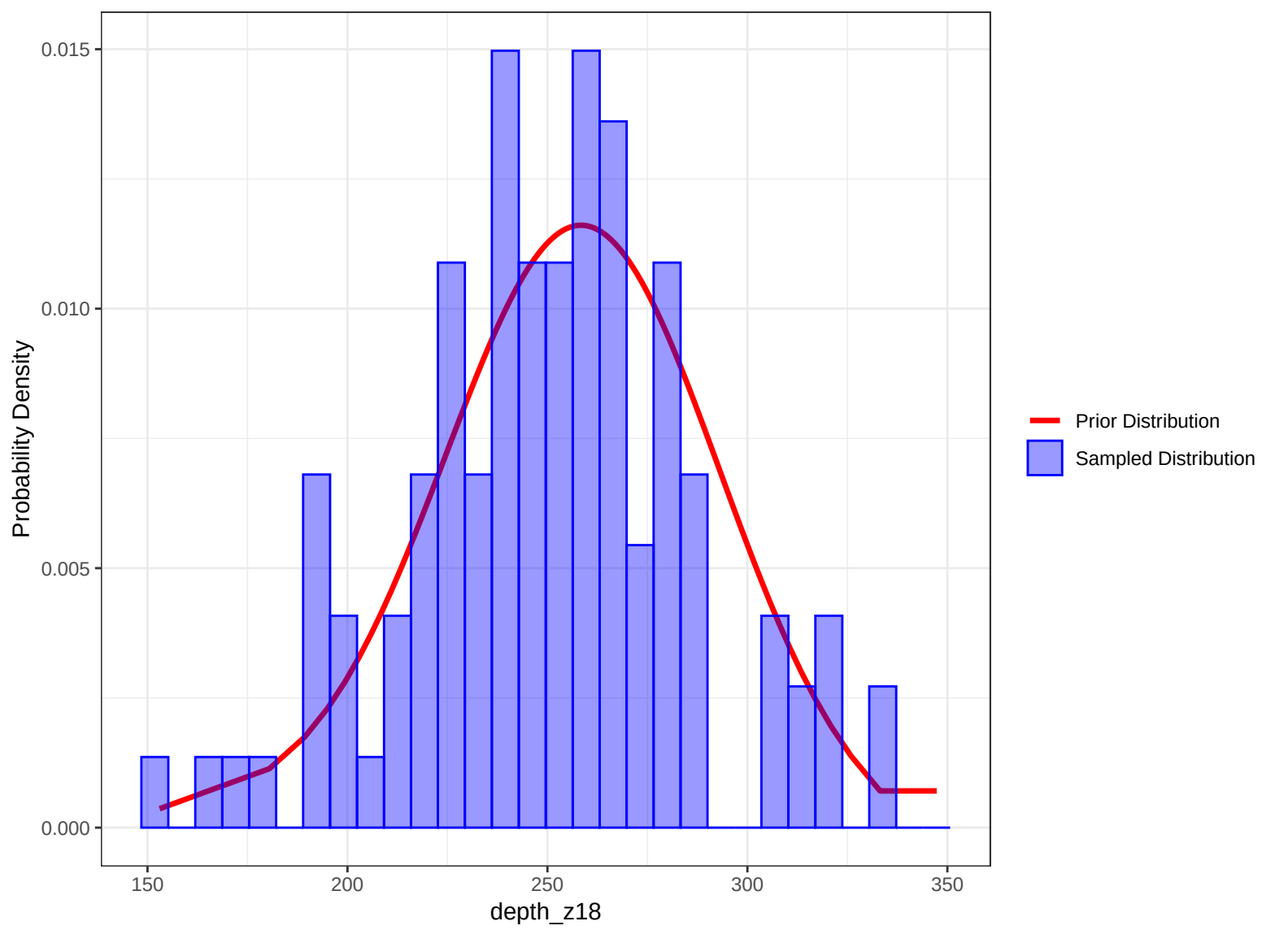

Probability Density
0.020
0.015
0.010
0.005
0.000
0
50
100
150
200
250
depth_z13
Prior Distribution
Sampled Distribution

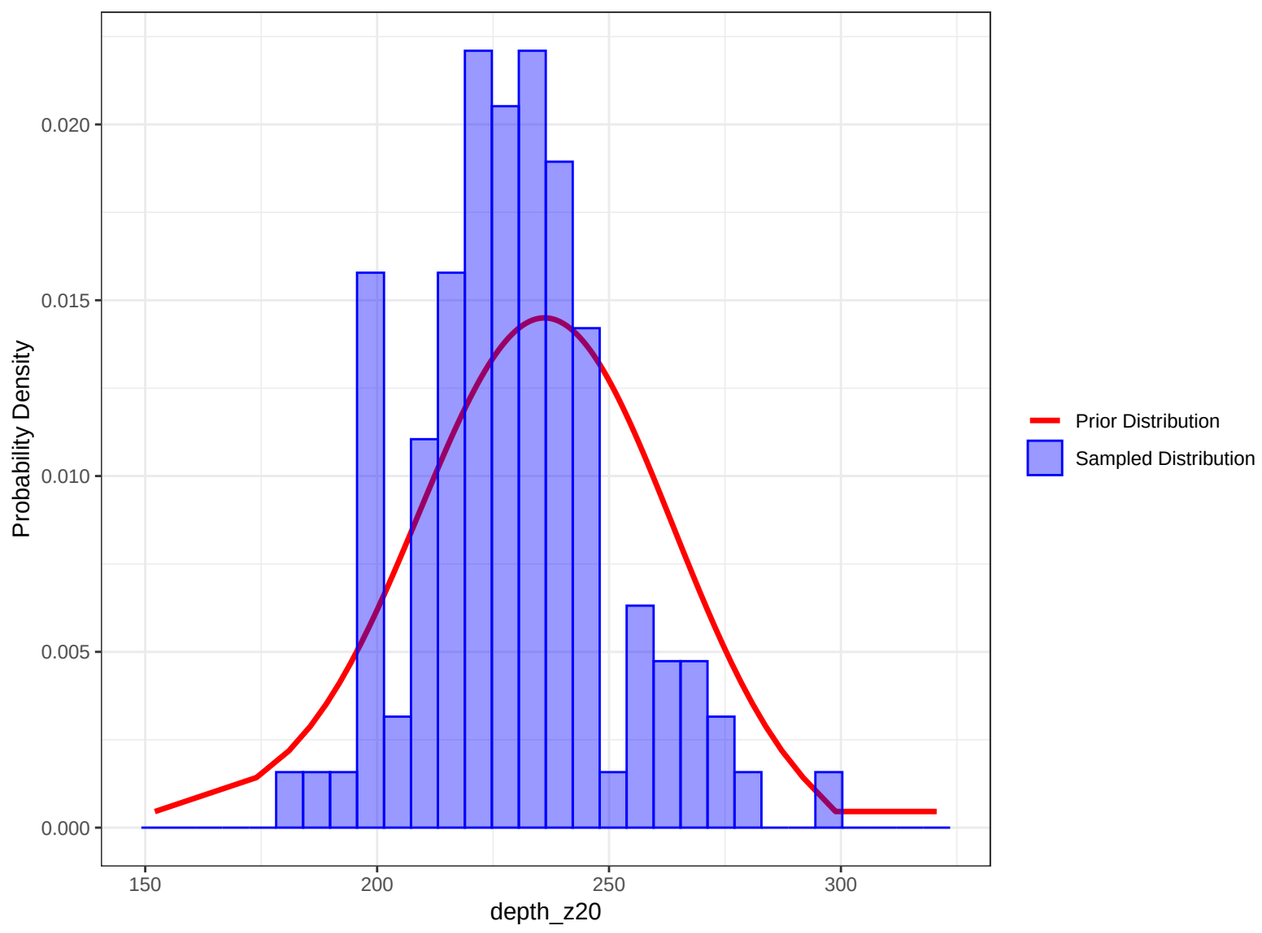

Probability Density
0.03
0.02
0.01
0.00
25
50
75
100
125
depth_z14
Prior Distribution
Sampled Distribution

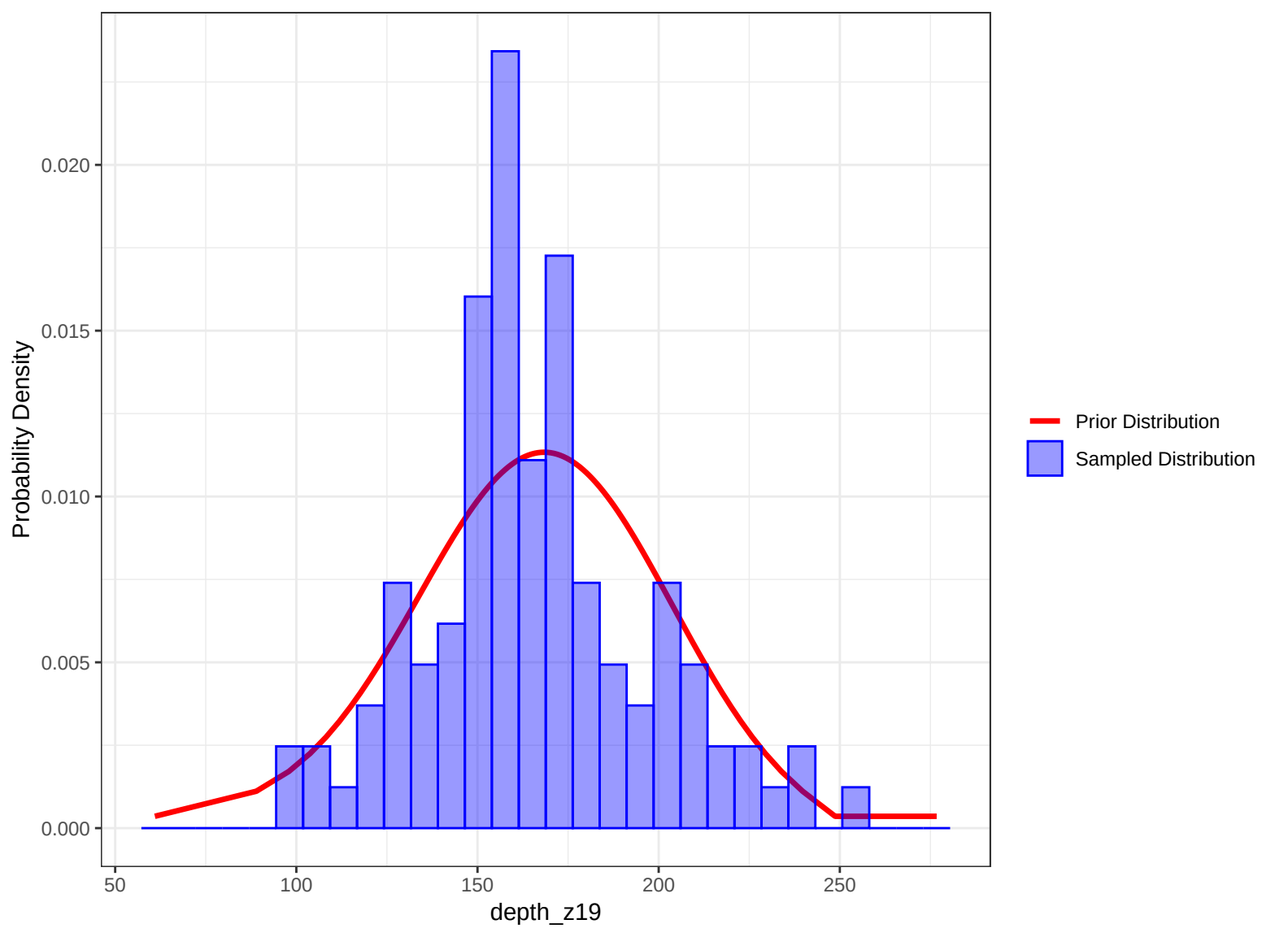

Probability Density
0.015
0.010
0.005
0.000
0
100
200
depth_z16
Prior Distribution
Sampled Distribution

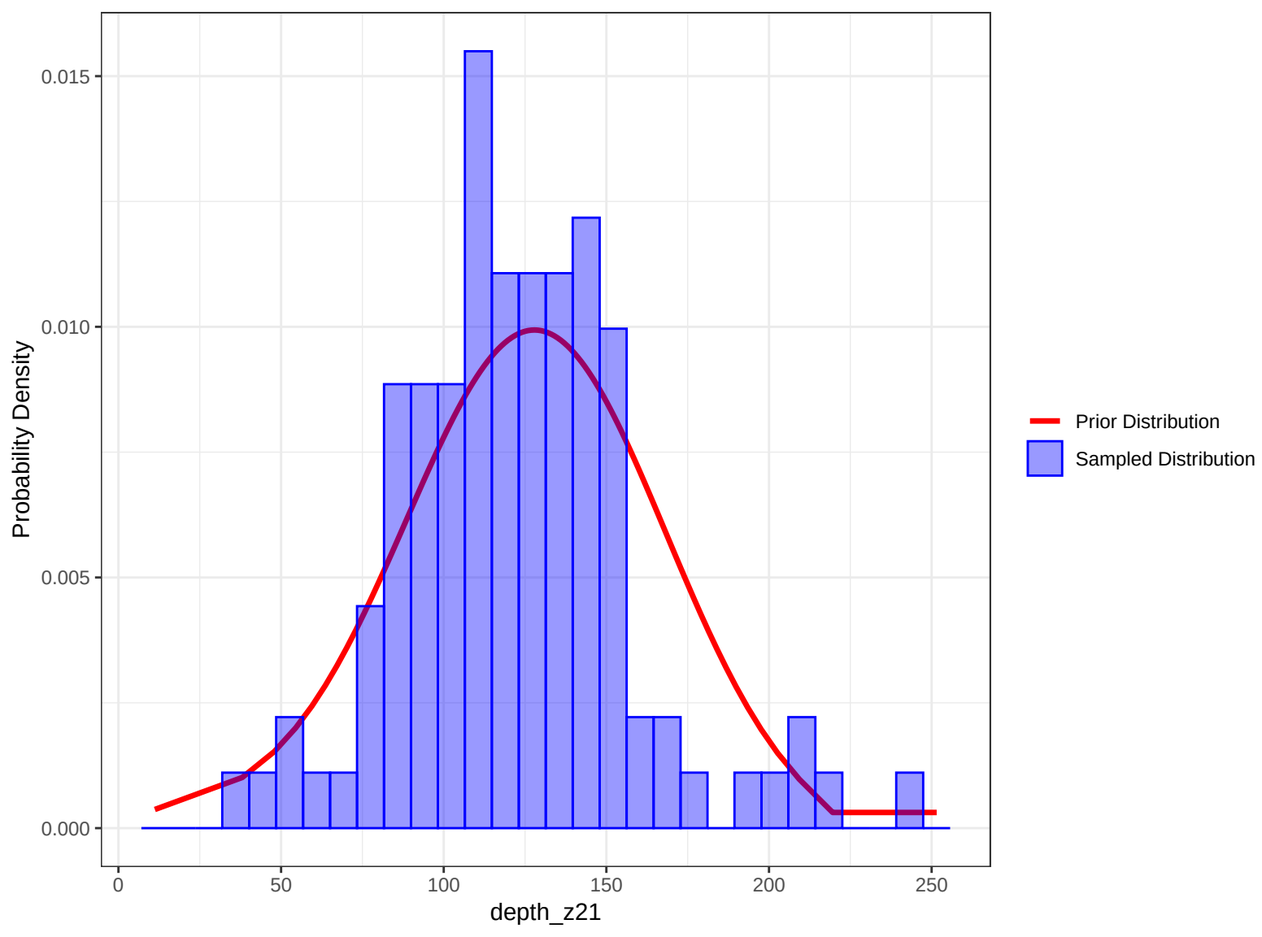

Probability Density
0.015
0.010
0.005
0.000
0
100
200
depth_z15
Prior Distribution
Sampled Distribution

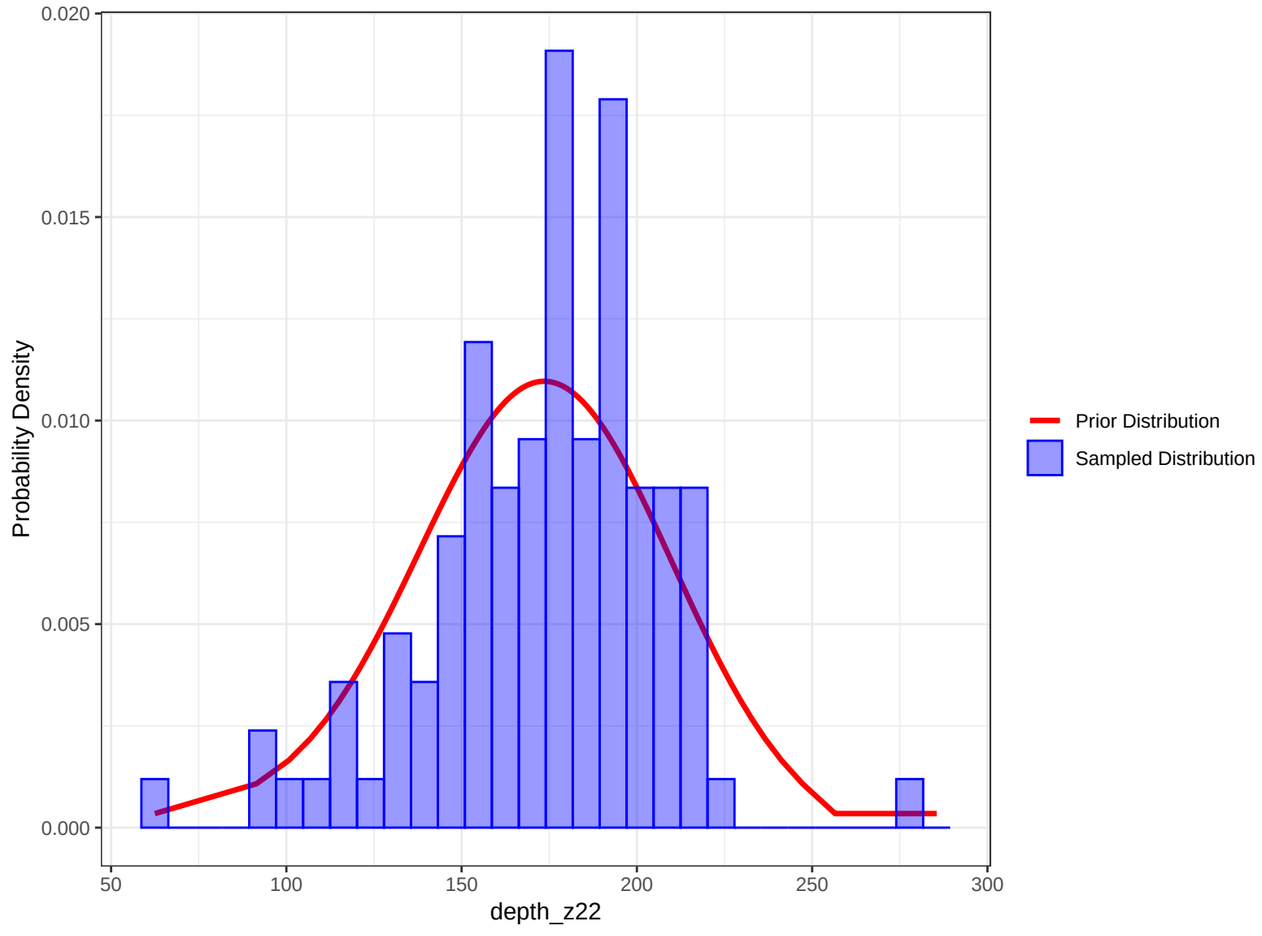

Probability Density
0.010
0.005
0.000
150
200
250
300
350
depth_z17
Prior Distribution
Sampled Distribution

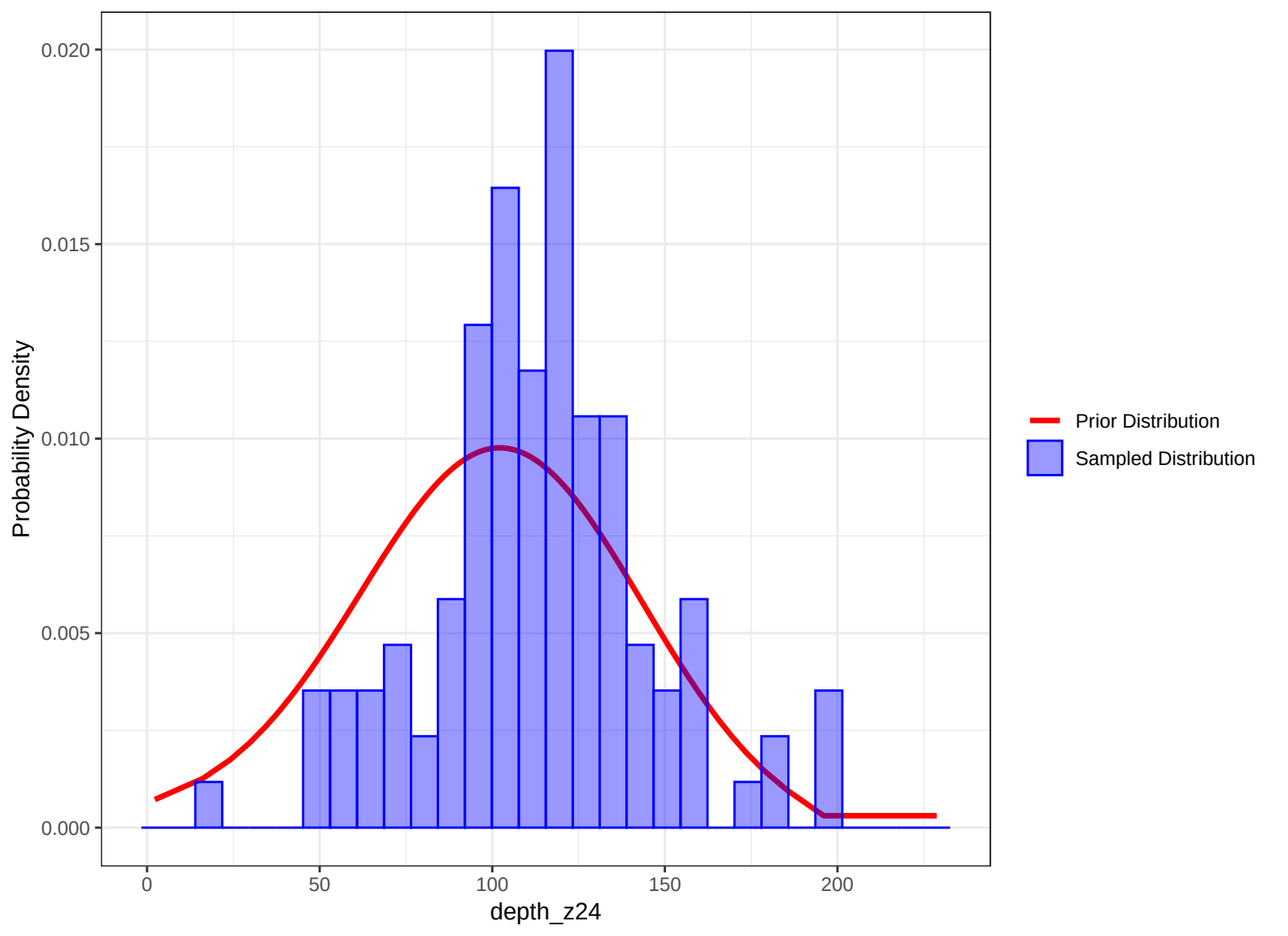

0.015
0.010
0.005
0.000
Probability Density
150
200
250
300
350
depth_z18
Prior Distribution
Sampled Distribution

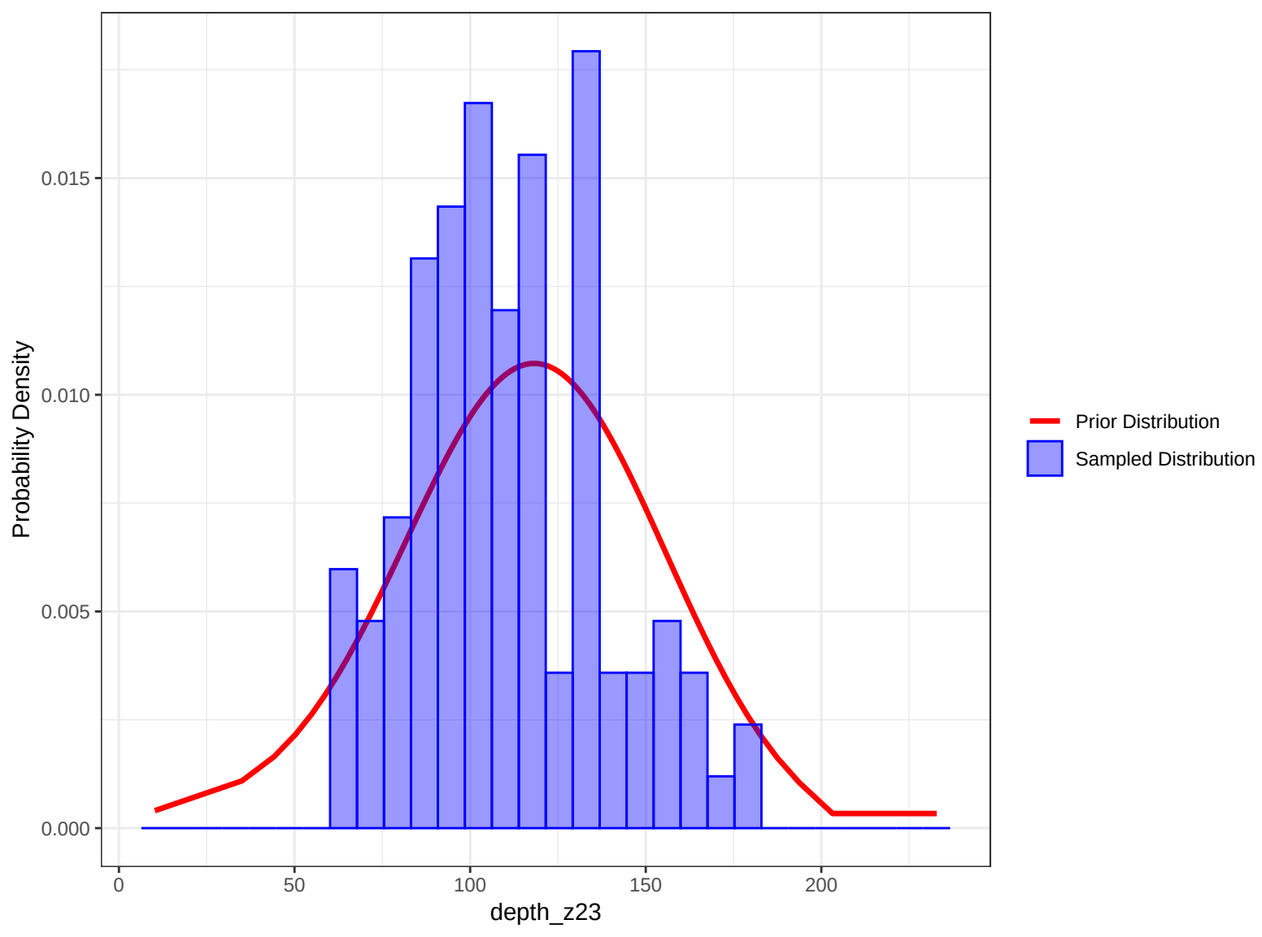

0.020
0.015
0.010
0.005
0.000
Probability Density
150
200
250
300
depth_z20
Prior Distribution
Sampled Distribution

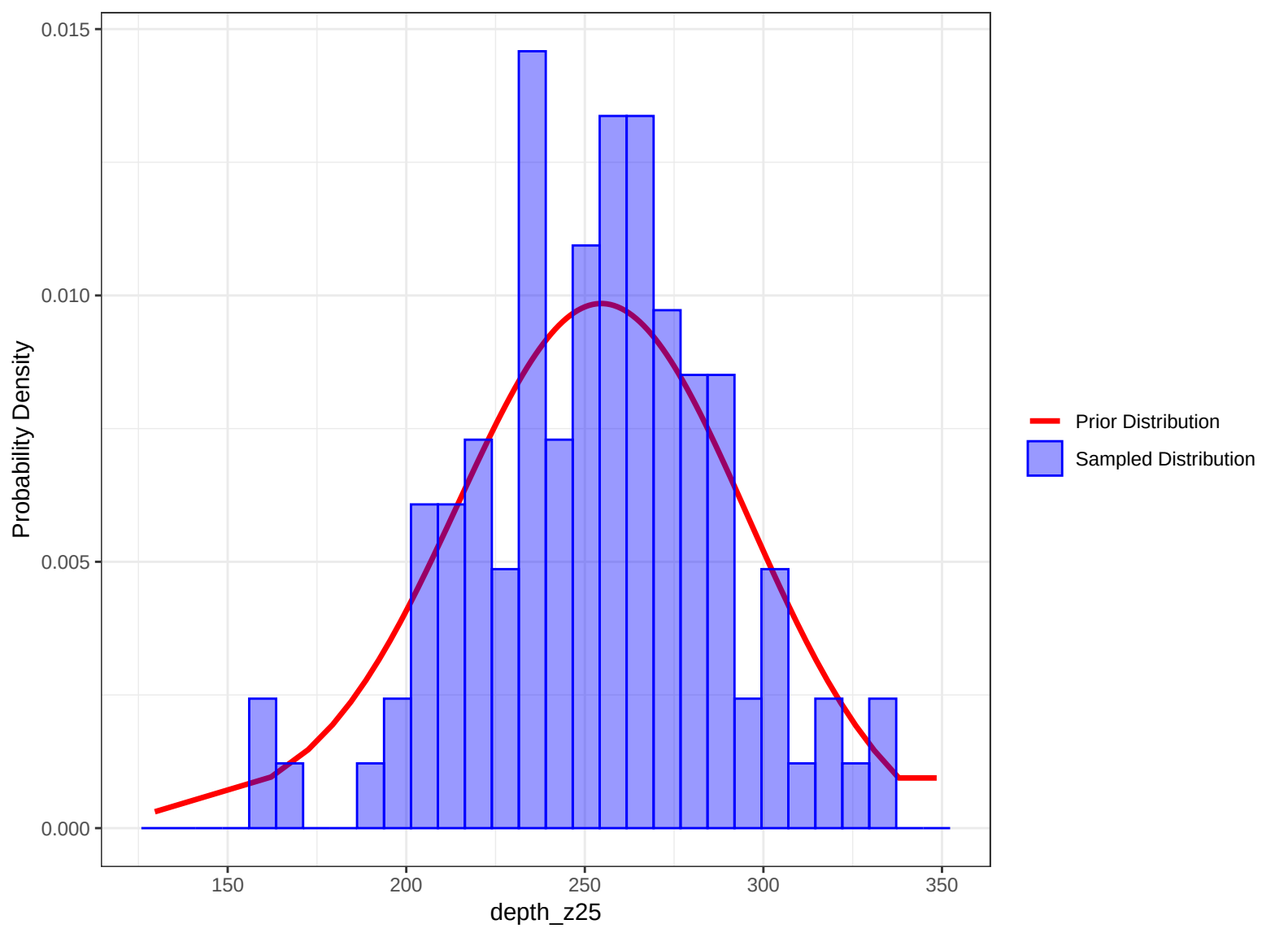

0.020
0.015
0.010
0.005
0.000
Probability Density
50
100
150
200
250
depth_z19
Prior Distribution
Sampled Distribution

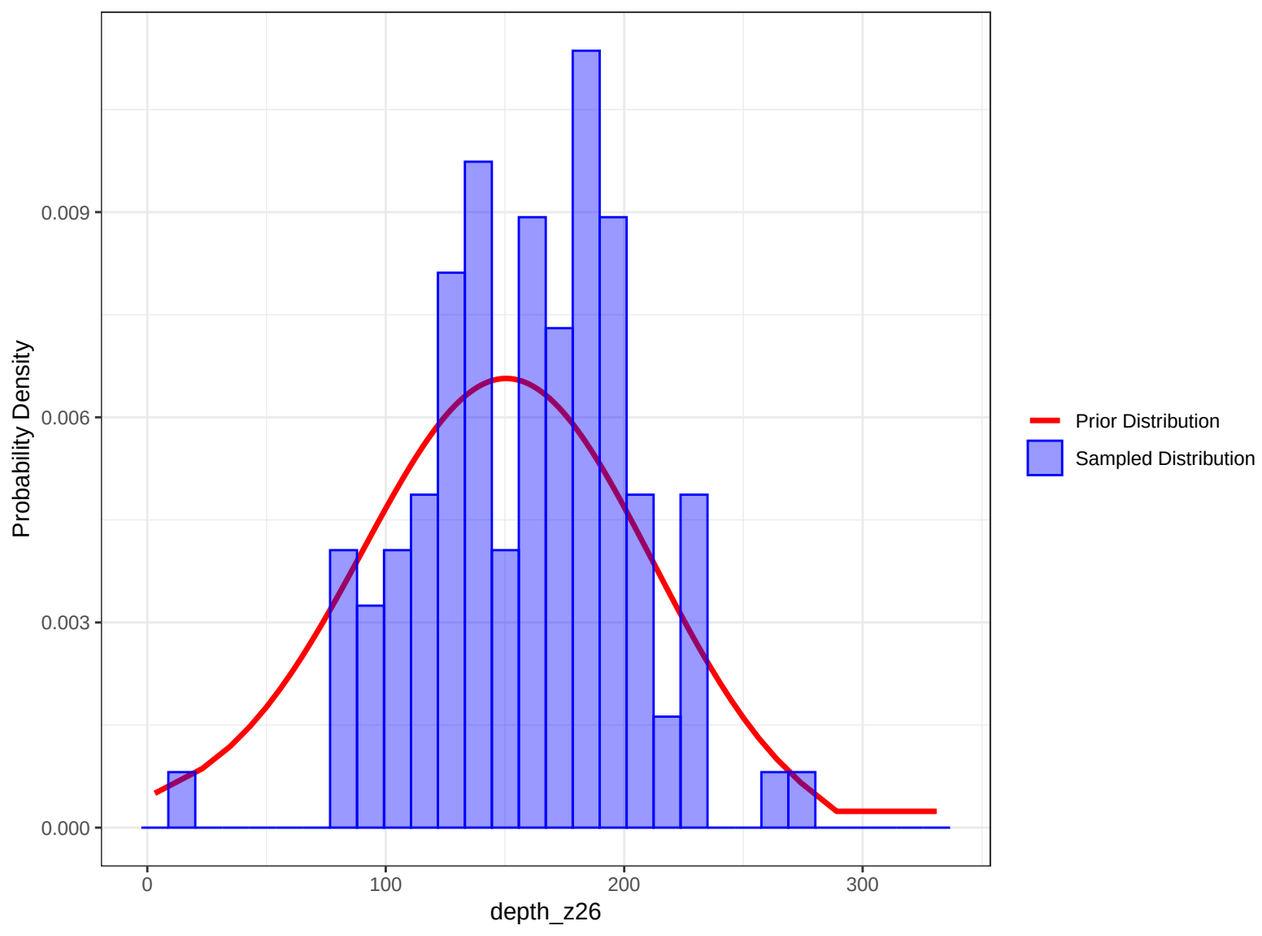

0.015
0.010
0.005
0.000
Probability Density
0
50
100
150
200
250
depth_z21
Prior Distribution
Sampled Distribution

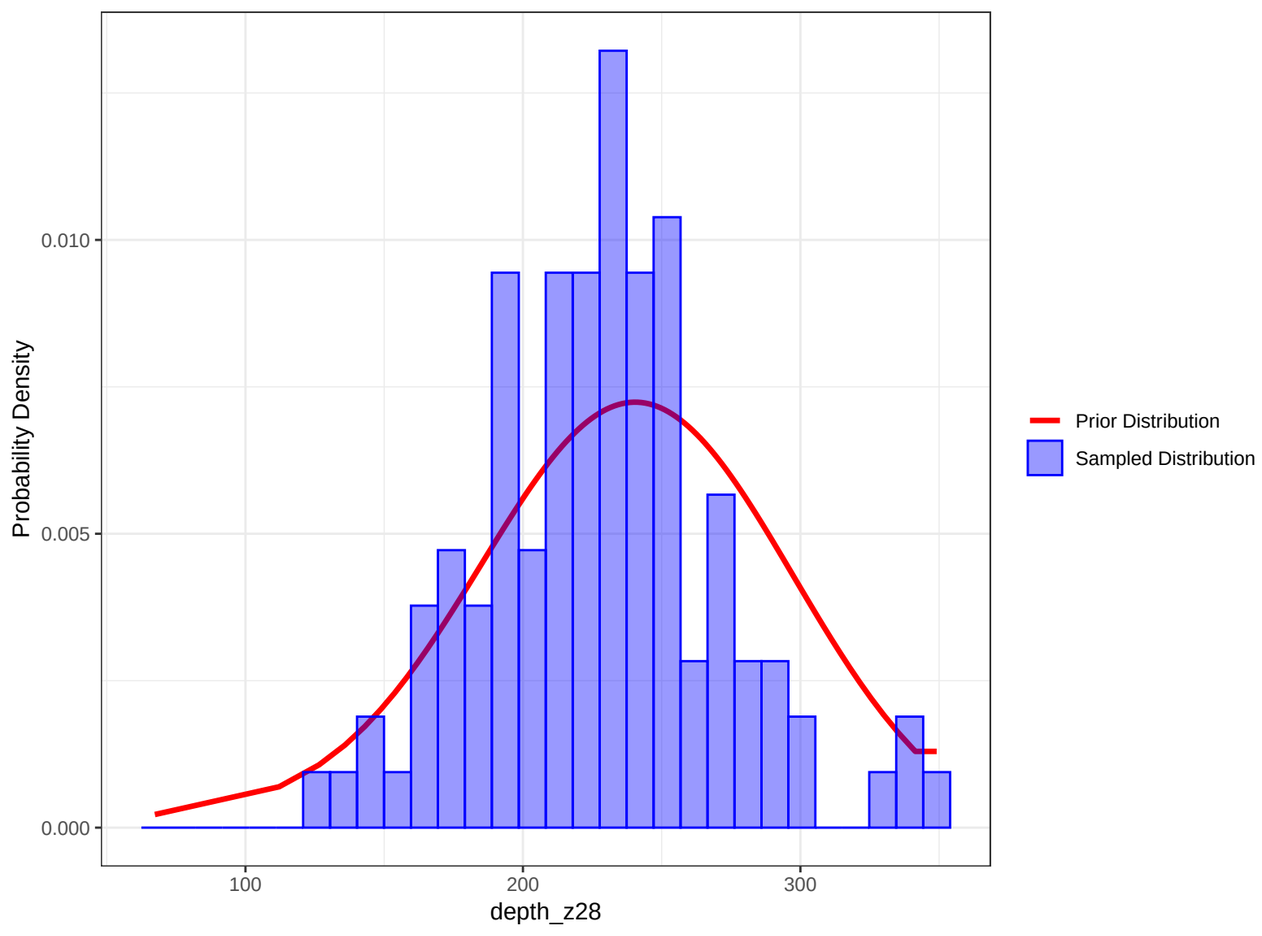

0.020
0.015
0.010
0.005
0.000
Probability Density
50
100
150
200
250
300
depth_z22
Prior Distribution
Sampled Distribution

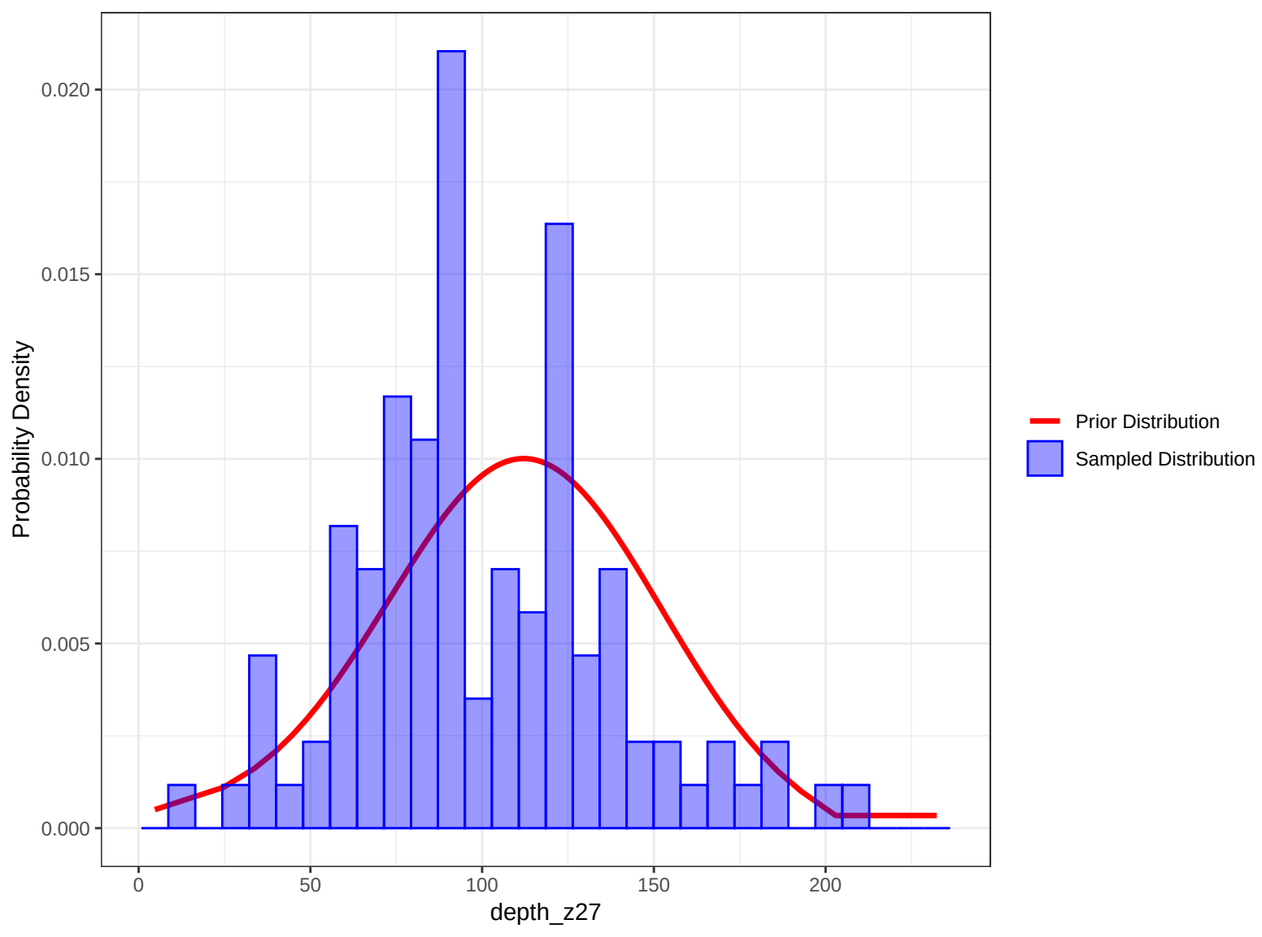

0.020
0.015
0.010
0.005
0.000
Probability Density
0
50
100
150
200
depth_z24
Prior Distribution
Sampled Distribution

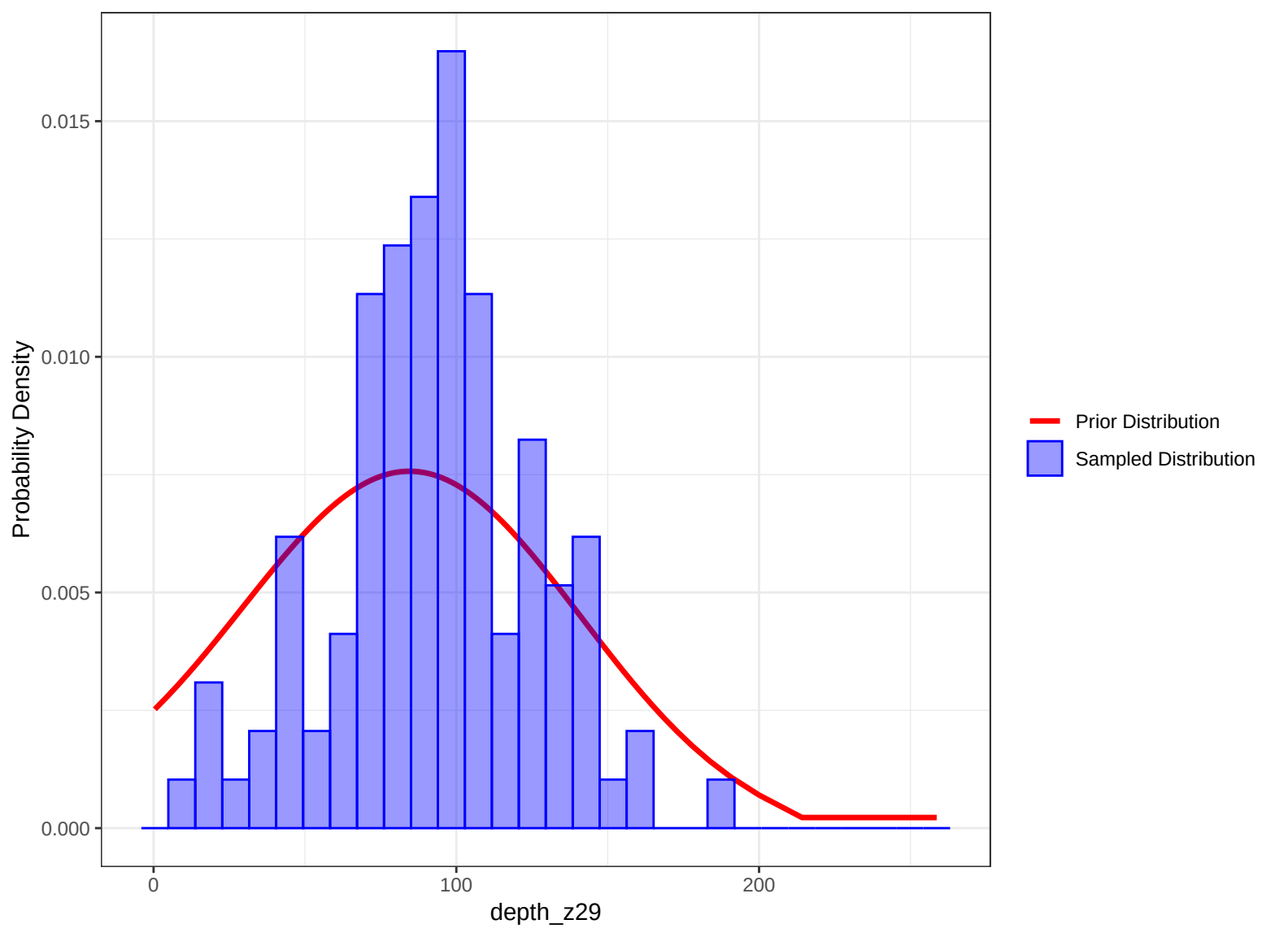

0.015
0.010
0.005
0.000
Probability Density
0
50
100
150
200
depth_z23
Prior Distribution
Sampled Distribution

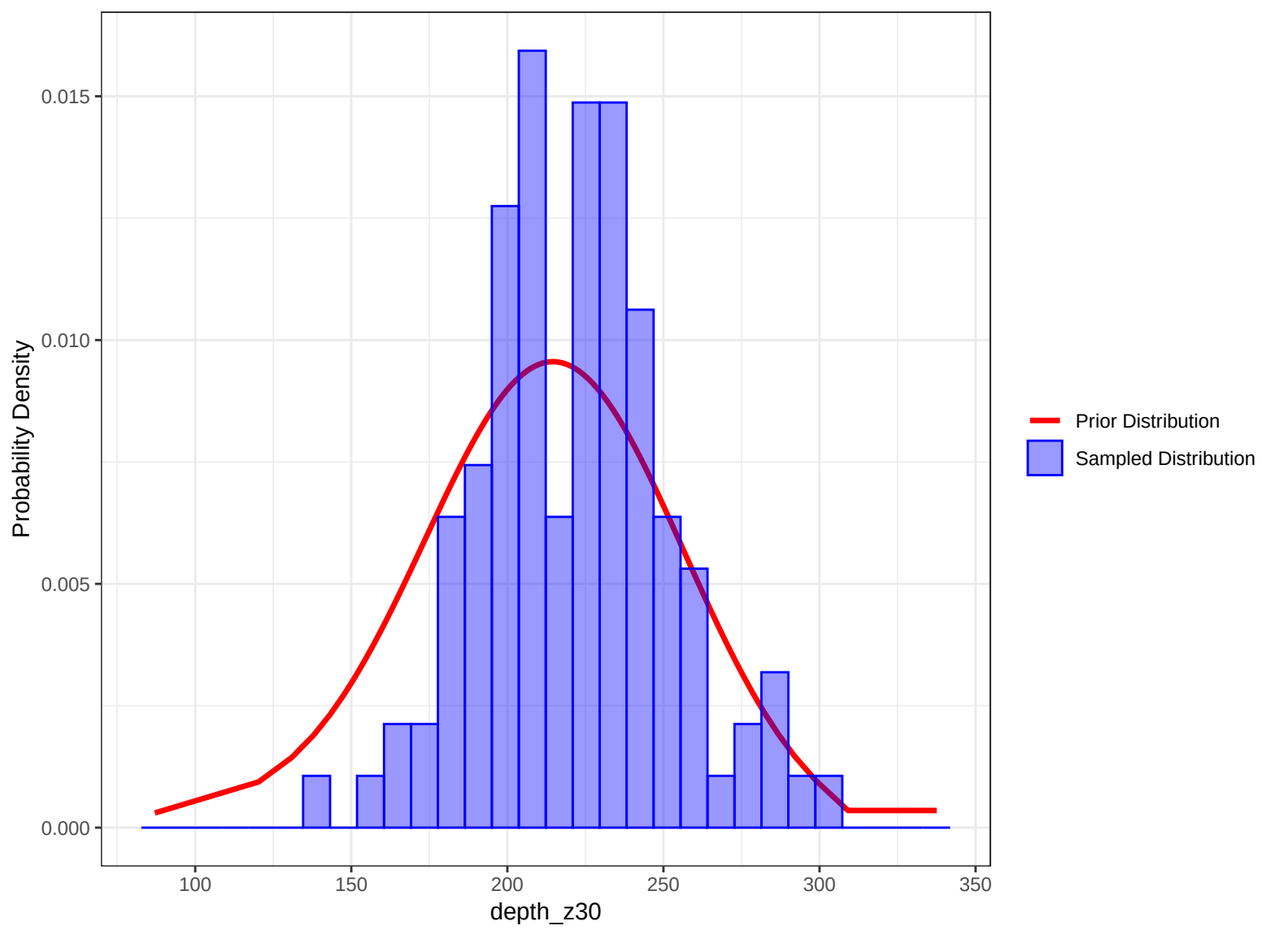

0.015
0.010
0.005
0.000
Probability Density
150
200
250
300
350
depth_z25
Prior Distribution
Sampled Distribution

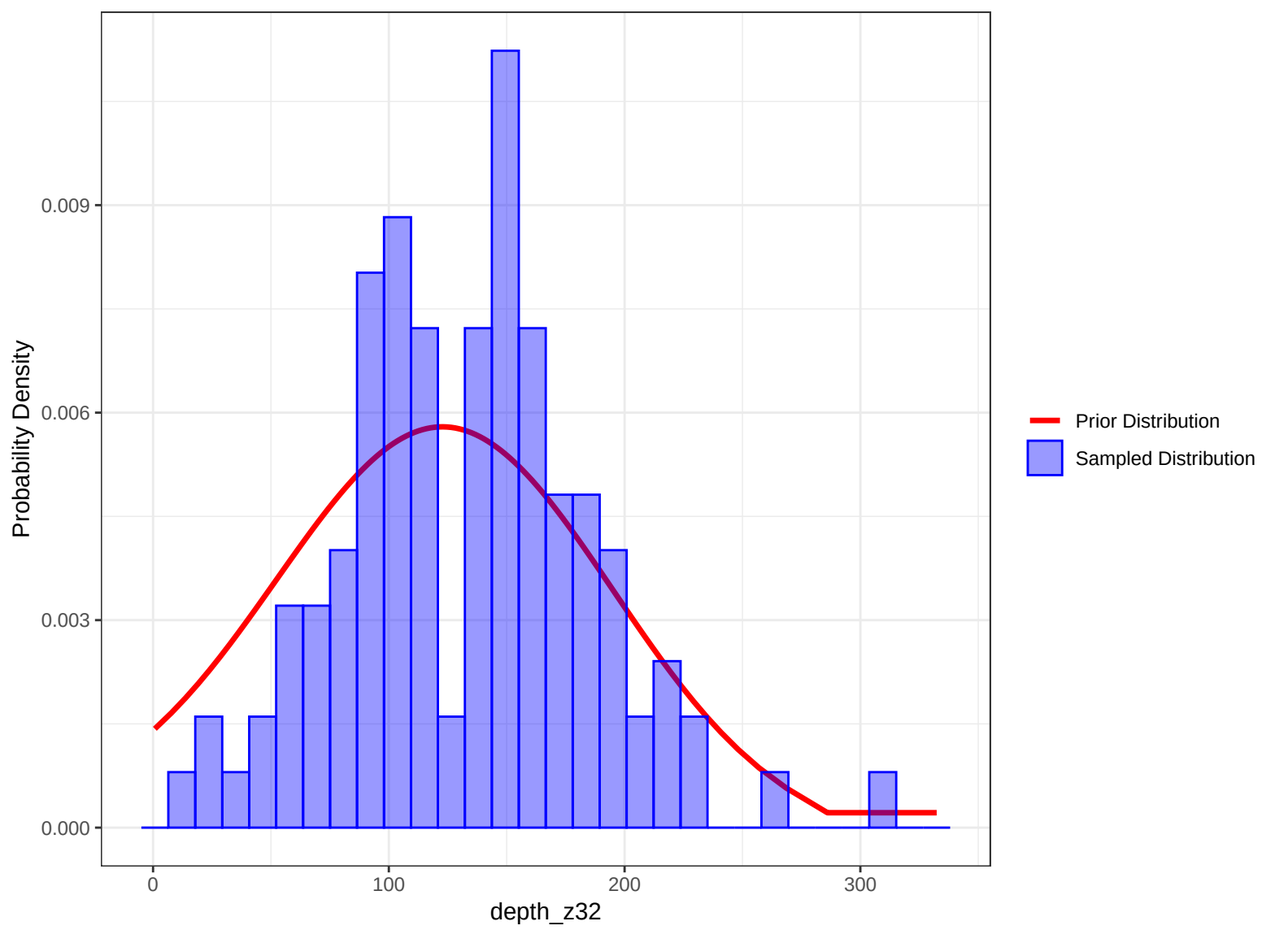

Probability Density
0.009
0.006
0.003
0.000
0
100
200
300
depth_z26
Prior Distribution
Sampled Distribution

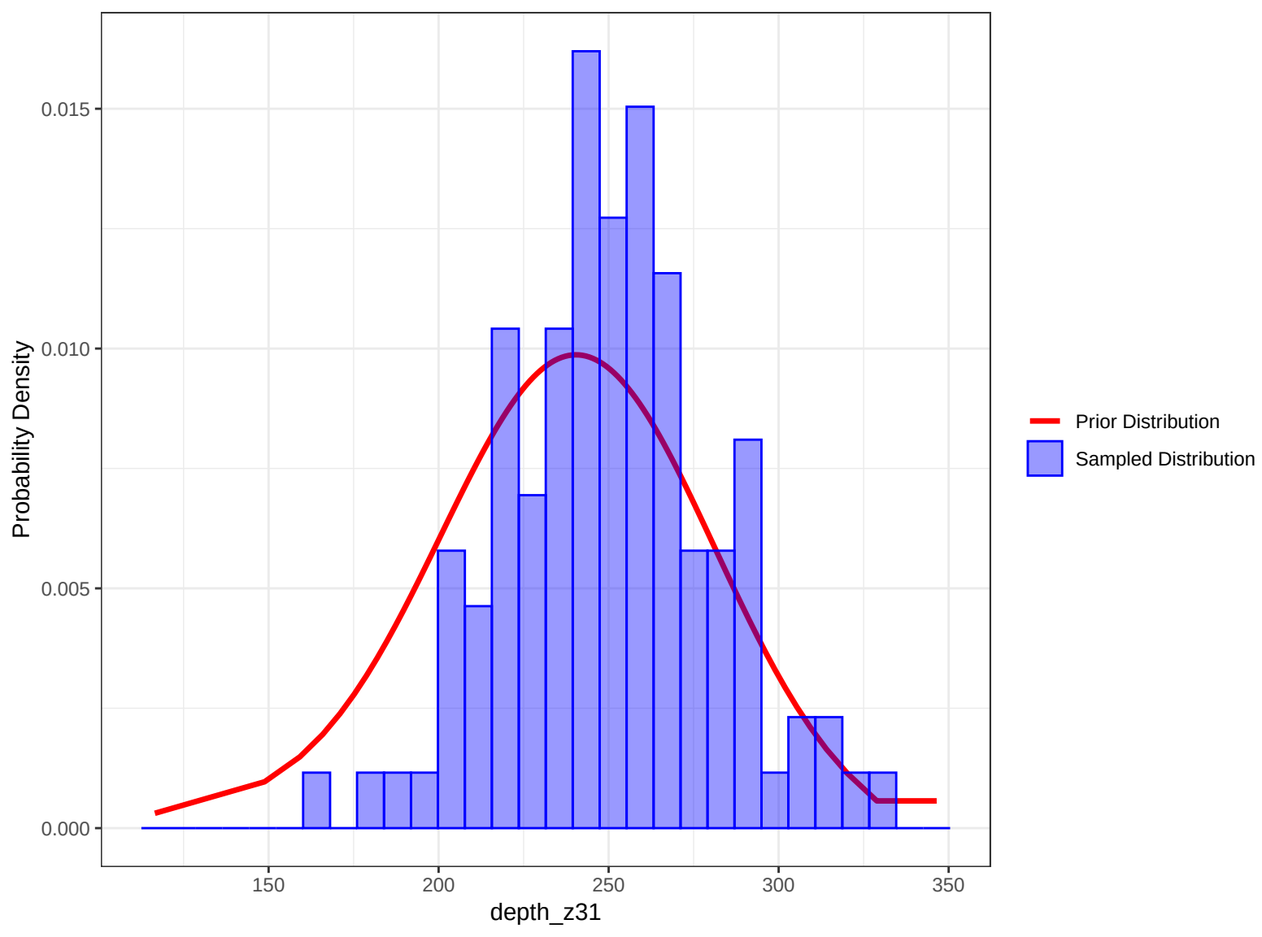

Probability Density
0.010
0.005
0.000
100
200
300
depth_z28
Prior Distribution
Sampled Distribution

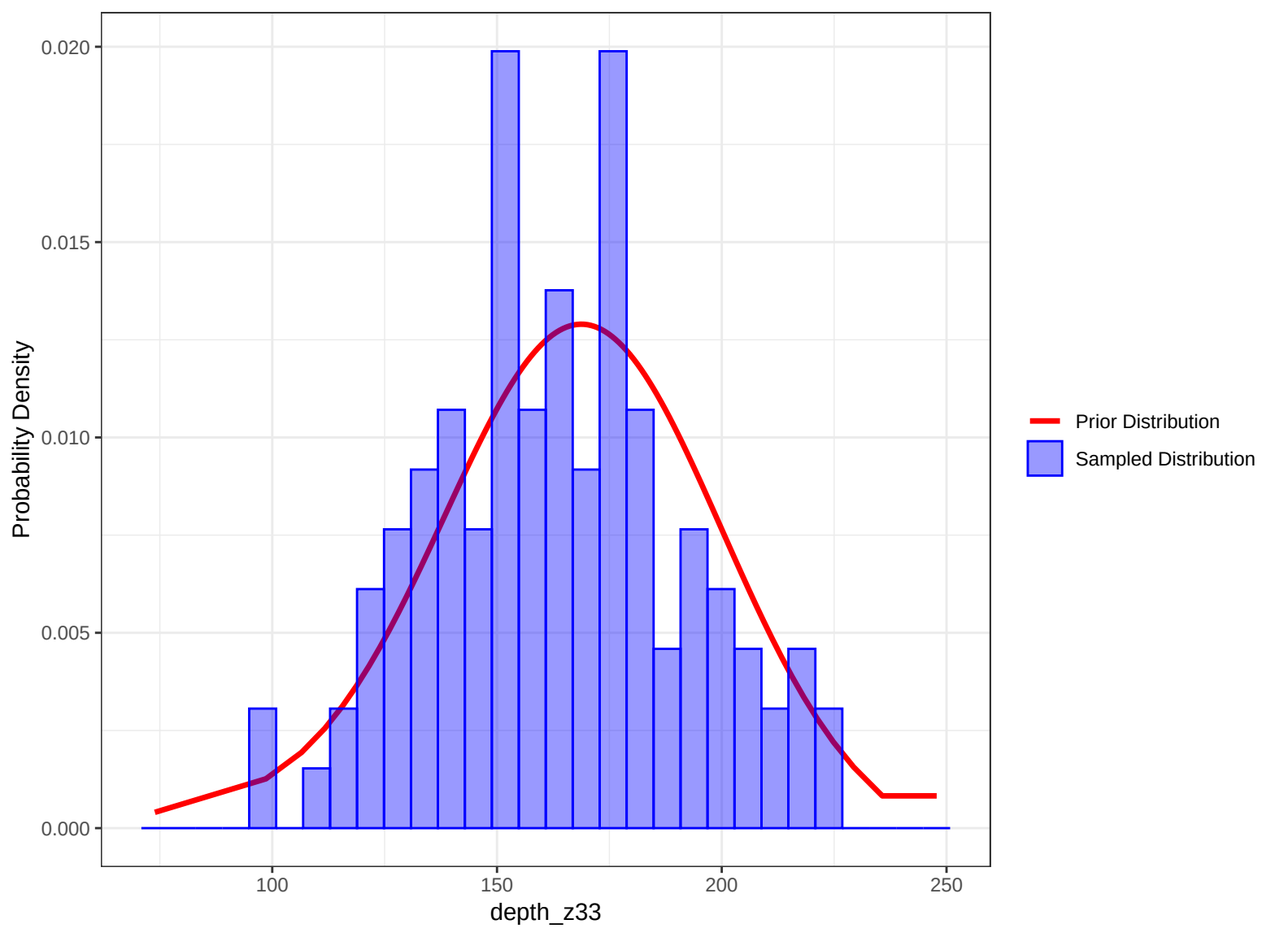

Probability Density
0.020
0.015
0.010
0.005
0.000
0
50
100
150
200
depth_z27
Prior Distribution
Sampled Distribution


Probability Density
0.015
0.010
0.005
0.000
0
100
200
depth_z29
Prior Distribution
Sampled Distribution


Probability Density
0.015
0.010
0.005
0.000
100
150
200
250
300
350
depth_z30
Prior Distribution
Sampled Distribution


Probability Density
0.009
0.006
0.003
0.000
0
100
200
300
depth_z32
Prior Distribution
Sampled Distribution


Probability Density
0.015
0.010
0.005
0.000
150
200
250
300
350
depth_z31
Prior Distribution
Sampled Distribution


Probability Density
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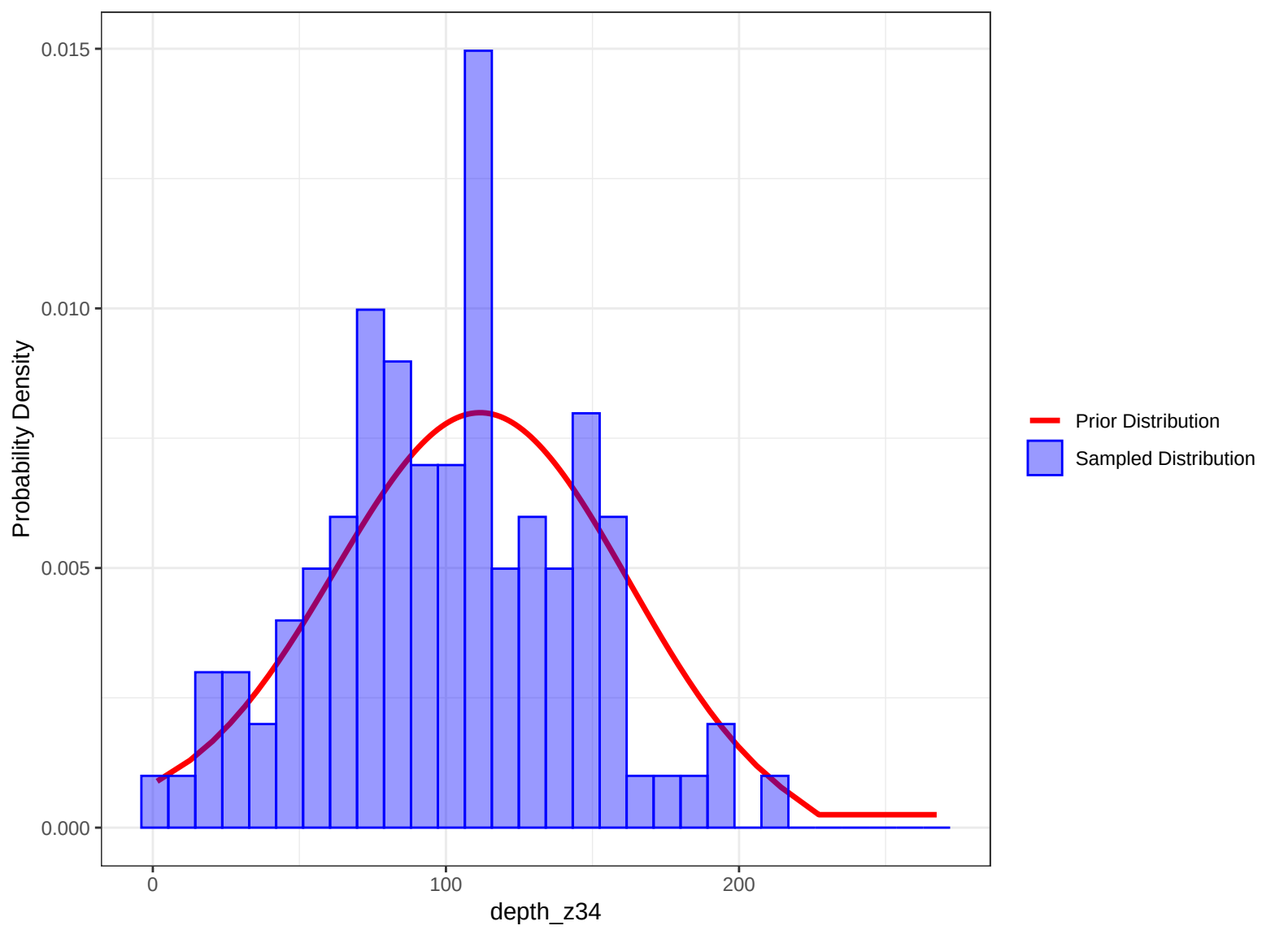
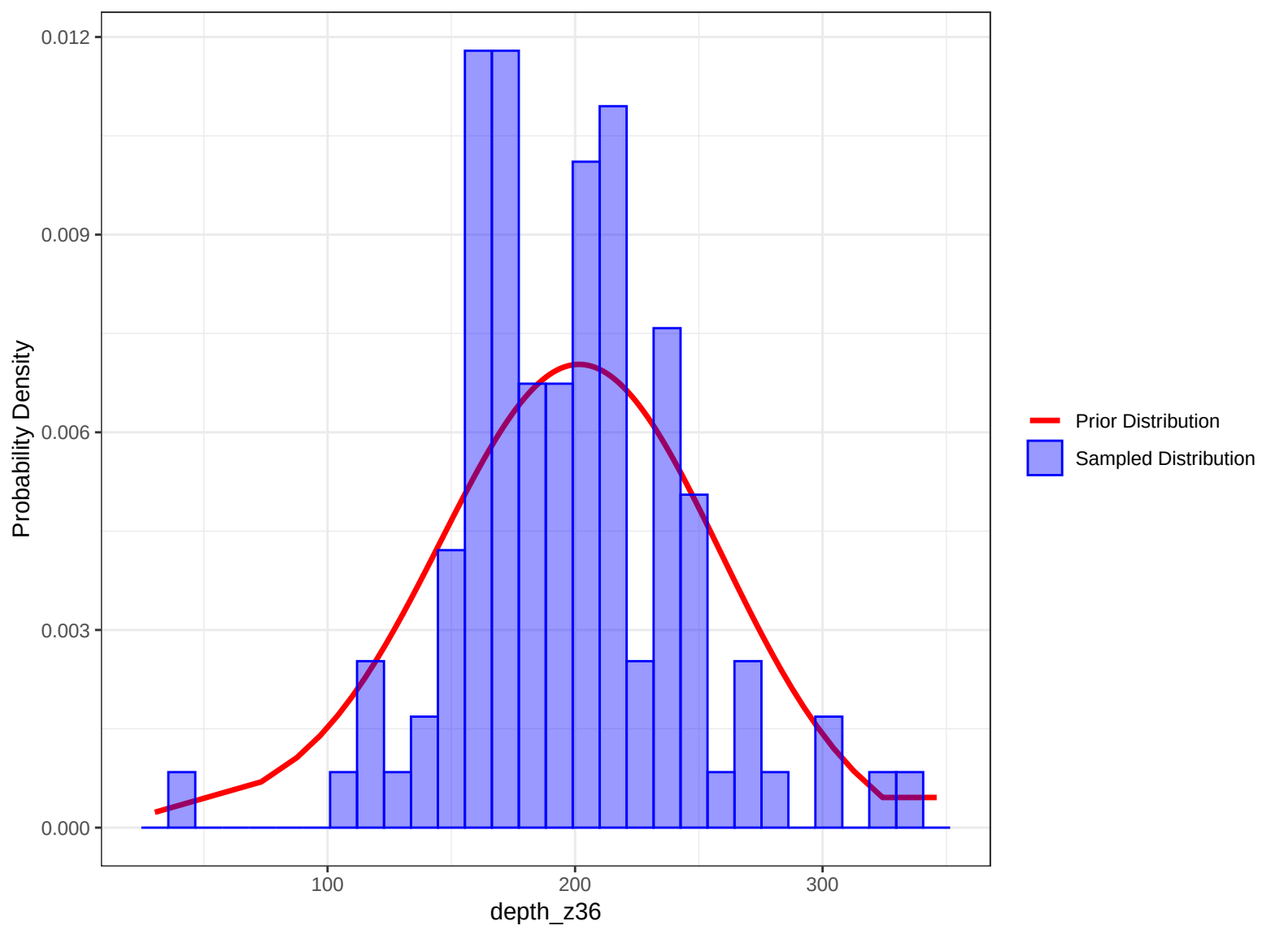
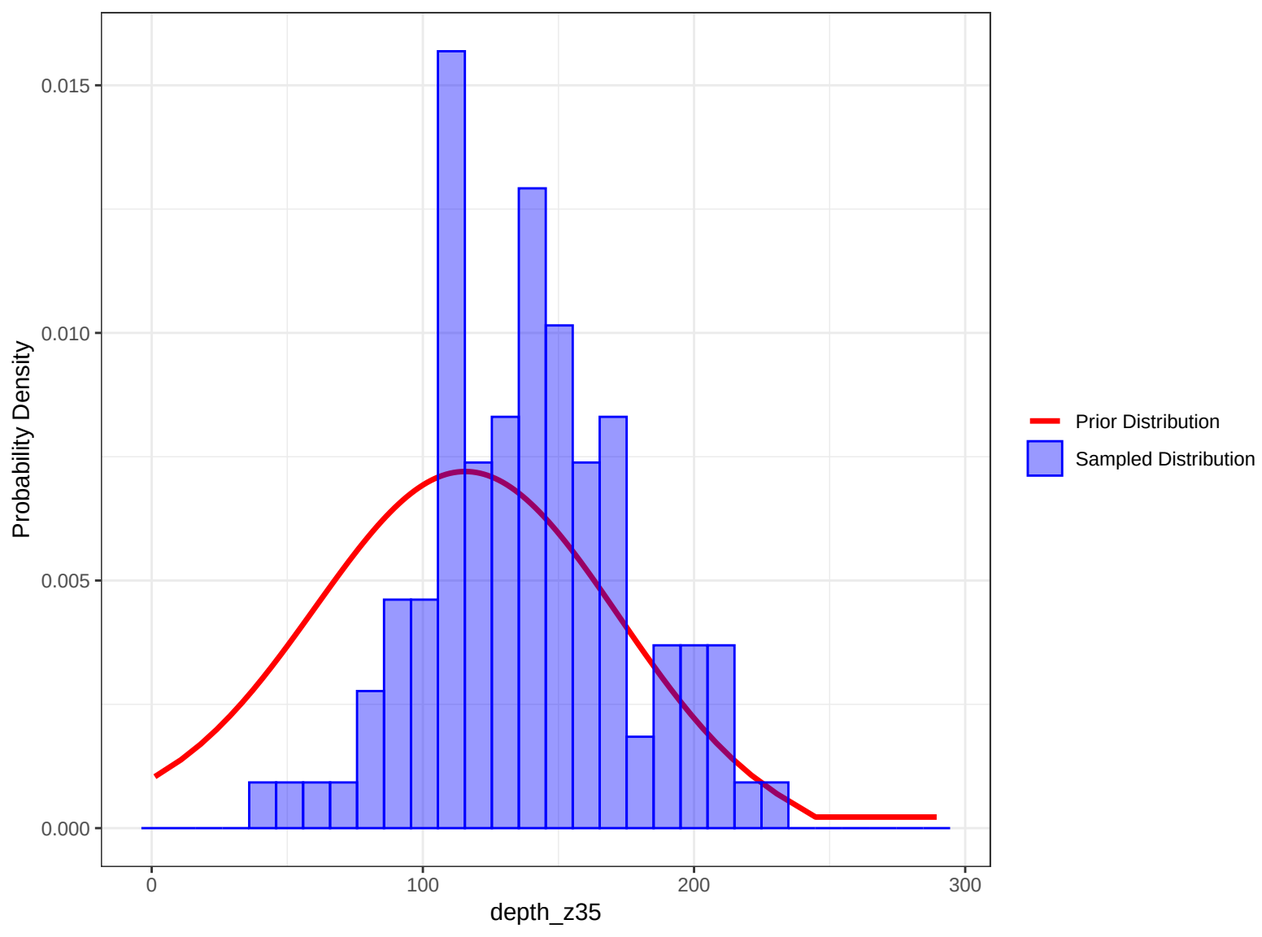
0.015
0.010
0.005
0.000
100
150
200
250
depth_z33
Prior Distribution
Sampled Distribution


0.015
0.010
0.005
0.000
Probability Density
0
100
200
depth_z34
Prior Distribution
Sampled Distribution


0.012
0.009
0.006
0.003
0.000
Probability Density
100
200
300
depth_z36
Prior Distribution
Sampled Distribution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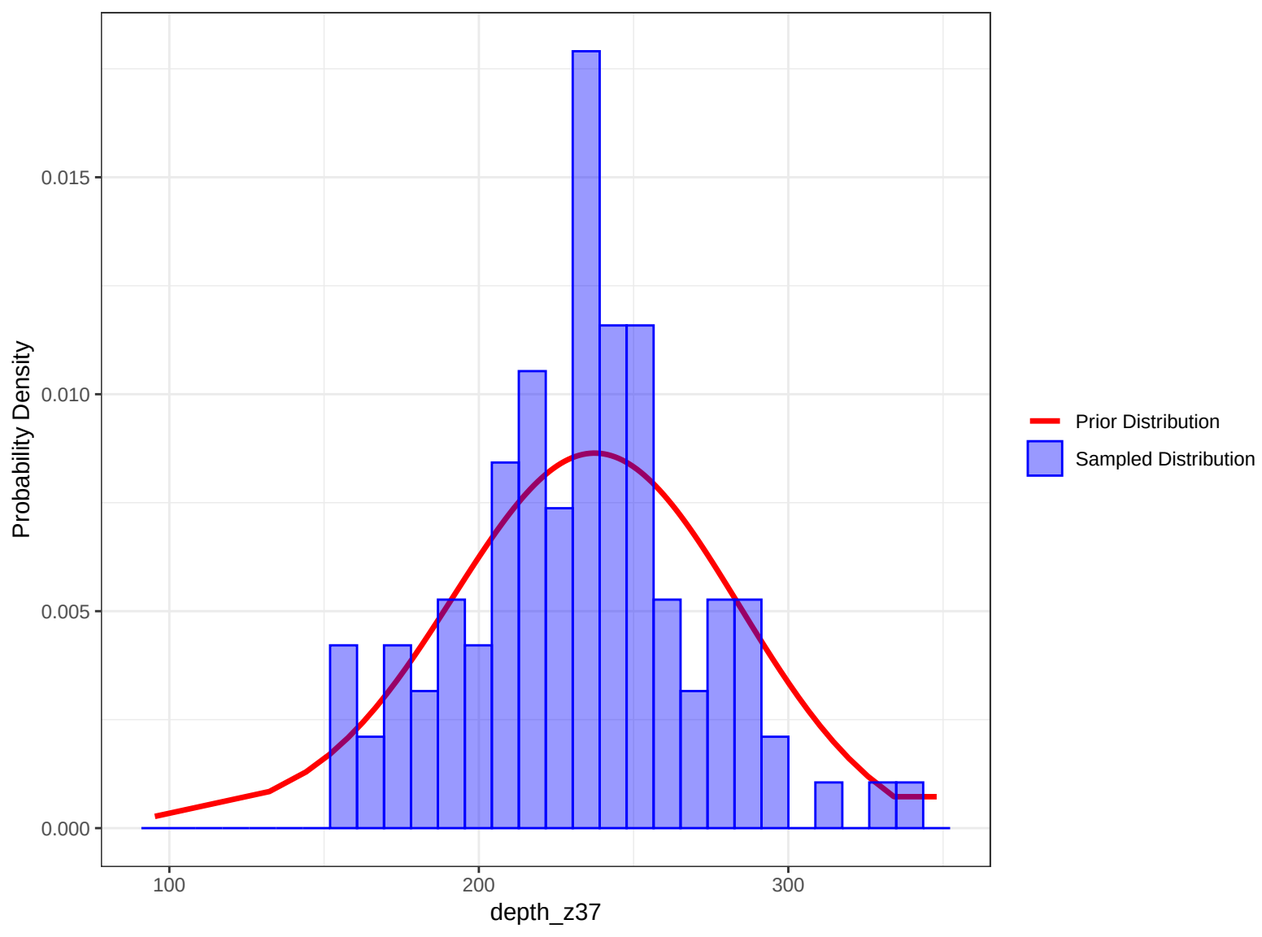
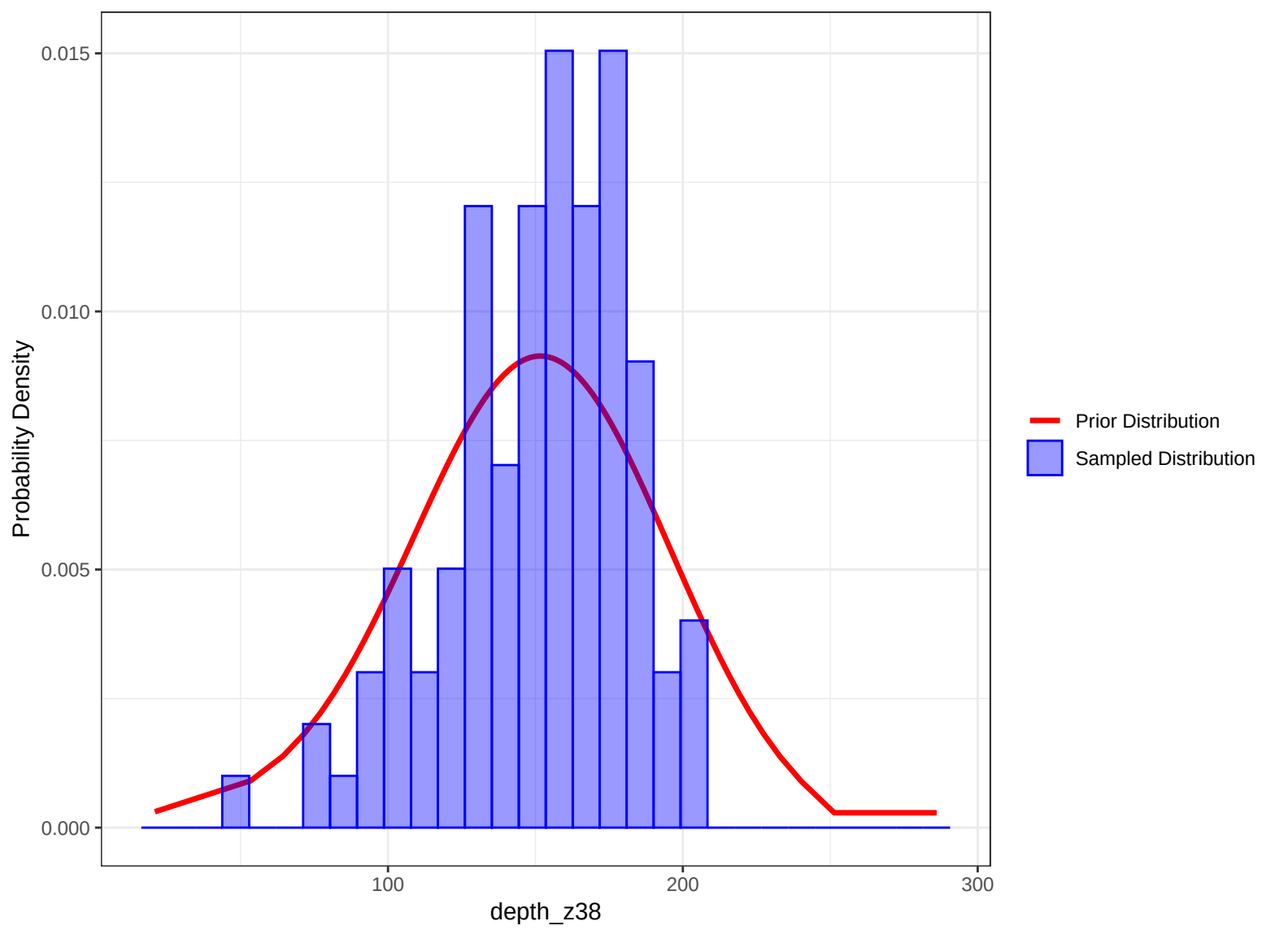
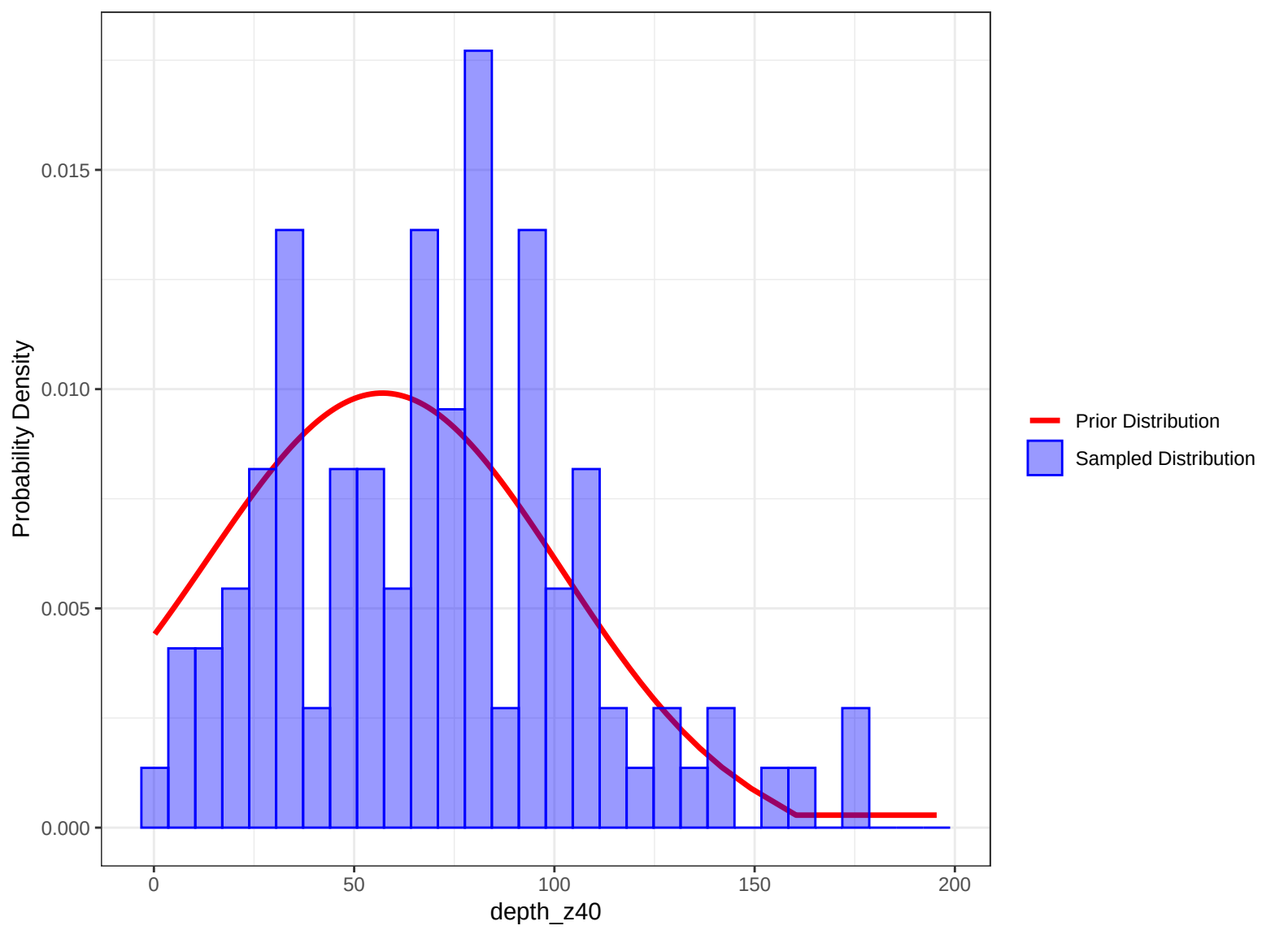
0.010
0.005
0.000
Probability Density
0
100
200
300
depth_z35
Prior Distribution
Sampled Distribution


0.015
0.010
0.005
0.000
Probability Density
100
200
300
depth_z37
Prior Distribution
Sampled Distribution


0.015
0.010
0.005
0.000
Probability Density
100
200
300
depth_z38
Prior Distribution
Sampled Distribution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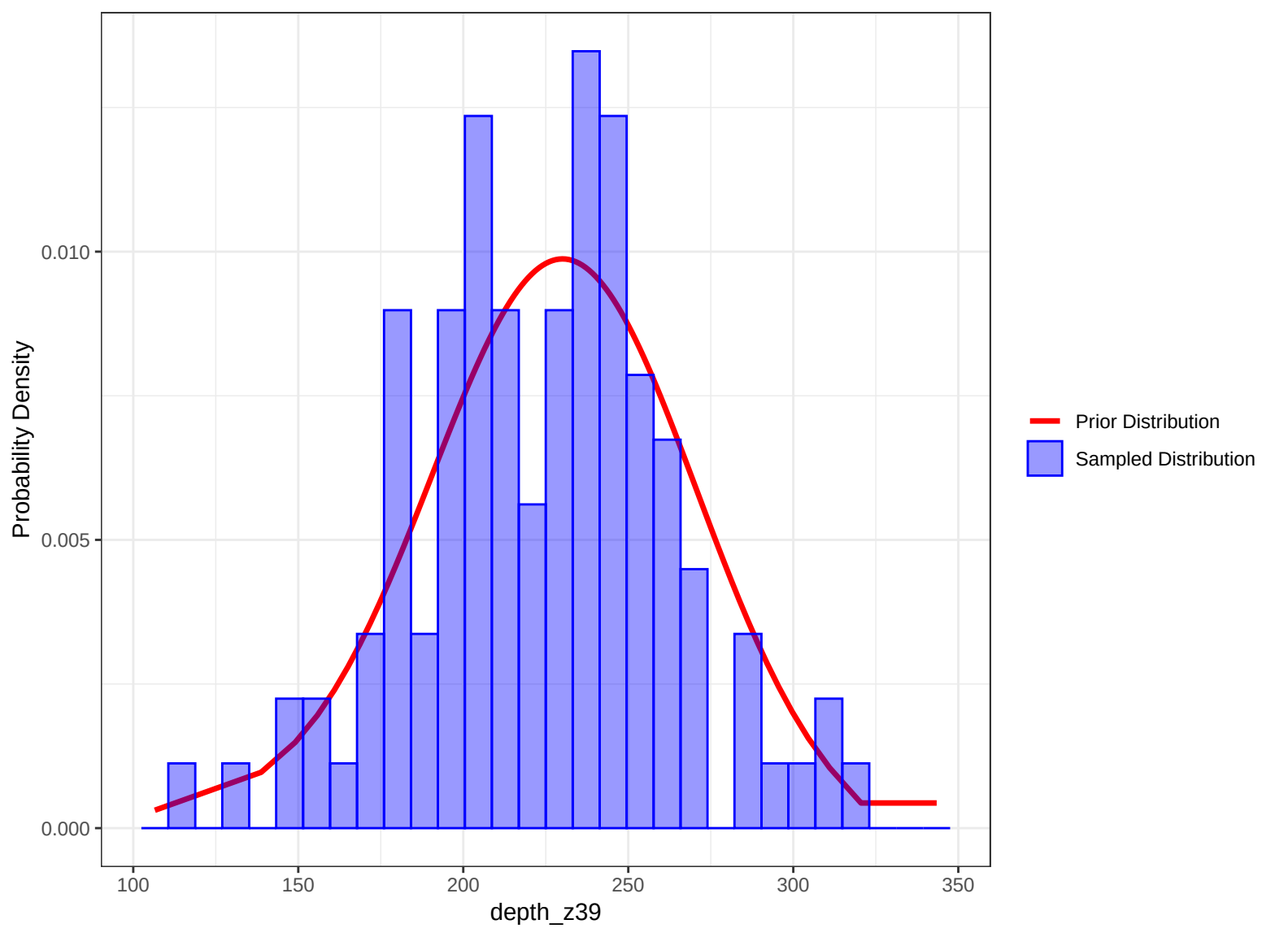
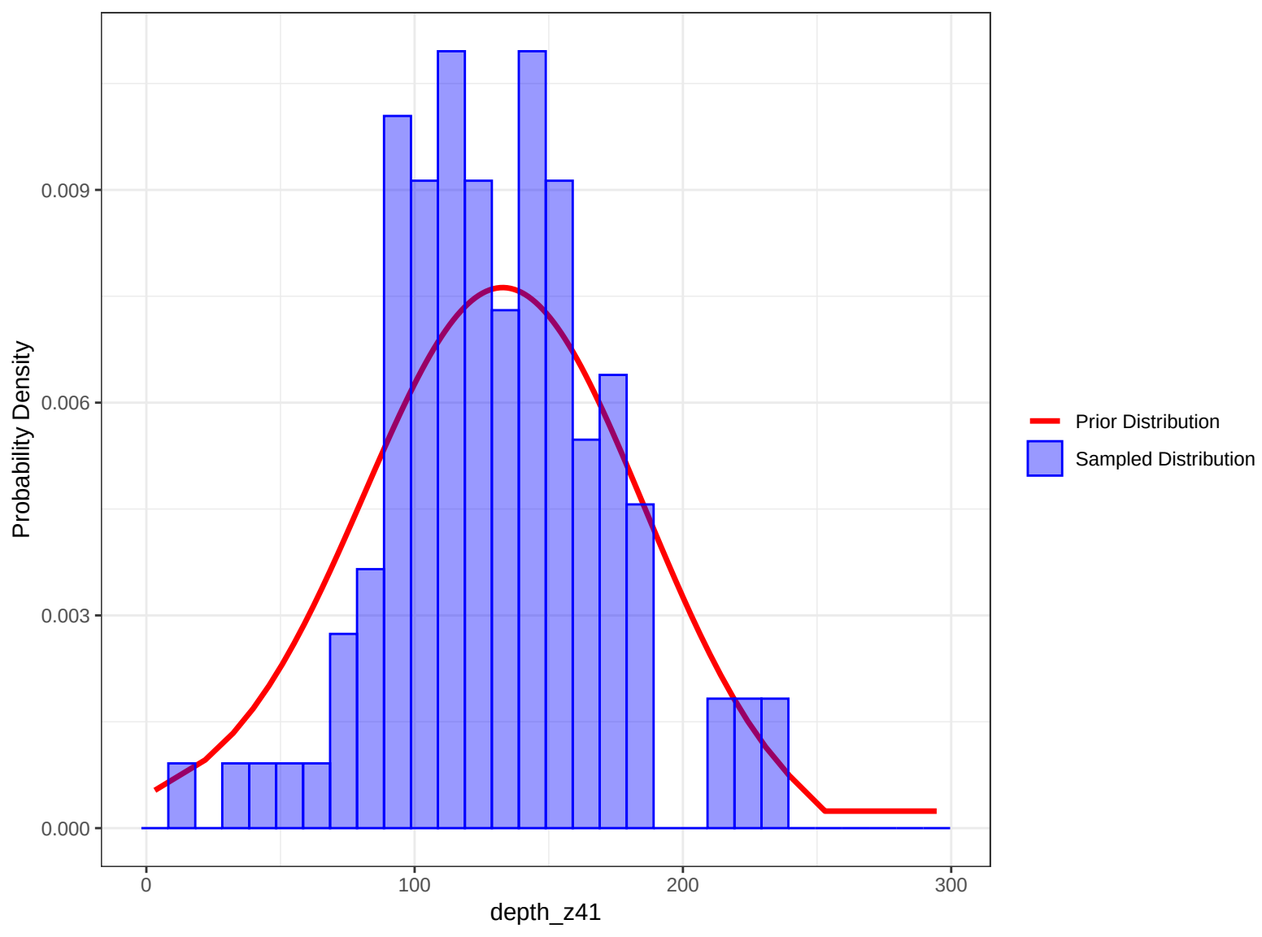
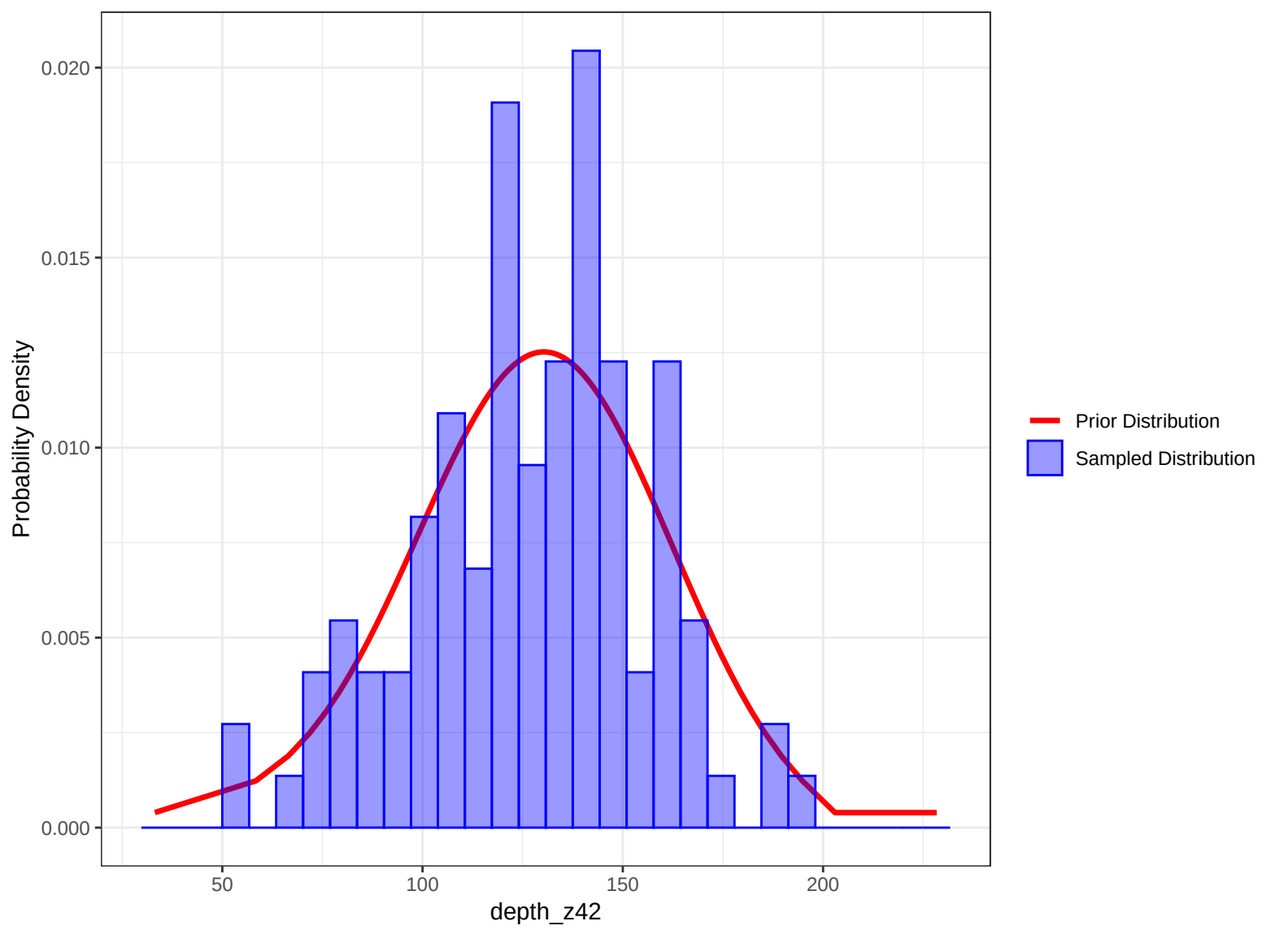
0.010
0.005
0.000
Probability Density
0
50
100
150
200
depth_z40
Prior Distribution
Sampled Distribution


0.010
0.005
0.000
Probability Density
100
150
200
250
300
350
depth_z39
Prior Distribution
Sampled Distribution


0.009
0.006
0.003
0.000
Probability Density
0
100
200
300
depth_z41
Prior Distribution
Sampled Distribution


Probability Density
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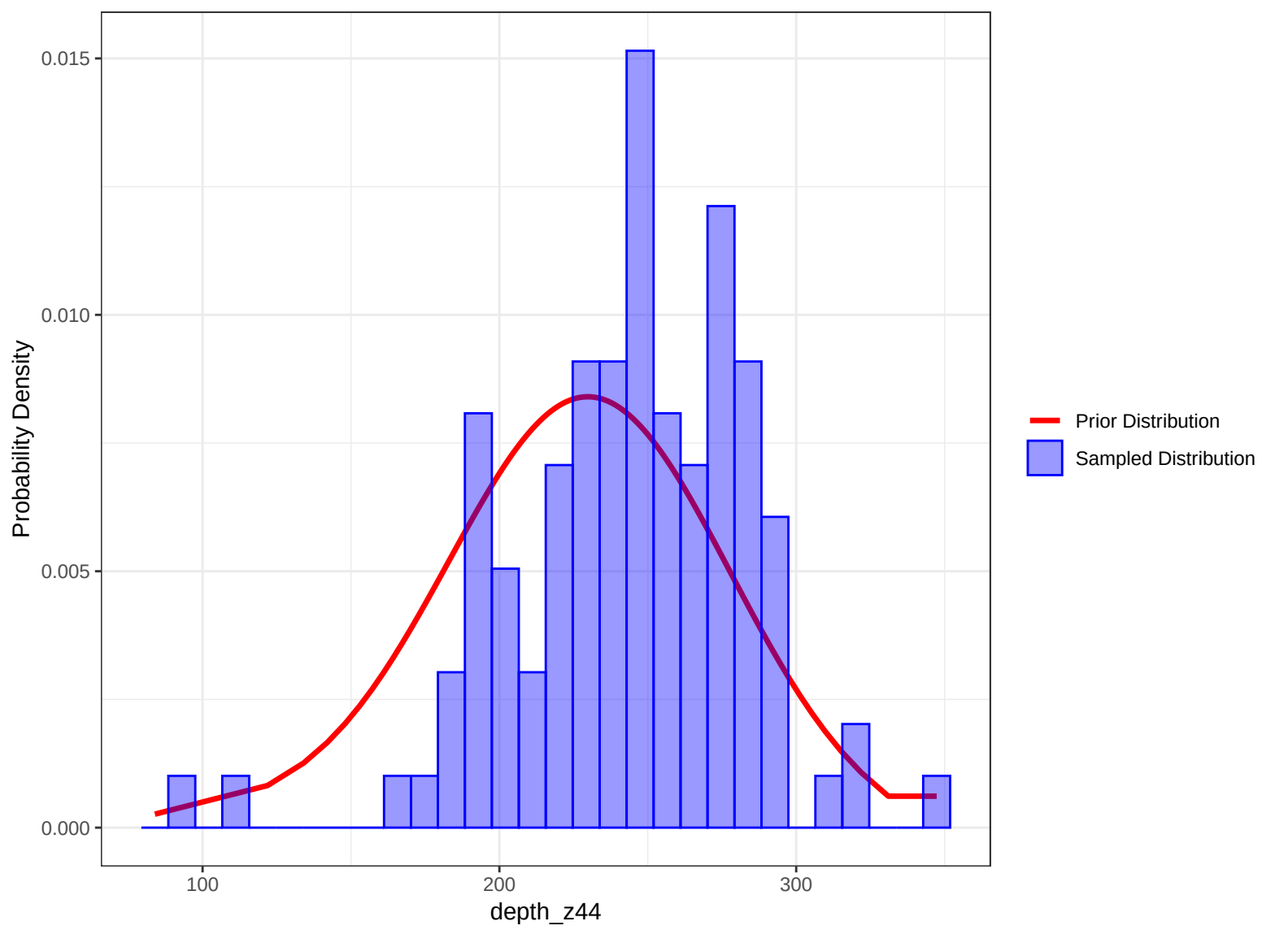
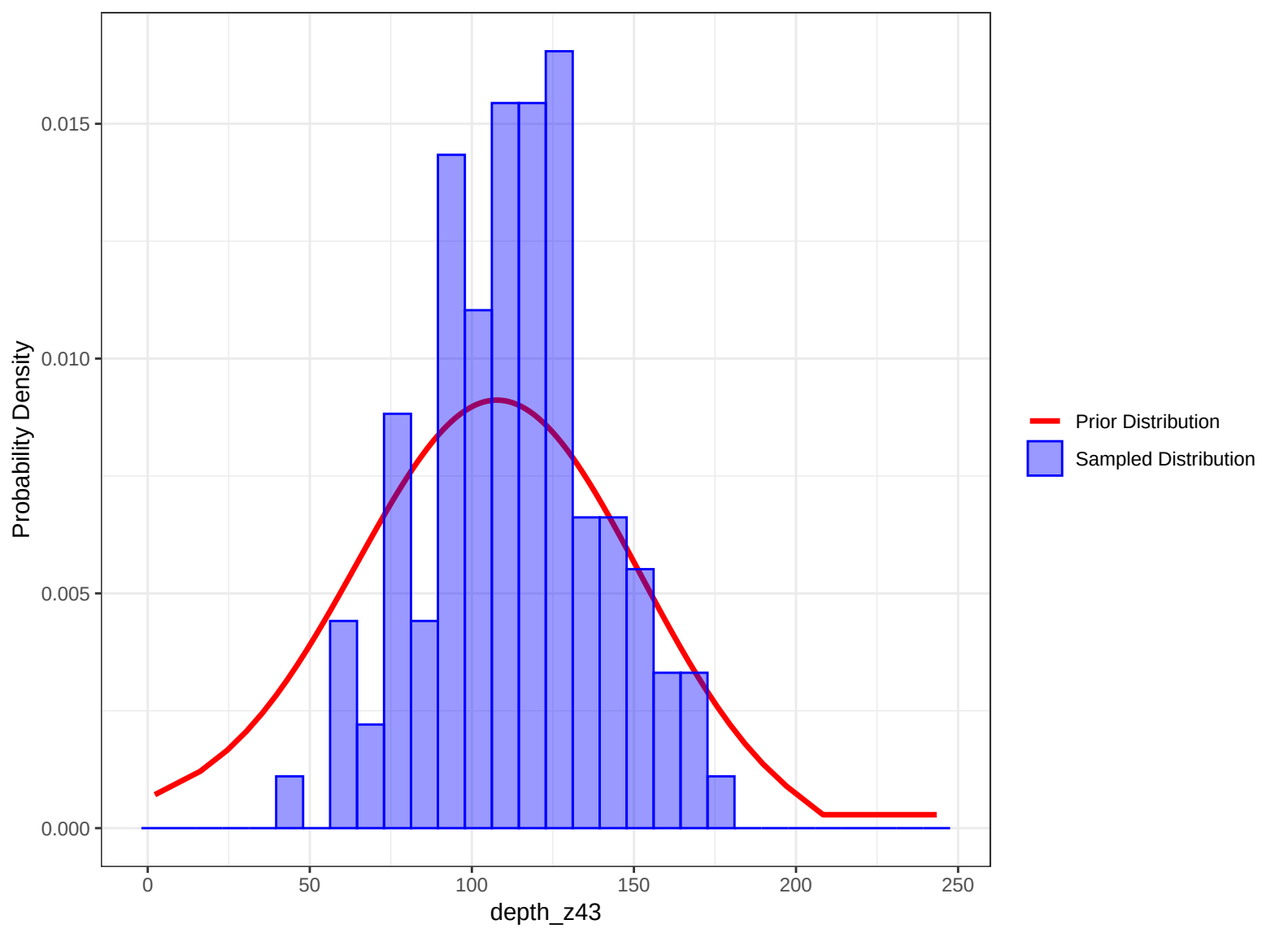
0.015
0.010
0.005
0.000
50
100
150
200
depth_z42
Prior Distribution
Sampled Distribution


Probability Density
0.015
0.010
0.005
0.000
100
200
300
depth_z44
Prior Distribution
Sampled Distribution


Probability Density
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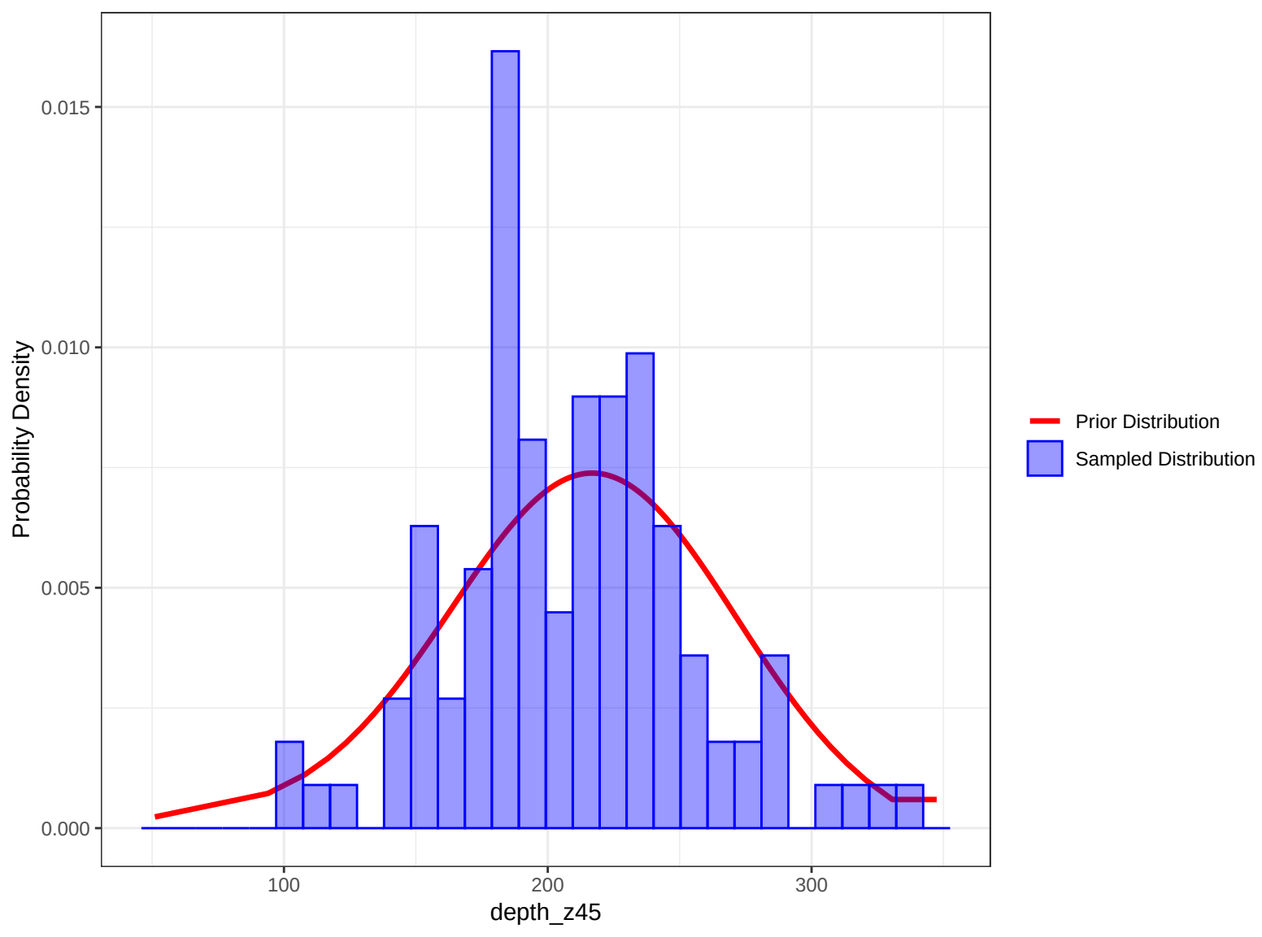
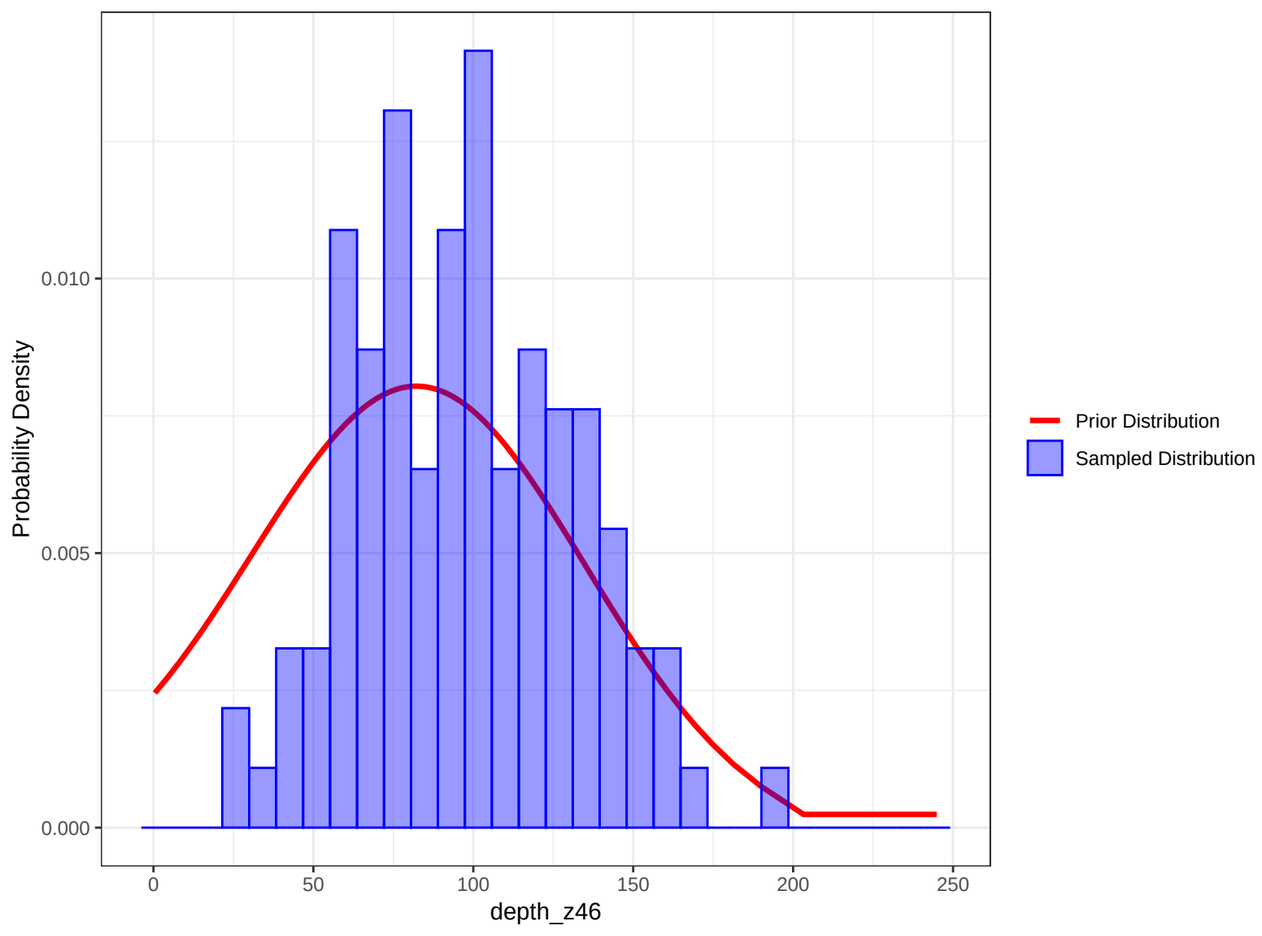
0.010
0.005
0.000
0
50
100
150
200
250
depth_z43
Prior Distribution
Sampled Distribution


Probability Density
0.015
0.010
0.005
0.000
100
200
300
depth_z45
Prior Distribution
Sampled Distribution


Probability Density
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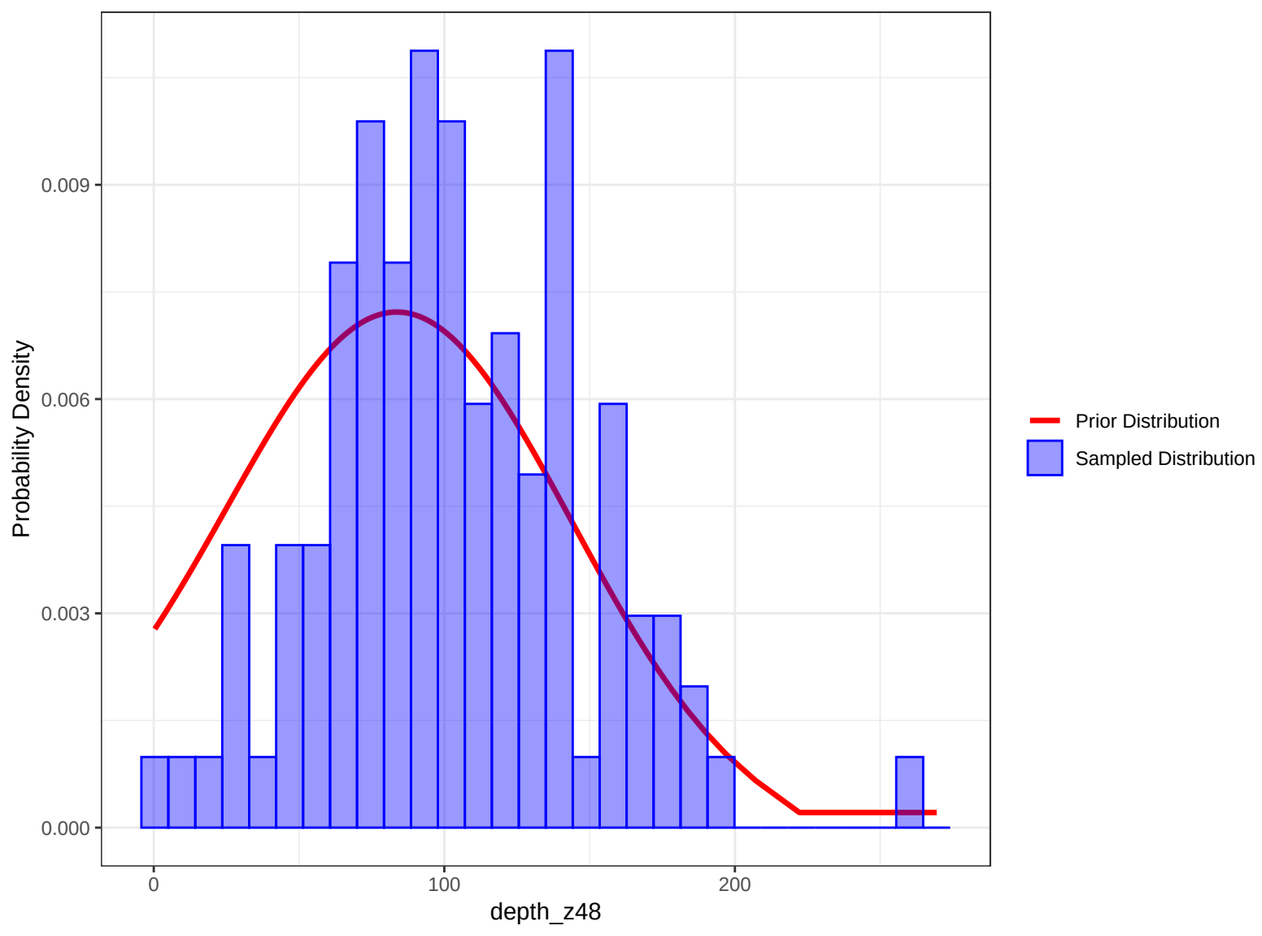
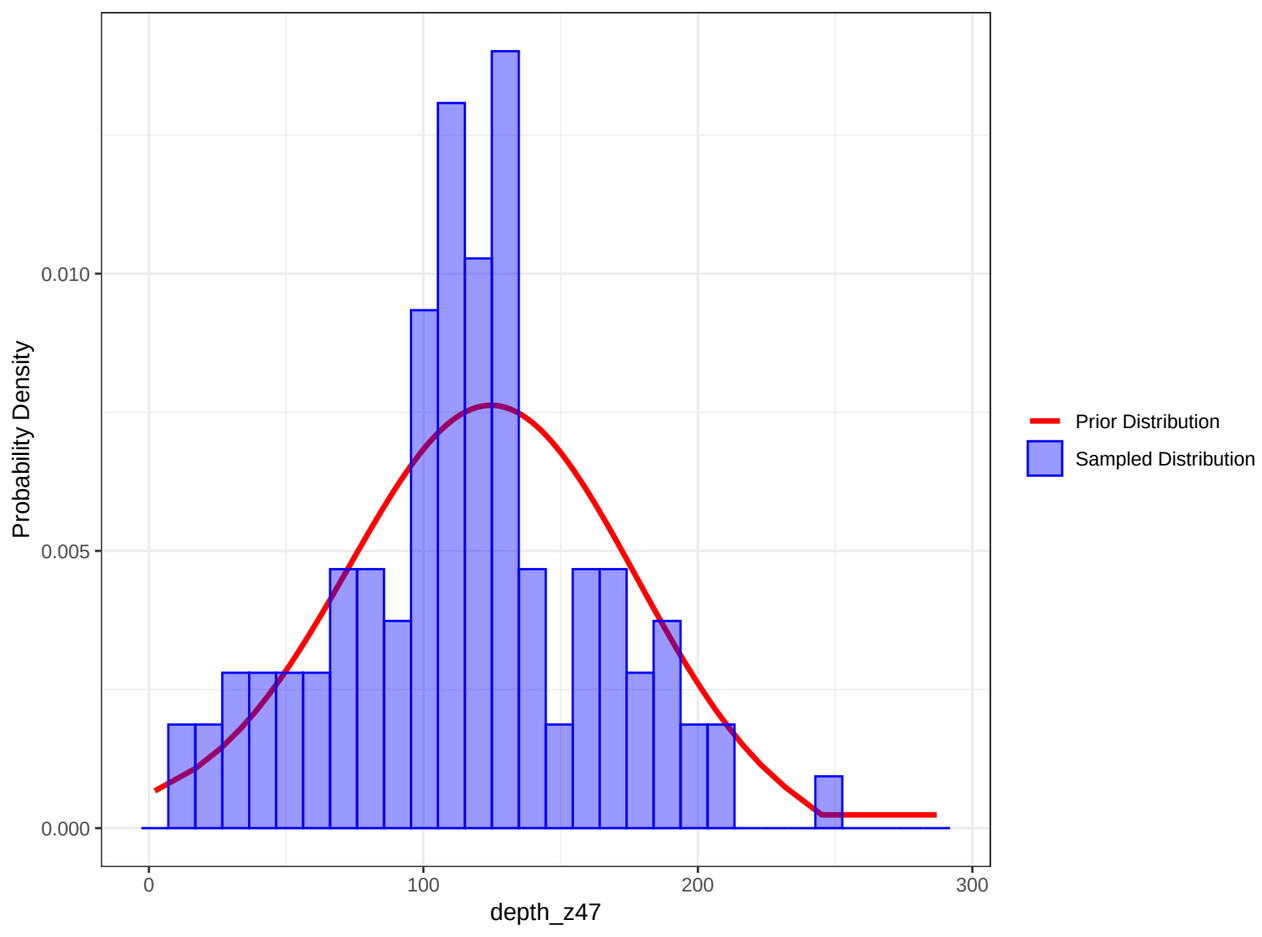
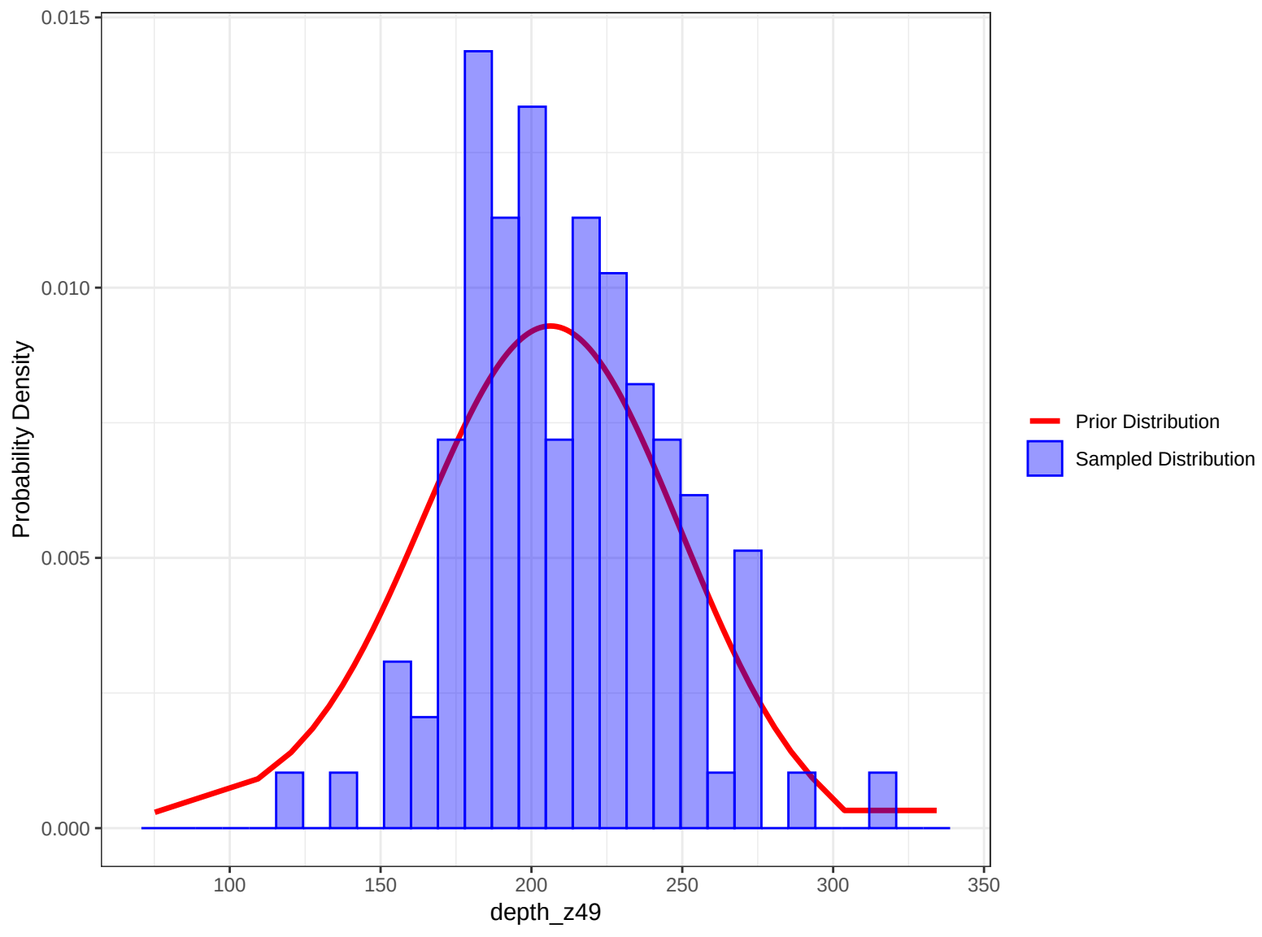
0.005
0.000
0
50
100
150
200
250
depth_z46
Prior Distribution
Sampled Distribution


Probability Density
0.009
0.006
0.003
0.000
0
100
200
depth_z48
Prior Distribution
Sampled Distribution


Probability Density
0.010
0.005
0.000
0
100
200
300
depth_z47
Prior Distribution
Sampled Distribution


Probability Density
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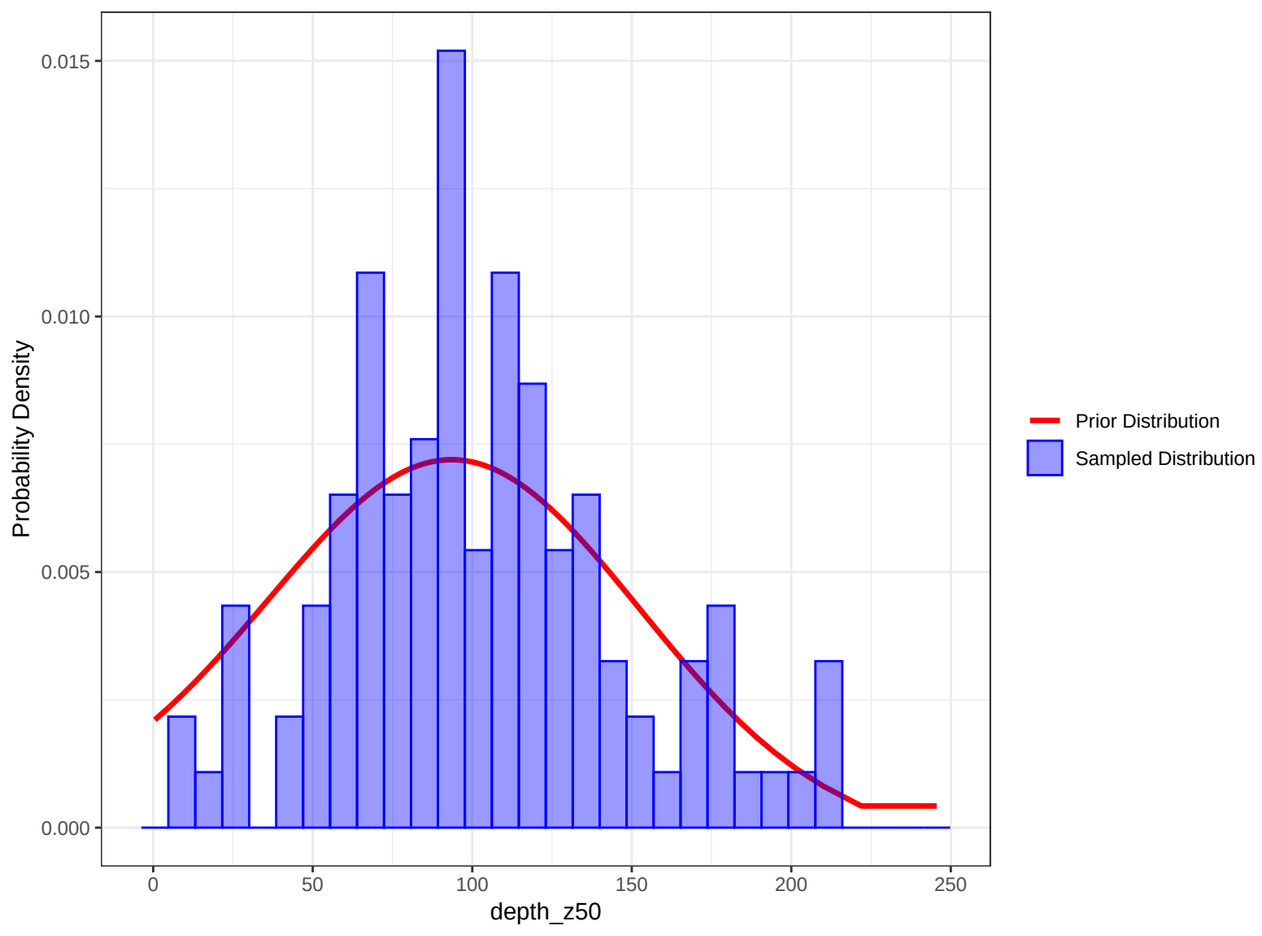
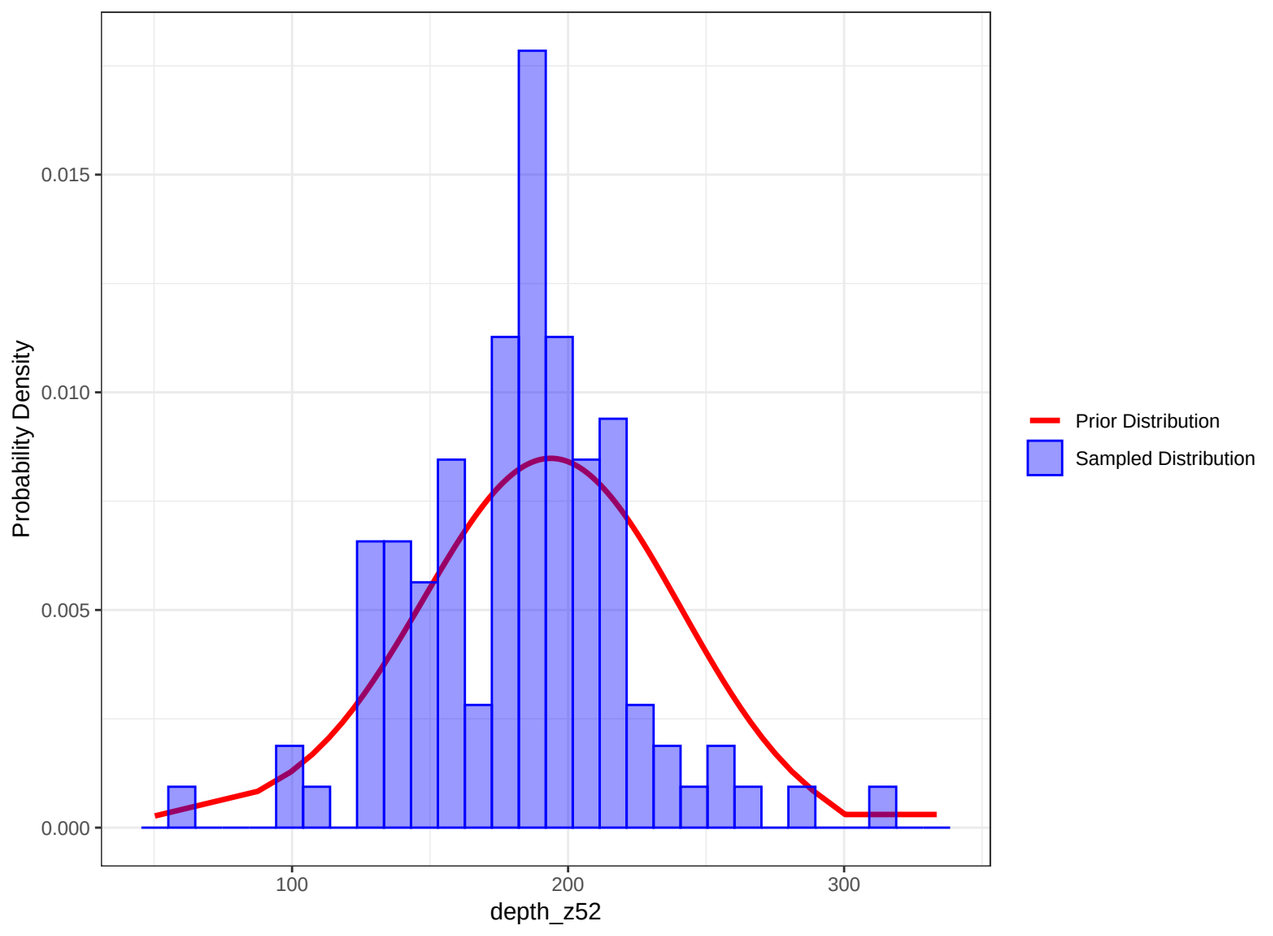
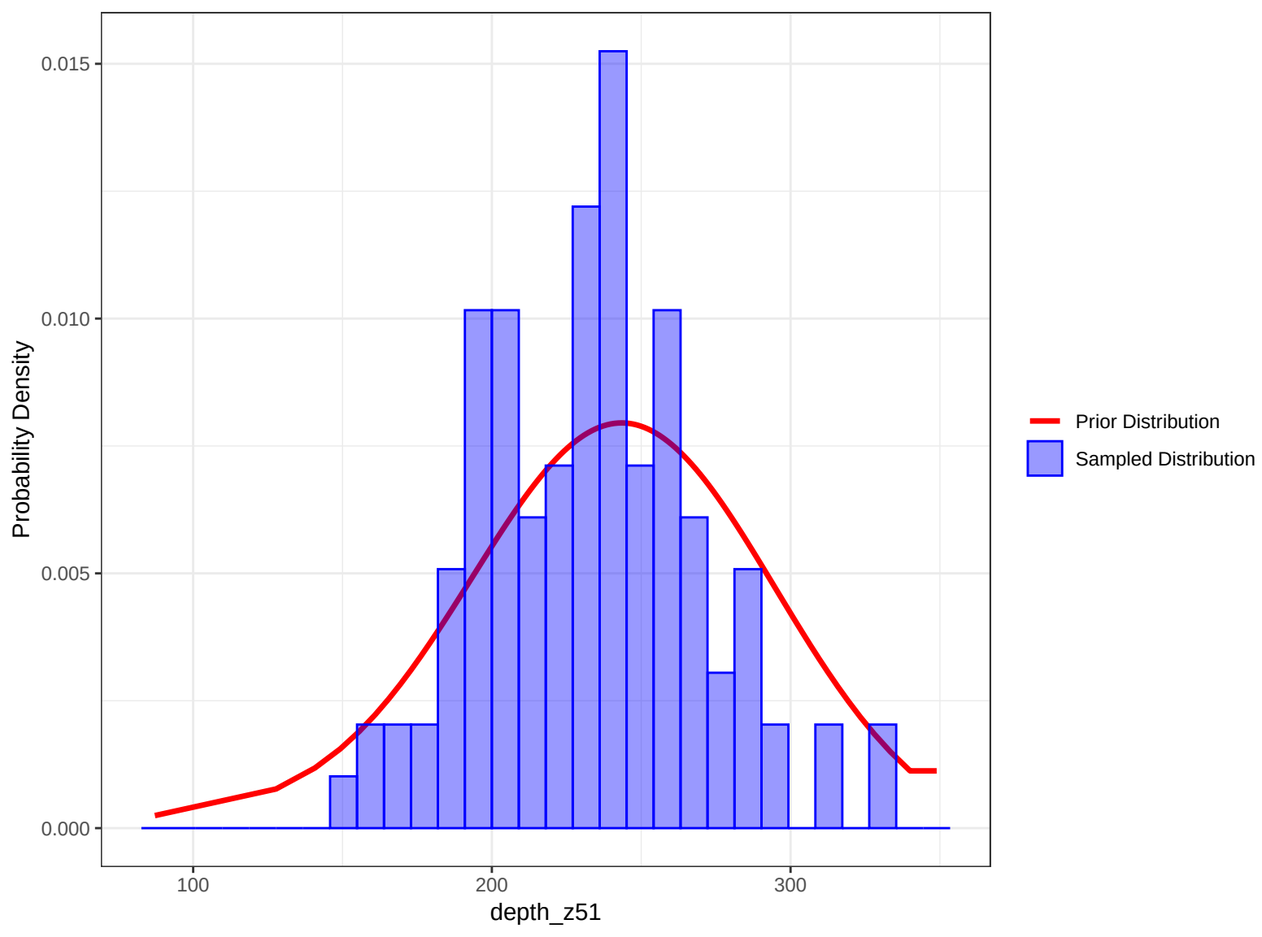
0.010
0.005
0.000
100
150
200
250
300
350
depth_z49
Prior Distribution
Sampled Distribution


0.015
0.010
0.005
0.000
Probability Density
0
50
100
150
200
250
depth_z50
Prior Distribution
Sampled Distribution


0.015
0.010
0.005
0.000
Probability Density
100
200
300
depth_z52
Prior Distribution
Sampled Distribution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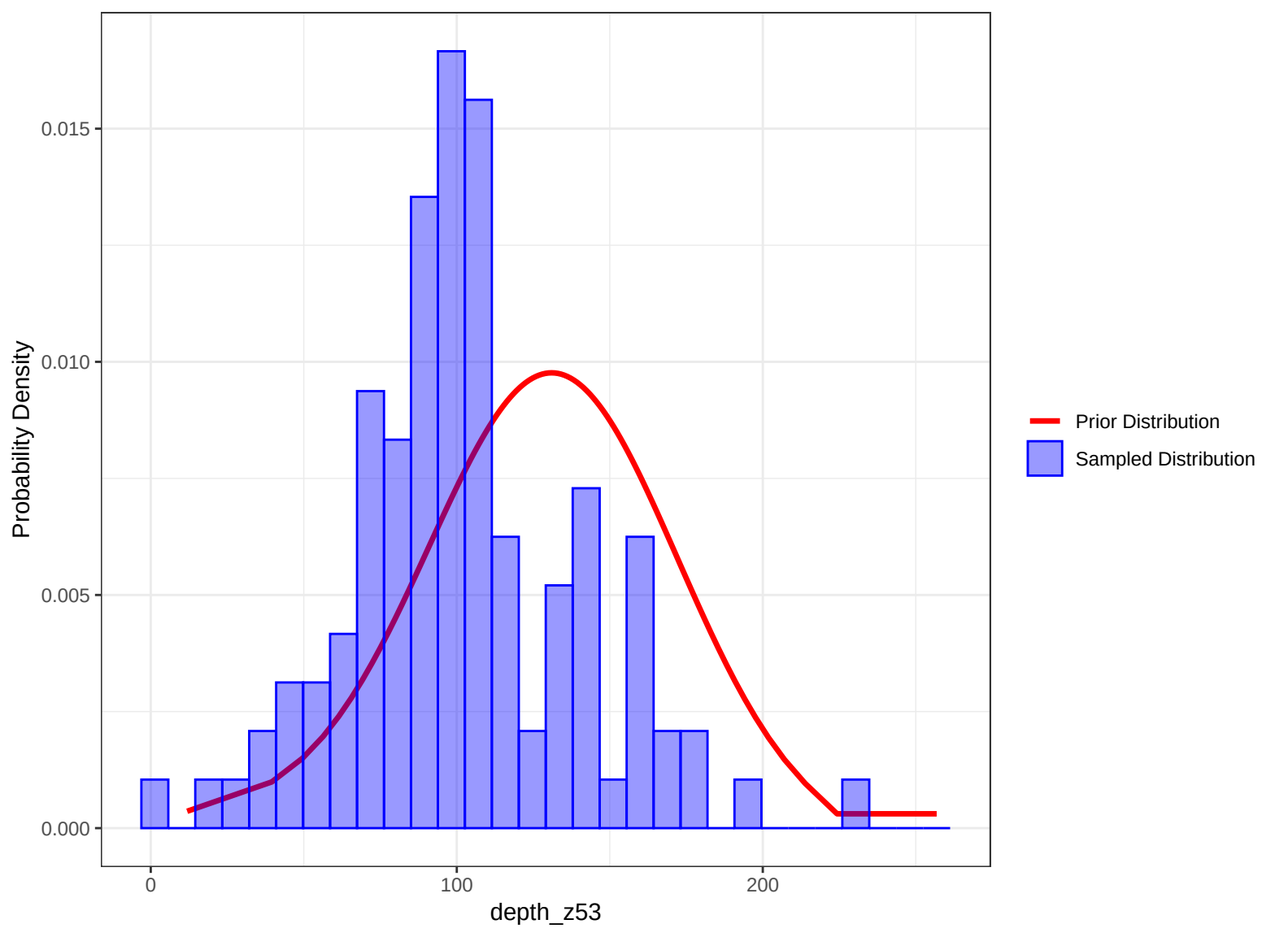
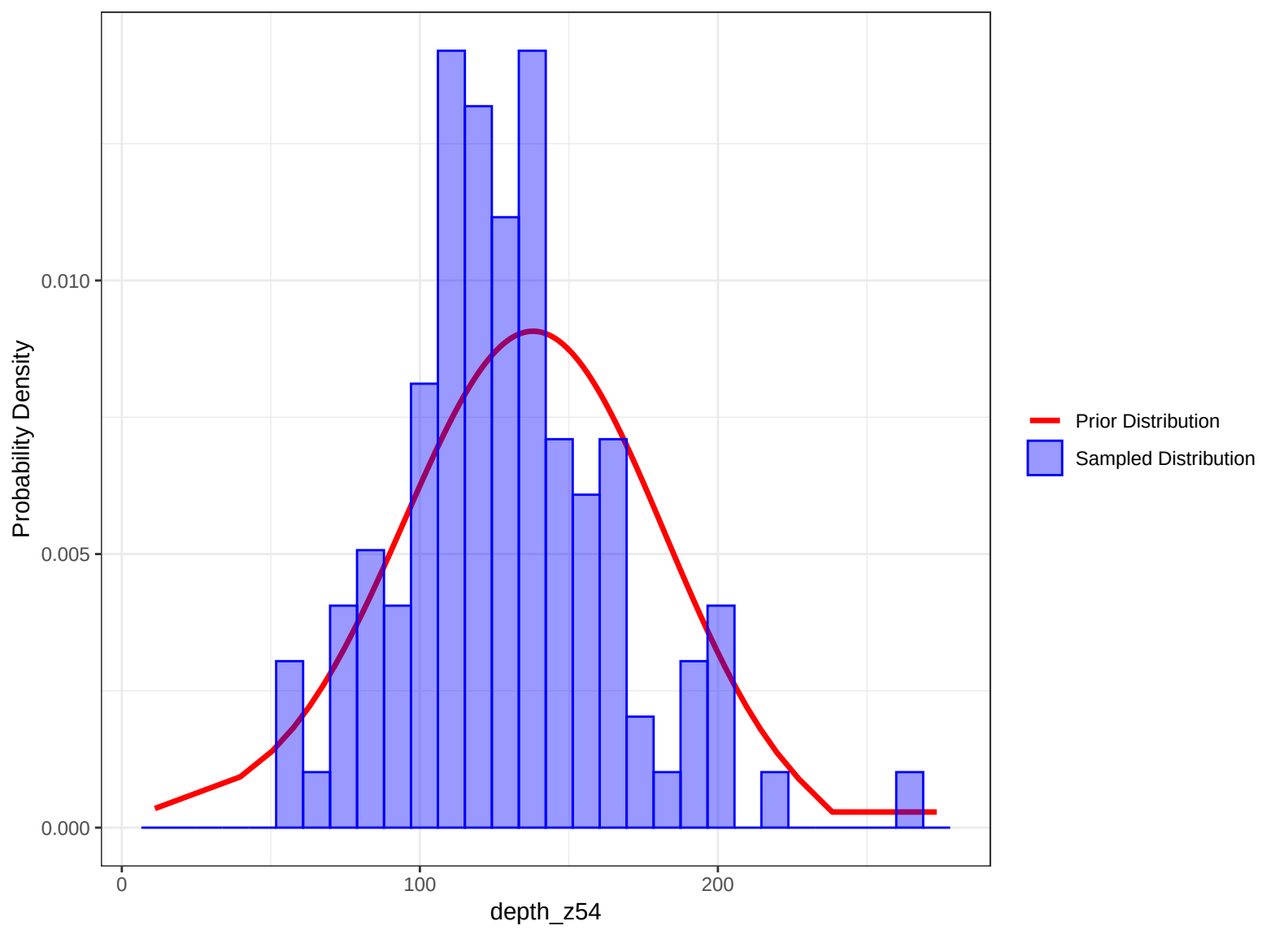
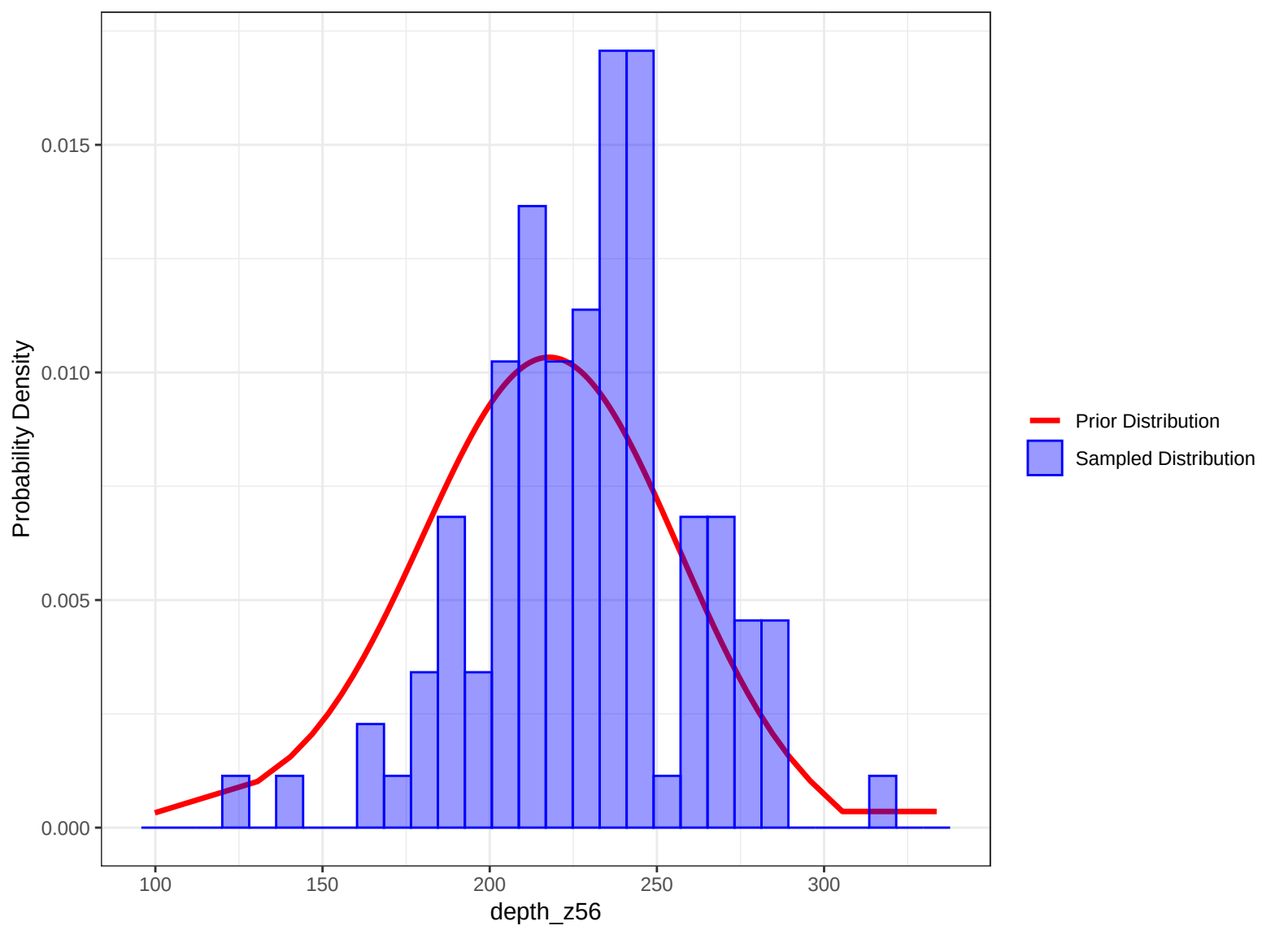
0.010
0.005
0.000
Probability Density
100
200
300
depth_z51
Prior Distribution
Sampled Distribution


0.015
0.010
0.005
0.000
Probability Density
0
100
200
depth_z53
Prior Distribution
Sampled Distribution


Probability Density
0.010
0.005
0.000
0
100
200
depth_z54
Prior Distribution
Sampled Distribution


Probability Density
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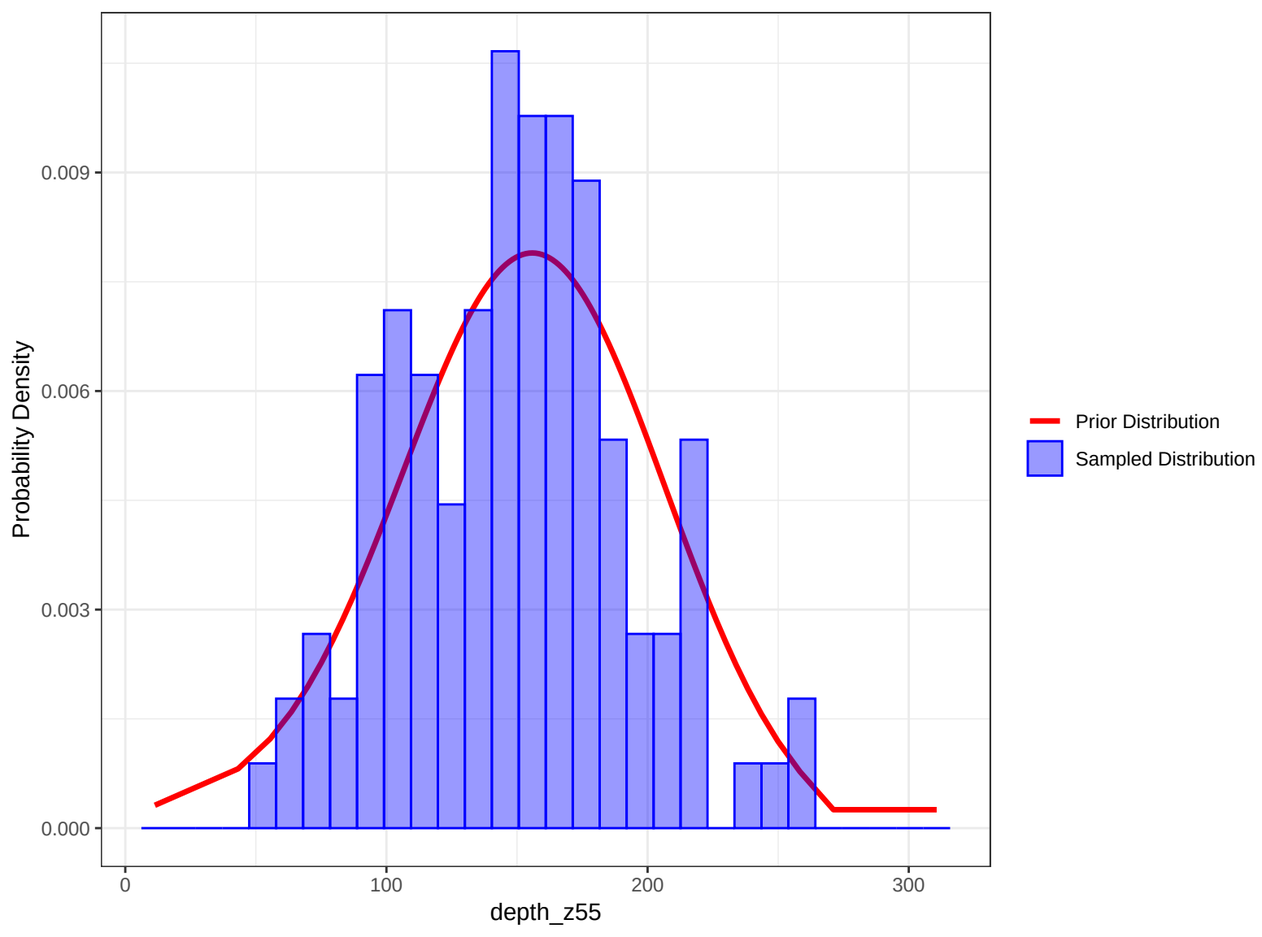
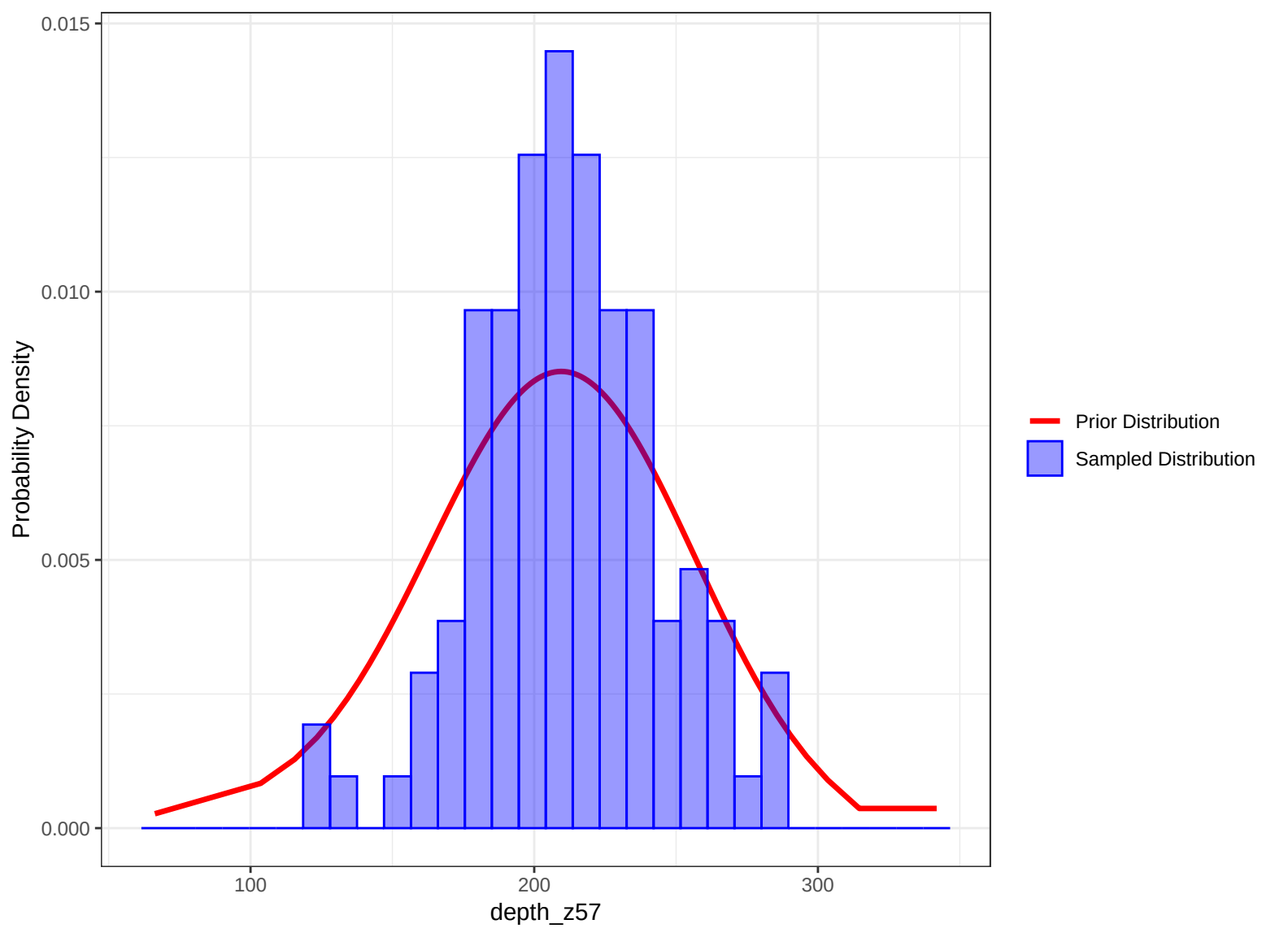
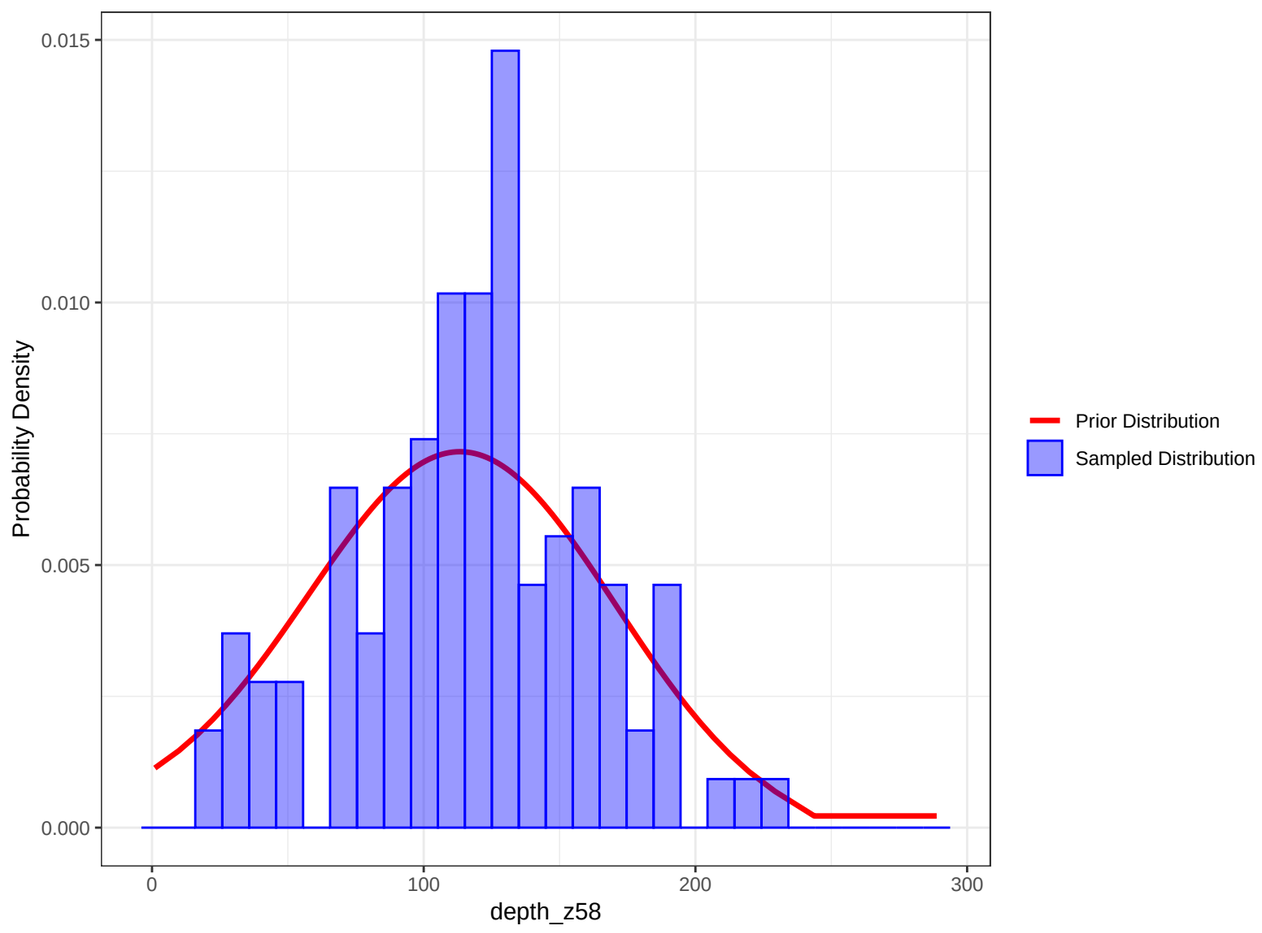
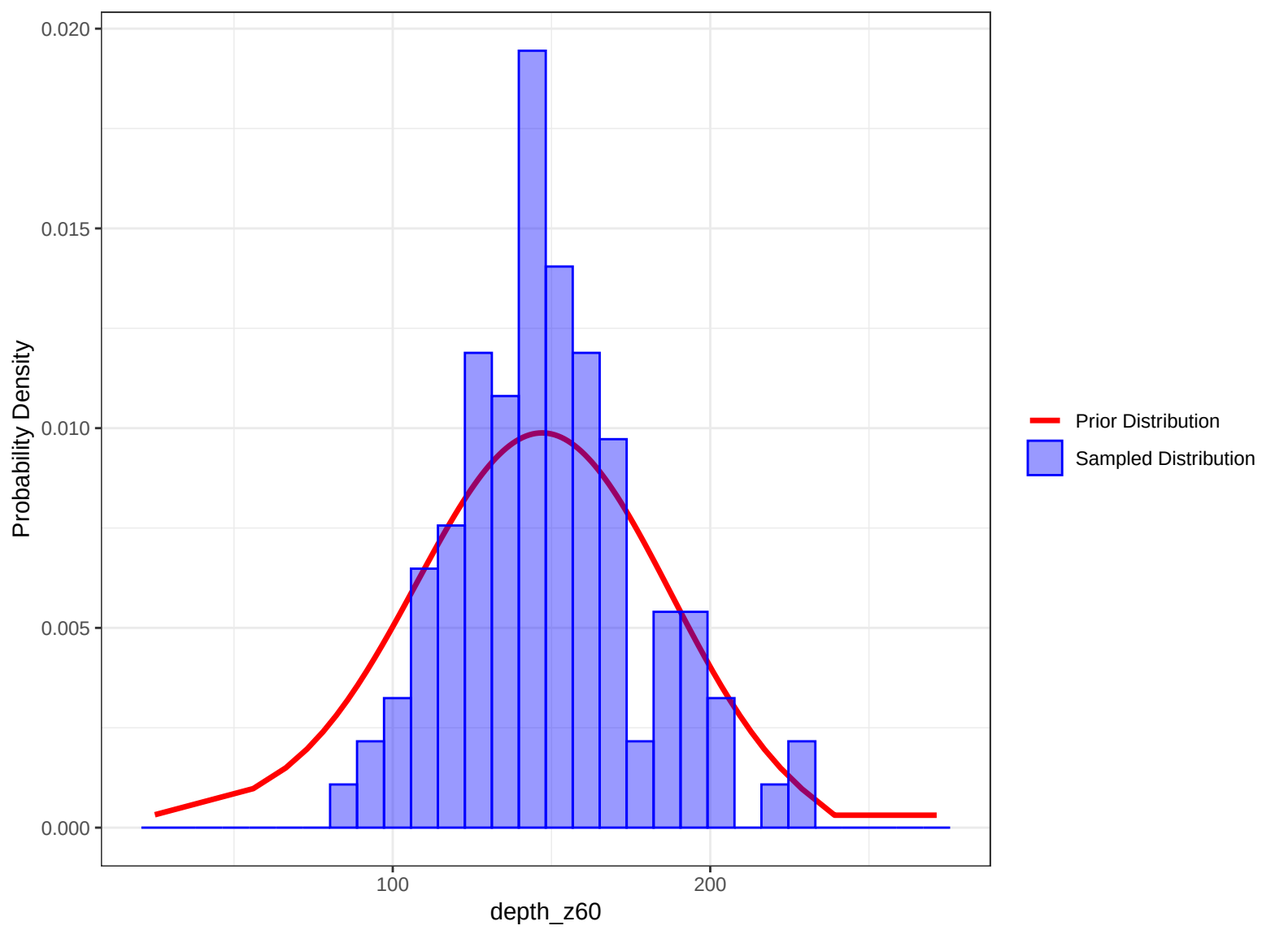
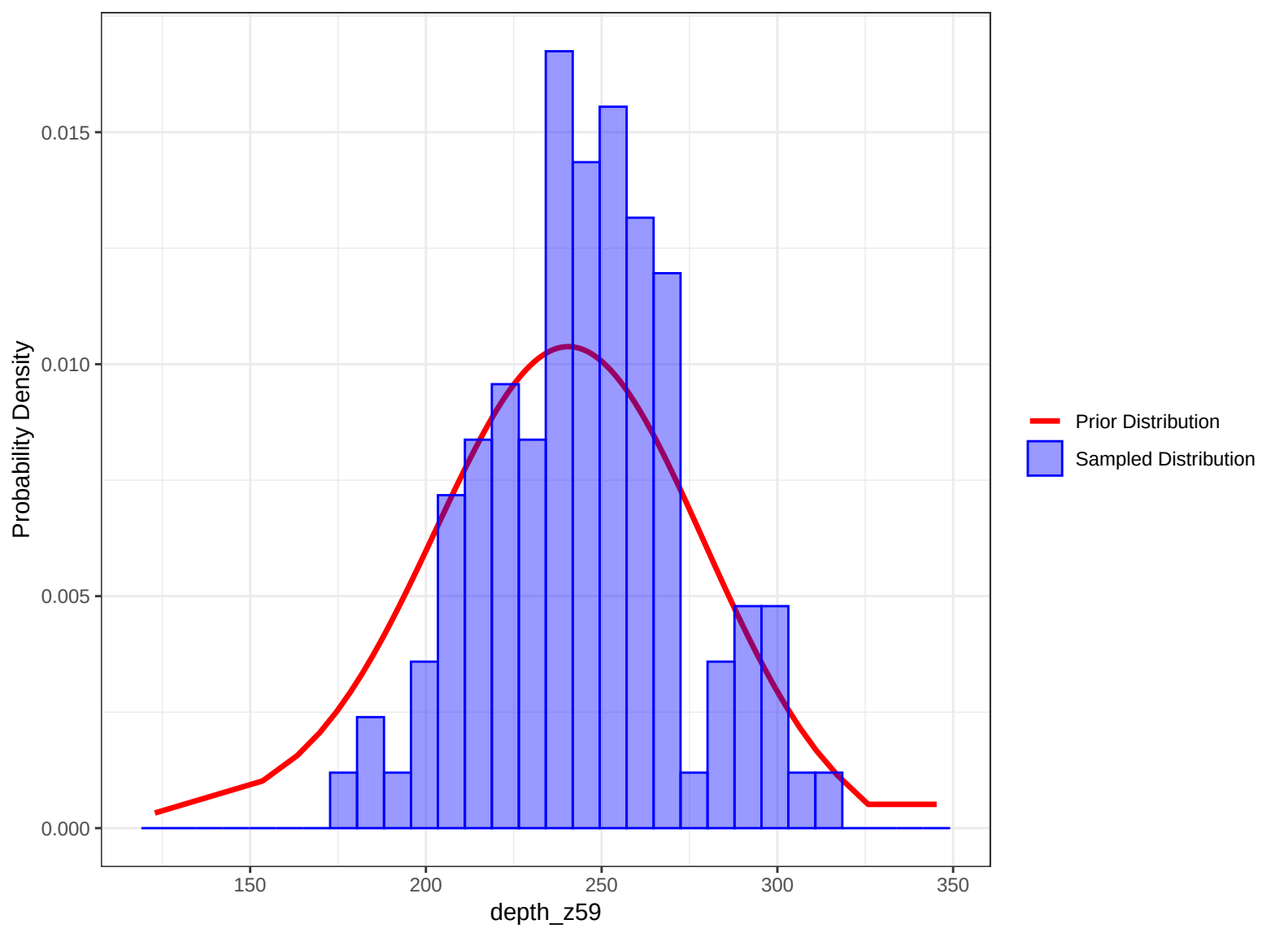
0.010
0.005
0.000
100
150
200
250
300
depth_z56
Prior Distribution
Sampled Distribution

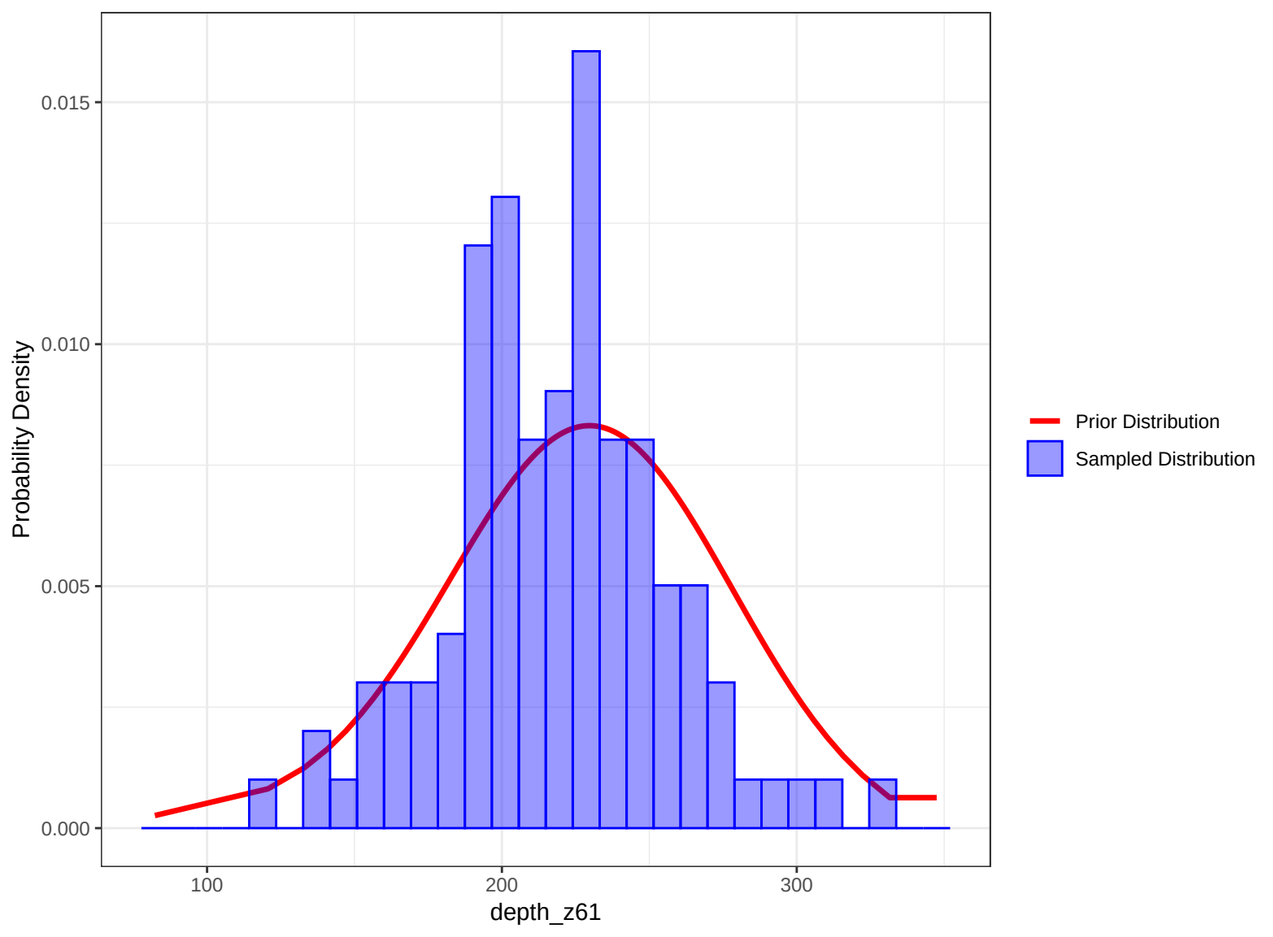

Probability Density
0.009
0.006
0.003
0.000
0
100
200
300
depth_z55
Prior Distribution
Sampled Distribution

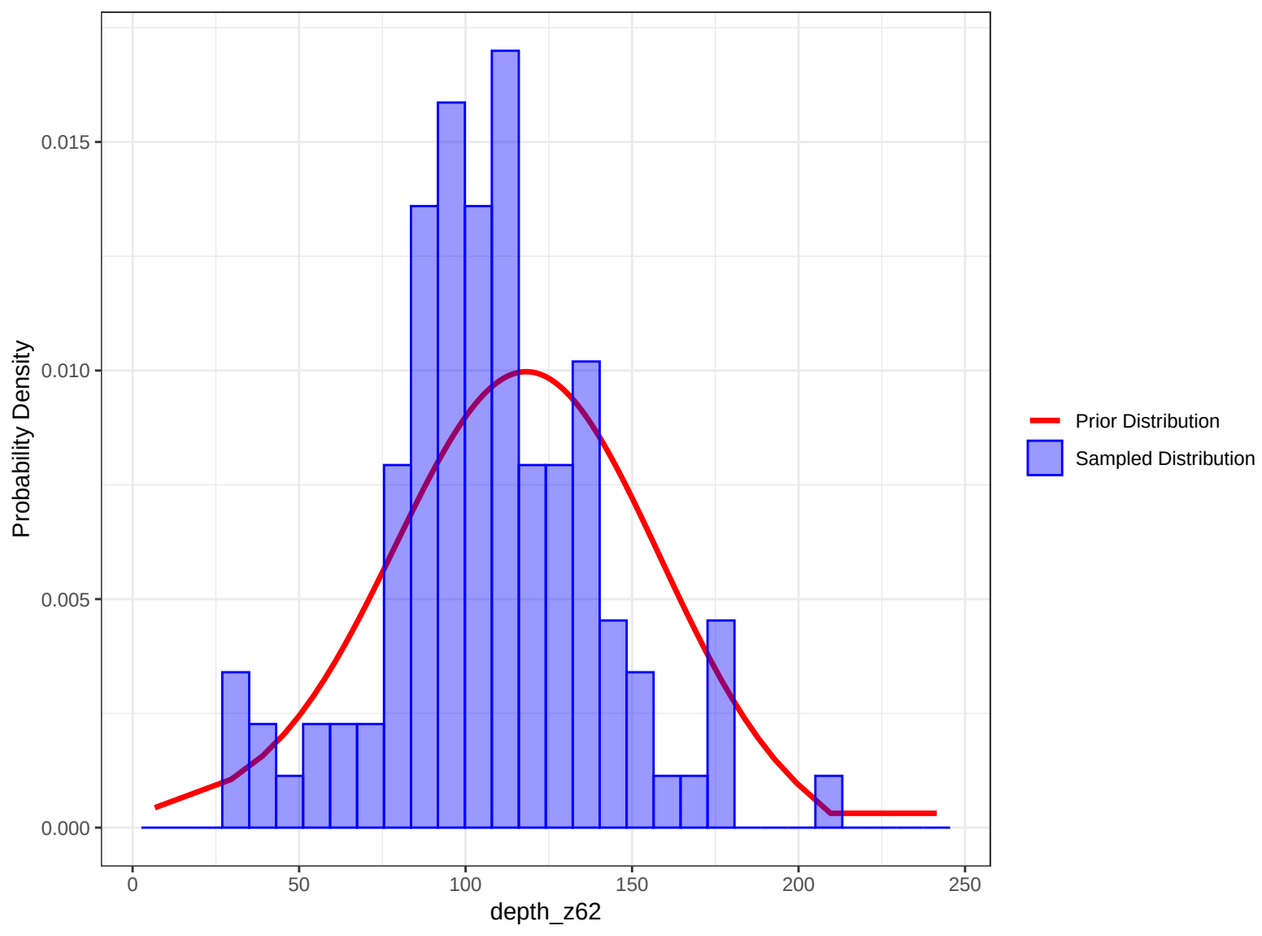

Probability Density
0.015
0.010
0.005
0.000
100
200
300
depth_z57
Prior Distribution
Sampled Distribution

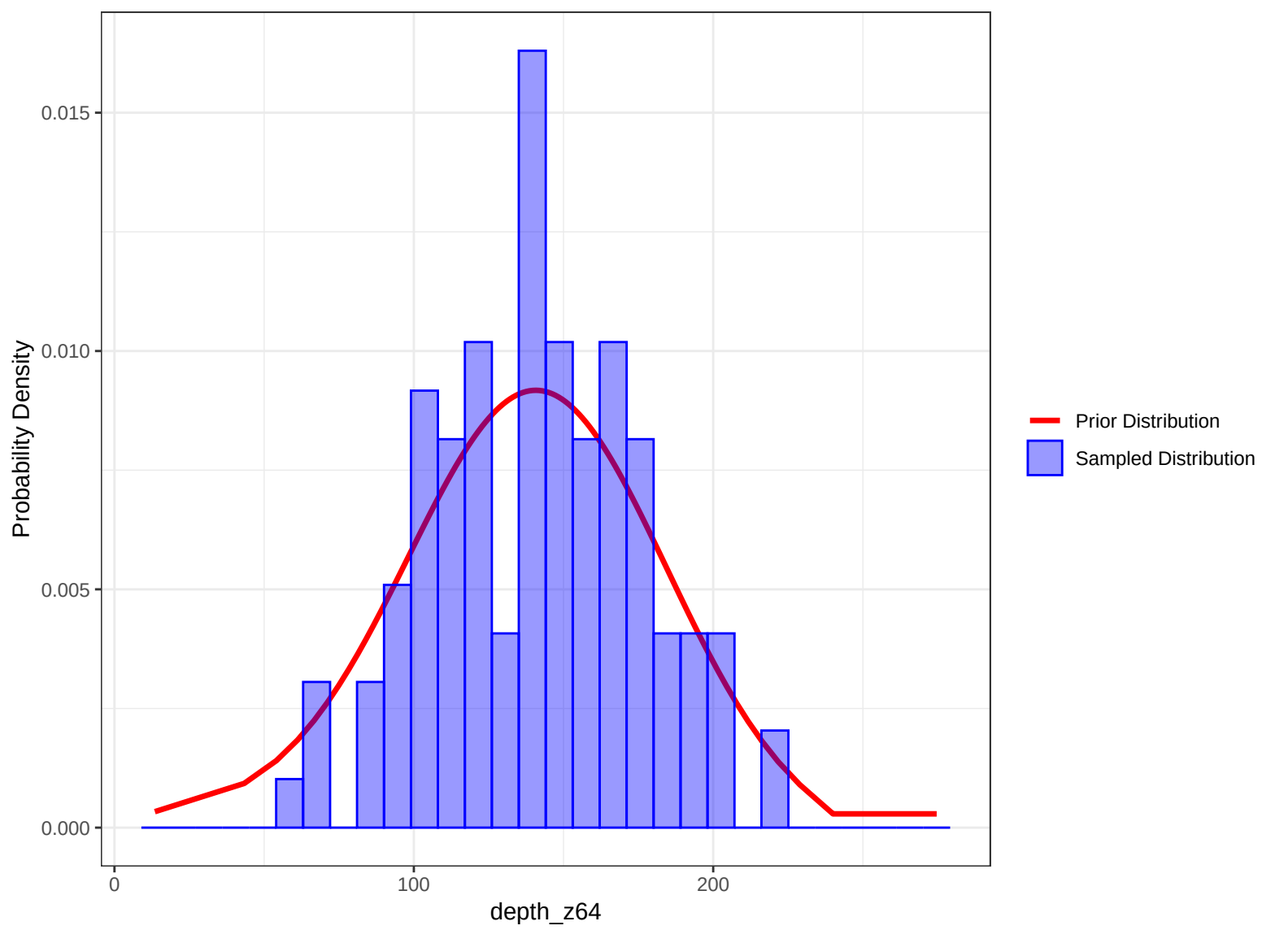

0.015
0.010
0.005
0.000
Probability Density
0
100
200
300
depth_z58
Prior Distribution
Sampled Distribution

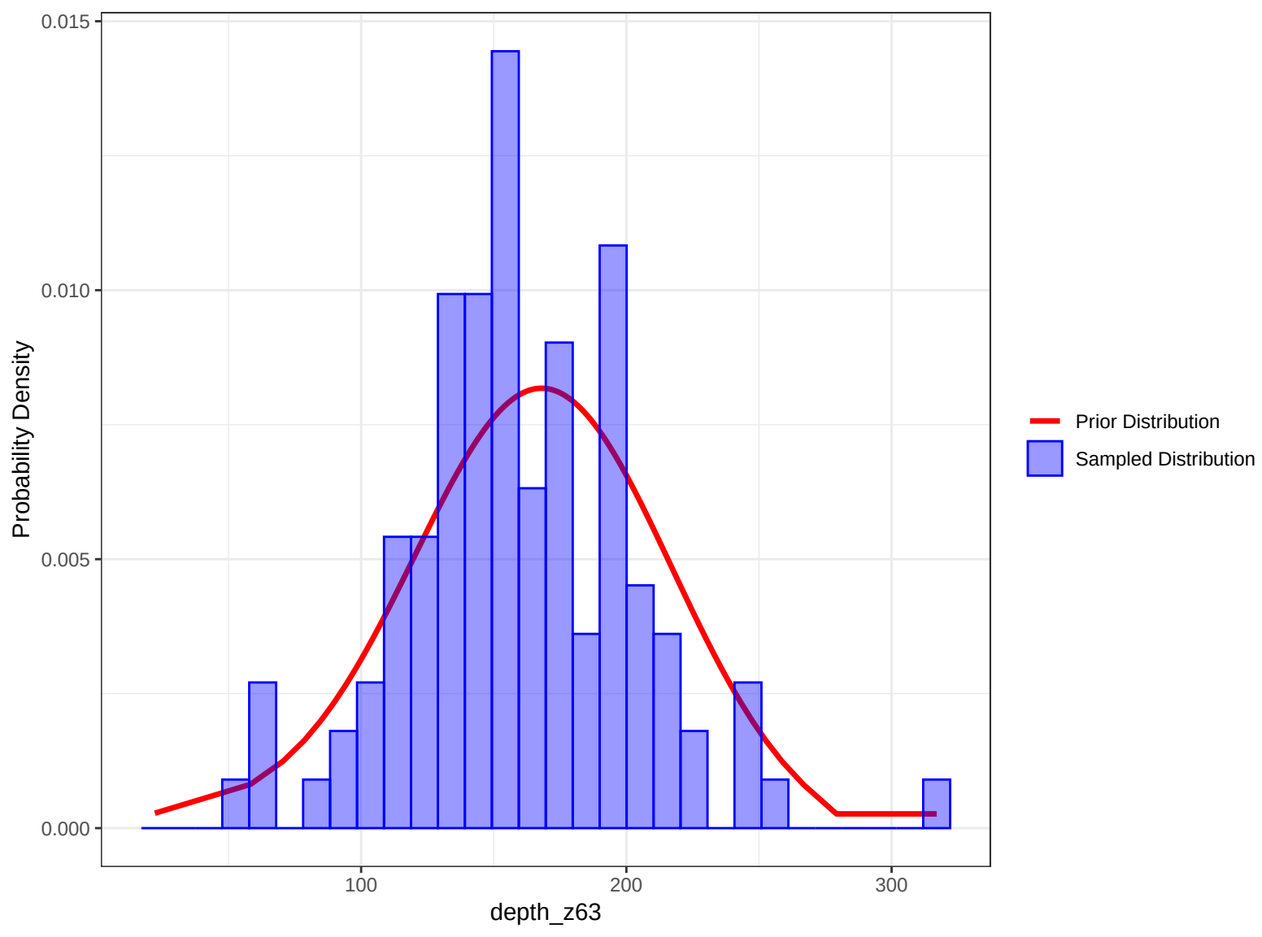

0.020
0.015
0.010
0.005
0.000
Probability Density
100
200
depth_z60
Prior Distribution
Sampled Distribution

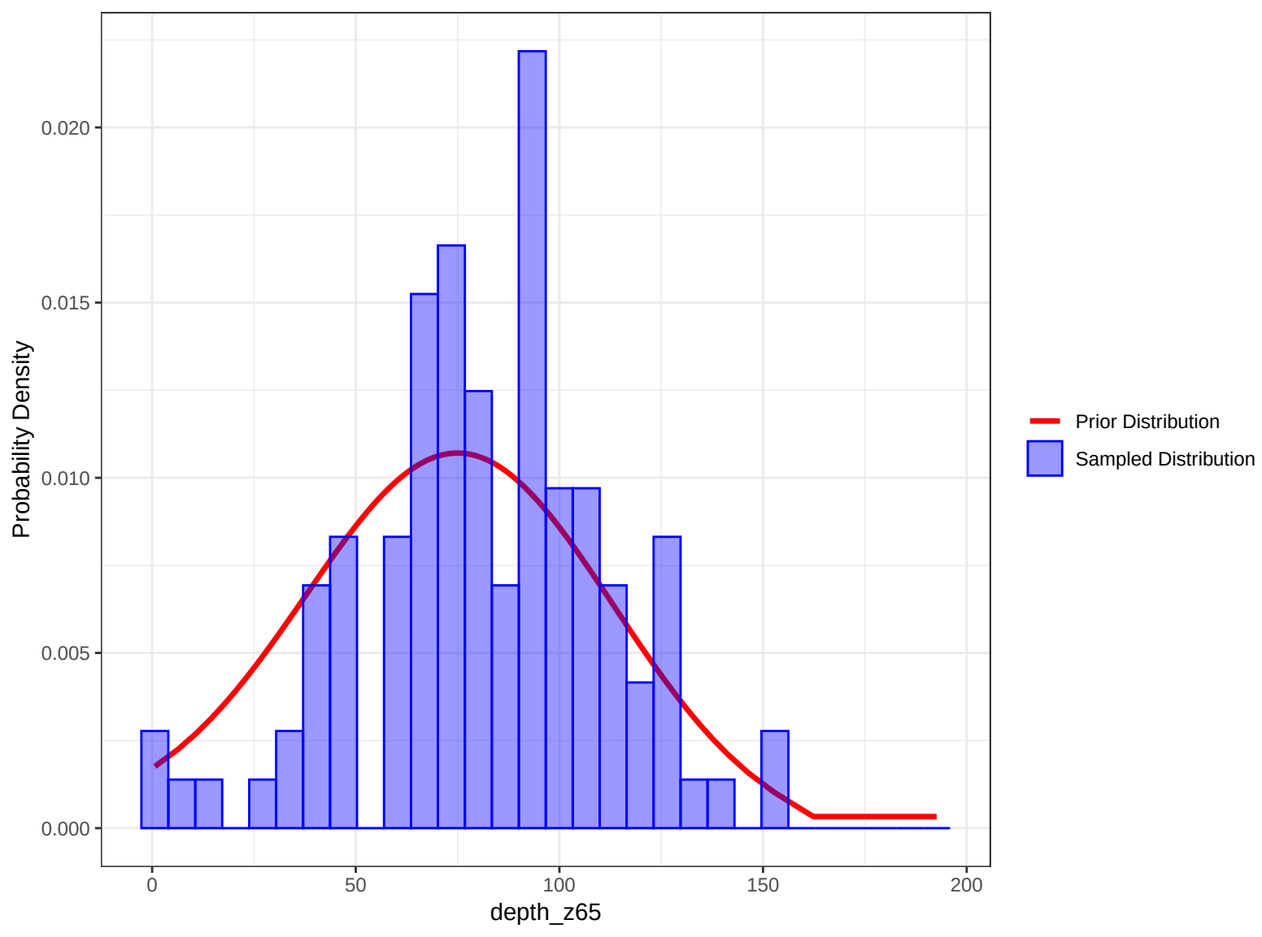

0.015
0.010
0.005
0.000
Probability Density
150
200
250
300
350
depth_z59
Prior Distribution
Sampled Distribution

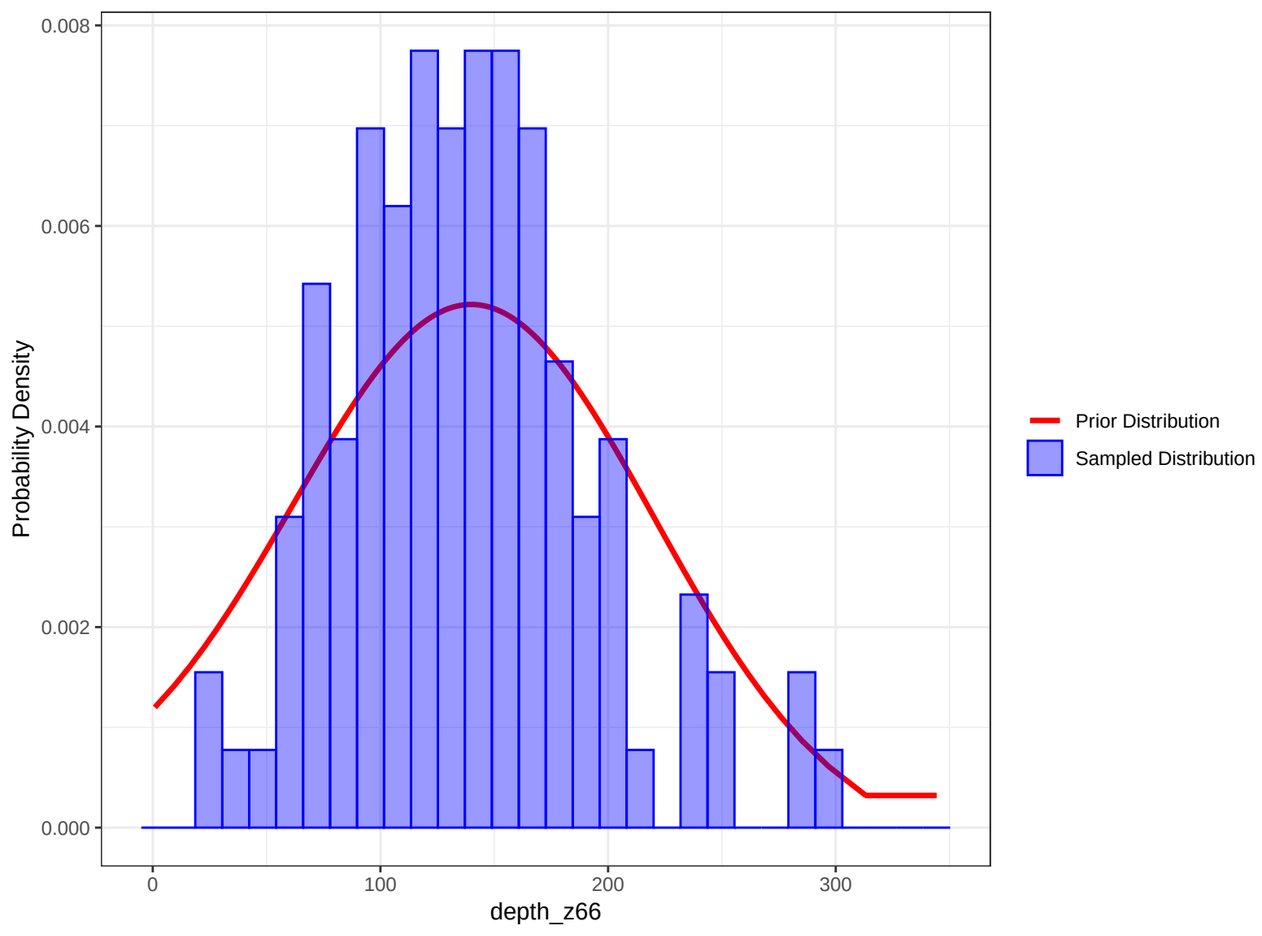

0.015
0.010
0.005
0.000
Probability Density
100
200
300
depth_z61
Prior Distribution
Sampled Distribution

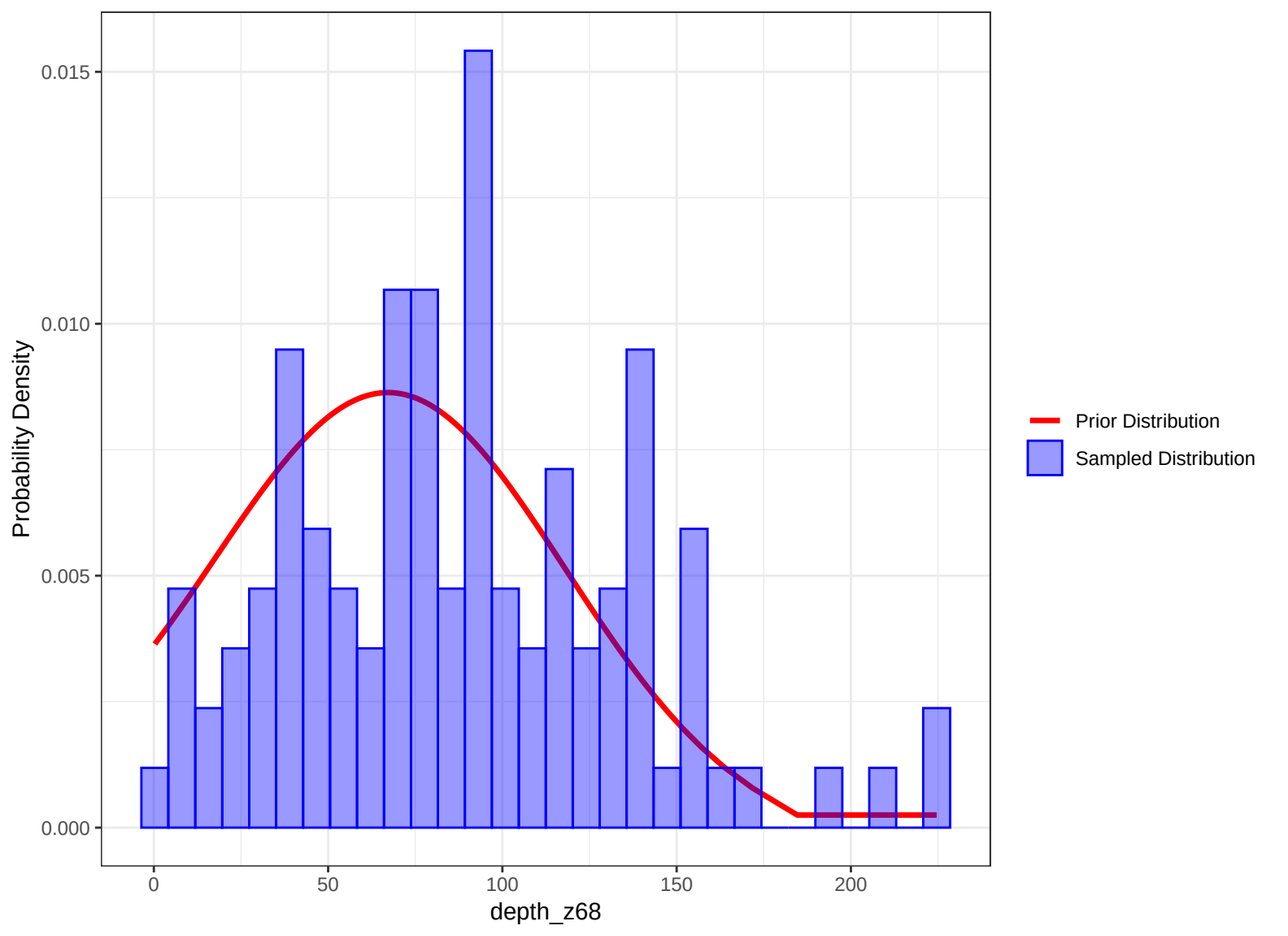

Probability Density
0.015
0.010
0.005
0.000
0
50
100
150
200
250
depth_z62
Prior Distribution
Sampled Distribution

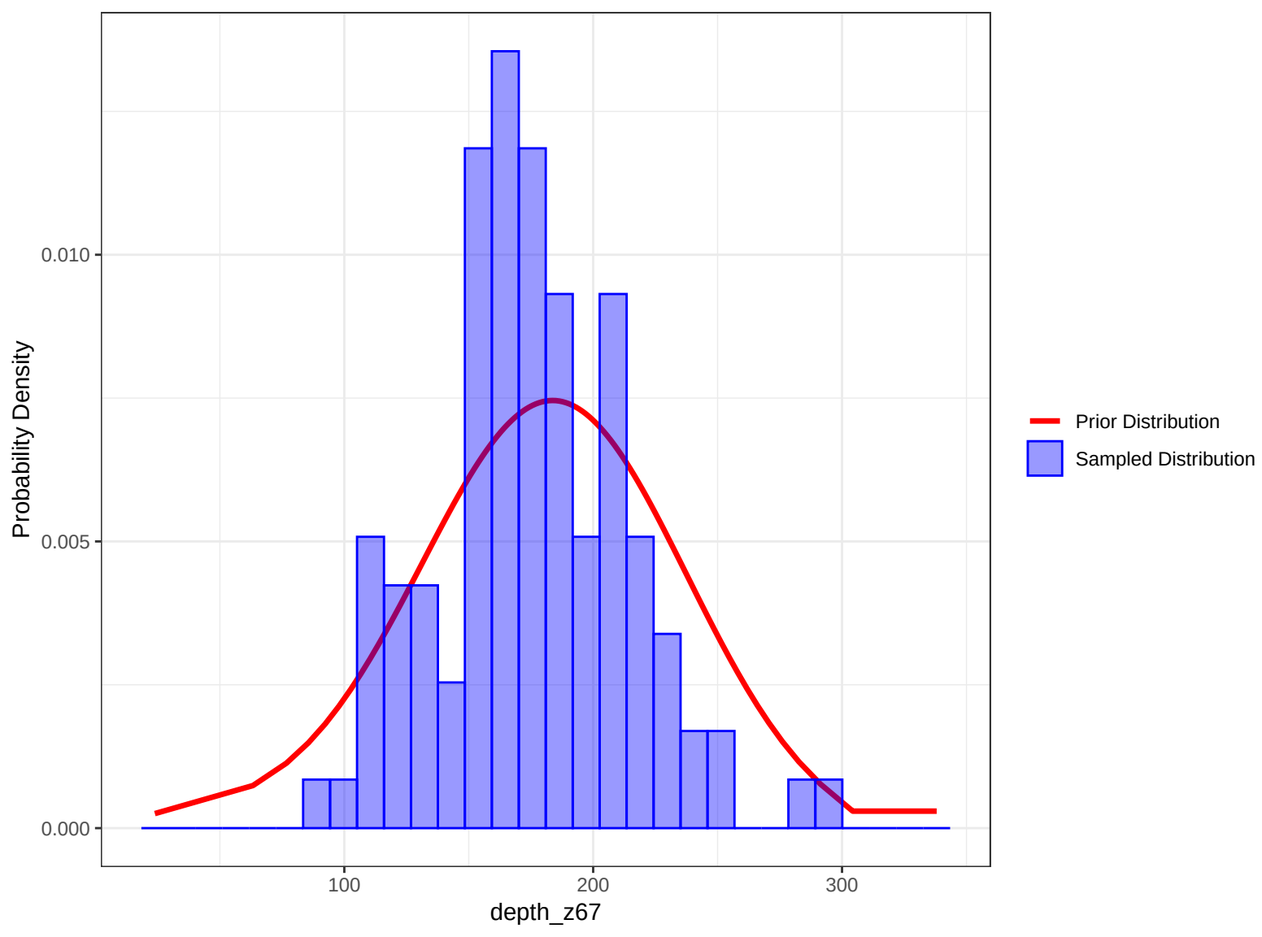

Probability Density
0.015
0.010
0.005
0.000
0
100
200
depth_z64
Prior Distribution
Sampled Distribution

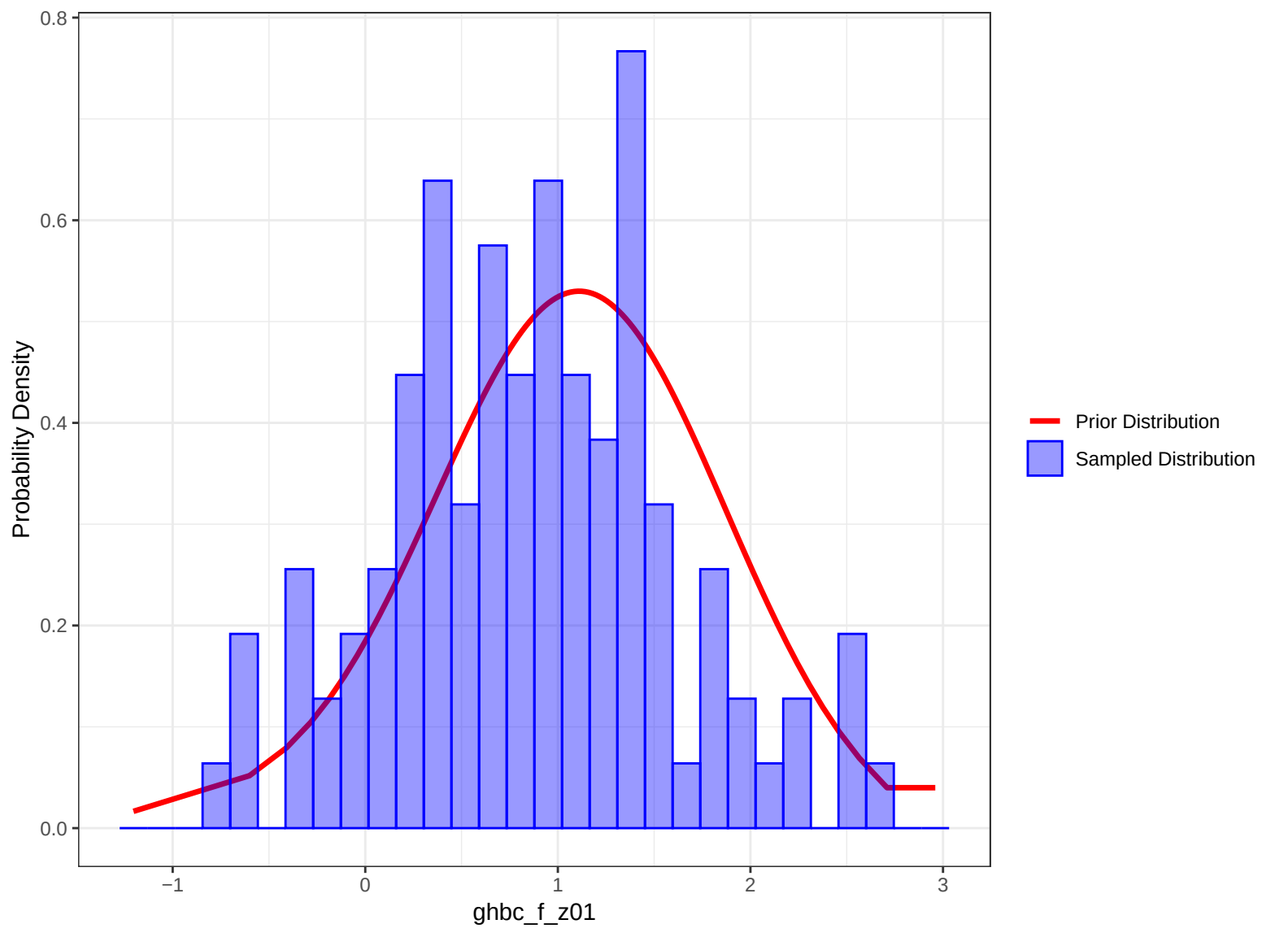

Probability Density
0.015
0.010
0.005
0.000
100
200
300
depth_z63
Prior Distribution
Sampled Distribution

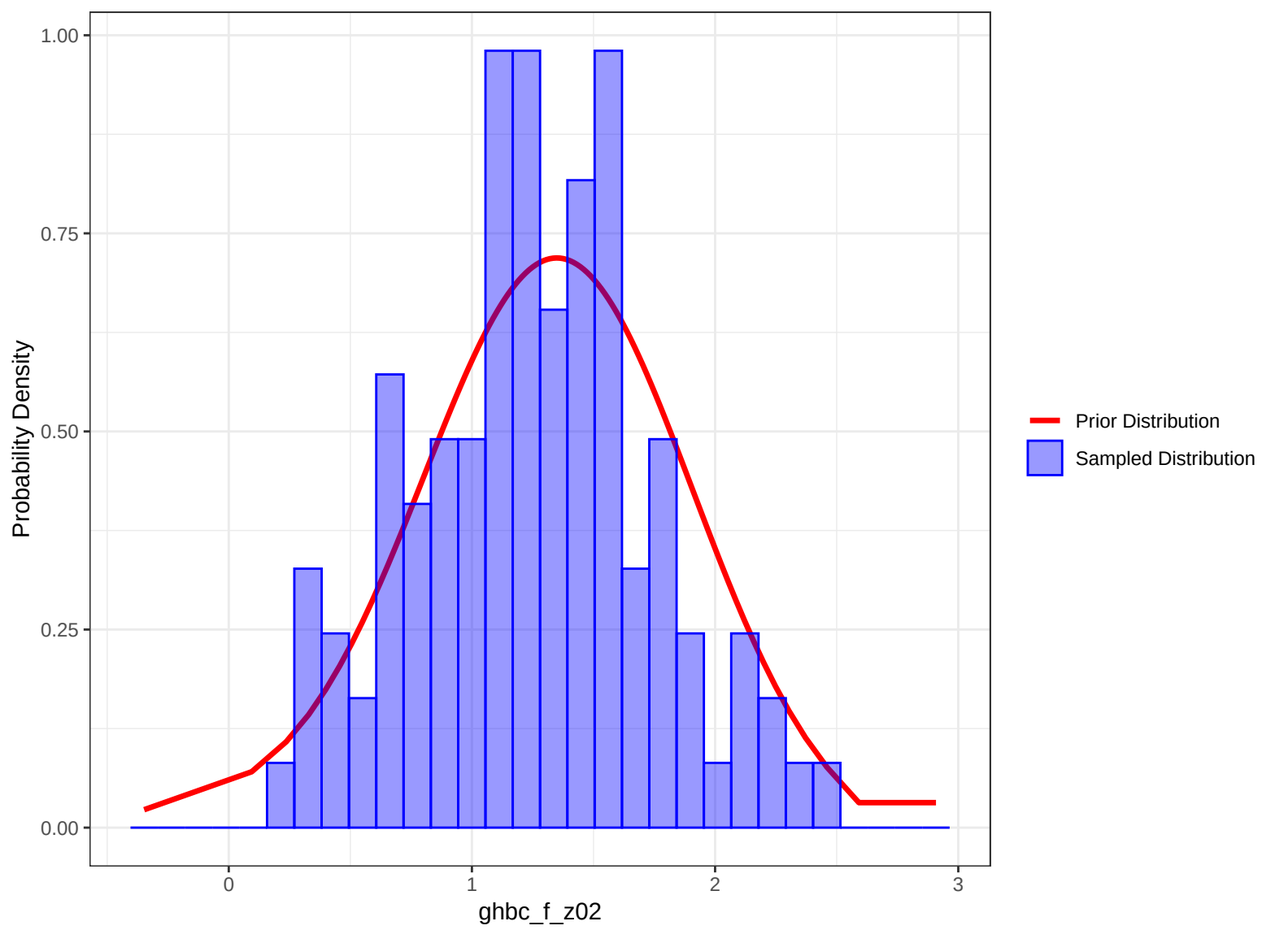

Probability Density
0.020
0.015
0.010
0.005
0.000
0
50
100
150
200
depth_z65
Prior Distribution
Sampled Distribution

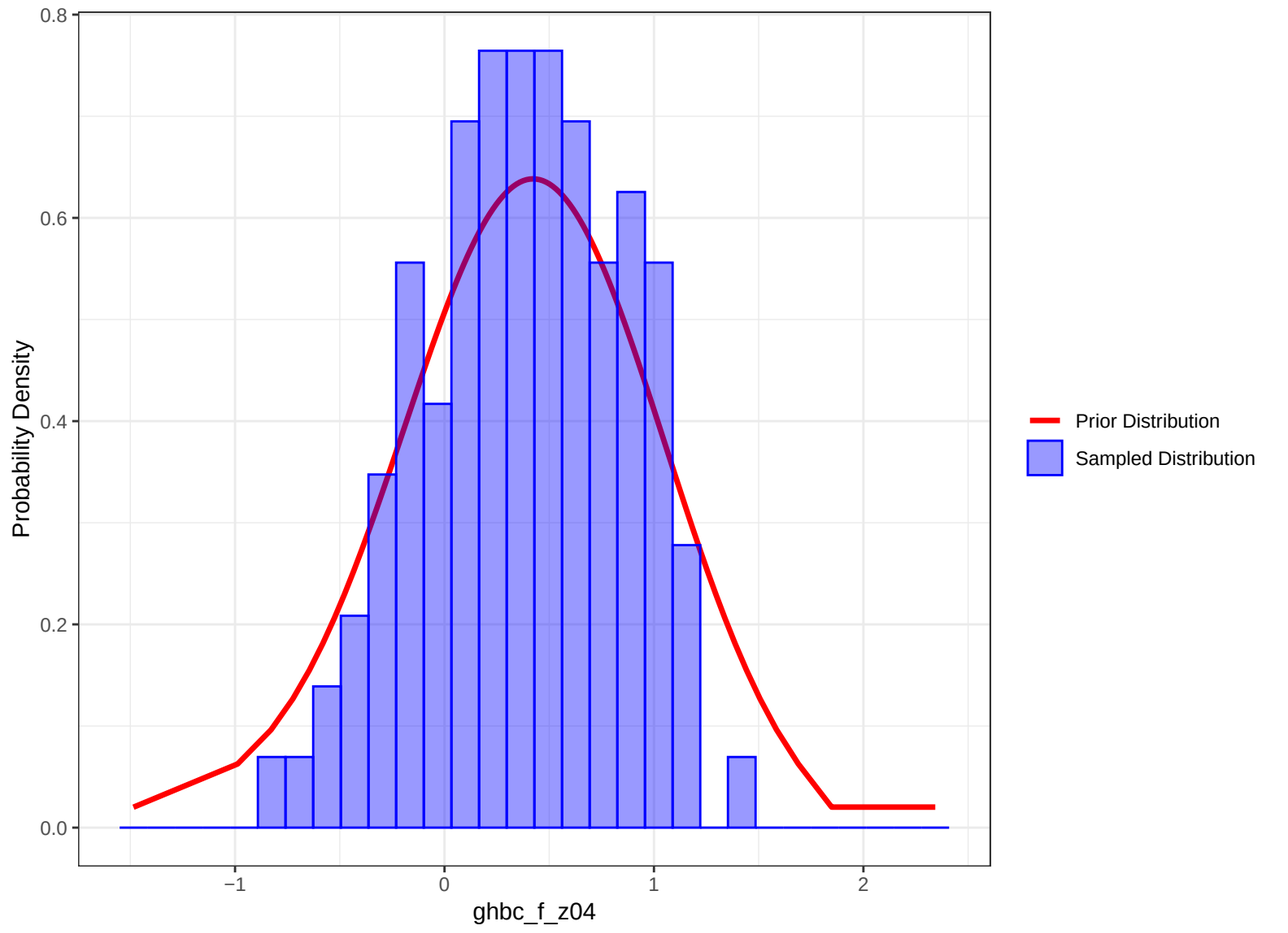

0.008
0.006
0.004
0.002
0.000
Probability Density
0
100
200
300
depth_z66
Prior Distribution
Sampled Distribution

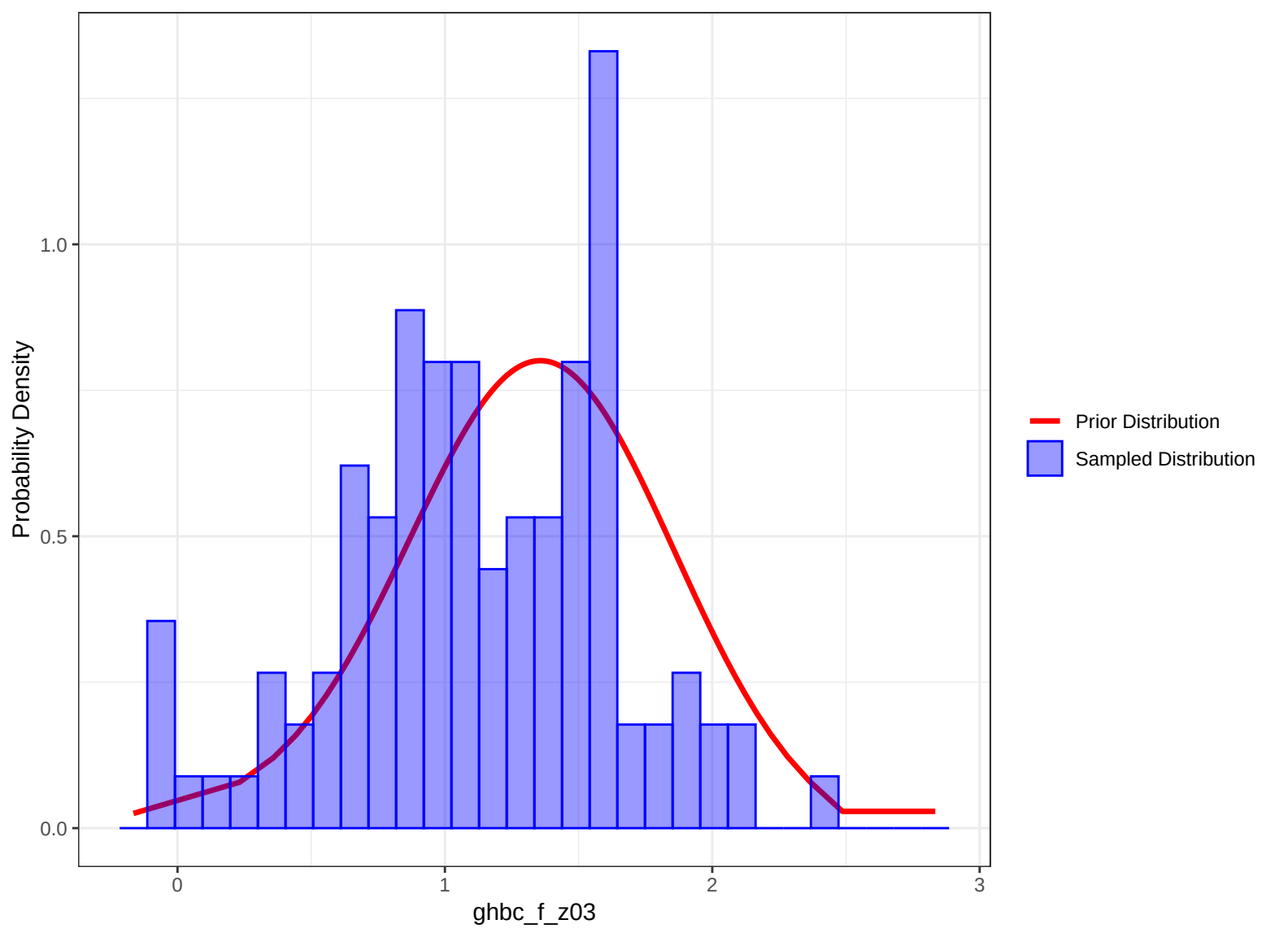

0.015
0.010
0.005
0.000
Probability Density
0
50
100
150
200
depth_z68
Prior Distribution
Sampled Distribution

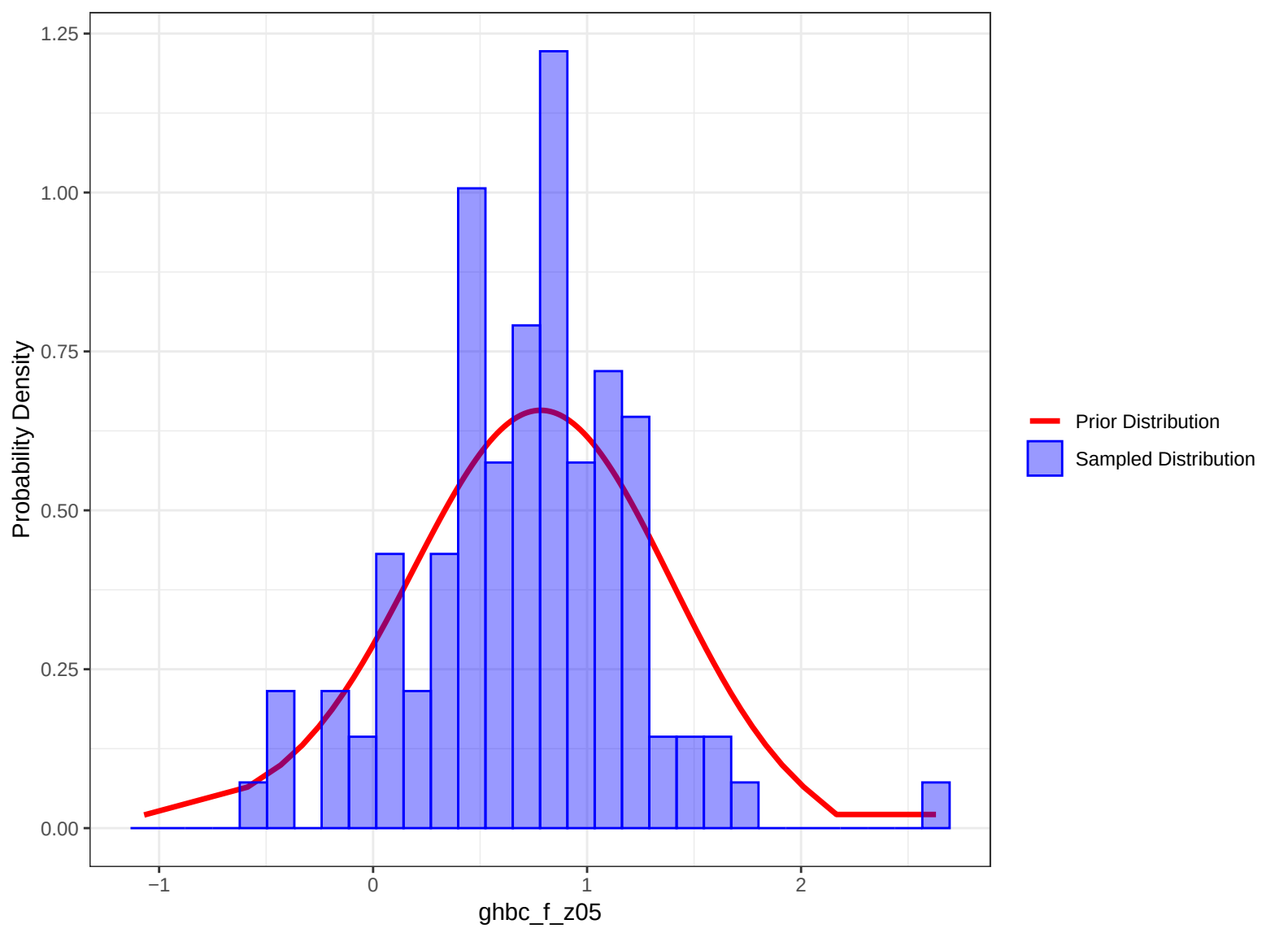

0.010
0.005
0.000
Probability Density
100
200
300
depth_z67
Prior Distribution
Sampled Distribution

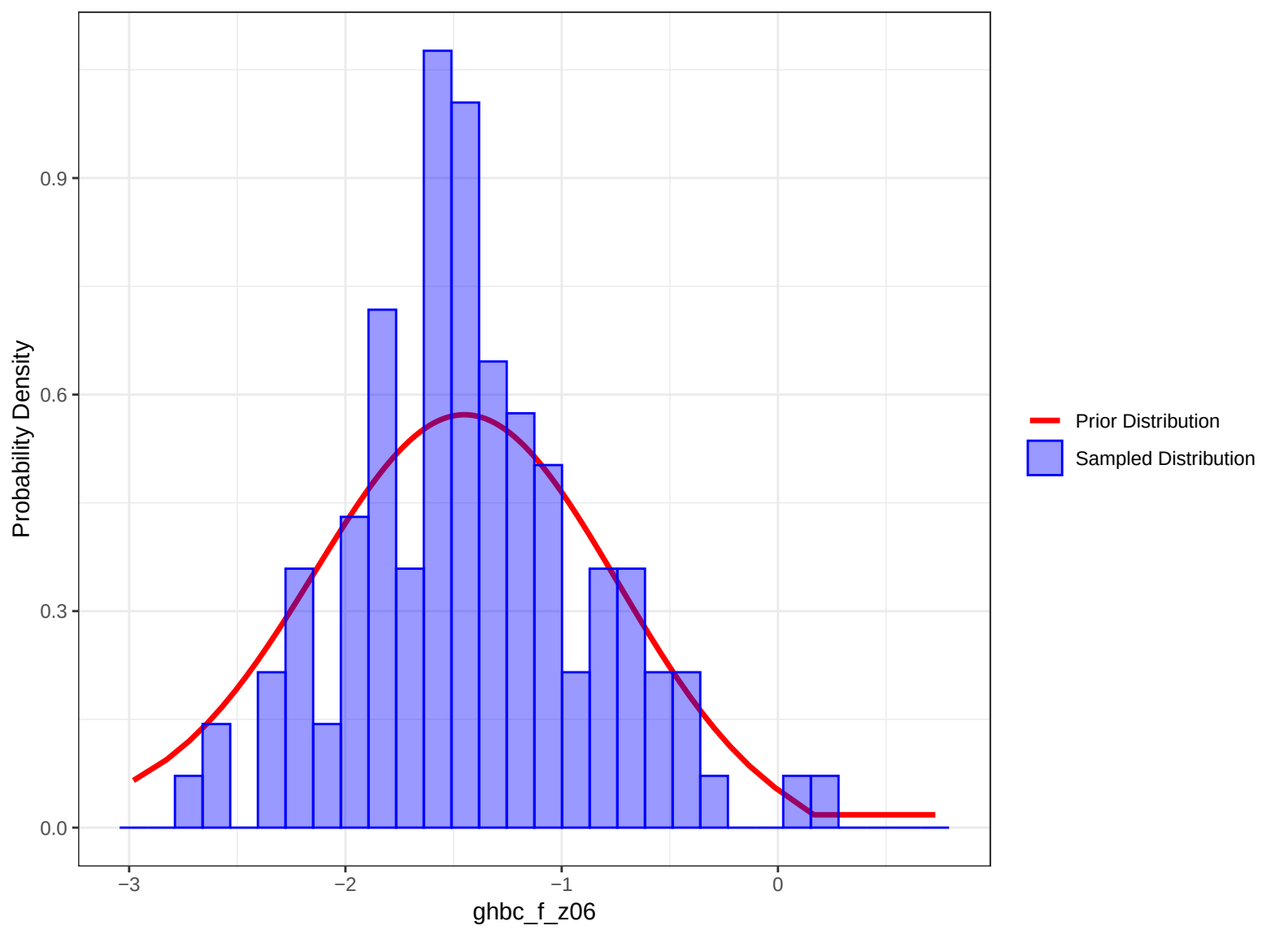

0.8
0.6
0.4
0.2
0.0
Probability Density
−1
0
1
2
3
ghbc_f_z01
Prior Distribution
Sampled Distribution

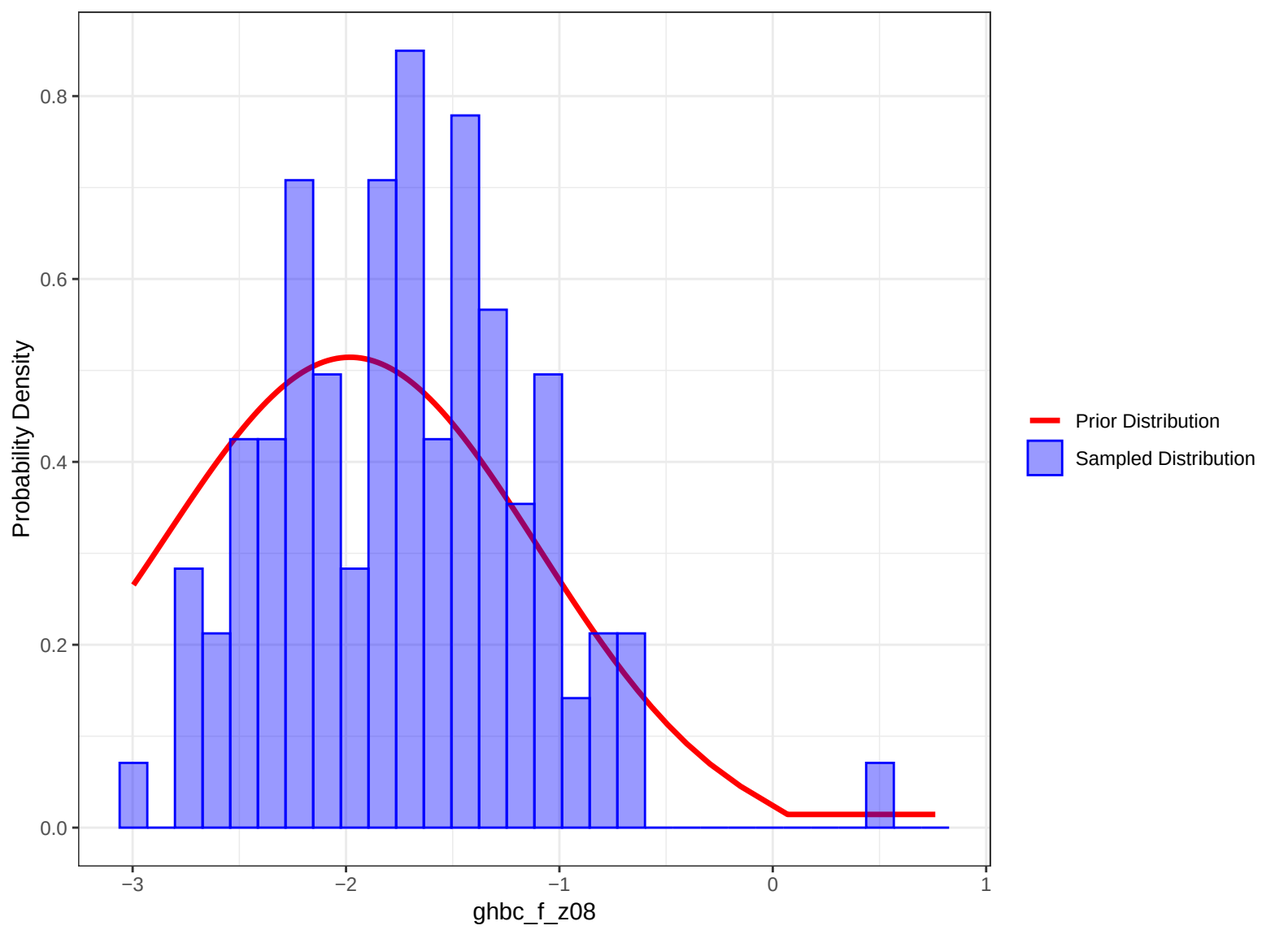

1.00
0.75
0.50
0.25
0.00
Probability Density
0
1
2
3
ghbc_f_z02
Prior Distribution
Sampled Distribution

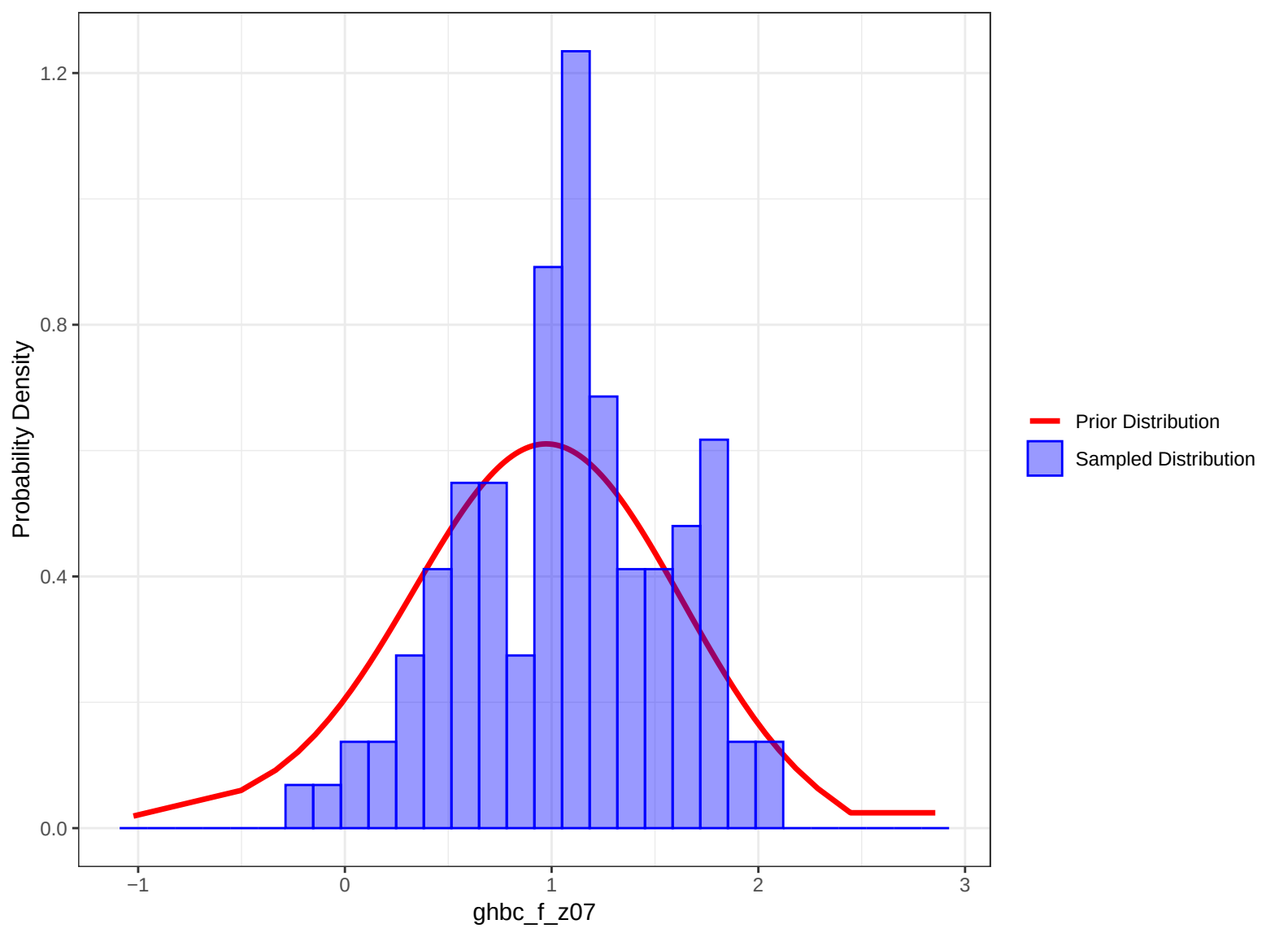

0.8
0.6
0.4
0.2
0.0
Probability Density
−1
0
1
2
ghbc_f_z04
Prior Distribution
Sampled Distribution

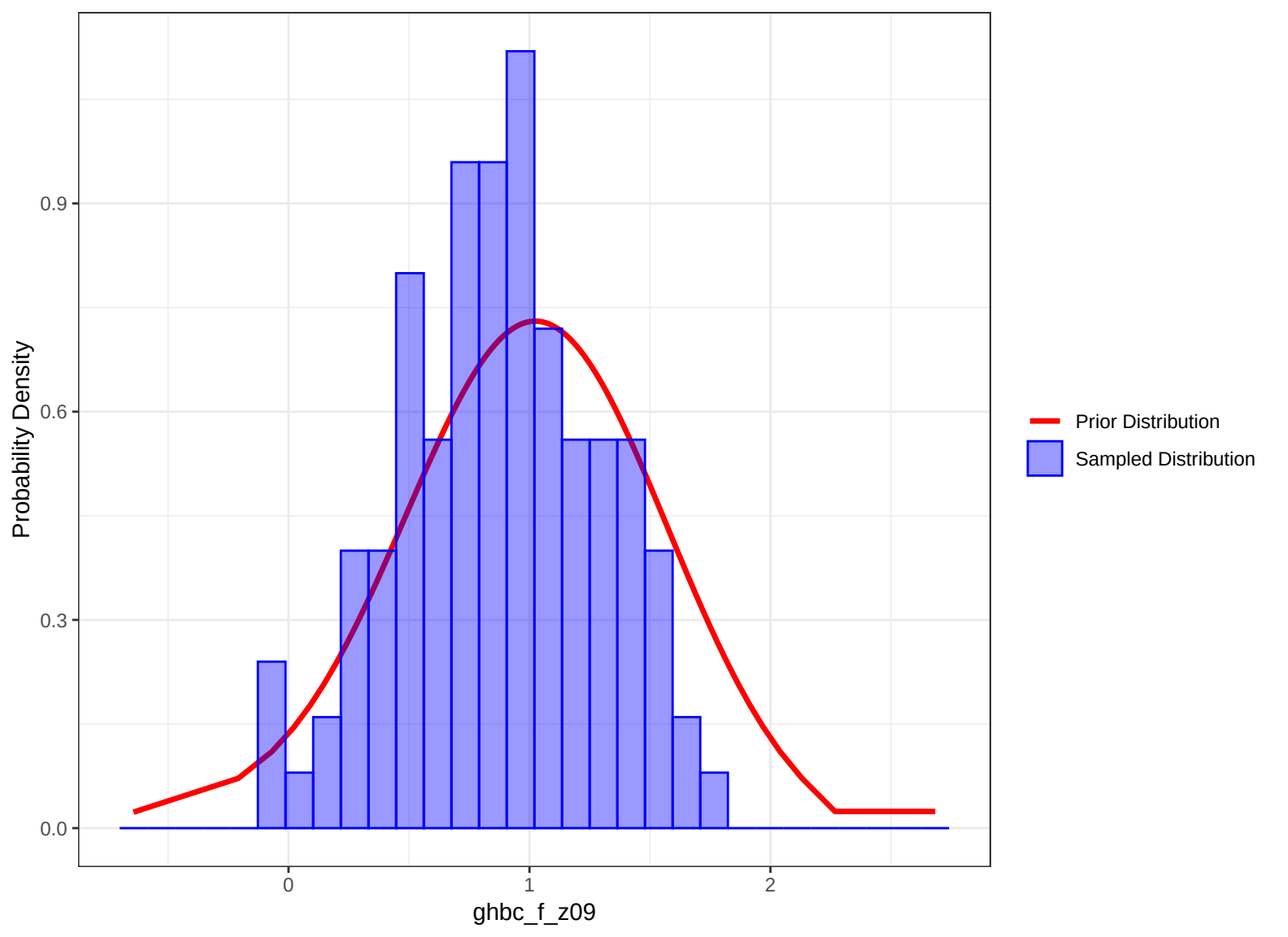

1.0
0.5
0.0
Probability Density
0
1
2
3
ghbc_f_z03
Prior Distribution
Sampled Distribution

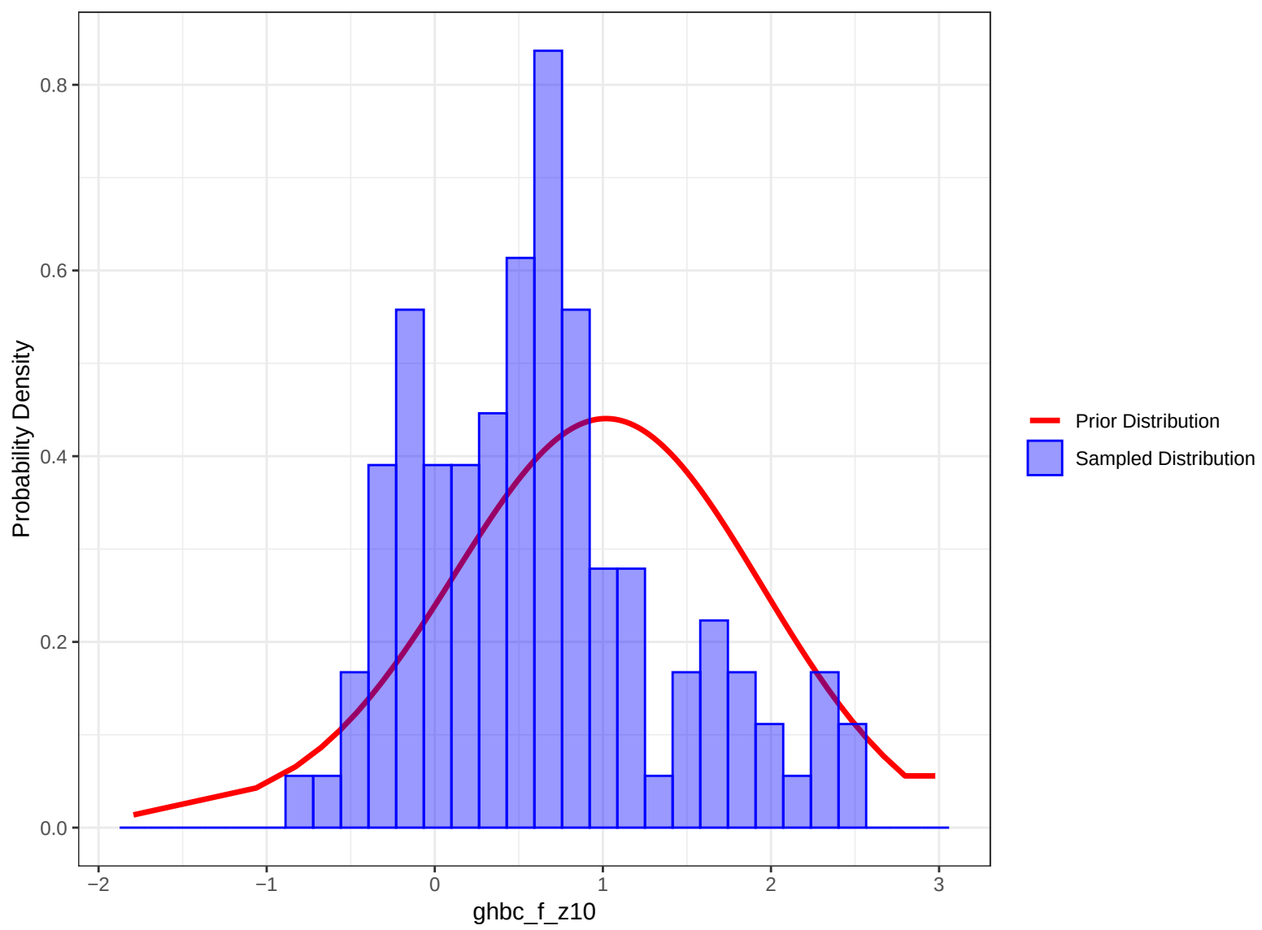

1.25
1.00
0.75
0.50
0.25
0.00
Probability Density
−1
0
1
2
ghbc_f_z05
Prior Distribution
Sampled Distribution

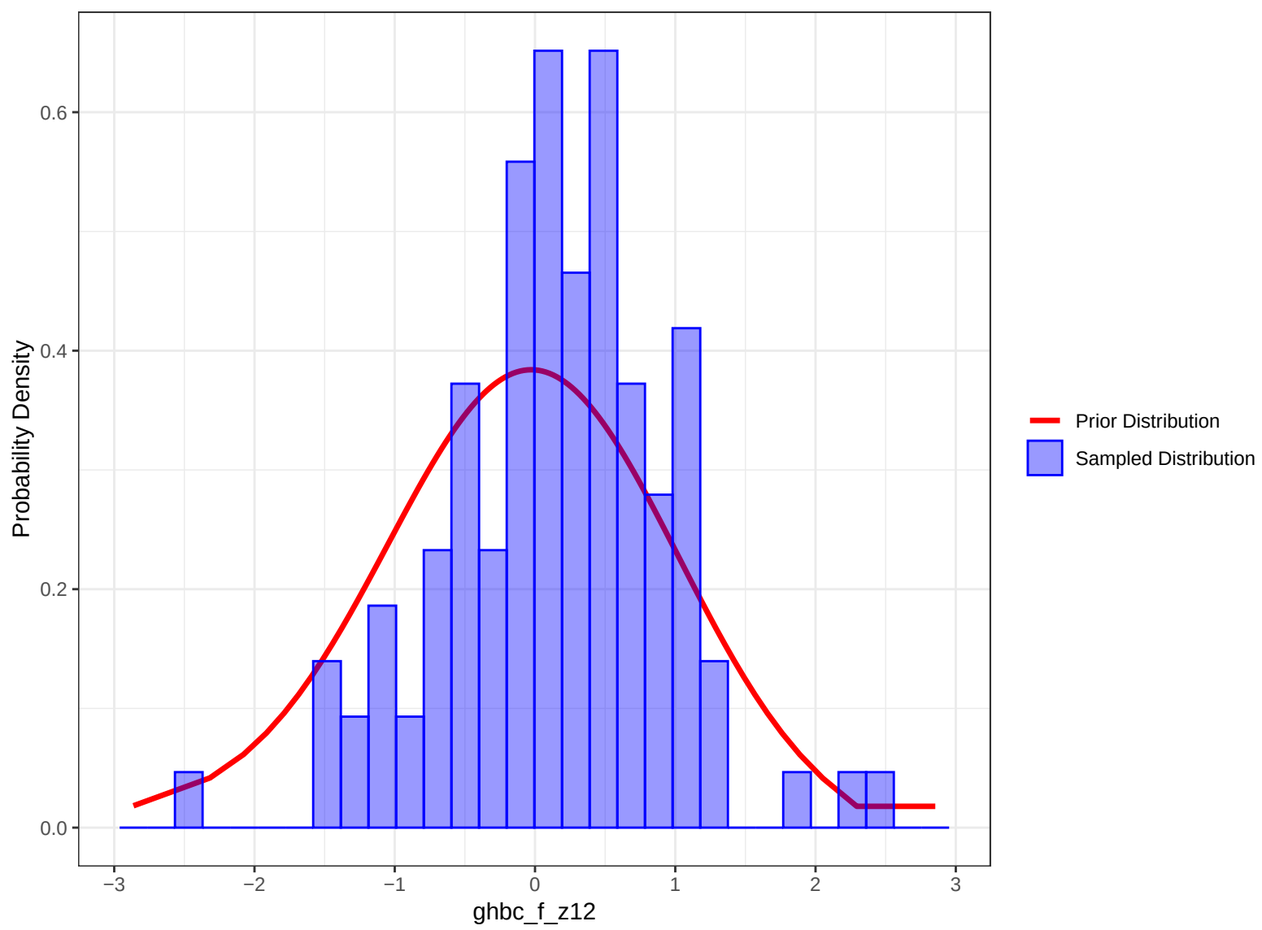

Probability Density
0.0
0.3
0.6
0.9
−3
−2
−1
0
ghbc_f_z06
Prior Distribution
Sampled Distribution

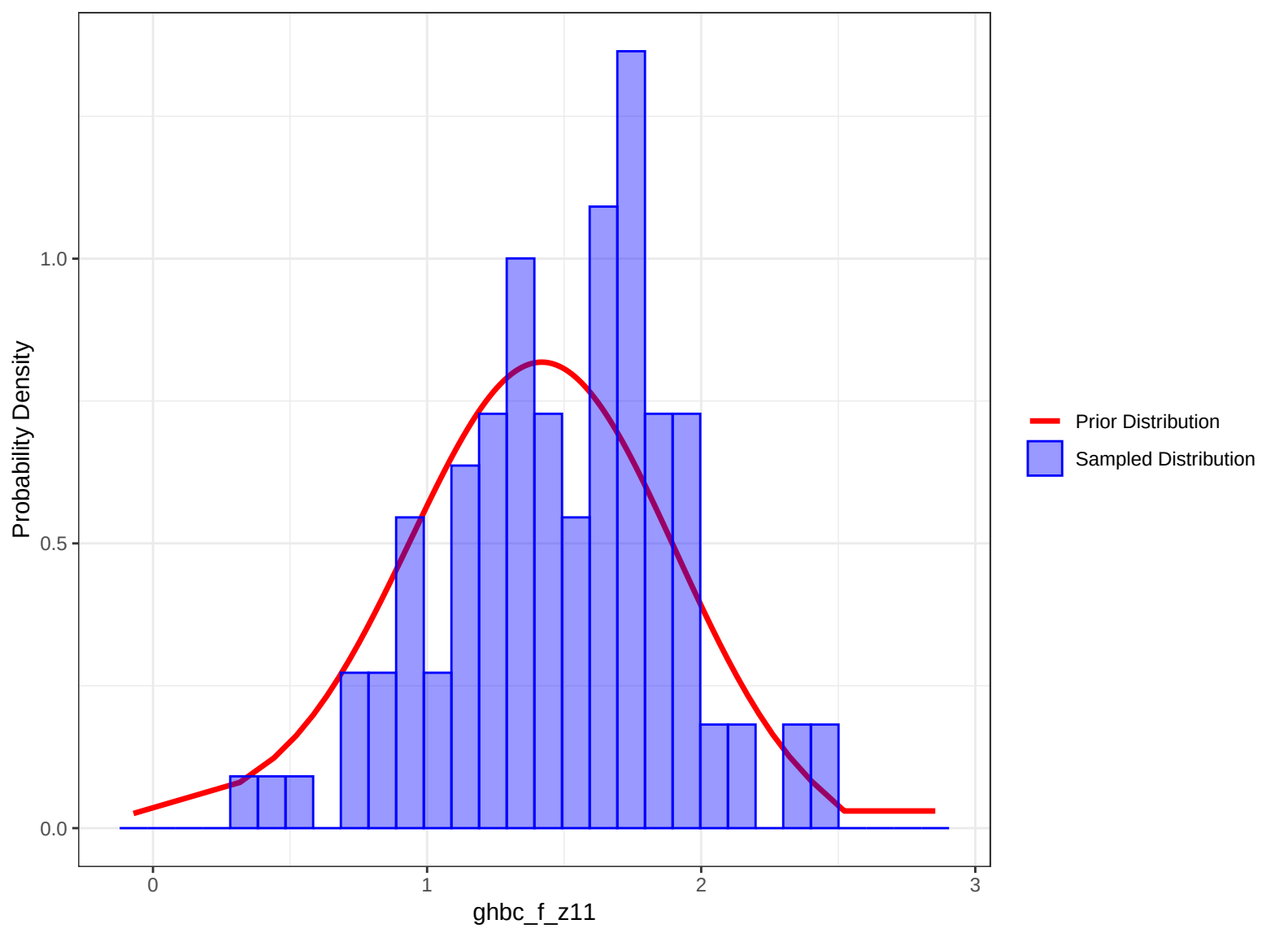

Probability Density
0.0
0.2
0.4
0.6
0.8
−3
−2
−1
0
1
ghbc_f_z08
Prior Distribution
Sampled Distribution

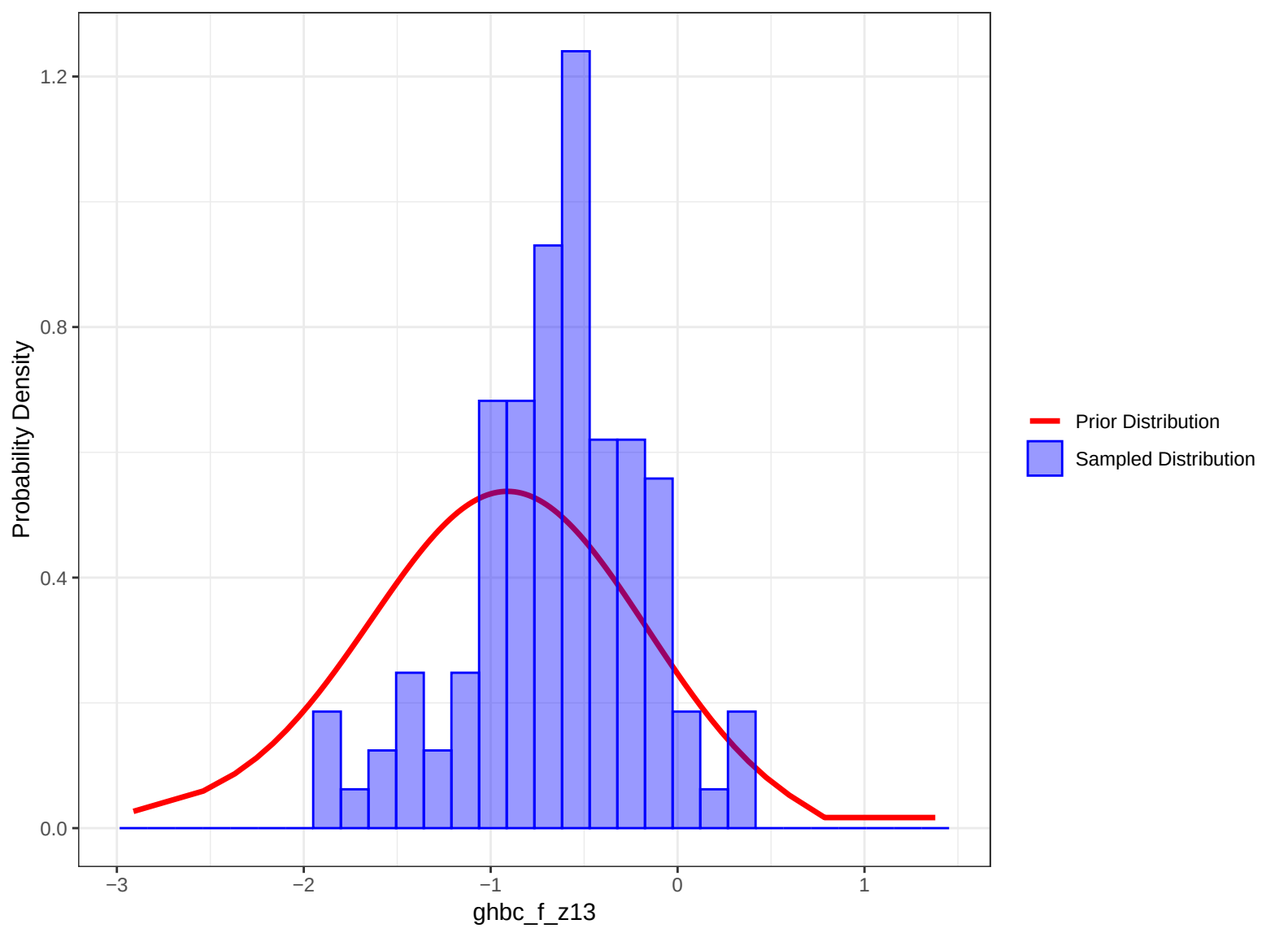

Probability Density
0.0
0.4
0.8
1.2
−1
0
1
2
3
ghbc_f_z07
Prior Distribution
Sampled Distribution

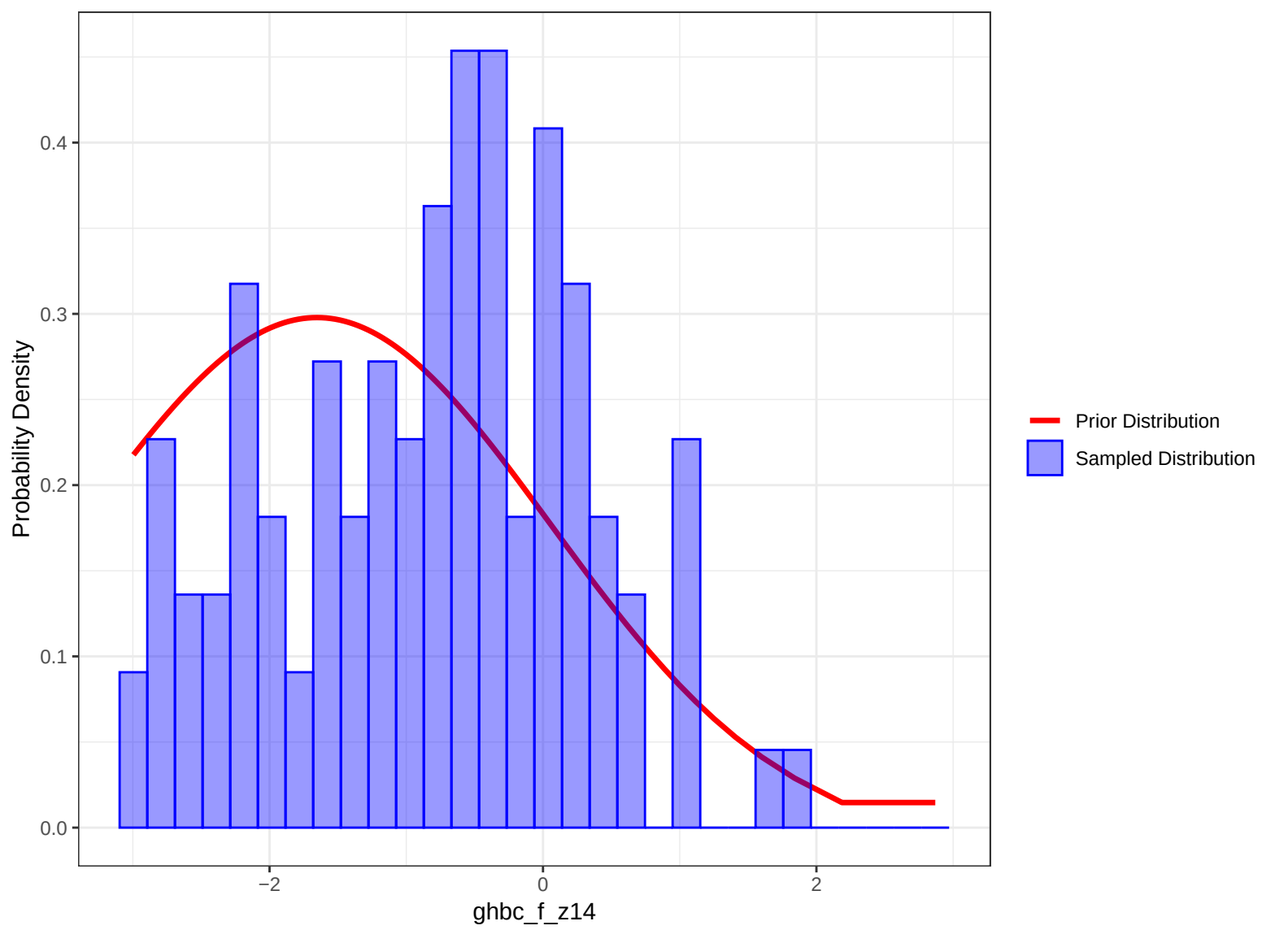

Probability Density
0.0
0.3
0.6
0.9
0
1
2
ghbc_f_z09
Prior Distribution
Sampled Distribution

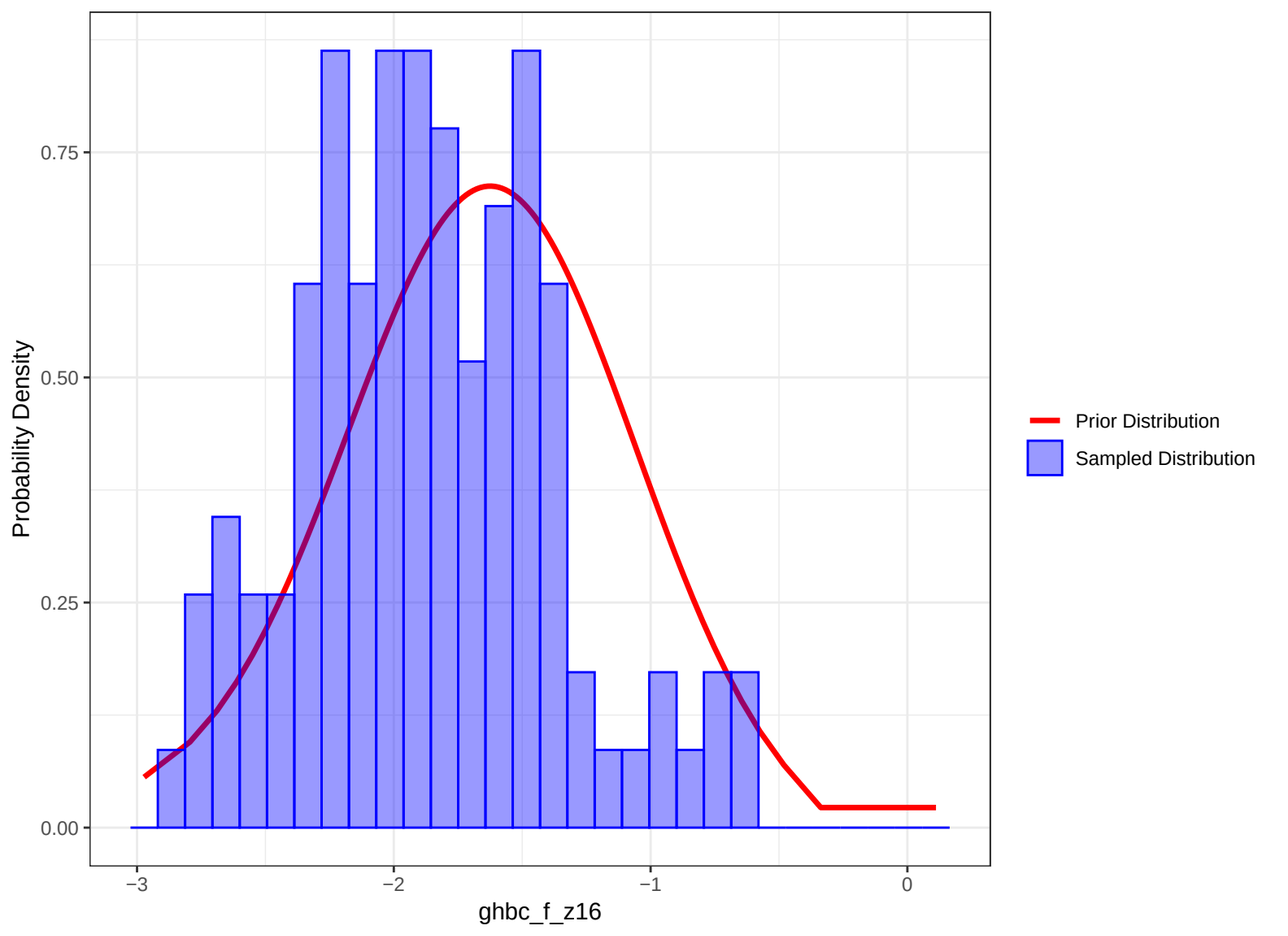

Probability Density
0.0
0.2
0.4
0.6
0.8
−2
−1
0
1
2
3
ghbc_f_z10
Prior Distribution
Sampled Distribution

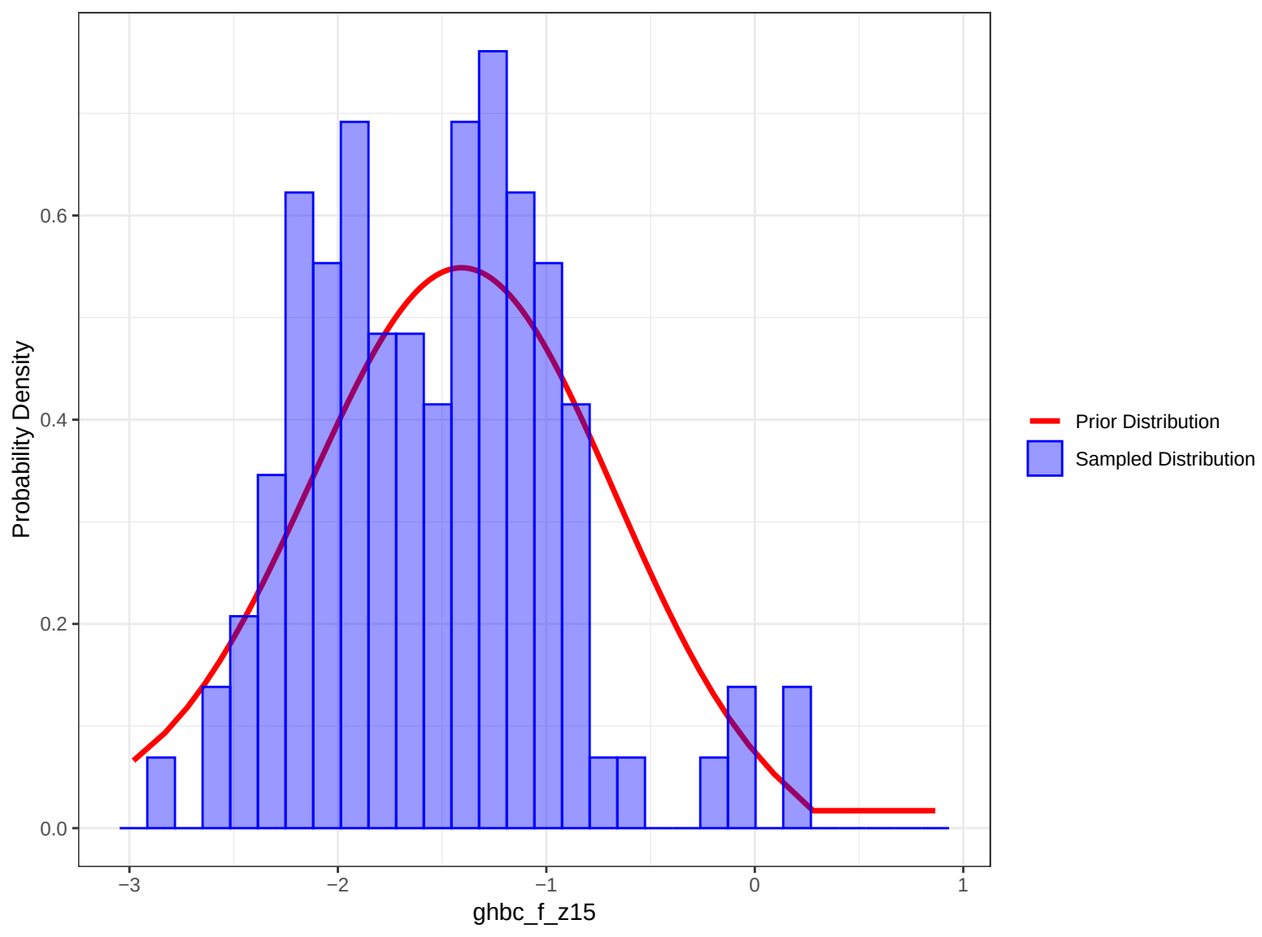

Probability Density
0.0
0.2
0.4
0.6
−3
−2
−1
0
1
2
3
ghbc_f_z12
Prior Distribution
Sampled Distribution

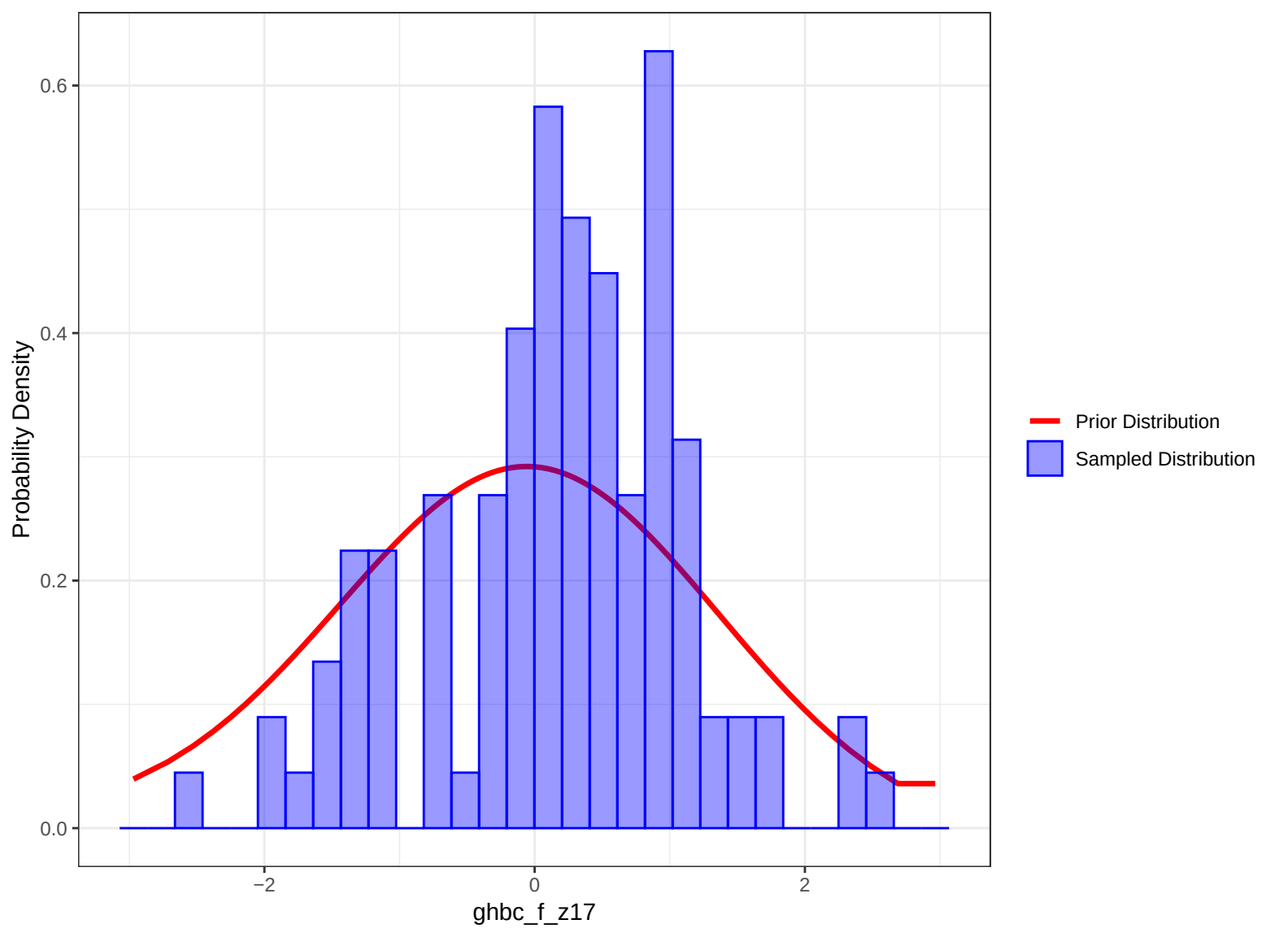

Probability Density
0.0
0.5
1.0
0
1
2
3
ghbc_f_z11
Prior Distribution
Sampled Distribution

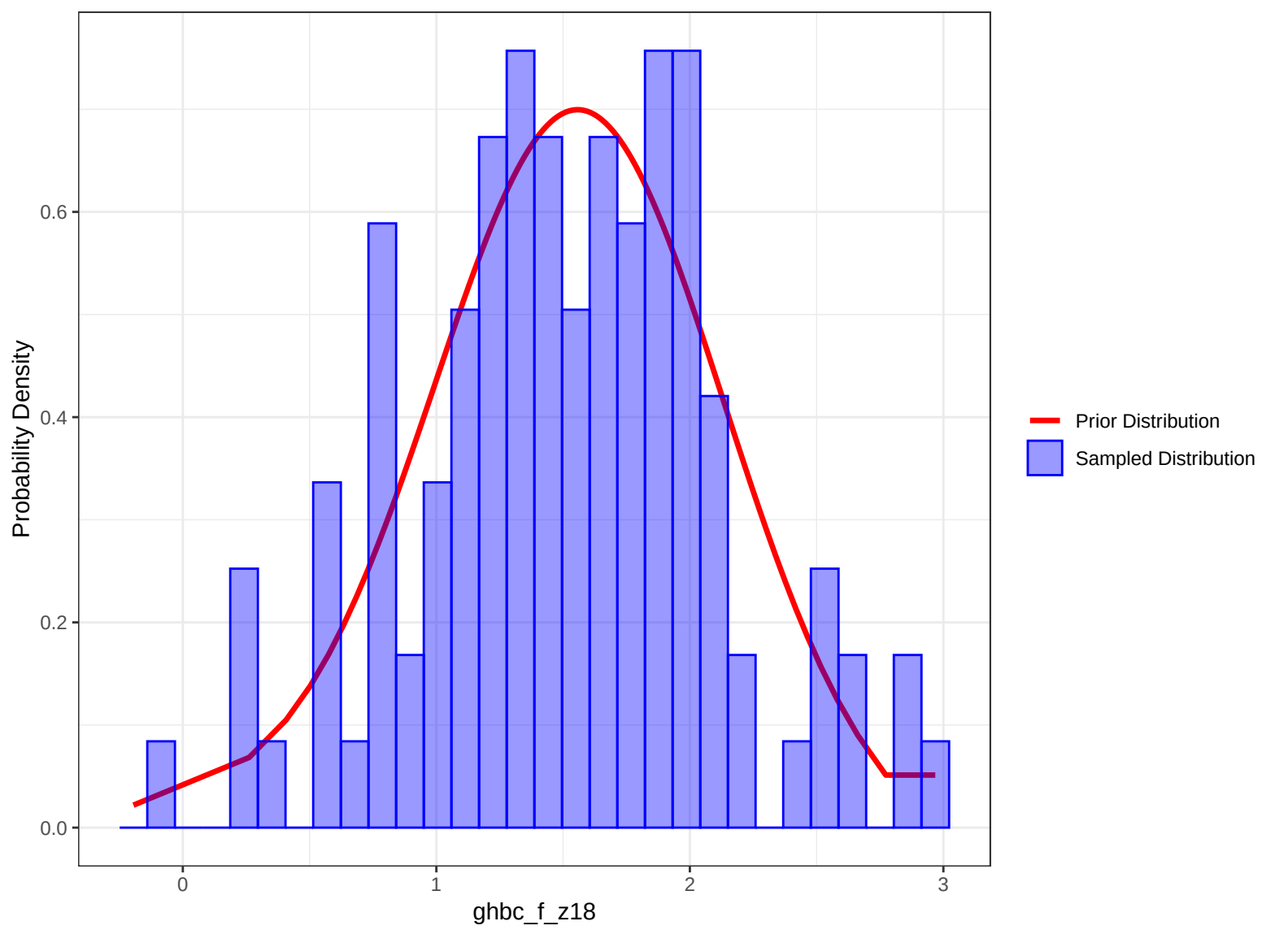

Probability Density
0.0
0.4
0.8
1.2
−3
−2
−1
0
1
ghbc_f_z13
Prior Distribution
Sampled Distribution

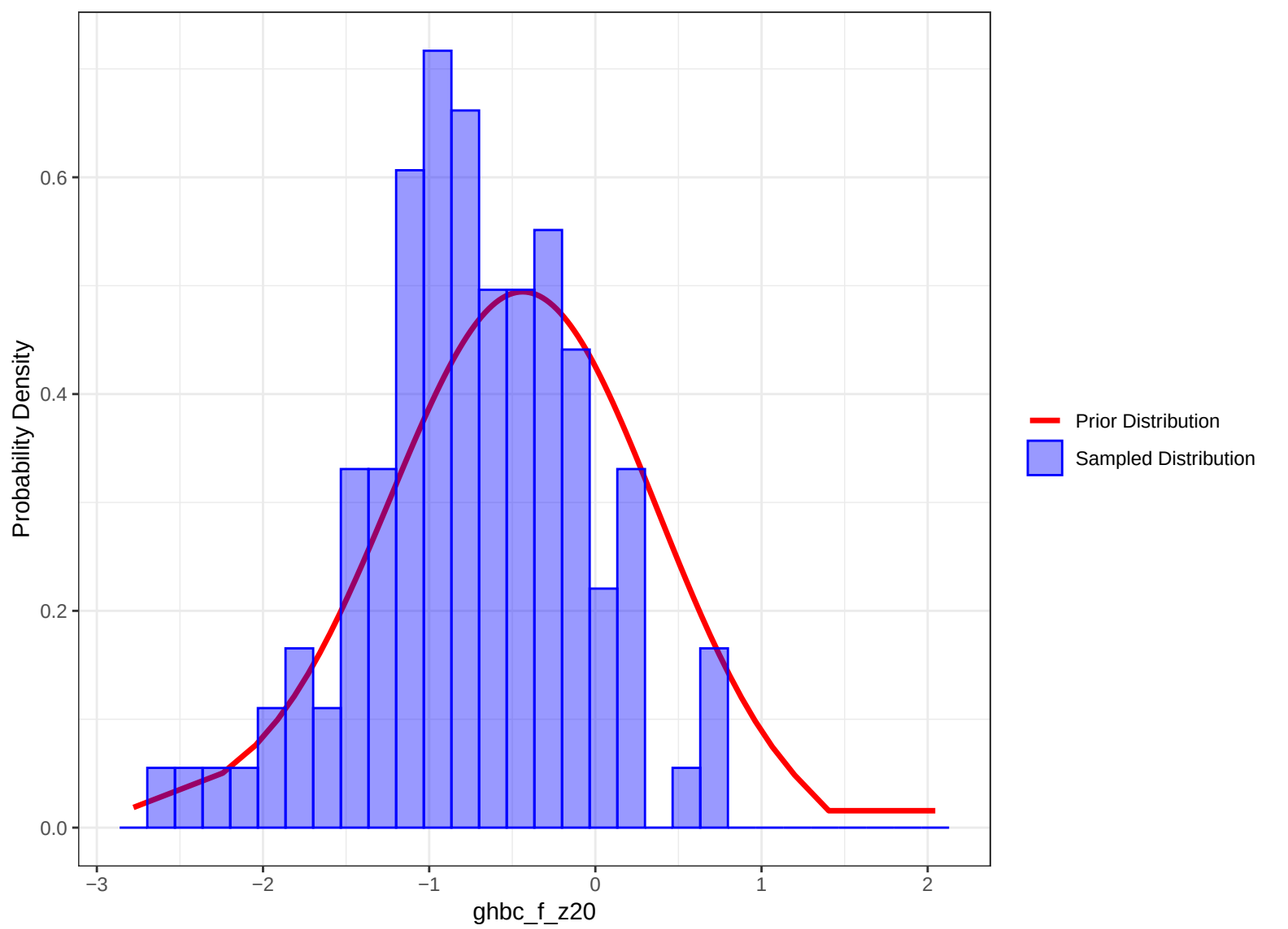

Probability Density
0.0
0.1
0.2
0.3
0.4
−2
0
2
ghbc_f_z14
Prior Distribution
Sampled Distribution

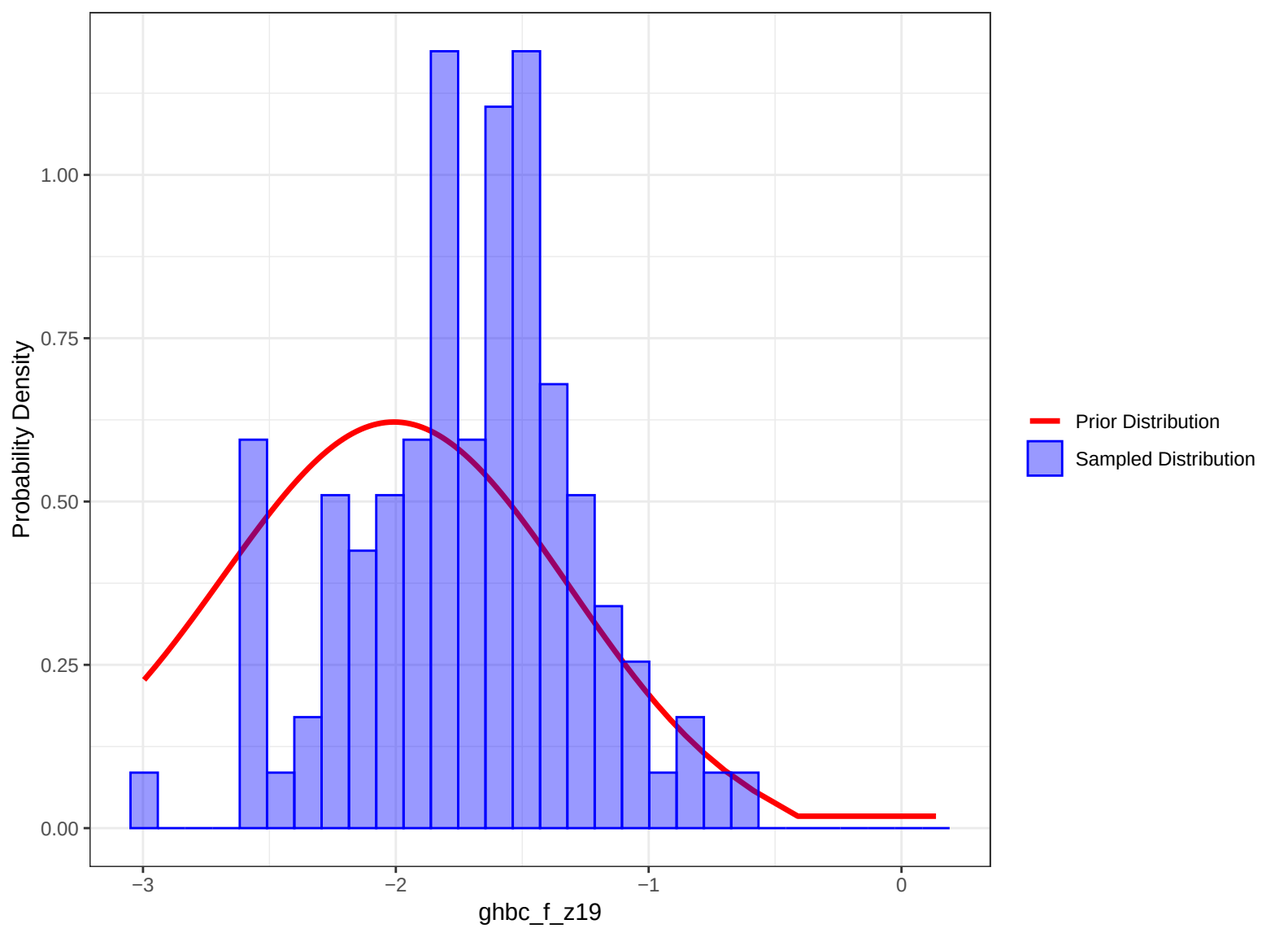

Probability Density
0.00
0.25
0.50
0.75
−3
−2
−1
0
ghbc_f_z16
Prior Distribution
Sampled Distribution

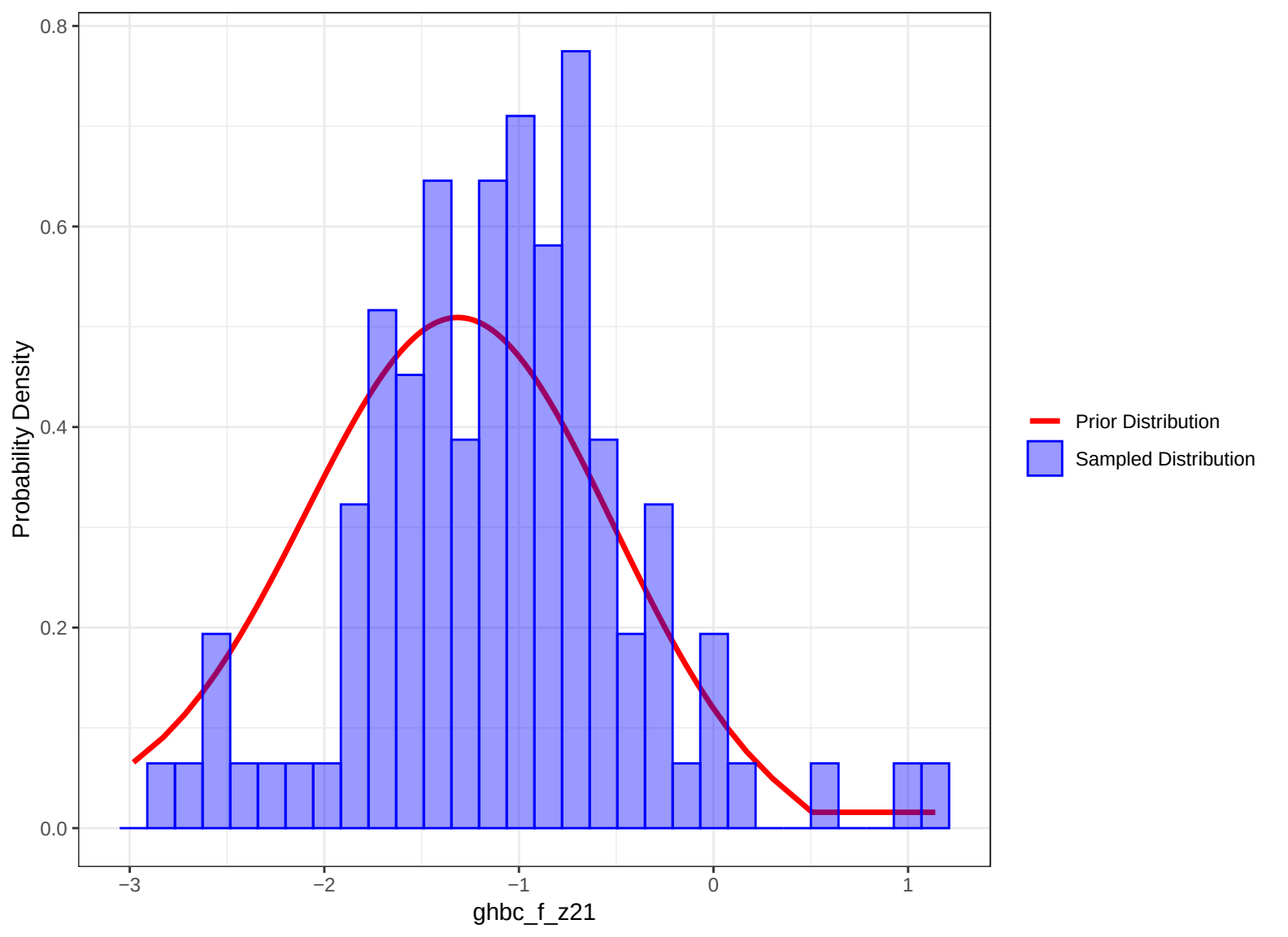

Probability Density
0.0
0.2
0.4
0.6
−3
−2
−1
0
1
ghbc_f_z15
Prior Distribution
Sampled Distribution

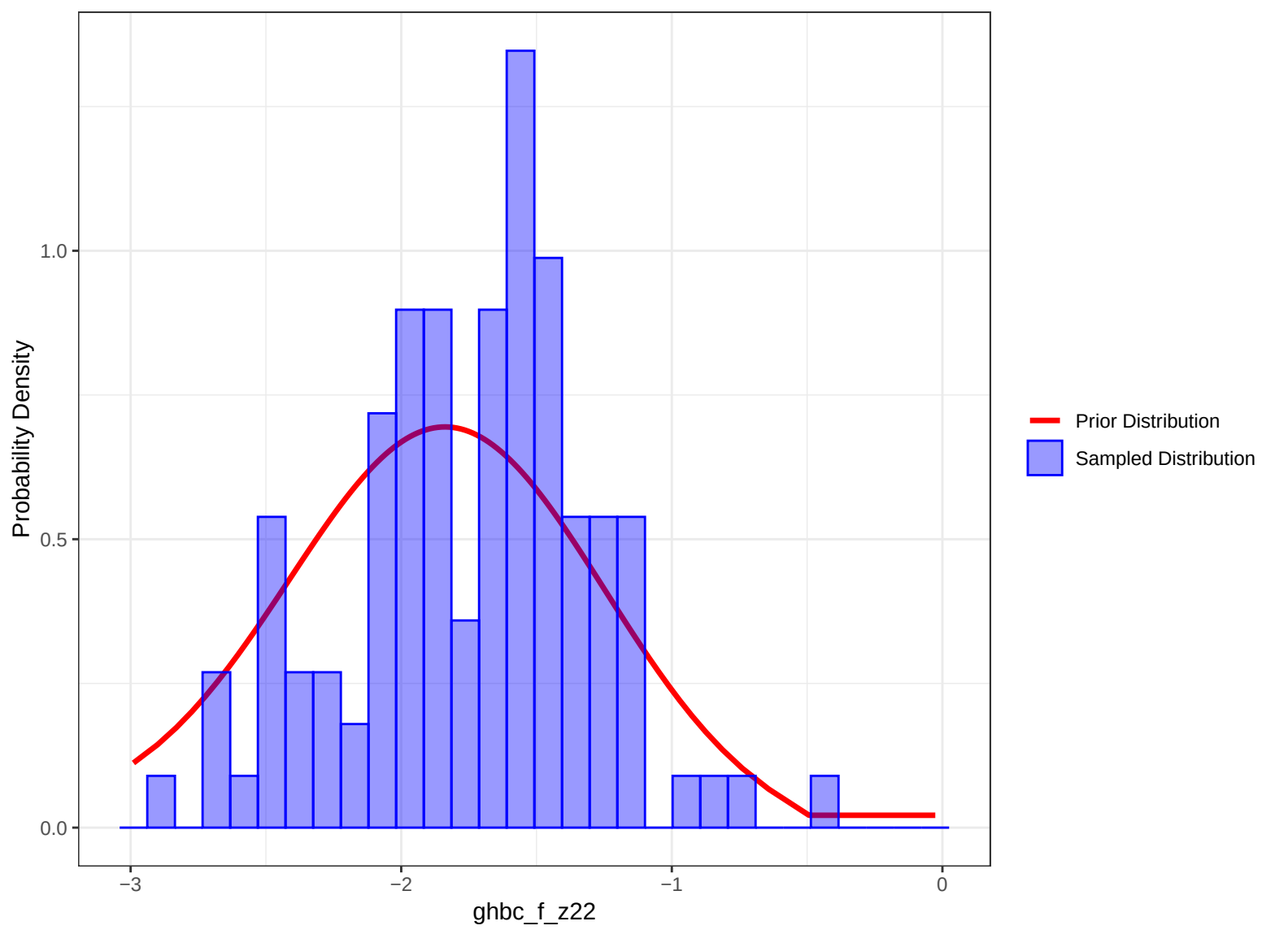

Probability Density
0.0
0.2
0.4
0.6
−2
0
2
ghbc_f_z17
Prior Distribution
Sampled Distribution

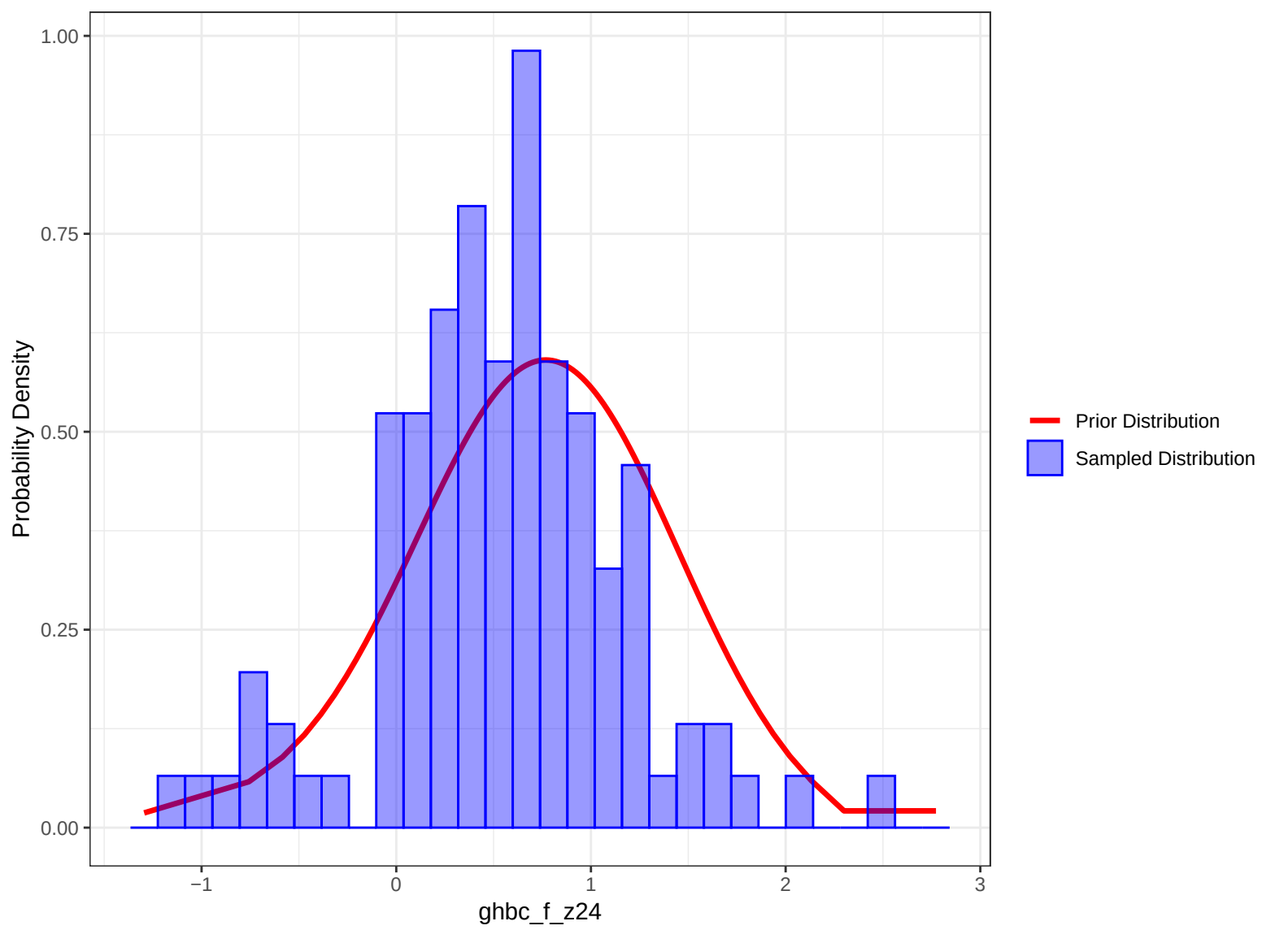

Probability Density
0.0
0.2
0.4
0.6
0
1
2
3
ghbc_f_z18
Prior Distribution
Sampled Distribution

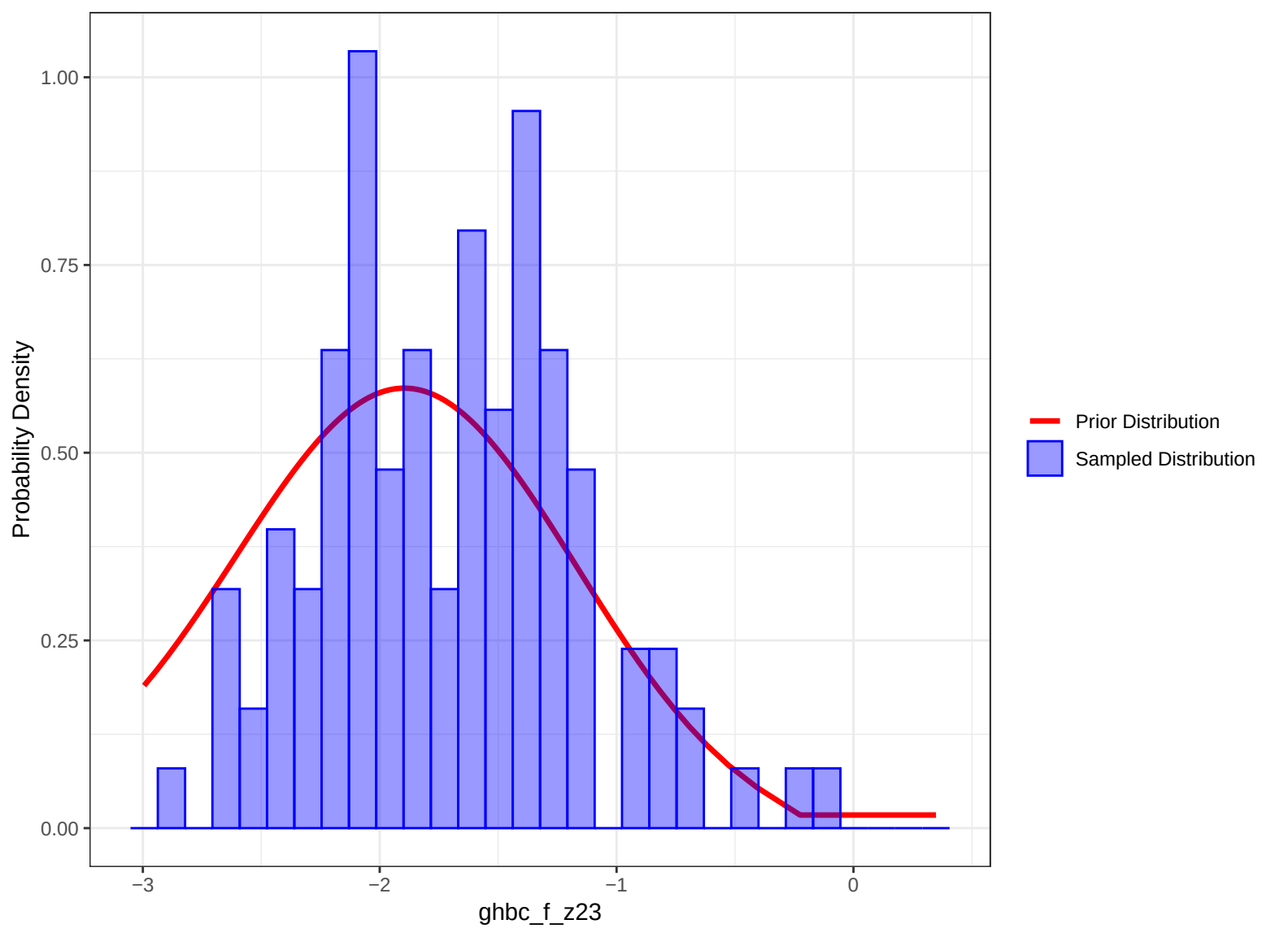

Probability Density
0.0
0.2
0.4
0.6
−3
−2
−1
0
1
2
ghbc_f_z20
Prior Distribution
Sampled Distribution

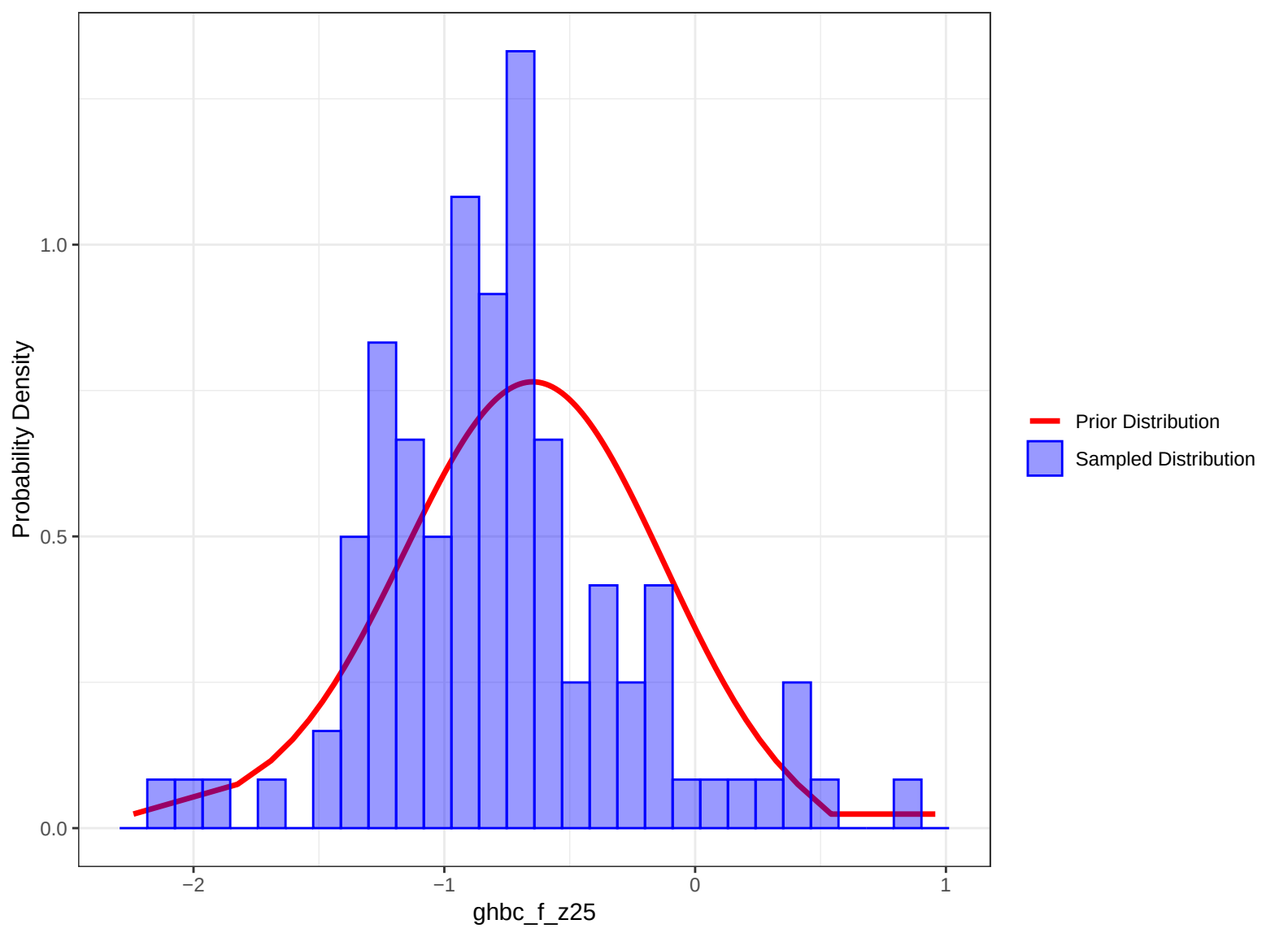

Probability Density
0.00
0.25
0.50
0.75
1.00
−3
−2
−1
0
ghbc_f_z19
Prior Distribution
Sampled Distribution

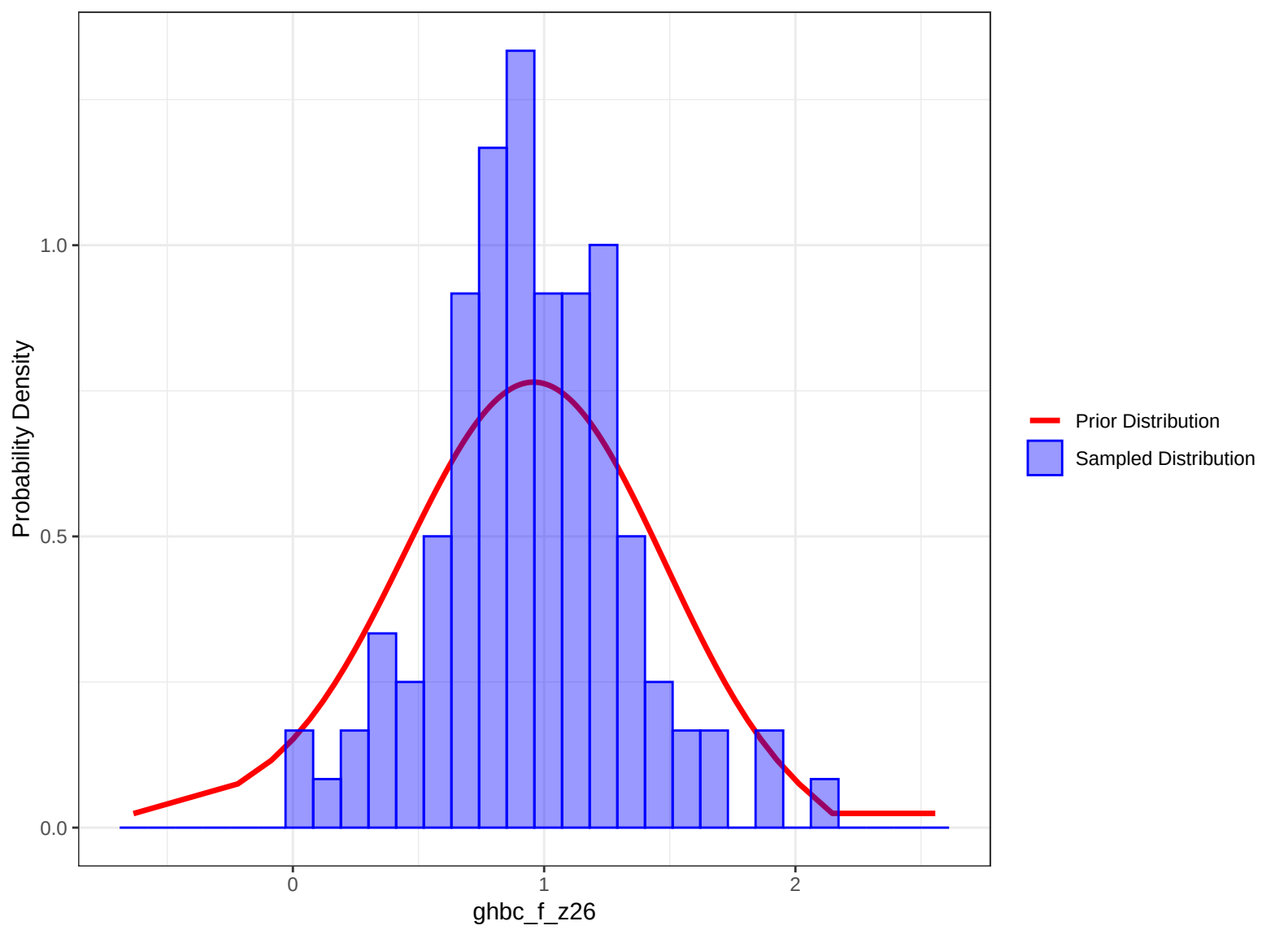

Probability Density
0.0
0.2
0.4
0.6
0.8
−3
−2
−1
0
1
ghbc_f_z21
Prior Distribution
Sampled Distribution

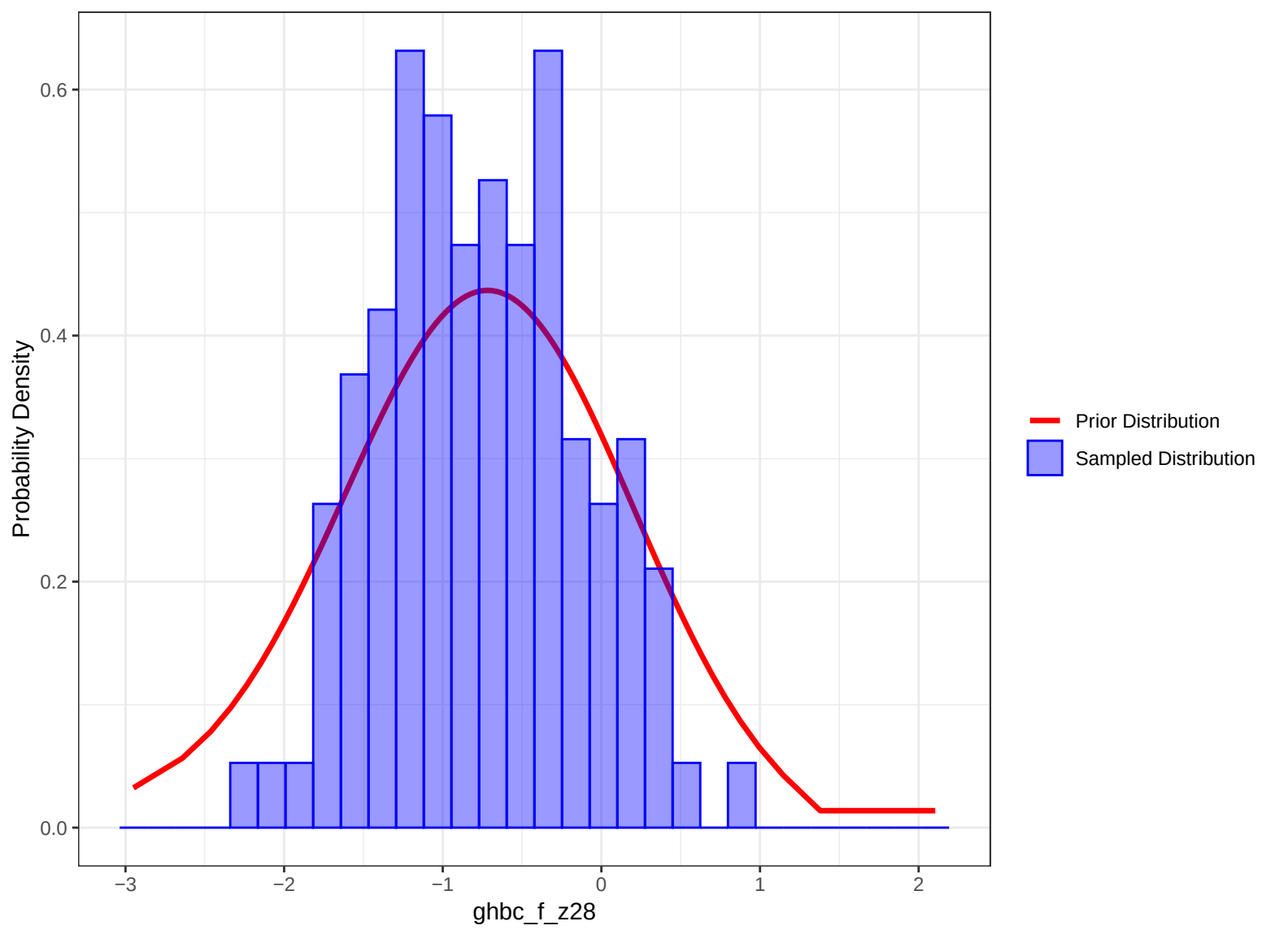

Probability Density
1.0
0.5
0.0
−3
−2
−1
0
ghbc_f_z22
Prior Distribution
Sampled Distribution

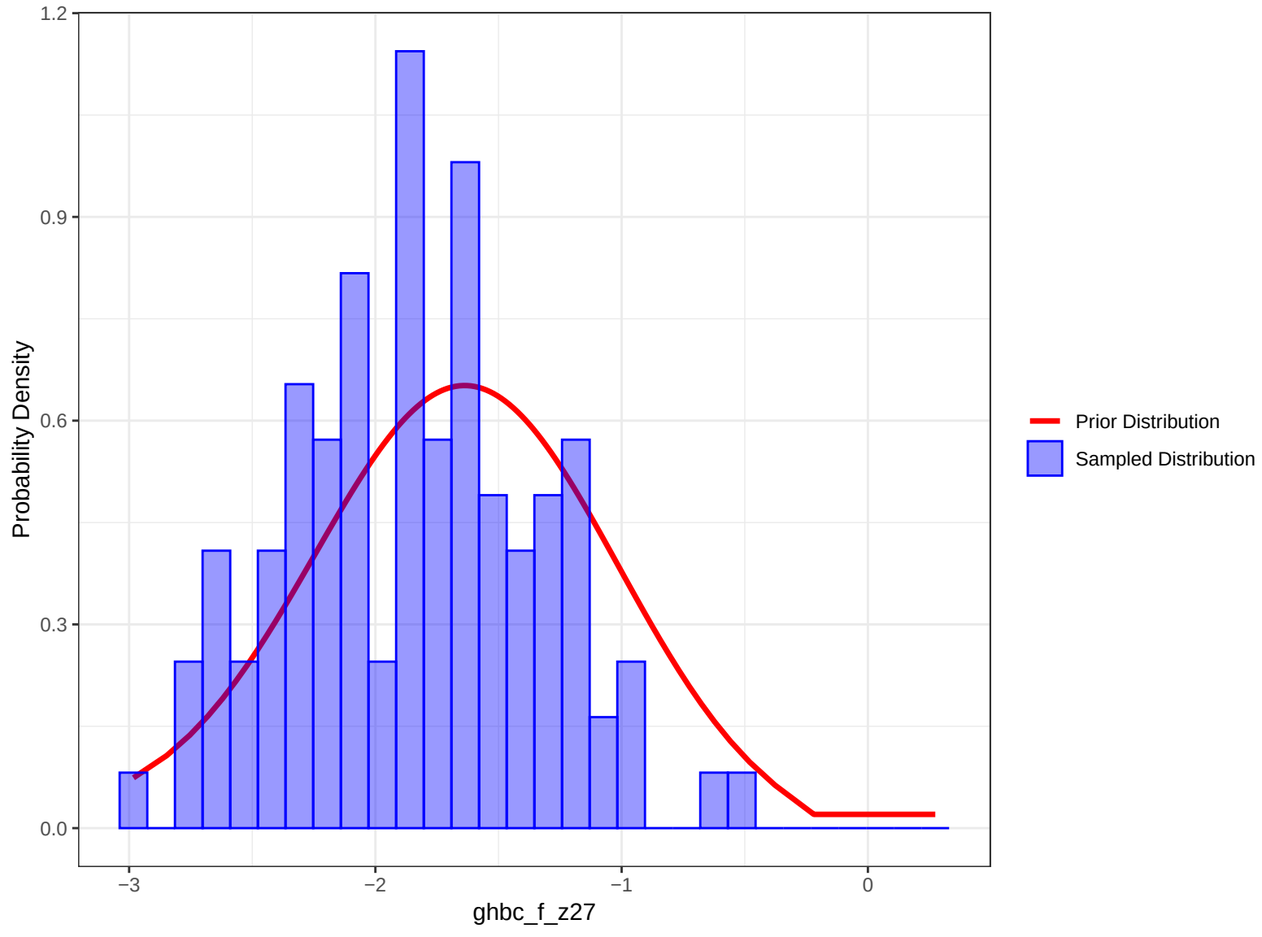

Probability Density
1.00
0.75
0.50
0.25
0.00
−1
0
1
2
3
ghbc_f_z24
Prior Distribution
Sampled Distribution

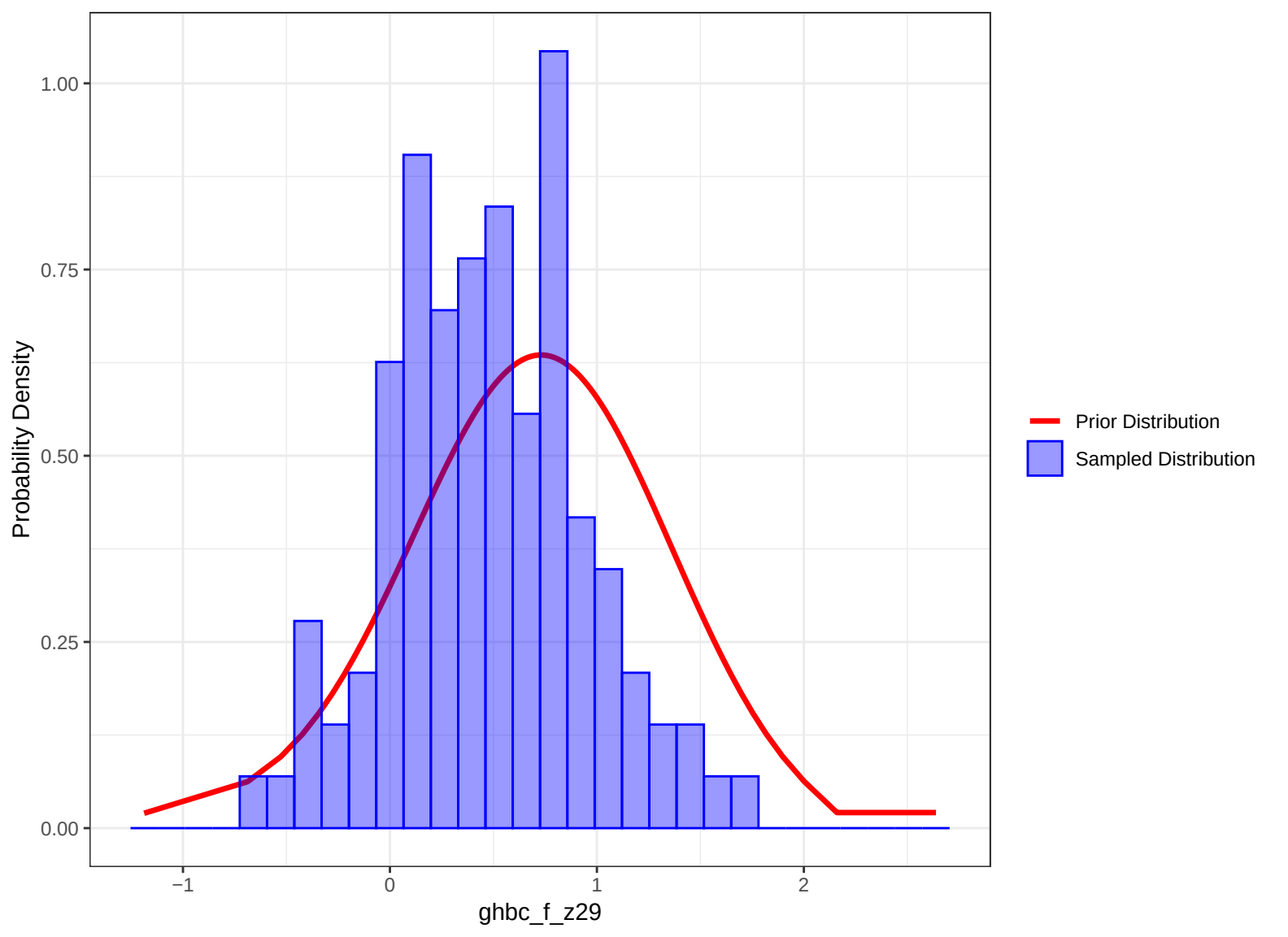

Probability Density
1.00
0.75
0.50
0.25
0.00
−3
−2
−1
0
ghbc_f_z23
Prior Distribution
Sampled Distribution

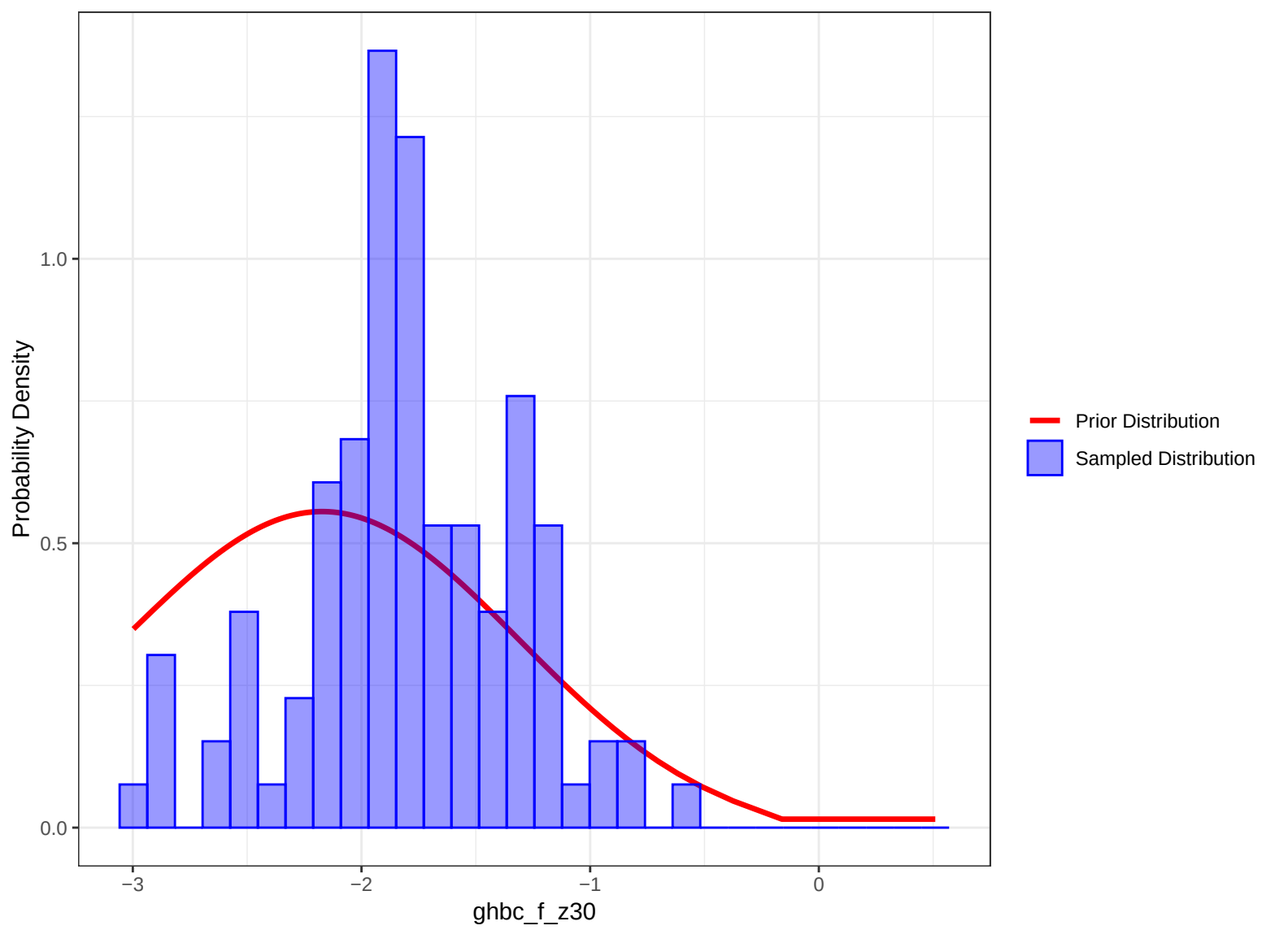

Probability Density
1.0
0.5
0.0
−2
−1
0
1
ghbc_f_z25
Prior Distribution
Sampled Distribution

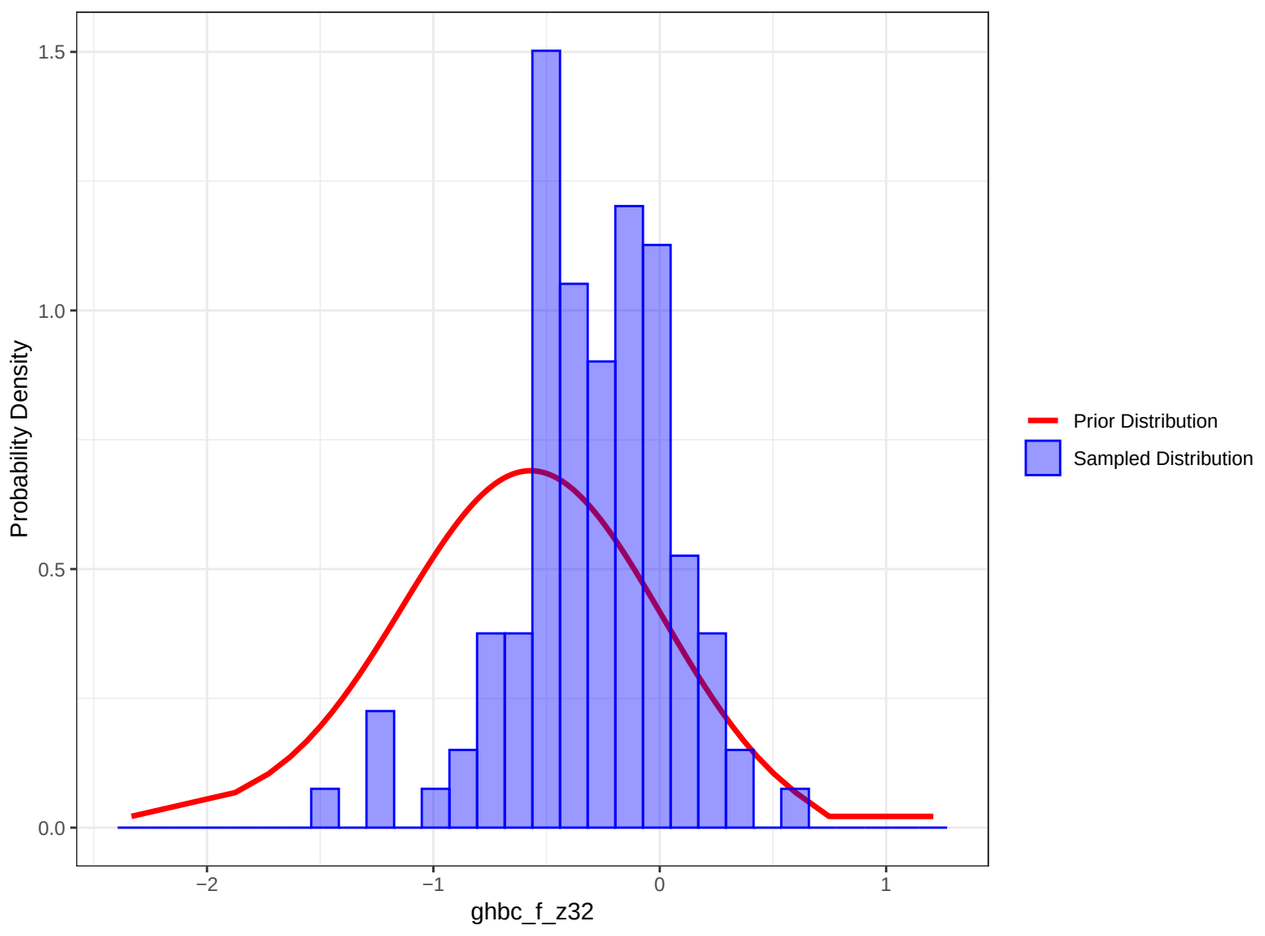

Probability Density
1.0
0.5
0.0
0
1
2
ghbc_f_z26
Prior Distribution
Sampled Distribution

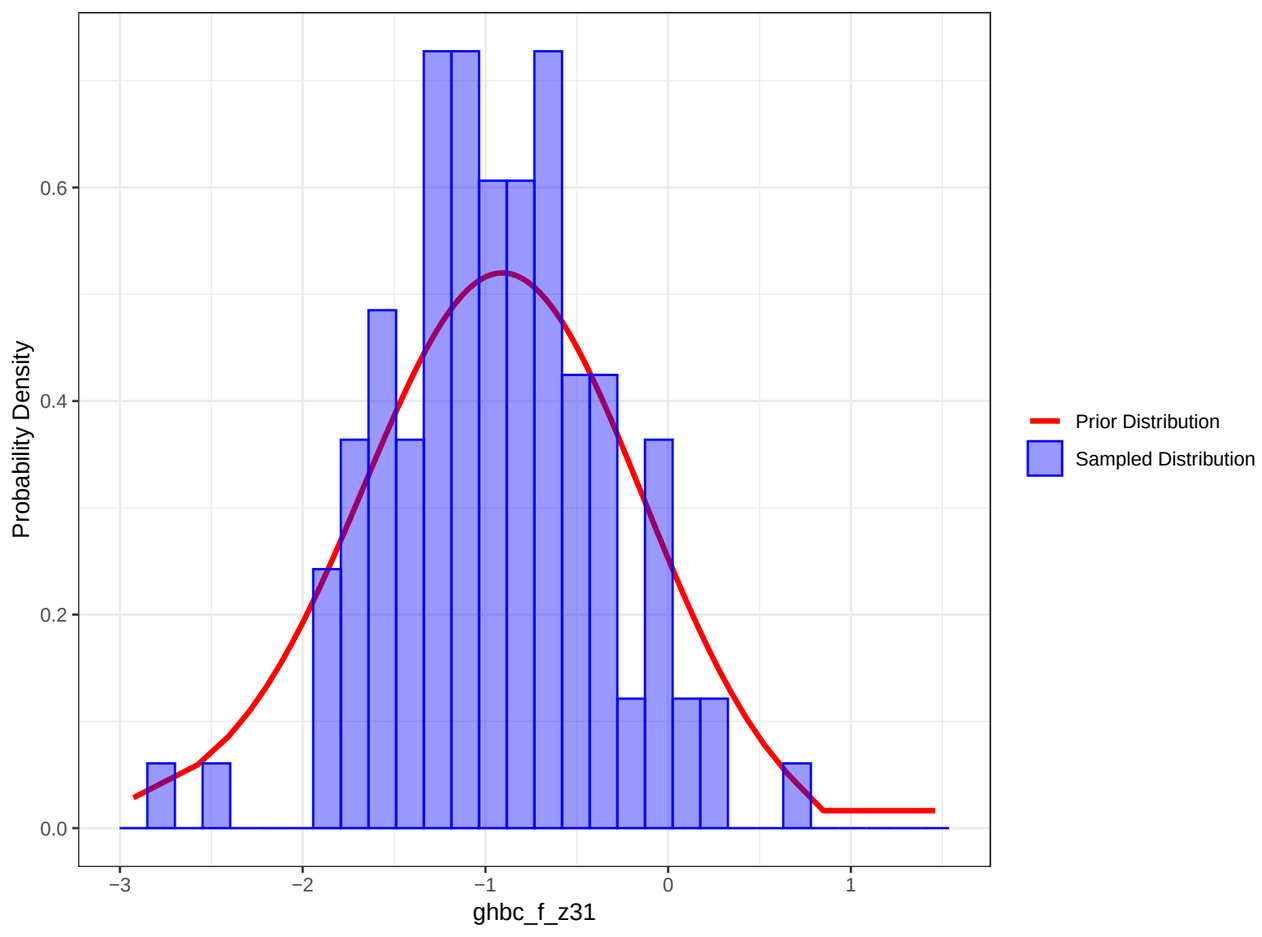

Probability Density
0.6
0.4
0.2
0.0
−3
−2
−1
0
1
2
ghbc_f_z28
Prior Distribution
Sampled Distribution

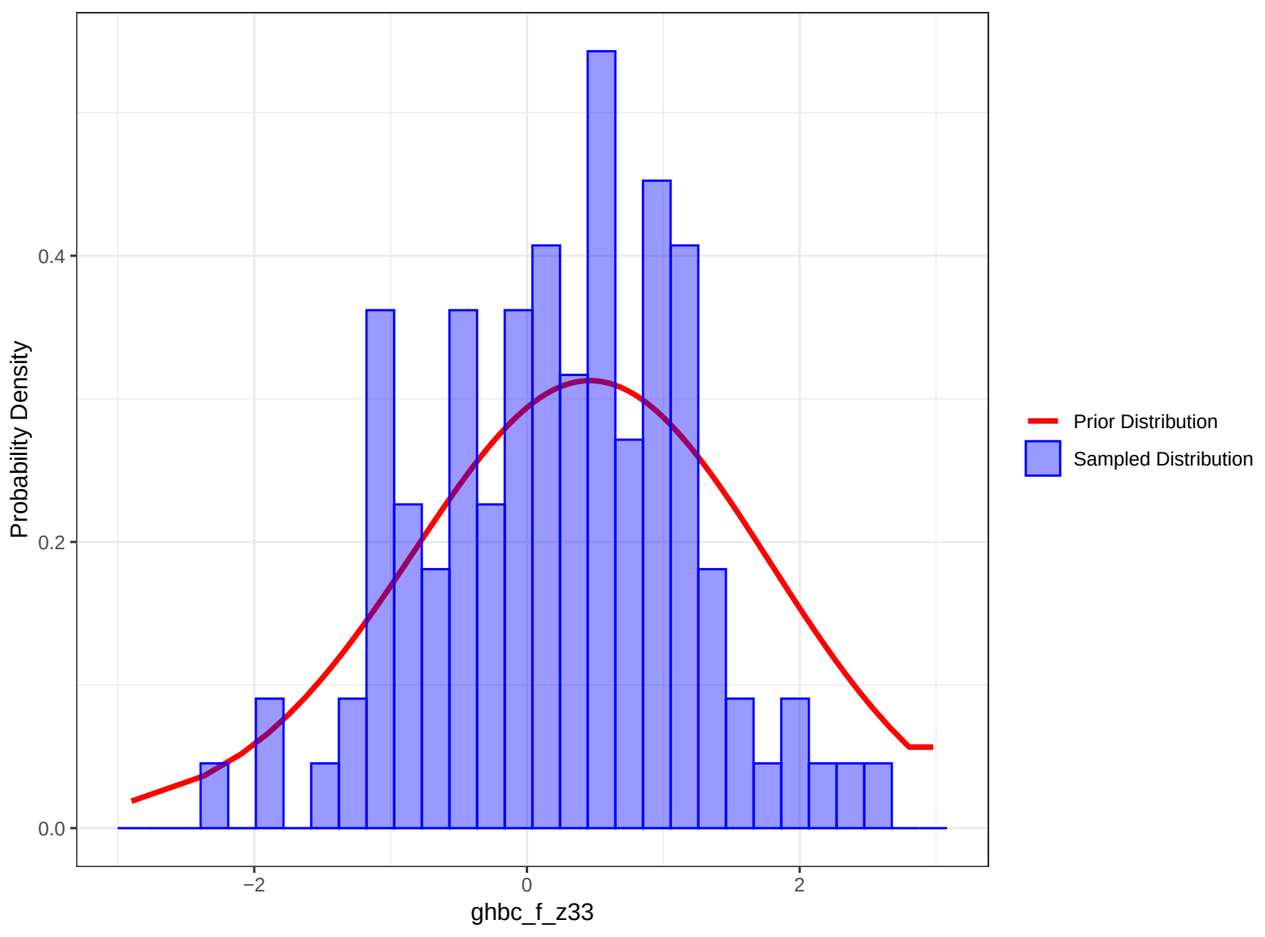

Probability Density
1.2
0.9
0.6
0.3
0.0
−3
−2
−1
0
ghbc_f_z27
Prior Distribution
Sampled Distribution

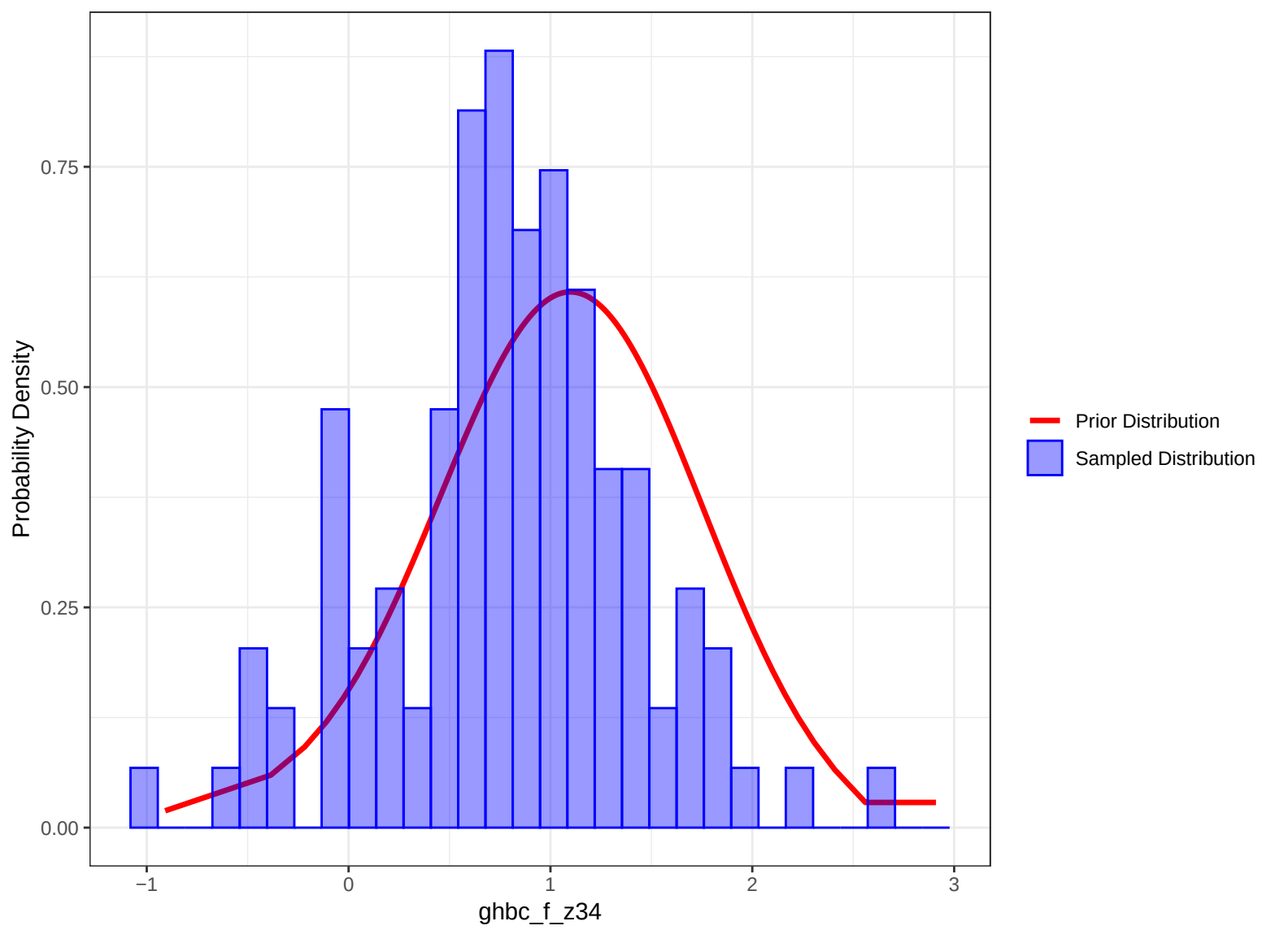

Probability Density
1.00
0.75
0.50
0.25
0.00
−1
0
1
2
ghbc_f_z29
Prior Distribution
Sampled Distribution

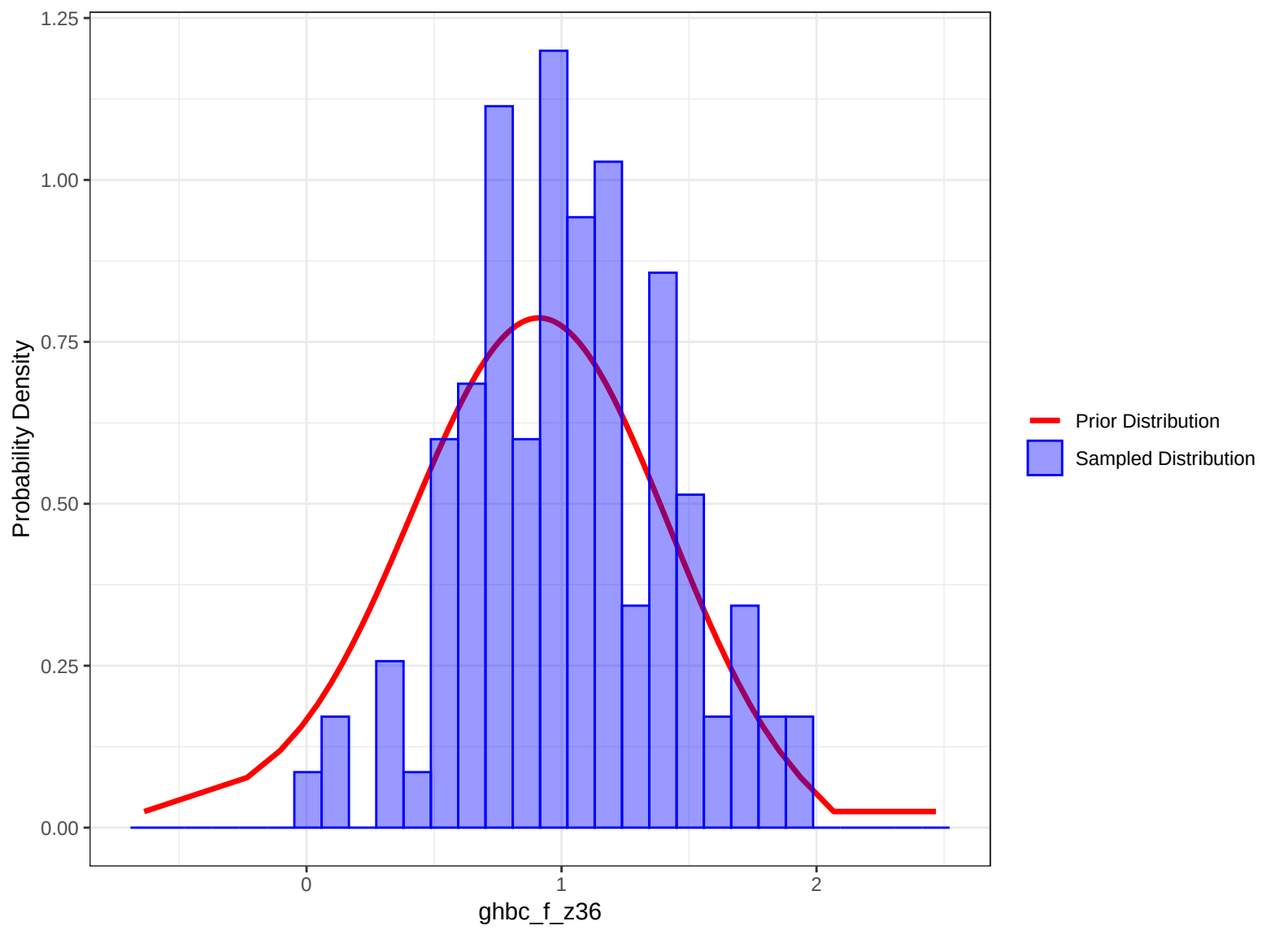

Probability Density
0.0
0.5
1.0
−3
−2
−1
0
ghbc_f_z30
Prior Distribution
Sampled Distribution

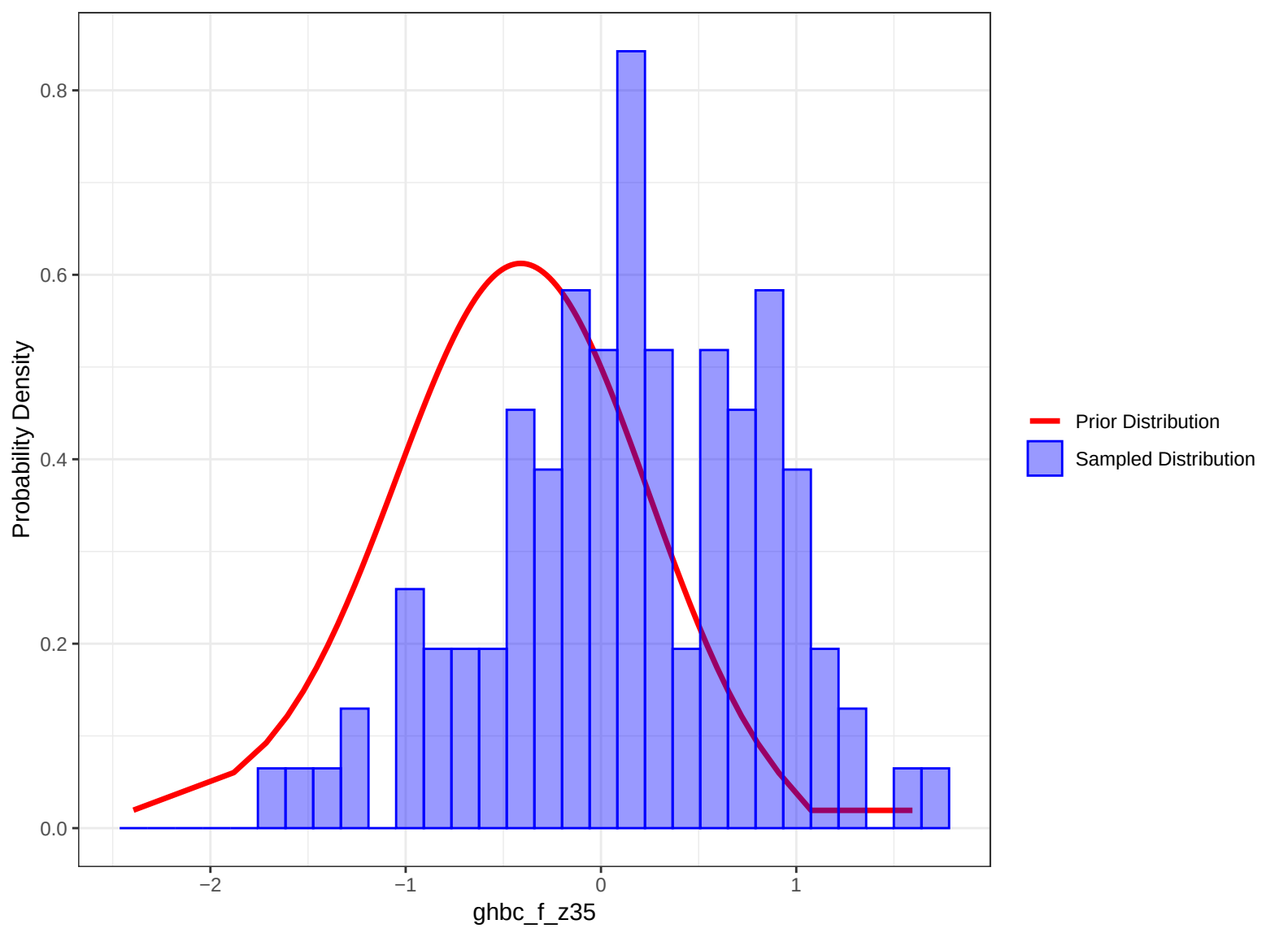

Probability Density
0.0
0.5
1.0
1.5
−2
−1
0
1
ghbc_f_z32
Prior Distribution
Sampled Distribution

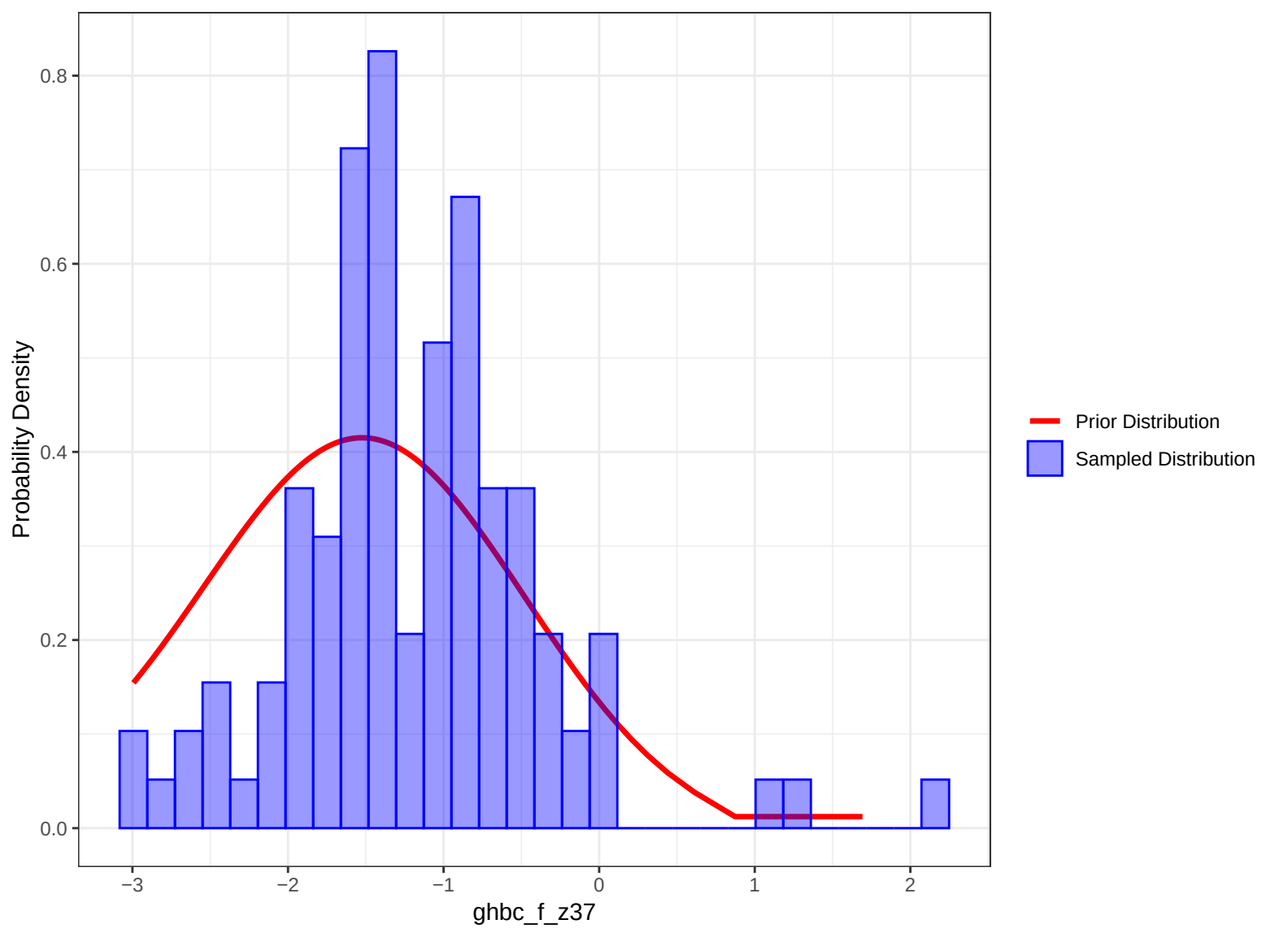

Probability Density
0.0
0.2
0.4
0.6
−3
−2
−1
0
1
ghbc_f_z31
Prior Distribution
Sampled Distribution

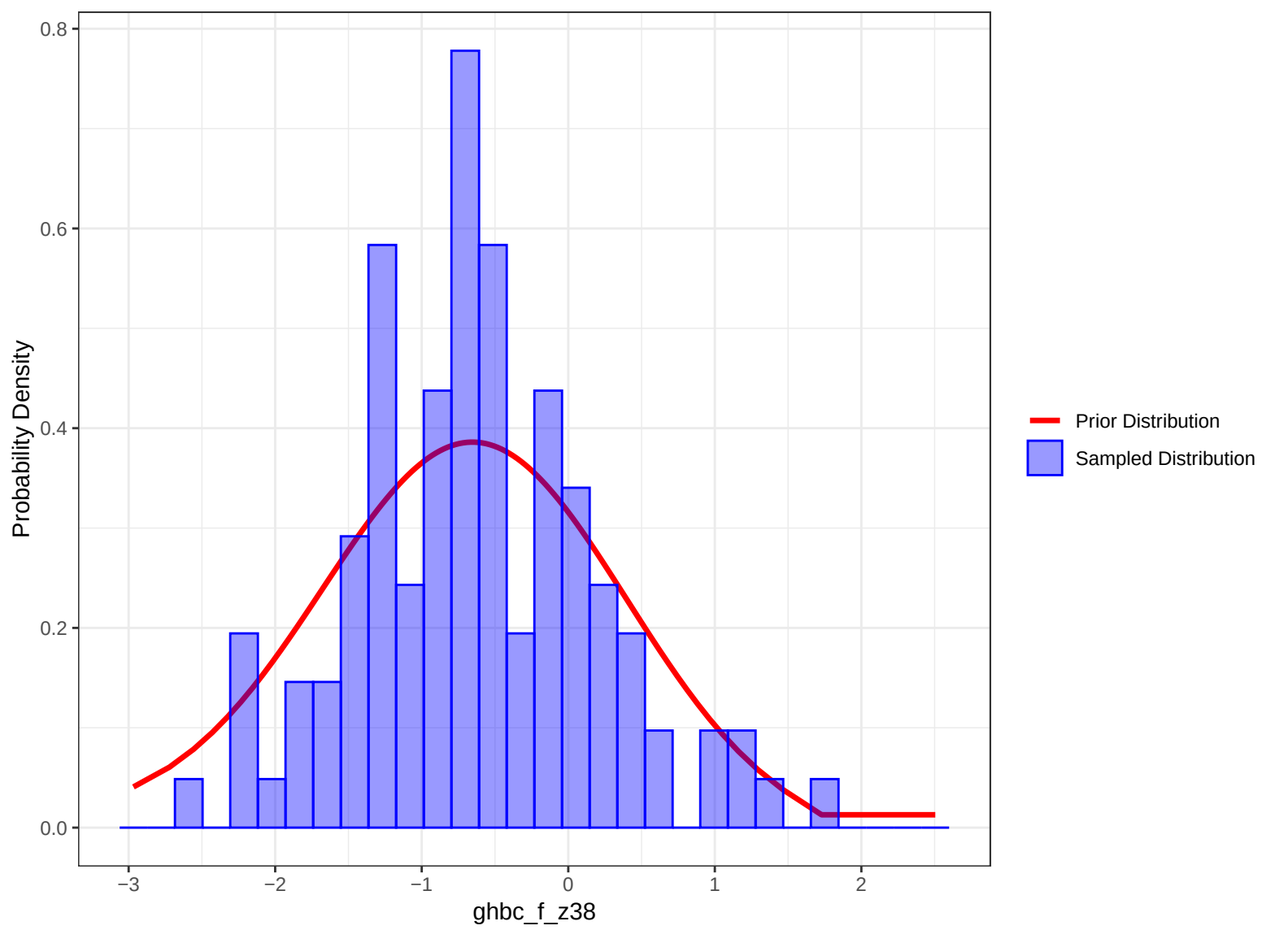

Probability Density
0.0
0.2
0.4
−2
0
2
ghbc_f_z33
Prior Distribution
Sampled Distribution

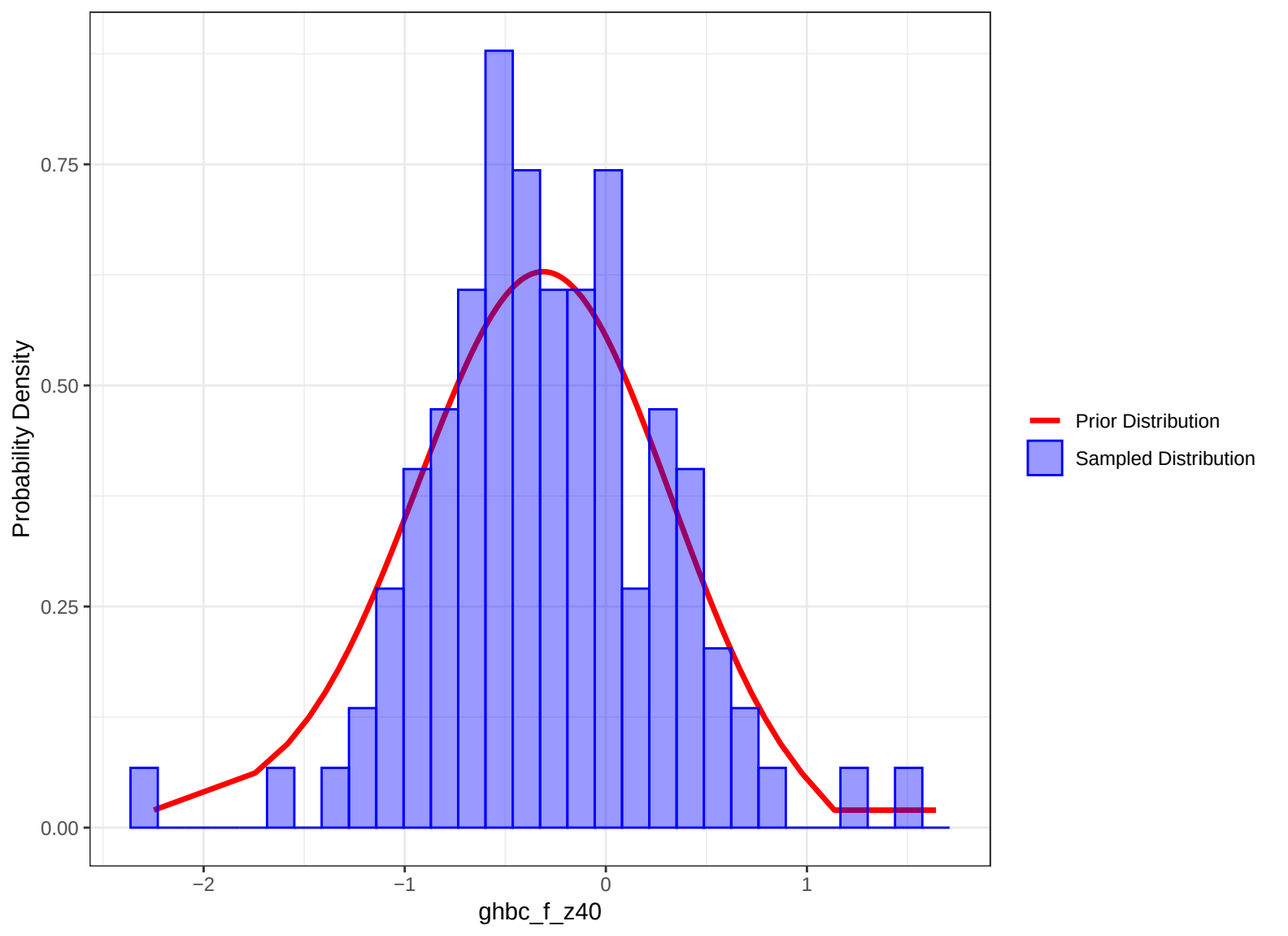

Probability Density
0.00
0.25
0.50
0.75
−1
0
1
2
3
ghbc_f_z34
Prior Distribution
Sampled Distribution

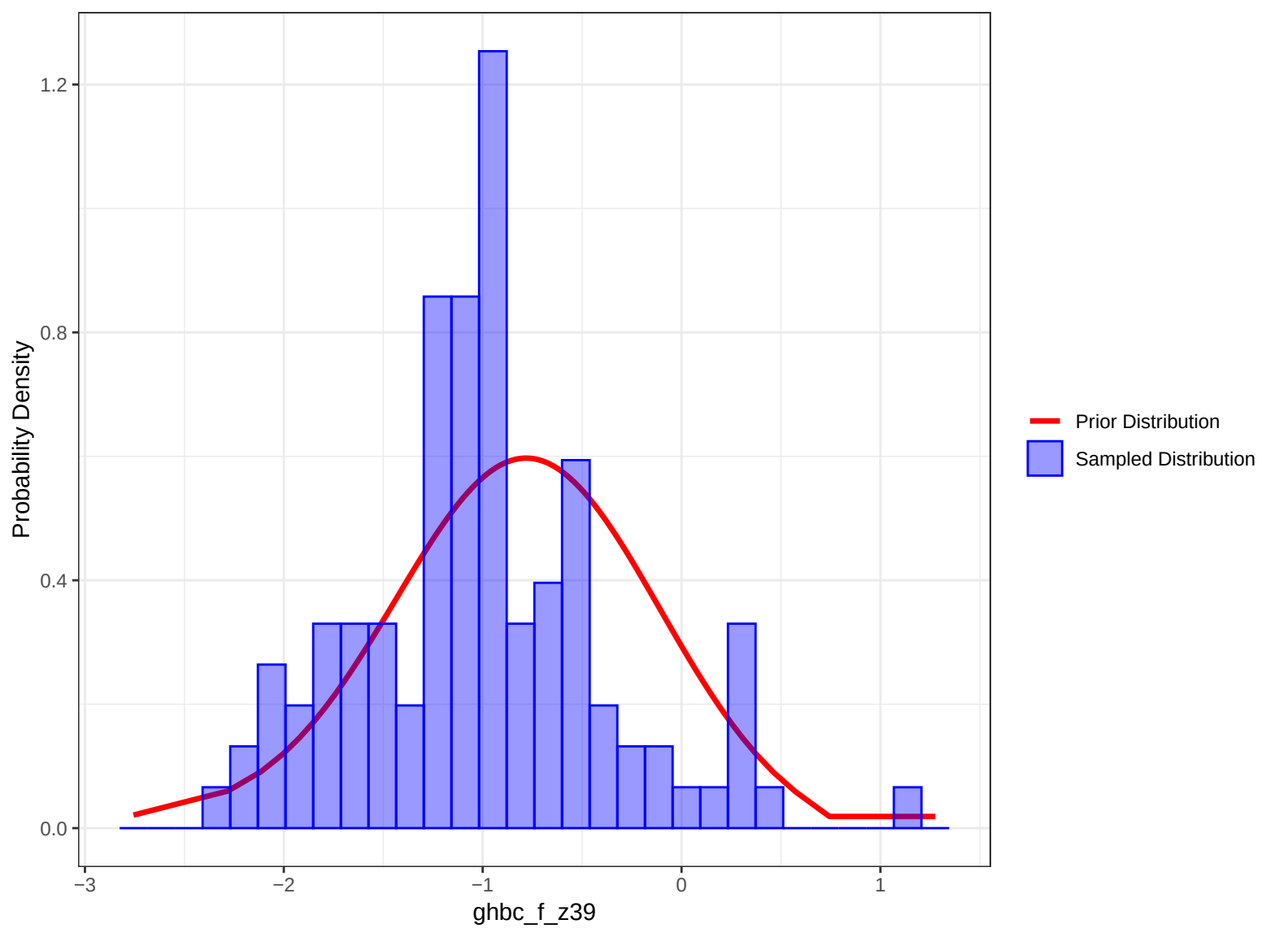

Probability Density
0.00
0.25
0.50
0.75
1.00
1.25
0
1
2
ghbc_f_z36
Prior Distribution
Sampled Distribution

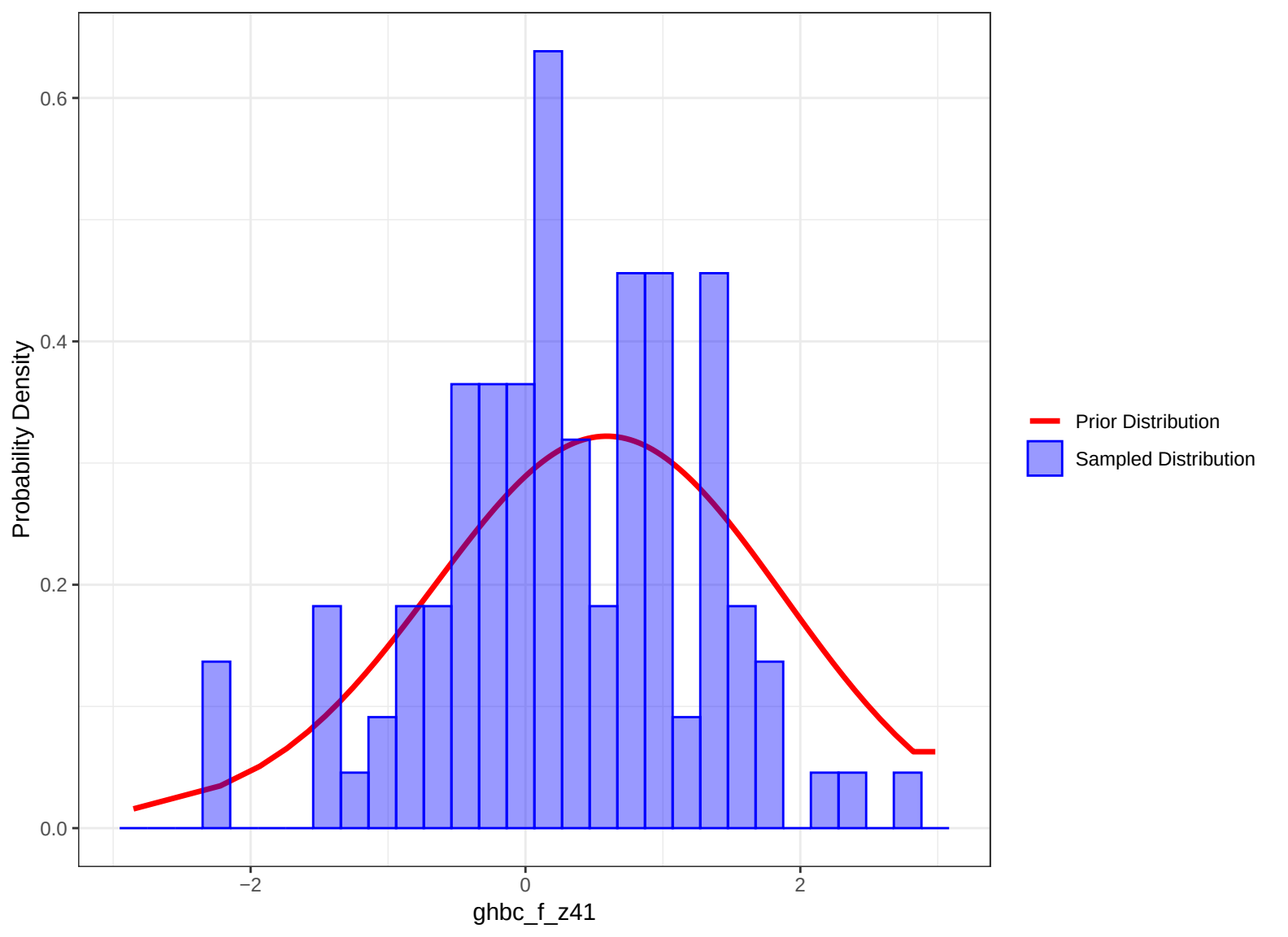

Probability Density
0.0
0.2
0.4
0.6
0.8
−2
−1
0
1
ghbc_f_z35
Prior Distribution
Sampled Distribution

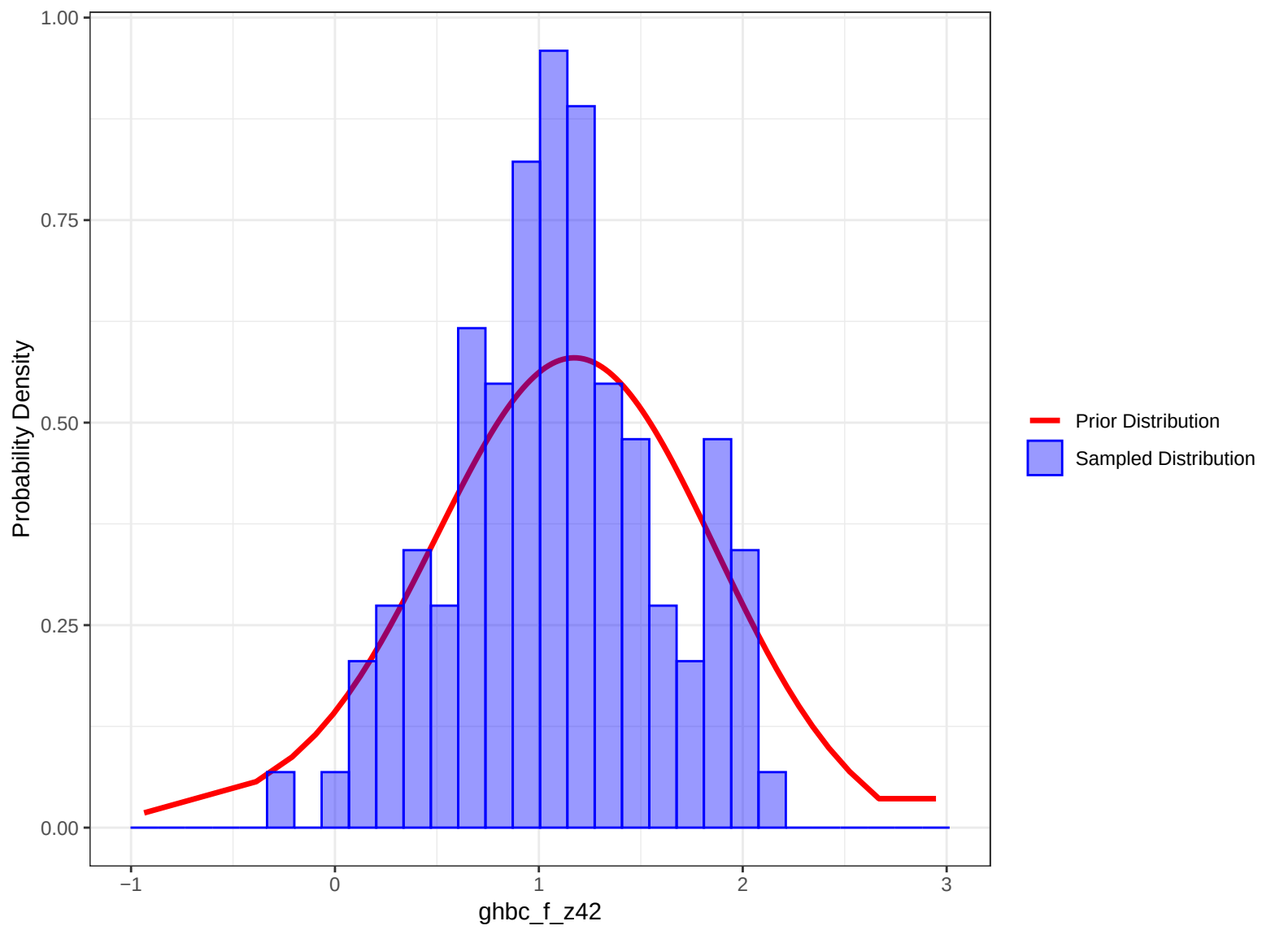

Probability Density
0.0
0.2
0.4
0.6
0.8
−3
−2
−1
0
1
2
ghbc_f_z37
Prior Distribution
Sampled Distribution

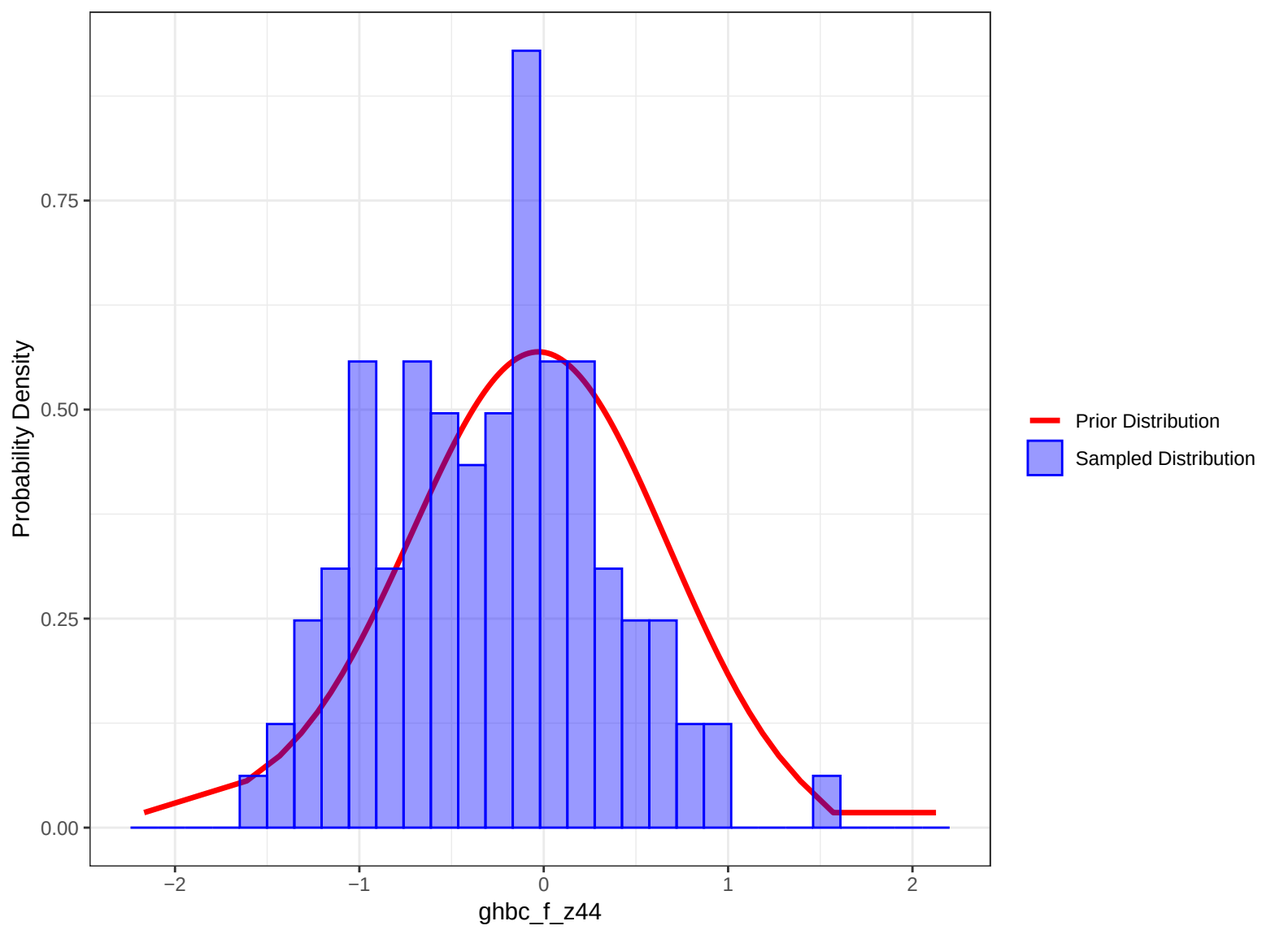

Probability Density
0.0
0.2
0.4
0.6
0.8
−3
−2
−1
0
1
2
ghbc_f_z38
Prior Distribution
Sampled Distribution

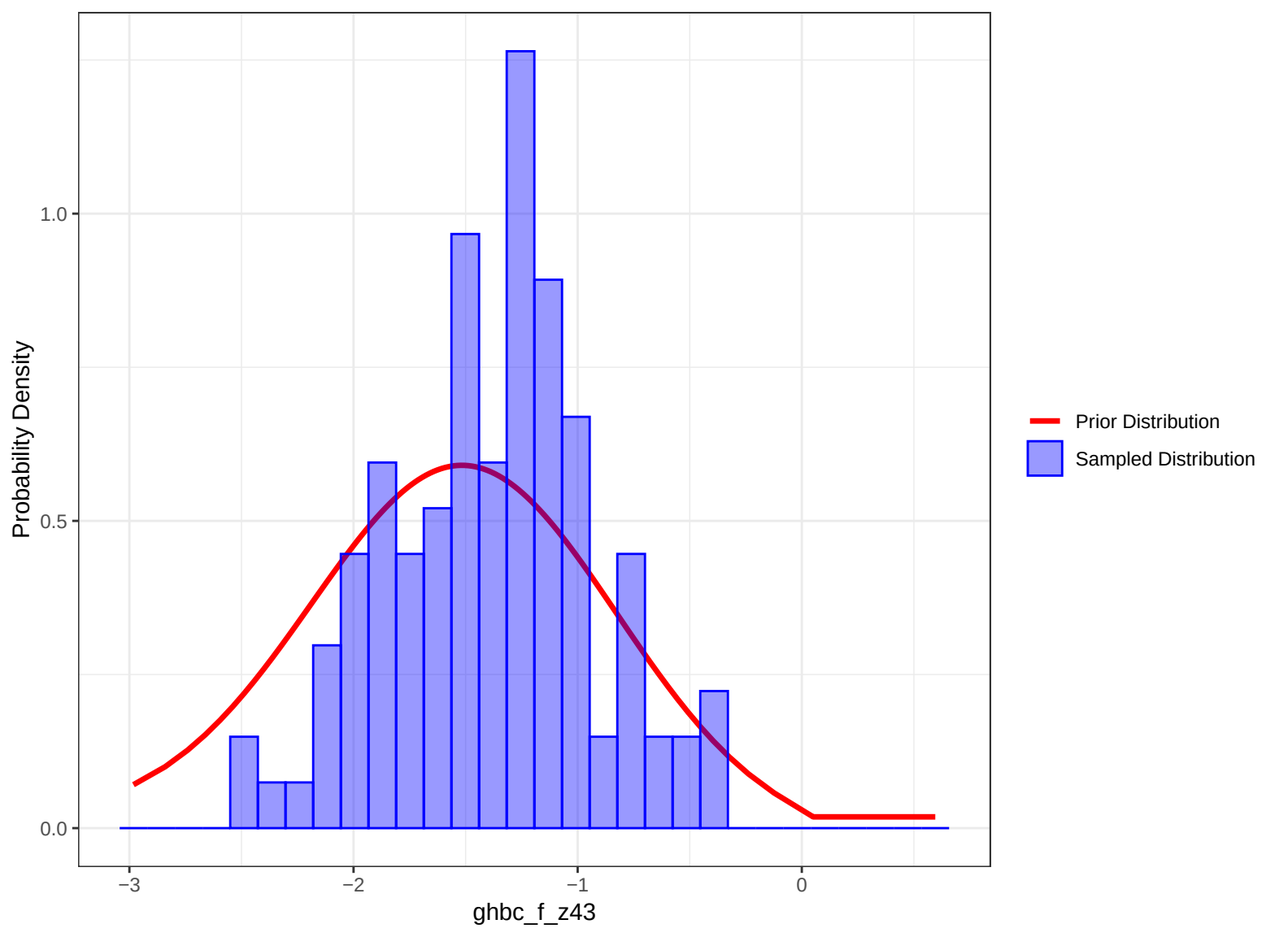

Probability Density
0.00
0.25
0.50
0.75
−2
−1
0
1
ghbc_f_z40
Prior Distribution
Sampled Distribution

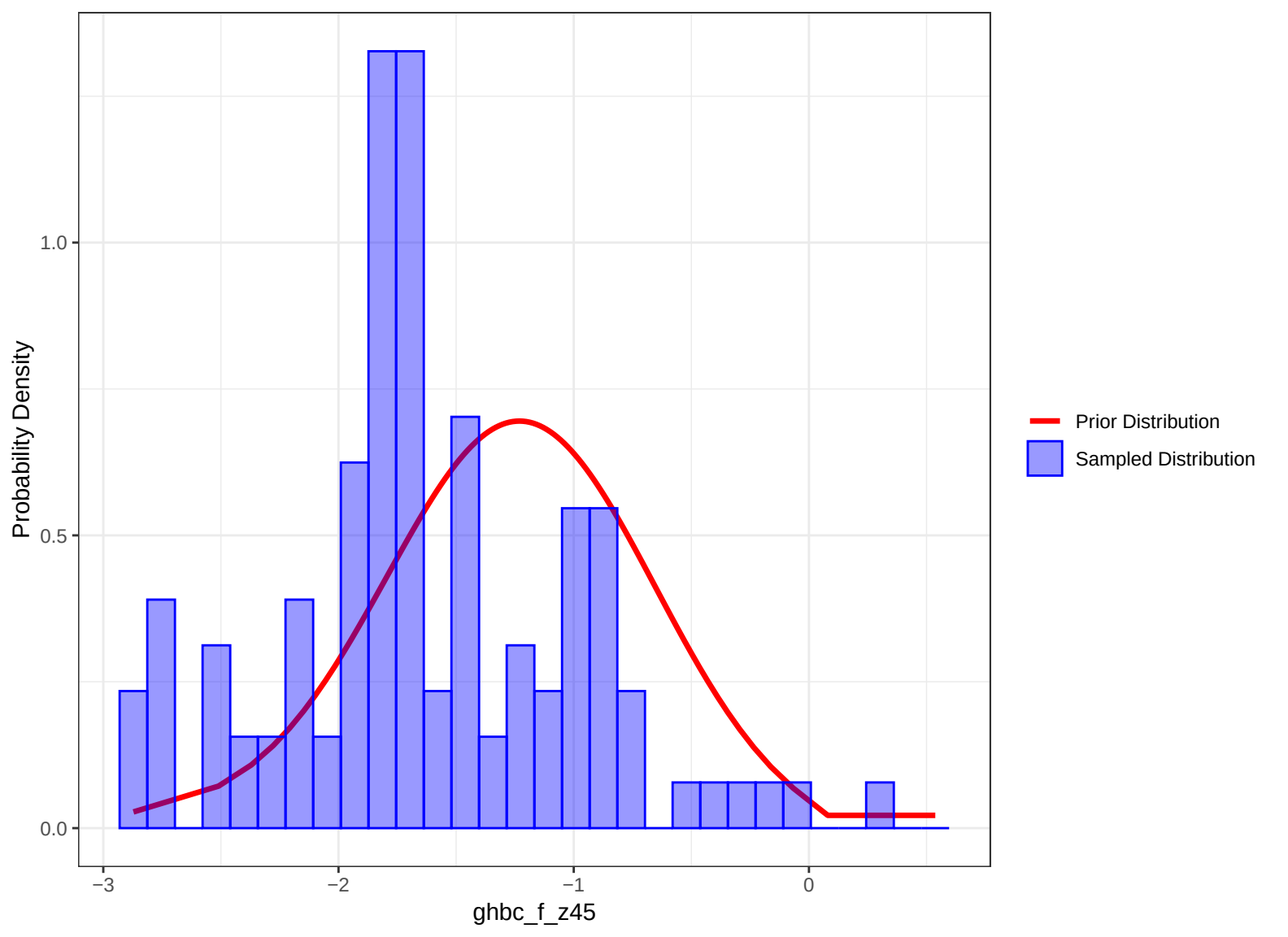

Probability Density
0.0
0.4
0.8
1.2
−3
−2
−1
0
1
ghbc_f_z39
Prior Distribution
Sampled Distribution

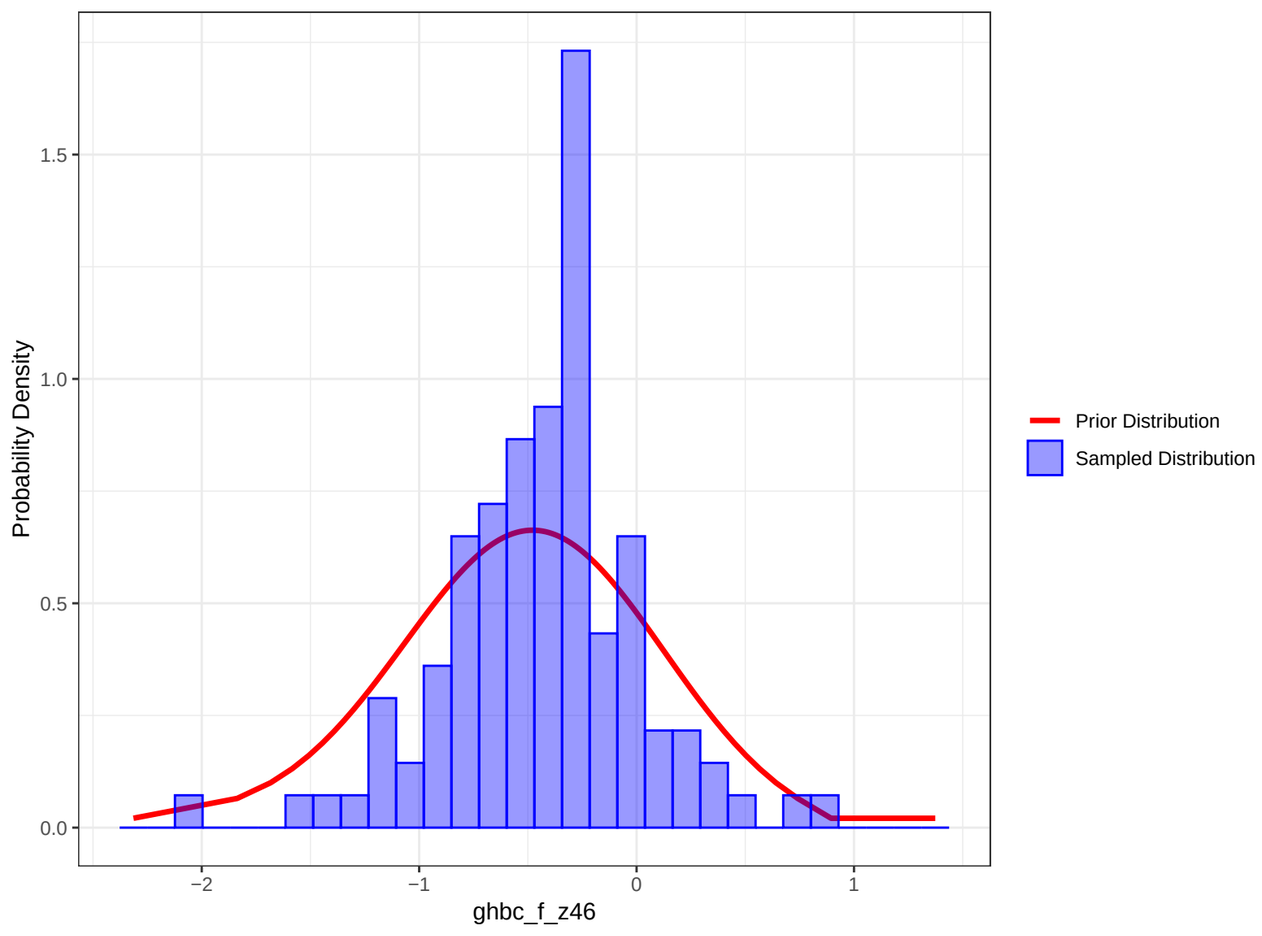

Probability Density
0.0
0.2
0.4
0.6
−2
0
2
ghbc_f_z41
Prior Distribution
Sampled Distribution

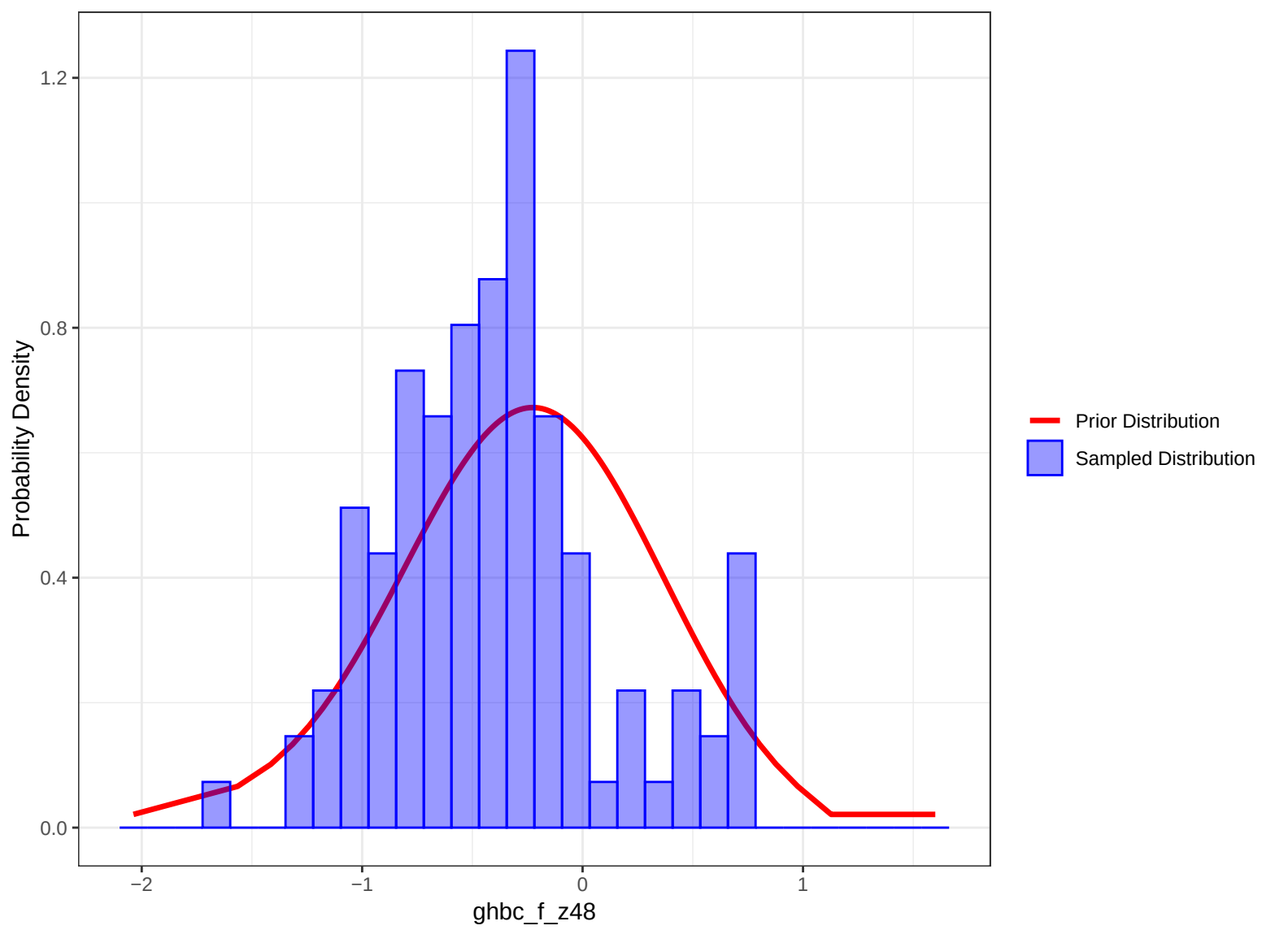

1.00
0.75
0.50
0.25
0.00
Probability Density
−1
0
1
2
3
ghbc_f_z42
Prior Distribution
Sampled Distribution

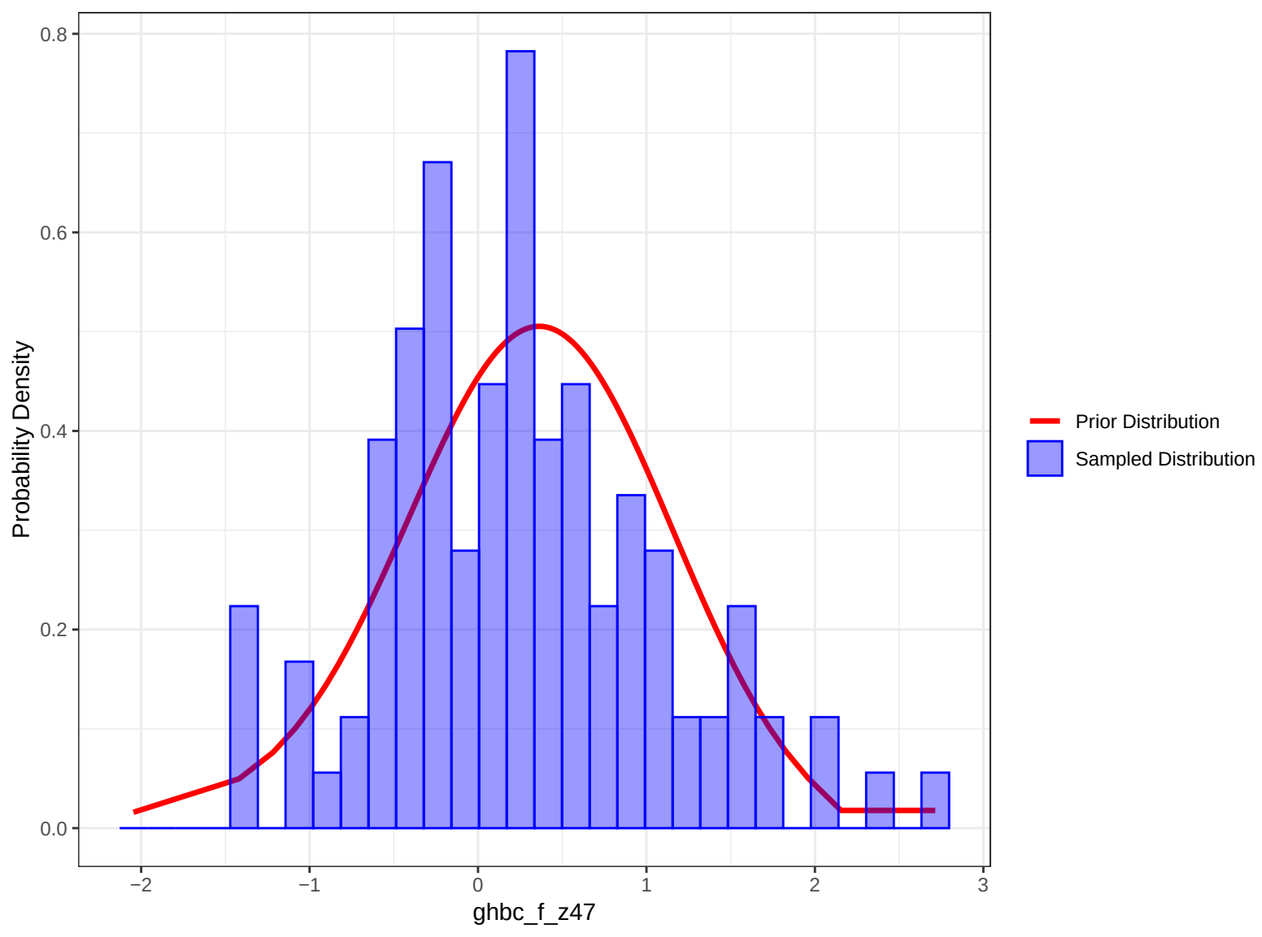

0.75
0.50
0.25
0.00
Probability Density
−2
−1
0
1
2
ghbc_f_z44
Prior Distribution
Sampled Distribution

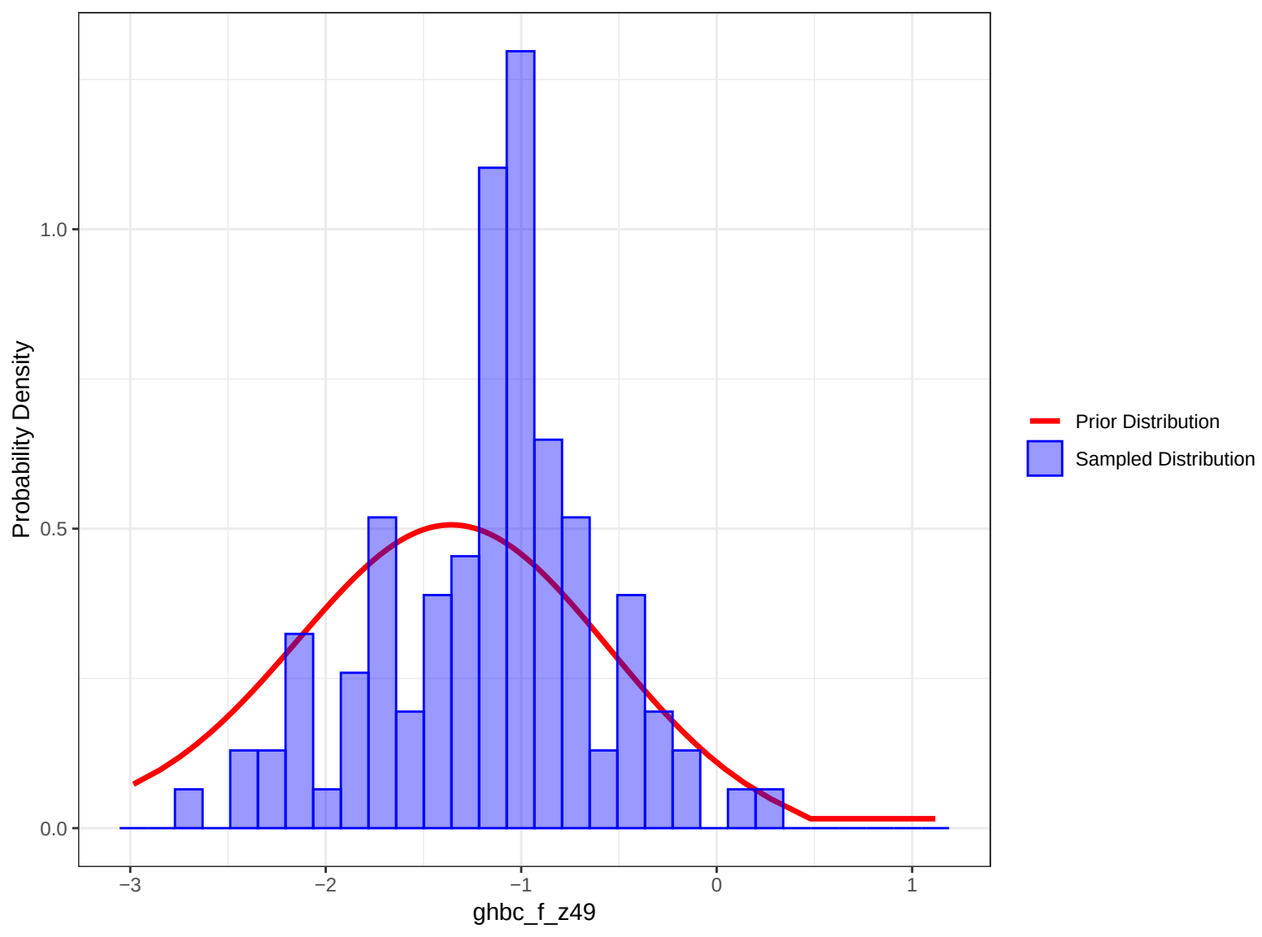

1.0
0.5
0.0
Probability Density
−3
−2
−1
0
ghbc_f_z43
Prior Distribution
Sampled Distribution

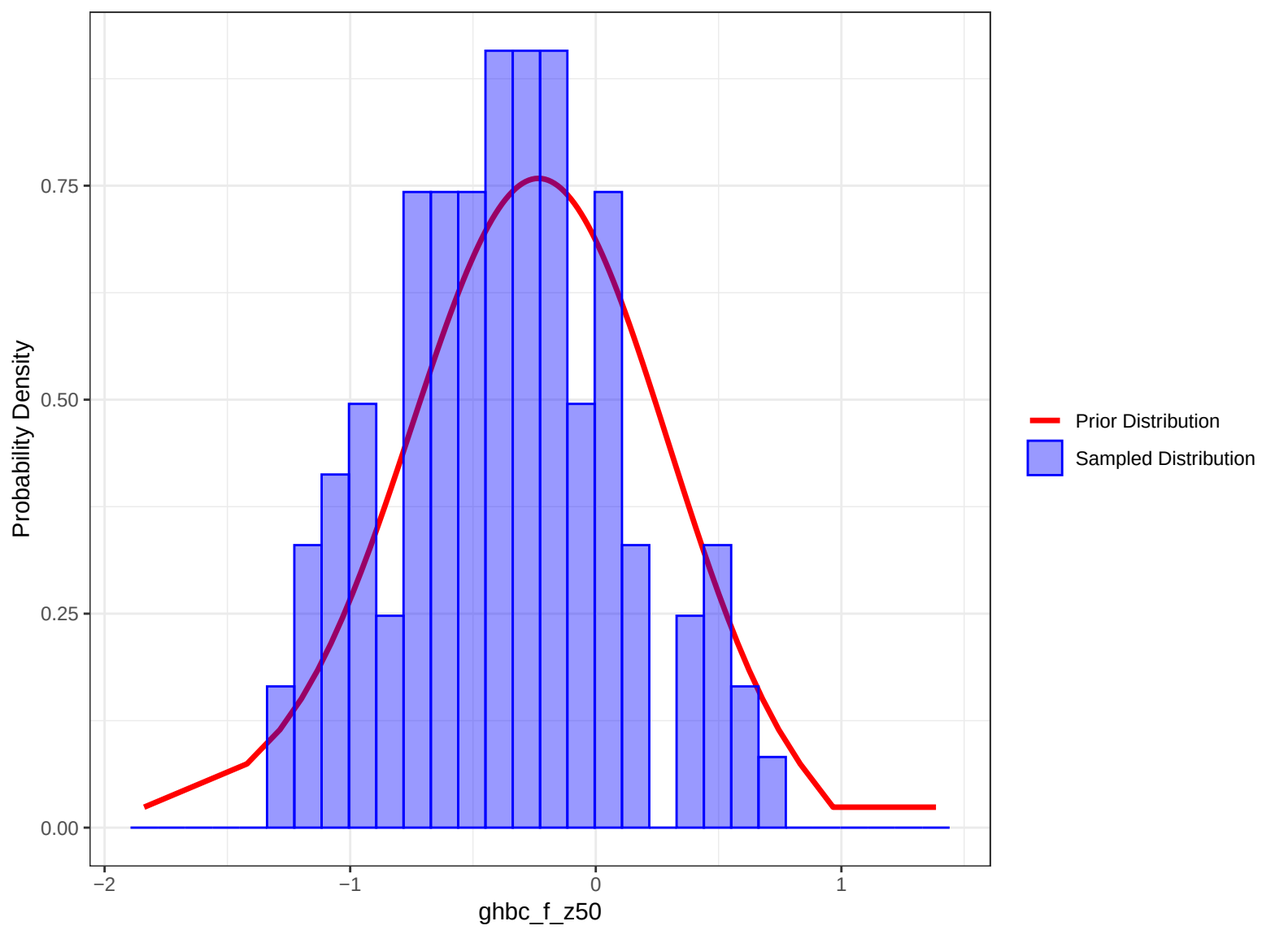

1.0
0.5
0.0
Probability Density
−3
−2
−1
0
ghbc_f_z45
Prior Distribution
Sampled Distribution

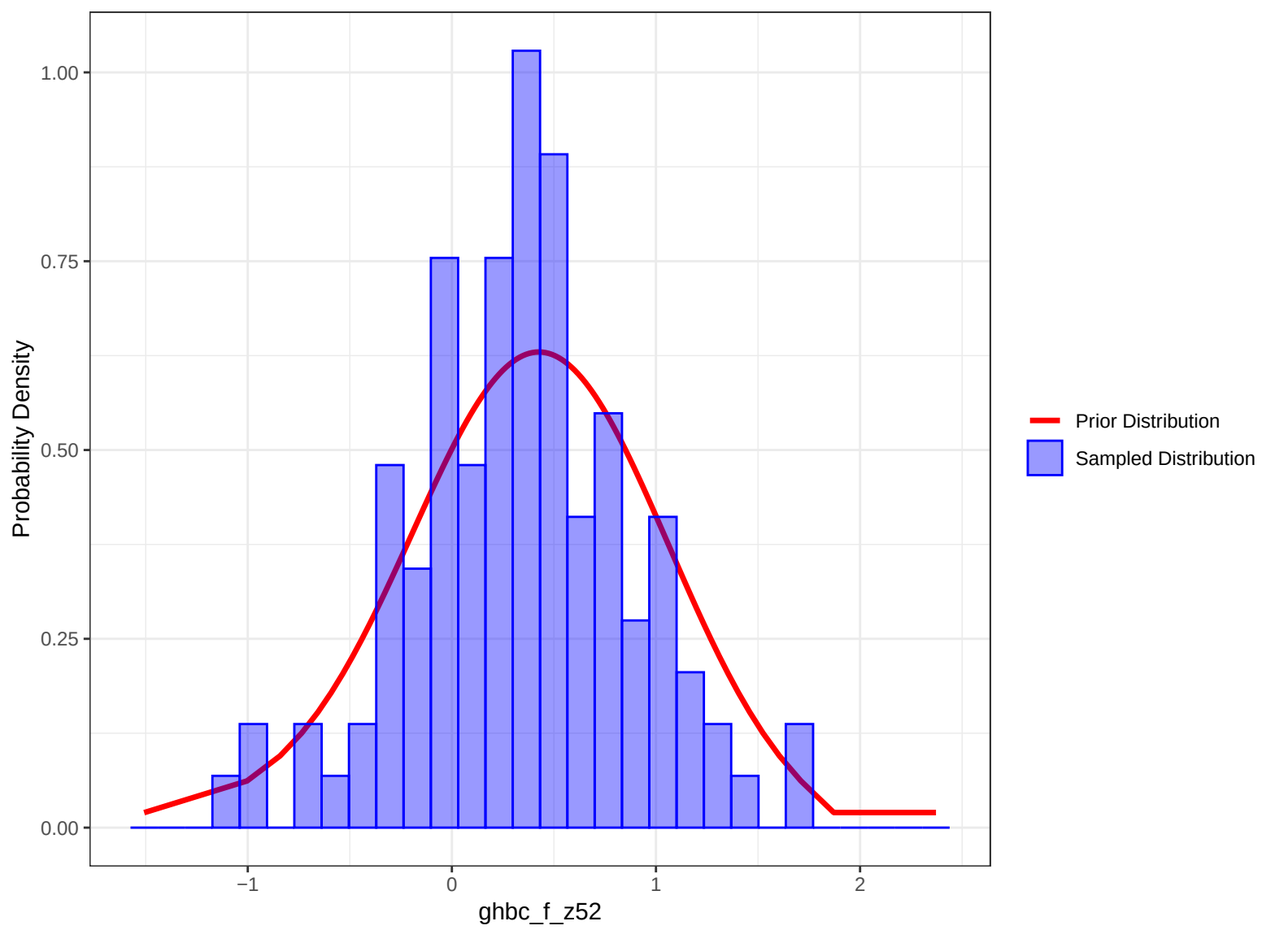

Probability Density
1.5
1.0
0.5
0.0
−2
−1
0
1
ghbc_f_z46
Prior Distribution
Sampled Distribution

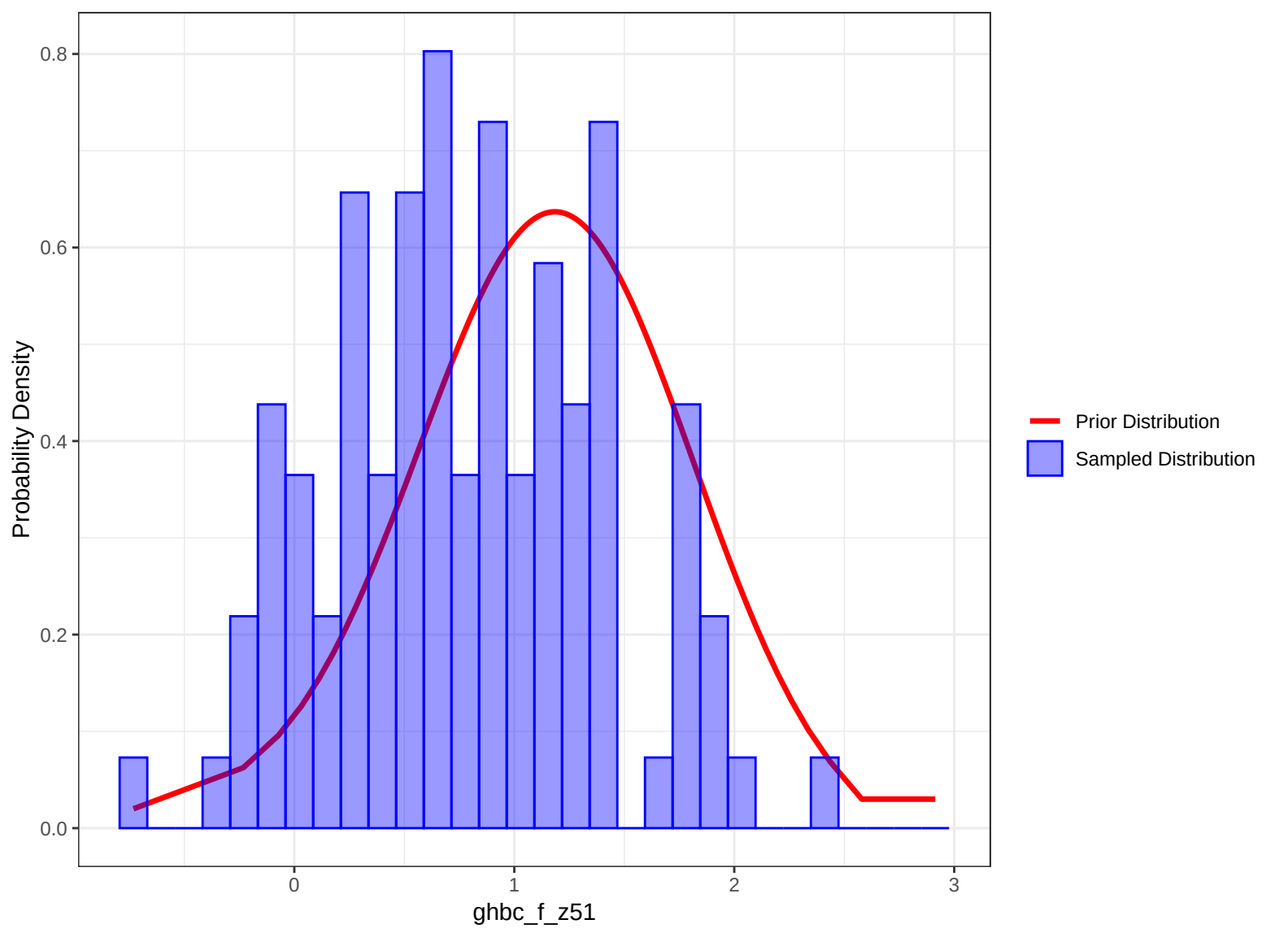

Probability Density
1.2
0.8
0.4
0.0
−2
−1
0
1
ghbc_f_z48
Prior Distribution
Sampled Distribution

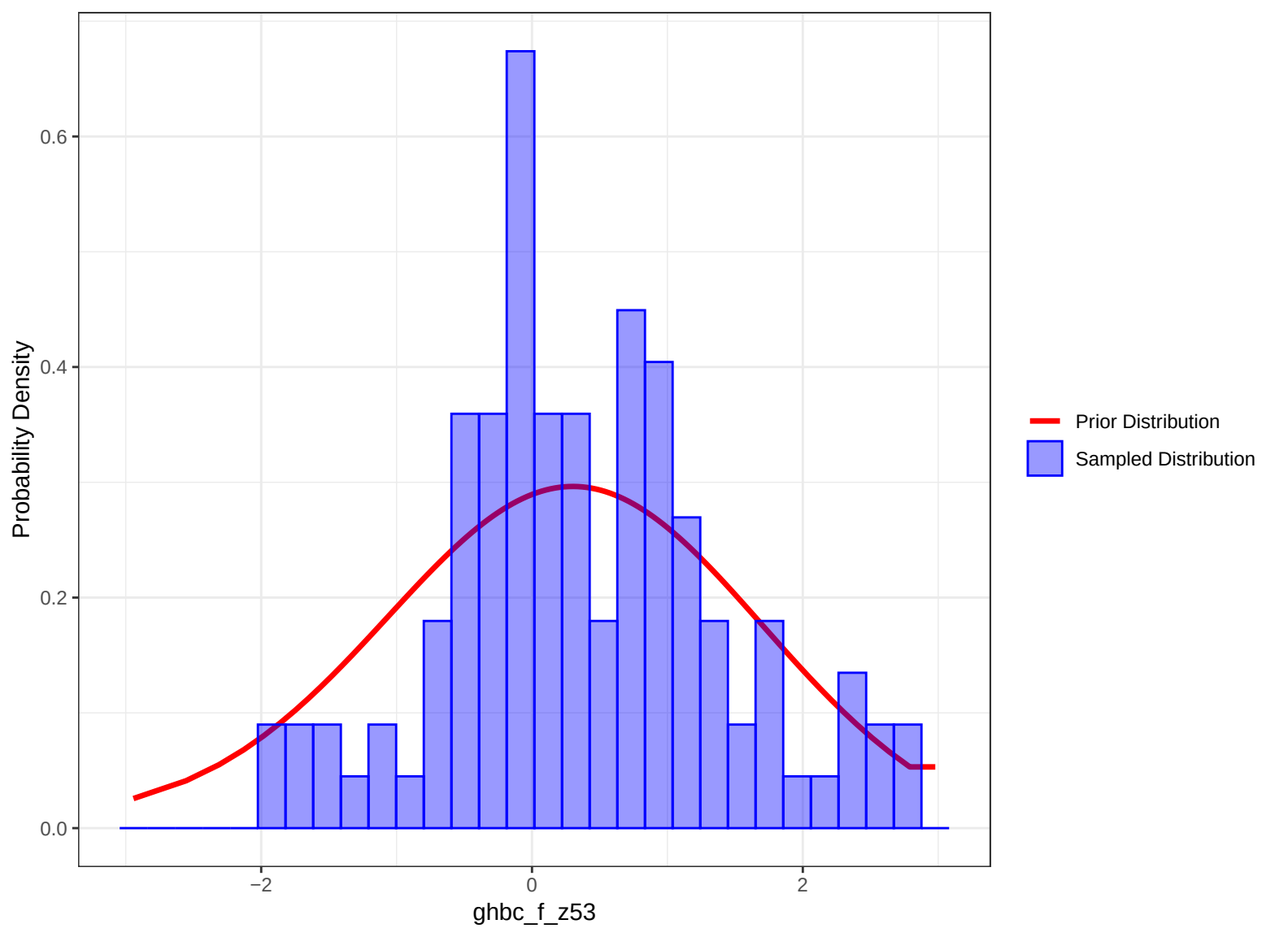

Probability Density
0.8
0.6
0.4
0.2
0.0
−2
−1
0
1
2
3
ghbc_f_z47
Prior Distribution
Sampled Distribution

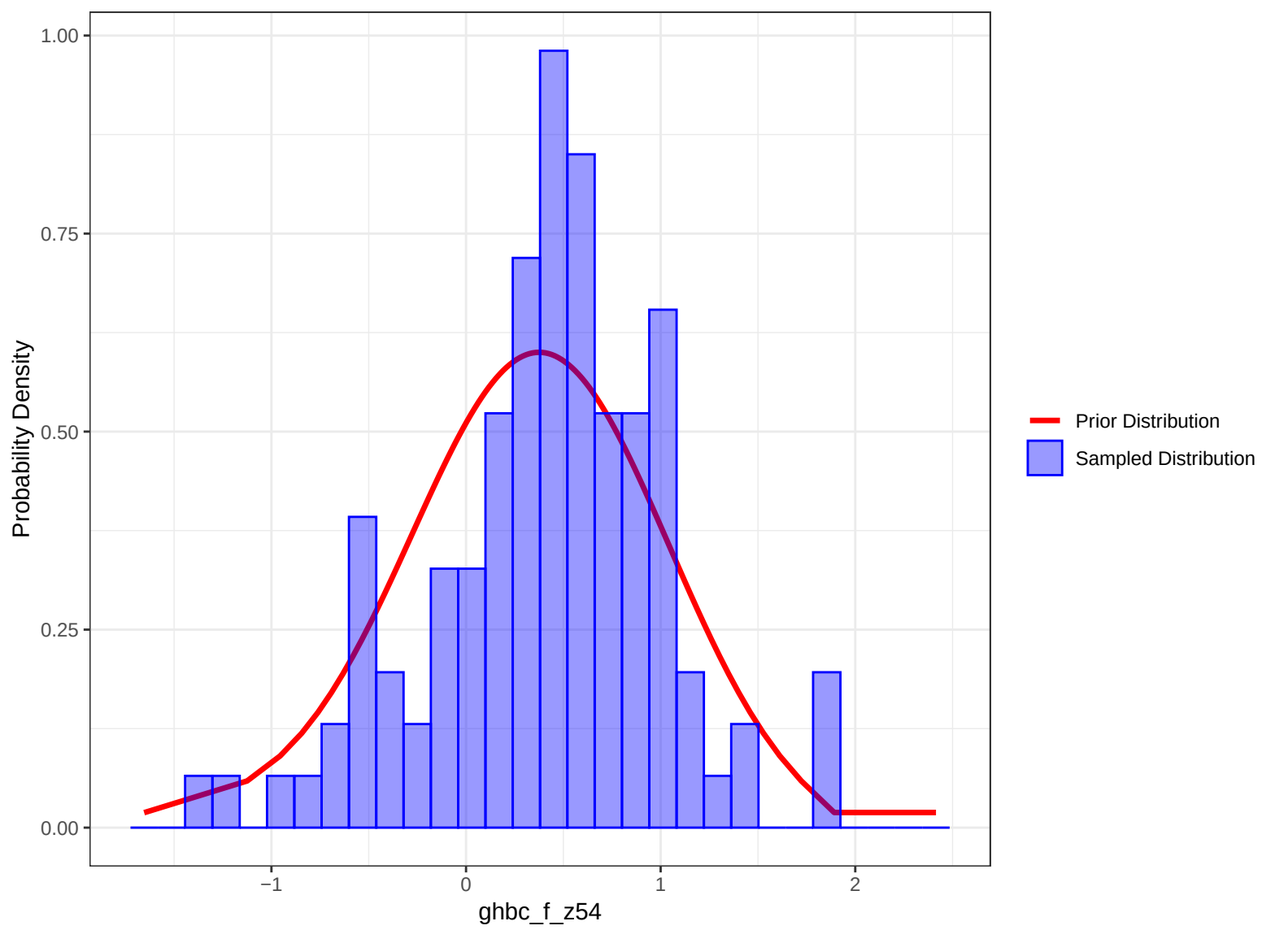

Probability Density
1.0
0.5
0.0
−3
−2
−1
0
1
ghbc_f_z49
Prior Distribution
Sampled Distribution

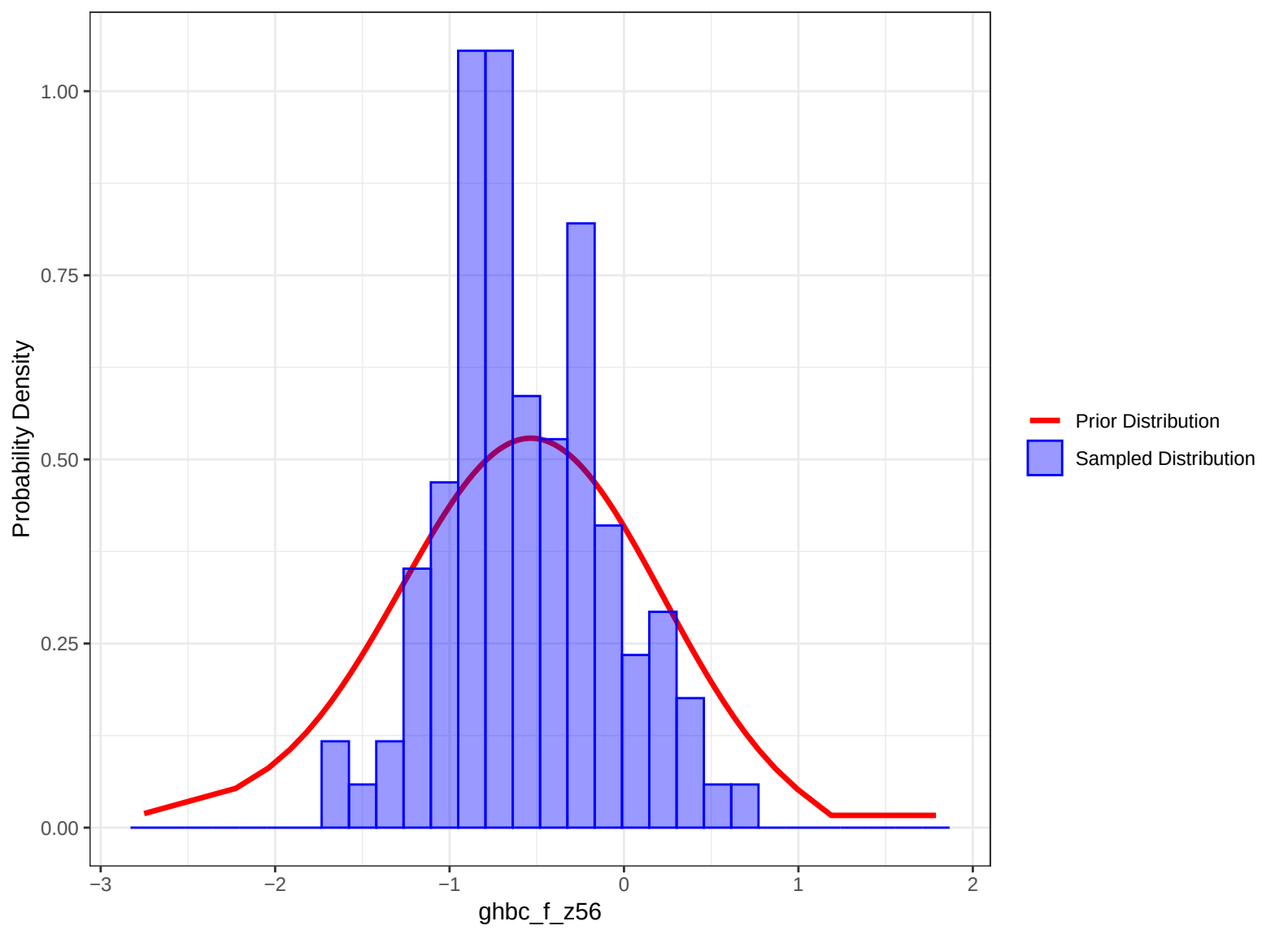

Probability Density
0.00
0.25
0.50
0.75
−2
−1
0
1
ghbc_f_z50
Prior Distribution
Sampled Distribution

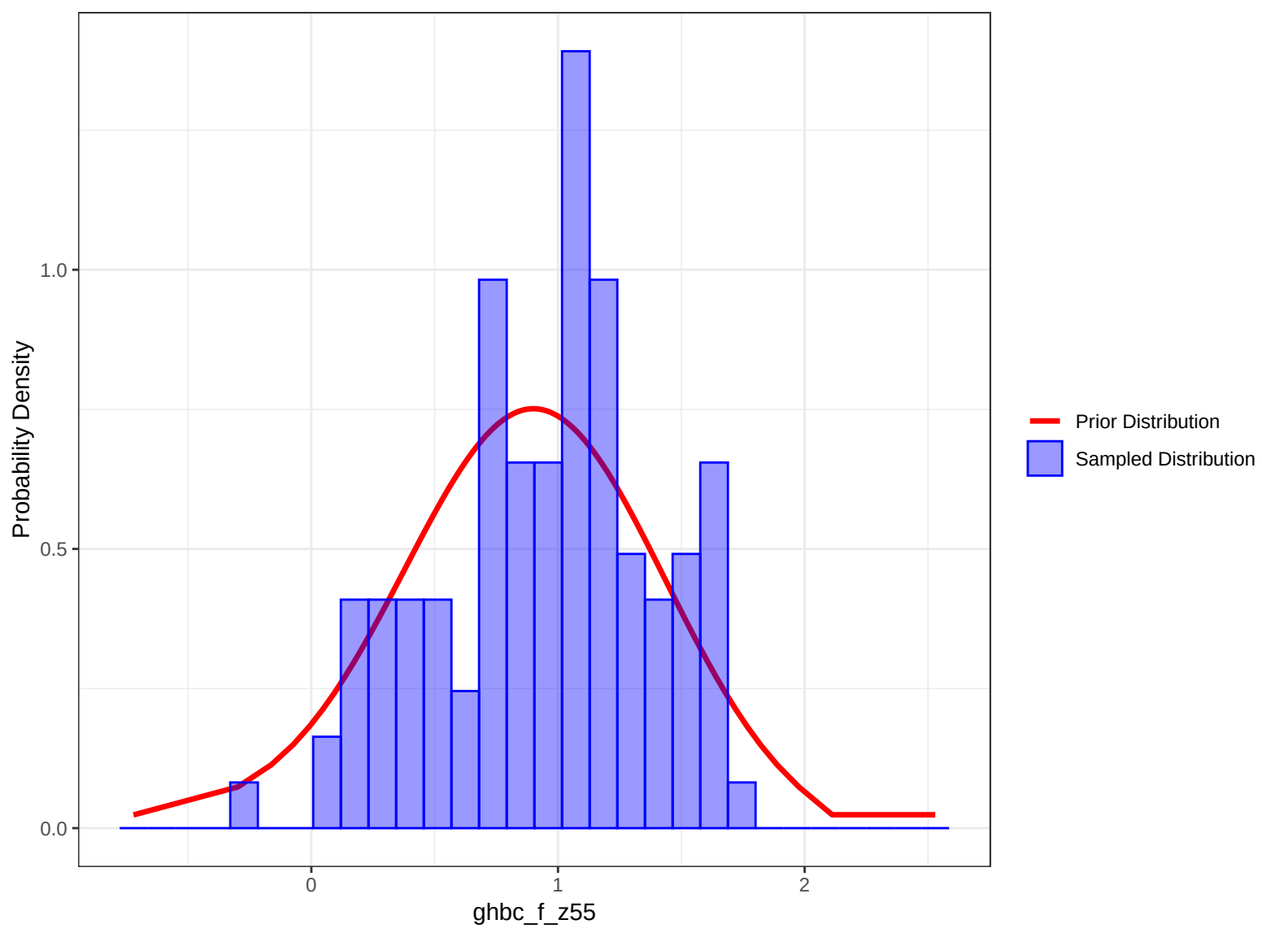

Probability Density
0.00
0.25
0.50
0.75
1.00
−1
0
1
2
ghbc_f_z52
Prior Distribution
Sampled Distribution

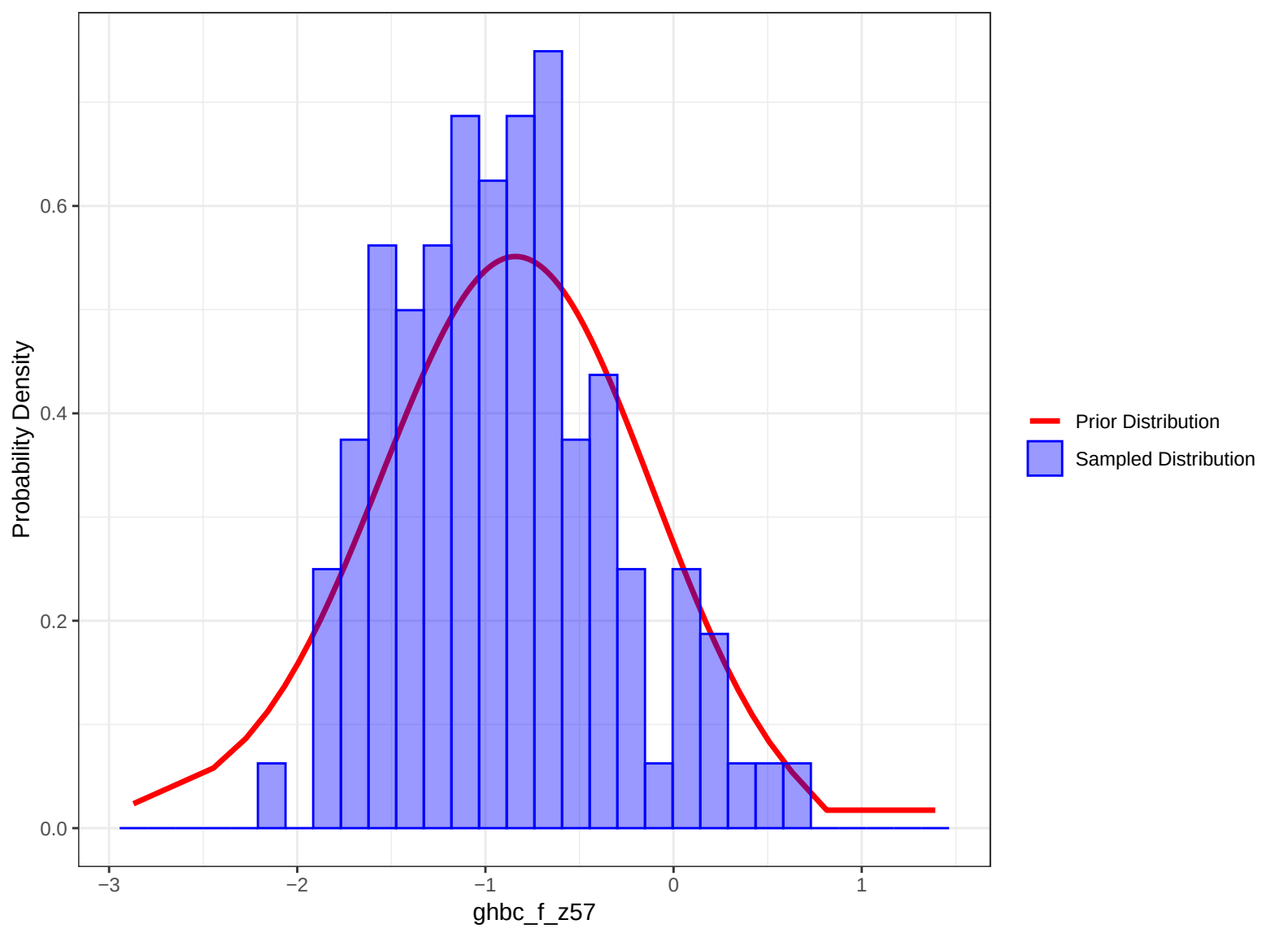

Probability Density
0.0
0.2
0.4
0.6
0.8
0
1
2
3
ghbc_f_z51
Prior Distribution
Sampled Distribution

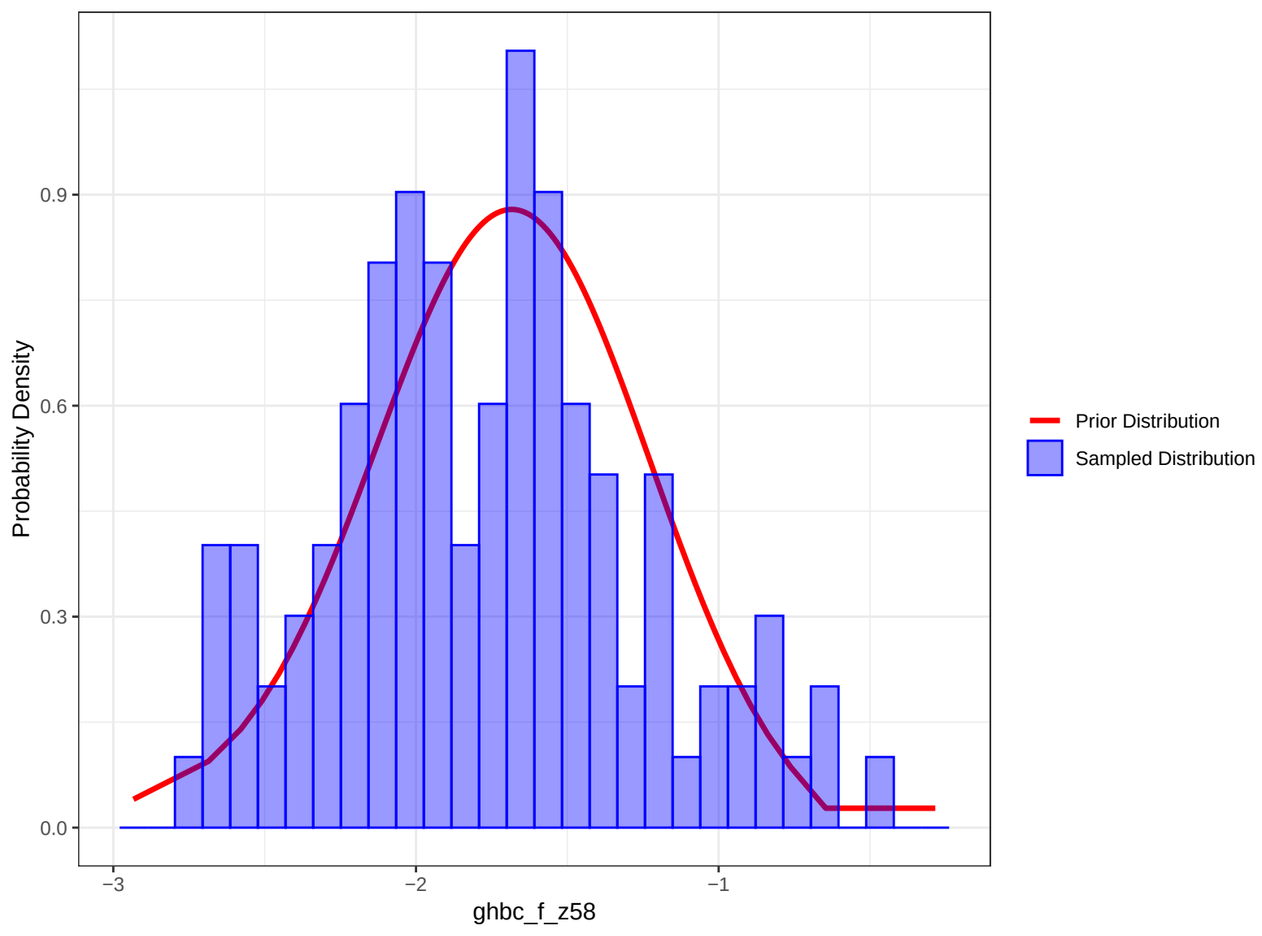

Probability Density
0.0
0.2
0.4
0.6
−2
0
2
ghbc_f_z53
Prior Distribution
Sampled Distribution

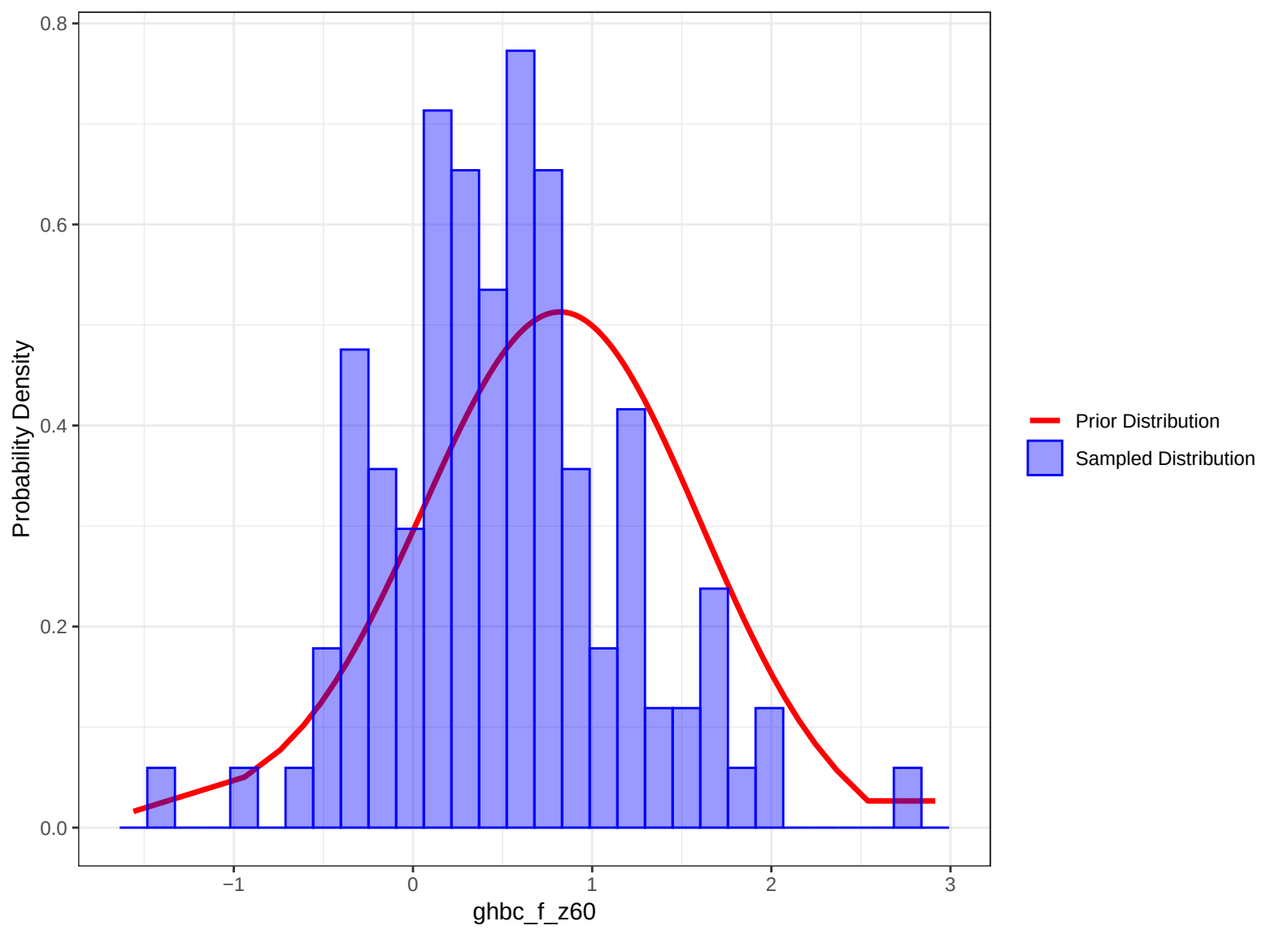

1.00
0.75
0.50
0.25
0.00
Probability Density
−1
0
1
2
ghbc_f_z54
Prior Distribution
Sampled Distribution

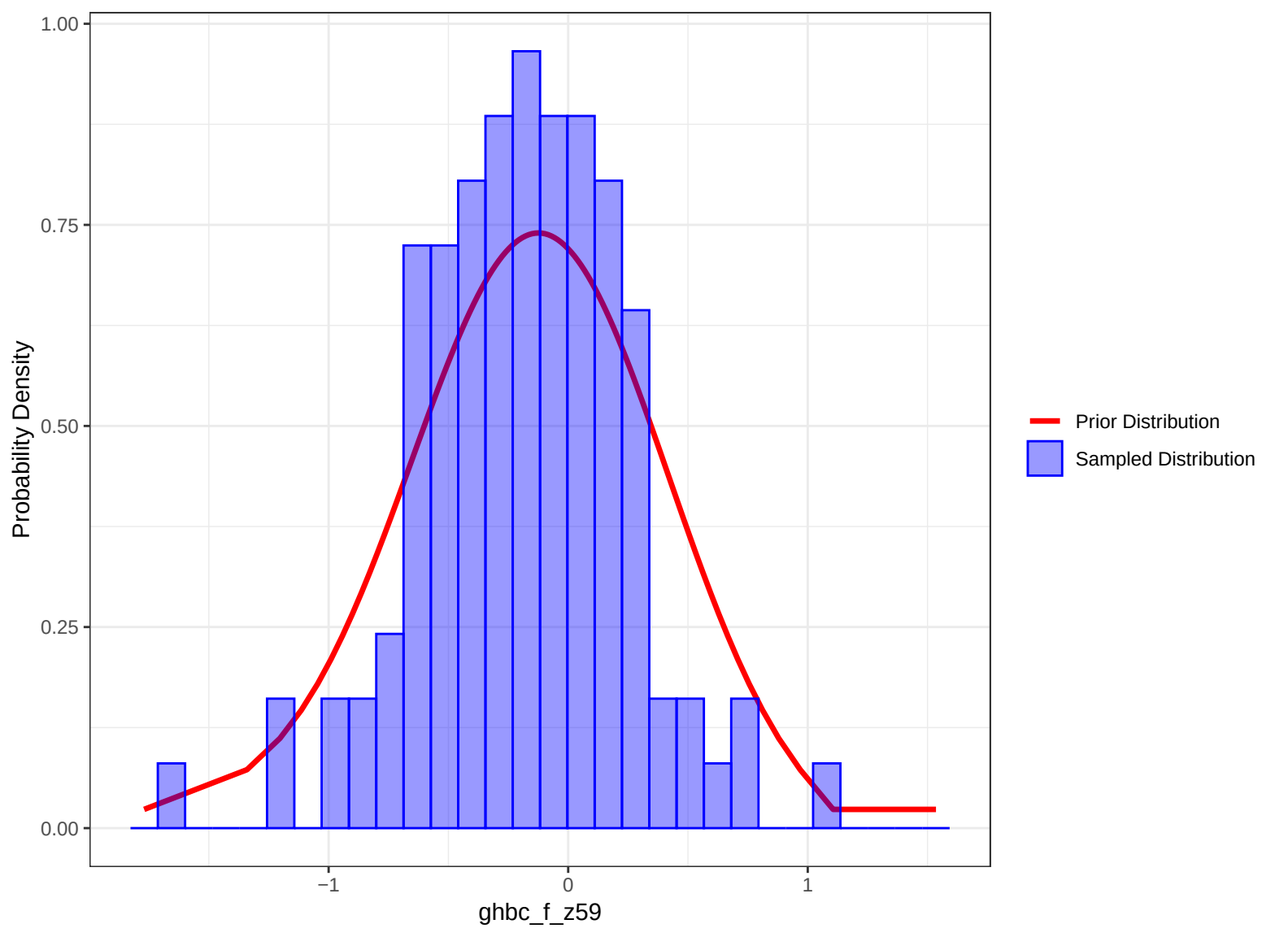

1.00
0.75
0.50
0.25
0.00
Probability Density
−3
−2
−1
0
1
2
ghbc_f_z56
Prior Distribution
Sampled Distribution

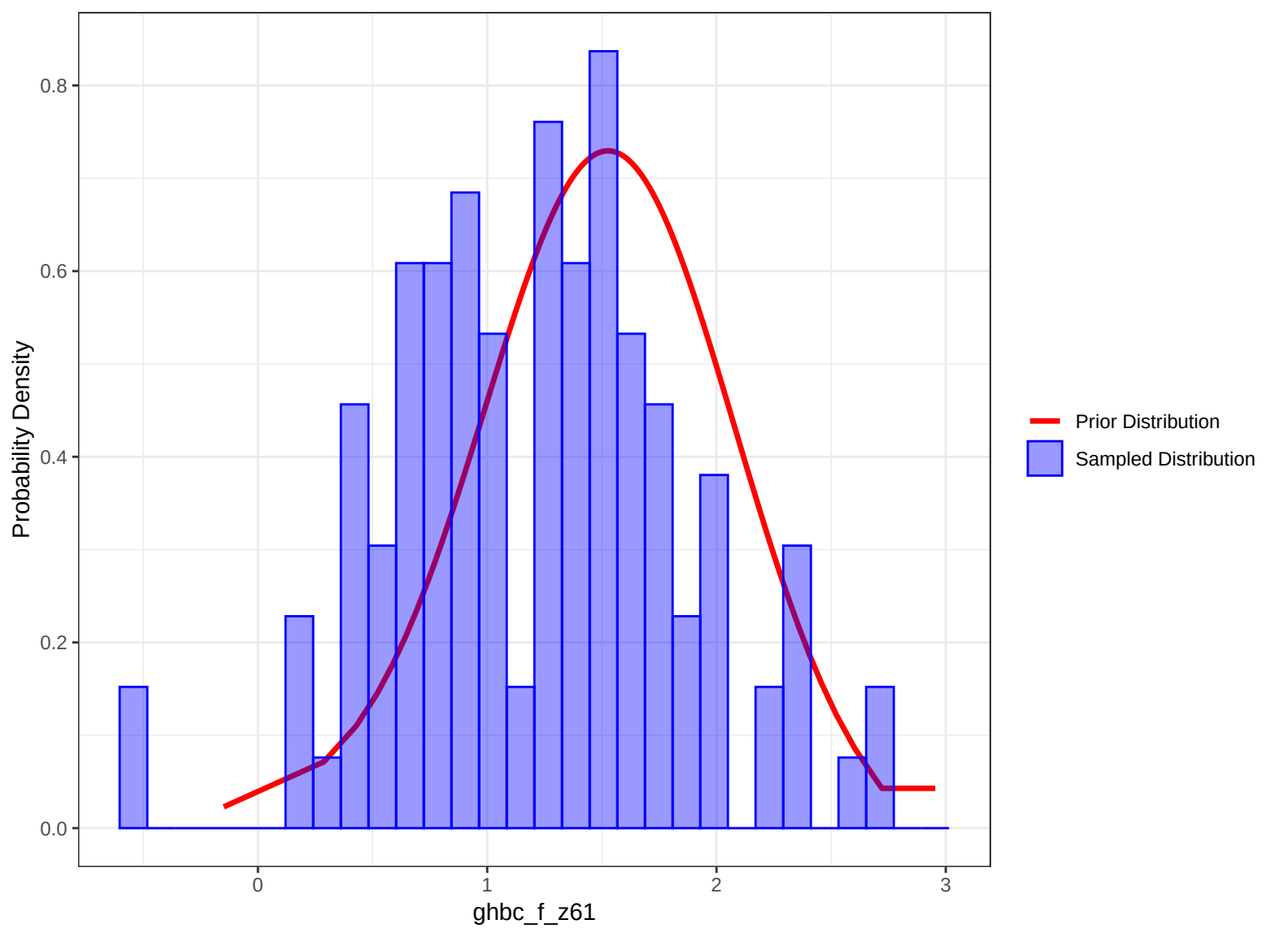

1.0
0.5
0.0
Probability Density
0
1
2
ghbc_f_z55
Prior Distribution
Sampled Distribution

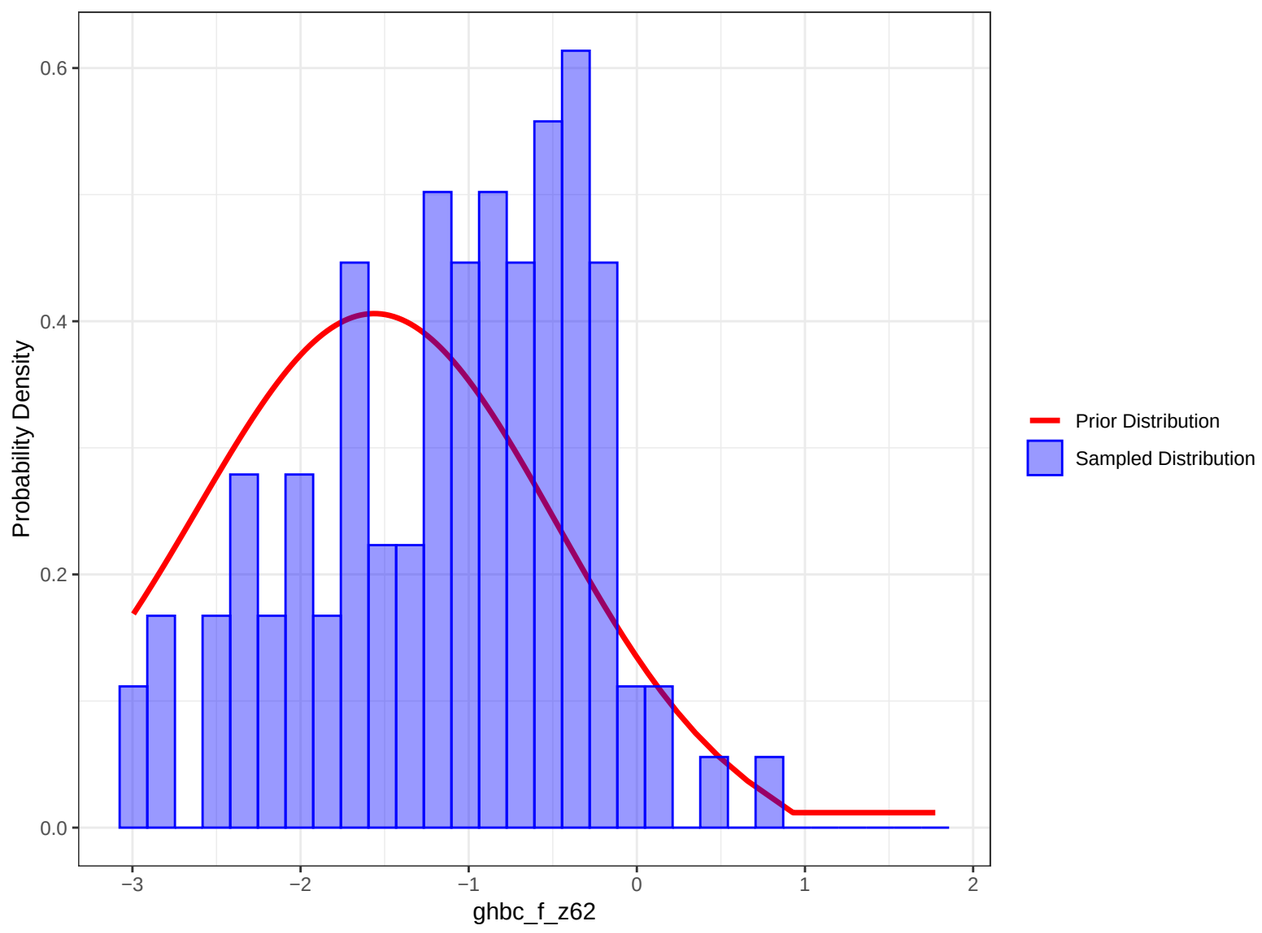

0.6
0.4
0.2
0.0
Probability Density
−3
−2
−1
0
1
ghbc_f_z57
Prior Distribution
Sampled Distribution

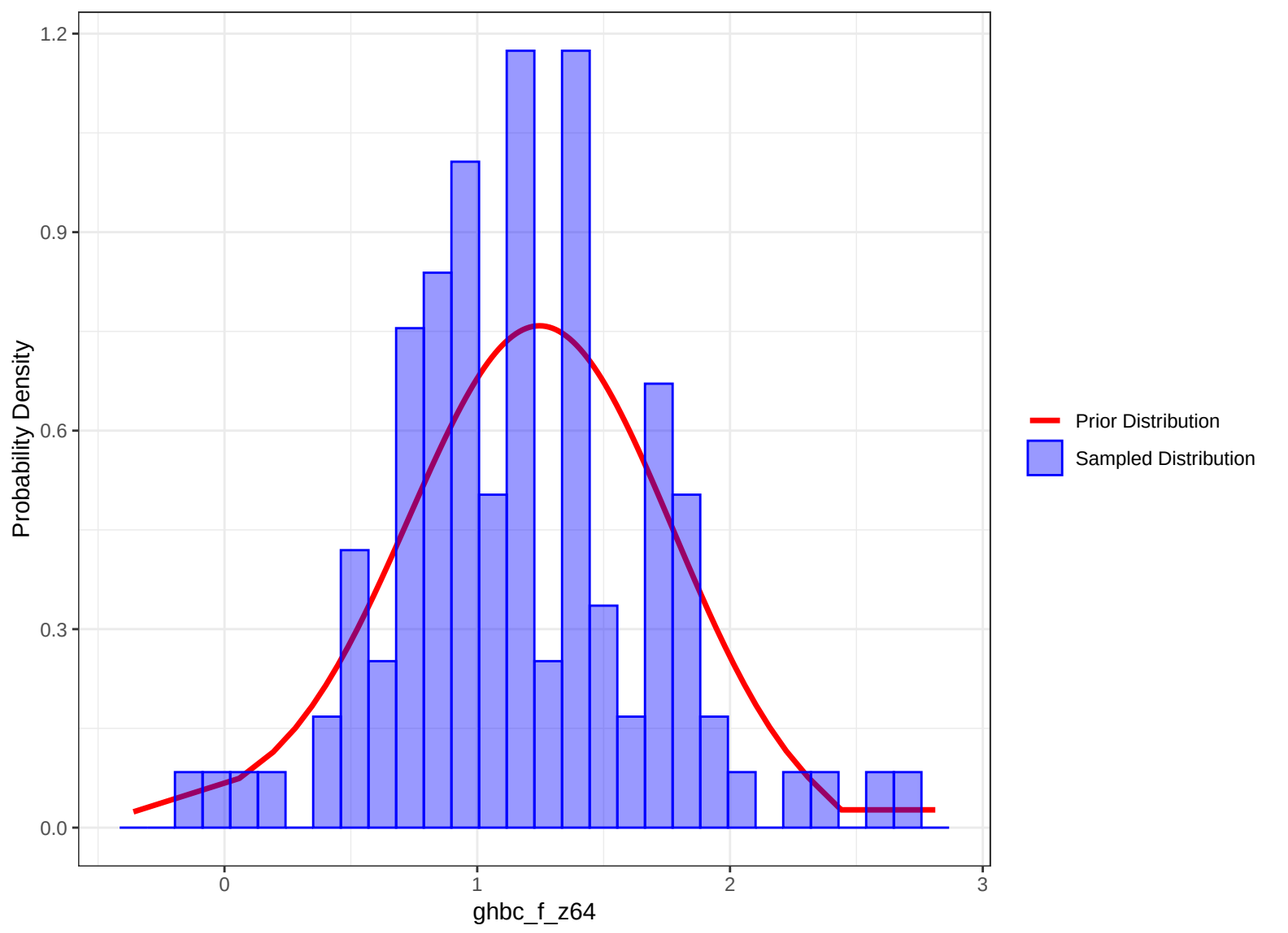

Probability Density
0.0
0.3
0.6
0.9
−3
−2
−1
ghbc_f_z58
Prior Distribution
Sampled Distribution

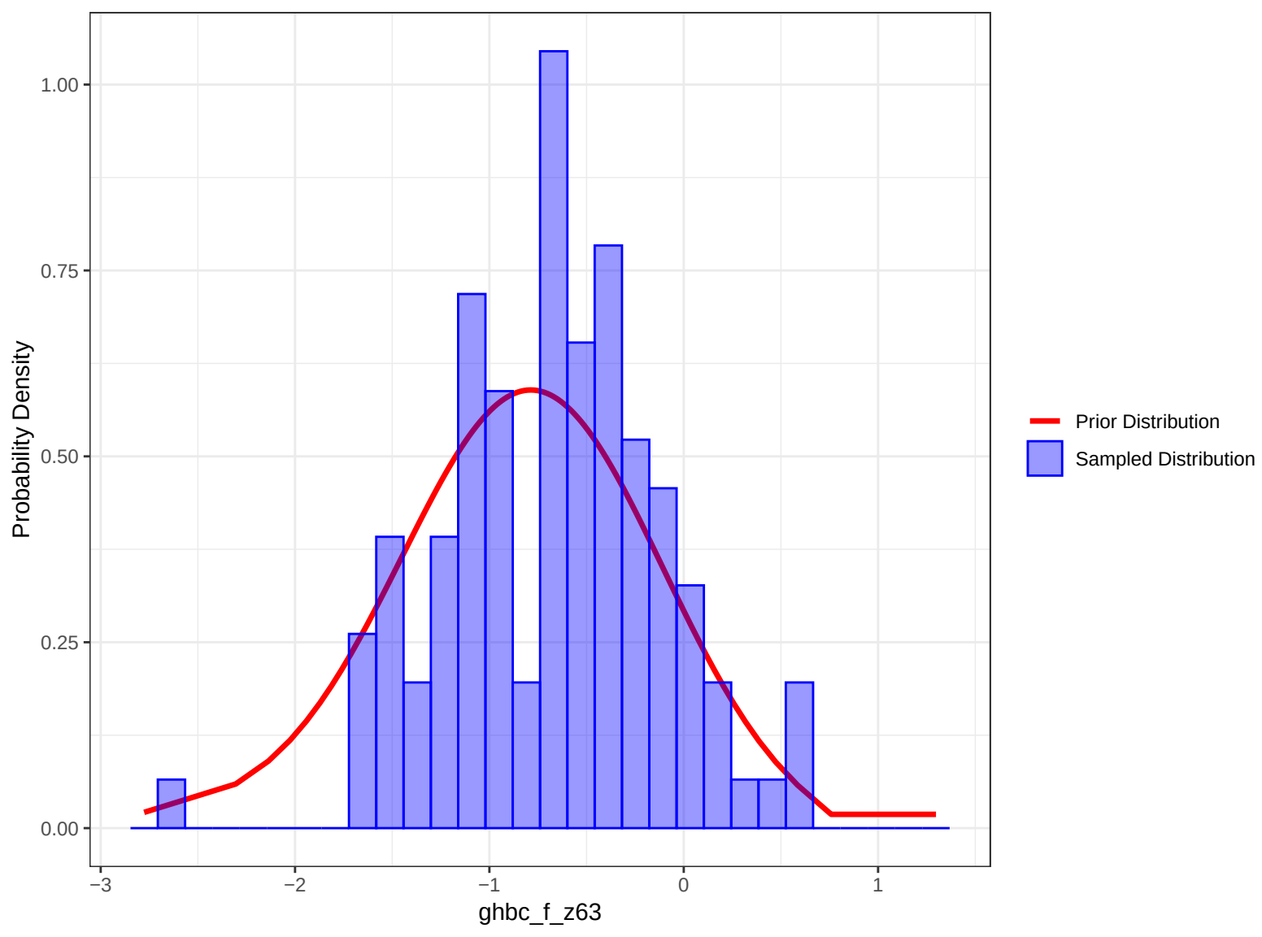

Probability Density
0.0
0.2
0.4
0.6
0.8
−1
0
1
2
3
ghbc_f_z60
Prior Distribution
Sampled Distribution

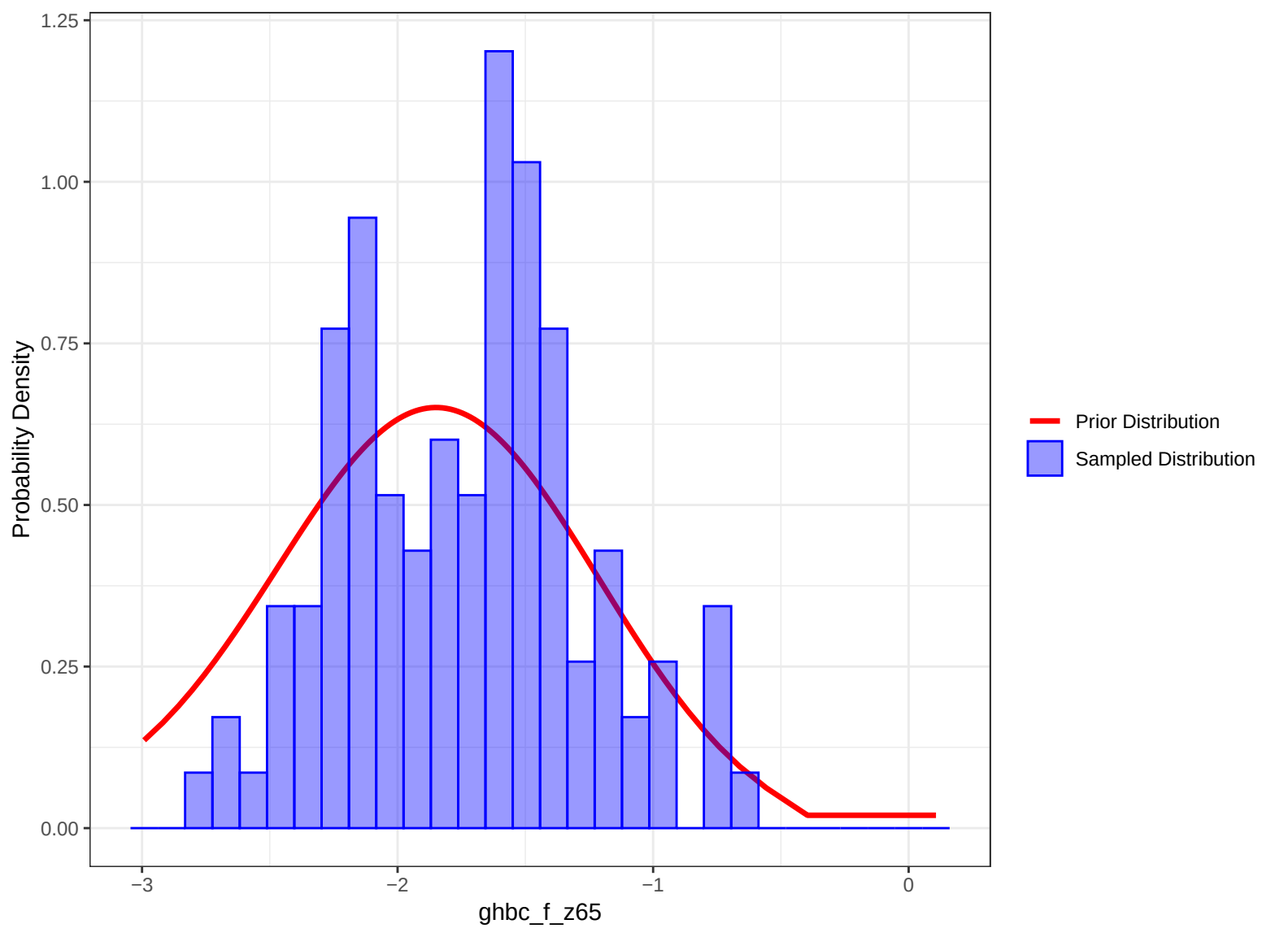

Probability Density
0.00
0.25
0.50
0.75
1.00
−1
0
1
ghbc_f_z59
Prior Distribution
Sampled Distribution

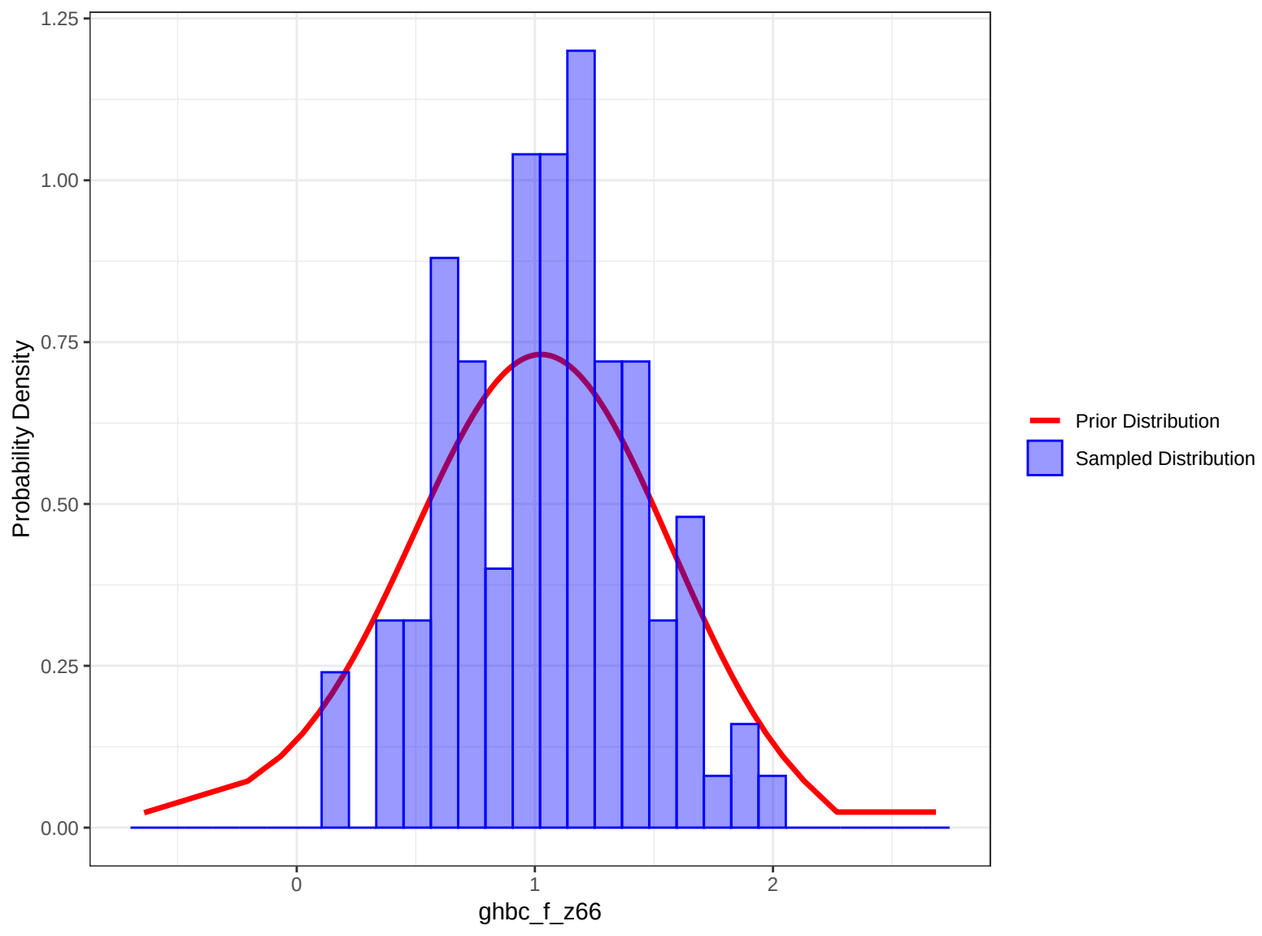

Probability Density
0.0
0.2
0.4
0.6
0.8
0
1
2
3
ghbc_f_z61
Prior Distribution
Sampled Distribution

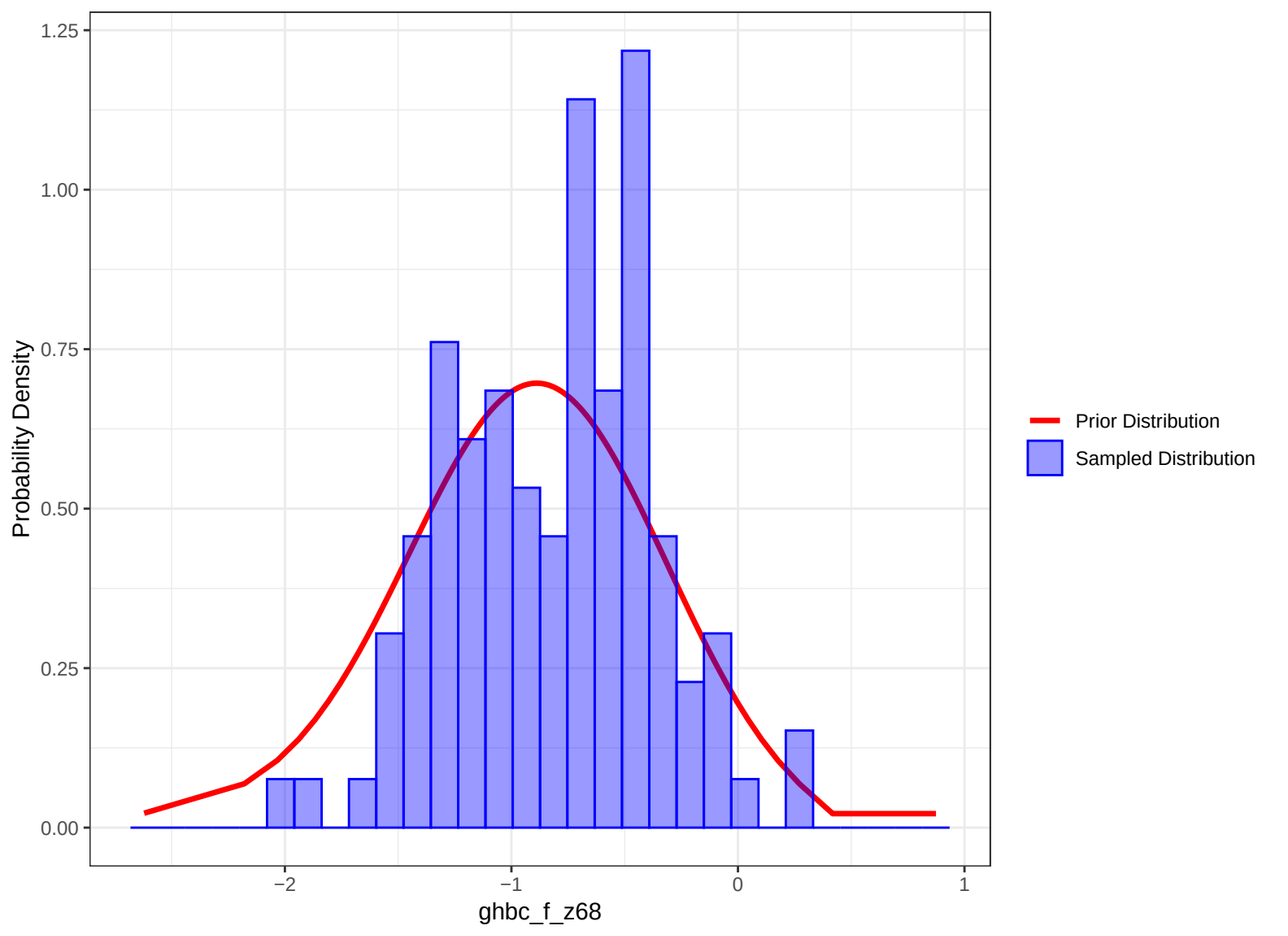

Probability Density
0.0
0.2
0.4
0.6
−3
−2
−1
0
1
2
ghbc_f_z62
Prior Distribution
Sampled Distribution

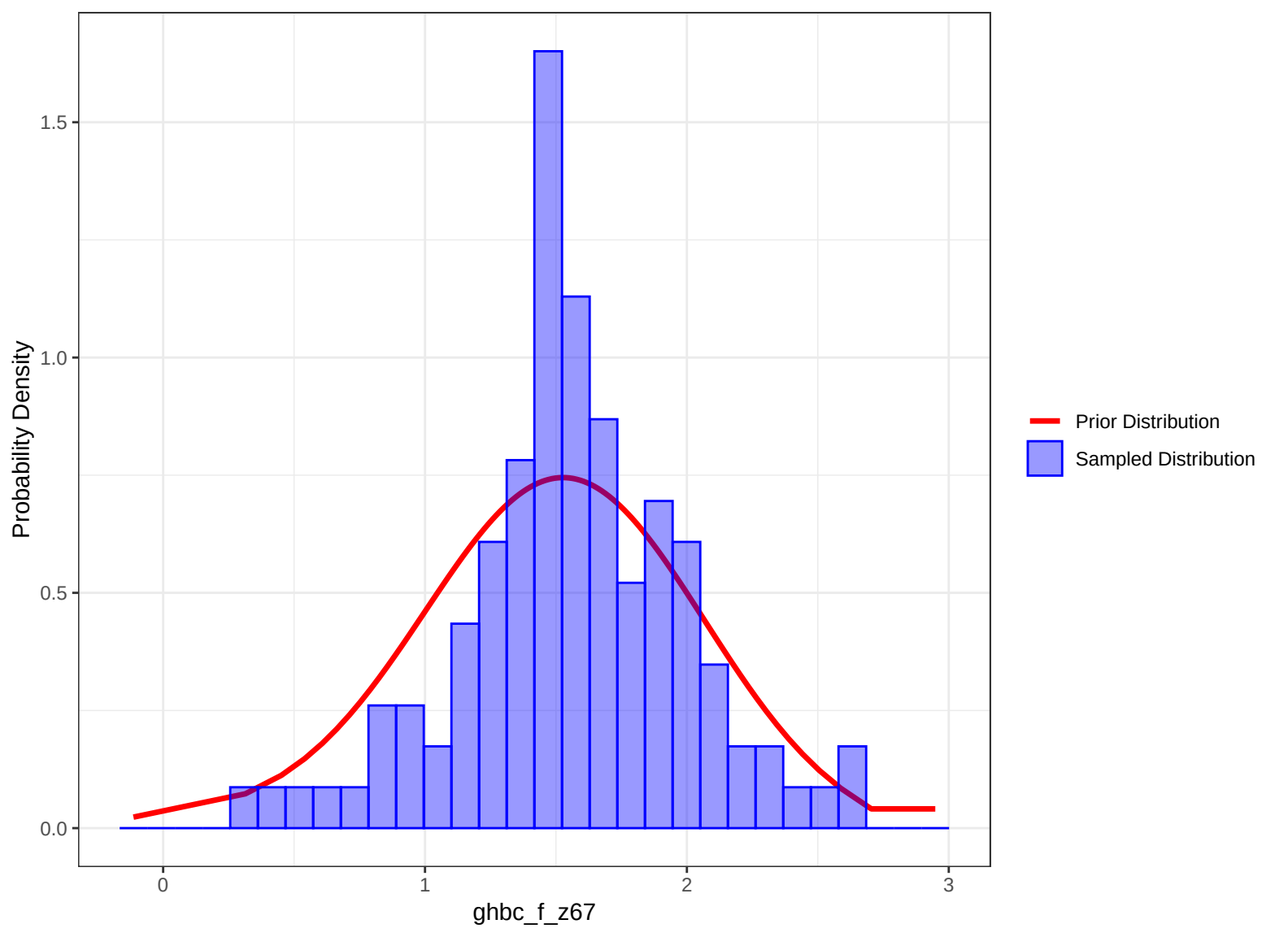

Probability Density
0.0
0.3
0.6
0.9
1.2
0
1
2
3
ghbc_f_z64
Prior Distribution
Sampled Distribution

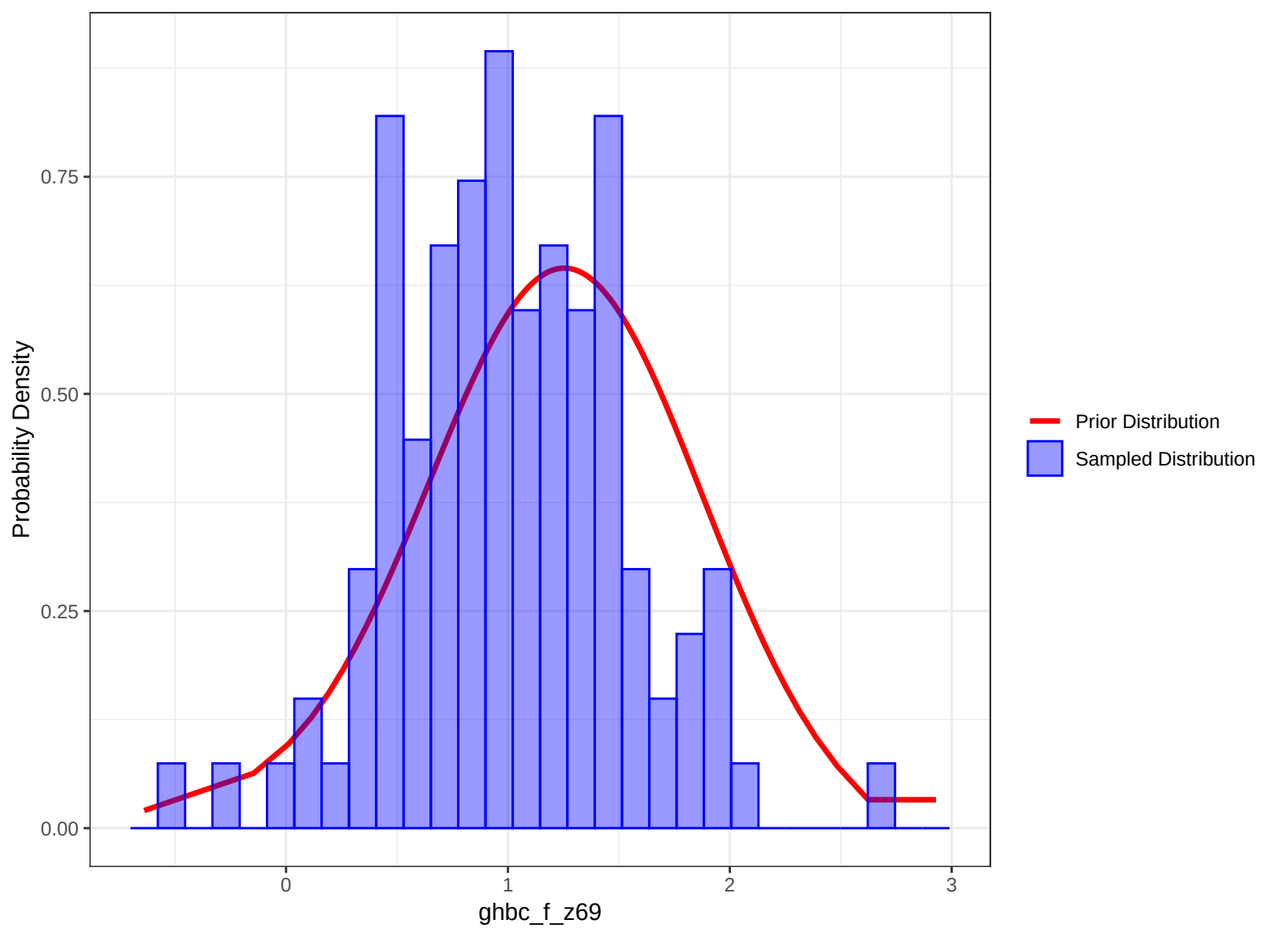

Probability Density
0.00
0.25
0.50
0.75
1.00
−3
−2
−1
0
1
ghbc_f_z63
Prior Distribution
Sampled Distribution

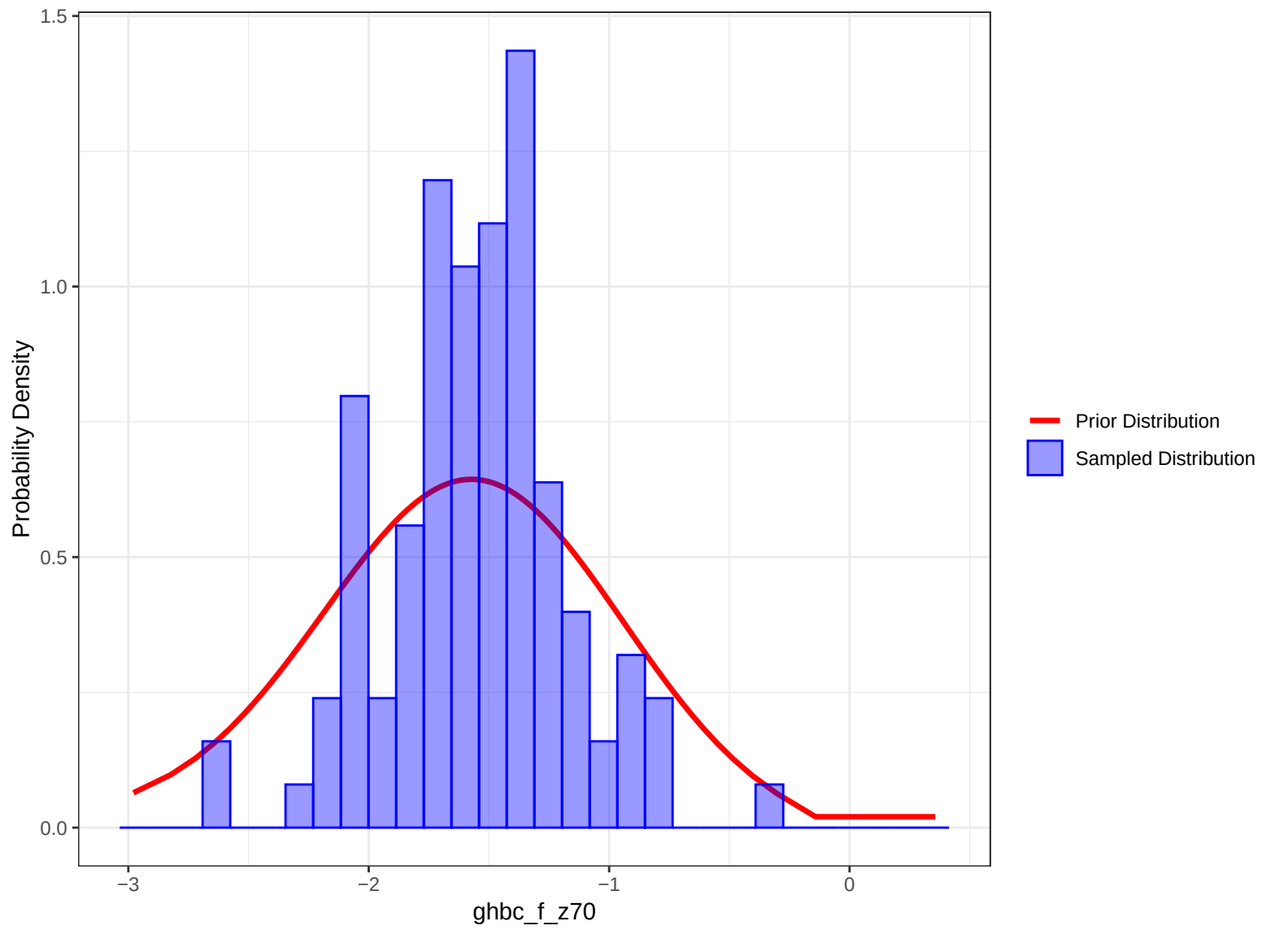

Probability Density
0.00
0.25
0.50
0.75
1.00
1.25
−3
−2
−1
0
ghbc_f_z65
Prior Distribution
Sampled Distribution

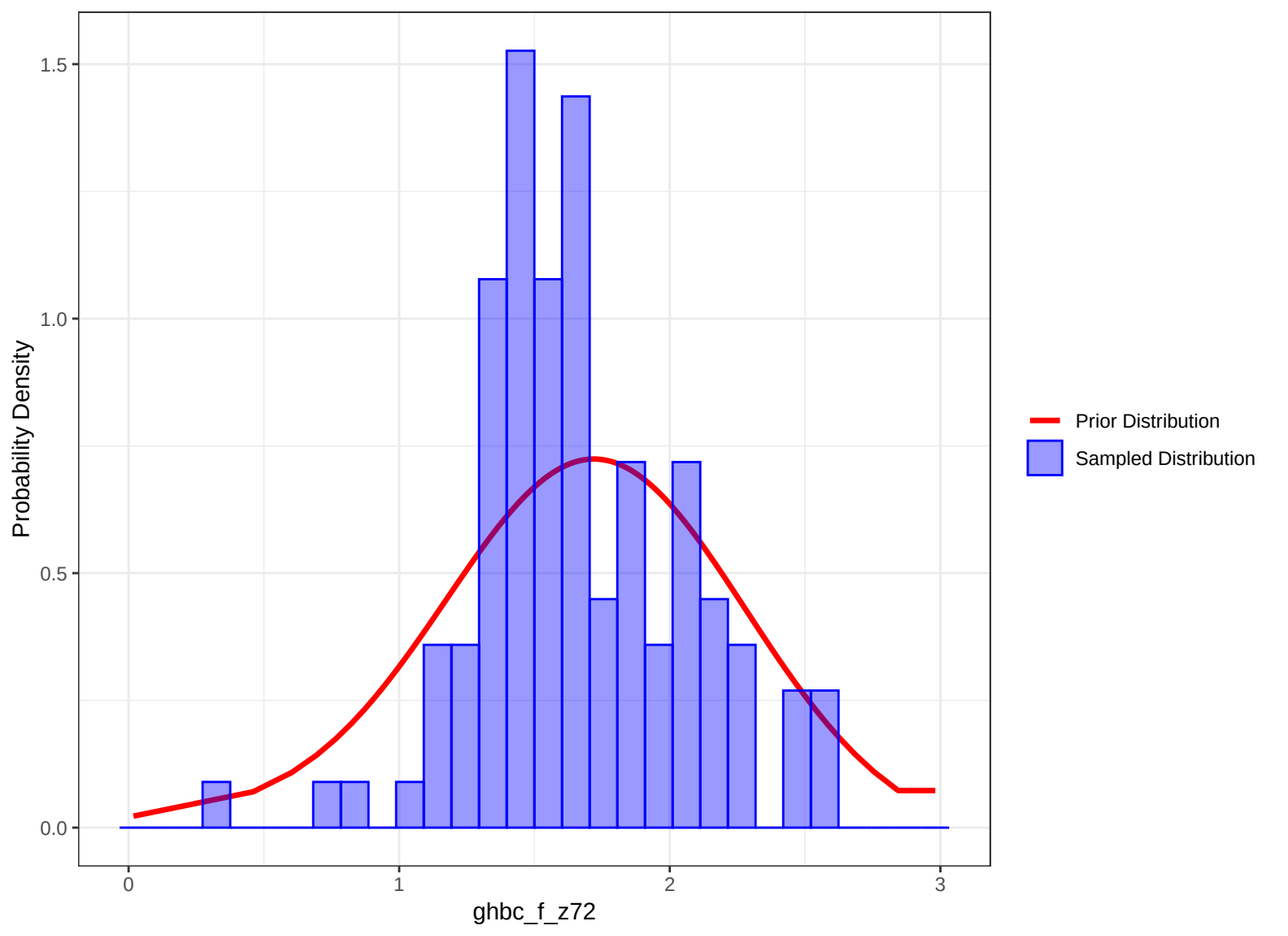

Probability Density
1.25
1.00
0.75
0.50
0.25
0.00
0
1
2
ghbc_f_z66
Prior Distribution
Sampled Distribution

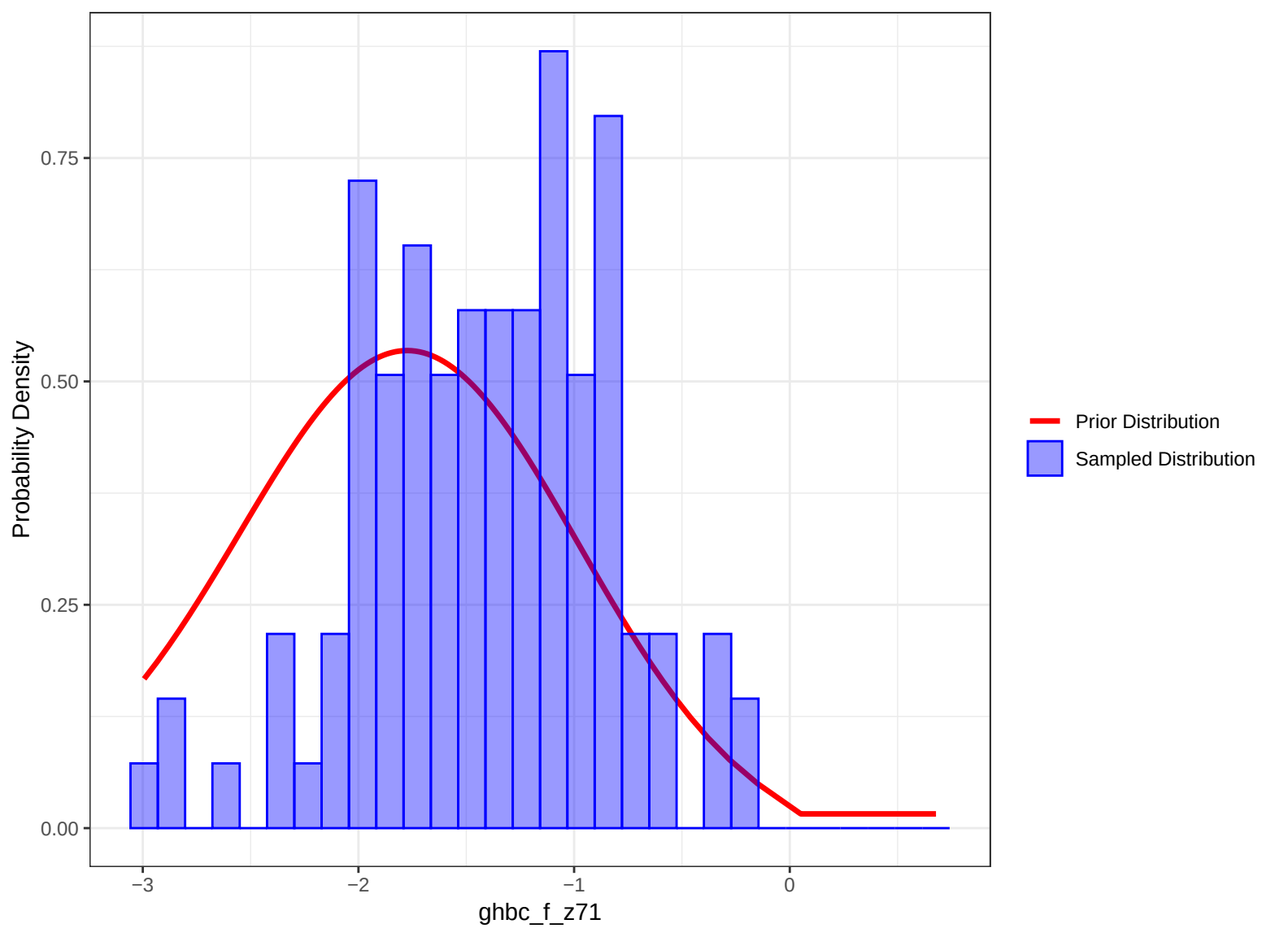

Probability Density
1.25
1.00
0.75
0.50
0.25
0.00
−2
−1
0
1
ghbc_f_z68
Prior Distribution
Sampled Distribution

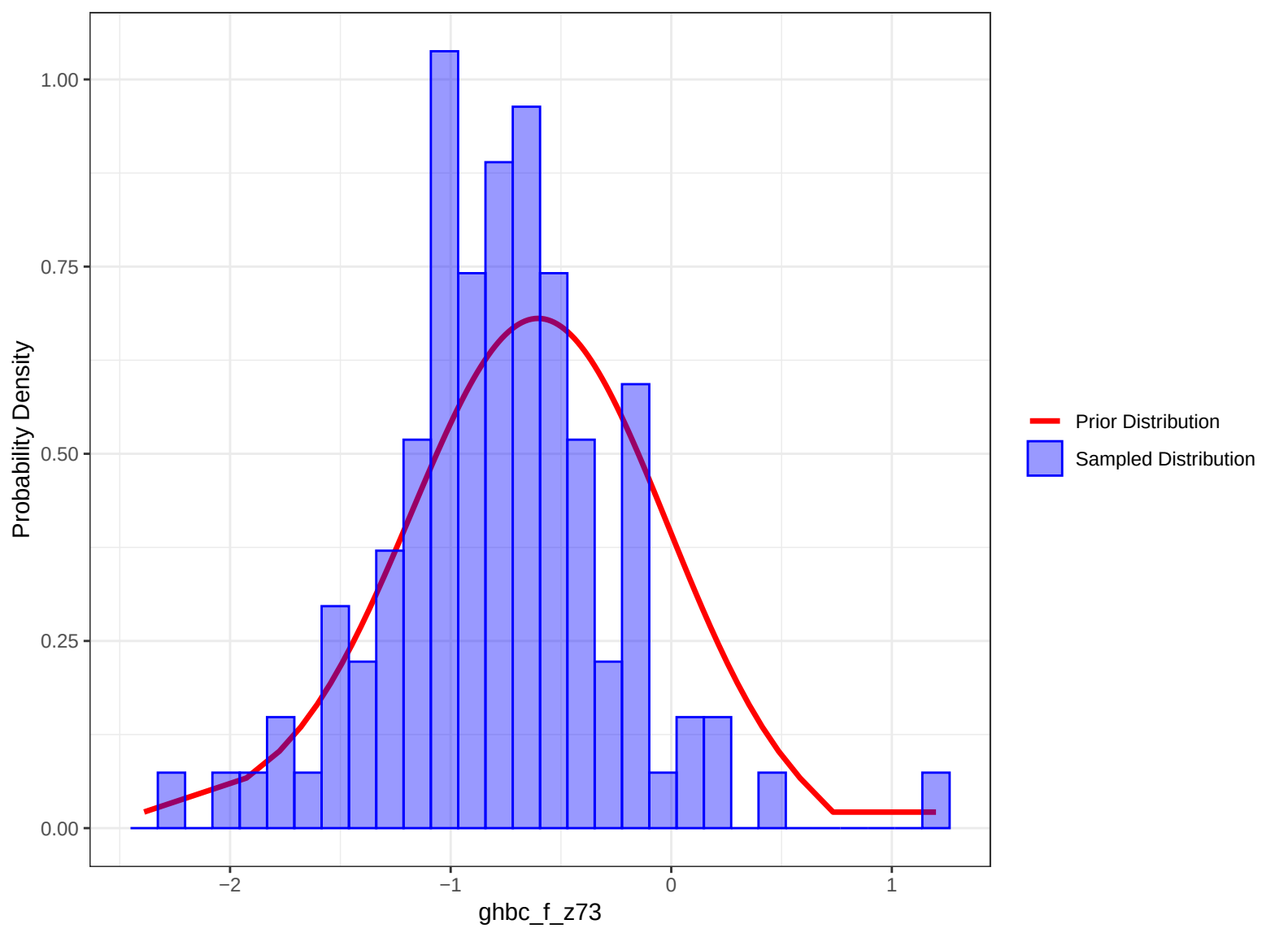

Probability Density
1.5
1.0
0.5
0.0
0
1
2
3
ghbc_f_z67
Prior Distribution
Sampled Distribution


Probability Density
0.75
0.50
0.25
0.00
0
1
2
3
ghbc_f_z69
Prior Distribution
Sampled Distribution


1.5
1.0
0.5
0.0
Probability Density
−3
−2
−1
0
ghbc_f_z70
Prior Distribution
Sampled Distribution


1.5
1.0
0.5
0.0
Probability Density
0
1
2
3
ghbc_f_z72
Prior Distribution
Sampled Distribution


0.75
0.50
0.25
0.00
Probability Density
−3
−2
−1
0
ghbc_f_z71
Prior Distribution
Sampled Distribution


1.00
0.75
0.50
0.25
0.00
Probability Density
−2
−1
0
1
ghbc_f_z73
Prior Distribution
Sampled Distribution

Appendix D Sensitivity Analysis Plots

Isaac Downs Extension Project

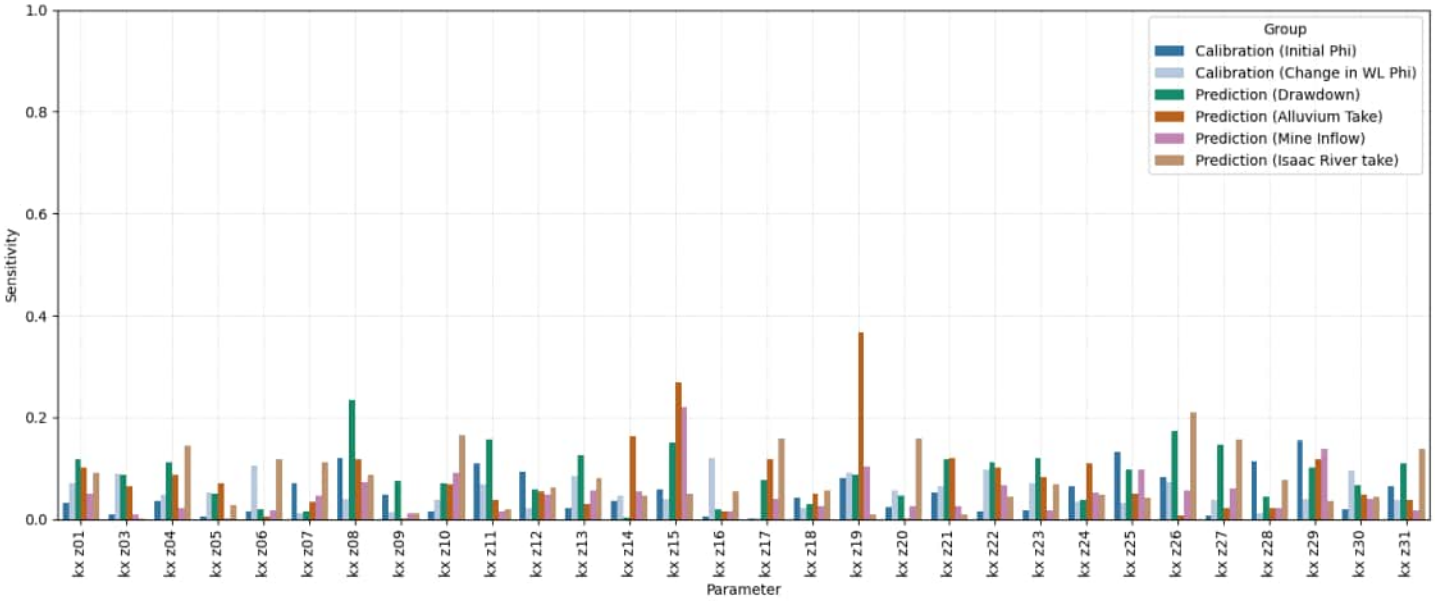
Groundwater Modelling Calibration and Prediction Report

Stanmore ID Extension Pty Ltd

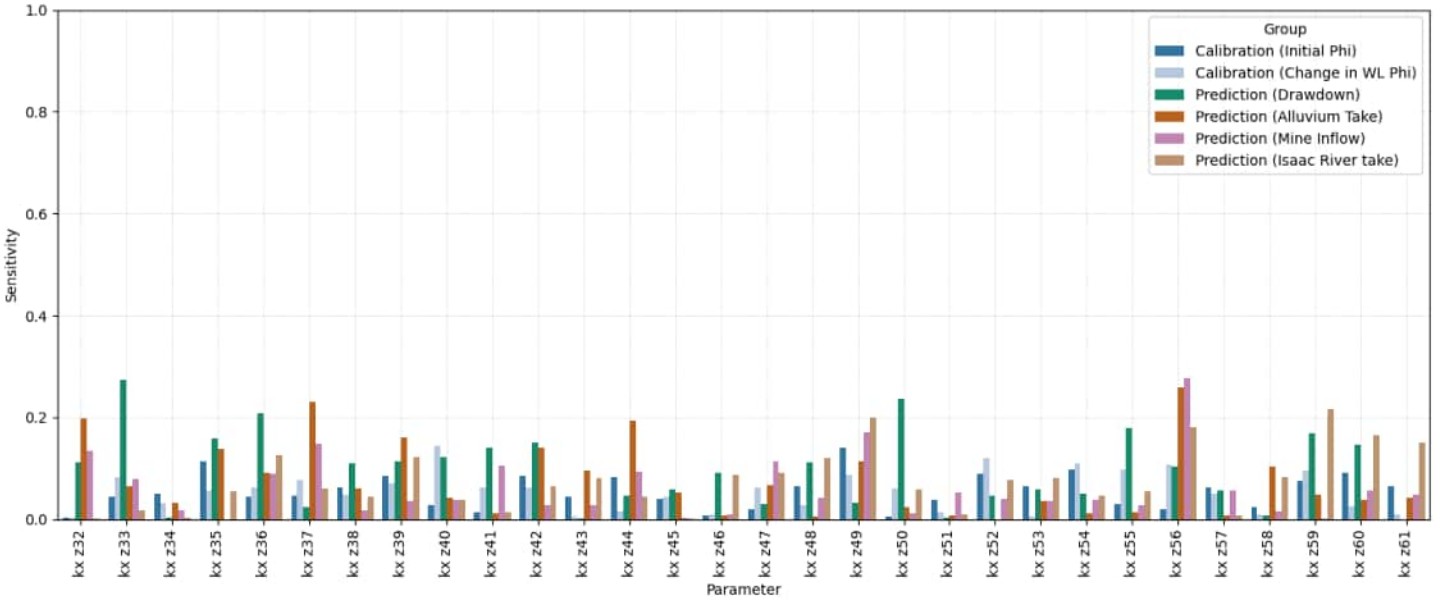
SLR Project No.: 620.041537.00006

29 May 2026

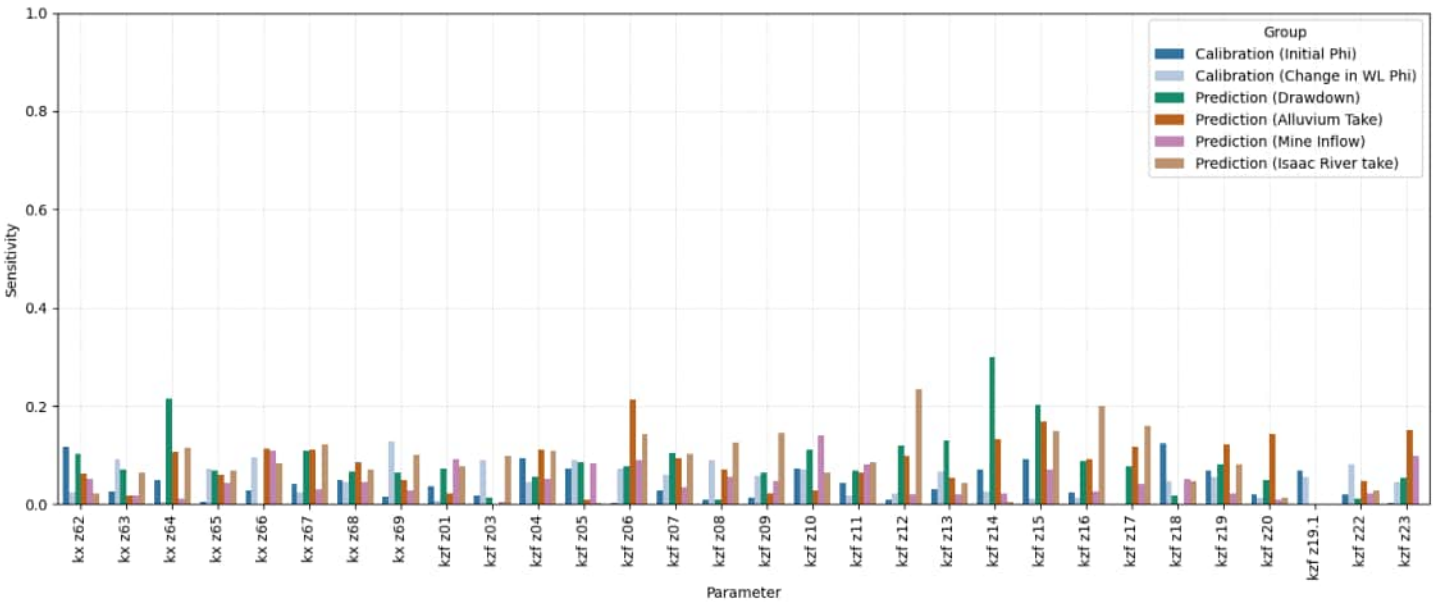
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure1



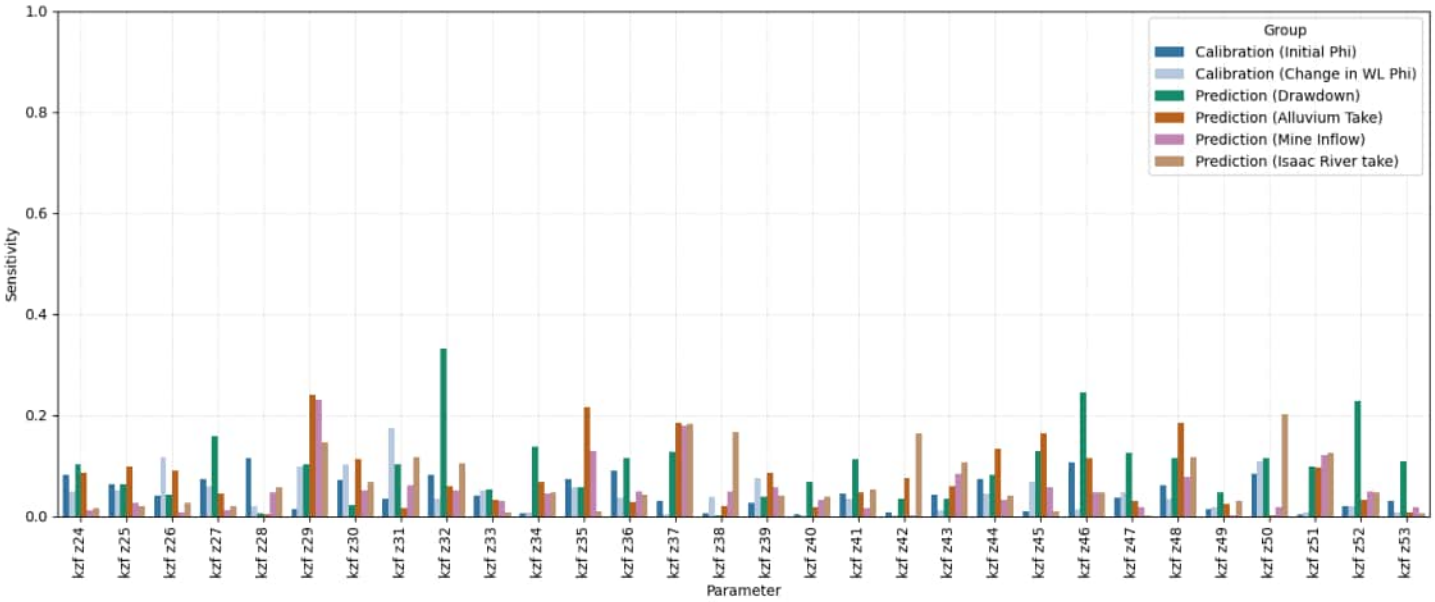
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure2



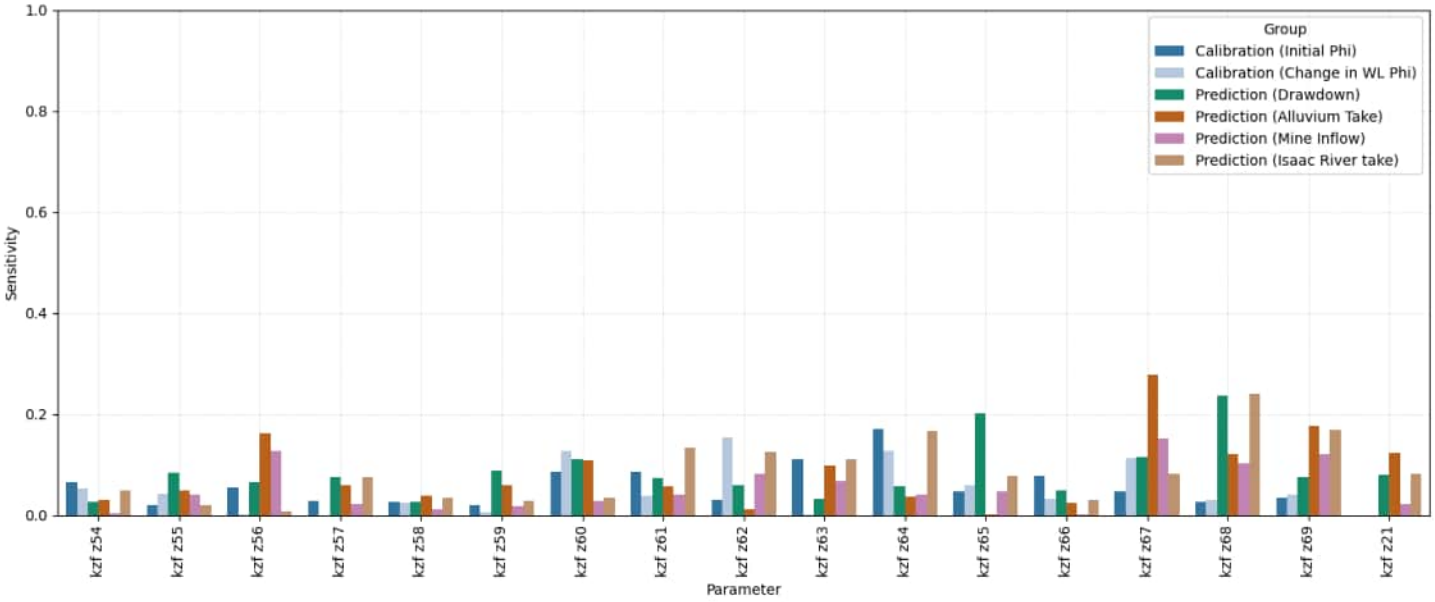
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure3



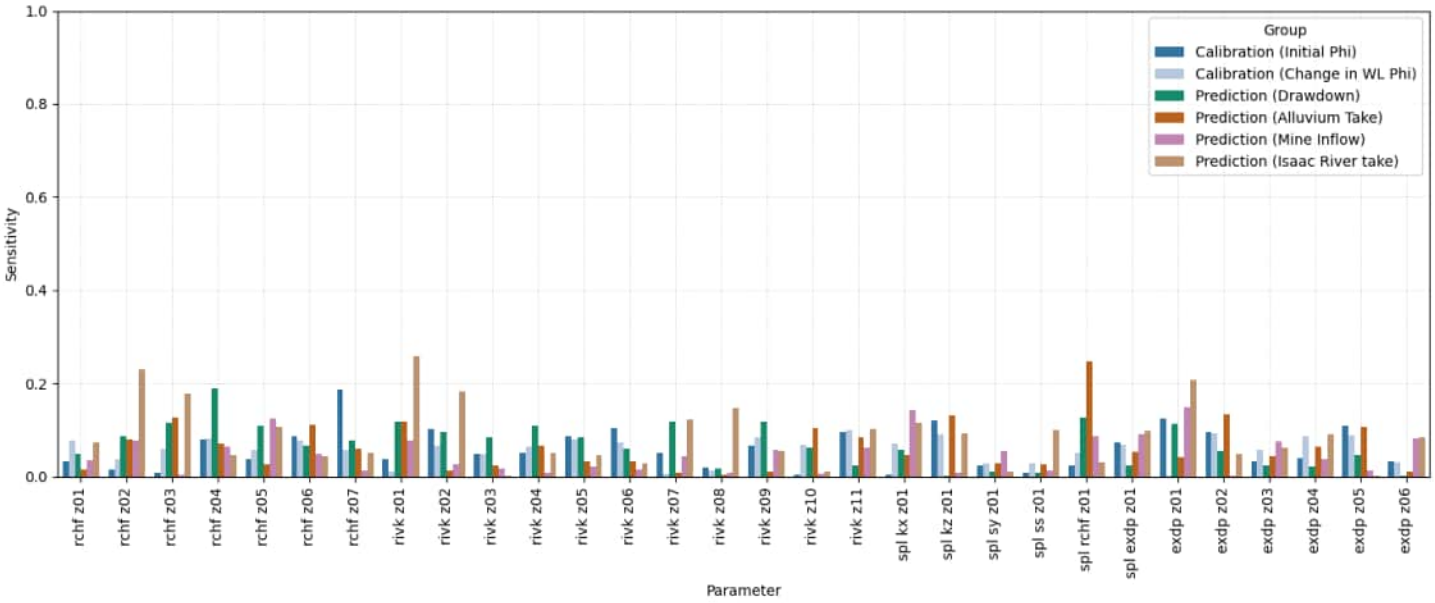
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure4



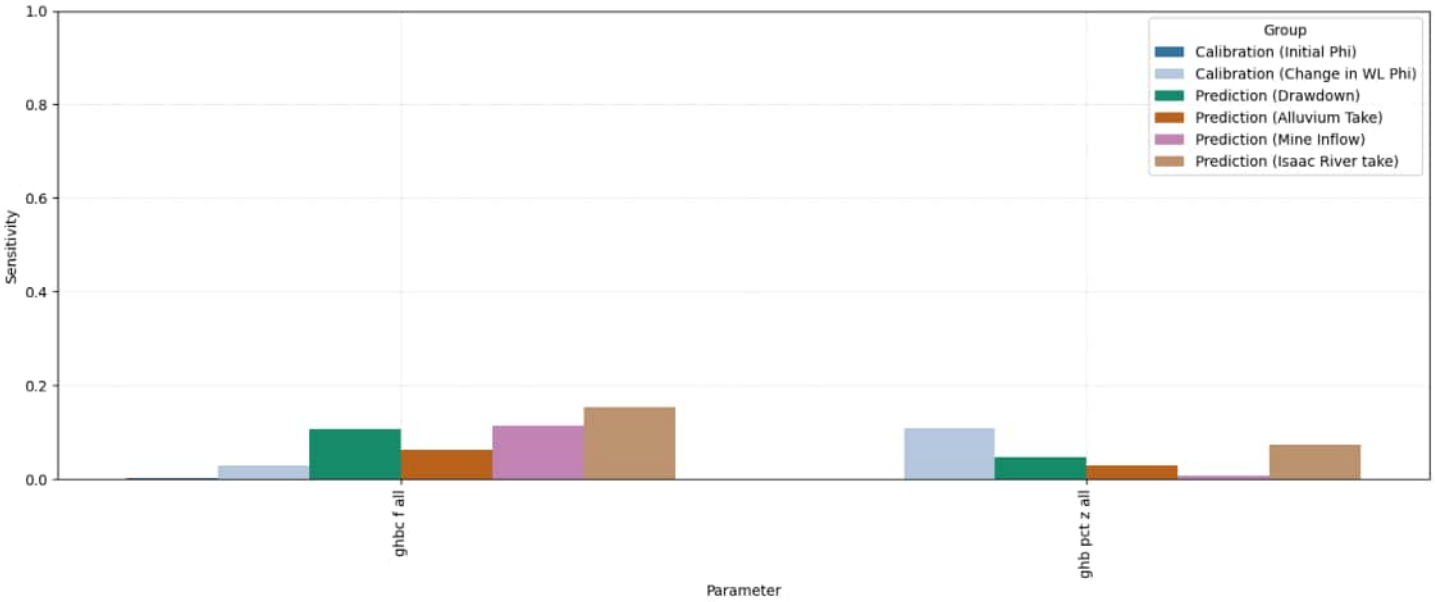
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure5



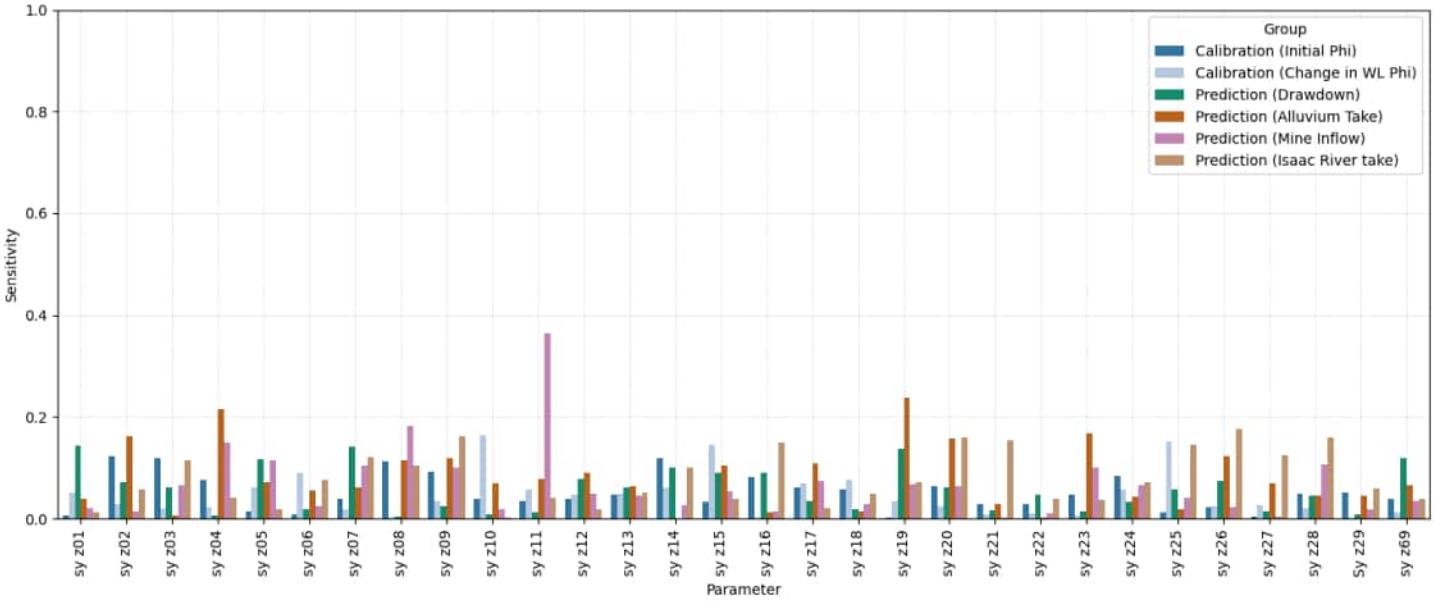
Linear Regression Sensitivity Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure1



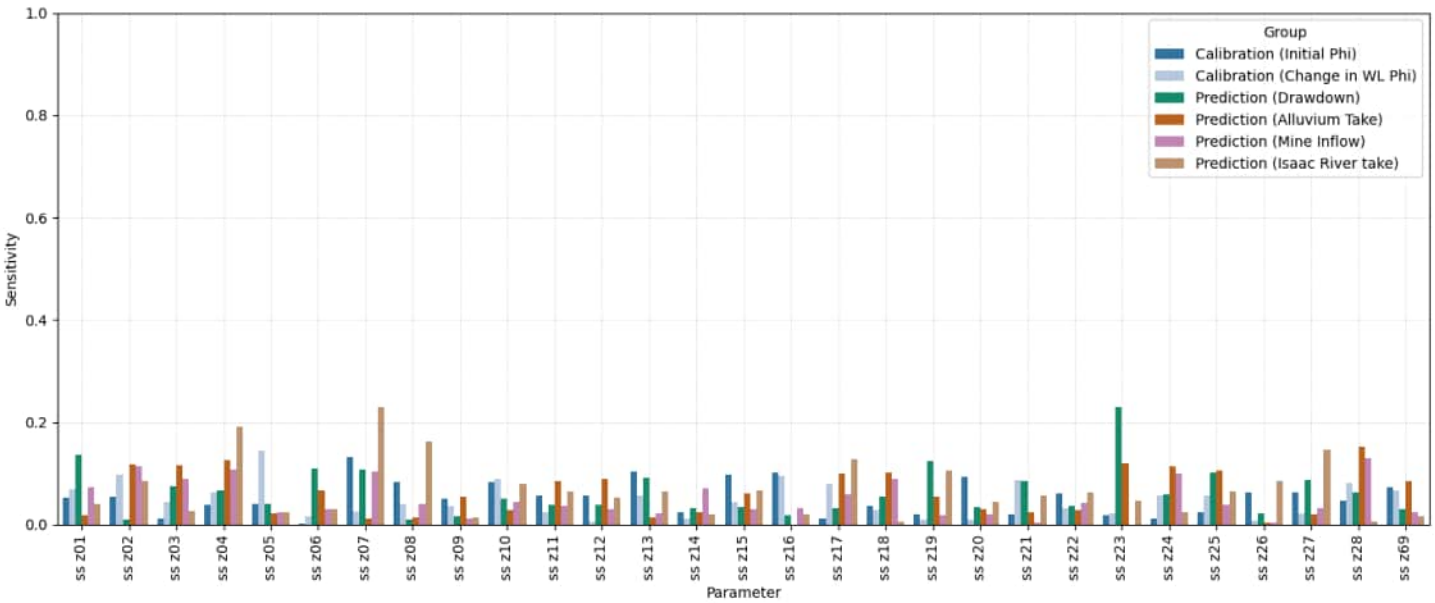
Linear Regression Sensitivity Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure2



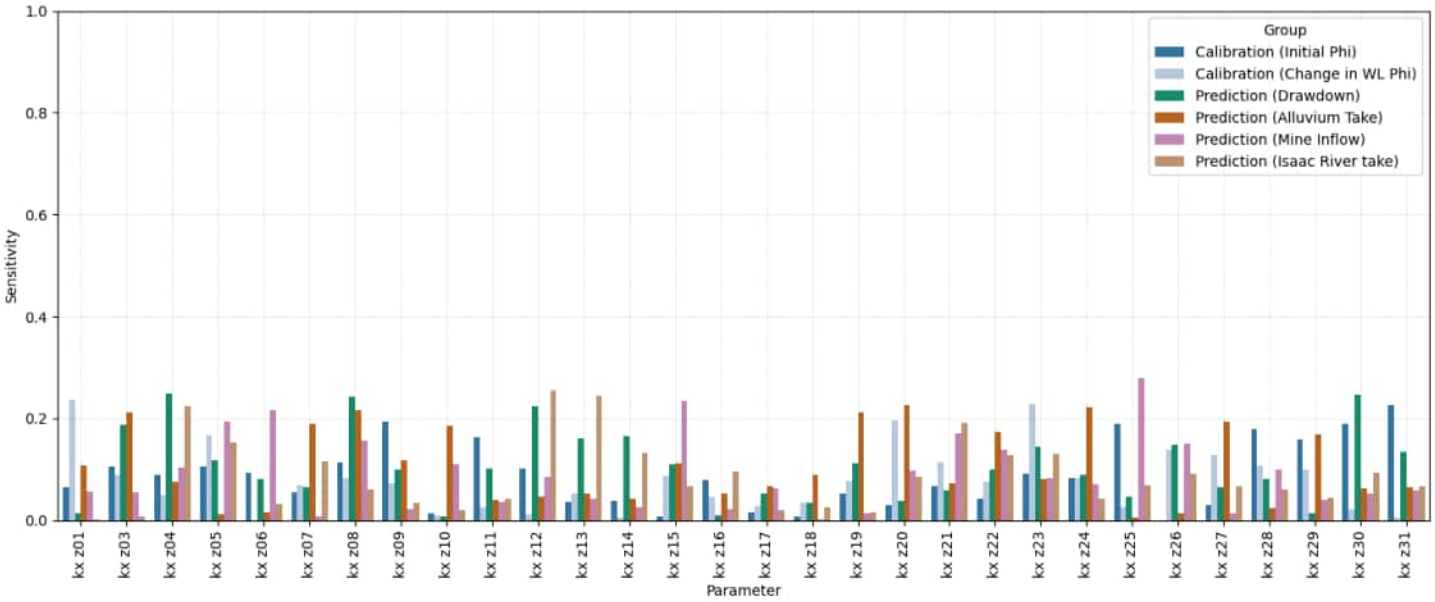
Linear Regression Sensitivity Coefficient (Absolute Value)_Storage Parameters_Figure1



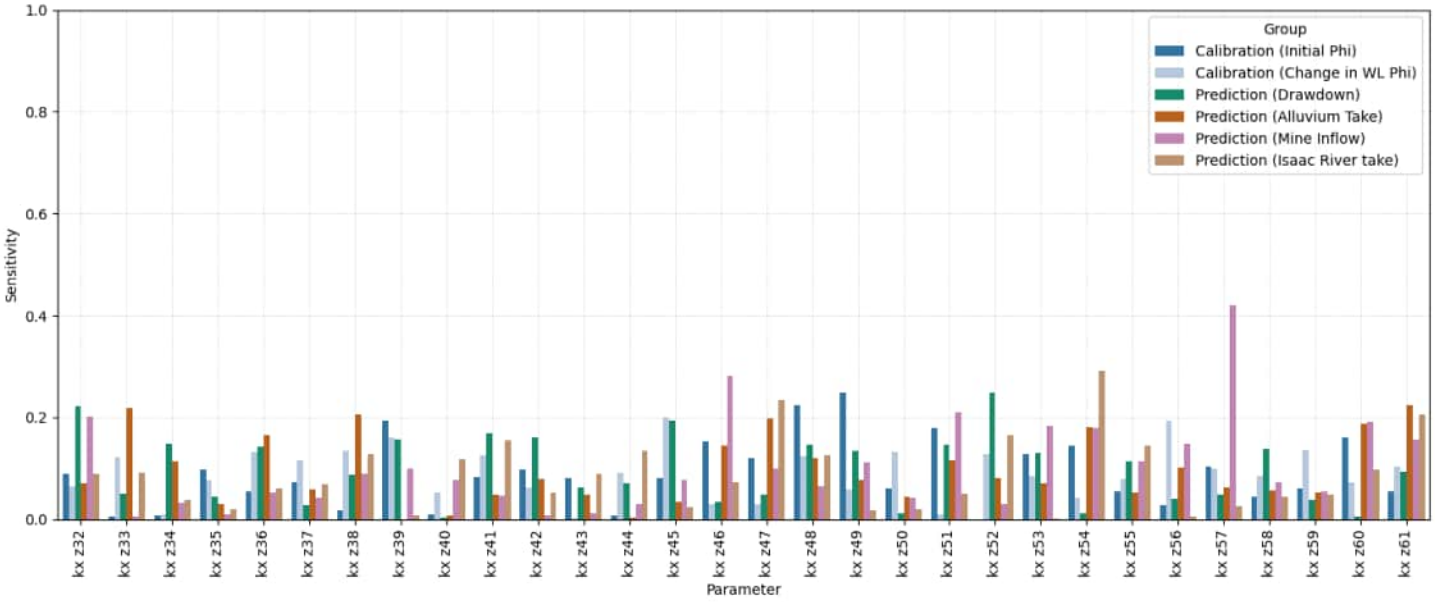
Linear Regression Sensitivity Coefficient (Absolute Value)_Storage Parameters_Figure2



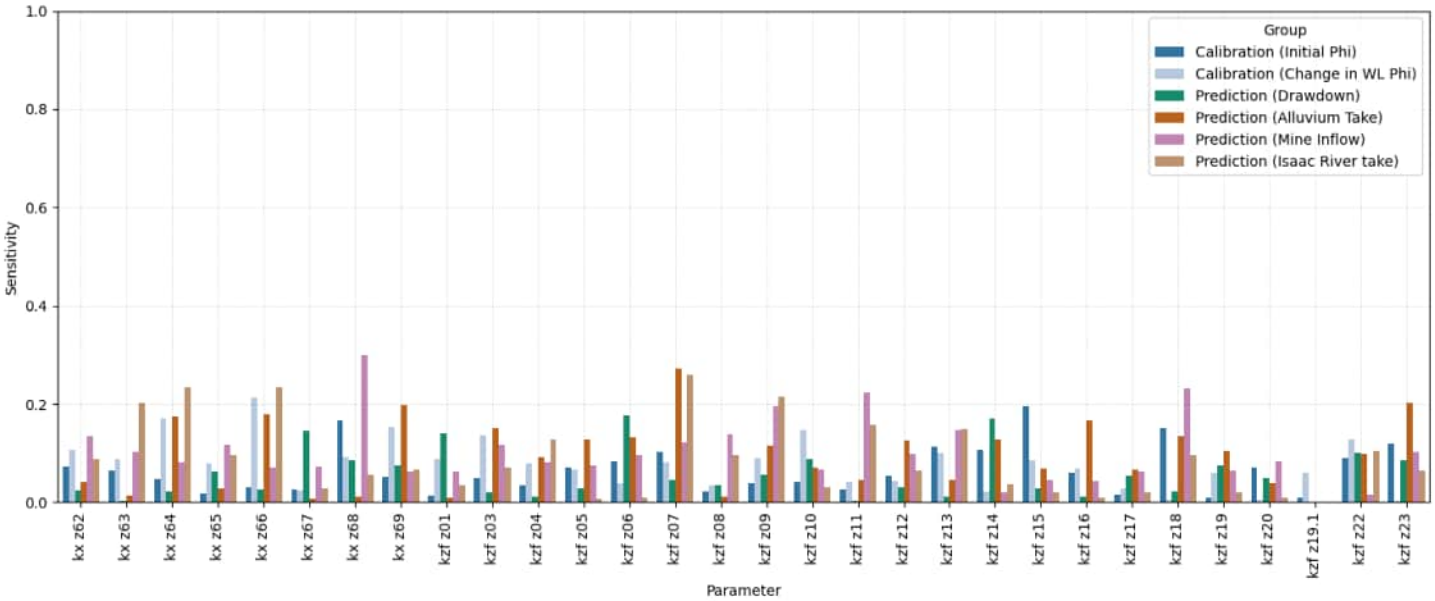
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure1



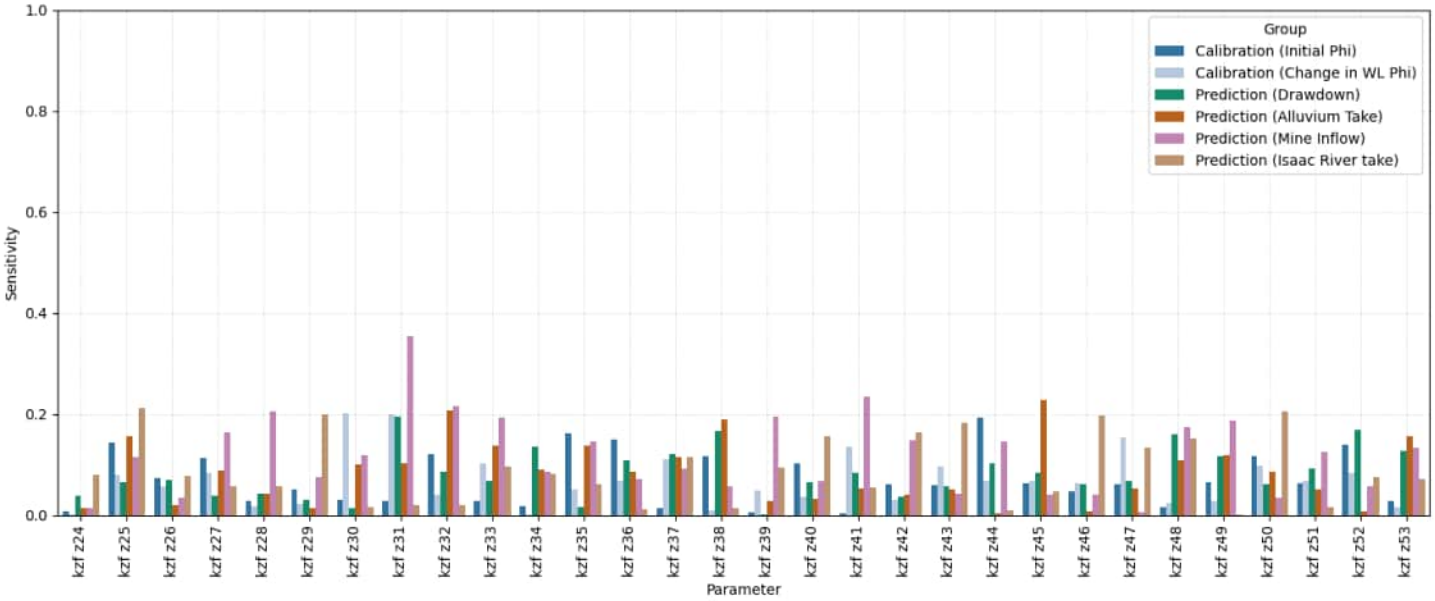
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure2



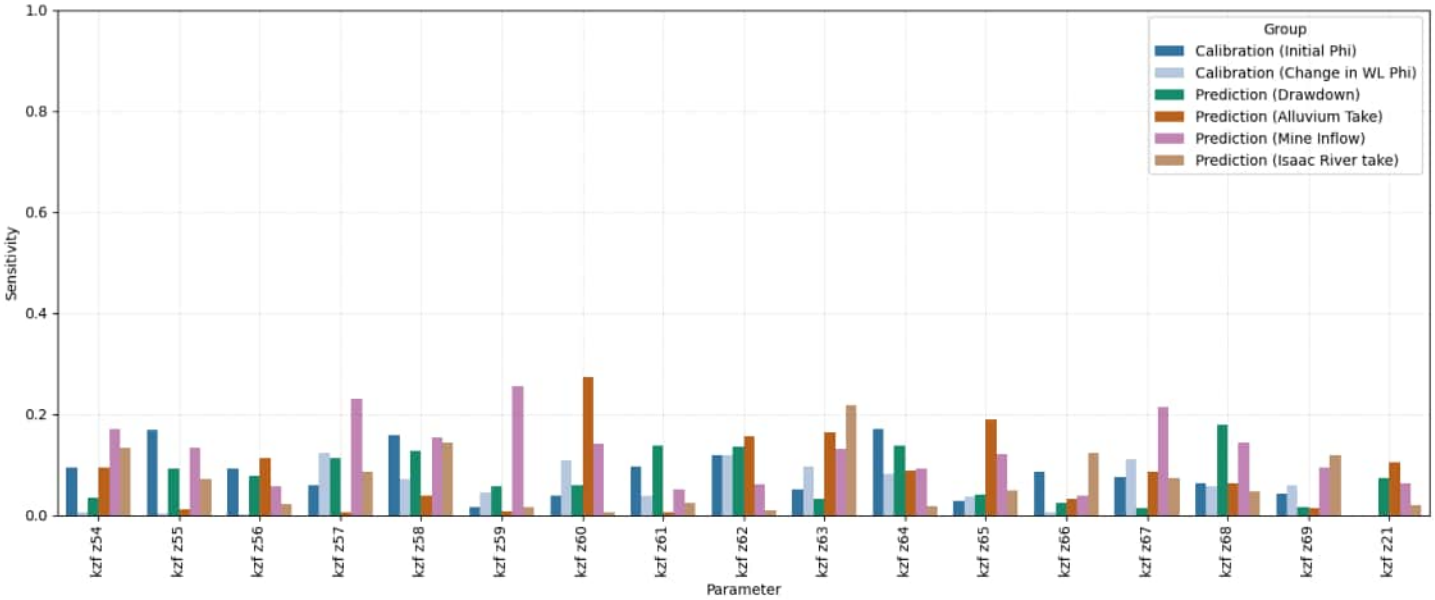
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure3



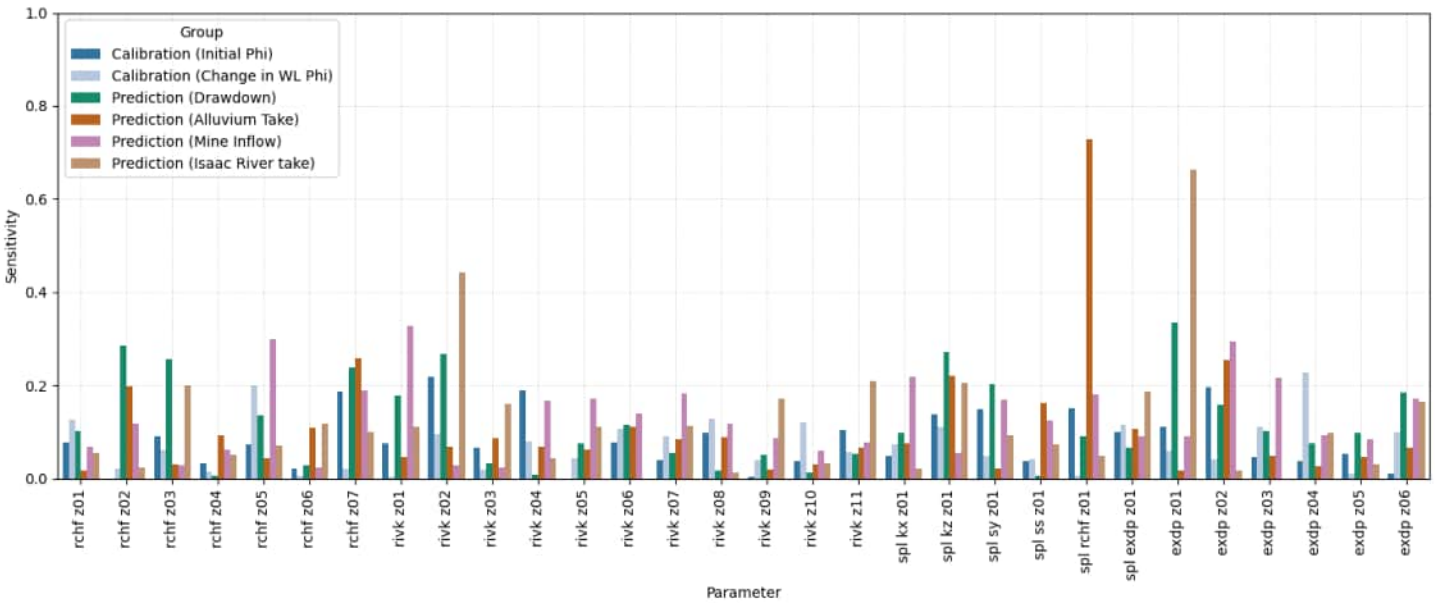
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure4



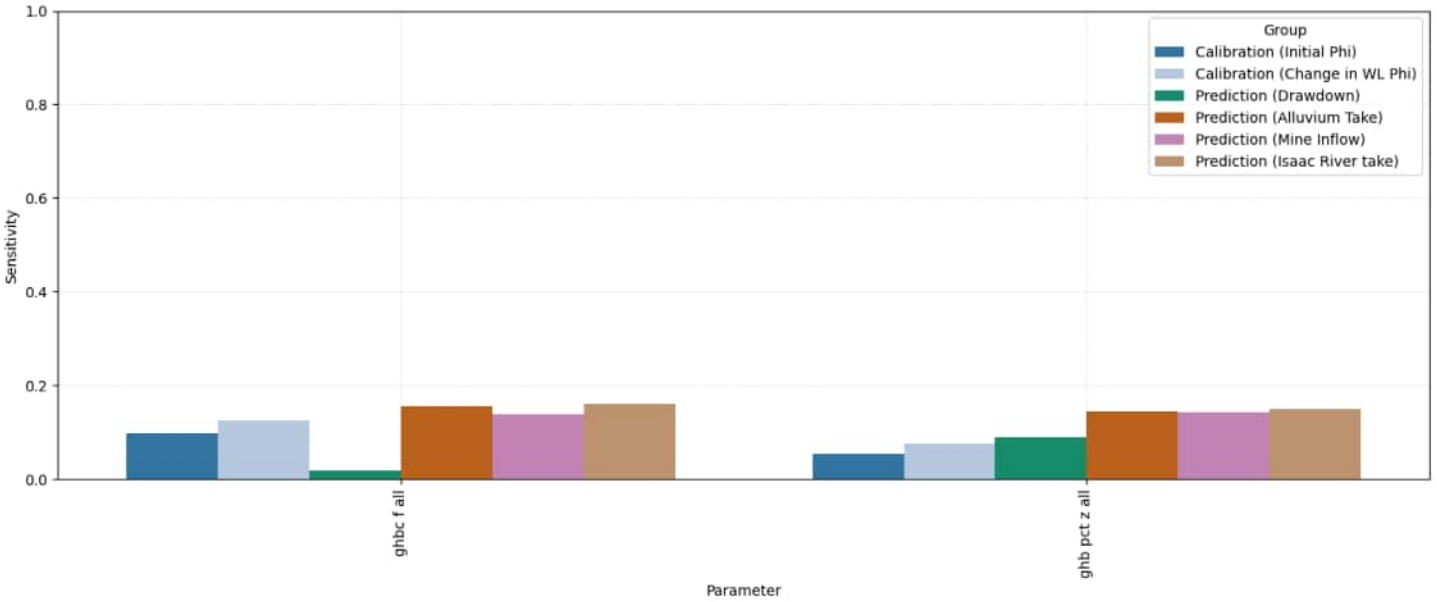
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure5



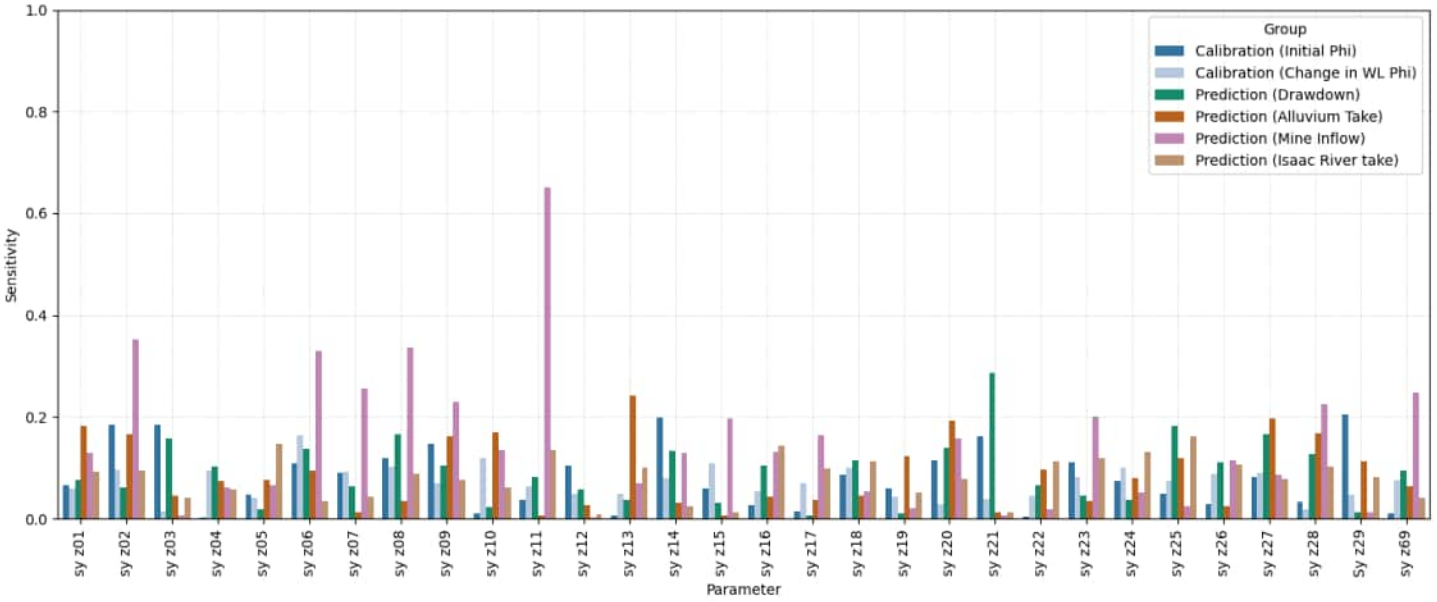
Spearman Rank Correlation Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure1



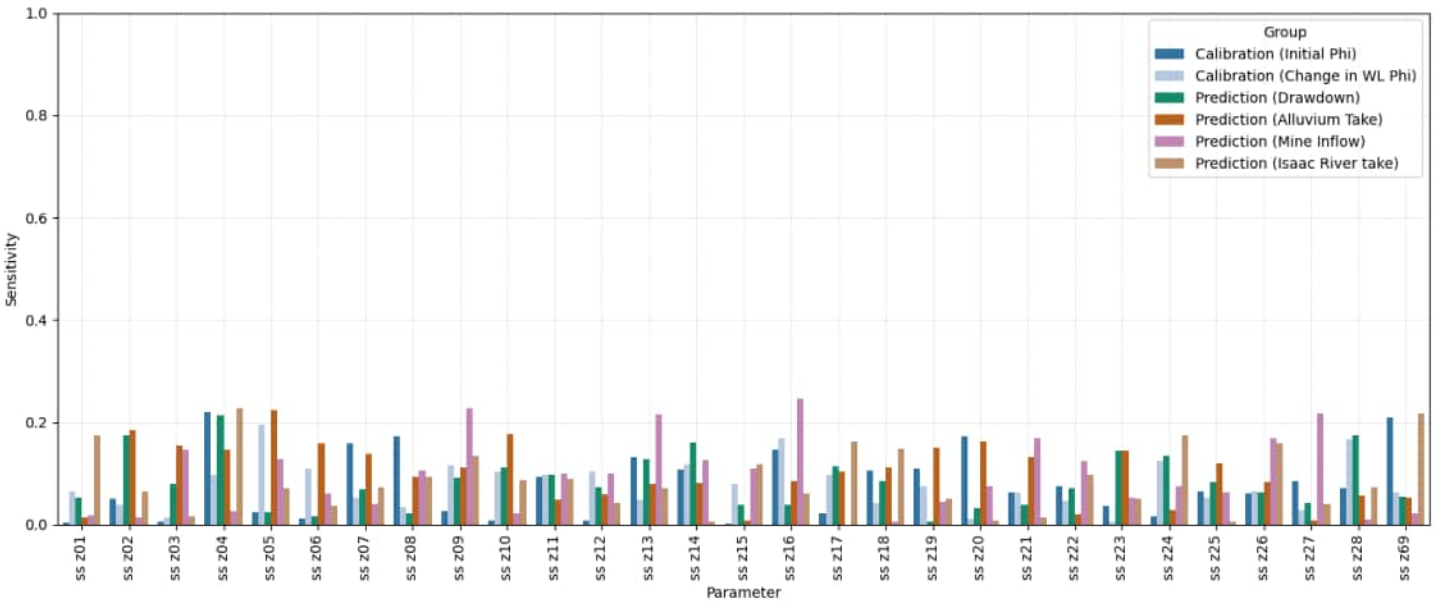
Spearman Rank Correlation Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure2



Spearman Rank Correlation Coefficient (Absolute Value)_Storage Parameters_Figure1



Spearman Rank Correlation Coefficient (Absolute Value)_Storage Parameters_Figure2



Appendix E Uncertainty in 1 m Drawdown Contours

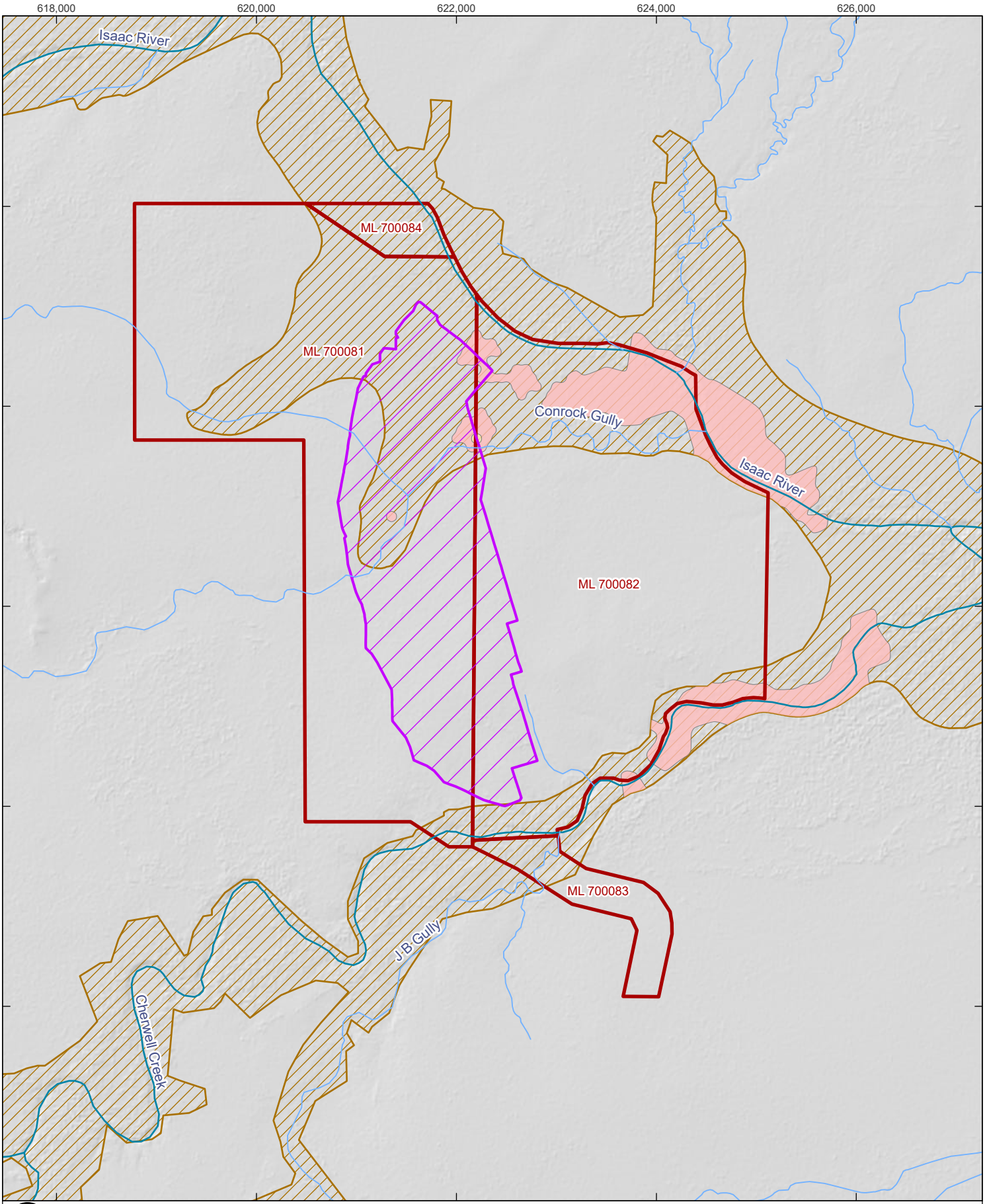
Isaac Downs Extension Project

Groundwater Modelling Calibration and Prediction Report

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00006

29 May 2026



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-May-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs
- Alluvium Extent

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

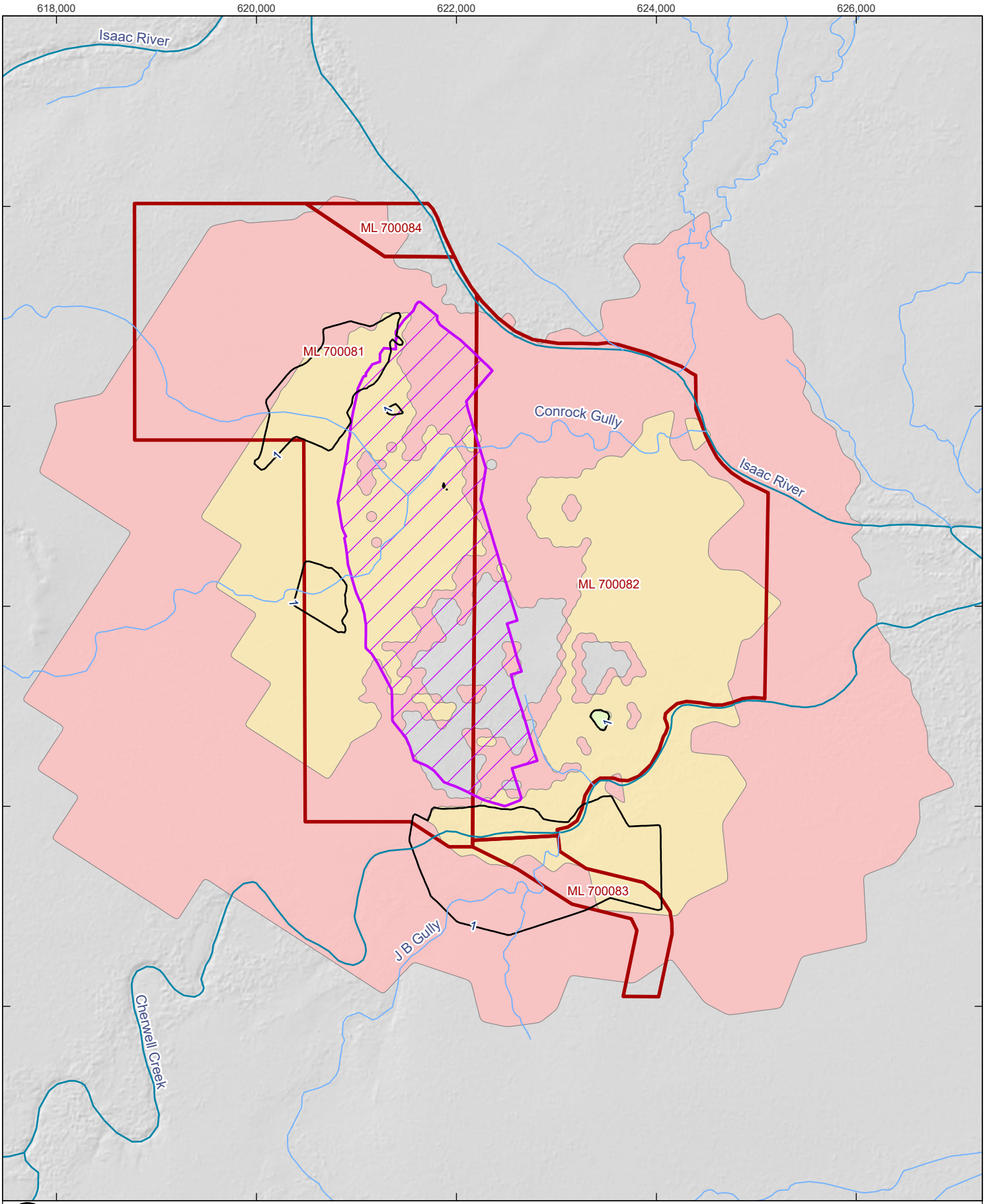
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN – ALLUVIUM (END OF RECOVERY) (LAYER 1)

SLR

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 E-1

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-E01_Uncertainty in Predicted 1m Incremental Drawdown – Alluvium (Layer 1) (EoR)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	17-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN – REGOLITH (END OF RECOVERY) (LAYER 2)

SLR

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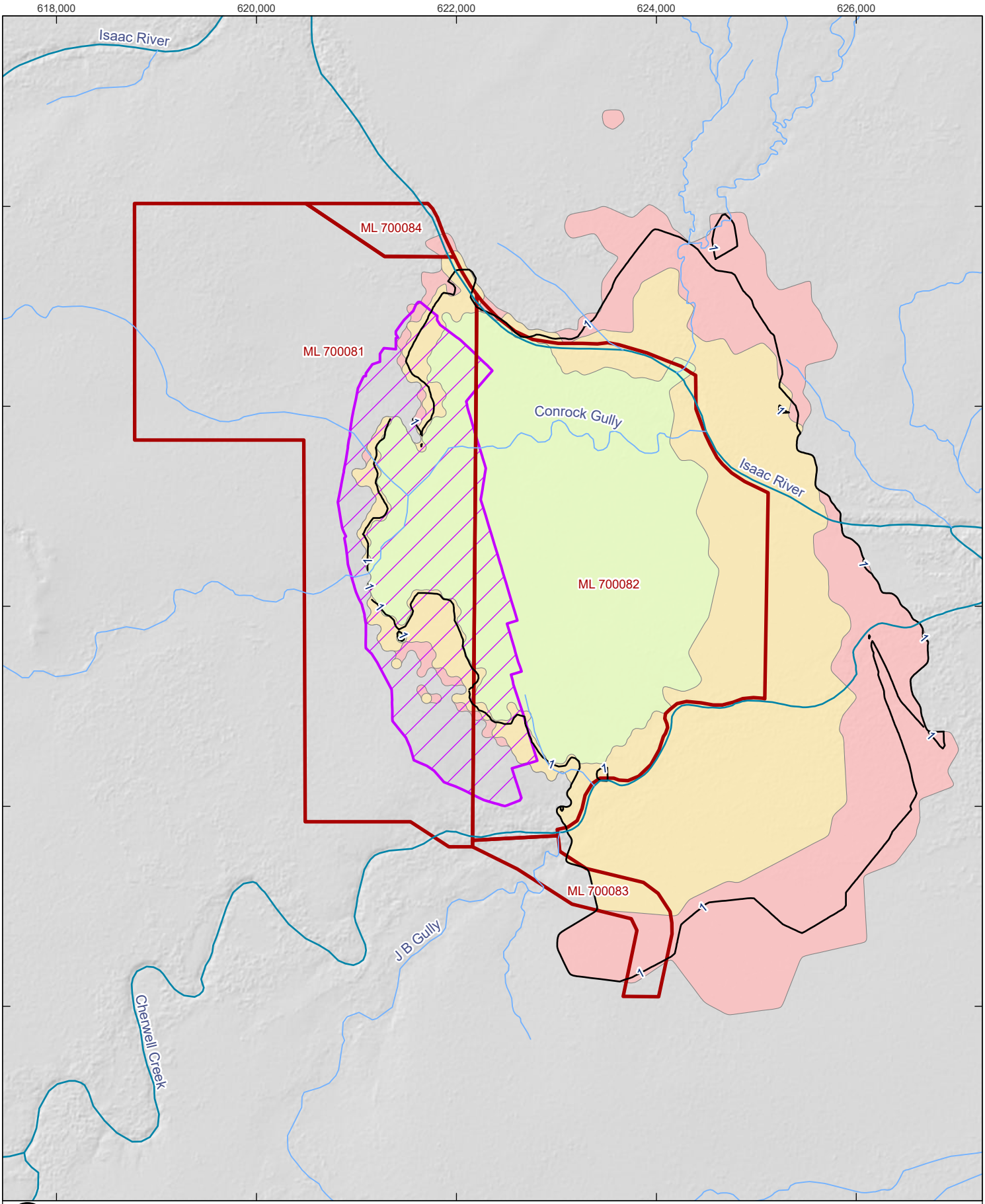
APPENDIX E-2

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-D02_Uncertainty in Predicted 1m Incremental Drawdown – Regolith (Layer 2) (EoR)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	17-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN – LEICHHARDT SEAM (END OF RECOVERY) (LAYER 5)

SLR

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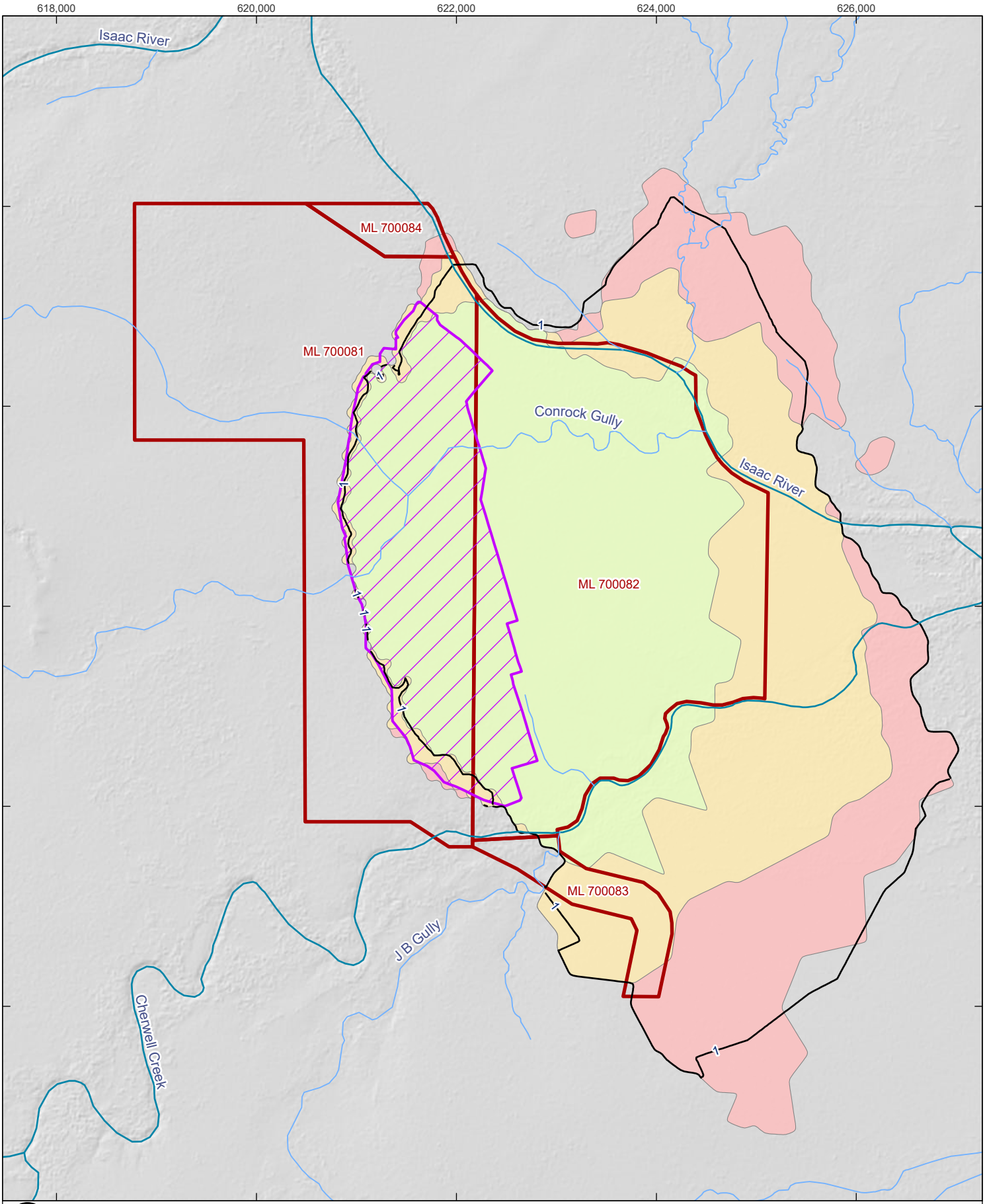
APPENDIX E-3

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-D03_Uncertainty in Predicted 1m Incremental Drawdown – Leichhardt Seam (Layer 5) (EoR)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	17-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN – VERMONT SEAM (END OF RECOVERY) (LAYER 7)

SLR

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APPENDIX E-4

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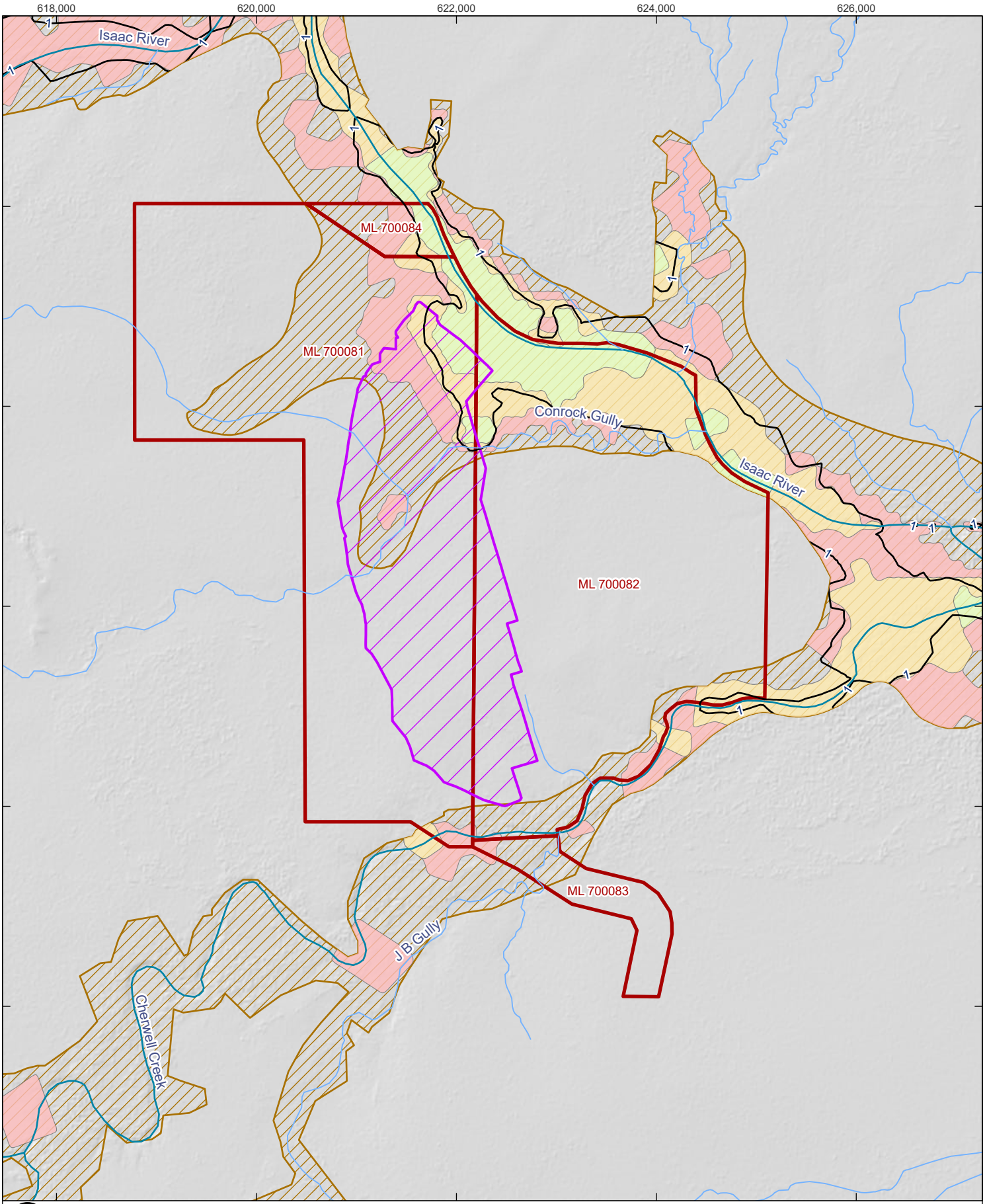

0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-May-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs
- Alluvium Extent

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN – ALLUVIUM (END OF RECOVERY) (LAYER 1)

SLR

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APPENDIX E-5

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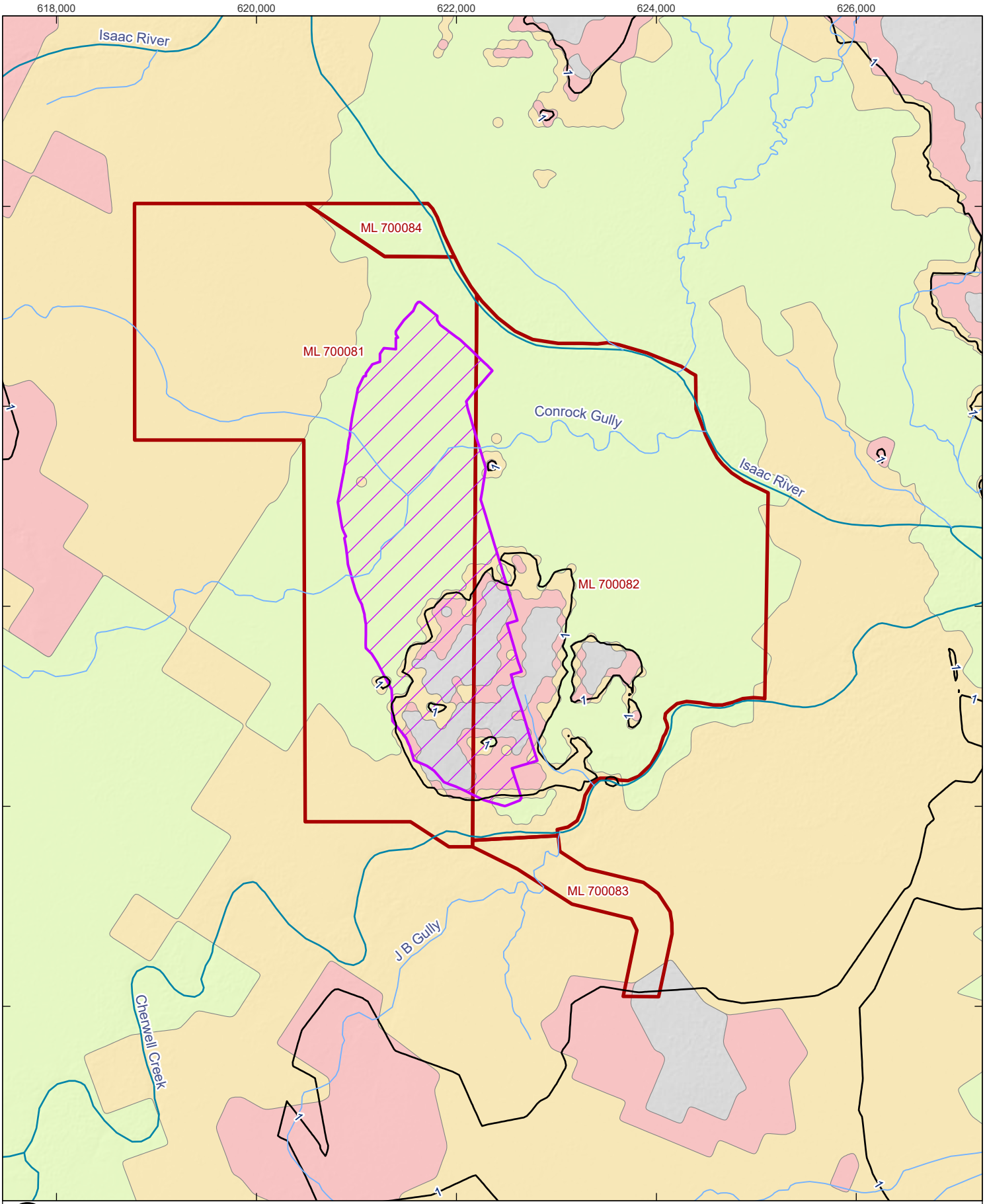

0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	17-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN – REGOLITH (END OF RECOVERY) (LAYER 2)

SLR

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APPENDIX E-6

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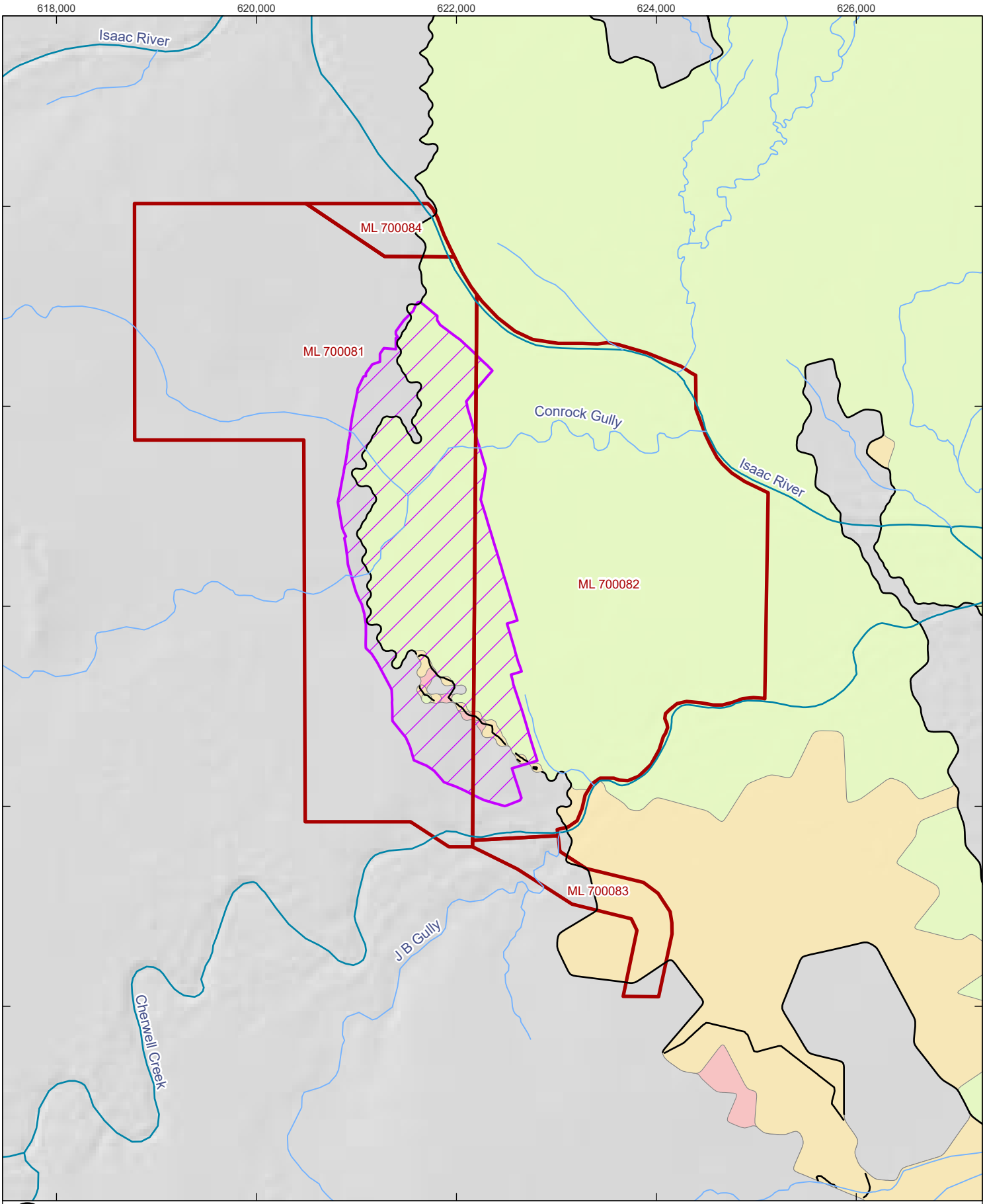

0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	23-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN – LEICHHARDT SEAM (END OF RECOVERY) (LAYER 5)

SLR

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APPENDIX E-7

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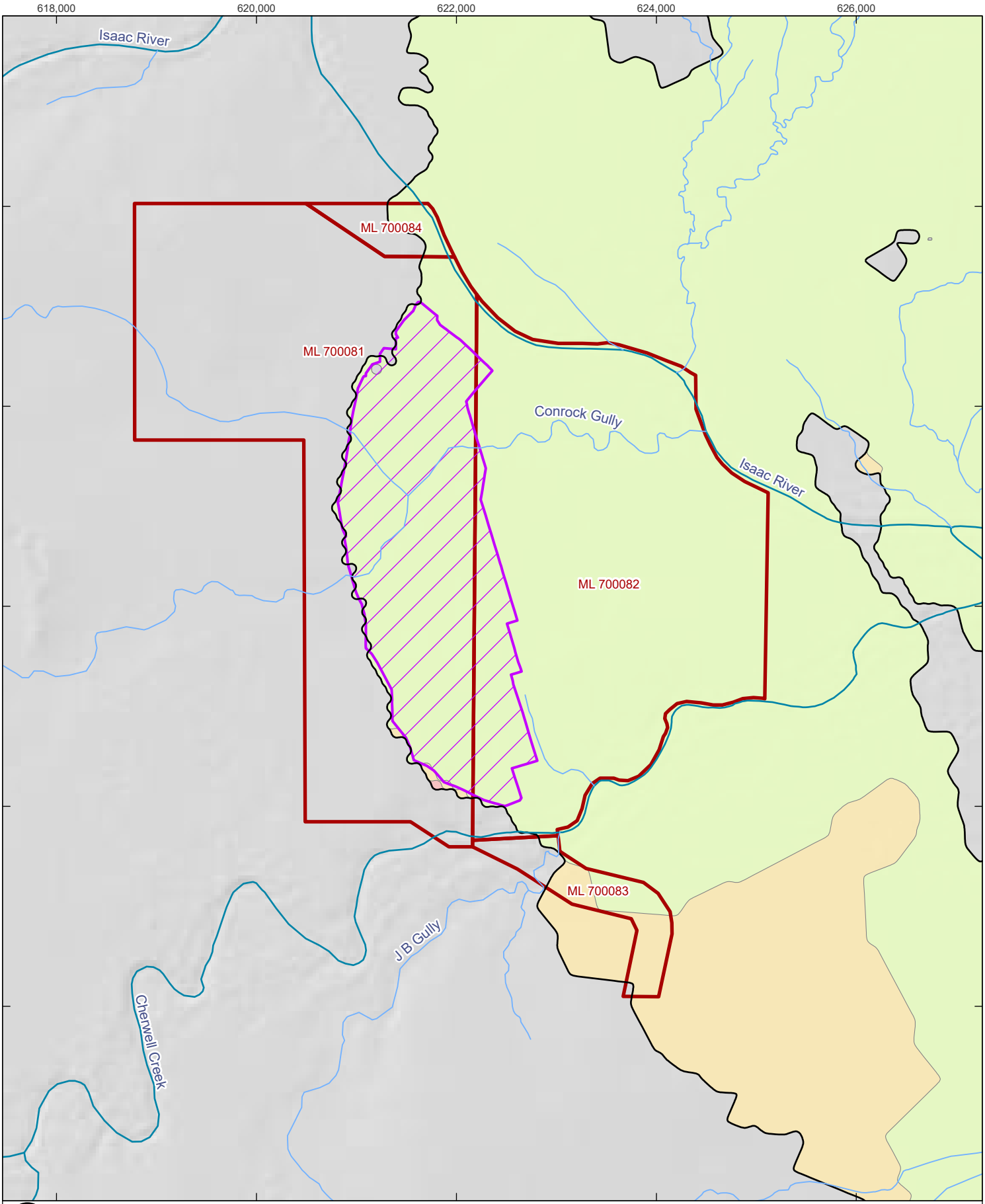

0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	23-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN – VERMONT SEAM (END OF RECOVERY) (LAYER 7)

SLR

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APPENDIX E-8

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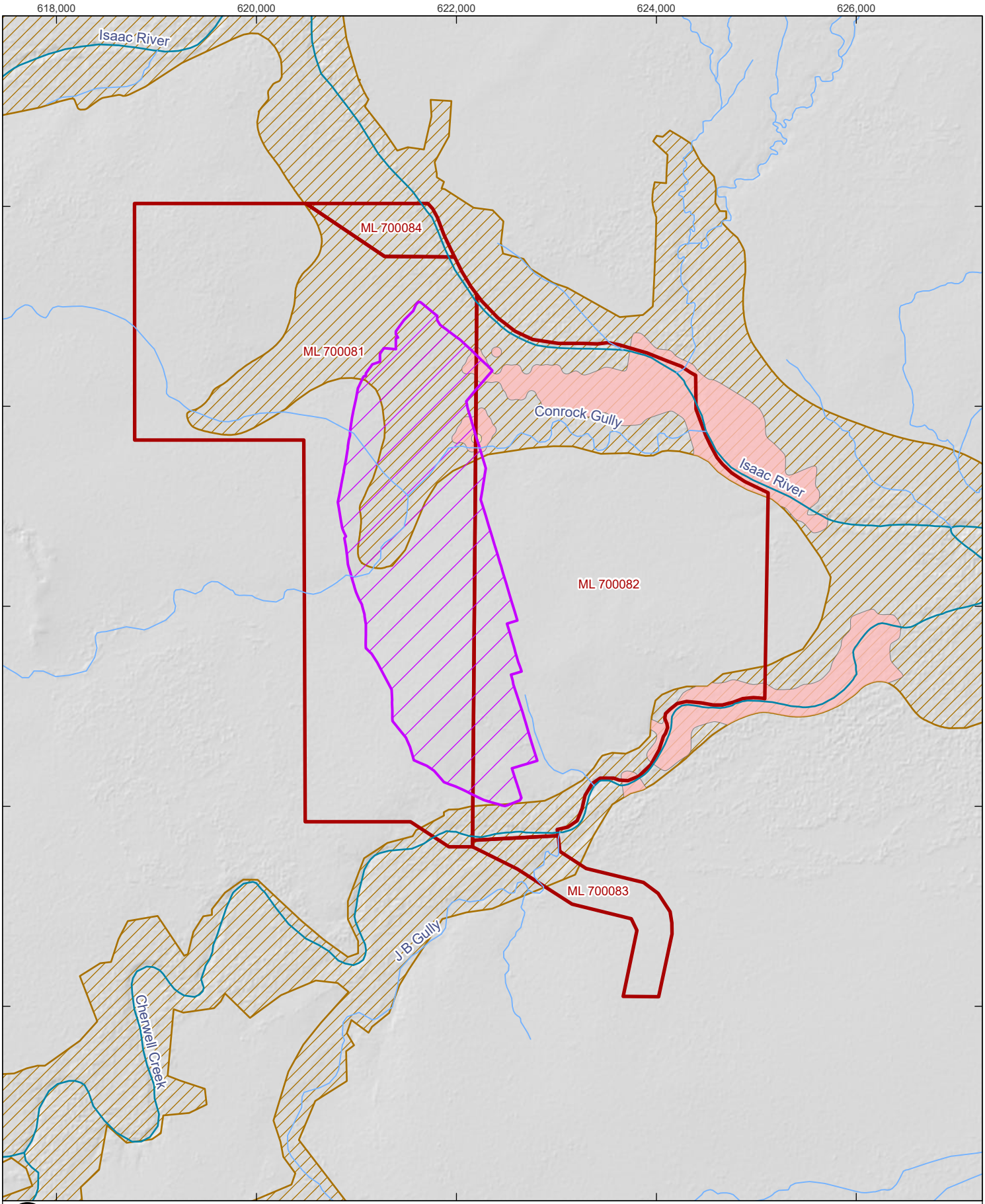

0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-May-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M RESIDUAL INCREMENTAL DRAWDOWN – ALLUVIUM (LAYER 1)

SLR

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APPENDIX E-9

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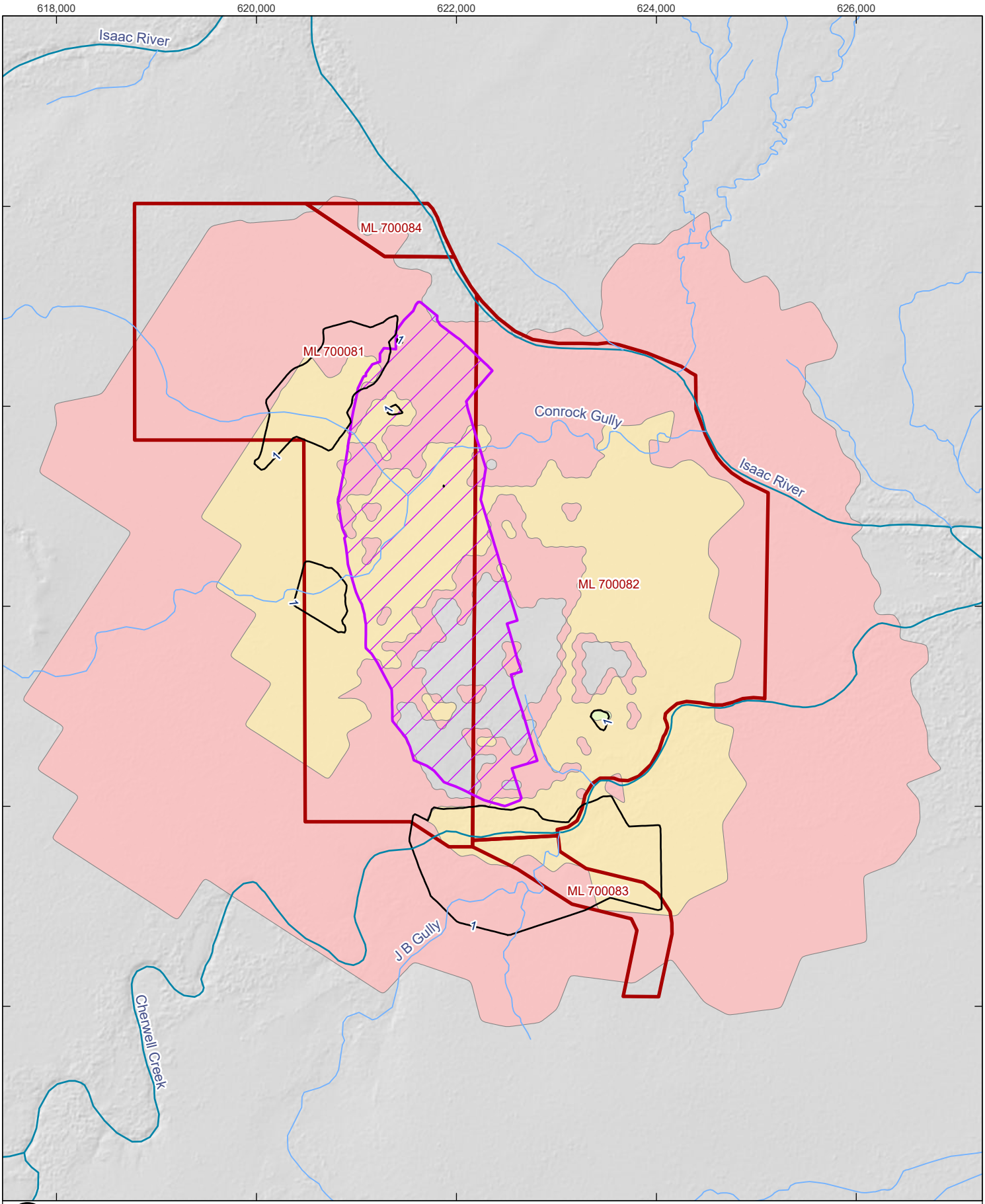

0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	19-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M RESIDUAL INCREMENTAL DRAWDOWN – REGOLITH (LAYER 2)

SLR

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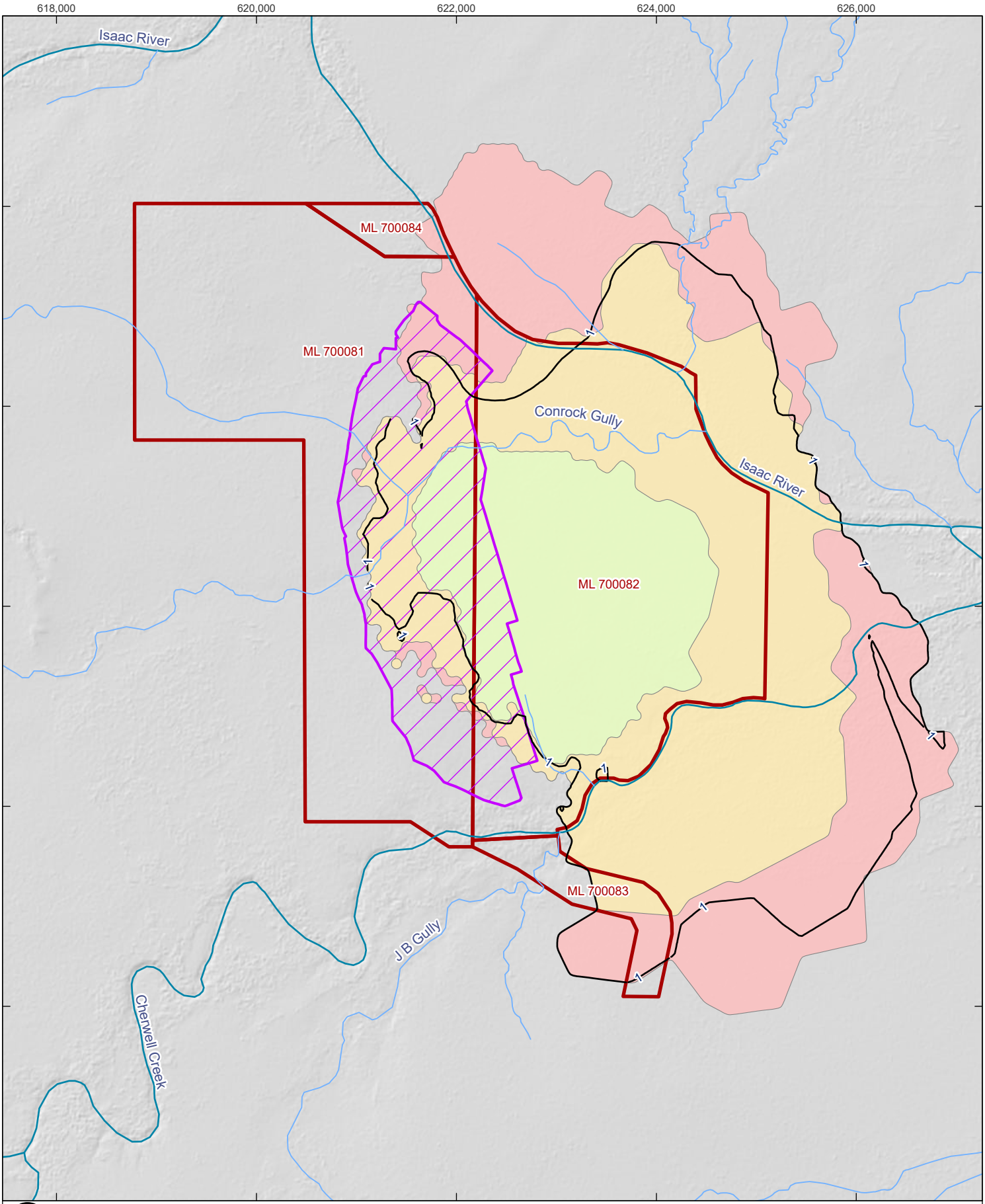
APPENDIX E-10

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-D10_Uncertainty in Predicted 1m Residual Incremental Drawdown – Regolith (Layer 2)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M RESIDUAL INCREMENTAL DRAWDOWN – LEICHHARDT SEAM (LAYER 5)

SLR

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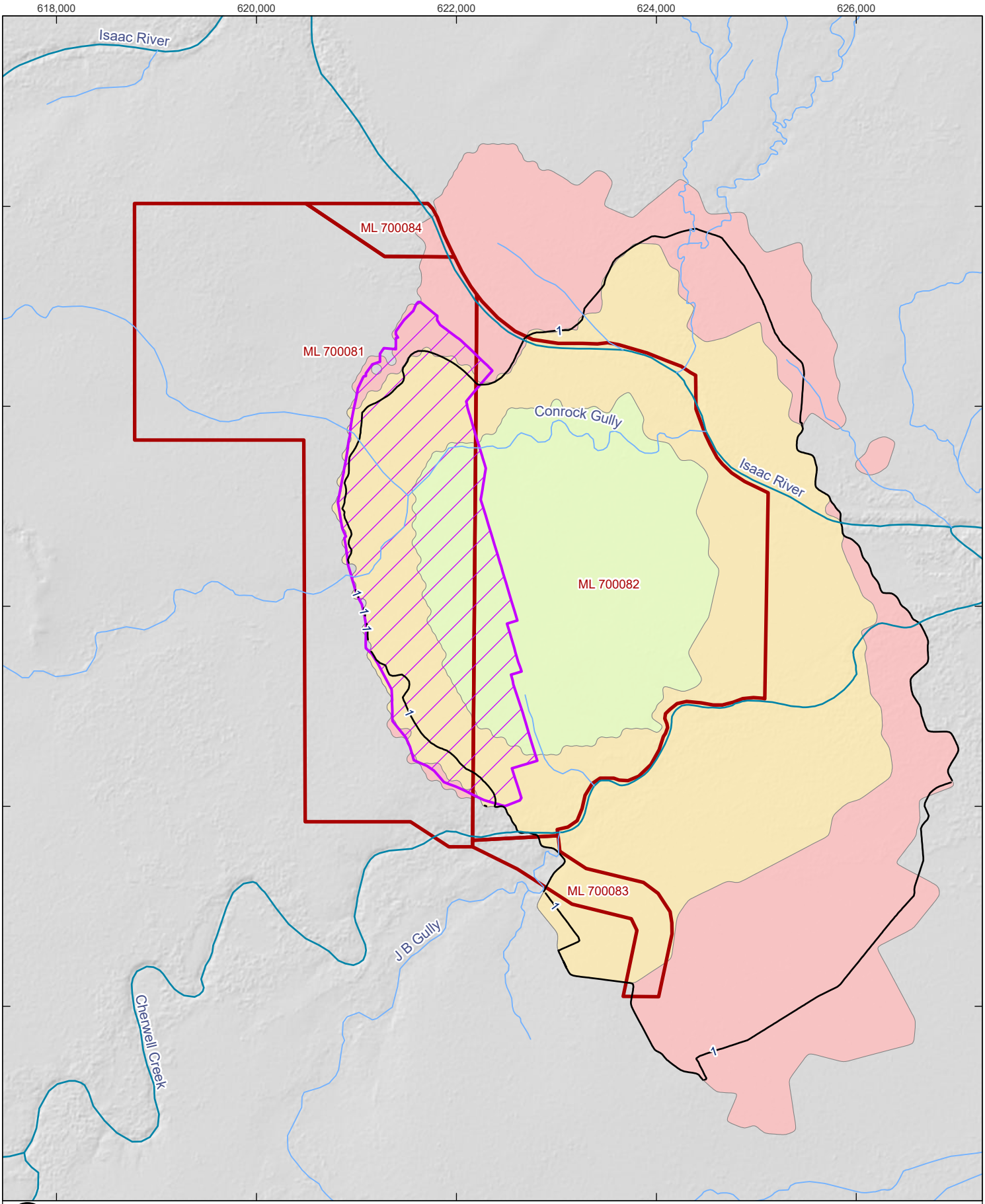
APPENDIX E-11

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-D11_Uncertainty in Predicted 1m Residual Incremental Drawdown – Leichhardt Seam (Layer 5)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	20-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M RESIDUAL INCREMENTAL DRAWDOWN – VERMONT SEAM (LAYER 7)

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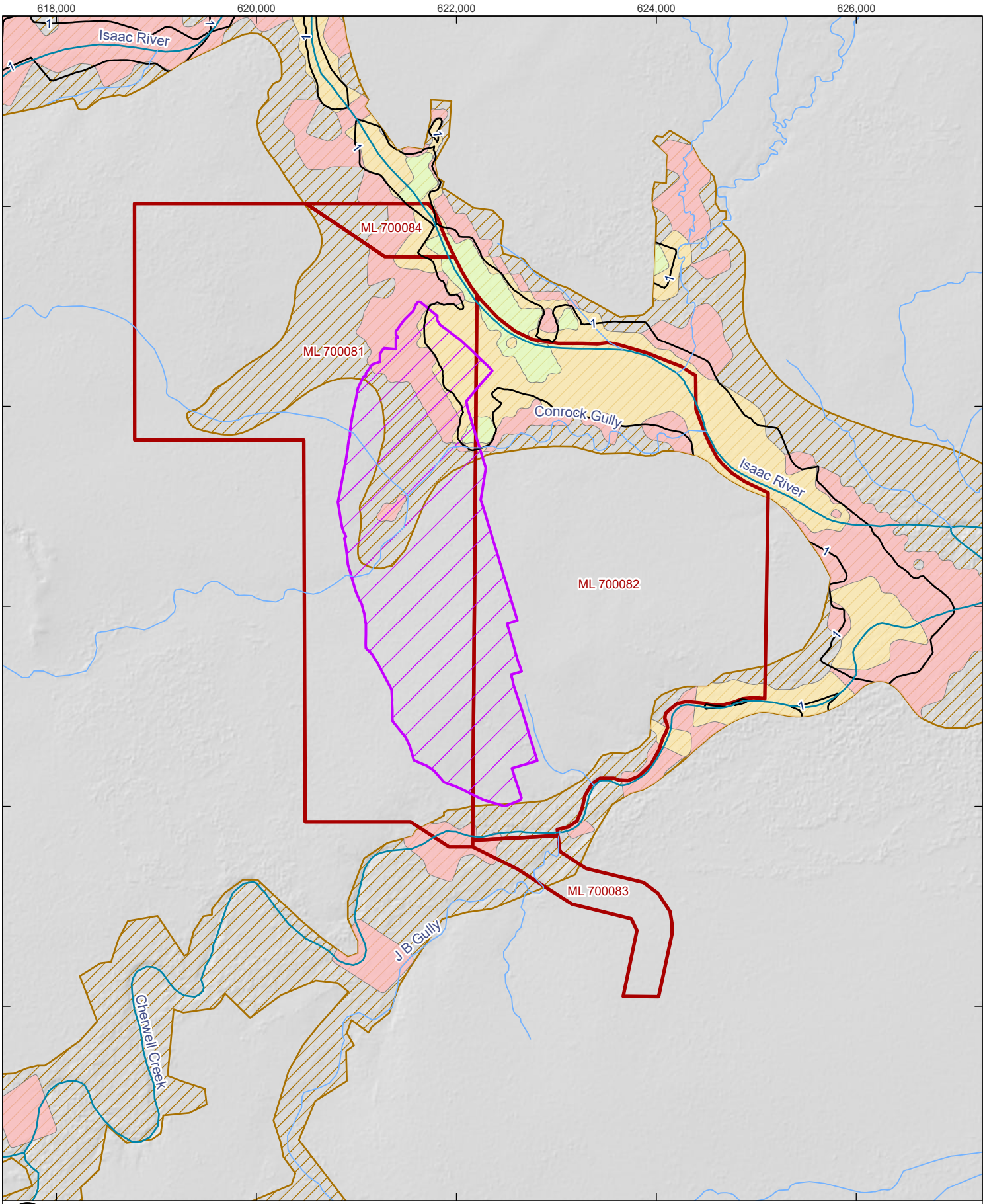
APPENDIX E-12

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-D12_Uncertainty in Predicted 1m Residual Incremental Drawdown – Vermont Seam (Layer 7)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	12-May-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M RESIDUAL CUMULATIVE DRAWDOWN – ALLUVIUM/TERTIARY (LAYER 1)

SLR

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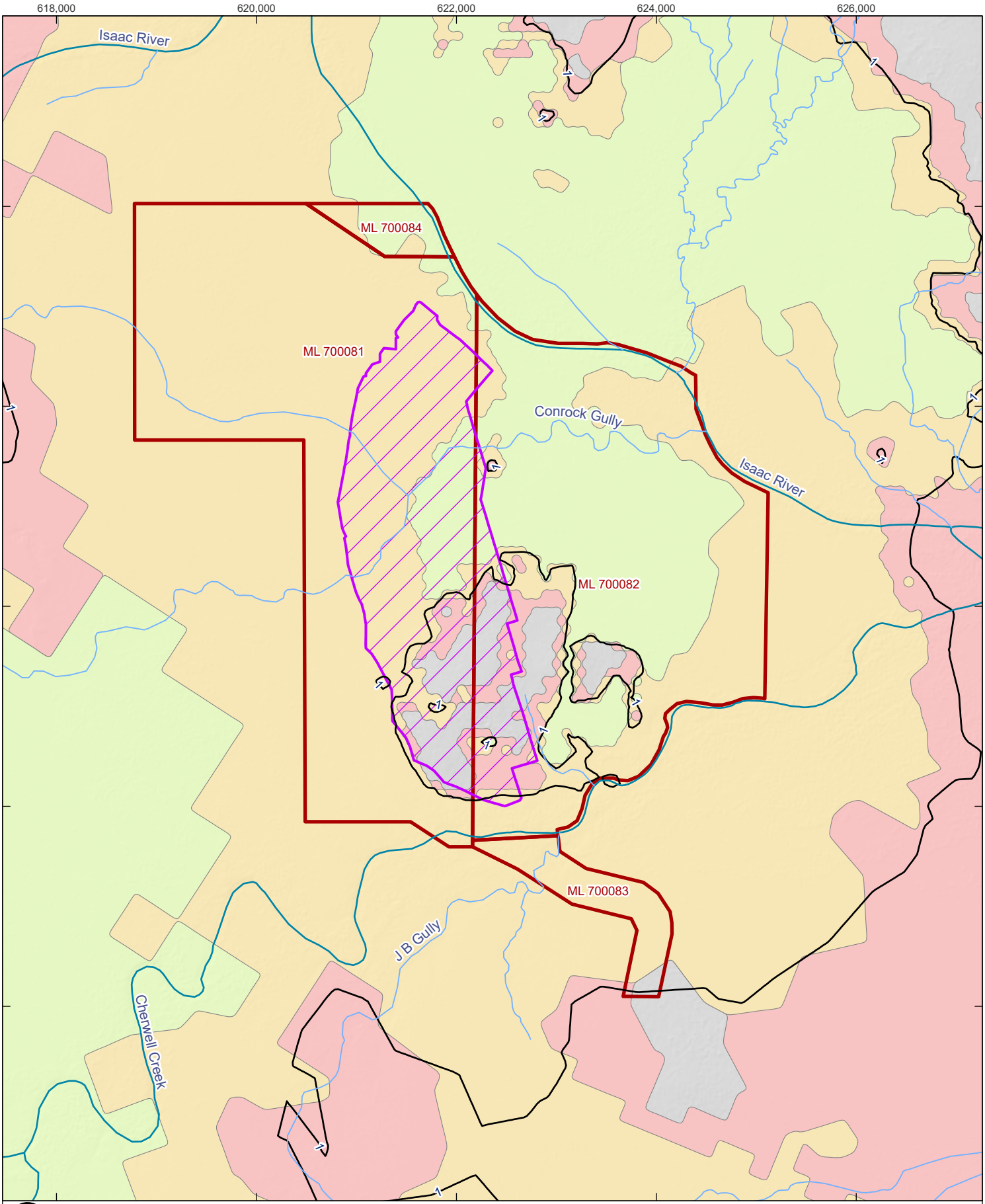
APPENDIX E-13

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-E13_Uncertainty in Predicted 1m Residual Cumulative Drawdown – Alluvium (Layer 1)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	19-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M RESIDUAL CUMULATIVE DRAWDOWN – REGOLITH (LAYER 2)

SLR

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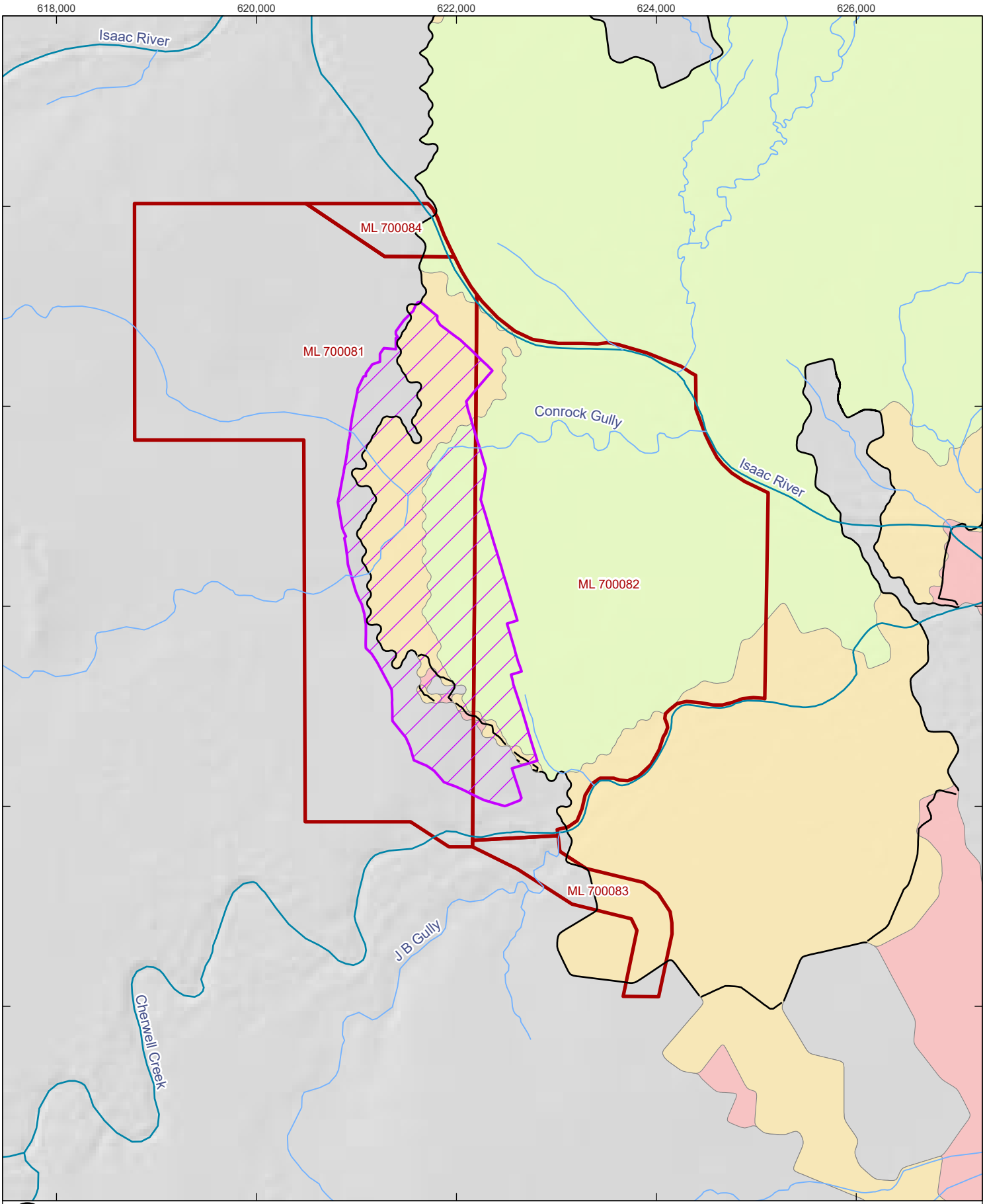
APPENDIX E-14

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-D14_Uncertainty in Predicted 1m Residual Cumulative Drawdown – Regolith (Layer 2)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	23-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M RESIDUAL CUMULATIVE DRAWDOWN – LEICHHARDT SEAM (LAYER 5)

SLR

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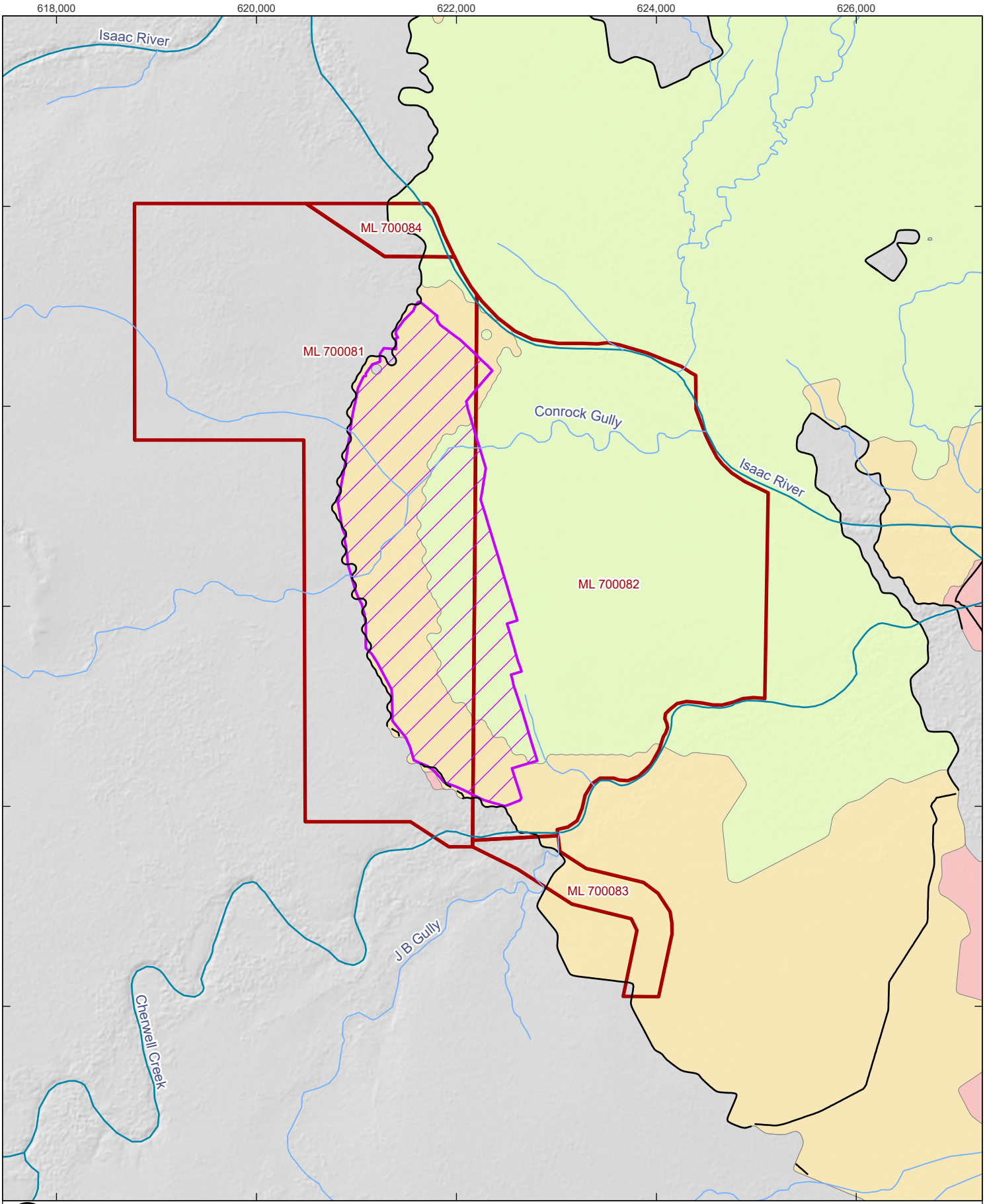
APPENDIX E-15

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-D15_Uncertainty in Predicted 1m Residual Cumulative Drawdown – Leichhardt Seam (Layer 5)



0 0.5 1 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:50,000 at A4
Project Number:	620.041537
Date Drawn:	24-Apr-2026
Drawn by:	RB

LEGEND

- Major Watercourse
- Minor Watercourse
- MLE
- Pit Extent
- IDE Project MLAs

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

ISAAC DOWNS EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

UNCERTAINTY IN PREDICTED 1M RESIDUAL CUMULATIVE DRAWDOWN – VERMONT SEAM (LAYER 7)

SLR

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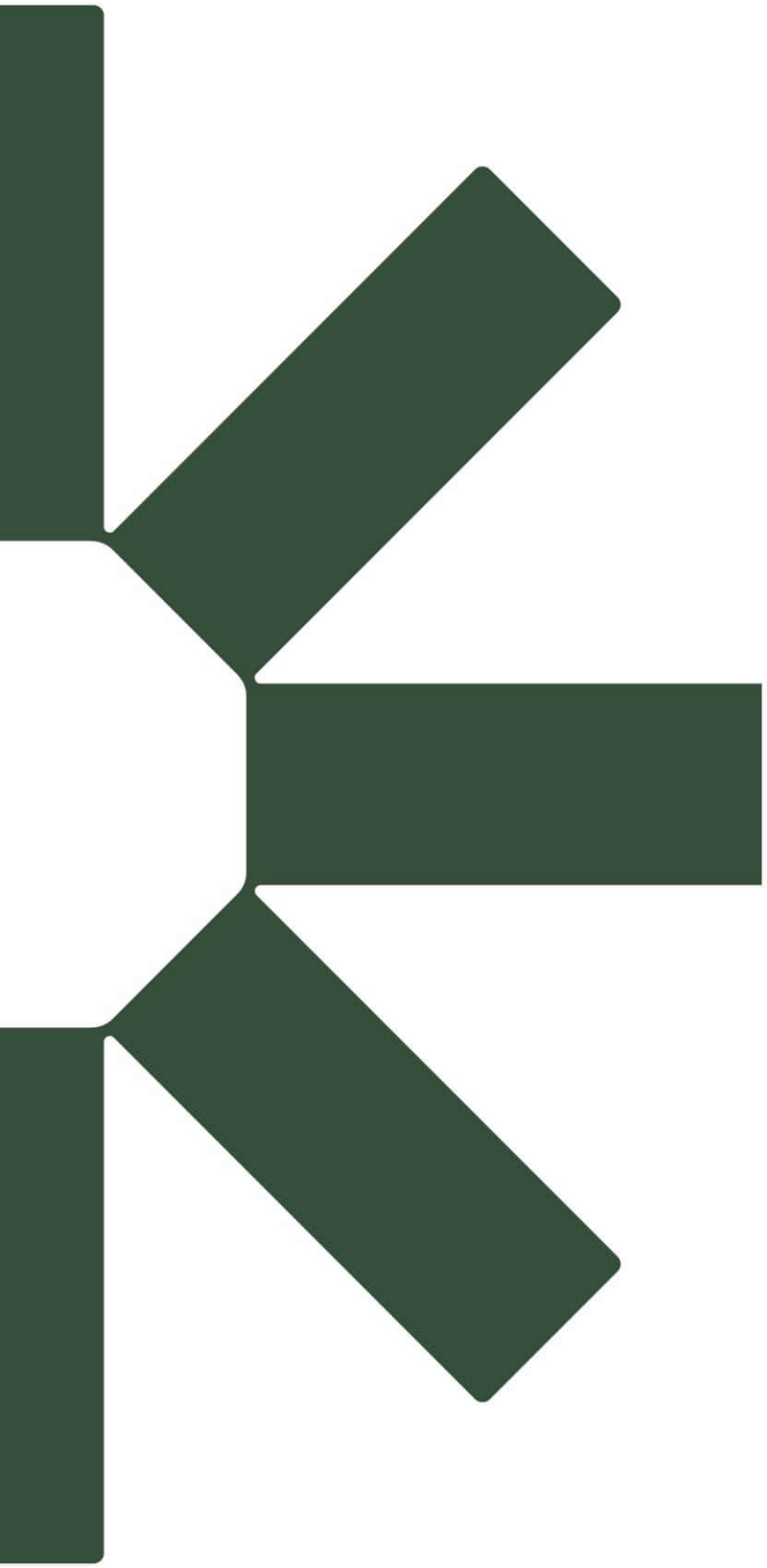
APPENDIX E-16

Path: H:\Projects-SLR\620-BNE\620-BNE\620.041537.00001 Isaac South EIS Groundwater\04 SLR Data\01 GIS\GIS\Isaac South EIS Groundwater\Isaac South EIS Groundwater.aprx\620041537_MOD_APP-D16_Uncertainty in Predicted 1m Residual Cumulative Drawdown – Vermont Seam (Layer 7)



Making Sustainability Happen

Appendix I Central Bowen Basin Regional Groundwater Model Version 6.0 (SLR, 2026c)

Isaac Downs Extension

Groundwater Impact Assessment

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00001

28 May 2026

Central Bowen Basin Regional Groundwater Model Version 6.0

Groundwater Model Update Technical Report

Stanmore ID Extension Pty Ltd

12 Creek Street Brisbane QLD 4000

Prepared by:

SLR Consulting Australia Pty Ltd

SLR Project No.: 620.041537.00006

29 May 2026

Revision: 3.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	16 January 2026	Maryam Kahe	Louis Bouchet	Brian Rask
2.0	8 May 2026	Maryam Kahe	Louis Bouchet	Brian Rask
3.0	26 May 2026	Maryam Kahe	Brian Rask	Brian Rask

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 Stanmore ID Extension Pty Ltd (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 A Calibration Stress Periods and Simulated Active Mines
Appendix B Hydraulic Parameters and Pilot Point Locations
Appendix C Prior Parameter Ranges for General Head Boundary (GHB) Properties

1.0 Introduction

The Central Bowen Basin Regional Numerical Groundwater Model (the Model) is a regional scale model that has been developed as part of data share agreements between some mining operators within the model domain (see **Table 1-1** for Model projects delivered pursuant to the data share agreements). The Model is therefore based upon information owned by different operators and supplied to SLR for use in the model development, calibration, and prediction of future groundwater conditions that account for cumulative impacts at the time of model development and predictions.

1.1 Purpose

The purpose of this report is to document the development and calibration method of the Model, for the latest update\version. The report provides a detailed explanation of the modelling process, the assumptions applied, and the calibration method.

1.2 Development Overview

The Model originated as the Olive Downs Project model (HydroSimulations, 2018), which served as the foundational regional-scale model. Since then, the model has been progressively updated and expanded to support a number of projects (**Table 1-1**).

Over time, the model has been enhanced to reflect improved geological and hydrogeological understanding. Updates have included domain extension to incorporate additional mining areas, mesh refinements around key mine areas, the incorporation of additional mine footprints, revised modelling packages, expanded calibration datasets, and an updated calibration method.

1.3 Model Version

The Model is regularly updated, validated and/or recalibrated as new data become available or new projects require structural updates. In order to track and document significant updates to the model, SLR has developed a version control, which is summarised in **Table 1-1**. Model version numbering presented is considered separately for regional model updates (first number, i.e. **1**.**0**) such as adding new layers or domain extensions, and internal model updates associated with local scale modifications subsequent to the regional updates (second number, i.e. 1.**1**).

The Model version presented in this report is **Version 6.0**.

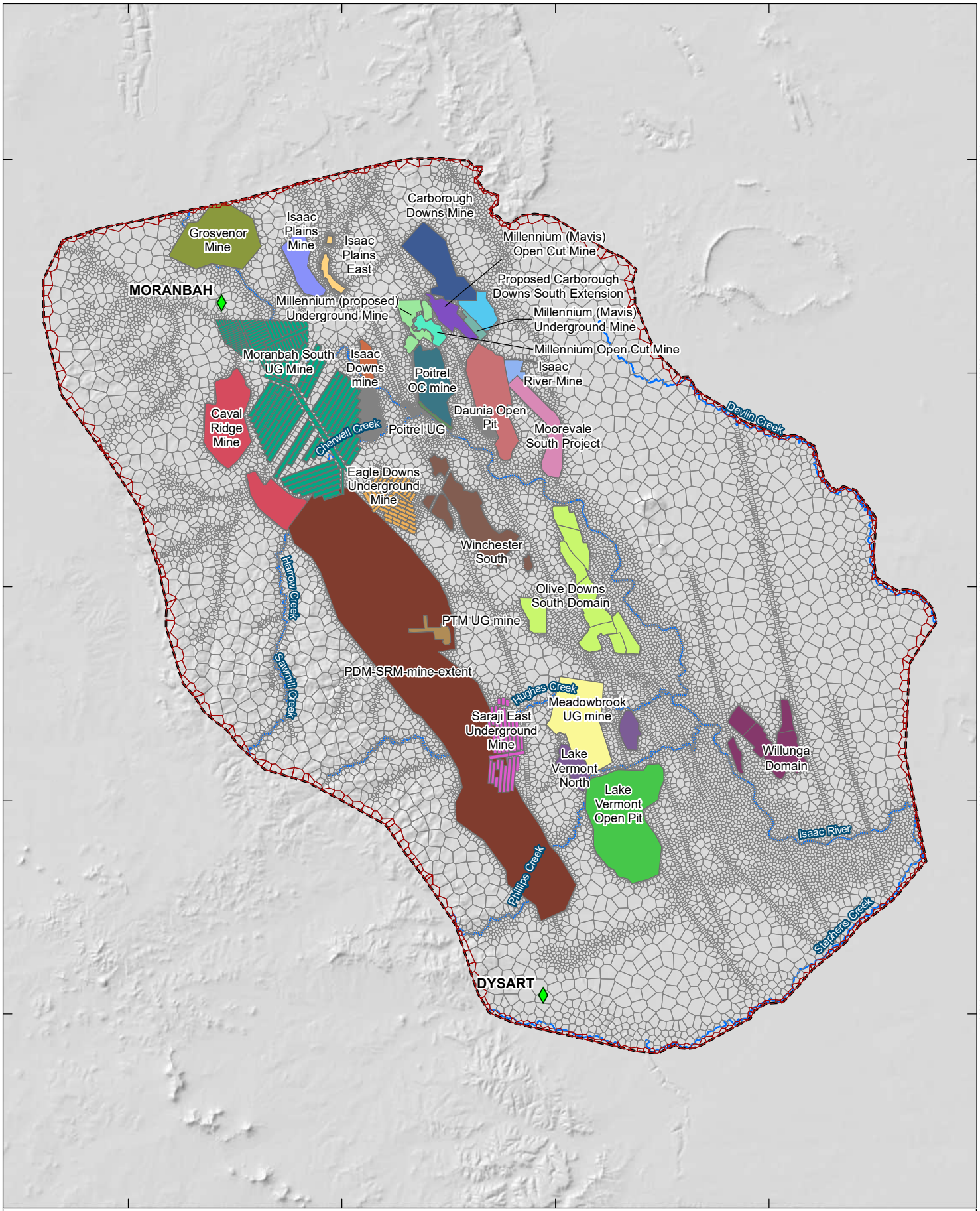
Table 1-1 Model Version History

Version	Regional Updates	Internal Model Updates	Project(s)
1.0	Foundational Model	Foundational Model	Olive Downs Project
1.1	Nil	Updates at MVS: layer elevations, mine plan, recalibration	Moorvale South Project (MVS)
2.0	Domain extension	Updates at WinSth: layer elevations, mine plan, recalibration	Winchester South Project (WinSth)
3.0	Domain extension Increase in layering for MCM;	Updates at CVM: layer elevations, mine plan Updates at LVN/MED: layer elevations, mine plans Recalibration	Lake Vermont (LVN) Meadowbrook (MED) Project Caval Ridge (CVM) Horse Pit Extension Project
3.1	Nil	Updates at DNM: layer elevations, mine plan Updates at Peak Downs Mine (PDM): layer elevations, mine plan	Daunia Mine (DNM) Water License
4.0	Domain extension; model wide regrid	Updates at MM: Layer elevations; mine plans Recalibration	Millennium Mine (MM) Mavis Underground Operations project
4.1	Nil	Updates at PDM, Saraji Mine (SRM), SEMLP, SSM: layer elevations, mine plans Recalibration	Saraji East Mining Lease Project (SEMLP) PDM PRCP CVM PRCP v1 DNM PRCP v1 SRM PRCP MVS PRCP
4.2	Nil	Updates at PTM: layer elevations, mine plans; localised re-gridding Recalibration	Poitrel (PTM) Highwall Mining Project PTM PRCP
4.3	Nil	Updates at MM: Grid refinement; mine plans; layer elevations Recalibration	MM Mavis South Extension Project MM PRCP
5.0	Model regrid	Re-do boundary conditions/approach Add Isaac Downs (ID) and Isaac Plains (IP) mines Revised calibration dataset & approach Revised calibration	CVM PRCP v2
5.1	Nil	Updated boundary condition setup (GHB) Updated layer elevations and alluvial extents near SRM Revised calibration	DNM PRCP v2 Daunia West Infrastructure Project (DWIP) PDM Continuation Project (PDMCP) SRM Grevillea Pit Continuation Project

Version	Regional Updates	Internal Model Updates	Project(s)
6.0	Model regrid	Update layer elevations at Isaac Downs Extension (IDE), ID, IP and Moorvale South Extension (MVSX) Add additional pilot points at IDE Add a hydraulic parameter zone for igneous rock at MVSX Revised calibration dataset Revised calibration Add Moranbah South mine	IDE Project MVSX Project

1.4 Regional Context

The model domain is located in the Bowen Basin of Central Queensland. It extends from Grosvenor and Isaac Plains Mines in the north to Saraji Mine near Dysart in the south, and from the edge of the Isaac River catchment in the east to the Caval Ridge Mine in the west. The extent of the model is shown in **Figure 1-1**.



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	14-Jan-2026
Drawn by:	RB

Town
Major Drainage System
Model Boundary
Model Grid
General Head Boundary

CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

MODEL MESH, BOUNDARY CONDITIONS AND APPROVED OPERATIONS

SLR

FIGURE 1-1

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_F01-01_Model Mesh, Boundary Conditions and Approved Operations.mxd

1.4.1 Included Mines

The Model incorporates a number of operating and historical coal mines across the Bowen Basin, including both open cut (OC) and underground (UG) operations. A summary of the included mines, operation type, approximate start dates, and current operational status is provided in **Table 1-2**. Detailed mining periods (start and end date) for each mine are presented in **Appendix A**. The spatial distribution of mine areas is illustrated in **Figure 1-1**.

Table 1-2 Summary of Mines within the Model Area (as Modelled)

Mine	Operation Type	Start Date in Calibration Model	Current Operational Status	Comment
Isaac Plains (OC)	Open Cut	1988	Mining ceased in 2019	
Peak Downs (OC)	Open Cut	1988	Operational	
Peak Downs (UG)	Underground	1988	Mining ceased in 2008	
Saraji (OC)	Open Cut	1988	Operational	
Poitrel (OC)	Open Cut	2008	Operational	
Lake Vermont / Lake Vermont North (OC)	Open Cut	2008	Operational	
Millennium (OC)	Open Cut	2008	Mining ceased in 2024	No future mining
Carborough Downs (UG)	Underground	2009	Operational (will cease in 2026)	
Daunia (OC)	Open Cut	2012	Operational	
Grosvenor (UG)	Underground	2015	Operational	
Caval Ridge (OC)	Open Cut	2015	Operational	
Isaac Plains East (OC)	Open Cut	2017	Operational	
Moorvale South (OC)	Open Cut	2018	Operational	
Isaac Downs (OC)	Open Cut	2021	Operational	
Olive Downs (OC)	Open Cut	2023	Operational	
Poitrel (HWM)	Highwall	2024	Mining ceased in 2025	
Willunga (OC)	Open Cut	NA	Project (approved)	Future mine (project)
Saraji East (UG)	Underground	NA	Project	Future mine (project)
Winchester South (OC)	Open Cut	NA	Project	Future mine (project)
Moranbah South (UG)	Underground	NA	Project (approved)	Future mine (project)
Eagle Downs (UG)	Underground	NA	Project (approved)	Future mine (project)

1.5 Modelling Objectives

The primary objective of the Model is to provide a consistent tool for assessing potential hydrogeological impacts associated with mining activities across the Central Bowen Basin (i.e. within the model domain). Specifically, the Model is used to:

- Assess groundwater level changes and drawdown in response to mining stresses.
- Evaluate changes in groundwater fluxes, including inflows to mine voids, discharges to rivers, and interactions with alluvial systems.
- Support assessment of water balance components under different development scenarios.
- Provide a framework to assess uncertainty in predictions, supported by the stochastic calibration approach applied in model development.

2.0 Model Construction and Development

2.1 Model Code

MODFLOW-USG Transport was used as the model code (Panday, 2021). MODFLOW-USG is a version of industry standard MODFLOW code and is suitable for accomplishing the Model objectives. MODFLOW-USG optimises the model grid and increases numerical stability by using unstructured, variably sized cells. Cells take any polygonal shape, with variable size allowing for refinement in areas of interest (e.g. geological or mining features).

Where previous MODFLOW versions restricted interlayer flow to vertical connectivity, MODFLOW-USG offers lateral connectivity between model layers. Lateral connectivity enables more accurate representations of hydrostratigraphic units, particularly those that pinch out, outcrop, or cross geological faults.

MODFLOW-USG is also able to simulate unsaturated conditions, allowing progressive mine dewatering and post mining rewetting to be represented by the model. For the current model, vadose zone properties have been excluded, and the unsaturated zone was simulated using the upstream-weighting method.

Python\Fortran code and a MODFLOW-USG edition of the Groundwater Data Utilities (Watermark Numerical Computing, 2021) were used to construct the MODFLOW-USG input files.

2.2 Model Extent and Mesh Design

The model extent is shown in **Figure 1-1**. The Model is a regional scale model with the domain extent designed to meet environmental approvals application requirements for cumulative impact assessment, (i.e., the domain is large enough to appropriately consider potential overlapping groundwater impacts from resource operations in the central Bowen Basin).

The model domain is intended to place boundary conditions sufficiently distant from the mines to allow the extent of potential impacts from mining activities on the groundwater system to be assessed. At its widest extents, the model is approximately 62 km west-east by 95 km north-south. 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 (HydroAlgorithmics, 2014). Varying Voronoi cell sizes allowed refinement around areas of interest, while a coarser resolution elsewhere reduces the total cell count to a manageable size. The model domain was vertically discretised into 19 layers, each layer comprising a cell count up to 101,427. The total number of cells in the Model is 1,302,124. This is after pinching out areas in layers 3 to 19 which were not present based on the mapped geology.

The following features have been included in the grid design:

- The Alluvium is represented in the model with 500 metre (m) cell edge length.
- The Isaac River is represented in the model with a 200 metre (m) Voronoi cell size constraint.
- Drainage systems are represented with 200m cells.
- Open cut mine areas are represented with a 100m regular cell size constraint.
- Longwall mining at Saraji East, Eagle Downs, Grosvenor, and Meadowbrook use an oriented regular grid with 200 m-wide squares to represent the longwall. For Carborough Downs and Mavis Downs, a 100 m grid is used. For the approved

Moranbah South underground mine, 500 m-wide square cells are used to represent the longwalls and 300 m-wide square cells for the bord and pillar areas.

- Highwall mining at Poitrel is represented using an oriented regular grid with 25 m-wide squares.
- Faults are represented using a 200 m Voronoi cell constraint.

2.3 Model Layers

Topography within the model domain has been defined using numerous sources of varying accuracy ranging from high resolution LiDAR to publicly available Digital Elevation Models (DEMs). Data extents of the sources used to define the model top are shown in **Figure 2-1**.

The model domain is discretised into 19 layers (convertible), as listed in **Table 2-1**. **Table 2-1** also presents the average thicknesses across the model domain for each layer. Model layer extents (lateral and vertical) have been defined using data from the following sources:

- **BMA:** Saraji site geological model, Saraji South site geological model, Peak Downs site geological model, Caval Ridge site geological model and Daunia site geological model (now owned by Whitehaven Limited), and bore hole logs.
- **BMC:** Poitrel site geological model (now owned by Stanmore Resources Limited) and bore hole logs.
- **Jellinbah Mining Pty Ltd:** Lake Vermont, Lake Vermont North and Lake Vermont Meadowbrook site geological models and bore hole logs.
- **Whitehaven WS Pty Ltd:** Winchester South site geological model and bore hole logs.
- **MetRes Pty Ltd**: Millennium site geological model and bore hole logs.
- **Peabody Energy Limited**: Moorvale South and Moorvale South Extension site geological model and bore hole logs.
- **Pembroke Resources Limited:** Olive Downs site geological model and bore hole logs.
- **Stanmore Resources Limited:** Isaac Plains, Isaac Downs, and Isaac Downs Extension site geological models
- **Public Domain:** CSIRO Regolith depth survey (Wilford et al., 2015), Queensland Globe bore hole logs (Geological Survey of Queensland, 2025), Queensland surface geology and basement geological maps (Geological Survey of Queensland, 2012).

Table 2-1 Model Layers and Thicknesses

Model Layer	Geologic Formation	Hydrogeologic Unit	Average Thickness (m)
1	Quaternary alluvium (Qa), Quaternary colluvium, Tertiary basalt (at outcrop)	Quaternary alluvium, surface cover	6.8
2	Tertiary-Quaternary alluvium (TQa), Tertiary sediments, Tertiary basalt	Tertiary-Quaternary alluvium, Tertiary sediments, weathered Permian, Tertiary basalt; collectively “Regolith”	18.5
3	Rewan Group	Triassic	74.6
4	Rangal Coal Measures	Leichhardt overburden	36.2
5		Leichhardt Seam	4.5
6		Interburden	34.5
7		Vermont Seam	3.8
8		Vermont Interburden	43.9
9	Fort Cooper Coal Measures	Fort Cooper Interburden	182.3
10		Fort Cooper Seams (combined)	58.1
11		Fort Cooper Interburden	58.2
12	Moranbah Coal Measures	Q Seam	3.3
13		Interburden	34.8
14		P Seam	2.8
15		Interburden	53.0
16		H Seam (Harrow Creek Seam, Goonyella Middle Seam)	5.4
17		Interburden	65.1
18		D Seam (Dysart Seam, Goonyella Lower Seam)	8.1
19		Interburden	496.2

In this version of the Model, all layers are updated for the Isaac Plains, Isaac Downs, Isaac Downs Extension and Moorvale South Extension areas based on geological data from Stanmore Resources and Peabody Energy.

Model Layer 1 is fully extensive across the model with an average thickness of 6.8 m. Model Layer 2 is also fully present across the model area with an average thickness of 18.5 m. The Saraji, South Saraji, Peak Downs, Winchester South, Caval Ridge, Moorvale South, Isaac Downs and Isaac Downs Extension site geology models were used to define the base of model Layer 2. Outside these site geology models the base of Layer 2 was interpreted from CSIRO regolith survey depths and Queensland Globe bore log lithology data, consistent with the previous version of the model.

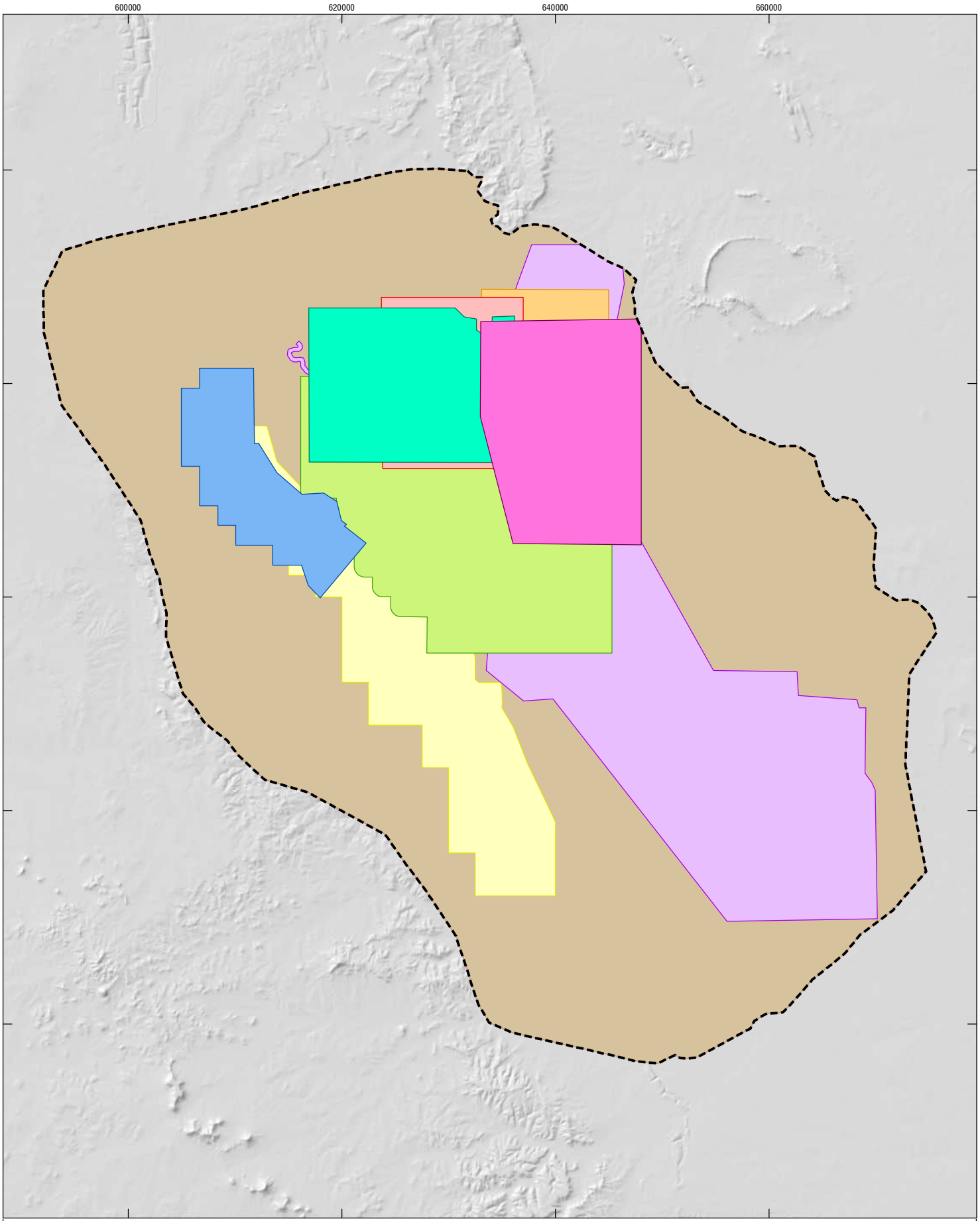
The underlying Triassic and Permian layers are present only to their outcrop extents, with some inference made for the presence of older units beneath the surface outcrop due to folding and faulting.

With regards to the Rangal Coal Measures, the Leichhardt and Vermont seams were updated in this version of the Model using provided geological interpretations from the Isaac Plains, Isaac Downs, Isaac Downs Extension and Moorvale South Extension geology models. For the Leichhardt seam, all four models—Isaac Plains, Isaac Downs, Isaac Downs Extension and Moorvale South Extension—were utilised to update seam elevations, thickness trends, and lateral continuity across the Model domain. For the Vermont seam, information from the Isaac Downs, Isaac Downs Extension and Moorvale South Extension geologic models was used to update the Model. Regionally, the layers remain unchanged and based upon previously incorporated geology models.

With regards to Moranbah Coal Measures, eight layers were included to account for all the coal seam targets within the Moranbah Coal Measures at the Caval Ridge, Peak Downs, and Saraji sites. It is not possible to represent every individual coal seam or ply in the model layers representing the Moranbah Coal Measures, therefore a ‘combined thickness’ totalling the approximate thickness of coal for the main seams has been simulated, consistent with the previous version of the model. The major coal seams represented in the model are the Q, P, H and D seams. In doing so, the thicknesses of each individual coal seam (typically < 1 m thickness) were combined separately for the major coal seams and the combined thicknesses were used in the model. The base of the lowest coal seam at each group was used to assign the bottom of the model layer. Outside of the geology model extents, where bore logs with information on Moranbah Coal Measures were available this information was included in the layer elevations. Elsewhere, average thicknesses were extrapolated out into the extended model area and Queensland Surface Geology maps were used to pinch-out the layers when the geology unit discontinues and does not exist laterally. These layers are consistent with the previous version.

Table 2-1 reports the average thicknesses of each layer over the entire model area. The basement layer has a thickness of about 500 m and is considered to replicate the Back Creek Group. The Back Creek Group, in general, has low permeability and will act as a regional aquitard, suppressing downward vertical flow.

In the model, lateral connectivity across the faults was implemented using Lateral Connection Groups in AlgoMesh, ensuring that layers displaced by faulting remain hydraulically connected to the rest of the model where appropriate.



0 5 10 km

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- Model Boundary
- Caval Ridge 1m DEM Data
- Daunia & Poitrel LiDAR Data
- Whitehaven 1m DEM Data
- Peabody LiDAR Data
- Pembroke LiDAR Data
- Saraji and Peaks Downs pre Mining
- Geoscience Australia DEM Data
- Moorvale South LiDAR Data
- Issac Downs LiDAR Data

CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

TOPOGRAPHY DATA EXTENTS

SLR

FIGURE 2-1

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2.4 Hydrogeological Parameterisation

2.4.1 Hydrogeological Zones

Hydrogeological zones were defined for each layer to represent the main hydrogeological units and their spatial extent. The model zones for each layer are represented in **Table 2-2**.

Table 2-2 Hydrogeological Zones

Geology Unit	Unit	Layer
Alluvium & Colluvium	Surface Cover	1
Isaac River Alluvium	Isaac River Alluvium	1
Regolith	Surface Cover	1
Weathered Permian	Surface Cover	1 & 2
Duaringa Formation	Surface Cover	1 & 2
Tertiary Basalt	Tertiary Basalt	1 & 2
Regolith	Surface Cover	2
Rewan	Triassic	3
Rangal Coal Measures	Interburden	4
Rangal Coal Measures	Leichhardt Seam	5
Rangal Coal Measures	Interburden	6
Rangal Coal Measures	Vermont Seam	7
Rangal Coal Measures	Interburden	8
Fort Cooper Coal Measures	Interburden	9
Fort Cooper Coal Measures	Fort Cooper Seams	10
Fort Cooper Coal Measures	Interburden	11
Moranbah Coal Measures	Q Seam	12
Moranbah Coal Measures	Interburden	13
Moranbah Coal Measures	P Seam	14
Moranbah Coal Measures	Interburden	15
Moranbah Coal Measures	H Seam	16
Moranbah Coal Measures	Interburden	17
Moranbah Coal Measures	D Seam	18
Moranbah Coal Measures	Interburden	19
Igneous intrusion	Igneous intrusion	1 to 19
Faults	Faults	4 to 13
Faults	Faults	4 to 6
Faults	Faults	3, 5, 7, 9, 10, 12, 14, 16, 18

2.4.1.1 Structural Geology

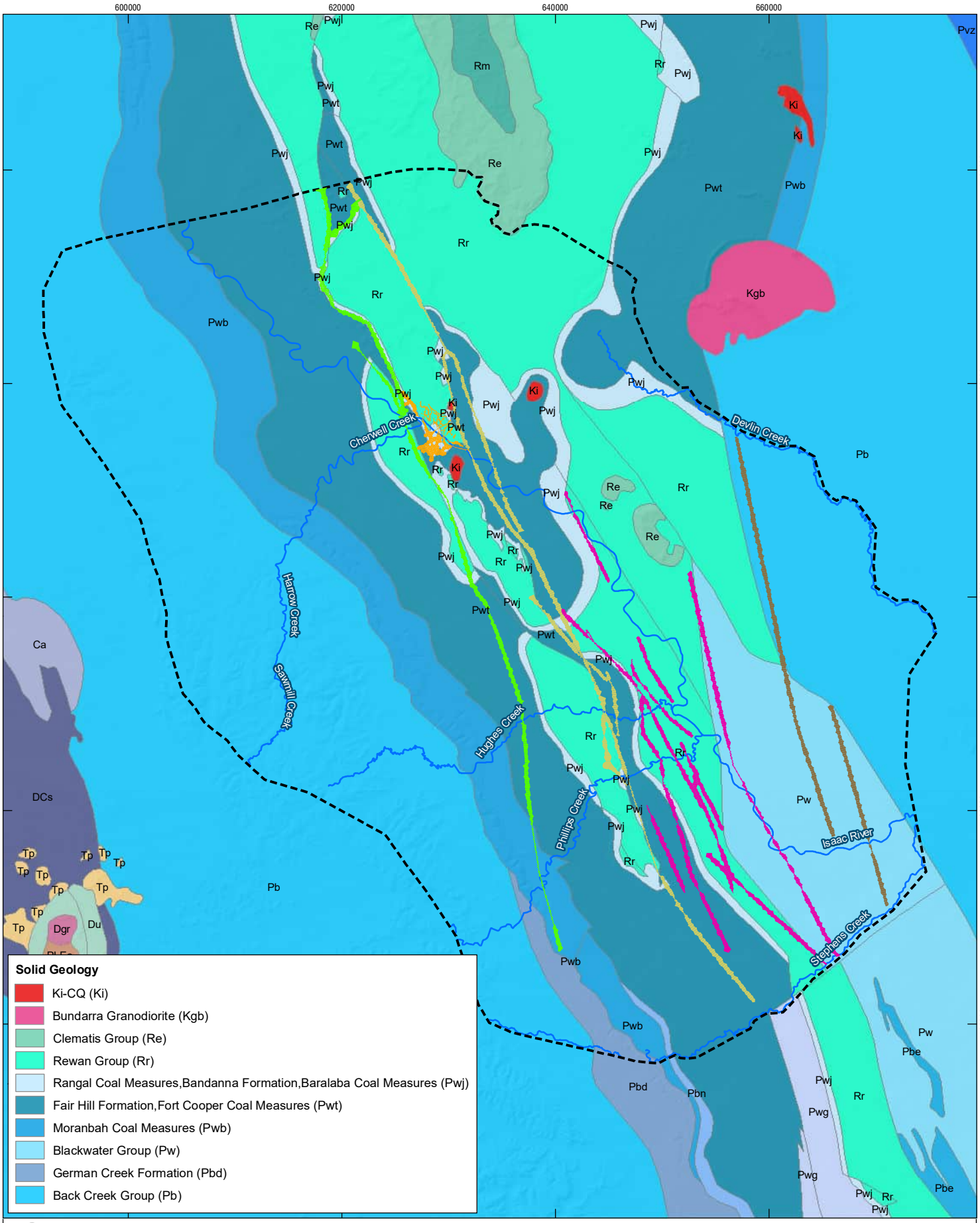
Modelled fault zones are represented in **Figure 2-2.**

The locations of faults (included in the model as hydrogeological zones) are based on regional fault mapping and site-specific geology models/fault mapping where available, and is consistent with the previous version of the model. Mesh refinement (200m) has been used along fault lines to allow for isolated changes of hydraulic properties along fault zones during calibration.

There are three key regional northwest-southeast trending fault zones included in the model, which are part of the large scale Jellinbah Thrust Belt. From west to east the three fault zones are:

- Jellinbah Fault, extending 50 km
- Isaac Thrust Fault, extending 70 km
- Yarrabee Fault, compromised of numerous shorter faults extending 25 km total

Vertical displacements along the faults were incorporated in the model based on geological models' data (where available, see **Section 2.3**). The magnitude of vertical displacement is highly variable spatially and can have vertical throws greater than 100 m.



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MODELLED FAULT ZONES

FIGURE 2-2

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2.4.2 Pilot Points

Pilot points[1] were used to model the spatial variability of horizontal and vertical hydraulic conductivity parameters (and specific yield, in the case of the Isaac River Alluvium) in some modelled geologic units (i.e. hydrogeological zones). Pilot points were placed in the Isaac River Alluvium and weathered formations (Layer 2), as well as any coal bearing formation, or formation with at least ten observation bores in the calibration database (**Table 2-3**).

The pilot point locations for each layer are presented in **Appendix B**. Pilot point locations were chosen using Delauney triangulation with observation target locations forming the vertices of the triangles. Pilot points were placed on the triangle centroids. Additional pilot points were placed at regular 5 km intervals around the outline of each formation, and along the edges of the Isaac River channel. Some additional pilot points were manually placed in areas that were not covered in the triangulation step to allow for some spatial variability within these areas. Compared to the previous version of the Model, additional pilot points were added at Isaac Downs/Isaac Downs Extension. In total, there are 2740 pilot point locations in the model. A breakdown of the counts is provided in **Table 2-3**.

Pilot point covariance matrices were constructed using a combination of the PEST utilities MKPPSTAT and PPCOV_SVA (Hugman, 2021). These utilities were used to generate covariance matrices built from multiple automatically generated local variogram models where the variogram range is a function of the average distance between each point and a number of its nearest neighbours. This allows for a spatially dependent heterogeneity in the parameter field, where higher heterogeneity is expected where there is a greater density of pilot points. The chosen model variograms were exponential and isotropic. The number of nearest neighbours used to calculate the average pilot point separation was 10, and the variogram range for each local variogram was set to approximately 4.5 times the average separation between each point and its 10 nearest neighbours. Pilot point covariance matrices were generated independently for each geologic zone in the groundwater model

[1] Points within a spatial field at which optimal property values are determined by a calibration process, considering the spatial correlation between points.

Table 2-3 Summary of Pilot Points Assigned to Geological Units by Model Layer

Geologic Unit	Layer Number	Pilot Point Count
Isaac River Alluvium	1	377
Regolith	2	300
Rewan Formation	3	221
Leichhardt Seam	5	291
Vermont Seam	7	258
Interburden	9	209
Fort Cooper Seams	10	220
Q seam	12	205
P seam	14	209
H seam	16	218
D Seam	18	232

2.4.3 Hydraulic Conductivity as a Function of Depth

The model incorporates depth dependence to account for variations in hydraulic conductivity with depth. Pilot points are defined within the relevant model layers, and the hydraulic properties are estimated through interpolation between these pilot points. The interpolation process considers the specified depth dependence values, ensuring that property variations with depth are represented in the model.

The following formula was used to represent depth dependence:

$$K_x = \frac{K_{x^0}}{10^{(depth \times slope)}} \qquad (Eq.1)$$

- K_x : Horizontal hydraulic conductivity at a given depth.
- K_{x^0}: Reference (or surface) hydraulic conductivity at ground level (depth = 0).
- depth: The vertical distance below ground surface, usually in metres.
- slope: A parameter that controls how quickly conductivity decreases with depth.

For implementation, each model cell is subdivided into 1 m vertical increments. Conductivity is evaluated at the centroid of each increment, and the representative conductivity assigned to the cell is the average of these values. A depth cap is enforced within each zone to limit the reduction of conductivity. When the depth of an increment exceeds the prescribed cap, the conductivity for that increment is computed using the cap depth rather than the actual depth.

The vertical hydraulic conductivity (Kz) is calibrated as a factor of Kx. Kz thus also decreases with depth, proportionally to Kx.

2.5 Model Stresses and Boundary Conditions

2.5.1 Regional Groundwater Flow

General Head Boundary (GHB) conditions have been specified along the entire model boundaries as represented in **Figure 1-1**. The GHB boundary condition is used to represent the regional flow into and out of the model area and was assigned using GHB cells in all layers using pre-mining head elevations. Groundwater will enter the model where the head in the GHB is higher than the modelled head in the adjacent cell, and will leave the model when the water level is lower in the GHB. GHB conductance is calculated using the hydraulic conductivity and the dimensions of each GHB cell and is therefore variable in this model due to variable cell size.

Multiple GHB zones have been defined within each layer, covering the entire model boundary. The zones have been defined based on overburden thickness, aiming to achieve a reasonable and consistent grouping.

Transient heads from the previous version were employed as starting heads. The transient heads and conductance factor were changed during the calibration process.

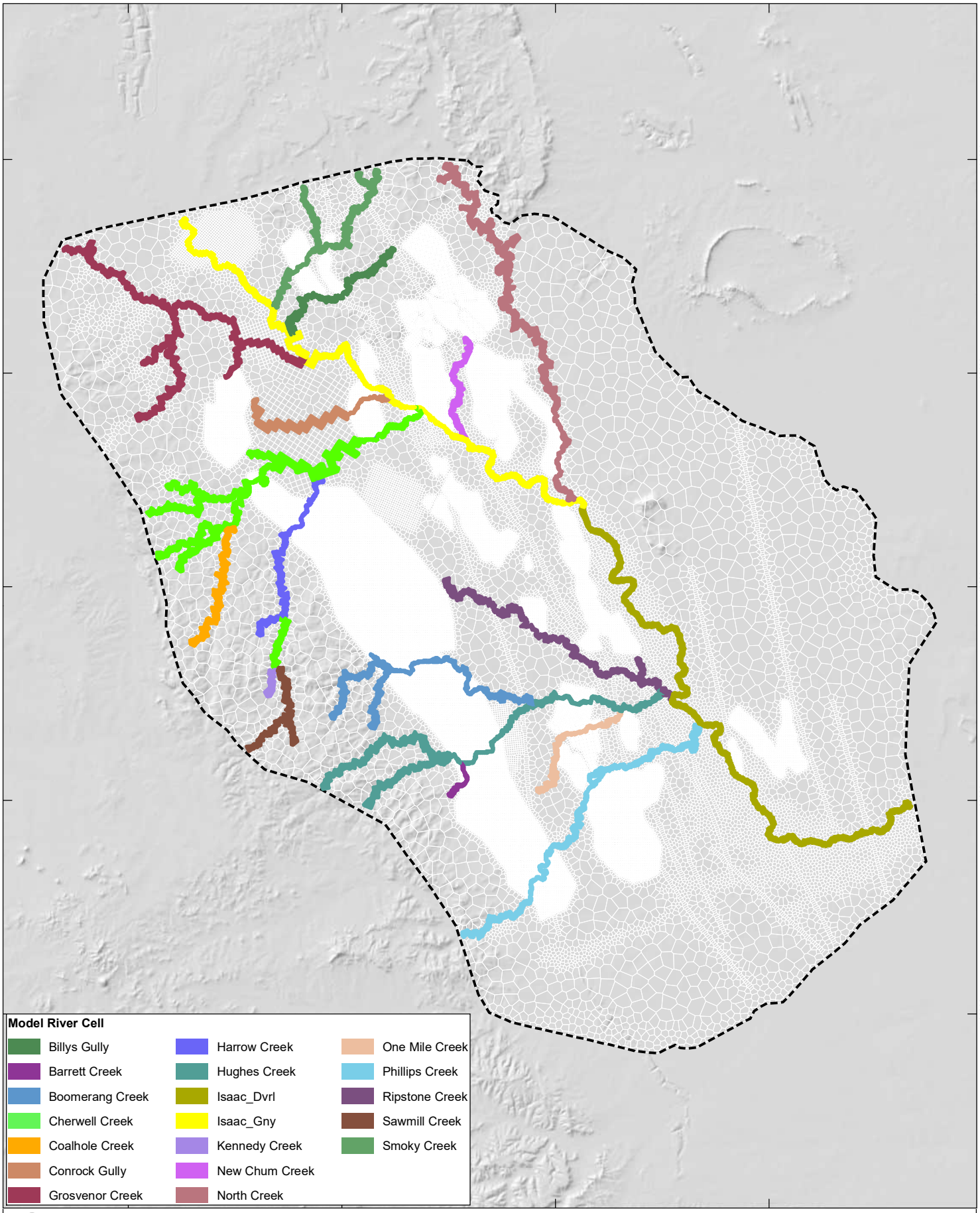
2.5.2 Watercourses

Major rivers, including the Isaac River, as well as minor creeks, were built into the model using the MODFLOW-USG RIV package. River cells in the model are shown in **Figure 2-3**, and streams within the model included in the RIV package are listed in **Table 2-4**. To prepare the minimum elevation data for the river cell package, topography data were used to export the minimum elevation for all rivers, including the Isaac River and its tributaries, shown in **Figure 2-3**. The riverbed elevation was then smoothed to ensure that the rivers could flow through their designated paths. To smooth the riverbed elevation, all river cells were labelled based on the river flow path. Using the overall river slope and the highest point elevation, the elevation of each cell centre was then calculated.

Surveyed river stage data was collected at various locations along the Isaac River. The closest gauging stations to the site are at Goonyella and Deverill, located in the northern and central parts of the model, respectively. River stage data from the Deverill station was used for the Isaac River, as the data available from the Goonyella station was insufficient for analysis.

River stage measurements, flow duration curves, flow measurements, and historic rating curves for the Deverill Station (Station number 130410A) were downloaded from the Queensland Government Water Monitoring Information Portal (WMIP). River stage data were adjusted based upon the historic rating curves to reflect a stage height and frequency that is consistent with periods of flow within the Isaac River, as indicated by the flow records, historic rating curves, and flow duration curves. The adjustments result in zero stage heights when there is no measured flow, and variable stage heights when there is flow.

Tributaries were activated only during periods when the Isaac River was flowing, assuming concurrent flow conditions. Surveyed river stage data were available at several locations along the Isaac River. **Table 2-4** shows the river and surface water features represented in the model, including the stage data used for each model period and stage group.



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MODELLED STREAM AND RIVER CELLS

SLR

FIGURE 2-3

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Table 2-4 River and Surface Water Features in the Model

Model Period	River Stage Data per Stage Group	Stage Group 1	Stage Group 2
Steady State and Pre-Calibration	Median (1968-2025)	Isaac River	Grosvenor Creek; Conrock Gully; Cherwell Creek; Coalhole Creek; Harrow Creek; Kennedy Creek; Sawmill Creek; Barrett Creek; Boomerang Creek; Hughes Creek; One Mile Creek; Phillips Creek; Ripstone Creek; Smoky Creek; Billys Gully; New Chum Creek; North Creek.
Calibration	Quarterly median per stress period (Jan 1988 to Dec 2025)		
Prediction	Median (1968-2025)		

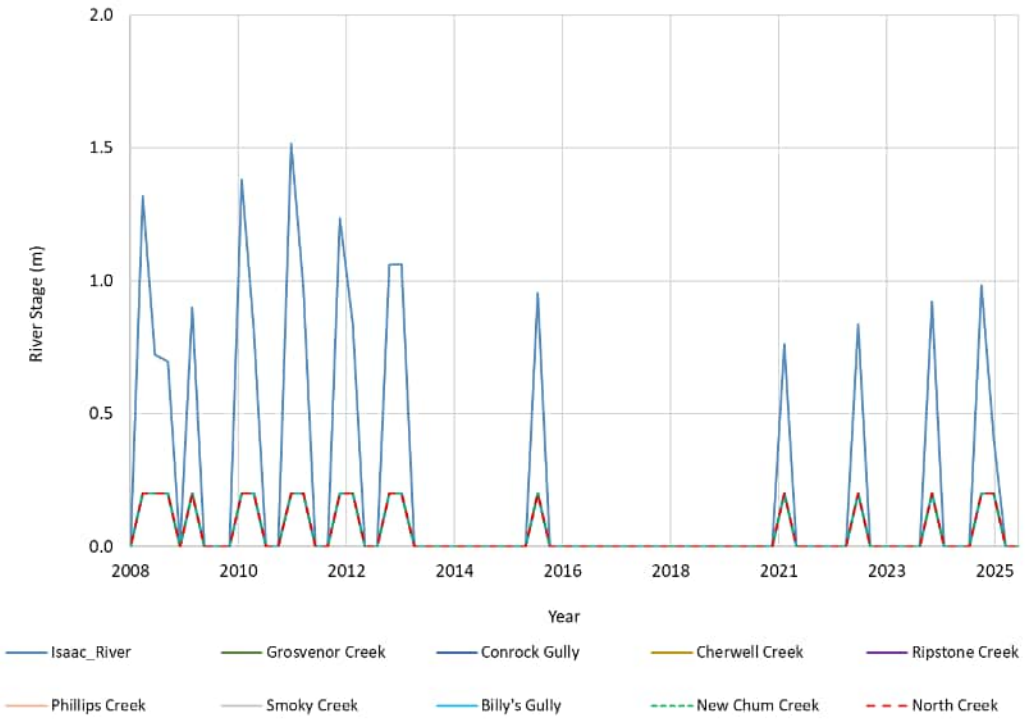


Figure 2-4 River Stage Setup

2.5.3 Rainfall Recharge

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 recharge rates were established through the calibration process, with bounds based on the conceptual understanding of the system and comparing them with other groundwater models prepared for the region.

Rainfall recharge was imposed as a percentage of deep drainage rate from the Bureau of Meteorology (BoM) Australian Water Resources Assessment Landscape model (AWRA-L) (Frost et al., 2018). Average rainfall (1988-2008) was used for the steady-state stress period. For the transient calibration model, quarterly averages of the AWRA-L deep drainage data were used (2008 to 2025). Multipliers are then utilised during the calibration process. Separate multipliers are used for each recharge zone.

The model included seven (7) recharge zones as listed below and shown in **Figure 2-5**:

- Isaac River Flood Plain Alluvium
- Isaac River Channel Alluvium
- Alluvium – rest of the model
- Regolith
- Weathered Permian
- Duaringa Formation
- Basalt

The initial recharge to emplaced mine spoil is set to 4% of actual rainfall and an equivalent percentage of deep drainage calculated. However, the recharge to spoil is varied during calibration.

2.5.4 Evapotranspiration

Evapotranspiration (ET) has been applied uniformly using MODFLOW's linear function in the ET package. Topographic elevation is used as the 'evaporation surface' at which MODFLOW simulates ET at the specific rate. Extinction depth zones, which is where the simulated rate of ET falls to zero, vary spatially based on land use or vegetation type and were refined during the calibration process. Extinction depths were included as calibration parameters. The spatial distribution of trees and grasses was based on the latest Land Use of Australia dataset (Tissott and Mueller, 2022).

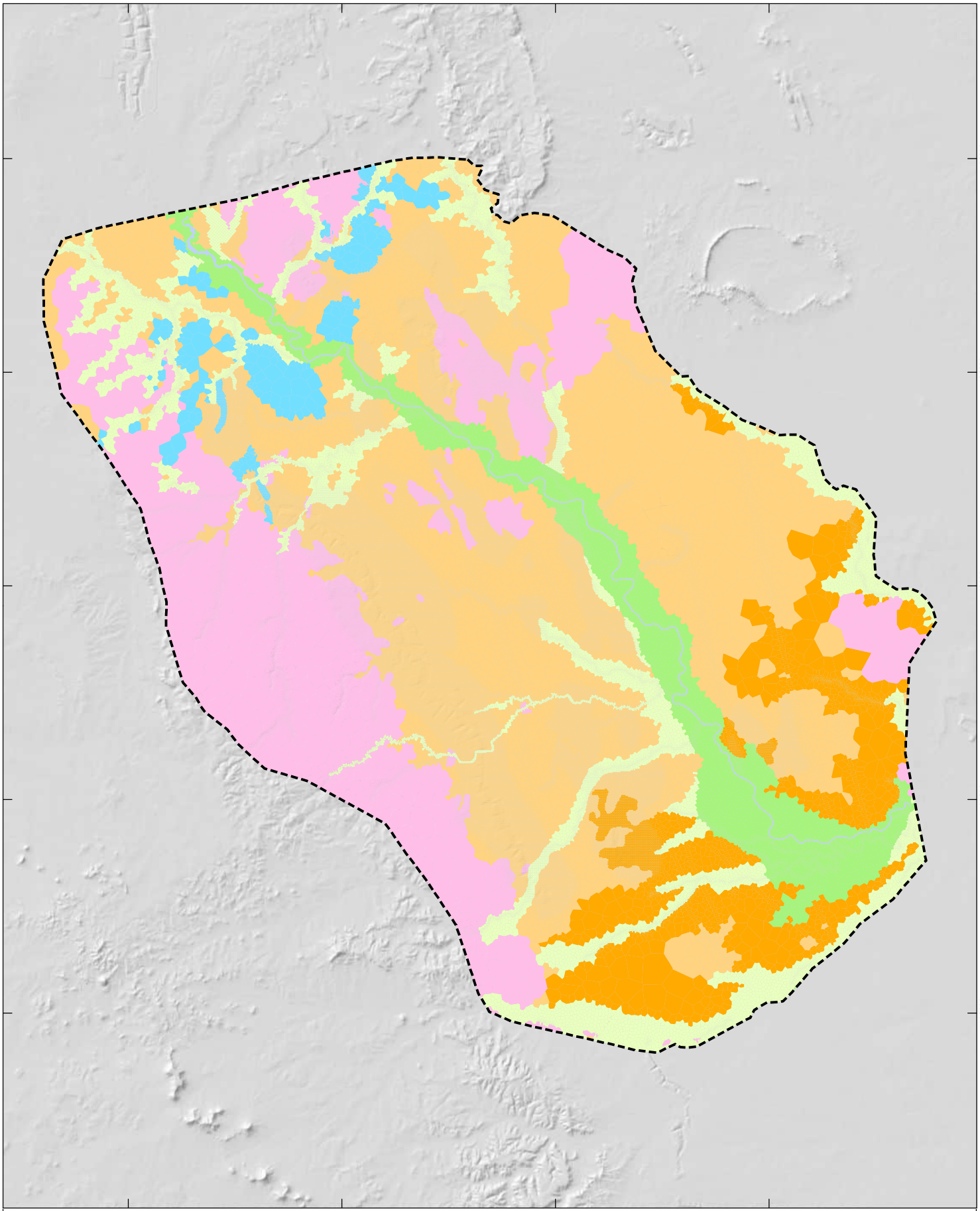
The MODFLOW Evapotranspiration (EVT) package was used to simulate evapotranspiration from the groundwater system.

Extinction depths were permitted to vary from 0.2 m to 20 m during calibration based on the EVT zones (Kath et al, 2014). The Evapotranspiration extinction depth parameter defines the maximum depth from which water can be extracted by vegetation through transpiration. Any water that is available below this depth is assumed to be unavailable to plants. Maximum potential rates were set using actual evapotranspiration values (from the Bureau of Meteorology), with the average value (600 mm/year) used as the transient calibration evapotranspiration rate. An EVT rate of 0 was assigned to the model cells representing the rivers.

The model included six (6) EVT zones as listed below and shown in **Figure 2-6**:

- Alluvium
- Regolith
- Weathered Permian
- Duaringa Formation
- Basalt
- Permian Outcrop

The same EVT rate was assigned for the six zones; however, the extinction depths were allowed to vary separately in calibration.



0 5 10 km

Model Boundary

Recharge Zone

- Alluvium
- Alluvium Isaac River
- Alluvium Isaac River Channel
- Basalt
- Duaringa Formation (Tu)
- Regolith
- Weathered Permian

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MODELLED RECHARGE ZONES

FIGURE 2-5

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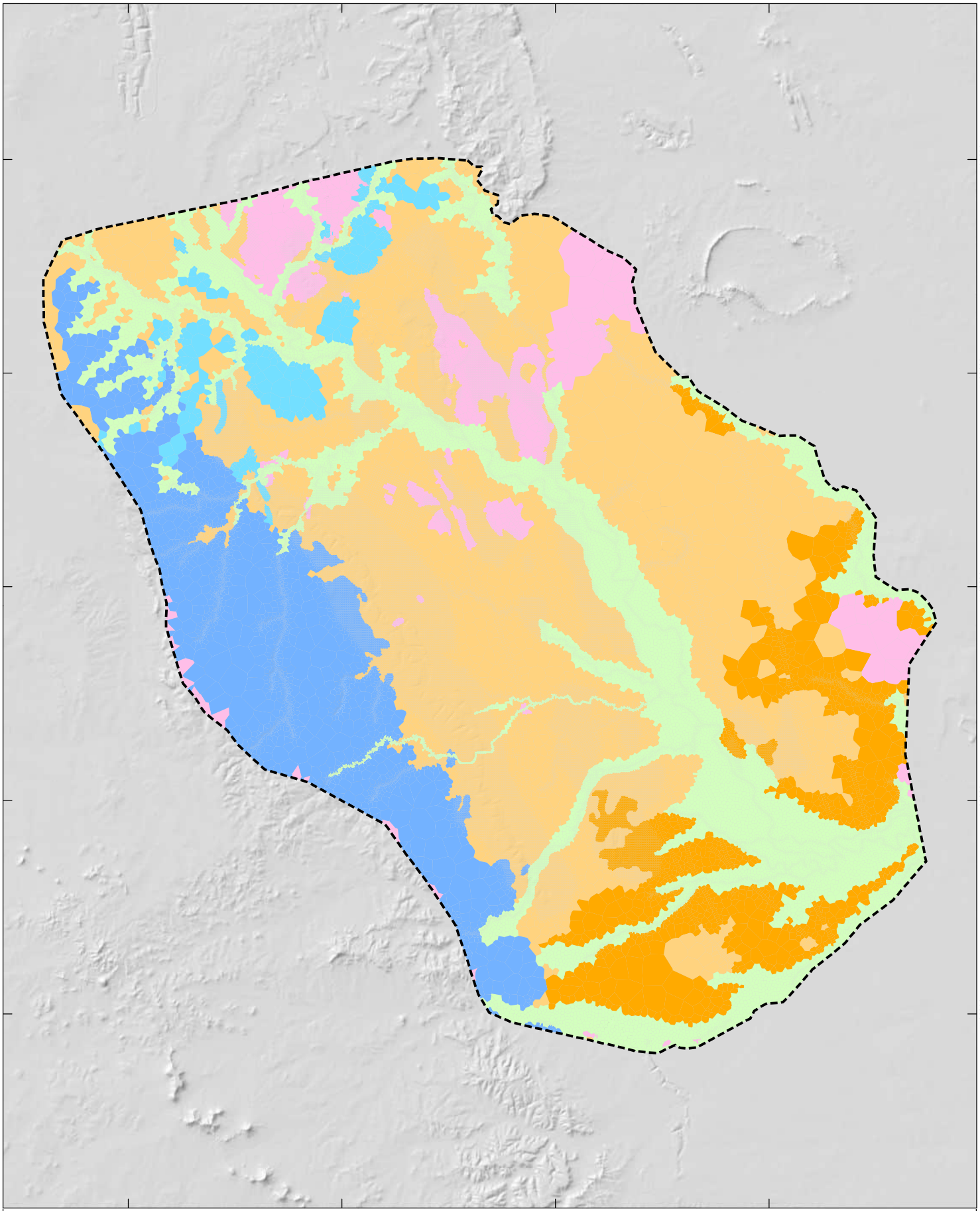

0 5 10 km

Model Boundary

EVT Zone

- Alluvium
- Basalt
- Duaringa Formation (Tu)
- Permian Outcrop
- Regolith
- Weathered Permian

Coordinate System:	GDA 1994 MGA Zone 55
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CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

MODELLED EVAPOTRANSPIRATION ZONES

FIGURE 2-6

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2.5.5 Groundwater Use

Private groundwater pumping bores have not been included in the model due to lack of information regarding abstraction rates across the model domain. Due to generally low groundwater abstraction across the model area, it is likely that the bores have very localised drawdowns and will not significantly impact model results.

2.5.6 Mining

The MODFLOW Drain (DRN) package is used to simulate mine dewatering in the model for all mines. Boundary conditions for drain cells allow one-way flow of water out of the model. When the computed head drops below the stage elevation of the drain, the drain cells become inactive. This is an effective way of theoretically representing removal of water seeping into a mine over time, with the actual removal of water being via pumping and evaporation.

To simulate open cut mines in the model, drain cells are applied to all active layers from the surface to the base of the mine target coal sequence. Historic underground mines were also simulated using the DRN package, with drains being active during estimated periods of mining activity.

2.5.6.1 Variation in Hydraulic Properties due to Mining

Backfilling of open cut mine areas with spoil was modelled using the Time-variant materials (TVM) package of MODFLOW-USG Transport. The model cell properties were updated to spoil properties guided by operational mine plans. Horizontal hydraulic conductivity (Kx), vertical hydraulic conductivity (Kz), storage properties (Sy and Ss) and recharge of spoil are all permitted to vary with time under calibration.

2.6 Timing

A combined steady state, transient warm-up and transient calibration model was developed, as follows:

- A pre-warmup transient stress period with one 1,000-day stress period from August 1960 to January 1988).
- A steady state model with one stress period to simulate the water levels pre-mining.
- A transient warm-up model with one 20-year stress period from January 1988 to January 2008).
- A transient calibration model with 73 quarterly stress periods from January 2008 to December 2025.

The first two stress periods of the model were pre-warmup transient and steady-state and did not include any mining. The transient warm-up model was built to incorporate pre-2008 mining activities and their impacts on groundwater levels in the model domain. The warm-up model provided appropriate starting conditions for the calibration model (i.e., starting heads and hydraulic properties). Together, the pre-warmup transient, steady state, warm-up and transient calibrations comprise 75 stress periods.

A summary of the calibration validation model stress periods and simulated active mine timings are shown in **Appendix A**.

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 1 day.

2.7 Solver Settings

The solver settings were defined in the Sparse Matrix Solver (SMS) package. The PCGU method was selected with inner and outer convergence set at 0.005 and 0.05 respectively during calibration.

2.8 Model Calibration

2.8.1 Calibration Methodology

Stochastic calibration is performed using sequential Monte Carlo analysis.

Monte Carlo (MC) analysis is a simulation technique used to understand the impact of uncertainty in a system by running many random simulations. It works by generating random inputs based on probability distributions, running the model multiple times with different inputs, and analysing the results to estimate possible outcomes and their probabilities (Rubinstein & Kroese, 2016).

Sequential Monte Carlo (SMC) analysis involves preforming MC analysis one after the other, using the results from the precedent step, to inform the next step by refining the probability distribution of inputs (Doucet et al., (2001); Gordon et al., (1993)).

SMC analysis uses a set of weighted samples to approximate the posterior distribution of a dynamic system over time. The weight of each sample is estimated using a likelihood function (i.e. likelihood of the sample, based on its ability to reproduce system past behaviour). One key strength of SMC analysis is its ability to handle non-linear and non-Gaussian systems.

SMC analysis has been used in environmental modelling [Liu & Chen, (1998); Zhou & Xie, (2012), including in groundwater modelling (Cohn & Luby, (2002); Moradkhani et al., (2005)].

In groundwater modelling, SMC methods can be used to calibrate models and reduce uncertainty in parameter distributions. Here, each sample represents a model realisation, and the process updates and refines the parameter distributions using observed data, such as water levels or groundwater fluxes.

2.8.2 Calibration Process

The general process involved in SMC analysis applied to groundwater modelling is:

2.8.2.1 Initialisation (Step 1)

The process is started by generating prior model realisations as follows:

- Define the parameter space (i.e. ranges in values for model parameters).
- Generate an ensemble of model realisations, each representing a plausible groundwater model.
- These realisations are sampled from prior distributions of uncertain parameters.

2.8.2.2 Forward Simulation and Processing (Step 2)

Each model realisation is used to simulate groundwater flow.

The following statistics are calculated by comparing measured data (e.g. water levels, fluxes) against simulated outputs:

- Mean residual

- Median residual
- Interquartile range (IQR)
- Standard deviation (StdDev)

2.8.2.3 Laplace Likelihood Calculation (Step 3)

The objective function used to rank and calibrate the realisations is a product of Laplace likelihoods (probability density) referred herein as "likelihood'. The likelihood is computed from the residual statistics (Mean, Median, IQR, StdDev) across different residual sets:

- Initial (the first measurement at a location).
- Change (the magnitude of change from the initial value).

A Laplace likelihood is calculated for each residual statistic, for both sets (i.e. initial and change) as:

$$\mathcal{L}(x) = \frac{1}{2b} \exp\left(-\frac{|x-\mu|}{b}\right)$$

Where:

x is a residual statistic for a given realisation; and

μ and b are the location (minimum) and scale for that statistic across all realisations.

The eight individual likelihoods are combined (i.e. multiplied) into one likelihood estimate and then normalised (so that the total sum equals 1) to produce a weighted set of likelihoods over the calibrated realisations.

2.8.2.4 Importance Sampling and Resampling (Step 4)

Once each realisation has been evaluated and ranked, the prior parameter space is then resampled, based on the (current) post parameter distribution.

2.8.2.5 Iteration and Sequential Update (Step 5)

This process (Steps 2 to 4) is repeated until the number of available calibrated realisations is deemed sufficient to constrain model uncertainty.

2.8.3 Calibration Dataset

The groundwater levels recorded between January 1988 to December 2025 are used for the model calibration and includes datasets for Caval Ridge, Peak Downs, Saraji, Lake Vermont, Poitrel, Daunia, Millennium, Isaac Plains, Olive Downs, Eagle Downs, Winchester South, Isaac Downs, Moorvale South, and Meadowbrook mines. In all, 7,028 target heads have been established for 334 bores detailed in **Table 2-5**. The locations of the calibration bores are shown in **Figure 2-7**.

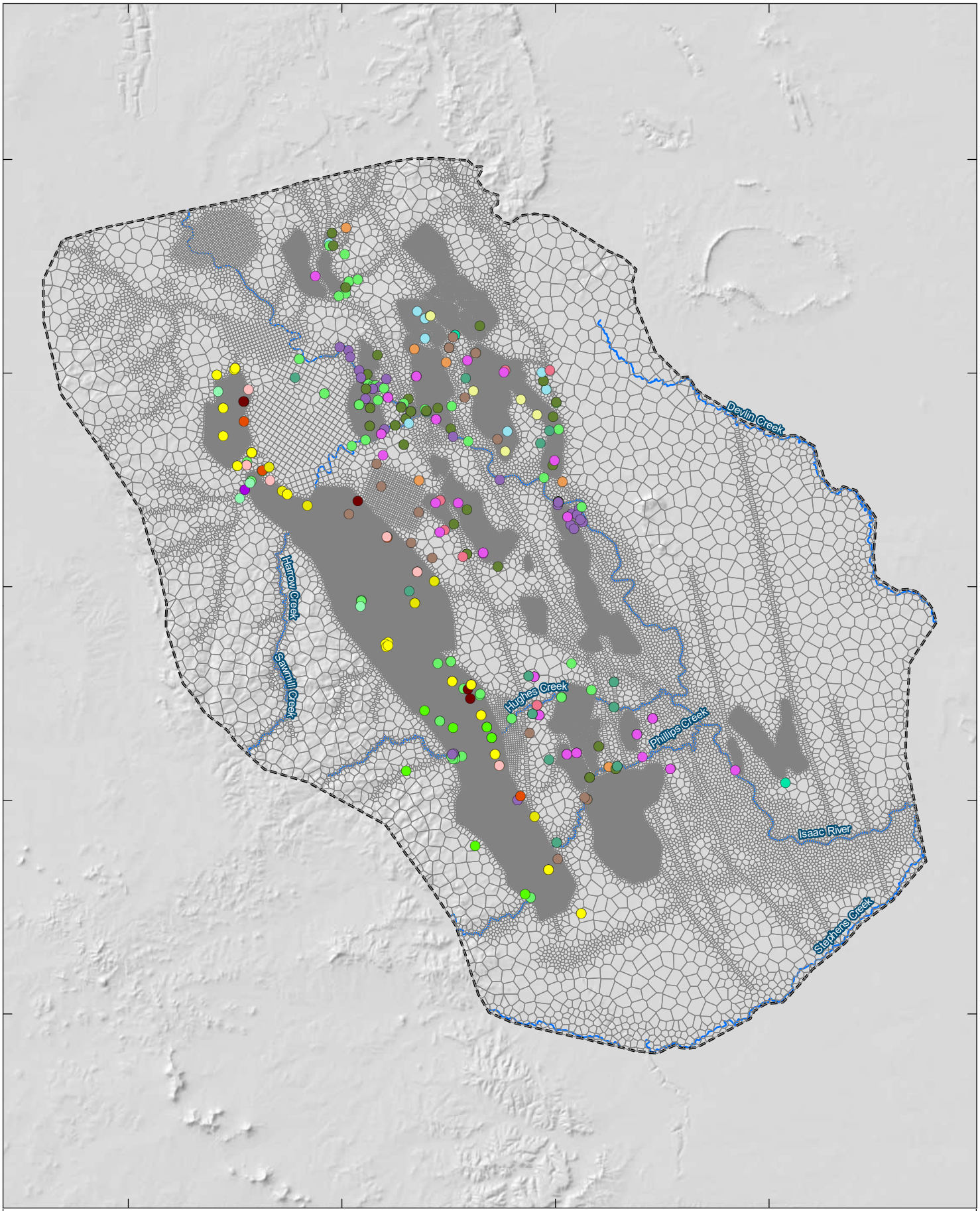
Groundwater targets have been selected where valid information on bore construction or geology information is available for the site. Targets have been manually reviewed to ensure the measurements were realistic.

The selected datasets have been separated into two separate target datasets: (i) initial water level elevations, and (ii) change in water level elevations. The initial water level elevations are the first (i.e. earliest) groundwater level readings at each selected calibration location. The change in water level elevations are all subsequent water levels readings minus the

initial water level elevation, thus providing a dataset on the variability of the water levels with time. By calibrating to both datasets, the objective of calibration is to provide a balanced approach to calibration whereby the model is calibrated to both water level elevations, and the magnitude and timing of changes in water levels.

Table 2-5 Observation Targets and Bores by Site

Site	Number of Observation Targets	Number of Bores
Caval Ridge	1,372	41
Daunia	379	11
Eagle Downs	242	6
Lake Vermont / Lake Vermont North	316	18
Meadowbrook	964	32
Millennium	340	11
Olive Downs	143	14
Peak Downs	336	24
Poitrel	668	17
Saraji	529	56
Winchester South	467	15
Isaac Downs / Isaac Downs Extension	513	50
Isaac Plains	304	14
Moorvale South / Moorvale South Extension	455	25



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Major Drainage System
Model Boundary
Model Grid

Model Layer

1	8	15
2	9	16
3	10	17
4	11	18
5	12	19
6	13	
7	14	

CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

BORE LOCATIONS

FIGURE 2-7

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2.8.4 Calibration Parameters

The following parameters are able to vary during calibration to provide the best match between the measurements and the model simulated levels:

- **Hydraulic Properties:** Horizontal and vertical hydraulic conductivity, storage properties (specific storage and specific yield), and maximum depth for depth dependence correction are allowed to vary between minimum and maximum ranges consistent with the available data and conceptualisation.
- **Evapotranspiration Extinction Depths:** Extinction depths are allowed to vary for each modelled evapotranspiration zone, and for spoil rock created during mining activities.
- **Recharge:** Transient recharge is based on the AWRA-L climate model's simulated deep drainage values. Multipliers are applied to this transient recharge rate for each geologic recharge zone. These multipliers are allowed to vary during calibration. Spoil is also given its own recharge rate multiplier in calibration.
- **General Head Boundaries:** Both the water level of the general head boundaries in each layer and the conductance of the boundary in each layer are subject to variation during calibration.
- **River Conductance:** River conductance is allowed to vary for each modelled river reach.

2.8.5 Parameter Setup and Prior Parameter Uncertainty

Table 2-6 to **Table 2-13** represents prior values for the different parameters to be used in the Monte Carlo simulations, with their lower, upper, mean, and standard deviation values specified. They represent the initial assumptions or distributions assigned before running the simulations, providing a basis for uncertainty analysis and probabilistic modelling. Prior values for GHB parameters are presented in **Appendix B**.

The ensemble of realisations calibrated using the previous Model version (version 5.1, see **Table 1.1**) were reviewed to inform parameters' prior distribution. The mean values for all parameters' prior distribution have been updated using the median of the 100 most likely realisations. The 100 most likely realisations were selected based on likelihood (see **Section 2.8.2.3)** and evaluated against the full regional calibration dataset.

For hydraulic properties in zones that include pilot points, both the standard deviation and mean values are updated following the addition of new pilot points to the model, as discussed in **Section 2.4.2**. In addition, the upper bounds for fault zones and river conductance are reduced. The model is run with a large number of parameter sets and is calibrated locally using site-specific bores. The calibration results are reported separately for each project, using the specific realisations and parameter sets used for the corresponding predictive models.

Table 2-6 Prior Parameter Ranges for Hydraulic Conductivity and Depth Dependence

Geology Unit	Unit	Layer	Min Kx0 (m/day)	Max Kx0 (m/day)	Mean Kx0 (m/day)	Std Kx0* (m/day)	Min Kz/Kx	Max Kz/Kx	Mean Kz/Kx	Std Kz/Kx *	Min Value for Maximum Depth for Depth Dependence Correction (m)	Max Value for Maximum Depth for Depth Dependence Correction (m)	Mean value for Maximum Depth for Depth Dependence Correction (m)	Std Value for Depth for Depth Dependence Correction (m)
Alluvium [1]	Surface Cover	1	0.001	50	0.6	0.58	0.001	1	0.01	0.58	–	–	–	–
Isaac River Alluvium [2]	Isaac River Alluvium	1	0.001	8.71	0.07	0.59	0.0001	1	0.004	0.7	–	–	–	–
Regolith [1]	Surface Cover	1	0.001	6.46	0.06	0.4	0.0001	1	.003	0.8	–	–	–	–
Weathered Permian [1]	Surface Cover	1 & 2	0.001	6.46	0.33	0.39	0.001	1	0.01	0.41	–	–	–	–
Duaringa Formation [1]	Surface Cover	1 & 2	0.001	6.46	0.04	0.68	0.001	1	0.004	0.55	–	–	–	–
Tertiary Basalt [1]	Tertiary Basalt	1 & 2	0.001	3.16	0.03	0.5	0.001	1	0.01	0.56	–	–	–	–
Regolith [2]	Surface Cover	2	0.001	6.46	0.06	0.4	0.0001	1	0.003	0.8	–	–	–	–
Rewan [2]	Triassic	3	0.001	123	0.25	0.8	0.0001	1	0.004	0.77	0	250	71.30	36.93
Rangal Coal Measures [1]	Interburden	4	0.0001	12.3	0.005	0.5	0.001	1	0.01	0.41	0	350	177.95	32.69

Geology Unit	Unit	Layer	Min Kx0 (m/day)	Max Kx0 (m/day)	Mean Kx0 (m/day)	Std Kx0* (m/day)	Min Kz/Kx	Max Kz/Kx	Mean Kz/Kx	Std Kz/Kx *	Min Value for Maximum Depth for Depth Dependence Correction (m)	Max Value for Maximum Depth for Depth Dependence Correction (m)	Mean value for Maximum Depth for Depth Dependence Correction (m)	Std Value for Depth for Depth Dependence Correction (m)
Rangal Coal Measures [2]	Leichhardt Seam	5	0.001	123	0.35	0.76	0.0001	1	.004	0.76	0	350	119.31	55.46
Rangal Coal Measures [1]	Interburden	6	0.0001	12.3	0.002	0.56	0.001	1	0.01	0.39	0	350	130.21	62.80
Rangal Coal Measures [2]	Vermont Seam	7	0.001	123	0.5	0.78	0.0001	1	0.004	0.77	0	350	204.28	38.71
Rangal Coal Measures [1]	Interburden	8	0.0001	12.3	0.002	0.54	0.001	1	0.01	0.39	0	350	129.76	38.41
Fort Cooper Coal Measures [2]	Interburden	9	0.0001	12.3	0.03	0.81	0.0001	1	0.003	0.81	0	150	73.16	17.31
Fort Cooper Coal Measures [2]	Fort Cooper Seams	10	0.001	123	0.24	0.86	0.0001	1	0.003	0.84	0	350	105.99	48.88

Geology Unit	Unit	Layer	Min Kx0 (m/day)	Max Kx0 (m/day)	Mean Kx0 (m/day)	Std Kx0* (m/day)	Min Kz/Kx	Max Kz/Kx	Mean Kz/Kx	Std Kz/Kx *	Min Value for Maximum Depth for Depth Dependence Correction (m)	Max Value for Maximum Depth for Depth Dependence Correction (m)	Mean value for Maximum Depth for Depth Dependence Correction (m)	Std Value for Depth for Depth Dependence Correction (m)
Fort Cooper Coal Measures [1]	Interburden	11	0.0001	12.3	0.003	0.84	0.001	1	0.01	0.3	0	350	126.54	41.78
Moranbah Coal Measures [2]	Q Seam	12	0.001	123	0.21	0.87	0.0001	1	0.002	0.85	0	350	254.68	39.42
Moranbah Coal Measures [1]	Interburden	13	0.0001	12.3	0.01	0.51	0.001	1	0.1	0.38	0	350	258.82	34.22
Moranbah Coal Measures [2]	P Seam	14	0.001	123	0.19	0.86	0.0001	1	0.004	0.86	0	350	168.84	34.91
Moranbah Coal Measures [1]	Interburden	15	0.0001	12.3	0.002	0.67	0.001	1	0.01	0.36	0	350	236.42	27.29
Moranbah Coal Measures [2]	H Seam	16	0.001	123	0.21	0.85	0.0001	1	0.004	0.84	0	350	128.39	39.58

Geology Unit	Unit	Layer	Min Kx0 (m/day)	Max Kx0 (m/day)	Mean Kx0 (m/day)	Std Kx0* (m/day)	Min Kz/Kx	Max Kz/Kx	Mean Kz/Kx	Std Kz/Kx *	Min Value for Maximum Depth for Depth Dependence Correction (m)	Max Value for Maximum Depth for Depth Dependence Correction (m)	Mean value for Maximum Depth for Depth Dependence Correction (m)	Std Value for Depth for Depth Dependence Correction (m)
Moranbah Coal Measures [1]	Interburden	17	0.0001	12.3	0.002	0.69	0.001	1	0.03	0.52	0	350	174.00	36.09
Moranbah Coal Measures [2]	D Seam	18	0.001	123	0.15	0.83	0.0001	1	0.003	0.84	0	350	118.72	36.93
Moranbah Coal Measures [1]	Interburden	19	0.0001	12.3	0.01	0.91	0.001	1	0.04	0.4	0	350	102.66	40.77
Igneous Zone [1]		1 to 19	1.0E-07	1.0E-05	1.0E-06	0.5	0.001	1	0.01	0.5	–	–	–	–

1 Pilot Points are not included; 2 Pilot Points are included; * Standard deviation, excluding depth dependence, values have been logarithmically transformed (base 10)

Table 2-7 Prior Parameter Ranges for Hydraulic Properties (Sy and Ss)

Geology Unit	Unit	Layer	Min Sy	Max Sy	Mean Sy	Std Sy	Min Ss (m-1)	Max Ss (m-1)	Mean Ss (m-1)	Std Ss (m-1)
Alluvium	Surface Cover	1	1.0X10-03	2.0X10-01	1.4X10-02	3.5X10-01	1.0X10-07	1.0X10-05	2.1X10-06	3.6X10-01
Isaac River Alluvium *	Isaac River Alluvium	1	1.0X10-03	2.0X10-01	1.2X10-02	6.3X10-01	1.0X10-07	1.0X10-05	2.1X10-06	3.6X10-01
Regolith	Surface Cover	1	1.0X10-03	5.0X10-02	1.6X10-02	3.8X10-01	1.0X10-07	1.0X10-05	5.8X10-07	2.9X10-01
Weathered Permian	Surface Cover	1 & 2	1.0X10-03	5.0X10-02	4.3X10-03	3.2X10-01	1.0X10-07	1.0X10-05	1.2X10-06	4.9X10-01
Duaringa Formation	Surface Cover	1 & 2	1.0X10-03	5.0X10-02	3.3X10-03	3.0X10-01	1.0X10-07	1.0X10-05	9.0X10-07	3.4X10-01
Tertiary Basalt	Tertiary Basalt	1 & 2	1.0X10-03	5.0X10-02	1.1X10-02	4.6X10-01	1.0X10-07	1.0X10-05	5.3X10-07	5.4X10-01
Regolith	Surface Cover	2	1.0X10-03	5.0X10-02	1.4X10-02	2.5X10-01	1.0X10-07	1.0X10-05	1.4X10-06	2.8X10-01
Rewan	Triassic	3	1.0X10-04	2.0X10-02	3.4X10-03	3.3X10-01	1.0X10-07	1.0X10-05	4.5X10-07	3.7X10-01
Rangal Coal Measures	Interburden	4	1.0X10-04	2.0X10-02	2.1X10-03	3.6X10-01	1.0X10-07	1.0X10-05	4.1X10-07	3.4X10-01
Rangal Coal Measures	Leichhardt Seam	5	1.0X10-04	2.0X10-02	1.9X10-03	2.7X10-01	1.0X10-07	1.0X10-05	4.5X10-07	4.5X10-01
Rangal Coal Measures	Interburden	6	1.0X10-04	2.0X10-02	3.9X10-03	3.1X10-01	1.0X10-07	1.0X10-05	6.1X10-07	2.9X10-01
Rangal Coal Measures	Vermont Seam	7	1.0X10-04	2.0X10-02	2.5X10-03	3.9X10-01	1.0X10-07	1.0X10-05	5.2X10-07	3.9X10-01
Rangal Coal Measures	Interburden	8	1.0X10-04	2.0X10-02	7.3X10-04	2.4X10-01	1.0X10-07	1.0X10-05	8.6X10-07	2.9X10-01
Fort Cooper Coal Measures	Interburden	9	1.0X10-04	2.0X10-02	1.1X10-03	4.3X10-01	1.0X10-07	1.0X10-05	3.2X10-07	3.3X10-01
Fort Cooper Coal Measures	Fort Cooper Seams	10	1.0X10-04	2.0X10-02	7.2X10-04	3.5X10-01	1.0X10-07	1.0X10-05	7.8X10-07	3.3X10-01
Fort Cooper Coal Measures	Interburden	11	1.0X10-04	2.0X10-02	1.7X10-03	4.4X10-01	1.0X10-07	1.0X10-05	7.4X10-07	3.0X10-01
Moranbah Coal Measures	Q Seam	12	1.0X10-04	2.0X10-02	2.0X10-03	3.7X10-01	1.0X10-07	1.0X10-05	1.4X10-06	3.1X10-01

Geology Unit	Unit	Layer	Min Sy	Max Sy	Mean Sy	Std Sy	Min Ss (m-1)	Max Ss (m-1)	Mean Ss (m-1)	Std Ss (m-1)
Moranbah Coal Measures	Interburden	13	1.0X10-04	2.0X10-02	2.1X10-03	4.1X10-01	1.0X10-07	1.0X10-05	6.1X10-07	3.5X10-01
Moranbah Coal Measures	P Seam	14	1.0X10-04	2.0X10-02	5.7X10-04	5.2X10-01	1.0X10-07	1.0X10-05	9.4X10-07	3.0X10-01
Moranbah Coal Measures	Interburden	15	1.0X10-04	2.0X10-02	1.8X10-03	3.8X10-01	1.0X10-07	1.0X10-05	1.5X10-06	2.7X10-01
Moranbah Coal Measures	H Seam	16	1.0X10-04	2.0X10-02	1.2X10-03	2.8X10-01	1.0X10-07	1.0X10-05	8.9X10-07	3.1X10-01
Moranbah Coal Measures	Interburden	17	1.0X10-04	2.0X10-02	2.2X10-03	3.3X10-01	1.0X10-07	1.0X10-05	5.8X10-07	5.0X10-01
Moranbah Coal Measures	D Seam	18	1.0X10-04	2.0X10-02	5.3X10-04	4.1X10-01	1.0X10-07	1.0X10-05	5.3X10-07	3.7X10-01
Moranbah Coal Measures	Interburden	19	1.0X10-04	2.0X10-02	1.1X10-03	3.7X10-01	1.0X10-07	1.0X10-05	1.0X10-06	3.8X10-01
Igneous Zone		1 to 19	1.0X10-04	1.0X10-02	1.0X10-03	5.0X10-01	1.0X10-07	1.0X10-05	5.0X10-06	5.0X10-01

* Pilot Points are included in the specific yield, in the case of the Isaac River Alluvium

Table 2-8 Parameter Ranges for Hydraulic Conductivity and Depth Dependence (Faults)

Geology Unit	Layer	Min Kx0 (m/day)	Max Kx0 (m/day)	Mean Kx0 (m/day)	Std Kx0 (m/day)	Min Kz/Kx	Max Kz/Kx	Mean Kz/Kx	Std Kz/Kx	Min Value for Maximum Depth for Depth Dependence Correction (m)	Max Value for Maximum Depth for Depth Dependence Correction (m)	Mean value for Maximum Depth for Depth Dependence Correction (m)	Std Value for Depth for Depth Dependence Correction (m)
Faults 1	4 to 13	0.001	12.3	0.20	0.54	0.001	1	0.004	0.45	0	350	146.31	40.17
Faults 1	4 to 13	0.0001	12.3	0.34	0.46	0.001	1	0.01	0.58	0	350	255.11	40.57
Faults 1	4 to 13	0.0001	12.3	0.00	0.57	0.001	1	0.01	0.50	0	350	151.23	60.67
Faults 1	4 to 13	0.001	12.3	0.03	0.49	0.001	1	0.01	0.29	0	250	112.60	39.64
Faults 1	4 to 6	0.001	12.3	1.07	0.62	0.001	1	0.00	0.41	0	350	241.11	56.14
Faults 2	3	0.001	10	0.15	0.56	0.001	100	0.01	0.37	0	350	215.11	41.43
Faults 2	5	0.001	10	0.02	0.70	0.001	100	3.58	0.58	0	350	240.91	40.23
Faults 2	7	0.001	10	0.08	1.43	0.001	100	0.43	0.61	0	350	123.61	71.30
Faults 2	9	0.001	10	0.01	0.40	0.001	100	0.08	0.38	0	250	169.14	30.81
Faults 2	10	0.0001	10	0.00	0.73	0.001	100	0.38	0.53	0	350	112.27	50.15
Faults 2	12	0.001	10	0.04	0.53	0.001	100	0.02	0.52	0	350	116.30	56.02
Faults 2	14	0.001	10	0.03	0.62	0.001	100	0.02	0.95	0	350	202.33	56.55
Faults 2	16	0.0001	10	0.00	0.88	0.001	100	0.38	0.41	0	350	238.00	46.14
Faults 2	18	0.001	10	0.05	0.59	0.001	100	0.03	0.68	0	350	152.22	43.33
Faults 2	3	0.001	10	0.01	0.65	0.001	100	0.02	0.33	0	350	230.59	40.14

Geology Unit	Layer	Min Kx0 (m/day)	Max Kx0 (m/day)	Mean Kx0 (m/day)	Std Kx0 (m/day)	Min Kz/Kx	Max Kz/Kx	Mean Kz/Kx	Std Kz/Kx	Min Value for Maximum Depth for Depth Dependence Correction (m)	Max Value for Maximum Depth for Depth Dependence Correction (m)	Mean value for Maximum Depth for Depth Dependence Correction (m)	Std Value for Depth for Depth Dependence Correction (m)
Faults 2	5	0.001	10	0.02	0.72	0.001	100	0.50	0.42	0	350	57.57	44.19
Faults 2	7	0.001	10	0.06	0.66	0.001	100	0.04	0.44	0	350	133.48	52.19
Faults 2	9	0.001	10	0.07	1.22	0.001	100	0.03	0.32	0	350	130.68	31.61
Faults 2	10	0.0001	10	0.00	0.53	0.001	100	0.01	0.42	0	350	108.26	43.70
Faults 2	12	0.001	10	0.33	0.47	0.001	100	0.15	0.57	0	350	230.37	47.37
Faults 2	14	0.001	10	0.03	0.71	0.001	100	0.04	0.41	0	350	217.50	53.97
Faults 2	16	0.001	10	0.45	0.49	0.001	100	1.69	0.42	0	350	82.85	52.14
Faults 2	18	0.0001	10	0.00	1.02	0.001	100	0.24	0.35	0	350	125.28	52.33
Faults 2	3	0.0001	10	0.00	0.49	0.001	100	0.06	0.43	0	350	84.33	59.47
Faults 2	5	0.0001	10	0.02	0.45	0.001	100	5.27	0.48	0	350	206.86	42.61
Faults 2	7	0.0001	10	0.00	0.51	0.001	100	1.14	0.46	0	250	94.22	58.29
Faults 2	9	0.001	10	0.02	0.52	0.001	100	5.39	0.43	0	350	244.09	50.69
Faults 2	10	0.001	10	0.01	0.67	0.001	100	1.67	0.52	0	350	194.29	46.67
Faults 2	12	0.001	10	3.93	0.54	0.001	100	1.60	0.42	0	350	131.51	40.55
Faults 2	14	0.0001	10	0.00	0.46	0.001	100	0.14	0.52	0	350	138.51	43.65
Faults 2	16	0.001	10	0.02	0.50	0.001	100	0.04	0.44	0	350	156.47	50.17
Faults 2	18	0.001	10	0.01	0.51	0.001	100	0.01	0.48	0	350	218.23	38.31
Faults 2	3	0.001	10	2.52	0.68	0.001	100	2.43	0.45	0	350	210.09	46.55

Geology Unit	Layer	Min Kx0 (m/day)	Max Kx0 (m/day)	Mean Kx0 (m/day)	Std Kx0 (m/day)	Min Kz/Kx	Max Kz/Kx	Mean Kz/Kx	Std Kz/Kx	Min Value for Maximum Depth for Depth Dependence Correction (m)	Max Value for Maximum Depth for Depth Dependence Correction (m)	Mean value for Maximum Depth for Depth Dependence Correction (m)	Std Value for Depth for Depth Dependence Correction (m)
Faults 2	5	0.001	10	0.02	0.52	0.001	100	0.06	0.48	0	350	114.02	56.52
Faults 2	7	0.0001	10	0.10	0.59	0.001	100	1.84	0.58	0	350	241.00	38.21
Faults 2	9	0.001	10	0.01	0.50	0.001	100	0.06	0.52	0	350	147.55	40.05
Faults 2	10	0.001	10	0.01	0.49	0.001	100	0.01	0.38	0	350	230.33	47.88
Faults 2	12	0.001	10	0.18	0.49	0.001	100	0.03	0.57	0	350	118.70	39.73
Faults 2	14	0.001	10	0.01	0.69	0.001	100	0.05	0.47	0	350	168.63	48.41
Faults 2	16	0.001	10	0.03	0.62	0.001	100	0.04	0.39	0	350	141.30	43.15
Faults 2	18	0.0001	10	0.00	0.64	0.001	100	0.03	0.30	0	350	75.45	37.84
Faults2	3	0.001	10	0.04	0.47	0.001	100	0.07	0.46	0	350	140.87	79.15
Faults 2	5	0.0001	10	1.08	0.57	0.001	100	0.13	0.62	0	350	184.36	53.12
Faults 2	7	0.001	10	2.30	0.55	0.001	100	0.01	0.50	0	350	67.75	50.31

1 These specifically refer to fault properties in the geology zone that do not have pilot points
2 These specifically refer to fault properties in the geology zone that have pilot points

Table 2-9 Prior Parameter Ranges for Hydraulic Properties (Sy and Ss) (Faults)

Geology Unit	Layer	Min Sy	Max Sy	Mean Sy	Std Sy	Min Ss (m-1)	Max Ss (m-1)	Mean Ss (m-1)	Std Ss (m-1)
Faults[1]	3 to 19	1.0X10-04	5.0X10-02	2.0X10-03	3.0X10-01	1.0X10-07	1.0X10-05	6.8X10-07	3.2X10-01
Faults[1]	3 to 19	1.0X10-04	5.0X10-02	1.3X10-03	4.2X10-01	1.0X10-07	1.0X10-05	7.2X10-07	4.1X10-01
Faults[1]	3 to 19	1.0X10-04	5.0X10-02	1.1X10-03	5.8X10-01	1.0X10-07	1.0X10-05	5.0X10-07	4.8X10-01
Faults[1]	3 to 19	1.0X10-04	5.0X10-02	1.8X10-03	4.9X10-01	1.0X10-07	1.0X10-05	6.6X10-07	2.9X10-01
Faults[1]	4 to 7	1.0X10-04	5.0X10-02	1.9X10-03	3.2X10-01	1.0X10-07	1.0X10-05	6.1X10-07	3.2X10-01

Table 2-10 Prior Parameter Ranges for Spoil Properties

Parameter	Min	Max	Mean	Std
Horizontal hydraulic conductivity (m/day)	0.01	5	0.24	0.66
Vertical hydraulic conductivity (m/day)	0.01	1	0.09	0.54
Specific Yield (%)	0.01	0.2	0.04	0.53
Specific Storage (1/m)	1.0x10-07	1.0x10-04	1.0x10-06	0.70

Table 2-11 Prior Recharge (% of rainfall) by Model Zone

Model Recharge Zone	Lower - % of Rainfall	Upper - % of Rainfall	Mean - % of Rainfall	Std - % of Rainfall
Alluvium Isaac River Channel	0.02%	30%	0.2%	0.8%
Alluvium Isaac River	0.02%	15%	0.1%	0.7%
Alluvium (rest of the model)	0.02%	15%	0.1%	0.7%
Regolith	0.002%	10%	0.01%	0.7%
Weathered Permian	0.002%	10%	0.1%	0.7%
Duaringa Formation (Tertiary)	0.002%	10%	0.1%	1.7%
Tertiary Basalts	0.002%	10%	0.2%	0.6%
Spoil	1.00%	6%	2.6%	1.2%

Table 2-12 Prior Extinction Depth by Model EVT Zone

Model EVT Zone	Lower (m)	Upper (m)	Mean (m)	Std (m)
Alluvium	0.2	20	15.7	0.3
Regolith	0.2	20	2.1	0.3
Weathered Permian	0.5	20	2.1	0.4
Duaringa Formation	0.5	20	2.2	0.3
Tertiary Basalts	0.5	20	2.1	0.4
Permian Outcrop	0.2	15	0.6	0.3
Spoil	0.5	10	1.8	0.6

Table 2-13 Prior Parameter Ranges for Riverbed Vertical Conductivity Properties

Model River Zone	Lower - Riverbed Vertical Conductivity (m/day)	Upper - Riverbed Vertical Conductivity (m/day)	Mean - Riverbed Vertical Conductivity (m/day)	Std - Riverbed Vertical Conductivity (m/day)
Isaac River_Goonyella	0.00001	0.1	0.0005	0.5
Isaac River_Deverill	0.00001	0.1	0.0001	0.4
Grosvenor Creek	0.00001	0.1	0.0014	0.3
Conrock Gully	0.00001	0.1	0.001	0.4
Cherwell Creek	0.00001	0.1	0.0001	0.4
Ripstone	0.00001	0.1	0.0001	0.7
Phillips Creek	0.00001	0.1	0.0024	0.4
Smoky Creek	0.00001	0.1	0.0010	0.8
Billy’s Gully	0.00001	0.1	0.0008	0.6
New Chum Creek	0.00001	0.1	0.0002	0.3
North Creek	0.00001	0.1	0.001	0.4

3.0 Groundwater Model and Data Limitations

The groundwater modelling is conducted in accordance with the *Australian groundwater modelling guideline* (Barnett et al. 2012) and the MDBC Groundwater Flow Modelling Guideline (MDBC, 2001). These are mostly generic guides and do not include specific guidelines on special applications, such as open cut mine modelling.

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 groundwater 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.
- 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 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 3-1 presents a discussion of the model fit in relation to its intended purpose, with the overarching objective of assessing the cumulative impacts of mining across the Bowen Basin. Given that each project has its own specific objectives, a tailored assessment of groundwater model limitations and data constraints will be provided for each application of the model—particularly in the context of predictive modelling (that is not presented in this report).

Table 3-1 Groundwater Model and Data Limitations and Potential Recommended Updates

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose.	The groundwater model has an unstructured Voronoi grid that includes detailed cell refinement around the mining area, mapped geological structures and along drainage features. The groundwater model extent was designed to prevent boundary influence on modelled drawdown/mounding.

Type	Part	Status	Comment
	Layers	Fit for purpose	Top of Layer 1 uses detailed Digital Elevation Model (DEM) data. Representation of alluvium and regolith based on publicly available mapped geology and Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2015) regolith mapping. Model vertical resolution is sufficient to represent relevant geological units and unstructured grid allows layer pinch out where units not present.
	Conceptualisation – Geological Structure	Fit for purpose Potential for further assessment	The structure of the geology within the mine area is based on mapped geology and existing ground investigation at the Mine, which is limited to bores drilled within different lithologies. Further ground investigation could improve the site conceptualisation, especially for the presence and thickness of alluvium associated with the Isaac River in areas outside of geophysical surveys already incorporated into the model..
	Conceptualisation – GDEs	Fit for purpose Potential for further assessment	GDE data from national assessment and local studies (where available) have been considered when updating the model mesh to ensure sufficient discretisation in GDE areas.
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose.	Key groundwater–surface water interaction included are drainage features and associated alluvium as well as pit lakes.
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose. Potential for further assessment.	Several monitoring bores for the regional area are present within the alluvium in the Isaac River and monitored regularly. Further investigations and monitoring could help assess flow dynamics along the Isaac River.
Parameterisation	Hydraulic Conductivity	Fit for purpose. Future improvements could be made.	Limited site-specific hydraulic conductivity data (horizontal) was available. Additional data (if available) should be utilised to verify and update the model.
	Rivers	Fit for purpose. Improvements possible.	Major rivers and creeks were represented using the RIV package with smoothed riverbed elevations. Stage data from regional gauging stations were adjusted to reflect the seasonal nature of the Isaac River. Local stage data

Type	Part	Status	Comment
			collection would improve future assessments.
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and regional site conceptualisation
Measurement Error	Observation Data Quality	Fit for purpose Future improvements could be made.	Incorporation of any new groundwater level monitoring to refine the groundwater model in future.
	Landholder Bore Data Quality	Fit for purpose	Publicly available private bore data were incorporated in the model calibration across the model domain.
	Temporal spread	Fit for purpose. Future improvements possible.	Timeseries water level data with varying resolution has been used in the model calibration.

4.0 References

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Appendix A Calibration Stress Periods and Simulated Active Mines

Central Bowen Basin Regional Groundwater Model Version 6.0

Groundwater Model Update Technical Report

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00006

29 May 2026

Calibration Period	Interval	Stress Period	Date		Moorvale South (OC)	Caval Ridge (OC)	Peak Downs (OC)	Saraji (OC)	Grosvenor (UG)	Poitrel (OC)	Peak Downs (UG)	Poitrel (HWM)	Lake Vermont (OC)	Carborough Downs (UG)	Isaac Downs (OC)	Daunia (OC)	Millennium (OC)	Isaac Plains (OC)	Isaac Plains East (OC)	Olive Downs (OC)
			(from)	(to)																
Warm-up	10 days	1	Transient Warm up																	
Steady-state		2	Steady-state																	
Calibration	20 years	3	01-01-1998	01-01-2008			x	x			x							x		
	Quarterly	4	01-01-2008	01-04-2008			x	x		x							x	x		
	Quarterly	5	01-04-2008	01-07-2008			x	x		x							x	x		
	Quarterly	6	02-07-2008	01-10-2008			x	x		x							x	x		
	Quarterly	7	01-10-2008	31-12-2008			x	x		x							x	x		
	Quarterly	8	31-12-2008	01-04-2009			x	x		x			x				x	x		
	Quarterly	9	02-04-2009	02-07-2009			x	x		x			x	x			x	x		
	Quarterly	10	02-07-2009	01-10-2009			x	x		x			x	x			x	x		
	Quarterly	11	01-10-2009	31-12-2009			x	x		x			x	x			x	x		
	Quarterly	12	01-01-2009	02-04-2009			x	x		x			x	x			x	x		
	Quarterly	12	01-01-2010	02-04-2010			x	x		x			x	x			x	x		
	Quarterly	13	02-04-2010	02-07-2010			x	x		x			x	x			x	x		
	Quarterly	14	02-07-2010	01-10-2010			x	x		x			x	x			x	x		
	Quarterly	15	01-10-2010	31-12-2010			x	x		x			x	x			x	x		
	Quarterly	16	01-01-2011	02-04-2011			x	x		x			x	x			x	x		
	Quarterly	17	02-04-2011	02-07-2011			x	x		x			x	x			x	x		
	Quarterly	18	02-07-2011	01-10-2011			x	x		x			x	x			x	x		
	Quarterly	19	02-10-2011	01-01-2012			x	x		x			x	x			x	x		
	Quarterly	20	01-01-2012	01-04-2012			x	x		x			x	x			x	x		
	Quarterly	21	01-04-2012	01-07-2012			x	x		x			x	x			x	x		

Calibration Period	Interval	Stress Period	Date		Moorvale South (OC)	Caval Ridge (OC)	Peak Downs (OC)	Saraji (OC)	Grosvenor (UG)	Poitrel (OC)	Peak Downs (UG)	Poitrel (HWM)	Lake Vermont (OC)	Carborough Downs (UG)	Isaac Downs (OC)	Daunia (OC)	Millennium (OC)	Isaac Plains (OC)	Isaac Plains East (OC)	Olive Downs (OC)
			(from)	(to)																
	Quarterly	22	02-07-2012	01-10-2012			x	x		x			x	x			x	x		
	Quarterly	23	01-10-2012	31-12-2012			x	x		x			x	x			x	x		
	Quarterly	24	31-12-2012	01-04-2013			x	x		x			x	x		x	x	x		
	Quarterly	25	02-04-2013	02-07-2013			x	x		x			x	x		x	x	x		
	Quarterly	26	02-07-2013	01-10-2013			x	x		x			x	x		x	x	x		
	Quarterly	27	01-10-2013	31-12-2013			x	x		x			x	x		x	x	x		
	Quarterly	28	01-01-2014	02-04-2014			x	x		x			x	x		x	x	x		
	Quarterly	29	02-04-2014	02-07-2014			x	x		x			x	x		x	x	x		
	Quarterly	30	02-07-2014	01-10-2014			x	x		x			x	x		x	x	x		
	Quarterly	31	01-10-2014	31-12-2014			x	x		x			x	x		x	x	x		
	Quarterly	32	01-01-2014	02-04-2014		x	x	x		x			x	x		x	x	x		
	Quarterly	32	01-01-2015	02-04-2015		x	x	x		x			x	x		x	x	x		
	Quarterly	33	02-04-2015	02-07-2015		x	x	x		x			x	x		x	x	x		
	Quarterly	34	02-07-2015	01-10-2015		x	x	x	x	x			x	x		x	x	x		
	Quarterly	35	02-10-2015	01-01-2016		x	x	x	x	x			x	x		x	x	x		
	Quarterly	36	01-01-2016	01-04-2016		x	x	x	x	x			x	x		x	x	x		
	Quarterly	37	01-04-2016	01-07-2016		x	x	x	x	x			x	x		x	x	x		
	Quarterly	38	02-07-2016	01-10-2016		x	x	x	x	x			x	x		x	x	x		
	Quarterly	39	01-10-2016	31-12-2016		x	x	x	x	x			x	x		x	x	x		
	Quarterly	40	31-12-2016	01-04-2017		x	x	x	x	x			x	x		x	x	x		
	Quarterly	41	02-04-2017	02-07-2017		x	x	x	x	x			x	x		x	x	x		
	Quarterly	42	02-07-2017	01-10-2017		x	x	x	x	x			x	x		x	x	x		

Calibration Period	Interval	Stress Period	Date		Moorvale South (OC)	Caval Ridge (OC)	Peak Downs (OC)	Saraji (OC)	Grosvenor (UG)	Poitrel (OC)	Peak Downs (UG)	Poitrel (HWM)	Lake Vermont (OC)	Carborough Downs (UG)	Isaac Downs (OC)	Daunia (OC)	Millennium (OC)	Isaac Plains (OC)	Isaac Plains East (OC)	Olive Downs (OC)
			(from)	(to)																
	Quarterly	43	01-10-2017	31-12-2017		x	x	x	x	x			x	x		x	x	x		
	Quarterly	44	31-12-2017	01-04-2018		x	x	x	x	x			x	x		x	x	x	x	
	Quarterly	45	01-04-2018	01-07-2018		x	x	x	x	x			x	x		x	x	x	x	
	Quarterly	46	01-07-2018	30-09-2018	x	x	x	x	x	x			x	x		x	x	x	x	
	Quarterly	47	30-09-2018	31-12-2018	x	x	x	x	x	x			x	x		x	x	x	x	
	Quarterly	48	31-12-2018	01-04-2019	x	x	x	x	x	x			x	x		x	x	x	x	
	Quarterly	49	01-04-2019	01-07-2019	x	x	x	x	x	x			x	x		x	x		x	
	Quarterly	50	01-07-2019	01-10-2019	x	x	x	x	x	x			x	x		x	x		x	
	Quarterly	51	01-10-2019	31-12-2019	x	x	x	x	x	x			x	x		x	x		x	
	Quarterly	52	31-12-2019	31-03-2020	x	x	x	x	x	x			x	x		x	x		x	
	Quarterly	53	31-03-2020	30-06-2020	x	x	x	x	x	x			x	x		x	x		x	
	Quarterly	54	30-06-2020	30-09-2020	x	x	x	x	x	x			x	x		x	x		x	
	Quarterly	55	30-09-2020	31-12-2020	x	x	x	x	x	x			x	x		x	x		x	
	Quarterly	56	01-01-2021	01-04-2021	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	57	02-04-2021	01-07-2021	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	58	02-07-2021	30-09-2021	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	59	01-10-2021	31-12-2021	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	60	01-01-2022	01-04-2022	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	61	02-04-2022	01-07-2022	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	62	02-07-2022	30-09-2022	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	63	01-10-2022	31-12-2022	x	x	x	x	x	x			x	x	x	x	x		x	

Calibration Period	Interval	Stress Period	Date		Moorvale South (OC)	Caval Ridge (OC)	Peak Downs (OC)	Saraji (OC)	Grosvenor (UG)	Poitrel (OC)	Peak Downs (UG)	Poitrel (HWM)	Lake Vermont (OC)	Carborough Downs (UG)	Isaac Downs (OC)	Daunia (OC)	Millennium (OC)	Isaac Plains (OC)	Isaac Plains East (OC)	Olive Downs (OC)
			(from)	(to)																
	Quarterly	64	01-01-2023	01-04-2023	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	65	02-04-2023	01-07-2023	x	x	x	x	x	x			x	x	x	x	x		x	
	Quarterly	66	02-07-2023	30-09-2023	x	x	x	x	x	x			x	x	x	x	x		x	x
	Quarterly	67	01-10-2023	31-12-2023	x	x	x	x	x	x			x	x	x	x	x		x	x
	Quarterly	68	01-01-2024	01-04-2024	x	x	x	x	x			x	x	x	x	x	x		x	x
	Quarterly	69	02-04-2024	01-07-2024	x	x	x	x	x			x	x	x	x	x			x	x
	Quarterly	70	02-07-2024	30-09-2024	x	x	x	x	x			x	x	x	x	x			x	x
	Quarterly	71	01-10-2024	31-12-2024	x	x	x	x	x			x	x	x	x	x			x	x
	Quarterly	72	01-01-2025	01-04-2025	x	x	x	x		x		x	x	x	x	x			x	x
	Quarterly	73	02-04-2025	01-07-2025	x	x	x	x		x		x	x	x	x	x			x	x
	Quarterly	74	02-07-2025	30-09-2025	x	x	x	x		x		x	x	x	x	x			x	x
	Quarterly	75	01-10-2025	31-12-2025	x	x	x	x		x		x	x	x	x	x			x	x

Appendix B Hydraulic Parameters and Pilot Point Locations

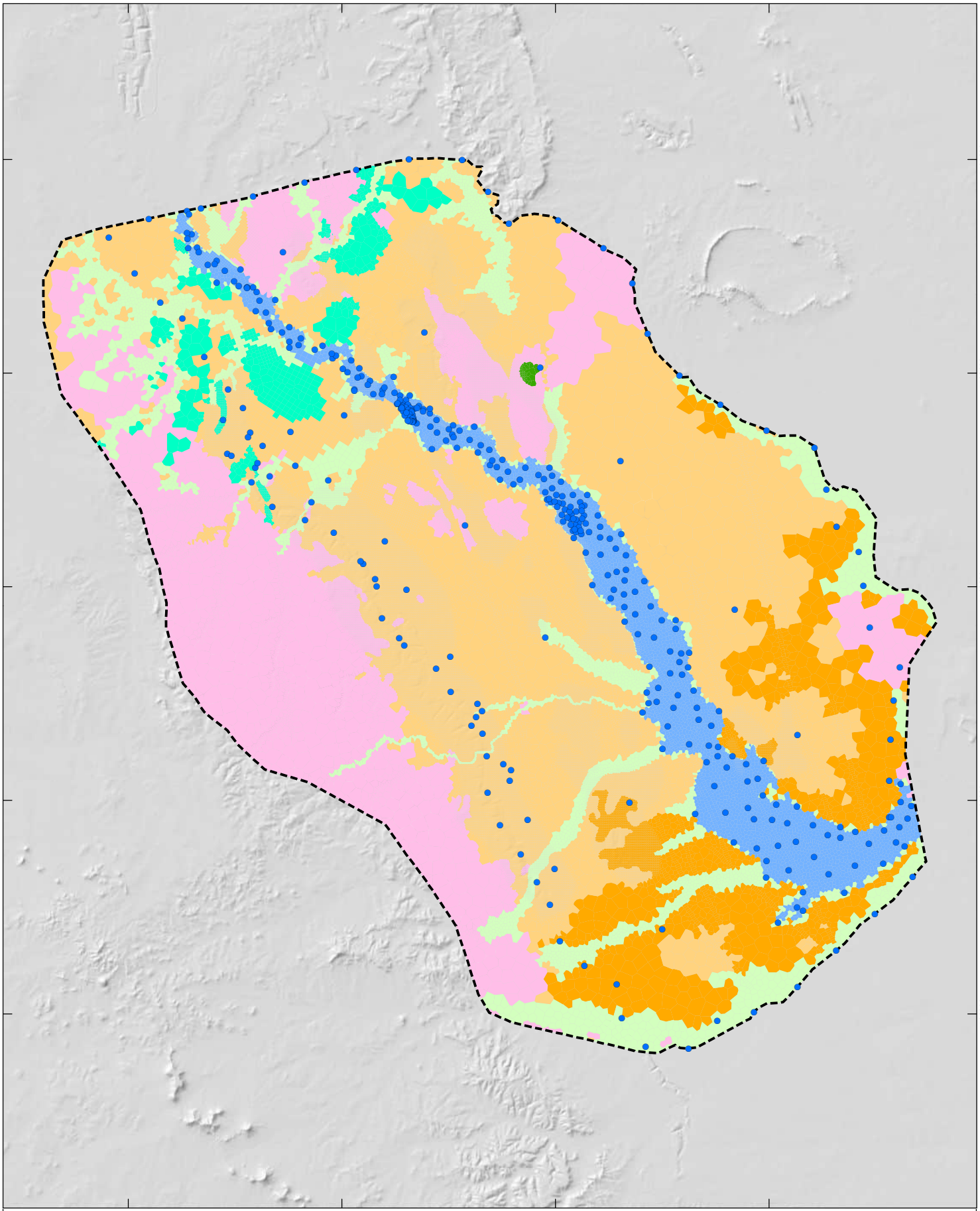
Central Bowen Basin Regional Groundwater Model Version 6.0

Groundwater Model Update Technical Report

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00006

29 May 2026



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	6XX.XXXXXX
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx, Kz and Sy

Model Boundary

Parameter Zone

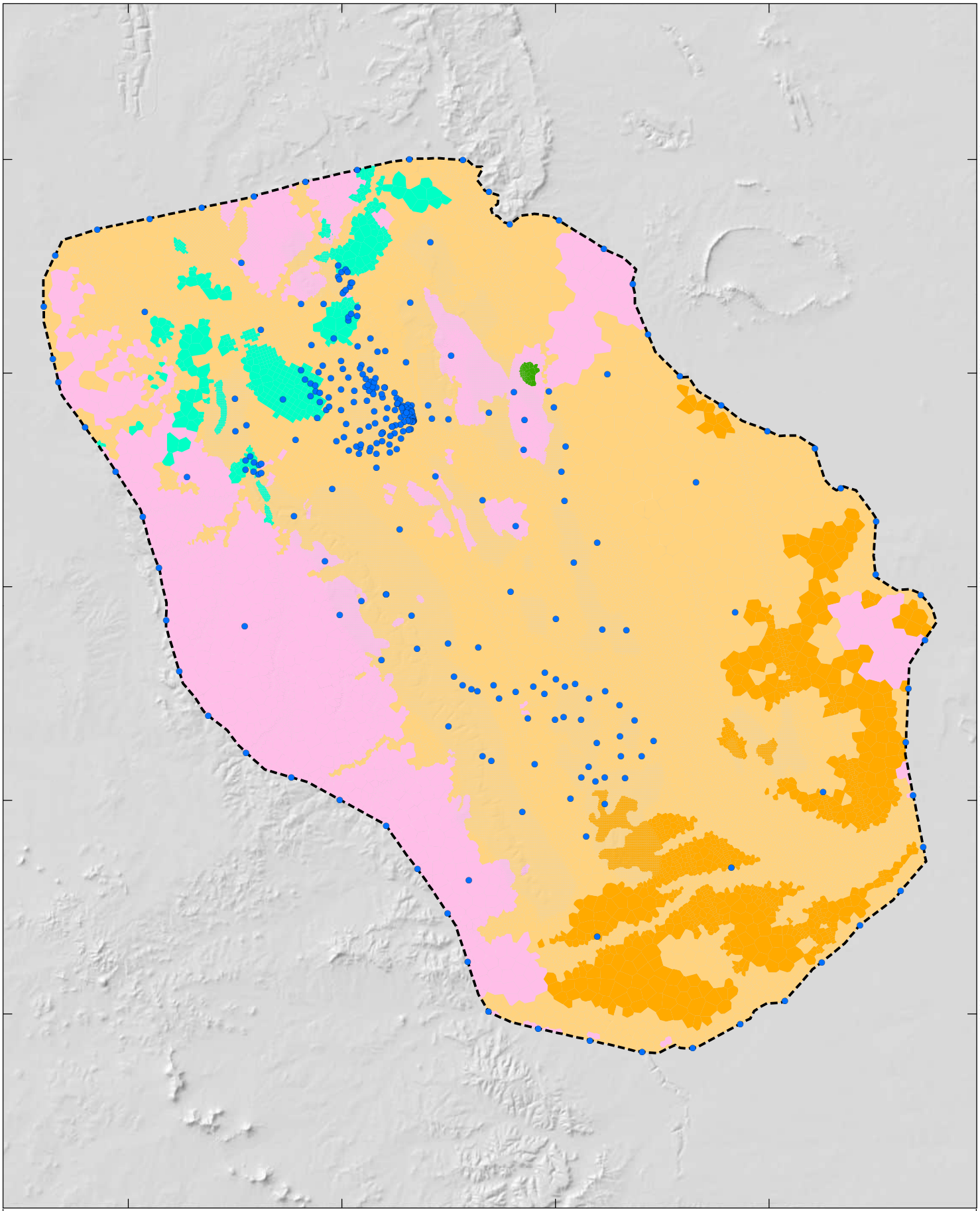
- Alluvium
- Duaringa Formation (Tu)
- Igneous Zone
- Isaac River Alluvium
- Regolith
- Tertiary Basalt
- Weathered Permian

CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 1

FIGURE B-1

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B01_Hydraulic Zone L1.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

- Duaringa Formation (Tu)
- Igneous Zone
- Regolith
- Tertiary Basalt
- Weathered Permian

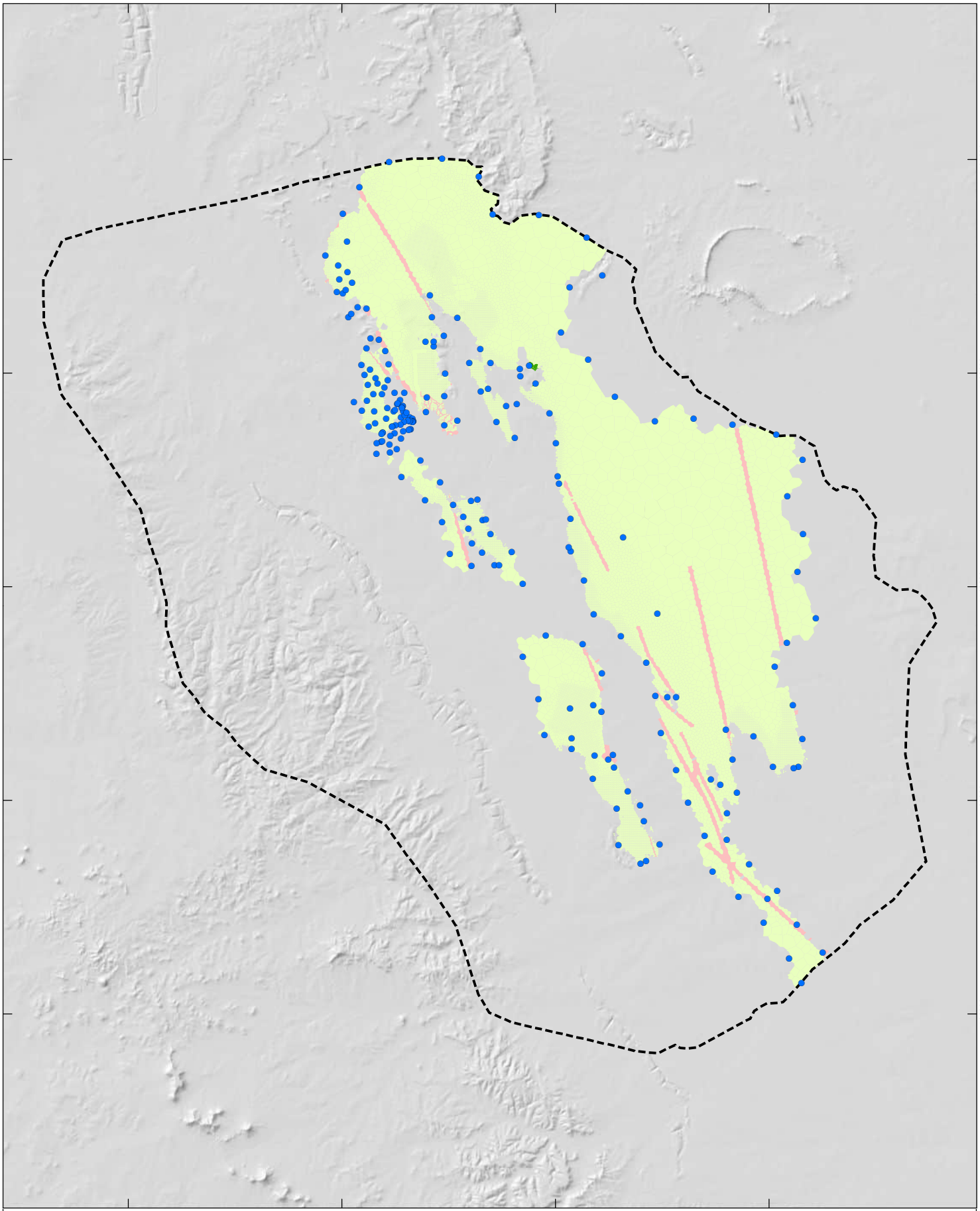
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 2

SLR

FIGURE B-2

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B02_Hydraulic Zone L2.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

Faults

Igneous Zone

Rewan

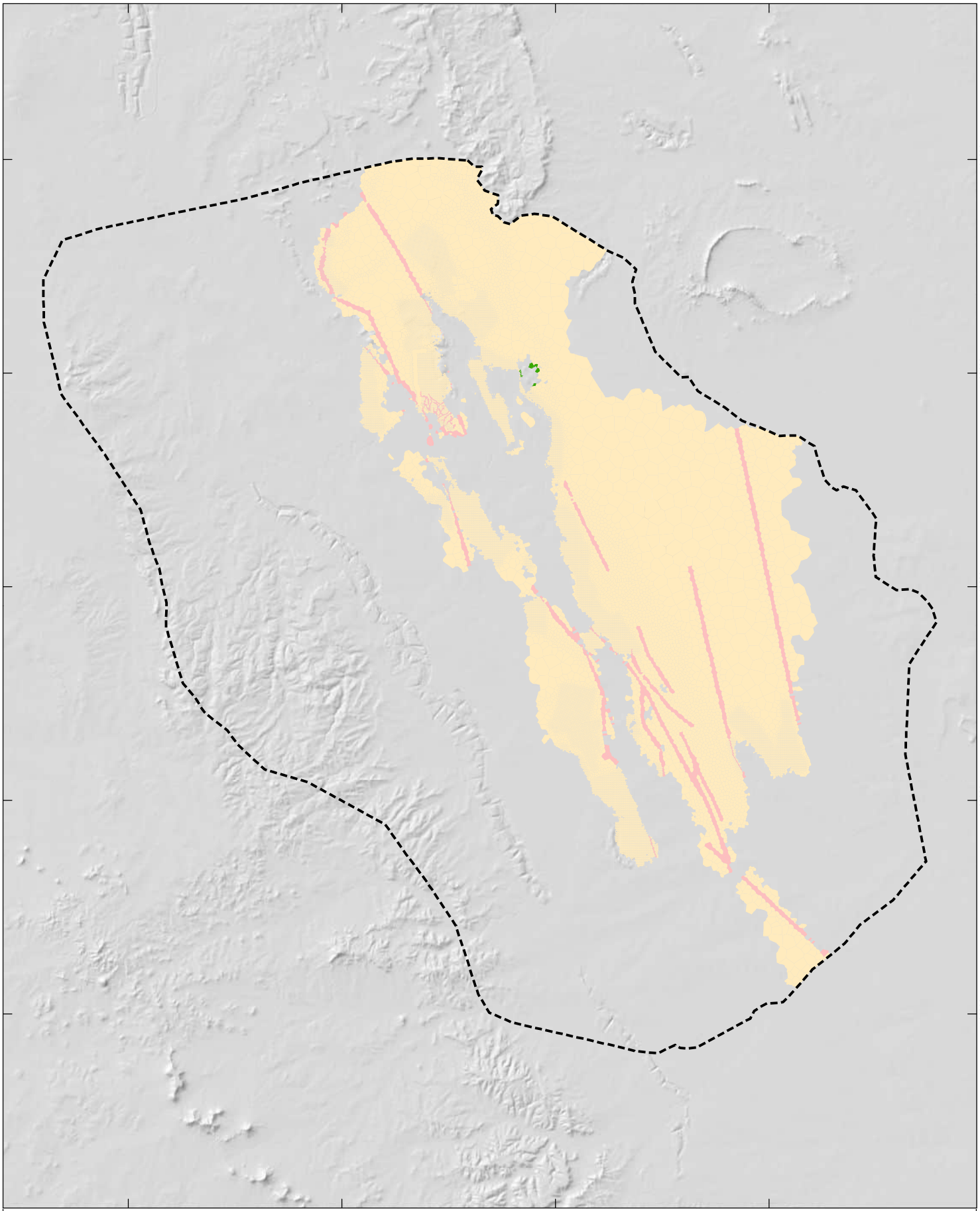
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 3

SLR

FIGURE B-3

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B03_Hydraulic Zone L3.mxd



0 5 10 km

Model Boundary

Parameter Zone

- Faults
- Igneous Zone
- Interburden

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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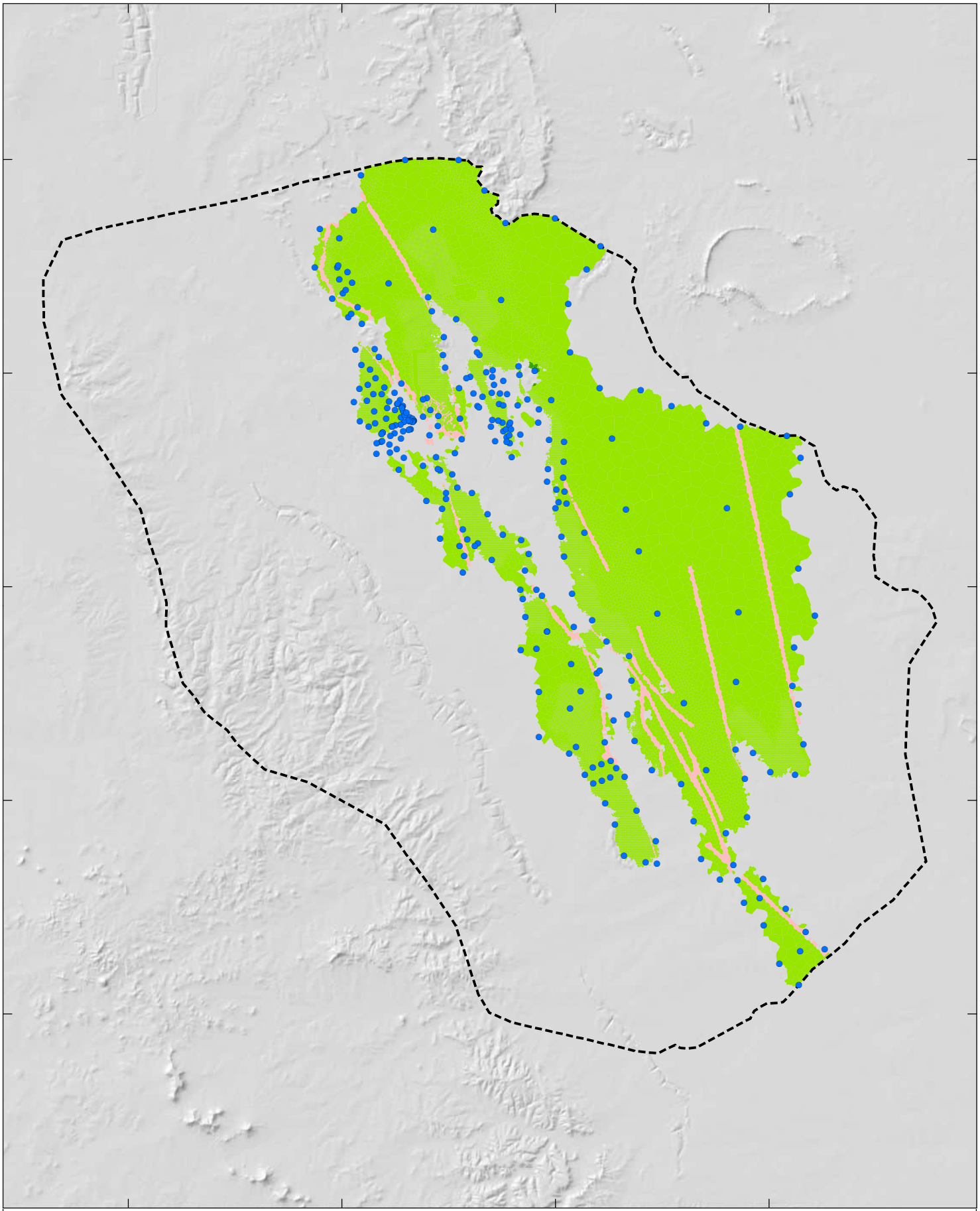
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 4

FIGURE B-4

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B04_Hydraulic Zone L4.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

Faults

Igneous Zone

Leichhardt Seam

CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 5

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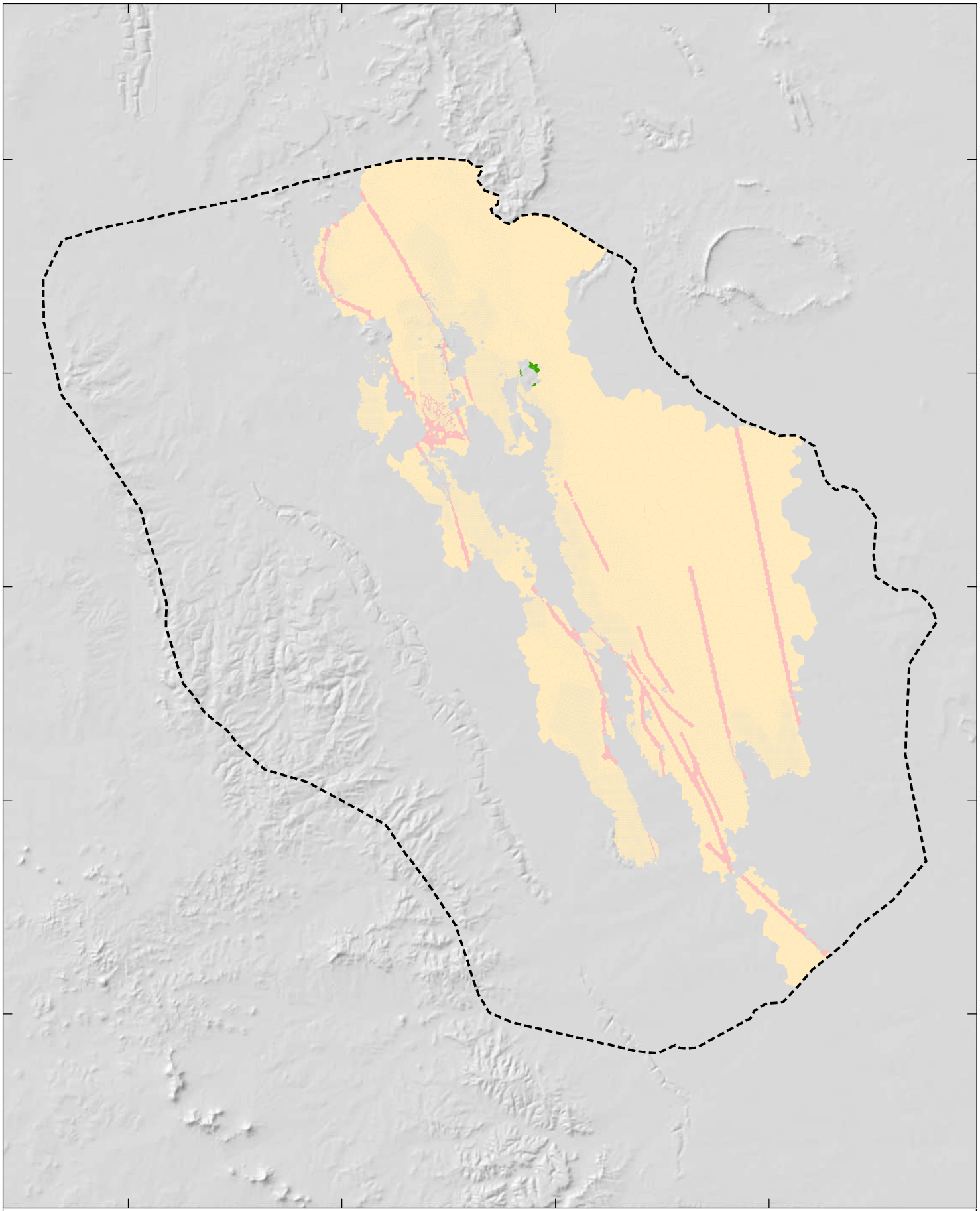
FIGURE B-5

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B05_Hydraulic Zone L5.mxd



0 5 10 km

Model Boundary

Parameter Zone

- Faults
- Igneous Zone
- Interburden

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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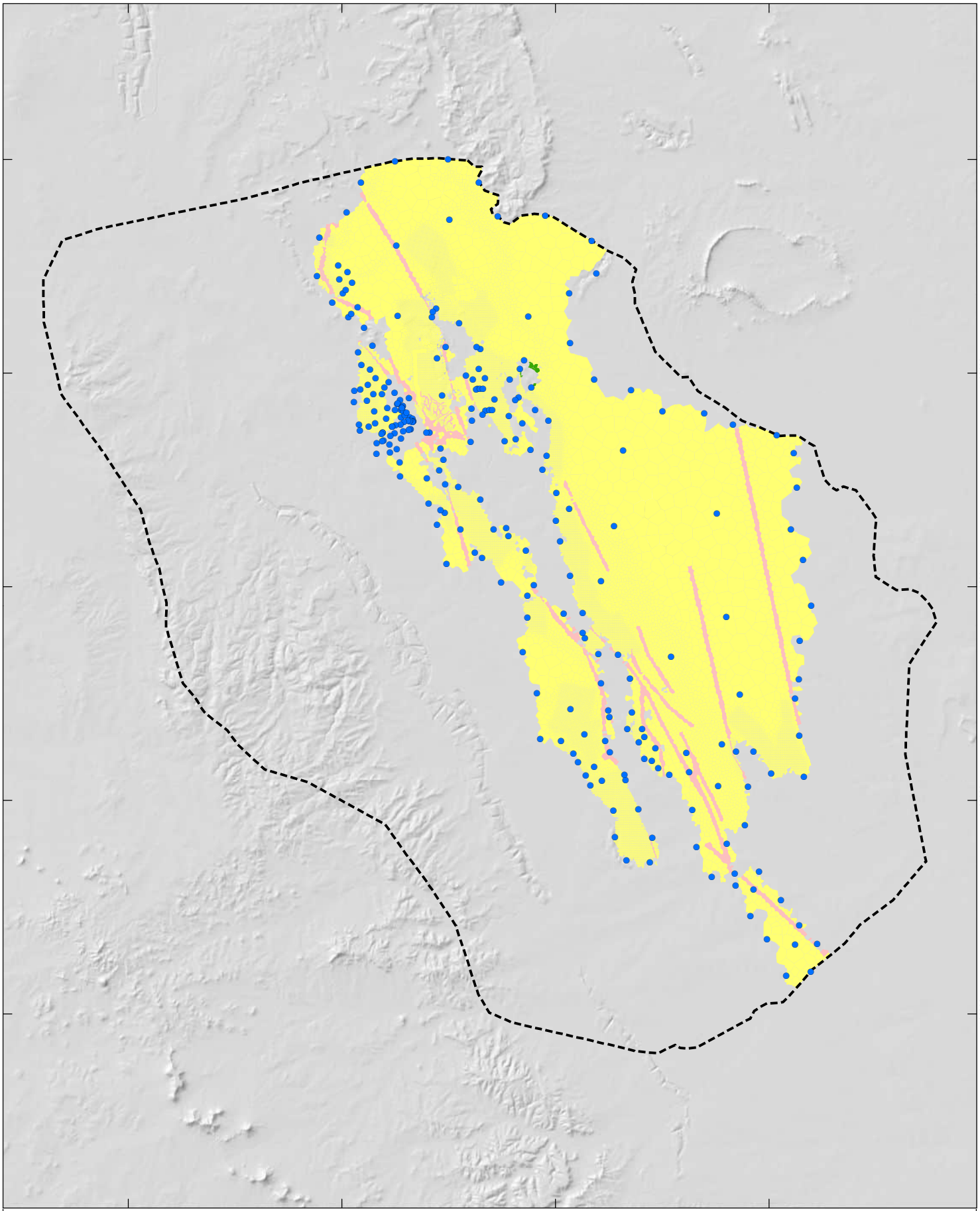
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 6

FIGURE B-6

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B06_Hydraulic Zone L6.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

Faults

Igneous Zone

Vermont Seam

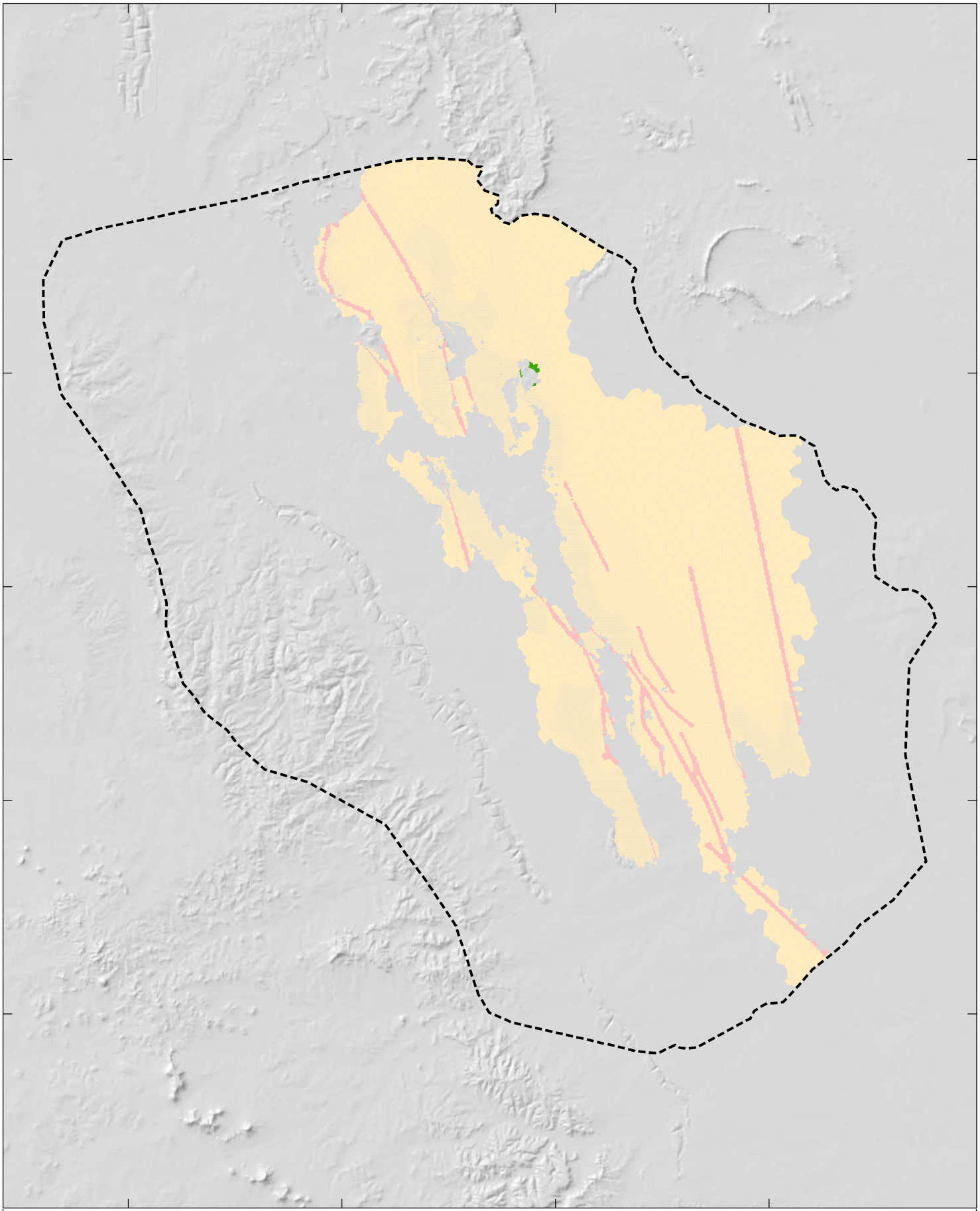
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 7

SLR

FIGURE B-7

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B07_Hydraulic Zone L7.mxd



0 5 10 km

Model Boundary

Parameter Zone

- Faults
- Igneous Zone
- Interburden

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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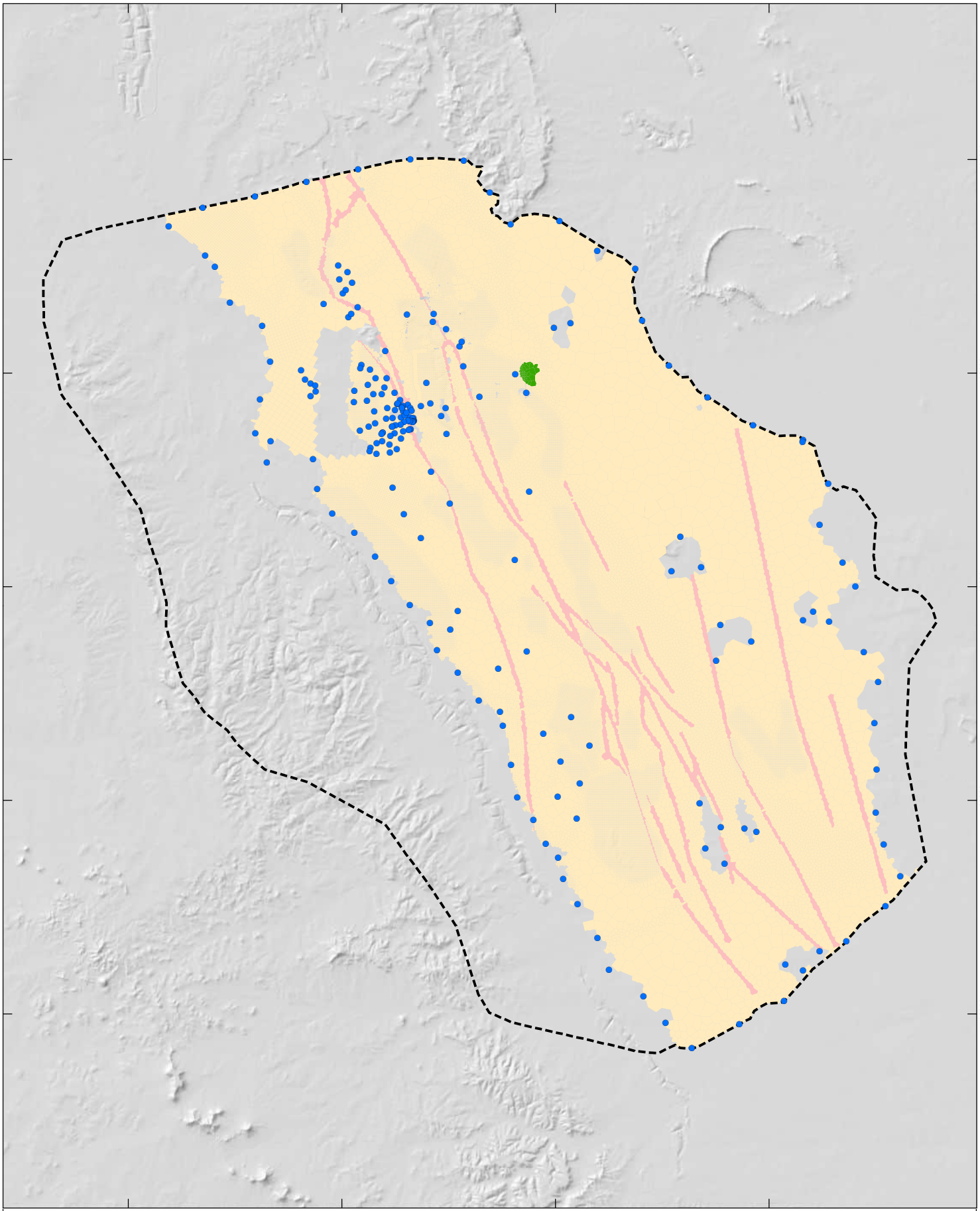
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 8

FIGURE B-8

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B08_Hydraulic Zone L8.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

Faults

Igneous Zone

Interburden

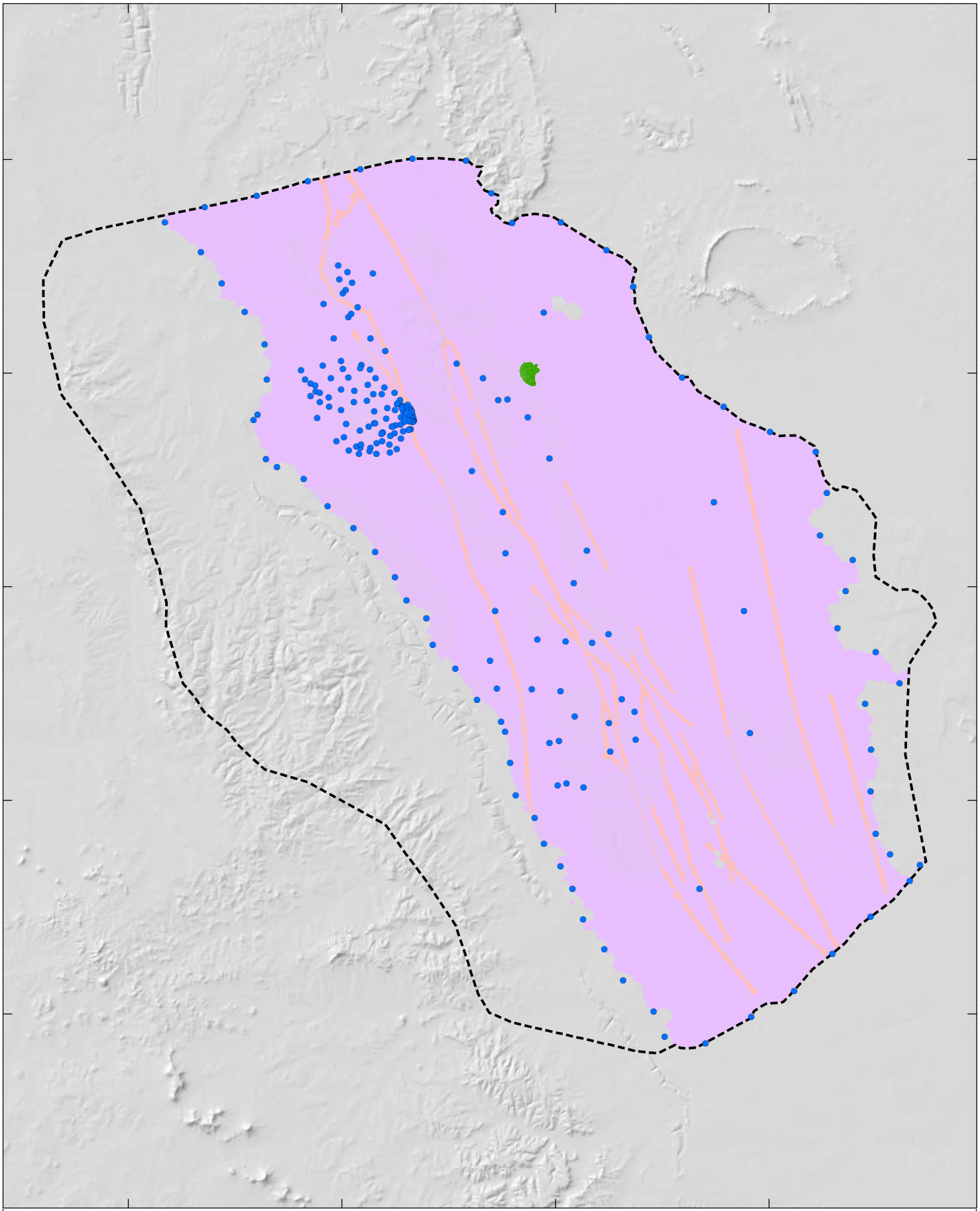
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 9

SLR

FIGURE B-9

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B09_Hydraulic Zone L9.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

Faults

Fort Cooper Seams (combined)

Igneous Zone

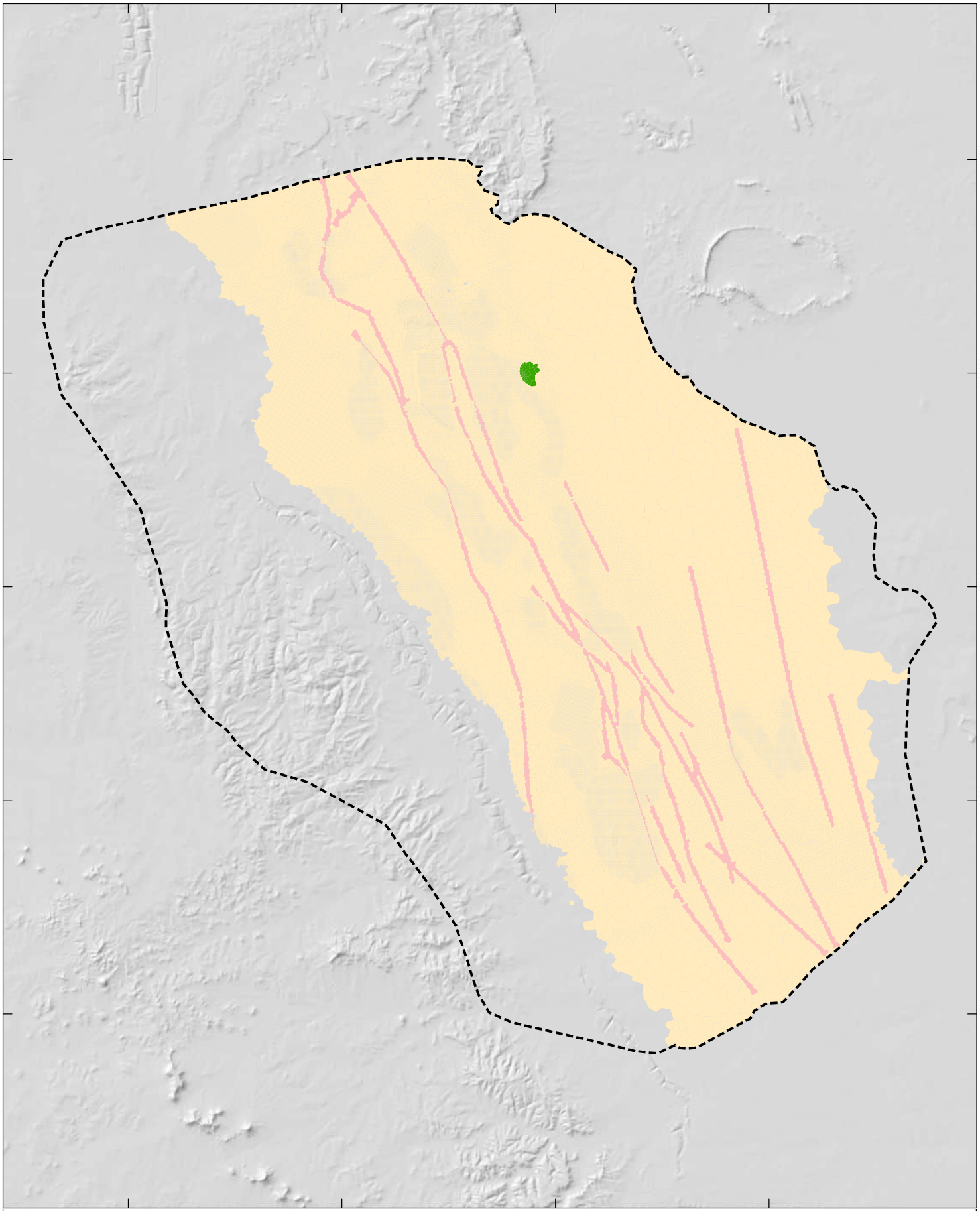
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 10

SLR

FIGURE B-10

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B10_Hydraulic Zone L10.mxd



0 5 10 km

Model Boundary

Parameter Zone

- Faults
- Igneous Zone
- Interburden

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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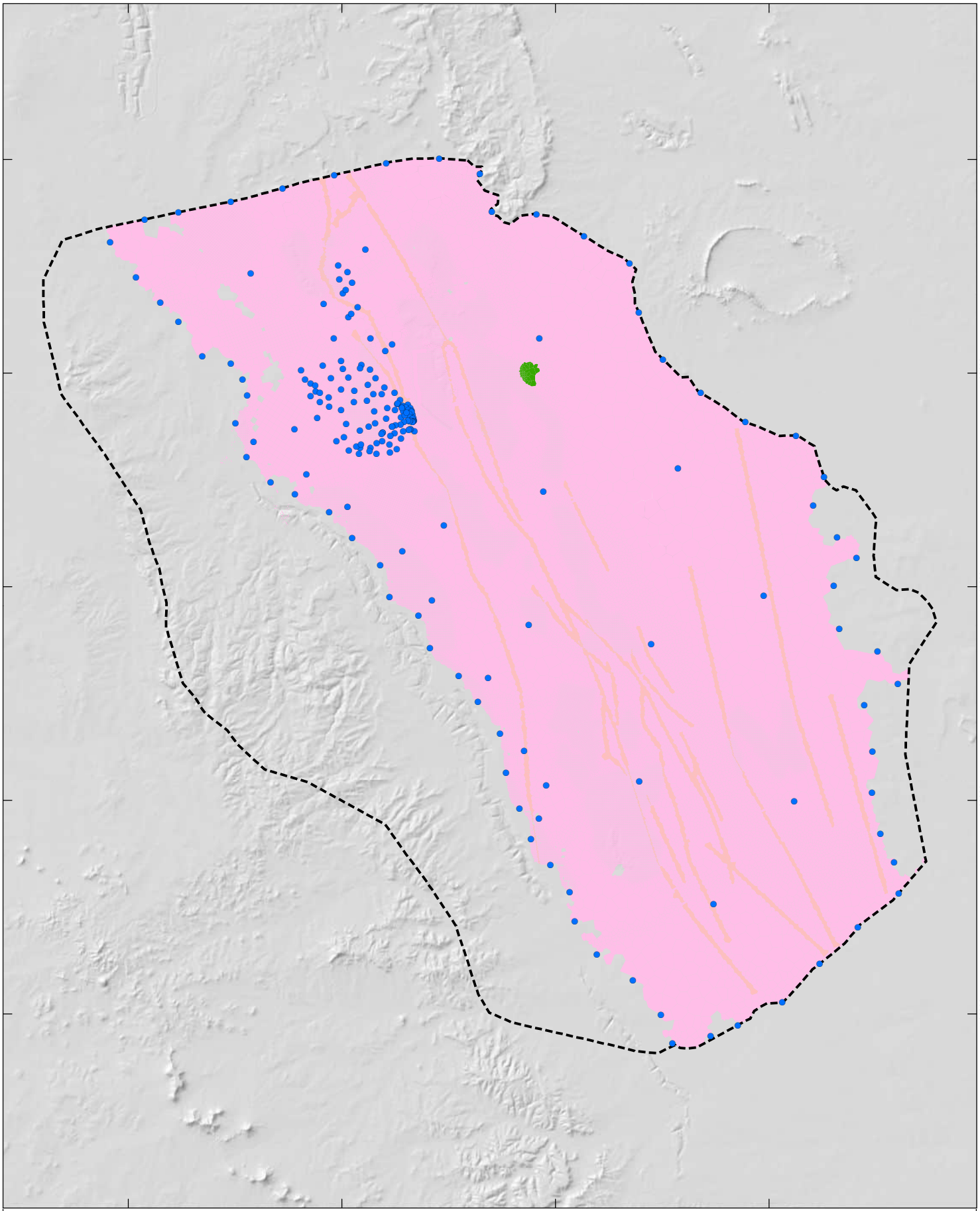
HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 11

FIGURE B-11

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B11_Hydraulic Zone L11.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

Faults

Igneous Zone

Q Seam

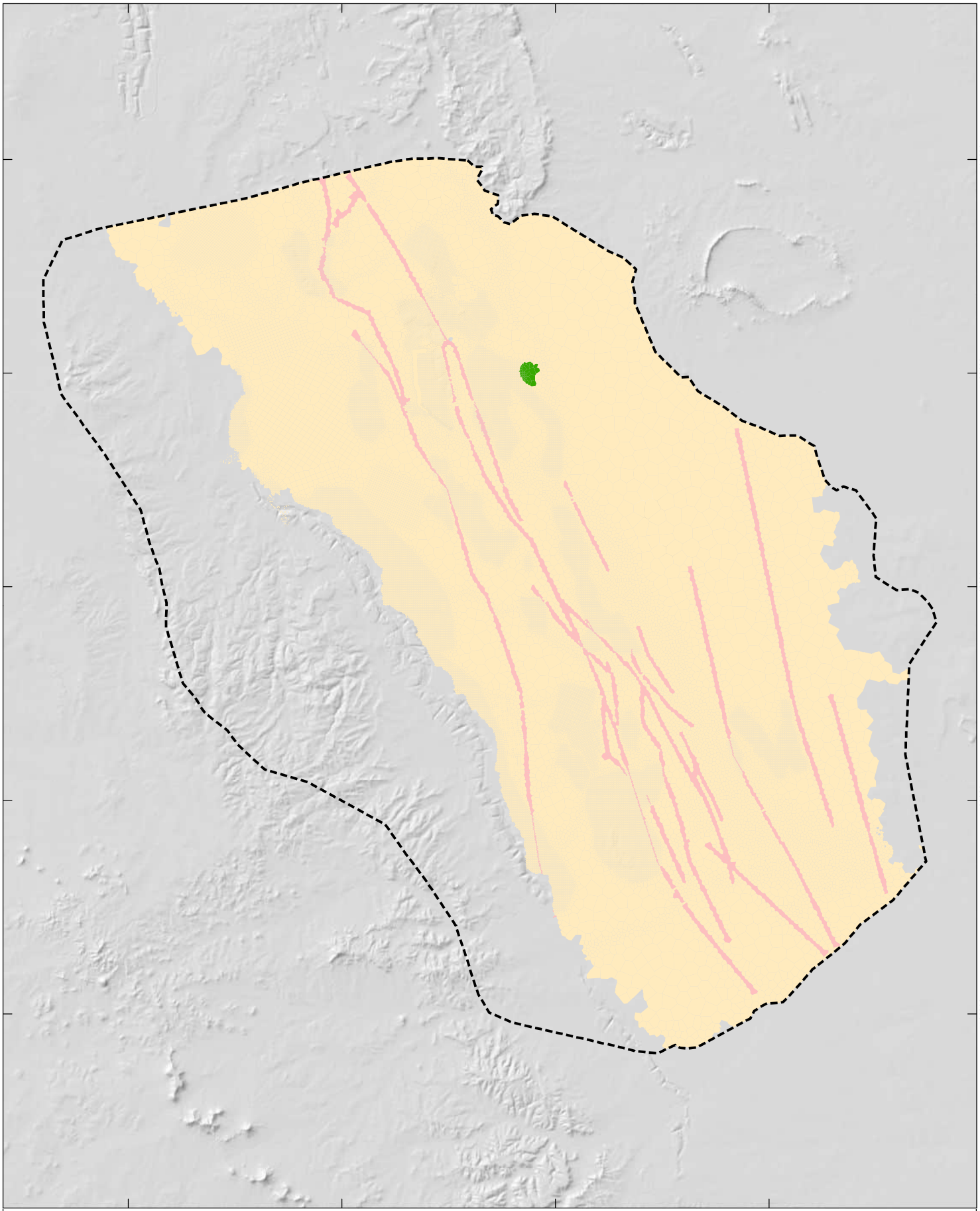
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 12

SLR

FIGURE B-12

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B12_Hydraulic Zone L12.mxd



0 5 10 km

Model Boundary

Parameter Zone

- Faults
- Igneous Zone
- Interburden

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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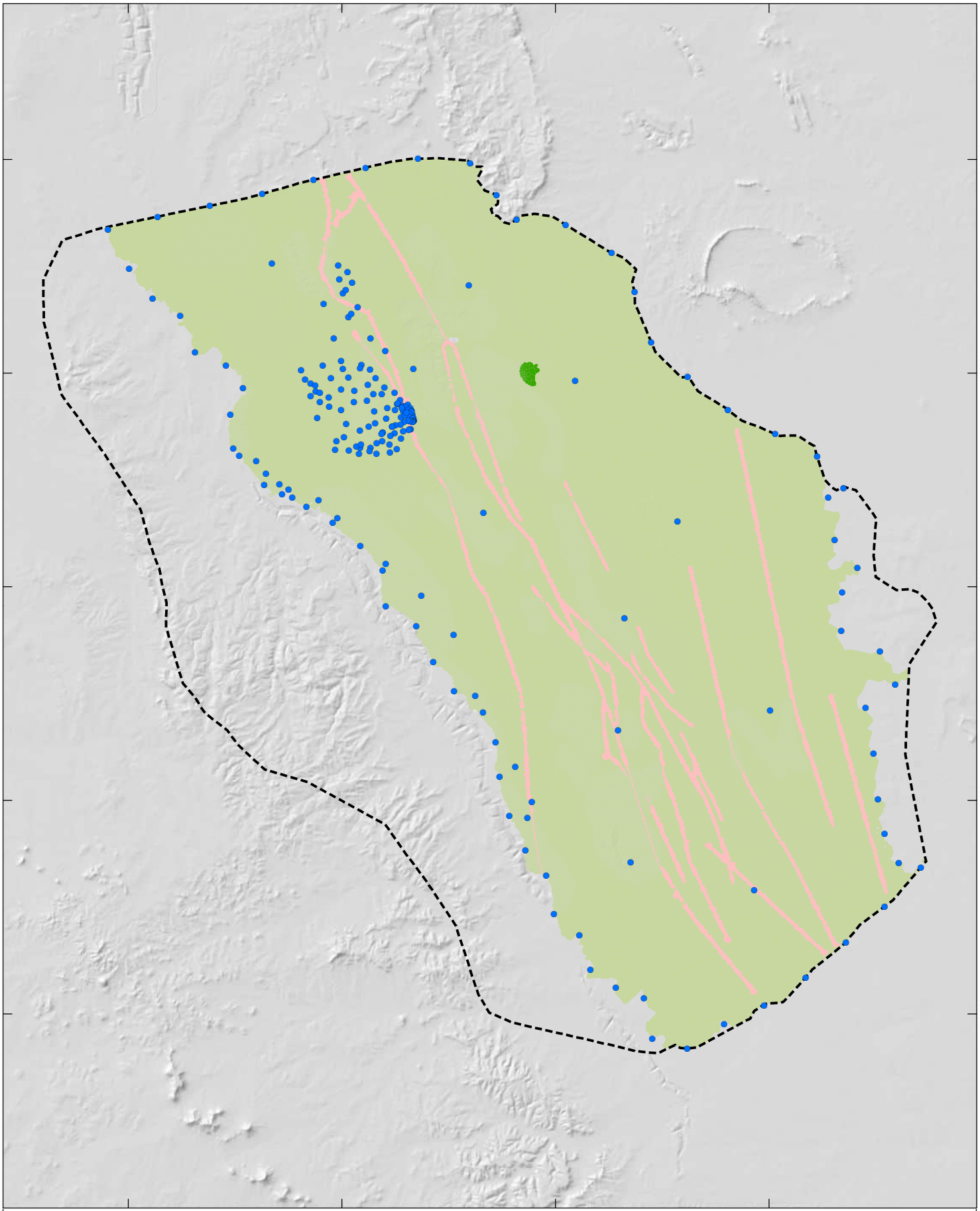
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 13

FIGURE B-13

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B13_Hydraulic Zone L13.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

Faults

Igneous Zone

P Seam

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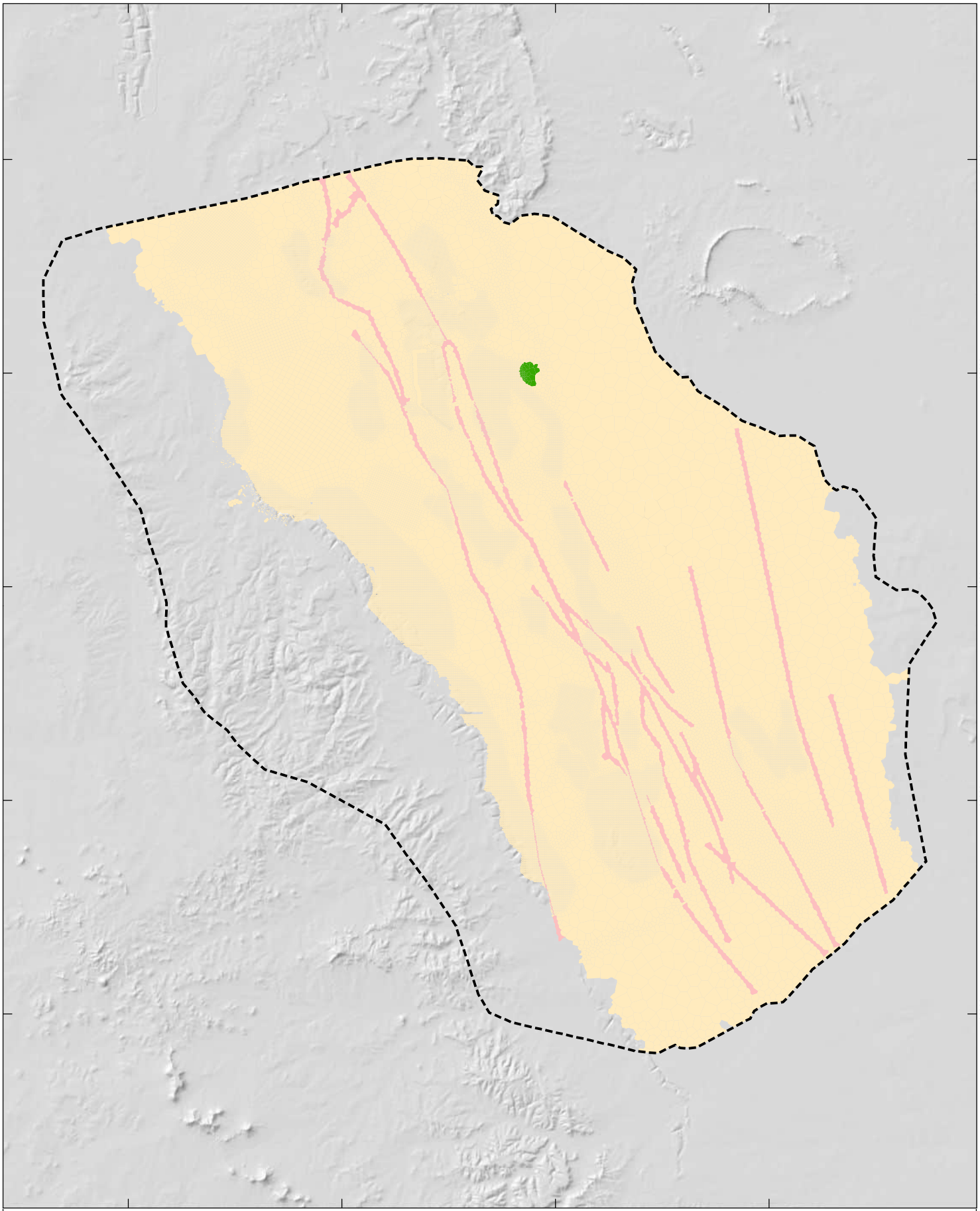
HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 14

SLR

FIGURE B-14

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B14_Hydraulic Zone L14.mxd



0 5 10 km

Model Boundary

Parameter Zone

- Faults
- Igneous Zone
- Interburden

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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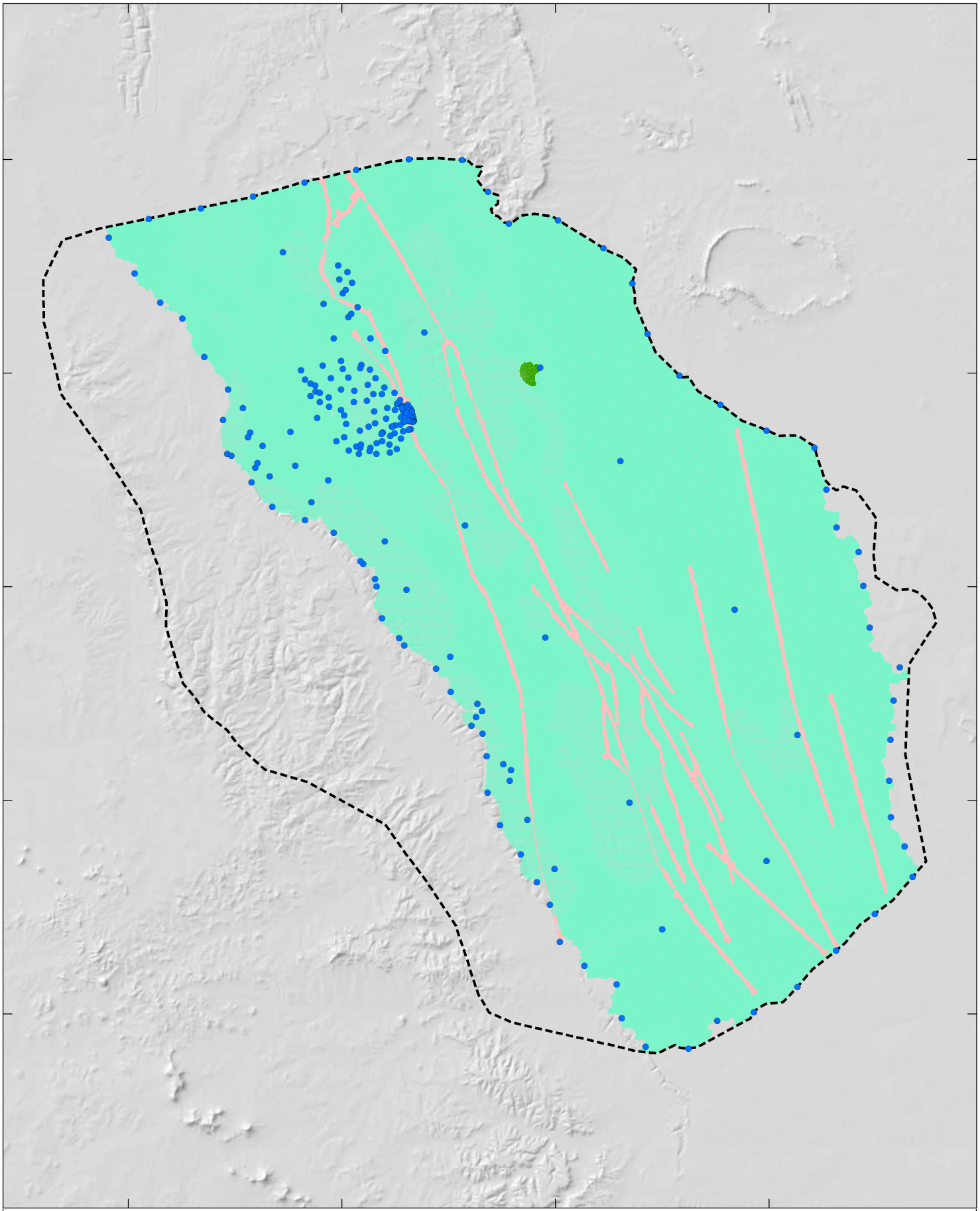
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 15

FIGURE B-15

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B15_Hydraulic Zone L15.mxd



0 5 10 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

Pilot Point - Kx and Kz

Model Boundary

Parameter Zone

Faults

H Seam

Igneous Zone

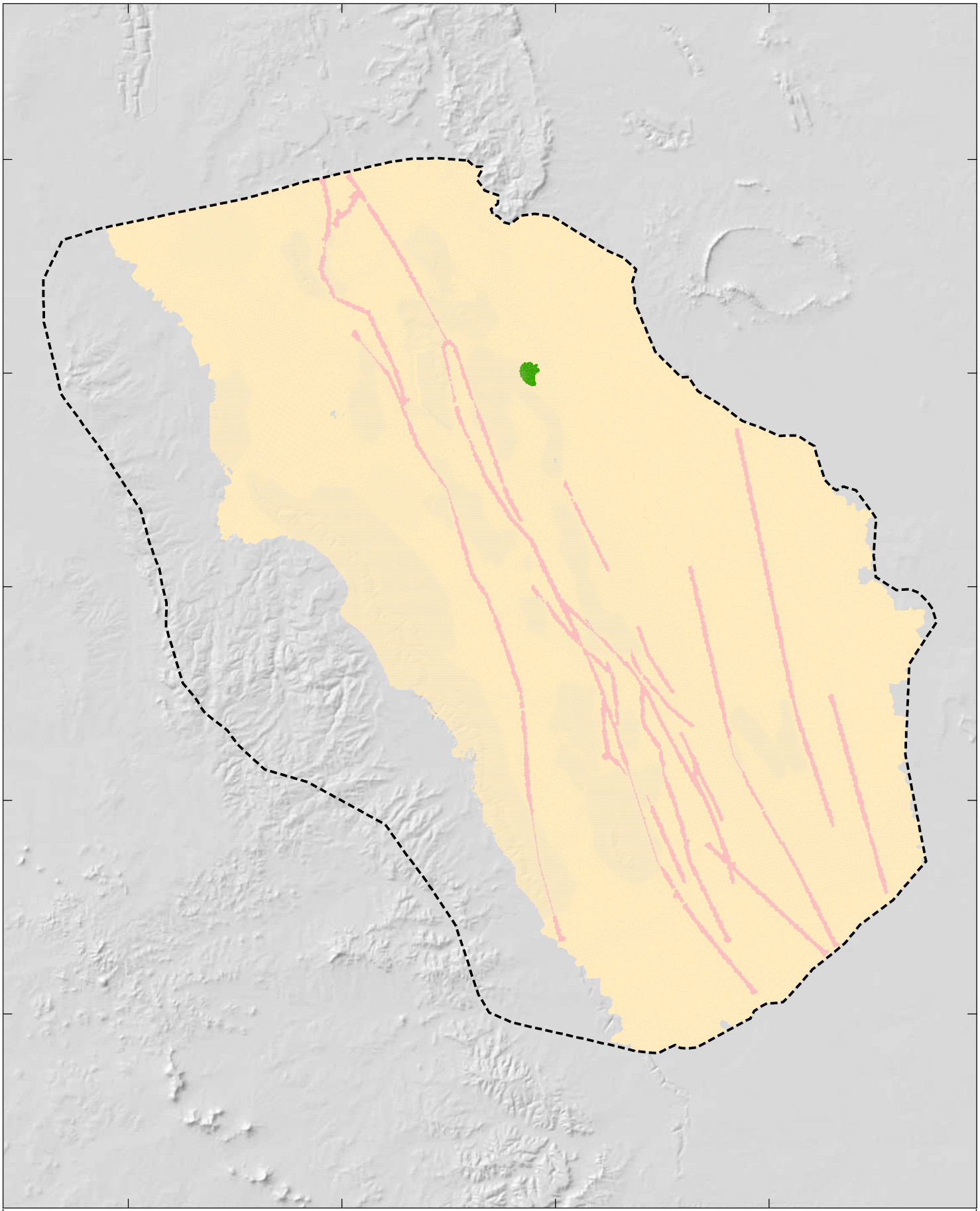
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 16

SLR

FIGURE B-16

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B16_Hydraulic Zone L16.mxd



0 5 10 km

Model Boundary

Parameter Zone

- Faults
- Igneous Zone
- Interburden

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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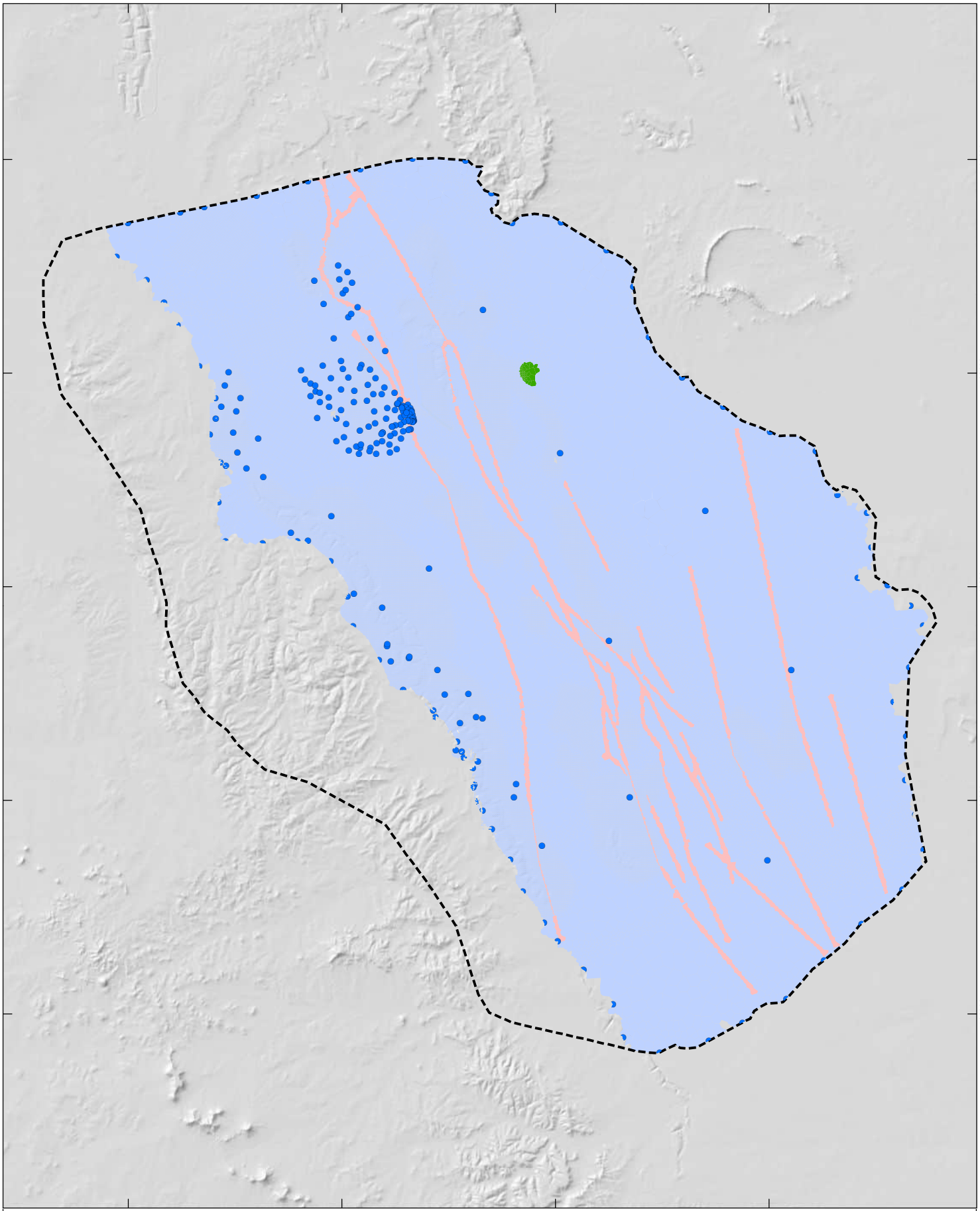
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 17

FIGURE B-17

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B17_Hydraulic Zone L17.mxd



0 5 10 km

Model Boundary

Parameter Zone

- D Seam
- Faults
- Igneous Zone

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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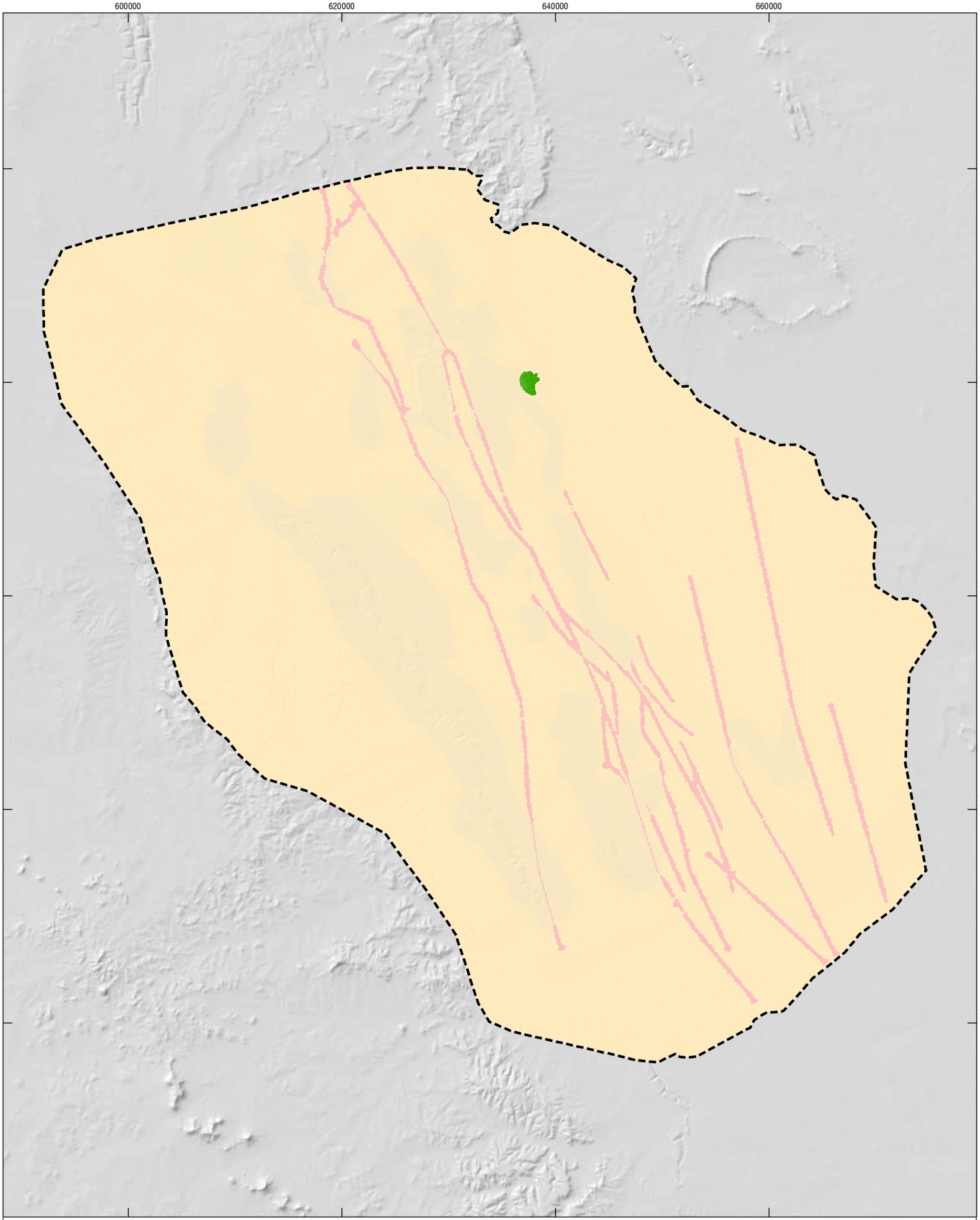
CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 18

FIGURE B-18

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B18_Hydraulic Zone L18.mxd



0 5 10 km

Model Boundary

Parameter Zone

- Faults
- Igneous Zone
- Interburden

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:470,000 at A4
Project Number:	620.V30759.40003
Date:	15-Jan-2026
Drawn by:	RB

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CENTRAL BOWEN BASIN REGIONAL GROUNDWATER MODELLING TECHNICAL REPORT

HYDRAULIC PARAMETER ZONE DISTRIBUTION – LAYER 19

FIGURE B-19

H:\Local Resources\BNE\HH_Mega_Model\01 CAD\GIS\GIS\DE\IDE_MOD_B19_Hydraulic Zone L19.mxd

Appendix C Prior Parameter Ranges for General Head Boundary (GHB) Properties

Central Bowen Basin Regional Groundwater Model Version 6.0

Groundwater Model Update Technical Report

Stanmore ID Extension Pty Ltd

SLR Project No.: 620.041537.00006

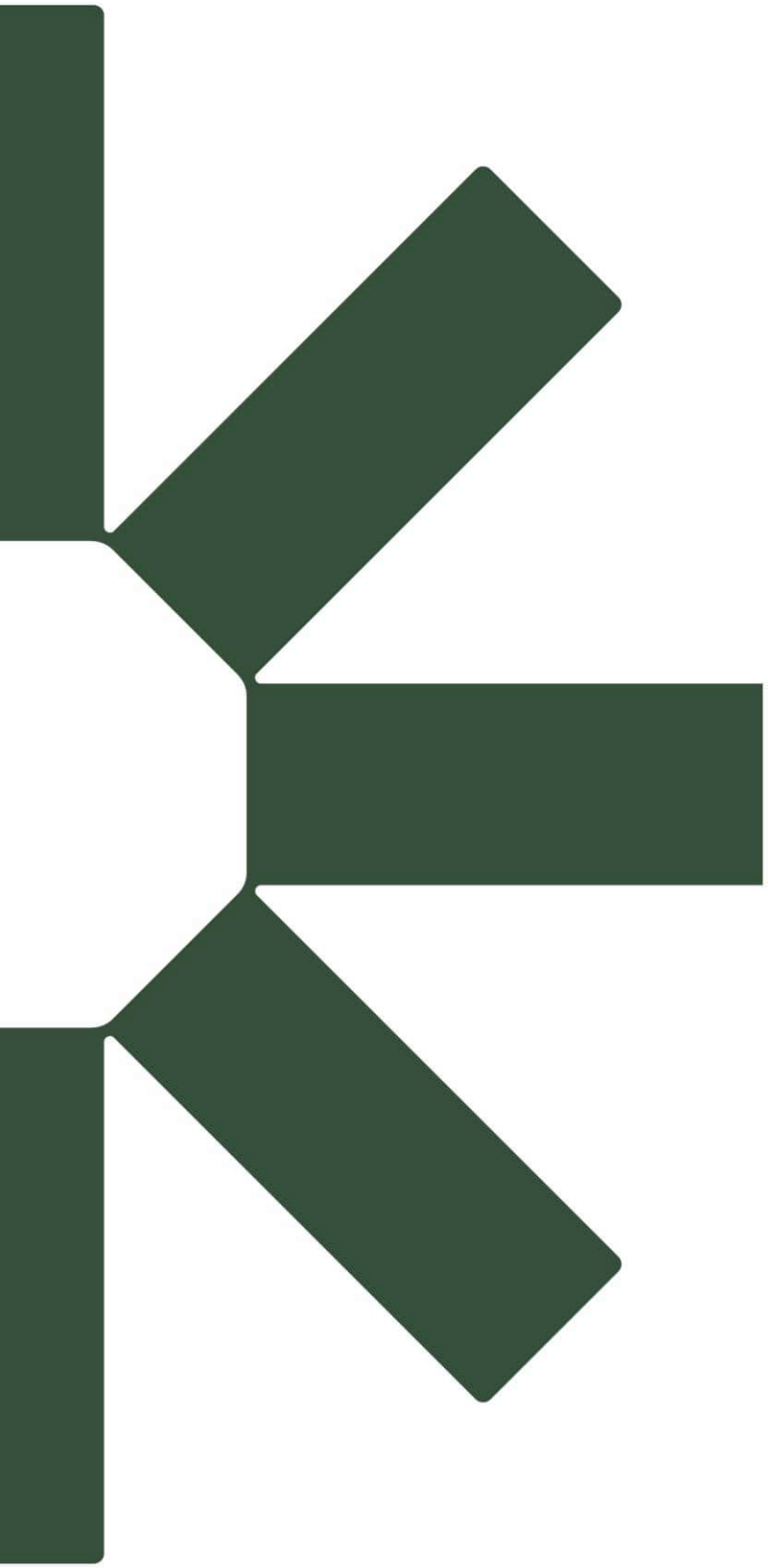
29 May 2026

Model Layer	Model GHB Zone	Lower - GHB Conductance Factor (m^2/day)	Upper - GHB Conductance Factor (m^2/day)	Mean - GHB Conductance Factor (m^2/day)	Std - GHB Conductance Factor (m^2/day)	Lower- GHB Head (m)	Upper- GHB Head (m)	Mean- GHB Head (m)	Std- GHB Head (m)
1	1	0.001	1000	13.17	0.75	1	70	22.37	9.54
1	2	0.001	1000	22.68	0.55	1	85	37.70	8.48
1	3	0.001	1000	23.08	0.49	1	85	33.31	7.43
2	4	0.001	1000	2.70	0.62	1	85	18.87	9.69
2	5	0.001	1000	6.17	0.60	1	85	20.02	9.72
2	6	0.001	1000	0.04	0.70	1	70	39.21	11.86
3	7	0.001	1000	9.59	0.65	1	85	43.35	13.58
3	8	0.001	1000	0.01	0.87	1	85	19.47	8.99
3	9	0.001	1000	10.74	0.54	1	85	40.24	10.77
4	10	0.001	1000	10.71	0.91	1	85	52.12	9.18
4	11	0.001	1000	26.56	0.48	1	85	62.27	8.24
4	12	0.001	1000	0.97	1.03	1	85	24.97	8.50
4	13	0.001	1000	0.13	0.74	1	85	46.65	8.65
5	14	0.001	1000	0.02	1.69	1	85	63.37	9.57
5	15	0.001	1000	0.04	0.73	1	85	28.43	10.70
5	16	0.001	1000	0.02	0.56	1	85	39.02	11.82
5	17	0.001	1000	0.91	1.40	1	85	21.75	11.87
6	18	0.001	1000	36.68	0.57	1	85	42.48	7.60
6	19	0.001	1000	0.01	0.69	1	85	20.47	11.04

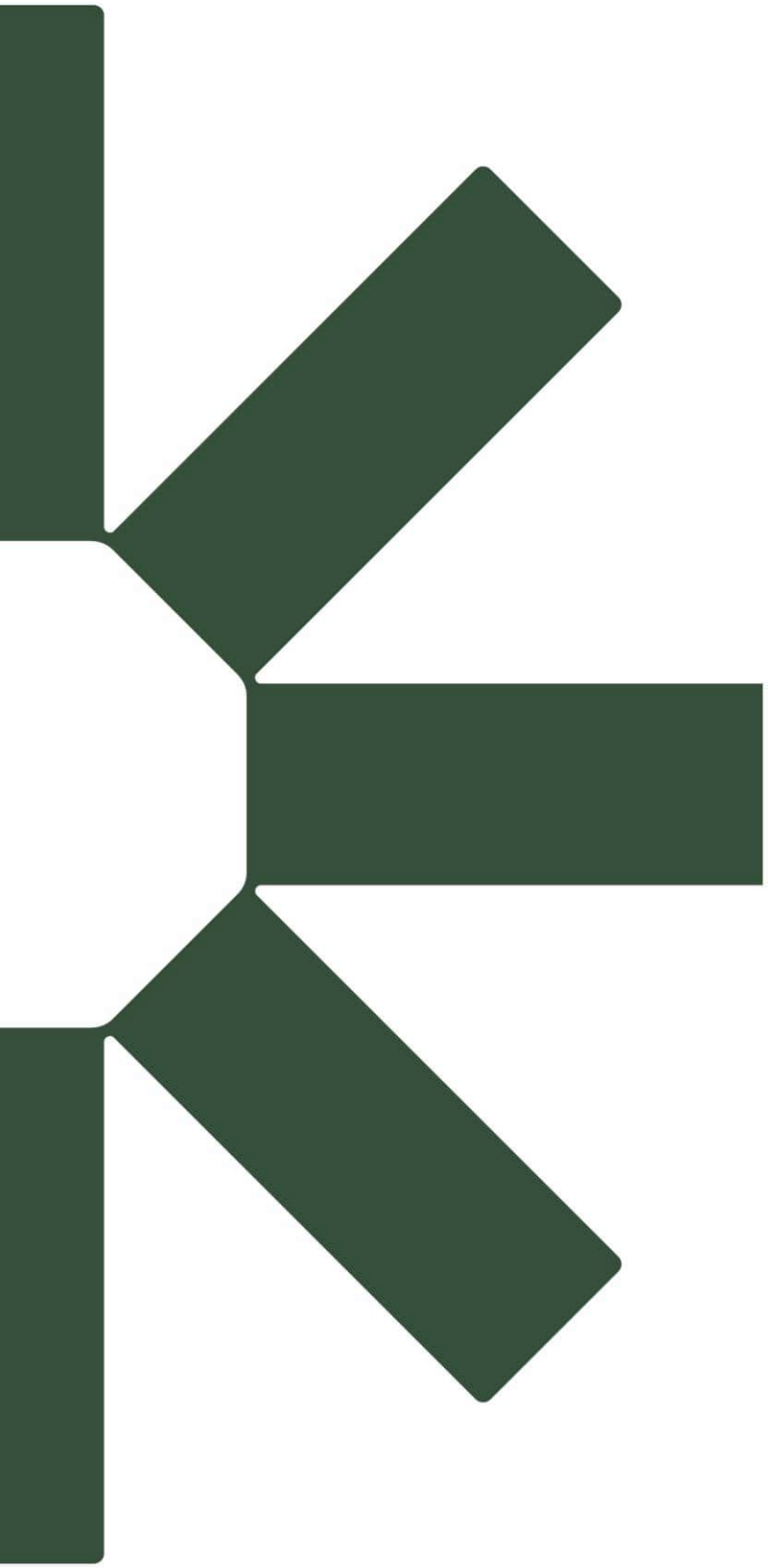
Model Layer	Model GHB Zone	Lower - GHB Conductance Factor (m^2/day)	Upper - GHB Conductance Factor (m^2/day)	Mean - GHB Conductance Factor (m^2/day)	Std - GHB Conductance Factor (m^2/day)	Lower- GHB Head (m)	Upper- GHB Head (m)	Mean- GHB Head (m)	Std- GHB Head (m)
6	20	0.001	1000	0.37	0.80	1	85	24.81	14.13
6	21	0.001	1000	0.05	0.79	1	85	38.64	8.64
7	22	0.001	1000	0.01	0.58	1	70	33.93	11.09
7	23	0.001	1000	0.01	0.72	1	85	40.96	15.25
7	24	0.001	1000	5.98	0.67	1	85	22.02	12.39
7	25	0.001	1000	0.23	0.52	1	85	30.51	9.23
8	26	0.001	1000	9.21	0.52	1	70	29.77	12.49
8	27	0.001	1000	0.02	0.62	1	85	57.35	8.00
8	28	0.001	1000	0.20	0.91	1	70	38.86	11.32
8	29	0.001	1000	5.47	0.62	1	85	20.29	11.12
9	30	0.001	1000	0.01	0.85	1	70	50.14	7.14
9	31	0.001	1000	0.13	0.76	1	85	14.93	11.81
9	32	0.001	1000	0.27	0.57	1	85	64.01	10.24
9	33	0.001	1000	3.00	1.31	1	85	26.32	9.80
10	34	0.001	1000	12.79	0.65	1	85	48.21	7.81
10	35	0.001	1000	0.40	0.65	1	85	51.12	8.69
10	36	0.001	1000	8.26	0.50	1	85	28.22	8.01
10	37	0.001	1000	0.03	1.03	1	85	36.15	10.68
11	38	0.001	1000	0.23	1.04	1	85	25.32	9.38

Model Layer	Model GHB Zone	Lower - GHB Conductance Factor (m^2/day)	Upper - GHB Conductance Factor (m^2/day)	Mean - GHB Conductance Factor (m^2/day)	Std - GHB Conductance Factor (m^2/day)	Lower- GHB Head (m)	Upper- GHB Head (m)	Mean- GHB Head (m)	Std- GHB Head (m)
11	39	0.001	1000	0.17	0.66	1	85	38.88	16.88
11	40	0.001	1000	0.50	0.63	1	85	32.96	8.94
11	41	0.001	1000	4.04	1.27	1	85	33.57	15.22
12	42	0.001	1000	15.20	0.68	1	70	42.30	7.32
12	43	0.001	1000	0.03	0.68	1	85	28.95	10.44
12	44	0.001	1000	0.95	0.70	1	85	27.40	10.12
12	45	0.001	1000	0.06	0.57	1	85	39.98	7.74
13	46	0.001	1000	0.34	0.60	1	70	35.49	8.07
13	47	0.001	1000	2.36	0.78	1	85	14.60	10.53
13	48	0.001	1000	0.60	0.59	1	70	21.00	11.03
13	49	0.001	1000	0.04	0.80	1	70	22.11	11.03
14	50	0.001	1000	0.59	0.52	1	70	49.12	8.20
14	51	0.001	1000	15.58	0.62	1	85	21.90	9.95
14	52	0.001	1000	2.72	0.63	1	85	34.56	10.50
14	53	0.001	1000	2.08	1.38	1	85	22.45	8.39
15	54	0.001	1000	2.42	0.66	1	70	46.21	7.63
15	55	0.001	1000	8.07	0.53	1	85	44.33	13.31
15	56	0.001	1000	0.30	0.75	1	70	28.37	9.85
15	57	0.001	1000	0.15	0.72	1	70	26.91	10.35

Model Layer	Model GHB Zone	Lower - GHB Conductance Factor (m^2/day)	Upper - GHB Conductance Factor (m^2/day)	Mean - GHB Conductance Factor (m^2/day)	Std - GHB Conductance Factor (m^2/day)	Lower- GHB Head (m)	Upper- GHB Head (m)	Mean- GHB Head (m)	Std- GHB Head (m)
16	58	0.001	1000	0.02	0.45	1	85	43.53	9.35
16	59	0.001	1000	0.76	0.53	1	70	19.69	12.23
16	60	0.001	1000	6.76	0.77	1	85	20.87	14.64
16	61	0.001	1000	34.17	0.54	1	70	37.15	9.50
17	62	0.001	1000	0.03	1.07	1	85	24.36	9.39
17	63	0.001	1000	0.17	0.67	1	85	18.36	11.49
17	64	0.001	1000	17.90	0.52	1	85	40.50	9.23
17	65	0.001	1000	0.01	0.63	1	85	28.36	8.95
18	66	0.001	1000	10.77	0.54	1	85	62.03	8.77
18	67	0.001	1000	34.17	0.53	1	85	19.18	11.48
18	68	0.001	1000	0.13	0.57	1	85	54.34	10.14
18	69	0.001	1000	18.27	0.62	1	85	29.64	30.47
19	70	0.001	1000	0.03	0.62	1	70	46.14	6.14
19	71	0.001	1000	0.02	0.79	1	85	27.27	9.11
19	72	0.001	1000	53.27	0.55	1	70	34.37	9.47
19	73	0.001	1000	0.25	0.58	1	85	23.05	9.44



Making Sustainability Happen



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