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APPENDIX N - GROUNDWATER DEPENDENT ECOSYSTEM ASSESSMENT



Groundwater Dependent Ecosystem
Assessment

Isaac Downs Extension

Revision 4_Final A, May 2026



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Groundwater Dependent Ecosystem Assessment – Isaac Downs Extension	REV 4 Final A	10 May 2026	Alexandra Kiss	Updated baseline assessment report following review.

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Yours Sincerely,



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Executive Summary

Stanmore IDE Extension Pty Ltd proposes to develop the Isaac Downs Extension Project (the Project), an open-cut coal mine pit and associated infrastructure situated approximately 145 km south-west of Mackay and 15 km south-east of Moranbah. The Project will form part of the Isaac Plains Complex (IPC), comprising Isaac Plains Mine (IPM) and Isaac Downs Mine (IDM). It will extend the life of the IPC by replacing coal mined in its currently active mining areas.

Coal resource developments have the potential to alter natural groundwater regimes and impact groundwater quality. An assessment of the potential for groundwater dependent ecosystems (GDEs) to occur is required to determine possible risks that the Project poses to water-dependent assets. Multiple lines of evidence, including measurements of leaf and soil water potentials, stable and radiogenic isotope analyses, and physical observations, were used to assess the groundwater dependence of vegetation within and adjacent to the Project area. The study concludes that riparian vegetation fringing the Isaac River channel, including the lower reaches of Cherwell Creek and an associated floodplain wetland, form the only likely representations of GDEs within and adjacent to the Project area.

Riparian vegetation fringing the Isaac River, plus lower reaches of Cherwell Creek, utilises a discontinuous and seasonally variable perched groundwater unit that is associated with active alluvial deposits, including fluvial sands, riverbanks, and river terraces, extending laterally from the main river channel underneath the riverbanks in some locations to support riparian terrestrial GDEs. Although not detected during the current GDE assessment, based on related studies conducted in adjacent areas, there is a very low likelihood of sporadic use of the deeper alluvial aquifer.

Recharge of the perched groundwater unit occurs through surface flows fed by seasonal rainfall events, which then leak into the alluvial aquifer via a weak unsaturated hydraulic connection. As surface water flows diminish after flooding, water stored in riverbanks may discharge back into the river to prolong surface flows. The persistence of surface pools depends on both climatic conditions and sedimentary processes that hollow out the channel, with river sand. However, residual pools are extremely minor in extent and occurrence in drier climatic periods.

Like the perched groundwater unit, groundwater supporting deep-rooted floodplain wetland vegetation in a state mapped 'high ecological significance' (HES) wetland occurs at the base of a thick sand unit, likely a river paleochannel, that lies above the weathered basement rock unconformity at ~7 mbgl. The groundwater at the base of the sand is hydraulically disconnected from both the perched groundwater unit associated with the Isaac River and the deeper alluvial aquifer and is ephemeral. Groundwater recharge is maintained by infiltration of seasonally ponded wetland surface water, with perched groundwater discharge driven by transpiration. For extended periods, deep-rooted wetland vegetation relies solely on stored soil moisture.

An impact assessment framework has been developed to identify the risks posed by Project activities to terrestrial GDEs. The impact assessment considers multiple impact pathways, including GDE clearing, groundwater drawdown, groundwater recharge mechanisms, groundwater quality and changes in surface water flows. Mitigation and management actions are proposed to detect impacts to GDEs and remediate them if detected. The measures include the development of a GDE monitoring and management plan (GDEMMP) in accompaniment to this assessment, with a framework for detecting potential changes in

GDE health, implementing measures to improve GDE health if required, and / or provision of biodiversity offsets if a change in GDE health leads to a significant impact of habitat for listed species. The results of the risk assessment identify the following residual risks:

- Direct clearing will result in up to 6.8 hectare (ha) of clearing of groundwater dependent riparian vegetation on the Isaac River. However, this clearing will be offset as part of the biodiversity offset package associated with clearing of terrestrial ecosystems and habitat for the Project as a whole. The proponent will seek to reduce clearing within this nominated disturbance areas to further reduce impacts.
- Groundwater modelling does not predict Project-related groundwater drawdown in the alluvial aquifer, and there is no potential for Project-related drawdown to impact the perched groundwater unit, which supports terrestrial GDEs (riverine and wetland).
- The groundwater modelling, however, identified that there are, and will be, cumulative drawdown impacts on the alluvial aquifer due to adjacent mines and projects, including IDM. Potential impacts to GDEs adjacent to IDM operations are currently monitored under an existing GDEMMP, which has not reported any detectable impacts in the four years since mining commenced.
- The potential for surface water changes from the Project to impact the perched groundwater units that support GDEs, including riparian vegetation fringing the Isaac River and the HES wetland, will be managed through the design, construction and operation of the water management systems and erosion and sediment controls, and through progressive rehabilitation. With these surface water management measures in place there are predicted to be negligible to minor impacts to the surface water environment and hence negligible impacts on the perched groundwater unit.

With implementation of the GDEMMP, the risk to GDEs posed by Project development ranges from low to insignificant.

Contents

1.0 Introduction.....	12
1.1 Project Overview	12
1.2 Project Objectives	13
1.3 GDE Definition Used for Assessment	17
2.0 Survey Timing, Rainfall and Climate	17
3.0 Ecological / Hydrogeological Setting	20
3.1 Ecological Characteristics of GDE Species and Communities	20
3.1.1 Regional Ecosystems and Mapped GDEs	20
3.1.2 Groundwater Dependent Species	21
3.1.3 Other Ecological Values	24
3.2 Hydrogeological Setting	27
3.2.1 Surface Geology and Significance for Groundwater Resources	27
3.2.2 Groundwater Monitoring Network	28
3.2.3 Groundwater Levels and Quality	28
3.3 Surface Water Flows	33
4.0 Summary of Assessment Methods.....	34
4.1 Site Selection	34
4.2 Leaf Water Potential	37
4.3 Soil Moisture Potential	40
4.4 Stable Isotope Sampling and Analyses	41
4.4.1 Local Meteoric Water Line	41
4.4.2 Line Conditioned Excess	42
4.4.3 Soil Moisture Isotopes	42
4.4.4 Xylem Water Isotopes	42
4.5 Water Sampling	43
4.6 Data Reconciliation and Interpretation	44
4.7 Limitations and Other Information Relevant to the Assessment	45
5.0 Results.....	46
5.1 Leaf Water Potential	46
5.2 Soil Auger Sampling	50
5.3 Stable Isotope Sampling and Analyses	57
5.3.1 Stable isotope biplots and soil profiles	57
5.3.2 Line Conditioned Excess	66
5.4 Radon Analysis	67
6.0 Discussion and Conceptual Site Models (CSMs)	70
7.0 Assessment of Impacts to GDEs	76

7.1	Summary of Findings Relevant to Impact Assessment	76
7.2	Potential Impacts to GDEs.....	77
7.2.1	Direct clearing	77
7.2.2	Partial or total loss or reduction in pressure of the aquifer being utilised by GDEs.....	78
7.2.3	Changes to the interaction between surface flows and aquifers being utilised by a GDE	78
7.2.4	Change in chemical composition or quality of an aquifer detrimentally impacting the health of a GDE	80
7.2.5	Sedimentation of surface flows responsible for aquifer recharge	81
7.2.6	Cumulative Impacts	81
7.3	Mechanisms of Potential GDE Impact	84
7.4	Mitigation, Management and Monitoring Measures	85
7.4.1	Reduction to the footprint of direct clearing.....	85
7.4.2	General operational measures.....	87
7.4.3	Groundwater monitoring	87
7.4.4	GDE Baseline Data Collection and Monitoring.....	87
7.5	Risk Assessment.....	88
8.0	Conclusions	93
9.0	References	95
10.0	Appendix	99
	Appendix A. Tree Structural Measurements.....	100
	Appendix B. Sampling locations and Moisture Availability.....	103
	Appendix C. Soil Moisture Potentials-Raw Data	120
	Appendix D. Stable Isotope Results (all Surveys)	122

Figures

Figure 1-1. Location of the Isaac Downs Extension Project.	14
Figure 1-2. Project layout and disturbance area.	15
Figure 1-3. Groundwater dependent ecosystem mapping from BOM (2024) for the Isaac Downs Extension area and surrounds.	16
Figure 2-1. Rainfall for the period from January 2021 to November 2025 for Moranbah Airport (Station 34035; -22.06° / 148.08°) showing extremely limited rainfall between September and October 2024, in the months prior to the primary field assessment.	18
Figure 2-2. Daily rainfall before each assessment event, showing dry conditions before the November 2024 assessment, and also before August and September 2025 sampling events.	19
Figure 2-3. Morton's Potential Evapotranspiration compared to rainfall for May 2023 to November 2025 (from SILO 2025).	19
Figure 2-4. Cumulative Rainfall Departure demonstrating major and minor rainfall fluctuations with declining rainfall volumes leading to the November 2024 assessment, after which rainfall volume increased.	19
Figure 3-1. Regional ecosystem mapping for the Isaac Downs Extension Project area and surrounds from Trend Environmental.	25
Figure 3-2. HES Wetlands in the vicinity of the Project area.	26
Figure 3-3. Surface geology mapping in the Project area (from DNRM, 2018).	31
Figure 3-4. The location of groundwater monitoring bores in the Project area and surrounds.	32
Figure 4-1. The location of GDE assessment sites targeted for LWP and auger sampling.	39
Figure 5-1. Range and average of LWP readings for all GDE Assessment sites including sampling completed at IS20 and IS25 in November 2025.	47
Figure 5-2. LWP values for individual trees across all assessment sites with moisture availability categories indicated within the dashed lines.	47
Figure 5-3. Spatial representation of average tree water availability for all GDE Assessment sites.	49
Figure 5-4. Auger profile for IS2_AU1 showing intersection of coarse gravel at the base of the alluvial profile. LWP and SMP values intersect at 2, 2.85 and >3.9 mbgl indicating regions in the soil profile where moisture is available for tree use.	53
Figure 5-5. Auger profile for IS8_AU1 showing intersection of competent sandy clay at 4.9 mbgl plus the intersection of LWP and SMP values in several regions of the soil profile, particularly below 3.5 mbgl.	53
Figure 5-6. Auger IS15_AU1 demonstrating intersection of LWP and SMP values through significant portions of the soil profile, indicating a likely soil-moisture source for riparian vegetation.	54
Figure 5-7. Downhole profile of IS5_AU2 completed in November 2025 with the position of the groundwater table at 3.5 mbgl.	54
Figure 5-8. Auger IS12_AU1 in riparian vegetation on Cherwell Creek, showing the broad intersection between LWP and SMP down to 2.5 mbgl. Below this depth, the entire soil profile is available for transpiration.	55
Figure 5-9. Auger IS14_AU1 from the riparian fringe of Cherwell Creek, showing intersection of bedrock at 3.7 mbgl, and general overlap between soil and SMP values below 2.4 mbgl.	55

Figure 5-10. Auger hole IS20_AU1 at the HES wetland site (RE11.3.27b). Significant overlap between SMP and LWP occurs at depths >3mbgl, with soils becoming moister towards the base of the profile.	56
Figure 5-11. Auger hole IS20_AU2 at the HES wetland site (RE11.3.27b) completed in November 2025. The profile is significantly wetter than the November 2024 assessment with overlap between SMP and LWP occurring in the upper 3 m of the soil profile.....	56
Figure 5-12. Stable isotope for water samples collected during the Project Assessment, showing the strong evaporative enrichment of surface water samples relative to groundwater. The dashed black line represents the LMWL developed from rainfall samples, and blue line represents the GMWL.	58
Figure 5-13. Stable isotope biplot for sites on the Isaac River channel showing a defined cluster of twig xylem samples (green dashed circle) that is clearly separated from the cluster formed by groundwater (blue circle), while overlapping with the soils (brown circle).	59
Figure 5-14. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for auger IS2_AU1. The data indicates overlap between $\delta^{18}\text{O}$ values reported for twig xylem and soils only near the soil surface (0.3 mbgl).	59
Figure 5-15. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for auger IS15_AU1. Consistent with IS2_AU1, the data indicates soil moisture uptake in the upper 1m of the soil profile.	60
Figure 5-16. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS8_AU1. The overlap between xylem and soil isotope values occurs predominantly toward the base of the soil profile.	60
Figure 5-17. Stable isotope biplot for sites on the channel of Cherwell Creek, demonstrating separation of twig xylem values (green circle) from those of groundwater and soil moisture (brown circle). The black dashed lines represent the LMWL and GMWL respectively.	61
Figure 5-18. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS12_AU1. There is a distinctive lack of overlap between twig and soil values down the entire soil profile, except for at the surface.	62
Figure 5-19. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS14_AU1, demonstrating is a distinctive lack of overlap between twig and soil values down the entire soil profile.....	62
Figure 5-20. Stable isotope biplot for site IS20, at the HES Wetland near the confluence of Isaac River and Cherwell Creek, demonstrating separation of twig xylem values (green circle) from those of groundwater, and only weak overlap with soil moisture (brown circle). The black dashed line represents the LMWL.	64
Figure 5-21. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS20_AU1. There is a distinctive lack of overlap between twig and soil values down the entire soil profile, except for at the surface	64
Figure 5-22. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS20_AU2 in November 2025. There is strong overlap between soil and xylem stable isotope values from surface to 3.5 mbgl, and also from 5 mbgl to the base of the profile at 7.2mbgl.	65
Figure 5-23. Stable isotope biplot for poplar box sites IS3 and IS11, demonstrating the weak overlap between isotopic values of twig xylem (green circle) and groundwater (blue circle). The black dashed line represents the LMWL.	65
Figure 5-24. Stable isotope biplot for Brigalow TEC sites IS1, IS4, IS13 and IS16, demonstrating the weak overlap between isotopic values of twig xylem and groundwater. The black dashed line represents the LMWL and blue dashed line the GMWL.	66

Figure 5-25. Box and whisker plot defining lc-excess values for rainfall, twig xylem, soils, and groundwater for each GDE Assessment site.	67
Figure 5-26. Radon activity (Bq/L) plotted against EC demonstrating three distinct clusters formed by the Alluvial Aquifer, perched groundwater and residual surface water in November 2025, and the August 2025 surface water.	68
Figure 6-1. Conceptual models demonstrating the ecohydrological function of the Isaac River and associated HES wetland including the dry season model (Figure 6-1 (a)), the wet season model (Figure 6-1 (b)), and post-wet model (Figure 6-1 (c)).	73
Figure 6-2. The distribution of groundwater dependent vegetation relative to the proposed project disturbance area.	75
Figure 7-1. GDE areas subject to proposed clearing.	79
Figure 7-2. Cumulative groundwater drawdown in the alluvium (Layer 1) based on modelling completed by SLR (2026a).	82
Figure 7-3. Cumulative groundwater drawdown in the regolith (Layer 2) based on modelling completed by SLR (2026a).	83
Figure 7-4. Models depicting pre-mining (Figure 7-4 (a)) and operational (Figure 7-4 (b)) ecohydrological function of GDEs on the Isaac River, adjacent to the northern limits of the proposed mine pit.	85
Figure 7-5. Existing Isaac River bridge crossing on the Peak Downs Highway.	86

Tables

Table 3-1. A summary of groundwater monitoring bores within the Isaac Downs Extension monitoring network.	29
Table 4-1. Summary of the GDE Assessment Sites for Field Survey.	34
Table 4-2. Rainfall data points used to construct LMWL.	41
Table 5-1. Summary details and results of LWP assessment for each GDE assessment site for the November 2024 sampling event.	48
Table 5-2. The location, depth and target of shallow auger holes sampled during the IDE program.	52
Table 7-1. Descriptors and ranking for the likelihood of impact occurring.	90
Table 7-2. Descriptors of Impact Magnitude applied in the risk assessment.	90
Table 7-3. Matrix applied in the risk assessment.	90
Table 7-4. List of relevant mitigations and management actions.	90
Table 7-5. Risk assessment for potential impacts and residual risks scores.	91

Glossary

Alluvial aquifer	An aquifer comprising unconsolidated sediments deposited by flowing water usually occurring beneath or adjacent to the channel of a river.
Aquifer	A geological formation or structure that stores or transmits water to wells or springs. Aquifers typically supply economic volumes of groundwater
Aquatic GDE	Ecosystem supported by surface expression of groundwater (e.g. spring fed watercourses and associated fringing vegetation).
Base flow	Streamflow derived from groundwater seepage into a stream.
Capillary fringe	The unsaturated zone above the water table containing water in direct contact with the water table though at pressures that are less than atmospheric. Water is usually held by soil pores against gravity by capillary tension.
Confined aquifer	A layer of soil or rock below the land surface that is saturated with water with impermeable material above and below providing confining layers with the water in the aquifer.
Edaphic	Relating to properties of soil or substrate including its physical and chemical properties and controls those factors impose on living organisms.
Evapotranspiration	The movement of water from the landscape to the atmosphere including the sum of evaporation from the lands surface and transpiration from vegetation through stomata
Evaporative enrichment (of stable isotopes).	The heavier isotopologues of water (those H ₂ O molecules containing ² H and ¹⁸ O) have lower vapour pressures than the lightest isotopologue (¹ H ¹ H ¹⁶ O). Therefore the lighter isotopologues evaporate faster and isotopologues concentrate in the residue. The isotopic composition of the remaining water moves to the right and below from its origin on the LMWL or GMWL.
Facultative phreatophyte	A plant that occasionally or seasonally utilises groundwater to maintain high transpiration rates, usually when other water sources aren't available.
Fractured rock aquifer	An aquifer in which water flows through and is stored in fractures in the rock caused by folding and faulting.
Fluvial	Relating to processes produced by or found in rivers
Groundwater	Those areas in the sub-surface where all soil or rock interstitial porosity is saturated with water. Includes the saturated zone and the capillary fringe.
Water table	The upper surface of the saturated zone in the ground, where all the pore space is filled with water.
Groundwater dependent ecosystems (GDE)	Natural ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (Richardson et al. 2011)
Infiltration	Passage of water into the soil by forces of gravity and capillarity, dependent on the properties of the soil and moisture content.
Leaf water potential (LWP)	The total potential for water in a leaf, consisting of the balance between osmotic potential (exerted from solutes), turgor pressure (hydrostatic pressure) and matric potential (the pressure exerted by the walls of capillaries and colloids in the cell wall).
Leaf area index (LAI)	The ratio of total one-sided area of leaves on a plant divided by the area of the canopy when projected vertically on to the ground.
Local Meteoric Water Line (LMWL)	Describes the relationship between hydrogen and oxygen isotope (Oxygen-18 and Hydrogen-2 (Deuterium)) ratios in local natural meteoric waters. LMWL is usually developed from precipitation data collected from either a single location or a set of locations within a "localised" area of interest and results are reported as the amount-weighted average $\delta^2\text{H}/\delta^{18}\text{O}$ composition of water in rainfall. LMWL's define a constant relationship between $\delta^2\text{H}/\delta^{18}\text{O}$ in local rainfall, and deviations from this relationship are imparted by stable isotope fractionation causally linked

	to evaporative processes (evaporative enrichment). Further information can be obtained from Kendall and Caldwell (1998) and Crosbie et al (2012).
Obligate phreatophyte	A plant that is completely dependent on access to groundwater for survival
Osmotic potential	The lowering of free energy of water in a system due to the presence of solute particles.
Percolation	The downward movement of water through the soil due to gravity and hydraulic forces.
Perched groundwater system	A groundwater system or aquifer that sits above the regional aquifer due to a capture of infiltrating moisture on a discontinuous aquitard.
Permeability	A materials ability to allow a substance to pass through it, such as the ability of soil or rocks to conduct water under the influence of gravity and hydraulic forces.
Permanent wilting point	The water content of the soil at which a plant can no longer extract water and leaves will wilt and die. Usually -1.5 Mpa (-217 psi). Generally applied to crops although Australian flora typically have much larger stress thresholds.
Phreatic zone	The zone of sub-surface saturation separated from the unsaturated zone in unconfined aquifers by the water table.
Phreatophyte	Plants whose roots extend downward to the water table to obtain groundwater or water within the capillary fringe
Piston flow	The movement of a water front through the soil uniformly downwards to the aquifer, with the same velocity, negligible dispersion, pushing older water deeper into the soil profile.
Preferential flow	Movement of surface water rapidly from surface to aquifer along preferential flow paths, bypassing older moisture in the upper soil profile.
Stable isotope	A stable isotope is an isotope that does not undergo radioactive decay. Oxygen has three different isotopes: The ^{16}O is the most common stable isotope of oxygen and ^{18}O is present in the atmosphere in amounts that are measurable. ^{17}O is much less common and often not measured. The masses of ^{16}O and ^{18}O are different enough that these isotopes are separated (or fractionated) by the process of evaporation leading to enrichment of the heavier (^{18}O) isotope. Hydrogen has two naturally occurring stable isotopes being ^1H (protium) and ^2H (deuterium) which also fractionate during evaporation, although the higher energy state of hydrogen means that the ratio between ^1H and ^2H is much more sensitive to fractionation. As noted above, evaporated water typically moves to the right and below from its source on a water line plotted with oxygen on the abscissa. . Further information can be obtained from Kendall and Caldwell (1998) and Singer (2014).
Standard Wilting Point	The minimum LWP or corresponding soil moisture potential that can be tolerated before a crop plant wilts in response to negative water supply. This is accepted at -15 bars or -1.5 MPa (or -217.55 PSI)
Specific Yield	The ratio of the volume of water that a saturated rock or soil will yield by gravity to the total volume of the rock or soil.
Surface water	Movement of water above the earths' surface as runoff or in streams
Transpiration	The process of water loss from leaves, through stomata, to the atmosphere.
Terrestrial GDE	Terrestrial vegetation supported by sub-surface expression of groundwater (i.e. tree has roots in the capillary fringe of groundwater table).
Turgor Pressure	Turgor pressure is the force exerted by stored water in a leaf against a cell wall.
Unconfined aquifer	An aquifer whose upper surface is at atmospheric pressure, producing a water table, which can rise and fall in response to recharge by rainfall
Vadose zone	The unsaturated zone, above the water table in unconfined aquifers
Water Potential	The free energy potential of water as applied to soils, leaves plants and the atmosphere.
Wetting front	The boundary of soil wet by water from rainfall and dry soil as the water moves downward in the unsaturated zone.

1.0 Introduction

Stanmore ID Extension Pty Ltd (ID Extension), a wholly owned subsidiary of Stanmore Resources Ltd (Stanmore), proposes to develop the Isaac Downs Extension Project (the Project), an open-cut coal mine pit and associated infrastructure situated immediately south of the Isaac Downs Mine (IDM) approximately 150 km south-west of Mackay and 15 km south-east of Moranbah. **Figure 1-1** shows the location of the Project and the mining lease (ML) application areas comprising the Project area. The Project will form part of the Isaac Plains Complex (IPC) comprising IDM and Isaac Plains Mine (IPM) and will extend the life of mining operations of the IPC with coal mined from the Project replacing coal mined from IPM and IDM. The Project adjoins IDM and will be integrated into IPC with ROM coal washed at the IPM coal handling and preparation plant (CHPP), shared mine infrastructure area (MIA) at IDM, and connecting infrastructure such as water management infrastructure and power supply.

Mining of ROM coal at IDM is expected to ramp down between 2026 and 2028, with Project construction commencing late 2027 / early 2028 and ROM coal extraction in 2029. The IPC workforce will transition to IDE as mining ramps down at IDM and IPM and ramps up at IDE. The Project, being an extension of mining activities at IPC, is therefore important to ensure a near steady state workforce across IPC beyond 2027 and 2028.

1.1 Project Overview

The open cut mining methods for the Project will be like those at IDM, including:

- clearing of vegetation, stripping and stockpiling of topsoil
- drilling and blasting of pre-strip overburden
- removing the pre-strip overburden using mining equipment at IDM being a dragline and / or truck and shovel fleets and / or dozers
- drilling and blasting of overburden
- drilling and blasting of pit floor for geotechnical stability to allow for in-pit dumping
- overburden removal using the existing dragline at IDM and / or truck and shovel fleets
- coal mining using excavators
- formation of out of pit and in-pit overburden dumps as mining progresses
- progressive rehabilitation of overburden dump areas.

ROM coal will be transported from the Project's ROM coal pad to the CHPP at IPM for washing, utilising existing haul roads at IPC and new haul roads, including a bridge across the Isaac River, constructed in the Project area. The dragline will be walked from IDM to the Project via a temporary crossing of the Isaac River. The primary access to the Project for workers and deliveries will be via IDM's existing access road and new internal roads connecting with the Project, utilising the bridge to be constructed across the Isaac River.

During operations, levees will be constructed to protect the open cut pit area from flooding of the Isaac River, Cherwell Creek and Conrock Gully up to a 0.1% annual exceedance probability (AEP) (1:1,000 year) flood event. Conrock Gully will be diverted around the active mining areas into the Isaac River, with the diversion remaining post mining. The residual void remaining post mine life will not be located within the extent of 0.1% AEP flood event.

A mine affected water dam will store water from the pit, ROM pads, go line and crib area, with the ability to transfer mine affected water to and from IDM and IPM within IPC's integrated water management system, thereby enabling the balancing of water supply and demand. Sediment water drains and dams will be constructed to capture runoff from overburden dumps. Clean water drains and dams will be constructed to separate clean water from mine affected water and sediment water.

Topsoil stockpile areas will be used for storage of topsoil that has been stripped from mining and infrastructure areas, for future use in rehabilitation. Power for the dragline will be supplied to the Project via powerline connections with existing power supply at IDM.

The proposed Project layout, four mining lease application (MLA) areas and proposed disturbance area are shown in

Figure 1-2 The proposed disturbance allows for working and construction areas within and around proposed Project activities and infrastructure. The area of the four MLAs is 2,707 hectares (ha) and the proposed disturbance area is 2,083 ha, inclusive of 2.5 ha of disturbance on IDM ML 700046.

1.2 Project Objectives

Coal resource developments have the potential to alter natural groundwater regimes and impact groundwater quality (IESC, 2018). Therefore, an assessment of the potential for groundwater dependent ecosystems (GDEs) to occur, and if they occur, the Project's potential impacts on ecosystems reliant on groundwater resources must be addressed. Potential GDEs are currently mapped within the Project area and surrounds (GDE Atlas, BOM 2024), necessitating a requirement for field assessment to confirm the presence and eco-hydrological function of GDEs, which may include:

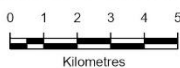
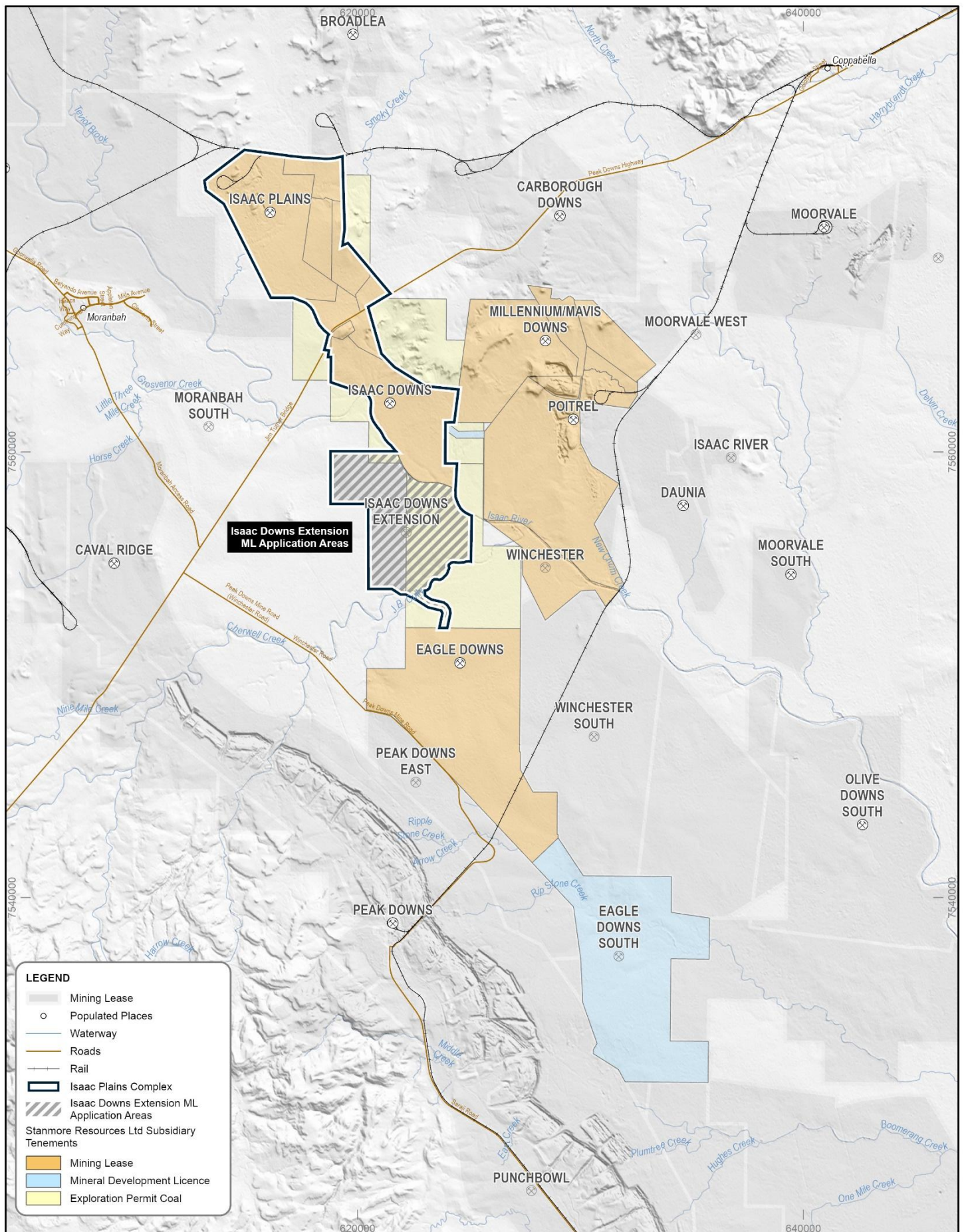
- Terrestrial GDEs that are reliant on the groundwater's sub-surface expression (into the tree-rooting zone).
- Aquatic GDEs that are dependent on the groundwater surface expression (springs and baseflow).

Figure 1-3 shows the existing government mapping of potential terrestrial and aquatic GDEs (BOM 2025). The mapping shows 'High-Potential' terrestrial GDEs are associated with the major watercourses of the Isaac River and Cherwell Creek, while 'Low-Potential' Terrestrial GDEs are more broadly related to elevated older alluvial and Tertiary rises. 'High-Potential' Aquatic GDEs are although associated with the major drainage features.

The objective of this study is to provide a detailed field-based investigation to assess the presence and nature of GDEs within and surrounding the Project area, which may be subject to an impact due to groundwater changes (e.g. drawdown) resulting from mining activities. Completion of the detailed assessment was through:

- General field traverse of mapped terrestrial GDE areas to identify any areas of groundwater seepage and assist in targeting field-based assessment sites.
- Biophysical assessments to characterise the physical interactions of potentially groundwater dependent trees with their edaphic controls.
- Stable isotope investigations to identify the source, or sources of moisture utilised by areas currently mapped as GDEs.

These field investigations aim to determine the presence, extent and ecohydrological function of GDEs within and surrounding the Project area, to allow a robust assessment of the impact of the Project to groundwater dependent assets.



Datum: GDA2020 Zone 55
 Scale: See Scale Bar
 Date: 25/02/2026 3:34 PM
 Drawn: Minserve
 Source: Minserve/Stanmore
 File: 20260223 Project Location.aprx

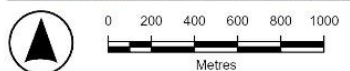
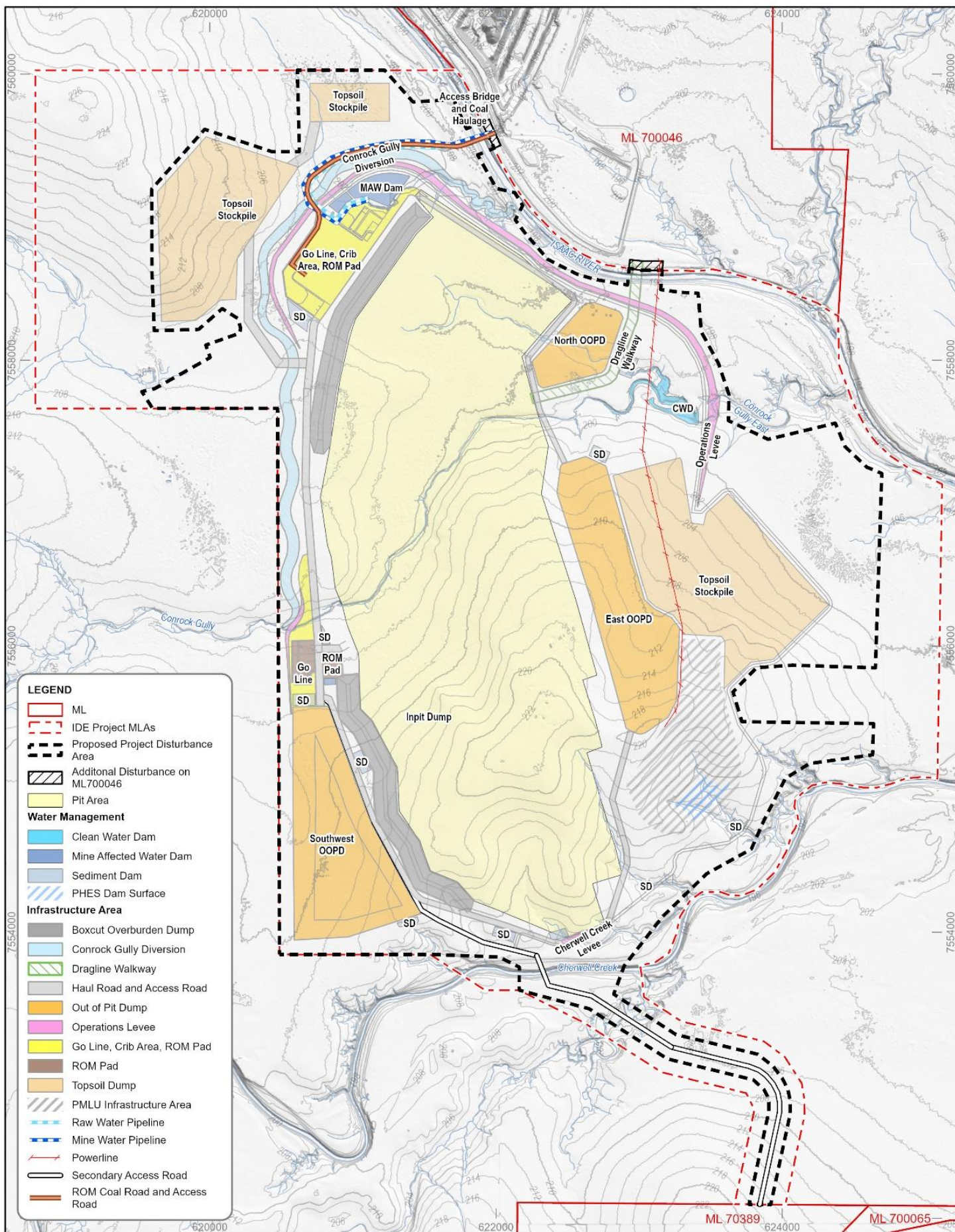
DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.



ISAAC DOWNS EXTENSION

Project Location

Figure | 1-1



Datum: GDA2020 Zone 55
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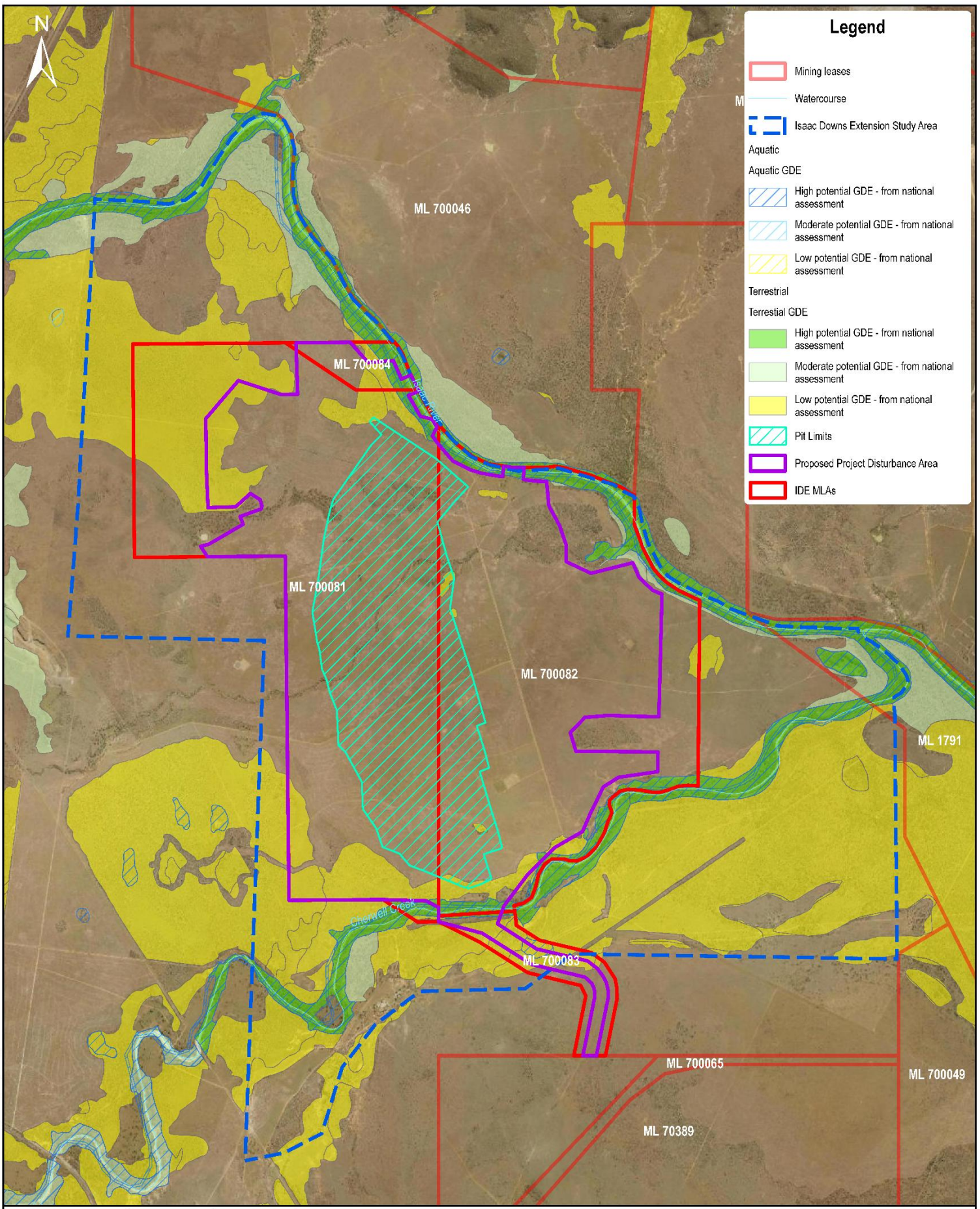
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ISAAC DOWNS EXTENSION

Project Layout and Disturbance Area

Path Name: F:\Water_Mark_Ecology\Isaac Downs Extension\Isaac Downs Extension March26



Legend

Mining leases

Watercourse

Isaac Downs Extension Study Area

Aquatic

Aquatic GDE

High potential GDE - from national assessment

Moderate potential GDE - from national assessment

Low potential GDE - from national assessment

Terrestrial

Terrestrial GDE

High potential GDE - from national assessment

Moderate potential GDE - from national assessment

Low potential GDE - from national assessment

Pit Limits

Proposed Project Disturbance Area

IDE MLAs

Scale: 1:59,256 @A4

0 1 2 K

Coordinate System: GDA 2020 MGA Zone 55

A4

Source: BOM GDE Atlas (2025).

Figure 1-3. Terrestrial and aquatic GDE mapping from the GDE Atlas (BOM 2025)

WATER MARK ECO

Kenmore, Qld 4069

Mobile: 0447 822 119

watermarkeco.com.au

Client : Stanmore IP South Pty Ltd

Project: Isaac Downs Extension

Drawn By D.G. Checked D.S. Date: 8/04/2026

1.3 GDE Definition Used for Assessment

The definition of a GDE applied to this assessment is consistent with the definition provided in the guidance document 'Modelling water-related ecological responses to coal seam gas extraction and coal mining' prepared by Commonwealth of Australia (2015) on the advice from the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) being: **Groundwater dependent ecosystems (GDEs)**: Natural ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (Richardson et al. 2011). The broad types of GDE are (from Eamus et al. 2006a and 2006b):

- Ecosystems dependent on surface expression of groundwater (springs).
- Ecosystems dependent on subsurface presence of groundwater (terrestrial GDEs).
- Subterranean ecosystems (caves).

Eamus (2006a) defines groundwater (when related to GDEs) as;

'all water in the saturated sub-surface; water that flows or seeps downwards and saturates soil or rock, supplying springs and wells, water stored underground in rock crevices and in the pores of material'.

For this GDE Assessment, the term groundwater refers to those areas in the sub-surface where all soil or rock interstitial porosity is saturated with water. It is assumed that in the overlying unsaturated zone, water may be present in varying amounts over time although saturation is rarely reached during infiltration or percolation of rainfall, stream water or other surface sources of groundwater recharge under gravity. Groundwater excludes water within wetting fronts, being the boundary between soil that is wet through the downward percolation of rainfall, or leakage from stream, lake or other surface sources of water and the dryer soil/rock in the unsaturated zone through which it is passing.

2.0 Survey Timing, Rainfall and Climate

The primary field survey occurred between the 4th and 8th November 2024, with supplementary sampling efforts completed in August, September, and November 2025. Long-term rainfall records from Moranbah Airport (BOM, 2025) (**Figure 2-1**) show above-average rainfall in 2021 and 2022, with 665 mm and 773.2 mm recorded, respectively, compared to the long-term average of 567.1 mm. Compared with 2023, 2024 was dry, with 541.4 mm recorded. The 10 months (January to October 2024) leading up to the November 2024 assessment were slightly above average, with 448 mm reported, compared to the long-term average of 416.6 mm for those months. Before the November 2024 assessment, the only significant rainfall was 33 mm between August 11th and 13th and 49.8 mm between October 9th and 15th, two weeks before the assessment, with the three months preceding the field assessment otherwise dry (**Figure 2-2**). Substantial rain was recorded over the 10 months leading up to the November 2025 assessment event, totalling 691 mm by the end of October 2025, with 594.6mm in January to April, three months before supplementary sampling in August and September 2025.

The integration of rainfall data with Morton's Potential Evapotranspiration (MPE) (Morton, 1983) indicates prevailing climatic conditions before each assessment event. **Figure 2-3**

shows that MPE peaked in November 2024, coincident with the primary field assessment, and then experienced a significant trough between February and July 2025, before increasing through November 2025. The period from June to November 2024 reported minimal rainfall, coinciding with extremely high MPE, resulting in intense soil moisture deficits at the soil surface and significant stress for any trees that rely solely on soil moisture for transpiration.

The MPE peak in November 2025 was not as high as in November 2024, and the final supplementary assessment in November 2025 occurred under substantially wetter climatic conditions than in 2024, buffered by large rainfall volumes in the first quarter of 2025. However, between 1st November 2024 and 30th November 2025, MPE was approximately four times the rainfall volume (2652 mm compared to 940 mm) and 122% of pan evaporation (2178 mm), indicating that vegetation development in the region is strongly rainfall limited.

The region has experienced several significant drought events, which are likely to have affected both surface flows and groundwater recharge, as well as having cyclical impacts on vegetation vigour. **Figure 2-4** illustrates the primary climatic cycles in terms of Cumulative Rainfall Departure (CRD) (Weber & Stewart, 2004), representing the cumulative departure of monthly rainfall from the long-term mean monthly rainfall between January 2010 and November 2025 (SILO, 2025). Strongly decreasing rainfall trends occurred between January 2013 and 2016, July 2017 and April 2021, and between January 2023 and November 2024. Rainfall volumes increased from December 2024 to May 2025, followed by a short-lived drying trend, before increasing through to November 2025. The analysis of CRD is relevant to this assessment, as shallow, unconfined groundwater tables generally follow similar trends: rising water tables and increased occupation of surface waters coincide with increasing trends in the CRD curve.

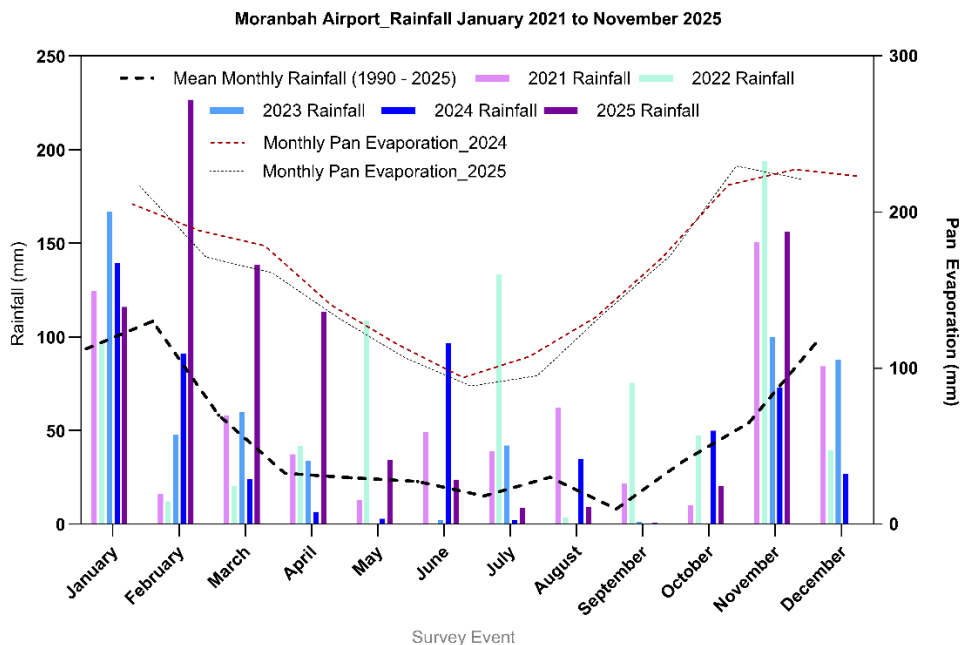


Figure 2-1. Rainfall for the period from January 2021 to November 2025 for Moranbah Airport (Station 34035; -22.06° / 148.08°) showing extremely limited rainfall between September and October 2024, in the months prior to the primary field assessment.

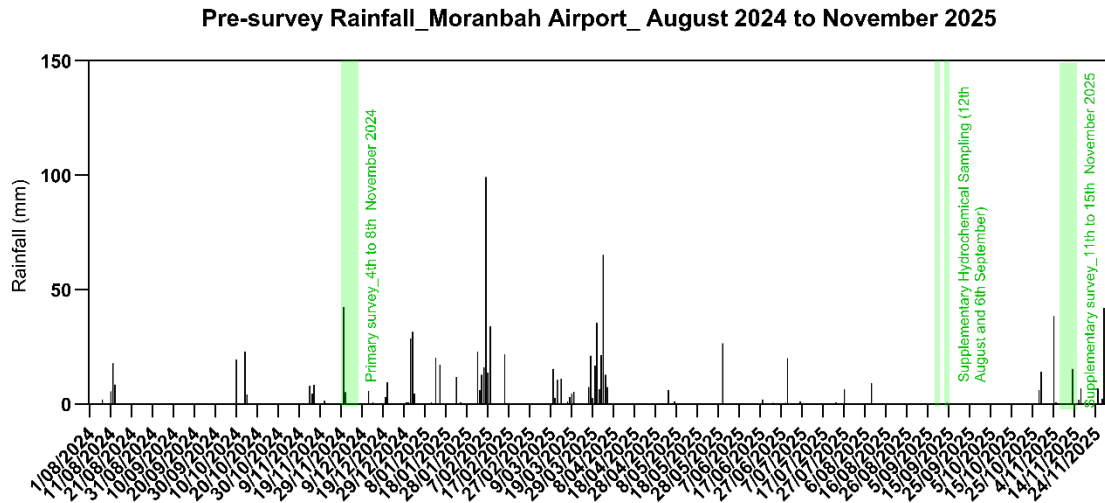


Figure 2-2. Daily rainfall before each assessment event, showing dry conditions before the November 2024 assessment, and also before August and September 2025 sampling events.

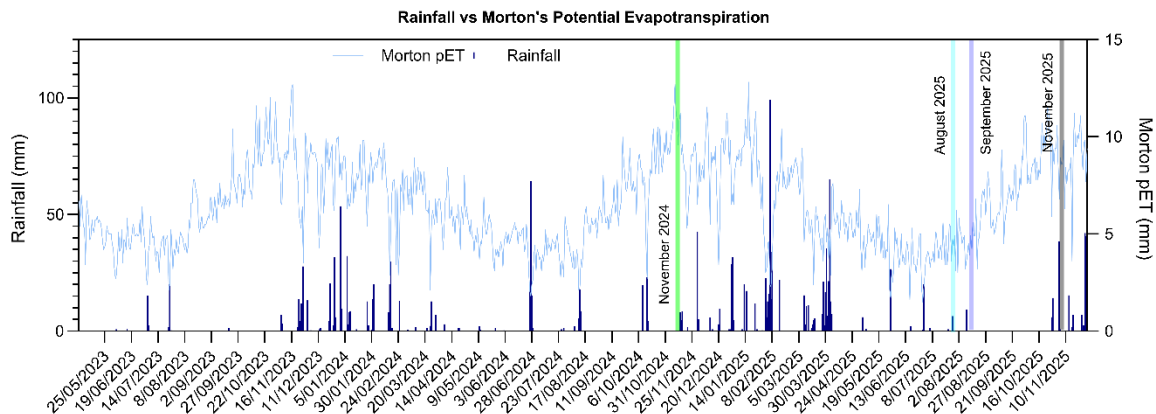


Figure 2-3. Morton's Potential Evapotranspiration compared to rainfall for May 2023 to November 2025 (from SILO 2025).

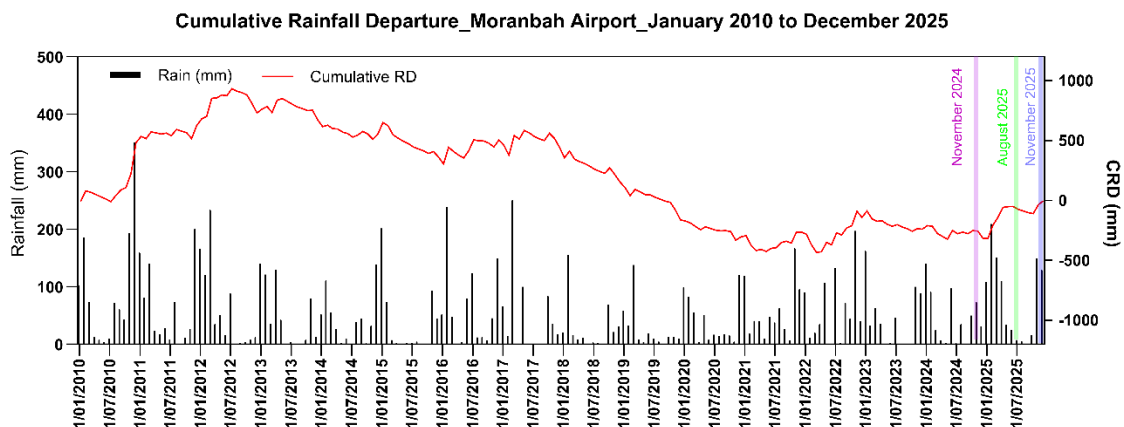


Figure 2-4. Cumulative Rainfall Departure demonstrating major and minor rainfall fluctuations with declining rainfall volumes leading to the November 2024 assessment, after which rainfall volume increased.

3.0 Ecological / Hydrogeological Setting

As GDEs define a continuum between groundwater and surface ecology, this section provides a description of both biotic factors and abiotic controls, enabling linkages to be drawn to assist in the assessment of risks to GDE function.

3.1 Ecological Characteristics of GDE Species and Communities

3.1.1 Regional Ecosystems and Mapped GDEs

Figure 3-1 provides regional ecosystem (RE) mapping (Trend Environmental 2025) for the Project area and surrounds. The mapping defines a broad number of REs, typically dominated by eucalypt woodland and open forest habitats. Dominant REs associated with the floodplain of the Isaac River include:

- RE11.3.1: Brigalow (*Acacia harpophylla*) dominant woodland and open forest on alluvial plains.
- RE11.3.2: Woodland on alluvial landforms dominated by poplar box (*Eucalyptus populnea*).
- RE11.3.3: Coolabah (*Eucalyptus coolabah*) woodland on alluvial plains.
- RE11.3.4: *Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains
- RE11.3.7: Woodland on alluvial landforms dominated by Clarkson's bloodwood (*Corymbia clarksoniana*) and Moreton Bay ash (*Corymbia tessellaris*).
- RE11.3.25: Riparian open forest dominated by forest red gum (*Eucalyptus tereticornis*), river red gum (*Eucalyptus camaldulensis*), and river oak (*Casuarina cunninghamiana*).
- RE11.3.27b: Palustrine wetland ecosystem dominated by forest red gum and/or river red gum
- RE11.4.8: *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains
- RE11.4.9: Brigalow (*Acacia harpophylla*) dominant shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains.
- RE11.4.13: Mountain coolabah (*Eucalyptus orgadophila*) open woodland on Cainozoic clay plains.
- RE11.5.3/11.5.3b: Poplar box (*Eucalyptus populnea*), sometimes with silver-leaf ironbark (*Eucalyptus melanophloia*) and Clarkson's bloodwood (*Corymbia clarksoniana*) woodland on Cainozoic sand plains and/or remnant surfaces.
- RE11.5.9: *Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains and/or remnant surfaces
- RE11.5.12: *Corymbia clarksoniana* woodland and other *Corymbia* spp. and *Eucalyptus* spp. on Cainozoic sand plains and/or remnant surfaces.
- RE11.8.5: *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks
- RE11.8.11: *Dichanthium sericeum* grassland on Cainozoic igneous rocks.
- RE11.8.13: Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks

Brigalow dominant woodlands, which include REs 11.4.9 and 11.3.1, are listed as 'Endangered' Threatened Ecological Communities (TECs) where they meet relevant criteria under the federal Environmental Protection and Biodiversity Conservation Act (EPBC Act). Poplar box woodland on alluvium (RE11.3.2) is also listed as a TEC where vegetation

condition thresholds are satisfied. Mapping from the GDE Atlas (BOM 2024) shown in **Figure 1-3** characterises riparian vegetation (RE11.3.25) associated with the Isaac River and Cherwell Creek as a 'high potential' terrestrial and GDE, in conjunction with a mapped wetland (RE11.3.27b) near the confluence of the two watercourses.

The following section (**Section 3.1.2**) characterises the ecohydrological function of the major canopy species that form REs within and surrounding the Project area. The purpose of characterisation is to identify those species most likely to exhibit groundwater dependence, allowing a thorough assessment of the risks to ecohydrological function to both habitats and species. Native grassland communities (i.e., RE11.8.11) are not considered further in this assessment as the shallow root system of native grasses precludes any likelihood of groundwater dependence.

3.1.2 Groundwater Dependent Species

The following section provides an overview of the ecohydrological characteristics of the major tree species associated with REs occurring within the Project area, which were the focus of sampling during the field assessment of their representation as potential GDEs in the GDE Atlas (BOM, 2024). Species sampled in the survey include the four eucalypts: river red gum (*Eucalyptus camaldulensis*), forest red gum (*Eucalyptus tereticornis*), poplar box (*Eucalyptus populnea*), coolabah (*Eucalyptus coolabah*), plus *Melaleuca fluviatilis* associated exclusively with RE11.3.25. The sampling of river and forest red gum occurred in all habitats that fringed watercourses (RE11.3.25) and wetlands (RE11.3.27b), while poplar box formed more laterally extensive habitats on elevated terraces. Brigalow and coolabah generally formed discrete patches, often mixing on the fringes of ephemeral watercourses.

Eucalyptus Species

River and Forest Red Gum: River red gum is a well-studied species known to have deep sinker roots, hypothesised to grow down towards zones of higher water supply (Bren et al., 1986), and the species mixes with forest red gum along the river frontage. The physiological attributes of river and forest red gum are assumed to be similar in this assessment, as the species can inhabit and mix within a similar ecological niche. However, Forest red gum is a more adaptable species, occupying dry hill slopes in some localities, and likely to be more tolerant of changes to the hydrological regime than *Eucalyptus camaldulensis*, a riparian specialist. Malik and Sharma (2004) found that *Eucalyptus tereticornis* also can extract moisture from the shallow soil profile (0 – 150cm). Therefore, attributing forest red gum with the ecological characteristics of the more specialised river red gum is prudent from a risk management perspective, because it adopts the attributes of the species with the highest sensitivity.

River red gum adapts to arid and semi-arid environments. Depending on water availability, it will go through alternate phases of shedding and regaining its crown. It is adapted to do so and over time and across the flood frequency classes, having the capacity to self-regulate and adjust its transpiration rates to match the average flood return interval (Collof 2014) while the species maintain a strong capacity for genetic selection to increase capacity for the species to survive drought stress. Trees less able to survive drought tend to die off. Hence, the genes associated with drought tolerance traits become more common in the remaining population.

The species is considered opportunistic in its water use, sourcing water according to osmotic and matric water potential and source reliability (Thorburn et al. 1994; Mensforth et al. 1994; Holland et al. 2006; Doody et al. 2009) with the water requirements obtained from three primary sources being groundwater, rainfall, and river flooding. Flooding enables the species to survive in semi-arid areas (ANBG 2004), where stands are intimately associated with the surface-flooding regime of watercourses and related groundwater flow. River red gum shifts its water usage between surface soil moisture and groundwater during high rainfall, shifting to exclusive groundwater use during drier periods. They will likely achieve this shift by inactivating surface roots during drier periods with increased reliance on deeper tap roots when surface water is unavailable. River red gum will often use saline groundwater in preference to fresh surface water, probably because it represents a more reliable supply (Colloff 2014). Doody et al. (2015) demonstrated that soil moisture alone can sustain *Eucalyptus camaldulensis*'s health through drought for up to six years before noting a significant decline in tree health.

The maximum potential rooting depth of river red gum is subject to considerable conjecture in current literature. However, the species has the capacity to access deep groundwater sources (Eamus et al., 2006a). Horner et al. (2009) found rooting depths at 12–15 mbgl based on observed mortality in plantation river red gum forests on the Murray River Floodplain. From excavations in 20-year-old plantation forests of *Eucalyptus tereticornis*, Kallarackal and Somen (1998) found that roots were traceable to depths of 9.3 mbgl and Jones et al. (2020) found maximum rooting depths of 8.1 mbgl in river red gum in a broad study area in the Great Artesian Basin. In conclusion, the maximum rooting depth of red gum is likely to be variable, dependent on on-site geology and depth to saturation, with the capillary fringe being the general depth for root penetration arrest (Eamus et al., 2006b).

Poplar box: All eucalyptus species are potential groundwater users (Cook and O'Grady, 2007) although few studies demonstrate this dependence. Fensham and Fairfax (2007) consider poplar box to possess a shallow rooting system with limited investment in deep root architecture, rendering them susceptible to droughting. Poplar box is typically associated with elevated upper river terraces with substantial depth to the underlying alluvial groundwater table. In contrast, Kath et al. (2014) hypothesise that poplar box can have a rooting depth range between 12.6 to 26.7 mbgl on the Condamine River alluvium in southern Queensland. However, the basis for this assessment is a statistical analysis of stand condition and known groundwater decline rather than the direct physical observation of Fensham and Fairfax (2007).

Coolabah: *Eucalyptus coolabah* favours sites with heavier clay soils, typically close to drainage lines and requires flooding for regeneration (Roberts 1993). There are few studies that attempt to detail the moisture sources and usage strategies of *Eucalyptus coolabah*. Costelloe et al. (2008) suggest that coolabah avoids using saline groundwater via the following mechanisms:

- Growing at sites that maximise the frequency of soil moisture replenishment (i.e. on drainage lines and overflow channels).
- Having extremely low transpiration rates.
- Strong capacity to extract moisture from soils with extremely low osmotic / matric potentials.

Costelloe et al. (2008) concluded that coolabah avoided using hypersaline groundwater (71 000 mg/L[Cl] or 70 290 $\mu\text{S}/\text{cm}$), instead favouring the use of low salinity soil moisture in the vadose zone above the groundwater table. Coolabah can however continue to extract moisture at Cl concentrations up to 30 000 mg/L ($\sim 27\,800\,\mu\text{S}/\text{cm}$) in soils where matric potential in the upper soil profile is extremely low due to a combination of extreme drying coupled with a clayey substrate.

The heavy clay soils that support the coolabah dominant communities (RE11.3.3) place a physical limitation on tree root penetration. Clay substrates are an unsuitable medium for development of a deep tap root system that would be necessary to penetrate to the groundwater table (Dupuy et al., 2005) and soils with low hydraulic conductivities, such as clays, greatly limit the ability of trees to utilise groundwater (Feikema et al., 2010). Hence it is not expected that coolabah would have the same capacity to develop deeper tap roots, and maximum rooting depth would most likely considerably less than 10 m.

Mountain coolibah (*Eucalyptus orgadophila*): There is no information in literature on moisture sources and requirements for mountain coolibah. The species occurrence on heavy clay soils, typically associated with weathered basalt plains (RE11.8.4/11.8.5) suggest limited capacity for development of deep sinker roots, and with reliance on moisture retained in clay soils in the shallow soil profile.

Dawson gum (*Eucalyptus cambageana*): There is limited information in literature on moisture sources and requirements for Dawson gum. However, the species occurrence mixed with brigalow ecosystems suggests an association with heavy clay substrates which limits deeper taproot penetration and capacity to utilise deeper moisture / groundwater sources.

Clarkson's bloodwood: Studies of tropical floodplain vegetation (O'Grady et al., 2006) suggest that Clarkson's bloodwood (*Corymbia clarksoniana*) utilised groundwater when the water table was at 10 mbgl indicating the potential for the species to develop a deep sinker root. Clarkson's bloodwood should be considered a facultative phreatophyte. It is likely that Clarkson's bloodwood occurring on the inner banks of the Isaac River will utilise groundwater if it is within reach of rooting depth and not saline.

Moreton Bay ash: Moreton Bay ash (*Corymbia tessellaris*) demonstrate groundwater usage when the water table was at 4 mbgl (O'Grady et al., 2006), although it is not known whether the species has capacity to utilise deeper groundwater sources. Moreton Bay ash should be considered a facultative phreatophyte.

Ironbark species: Fensham and Fairfax (2007) describe ironbark species, including narrow-leaf ironbark (*Eucalyptus crebra*) and silver-leaf ironbark (*Eucalyptus melanophloia*) to possess a shallow rooting system. Both ironbark species generally occupy more elevated portions of the landscape, away from drainage lines where depth to groundwater would be greatest.

Acacia Species

Brigalow (*Acacia harpophylla*) habitats and individual trees regularly occur adjacent to the floodplain of the major drainage systems and generally occupy heavy clay soils (vertosols) with well-developed gilgai microtopography in the upper soil profile (0.6 m to surface) where the bulk of nutrient recycling occurs. The subsoil components are however typically strongly cohesive clays with high levels of salinity, sodicity, acidity and phytotoxic concentrations of chloride which may reduce the effective rooting depth in these soils (Dang et al., 2012). Johnson et al., (2016) describe brigalow as ‘a clonal species with stems arising from horizontal roots which draw resources from a substantial area around the plant’. The concentration of the brigalow root mass in the upper soil profile enables the species to resprout profusely from horizontal roots after physical disturbance and limits the capacity for other woody species to compete for moisture and nutrients. Brigalow’s shallow rooting habit is evident with the tendency of mature trees to topple because of churning in the upper soil profile with fallen trees universally exposing a well-developed lateral root system with little evidence for development of deeper sinker roots that would have capacity to propagate to deeper groundwater tables. Brigalow is not considered to represent groundwater dependent vegetation.

Melaleuca Species

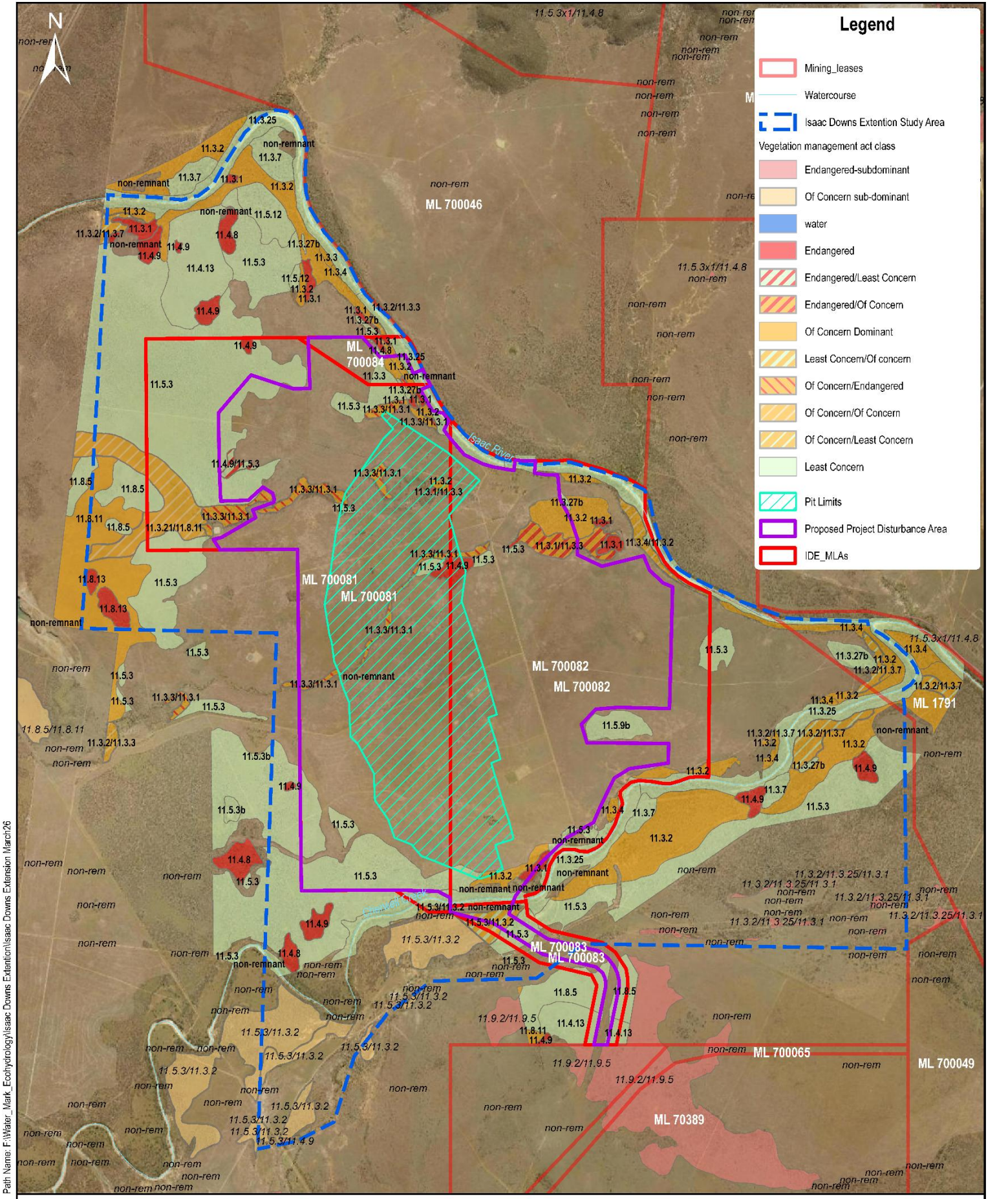
There is limited information on the water use strategies of the larger paperbark species in the literature. Two studies (O’Grady et al, 2006; O’Grady et al, 2005) indicate *Melaleuca argentea* and *Melaleuca leucadendra* directly utilise surface water, although their capacity to utilise water from deeper aquifers when surface water is not available is unknown. Based on observations of matted tree roots concentrated in wet sands within river channel deposits, it is expected that weeping tea-tree will utilise mostly surface water, with the capacity to utilise residual moisture in river channel deposits as surface water recedes. There is no evidence for the development of deeper sinker roots in weeping tea tree with significant investment in spreading lateral roots adapted to utilising shallow moisture sources.

River Oak

The water use strategy of river oak (*Casuarina cunninghamiana*) appears dependent on its position relative to a watercourse. O’Grady et al (2006b) determined river oak mainly utilised river water when adjacent to a stream channel, which is its most common topographic position. There has been no demonstration that river oak has capacity to utilise deeper groundwater sources.

3.1.3 Other Ecological Values

As per **Figure 3-2**, the large wetland at the confluence of Isaac River and Cherwell Creek, to the west of the Isaac River channel, is identified as a ‘wetland of high ecological significance (HES)’ under the *Environmental Protection Regulation 2008*, providing the most significant wetland representation in the local area.



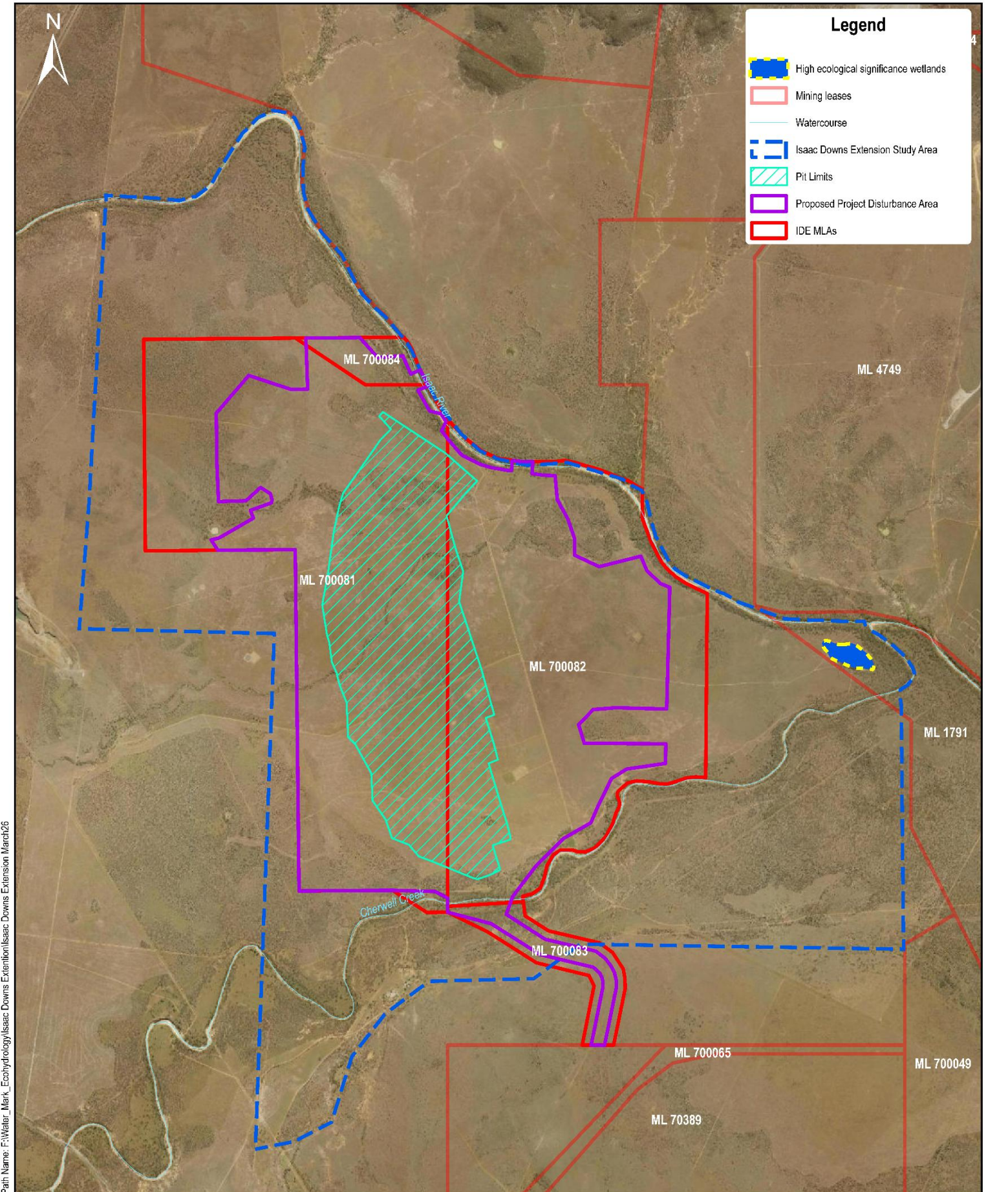
Legend

- Mining_Leases
- Watercourse
- Isaac Downs Extension Study Area
- Vegetation management act class
 - Endangered-subdominant
 - Of Concern sub-dominant
 - water
 - Endangered
 - Endangered/Least Concern
 - Endangered/Of Concern
 - Of Concern Dominant
 - Least Concern/Of concern
 - Of Concern/Endangered
 - Of Concern/Of Concern
 - Of Concern/Least Concern
 - Least Concern
- Pit Limits
- Proposed Project Disturbance Area
- IDE_MLAs

Path Name: F:\Water_Mark_Ecology\Isaac Downs Extension\Isaac Downs Extension March 26

Scale: 1:59,256 @A4 0 1 2 K Coordinate System: GDA 2020 MGA Zone 55 A4

Source: Vegetation Management Regional Ecosystems Version 13.0 (DNRM 2025) and Trend Environmental.	Figure 3-1. Regional ecosystem mapping for the Isaac Downs Extension Project area and surrounds from Trend Environmental.	WATER MARK ECO Kenmore, Qld 4069 Mobile: 0447 822 119 watermarkeco.com.au
Client : Stanmore IP South Pty Ltd Project: Isaac Downs Extension		Drawn By D.G. Checked D.S. Date: 31/03/2026



Path Name: F:\Water_Mark_Ecology\Isaac Downs Extension\Isaac Downs Extension March26

Scale: 1:59,256 @A4 0 1 2 K

Coordinate System: GDA 2020 MGA Zone 55 A4

Source: Matters of State Environmental Significance
- High Ecological Significance Wetland (DES 2020)

Figure 3-2. HES Wetlands in the vicinity of the Project area.



Kenmore, Qld 4069
Mobile: 0447 822 119
watermarkeco.com.au

Client : Stanmore IP South Pty Ltd Project: Isaac Downs Extension

Drawn By D.G. Checked D.S. Date: 8/04/2026

3.2 Hydrogeological Setting

A detailed description of the site geology and hydrogeological setting is included in the Isaac Downs Groundwater Impact Assessment Baseline Report (SLR 2026a).

3.2.1 Surface Geology and Significance for Groundwater Resources

The Project area lies within the northern portion of the Bowen Basin, where coal resource activities focus on late Permian-aged Blackwater Group. The Rangal Coal measures are the shallowest / youngest Permian strata in the Project area and host the economic coal seams. The most substantial groundwater units occur within Cenozoic sediments, including the Isaac River alluvium, and regolith; Triassic-aged terrestrial sedimentary rocks of the Rewan Group, and the Permian coal seams. The alluvial sediments are localised along major rivers and attenuate upstream along minor tributary watercourses and form the focus of those areas mapped as 'high potential' terrestrial and aquatic GDEs (as per **Section 3.1.1**). Surface geology, as compiled within the Queensland Geology Detailed Surface Mapping (Department of Natural Resources, Mines and Energy [DNRME] 2018) is provided in **Figure 3-3**, although the mapping of alluvium has been refined in SLR (2026a).

Isaac River Alluvium: The Isaac River is deeply incised drainage system and comprises a broad, sandy channel that has meandered across its flood plain over time. During flood plain development, variable flow regimes have influenced the deposition of fluvial sediments with coarser sediments deposited in higher energy situations and finer sands and silts deposited at greatest distance from the active flood channel. The channel is typically formed by thick, fluvial sand deposits which host a seasonally sustained unconfined groundwater table. Recharge to the alluvium is mostly from stream flow or flooding (i.e. a losing stream), with direct infiltration of rainfall also occurring where there are no substantial clay barriers in the shallow subsurface. Drill logs across the Project Area and surrounds indicate that alluvial sequences are composed of interbedded clay, silt, sand, and gravel layers that reflect fluvial depositional processes. Coarse sands and gravels are present near active surface drainage channels, particularly adjacent to the Isaac River, where alluvium thicknesses of 15 to 20 m have been recorded and alluvium thins toward floodplain margins, where finer grained sediments such as clay and silt become more prevalent. Several paleochannels have been identified within the Isaac River alluvium, marked by coarser sand facies, which accounts for some variation in alluvial thickness.

Alluvium along Cherwell Creek is closely aligned with the modern creek channel, compared to the broader extent of alluvium associated with the Isaac River. Groundwater within the alluvium forms an unconfined aquifer (referred to as the 'alluvial aquifer'), which is sporadically saturated and generally localised to the major ephemeral drainage line channels of the Isaac River and Cherwell Creek.

Regolith: The surficial material covering much of the broader Project area comprises Cainozoic (Quaternary to Tertiary) aged sediments, including alluvium, colluvium, and semi-consolidated undifferentiated sediments which have been referred to collectively as regolith. The Regolith also includes older alluvial (TQa) sediments that are distributed extensively across the Project area and region. Based on Project geological logs, the regolith comprises a heterogeneous distribution of fine to coarse grained sand, clay, sandstone and claystone.

Regolith deposits over the Project area comprise colluvium, residual deposits (Qr) and weathered Permian units which are an unconfined unit with variable but limited saturation within and surrounding the Project Area (SLR 2026a).

Rewan Group: The Rewan Group represents consolidated Triassic sedimentary strata which unconformably overly the Permian coal measures and is extensive over eastern and northern parts of the Project area, outcropping and sub-cropping in several places. Where intersected within the Project Area, the unit is generally comprised of a well consolidated pink-brown sandstone (SLR 2026a). While the Rewan Group is considered a regional scale aquitard, saturated zones of increased hydraulic conductivity exist, particularly within the upper weathered zone

Permian Coal Measures: Coal seams form the principal water-bearing strata within the Permian sediments, where groundwater storage and movement is associated with secondary porosity features such as cracks and fissures.

3.2.2 Groundwater Monitoring Network

A total of 35 bores form the Project's baseline groundwater monitoring network which includes:

- Sixteen pre-existing and functional monitoring bores,
- Four pre-existing but non-functional monitoring bores that were successfully rehabilitated and made functional in 2025,
- Fifteen new monitoring bores drilled in 2025

Of these monitoring bores, seven monitor groundwater levels in the alluvium (associated with either Isaac River or Cherwell Creek), nine target the regolith, and 17 monitor groundwater levels in the Permian Coal Measures. Monitoring bores installed in the coal measures include ten bores installed in the Leichardt Seam, five in the Vermont Seam, two in the Fort Cooper Coal Measures and a single bore installed in the Isaac Thrust Fault.

Figure 3-4 shows the location of groundwater monitoring bores.

3.2.3 Groundwater Levels and Quality

Table 3-1 documents a selection of the groundwater monitoring network with available data on standing water level (SWL) and water quality. In summary:

- SWLs levels in the alluvial bores typically range from 9 to 13 mbgl and three alluvial bores reported as dry. Electrical conductivity (EC) values in bores close to the Isaac River are typically < 3000 microsiemens per centimeter ($\mu\text{S}/\text{cm}$), although some bores have high values, such as MBIS20 on Conrock Gully with EC 29300 $\mu\text{S}/\text{cm}$.
- SWLs in the Permian Coal Measures are generally deeper, and groundwater is more saline (up to 29664 $\mu\text{S}/\text{cm}$ in bore MBIS15) than in the alluvium. SWLs for alluvial and coal seam bores however overlap in some cases, and some values are fresh including groundwater sampled in monitoring bore RN182851, which reported an EC of 3492 $\mu\text{S}/\text{cm}$.

The Groundwater Baseline Assessment (SLR 2026a) identifies additional bores in the local area, associated with other mining operations (e.g., Poitrel, Winchester South), which have been used for general groundwater resource characterisation and to inform groundwater modelling. Due to the distance from IDE and less comprehensive nature of the monitoring data, information from these bores has not specifically been utilised in this assessment.

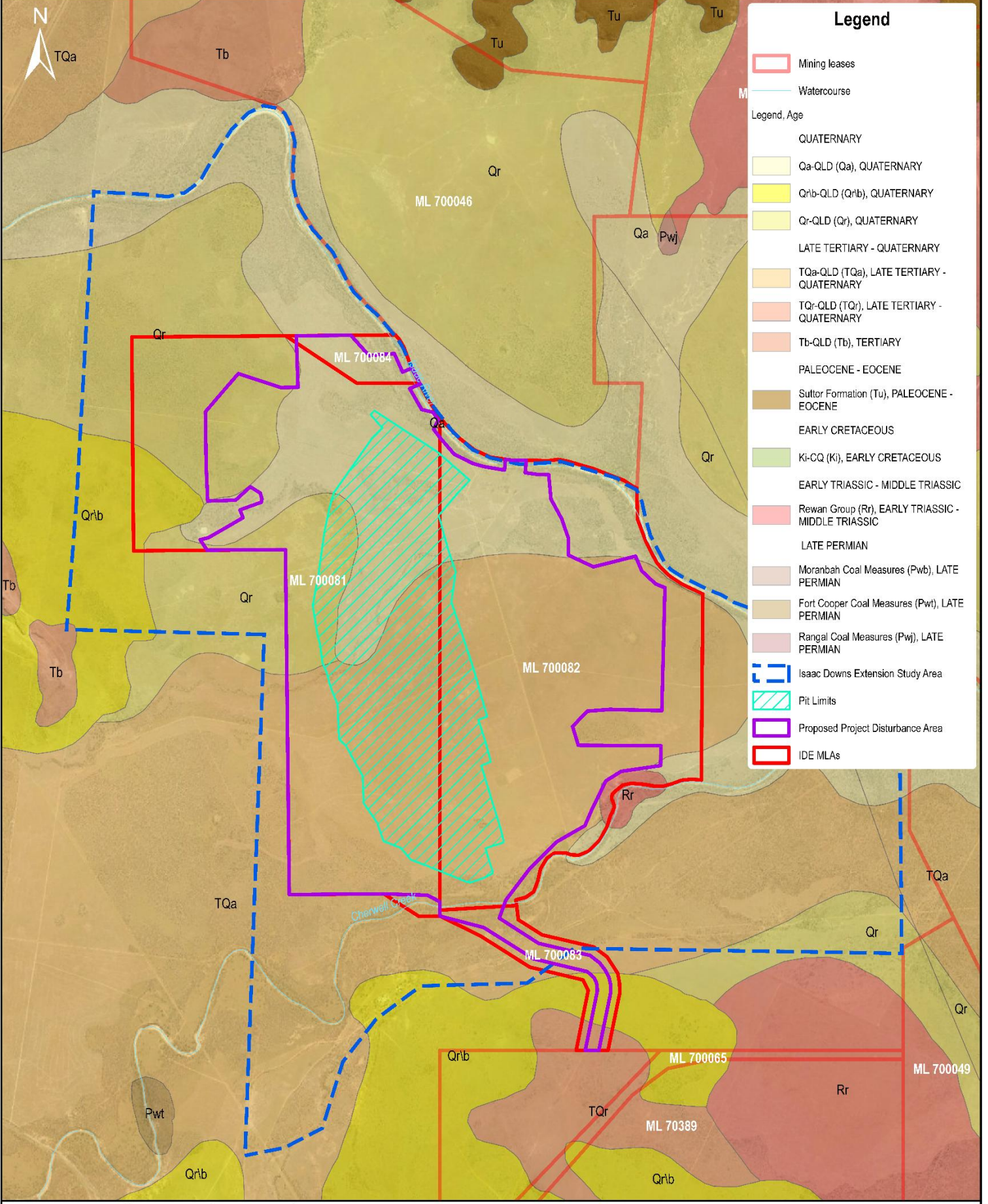
Table 3-1. A summary of groundwater monitoring bores within the Isaac Downs Extension monitoring network.

Bore ID	Easting (GDA94)	Northing (GDA94)	Aquifer	Lithology screened	Total Depth_ mbgl	Top Screen_ mbgl	Base Screen_ mbgl	Recorded Values - May 2024 to October 2025	
								Field EC (µS/cm)	SWLs (mbgl)
MBIS07	624029.8	7554748.0	Alluvium (Cherwell Creek)	Unknown	19	9	12	2521 - 3025	9.31 – 10.97
MBIS12 ³	626014.5	7555721.8	Alluvium (Cherwell Creek)	gravel	20	15	18	1161 - 21703	11.49 – 12.54
MBIS14	626469.9	7556440.9	Alluvium (HES Wetland)	Clayey Sand	11	7	10	Dry	Dry
MBID23 1, 2, 3, 4	621795.1	7559590.4	Alluvium (Isaac River)	silty sand	14.12	7.5	13.5	1037 - 3471	9.12 - 13.19
MBID28 2, 3, 4	622911.1	7558533.4	Alluvium (Isaac River)	clayey silty sand	15.79	12	15	836 - 3407	9.26 - 11.67
MBIS01	624334.5	7557705.6	Alluvium (Isaac River)	Silty clays	22	9	12	Dry	Dry
MBIS04 ³	625559.5	7556807.4	Alluvium (Isaac River)	Sand	19	12	18	1871 - 3217	10.82 - 11.16
MB08b	615638.1	7559628.4	Coal Measures (FCCM)	Sandstone / Siltstone / Coal	84.2	71	83	1995 - 20005	20.68 – 21.01
MB09B	618281.1	7557938.4	Coal Measures (FCCM)	Sandstone / Siltstone / Coal	36	24	36	1612 - 16310	18.72 – 18.78
MBIS19	626602.6	7555490.8	Coal Measures (Isaac Thrust)	Unknown	86	79	85	14298	10.13 – 16.97
594 ²	622610.0	7555054.0	Coal Measures (Leichardt Seam)	Unknown	47.0	Unk.	47.0	18853 - 22096	26.14 – 27.24
205DR	621618.1	7557029.4	Coal Measures (Leichardt Seam)	Unknown	47	43	46	24595 - 28638	11.51 – 12.24
592S	622278.0	7558539.0	Coal Measures (Leichardt Seam)	Unknown	57.1	Unk.	Unk.	20055 - 23319	13.34 – 18.05
MBIS02	624339.1	7557709.6	Coal Measures (Leichardt Seam)	Coal and siltstone	138	133	136	11681 - 13513	10.22 – 10.33
MBIS05 ³	625563.4	7556798.2	Coal Measures (Leichardt Seam)	Coal and sandstone	155	148	154	10472 - 11892	10.44 - 11.23
MBIS08 ²	623713.9	7554317.8	Coal Measures (Leichardt Seam)	coal	50	42	48	9019 – 11216	11.62 – 12.85
MBIS11	625001.9	7555113.2	Coal Measures (Leichardt Seam)	coal	94	90	93	11925	13.13 - 13.73

Bore ID	Easting (GDA94)	Northing (GDA94)	Aquifer	Lithology screened	Total Depth_ mbgl	Top Screen_ mbgl	Base Screen_ mbgl	Recorded Values - May 2024 to October 2025	
								Field EC (µS/cm)	SWLs (mbgl)
MBIS13	626009.0	7555718.7	Coal Measures (Leichardt Seam)	coal	153	149	152	12219 - 28638	12.26 – 14.53
MBIS15 ⁴	626471.4	7556435.6	Coal Measures (Leichardt Seam)	coal and sandstone	52	42	51	15600 - 29664	11.46 – 11.58
MBIS18	625803.5	7553334.8	Coal Measures (Leichardt Seam)	coal and sandstone	>150	146	149	8061 - 13101	19.16 – 20.21
MBIS10 ²	625005.4	7555129.9	Coal Measures - regolith (Overburden)	sandstone / siltstone	24.15	17.5	23.5	2315 - 2734	12.95 – 13.91
205S	621618.1	7557018.4	Coal Measures - regolith (Overburden)	Unknown	26	Unk.	Unk.	17651	11.47 – 13.06
RN182851 ²	620943	7553218	Coal Measures - regolith (Overburden)	Unknown	35.35	6	34.5	3492 - 9185	12.73 – 13.69
593 ²	622610	7555055	Coal Measures (Vermont Seam)	Unknown	95	Unk.	95	8599 - 14052	26.07 – 27.19
592D	621616	7557019	Coal Measures (Vermont Seam)	Unknown	86.43	Unk.	Unk.	13495 - 15600	11.91 - 13.26
MBIS03	624324.6	7557705.3	Coal Measures (Vermont Seam)	Coal and siltstone	181	171	180	8264 - 9461	9.4 – 9.52
MBIS09	623698.9	7554314.8	Coal Measures (Vermont Seam)	coal and sandstone	96.41	80	92	8351 - 9950	13.85 – 13.46
MBIS16 ²	623862.0	7552350.3	Coal Measures (Vermont Seam)	coal	69.19	59	67	8060 - 23319	17.31 – 32.09
MBIS06	622207.6	7553763.6	Tertiary Sediments & Basalts (regolith)	fine to coarse sand	12.4	7	10	Dry	Dry
MBIS17	625821.4	7553336.4	Colluvium (regolith)	Siltstone and claystone	23	17	20	Dry	Dry
MBIS20	623375.6	7557514.1	Tertiary Sediments & Basalts (regolith)	Clayey sand	22	17	20	29300	12.27 – 12.30
MB06	616017.1	7561336.4	Tertiary Sediments & Basalts (regolith)	Basalt / Clay	23	16	22	10850	9.13 – 10.28
MB09C	618351.1	7558101.4	Tertiary Sediments & Basalts (regolith)	Basalt / Claystone	15	9	15	Dry	Dry
MBID22	622907.1	7558532.4	Weathered Triassic Sediments (regolith)	Unknown	37	24	36	2836	10.58 – 13.52

¹Sampled for stable Isotopes in November 2024; ²Sampled for stable isotopes in bore sampling from March 2025; ³Sampled for Stable Isotopes and Radon in September 2025; ⁴Sampled for Stable Isotopes and Radon in November 2025; # Meters below top of casing; Unk = Unknown

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Scale: 1:59,256 @A4 0 1 2 K

Coordinate System: GDA 2020 MGA Zone 55 A4

Source: Detailed Surface Geology of Queensland (1:100 000) (DNRME 2018)

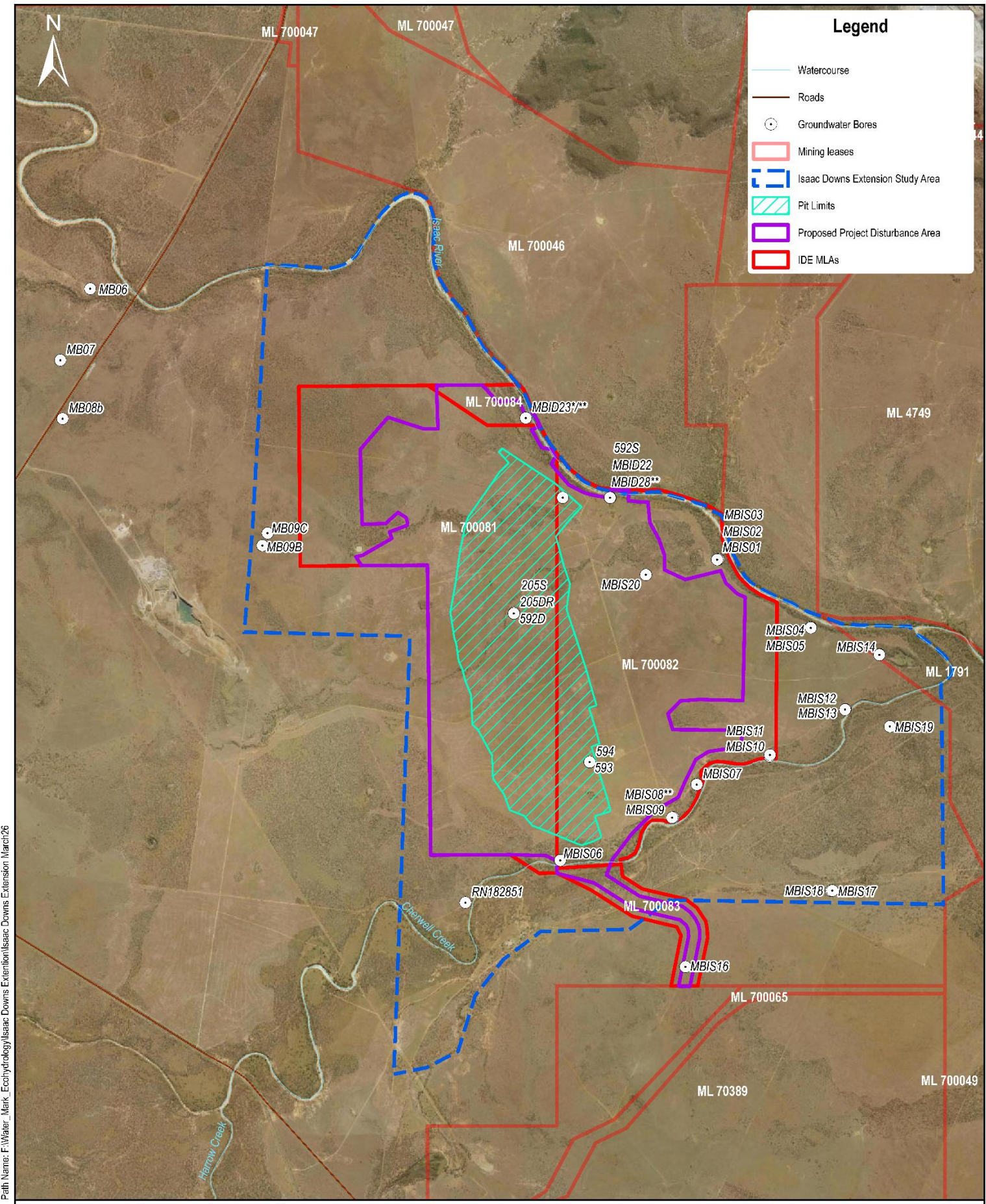
Figure 3-3. Surface geology in the Project Area

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Drawn By D.G. Checked D.S. Date: 8/04/2026



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Figure 3-4. The location of groundwater monitoring bores in the Project area and surrounds

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ECO**

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3.3 Surface Water Flows

The Project's location is within the headwaters of the Isaac sub-catchment, part of the greater Fitzroy Basin, where the Isaac River flows from northwest to southeast. The Isaac River is the major watercourse in the assessment area, flowing north to south between the Project and IDM, which lies to the east of the river. Headwaters of the Isaac River form in the Denham Range approximately 98 km north of the Project, joining with the Connor's River 120 km downstream of the Project, eventually converging with the Mackenzie River before joining the Fitzroy River.

The flood channel is characterised by extensive deposits of coarse sand, indicating a sediment excess, and sand point bars deposit on the inside of channel meanders, often with well-developed vegetation that forms a continuous riparian buffer on both sides of the channel, stabilising near-vertical erosion scarps that form on the inner channel to a depth of 1 m to 2 m. The river experiences seasonal surface flows during the wetter months, from November to April, although it reduces to subsurface flows in the channel sands from May to October (Hydrobalance 2026a). Daily flow data collected from 1968 indicates that the Isaac River is highly ephemeral, flowing only 27 % of the time with less than 11 % probability of flows exceeding 100 ML/day, and less than 1 % of readings exceed 10,000 ML/day (SLR 2026a).

Cherwell Creek, a larger tributary, converges with the Isaac River in the southeast of the Project area, with a sandy channel that is continuous with the Isaac River bedform. The creek channel is generally deeply incised to a depth of 6 m to 10 m, with steep channels (1(V) in 2(H)) vegetated with native long grass and scattered trees (Hydrobalance 2026a).

Other ephemeral watercourses occur in the Project area, including Conrock Gully passing through the central portion of the Project area to join with the Isaac River, and JB Gully, which joins with Cherwell Creek.

4.0 Summary of Assessment Methods

The field survey included an assessment of twenty sites, all considered to represent potential GDEs from the BOM GDE Atlas (BOM 2024). At each assessment site, sampling of two to five trees for leaf water potential (LWP) was completed, with twig samples collected to analyse xylem stable isotope composition. Seven locations were subject to soil auger profiling to facilitate the collection of soil moisture potential (SMP) and stable isotope data from the soil profile. Sampling of groundwater was completed from soil auger holes when groundwater was intersected, and from monitoring bores by the Project hydrogeologist in a separate dedicated groundwater monitoring event. All methods are consistent with GDE assessment protocols detailed by Doody et al. (2019) and Richardson et al., (2011).

Four sampling events contributed to the data analyses in this assessment, including:

- A primary phase of biophysical and hydrochemical sampling (leaf, soil, and water) occurred between the 4th and 8th of November 2024.
- Additional isotopic sampling occurred in two supplementary stages, which occurred on 12th of August and on the 1st and 2nd September 2025, and
- A subsequent phase of isotopic and biophysical sampling occurred between the 11th and 15th November 2025.

4.1 Site Selection

The survey focused on areas mapped as potential terrestrial GDEs in the GDE Atlas, including watercourses where potential aquatic GDEs have been mapped, and representative woodland ecosystems. **Figure 4-1** shows sampling localities relative to the GDE Atlas mapped GDEs with **Table 4-1** providing a summary of the purpose and sampling undertaken at individual GDE Assessment Sites. **Photograph 1** shows the broad depression of the HES wetland at GDE Assessment Site (referred to as Isaac Site (IS)) 20. **Photograph 2** shows the riparian frontage of Cherwell Creek at IS14, and **Photograph 3** shows the broad riparian frontage of the Isaac River at IS7.

Table 4-1. Summary of the GDE Assessment Sites for Field Survey

GDE Assessment Site	Geomorphic Position	LWP	Auger / SMP	Surface / Groundwater	Stable Isotopes
Isaac River Riparian Fringe (RE11.3.25)					
IS2	Incised inner banks of the Isaac River within well-developed riparian vegetation.	3 trees	One auger on the lower river terrace.	Present in the river channel	Tree xylem, soils, surface water
IS5		3 trees	One auger on the lower river terrace completed in a supplementary assessment in November 2025.	Shallow groundwater from river sand plus a surface water sample from a residual pool sampled in November 2025.	Tree xylem, shallow groundwater plus surface water.
IS7		3 trees	NA	NA	Tree xylem
IS8		4 trees	One auger on the lower river terrace in November 2024, and surface water sample in November 2025	NA	Tree xylem, soils

GDE Assessment Site	Geomorphic Position	LWP	Auger / SMP	Surface / Groundwater	Stable Isotopes
IS9		3 trees	NA	NA	Tree xylem
IS15		3 trees	Two augers; one on the lower terrace and another in the river sand.	Surface water sampling in November 2024 and 2025.	Tree xylem, soils, surface water
IS17		3 trees	Shallow auger in river sand in November 2025	Groundwater in river sand sampled in November 2025	Tree xylem, shallow groundwater
Cherwell Creek Riparian Fringe (RE11.3.25)					
IS10	Steep incised banks of Cherwell Creek	3 trees	NA	NA	Tree xylem
IS12		4 trees	Single auger on lower river terrace	NA	Tree xylem, soils
IS14		4 trees	Single auger on lower river terrace	NA	Tree xylem, soils
IS18		4 trees	NA	NA	Tree xylem
Brigalow TEC Habitats					
IS1	Heavy clay soils on upper alluvial terrace	5 trees	NA	NA	Tree xylem
IS4		4 trees	NA	NA	Tree xylem
IS6		3 trees	NA	NA	Tree xylem
IS13		5 trees	NA	NA	Tree xylem
IS16		4 trees	NA	NA	Tree xylem
Poplar Box (RE11.3.2)					
IS3	Sandy residual soils on upper river terrace	3 trees	NA	NA	Tree Xylem
IS11		3 trees	NA	NA	Tree Xylem
IS19		2 trees	NA	NA	Tree Xylem
RE11.3.27b (HES Wetland)					
IS20	Clay soils associated with a wetland depression	4 trees	One auger in on the margins of the wetland near sampling Tree 1 plus supplementary auger and stable isotope sampling in November 2025. Auger sampling was also completed for Poitrel Mine (directly across the river).	Single surface water sample in August 2025.	Tree xylem, soils, surface water



Photograph 1. HES Wetland sampled at site IS20, with Tree 1, a tall specimen of forest red gum in the foreground.



Photograph 2. The riparian fringes of Cherwell Creek as site IS14, with slabby bedrock exposures on the northern bank, and well-developed riparian forest on the south levee.



Photograph 3. Riparian reaches of the Isaac River with characteristic sandy channel at site IS7.

4.2 Leaf Water Potential

Leaf Water Potential (LWP) defines the work required per unit quantity of water to transport it from the moisture held in the soil to leaf stomata. LWP balances osmotic potential, turgor pressure, and matric potential. It is a function of soil water availability, evaporative demand, and soil conductivity. LWP was measured pre-dawn (before sunrise) as per standard protocol. Due to a lack of transpiration, LWP will equilibrate with the wettest portion of the soil, which contains a significant amount of root material. LWP will shift to a lower status pre-dawn as the soil dries out seasonally (Eamus 2006a). Measurement of LWP pre-dawn thus indicates the water availability to trees at each assessment site and whether trees are tapping saturated zones of the soil profile where water is freely accessible or utilising moisture that is more tightly bound to soil particles.

Survey localities were sampled pre-dawn (first light to pre-sunrise), and leaves were collected from three to five mature canopy trees with a 9 m extension pole fitted with a lopping head. Sampling focused on eucalypt species with potential to be a facultative phreatophytes, although other species (e.g., poplar box) were sampled where these species were associated with mapped GDEs. Collected branches were double bagged in black plastic to avoid moisture loss and sun exposure, and LWP was measured on-site within half an hour of harvest. Leaf material was trimmed with a fine blade and inserted into an appropriate grommet for sealing within a Model 3115 Plant Water Status Console (Soil Moisture Equipment Corp 2007). The chamber was sealed and gradually pressurised with nitrogen until the first drop of leaf water emerged from the petiole with values represented in millipascals (MPa) for direct comparison to Soil Moisture Potential (SMP) measurements. In total, 70 trees were assessed for LWP across the twenty assessment sites. Raw field data

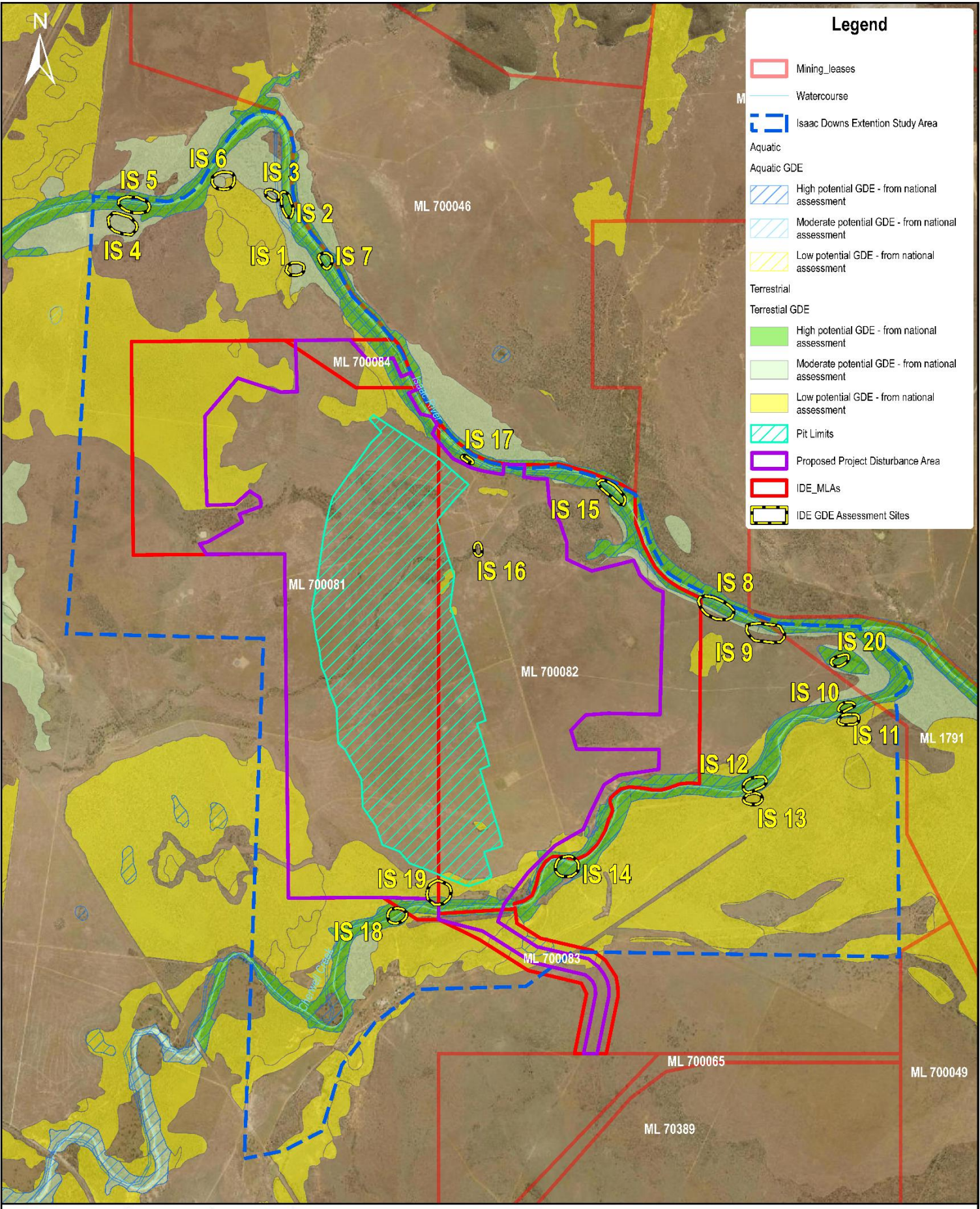
with LWP values and tree structural details are provided in **Appendix A**, with the location of these trees detailed in **Appendix B**. The following categories were applied as a measure of relative water availability:

- Extremely High: LWP >-0.276 MPa
- Very High: LWP -0.276 to -0.580 MPa
- High: LWP <-0.580 to -0.896 MPa
- Moderate: LWP <-0.896 to -1.21 MPa
- Low: LWP <-1.21 to -1.72 MPa
- Very Low: LWP <-1.72 to -2.21 MPa
- Extremely Low: LWP <-2.21 MPa

While the defining values of these categories are arbitrary, they indicate the likely degree and nature of groundwater dependence or interaction. The 'Extremely High' category would indicate the potential for interaction with a highly fresh groundwater source, with the degree of groundwater interaction decreasing to the 'Moderate' category, which may indicate either utilisation of soil moisture from the vadose zone or interaction with saline groundwater.

Categories of 'Low' to 'Extremely Low' are considered unlikely to utilise groundwater to any degree, regardless of salinity. It should also be noted that soil moisture in the 'Extremely High' category can be supplied directly from unsaturated portions of the soil profile depending on moisture availability, which can be assessed by measuring SMP.

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Coordinate System: GDA 2020 MGA Zone 55 A4

Figure 4-1 Location of GDE assessment sites targeted for LWP and auger sampling.



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4.3 Soil Moisture Potential

A hand auger was utilised to collect shallow soil samples at regular depths down the soil profile at selected sites and opportunistic sampling of groundwater where intersected.

Selection of sites for auger placement considered:

1. Whether LWP measurements indicated a higher degree of water availability in the soil profile than other assessment localities, suggesting that shallow groundwater or a soil zone of higher matric potential exists at depth (i.e. a sand lens may be present in the soil profile).
2. The representativeness of a particular chosen site as a means to provide information that applies to other assessment localities.

At each site chosen for auger sampling, the aim was to collect soil samples to the maximum depth of the auger of penetration, with penetration often arrested by coarse gravel / cobble substrates, large tree roots, or refusal at relatively shallow depths in the soil profile due to a high density of root material. Observations taken for each auger hole included:

1. Soil structure, colour, and texture.
2. Presence of root matter.
3. Soil moisture/water and areas of saturation.

Soil sampling was undertaken at regular intervals down the soil profile for analysis of stable isotopes of oxygen ($\delta^{18}\text{O}$) and hydrogen ($\delta^2\text{H}$), and duplicate samples were retained for analysis of SMP.

Sample collection was generally spaced at 0.5 m down the auger profile, with additional samples taken where changes in soil structure/texture, moisture content, or zones of tree roots were intersected. Samples were sealed in airtight plastic vials and placed on ice for later measurement of SMP.

SMP, which includes the matric (water availability) and osmotic (saltiness) potential, measures the energy required to extract moisture from the soil. Water can only move down a hydraulic gradient from soil to root (Gardner, 1960). Areas in the soil profile with a less negative SMP than measured pre-dawn LWP will be accessible as a source of moisture. Large, mature trees are unable to extract moisture from regions in the soil profile where the total SMP is significantly below LWP measured in pre-dawn leaf material (Feikema et al., 2010; Lamontagne et al., 2005; Thorburn et al., 1994; Mensforth et al., 1994; Holland et al., 2006 and Doody et al., 2015). The maximum suction roots for crops can apply to soil/rock before a plant wilts due to a negative water supply is approximately -15 bars or -1.5 MPa (or -217.55 psi). This wilting point is relatively consistent between all plant species. However, many Australian plants have adapted to conditions of low water availability and can persist strongly in soil conditions where moisture potential is below standard wilting point (Eamus, 2006a). As a general measure, however, where measured LWP is below the standard wilting point, it indicates plant water deficit, and the tree is unlikely to be supported by a saturated water source regardless of groundwater salinity.

Soils were sampled at regular intervals down a soil profile for measurement of SMP, with sampling intervals dependent on the degree of structural and lithological heterogeneity. The measurement of SMP was completed in the laboratory with a portable Dew Point Potentiometer (WP4C). The WP4C meter uses the chilled mirror dew point technique with

the sample equilibrated within the headspace of a sealed chamber that contains a mirror and a means of detecting condensation on the mirror. Soil moisture potential samples were measured in millipascals (mPa). A 7 ml soil sample was inserted into the WP4C meter using a stainless-steel measuring tray.

4.4 Stable Isotope Sampling and Analyses

Trees may utilise water from various sources including the phreatic zone (saturated zone), the vadose zone (unsaturated zone) and surface water. The stable isotopes of water, oxygen 18 ($\delta^{18}\text{O}$), and hydrogen ($\delta^2\text{H}$) are valuable tools to help define terrestrial vegetation's predominant water source. The method relies on a comparison between the stable isotope ratios of water contained in plant xylem (from a twig or xylem core) with stable isotope ratios found in the various sources of water, including a shallow groundwater table, potential sub-artesian aquifer water sources, rainfall or shallow soil moisture. Methods used to assess stable isotopes are detailed below.

4.4.1 Local Meteoric Water Line

Construction of the LMWL considers 13 samples collected opportunistically between 2021 and 2025 using a portable rain gauge, decanted into a 60 ml polypropylene container. The data includes 13 points in total, incorporating two 2008 data points collected in Clermont (Crosbie et al., 2012) applied to construct a best-fit Local Meteoric Water Line (LMWL) using least squares regression). The constructed LMWL defines a slope of 7.013 and d-excess of 11.39 ($Y = 7.013 \cdot X + 11.39$), which is shallower than the Global Meteoric Water Line ($(Y = 8 \cdot X + 10)$) (Craig 1961). The LMWL incorporates three rainfall samples collected in Moranbah from November 2025, and a single sample collected from a monsoonal rainfall event in April 2025 (**Table 4-2**).

Table 4-2. Rainfall data points used to construct LMWL.

Event	$\delta^{18}\text{O}$	$\delta^2\text{H}$
Storm_Dysart_Nov, 2024	-1.24	1.74
Clermont Mar-Apr-08 (Crosbie et al, 2012)	-1.77	-2.1
Clermont Mar-Apr-08 (Crosbie et al, 2012)	-3.49	-13.9
Moderate Storm_Moranbah, 16 Nov 2021.	-0.21	7.39
Heavy rain_Moranbah_17 Nov 2021.	0.78	15.2
Light rain Moranbah_18 Nov 2021.	2.72	28.79
Heavy rain_South Walker_front from west, June 2024.	-2.79	-8.29
Heavy rain_South Walker_front from west, June 2024.	-4.43	-22.01
Heavy rain_South Walker_front from west, June 2024.	-4.7	-20.91
Rainfall_Moranbah_Moderate Storm_Nov 2025.	0.55	19.06
Rainfall_Moranbah_Moderate Storm_Nov 2025.	-2.54	-2.5
Rainfall_Moranbah_Front from West_Nov 2025	-1.6	3.27
Rainfall_Moranbah_Slow moving depression_April 2025	-14.62	-91.46

4.4.2 Line Conditioned Excess

To further define the isotopic differences in the various moisture pools used by potentially groundwater dependent vegetation, line conditioned excess ('lc-excess' or 'precipitation offset') was calculated using the LMWL as a reference. Line conditioned excess describes the differences in stable isotope composition of various moisture pools compared to local precipitation (Landwehr and Coplen 2006; Evaristo et al 2017; Petit and Froend 2018) through application of the following equation:

$$\text{lc-excess}^* = [\delta^2\text{H} - a \delta^{18}\text{O} - b]/S$$

Where a and b are the slope and intercept of the LMWL, and S is the standard deviation of both $\delta^2\text{H}$ and $\delta^{18}\text{O}$ values. Local precipitation has a line conditioned excess =0, and evaporation of moisture on the land surface results in line conditioned excess values that variably fall below this dependent on the degree of evapotranspiration they have been subjected to (Evaristo et al 2017). In contrast, those values that have line conditioned excess values >0 have accumulated deuterium as part of their evolutionary process.

4.4.3 Soil Moisture Isotopes

Sampling was undertaken regularly in auger holes to capture isotopic signatures from a range of potential plant moisture sources from the upper soil surface to the top of the phreatic zone in shallow water tables. The sampling intervals for soil moisture isotope analyses depended on auger yield and soil variation. In general, the initial soil sample was taken within the top 0.2 m of the soil profile, and subsequent samples were taken at 0.5 m intervals down the soil profile to the end of the hole, mirroring the interval for SMP. Approximately 200 milligrams (mg) of soil was collected for isotope analysis, sealed in airtight plastic sampling containers, double-sleeved in click-seal plastic bags, and placed on ice for storage prior to dispatch to the Australian National University (ANU) Stable Isotope Laboratory for analysis where they were snap frozen until analysis was complete.

Soil intervals selected for stable isotope analysis include where tree roots were recorded, exceptionally moist intervals, or at the base of the auger hole where high soil moisture/groundwater was recorded.

4.4.4 Xylem Water Isotopes

Twigs were collected from the outer canopy branches of target trees used to sample LWP. The following sampling procedure was applied:

1. Harvesting of outer branches of trees of the target tree at the GDE assessment site was completed, with two duplicate samples prepared from each branch for analysis.
2. The position of trees subject to assessment was marked with a GPS, and structural measurements, including height and diameter at breast height (dbh), were recorded.
3. Outer branches from each tree were harvested with an extendable aluminium pole.
4. Stem material approximately 5 cm in length was sourced with stainless-steel secateurs.
5. The bark was immediately removed, and stems were sealed in wide-mouth sample containers with leakproof polypropylene closures (approx. 125 ml volume). They were immediately labelled with the tree number and placed in an iced storage vessel prior to dispatch to the ANU Stable Isotope Laboratory.

6. Upon receipt of samples at the ANU Stable Isotope Laboratory, samples were snap-frozen (-18 degrees Celsius) until analysis.
7. Samples were taken from the xylem to be as close to the centre of the twig as possible. Extracted water was analysed using a Picarro L2130i cavity ring-down spectrometer for both xylem and soil samples.

There is potential for fractionation of stable isotope values, particularly $\delta^2\text{H}$, during water movement through the xylem from roots to leaves (Evaristo et al., 2017; Petit & Froend, 2018). As fractionation will likely result in isotopic enrichment rather than depletion, the least enriched sample from each tree is considered most likely to be representative of the soil moisture or groundwater source.

4.5 Water Sampling

Stable isotopes: To compare the isotopic signature of groundwater to that of vegetation, water samples were collected from various sources including shallow groundwater intercepted in augers, surface water in residual pools, and groundwater monitoring bores. Sampling events included:

- A single groundwater monitoring bore (MBID23) was sampled with a hand bailer during the field assessment in November 2024 and single surface water sample from a residual surface pool.
- Sampling of a selection of developed groundwater monitoring bores completed by the Project hydrogeologist (SLR) in March 2025 which included the resampling of MBID23.
- Sampling of surface water in the Isaac River and the HES Wetland (Area 20) in August 2025.
- Supplementary sampling of groundwater monitoring bores completed by the Project hydrogeologist in September 2025.
- Sampling of shallow groundwater, groundwater monitoring bores and surface water in November 2025.

All samples were dispatched to ANU to analyse stable isotope composition. **Table 3-1** indicates the bores that were sampled for stable isotope composition, with the location of Project groundwater monitoring bores previously shown in **Figure 3-4** relative to mapped GDEs.

Radon: Radon ($^{222}\text{Radon}$) is a by-product of uranium decay that has a much higher concentration in groundwater than surface water. It can therefore provide an accurate indication of how much groundwater has entered surface water bodies (Hoffman & Marshall, 2025). Radon concentrations in groundwater depend on several factors including aquifer grain size, porosity, and rock type, with groundwater from alluvium typically producing lower concentrations than bedrock samples.

As radon has a half-life of 3.8 days, its concentration will decrease downstream along a river from a source of groundwater discharge. Surface water that has no groundwater input will generally have radon concentrations of <0.1 Becquerel per litre (Bq/L), with that radon captured during hyporheic exchange (i.e. radon exchange between surface waters and creek sediments) (Hofman & Marshall, 2025), while groundwater is often in the tens to hundreds Bq/L (Suckow 2014; Adyasari 2023). Due to the short half-life, it is necessary to

analyse waters as soon as possible after sampling, and a correction factor is applied to correct for the interval between sampling and analysis. Radon sampling targeted the detection of groundwater discharge into surface waters, and hence sampling included a residual surface water body on the Isaac River at IS8, an additional residual water body on the Isaac River near the confluence of Cherwell Creek, plus a surface water sample from the HES Wetland. To determine groundwater radon baseline values, alluvial monitoring bores MBIS04, MBIS12, MBIS23, MBIS28 were sampled along with groundwater from the coal seams in MBIS05 with a low-flow bladder pump which provides for a continuous water column. Sampling of surface water bodies occurred on 12th August 2025 and groundwater sampling occurred on 2nd September 2025.

A subsequent sampling event occurred in November 2025, which resampled two of the monitoring bores installed into the alluvium (MBID023 and MBID028), groundwater collected from a soil auger hole at Area 5 and from the river sand from Area 17, plus residual surface water bodies on the Isaac River at Area 5, Area 8 and Area 15. A stainless-steel bailer was used to sample groundwater from auger holes, as well as monitoring bores, with three volumes of groundwater purged prior from monitoring bores before sampling to displace stagnant water. While sampling methods differ from the August monitoring round, sampling will only lead to loss of radon from waters rather than gain, and the values reported from monitoring bores represent minimum potential radon concentrations.

4.6 Data Reconciliation and Interpretation

Data interpretation followed a structured approach by filtering multiple lines of evidence to assess groundwater dependence. The biophysical measurement of LWP formed the primary assessment, followed by the adjunct comparison with SMP, with stable isotope data used to provide supplementary evidence where ambiguity remained. In addition, an overview of the depth of the groundwater table and groundwater salinity was completed as a final filter to determine the accessibility of groundwater and suitability as a source of moisture to support transpiration at each assessment locality.

Step 1. LWP: An initial comparison of individual trees' LWP values within the expected range for known terrestrial GDEs subject to various salinity regimes, assuming complete saturation of sediments in the groundwater table and minimal influence of soil matrix potential, is applied. This data is derived from a range of published sources, including Jones et al. (2020), Holland et al. (2006), and Mensforth et al. (1994):

- Expected LWP for trees in equilibrium with a fresh to brackish saturated source of moisture ($EC < 1500 \mu S/cm$) = > -0.2 MPa.
- Expected LWP for trees in equilibrium with a moderately saline soil moisture source ($EC > 1500$ to $10\,000 \mu S/cm$) = -0.2 MPa to -0.55 MPa.
- Expected LWP for trees in equilibrium with a saline soil moisture source ($EC > 10\,000$ to $30\,000 \mu S/cm$) = -0.55 MPa to -1.5 MPa.

Where groundwater regimes exhibit varying salinity regimes, this greatly increases the complexity and uncertainty of LWP assessments, meaning much greater reliance on other analytical tools, such as stable isotopes. However, trees that demonstrate LWP values that are considerably more negative than expected ranges for the local groundwater salinity regimes are assumed not to exhibit any significant degree of groundwater dependence. From the range of groundwater salinities recorded from monitoring bores, sites with average

LWP < -1.5 MPa (standard wilting point) were not subject to further scrutiny other than for comparative purposes. Groundwater with salinity ~30 000 $\mu\text{S}/\text{cm}$ is considered an unsuitable source of moisture for most trees and unlikely to be utilised by deep rooted vegetation.

Step 2. Soil Augering and SMP: Soil augering is helpful for a) direct observation of soil physical properties including depth to bedrock; b) physical observation of distribution of tree roots down within the soil profile; c) identification and sampling of shallow groundwater tables; and d) measurement of soil biophysical properties including SMP. For trees where LWP was within the expected range of values for GDEs under specific local salinity regimes, soil augering allowed the direct observation of the physical features of the soil profile, as well as facilitated measurement of SMP to identify the likelihood that moisture for transpiration was being supplied from the upper soil profile, or whether deeper sources of moisture may exist. As described in **Section 4.3**, water can only move down a hydraulic gradient from soil to root, meaning that only those portions of the soil profile with an SMP that is less negative than measured pre-dawn LWP will be accessible as a source of moisture (Gardner, 1960). This does not provide an absolute assessment of groundwater dependence, though it identifies potential sources of moisture to give context to evaluating stable isotopes (Step 3). SMP data is only available at some sites, increasing the reliance on stable isotopes during data reconciliation.

Step 3. Stable Isotopes and Radon: For trees that demonstrate potential groundwater dependence from LWP measurements, stable isotope signatures from the xylem samples were compared to signatures from groundwater, surface water from residual and permanent pools, and soil moisture (where this data was available) to provide a fingerprint for the source of moisture being utilised. Where three lines of evidence indicated utilisation of a groundwater source, the tree was generally accepted as being groundwater dependent. Where ambiguity remained in the assessment, additional features were considered, including site-specific geology, geomorphology, soil physical properties, groundwater salinity, and depth to the water table at the location to inform the final assessment of groundwater dependence for any tree or site. Radon sampling was useful for conceptualisation of groundwater and surface water interactions, and was used specifically for this purpose,

4.7 Limitations and Other Information Relevant to the Assessment

This GDE assessment provides a snapshot of ecohydrological process at each of the 20 GDE assessment sites across this dry season baseline assessment (November 2024), and one dry season baseline monitoring event (November 2025). The dry season timing is considered optimal for sampling of groundwater dependent vegetation as it can limit the influence of confounding variables, such as recent rainfall recharge of soil moisture. Due to the intensive nature of the data collection process, representative areas were chosen for GDE sampling which were used as a basis for extrapolation over broader areas considered to present similar ecohydrological function. The data collection process aimed to conceptualise the ecohydrological characteristics of any GDEs confirmed to be present in the Project area and their general distribution.

5.0 Results

5.1 Leaf Water Potential

Figure 5-1 shows the average and range of LWP values reported for each of the 20 assessment areas. Site IS5 reports the highest average LWP value (Very High at -0.4 MPa), and this was consistent when sampled in the November 2025 assessment (-0.44 MPa). Site IS8 and IS9 report values in the 'High' range (-0.75 and -0.96) respectively. However, most sites on the Isaac River channel (IS2, IS7, IS15, IS17) fall within the range of 'Low' to 'Very Low', suggesting that groundwater usage at the time of assessment is unlikely to be occurring. Assessment areas associated with Cherwell Creek present similar values, with IS10, IS12, and IS14 all demonstrating 'Low' to 'Very Low' moisture availability. Only assessment area IS18 presents a 'High' moisture availability (-0.65 MPa), suggesting possible interaction with a brackish groundwater source.

HES Wetland Site 20 demonstrated a 'High' moisture availability in November 2024 (-0.855 MPa), similarly suggesting the potential for interaction with a brackish groundwater source. However, when sampled in November 2025, average LWP values had increased to 'Very High' (-0.45) indicating increased water availability during the follow up assessment.

Habitats associated with elevated clay pans and Tertiary/residual surfaces, such as the brigalow (IS1, IS4, IS6, IS13 and IS16) and poplar box (IS3, IS11 and IS19) have considerably more negative LWP values in the 'Low' to Extremely Low' range (-1.66 MPa for IS3 to -3.375 MPa for IS16). Based on LWP values alone, this suggests that brigalow and poplar box habitats are moisture-limited and unlikely to be utilising groundwater to any significant degree. Data for individual trees (**Figure 5-2**) indicates considerable variability for LWP values from individual trees at each assessment site, with two trees indicating 'Extremely High' moisture availability at the Isaac River site IS5 (-2 and -0.25 MPa for Tree 1 and Tree 2). There is potential for these trees to be directly utilising a fresh groundwater source. **Figure 5-3** provides a spatial representation of tree water availability for GDE Assessment sites. Raw field data with LWP values and tree structural details are provided in **Appendix A**, with the location of these trees detailed in **Appendix B**. **Table 5-1** provides a summary of the LWP assessment, providing an indication of which samples demonstrate potential utilisation of a saturated (groundwater) moisture source.

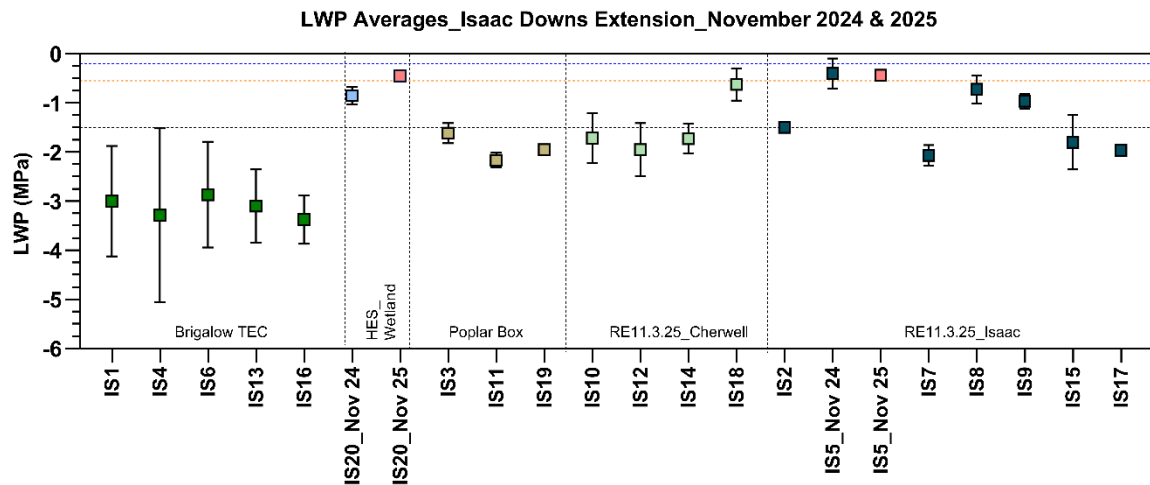


Figure 5-1. Range and average of LWP readings for all GDE Assessment sites including sampling completed at IS20 and IS25 in November 2025. The blue line ($>-0.2\text{MPa}$) indicates expected LWPs for trees in equilibrium with a non-saline saturated source of soil moisture; the orange line ($>-0.55\text{MPa}$) indicating potential values for trees in equilibrium with a moderately saline soil moisture source ($\text{EC } 10\,000\,\mu\text{S/cm}$). The black line approximates 'standard wilting point' which would be equivalent to trees in equilibrium with a saline groundwater source ($\sim 30\,000\,\mu\text{S/cm}$).

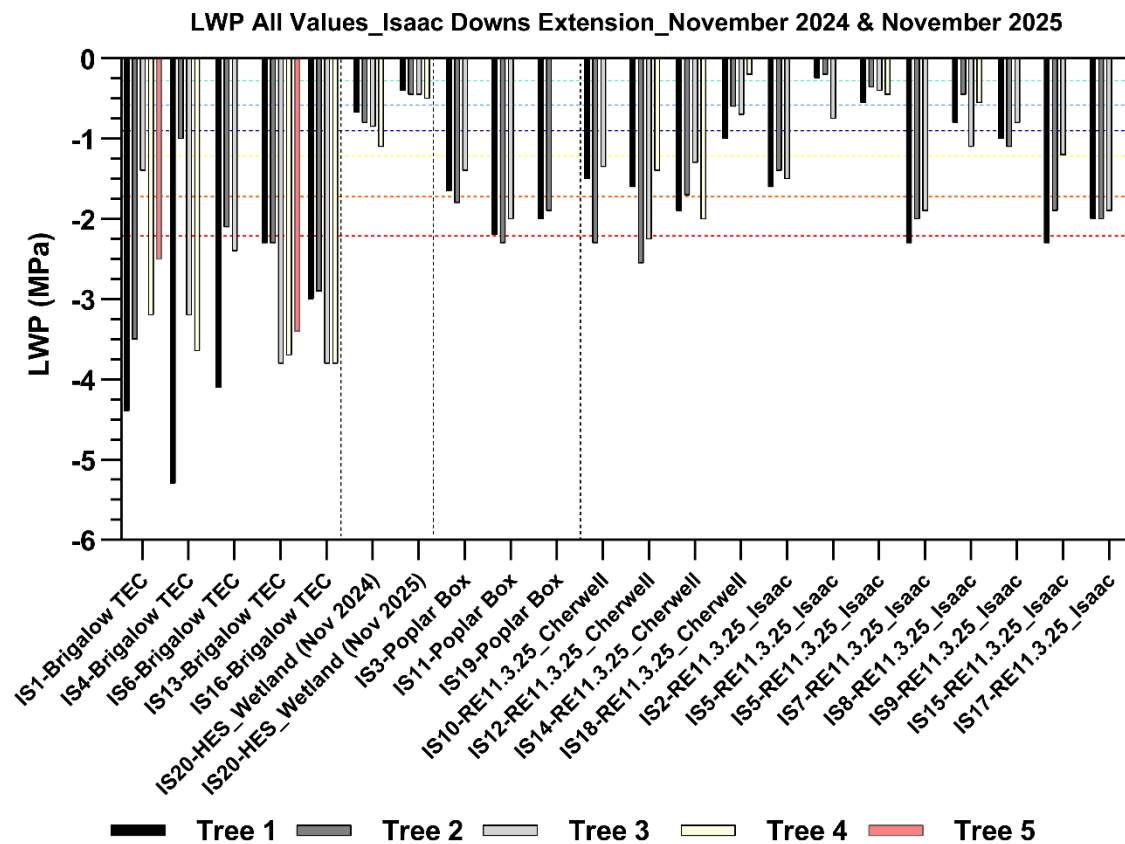


Figure 5-2. LWP values for individual trees across all assessment sites with moisture availability categories indicated within the dashed lines.

Table 5-1. Summary details and results of LWP assessment for each GDE assessment site for the November 2024 sampling event.

Site	Average LWP (MPa)	Site Location	Water Availability	Comments
Sites Potentially Utilising a Source of Fresh Groundwater				
IS5 (Nov 24)	-0.4	Isaac River	Very High	Tree 1 and Tree 2 at site IS5 present extremely high moisture availability suggesting the possible utilisation of a source of fresh groundwater. Site is located within the riparian habitat RE11.3.25.
IS5 (Nov 25)	-0.44	Isaac River	Very High	All trees present 'Very High' LWP values (-0.36 to -0.55 MPa) suggesting the possible use of a fresh groundwater source)
IS20 (Nov 25)	-0.45	HES Wetland	Very High	All trees present 'Very High' LWP values (-0.4 to -0.5 MPa) suggesting the possible use of a fresh groundwater source)
Sites Potentially Utilising a Source of Brackish Groundwater				
IS8, IS9, IS18 IS20	-0.73 -0.97 -0.63 -0.86	Isaac River (IS8, IS9) Cherwell Creek (IS18) HES Wetland (IS20)	High to Moderate	LWP values suggest the possibility that riparian vegetation (within RE11.3.25 and RE11.3.27b) are utilising a brackish groundwater source.
Sites that are Moisture Limited and Unlikely to be Utilising a Saturated Moisture Source				
IS2 IS7 IS15 IS17	-1.50 -2.10 -1.80 -1.96	Isaac River	Low to Very Low	LWP values indicate limited moisture availability with riparian vegetation (RE11.3.25) that is utilising soil moisture sources in the vadose zone
IS10 IS12 IS14	-1.72 -1.95 -1.73	Cherwell Creek	Low to Very Low	LWP values indicate limited moisture availability with riparian vegetation (RE11.3.25) that is utilising soil moisture sources in the vadose zone
IS3 IS11 IS19	-1.62 -2.17 -1.95	Poplar box habitats	Low to Very Low	LWP values indicate limited moisture availability vegetation utilising soil moisture sources in the vadose zone.
IS1 IS4 IS6 IS13 IS16	-3.00 -3.29 -2.87 -3.1 -3.37	Brigalow TEC habitats	Very Low to Extremely Low	Brigalow habitats are strongly moisture limited with LWP values indicative of a moisture source that is strongly bound to clay soils in the vadose zone.

Path Name: F:\Water_Mark_Ecology\Isaac Downs Extension\Isaac Downs Extension March26

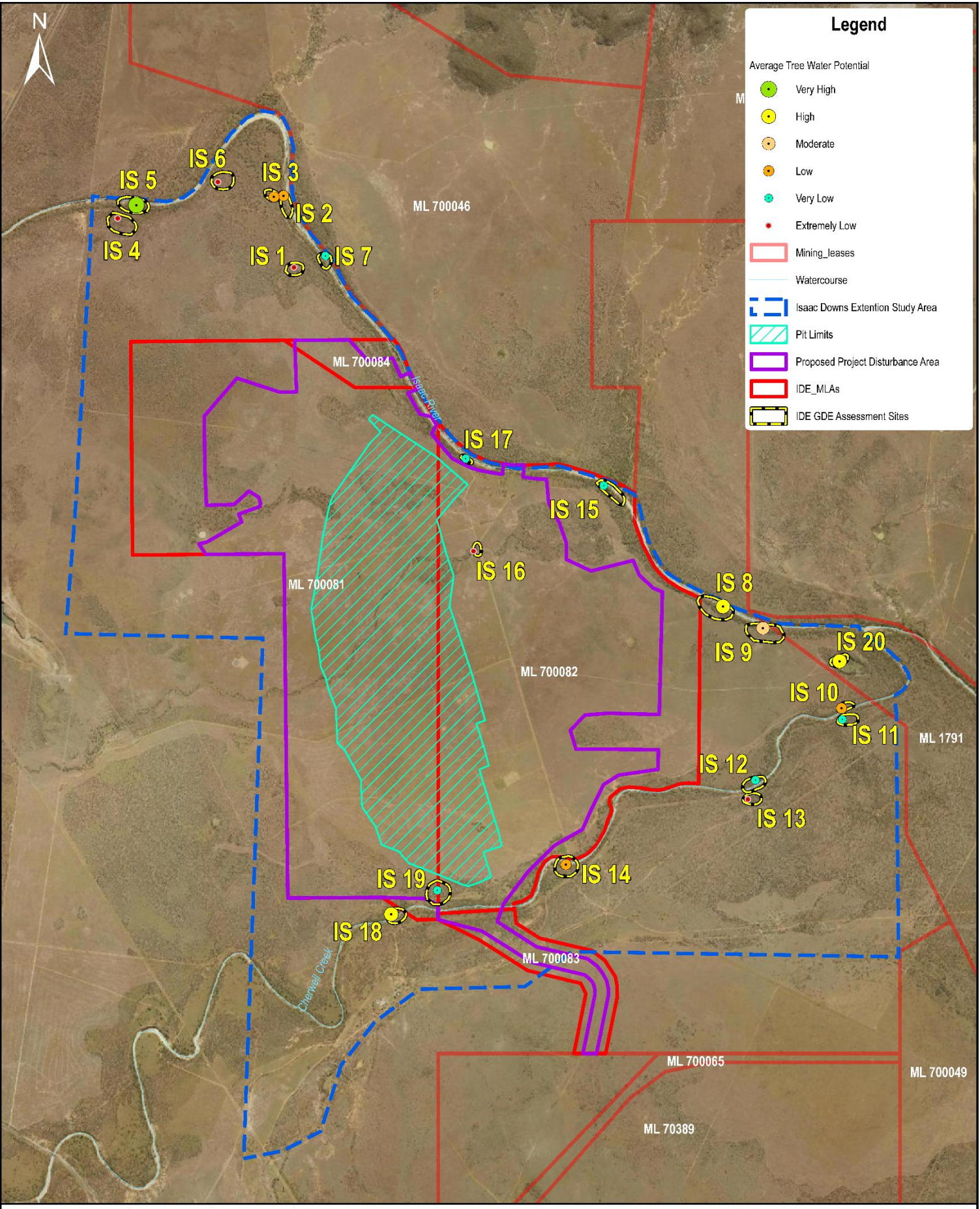


Figure 5-3. Spatial representation of average tree water availability for all GDE Assessment Sites.



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5.2 Soil Auger Sampling

Seven auger profiles were completed during the November 2024 assessment, plus an additional two auger samples in November 2025. While the auger sampling mainly targeted riparian landforms associated with Cherwell Creek and the Isaac River, the HES wetland (IS20) was sampled in both November 2024 and 2025. Directly upstream from IS14, the alluvium on Cherwell Creek thins considerably and metasedimentary bedrock is exposed in creek banks and in the riverbed (**Photograph 4**). For this reason, auger holes were not placed on Cherwell Creek upstream from IS14. **Table 5-2** provides a summary of the auger location, target, and depth, with **Appendix B** providing a spatial representation of the auger location. Auger logs, inserted in the following sections, provide a representation of the significant elements of the soil profile, including the location of major soil intervals, the depth of the groundwater table, and the presence of tree roots. Collection of soil samples occurred at each significant change in soil texture/moisture, and these were analysed for stable isotope composition. SMP values are plotted directly on the auger logs, with **Appendix C** providing raw SMP data.



Photograph 4. Bedrock exposure on Cherwell Creek, at the location of IS14.

Auger IS2_AU1, IS8_AU1, IS15_AU1, IS15_AU2, IS5_AU2: Augers IS2_AU1, IS8_AU1, and IS15_AU1 & AU2 all targeted sampling of recent alluvium on the riparian fringe of the Isaac River, to intersect either shallow groundwater, the contact with competent clays, or sedimentary rock. While all four augers intersected either competent clay or bedrock strata, perched groundwater was not present above the contact. Downhole SMP profiling, shown in **Figure 5-4**, **Figure 5-5**, and **Figure 5-6** for IS2_AU1, IS8_AU1, and IS15_AU1, respectively, demonstrates consistent overlap between site LWP and SMP values down significant portions of the soil profiles, suggesting that that soil moisture from the vadose zone can account for the reported LWP values at these sites, and the presence of shallow groundwater is not necessary to account for any measured high LWP values. Auger

IS15_AU2 was placed in the river sand, intersection water at 0.8 mbgl, although the water could not be sampled due to collapsing sand. A profile has not been constructed for IS15_AU2.

Auger IS5_AU2 was sampled in November 2025, specifically targeting the groundwater intersection within the river terrace. Fresh (280 $\mu\text{S}/\text{cm}$) groundwater was intersected at 3.5 mbgl in the deep sandy soil profile, with profiling completed to a depth of 4.7 mbgl. **Figure 5-7** demonstrates a variable, though consistent, interaction between LWP and SMP throughout the entire soil profile, with the highest moisture availability occurring between 3.0 and 3.9 mbgl, overlapping the position of the water table. Groundwater isotopic and radon sampling was completed with a bailer

Auger IS12_AU1, IS14_AU1: Augers IS12_AU1 and IS14_AU1 targeted the sampling of recent alluvium associated with well-developed riparian vegetation on Cherwell Creek. Like the auger profiles on the Isaac River, the augers did not intersect perched groundwater above the potential perching layer, reported as either plastic clay (IS12_AU1 in **Figure 5-8**) or sedimentary basement rock (IS14_AU1 in **Figure 5-9**). For site IS12, there is a significant overlap between SMP and LWP values down to depths of 2 mbgl, indicating that soil moisture alone can account for the measured LWP values at these localities. Similarly, for IS14_AU1, there is sufficient moisture in the vadose zone to account for the measured LWP values at that site. For both auger localities, LWP values can be readily accounted for by the moisture availability in the vadose zone, supporting the inference that groundwater is not contributing to the moisture sources at either of these Cherwell Creek assessment points.

Auger IS20_AU1: The location of Auger IS20_AU1 is within the central portion of the HES wetland body near a mature tree measured for LWP and LAI sampling (IS20_T1). **Figure 5-10** illustrates the significant features of the soil profile, which consists of a 2.5 m thick upper unit of massive, hardened, and dry loamy clay that transitions sharply into a 3.5 m thick interval of yellow to orange, fine to medium, free-draining sand. The sand directly overtops a dense unit of mottled gravelly clay at 6.0 metres below ground level (mbgl), inferred to be the base of the Isaac River alluvium and the likely surface of weathered Triassic sediments. The auger sampling did not confirm the perching of groundwater above the clay basement at the time of the assessment. However, strong oxidation, evidenced by orange staining in the sand interval, indicates that the sand may intermittently host a seasonally variable perched water table. Downhole SMP data, as shown in **Figure 5-10**, suggest that while the upper clay profile is dry with limited water availability, SMP values overlap with LWP values below deeper than three mbgl, which provides direct evidence that soil moisture within the sand provided the source of moisture for deep-rooted vegetation at the time of the assessment. There is no evidence for significant groundwater usage.

Auger IS20_AU2: Auger IS20 was shifted approximately 200 m south-east in November 2025, to sample the central portion of the wetland where residual surface water pools, to gain a better understanding of wetland edaphic conditions more broadly throughout the wetland feature. The sampled trees were also shifted in conjunction with the auger shift. **Appendix B15** shows the location of the updated auger and trees relative to November 2024 sampling localities. In the November 2025 auger, the profile was formed by 1.5 m of dark sandy clay and then brown sandy clay to 2.7 m. The profile became increasingly sandy with greater depth with 1.6 m of free draining coarse sand between 5.2 and 6.8 mbgl, and

then coarse sand and gravel down to 7.2 mbgl where the auger intersected weathered basement rock (**Figure 5-11**). The entire sandy portion of the profile was stained orange with Fe-oxide coating on sand grains. Compared to November 2024, the November 2025 auger has much greater moisture availability in the upper 3 m of the profile, with moisture attenuated in clay at 3.5 mbgl (-1.69 MPa), before becoming extremely moist in sandier regions below 4 m. A small quantity of groundwater was perched above the basement, though there was insufficient volume for effective sampling. The most consistent intersection between LWP and SMP occurred in the upper clayey 2.8 m of the profile, though the entire soil profile except for a narrow band of drying at 3.5 mbgl, the entire profile was potentially contributing to tree moisture sources at the time of the assessment.

Table 5-2. The location, depth and target of shallow auger holes sampled during the IDE program.

Auger Hole	Latitude	Longitude	Auger Result	Total Auger Depth (m)
November 2024 Sampling Event				
IS2_AU1	-22.0471	148.168	Intersection of the base of recent alluvium below the Isaac River terrace. Auger terminated on a coarse gravel layer. No perched groundwater was intersected.	4.2
IS8_AU1	-22.0925	148.2281	Intersection of the base of recent alluvium below the Isaac River terrace. Auger terminated on a dense mottled clay. No perched groundwater was intersected.	5.1
IS15_AU1	-22.0748	148.2025	Auger terminated on coarse gravel layer, possibly indicative of the top of the sedimentary basement rock.	3.8
IS15_AU2	-22.0746	148.2024	Auger terminated at the base of the river sand layer within the river channel. Terminated on a coarse gravel layer. Free water intersected at shallow depths (80cm) although could not be sampled due to hole collapse.	1.2
IS12_AU1	-22.1043	148.2195	Intersection of the base of recent alluvium below the inner terrace of Cherwell Creek. Auger terminated on weathered sedimentary rock. No perched groundwater was intersected.	5.1
IS14_AU1	-22.1128	148.1981	Hole terminated on intersection with sedimentary basement rock. No perched groundwater was intersected.	3.7
IS20_AU1	-22.0472	148.1686	Auger terminated in dense plastic clay below a 3m thick sequence of fine sand. Groundwater was not intersected at the base of the sequence.	6.1
November 2025 Sampling Event				
IS20_AU2	-22.0932	148.2294	Auger terminated on weathered Permian basement. Perched groundwater intersected though insufficient volume to allow sampling.	7.2
IS5_AU2	-22.0466	148.1500	Saturated at base of auger with groundwater sampled for stable isotopes and radon.	4.6

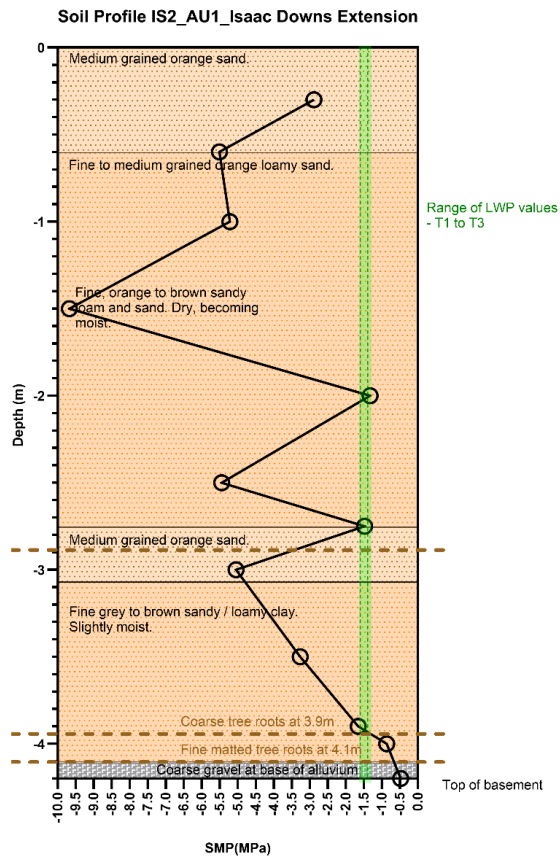


Figure 5-4. Auger profile for IS2_AU1 showing intersection of coarse gravel at the base of the alluvial profile. LWP and SMP values intersect at 2, 2.85 and >3.9 mbgl indicating regions in the soil profile where moisture is available for tree use.

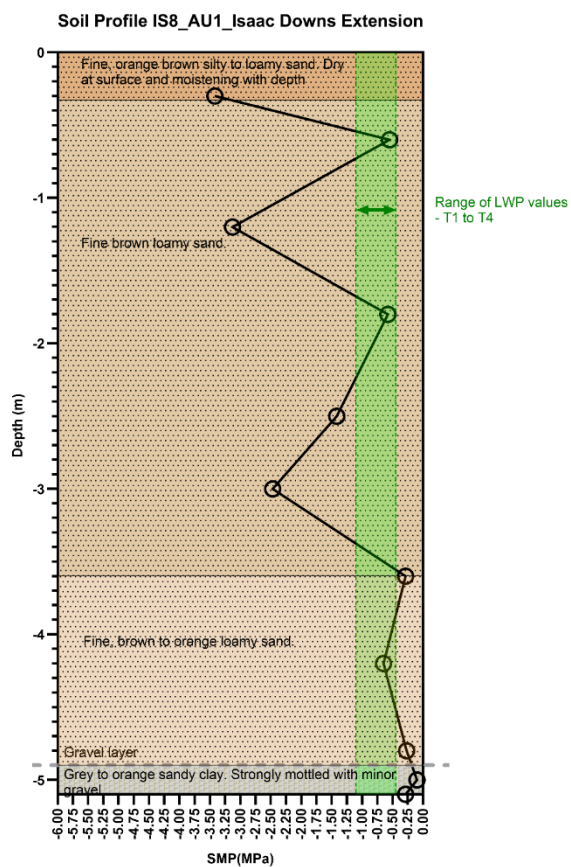


Figure 5-5. Auger profile for IS8_AU1 showing intersection of competent sandy clay at 4.9 mbgl plus the intersection of LWP and SMP values in several regions of the soil profile, particularly below 3.5 mbgl.

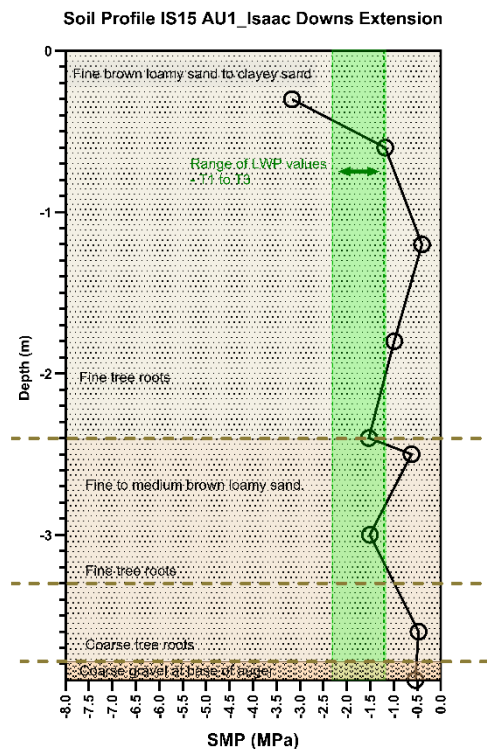


Figure 5-6. Auger IS15_AU1 demonstrating intersection of LWP and SMP values through significant portions of the soil profile, indicating a likely soil-moisture source for riparian vegetation.

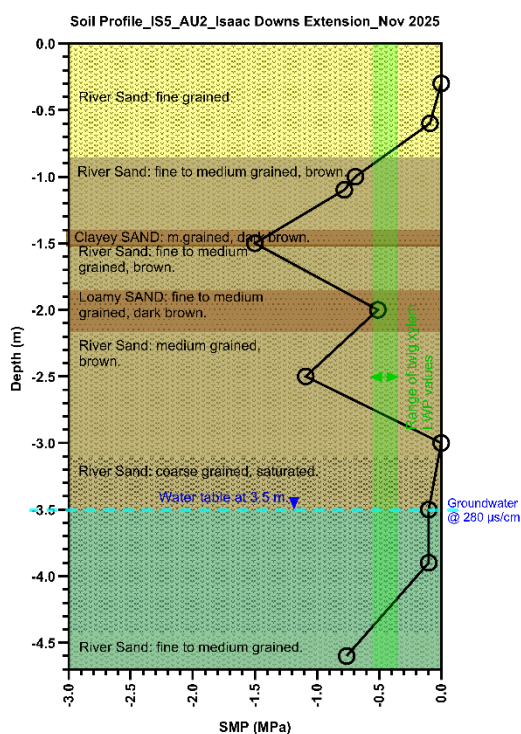


Figure 5-7. Downhole profile of IS5_AU2 completed in November 2025 with the position of the groundwater table at 3.5 mbgl.

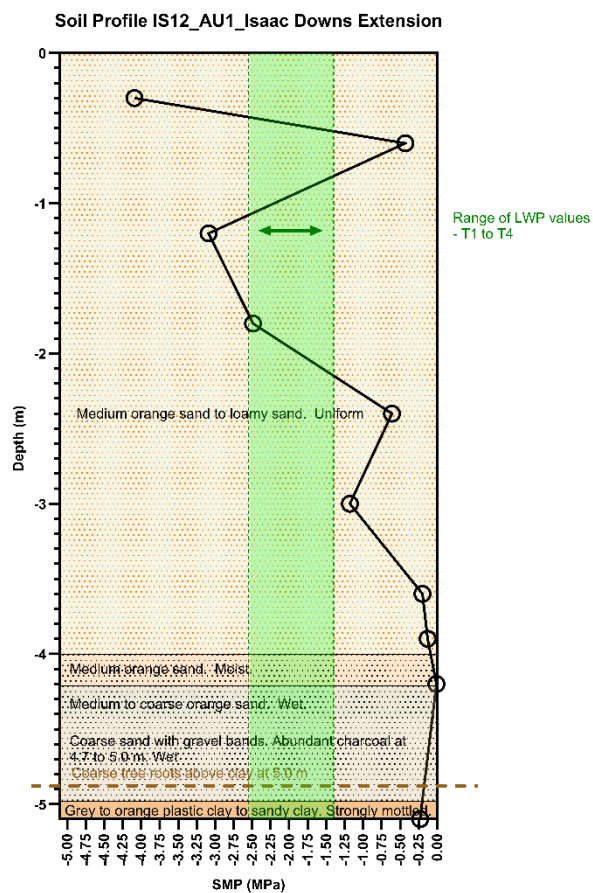


Figure 5-8. Auger IS12_AU1 in riparian vegetation on Cherwell Creek, showing the broad intersection between LWP and SMP down to 2.5 mbgl. Below this depth, the entire soil profile is available for transpiration.

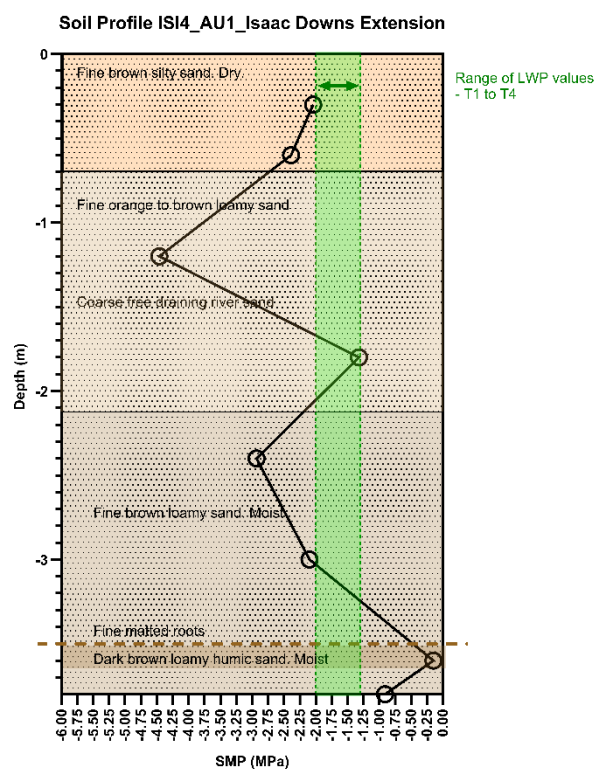


Figure 5-9. Auger IS14_AU1 from the riparian fringe of Cherwell Creek, showing intersection of bedrock at 3.7 mbgl, and general overlap between soil and SMP values below 2.4 mbgl.

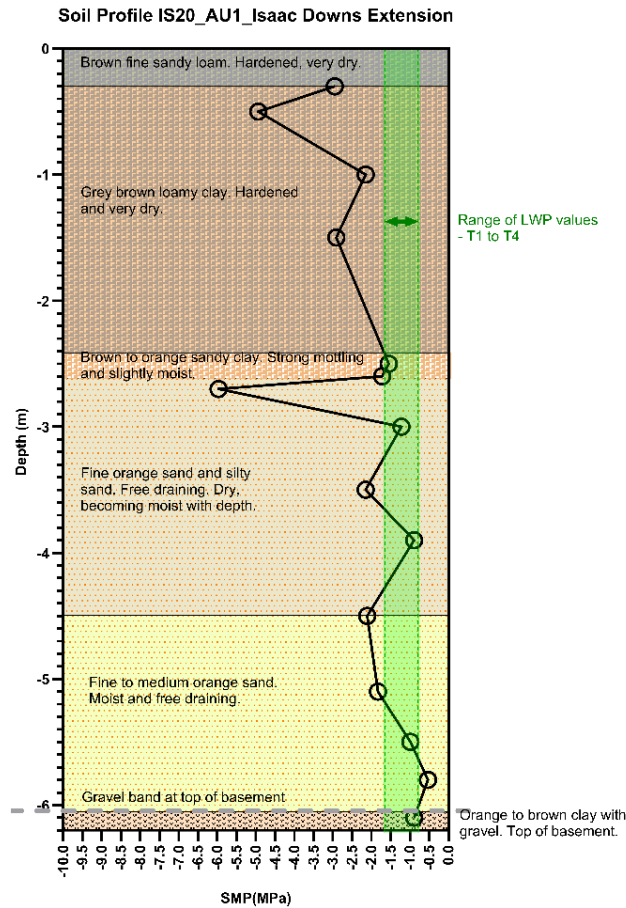


Figure 5-10. Auger hole IS20_AU1 at the HES wetland site (RE11.3.27b). Significant overlap between SMP and LWP occurs at depths >3mbgl, with soils becoming moister towards the base of the profile.

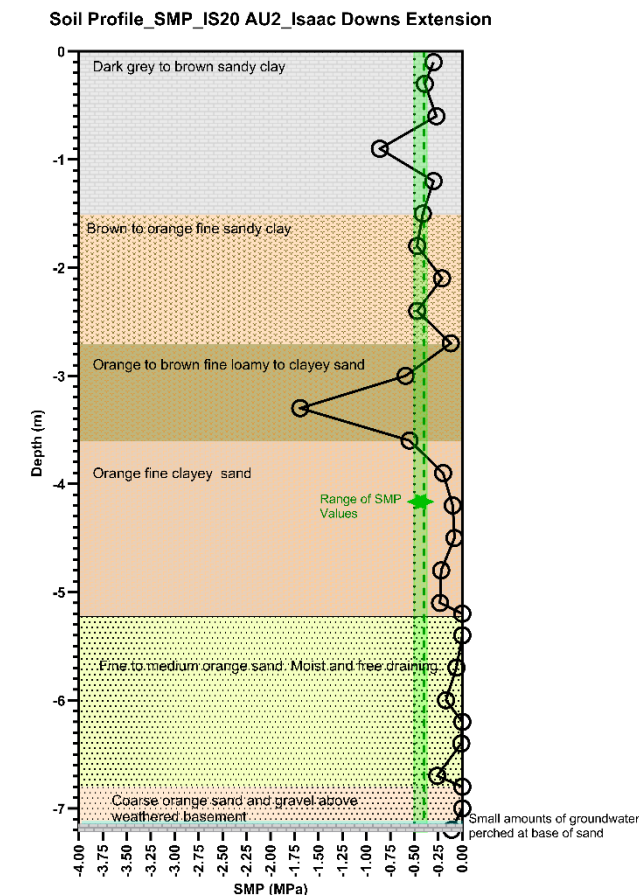


Figure 5-11. Auger hole IS20_AU2 at the HES wetland site (RE11.3.27b) completed in November 2025. The profile is significantly wetter than the November 2024 assessment with overlap between SMP and LWP occurring in the upper 3 m of the soil profile.

5.3 Stable Isotope Sampling and Analyses

Section 5.3 presents an analysis of stable isotope data collected from soils, twig xylem, groundwater and surface water during the assessment. The data is applied as an additional line of evidence to support biophysical measurements.

5.3.1 Stable isotope biplots and soil profiles

Stable isotopes ratios of oxygen and deuterium ($\delta^{18}\text{O}$ and $\delta^2\text{H}$) extracted from water found within the xylem of sampled twigs, soil, surface water and groundwater are represented in **Figure 5-12** to **Figure 5-24** with raw data provided in **Appendix D**. **Figure 5-12** represents data from water samples collected during throughout the Project as detailed in **Section 4.5**, demonstrating the following data trends:

1. Surface water values from all sampling events, including values from the HES Wetland and Isaac River have been evaporatively enriched, indicated by a substantial offset below the LMWL.
2. An isotopically depleted rainfall event occurred in April 2025, associated with an extensive tropical depression. Rainfall was sampled on 3rd April 2025 and recorded a $\delta^{18}\text{O}$ value of -14.62 ‰ and a $\delta^2\text{H}$ of -91.46 ‰.
3. The isotopically depleted rainfall (which would have influenced associated surface flows) was detected in groundwater extracted from the riverbanks in November 2025 at IDE5 ($\delta^{18}\text{O}$ value of -12.42 ‰ and $\delta^2\text{H}$ of -91.74 ‰), that was distinct from the isotope values reported in alluvial monitoring bores.
4. Isotopic values for from the Alluvial Aquifer (MBID023 and MBID028) were all consistent for the November 2024, May 2025 and September 2025 sampling events ($\delta^{18}\text{O}$ range -4.46 to -3.56 ‰ and $\delta^2\text{H}$ range from -22.05 to -26.06 ‰). For the November 2025 sampling event, the stable isotope values in MBID023 were significantly more depleted ($\delta^{18}\text{O}$ of -6.34‰ and $\delta^2\text{H}$ -44.19‰). suggesting that isotopically depleted groundwater extracted from the riverbank at IDE5 was influencing the composition of the Alluvial Aquifer, with a lag period of 6 – 8 months.

Isaac River Channel Sites: Assessment sites on the Isaac River channel include sites IS2, IS5, IS7, IS8, IS9, IS15, and IS17. Twig xylem isotope values from Isaac River samples form a cluster that is isotopically heavier (enriched in $\delta^{18}\text{O}$ through evaporation) and distinct from the cluster formed by groundwater samples (**Figure 5-13**). The lack of overlap between isotopic clusters formed by twig xylem and groundwater indicates that groundwater was not a significant source of moisture for riparian trees at the time of assessment. The twig xylem values however tend to lie consistently between the soil and surface water values, indicating that both sources likely contribute moisture to riparian vegetation. For Site IS5 in November 2025, xylem isotopes are substantially lighter than reported in November 2024, reflecting the influence of the isotopically light perched groundwater intersected in auger IS5_AU2. However, surface water and soil moisture were the predominant moisture sources utilised by riparian vegetation at Site IS5, when sampled in November 2025, with smaller quantities of perched groundwater. The contribution of perched groundwater may increase as soil moisture and surface water availability declines. **Photograph 5** shows the surface water expression at ID5, indicative of saturation of the Isaac River channel sand.

Downhole $\delta^{18}\text{O}$ profiles for augers IS2_AU1, IS8_AU1, and IS15_AU1 present mixed results. The profiles from IS2_AU1 and IS15_AU1 are shown in **Figure 5-14** and

Figure 5-15, respectively, indicating limited overlap between twigs and soil $\delta^{18}\text{O}$ values except in the upper portion of the soil profile. In comparison, the profile for IS8_AU1 (**Figure 5-16**) shows overlap between twig and soil values at depth in the soil profile, above the heavy clay at the base of the auger. These disparities tend to indicate moisture scavenging, with trees utilising moisture from various regions of the soil profile depending on availability.

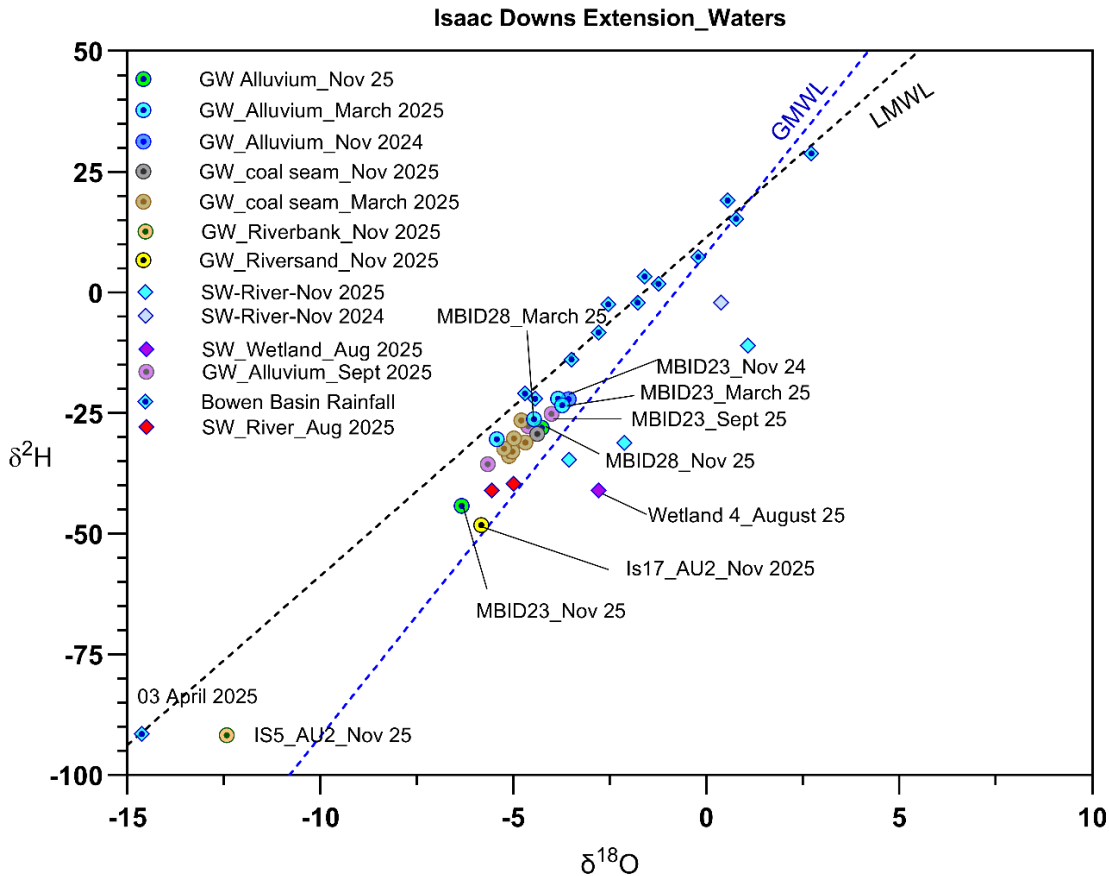


Figure 5-12. Stable isotope for water samples collected during the Project Assessment, showing the strong evaporative enrichment of surface water samples relative to groundwater. The dashed black line represents the LMWL developed from rainfall samples, and blue line represents the GMWL.



Photograph 5. Surface water sampled at IS5, in November 2025 with surface expression indicative of saturation of the Isaac River channel sand at that location.

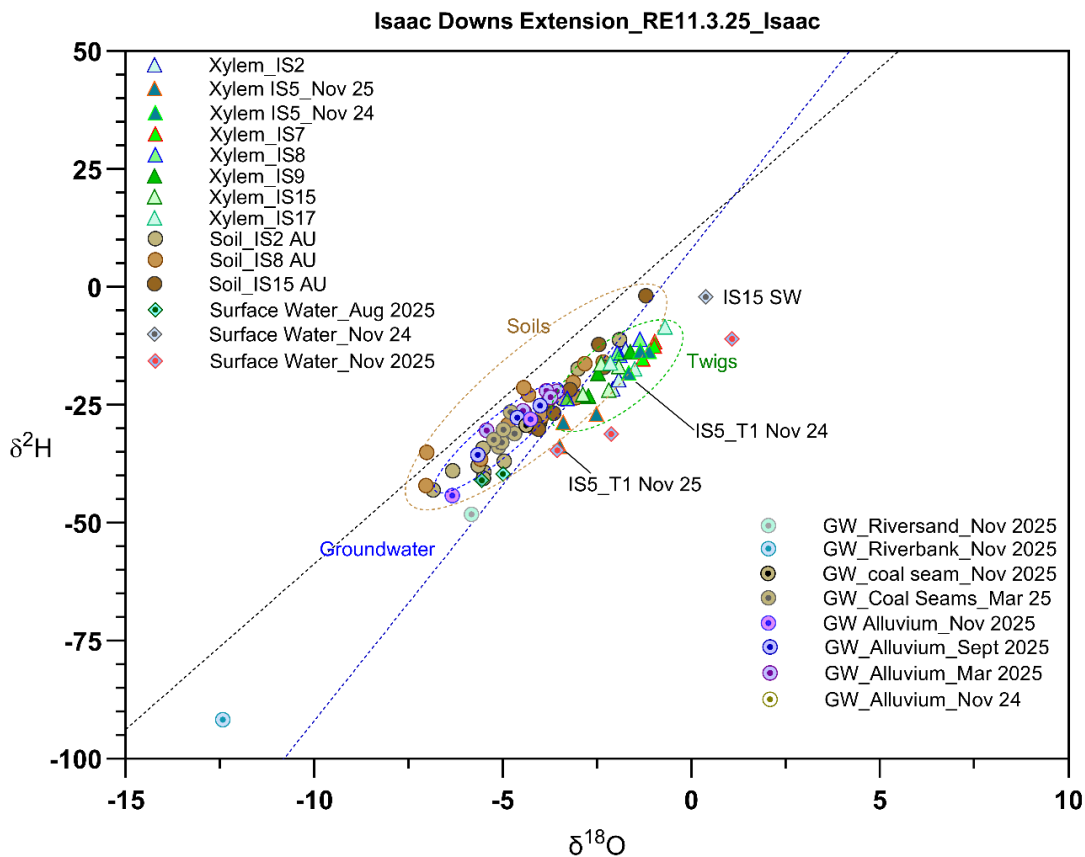


Figure 5-13. Stable isotope biplot for sites on the Isaac River channel showing a defined cluster of twig xylem samples (green dashed circle) that is clearly separated from the cluster formed by groundwater (blue circle), while overlapping with the soils (brown circle).

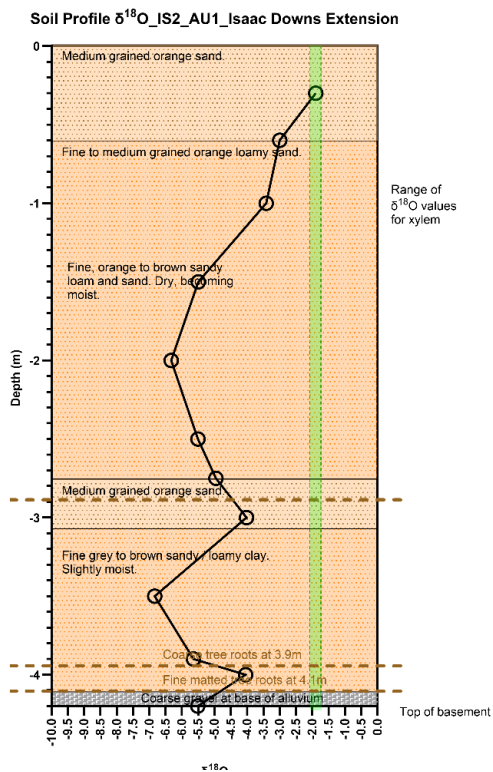


Figure 5-14. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for auger IS2_AU1. The data indicates overlap between $\delta^{18}\text{O}$ values reported for twig xylem and soils only near the soil surface (0.3 mbgl).

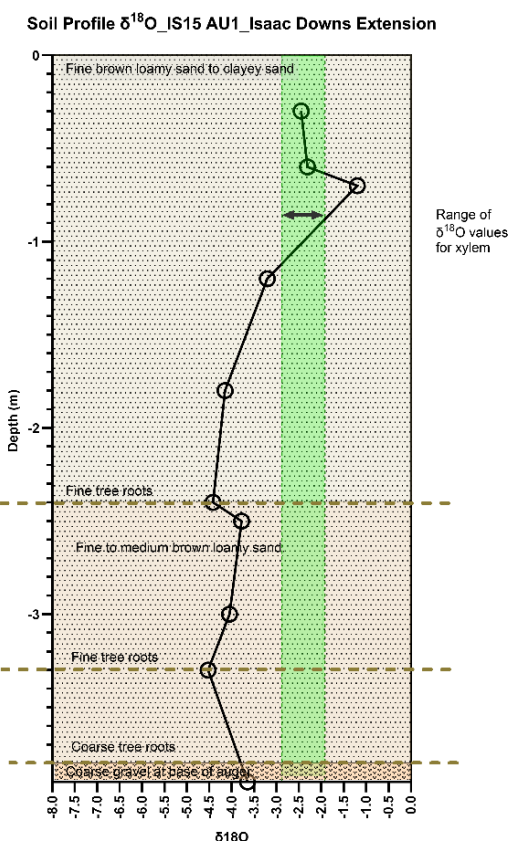


Figure 5-15. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for auger IS15_AU1. Consistent with IS2_AU1, the data indicates soil moisture uptake in the upper 1m of the soil profile.

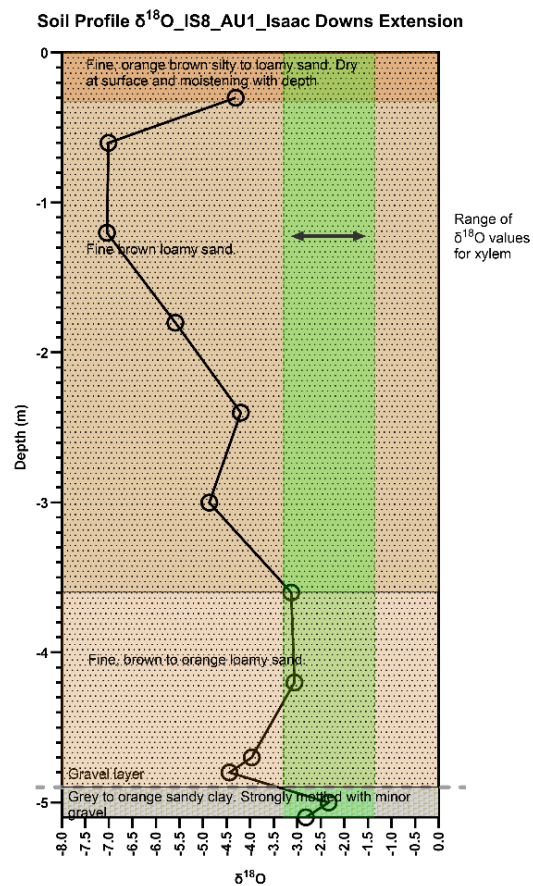


Figure 5-16. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS8_AU1. The overlap between xylem and soil isotope values occurs predominantly toward the base of the soil profile.

Cherwell Creek Sites: Assessment sites on the Cherwell Creek include sites IS10, IS12, IS14, and IS18. Twig xylem isotope values form a cluster that is distinct from the cluster formed by groundwater samples (

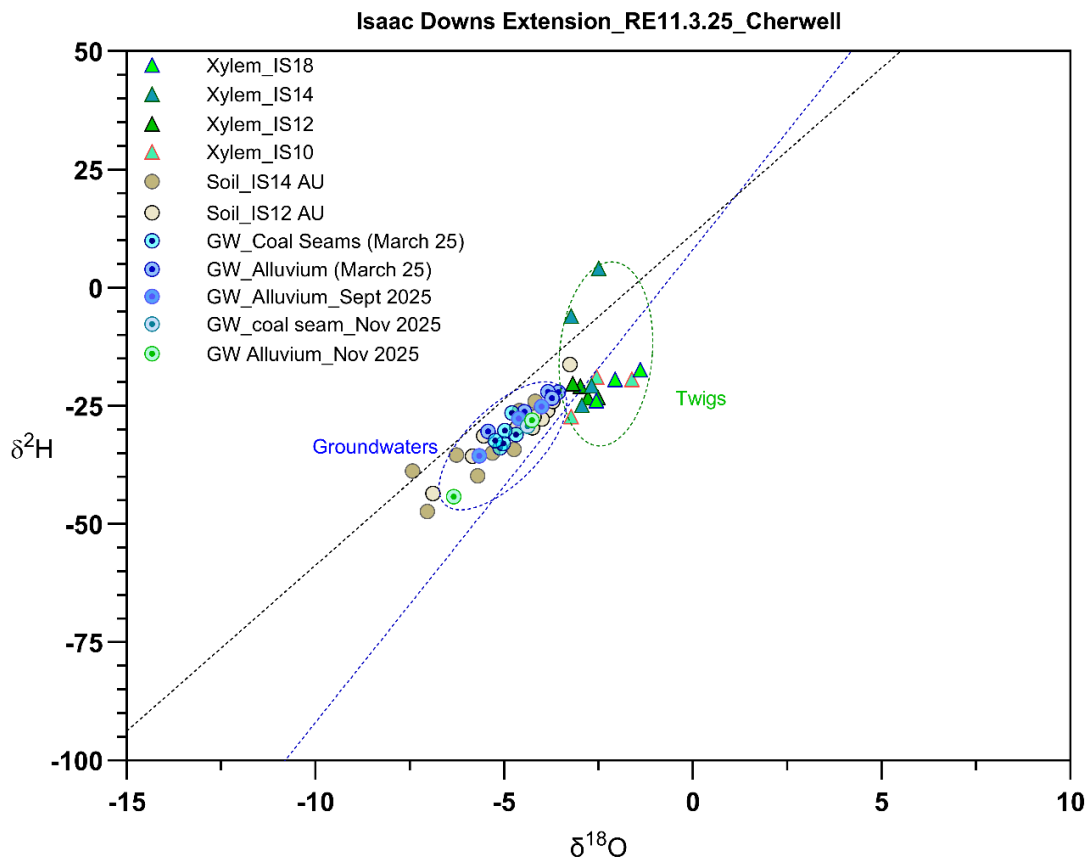


Figure 5-17) and is also separate from the cluster of soil samples. The lack of overlap between isotopic clusters formed by twig xylem and groundwater indicates that groundwater was not a significant source of moisture for riparian trees at the time of assessment. The downhole profile for IS12 (**Figure 5-18**) indicates overlap between $\delta^{18}\text{O}$ values for soils and xylem only in the upper 30 cm of the soil profile, and isotopic values depart significantly as soil depth increases. This indicates that trees are either utilising moisture from the upper 30 cm of the soil profile, or that strongly fractionated moisture vapour held in soil pore spaces is affecting values reported for twig xylem (the gas vapour fraction). The lack of overlap between twig xylem and soil samples demonstrates the complexities of moisture uptake in a drying soil profile. In this case, the gas vapour fraction of the soil profile may have had a significant influence on the isotopic results (Tetzlaff et al., 2020), which has ultimately confounded the relationship between soil and twig xylem values. This is further demonstrated in the downhole $\delta^{18}\text{O}$ profiles for IS14_AU1, (**Figure 5-19**) where the lack of overlap between twig and soil values is strongly evident. Regardless, there is no evidence that groundwater has been a significant source of moisture for riparian vegetation associated

with Cherwell Creek.

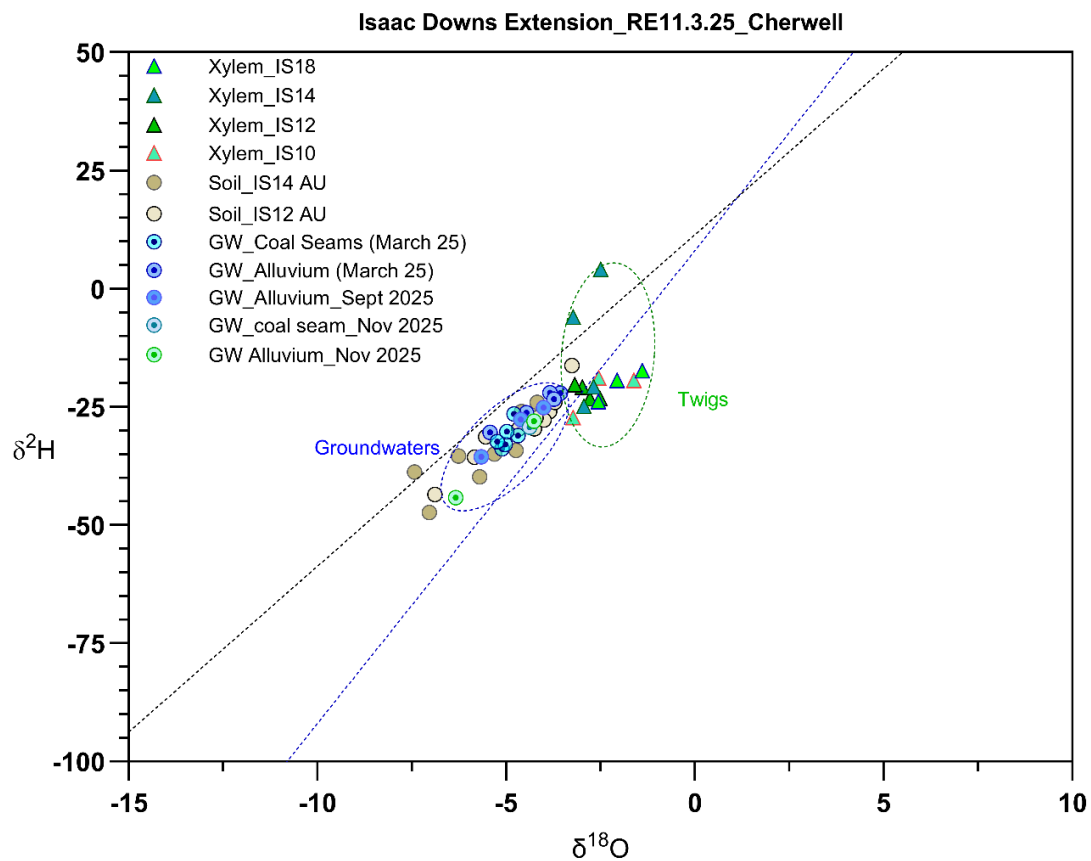


Figure 5-17. Stable isotope biplot for sites on the channel of Cherwell Creek, demonstrating separation of twig xylem values (green circle) from those of groundwater and soil moisture (brown circle). The black dashed lines represent the LMWL and GMWL respectively.

Soil Profile $\delta^{18}\text{O}$ _IS12_AU1_Isaac Downs Extension

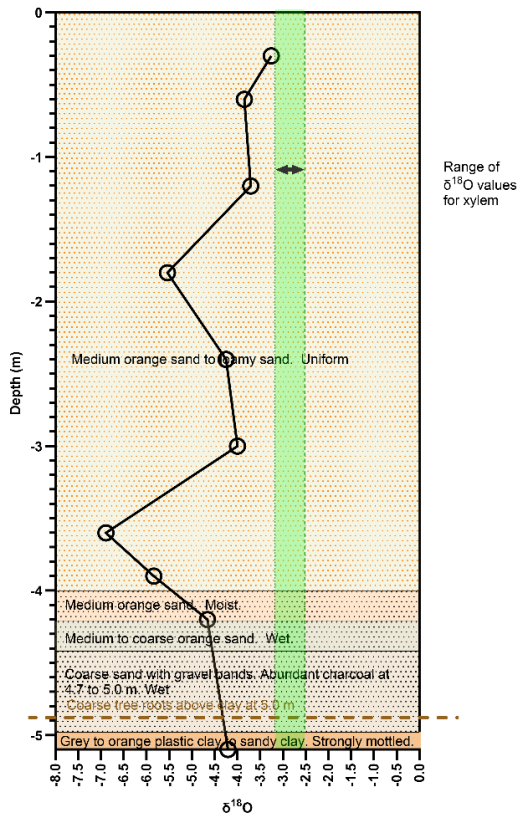


Figure 5-18. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS12_AU1. There is a distinctive lack of overlap between twig and soil values down the entire soil profile, except for at the surface.

Soil Profile $\delta^{18}\text{O}$ _IS14_AU1_Isaac Downs Extension

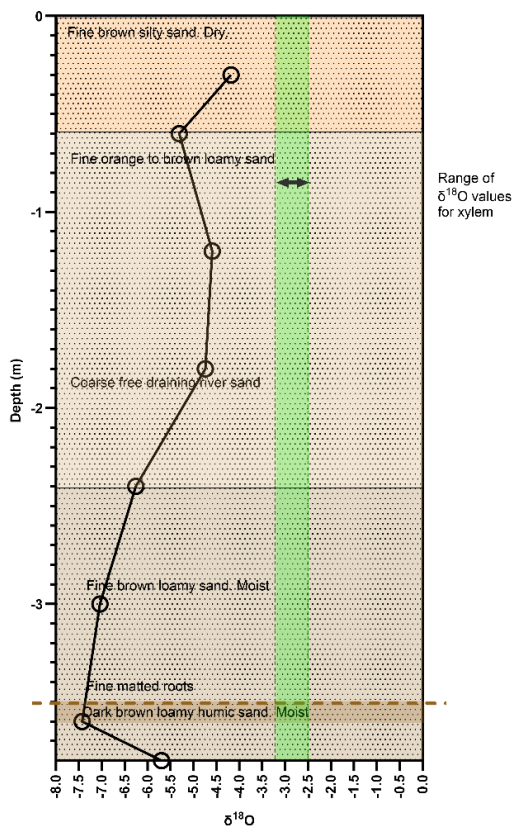


Figure 5-19. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS14_AU1, demonstrating a distinctive lack of overlap between twig and soil values down the entire soil profile.

HES Wetland Site IS20: Figure 5-20 illustrates the Stable isotope results from the floodplain wetland (site IS20). Three sampling events are indicated including August 2023 (undertaken for Poitrel Mine), November 2024, and November 2025 assessments.

For the August 2023 and November 2024 assessments, twig xylem isotope values form clusters that are distinct from the groundwater clusters, and limited overlap with the soil isotope values. The lack of overlap between isotopic clusters formed by twig xylem and groundwater indicates that groundwater was not a significant source of moisture for riparian trees at the time of assessment. The lack of overlap between twig xylem and soil samples also suggests that the interaction between tree roots and the soil gas vapour fraction may have influenced the isotopic results. The downhole $\delta^{18}\text{O}$ profile for IS20_AU1, shown in Figure 5-21, further demonstrates the disjunct between soil and twig xylem isotopic values with overlap only occurring at the soil surface (0.3 mbgl). Based on the isotopic data, there is no evidence that groundwater from Coal or Alluvial Aquifers formed a significant source of moisture for deep-rooted wetland vegetation at the HES wetland in August 2023 or November 2024.

Soil sampling was completed at consistent 0.3 m intervals after the auger was shifted in November 2025 to give greater resolution to soil isotope variations (Figure 5-21). The November 2025 data indicate that the xylem isotope cluster has shifted toward lighter isotopic compositions, with substantial interaction between xylem and soil samples, both showing consistent offsets below the LMWL. The $\delta^{18}\text{O}$ profile suggests substantial interaction between soil and twig xylem values from 0.2 to 3.5 mbgl, and in the free-draining sand from 5.2 mbgl to the base of the auger at 7.2 mbgl, consistent with the SMP profile (Section 5.2). Combined, SMP and isotope sampling provide strong evidence that moisture was derived from the soil profile in November 2025, with possible minor contribution from small quantities of groundwater perched above the basement contact.

Sites associated with Poplar Box RE 11.5.3: Figure 5-23 provides a biplot comparing the isotopic composition of tree xylem sampled from sites within poplar box dominant habitats (sites IS3, IS11) with the isotopic compositions of groundwater both from coal seams and alluvium. The data demonstrates a relatively tight cluster of twig xylem values that has a weak overlap with groundwater sources. The LWP values for these sites confirm that trees are not interacting with a saturated source of moisture (Section 5.1), and that the vadose zone is the dominant source of moisture supporting transpiration. The weak overlap in values is therefore an artefact of the isotopic similarities between soil moisture and groundwater sources.

Sites associated with the Brigalow TEC: Figure 5-24 provides a biplot comparing the isotopic composition of tree xylem sampled from sites within the Brigalow TEC (RE11.3.1 and 11.4.9 represented in sites IS1, IS4, IS13, and IS16), with the isotopic compositions of groundwater both from coal seams and alluvium. Like poplar box habitats, the data demonstrates a relatively tight cluster of twig xylem values that has a weak overlap with groundwater sources. The LWP values for these sites are extremely negative, confirming that trees are not interacting with a saturated source of moisture (Section 5.1) and that the vadose zone is the dominant source of moisture supporting transpiration. The weak overlap is therefore an artefact of the isotopic similarities between brigalow's soil moisture sources and groundwater.

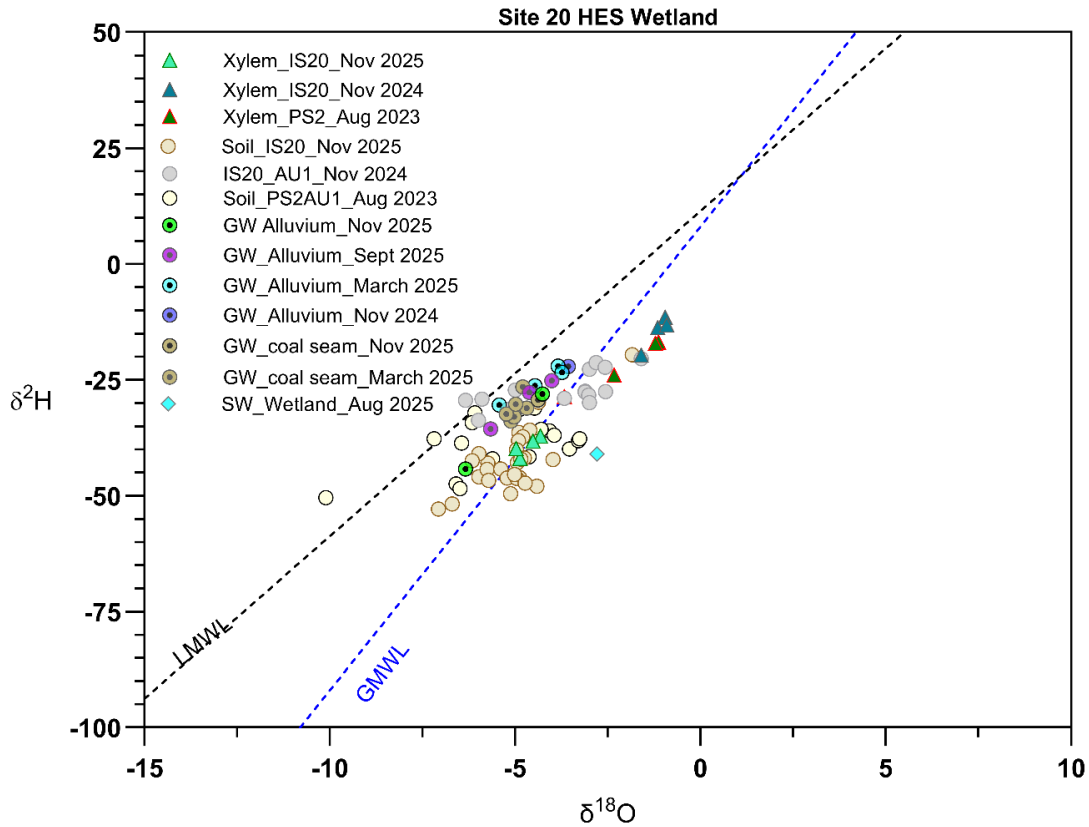


Figure 5-20. Stable isotope biplot for site IS20, at the HES Wetland near the confluence of Isaac River and Cherwell Creek, demonstrating separation of twig xylem values (green circle) from those of groundwater, and only weak overlap with soil moisture (brown circle). The black dashed line represents the LMWL.

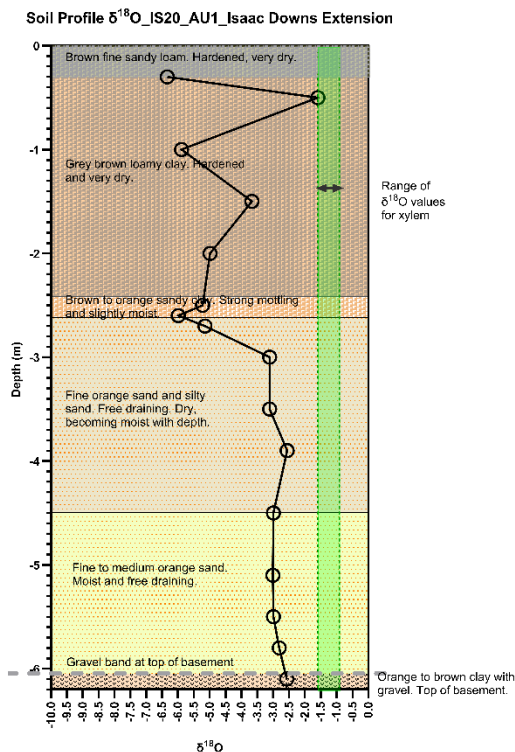


Figure 5-21. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS20_AU1. There is a distinctive lack of overlap between twig and soil values down the entire soil profile, except for at the surface

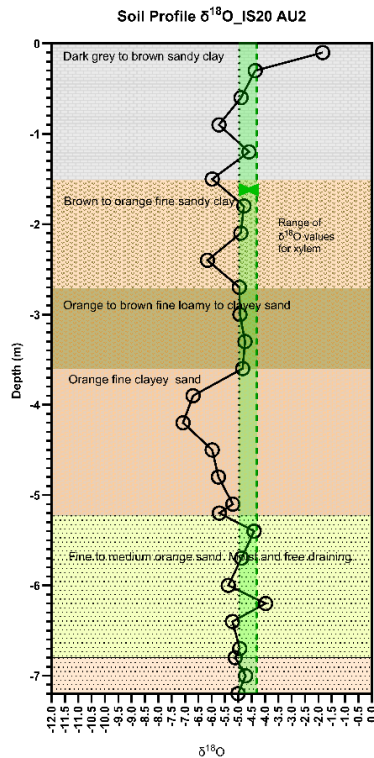


Figure 5-22. Downhole $\delta^{18}\text{O}$ profile reconciling soil moisture isotope values with those reported for twig xylem for site IS20_AU2 in November 2025. There is strong overlap between soil and xylem stable isotope values from surface to 3.5 mbgl, and also from 5 mbgl to the base of the profile at 7.2mbgl.

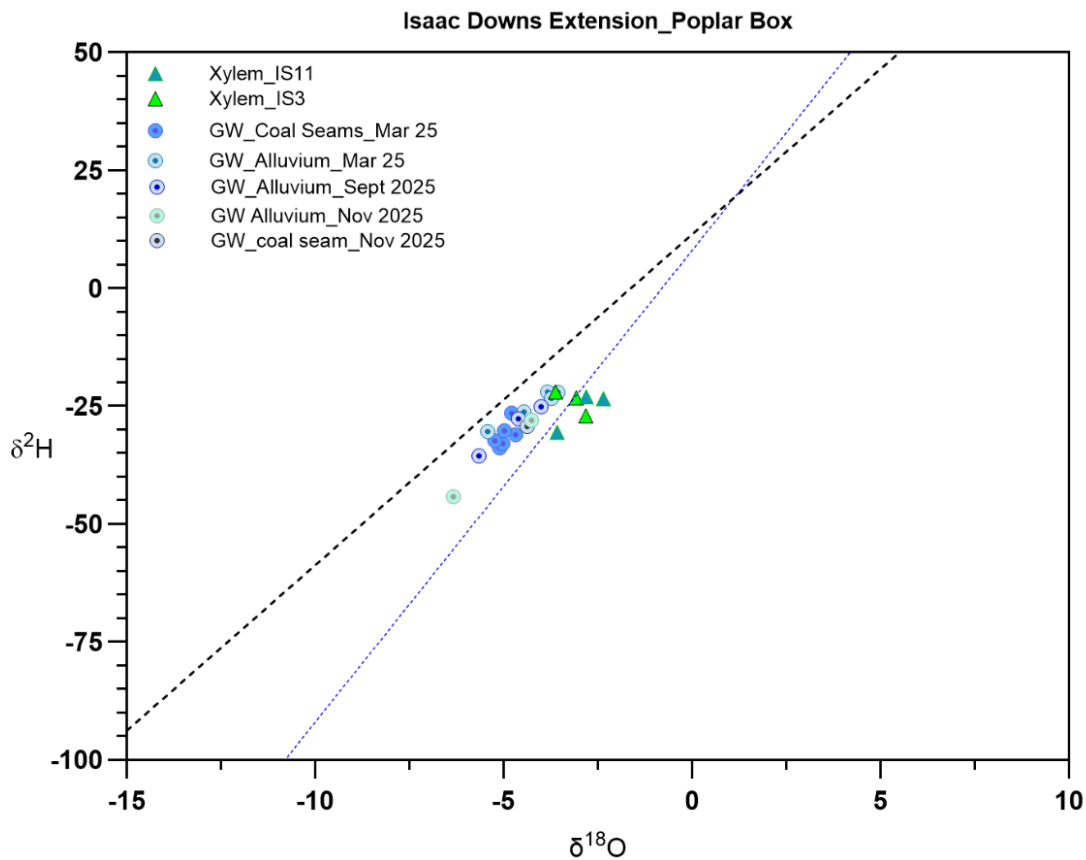


Figure 5-23. Stable isotope biplot for poplar box sites IS3 and IS11, demonstrating the weak overlap between isotopic values of twig xylem (green circle) and groundwater (blue circle). The black dashed line represents the LMWL. Material was not submitted for isotope analysis at IS19, on account of the extremely negative pre-dawn LWP values.

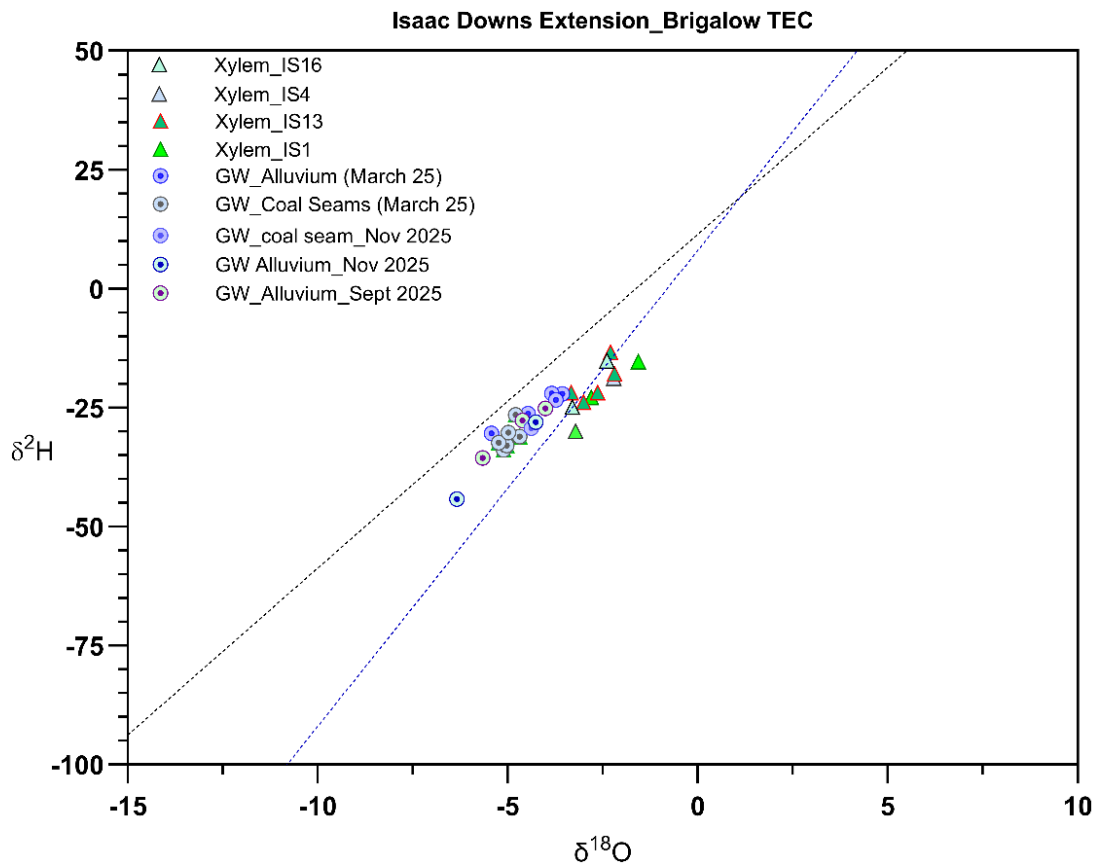


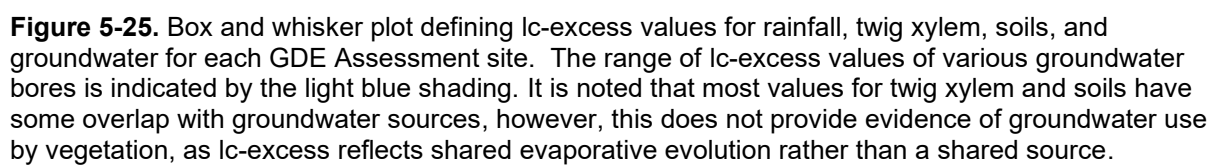
Figure 5-24. Stable isotope biplot for Brigalow TEC sites IS1, IS4, IS13 and IS16, demonstrating the weak overlap between isotopic values of twig xylem and groundwater. The black dashed line represents the LMWL and blue dashed line the GMWL.

5.3.2 Line Conditioned Excess

Figure 5-25 provides box and whisker plots for lc-excess values from all GDE assessment sites and moisture sources. lc-excess excess indicates the evolution of various moisture sources away from their meteoric origin. Trees that have strongly negative line conditioned excess value are utilising moisture that has undergone significant degrees of evaporative enrichment, while trees with higher values are utilising moisture that has evolved little from its primary meteoric source, which is isotopically variable along the LMWL in time and space.

The line conditioned excess data indicates that isotopic values from all sources, including groundwater from coal seams, soils, and twig xylem, form a broad range of values that are mostly offset significantly below the LMWL (i.e., the lc-excess value of rainfall). The consistently negative values indicate the effects of evaporative enrichment on rainfall and derived sources of groundwater recharge, such as surface water, before and during infiltration into the soil profile. Some groundwater samples from alluvial sources, however, align with meteoric values, indicating the likelihood that some rainfall recharge of the alluvial groundwater system occurs through rapid (preferential) flow with limited surface residence time. Similarly, the spread of twig xylem lc-excess values for the Cherwell Creek site IS14,

Overall, the overlap in the lc-excess data indicates a continuum of isotopic values from rainfall, soil moisture, surface water, and moisture users, such as deep-rooted woody vegetation. Despite this overlap, the lc-excess plot does not provide evidence for any significant use of groundwater by woody vegetation at any of the assessment sites, as lc-excess reflects shared evaporative evolution rather than a shared source.



While radon is an important tracer for detecting groundwater baseflow into surface waters, combining radon with other chemical tracers enhances its utility for differentiating groundwater reservoirs.

sampling in the HES Wetland (IS20) and Isaac River surface waters (S1 and S2) indicates very low radon concentrations (0.08 to 0.39 Bq/L) and low EC (<500 $\mu\text{S}/\text{cm}$) providing evidence for a meteoric origin and limited groundwater influence. Although the surface water sample from IS15 (IS15_SW2) retained low radon concentration in November 2025 (0.38 Bq/L), increases occurred in other surface water samples (1.36 – 2.24 Bq/L). Sampling completed for alluvial aquifer bores in September 2025 (MBID023, MBID028, MBIS04) indicates elevated radon (6 – 8 Bq/L), providing the groundwater ‘end member’ radon concentration. Radon concentration in the single sampled coal seam is relatively low compared to groundwater in alluvial aquifers, suggesting lower levels of uranium- and thorium-bearing minerals in the coal seams and lower radon emanation rates (Hoffman and Marshall 2025).

The third phase of radon sampling, completed in November 2025, re-sampled MBID028 and MBID023, and sampled groundwater extracted from river sand, riverbanks, and residual surface waters in the Isaac River late in the dry season (**Photograph 6**). Data from the third phase indicate that radon values in the alluvial aquifer fall within the same cluster as the September samples, with variable concentrations possibly the result of differing sampling techniques (November 2025 wells were purged and sampled using a stainless-steel bailer). Radon concentrations in the river sand, riverbanks, and residual surface waters (except for IS15_SW2) form a distinct cluster, with radon concentrations and EC values lower than those in the alluvial monitoring bores, though higher than those in the August 2025 surface waters.

The radon–EC relationships indicate that residual surface waters and water extracted from river sands share similar signatures, reflecting limited but detectable interaction with bank stored water, while both remain clearly distinct from the higher-radon groundwater of the alluvial aquifer. This separation reinforces the interpretation that surface pools and shallow riverbank waters are influenced by shorter-term hydrological processes rather than direct discharge from the deeper alluvial groundwater system.

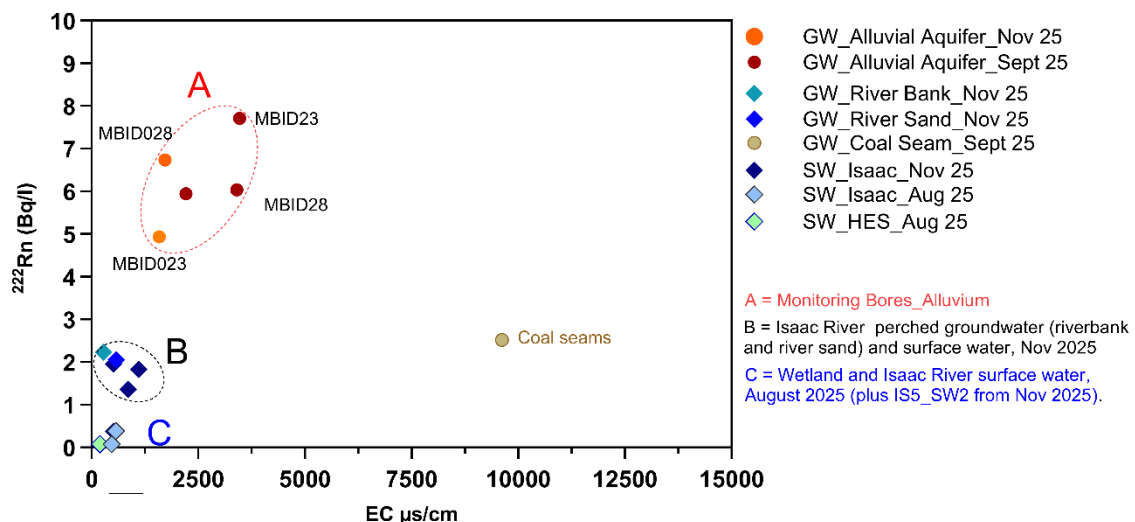


Figure 5-26. Radon activity (Bq/l) plotted against EC demonstrating three distinct clusters formed by the Alluvial Aquifer, perched groundwater and residual surface water in November 2025, and the August 2025 surface water. The single coal seam sample represents a high EC, low radon end member.



Photograph 6. Residual pool on the Isaac River at site IS8 in November 2025, representing a restricted water table window in the perched groundwater unit.

6.0 Discussion and Conceptual Site Models (CSMs)

Data from LWP measurement, soil augering, and SMP measurements provide evidence of tree moisture usage at the time of the assessment (late-dry season), demonstrating the following:

1. Combined application of LWP and SMP measurements demonstrates riparian vegetation (RE11.3.25) fringing both the Isaac River and Cherwell Creek, was utilising soil moisture in the unsaturated portion of the soil profile to support transpiration at the time of the November 2024 assessment. The stable isotope composition of tree xylem is substantially enriched and distinct from other sources, possibly influenced by surface water usage where this is available. Isotopic data from Site IS5 in November 2025 indicates increased use of water in the perched groundwater unit by riparian vegetation, though soil moisture and surface water remained the dominant moisture sources.
2. Similarly, deep-rooted woody vegetation both within and fringing the HES wetland (Site IS20) was utilising moisture sourced from the vadose zone in November 2024, preferably utilising moisture from an unsaturated interval of sand that formed a 3m thick massive sequence above weathered basement rock. When sampled in November 2025, the soil profile carried substantially more moisture, and wetland trees were using moisture held throughout the soil profile, including the potential use of small volumes of groundwater, attributed to surface infiltration, that was perched in sand above weathered Permian sediments.
3. For the poplar box (RE11.5.3) and Brigalow TEC habitats (RE11.3.1 and 11.4.9), the highly negative LWP measurements confirm that trees are utilising moisture tightly bound to soil grains within the vadose zone, and not groundwater.

Despite the lack of demonstrated groundwater use at the time of the November 2024 assessment for any habitats within and surrounding the Project area, the saturation of soil profiles and seasonal perching of groundwater above impervious strata and the regional water table is likely to occur during wetter climatic periods following moisture recharge by rainfall and surface flows. Increased volumes of groundwater from the perched groundwater unit (as distinct from the deeper alluvial aquifer) were demonstrated during sampling in November 2025, intersected in auger profiles at sites IS5 and IS20 in a lower terrace of the Isaac River, and the HES wetland respectively. Although seasonal in nature, and being discharged through evapotranspiration as the climate dries, the accumulation of groundwater (in the perched groundwater unit) in the root zone of woody vegetation is consistent with the definition of a 'terrestrial' GDE. Where groundwater use occurs, it is restricted to the immediate riverbanks where trees interact directly with perched groundwater unit, and not with the deeper alluvial aquifer.

Sandy soils facilitate the rapid infiltration of rainfall and surface flows, while also having the capacity to store and transmit groundwater, typically found within the channel and stream banks of the Isaac River and Cherwell Creek. The thick sandy interval lying below the HES wetland will be variably saturated during wet seasons through downward leakage of surface waters. The pervasive intense iron oxide staining evident in the thick sand interval suggests sustained wetting and moisture infiltration rather than prolonged saturation which would result in iron dissolution (Taylor and Eggleton, 2003). Perching of small volumes of groundwater at the base of the sandy interval was confirmed during November 2025 auger

sampling, though groundwater perching only occurs following significant surface pondage and associated leakage. Perched groundwater in this wetland is not associated with the deeper alluvial aquifer.

Radon sampling provided additional context to the partitioning of groundwater with the alluvium, particularly the differentiation of the alluvial aquifer and the perched groundwater unit. Surface water was abundant in the Isaac River, consistent with ponding in the HES wetland in August 2025. Surface water from this sampling event is rainfall-derived on account of its low radon concentration and low EC. Most isolated residual pools sampled in the Isaac River in November 2025 had more elevated radon concentrations, consistent with groundwater in the perched groundwater unit (both in the river sand and the riverbank). The increased radon concentrations in November 2025 suggest that the residual waterbodies in the Isaac River are a surface expression of the perched groundwater unit, encompassing groundwater in the river sand and riverbank. The perched groundwater unit is distinct from the alluvial aquifer sampled in monitoring bores, and groundwater from the perched unit slowly leaks into the alluvial aquifer, providing a source of recharge to it. Data from stable isotopes suggests that leakage is diffuse and slow, with the first evidence of groundwater influx from the perched groundwater unit to the alluvial aquifer taking several months.

Figure 6-1 (a) provides a dry season ecohydrological conceptualisation of the Isaac River and the HES wetland, based on auger profiling, coupled with LWP and SMP measurements, and stable and radiogenic isotope assessments. The model demonstrates the partitioning of the perched groundwater unit and the alluvial aquifer, the slow leakage of groundwater from the perched groundwater unit to the alluvial aquifer, plus the use of the perched groundwater unit by fringing riparian vegetation. The hydrological function of the lower reaches of Cherwell Creek mimics the Isaac River, except for shorter flow duration and more rapid discharge of water from the river sand. The IDE Groundwater Impact Assessment (SLR 2026a) indicates that the Permian sedimentary basement shallows upstream and attenuates along Cherwell Creek, where alluvium is confined to the immediate river channel and terrace. The westward shallowing of alluvium is consistent with observations at Site IS14, where outcrops of the Permian basement are visible in road and river cuttings (near Site IS14 and upstream).

Soil profiling at the HES wetland indicates a thick, free-draining sand unit down to 7.2 mbgl (IS20_AU2), with coarse river sand at the base, suggesting that the wetland feature forms on a river paleochannel. This sand is moist to wet, depending on rainfall recharge. Small volumes of groundwater seasonally perch in the sand above the basement contact with weathered Permian sediments, where they may contribute to moisture use by deep-rooted wetland vegetation. The 2.5m-thick sequence of clay that forms the wetland floor limits surface water infiltration, facilitating surface water accumulation during the wet season. However, the deep wetting of the soil profile and associated highly negative soil I_c -excess values recorded in November 2025, suggest that infiltration of surface water into the wetland soil profile occurs through diffuse matric flow rather than more rapid preferential flow along fractures.

The wet season conceptualisation shown in **Figure 6-1 (b)** demonstrates recharge of the perched groundwater unit hosted in recent/active alluvia on the inner banks of the Isaac River. Flooding drives surface water into the riverbanks during seasonal 'wet-ups' and associated flooding, creating a bulge in the perched groundwater table. This 'bank storage' is

utilised by the bulk of the riparian vegetation fringing the Isaac River channel and the lower reaches of Cherwell Creek, with the degree of utilisation diminishing in trees positioned progressively higher upslope along the riverbanks. The seasonal bank storage has a weak unsaturated hydraulic linkage to the deeper alluvial aquifer. However, it predominantly discharges back into the river as surface flows subside or depletion occurs through evapotranspiration. The discharge of bank storage back into the river, as surface flows subside, extends the period of river flow and sustains water levels in the river sand (Figure 6-1 (c)). The persistence of surface pools depends on climatic variables and fluvial processes that form channel hollows to expose the perched groundwater unit. The residual pools, however, are spatially restricted and rapidly diminish in size and extent as the perched groundwater unit discharges during dry climatic periods.

Figure 6-1 (a). Dry season conceptual model

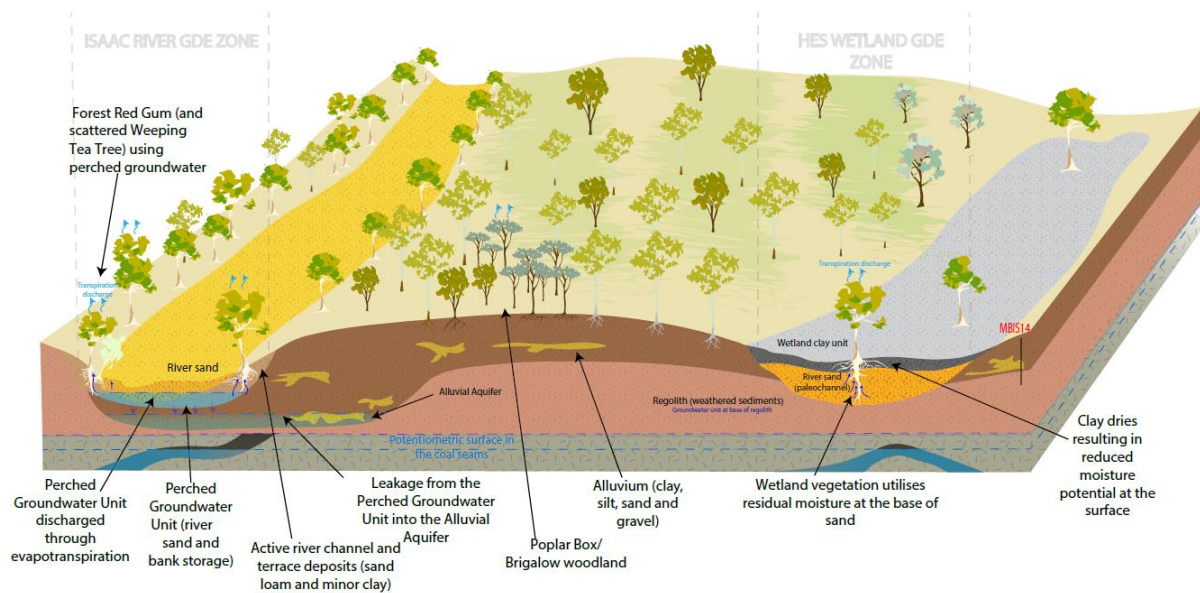


Figure 6-1 (b). Wet season conceptual model

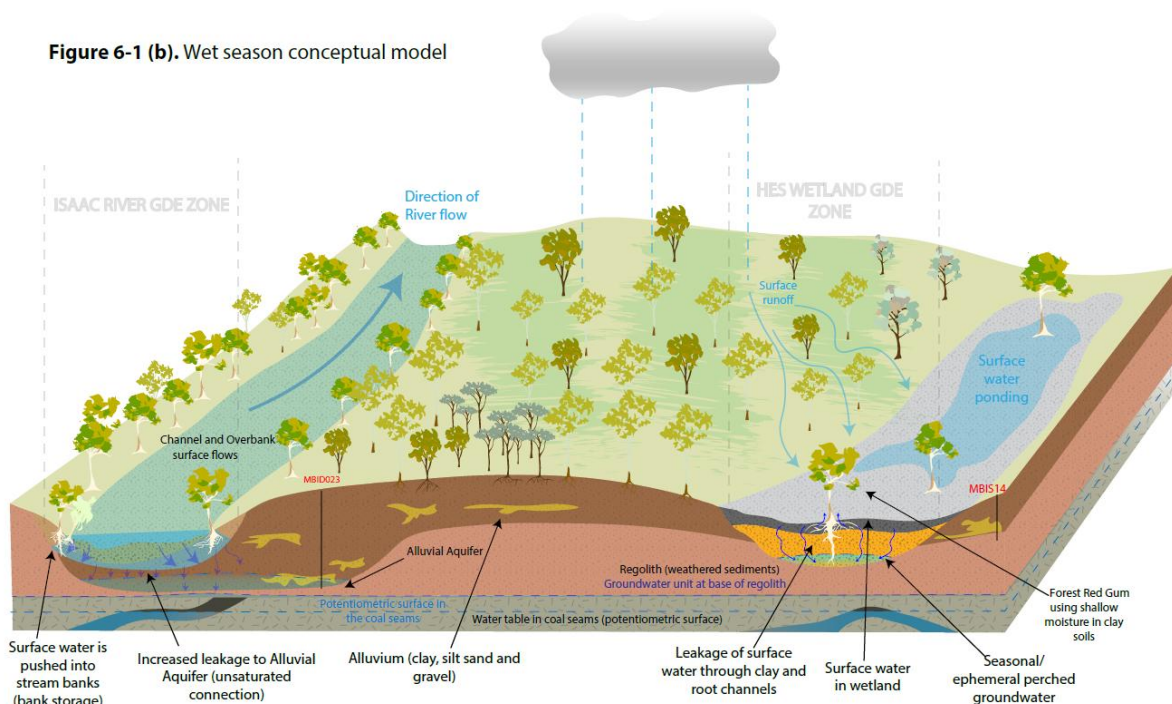


Figure 6-1 (c). Post wet season conceptual model

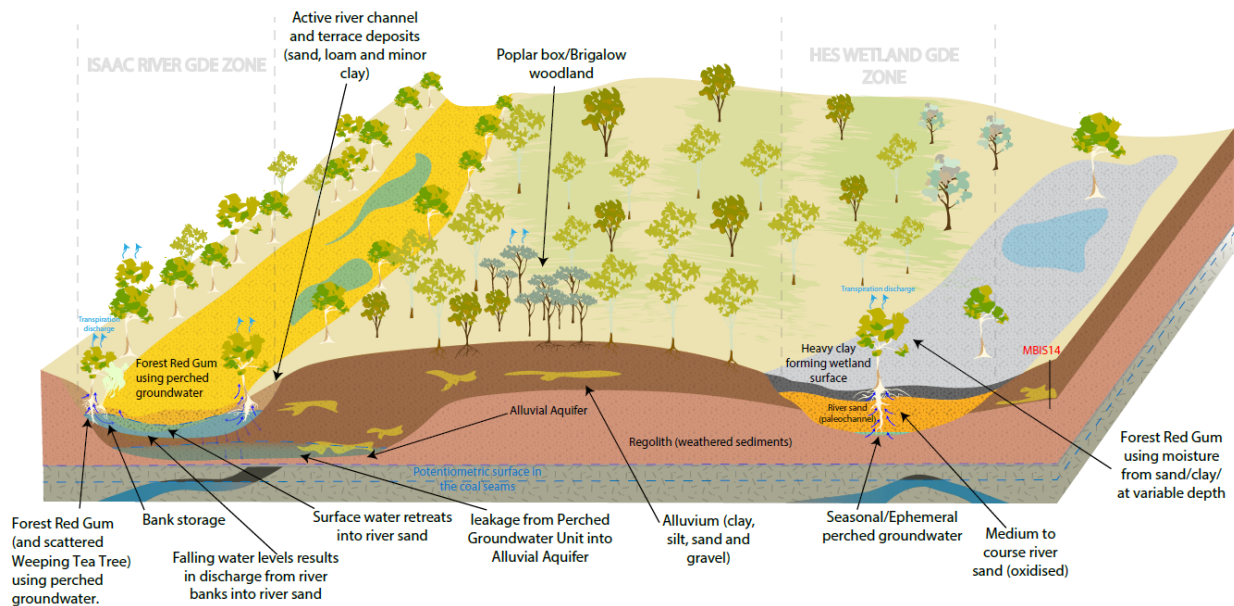
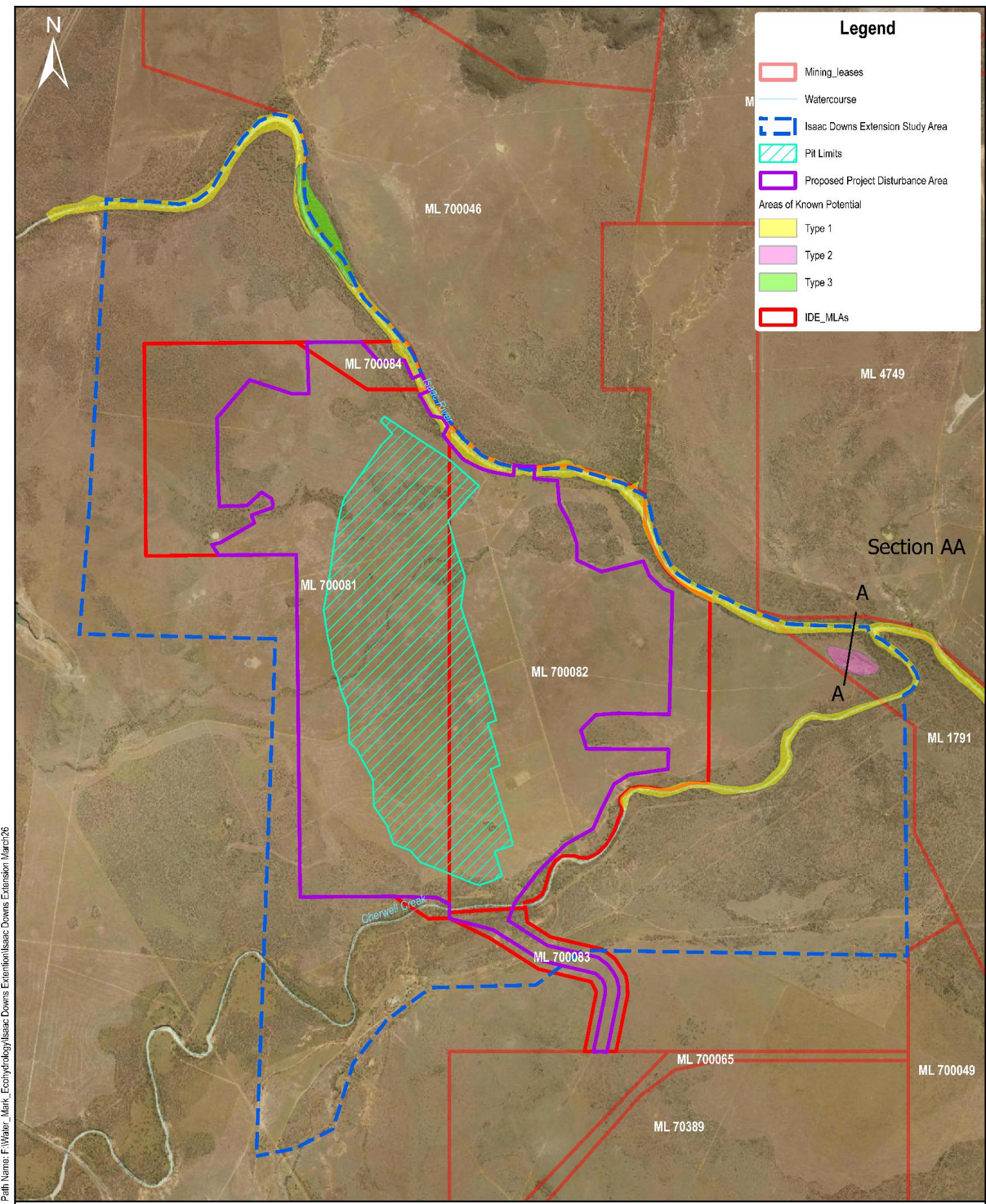


Figure 6-1. Conceptual models demonstrating the ecohydrological function of the Isaac River and associated HES wetland including the dry season model (**Figure 6-1 (a)**), the wet season model (**Figure 6-1 (b)**), and post-wet model (**Figure 6-1 (c)**).

Wet season ponding of surface water in the HES wetland is also responsible for the most substantial moisture recharge of the wetland soil profile and associated perched groundwater. Evapotranspiration regulates discharge from the perched groundwater units associated with both the Isaac River and the HES wetland during drying cycles. As perched groundwater depletes seasonally, reliance on soil moisture to support transpiration increases.

Although not detected during the current field assessment, the IDM GDE Baseline Assessment (3d Environmental 2023b) concluded that periodic use of small quantities of groundwater from the regional alluvial groundwater table (as distinct from the perched groundwater unit) by woody riparian vegetation (RE11.3.25) occurs, particularly where this groundwater is <10 mbgl (e.g., monitoring bores MBID27 and 28). Never-the-less there remains a very low likelihood of use of groundwater from the deeper alluvial aquifer based on the current data. Any use of alluvial aquifer water by riparian vegetation is, however, not widespread and extensive. Immersion of the riparian tree root zone in a seasonally fluctuating perched groundwater unit will however occur during seasonal flow events, where it is associated with bank recharge and storage, implying that groundwater dependence on the perched groundwater unit is seasonal. Away from the river, groundwater usage is restricted by the shallow rooting depth of vegetation, increased aquifer salinity, and increased depth of the regolith groundwater unit. The most significant control on groundwater dependence across the study area is a lack of well-developed alluvial deposits, except for the relatively narrow Isaac River floodplain and thin slivers of alluvium attenuating upstream along the larger tributary streams (e.g., Cherwell Creek). The lack of significant alluvium away from the Isaac River channel means that, away from the drainage channels, the base of the regolith or coal seams hosts the shallowest groundwater sources.

In summary, the local extent of GDEs within and surrounding the Project area is restricted to the margins of the Isaac River, attenuating upstream along Cherwell Creek. The likelihood of GDEs pinches out upstream along Cherwell Creek due to shallowing of the sedimentary basement toward the west, associated with a thinning of the alluvium. Additional terrestrial GDE areas may coincide with the HES wetland near the confluence of the Isaac River and Cherwell Creek. Field evidence suggests that groundwater reliance in this wetland is seasonal, with groundwater recharge driven by infiltration of ponded surface waters, and groundwater is rapidly discharged via transpiration as the climate dries. **Figure 6-2** shows the location of riverine (Type 1) and wetland (Type 2) GDEs within and surrounding the Project area. Type 3 GDEs represent areas that have extended water availability through drier seasonal periods, as identified in the IDM GDE assessment (3d Environmental, 2020a).



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Scale: 1:59,256 @A4 0 1 2 K Coordinate System: GDA 2020 MGA Zone 55 A4

Figure 6-2. The location of known / likely GDE areas including riverine (Type 1) and wetland (Type 2) GDEs relative to the Isaac Downs Extension area

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7.0 Assessment of Impacts to GDEs

Section 7.1 provides a summary of the hydro-ecological conceptual understanding of the GDE types within the potential impact area of the Project. Potential impact mechanisms and their relevance to GDEs within the assessment area are discussed in **Section 7.2** with impact concepts modelled in **Section 7.3**. Measures for impact mitigation and management are provided in **Section 7.4**, and a risk assessment has been undertaken in **Section 7.5** consistent with the approach identified in the IESC summary guide – assessing groundwater dependent ecosystems (IESC 2019).

A standalone Groundwater Dependent Ecosystem Management and Monitoring Plan (GDEMMP) has also been prepared by WMECO for submission with the Project EIS. This document has been prepared to manage the environmental impacts of the Project on GDEs, and details the applied monitoring actions, analysis methods, reporting requirements, and corrective action responses to be applied consistently throughout the life of the Project (see **Section 7.4.4**).

7.1 Summary of Findings Relevant to Impact Assessment

As discussed in **Section 6.0**, data from groundwater monitoring, soil profiling, and radon sampling indicate groundwater partitioning in the alluvium, with a perched groundwater unit directly linked to recharge from Isaac River surface flows and a deeper alluvial aquifer linked through an unsaturated connection. Riparian vegetation on the Isaac River uses groundwater from the perched groundwater unit seasonally (when recharged). However, it shifts to predominantly using soil moisture when the perched groundwater unit dries. There was no evidence for vegetation use of the deeper alluvial aquifer at the time of the November 2024 assessment. Never-the-less there remains a very low likelihood of sporadic use of the deeper alluvial aquifer by riparian vegetation patches during periods of extreme drought. In contrast, reaches of Cherwell Creek within the Project area lack development of the perched groundwater unit, and riparian vegetation persists primarily due to its use of soil moisture.

Riparian vegetation associated with a mapped HES wetland demonstrated groundwater use patterns like those of the Isaac River: groundwater perched at the base of a thick sandy soil interval (paleochannel) following wet-season recharge, then discharged through transpiration during drier periods, after which transpiration is sustained solely by soil moisture. The HES wetland does not rely on water in the deeper alluvial aquifer.

Other habitats assessed, including remnants of the Poplar Box TEC (RE11.3.2), the Brigalow TEC (RE11.3.1 & RE11.4.9), are sustained solely by soil moisture in unsaturated regions of the soil profile.

The monitoring and assessment of impacts to GDEs has been completed in association with both IDM and Poitrel Mines (3d Environmental, 2020a and 3d Environmental, 2023b) with the outcomes of longer-term GDE monitoring completed under the IDM GDEMMP (3d Environmental, 2020a) further discussed in **Section 7.4.4**. These assessments have confirmed the following GDE condition trends:

- At the completion of the IDM GDEMMP monitoring event in November 2025, the data indicate GDEs associated with the Isaac River have maintained robust health

throughout the 5 years of IDM operation, strongly responding to the stimulus of high rainfall volumes in the early part of 2025.

- An assessment of GDE health completed for the Poitrel Mine included measuring LAI values in riparian GDE areas adjacent to the proposed mining area, indicating that canopy trees retain excellent condition with no evidence of impact from the existing mining operations, which commenced in 2006.

7.2 Potential Impacts to GDEs

The GDE Toolbox (Richardson et al. 2011) provides a starting point for investigating potential impacts on GDEs through the following impact mechanisms:

1. A total or partial loss or reduction in the volume or pressure of the aquifer utilised by GDEs.
2. A change in the magnitude and timing of volume fluctuations in the aquifer utilised by GDEs.
3. Changes to the interaction between surface flows and aquifers utilised by a GDE.
4. A change in the chemical composition or quality of an aquifer to a degree that it detrimentally impacts GDE health.

There may be a common linkage between these mechanisms, such that changes in surface flows (3) may lead to changes in aquifer volumes (1) and in the timing of aquifer fluctuations. Other mechanisms also exist, including direct clearing of GDEs and destabilisation of aquifer confining layers, leading to groundwater leakage. Direct clearing of a GDE system, changes to surface flows and aquifers being utilised by GDEs, plus sedimentation of waters associated with aquifer recharge, are other impacts that require consideration. While the impact of direct clearing is quantifiable, the manifestation of impacts through other mechanisms can be subtle, resulting in:

- Loss of canopy vigour leading to senescence of groundwater dependent vegetation.
- Changes to sub-canopy and groundcover because of increased light penetration through the canopy of senescing vegetation.
- Change in species composition, replacing species not adapted to changing ecological parameters with species with greater capacity to adapt.

The following sections discuss the major mechanisms of impact and potential impacts on groundwater dependent vegetation from the Project.

7.2.1 Direct clearing

The Project will result in disturbance to vegetation (RE11.3.25) that is a mapped GDE, as shown in **Figure 7-1**. This disturbance is associated with the following Project activities:

- The proposed Isaac River bridge crossing has a nominated 200 m-wide construction corridor which, if it were all to be cleared, would impact 2.47 ha of groundwater dependent riparian vegetation fringing the Isaac River. However, this construction corridor width has been nominated to allow some flexibility in detailed design and it is likely that the disturbance in this area will be reduced.
- The proposed clearing for the dragline walk route to cross the Isaac River has a nominal 250 m-wide construction corridor which, if it were all to be cleared, would impact 2.78 ha of groundwater dependent vegetation. However, this construction

corridor has been nominated to allow some flexibility in detailed design and it is likely that the disturbance in this area will be reduced.

- Clearing of a maximum of 1.58 ha of groundwater dependent vegetation may be associated with the tie in point of the diversion of Conrock Gully and the Isaac River. However, this disturbance area allows for some flexibility in the construction of this tie in point, and is likely that the disturbance in this area will be reduced.

All disturbance within identified GDE areas is within the nominated 'disturbance area' for the Project and hence has been assessed as a direct impact in the terrestrial ecology impact assessment (Trend 2026), including identification of significant residual impacts to areas that require biodiversity offsets. Further, the nominated post mining land use for these locations is riparian vegetation which would ultimately aim to achieve a similar ecosystem to that which existed pre-mining. Mapped GDEs, as shown in **Figure 6-2**, do not intersect with potential vegetation clearance associated with the bridge crossing of Cherwell Creek.

7.2.2 Partial or total loss or reduction in pressure of the aquifer being utilised by GDEs

As described in the IDE Groundwater Impact Assessment Report (SLR 2026a), there is no drawdown greater than 1m attributable to the Project (i.e. the 'incremental drawdown') in the Alluvial Aquifer. The perched groundwater system is reliant on water from surface flows and hence is not subject to drawdown associated with mining projects.

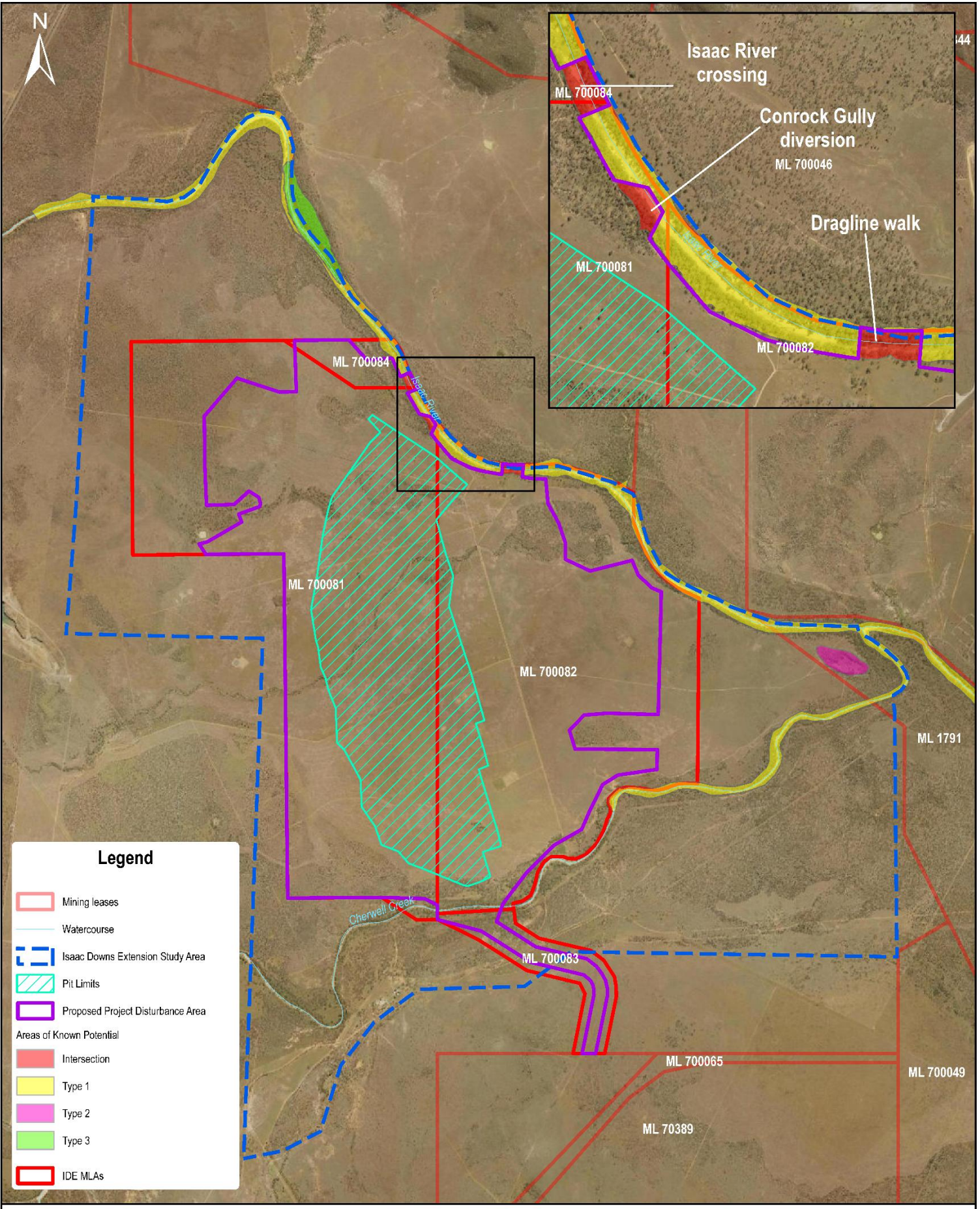
While modelling predicts minor areas of groundwater drawdown within the Regolith layer, the GDE assessment found that groundwater in the Regolith is unlikely to support GDEs in the Project Area, and the predicted drawdown is outside the mapped GDE area. **Section 7.4** provides further discussion on the cumulative impacts of groundwater drawdown with other projects in the local and regional area.

7.2.3 Changes to the interaction between surface flows and aquifers being utilised by a GDE

Monitoring bore hydrographs developed by SLR (2026a) indicate that the alluvial aquifer at MBIS07 and MBIS12 has a subtle positive response to CRD trends, which in turn influences surface flows and their volume and duration. The perched groundwater unit, which supports GDEs along the Isaac River, is, however, hosted in active river channel and terrace deposits that interact directly with channel and overbank flows. Compared to the alluvial aquifer, the perched groundwater unit is also subject to much more rapid recharge and discharge. Any Project-related change to surface flow volume and duration can influence recharge of the perched groundwater unit and affect the integrity of GDEs reliant on it.

The IDE flooding impact assessment (Hydrobalance 2026b) provides comprehensive descriptions of potential changes to the surface flow regimes on both the Isaac River and Cherwell Creek, including from the Isaac River levee (and to a much lesser extent a levee plug along Cherwell Creek), the diversion of Conrock Gully, and infrastructure crossings of watercourses.

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Legend

- Mining leases
- Watercourse
- Isaac Downs Extension Study Area
- Pit Limits
- Proposed Project Disturbance Area
- Areas of Known Potential
 - Intersection
 - Type 1
 - Type 2
 - Type 3
- IDE MLAs

Scale: 1:59,256 @A4 0 1 2 K

Coordinate System: GDA 2020 MGA Zone 55 A4

Figure 7-1. GDE areas subject to proposed clearing.



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Client : Stanmore IP South Pty Ltd Project: Isaac Downs Extension

Drawn By D.G. Checked D.S. Date: 8/04/2026

Detailed hydraulic and hydrology modelling for a range of AEP events has been completed for the Project for the operational and closure periods, inclusive of all Project structures and landforms with the potential to alter hydrology and geomorphology (Hydrobalance 2026b). The design of infrastructure with the potential to alter hydrology and geomorphology has been undertaken to minimise impacts (e.g. locating the Isaac River levee approximately 100–400 m from the high bank; bridge designs with minimal interference with flows; and a temporary dragline crossing). In addition, hydraulic and hydrology modelling has been completed for five cross sections through the Isaac River and adjoining floodplain upstream, adjacent and downstream of the Project, with the five cross sections representing areas of potential ecological value, containing REs, TECs, and GDEs. This modelling has identified:

- The Project will have negligible impact on hydrology and geomorphology (e.g. flood levels, velocity, bed shear stress and stream power) for more frequent flood events (e.g. 10% AEP or 1:10 year flood event)
- The Project will have negligible to minor impact on hydrology and geomorphology for less frequent flood events (e.g. 1% AEP or 1:100-year flood event) during operations.
- Post mining, with the decommissioning and rehabilitation of the crossing infrastructure and the Isaac River levee, and restoration of the associated floodplain, the Project will have negligible impact on hydrology and geomorphology.
- The Project will result in almost no change in the duration for which flood events will occur (less than 1 hour change in duration for all AEP events), as measured at the nominated cross section locations.

Based on these findings, it is expected that the Project will have a negligible impact on the landforms that host GDEs and the surface water flows that recharge the groundwater resources upon which the GDEs rely; and therefore impacts to floodplain vegetation, riparian habitat, and vegetation condition from changes to hydrology, hydraulics, or geomorphology are expected to be negligible (Hydrobalance 2026b).

7.2.4 *Change in chemical composition or quality of an aquifer detrimentally impacting the health of a GDE*

Groundwater predictive modelling by SLR (2026a) identifies a permanent cone of depression around the mining void into which potentially saline groundwater flows from coal seams and regolith will be directed during and post mining. This will facilitate the direct drainage of groundwater into the mining void, where discharge capture will be controlled via the mine water management system (WMS) during operations; and post mining the void will act as a groundwater sink.

Mine affected water (MAW) will be captured within one of three proposed containment storages (MAW1, MAW2 & MAW3) (Hydrobalance 2026a). The controlled release of MAW will occur under approved release conditions, based on flows and water quality, which are designed to protect downstream environmental values. Hydrobalance (2026a) also identified that there will be no uncontrolled releases of MAW from the Project.

Recharge to the perched groundwater unit that supports Isaac River GDEs occurs during river channel flows associated with high-volume flood events with a substantial dilution factor and is unlikely that controlled releases of MAW would impact water quality within the perched groundwater unit to a degree that would compromise GDE health.

7.2.5 Sedimentation of surface flows responsible for aquifer recharge

Surface water runoff from disturbed mining areas will carry sediment, requiring capture and management to prevent environmental harm. Uncontrolled, this sediment can smother the root systems of riparian habitats, reduce vegetation productivity and potentially alter the riparian landform. The Project's Erosion and Sediment Control Plan (ESCP) will manage sediment captured in runoff, adopting the three cornerstones of erosion and sediment control:

- Drainage control – prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of diverted and surface water through the area of concern.
- Erosion control – prevention or minimisation of soil erosion (from dispersive, nondispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- Sediment control – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e., from up-slope erosion), or from windborne particles.

The Project will implement a combination of these control measures to effectively manage sediment and erosion at the site (Hydrobalance 2026a). When managed under the ESCP, there is an extremely low risk that excess sediment from disturbed mining areas will impact groundwater dependent vegetation.

7.2.6 Cumulative Impacts

Cumulative groundwater impacts are described in SLR (2026a). **Figure 7-2** presents cumulative groundwater drawdown modelling (SLR 2026a) for the alluvial layer (layer 1), indicating drawdown of 1 to 5 m directly adjacent to Project. As described in **Section 7.2.2**, the Project does not contribute to drawdown in the alluvial layer and hence drawdown in this layer is attributable to other mines in the local and regional area. While cumulative drawdown in the regolith is more extensive, based on the assessment that vegetation does not demonstrate dependence on the regolith (see **Section 5.0** and **Section 6.0**) these drawdown impacts (**Figure 7-3**) are not expected to affect water availability to GDEs.

While these mining operations have the potential to impact GDEs on the Isaac River and associated local catchments, there are no reports of GDE impacts from existing mining operations. IDM implemented a GDEMMP in 2020 (3d Environmental 2020b), specifically to monitor the impact of mining operations on GDEs fringing the Isaac River. To date, the monitoring at IDM has not identified any impacts to the health or function of GDEs associated with the Isaac River from operations. The outcomes of the IDM monitoring are discussed further in **Section 7.4.4**. In addition, the GDE assessment completed for the Winchester South Project (3d Environmental 2023c) concluded a similar GDE function to areas assessed for the IDM and ID Extension, with groundwater-dependence restricted to the immediate riparian fringe of Isaac River and an associated floodplain wetland, and a GDE Risk Assessment for the Poitrel mine predicted no adverse impacts to GDEs.

Based on groundwater modelling completed by SLR (2026a), the IDE Project does not further contribute to the cumulative impact of groundwater drawdown in the alluvial aquifer. Other local and regional mines or future projects will be subject to their own approval requirements for the management of GDEs, which will complement the proposed management of GDEs for the Project, as described in **Section 7.4**.

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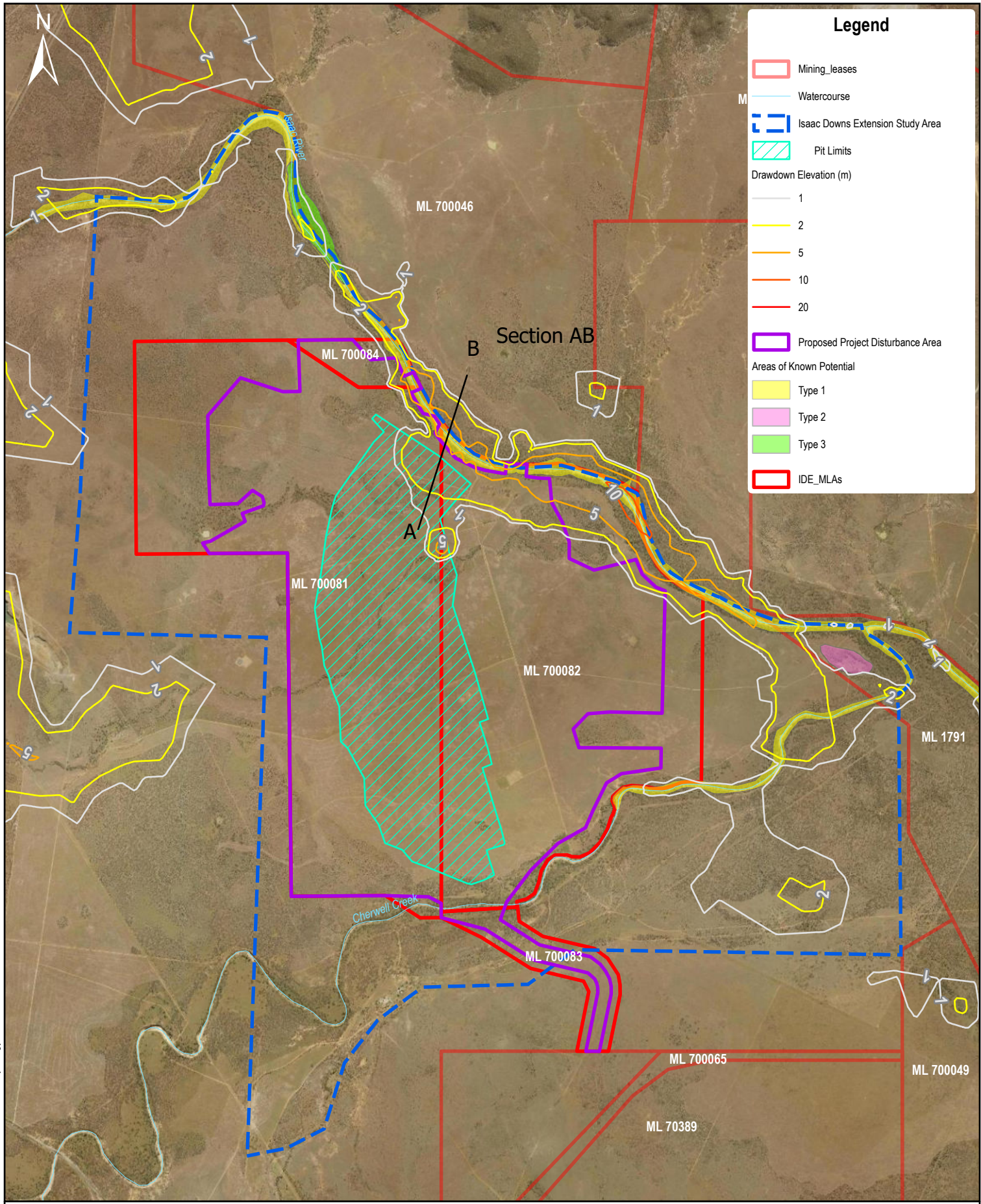
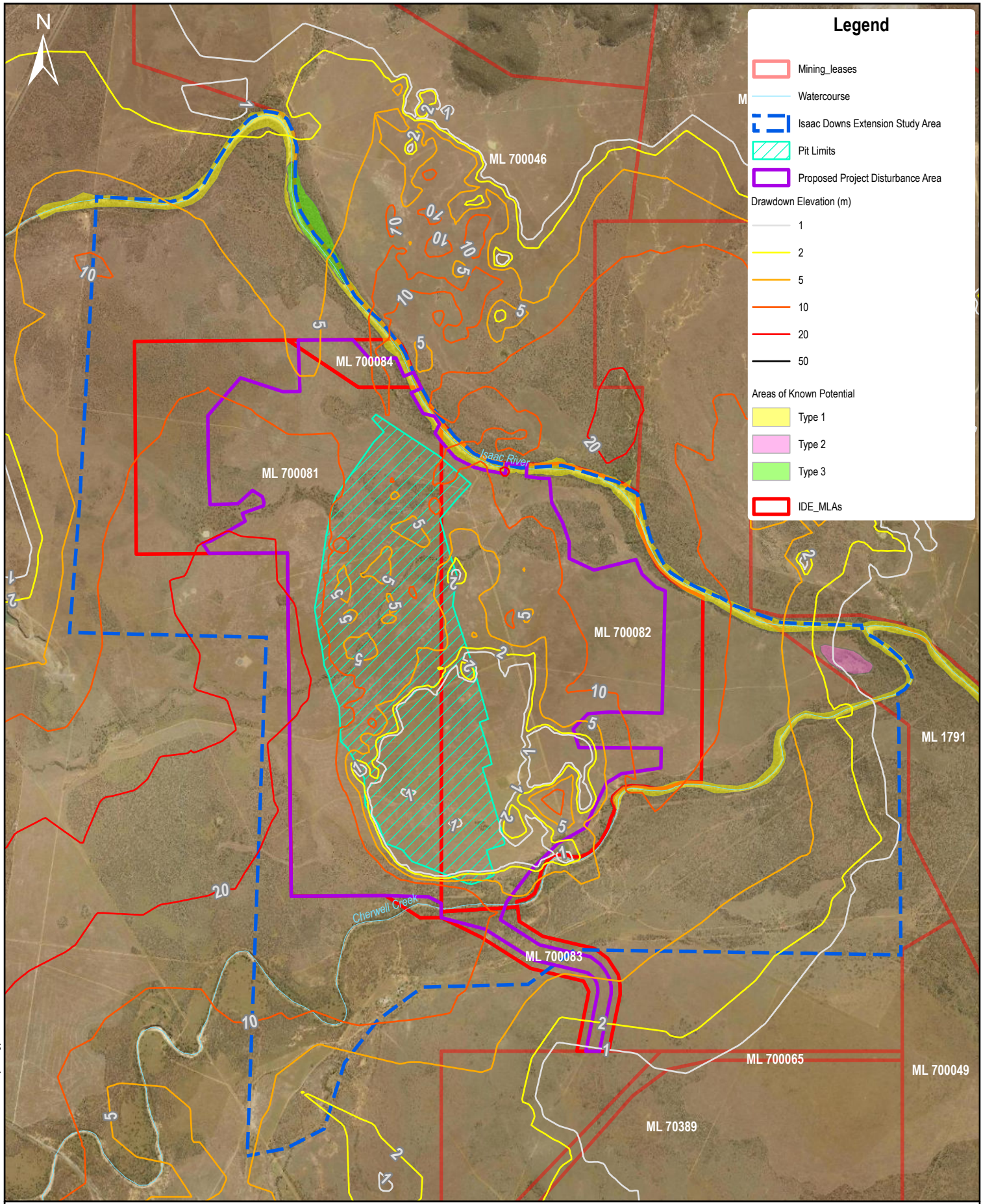


Figure 7-2. Cumulative groundwater drawdown in the alluvium (Layer 1) based on modelling completed by SLR (2026)



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Scale: 1:59,256 @A4 0 1 2 K

Coordinate System: GDA 2020 MGA Zone 55 A4

Figure 7-3. Cumulative groundwater drawdown in the regolith (Layer 2) based on modelling completed by SLR (2026)

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7.3 Mechanisms of Potential GDE Impact

While there is no prediction of Project related groundwater drawdown in the alluvial aquifer, cumulative impacts may affect alluvial groundwater levels. However, the partitioning of groundwater in the alluvium between the perched groundwater unit and the alluvial aquifer limits the potential for propagation of drawdown impacts into the perched groundwater unit that supports GDEs. **Figure 7-4 (a)** shows a pre-mining (all mining activity) GDE function in the Isaac River adjacent to the north section of the proposed mining pit, with **Figure 7-2** providing an indicative cross-section location. There is a separation through an unsaturated connection between the perched groundwater unit on which GDEs rely, and the alluvial aquifer on which drawdown impacts may occur. The mining operations model (**Figure 7-4 (b)**) shows cumulative drawdown impacts on the alluvial aquifer, which have not influenced groundwater levels in the perched groundwater unit due to partitioning and hydraulic separation. Cumulative drawdown on the regolith groundwater unit is also evident, though it has no impact on GDEs. In the operations model, groundwater in the coal seams drains into the mine pit for management within the MWS.

Figure 7-4 (a). Isaac River - pre mining groundwater regime

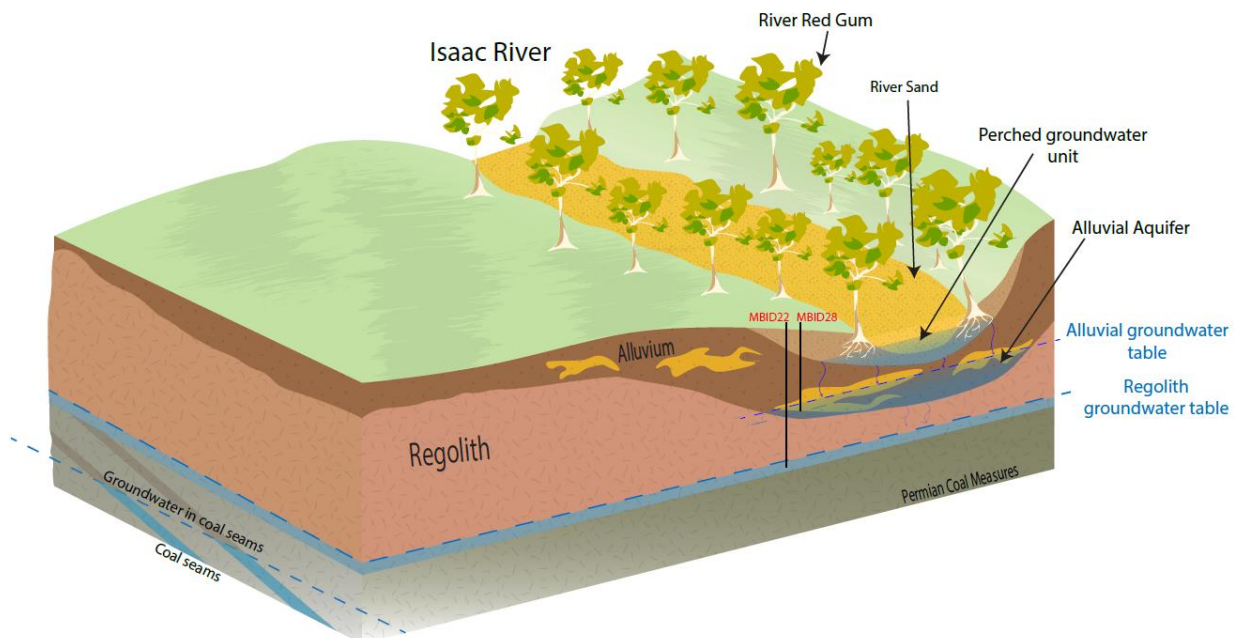


Figure 7-4(b). Isaac River - Operational model with maximum cumulative draw down.

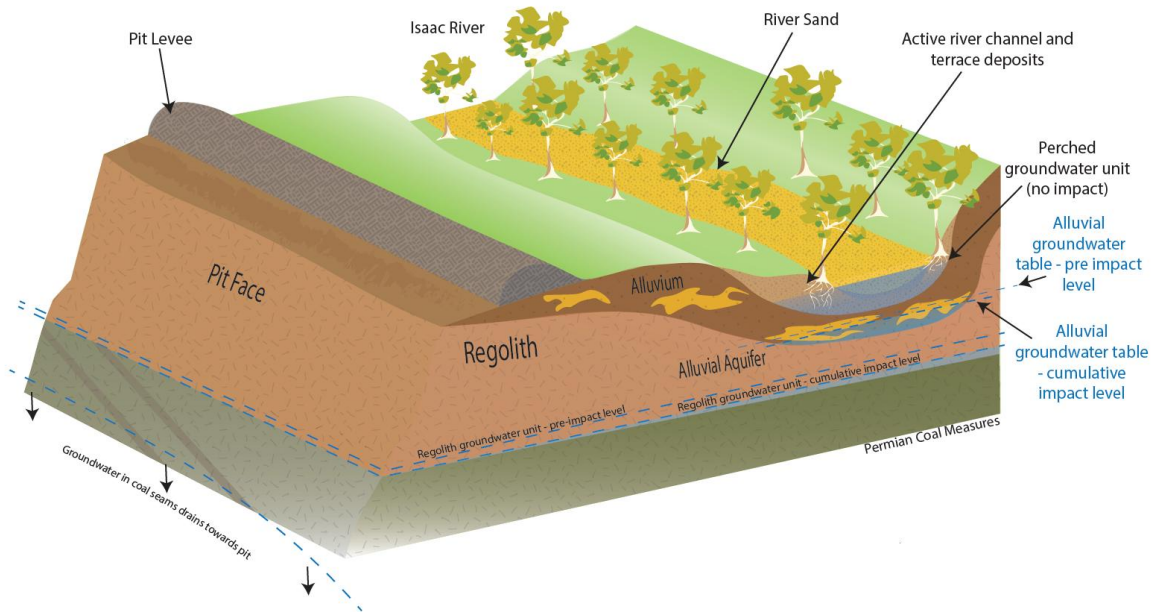


Figure 7-4. Models depicting pre-mining (**Figure 7-4 (a)**) and operational (**Figure 7-4 (b)**) ecohydrological function of GDEs on the Isaac River, adjacent to the northern limits of the proposed mine pit.

7.4 Mitigation, Management and Monitoring Measures

Section 7.2 indicates that Project related clearing would impact identified GDEs. There is limited potential for other impacts to affect GDE function on the basis that:

1. There is no Project related drawdown in the alluvial aquifer predicted.
2. The perched groundwater unit that supports GDEs is distinct from the alluvial aquifer which may be subject to cumulative impacts.
3. The seasonally variable perched groundwater unit that supports GDEs on the frontage of the Isaac River is supported and recharged by surface flows, and Project impacts on surface flows, hydrology and geomorphology is negligible to minor, with negligible potential for impacts to GDEs.

While a risk assessment is dealt with more comprehensively in **Section 7.5**, general operational measures that will minimise risk of impact to GDEs are provided in **Section 7.4.2**.

7.4.1 Reduction to the footprint of direct clearing

While several potential crossing points for the Isaac River bridge were considered, all had similar riparian vegetation clearance footprints. Therefore, the preferred alignment location is based on engineering considerations and linkages with IDM. While a nominal 200 m wide construction width has been allowed for in Project nominated disturbance area, this will likely be reduced during construction. Ultimately, the bridge clearance will be similar to existing Isaac River crossing on the Peak Downs Highway (**Figure 7-5**), where vegetation clearance is approximately 50m.



Figure 7-5. Existing Isaac River bridge crossing on the Peak Downs Highway.

The dragline currently operating at IDM will be walked to the Project with a temporary crossing of the Isaac River. The walk route will require short-term removal of bed material (<180 days) and will be constructed and utilised preferentially in the dry season, when flows in the Isaac River are unlikely. The basis for dragline walk route selection has been the location of relatively shallow river banks, in conjunction with minimising the extent of remnant vegetation clearing. The dragline crossing construction will involve:

- gravel, road base or similar overlain on the bed of the river to a height of around 100 – 250 mm above the bed (noting that there will be flexibility in the height of the base as part of detailed design)
- bank cuttings on either side of the river to create a suitable gradient to facilitate the dragline's movements
- stabilisation of the banks of the river with rock protection.

Following utilisation of the crossing, and within 180 days of construction commencement, the temporary gravel base will be removed, and sand will be replaced to restore the natural bed of the Isaac River. Bank cuttings and the walk route itself will be stabilised and rehabilitated through topsoiling, seeding and vegetation establishment. Post mining the crossing will be fully rehabilitated with bank cuttings filled to resemble pre-mining topography and landforms rehabilitated through topsoiling, seeding and revegetation to restore riparian habitat.

The disturbance area associated with the tie in point of Conrock Gully diversion with the Isaac River allows for some flexibility in the construction, with disturbance in this area likely to be reduced. Construction of the diversion will occur in the initial years of the Project,

including stabilisation and rehabilitation of the diversion. At the tie in point with the Isaac River this will involve rehabilitation to a riparian ecosystem in any disturbance areas.

7.4.2 General operational measures

The Project's site water management system will be integrated with IPC. The water management strategy involves separating MAW, sediment-affected water, and clean water, and applying appropriate management to each. MAW will then be collected in the pit before transfer to the primary turkey's nest mine water dam, and two smaller mine water dams will collect runoff from the ROM pads, which will then pump mine water to the primary mine water dam. MAW will be used for either dust suppression or piped to IDM or IPM if in excess. Alternatively, MAW will be released in a controlled manner to the Isaac River (i.e., dependent on flows and water quality in the receiving environment) to protect downstream water quality.

Sediment-affected water, which is primarily runoff from overburden dumps before and during the rehabilitation stages, will be captured in sediment dams, which will be designed in accordance with relevant engineering standards to allow sediment settlement before water release. Water from sediment water storages will be used preferentially for dust suppression. In contrast, clean water from upgradient of the mining activities will be diverted around the mining activities into the Isaac River or Cherwell Creek, including via the Conrock Gully diversion.

7.4.3 Groundwater monitoring

A groundwater monitoring and management plan (GMMP) has been prepared for the Project (SLR 2026b). The GMMP demonstrates that a comprehensive groundwater monitoring network will be maintained throughout the Project life. Monitoring covers all the major groundwater units, including the alluvial aquifer, groundwater within the regolith, and coal seams. The primary purpose of the groundwater monitoring network will be to enable the detection and distinction of natural groundwater fluctuations from groundwater-level impacts associated with the de-watering of aquifers impacted by the Project. Additional monitoring bores may be recommended within the GDEMMP to provide more specific information on the degree of hydraulic interaction between the perched groundwater unit and the alluvial aquifer to inform the management of potential impacts to GDEs.

Groundwater monitoring will include groundwater levels, physico-chemical indicators (pH and EC), water quality parameters such as major ions and total alkalinity, and hydro-geochemistry, including dissolved metals.

7.4.4 GDE Baseline Data Collection and Monitoring

A GDEMMP has been prepared for the Project (WMECO 2026), which complements the GDEMMP implemented at IDM. The purpose of the GDEMMP is to collect data as a basis for detecting future declines in ecological condition that can be linked to changes in groundwater levels and physico-chemical indicators resulting from the Project. In addition, the GDEMMP will aim to address any uncertainties identified in field assessment, including:

- The seasonality and persistence of the perched groundwater system that supports GDEs.

- Whether groundwater usage is contained within the seasonally variable perched groundwater unit, or deeper dimorphic root systems have developed, enabling utilisation of the alluvial aquifer when the perched system dries.
- Consistent with the intent of the groundwater monitoring program, additional baseline data will be collected to further characterise the seasonal ecohydrological function and baseline condition of GDEs adjacent to the Project, recognising that any GDE impact related to drawdown will be cumulative and not attributed to the development of the Project.

The IDM GDEMMP (3d Environmental, 2020b), approved by DCCEE, has been in place since November 2020, collecting 2 years of data (4 surveys) in Phase 1 (baseline assessment), and has completed 3 subsequent annual surveys as part of a 5-year Phase 2 program. The baseline assessment provides detailed information on the water use of terrestrial GDEs associated with the Isaac River through temporal analysis of stable isotopes and biophysical assessments and proposes condition thresholds to initiate investigative action based primarily on Leaf Area Index (LAI) measurements. A decrease in LAI is a precursor to more intensive impacts to habitat values, including canopy dieback and conversion to an alternative ecological state that may manifest over a longer time frame. As described in **Section 7.1**, LAI data collected over 5 years following implementation of the GDEMMP has not detected any decline in GDE health in habitats fringing the IDM operation.

In addition, the baseline assessment period of the IDM GDEMMP provided the following assessment of seasonal water use by riparian vegetation, which is consistent with the findings of this assessment for the Project:

- During dry seasonal periods with little rainfall and surface flow events, riparian trees predominantly utilise soil moisture supplemented by groundwater from the alluvial groundwater table where this is accessible.
- During seasonal surface flows and associated river sand recharge, this water is driven into the stream banks, where the seasonal groundwater is used by the bulk of the riparian vegetation fringing the river channel. The degree of groundwater utilisation diminishes progressively with trees positioned higher on the riverbanks.

Although this groundwater bulge held in the riverbanks may have some hydrogeological linkage to the regional alluvial aquifer, it does not significantly contribute to its recharge, and the groundwater bulge either drains back into the river or is discharged through evapotranspiration.

7.5 Risk Assessment

Drawing on information on GDE presence and function from previous sections, a risk assessment has been prepared which presents the likelihood of an impact occurring and the magnitude associated with that impact. The risk assessment deals with primarily with Project related risks, although cumulative risks are also considered. The significance of the risks is described below:

- **High significance:** Complete destruction of a GDE in terms of complete loss of keystone species and conversion to an alternate degraded ecological state. Impacts are irreversible and the only feasible option for mitigation is an environmental offset under relevant environmental policy.

- **Moderate significance:** Degradation of a GDE to an extent such that 25% or more keystone species are affected by the action. Impacts will be reversible only with mitigation.
- **Low significance:** Impacts are short in duration and reversible without mitigation required.
- **Insignificant:** Impacts are undetectable when assessed against a relevant ecological baseline.

The ranking applied to the assessment of likelihood including descriptor is provided in **Table 7-1**, descriptions of magnitude are applied in **Table 7-2**, and the derived risk matrix is provided in **Table 7-3**. A list of potentially applicable mitigations and management measures is provided in **Table 7-4**, although it should be noted that mitigations will only be applied if monitoring as per the Project's GDEMMP detect significant detrimental change to GDE health and function. The constructed risk assessment with a residual risk score is provided in **Table 7-5**. This assessment differs from the matrix supplied in Doody et al (2019) as it serves to identify the risk of impact and consequence in terms of habitat degradation in a GDE, without attributing any degree of sensitivity to the receptor. Based on risk assessment protocols described in Doody et al (2019) and the Queensland guideline '*Groundwater dependent ecosystems: EIS information guideline*' (DETSI 2026) the GDE areas identified within this assessment are considered 'High Value' ecological receptors. This is due to the attribution of conservation values recognised as significant under relevant Qld legislation (e.g. HES Wetlands, or habitat for listed threatened species as per Trend Environmental 2026). The riparian corridor of the Isaac River is also mapped as a matter of state environmental significance (MSES) in Queensland, consistent with intent of DETSI (2026).

Based on the risk assessment outcomes in **Table 7-5** outside direct clearing where the unmitigated risk is 'High', risk to GDEs identified in this assessment are classified as 'Low'. Residual risk ranking is 'Low' for direct clearing and 'Low' to 'Insignificant' for other impact mechanisms following application of appropriate management measures, including mitigations if required. It should be noted that for all impact pathways, the initial stages of GDE monitoring would assist in informing mitigations if the Project results in impacts to GDE health.

Table 7-1. Descriptors and ranking for the likelihood of impact occurring.

Rank	Likelihood	Description
1	Highly unlikely	There is no impact pathway present
2	Unlikely	There is no precedent for this event in the industry and similar events have not previously occurred.
3	Possible	Impacts have been associated with previous industry actions although similar impact pathways are not identified for the Project.
4	Likely	Impact pathways are not clearly understood and impacts have been previously associated with a similar industry action
5	Highly Likely	Impacts have previously been associated with the industry and a clear impact pathway exists.

Table 7-2. Descriptors of Impact Magnitude applied in the risk assessment.

Magnitude	Description
Negligible	No measurable impact above baseline ecological conditions. No detectable change in vegetation condition, groundwater interaction, or GDE function.
Low	Plant stress linked to mining activity that results in the reduction in volume and duration of groundwater supporting a GDE system, resulting up to 5% dieback of mature canopy trees*. Impacts are localised, small-scale (up to 2 ha), and reversible with mitigation.
Moderate	Plant stress linked to mining activity that results in the reduction in volume and duration of groundwater supporting a GDE system, resulting in up to 25% dieback of mature canopy trees. Impacts occur over a 2-5 ha area and are reversible with mitigation.
High	Significant harm to GDE vegetation, resulting in 25-50% dieback of mature canopy trees over a 5-10 ha area. Impact is reversible, although a significant lag in return to pre-disturbance condition occurs (lag > 20yrs). Vegetation is converted from remnant to non-remnant status and significant impacts to habitat for listed threatened species occurs. Biodiversity offsets may be required.
Severe	Irreversible impact to > 50% mature canopy trees across a > 10 ha area. Vegetation is converted from remnant to non-remnant status and significant impacts to habitat for listed threatened species occurs. Impacts cannot be mitigated. Biodiversity offsets will be required.

*A mature canopy tree is defined for the purpose of this risk assessment as a tree that forms a component of the undisturbed canopy (T1 or upper structural layer) of a remnant vegetation community. In eucalyptus species, a mature canopy tree has a DBH of >60cm and often is at the stage of maturity where significant habitat features may form including branch hollows.

Table 7-3. Matrix applied in the risk assessment.

		Likelihood				
		Highly Unlikely (1)	Unlikely (2)	Possible (3)	Likely (4)	Highly Likely (5)
Magnitude	Severe	Insignificant	Low	High	High	High
	High	Insignificant	Low	Moderate	High	High
	Moderate	Insignificant	Low	Moderate	Moderate	Moderate
	Low	Insignificant	Low	Low	Low	Low
	Negligible	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

Table 7-4. List of relevant mitigations and management actions.

Mitigation No	Mitigations	Management Actions
1	GDE avoidance, rehabilitation	-
2	Biodiversity offsets	-
3	Habitat augmentation	-
4	Injection of water into the tree root zone	-
5	-	Baseline data collection / Implementation of a Project GDEMMP.
6	-	Operation of Project under EA conditions, that includes a mine WMS and ESCP.
7	-	Groundwater monitoring

Table 7-5. Risk assessment for potential impacts and residual risks scores.

Location	Pre-mitigated Risk			Comments	Management /Mitigation Measures*	Residual Risk Ranking		
	Likelihood	Magnitude	Risk			Likelihood	Magnitude	Risk
1. Direct Clearing								
Isaac River terrestrial GDE zone	5	High	High	Potential combined clearing of up to 6.8 ha of identified terrestrial GDE for the Isaac River crossing, dragline walk, & Conrock Gully diversion. The impact footprint may be reduced as described in Section 7.4.1. All areas will be rehabilitated to riparian vegetation following construction and / or operations.	1, 2, 3	5	Low	Low
2. A total or partial loss or reduction in the volume or pressure of the aquifer being utilised by Terrestrial GDEs.								
All GDE Areas – Project Impact	2	Low	Low	Project related groundwater drawdown is not predicted for the alluvial aquifer. The perched groundwater unit which supports GDEs is hydraulically disconnected from the alluvial aquifer, providing an additional buffer to drawdown impacts.	5, 7	1	Low	Insignificant
All GDE Areas – Cumulative Impact	2	Moderate	Low	Cumulative drawdown in the alluvial aquifer is predicted; however GDEs likely to place reliance on perched groundwater unit rather than alluvial aquifer. IDM has a GDEMMP in place to detect and manage potential impacts to GDEs on the Isaac River frontage directly adjacent to the Project. After a 5-year implementation period, there have been no detectable impact on terrestrial GDE health detected within the framework of the IDM GDEMMP. A complementary GDEMMP has been prepared for the Project . Other mines and projects will manage impacts to GDEs in accordance with their assessments and approval requirements.	5, 7	2	Low	Low

Location	Pre-mitigated Risk			Comments	Management /Mitigation Measures*	Residual Risk Ranking		
	Likelihood	Magnitude	Risk			Likelihood	Magnitude	Risk
3. Changes to the interaction between surface flows and aquifers being utilised by Terrestrial GDEs.								
All GDE Areas	2	Low	Low	Volume fluctuations in the perched groundwater unit that supports terrestrial GDEs (both the Isaac River and HES wetland) are regulated by surface flows and local infiltration of surface water. The Project will have negligible to minor impact during mining (negligible post mining after rehabilitation) on surface water flow hydrology and geomorphology and no resultant change in recharge to groundwater units that support GDEs (both the perched groundwater unit and the alluvial aquifer).	1, 5, 6	1	Negligible	Insignificant
4. Change in chemical composition of an aquifer detrimentally impacting the health of a Terrestrial GDE.								
All GDE Areas	2	Low	Low	No uncontrolled releases of mine water predicted. Controlled releases of mine water have negligible potential to impact the chemical composition of infiltrating surface waters. WMS controls in place for mine water and sediment water. Post mining rehabilitation of disturbed areas.	1, 5, 6, 7	1	Negligible	Insignificant
5. Sedimentation of surface flows responsible for aquifer recharge								
All GDE Areas	2	Low	Low	Sediment within surface runoff from mining areas will be captured in sediment dams and managed under the ESCP. This will contain sediment within mining areas so that it minimises impacts to waterways, wetlands or associated terrestrial GDEs. Post mining rehabilitation of disturbed areas.	1, 5, 6, 7	2	Negligible	Insignificant

*Management measures are applied during implementation of a Project GDEMMP, after which mitigations can be applied if significant impact to GDE function and health is detected.

8.0 Conclusions

Multiple lines of evidence, including measurements of LWP and SMP, stable isotopes, radon, and physical observations, have been applied to assess the groundwater dependence of vegetation across multiple assessment areas within and surrounding the Project area. It is concluded that riparian vegetation fringing the Isaac River channel, lower reaches of Cherwell Creek and a floodplain wetland, is the only likely representation of GDEs within and surrounding the Project area. Generally, the potential for groundwater usage by riparian/floodplain vegetation decreases with elevation above and distance from the Isaac River and the lower reaches of Cherwell Creek. On older elevated residual terraces, the shallow rooting depth of vegetation, the significant depth to the groundwater table (>10 mbgl), and the highly variable nature of groundwater salinity restrict vegetation's groundwater use.

Riparian vegetation fringing the Isaac River, plus lower reaches of Cherwell Creek, utilises a discontinuous and seasonally variable perched groundwater unit that is associated with active alluvial deposits, including fluvial sands, riverbanks, and river terraces, extending laterally from the main river channel underneath the riverbanks in some locations to support riparian terrestrial GDEs. Although not detected during the current GDE assessment, based on related studies conducted in adjacent areas, there is a very low likelihood of sporadic use of the deeper alluvial aquifer.

Recharge of the perched groundwater unit occurs through surface flows fed by seasonal rainfall events, which leak into the alluvial aquifer via a weak unsaturated hydraulic connection. As surface water flows diminish after flooding, water stored in riverbanks may discharge back into the river to prolong surface flows. The persistence of surface pools depends on both climatic conditions and sedimentary processes that hollow out the channel, with river sand. However, residual pools are extremely minor in extent and occurrence in drier climatic periods.

Like the perched groundwater unit, groundwater supporting deep-rooted floodplain wetland vegetation in the HES wetland occurs at the base of a thick sand unit, likely a river paleochannel, that lies above the weathered basement rock unconformity at depths of ~7 mbgl. The groundwater at the base of the sand is hydraulically disconnected from both the perched groundwater unit associated with the Isaac River and the deeper alluvial aquifer and is ephemeral. Groundwater recharge is maintained by infiltration of seasonally ponded wetland surface water, with perched groundwater discharge driven by transpiration. For extended periods, deep-rooted wetland vegetation relies solely on stored soil moisture.

An impact assessment framework has been developed to identify the risks posed by Project activities to terrestrial GDEs. The impact assessment considers multiple impact pathways, including GDE clearing, groundwater drawdown, groundwater recharge mechanisms, groundwater quality and changes in surface water flows. Mitigation and management actions are proposed to detect impacts to GDEs and remediate them if detected. The measures include the development of a GDE monitoring and management plan (GDEMMP) in accompaniment to this assessment, with a framework for detecting potential changes in GDE health, implementing measures to improve GDE health if required, and / or provision of biodiversity offsets if a change in GDE health leads to a significant impact of habitat for listed species. The results of the risk assessment identify the following residual risks:

- Direct clearing will result in up to 6.8 ha of clearing of groundwater dependent riparian vegetation on the Isaac River. However this clearing will be offset as part of the biodiversity offset package associated with clearing of terrestrial ecosystems and habitat for the Project as a whole. The proponent will seek to reduce clearing within this nominated disturbance areas to further reduce impacts.
- Groundwater modelling does not predict Project-related groundwater drawdown in the alluvial aquifer, and there is no potential for Project-related drawdown to impact the perched groundwater unit, which supports terrestrial GDEs (riverine and wetland).
- The groundwater modelling, however, identified that there are, and will be, cumulative drawdown impacts on the alluvial aquifer due to adjacent mines and projects, including IDM. Potential impacts to GDEs adjacent to IDM operations are currently monitored under an existing GDEMMP, which has not reported any detectable impacts in the four years since mining commenced.
- The potential for surface water changes from the Project to impact the perched groundwater units that support GDEs, including riparian vegetation fringing the Isaac River and the HES wetland, will be managed through the design, construction and operation of the water management systems and erosion and sediment controls, and through progressive rehabilitation. With these surface water management measures in place there are predicted to be negligible to minor impacts to the surface water environment and hence negligible impacts on the perched groundwater unit.

With implementation of the GDEMMP, the risk to GDEs posed by Project development ranges from low to insignificant.

9.0 References

- 3d Environmental (2020a). Groundwater Dependent Ecosystem (GDE) Assessment for the Isaac Downs Project. Prepared for Stanmore IP South Pty Ltd.
- 3d Environmental (2020b). Groundwater Dependent Ecosystem (GDE) Management and Monitoring Plan. Prepared for Stanmore IP South Pty Ltd.
- 3d Environmental (2023a). Groundwater Dependent Ecosystem Monitoring and Management Plan - Isaac Downs Mine – Baseline Assessment. Unpublished report to Stanmore Resources Ltd.
- 3d Environmental (2023b). Poitrel Mine - Groundwater Dependent Ecosystem Risk Assessment for the High Wall Mining Project. Report prepared for Stanmore Resources Ltd.
- Adyasari D, Dimova NT, Dulai H, Gilfedder BS, Cartwright I, McKenzie T, Fuleky P (2023). Radon-222 as a groundwater discharge tracer to surface waters. *Earth-Science Reviews*, 238, 104321.
- Australian National Botanic Gardens (ANBG)(2004). Water for a Healthy Country – Taxon Attribute Profile, *Eucalyptus camaldulensis*. Available at:
<https://www.anbg.gov.au/cpbr/WfHC/Eucalyptus-camaldulensis/index.html>
- Bren, L.J. and Gibbs, N.L. (1986) Relationships between flood frequency, vegetation and topography in a river red gum forest. *Australian Forest Research* 16, 357-370.
- Bureau of Meteorology (BoM) (2025). Australian Government.
www.bom.gov.au/climate/data/ accessed 12 April 2025.
- Bureau of Meteorology (BOM)(2024). Groundwater Dependent Ecosystems Atlas; available at: <http://www.bom.gov.au/water/groundwater/gde/map.shtml>
- Craig, H., 1961. Isotopic variation in meteoric waters. *Science* 133, 1702–1703.
- Colloff M. (2014). *Ecology and History of the River Red Gum*. CSIRO Publishing. Collingwood, Victoria.
- Commonwealth of Australia (2015), Modelling water-related ecological responses to coal seam gas extraction and coal mining, prepared by Auricht Projects and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) for the Department of the Environment, Commonwealth of Australia’.
- Cook, P., & O’Grady, A. (2006). Determining soil and ground water use of vegetation from heat pulse, water potential and stable isotope data. *Oecologia*, 148(1), 97-107.
- Crosbie RS, Morrow D, Cresswell RG, Leaney FW, Lamontagne S and Lefournour M (2012) New insights into the chemical and isotopic composition of rainfall across Australia. CSIRO Water for a Healthy Country Flagship, Australia
- Dang Y.P, Dalal R.C., Mayer D.G., McDonald M. M., Routley R. R., Schwenke G. D., Buck S. R. S.R., Daniells I.G., Singh D. K, Manning W., and Ferguson N. (2008) High subsoil chloride concentrations reduce soil water extraction and crop yield on Vertosols in north-eastern Australia. *Crop and Pasture Science* 59.4 (2008): 321-330.

Department of Tourism, Science, Innovation (DETSI) (2026). EIS Information Guideline – Terrestrial Ecology. Available at: [Terrestrial ecology](#)

Doody TM, Hancock PJ, Pritchard JL (2019). Information Guidelines explanatory note: Assessing groundwater-dependent ecosystems. Report to the Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2019.

Doody, T., Colloff, M., Davies, M., Koul, V., Benyon, R., & Nagler, P. (2015). Quantifying water requirements of riparian river red gum (*Eucalyptus camaldulensis*) in the Murray–Darling Basin, Australia – implications for the management of environmental flows. *Ecohydrology*, 8(8), 1471-1487.

Doody, T. M., Holland K. L., Benyon R. G., and Jolly I. D. (2009). Effect of groundwater freshening on riparian vegetation water balance. *Hydrological Processes* 23.24: 3485-3499.

Eamus D., Hatton T., Cook P., Colvin C. (2006a). *Ecohydrology*. CSIRO Publishing, Collingwood, Australia.

Eamus D., Froend F., Loomes R., Hose G., Murray B., (2006b). A functional methodology for determining the groundwater regime needed to maintain the health of groundwater dependent vegetation. *Australian Journal of Botany*; 54, 97 -114.

Evaristo, J; McDonnell, J.; Clemens, J. (2017). Plant source water apportionment using stable isotopes: A comparison of simple linear, two-compartment mixing model approaches. *Hydrological Processes* , Volume 31 (21).

Fensham R. J and Fairfax R.J (2007), Drought-related tree death of savanna eucalypts: Species susceptibility, soil conditions and root architecture. *Journal of Vegetation Science* 18: 71-80

Gardner W. R. (1960). Dynamic aspects of water availability to plants. *Soil Science*, 89, 63 – 73.

Hoffman H, Marshall J (2025). Assessing groundwater connection/disconnection to waterholes along the Balonne River and in the Barwon–Darling River System in Queensland and New South Wales, Australia, for waterhole persistence. *Hydrology*, 12(1), 15, 1–15.

Holland, L. K, Tyerman S. D., Mensforth L. J., and Walker G. R. G.R. "Tree water sources over shallow, saline groundwater in the lower River Murray, south-eastern Australia: implications for groundwater recharge mechanisms." *Australian Journal of Botany* 54.2 (2006): 193-205.

Horner, G.J., Baker, P.J., Mac Nally, R., Cunningham, S.C., Thomson, J.R., Hamilton, F., 2009. Mortality of developing floodplain forests subjected to a drying climate and water extraction. *Global Change Biol.* 15, 2176–2186.

HydroBalance (2026a). Isaac Downs Extension Surface Water Impact Assessment. Report prepared for Stanmore Resources Limited.

HydroBalance (2026b). Isaac Downs Extension Flood Impact Assessment. Report prepared for Stanmore Resources Limited.

Johnson, R., McDonald, W., Fensham, R., McAlpine, C., & Lawes, M. (2016). Changes over 46 years in plant community structure in a cleared brigalow (*Acacia harpophylla*) forest. *Austral Ecology*, 41(6), 644-656.

Jones C., Stanton D., Hamer N., Denner S., Singh K., Flook S., Dyring M. (2019). Field Investigations of Potential Terrestrial Groundwater Dependent Ecosystems within Australia's Great Artesian Basin. *Hydrogeology Journal*. Springer Nature PP 4 - 27.

- Kallarackal J. and Somen C.K (1998). Water Relations and Rooting Depths of Selected Eucalypt Species. Kerala Forest Research Institute, Peechi, Thrissure.
- Kath, J., Reardon-Smith, K., Le Brocque, A., Dyer, F. and others (2014) Groundwater decline and tree change in floodplain landscapes: Identifying non-linear threshold responses in canopy condition. *Global Ecology and Conservation* 2, 148-160.
- Kendall, C. and Caldwell, E. A. (1998). "[Fundamentals of Isotope Geochemistry](#)", In: C. Kendall and J.J. McDonnell (Eds.), [Isotope Tracers in Catchment Hydrology](#). Elsevier Science, Amsterdam, pp. 51-86.
- Lamontagne, S., Leaney, F.W. and Herczeg, A.L. (2005), Groundwater–surface water interactions in a large semi-arid floodplain: implications for salinity management. *Hydrol. Process.*, 19: 3063-3080.
- Landwehr, J., & Coplen, T. (2006). Line conditioned excess: A new method for characterizing stable hydrogen and oxygen isotope ratios in hydrologic systems. In: *Isotopes in environmental studies* pp132–135. IAEA-CN-118/56, International Atomic Energy Agency (IAEA).
- Malik, R., & Sharma, S. (2004). Moisture extraction and crop yield as a function of distance from a row of *Eucalyptus tereticornis*. *Agroforestry Systems*, 12(2), 187-195.
- Mensforth, L., Thorburn, P., Tyerman, S., & Walker, G. (1994). Sources of water used by riparian *Eucalyptus camaldulensis* overlying highly saline groundwater. *Oecologia*, 100(1), 21-28.
- O'Grady, A., Cook P. G., Howe P. P., and Werren G. G. (2006b). "Groundwater use by dominant tree species in tropical remnant vegetation communities." *Australian Journal of Botany* 54.2 (2006): 155-171.
- Petit N. E and Froend R. H (2018). How important is groundwater availability and stream perennality to riparian and floodplain tree growth. *Hydrological Process*. Volume 32 (10) – Jan 15, 2018
- Richardson S, et al 2011 Australian groundwater-dependent ecosystem toolbox part 1: assessment framework, Waterlines report, National Water Commission, Canberra
- Singer M. B, Sargeant C. I, Peigay H., Riquier J., Wilson R. J., Evans C. M. (2014). Floodplain ecohydrology: Climatic, anthropogenic, and local physical controls on partitioning of water sources to riparian trees. *Water Resources Research*.
- SLR (2026a). Groundwater Impact Assessment Report - Isaac Downs Extension. Prepared for Stanmore ID Extension Pty Ltd.
- SLR (2026b). Groundwater Monitoring and Management Plan - Isaac Downs Extension. Prepared for Stanmore ID Extension Pty Ltd.
- SILO (2025). Australian Climate Data from 1989 to Yesterday. [SILO | LongPaddock | Queensland Government](#)
- Soil Moisture Equipment Corp. (2006). Model 3115 – Portable Plant Water Status Console – Operation Manual.
- Suckow A (2014). The age of groundwater - definitions, models and why we do not need this term. *Applied Geochemistry*, 50, 222-230.
- Taylor, G. & Eggerton, R. A. (2001). *Regolith Geology and Geomorphology*. viii+375 pp. Chichester, New York, Weinheim, Brisbane, Singapore, Toronto: John Wiley & Sons Ltd.

Tetzlaff, D., Buttle, Jim., Carey, S., Kohn, M., Laudon, H., Mcnamara, J., Smith, A., Sprenger, M., Soulsby, C. (2020). Stable isotopes of water reveal differences in plant – soil water relationships across northern environments. *Hydrological Processes*. 35. 10.1002/hyp.14023.

Thorburn, P. J, and Walker G. R (1994) Variations in stream water uptake by *Eucalyptus camaldulensis* with differing access to stream water. *Oecologia*, 100, 293-301.

Trend Environmental (2026). Terrestrial Ecology Impact Assessment Report - Isaac Downs Extension. Report to Stanmore Resources Limited.

WRM (2020). Isaac Downs Project Surface Water Assessment. Report to Stanmore IP South Pty Ltd.

WMECO (2026). Groundwater Dependent Ecosystem Management and Monitoring Plan - Isaac Downs Extension. Prepared for Stanmore ID Extension Pty Ltd. Preliminary GDEMMP report issued April 2026.

Zolfhaghar, S Villalobos-Vega, R Cleverly, J Zeppel, M Rumman, R Eamus, D. (2014) The influence of depth-to-groundwater on structure and productivity of *Eucalyptus* woodlands. *Australian Journal of Botany*. 62(5) pp. 428 – 437.

Zolfhager, S (2013) Comparative ecophysiology of *Eucalyptus* woodlands along a depth-to groundwater gradient. PhD Thesis, University of Technology, Sydney.

<https://opus.lib.uts.edu.au/bitstream/10453/24201/2/02whole.pdf>

10.0 Appendix

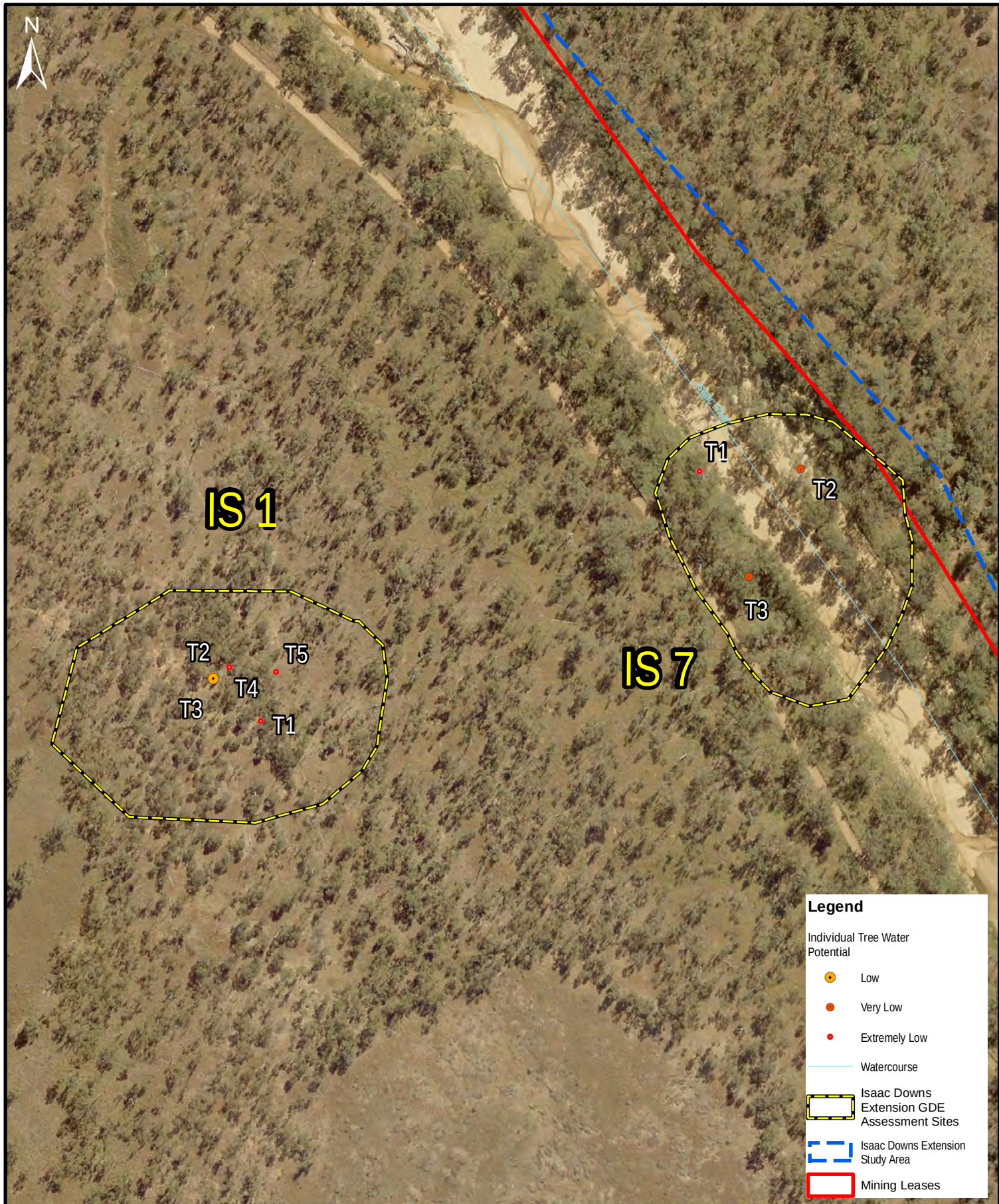
Appendix A. Tree Structural Measurements

Isaac Downs_Trees	Y	X	Tree Sample Point	Species	DBH (mm)	Height (m)	LWP	Tree Water Availability	Grouping
IS1	-22.053307	148.169119	T1	<i>Acacia harpophylla</i>	320	9	-4.4	Extremely Low	Brigalow TEC
IS1	-22.053062	148.168835	T2	<i>Acacia harpophylla</i>	320	8	-3.5	Extremely Low	Brigalow TEC
IS1	-22.053015	148.168933	T4	<i>Acacia harpophylla</i>	220	12	-3.2	Extremely Low	Brigalow TEC
IS1	-22.053037	148.169206	T5	<i>Eucalyptus populnea</i>	450	16	-2.5	Extremely Low	Brigalow TEC
IS1	-22.053076	148.168841	T3	<i>Eucalyptus populnea</i>	350	13	-1.4	Low	Brigalow TEC
IS10	-22.097288	148.228339	T2	<i>Eucalyptus tereticornis</i>	130	25	-2.3	Extremely Low	RE11.3.25_Chervell
IS10	-22.097238	148.228094	T1	<i>Eucalyptus tereticornis</i>	90	22	-1.5	Low	RE11.3.25_Chervell
IS10	-22.09693	148.228749	T3	<i>Eucalyptus tereticornis</i>	100	26	-1.35	Low	RE11.3.25_Chervell
IS11	-22.098267	148.228525	T2	<i>Eucalyptus populnea</i>	50	20	-2.3	Extremely Low	Poplar Box
IS11	-22.098363	148.228167	T1	<i>Eucalyptus populnea</i>	60	15	-2.2	Very Low	Poplar Box
IS11	-22.098287	148.228991	T3	<i>Eucalyptus populnea</i>	55	23	-2	Very Low	Poplar Box
IS12	-22.104382	148.219455	T2	<i>Eucalyptus tereticornis</i>	90	22	-2.55	Extremely Low	RE11.3.25_Chervell
IS12	-22.104427	148.218771	T3	<i>Eucalyptus tereticornis</i>	90	25	-2.25	Extremely Low	RE11.3.25_Chervell
IS12	-22.105401	148.217785	T1	<i>Eucalyptus tereticornis</i>	70	23	-1.6	Low	RE11.3.25_Chervell
IS12	-22.105035	148.217699	T4	<i>Eucalyptus tereticornis</i>	130	26	-1.4	Low	RE11.3.25_Chervell
IS13	-22.106407	148.218588	T3	<i>Acacia harpophylla</i>	30	12	-3.8	Extremely Low	Brigalow TEC
IS13	-22.10633	148.217973	T4	<i>Acacia harpophylla</i>	35	13	-3.7	Extremely Low	Brigalow TEC
IS13	-22.106341	148.217955	T5	<i>Acacia harpophylla</i>	35	12	-3.4	Extremely Low	Brigalow TEC
IS13	-22.106073	148.218443	T1	<i>Eucalyptus populnea</i>	120	23	-2.3	Extremely Low	Brigalow TEC
IS13	-22.106257	148.21892	T2	<i>Eucalyptus populnea</i>	60	22	-2.3	Extremely Low	Brigalow TEC
IS14	-22.112903	148.197971	T4	<i>Eucalyptus tereticornis</i>	100	24	-2	Very Low	RE11.3.25_Chervell
IS14	-22.112958	148.198514	T1	<i>Eucalyptus tereticornis</i>	80	21	-1.9	Very Low	RE11.3.25_Chervell
IS14	-22.112886	148.198257	T2	<i>Eucalyptus tereticornis</i>	110	25	-1.7	Low	RE11.3.25_Chervell
IS14	-22.112721	148.198228	T3	<i>Eucalyptus tereticornis</i>	100	22	-1.3	Low	RE11.3.25_Chervell
IS15	-22.07504	148.202598	T1	<i>Eucalyptus camaldulensis</i>	100	25	-2.3	Extremely Low	RE11.3.25_Isaac
IS15	-22.074922	148.20235	T2	<i>Eucalyptus tereticornis</i>	80	25	-1.9	Very Low	RE11.3.25_Isaac

IS15	-22.075457	148.203314	T3	<i>Eucalyptus tereticornis</i>	100	24	-1.2	Moderate	RE11.3.25_Isaac
IS16	-22.081459	148.188349	T3	<i>Acacia harpophylla</i>	30	12	-3.8	Extremely Low	Brigalow TEC
IS16	-22.081492	148.18827	T4	<i>Acacia harpophylla</i>	30	10	-3.8	Extremely Low	Brigalow TEC
IS16	-22.080987	148.188659	T1	<i>Eucalyptus coolabah</i>	60	20	-3	Extremely Low	Brigalow TEC
IS16	-22.08131	148.188408	T2	<i>Eucalyptus coolabah</i>	70	20	-2.9	Extremely Low	Brigalow TEC
IS17	-22.072414	148.18776	T1	<i>Eucalyptus tereticornis</i>	70	22	-2	Very Low	RE11.3.25_Isaac
IS17	-22.072233	148.187408	T2	<i>Eucalyptus tereticornis</i>	80	25	-2	Very Low	RE11.3.25_Isaac
IS17	-22.072182	148.18744	T3	<i>Eucalyptus tereticornis</i>	100	23	-1.9	Very Low	RE11.3.25_Isaac
IS18	-22.117819	148.179941	T1	<i>Eucalyptus tereticornis</i>	60	25	-1	Moderate	RE11.3.25_Chervell
IS18	-22.117854	148.179345	T3	<i>Eucalyptus tereticornis</i>	70	23	-0.7	High	RE11.3.25_Chervell
IS18	-22.117812	148.179824	T2	<i>Eucalyptus tereticornis</i>	75	23	-0.6	High	RE11.3.25_Chervell
IS18	-22.118093	148.17947	T4	<i>Casuarina cunninghamiana</i>	60	23	-0.2	Extremely High	RE11.3.25_Chervell
IS19	-22.11594	148.18432	T1	<i>Eucalyptus populnea</i>	40	18	-2	Very Low	Poplar Box
IS19	-22.115458	148.18434	T2	<i>Eucalyptus populnea</i>	45	18	-1.9	Very Low	Poplar Box
IS2	-22.047293	148.168046	T1	<i>Eucalyptus tereticornis</i>	850	20	-1.6	Low	RE11.3.25_Isaac
IS2	-22.045914	148.167697	T3	<i>Eucalyptus tereticornis</i>	800	21	-1.5	Low	RE11.3.25_Isaac
IS2	-22.046828	148.167941	T2	<i>Eucalyptus tereticornis</i>	750	15	-1.4	Low	RE11.3.25_Isaac
IS20_2024	-22.092721	148.227982	T1	<i>Eucalyptus tereticornis</i>	110	25	-0.67	High	HES_Wetland
IS20_2024	-22.092519	148.227865	T2	<i>Eucalyptus tereticornis</i>	75	21	-0.8	High	HES_Wetland
IS20_2024	-22.092666	148.227237	T3	<i>Eucalyptus tereticornis</i>	55	17	-0.85	High	HES_Wetland
IS20_2024	-22.092079	148.228357	T4	<i>Eucalyptus tereticornis</i>	50	17	-1.1	Moderate	HES_Wetland
IS20_2025	-22.092079	148.228357	T4	<i>Eucalyptus tereticornis</i>	50	17	-1.1	Moderate	HES_Wetland
IS20_2025	-22.092666	148.227237	T3	<i>Eucalyptus tereticornis</i>	55	17	-0.85	High	HES_Wetland
IS20_2025	-22.092519	148.227865	T2	<i>Eucalyptus tereticornis</i>	75	21	-0.8	High	HES_Wetland
IS20_2025	-22.092721	148.227982	T1	<i>Eucalyptus tereticornis</i>	110	25	-0.67	High	HES_Wetland
IS3	-22.045739	148.166436	T2	<i>Eucalyptus populnea</i>	400	14	-1.8	Very Low	Poplar Box
IS3	-22.046016	148.166656	T1	<i>Eucalyptus populnea</i>	650	17	-1.65	Low	Poplar Box
IS3	-22.045783	148.166113	T3	<i>Eucalyptus populnea</i>	450	15	-1.4	Low	Poplar Box

IS4	-22.048728	148.149935	T1	<i>Acacia harpophylla</i>	150	8	-5.3	Extremely Low	Brigalow TEC
IS4	-22.04815	148.149758	T4	<i>Eucalyptus populnea</i>	400	17	-3.65	Extremely Low	Brigalow TEC
IS4	-22.048569	148.150222	T3	<i>Eucalyptus populnea</i>	600	18	-3.2	Extremely Low	Brigalow TEC
IS4	-22.048735	148.150091	T2	<i>Acacia harpophylla</i>	150	7	-1	Moderate	Brigalow TEC
IS5	-22.046823	148.15032	T3	<i>Eucalyptus tereticornis</i>	800	23	-0.75	High	RE11.3.25_Isaac
IS5	-22.046843	148.151762	T1	<i>Eucalyptus tereticornis</i>	750	25	-0.25	Very High	RE11.3.25_Isaac
IS5	-22.046803	148.151129	T2	<i>Eucalyptus tereticornis</i>	700	23	-0.2	Extremely High	RE11.3.25_Isaac
IS6	-22.04422	148.160906	T1	<i>Acacia harpophylla</i>	300	9	-4.1	Extremely Low	Brigalow TEC
IS6	-22.044512	148.160601	T3	<i>Acacia harpophylla</i>	275	9	-2.4	Extremely Low	Brigalow TEC
IS6	-22.044234	148.160624	T2	<i>Acacia harpophylla</i>	350	11	-2.1	Very Low	Brigalow TEC
IS7	-22.051936	148.171652	T1	<i>Eucalyptus tereticornis</i>	120	27	-2.3	Extremely Low	RE11.3.25_Isaac
IS7	-22.051921	148.172237	T2	<i>Eucalyptus tereticornis</i>	130	28	-2	Very Low	RE11.3.25_Isaac
IS7	-22.052506	148.171941	T3	<i>Eucalyptus tereticornis</i>	80	23	-1.9	Very Low	RE11.3.25_Isaac
IS8	-22.087113	148.215092	T3	<i>Eucalyptus tereticornis</i>	125	23	-1.1	Moderate	RE11.3.25_Isaac
IS8	-22.086508	148.213856	T1	<i>Eucalyptus tereticornis</i>	130	25	-0.8	High	RE11.3.25_Isaac
IS8	-22.087034	148.21526	T4	<i>Melaleuca fluvialis</i>	70	16	-0.55	Very High	RE11.3.25_Isaac
IS8	-22.086884	148.214615	T2	<i>Eucalyptus tereticornis</i>	130	27	-0.45	Very High	RE11.3.25_Isaac
IS9	-22.089197	148.219919	T2	<i>Eucalyptus tereticornis</i>	120	24	-1.1	Moderate	RE11.3.25_Isaac
IS9	-22.089206	148.21958	T1	<i>Eucalyptus tereticornis</i>	90	25	-1	Moderate	RE11.3.25_Isaac
IS9	-22.089418	148.219998	T3	<i>Eucalyptus tereticornis</i>	100	24	-0.8	High	RE11.3.25_Isaac

Appendix B. Sampling locations and Moisture Availability



Legend

- Individual Tree Water Potential
- Low
 - Very Low
 - Extremely Low
- Watercourse
- Isaac Downs Extension GDE Assessment Sites
- Isaac Downs Extension Study Area
- Mining Leases

Scale 1:3,004 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55 A4

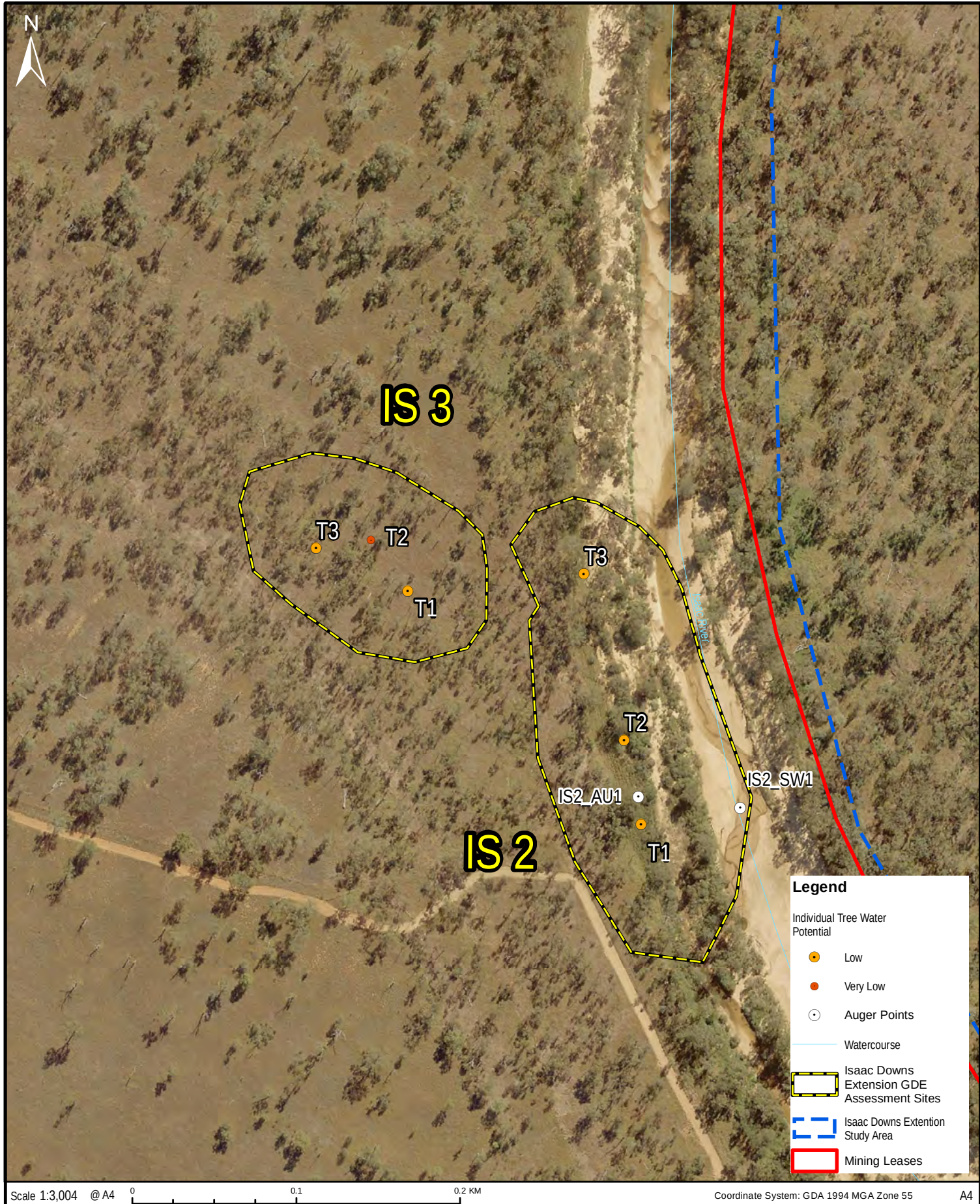
Appendix B1. Sampling detail at Assessment Site 1 and Assessment Site 7

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026



Scale 1:3,004 @ A4 0 0.1 0.2 KM Coordinate System: GDA 1994 MGA Zone 55 A4

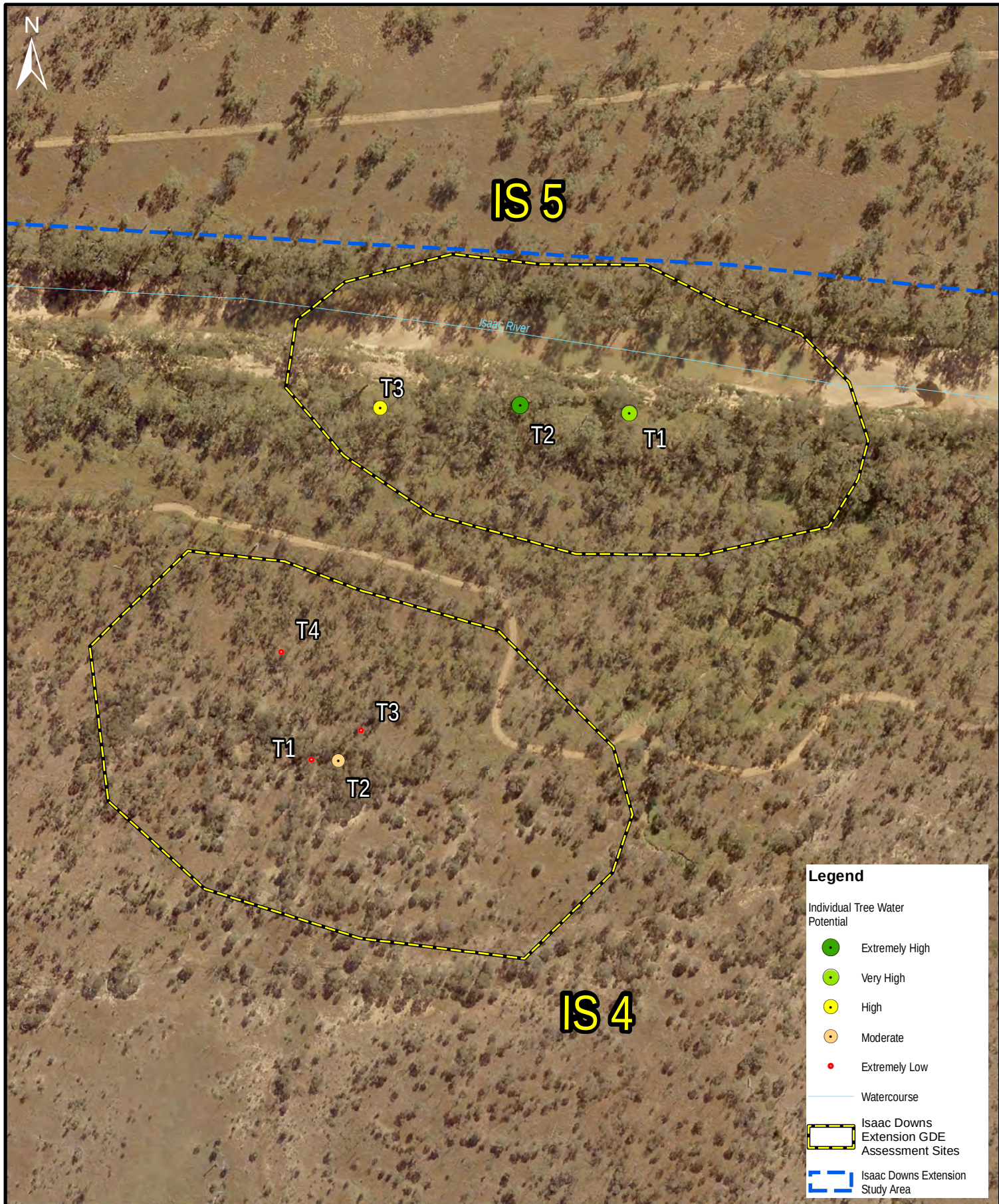
Appendix B2. Sampling detail at Assessment Site2 and Assessment Site 3

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026



Scale 1:3,004 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55 A4

Appendix B3. Sampling detail at Assessment Site 4 and Assessment Site 5

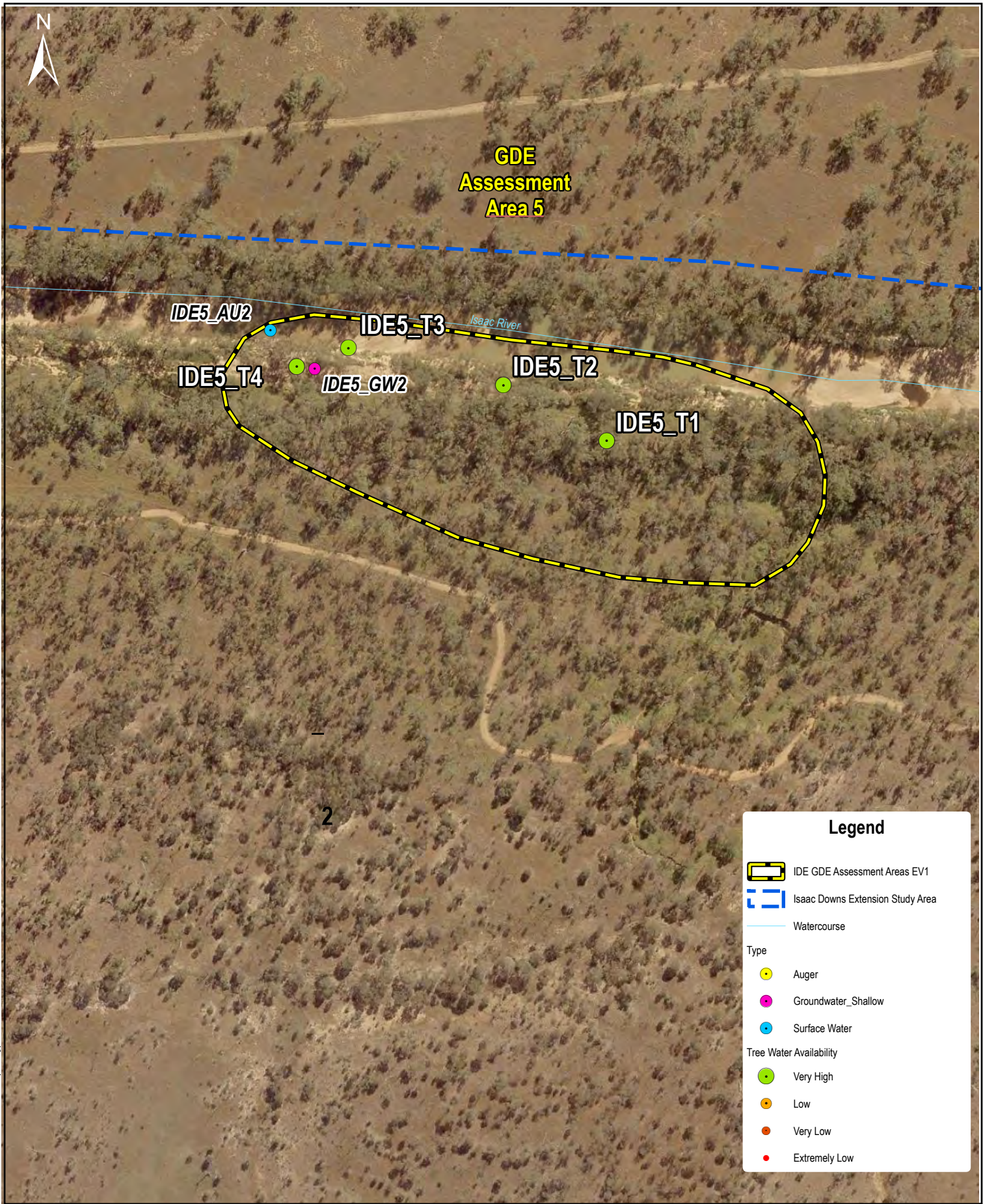
Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026

Path Name: F:\Water_Mark_Ecology\Isaac Downs Extension\Isaac Downs Extension March26



Scale: 1:3,180 @A4 0 0.06 0.11 K Coordinate System: GDA 2020 MGA Zone 55 A4

**Appendix B3A. Sampling detail at
Assessment Area 5 In November 2025**

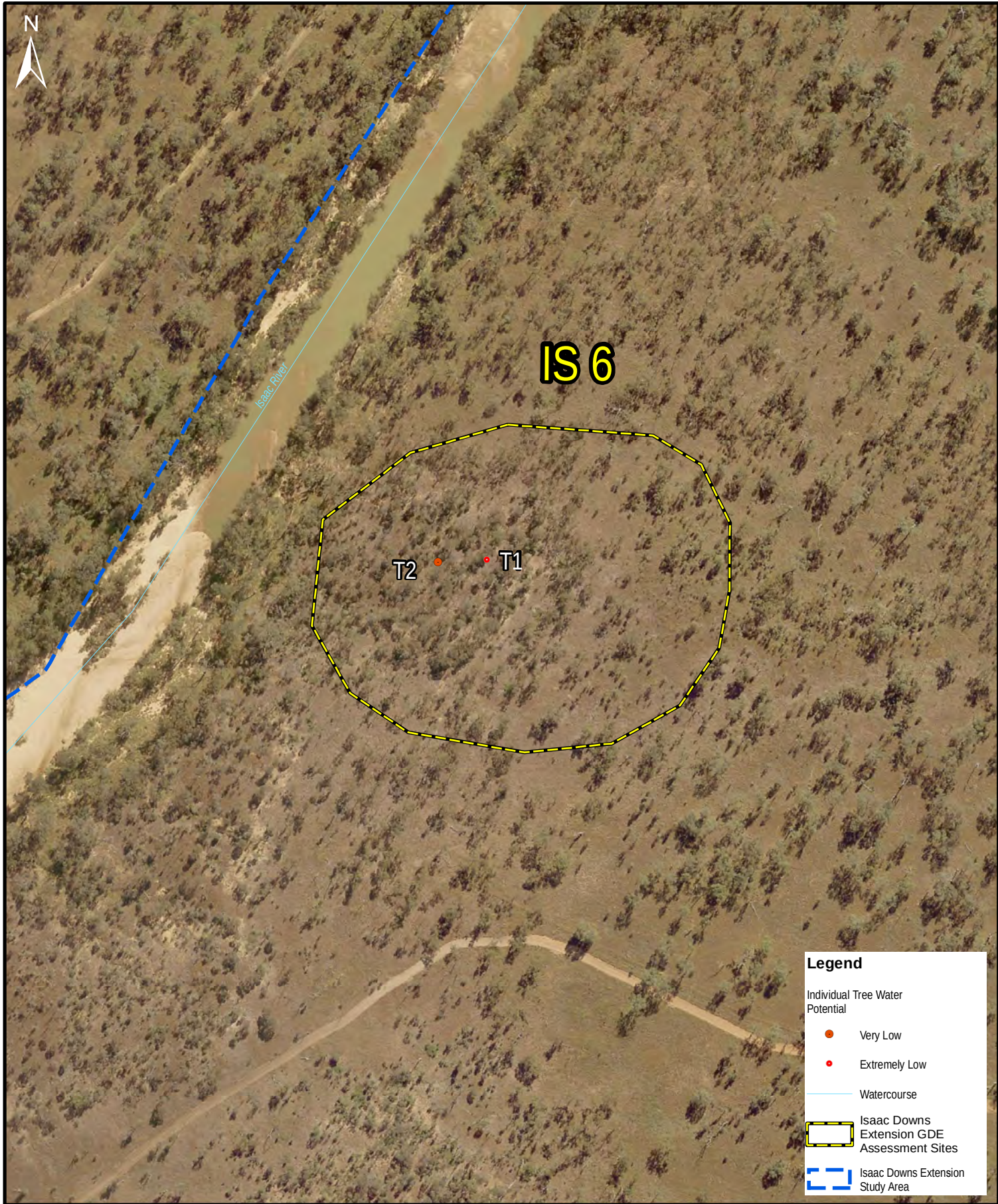


Kenmore, Qld 4069
Mobile: 0447 822 119
watermarkeco.com.au

Client : Stanmore IP South Pty Ltd

Project: ID GDEMMP PH3

Drawn By D.G. Checked D.S. Date: 10/03/2026



Legend

Individual Tree Water Potential

- Very Low
- Extremely Low

Watercourse

Isaac Downs Extension GDE Assessment Sites

Isaac Downs Extension Study Area

Scale 1:3,004 @ A4 0 0.1 0.2 KM Coordinate System: GDA 1994 MGA Zone 55 A4

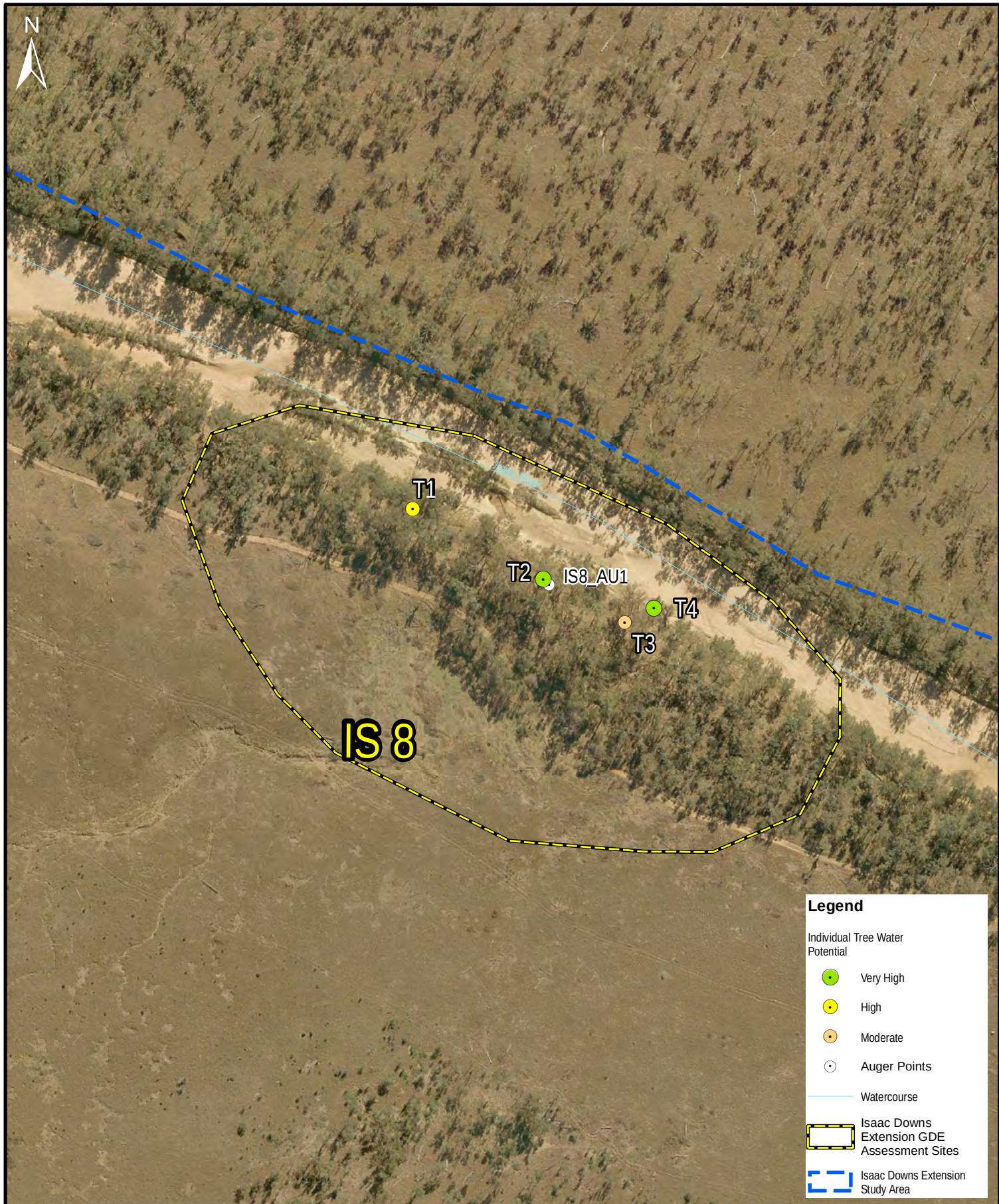
Appendix B4. Sampling detail at
Assessment Site 6

WATER MARK ECO

Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension

Drawn By DG Checked DS Date 7/04/2026



Scale 1:3,005 @ A4 0 0.1 0.2 KM Coordinate System: GDA 1994 MGA Zone 55 A4

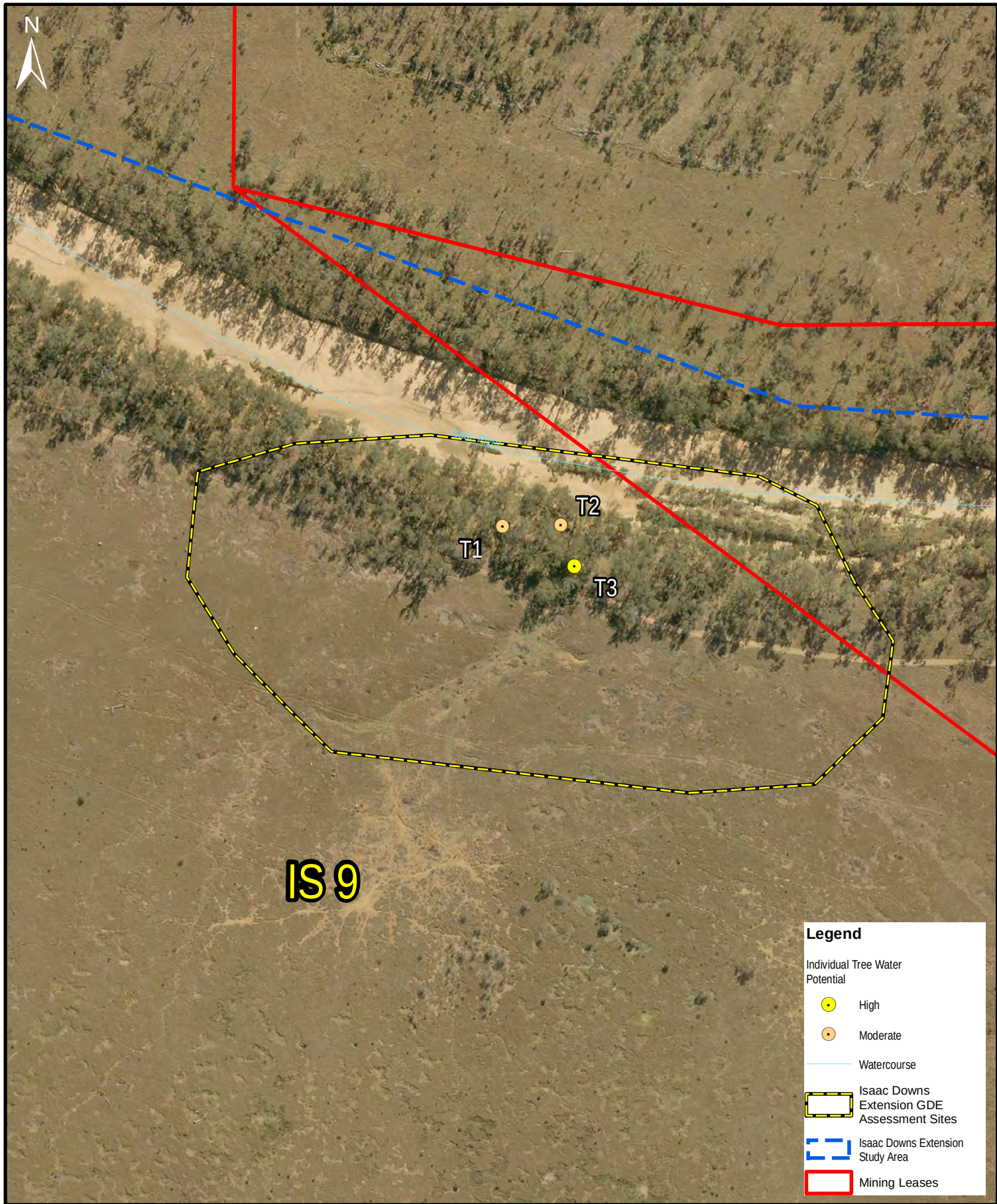
Appendix B5. Sampling detail at Assessment Site 8

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026



Scale 1:3,005 @ A4 0 0.1 0.2 KM Coordinate System: GDA 1994 MGA Zone 55 A4

Appendix B6. Sampling detail at Assessment Site 9

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026



IS 10

T1

T2

T3

Cherwell Creek

IS 11

T1

T2

T3

Legend

Individual Tree Water Potential

- Low
- Very Low
- Extremely Low

Watercourse

Isaac Downs Extension GDE Assessment Sites

Isaac Downs Extension Study Area

Mining Leases

Scale 1:3,005 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55 A4

Appendix B7. Sampling detail at
Assessment Site 10 and
Assessment Site 11

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026



IS 12

IS12_AU1

T3

T2

T4

T1

T1

T4

T2

T5

T3

IS 13

Legend

Individual Tree Water Potential

● Low

● Extremely Low

○ Auger Points

— Watercourse

Isaac Downs Extension GDE Assessment Sites

Isaac Downs Extension Study Area

Scale 1:3,005 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55

A4

Appendix B8. Sampling detail at Assessment Site 12 and Assessment Site 13

Client: Stanmore IP South Pty Ltd

Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026



IS 14

IS14_AU1

T3

T2

T4

T1

Legend

Individual Tree Water Potential

● Low

● Very Low

○ Auger Points

— Watercourse

Isaac Downs Extension GDE Assessment Sites

Isaac Downs Extension Study Area

Scale 1:3,005 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55

A4

Appendix B9. Sampling detail at Assessment Site 14

Client: Stanmore IP South Pty Ltd

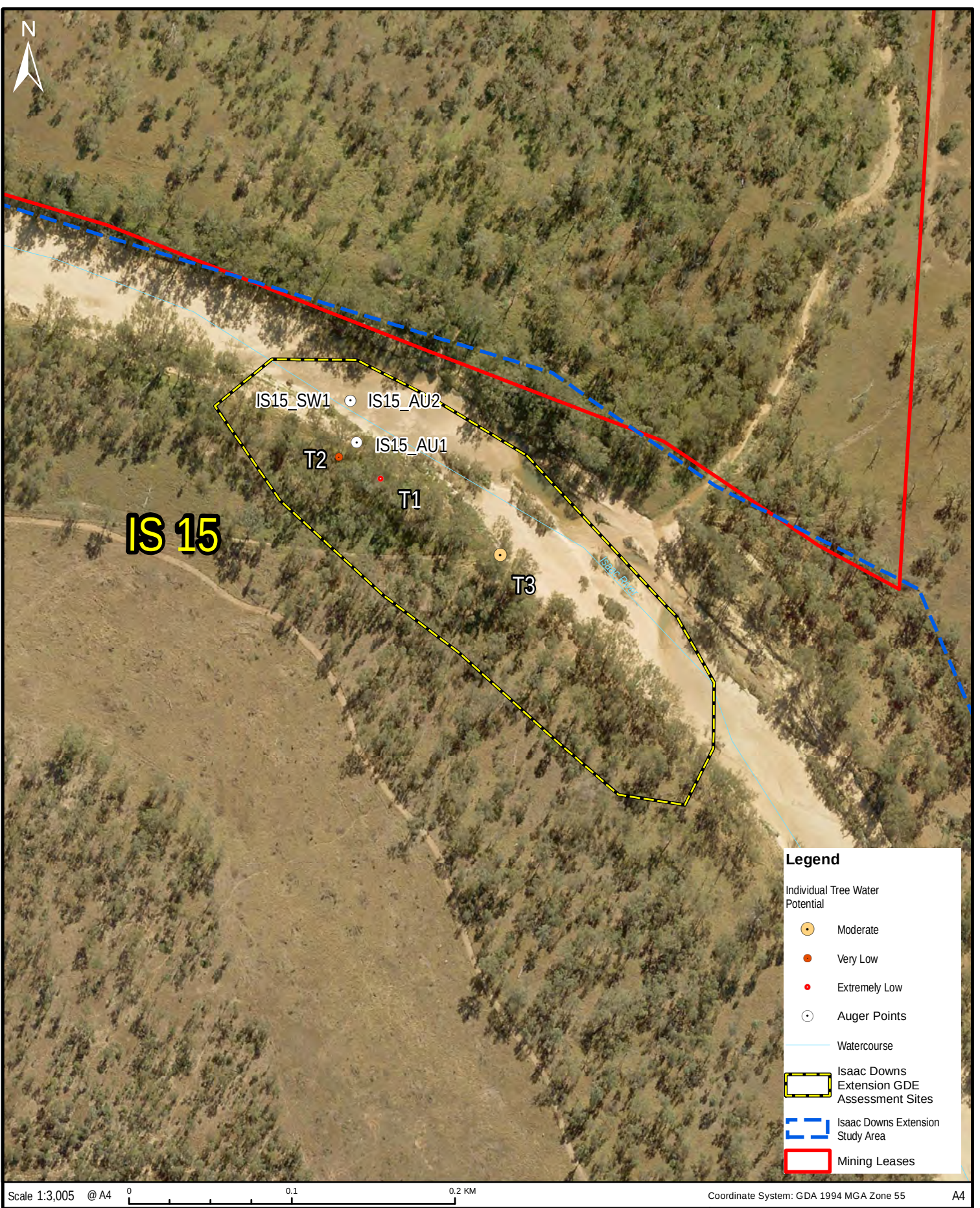
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026

F:\Water_Mark_Ecohydrology\Isaac Downs Extension\3d_IDE_A4P_29625.mxd



Legend

Individual Tree Water Potential

- Moderate (Yellow dot)
- Very Low (Orange dot)
- Extremely Low (Red dot)
- Auger Points (White dot)
- Watercourse (Cyan line)
- Isaac Downs Extension GDE Assessment Sites (Yellow dashed line)
- Isaac Downs Extension Study Area (Blue dashed line)
- Mining Leases (Red solid line)

Appendix B10. Sampling detail at Assessment Site 15		 Kenmore, Qld 4069 Mobile: 0447 822 119 www.watermarkeco.com.au
Client: Stanmore IP South Pty Ltd	Project: Isaac Downs Extension	
Drawn By DG Checked DS Date 7/04/2026		



IS 16

T1

T2

T4

T3

Legend

Individual Tree Water Potential

• Extremely Low

Watercourse

GDE Assessment Site 16

Isaac Downs Extension Study Area

Scale 1:3,004 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55

A4

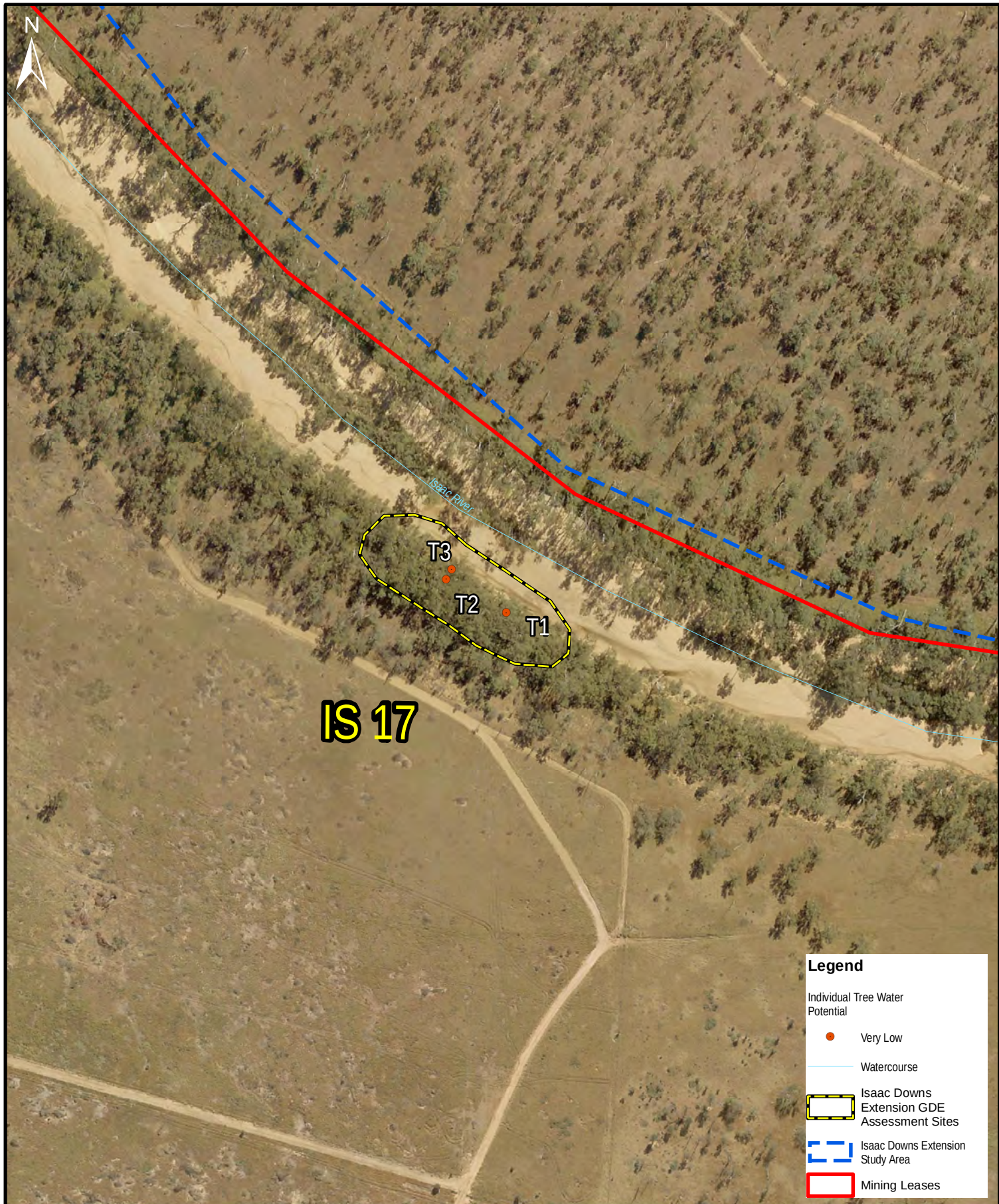
Appendix B11. Sampling detail at Assessment Site 16

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026



Scale 1:3,004 @ A4 0 0.1 0.2 KM Coordinate System: GDA 1994 MGA Zone 55 A4

Appendix B12. Sampling detail at Assessment Site 17

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 7/04/2026



IS 18

T3
T2
T4
T1

Cherwell Creek

Legend

Individual Tree Water Potential

- Extremely High
- High
- Moderate

Isaac Downs Extension GDE Assessment Sites

Isaac Downs Extension Study Area

Watercourse

Scale 1:3,001 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55

A4

Appendix B13. Sampling detail at Assessment Area 18

Client: Stanmore IP South Pty Ltd
Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 8/04/2026



GDE Assessment Area 19

ML 700081

ML 700082

T2

T1

MBIS06

Chewell Creek

ML 700083

Legend

○ Groundwater Bores

Tree Water Availability

● Very Low

— Watercourse

▭ GDE Assessment Areas
Isaac Downs Extension

▭ Isaac Downs Extension
Study Area

▭ Mineral development
licence

▭ Mining leases

Scale 1:3,000 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55

A4

Appendix B14. Sampling detail at Assessment Area 19

Client: Stanmore Resources Ltd

Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 3/10/2025



Legend

Individual Tree Water Potential

● High

● Moderate

○ Auger Points

Individual Tree Water Potential **November 2025** sampling (Red Labels)

● Very High

● Low

Isaac Downs Extension GDE Assessment Sites

Isaac Downs Extension Study Area

Watercourse

Mining Leases

Scale 1:3,004 @ A4 0 0.1 0.2 KM

Coordinate System: GDA 1994 MGA Zone 55

A4

Appendix B15. Sampling detail at Assessment Site 20

Client: Stanmore IP South Pty Ltd

Project: Isaac Downs Extension



Kenmore, Qld 4069
Mobile: 0447 822 119
www.watermarkeco.com.au

Drawn By DG Checked DS Date 8/04/2026

Appendix C. Soil Moisture Potentials-Raw Data

Code	Project	Type	Depth	Description	SMP (Mpa)
IS12_AU_0.3	Isaac South	Soil	30	Fine brown silty to loamy sand.	-4.09
IS12_AU_0.6	Isaac South	Soil	60	Fine brown silty to loamy sand.	-0.43
IS12_AU_1.2	Isaac South	Soil	120	Fine orange to brown sand.	-3.09
IS12_AU_1.8	Isaac South	Soil	180	Fine brown silty to loamy sand.	-2.49
IS12_AU_2.4	Isaac South	Soil	240	Medium brown fine loamy sand.	-0.61
IS12_AU_3.0	Isaac South	Soil	300	Medium brown to loamy fine sand.	-1.18
IS12_AU_3.6	Isaac South	Soil	360	Fine orange to brown sand.	-0.2
IS12_AU_3.9	Isaac South	Soil	390	Medium brown to orange sand. Wet	-0.13
IS12_AU_4.2	Isaac South	Soil	420	Medium brown to orange sand. Wet	-0.01
IS12_AU_5.1	Isaac South	Soil	510	Fine brown to grey strongly mottled sandy clay	0.23
IS14_AU1_0.3	Isaac South	Soil	300	Fine brown silty sand.	-2.04
IS14_AU1_0.6	Isaac South	Soil	60	Fine brown silty sand.	-2.39
IS14_AU1_1.2	Isaac South	Soil	120	Fine orange to brown loamy sand.	-4.46
IS14_AU1_1.8	Isaac South	Soil	180	Fine orange to brown loamy sand.	-1.32
IS14_AU1_2.4	Isaac South	Soil	240	Fine orange to brown loamy sand.	-2.93
IS14_AU1_3.0	Isaac South	Soil	300	Fine brown sand.	-2.1
IS14_AU1_3.6	Isaac South	Soil	360	Dark brown sand	-0.15
IS14_AU1_3.8	Isaac South	Soil	300	Dark brown loamy sand	-0.91
IS15_AU_0.3	Isaac South	Soil	30	Fine brow to orange sand	-3.17
IS15_AU_0.6	Isaac South	Soil	180	Brown fine sand.	-1.18
IS15_AU_1.2	Isaac South	Soil	120	Fine brown loamy sand	-0.4
IS15_AU_1.8	Isaac South	Soil	180	Brown fine loamy sand.	-0.99
IS15_AU_2.4	Isaac South	Soil	240	Brown fine loamy sand.	-1.53
IS15_AU_2.5	Isaac South	Soil	250	Fine brown loamy sand	-0.62
IS15_AU_3.0	Isaac South	Soil	300	Fine brown loamy sand	-1.51
IS15_AU_3.6	Isaac South	Soil	360	Fine brown loamy sand	-0.47
IS15_AU_3.9	Isaac South	Soil	390	Brown fine loamy sand.	-0.54
IS15_AU2_0.7	Isaac South	Soil	70	Saturated river sand	0
IS15_AU2_0.7	Isaac South	Soil	70	Coarse river sand	0
IS2_AU_0.3	Isaac South	Soil	30	Medium orange sand	-2.89
IS2_AU_0.6	Isaac South	Soil	60	Medium orange sand	-5.51
IS2_AU_1.0	Isaac South	Soil	100	Fine orange loamy sand.	-5.22
IS2_AU_1.5	Isaac South	Soil	150	Fine orange loamy sand.	-9.68
IS2_AU_2.0	Isaac South	Soil	150	Fine orange loamy sand.	-1.33
IS2_AU_2.5	Isaac South	Soil	250	Medium orange silty to loamy sand.	-5.45
IS2_AU_2.75	Isaac South	Soil	250	Fine orange loamy sand.	-1.48
IS2_AU_3.0	Isaac South	Soil	300	Medium orange sand	-5.05
IS2_AU_3.5	Isaac South	Soil	250	Medium orange loamy sand.	-3.27
IS2_AU_3.9	Isaac South	Soil	390	Medium orange loamy sand.	-1.66
IS2_AU_4.0	Isaac South	Soil	400	Medium orange loamy sand.	-0.87
IS2_AU_4.2	Isaac South	Soil	420	Medium orange sand. Wet	-0.48

Code	Project	Type	Depth	Description	SMP (Mpa)
IS8_AU_0.3	Isaac South	Soil	60	Fine orange to brown loamy sand.	-3.42
IS8_AU_0.6	Isaac South	Soil	60	Fine brown loamy sand.	-0.55
IS8_AU_1.2	Isaac South	Soil	120	Fine brown loamy sand.	-3.13
IS8_AU_1.8	Isaac South	Soil	180	Fine brown loamy sand.	-0.58
IS8_AU_2.4	Isaac South	Soil	240	Fine brown loamy sand.	-1.42
IS8_AU_3.0	Isaac South	Soil	300	Fine brown loamy sand.	-2.47
IS8_AU_3.6	Isaac South	Soil	360	Fine brown loamy sand.	-0.29
IS8_AU_4.2	Isaac South	Soil	420	Fine brown to orange loamy sand.	-0.65
IS8_AU_4.8	Isaac South	Soil	480	Fine brown to orange loamy sand.	-0.27
IS8_AU_5.0	Isaac South	Soil	480	Fine brown to orange loamy sand.	-0.1
IS8_AU_5.1	Isaac South	Soil	510	Orange brown to grey sandy clay to clayey sand. Strongly mottled	-0.29
IS9_AU_4.7	Isaac South	Soil	470	Fine brown to dark brown loamy sand	-0.02
IS20_AU1_0.3	Isaac South	Soil	30	Brown loamy clay. Slightly mottled and very dry.	-2.95
IS20_AU1_0.5	Isaac South	Soil	50	Brown to orange clay loamy clay. Very hard and dry.	-4.94
IS20_AU1_1.0	Isaac South	Soil	199	Brown to orange clay loamy clay. Very hard and dry.	-2.15
IS20_AU1_1.5	Isaac South	Soil	150	Brown to orange sandy clay. Strong mottling and slightly moist.	-2.91
IS20_AU1_2.5	Isaac South	Soil	250	Fine orange to brown sand. Slightly moist.	-1.55
IS20_AU1_2.6	Isaac South	Soil	260	Fine orange sand. Dry to moist.	-1.72
IS20_AU1_2.7	Isaac South	Soil	270	Fine orange sand and silty sand. Dry to moist.	-5.97
IS20_AU1_3.0	Isaac South	Soil	300	Fine orange sand and silty sand. Slightly moist and free draining	-1.22
IS20_AU1_3.5	Isaac South	Soil	350	Fine orange sand and silty sand. Dry to moist.	-2.15
IS20_AU1_3.9	Isaac South	Soil	390	Fine orange sand. Free draining and slightly moist	-0.89
IS20_AU1_4.5	Isaac South	Soil	450	Fine to medium orange sand. Slightly moist and free draining	-2.11
IS20_AU1_5.1	Isaac South	Soil	510	Fine to medium orange sand. Slightly moist and free draining	-1.83
IS20_AU1_5.5	Isaac South	Soil	550	Fine to medium orange sand. Slightly moist and free draining	-0.99
IS20_AU1_5.8	Isaac South	Soil	580	Medium to coarse poorly sorted sand and minor gravel. Moist	-0.53
IS20_AU1_6.1	Isaac South	Soil	610	Orange to brown loamy clay. Hardened.	-0.89

Appendix D. Stable Isotope Results (all Surveys)

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
594	Isaac Downs Extension	Apr-25	Groundwater	-4.69	-31.06	6.48	-12.81
MB1D023	Isaac Downs Extension	Nov-24	Groundwater	-3.56	-22.13	6.36	-10.74
MBID023	Isaac Downs Extension	Apr-25	Groundwater	-3.84	-22.05	8.69	-9.25
MBID023_2	Isaac Downs Extension	Apr-25	Groundwater	-3.73	-23.41	6.41	-11.01
MBID27	Isaac Downs Extension	Apr-25	Groundwater	-5.43	-30.41	13.02	-8.55
MBID27_2	Isaac Downs Extension	Apr-25	Groundwater	-2.30	-2.45	15.95	0.04
MBID28	Isaac Downs Extension	Apr-25	Groundwater	-4.46	-26.26	9.41	-9.81
MBIS08	Isaac Downs Extension	Apr-25	Groundwater	-5.11	-33.89	6.97	-13.19
MBIS10	Isaac Downs Extension	Apr-25	Groundwater	-4.79	-26.53	11.80	-8.37
MBIS16	Isaac Downs Extension	Apr-25	Groundwater	-5.02	-32.93	7.25	-12.78
RN182851	Isaac Downs Extension	Apr-25	Groundwater	-4.98	-30.23	9.60	-10.65
S93	Isaac Downs Extension	Apr-25	Groundwater	-5.24	-32.34	9.61	-11.15
IS12 AU 0.3	Isaac Downs Extension	6/11/2024	Soil	-3.26	-16.27	9.81	-7.15
IS12 AU 0.6	Isaac Downs Extension	6/11/2024	Soil	-3.85	-26.02	4.78	-12.66
IS12 AU 1.2	Isaac Downs Extension	6/11/2024	Soil	-3.71	-24.06	5.62	-11.66
IS12 AU 1.8	Isaac Downs Extension	6/11/2024	Soil	-5.54	-31.32	13.00	-8.78
IS12 AU 2.4	Isaac Downs Extension	6/11/2024	Soil	-4.25	-29.63	4.37	-13.79
IS12 AU 3.0	Isaac Downs Extension	6/11/2024	Soil	-4	-27.81	4.19	-13.47
IS12 AU 3.6	Isaac Downs Extension	6/11/2024	Soil	-6.89	-43.51	11.61	-12.59
IS12 AU 3.9	Isaac Downs Extension	6/11/2024	Soil	-5.84	-35.64	11.08	-11.03
IS12 AU 4.2	Isaac Downs Extension	6/11/2024	Soil	-4.66	-29.66	7.62	-11.76
IS12 AU 5.1	Isaac Downs Extension	6/11/2024	Soil	-4.21	-27.34	6.34	-12.00
IS14 AU 0.3	Isaac Downs Extension	7/11/2024	Soil	-4.18	-24.04	9.40	-9.28
IS14 AU 0.6	Isaac Downs Extension	7/11/2024	Soil	-5.31	-35.03	7.45	-13.16
IS14 AU 1.2	Isaac Downs Extension	7/11/2024	Soil	-4.59	-26.04	10.68	-8.96
IS14 AU 1.8	Isaac Downs Extension	7/11/2024	Soil	-4.74	-34.2	3.72	-15.30
IS14 AU 2.4	Isaac Downs Extension	7/11/2024	Soil	-6.26	-35.38	14.70	-8.69
IS14 AU 3.0	Isaac Downs Extension	7/11/2024	Soil	-7.04	-47.33	8.99	-15.16
IS14 AU 3.6	Isaac Downs Extension	7/11/2024	Soil	-7.43	-38.81	20.63	-5.79
IS14 AU 3.8	Isaac Downs Extension	7/11/2024	Soil	-5.7	-39.86	5.74	-15.40
IS15 AU 0.3	Isaac Downs Extension	7/11/2024	Soil	-2.45	-12.19	7.41	-7.68
IS15 AU 0.6	Isaac Downs Extension	7/11/2024	Soil	-2.31	-17	1.48	-12.56
IS15 AU 0.7	Isaac Downs Extension	7/11/2024	Soil	-1.2	-1.91	7.69	-5.02
IS15 AU 1.2	Isaac Downs Extension	7/11/2024	Soil	-3.21	-21.8	3.88	-12.21
IS15 AU 1.8	Isaac Downs Extension	7/11/2024	Soil	-4.15	-28.63	4.57	-13.43
IS15 AU 2.4	Isaac Downs Extension	7/11/2024	Soil	-4.42	-26.62	8.74	-10.32
IS15 AU 2.5	Isaac Downs Extension	7/11/2024	Soil	-3.78	-23.91	6.33	-11.18
IS15 AU 3.0	Isaac Downs Extension	7/11/2024	Soil	-4.05	-30.15	2.25	-15.25
IS15 AU 3.3	Isaac Downs Extension	7/11/2024	Soil	-4.53	-27.36	8.88	-10.41
IS15 AU 3.9	Isaac Downs Extension	7/11/2024	Soil	-3.65	-26.76	2.44	-14.31
IS2 AU 0.3	Isaac Downs Extension	5/11/2024	Soil	-1.9	-11.21	3.99	-9.59
IS2 AU 0.6	Isaac Downs Extension	5/11/2024	Soil	-3	-17.34	6.66	-9.39

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
IS2 AU 1.0	Isaac Downs Extension	5/11/2024	Soil	-3.42	-23.74	3.62	-12.84
IS2 AU 1.5	Isaac Downs Extension	5/11/2024	Soil	-5.5	-39.21	4.79	-15.84
IS2 AU 2.0	Isaac Downs Extension	5/11/2024	Soil	-6.33	-39	11.64	-11.48
IS2 AU 2.5	Isaac Downs Extension	5/11/2024	Soil	-5.51	-40.58	3.50	-16.98
IS2 AU 2.75	Isaac Downs Extension	5/11/2024	Soil	-4.96	-36.93	2.75	-16.57
IS2 AU 3.0	Isaac Downs Extension	5/11/2024	Soil	-4.02	-28.72	3.44	-14.16
IS2 AU 3.5	Isaac Downs Extension	5/11/2024	Soil	-6.84	-43.03	11.69	-12.42
IS2 AU 3.9	Isaac Downs Extension	5/11/2024	Soil	-5.65	-37.86	7.34	-13.91
IS2 AU 4.0	Isaac Downs Extension	5/11/2024	Soil	-4.05	-28.57	3.83	-13.88
IS2 AU 4.2	Isaac Downs Extension	5/11/2024	Soil	-5.52	-34.22	9.94	-11.40
IS8 AU 0.3	Isaac Downs Extension	6/11/2024	Soil	-4.31	-22.91	11.57	-7.65
IS8 AU 0.6	Isaac Downs Extension	6/11/2024	Soil	-7.01	-35.06	21.02	-4.64
IS8 AU 1.2	Isaac Downs Extension	6/11/2024	Soil	-7.04	-42.14	14.18	-10.65
IS8 AU 1.8	Isaac Downs Extension	6/11/2024	Soil	-5.59	-36.54	8.18	-13.06
IS8 AU 2.4	Isaac Downs Extension	6/11/2024	Soil	-4.2	-29.62	3.98	-14.03
IS8 AU 3.0	Isaac Downs Extension	6/11/2024	Soil	-4.87	-29.27	9.69	-10.36
IS8 AU 3.6	Isaac Downs Extension	6/11/2024	Soil	-3.13	-20.27	4.77	-11.28
IS8 AU 4.2	Isaac Downs Extension	6/11/2024	Soil	-3.06	-23.45	1.03	-14.40
IS8 AU 4.7	Isaac Downs Extension	6/11/2024	Soil	-3.97	-27.43	4.33	-13.29
IS8 AU 4.8	Isaac Downs Extension	6/11/2024	Soil	-4.44	-21.4	14.12	-5.68
IS8 AU 5.0	Isaac Downs Extension	6/11/2024	Soil	-2.34	-15.96	2.76	-11.51
IS8 AU 5.1	Isaac Downs Extension	6/11/2024	Soil	-2.82	-16.29	6.27	-9.38
IS20 AU1 0.3	Isaac Downs Extension	8/11/2024	Soil	-1.59	-20.42	-7.70	-19.15
IS20 AU1 0.5	Isaac Downs Extension	8/11/2024	Soil	-6.34	-29.42	21.30	-3.10
IS20 AU1 1.0	Isaac Downs Extension	8/11/2024	Soil	-5.89	-29.15	17.97	-5.13
IS20 AU1 1.5	Isaac Downs Extension	8/11/2024	Soil	-3.67	-28.98	0.38	-16.14
IS20 AU1 2.0	Isaac Downs Extension	8/11/2024	Soil	-4.99	-27.22	12.70	-7.98
IS20 AU1 2.5	Isaac Downs Extension	8/11/2024	Soil	-5.22	-31.43	10.33	-10.48
IS20 AU1 2.6	Isaac Downs Extension	8/11/2024	Soil	-5.99	-33.71	14.21	-8.59
IS20 AU1 2.7	Isaac Downs Extension	8/11/2024	Soil	-5.15	-32.65	8.55	-11.89
IS20 AU1 3.0	Isaac Downs Extension	8/11/2024	Soil	-3.11	-27.44	-2.56	-17.62
IS20 AU1 3.5	Isaac Downs Extension	8/11/2024	Soil	-3.11	-27.65	-2.77	-17.80
IS20 AU1 3.9	Isaac Downs Extension	8/11/2024	Soil	-2.56	-27.55	-7.07	-20.48
IS20 AU1 4.5	Isaac Downs Extension	8/11/2024	Soil	-2.99	-22.7	1.22	-14.10
IS20 AU1 5.1	Isaac Downs Extension	8/11/2024	Soil	-3.01	-28.27	-4.19	-18.84
IS20 AU1 5.5	Isaac Downs Extension	8/11/2024	Soil	-2.99	-29.89	-5.97	-20.35
IS20 AU1 5.8	Isaac Downs Extension	8/11/2024	Soil	-2.81	-21.25	1.23	-13.74
IS20 AU1 6.1	Isaac Downs Extension	8/11/2024	Soil	-2.57	-22.3	-1.74	-15.86
IS2_SW	Isaac Downs Extension	4/11/2024	Surface Water	6.69	24.89	-28.63	-21.38
IS15 SW	Isaac Downs Extension	7/11/2024	Surface Water	0.38	-2.17	-5.17	-13.16

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
IS1 T3	Isaac Downs Extension	4/11/2024	Twig	-2.8	-22.87	-0.47	-15.20
IS1 T5	Isaac Downs Extension	4/11/2024	Twig	-1.56	-15.38	-2.90	-14.92
IS10 T1	Isaac Downs Extension	4/11/2024	Twig	-3.22	-27.27	-1.51	-16.92
IS10 T3	Isaac Downs Extension	6/11/2024	Twig	-2.55	-18.9	1.50	-13.01
IS10 T3A	Isaac Downs Extension	6/11/2024	Twig	-1.62	-19.39	-6.43	-18.11
IS11 T1	Isaac Downs Extension	6/11/2024	Twig	-3.59	-30.59	-1.87	-17.94
IS11 T2	Isaac Downs Extension	6/11/2024	Twig	-2.81	-23.05	-0.57	-15.31
IS11 T3	Isaac Downs Extension	6/11/2024	Twig	-2.36	-23.45	-4.57	-17.92
IS12 T1	Isaac Downs Extension	6/11/2024	Twig	-2.78	-23.27	-1.03	-15.65
IS12 T2	Isaac Downs Extension	6/11/2024	Twig	-2.98	-20.82	3.02	-12.52
IS12 T3	Isaac Downs Extension	6/11/2024	Twig	-3.18	-20.32	5.12	-11.08
IS12 T4	Isaac Downs Extension	6/11/2024	Twig	-2.52	-23.22	-3.06	-16.91
IS13 T1	Isaac Downs Extension	6/11/2024	Twig	-3	-23.87	0.13	-15.07
IS13 T2	Isaac Downs Extension	6/11/2024	Twig	-2.63	-21.84	-0.80	-15.16
IS13 T3	Isaac Downs Extension	6/11/2024	Twig	-2.29	-13.38	4.94	-9.51
IS13 T4	Isaac Downs Extension	6/11/2024	Twig	-3.33	-21.89	4.75	-11.69
IS13 T5	Isaac Downs Extension	6/11/2024	Twig	-2.19	-17.92	-0.40	-13.96
IS15 T1	Isaac Downs Extension	7/11/2024	Twig	-2.19	-21.85	-4.33	-17.38
IS15 T2	Isaac Downs Extension	7/11/2024	Twig	-2.39	-16.29	2.83	-11.54
IS15 T3	Isaac Downs Extension	7/11/2024	Twig	-1.92	-16.86	-1.50	-14.40
IS15 T4	Isaac Downs Extension	7/11/2024	Twig	-2.88	-22.8	0.24	-14.74
IS16 T1	Isaac Downs Extension	7/11/2024	Twig	-3.3	-24.94	1.46	-14.49
IS16 T2	Isaac Downs Extension	7/11/2024	Twig	-2.39	-15.18	3.94	-10.58
IS17 T1	Isaac Downs Extension	7/11/2024	Twig	-1.5	-17.39	-5.39	-16.97
IS17 T2	Isaac Downs Extension	7/11/2024	Twig	-0.7	-8.5	-2.90	-13.26
IS17 T3	Isaac Downs Extension	7/11/2024	Twig	-2.15	-16.11	1.09	-12.59
IS18 T1	Isaac Downs Extension	8/11/2024	Twig	-2.56	-23.9	-3.42	-17.30
IS18 T2	Isaac Downs Extension	8/11/2024	Twig	-1.39	-17.35	-6.23	-17.49
IS18 T3	Isaac Downs Extension	8/11/2024	Twig	-2.06	-19.45	-2.97	-15.95
IS2 T1	Isaac Downs Extension	4/11/2024	Twig	-2.08	-21.61	-4.97	-17.73
IS2 T2	Isaac Downs Extension	4/11/2024	Twig	-1.92	-19.7	-4.34	-16.87
IS2 T3	Isaac Downs Extension	4/11/2024	Twig	-1.74	-13.21	0.71	-12.13
IS3 T1	Isaac Downs Extension	4/11/2024	Twig	-2.82	-27.09	-4.53	-18.77
IS3 T2	Isaac Downs Extension	4/11/2024	Twig	-3.08	-23.29	1.35	-14.16
IS3 T3	Isaac Downs Extension	4/11/2024	Twig	-3.63	-22.03	7.01	-10.30
IS4 T3	Isaac Downs Extension	4/11/2024	Twig	-3.21	-29.98	-4.30	-19.32
IS4 T4	Isaac Downs Extension	4/11/2024	Twig	-2.21	-18.85	-1.17	-14.67
IS7 T1	Isaac Downs Extension	5/11/2024	Twig	-1.29	-15.23	-4.91	-16.15
IS7 T2	Isaac Downs Extension	5/11/2024	Twig	-0.97	-11.62	-3.86	-14.62
IS7 T3	Isaac Downs Extension	5/11/2024	Twig	-0.98	-12.54	-4.70	-15.37
IS8 T1	Isaac Downs Extension	5/11/2024	Twig	-1.89	-14.48	0.64	-12.48
IS8 T2	Isaac Downs Extension	5/11/2024	Twig	-1.36	-11.08	-0.20	-12.19
IS8 T3	Isaac Downs Extension	5/11/2024	Twig	-3.29	-23.64	2.68	-13.41
IS8 T4	Isaac Downs Extension	5/11/2024	Twig	-1.97	-13.99	1.77	-11.65

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
IS9 T1	Isaac Downs Extension	5/11/2024	Twig	-2.47	-18.33	1.43	-12.91
IS9 T2	Isaac Downs Extension	5/11/2024	Twig	-1.62	-13.73	-0.77	-13.19
IS9 T3	Isaac Downs Extension	5/11/2024	Twig	-2.73	-23.15	-1.31	-15.80
IS14 T1	Isaac Downs Extension	6/11/2024	Twig	-2.94	-24.92	-1.40	-16.28
IS14 T2	Isaac Downs Extension	6/11/2024	Twig	-3.22	-6.02	19.74	1.56
IS14 T3	Isaac Downs Extension	6/11/2024	Twig	-2.5	4.07	24.07	6.72
IS14 T4	Isaac Downs Extension	6/11/2024	Twig	-2.69	-20.75	0.77	-13.91
IS20 T1	Isaac Downs Extension	Aug-23	Twigs	-0.95	-11.52	-3.92	-14.63
IS20 T2	Isaac Downs Extension	Aug-23	Twigs	-1.15	-13.75	-4.55	-15.57
IS20 T3	Isaac Downs Extension	Aug-23	Twigs	-1.59	-19.67	-6.95	-18.50
IS20T4	Isaac Downs Extension	Aug-23	Twigs	-0.91	-13.14	-5.86	-16.24
MBID04	Isaac Downs	Nov-19	Groundwater_Allu vium	-4.77	-32.31	5.85	-13.51
MBID05	Isaac Downs	Nov-19	Groundwater_Allu vium	-5.7	-38.17	7.43	-13.93
MBID08	Isaac Downs	Nov-19	Groundwater_Allu vium	-5.81	-39.2	7.28	-14.27
MBID17	Isaac Downs	Nov-19	Groundwater_Allu vium	-4.52	-28.2	7.96	-11.19
Winnet Bore	Winchester	Nov-19	Groundwater_Allu vium	-3.98	-26.68	5.16	-12.58
Knob Hill 2	Winchester	Nov-19	Groundwater_Allu vium	-4.81	-33.91	4.57	-14.70
MBID01	Isaac Downs	Nov-19	Groundwater_Co al	-3.6	-26.92	1.88	-14.70
MBID02	Isaac Downs	Nov-19	Groundwater_Co al	-4.15	-29.05	4.15	-13.79
MBID10	Isaac Downs	Nov-19	Groundwater_Co al	-5.12	-35.16	5.80	-14.23
OBS 10	Poitrel	Nov-19	Groundwater_Co al	-4.2	-24.47	9.13	-9.56
OBS 9	Poitrel	Nov-19	Groundwater_Co al	-4.9	-30.62	8.58	-11.39
PS5 AU1 1.3	Poitrel	Aug-23	Groundwater_Riv er Sand	-3.74	-19.13	10.79	-7.23
PS8 AU1 1.7	Poitrel	Aug-23	Groundwater_Riv er Sand	-3.99	-25.78	6.14	-11.75
PS2 AU1 0.3	Poitrel	Aug-23	Soil	-6.59	-47.42	5.30	-17.50
PS2 AU1 0.5	Poitrel	Aug-23	Soil	-10.11	-50.42	30.46	-2.41
PS2 AU1 1.0	Poitrel	Aug-23	Soil	-6.08	-32.08	16.56	-6.72
PS2 AU1 1.5	Poitrel	Aug-23	Soil	-4.07	-36	-3.44	-20.24
PS2 AU1 2.0	Poitrel	Aug-23	Soil	-6.16	-34.22	15.06	-8.18
PS2 AU1 2.5	Poitrel	Aug-23	Soil	-7.18	-37.69	19.75	-6.07
PS2 AU1 2.6	Poitrel	Aug-23	Soil	-6.44	-38.61	12.91	-10.59
PS2 AU1 2.7	Poitrel	Aug-23	Soil	-5.61	-42.02	2.86	-17.73
PS2 AU1 3.0	Poitrel	Aug-23	Soil	-4.29	-35.71	-1.39	-18.88
PS2 AU1 3.5	Poitrel	Aug-23	Soil	-4.62	-41.56	-4.60	-22.31
PS2 AU1 3.9	Poitrel	Aug-23	Soil	-3.53	-39.94	-11.70	-26.38
PS2 AU1 4.5	Poitrel	Aug-23	Soil	-3.95	-36.92	-5.32	-21.64
PS2 AU1 5.1	Poitrel	Aug-23	Soil	-3.29	-38.14	-11.82	-26.02

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
PS2 AU1 5.5	Poitrel	Aug-23	Soil	-3.26	-37.67	-11.59	-25.76
PS2 AU1 5.8	Poitrel	Aug-23	Soil	-4.88	-31.35	7.69	-12.12
PS2 AU1 6.0	Poitrel	Aug-23	Soil	-6.49	-48.49	3.43	-18.93
PS2 AU1 6.1	Poitrel	Aug-23	Soil	-4.47	-31.11	4.65	-13.97
PS5 AU2 0.30	Poitrel	Aug-23	Soil	-2.97	-5.68	18.08	0.60
PS5 AU2 0.6	Poitrel	Aug-23	Soil	-8.49	-45.41	22.51	-6.20
PS5 AU2 1.00	Poitrel	Aug-23	Soil	-7.52	-44.35	15.81	-10.15
PS5 AU2 1.25	Poitrel	Aug-23	Soil	-7.29	-42.63	15.69	-9.81
PS5 AU2 1.5	Poitrel	Aug-23	Soil	-8.21	-40.24	25.44	-3.11
PS5 AU2 2.1	Poitrel	Aug-23	Soil	-7.38	-32.75	26.29	-0.77
PS5 AU2 2.5	Poitrel	Aug-23	Soil	-6.44	-31.93	19.59	-4.78
PS5 AU2 3.0	Poitrel	Aug-23	Soil	-5.52	-27.1	17.06	-5.21
PS5 AU2 3.2	Poitrel	Aug-23	Soil	-5.1	-26.01	14.79	-6.37
PS5 AU2 3.5	Poitrel	Aug-23	Soil	-5.41	-24.93	18.35	-3.87
PS5 AU2 3.7	Poitrel	Aug-23	Soil	-5.01	-24.81	15.27	-5.78
PS5 AU2 4.0	Poitrel	Aug-23	Soil	-3.4	-12.6	14.60	-3.26
PS5 AU2 4.1	Poitrel	Aug-23	Soil	-3.62	-16.82	12.14	-5.82
PS8 AU2 0.3	Poitrel	Aug-23	Soil	-4.37	-15.23	19.73	-0.67
PS8 AU2 1.5	Poitrel	Aug-23	Soil	-4.61	-21.01	15.87	-4.49
PS8 AU2 1.8	Poitrel	Aug-23	Soil	-7.53	-41.65	18.59	-7.76
PS8 AU2 2.0	Poitrel	Aug-23	Soil	-7.8	-36.4	26.00	-1.83
PS8 AU2 2.5	Poitrel	Aug-23	Soil	-9.11	-47.45	25.43	-4.86
PS1 T1	Poitrel	Aug-23	Twigs	-2.92	-18.72	4.64	-10.99
PS1 T2	Poitrel	Aug-23	Twigs	-1.72	-6.64	7.12	-6.52
PS1 T3	Poitrel	Aug-23	Twigs	-2.95	-16.31	7.29	-8.74
PS1 T4	Poitrel	Aug-23	Twigs	-1.04	-8.66	-0.34	-11.69
PS10 T1	Poitrel	Aug-23	Twigs	-2.5	-15.03	4.97	-9.89
PS10 T2	Poitrel	Aug-23	Twigs	-1.85	-18.27	-3.47	-15.98
PS10 T3	Poitrel	Aug-23	Twigs	0.4	-7.95	-11.15	-18.32
PS2 T1	Poitrel	Aug-23	Twigs	-1.13	-16.91	-7.87	-18.42
PS2 T2	Poitrel	Aug-23	Twigs	-2.33	-23.98	-5.34	-18.53
PS2 T3	Poitrel	Aug-23	Twigs	-3.67	-28.67	0.69	-15.87
PS2 T4	Poitrel	Aug-23	Twigs	-1.21	-17.14	-7.46	-18.21
PS3 T1	Poitrel	Aug-23	Twigs	-0.87	-10.5	-3.54	-14.15
PS3 T2	Poitrel	Aug-23	Twigs	-1	-15.56	-7.56	-17.89
PS3 T3	Poitrel	Aug-23	Twigs	-1.38	-11.14	-0.10	-12.14
PS3 T4	Poitrel	Aug-23	Twigs	-1.77	-15.89	-1.73	-14.31
PS4 T1	Poitrel	Aug-23	Twigs	-2.95	-17.07	6.53	-9.41

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
PS4 T2	Poitrel	Aug-23	Twigs	-2.5	-15.31	4.69	-10.14
PS4 T3	Poitrel	Aug-23	Twigs	-2.24	-15.12	2.80	-11.28
PS4 T4	Poitrel	Aug-23	Twigs	-1.55	-4.88	7.52	-5.84
PS5 T1	Poitrel	Aug-23	Twigs	-2.37	-20.54	-1.58	-15.34
PS5 T2	Poitrel	Aug-23	Twigs	-2.41	-15.69	3.59	-10.92
PS5 T3	Poitrel	Aug-23	Twigs	-2.97	-18.55	5.21	-10.59
PS5 T4	Poitrel	Aug-23	Twigs	-2.96	-17.86	5.82	-10.04
PS5 T5	Poitrel	Aug-23	Twigs	-2.88	-15.83	7.21	-8.68
PS6 T1	Poitrel	Aug-23	Twigs	-3.02	-29.28	-5.12	-19.67
PS6 T2	Poitrel	Aug-23	Twigs	-0.61	-16.6	-11.72	-20.76
PS6 T3	Poitrel	Aug-23	Twigs	-2.22	-23.02	-5.26	-18.25
PS6 T4	Poitrel	Aug-23	Twigs	0.46	-13.96	-17.64	-23.84
PS7 T1	Poitrel	Aug-23	Twigs	-1.13	-11.55	-2.51	-13.75
PS7 T2	Poitrel	Aug-23	Twigs	-1.92	-16.02	-0.66	-13.67
PS7 T3	Poitrel	Aug-23	Twigs	-0.36	-4.73	-1.85	-11.69
PS7 T4	Poitrel	Aug-23	Twigs	-1.98	-15.4	0.44	-12.83
PS8 T1	Poitrel	Aug-23	Twigs	-3.45	-23.12	4.48	-12.15
PS8 T2	Poitrel	Aug-23	Twigs	-2.25	-13.19	4.81	-9.55
PS8 T3	Poitrel	Aug-23	Twigs	-1.52	-10.9	1.26	-11.23
PS8 T4	Poitrel	Aug-23	Twigs	-2.36	-18.24	0.64	-13.39
PS9 T1	Poitrel	Aug-23	Twigs	-2.03	-11.5	4.74	-9.19
PS9 T2	Poitrel	Aug-23	Twigs	-3.44	-23.23	4.29	-12.30
PS9 T3	Poitrel	Aug-23	Twigs	-4.56	-27.27	9.21	-10.18
PS9 T4	Poitrel	Aug-23	Twigs	-3.12	-19.78	5.18	-10.91
MBID01	Isaac Downs	EIS_Baseline November 2019	Groundwater	-2.81	-24.1	-1.62	-16.22
MBID06	Isaac Downs	EIS_Baseline November 2019	Groundwater	-7.2	-49.66	7.94	-16.38
MBID16	Isaac Downs	EIS_Baseline November 2019	Groundwater	-4.3	-32.75	1.65	-16.25
MBID12	Isaac Downs	EIS_Baseline November 2019	Groundwater	-5.1	-35.13	5.67	-14.30
MBID07	Isaac Downs	EIS_Baseline November 2019	Groundwater	-5.46	-36.51	7.17	-13.69
MBID05	Isaac Downs	EIS_Baseline November 2019	Groundwater	-5.78	-37.3	8.94	-12.77
MBID10	Isaac Downs	EIS_Baseline November 2019	Groundwater	-5.12	-35.16	5.80	-14.23
MBID17	Isaac Downs	EIS_Baseline November 2019	Groundwater	-4.52	-28.2	7.96	-11.19
MBID08	Isaac Downs	EIS_Baseline November 2019	Groundwater	-5.81	-39.2	7.28	-14.27
MBID02	Isaac Downs	EIS_Baseline November 2019	Groundwater	-3.89	-28.26	2.86	-14.41
MBID07	Isaac Downs	Nov-20	Groundwater	-5.31	-36.25	6.23	-14.22

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
MBID03	Isaac Downs	Nov-21	Groundwater	-4.52	-31.92	4.24	-14.43
MBID19	Isaac Downs	Apr-22	Groundwater	-4.61	-30.7	6.18	-12.91
MBID21	Isaac Downs	Apr-22	Groundwater	-4.81	-33.92	4.56	-14.71
S6_AU6_1.6	Isaac Downs	EIS_2018	Groundwater, River Sand	-2.46	-26.81	-7.13	-20.34
ND_3	Isaac Downs	Nov-20	Groundwater, River Sand	-4.13	-25.31	7.73	-10.64
DD1-AU1-0.8	Isaac Downs	Apr-21	Groundwater, River Sand	-0.87	-15.93	-8.97	-18.87
DC2-AU1-1.0	Isaac Downs	Apr-21	Groundwater, River Sand	-6.63	-44.71	8.33	-14.94
DD2-AU1-1.2	Isaac Downs	Apr-21	Groundwater, River Sand	-4.48	-32.72	3.12	-15.32
ND1-AU2-1.5	Isaac Downs	Apr-21	Groundwater, River Sand	-4.28	-37.51	-3.27	-20.49
USC2_RW_03	Isaac Downs	Apr-21	Groundwater, River Sand	-3.52	-24	4.16	-12.57
UC2_GW1	Isaac Downs	Apr-22	Groundwater, River Sand	-4.13	-19.55	13.49	-5.63
DD2_GW1	Isaac Downs	Apr-22	Groundwater, River Sand	-3.66	-18.34	10.94	-6.94
DD1-AU1	Isaac Downs	Apr-22	Groundwater, River Sand	-3.18	-13.22	12.22	-4.90
DD3_SW1	Isaac Downs	Apr-21	Surface Water	-2.12	-18.66	-1.70	-14.96
USC2_SW_1	Isaac Downs	Apr-21	Surface Water	2.63	3.11	-17.93	-19.91
DC2_SW1	Isaac Downs	Apr-21	Surface Water	0.78	1.33	-4.91	-12.16
DC2-SW1	Isaac Downs	Nov-21	Surface Water	-0.41	3.76	7.04	-4.06
DD2-SW1	Isaac Downs	Nov-21	Surface Water	-1.69	-3.14	10.38	-3.63
ND1-SW1	Isaac Downs	Nov-21	Surface Water	-1.8	-5.7	8.70	-5.30
USC2-SW1	Isaac Downs	Nov-21	Surface Water	-1.83	-6.41	8.23	-5.77
ND3-Surface	Isaac Downs	Nov-21	Surface Water	-1.55	-5.57	6.83	-6.44
ND1-River sand	Isaac Downs	Nov-21	Surface Water	-0.56	0.86	5.34	-5.83
UC2_SW1	Isaac Downs	Apr-22	Surface Water	-0.55	-6.57	-2.17	-12.34
ND1_T1	Isaac Downs	EIS_2018	Xylem	-3.02	-24.09	0.07	-15.16
ND1_T2	Isaac Downs	EIS_2018	Xylem	-2.94	-26.6	-3.08	-17.74
ND1_T3	Isaac Downs	EIS_2018	Xylem	-3.04	-28.36	-4.04	-18.77
ND2_T1	Isaac Downs	EIS_2018	Xylem	-3.9	-29.24	1.96	-15.21
ND2_T2	Isaac Downs	EIS_2018	Xylem	-1.64	-21.62	-8.50	-19.95
ND2_T3	Isaac Downs	EIS_2018	Xylem	-2.45	-25.48	-5.88	-19.23
ND3_T1	Isaac Downs	EIS_2018	Xylem	-2.1	-13.17	3.63	-10.29
ND3_T2	Isaac Downs	EIS_2018	Xylem	-3.94	-34.2	-2.68	-19.32
ND3_T3	Isaac Downs	EIS_2018	Xylem	-4.39	-46.7	-11.58	-27.93
S6_T1	Isaac Downs	EIS_2018	Xylem	-3.28	-25.52	0.72	-15.09
S6_T2	Isaac Downs	EIS_2018	Xylem	-4.12	-27.41	5.55	-12.52
S6_T3	Isaac Downs	EIS_2018	Xylem	-4.57	-27.86	8.70	-10.64
ND1_AU1_0.2	Isaac Downs	EIS_2018	Soils	3.71	19.04	-10.64	-11.48
ND1_AU1_0.5	Isaac Downs	EIS_2018	Soils	2.18	3.31	-14.13	-17.47
ND1_AU1_1	Isaac Downs	EIS_2018	Soils	0.81	-1.85	-8.33	-15.07
ND1_AU1_1.5	Isaac Downs	EIS_2018	Soils	-1.68	-20.14	-6.70	-18.46
ND1_AU1_2	Isaac Downs	EIS_2018	Soils	-2	-18.49	-2.49	-15.42

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
ND1_AU1_2.25	Isaac Downs	EIS_2018	Soils	-5.14	-27.64	13.48	-7.59
ND2_AU2_0.2	Isaac Downs	EIS_2018	Soils	-3.35	-13.98	12.82	-4.71
ND2_AU2_0.5	Isaac Downs	EIS_2018	Soils	-7.82	-31	31.56	2.96
ND2_AU2_1.0	Isaac Downs	EIS_2018	Soils	-10.25	-73.61	8.39	-21.87
ND2_AU2_1.5	Isaac Downs	EIS_2018	Soils	-9.27	-57.24	16.92	-12.57
ND2_AU2_1.75	Isaac Downs	EIS_2018	Soils	-8.47	-16.83	50.93	18.55
ND2_AU2_2.0	Isaac Downs	EIS_2018	Soils	-9.64	-71.89	5.23	-23.44
ND2_AU2_2.25	Isaac Downs	EIS_2018	Soils	-8.26	-58.59	7.49	-18.82
DD3-AU2-1.1	Isaac Downs	Nov-20	Soils	-4.87	-29.13	9.83	-10.24
DD2-AU1-1.5	Isaac Downs	Nov-20	Soils	-4.83	-34.7	3.94	-15.29
DD2-AU1-1.7	Isaac Downs	Nov-20	Soils	-5.31	-39.29	3.19	-16.86
DD1-AU1-0.1	Isaac Downs	Nov-20	Soils	-3.72	-17.35	12.41	-5.78
DD1-AU1-0.3	Isaac Downs	Nov-20	Soils	-0.38	-13.82	-10.78	-19.50
DD1-AU1-1.0	Isaac Downs	Nov-20	Soils	-6.3	-31.67	18.73	-5.26
DD1-AU1-1.5	Isaac Downs	Nov-20	Soils	-5.69	-34.49	11.03	-10.78
DD1-AU1-1.6	Isaac Downs	Nov-20	Soils	-5.72	-29.65	16.11	-6.42
IDCU-AU1-0.4	Isaac Downs	Nov-20	Soils	-4.61	-24.45	12.43	-7.48
IDCU-AU1-0.7	Isaac Downs	Nov-20	Soils	-1.33	-13.78	-3.14	-14.69
IDCU-AU1-1.0	Isaac Downs	Nov-20	Soils	-4.23	-46.28	-12.44	-28.37
IDCU-AU1-1.5	Isaac Downs	Nov-20	Soils	-1.87	-17.55	-2.59	-15.25
IDCU-AU1-1.7	Isaac Downs	Nov-20	Soils	-1.98	-14.67	1.17	-12.19
IDDC-AU1-2.0	Isaac Downs	Nov-20	Soils	-9.63	-62.01	15.03	-14.90
IDDC-AU2-0.5	Isaac Downs	Nov-20	Soils	-2.75	-12.67	9.33	-6.58
IDDC-AU2-1.0	Isaac Downs	Nov-20	Soils	-3.17	-16.93	8.43	-8.18
IDDC-AU2-1.5	Isaac Downs	Nov-20	Soils	-5.04	-30.52	9.80	-10.59
IDDC-AU2-2.0	Isaac Downs	Nov-20	Soils	-5.06	-22.69	17.79	-3.69
ND1-AU1-0.2	Isaac Downs	Nov-20	Soils	-1.1	-23.13	-14.33	-23.97
ND1-AU1-0.6	Isaac Downs	Nov-20	Soils	-7.11	-53.81	3.07	-20.44
ND1-AU1-1.0	Isaac Downs	Nov-20	Soils	-7.24	-44.24	13.68	-11.47
ND1-AU1-1.5	Isaac Downs	Nov-20	Soils	-9.4	-63.51	11.69	-17.36
ND1-AU1-2.0	Isaac Downs	Nov-20	Soils	-13.11	-78.12	26.76	-11.42
ND1-AU1-2.3	Isaac Downs	Nov-20	Soils	-8.59	-75.44	-6.72	-31.81
ND1-AU1-3.5	Isaac Downs	Nov-20	Soils	-13.77	-82.05	28.11	-11.52
ND1-AU1-4.2	Isaac Downs	Nov-20	Soils	-12.2	-73.56	24.04	-12.03
ND1-AU1-5.0	Isaac Downs	Nov-20	Soils	-14.14	-78.39	34.73	-6.48

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
ND1_AU2_2.0	Isaac Downs	Nov-20	Soils	-4.65	-43.22	-6.02	-23.60
ND3-AU1-0.2	Isaac Downs	Nov-20	Soils	0.69	-1.02	-6.54	-13.75
ND3-AU1-0.5	Isaac Downs	Nov-20	Soils	-4.3	-18.04	16.36	-3.46
ND3-AU1-1.5	Isaac Downs	Nov-20	Soils	-5.39	-36.96	6.16	-14.44
ND3-AU1-1.9	Isaac Downs	Nov-20	Soils	-5.94	-22.85	24.67	0.60
ND3-AU1-2.0	Isaac Downs	Nov-20	Soils	-4.5	-47.02	-11.02	-27.66
ND3-AU3-2.2	Isaac Downs	Nov-20	Soils	-4.94	-38	1.52	-17.60
DD3-AU3-0.25	Isaac Downs	Apr-21	Soils	-2.68	-41.4	-19.96	-31.92
DD3-AU3-0.5	Isaac Downs	Apr-21	Soils	-1.25	-26.86	-16.86	-26.46
DD3-AU3-1.0	Isaac Downs	Apr-21	Soils	0.39	-31.34	-34.46	-38.60
DD3-AU3-1.5	Isaac Downs	Apr-21	Soils	-3.43	17.2	44.64	22.81
DD3-AU3-2.0	Isaac Downs	Apr-21	Soils	-4.87	-18.13	20.83	-0.68
DD3-AU3-2.25	Isaac Downs	Apr-21	Soils	-4.15	-55.46	-22.26	-36.76
DD3-AU3-2.5	Isaac Downs	Apr-21	Soils	-8.13	-12.57	52.47	20.55
DD3-AU3-3.0	Isaac Downs	Apr-21	Soils	-5.49	-23.1	20.82	-1.88
DD3-AU3-3.5	Isaac Downs	Apr-21	Soils	-7.77	-39.77	22.39	-4.91
ND1-0.3	Isaac Downs	Apr-21	Soils	-8.24	-37.1	28.82	-0.23
ND1-0.6	Isaac Downs	Apr-21	Soils	-6.12	-32.54	16.42	-6.92
ND1-1.0	Isaac Downs	Apr-21	Soils	-7.66	-34.68	26.60	-1.04
ND1-1.5	Isaac Downs	Apr-21	Soils	-11.03	-63.19	25.05	-8.89
ND1-2.0	Isaac Downs	Apr-21	Soils	-10.29	-96.75	-14.43	-41.79
ND1-2.5	Isaac Downs	Apr-21	Soils	-13.07	-72.3	32.26	-6.56
ND1-3.0	Isaac Downs	Apr-21	Soils	-12.56	-84.56	15.92	-19.78
ND1-3.7	Isaac Downs	Apr-21	Soils	-12.72	-71.44	30.32	-7.57
ND1-4.0	Isaac Downs	Apr-21	Soils	-12.15	-117.04	-19.84	-50.09
ND1-4.5	Isaac Downs	Apr-21	Soils	-11.97	-74.64	21.12	-14.12
ND1-5.0	Isaac Downs	Apr-21	Soils	-13.06	-74.31	30.17	-8.36
ND1-6.0	Isaac Downs	Apr-21	Soils	-11.21	-103.37	-13.69	-42.93
DD2-AU1-0.7	Isaac Downs	Apr-21	Soils	-3.58	-18.5	10.14	-7.48
DC2-AU1-0.6	Isaac Downs	Apr-21	Soils	-3.08	-47.84	-23.20	-35.51
ND1-AU2-1.3	Isaac Downs	Apr-21	Soils	-1.4	-38.58	-27.38	-35.90
DD2 AU1-0.3	Isaac Downs	Nov-21	Soils	-5.87	-28.61	18.35	-4.76
DD2 AU1-0.5	Isaac Downs	Nov-21	Soils	-7.79	-30.45	31.87	3.29
DD2 AU1-1.0	Isaac Downs	Nov-21	Soils	-7.59	-42.26	18.46	-7.98
DD2 AU1-1.5	Isaac Downs	Nov-21	Soils	-6.34	-35.61	15.11	-8.49
DD2 AU1-2.0	Isaac Downs	Nov-21	Soils	-8.04	-39.92	24.40	-3.69
DD2 AU1-2.5	Isaac Downs	Nov-21	Soils	-7.32	-34.71	23.85	-2.78

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
DD2 AU1-2.6	Isaac Downs	Nov-21	Soils	-5.75	-37.6	8.40	-13.18
DD2 AU2-3.0	Isaac Downs	Nov-21	Soils	-6.73	-32.35	21.49	-3.69
DD2 AU1-3.5	Isaac Downs	Nov-21	Soils	-5.94	-33.06	14.46	-8.28
DD2 AU1-3.8	Isaac Downs	Nov-21	Soils	-8.51	-31.76	36.32	5.77
DD2 AU1-4.0	Isaac Downs	Nov-21	Soils	-6.86	-36.33	18.55	-6.50
DD2 AU1-4.2	Isaac Downs	Nov-21	Soils	-6.39	-35.92	15.20	-8.50
ND1 AU1-0.3	Isaac Downs	Nov-21	Soils	-4.15	-14.55	18.65	-1.18
ND1 AU1-0.6	Isaac Downs	Nov-21	Soils	-4.8	-16.39	22.01	0.49
ND1 AU1-1.0	Isaac Downs	Nov-21	Soils	-5.88	-30.91	16.13	-6.71
ND1 AU1-1.5	Isaac Downs	Nov-21	Soils	-8.94	-51.95	19.57	-9.62
ND1 AU1-2.0	Isaac Downs	Nov-21	Soils	-10.34	-59.94	22.78	-9.53
ND1 AU1-2.5	Isaac Downs	Nov-21	Soils	-10.08	-73.89	6.75	-22.97
ND1 AU1-3.0	Isaac Downs	Nov-21	Soils	-11.81	-75.21	19.27	-15.42
ND1-AU1-3.5	Isaac Downs	Nov-21	Soils	-13.1	-81.93	22.87	-14.78
ND1 AU1-4.0	Isaac Downs	Nov-21	Soils	-12.04	-64.15	32.17	-4.65
ND1 AU1-4.5	Isaac Downs	Nov-21	Soils	-12.26	-51.46	46.62	7.49
ND1 AU1-5.0	Isaac Downs	Nov-21	Soils	-10.72	-75.27	10.49	-20.95
ND1 AU1-5.5	Isaac Downs	Nov-21	Soils	-11.53	-68.09	24.15	-10.64
ND1 AU1-6.2	Isaac Downs	Nov-21	Soils	-11.71	-60.44	33.24	-3.08
USC2 AU1-0.5	Isaac Downs	Nov-21	Soils	-4.31	-17.18	17.30	-2.66
USC2 AU1-1.3	Isaac Downs	Nov-21	Soils	-9.43	-35.45	39.99	7.19
USC2 AU1-2.0	Isaac Downs	Nov-21	Soils	-8.21	-32.88	32.80	3.29
US2 AU1-2.5	Isaac Downs	Nov-21	Soils	-8.76	-39.63	30.45	0.18
USC2 AU1-3.0	Isaac Downs	Nov-21	Soils	-8.18	-17.15	48.29	16.82
USC2 AU1-3.5	Isaac Downs	Nov-21	Soils	-7.58	-47.81	12.83	-12.86
USC2 AU1-3.9	Isaac Downs	Nov-21	Soils	-7.03	-31.01	25.23	-1.02
USC2 AU1-4.1	Isaac Downs	Nov-21	Soils	-6.92	-36.99	18.37	-6.77
DD1-AU1-0.3	Isaac Downs	Apr-22	Soils	-1.32	-1.48	9.08	-4.04
DD1-AU1-0.5	Isaac Downs	Apr-22	Soils	-0.51	-2.7	1.38	-9.18
DD1-AU1-1.0	Isaac Downs	Apr-22	Soils	-1.73	-10.04	3.80	-9.43
DD1-AU1-1.5	Isaac Downs	Apr-22	Soils	-4.49	-15.38	20.54	-0.19
DD1-AU4-1.6	Isaac Downs	Apr-22	Soils	-3.65	-5.2	24.00	4.44
DD1-AU1-2.0	Isaac Downs	Apr-22	Soils	-2.63	-6.86	14.18	-2.14
DD1-AU1-2.5	Isaac Downs	Apr-22	Soils	-2.82	-3.92	18.64	1.38
DD1-AU1-2.6	Isaac Downs	Apr-22	Soils	-2.86	-7.1	15.78	-1.19

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
USC2-AU4-0.3	Isaac Downs	Apr-22	Soils	-1.6	2.97	15.77	1.23
USC2-AU4-0.5	Isaac Downs	Apr-22	Soils	-1.02	0.72	8.88	-3.64
USC2-AU4-1.0	Isaac Downs	Apr-22	Soils	-2.63	-1.47	19.57	2.55
USC2-AU4-1.5	Isaac Downs	Apr-22	Soils	-5.02	-16.49	23.67	1.50
USC2-AU4-2.0	Isaac Downs	Apr-22	Soils	-3	-27.26	-3.26	-18.01
USC2-AU4-2.5	Isaac Downs	Apr-22	Soils	-4.1	-33.05	-0.25	-17.52
USC2-AU4-3.0	Isaac Downs	Apr-22	Soils	-4.76	-27.55	10.53	-9.42
USC2-AU4-3.25	Isaac Downs	Apr-22	Soils	-4.06	-19.62	12.86	-6.04
USC2-AU4-3.5	Isaac Downs	Apr-22	Soils	-3.19	-8.3	17.22	-0.57
USC2-AU4-3.7	Isaac Downs	Apr-22	Soils	-4.53	-12.84	23.40	2.22
USC2-AU4-3.8	Isaac Downs	Apr-22	Soils	-3.76	-8.37	21.71	2.23
USC2-AU4-3.9	Isaac Downs	Apr-22	Soils	-2.44	0.2	19.72	3.05
USC2-AU4-4.0	Isaac Downs	Apr-22	Soils	-3.28	-11.26	14.98	-2.69
DD3-T1	Isaac Downs	Nov-20	Xylem	-3.92	-42.1	-10.74	-26.29
DD3-T3	Isaac Downs	Nov-20	Xylem	-3.65	-41.1	-11.90	-26.78
DD3-T6	Isaac Downs	Nov-20	Xylem	-3.91	-47.33	-16.05	-30.89
DD2-T1	Isaac Downs	Nov-20	Xylem	-2.33	-27.14	-8.50	-21.28
DD2-T2	Isaac Downs	Nov-20	Xylem	-4.95	-36.55	3.05	-16.29
DD2-T4	Isaac Downs	Nov-20	Xylem	-4.46	-38.4	-2.72	-20.36
DD2-T5	Isaac Downs	Nov-20	Xylem	-5.23	-28.2	13.64	-7.62
DD1-T1	Isaac Downs	Nov-20	Xylem	-5.3	-47.82	-5.42	-24.33
DD1-T3	Isaac Downs	Nov-20	Xylem	-3.29	-28.44	-2.12	-17.58
DD1-T5	Isaac Downs	Nov-20	Xylem	-3.68	-37.77	-8.33	-23.74
DD4-T1	Isaac Downs	Nov-20	Xylem	-6.97	-46.98	8.78	-15.21
DD4-T3	Isaac Downs	Nov-20	Xylem	-4.02	-31.77	0.39	-16.81
DD4-T5	Isaac Downs	Nov-20	Xylem	-6.1	-52.39	-3.59	-24.28
IDDC-T1	Isaac Downs	Nov-20	Xylem	-2.52	-26.55	-6.39	-19.81
IDDC-T3	Isaac Downs	Nov-20	Xylem	-3.68	-32.33	-2.89	-19.01
IDDC-T4	Isaac Downs	Nov-20	Xylem	-3.35	-33.18	-6.38	-21.40
IDUC-T1	Isaac Downs	Nov-20	Xylem	-4.01	-29.06	3.02	-14.50
IDUC-T3	Isaac Downs	Nov-20	Xylem	-1.48	-16.66	-4.82	-16.44
IDUC-T4	Isaac Downs	Nov-20	Xylem	-2.23	-33.97	-16.13	-27.72
ND1-T1	Isaac Downs	Nov-20	Xylem	-3.84	-33.06	-2.34	-18.84
ND1-T3	Isaac Downs	Nov-20	Xylem	-3.74	-37.6	-7.68	-23.29
ND1-T5	Isaac Downs	Nov-20	Xylem	-4.89	-42.44	-3.32	-21.71
ND3-T2	Isaac Downs	Nov-20	Xylem	-1.11	-24.45	-15.57	-25.07
ND3-T3	Isaac Downs	Nov-20	Xylem	-4.68	-36.65	0.79	-17.73
ND3-T4	Isaac Downs	Nov-20	Xylem	-3.47	-29.66	-1.90	-17.74
ND1-T1	Isaac Downs	Apr-21	Xylem	-4.41	-22.23	13.05	-6.55
ND1-T3	Isaac Downs	Apr-21	Xylem	-7.2	-40.61	16.99	-8.51
ND1-T5	Isaac Downs	Apr-21	Xylem	-6.53	-34.53	17.71	-6.59

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
DD2-T1	Isaac Downs	Apr-21	Xylem	-6.46	-41.83	9.85	-13.29
DD2-T4	Isaac Downs	Apr-21	Xylem	-3.55	-26.74	1.66	-14.80
DD2-T5	Isaac Downs	Apr-21	Xylem	-3.28	-25.34	0.90	-14.94
DD1-T1	Isaac Downs	Apr-21	Xylem	-2.45	-22.46	-2.86	-16.61
DD1-T3	Isaac Downs	Apr-21	Xylem	-5.63	-31.31	13.73	-8.32
DD1-T5	Isaac Downs	Apr-21	Xylem	-3.93	-23.4	8.04	-9.98
DD3-T1	Isaac Downs	Apr-21	Xylem	-4.72	-31.67	6.09	-13.20
DD3-T6	Isaac Downs	Apr-21	Xylem	-4.3	-27.22	7.18	-11.44
DD3-T4	Isaac Downs	Apr-21	Xylem	-5.94	-35.55	11.97	-10.44
DD4-T1	Isaac Downs	Apr-21	Xylem	-5.21	-39.13	2.55	-17.23
DD4-T3	Isaac Downs	Apr-21	Xylem	-3.32	-39.7	-13.14	-27.22
DD4-T5	Isaac Downs	Apr-21	Xylem	-4.33	-44.03	-9.39	-25.91
DC1-T1	Isaac Downs	Apr-21	Xylem	-3.58	-39.42	-10.78	-25.67
DC1-T3	Isaac Downs	Apr-21	Xylem	-1.56	-17.68	-5.20	-16.92
DC1-T4	Isaac Downs	Apr-21	Xylem	-2.93	-26.93	-3.49	-18.08
DC2-T1	Isaac Downs	Apr-21	Xylem	-4.4	-41.69	-6.49	-23.52
DC2-T3	Isaac Downs	Apr-21	Xylem	-4.16	-35.39	-2.11	-19.25
DC2-T5	Isaac Downs	Apr-21	Xylem	-3.37	-38.28	-11.32	-25.74
UC2-T1	Isaac Downs	Apr-21	Xylem	-3.96	-30.06	1.62	-15.62
UC2-T2	Isaac Downs	Apr-21	Xylem	-6.04	-36.35	11.97	-10.64
UC2-T5	Isaac Downs	Apr-21	Xylem	-3.95	-28.78	2.82	-14.56
ND1-T1	Isaac Downs	Apr-21	Xylem	-4.41	-22.23	13.05	-6.55
ND1-T3	Isaac Downs	Apr-21	Xylem	-7.2	-40.61	16.99	-8.51
ND1-T5	Isaac Downs	Apr-21	Xylem	-6.53	-34.53	17.71	-6.59
ND3-T2	Isaac Downs	Apr-21	Xylem	-4.86	-30.19	8.69	-11.21
ND3-T3	Isaac Downs	Apr-21	Xylem	-4.01	-34.14	-2.06	-18.92
ND3-T4	Isaac Downs	Apr-21	Xylem	-4.85	-26.24	12.56	-7.83
DD2-T1	Isaac Downs	Nov-21	Xylem	-1.24	-17.7	-7.78	-18.55
DD2-T3	Isaac Downs	Nov-21	Xylem	-1.59	-15.32	-2.60	-14.72
DD2-T4	Isaac Downs	Nov-21	Xylem	-2.29	-18.38	-0.06	-13.86
DD2-T5	Isaac Downs	Nov-21	Xylem	-1.71	-23.45	-9.77	-21.19
ND3-T1	Isaac Downs	Nov-21	Xylem	-2.7	-12.36	9.24	-6.57
ND3-T2	Isaac Downs	Nov-21	Xylem	-2.5	-16.19	3.81	-10.90
ND3-T3	Isaac Downs	Nov-21	Xylem	-2.1	-16.75	0.05	-13.40
ND3-T4	Isaac Downs	Nov-21	Xylem	-3.71	-27.15	2.53	-14.35
ND1_T1	Isaac Downs	Nov-21	Xylem	-2.25	-24.4	-6.40	-19.30
ND1_T2	Isaac Downs	Nov-21	Xylem	-2.22	-24.23	-6.47	-19.30
ND1_T3	Isaac Downs	Nov-21	Xylem	-3.51	-29.37	-1.29	-17.29
ND1_T4	Isaac Downs	Nov-21	Xylem	-0.76	-17.83	-11.75	-21.08
ND1_T5	Isaac Downs	Nov-21	Xylem	-3.16	-33.77	-8.49	-22.87
DD1-T1	Isaac Downs	Nov-21	Xylem	-2.02	-18.09	-1.93	-14.97
DD1-T3	Isaac Downs	Nov-21	Xylem	-2.52	-25.14	-4.98	-18.58
DD1-T5	Isaac Downs	Nov-21	Xylem	-2.35	-23.57	-4.77	-18.07
DD3-T1	Isaac Downs	Nov-21	Xylem	-1.51	-21.67	-9.59	-20.64

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
DD3-T4	Isaac Downs	Nov-21	Xylem	-2.75	-26.89	-4.89	-18.95
DD3-T6	Isaac Downs	Nov-21	Xylem	-1.76	-17.38	-3.30	-15.66
IDDC2-T1	Isaac Downs	Nov-21	Xylem	-4.38	-26.89	8.15	-10.76
IDDC2-T3	Isaac Downs	Nov-21	Xylem	-3.47	-23.62	4.14	-12.49
IDDC2-T5	Isaac Downs	Nov-21	Xylem	-3.83	-31.56	-0.92	-17.58
IDUC2-T1	Isaac Downs	Nov-21	Xylem	-4.15	-32.68	0.52	-16.95
IDUC2-T2	Isaac Downs	Nov-21	Xylem	-3.61	-25.49	3.39	-13.41
IDUC2-T4	Isaac Downs	Nov-21	Xylem	-0.06	-17.68	-17.20	-24.46
IDUC2-T5	Isaac Downs	Nov-21	Xylem	-0.73	-11.45	-5.61	-15.68
DD4-T1	Isaac Downs	Nov-21	Xylem	-1.05	-13.44	-5.04	-15.80
DD4-T3	Isaac Downs	Nov-21	Xylem	-3.54	-27.87	0.45	-15.83
DD4-T5	Isaac Downs	Nov-21	Xylem	-1.71	-23.45	-9.77	-21.19
DD1-T1	Isaac Downs	Apr-22	Xylem	-1.27	-8.88	1.28	-10.73
DD1-T3	Isaac Downs	Apr-22	Xylem	-1.41	-9.79	1.49	-10.82
DD1-T5	Isaac Downs	Apr-22	Xylem	1.11	-1.06	-9.94	-15.89
DD2-T1	Isaac Downs	Apr-22	Xylem	0.26	-4.41	-6.49	-14.53
DD2-T2	Isaac Downs	Apr-22	Xylem	-0.43	-6.81	-3.37	-13.15
DD2-T3	Isaac Downs	Apr-22	Xylem	-0.56	-8.86	-4.38	-14.28
DD2-T4	Isaac Downs	Apr-22	Xylem	0.77	1.54	-4.62	-11.92
DD2-T5	Isaac Downs	Apr-22	Xylem	-0.32	-10.42	-7.86	-16.84
DD3-T1	Isaac Downs	Apr-22	Xylem	0.5	-1.28	-5.28	-13.02
DD3-T3	Isaac Downs	Apr-22	Xylem	2.28	2.36	-15.88	-18.80
DD3-T5	Isaac Downs	Apr-22	Xylem	-0.55	-2.7	1.70	-8.97
DD3-T6	Isaac Downs	Apr-22	Xylem	-0.92	-10.2	-2.84	-13.64
DD4-T1	Isaac Downs	Apr-22	Xylem	0.36	-10.92	-13.80	-20.70
DD4-T3	Isaac Downs	Apr-22	Xylem	-1.14	-9.11	0.01	-11.58
DD4-T5	Isaac Downs	Apr-22	Xylem	1.47	1.17	-10.59	-15.76
ND3-T1	Isaac Downs	Apr-22	Xylem	0.03	2.79	2.55	-7.12
ND3-T2	Isaac Downs	Apr-22	Xylem	0.51	1.15	-2.93	-10.96
ND3-T3	Isaac Downs	Apr-22	Xylem	0.57	-2.56	-7.12	-14.48
ND3-T4	Isaac Downs	Apr-22	Xylem	0.7	-4.28	-9.88	-16.63
ND1-T1a	Isaac Downs	Apr-22	Xylem	-0.74	-6.41	-0.49	-11.25
ND1-T2a	Isaac Downs	Apr-22	Xylem	-0.31	-7.06	-4.58	-13.97
ND1-T3a	Isaac Downs	Apr-22	Xylem	1.12	1.11	-7.85	-14.06
ND1-T4a	Isaac Downs	Apr-22	Xylem	0.79	1.5	-4.82	-12.06
ND1-T5a	Isaac Downs	Apr-22	Xylem	-1.21	-9.45	0.23	-11.53
IDDC2-T1	Isaac Downs	Apr-22	Xylem	-0.46	-3.64	0.04	-10.24
IDDC2-T3	Isaac Downs	Apr-22	Xylem	-0.92	-7.84	-0.48	-11.58
IDDC2-T5	Isaac Downs	Apr-22	Xylem	0.64	-4.32	-9.44	-16.37
USC2-T1	Isaac Downs	Apr-22	Xylem	-1.15	-9.75	-0.55	-12.09
USC2-T3	Isaac Downs	Apr-22	Xylem	1.76	-1.99	-16.07	-19.97
USC2-T5	Isaac Downs	Apr-22	Xylem	-1.02	-7.39	0.77	-10.69
ID Rain 1 Nov 2021	Isaac Downs	Rainfall Regional	Rainfall	2.72	28.79	7.03	1.97
ID Rain 2 Nov 2022	Isaac Downs	Rainfall Regional	Rainfall	0.78	15.2	8.96	-0.09

Sample	Project	Date	Type	d ¹⁸ O VSMOW	d ² H VSMOW	D_Ex cess	Lc_Ex cess
Rainfall_Nov 2020	Isaac Downs	Rainfall Regional	Rainfall	-0.21	7.39	9.07	-1.91
ID Rain Clermont_M arch 2008	Isaac Downs	Rainfall Regional	Rainfall	-1.77	-2.1	12.06	-2.32
ID Rain Clermont_M ay 2008	Isaac Downs	Rainfall Regional	Rainfall	-3.49	-13.9	14.02	-3.93
RAINFALLD YS_231120 25	External	Nov-24	Rainfall	-1.24	1.74	11.63	-1.67
Clermont M ar-Apr-08	External	Apr-08	Rainfall	-1.77	-2.1	12.06	-2.32
Clermont M ar-Apr-08	External	Apr-08	Rainfall	-3.49	-13.9	14.02	-3.93
RAIN MOR 19-11	Isaac Downs	Nov-19	Rainfall	-0.21	7.39	9.07	-1.91
RAIN MOR_ 171121_180 6	Isaac Downs	Nov-21	Rainfall	0.78	15.2	8.96	-0.09
RAIN MOR_ 181121_080 6	Isaac Downs	Nov-21	Rainfall	2.72	28.79	7.03	1.97
Rainfall_SW C_13.05	South Walker Creek	Jun-24	Rainfall	-2.79	-8.29	14.03	-2.57
Rainfall_SW C_19.30_27 0624	South Walker Creek	Jun-24	Rainfall	-4.43	-22.01	13.43	-6.26
Rainfall_SW C_21.00_27 0624	South Walker Creek	Jun-24	Rainfall	-4.7	-20.91	16.69	-3.95