MINERAL RESOURCES

APPENDIX G
LOCKYER DEVELOPMENT INLAND WATERS ASSESSMENT (HGG 2023)

Lockyer Development

Inland Waters Assessment

25 January 2024

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HYDRO GEOCHEM GROUP

GREENROAD GROUP

Lockyer Development

Inland Waters Assessment

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1 INTRODUCTION

1.1 Background

Energy Resources Limited, a wholly owned subsidiary of Mineral Resources Limited (MinRes), is planning to develop a central processing facility (CPF) and associated infrastructure in the mid-west region of Western Australia within petroleum Exploration Permit EP 368 (the Project) for the transport, processing, and provision of natural gas. The Project is for a conventional gas development and fracking of the gas reservoir will not be required.

The Project is located within the Shires of Irwin and Mingenew on already cleared farmland, approximately 15 km west of Mingenew and 25 km east of Dongara. Gas will be produced from conventional wells linked to an upstream gathering network which feeds the CPF.

The project is understood to include the following components:

- A CPF, producing up to 250 TJ/day to treat the raw gas to the specification required for export to the Dampier to Bunbury Natural Gas Pipeline (DBNGP), inclusive of utilities.
- An upstream gas gathering network comprised of conventional gas wells connected to a flowline either in a hub-and-spoke arrangement or direct tie-back to the facilities depending on proximity to the CPF. One hub is envisaged to supply the CPF.
- A gas export trunkline connecting the CPF to the DBNGP.
- Condensate stabilization, storage and truck loading facilities sized to handle hydrocarbon liquids from the CPF raw gas.
- Produced water treatment and disposal facilities sized to handle produced and formation water from the CPF well stream fluids.
- Site infrastructure to support the operations phase.
- Groundwater extraction bores.
- An accommodation camp.

1.2 Objectives

The primary objective of the Project included providing:

- A baseline Inland Waters assessment of the proposed activities and disturbance areas which satisfies regulatory guidelines. This includes the *Environmental Factors Guideline – Inland Waters* published by the Western Australia Environmental Protection Authority (WA EPA, 2018).
- Assessment of potential impacts to Inland Waters and associated values as a result of construction and implementation of the Project.

1.3 Scope of Work

The scope of work for the Project included the following:

- Review of relevant background information, including publicly available geology and hydrogeology reports, available information on existing groundwater bores and use, surface water features as well as existing groundwater and surface water monitoring data for the area.
- Conducting a site visit to view the Project area, with the site visit including additional surface water and groundwater sampling conducted over three days during 17-19 October 2023.
- Providing a description of baseline groundwater and surface water conditions, based on the results of the background review as well as the observations and sampling conducted as part of the October 2023 site visit.
- Undertaking an impact assessment for Inland Waters, based on a source-pathway-receptor (SPR) framework and taking into consideration identified environmental values.
- Identification of mitigation strategies to avoid and minimise potential impacts to Inland Waters.
- Making recommendations for groundwater bores and surface water monitoring such that they can inform and provide data for an on-going water quality monitoring program for the project where key risks are identified.

1.4 Report Structure

The remainder of this report has been structed into the following sections:

- Section 2: Environmental setting. The environmental setting includes specifics around site location, topography and surface water drainages, regional geology, and regional hydrogeology.
- Section 3: Baseline surface water and groundwater conditions. This section includes a review of the studies and sampling events informing the baseline conditions, a description of baseline water quality conditions, and identification of relevant environmental values for the Project area.
- Section 4: Impact assessment. The impact assessment outlines activities forming part of the Project, potential sources of water impacts associated with these activities, pathways through which water impacts may propagate, assessment of potentially affected environmental values, and evaluating risk of impact through a risk assessment.
- Section 5: Conclusions and recommendations. This section summarising the conclusions of the assessment and provides recommendations based on the risk assessment completed in Section 4.

2 ENVIRONMENTAL SETTING

2.1 Site Location

The Project is located approximately 15 km west of Mingenew, and 25 km northeast of Dongara, Western Australia. Pipeline infrastructure will extend approximately 30 km within the project area, with conditioned gas exported 12 km west of the CPF to the DBNGP. The site location, including CPF, pipelines and exploration / production gas wells are shown in Figure 1.

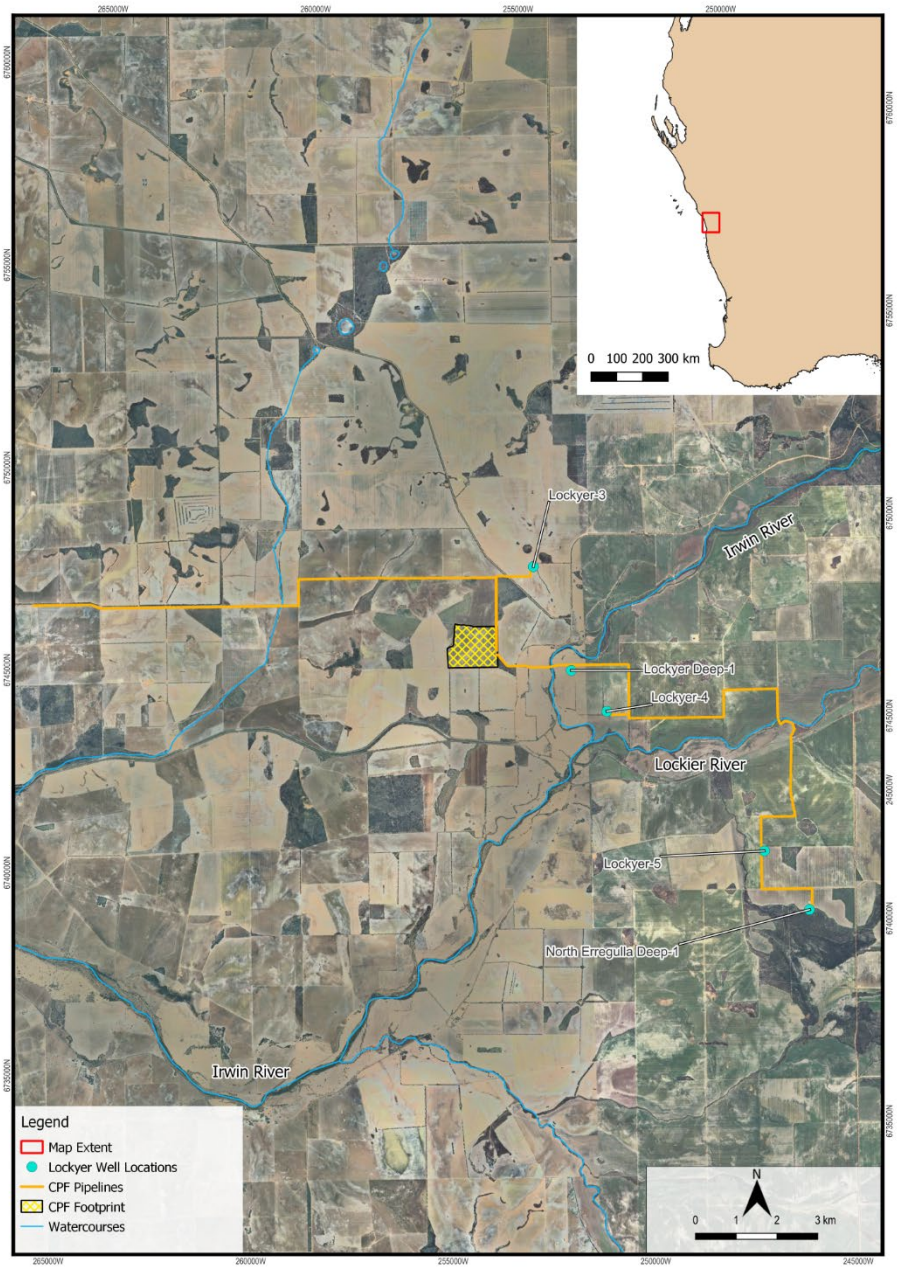

Figure 1: Site location and broader assessment area.

Note that the Lockyer Deep 1, Lockyer 3 and North Erregulla Deep 1 gas wells have been drilled and constructed, while Lockyer 4 and Lockyer 5 shown on Figure 1 are in the planning stage.

2.2 Regional Geology

The regional geology of the Project area as described in DOW (2017) is summarised below.

The CPF and associated infrastructure are situated within the Northern Perth Basin. This basin consists of a deep sequence of sedimentary units dipping in an easterly direction, bounded by the north-south striking Urella Fault in the east (see Figure 3). The sequence shallows to the north, with depths to basement units approximately 3,000 m to 5,500 m below ground level. Approximately 1.8 - 3.4 km north of the study area lies the Allanooka Fault, beyond which the sedimentary sequence extends to approximately 1,000 m to 3,000 m below ground level.

The dominant near surface sedimentary sequence in the study area is the Jurassic Yarragadee Formation. The Formation generally dips eastwards and the regional strike is approximately north-south.

The Yarragadee Formation consists of a multilayered sequence of sandstone beds with interbedded siltstone, claystone and shale. There are four units within the Yarragadee Formation, including Units A and C (consisting predominantly of unconsolidated sands) and Units B and D (consisting predominantly of siltstone, claystone and shale with interbedded sandstone). Unit D of the Yarragadee Formation outcrops in part at the surface, with thicknesses of the Unit approximately 400 m to 500 m in the study area. The Yarragadee Formation is underlain by the clay rich Cadda Formation, which has a maximum onshore thickness of 290 m.

The Kingia sandstone of Early Permian age (located > 4,000m below ground surface) presents the gas reservoir that is being targeted for development, with the Irwin River Coal Measures presenting the capping/sealing unit of the gas reservoir system.

Locally, borelogs from MinRes installed monitoring and production bores across the gas well drilling pads (see Section 3.1.1) show fairly consistent lithology profiles. Surficial loam and/or caprock covers intermittent layers of clay, sand, and sandy clays to depth. Notable clay zones exist within the Lockyer 2 and North Erregulla Deep-1 gas well sites, with a clay layer logged near surface from 4-22 m in the Lockyer 2 Water Bore (LD2WB), and from 5-36 m in the North Erregulla Deep Production Bore (NED1PB). These units are all considered to be part of the Yarragadee Formation.

Figure 2 shows the regional pre-Cenozoic geology of the Northern Perth Basin, with Figure 3 presenting the geological cross-sections along the Allanooka-Casuarinas and Dongarra borehole lines, north and south of the project area respectively.

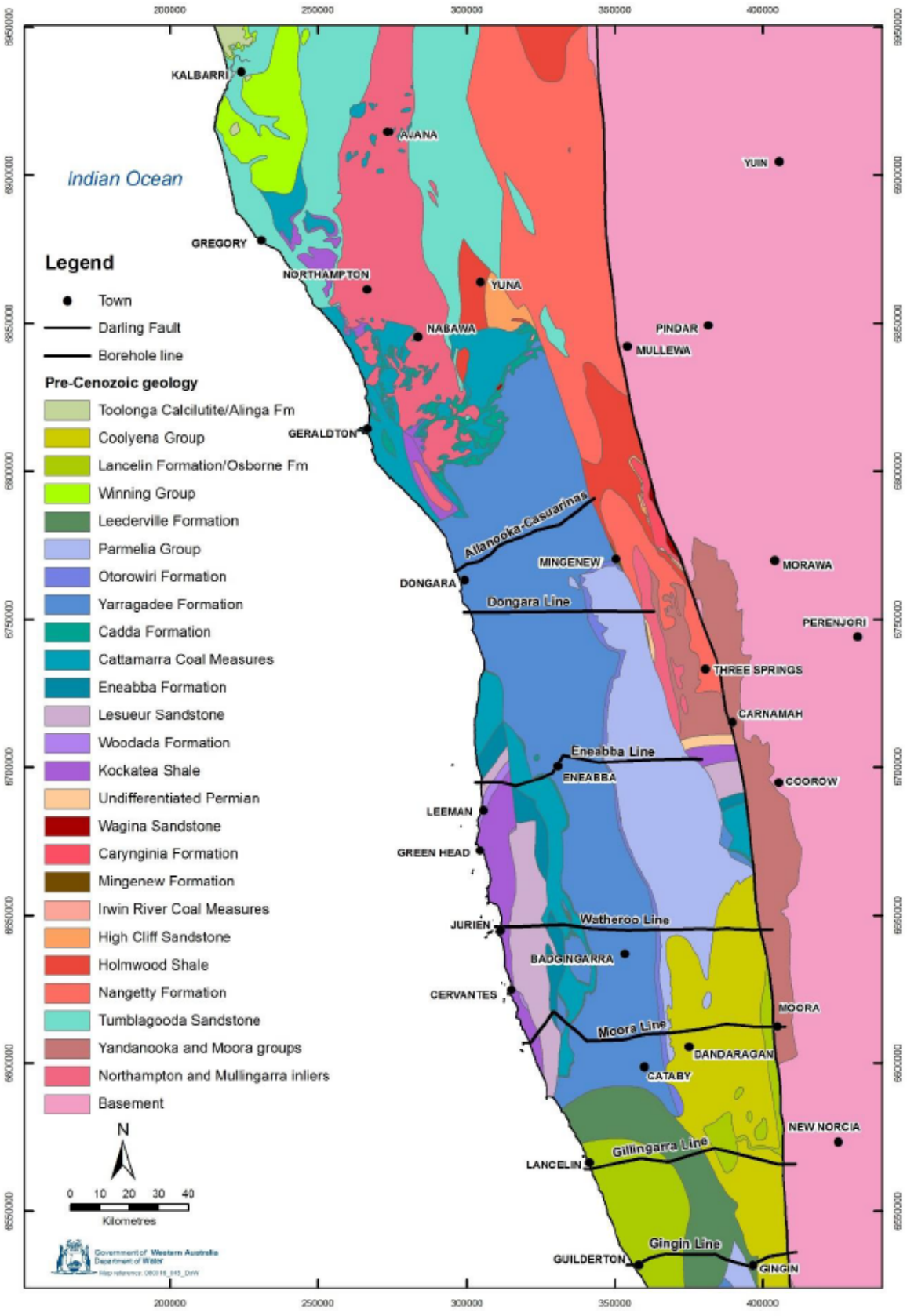

Figure 2: Regional pre-Cenozoic geology in outcrop or subcrop (DoW, 2017).

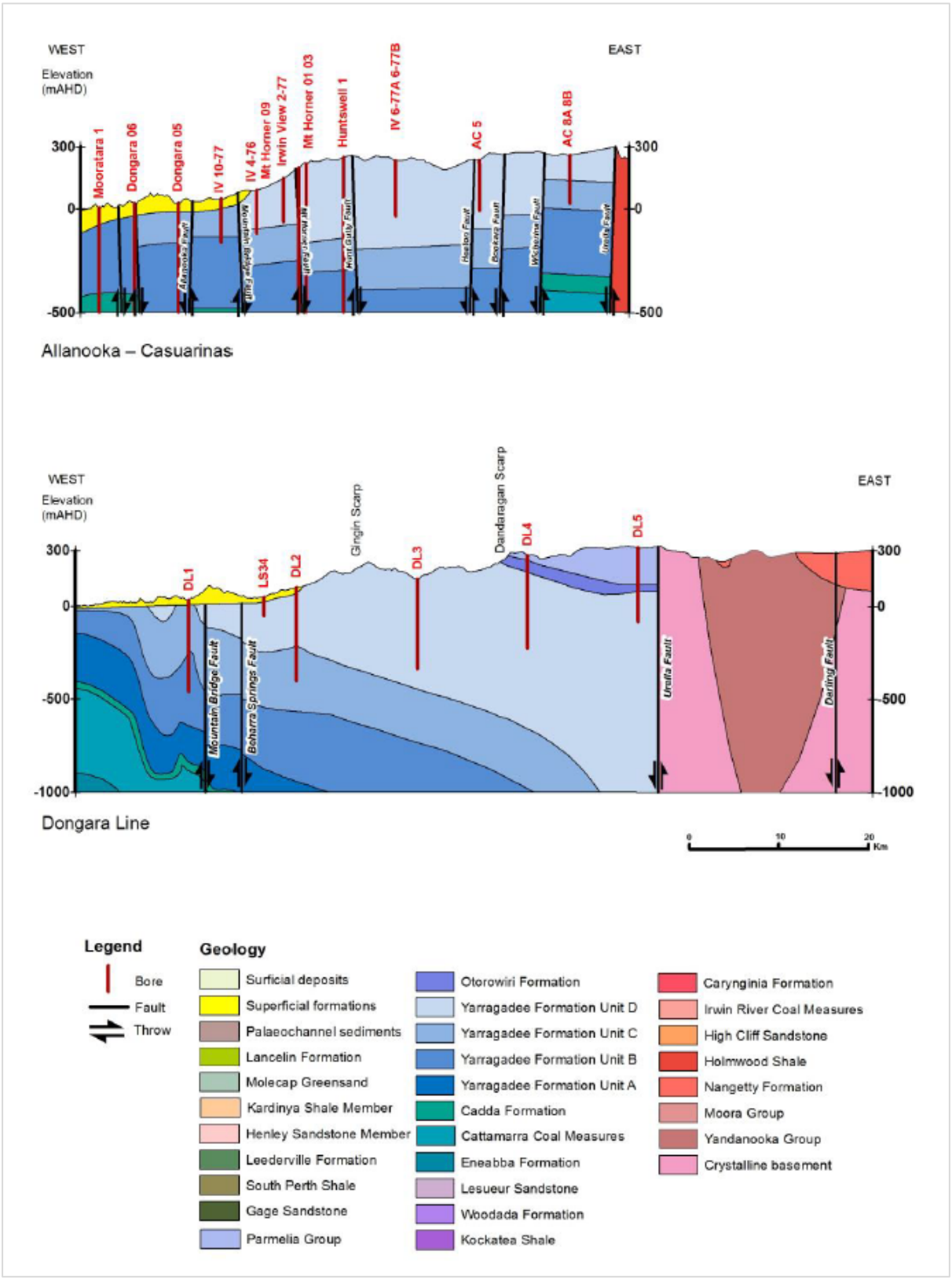

Figure 3: Geological cross-sections of the Allanooka-Casuarinas and Dongara borehole lines (DoW, 2017).

2.3 Regional Hydrogeology

The Groundwater Survey of Western Australia has undertaken a drilling program to investigate stratigraphy and map the hydrogeology of the northern Perth Basin (DoW, 2017).

As part of the drilling program, six deep east-west lines were drilled in the northern Perth Basin approximately 50 km apart up to depths of 800 m. The Dongarra Line, extending east from Dongarra to the Dandaragan Scarp, was completed in 1995. This investigation confirmed the Yarragadee aquifer as a major groundwater resource in the area. Salinity increases with depth and towards coastal zones. The regional groundwater table in the area was found to vary, and could be as deep as 181 m below ground level.

Figure 4 shows the interpreted depths to the regional water table in 2015 (DoW, 2017). Elevated groundwater levels are seen generally near aquifer recharge points and surface water features such as rivers and tributaries, with structural geological features such as faults acting as aquifer boundaries.

Locally, the Irwin and Lockier rivers and associated tributaries act as groundwater recharge zones, with the watertable deepening with distance from the waterways.

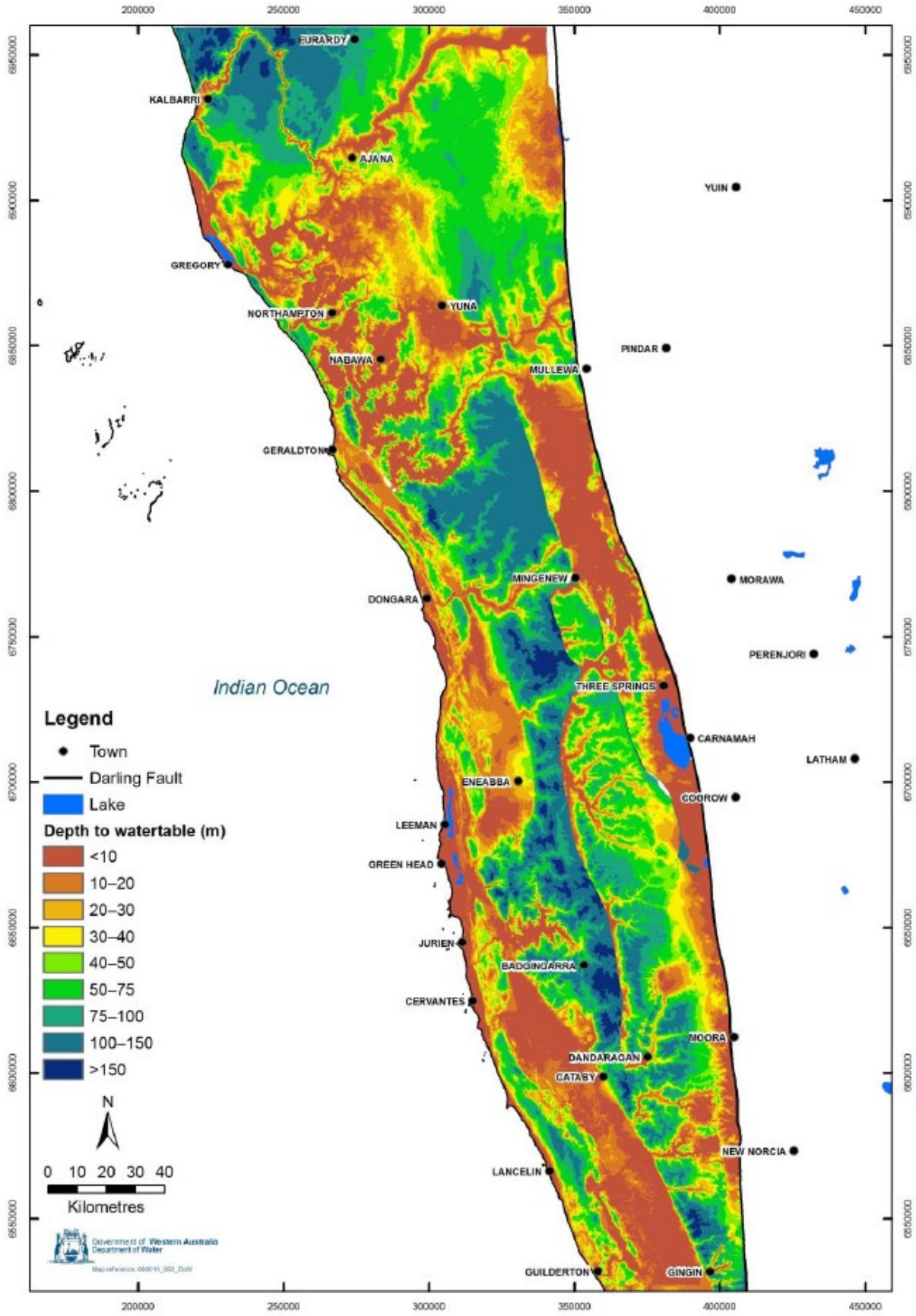

Figure 4: Representative depth to watertable based on 2015 data (DoW, 2017).

2.4 Surface Water Drainages

The Project area is located within the Irwin River catchment, with the catchment covering a surface area of 6,071 km^2. Mean annual flow at Mountain Bridge gauging station, with a catchment area of 5,264 km^2 was 16 gigalitres per annum (GL/a) between 2000 and 2015. Flow is generally highest during the winter months (DoW, 2017).

The main surface water drainages in the project area are the Irwin and the Lockier rivers (see Figure 5). The Lockier River acts as a tributary to the Irwin River, with the confluence of the rivers located approximately 3 km from the southeastern boundary of the CPF. From the confluence, the Irwin River drains in a general westerly direction before draining into the Indian Ocean at Dongara.

3 BASELINE SURFACE WATER AND GROUNDWATER CONDITIONS

3.1 Studies and Sampling Informing Baseline Conditions

3.1.1 Available Studies and Sources of Information

Studies and available source of information that were available to review for the Inland Waters assessment included:

- The Northern Perth Basin: Geology, hydrogeology and groundwater resources report (DoW, 2017).
- The Bureau of Meteorology (BoM) Australia Groundwater Explorer website (BoM, 2023a) for the identification of existing groundwater bores and use.
- The BOM Groundwater Dependent Ecosystems (GDEs) Atlas (BoM, 2023b) for the identification of potential GDEs.
- A Water Quality Assessment – Factual Report for the Project area (CDM Smith, 2022).
- Available borelogs for short term water supply bores and groundwater monitoring bores at the gas well drill pads, provided by MinRes.

3.1.2 Water Monitoring

Previous water monitoring available for review and included in the baseline assessment include surface water and groundwater monitoring conducted in December 2020 by CDM Smith (2022), baseline groundwater sampling reported by Gemec in December 2022 and February 2023, and the sampling undertaken during the October 2023 site visit. Groundwater and surface water sampling locations are presented in Figure 5.

CDM Smith (2022) sampled one groundwater location, GW01, a pastoral bore on private property approximately 400m east of the boundary of the proposed CPF. Four surface water samples (SW01 to SW04) were taken from the Irwin River, with three samples upstream (SW01 to SW03) from the convergence with the Lockier River, and one downstream (SW04).

Samples were analysed for filtered metals and metalloids, major ions, nitrates and nitrites, alkalinity, total recovery and petroleum hydrocarbons, aromatic hydrocarbons including benzene, toluene, ethylbenze and xylenes (BTEX), halogenated benzenes and hydrocarbons, solvents, and a range of radiological species for GW01. Field water quality parameters were also collected including electrical conductivity (EC), pH, dissolved oxygen (DO), total dissolved solids (TDS), turbidity, and temperature.

Gemec (2022 and 2023) sampled four groundwater bores, one monitoring and one production bore at North Erragulla Deep 1 and Lockyer 2 gas well sites respectively. Samples were analysed for total metals and metalloids, major ions, nitrates and nitrites, total recoverable hydrocarbons (TRH), BTEX, naphthalene MTBE, methane, and ethane. Field water quality parameters were also collected.

As part of the October 2023 site visit HGG sampled five surface water locations along the Irwin and Lockier rivers. SW01 to SW04 locations mirrored those from CDM Smith (2022) with an additional sample (SW05) collected in the Lockier River where gas pipeline infrastructure was proposed to cross the Lockier River. Subsequent to the sampling event, the proposed pipeline route has been amended and the crossing point near SW05 will no longer be used. Opportunistic water quality measurements

were also taken for seven groundwater bores across the Project, however the bores were not purged and results for the grab samples are only considered indicative.

The available field measurements, as well as laboratory data collected through the studies and sampling programmes outlined above, have been collated and are presented in Appendix B and Appendix C (for field measurements and laboratory results respectively).

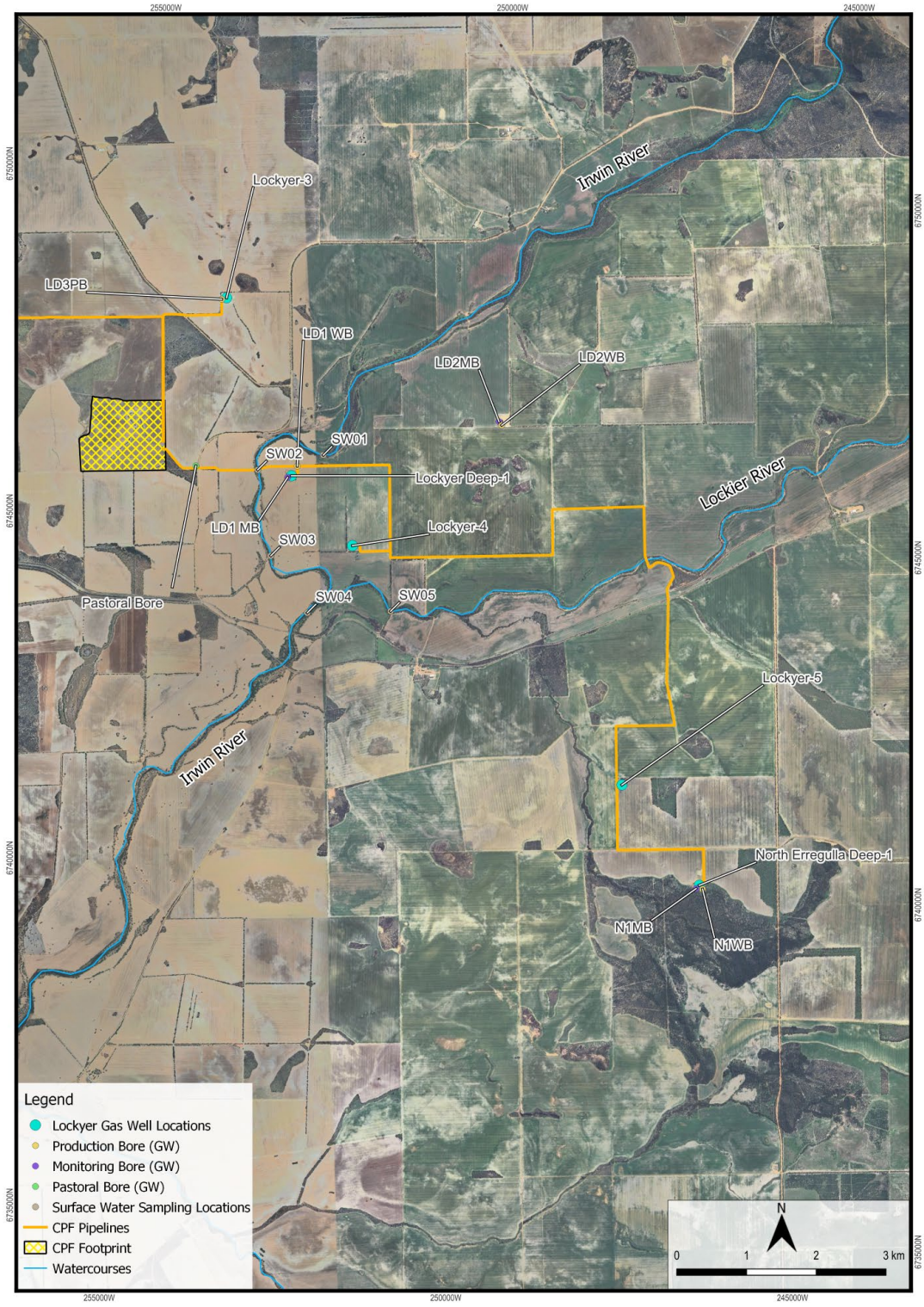

Figure 5: Groundwater and Surface Water Sampling Locations.

3.2 Surface Water Baseline Conditions

3.2.1 Field Measurements

Field water quality measurements collected from the Irwin and Lockier rivers in 2020 and 2023 indicate generally oxidising and brackish conditions with circumneutral pH.

Electrical conductivity (EC) in surface water samples from December 2020 ranged from 3,267 µS/cm to 7,345 µS/cm, and from samples collected in October 2023 ranged from 2,647 µS/cm to 6,045 µS/cm. Across both the 2020 and 2023 sampling events, EC levels increased downstream in the Irwin River. During the most recent sampling event, the sample taken from the Lockier River (SW05) had the highest EC at 6,045 µS/cm. This sample was taken from a pool of water with no observable flow.

pH levels in the rivers were circumneutral, ranging from 6.66 to 7.27 in 2020, and 6.93 to 7.35 in 2023. No specific trends in pH were observed.

Oxidation-reduction potential (ORP) in samples from 2020 ranged from 165.2 mV to 228.9 mV, with samples from 2023 ranging from 26 mV to 154 mV. It is noted that sample SW05, which reported 26mV ORP, was collected from an apparent non-flowing pool in the Lockier River with high organic matter content. With organic matter typically acting as an electron donor to water systems, it serves to lower ORP and dissolved oxygen levels. Dissolved oxygen levels in the samples ranged from 70.3% to ~100% in 2020, and 39% to 78% in 2023.

Collated field measurements are provided in Table B1 in Appendix B.

3.2.2 Laboratory Results

Major ion composition of the water samples is shown in the Piper Diagram presented in Appendix D. All surface water samples were of the sodium chloride type with relatively low concentrations of the other major ions calcium, magnesium, potassium, sulfate and bicarbonate.

The collated surface water chemistry data from the laboratory analysis were screened against the 95% species protection default guideline values (DGVs) for freshwater ecosystems that have been developed for slightly to moderately disturbed systems (ANZECC, 2000a; ANZG, 2018). Note that the ANZECC 2000a value for nitrate is erroneous (ANZG, 2018) and as per the ANZG guidance the NIWA (2013) value for nitrate was used as screening criteria for freshwater ecosystems.

Of the analytes with freshwater aquatic DGVs, boron exceeding the criteria for all samples taken indicated that this metalloid is naturally elevated in the Irwin and Lockier rivers. Nitrate showed once exceedance of the assessment criteria, for sample SW02 taken in October 2023. No other analytes, that had reported concentration above the laboratory limit of reporting (LOR), exceeded the available DGVs.

Petroleum hydrocarbons including TRH fractions (C_6 - C_{40}) and BTEXN were below detection limits for all samples taken. Methane, tested in the October 2023 sampling event, was found to be present above the LOR in samples three of the five primary surface water samples taken including SW01, SW02 and SW04.

Surface water laboratory results are summarised in Table C1 and Table C2 in Appendix C.

3.3 Groundwater Baseline Conditions

3.3.1 Field Measurements

Groundwater levels vary significantly across the Project area, from approximately seven metres below ground level at the Lockyer Deep 1 drilling location (as measured at LD1-MB and LD1-PB in October 2023) to approximately 70 metres at North Erregulla Deep 1. The available bore network has variable screening depths (see Table B2, Appendix B) and the available groundwater level dataset likely present a combination of water table elevations from unconfined aquifer conditions to potentiometric levels from semi-confined conditions. Water levels were generally shallower in bore locations closer to the Irwin River, aligning with the regional hydrogeology observations (see Section 2.3) that elevated groundwater levels are seen generally near aquifer recharge areas such as surface water features.

Field measurements indicate that groundwater in the Project area is generally reducing and slightly brackish to brackish with circumneutral pH.

Field EC measurements from bores at North Erregulla Deep 1 and Lockyer 2 gas well sites ranged from 2,763 µS/cm (LD2-WB) to 6,671 µS/cm (NED1-MB). These ranges in EC are similar to that measured in the surface water samples.

Field pH ranged from 6.0 (NED1-WB) to 6.8 (LD2-MB). The nearby pastoral bore (Kelly's Bore) recorded EC and pH measurements of 1,325 µS/cm and 6.43 respectively.

Field measurements are summarised in Table B1 in Appendix B.

3.3.2 Laboratory Results

Major ion composition of the water samples is shown in the Piper Diagram presented in Appendix D. As with the surface water samples, all groundwater samples were found to be of the sodium chloride type with relatively low concentrations of the other major ions (calcium, magnesium, potassium, sulfate and bicarbonate).

The collated groundwater water chemistry data from the laboratory analysis were screened against both livestock drinking water guidelines (ANZECC, 2000b) and the Australian Drinking Water Guidelines (ADWGs) (NHMRC, 2011) given the identified groundwater use (see Section 3.4.1).

Exceedances of ADWGs were identified for Ba (LD2-MB), Ni (NED1-MB) and Mn (NED1-MB, NED1-WB, LD2-MB). Exceedances of the total dissolved solids (TDS) limit of 1,200 mg/L, seen as the level above which salinity is unacceptable for drinking water purposes (NHMRC, 2011), were seen for all sampled locations except the pastoral bore (known as Kelly's Bore).

Reported concentrations exceeding the livestock drinking water guidelines were limited to exceedances of TDS in groundwater samples taken from NED1-MB and LD2-MB.

BTEXN concentrations were below the LOR for all samples analysed. Total recoverable hydrocarbons above the LOR were reported for the C_{10}-C_{16} and C_{16}-C_{34} fractions in groundwater sampled from the NED1-WB, NED1-MB, LD2-WB, and LD2-MB bores. The highest reported measurements for the C_{10}-C_{16} and C_{16}-C_{34} fractions were 3,500 µg/L and 900 µg/ respectively, both detected in NED1-MB during the February 2023 sampling round.

Groundwater laboratory results are summarised in Table C3 in Appendix C.

3.4 Identified Environmental Values

As described in the Environmental Protection Authority (EPA) *Environmental Factor Guideline: Inland Waters* (EPA, 2018), environmental values include both beneficial use of water resources as well as ecosystem health values.

3.4.1 Beneficial Use

The identification of beneficial groundwater use is based on a combination of 1) evaluating existing use and 2) considering potential use of water.

To evaluate existing use of groundwater, a bore search was undertaken using the BOM Australian Groundwater Explorer (BOM, 2023a). Lead water agencies from each state provide water bore information to the BOM database and the database is updated on an annual basis. The survey included an area extending 2 km from the CPF boundaries and a 500m buffer from all gas well pads and gas pipelines. A total of 12 bores were identified within this area through the BOM groundwater bore database. The 12 bores included:

- Two monitoring bores.
- Three stock and domestic bores.
- Seven bores with unknown purpose.

The closest identified bore to Project infrastructure is a pastoral bore located 430 m to the east and downgradient of the CPF. Coordinates for all identified bores, as well as available information on use, status and screened lithology, are provided in Table E1 in Appendix E.

Based on the results of the bore search, and the baseline groundwater conditions described in Section 3.3, beneficial use include:

- Stock watering.
- Domestic supply (including drinking water in areas where TDS levels are below 1,200 mg/L).

3.4.2 Ecosystem Health Values

As described in the Environmental Factor Guideline: Inland Waters (EPA, 2018), the EPA is focussed on impacts to significant ecosystems, which include (but are not limited to):

- Ramsar Wetlands
- Wetlands listed in the Directory of Important Wetlands in Australia (DIWA)
- Wetlands protected by Environmental Protection Policies under Parth III of the Environmental Protection (EPA) Act 1986.
- Ecosystems that support significant flora or fauna species or communities including subterranean fauna.
- Wild Rivers as identified by the Australian Heritage Commission and DWER.

No Ramsar wetlands, wetlands listed in DIWA, wetlands protected under the EP Act or Wild Rivers were identified within a 20 km radius of the Project infrastructure. At the time of completing this Inland Waters assessment HGG was not aware of studies for the identification of significant flora or fauna

species or communities in the Project area. Freshwater aquatic ecosystems associated with the Irwin and Lockier rivers is considered to present a water dependant ecosystem health value.

A high potential GDE has been identified in the lower Lockier River through a search of the BOM GDE Atlas (BOM, 2003b), spanning from east of Mingenew to the Irwin-Lockier river confluence. Two sections of the Irwin River of 'unclassified potential' for supporting GDEs have further been identified, both upstream and downstream of the Irwin-Lockier river confluence. These potential GDE's may support ecologically valuable systems for fauna and flora.

Figure F1, Figure F2 and Figure F3 in Appendix F show these potential GDEs as described by the BOM GDE Atlas.

4 IMPACT ASSESSMENT

4.1 Activity Description

Gas and condensate will be produced from the conventional well network including the Lockyer Deep 1, Lockyer 3, and North Erregulla Deep 1 gas wells (drilling results from Lockyer 2 did not support further development at that specific location). Additional gas wells that are in the planning phase include Lockyer 4 and Lockyer 5. Gas will be extracted from the Kingia sandstone of Early Permian age, located > 4,000m below ground surface.

The Project is a conventional gas development, accordingly no fracking is required.

Buried pipelines will connect the production wells to the CPF in a hub-and-spoke arrangement. Where flow lines intersect the Lockier and Irwin Rivers, Horizontal Directional Drilling (HDD) will be conducted to allow the pipeline to be sufficiently deep beneath the rivers to not impact surface water.

The CPF will include the main gas processing infrastructure, condensate truck loading area, a stormwater basin, evaporation ponds, a temporary construction camp, an operations camp, offices and workshops, and other associated infrastructure including access roads.

A 14 km long gas export pipeline will be constructed to join the CPF to the DBNGP, allowing conditioned gas to be directly exported into the main gas pipeline. Hydrocarbon condensate will be trucked from the CPF.

Water supply for the project will include development of a groundwater production bore network for construction and operational requirements, estimated as 0.3 GL for the 18 – 24 month construction period and 0.025 GL per annum for ongoing operations. MinRes currently hold two groundwater licences (GWL 205861 and GWL 209032) with a combined allocation of 0.016 GL and are seeking licence amendments to increase this allocation to 0.5 GL for each licence. While the application process is being managed separately for the uplift in groundwater allocation, the impact assessment does provide reference and consideration to potential drawdown effects of groundwater abstraction.

4.2 Potential Sources of Water Impacts

Potential sources of water impacts include:

- Sediment loads if excessive erosion was to occur during ground disturbance activities associated with the construction phase.
- Spills or leaks from the gas production wells and associated operational activities, pipelines connecting the production wells to the CPF, condensate storage, condensate piping, gas export pipelines, and evaporation ponds. Leaks from the gas production wells include the potential for cross contamination of aquifers, if the well bore integrity was affected allowing for migration of groundwater from deeper units to raise to shallower aquifers. Potential contaminants include natural-gas condensate, saline groundwater, and operational fuel and petroleum products.
- Spills or leaks of hazardous materials stored and handled onsite during construction and operations, including fuels for powering vehicles and equipment.
- Spills and leaks of effluent and grey water from the temporary construction or permanent camp.

- Groundwater level drawdown associated with groundwater abstraction for water supply during the construction and operational phase of the Project.

4.3 Pathways of Water Impacts

4.3.1 Surface Water Drainage

Surface water drainage pathways would include:

- Overland run-off from areas of ground disturbance (for potential sediment load impacts).
- Overland run-off from areas of spills (for potential water quality impacts).
- Transport within natural drainages such as the Irwin and Lockier rivers if sediment / spills have reached these features.

The likelihood of pathways to receptors being complete would depend on the size and location of the spill/sediment load impact. Distances from the CPF to the Irwin River (~1,300m) and the drill pads to the closest river (> 400m for all existing and planned gas wells) would make the completeness of surface drainage pathways to these rivers unlikely, except in the case of a complete breach of pressure control at the surface infrastructure associated with a gas well. The most likely complete surface water drainage pathway would be in the case of a leak or spill from a pipeline that is in close proximity to the Irwin or Lockier rivers.

Surface spills may further seep into the subsurface, potentially affecting groundwater if the spills were to reach the underlying Yarragadee aquifer.

4.3.2 Groundwater

Groundwater pathways would include:

- Transport of contaminants through the Yarragadee aquifer if surface spills have seeped sufficiently through the vadose sone with subsequent transport in the aquifer.
- Transport of contaminants through the Yarragadee aquifer or underlying groundwater units, if leaks within a gas well has occurred within the groundwater saturated zone.

Groundwater flow could then potentially present a pathway for water quality impacts to groundwater users, including groundwater bores used for abstraction and GDEs. Airlift yields measured during the development of groundwater production bores installed at the gas well drill pads, which varied between 4 and 6 L/s, indicates a relatively permeable groundwater system.

4.4 Potentially affected Environmental Values and Receptors

4.4.1 Surface Water

Potentially affected environmental values and receptors for surface water impacts include the following:

- Freshwater aquatic species in the Lockier and Irwin rivers.
- Recreational users of the lower Irwin River.

4.4.2 Groundwater

Potentially affected environmental values and receptors for groundwater impacts include the following:

- Livestock Receptors being watered from pastoral bores.
- Domestic users of pastoral bores.
- The GDES outlined in Section 3.4 may be adversely affected by groundwater impacts through water quality degradation or large fluctuations in groundwater levels.

4.5 Risk Assessment

4.5.1 Risk Identification, Analysis, and Evaluation

The likelihood of an impact occurring and the consequence of that impact on environmental factors and values forms the risk. The consequence likelihood categories adopted for this risk assessment are listed in Table 1 and Table 2 respectively. The consequence assessment was informed both by the factors determined in Sections 4.2, and 4.3, and by the sensitivity of the environmental values and receptors in Section 4.4.

A site-specific interpretation of the consequences are listed in Table 3, with consideration of potential water quality impacts and potential impacts on (physical) hydrogeological processes. The combined likelihood and consequence ratings matrix shown in Table 4 was used to form the overall risk rating for each identified risk at the Project.

Table 1: Consequence Categories Adopted in Risk Assessment

Consequence or Severity of Impact	Description
Severe	A severe impact has two or more of the following characteristics: • Widespread – Impact occurs at a state scale (Western Australia), or greater. • High Intensity – Impact irreversibly compromises the integrity of environmental values. • Permanent – environmental values will not recover on human time scales.
Major	A major impact has two or more of the following characteristics: • Regional – Impact extends to the regional scale (Greater North Perth Basin). • Moderate Intensity – Integrity of environmental values altered but impact can practicably be reversed. • Long Term – Impact to environmental values measurable after Project closure.
Moderate	A moderate impact has two or more of the following characteristics: • Localised – Impact is confined to the Project area and adjacent areas, such as neighbouring allotments and watercourses. • Low Intensity – Impact alters the quality, abundance or distribution of environmental values without compromising their integrity, and can reversed. • Medium Term – Impact to environmental values measurable until completion of the Project.
Minor	A minor impact has two or more of the following characteristics: • Limited – Impact is limited to the Project area. • Very Low Intensity – Impact does not significantly alter the quality, abundance or distribution of environmental values. • Short Term – Impact to environmental values measurable until completion of construction of the Project.
Insignificant	No noticeable or measurable impacts to environmental values.

Table 2: Likelihood Categories Adopted in Risk Assessment

Likelihood Category	Description
Almost Certain	The impact will occur or is expected to occur within 1 year. The impact occurs regularly in association with similar projects or similar environments.
Likely	The impact will probably occur in most circumstances, likely within 1 to 10 years. The impact has occurred on more than one occasion in association with similar projects or similar environments.
Possible	The impact could occur in some circumstances, likely within 10 to 50 years. The impact has occurred infrequently on similar projects or in similar environments.
Unlikely	The impact is not expected to occur once within 50 years. The impact occurs very infrequently on similar projects or similar environments.
Rare	The impact is very unlikely to occur once within 100 years. The impact has not occurred on similar projects or in similar environments.

Table 3: Consequence Categories Adopted in Risk Assessment adapted for each Site-specific factor.

Likelihood Category	Water Quality	Hydrogeological Processes
Severe	Exceedance of baseline water quality that permanently alters the ecological function and / or amenity of the Irwin and Lockier Rivers, Indian Ocean, and groundwater receptors.	Change in surface water flow regimes or groundwater levels that permanently alter functioning and / or amenity of the Irwin and Lockier rivers and significantly alters potential GDEs and the beneficial uses of groundwater.
Major	Exceedance of baseline water quality that alters the regional ecological function and / or amenity of the Irwin and Lockier Rivers and groundwater receptors for several years after Project closure.	Reduction in surface water flow regimes or groundwater levels that compromises regional ecological functioning of the Irwin and Lockier rivers, alters potential GDEs and the beneficial uses of groundwater for several years after Project closure.
Moderate	Localised exceedances of baseline water quality that occurs throughout Project operations that	Localised alteration in surface water flow regimes and drawdown of groundwater that has a negligible to

Likelihood Category	Water Quality	Hydrogeological Processes
	cease within months of Project closure.	low impact on the ecological health of the Irwin and Lockier rivers, potential GDEs and groundwater receptors for several months after Project closure.
Minor	Exceedances of baseline water quality at the Project until completion of Project construction.	Localised alteration in surface water flow regimes and drawdown of groundwater that has a negligible to low impact on the ecological health of the Irwin and Lockier rivers, potential GDEs and groundwater receptors until completion of Project construction.
Insignificant	No significant change to baseline water quality.	No measurable change to hydrogeological processes.

Table 4: Risk Matrix Adopted in Risk Assessment.

			Consequence				
			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Severe
Likelihood	5	Almost Certain	Medium	Medium	High	Very High	Very High
	4	Likely	Medium	Medium	High	Very High	Very High
	3	Possible	Low	Medium	Medium	High	Very High
	2	Unlikely	Low	Low	Medium	Medium	High
	1	Rare	Low	Low	Low	Medium	High

4.5.2 Inherent Risk Assessment

For each potential impact to an environmental value, an inherent risk rating was assigned by ranking the likelihood and consequence of the impact in the absence of any mitigation. Site-specific environmental factors were considered when determining the inherent risk rating, including potential impact sources and pathways, environmental conditions, and sensitivity of environmental values and receptors.

4.5.3 Responses to Inherent Risk Levels

The response matrix shown in Table 5 was used to determine the level of mitigation required for each inherent risk rating.

Table 5: Risk Level and Mitigation Response Matrix

Risk Level	Response
Very High	Risk is unacceptable. Immediate intervention and specific action plans required to reduce risk to an acceptable level.
High	Risk is unacceptable. Immediate intervention and specific action plans required to reduce risk to 'as low as reasonably practicable'.
Medium	Risk is generally acceptable. Proactive action is required to reduce risk to 'as low as reasonable possible', with routine monitoring and management.
Low	Risk is acceptable. Management by routine policies and procedures.

4.5.4 Residual Risk Assessment

Practicable mitigation measures were developed for each risk rating with a very high, high, or medium risk levels. Each risk with mitigation measures was reassessed with the assumption of implementation of proposed mitigation measured to determine a residual risk rating.

4.6 Environmental Risk Assessment

Table 6 presents the environmental risk assessment undertaken for the Project, incorporating the methodology described in Section 4.5.

Table 6: Lockyer Inland Waters Environmental Risk Assessment

Environmental Hazard	Risk Pathways	Impacts	L	C	Risk Rating	Risk Mitigation	L	C	Residual Risk Rating	Phase
Environmental Factor: Water Quality										
Site construction works and earthworks exposing underlying soil followed by increased erosion and sediment load.	Sediment being transported through surface water runoff.	Increased sediment load and reduction of quality of surface water in the Irwin and Lockier rivers.	4	2	Medium	• Incorporate erosion and sediment control during construction activities. • During earthworks, conduct routine inspections of stormwater pathways for sediment load.	2	2	Low	Construction
Leaks and spills of fuel and other hazardous chemicals used during construction and operational activities.	Transport in overland runoff, surface water drainage and/or groundwater flow	Adverse changes to the quality of surface water in the Irwin and Lockier rivers and groundwater in the Project area.	3	2	Medium	• Store hazardous chemicals in bunded areas. • Record and report all chemical and hazardous substance spills. • Ensure spill kits are easily available to all personnel and contain absorbent material. • Dispose of contaminated soil and absorbent material at designated disposal sites approved by regulator. •	1	2	Low	Construction and Operations
Leaks and spills of hydrocarbon condensate from above ground infrastructure.	Transport in overland runoff, surface water drainage and/or groundwater flow.	Adverse changes to the quality of surface water in the Irwin and Lockier rivers and groundwater in the Project area.	3	4	High	• Conduct routine visual inspections of above-ground pipelines for leaks. • Monitor pipeline pressures for signs of dropping pressure caused by potential leaks in the system. • Conduct routine monitoring and sampling of surface water and groundwater in the Project area to identify impacts to the environment.	2	4	Medium	Operations

Environmental Hazard	Risk Pathways	Impacts	L	C	Risk Rating	Risk Mitigation	L	C	Residual Risk Rating	Phase
Leaks from gas wells including cross contamination of aquifers	Transport in groundwater	Adverse changes to the quality of groundwater in the Project area, and to GDEs where hydraulic connectivity exists.	3	3	High	• Drilling the gas well in sections through telescope drilling, with each consecutive section deepening the well with a smaller diameter than the previous section. • Cementing protective, pressure rated, steel casings between the well bore and the surrounding rock formation in each section. • Performing pressure testing to ensure the cement and casing can withstand formation pressure conditions. • Having an above ground barrier in the form of a “Christmas tree” assembly with valves and fittings that control the flow of gas.	3	3	Medium	Construction and Operations
Leaks through evaporation ponds.	Contamination of surface water and groundwater from spills, leaks, and transport in runoff.	Adverse changes to the quality of surface water in the Irwin and Lockier rivers and groundwater in the Project area.	5	3	High	• Ponds to be constructed with a HDPE and/or geosynthetic clay liner or similar to create hydraulic barrier and prevent vertical migration of water into the subsurface. • Inspection of liner prior to commissioning of evaporation ponds. • Routine monitoring and sampling of nearby monitoring bores and surface water locations to assess against baseline conditions.	2	3	Medium	Operations
Leaks and spills of effluent and grey water from the construction and operational camp.	Contamination of surface water and groundwater from spills, leaks, and transport in runoff.	Adverse changes to the quality of surface water in the Irwin and Lockier rivers and groundwater in the Project area.	2	2	Low	• Conduct routine visual inspections of above ground pipelines. • Routine monitoring bore sampling at the camp facilities to include analysis for microorganisms (e.g. E.coli) at specified intervals.	1	2	Low	Construction and Operations
Environmental Factor: Hydrogeological Processes										

Environmental Hazard	Risk Pathways	Impacts	L	C	Risk Rating	Risk Mitigation	L	C	Residual Risk Rating	Phase
Groundwater Abstraction.	Alteration of groundwater levels.	Increased drawdown from groundwater abstraction impacting surrounding groundwater users and GDEs.	2	3	Medium	• Groundwater abstraction to be compliant with conditions set out in 5C licence. • Abstraction bores to be metered and routinely monitored. Abstraction volumes to be reported to DWER as per licence conditions. • Local monitoring bores to be routinely monitored for groundwater levels, with a trigger action response plan (TARP) to be implemented as required.	1	3	Low	Construction and Operations
Site earthworks and layout.	Alteration of surface hydrology.	Increased volume of surface water runoff and / or ponding of surface water runoff. Site flooding from heavy rainfall.	3	2	Medium	• Design stockpiled material, earthworks, and excavations as to reduce alterations to natural stormwater runoff.	1	2	Low	Construction and operations

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main surface water drainages in the project area are the Irwin and the Lockier rivers. The Lockier River acts as a tributary to the Irwin River, with the confluence of the rivers located approximately 3 km from the southeastern boundary of the CPF. From the confluence, the Irwin River drains in a general westerly direction towards Dongara. Surface water sampling indicates that boron is naturally elevated in the Irwin and Lockier rivers (with baseline concentrations in all samples taken exceeded the screening criteria for freshwater aquatic ecosystems). No Ramsar wetlands, wetlands listed in DIWA, wetlands protected under the EPA Act or Wild Rivers were identified within a 20 km radius of the project infrastructure. Freshwater aquatic ecosystems associated with the Irwin and Lockier rivers is considered to present a water dependant ecosystem health value. Sections of these rivers have been identified as potential GDEs.

The Yarragadee aquifer that underlies the project area presents a groundwater resource. The aquifer consists of a multilayered sequence of sand units with interbedded siltstone, claystone and shale. Airlift yields measured during the development of groundwater production bores installed at the gas well drill pads, which varied between 4 and 6 L/s, indicates a relatively permeable groundwater system. An assessment of baseline conditions identified stock watering and domestic use (including drinking water where groundwater salinity is below 1,200 mg/L) as beneficial uses of groundwater in the area.

The impact assessment included consideration of the Project activities and potential impacts (to environmental values including beneficial uses) that could be associated with activities during construction and operational phases. Potential impacts include water quality impacts from increased erosion during ground disturbance activities, spills/leaks if they were to occur from above ground or underground infrastructure, leaks from evaporation cells and spills/leaks associated with ancillary services (such as refuelling areas). Potential water level drawdown impacts could further be associated with groundwater abstraction for water supply purposes.

The risk assessment evaluated potential risk to environmental values including beneficial use on the basis of likelihood and consequence, with the residual impact including consideration of risk mitigation measures. Mitigation measures are summarised in Table 6 and include engineering controls (such as drilling gas wells in sections through telescope drilling, cementing pressure rated steel casings in each section and conducting pressure testing while constructing gas wells as well as having evaporations ponds constructed with liners) as well as monitoring controls.

Residual risk ratings where all low to medium, with no high to very high residual risks identified. The highest residual risks, classified as medium based on the risk rankings, included water quality risks associated with potential spills from above ground infrastructure, leaks from gas wells (including cross contamination of aquifers) and leaks through evaporation ponds. Recommendations made in the following section include measures to address these risks.

5.2 Recommendations

The following recommendations are made as part of this assessment:

- Develop and implement a construction environmental management plan, including erosion and sediment load controls.

- Develop and implement a quality assurance and quality control (QAQC) procedure to test and verify the integrity of engineered barriers to potential water quality impacts. This would include verification and documentation of liners being placed according to specifications at the evaporation ponds, construction of gas wells being undertaken as per the gas well drilling and construction plans and pressure testing results.
- Develop and implement an ongoing infrastructure monitoring program including pressure monitoring of gas wells and pipelines, and visual inspection of above ground infrastructure.
- As part of an environmental monitoring program, develop and implement a surface water and groundwater monitoring plan in the Project area:
    - Key elements of the groundwater monitoring should include having a groundwater monitoring bore at each of the operational gas well drill pads, sampling these on a six-monthly basis while operational, and including QAQC procedures for the sampling and analysis.
    - Key elements of the surface water sampling programme should include establishing sampling locations at the local surface water drainages, including an upstream sampling location in the Irwin River and a sampling location downgradient of the confluence of the Irwin and Lockier Rivers. Laboratory samples should be taken on a six-monthly basis with the sampling plan including QAQC procedures.
- If additional water bores are drilled and tested as part of the hydrogeological assessment forming part of the groundwater licence amendment application, incorporate additional hydrogeological characterisation data collected as part of the process into the design of the above mentioned groundwater monitoring plan.
- As part of the groundwater abstraction licence conditions, develop a Groundwater Operating Strategy (GWOS) that is specific to managing groundwater abstraction and the monitoring of the effects of groundwater abstraction.

6 REFERENCES

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7 LIMITATIONS

Attention is drawn to the document “Limitations”, which is included in Appendix A of this report. The statements presented in this document are intended to provide advice on what the realistic expectations of this report should be, and to present recommendations on how to minimise the risks associated with this project. The document is not intended to reduce the level of responsibility accepted by Hydro Geochem Group, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in doing so.

APPENDIX A LIMITATIONS

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APPENDIX B FIELD MEASUREMENTS AND BORE CONSTRUCTION DETAILS

Table B1. Field Measurements

Sample ID	Date	Sample Type	Groundwater Level (m bTOC)	Flow Rate (s/m)	Electrical Conductivity (µS/cm)	pH	Temperature (°C)	Oxidation-Reduction Potential (mV)	DO (%)	Comments
SW01_CDM	17/12/2020	Surface Water	Not Applicable (NA)	>10	3267	6.66	20.5	184.5	70.3	Irwin River upstream. Clear, no odour, no sheen, low sediment.
SW02_CDM	17/12/2020		NA	>10	3686	7.19	20.2	224.8	94.3	Irwin River downstream from SW01_CDM. Clear, no odour, no sheen, low sediment.
SW03_CDM	17/12/2020		NA	>10	6623	7.17	22.3	228.9	105.3	Irwin River downstream from SW02_CDM at road crossing. Clear, no odour, no sheen, low to no sediment.
SW04_CDM	17/12/2020		NA	10	7345	7.27	22.1	165.2	72.2	Downstream from confluence of Irwin and Lockier rivers. Clear, no odour, no sheen, low to no sediment.
SW01_HGG	19/10/2023		NA	18	2647	7.34	18.9	154	78	Channel ~3m wide, 0.2m deep. High degree of algae in water. Clear sample, no specific odour. Sandy gravely stream fed with high degree of leaves and algae.
SW02_HGG	19/10/2023		NA	15	2867	7.35	21.8	140	72	Channel ~3m wide, 0.3m deep. Moderate degree of algae in water. Clear sample. Sandy stream bed with high degree of leaves.
SW03_HGG	19/10/2023		NA	70	4914	7.04	24.4	123	71	Channel ~4m wide, 0.1m deep. Moderate degree of algae in water. Clear sample, no odour. Sandy stream bed with high degree of leaves and branches in water. Sample taken upgradient of river crossing.
SW04_HGG	19/10/2023		NA	11	5855	7.14	24.2	101	55	Channel ~2m wide, 0.3m deep. Moderate degree of algae in water. Clear sample, no odour. Gravely sandy stream bed, branches and leaves on stream bed.
SW05_HGG	19/10/2023		NA	No flow	6045	6.93	21.9	26	39	Pool within river ~5m across, 0.1m deep. Lots of reeds. Sample clear, slight organic odour. Pool bed contains high degree of organic matter, mostly decomposing leaves.
GW01 (Pastoral Bore)	17/12/2020	Groundwater	23.30	-	1325	6.43	30.8	222.8	71.7	Total depth = 140m. Sample taken from abstration bore. Water levels taken from adjacent monitoring bore (23.3 m bTOC).
LD2-MB	15/12/2022		45.46	-	5589	6.4	-	-137	3.63	-
LD2-WB	15/12/2022		-	-	2763	6.1	-	12	23	-
NED1-MB	15/12/2022		69.59	-	6061	6.1	-	-121	2.42	-
NED1-WB	15/12/2022		-	-	3660	6.0	-	-11	44.78	-
LD2-MB	8/02/2023		45.45	-	5072	6.8	-	-139	1.21	-
NED1-MB	8/02/2023		69.35	-	6671	6.7	-	-113	1.21	-
GW01 (Pastoral Bore)	18/10/2023		-	-	1147	6.33	21.7	178	62	Clear water, no odour. Water sample taken by running installed pump.
LD1-MB	18/10/2023		~6.9	-	2228	7.30	23.5	84	67	Slightly murky water, no odour.
LD1-PB	18/10/2023		~7.2	-	4933	6.96	24.4	73	23	Clear water, no odour.
LD2-MB	18/10/2023		~45.6	-	2829	7.00	25.2	-116	7	Clear water, slight sulfur smell.
LD3-PB	18/10/2023		~33.3		1626	6.25	23.7	168	58	Clear water, no odour.
NED1-MB	17/10/2023		~67	-	4574	6.88	24.7	-119	5	Slightly murky water, slight sulfur smell.
NED1-WB	17/10/2023		~71	-	2742	6.35	24.6	-33	20	Clear water, slight sulfur smell.

Notes: For measurements taken in October 2023, water quality from grab sample (no purging) and water level measurements from downhole camera survey

Table B2. Available Water Bore Construction Details

Bore ID	Total Depth	Screened Length	Screened Lithology	Reported Airlift Yield	Airlift Duration
LD1-MB	12	5-11 (6m)	Medium-coarse Sand	-	-
LD1-WB	84	30-42 (12m)	Sands, clay, sandy clays	6 L/s	5 hr
		54-60 (6m)	Medium to course sand		
LD2-MB	57	39-57 (18m)	Medium-coarse sand	0.3 L/s	4 hr
LD2-WB	96	72-96 (24m)	Medium-coarse sand	5 L/s	3 hr
LD3-WB	74	48-72 (24m)	Medium-coarse sand with clay lenses	4 L/s	3 hr
NED1-MB	82	64-82 (18m)	Medium-coarse sand with clay lenses	0.1 L/s	3 hr
NED1-WB	130	104-128 (24m)	Medium-coarse sand with sandy clay lenses	5.5 L/s	3 hr

Notes: Reported airlift yields and durations from bore development (captured on Form 2s)

APPENDIX C SURFACE WATER AND GROUNDWATER LABORATORY CHEMISTRY RESULTS

			Dissolved Metals																Major Ions								
		Analyte	Aluminium	Arsenic	Barium	Boron	Cadmium	Chromium (hexavalent)	Chromium (III+VI)	Chromium (Trivalent)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Phosphorus	Zinc	Calcium	Chloride	Sulphate	Potassium	Magnesium	Sodium	Reactive Phosphorus as P	Ammonium Ion
		Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		Limit of Reporting (LoR)	0.05	0.001	0.02	0.05	0.0002	0.005	0.001	0.005	0.001	0.05	0.001	0.005	0.0001	0.001	0.01	0.005	0.5	1	5	0.5	0.5	0.5	0.01	0.01
ANZECC 95% Species Protection - Freshwater				0.013		0.37	0.0002	0.001			0.001		0.003	1.9	0.0006	0.011		0.008								
Location ID	Date	Sample Type																								
SW01_CDM	17/12/2020	Surface Water	<0.05	<0.001	0.1	0.64	<0.0002	<0.005	<0.001	<0.005	<0.001	<0.05	<0.001	0.2	<0.0001	<0.001	0.01	<0.005	26	1,100	150	13	59	510	<0.01	<0.01
SW02_CDM	17/12/2020	Surface Water	<0.05	<0.001	0.09	0.66	<0.0002	<0.005	<0.001	<0.005	<0.001	<0.05	<0.001	0.25	<0.0001	<0.001	<0.01	<0.005	31	1,300	150	14	66	590	<0.01	<0.01
D01_(SW02)_CDM	17/12/2020	Surface Water	<0.05	<0.001	0.08	0.62	<0.0002	<0.005	<0.001	<0.005	<0.001	<0.05	<0.001	0.24	<0.0001	<0.001	0.01	<0.005	30	1,200	150	14	65	550	<0.01	<0.01
SW03_CDM	17/12/2020	Surface Water	<0.05	<0.001	0.07	1.1	<0.0002	<0.005	<0.001	<0.005	<0.001	<0.05	<0.001	0.4	<0.0001	0.002	<0.01	<0.005	71	2,200	390	25	130	1,100	<0.01	<0.01
SW04_CDM	17/12/2020	Surface Water	<0.05	<0.001	0.09	1.3	<0.0002	<0.005	<0.001	<0.005	<0.001	<0.05	<0.001	0.45	<0.0001	<0.001	0.01	<0.005	79	2,500	380	28	150	1,300	<0.01	0.02

			Nitrogen						Carbonates					Physical		Hydrocarbons												BTEXN					
		Analyte	Nitrogen (Total)	Kjeldahl Nitrogen Total	Ammonia as N	Nitrate (as N)	Nitrite (as N)	Nitrite + Nitrate as N	Alkalinity (Carbonate as CaCO3)	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Hydroxide) as CaCO3	Hardness as CaCO3	Alkalinity (total) as CaCO3	Total Dissolved Solids (mg/L)	Turbidity	C6-C9	C10-C14	C15-C28	C29-C36	C10-C36 (Sum of total)	C6-C10	C6-C10 (F1 minus BTEX)	C10-C16	C10-C16 (F2 minus Naphthalene)	C16-C34	C34-C40	C10-C40 (Sum of total)	Benzene	Toluene	Ethylbenzene	Naphthalene	Xylene Total	Xylene (m & p)
		Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Limit of Reporting (LoR)	0.2	0.2	0.01	0.02	0.02	0.05	20	20	20	5	20	10	1	20	50	100	100	100	20	20	50	50	100	100	100	1	1	1	1	3	2
ANZECC 95% Species Protection - Freshwater						2.4*																					950			16		
Location ID	**Date**	**Sample Type**																														
SW01_CDM	**17/12/2020**	**Surface Water**	1.3	<0.2	<0.01	1.2	0.04	1.3	<20	91	<20	310	91	2,300	5	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<1	<1	<1	<1	<3	<2
SW02_CDM	**17/12/2020**	**Surface Water**	1.8	<0.2	<0.01	1.8	0.03	1.8	<20	100	<20	350	100	2,300	4.6	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<1	<1	<1	<1	<3	<2
D01_(SW02)_CDM	**17/12/2020**	**Surface Water**	1.8	<0.2	<0.01	1.8	0.03	1.8	<20	100	<20	340	100	2,200	4.7	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<1	<1	<1	<1	<3	<2
SW03_CDM	**17/12/2020**	**Surface Water**	0.44	<0.2	<0.01	0.43	<0.02	0.44	<20	120	<20	730	120	4,000	3.3	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<1	<1	<1	<1	<3	<2
SW04_CDM	**17/12/2020**	**Surface Water**	<0.2	<0.2	0.02	0.09	<0.02	0.09	<20	170	<20	820	170	4,900	10	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<1	<1	<1	<1	<3	<2

Notes: * As the ANZECC (2000) guideline for nitrate is erroneous the grading value for 95% species protection (slightly to moderately disturbed ecosystems) of 2.4 mg NO3-N/L (NIWA, 2013) has been utilised for nitrate

		Analyate	Xylene (o)
		Unit	µg/L
		Limit of Reporting (LoR)	1
ANZECC 95% Species Protection - Freshwater			350
Location ID	Date	Sample Type	
SW01_CDM	17/12/2020	Surface Water	<1
SW02_CDM	17/12/2020	Surface Water	<1
D01_(SW02)_CDM	17/12/2020	Surface Water	<1
SW03_CDM	17/12/2020	Surface Water	<1
SW04_CDM	17/12/2020	Surface Water	<1

			MAH					PAH																Halogenated Benzenes						Halogenated Hydrocarbons				
		Analyate	Total MAH	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	Isopropylbenzene	Styrene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b+j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene	PAHs (Sum of total)	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	4-chlorotoluene	Bromobenzene	Chlorobenzene	1,2-dibromoethane	Bromomethane	Dichlorodifluoromethane	Iodomethane	Trichlorofluoromethane
		Unit	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Limit of Reporting (LoR)	0.003	1	1	1	1	1	1	1	1	1	0.001	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ANZECC 95% Species Protection - Freshwater																																		
Location ID	Date	Sample Type																																
SW01_CDM	17/12/2020	Surface Water	<0.003	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.001	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SW02_CDM	17/12/2020	Surface Water	<0.003	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.001	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
D01_(SW02)_CDM	17/12/2020	Surface Water	<0.003	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.001	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SW03_CDM	17/12/2020	Surface Water	<0.003	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.001	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SW04_CDM	17/12/2020	Surface Water	<0.003	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.001	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

			Solvents					Chlorinated Hydrocarbons																												
		Analyate	Methyl Ethyl Ketone	4-Methyl-2-pentanone	Acetone	Allyl chloride	Carbon disulfide	Chlorinated hydrocarbons EPAVic	Other chlorinated hydrocarbons EPAVic	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,2,3-trichloropropane	1,2-dichloroethane	1,2-dichloropropane	1,3-dichloropropane	Bromochloromethane	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Dichloromethane	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Vinyl chloride
		Unit	µg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Limit of Reporting (LoR)	1	1	0.001	0.001	1	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1	1	1	1	1	1	1
ANZECC 95% Species Protection - Freshwater																																				
Location ID	**Date**	**Sample Type**																																		
SW01_CDM	**17/12/2020**	**Surface Water**	<1	<1	0.002	<0.001	<1	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
SW02_CDM	**17/12/2020**	**Surface Water**	<1	<1	0.002	<0.001	<1	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1
D01_(SW02)_CDM	**17/12/2020**	**Surface Water**	<1	<1	0.002	<0.001	<1	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1
SW03_CDM	**17/12/2020**	**Surface Water**	<1	<1	0.002	<0.001	<1	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1
SW04_CDM	**17/12/2020**	**Surface Water**	<1	<1	0.002	<0.001	<1	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1

			Dissolved Metals															Physical Parameters			
		Analyte	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Selenium	Vanadium	Zinc	pH Value	Electrical Conductivity @ 25°C	Total Dissolved Solids (Calc.)	Sodium Adsorption Ratio
		Unit	0.001	0.001	0.001	0.05	0.0001	0.001	0.001	0.001	0.001	0.001	0.0001	0.001	0.01	0.01	0.005	0.01	1	1	0.01
		Limit of Reporting (LoR)	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH Unit	µS/cm	mg/L	-
ANZECC 95% Species Protection - Freshwater			0.013			0.37	0.0002	0.001		0.0014	0.0034	1.9	0.0006	0.011	0.011		0.008				
SAMPLE ID	**Date**	**Type**																			
SW01_HGG	19/10/2023	**Surface Water**	<0.001	0.092	<0.001	0.53	<0.0001	<0.001	<0.001	<0.001	<0.001	0.6	<0.0001	0.003	<0.01	<0.01	<0.005	7.8	3220	2090	13.5
SW02_HGG	19/10/2023	**Surface Water**	<0.001	0.088	<0.001	0.49	<0.0001	<0.001	<0.001	<0.001	<0.001	0.344	<0.0001	0.001	<0.01	<0.01	<0.005	7.78	3280	2130	12.9
SW03_HGG	19/10/2023	**Surface Water**	<0.001	0.058	<0.001	0.78	<0.0001	<0.001	0.002	<0.001	<0.001	0.404	<0.0001	0.002	<0.01	<0.01	<0.005	7.61	5580	3630	16.2
SW04_HGG	19/10/2023	**Surface Water**	<0.001	0.073	<0.001	0.83	<0.0001	<0.001	<0.001	<0.001	<0.001	0.434	<0.0001	0.002	<0.01	<0.01	<0.005	7.71	6770	4400	18
SW05_HGG	19/10/2023	**Surface Water**	<0.001	0.111	<0.001	1.08	<0.0001	<0.001	<0.001	<0.001	<0.001	1.04	<0.0001	<0.001	<0.01	<0.01	<0.005	7.62	7060	4590	20.5
QC01_(SW02)_HGG	19/10/2023	**Duplicate (QAQC)**	<0.001	0.086	<0.001	0.44	<0.0001	<0.001	<0.001	<0.001	<0.001	0.323	<0.0001	0.002	<0.01	<0.01	<0.005	7.76	3270	2120	12.8

			Major Ions									Carbonates					Nitrogen					
		Analyte	Calcium	Chloride	Fluoride	Magnesium	Potassium	Reactive Phosphorus as P	Sodium	Sulfate as SO4 - Turbidimetric	Total Phosphorus as P	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Hydroxide Alkalinity as CaCO3	Total Hardness as CaCO3	Ammonia as N	Nitrate as N	Nitrite as N	Nitrite + Nitrate as N	Total Kjeldahl Nitrogen as N	Total Nitrogen as N
		Unit	1	1	0.1	1	1	0.01	1	1	0.01	1	1	1	1	1	0.01	0.01	0.01	0.01	0.1	0.1
		Limit of Reporting (LoR)	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ANZECC 95% Species Protection - Freshwater																		2.4*				
SAMPLE ID	Date	Type																				
SW01_HGG	19/10/2023	Surface Water	29	904	0.2	59	14	<0.01	550	127	<0.01	84	<1	84	<1	315	0.05	1.64	0.06	1.7	0.5	2.2
SW02_HGG	19/10/2023	Surface Water	32	916	0.3	64	14	<0.01	551	125	<0.01	90	<1	90	<1	343	0.04	3.32	0.06	3.38	0.7	4.1
SW03_HGG	19/10/2023	Surface Water	52	1490	0.3	95	20	<0.01	852	287	0.02	105	<1	105	<1	521	0.04	1.37	0.04	1.41	0.5	1.9
SW04_HGG	19/10/2023	Surface Water	59	1840	0.3	105	22	<0.01	998	304	<0.01	142	<1	142	<1	580	0.03	0.43	0.01	0.44	0.5	0.9
SW05_HGG	19/10/2023	Surface Water	62	1840	0.4	107	22	<0.01	1150	235	0.03	234	<1	234	<1	595	0.02	0.35	<0.01	0.35	0.6	1
QC01_(SW02)_HGG	19/10/2023	Duplicate (QAQC)	31	909	0.3	62	15	<0.01	536	112	<0.01	90	<1	90	<1	333	0.03	3.3	0.06	3.36	0.6	4

Notes: * As the ANZECC (2000) guideline for nitrate is erroneous the grading value for 95% species protection (slightly to moderately disturbed ecosystems) of 2.4 mg NO3-N/L (NIWA, 2013) has been utilised for nitrate

			Hydrocarbons													BTEXN							
		Analyte	>C10 - C16 Fraction	>C10 - C16 Fraction minus Naphthalene (F2)	>C10 - C40 Fraction (sum)	>C16 - C34 Fraction	>C34 - C40 Fraction	C10 - C14 Fraction	C10 - C36 Fraction (sum)	C15 - C28 Fraction	C29 - C36 Fraction	C6 - C10 Fraction	C6 - C10 Fraction minus BTEX (F1)	C6 - C9 Fraction	Sum of BTEX	Benzene	Ethylbenzene	meta- & para-Xylene	Naphthalene	ortho-Xylene	Total Xylenes	Toluene	Methane
		Unit	100	100	100	100	100	50	50	100	50	20	20	20	1	1	2	2	5	2	2	2	10
		Limit of Reporting (LoR)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
ANZECC 95% Species Protection - Freshwater																950		200	16	350			
SAMPLE ID	Date	Type																					
SW01_HGG	19/10/2023	Surface Water	<100	<100	<100	<100	<100	<50	<50	<100	<50	<20	<20	<20	<1	<1	<2	<2	<5	<2	<2	<2	19
SW02_HGG	19/10/2023	Surface Water	<100	<100	<100	<100	<100	<50	<50	<100	<50	<20	<20	<20	<1	<1	<2	<2	<5	<2	<2	<2	11
SW03_HGG	19/10/2023	Surface Water	<100	<100	<100	<100	<100	<50	<50	<100	<50	<20	<20	<20	<1	<1	<2	<2	<5	<2	<2	<2	<10
SW04_HGG	19/10/2023	Surface Water	<100	<100	<100	<100	<100	<50	<50	<100	<50	<20	<20	<20	<1	<1	<2	<2	<5	<2	<2	<2	14
SW05_HGG	19/10/2023	Surface Water	<100	<100	<100	<100	<100	<50	<50	<100	<50	<20	<20	<20	<1	<1	<2	<2	<5	<2	<2	<2	<10
QC01_(SW02)_HGG	19/10/2023	Duplicate (QAQC)	<100	<100	<100	<100	<100	<50	<50	<100	<50	<20	<20	<20	<1	<1	<2	<2	<5	<2	<2	<2	11

			Total Metals															
		Analyte	Aluminium	Arsenic	Barium	Boron	Cadmium	Chromium (hexavalent)	Chromium (III+VI)	Chromium (Trivalent)	Copper	Iron	Lead	Manganese	Mercury	Nickel	Phosphorus	Zinc
		Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		Limit of Reporting (LoR)	0.05	0.001	0.02	0.05	0.0002	0.005	0.001	0.005	0.001	0.05	0.001	0.005	0.0001	0.001	0.01	0.005
ANZECC - Livestock Trigger Values			5	0.5		5	0.01	1	1	1	0.4*		0.1		0.002	1		20
Australian Drinking Water Guidelines - Health				0.01	2	4	0.002				2		0.01	0.5	0.001	0.02		
Location ID	Date	Sample Type																
GW01 (Pastoral)	17/12/2020	Groundwater	<0.05	<0.001	0.12	0.39	<0.0002	<0.005	<0.001	<0.005	0.011	<0.05	<0.001	<0.005	<0.0001	0.003	<0.01	0.045
NED1-WB	15/12/2022	Groundwater																
NED1-MB	15/12/2022	Groundwater																
NED1-MB	8/02/2023	Groundwater																
LD2-WB	15/12/2022	Groundwater																
LD2-MB	15/12/2022	Groundwater																
LD2-MB	8/02/2023	Groundwater																

* Conservative value for sheep grazing

** Conservative value chosen for dairy cattle

			Dissolved Metals																						
		Analyate	Aluminium	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Chromium (Hexavalent)	Cobalt	Copper	Iron	Lead	Lithium	Manganese	Mercury	Molybdenum	Nickel	Selenium	Strontium	Titanium	Uranium	Vanadium	Zinc
		Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		Limit of Reporting (LoR)	0.010	0.001	0.001	0.001	0.020	0.0001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
ANZECC - Livestock Trigger Values			5	0.5			5	0.01	1	1		0.4*		0.1			0.002	0.15	1	0.02			0.2		20
Australian Drinking Water Guidelines - Health				0.01	2	0.06	4	0.002				2		0.01		0.5	0.001	0.05	0.02	0.01			0.017		
Location ID	**Date**	**Sample Type**																							
GW01 (Pastoral)	**17/12/2020**	**Groundwater**																							
NED1-WB	**15/12/2022**	**Groundwater**	0.022	0.0065	0.061	<0.0005	1	<0.0001	0.0037	<0.001	0.011	<0.01	1.7	<0.01	0.018	0.64	<0.000050	0.0018	0.014	<0.01	0.28	<0.01	<0.01	0.0019	0.018
NED1-MB	**15/12/2022**	**Groundwater**	0.15	0.0026	0.17	<0.0005	1.4	<0.0001	0.0052	<0.01	0.046	0.0032	1.1	0.0018	0.041	4.4	<0.000050	0.0015	0.031	0.0025	0.71	0.0047	0.0031	0.0038	0.026
NED1-MB	**8/02/2023**	**Groundwater**	0.023	0.0054	0.78	<0.0005	0.9	<0.0001	<0.001	<0.01	0.0088	<0.01	27	<0.01	0.15	15	<0.000050	<0.01	0.004	<0.01	0.46	<0.01	0.0016	0.0014	<0.01
LD2-WB	**15/12/2022**	**Groundwater**	<0.01	<0.001	0.046	<0.0005	0.92	<0.0001	0.0025	<0.001	0.0052	<0.01	0.42	<0.01	0.01	0.4	<0.000050	<0.01	0.0042	0.0021	0.2	<0.01	<0.01	<0.01	0.0066
LD2-MB	**15/12/2022**	**Groundwater**	0.014	0.008	1.3	<0.0005	0.96	<0.0001	0.0027	<0.01	0.044	0.0019	15	0.0078	0.024	23	<0.000050	0.0018	0.011	<0.01	0.76	<0.01	0.0026	0.0042	0.024
LD2-MB	**8/02/2023**	**Groundwater**	0.026	0.014	2.9	<0.0005	0.61	<0.0001	<0.001	<0.01	0.0035	<0.01	32	<0.01	0.011	23	<0.000050	0.0015	0.0015	<0.01	0.59	<0.01	<0.01	0.002	0.0019

* Conservative value for sheep grazing

** Conservative value chosen for dairy cattle

			Major Ions										Nitrogen						Carbonates					Physical			
		Analyate	Calcium	Chloride	Sulphate	Potassium	Magnesium	Sodium	Phosphorus (as P)	Total Phosphorus	Reactive Phosphorus as P	Ammonium Ion	Nitrogen (Total)	Kjeldahl Nitrogen Total	Ammonia as N	Nitrate (as N)	Nitrite (as N)	Nitrite + Nitrate as N	Alkalinity (Carbonate as CaCO3)	Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Hydroxide) as CaCO3	Hardness as CaCO3	Alkalinity (total) as CaCO3	Lab pH	Total Dissolved Solids (mg/L)	Lab Electrical Conductivity (µS/cm)	Turbidity
		Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH unit	mg/L	µS/cm	NTU
		Limit of Reporting (LoR)	0.5	1	5	0.5	0.5	0.5	0.005	0.05	0.01	0.01	0.2	0.2	0.01	0.02	0.02	0.05	20	20	20	5	20	0.1	10	2	1
ANZECC - Livestock Trigger Values																									4000**		
Australian Drinking Water Guidelines - Health																50	3								1200		
Location ID	**Date**	**Sample Type**																									
GW01 (Pastoral)	**17/12/2020**	**Groundwater**	31	440	37	11	21	240			<0.01	<0.01	1.4	<0.2	<0.01	1.4	<0.02	1.4	<20	36	<20	170	36		930		<1
NED1-WB	**15/12/2022**	**Groundwater**	24	1100	160	18	48	640	<0.0050	0.065			16	16	0.30	<0.0050	<0.0050		<5.0	150	<5.0	260	150	6.3	2400	3700	
NED1-MB	**15/12/2022**	**Groundwater**	75	1700	430	27	100	1200	0.24	0.15			140	140	4.5	<0.10	<0.10		<5.0	540	<5.0	600	540	6.3	5000	6100	
NED1-MB	**8/02/2023**	**Groundwater**	45	1900	64	27	110	1300	0.012	0.17			80	80	23	<0.10	<0.10		<5.0	820	<5.0	550	820	7.3	4400	6700	
LD2-WB	**15/12/2022**	**Groundwater**	16	860	120	16	36	470	<0.0050	<0.050			0.54	0.29	0.028	0.24	0.016		<5.0	65	<5.0	190	65	6.4	1600	2800	
LD2-MB	**15/12/2022**	**Groundwater**	84	1500	220	18	86	1000	0.024	0.42			33	33	0.099	<0.25	<0.25		<5.0	650	<5.0	560	650	6.8	4300	5500	
LD2-MB	**8/02/2023**	**Groundwater**	57	1300	3.7	18	76	960	0.0067	0.13			21	21	2.5	<0.10	<0.10		<5.0	810	<5.0	460	810	7.3	3500	5100	

* Conservative value for sheep grazing

** Conservative value chosen for dairy cattle

			Total Recoverable Hydrocarbons												BTEXN						Other			MAH					PAH								
		Analyate	C6-C9	C10-C14	C15-C28	C29-C36	C10-C36 (Sum of total)	C6-C10	C6-C10 (F1 minus BTEX)	C10-C16	C10-C16 (F2 minus Naphthalene)	C16-C34	C34-C40	C10-C40 (Sum of total)	Benzene	Toluene	Ethylbenzene	Xylene Total	Xylene (m & p)	Xylene (o)	MTBE	Methane	Ethane	Total MAH	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	Isopropylbenzene	Styrene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b+j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L
		Limit of Reporting (LoR)	20	50	100	100	100	20	20	50	50	100	100	100	1	1	1	3	2	1	5	5	5	0.003	1	1	1	1	1	1	1	1	1	0.001	1	1
ANZECC - Livestock Trigger Values																																				
Australian Drinking Water Guidelines - Health																			6	6								3					0.1			
Location ID	**Date**	**Sample Type**																																		
GW01 (Pastoral)	**17/12/2020**	**Groundwater**	<20	<50	<100	<100	<100	<20	<20	<50	<50	<100	<100	<100	<1	<1	<1	<3	<2	<1				<0.003	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.001	<1	<1
NED1-WB	**15/12/2022**	**Groundwater**							<10		1000	170	<100		<1.0	<1.0	<1.0		<2.0	<1.0	-	<5.0	<5.0													
NED1-MB	**15/12/2022**	**Groundwater**							<100		2400	690	100		<10	<10	<10		<20	<10	-	<5.0	<5.0													
NED1-MB	**8/02/2023**	**Groundwater**							<10		3500	900	<100		<1.0	<1.0	<1.0		<2.0	<1.0	<1.0	3600	<5.0													
LD2-WB	**15/12/2022**	**Groundwater**							<10		<50	<100	<100		<1.0	<1.0	<1.0		<2.0	<1.0	-	<5.0	<5.0													
LD2-MB	**15/12/2022**	**Groundwater**							<100		2600	440	<100		<10	<10	<10		<20	<10	-	<5.0	<5.0													
LD2-MB	**8/02/2023**	**Groundwater**							<50		820	210	<100		<5.0	<5.0	<5.0		<10	<5.0	<5.0	3300	<5.0													

* Conservative value for sheep grazing

** Conservative value chosen for dairy cattle

			PAH									Chlorinated hydrocarbons																																			
		Analyate	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Pyrene	PAHs (Sum of total)	Chlorinated hydrocarbons EPAVic	Other chlorinated hydrocarbons EPAVic	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,2,3-trichloropropane	1,2-dichloroethane	1,2-dichloropropane	1,3-dichloropropane	Bromochloromethane	Bromodichloromethane	Bromoform	Carbon tetrachloride	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Dichloromethane	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Limit of Reporting (LoR)	1	1	1	1	1	1	1	1	1	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	1	1	1	1	1	1	1
ANZECC - Livestock Trigger Values																																													
Australian Drinking Water Guidelines - Health																																		10		4				10	
Location ID	Date	Sample Type																																									
GW01 (Pastoral)	17/12/2020	Groundwater	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
NED1-WB	15/12/2022	Groundwater						<1.0																																			
NED1-MB	15/12/2022	Groundwater						<10																																			
NED1-MB	8/02/2023	Groundwater						<1.0																																			
LD2-WB	15/12/2022	Groundwater						<1.0																																			
LD2-MB	15/12/2022	Groundwater						<10																																			
LD2-MB	8/02/2023	Groundwater						<5.0																																			

* Conservative value for sheep grazing

** Conservative value chosen for dairy cattle

		Analyte	Vinyl chloride
		Unit	µg/L
		Limit of Reporting (LoR)	1
ANZECC - Livestock Trigger Values			
Australian Drinking Water Guidelines - Health			
Location ID	Date	Sample Type	
GW01 (Pastoral)	17/12/2020	Groundwater	<1
NED1-WB	15/12/2022	Groundwater	
NED1-MB	15/12/2022	Groundwater	
NED1-MB	8/02/2023	Groundwater	
LD2-WB	15/12/2022	Groundwater	
LD2-MB	15/12/2022	Groundwater	
LD2-MB	8/02/2023	Groundwater	

* Conservative value for sheep grazing

** Conservative value chosen for dairy cattle

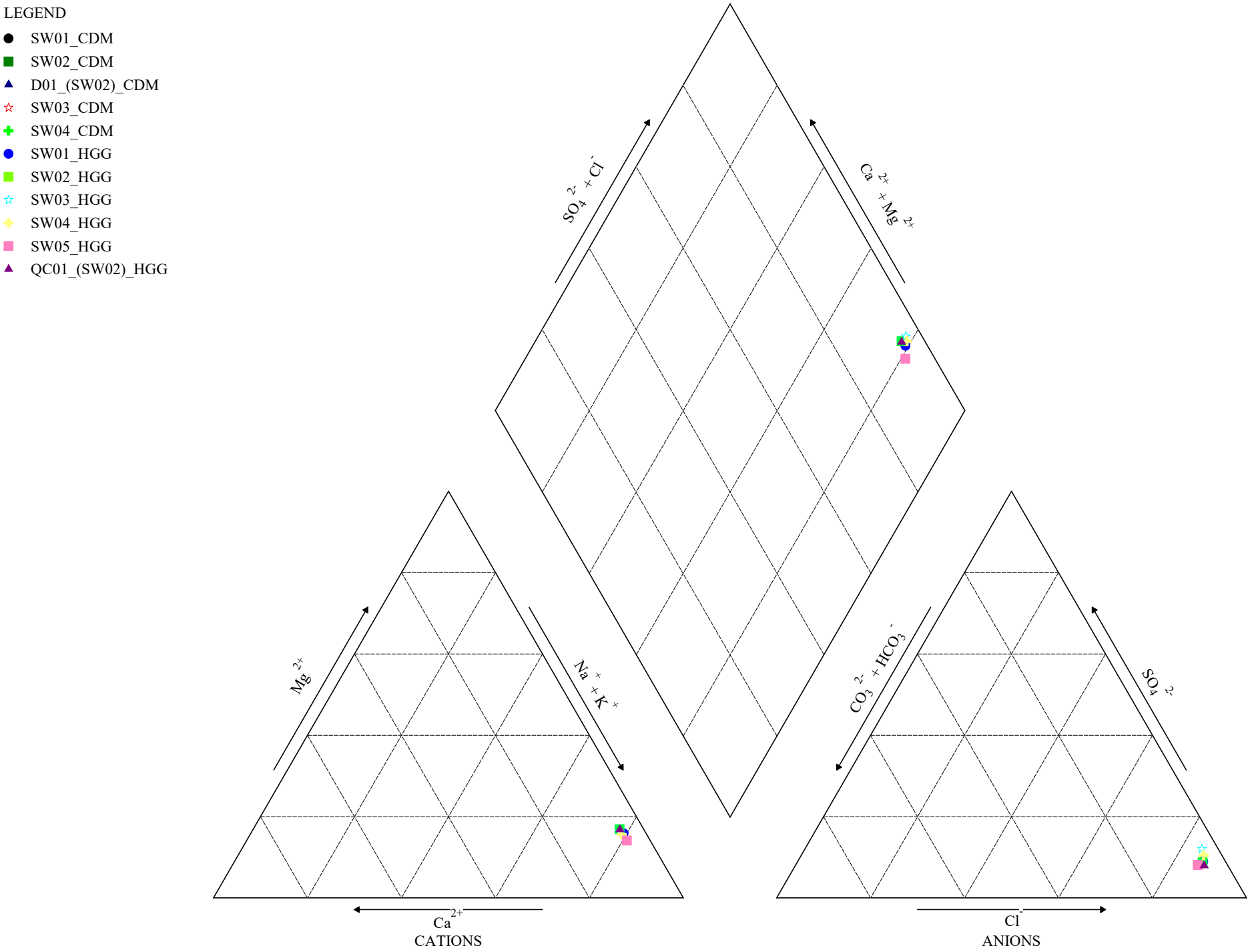
			Halogenated Benzenes						Halogenated Hydrocarbons					Solvents					Radiological										
		Analyate	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	4-chlorotoluene	Bromobenzene	Chlorobenzene	1,2-dibromoethane	Bromomethane	Dichlorodifluoromethane	Iodomethane	Trichlorofluoromethane	Methyl Ethyl Ketone	4-Methyl-2-pentanone	Acetone	Allyl chloride	Carbon disulfide	Gross Alpha	Gross Beta	Potassium	Potassium-40 1	Rest Beta 1	U-235	U-238	Th-232	Ra-226	Ra-228	Cs-137
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L	Bq.L-1	Bq.L-1	mg.L-1	Bq.L-1	Bq.L-1	Bq.L-1	Bq.L-1	Bq.L-1	Bq.L-1	Bq.L-1	Bq.L-1
		Limit of Reporting (LoR)	1	1	1	1	1	1	1	1	1	1	1	1	1	0.001	0.001	1	0.04	0.03	0.17	0.005	0.03	0.001	0.0011	0.003	15	3	0.7
ANZECC - Livestock Trigger Values																													
Australian Drinking Water Guidelines - Health																													
Location ID	**Date**	**Sample Type**																											
GW01 (Pastoral)	**17/12/2020**	**Groundwater**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.001	<0.001	<1	0.42	0.89	9.41	0.26	0.63	<0.001	0.0034	<0.003	<15	<3	<0.7
NED1-WB	**15/12/2022**	**Groundwater**																											
NED1-MB	**15/12/2022**	**Groundwater**																											
NED1-MB	**8/02/2023**	**Groundwater**																											
LD2-WB	**15/12/2022**	**Groundwater**																											
LD2-MB	**15/12/2022**	**Groundwater**																											
LD2-MB	**8/02/2023**	**Groundwater**																											

* Conservative value for sheep grazing

** Conservative value chosen for dairy cattle

APPENDIX D PIPER DIAGRAMS

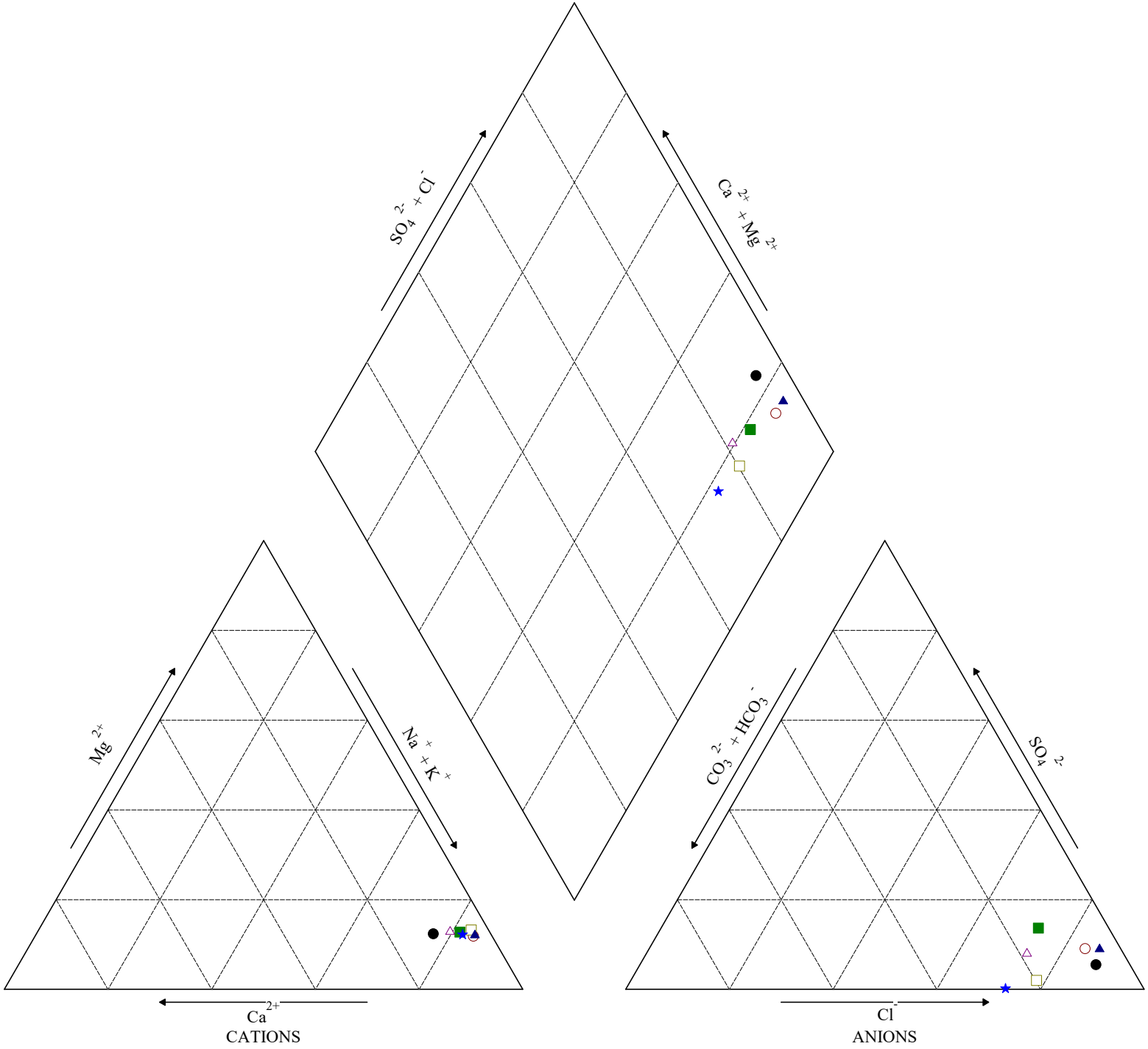
Surface Water Laboratory Results



Groundwater Laboratory Results

LEGEND

- ● Pastoral Bore (Kelly's)
- ○ NED1-WB (Dec 22)
- ■ NED1-MB (Dec 22)
- □ NED1-MB (Feb 23)
- ▲ LD2-WB (Dec 22)
- △ LD2-MB (Dec 22)
- ★ LD2-MB (Feb 23)



APPENDIX E IDENTIFIED GROUNDWATER BORES (BOM GROUNDWATER EXPLORER)

Table E1. Identified groundwater bores within 2 km of CPF and 500 m of drill pads and pipelines

Bore ID	Purpose	Status	Geology	Latitude	Longitude
70118138	Monitoring	Functioning	Yarragadee Formation	-29.17816	115.150437
70118139	Monitoring	Functioning	Yarragadee Formation	-29.172278	115.21842
70111667	Stock and Domestic	Unknown	Unknown	-29.206718	115.254891
70111678	Stock and Domestic	Unknown	Unknown	-29.213125	115.275786
70111788	Stock and Domestic	Unknown	Unknown	-29.198161	115.219762
70111666	Unknown	Unknown	Unknown	-29.19320	115.258278
70111684	Unknown	Unknown	Unknown	-29.217117	115.285131
70111685	Unknown	Unknown	Unknown	-29.183823	115.261665
70111686	Unknown	Unknown	Unknown	-29.171623	115.257491
70111782	Unknown	Unknown	Unknown	-29.203644	115.234467
70113929	Unknown	Unknown	Unknown	-29.17790	115.258834
70113930	Unknown	Unknown	Unknown	-29.180761	115.258642

Bureau of Meteorology (BOM), 2023a, Australian Groundwater Explorer: Water Information, Accessed between 01/09/2023 and 27/11/2023.

APPENDIX F GROUNDWATER DEPENDENT ECOSYSTEMS

Appendix F. Groundwater Dependent Ecosystems – BoM Atlas

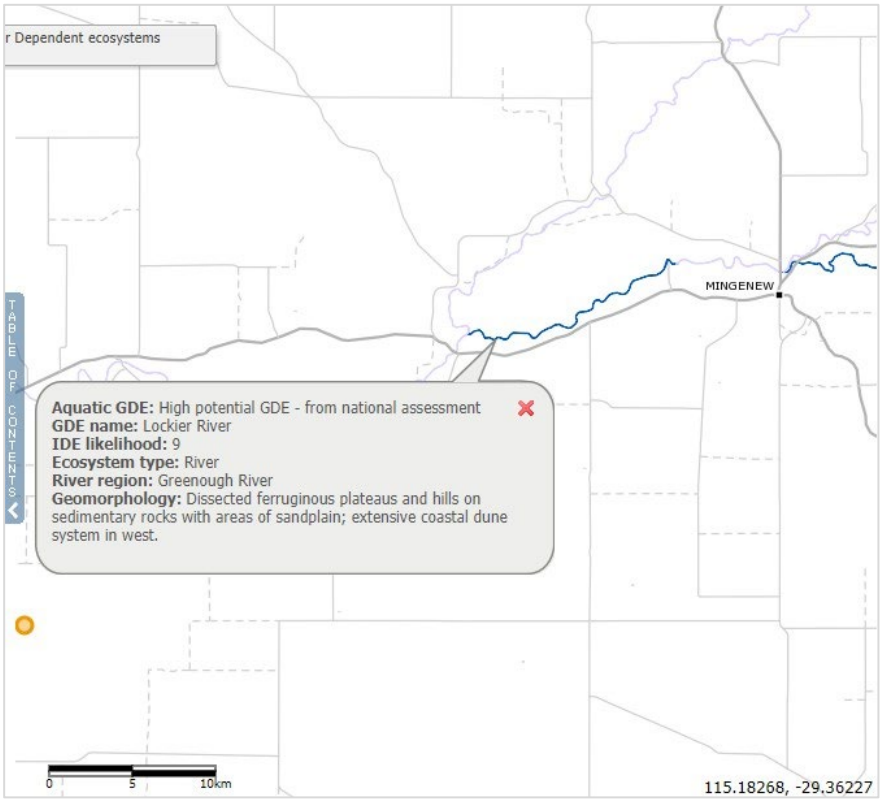


Figure F1. High Potential GDE – Lockier River

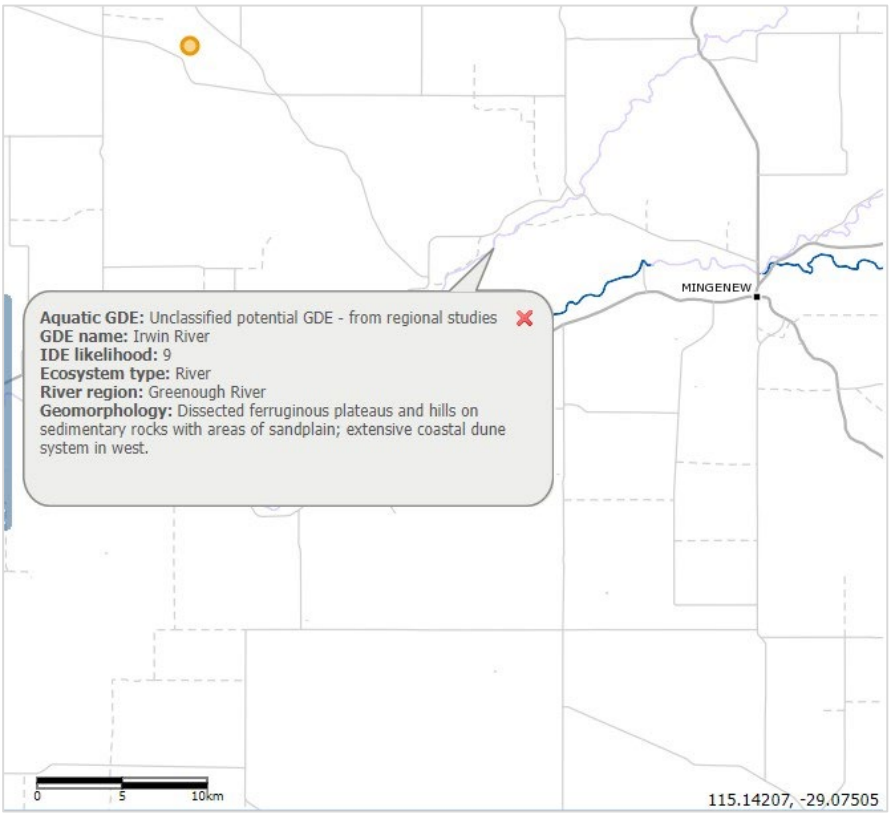


Figure F2. Unclassified Potential GDE – Irwin River

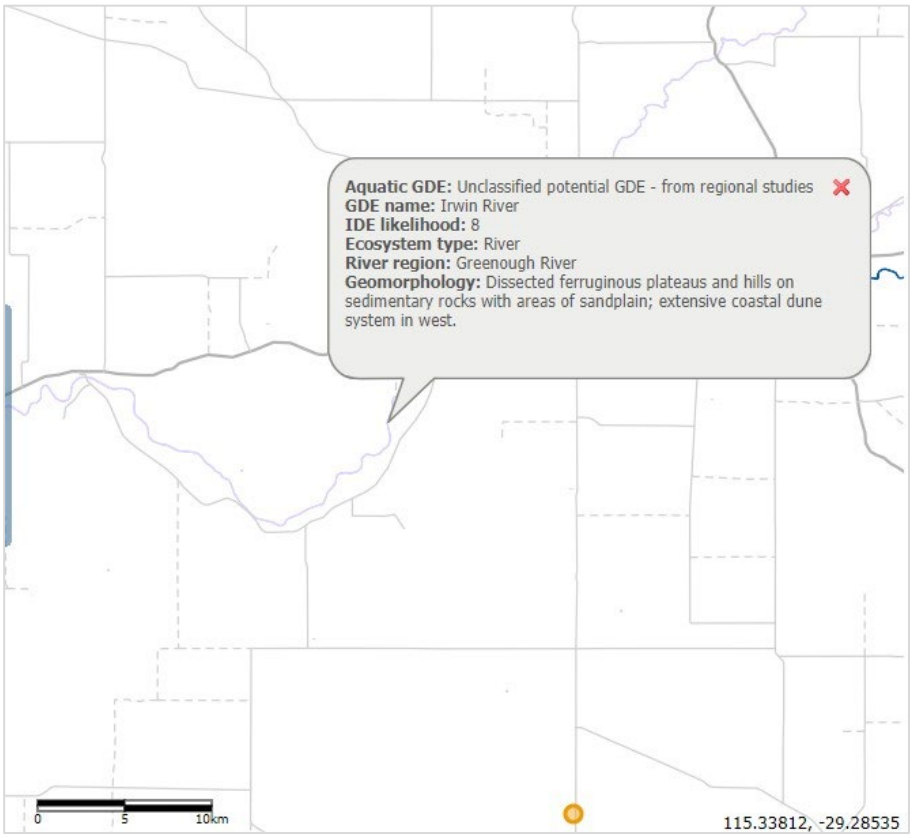


Figure F3. Unclassified Potential GDE – Irwin River

HYDRO
GEOCHEM
GROUP

GREENROAD GROUP