
Humbolt Creek (March 2025)

Comet Ridge Limited

DCCEEW IESC Advice Response
Mahalo North PL 1128

EPBC 2023/09689

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

Abbreviation	Definition
ANZECC	Australian and New Zealand Environment and Conservation Council
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CSG	Coal Seam Gas
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EA	Environmental Authority
EC	Electrical Conductivity
EP Act	Environmental Protection Act 1994
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESA	Environmentally Sensitive Area
GCF	Gas Compression Facility
GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse Gas
GL	Gigalitre
HSE	Health, Safety and Environment
IESC	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development
LOR	Limit of Reporting
MAH	Monocyclic Aromatic Hydrocarbons
MODFLOW-USG	Modular Three-Dimensional Finite-Difference Groundwater Flow Model
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
OGIA	Office of Groundwater Impact Assessment
PAH	Polycyclic Aromatic Hydrocarbons
PL	Petroleum Lease
QA/QC	Quality Assurance / Quality Control
RCP	Rewan Connectivity Study
RL	Reduced Level
SWCD	Surface Water Catchment Dam
SW/GW	Surface Water / Groundwater
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids
WMMP	Water Monitoring and Management Plan

1 CONTEXT

The Mahalo North Coal Seam Gas Project (the 'project') is proposed by Comet Ridge Mahalo North Pty Ltd (the proponent) in the Bowen Basin, Queensland. The project is located 45 kilometres north of Rolleston and 70 km southeast of Emerald, located on the PL 1128 application (the PL) and covering an area of 14,000 ha. The project will include the construction, decommissioning and rehabilitation of 68 CSG production wells (34 vertical and 34 lateral) and supporting infrastructure, including water- and gas-gathering pipelines, a gas compression facility (GCF) and a water treatment plant.

On 20 October 2023, the proponent lodged a Referral application to the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the project. On 19 March 2024, the Referral application was decided by DCCEEW, with the project deemed a controlled action (EPBC 2023/09689), for the following relevant controlling provisions:

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

In the Referral decision, DCCEEW advised that the project is to be assessed by preliminary documentation under the EPBC Act. On 6 December 2024, the proponent lodged the preliminary documentation to DCCEEW for assessment. On 16 January 2025, DCCEEW requested that the Independent Expert Scientific Committee on Unconventional Gas Development and Large Coal Mining Development (the IESC) provide comment on the project.

The IESC provides independent, expert, scientific advice to the Australian and State government regulators on the potential impacts of unconventional gas and large coal mining proposals on water resources. The advice is designed to ensure that decisions by regulators are informed by the best available science. The IESC's functions are prescribed in Section 505D of the EPBC Act.

The IESC were requested to comment on the following questions:

Question 1:

Can the Committee provide comment on whether the information provided in the PD, particularly the baseline and modelled data, and the conclusions drawn by the proponent, are sufficient to assess the project's impacts on surface and groundwater resources, GDEs and other third-party users, and cumulative impacts with other proposed and existing projects?

a. *Specifically, is the baseline monitoring information provided by the proponent sufficient to provide confidence in the accuracy of the groundwater conceptualisation model given it does not meet the minimum of 2 years requested in the PD-RFI?*
b. *Does the groundwater conceptualisation and modelling adequately represent the Rewan Formation extent and possible variability in hydraulic properties?*
c. *Could groundwater drawdown propagate to the surface and impact potential White-throated snapping turtle refugial habitat or riparian vegetation?*

Question 2:

Can the Committee identify and discuss what, if any, additional work is needed to inform the understanding and assessment of impacts on surface and groundwater resources, and to develop a suitable management and monitoring program?

Question 3:

Can the Committee provide comment on the adequacy of the proposed mitigation, management and monitoring measures? Does the Committee consider that any additional measures are needed to remain within the projected levels of impact or reduce risks to groundwater resources and associated users, considering the project impacts alone as well as cumulative impacts with other proposed and existing projects?

a. *More specifically, are the proposed future monitoring and management plans adequate? If not, where should additional effort be focussed?*

On 11 March 2025, the IESC responded to DCCEEW with 24 comments. This document provides a response to each of the IESC's 24 comments. The preliminary documentation has been updated to incorporate this response to DCCEEW.

2 GENERAL MATTERS

2.1 Response Advice Item 1

1. *The information in the project documentation provided is limited. The hydraulic properties and nature of the Rewan Formation are key to restricting the propagation of CSG drawdown to the overlying aquifers. However, the current baseline data, hydraulic testing methodologies, analytical approaches, and conceptual presentations are insufficient to comprehensively characterise the Rewan Formation across the project area. This inadequacy in data and analysis limits confidence in the assessment of the Formation's effectiveness as a hydraulic barrier, contributing to uncertainties in predicting the potential impacts of CSG activities on ground and surface water resources, groundwater-dependent ecosystems (GDEs) and other third-party users, as well as potential cumulative impacts.*

To characterise the Rewan Formation across the project area, a targeted program of hydrogeological investigations is being developed as part of the Water Management and Monitoring Plan, prepared by Terra Sana Consultants, 2025 (herein referred as WMMP 2025) and additional details have been provided in the Rewan Connectivity Plan (RCP) prepared by Terra Sana Consultants 2025 (herein referred as RCP, 2025).

This includes installation of multi-level nested piezometer nests intersecting the Bandanna Formation, Rewan Formation, and overlying Quaternary and Tertiary aquifers, particularly at locations where geological structures (e.g. faults, Rewan sub cropping areas) may influence vertical connectivity (refer to Section 8.5 WMMP 2025).

Additional aquifer testing will be conducted within the Rewan Formation to derive in-situ hydraulic conductivity, storativity, and vertical anisotropy with downhole packer tests and slug tests at selected intervals. These tests will be supported by laboratory permeability analysis of recovered core material, wireline logging data, and geophysical profiling.

Hydrochemical and isotopic sampling will be used to fingerprint groundwater age and chemistry to evaluate hydraulic separation between aquifers and identify recharge and flow pathways.

Results will support an updated Hydrogeological Conceptual Model (HCM), improve aquifer vertical connectivity assessments, and provide the necessary parameters for revising and recalibrating the site-specific numerical groundwater flow model.

This program is designed to increase confidence in the role of the Rewan Formation as a confining unit and to reduce uncertainty in predictions of potential drawdown propagation and associated risks to groundwater-dependent values and users.

2.2 Response Advice Item 2

2. *Paragraphs below provide further details of these limitations and suggest additional work to inform the understanding and assessment of potential impacts on surface and groundwater resources, in accordance with the IESC Information Guidelines (IESC 2024), and to develop a suitable management and monitoring program.*

An up-dated WMMP 2025 has been developed for the project to address potential impacts on surface and groundwater resources.

2.3 Response Advice Item 3

3. *After this additional work has been completed, the information should be incorporated into an evidence-based ecohydrological conceptual model. This can be used to develop one or more impact pathway diagrams (Commonwealth of Australia 2024) to describe the ecological implications of all potential impact processes, including groundwater drawdown and seepage, spills, leaks or overtopping of produced water and brine storages.*

An evidence-based ecohydrological conceptual model (herein referred as the conceptual model) (prepared by Comet Ridge 2025) has been prepared to synthesise geological, hydrogeological, hydrological, and ecological data and describe key aquifer relationships, recharge processes, and groundwater–surface water interactions.

The conceptual model refines the impact pathway diagrams in accordance with the IESC Information Guidelines (2024) methodologies. These conceptual models describes cause–effect linkages between project activities and potential ecological consequences, including:

- Groundwater drawdown and its effects on surface water baseflow;
- Potential vertical seepage through confining units; and
- Risks of spills, leaks, or overtopping of produced water and brine storages and subsequent contamination of soil, surface water, or shallow aquifers.

2.4 Response Advice Item 4

4. *Once the proponent has conducted further assessment of potential impacts of the project as detailed below, an assessment of cumulative impacts from the project and surrounding proposed and existing projects should be provided.*

A Cumulative Impact Assessment (CIA) has been provided in Section 9, WMMP 2025. Following the completion of the hydrogeological investigations, additional baseline monitoring, and data integration activities, the CIA will be updated and refined in accordance with the DCCEEW (2022) Significant Impact Guidelines.

The updated CIA will evaluate the combined effects of the Mahalo North Project in the context of:

- Existing and proposed coal seam gas (CSG) developments;
- Adjacent open-cut coal mining activities; and
- Regional agricultural groundwater and surface water usage.

The updated CIA will be underpinned by the revised site-specific numerical groundwater model, incorporating:

- Updated aquifer parameters and recharge assumptions;
- Refined drawdown predictions across relevant timeframes; and
- Improved representation of aquifer connectivity and fault influence.

The updated CIA will assess the spatial and temporal overlap of stressors—such as groundwater drawdown, changes in surface water baseflow, and brine or produced water migration—and their potential to result in additive, synergistic, or threshold-exceeding impacts to environmental values, including:

- Third-party groundwater users, such as landholder bores;
- Surface water ecosystems, including the Comet River and Humboldt Creek; and
- Groundwater-dependent ecosystems (GDEs) and EPBC Act–listed species reliant on refugial pools or shallow alluvium.

The results of the CIA will inform adaptive project design, monitoring, and Trigger Action Response Plans (TARPs). Where elevated risk is identified, mitigation and monitoring measures will be expanded or intensified to ensure the protection of environmental values and compliance with regulatory requirements under the EPBC Act.

3 GROUNDWATER

3.1 Response Advice Item 5

5. *The information in the project documentation is insufficient to support the hydrogeological conceptualisation, so the reliability of the modelled results and the conclusions cannot yet be determined. The critical issue is the proponent's assertion that there is no hydraulic connection between the coals and the Tertiary aquifer, which determines whether groundwater drawdown can propagate to the surface. Although the Rewan Formation and coal interburden are likely to have very low vertical hydraulic conductivity, this needs to be measured. The baseline data do not convincingly demonstrate the large differences in potentiometric heads between the deeper and upper aquifers that would indicate little or no connectivity, particularly where the coal measures subcrop beneath the Tertiary aquifer.*

The WMMP 2025 in section 8.5 summarise the additional investigation proposed to assess the aquifers interconnectivity. This investigation includes the installation of four (4) nested piezometer clusters (M1 to M4) designed to monitor key hydrostratigraphic units:

- Bandanna Formation (CSG target zone),
- Rewan Formation (interpreted regional aquitard),
- Tertiary Basalt, and
- Quaternary Alluvium.

The nested bore design supports direct assessment of vertical hydraulic gradients, head differentials, and connectivity risks. The locations are show in **Figure 1** and were selected to reduce conceptual uncertainty in geologically sensitive areas, as follows:

1. M1 – Western Fault Zone (Arcturus Fault)
   Installed proximal to the Arcturus Fault, a major structural feature that may compromise the integrity of the Rewan aquitard. This cluster is intended to assess the

potential for fault-assisted vertical hydraulic connectivity between the Bandanna coals and shallower aquifers.

2. M2 – Southern Reference Site
   Located in the southern section of the PL, where sedimentary facies transitions within the Rewan Formation may influence vertical permeability. This site provides a comparative baseline to evaluate natural stratigraphic separation in the absence of structural complexity.
3. M3 – Subcrop Transition Zone
   Positioned where the Rewan Formation subcrops beneath the Tertiary strata, offering a direct opportunity to assess vertical gradients and evaluate the integrity of the aquitard system where protective layering is potentially thin or absent.
4. M4 – Alluvial Interface Zone
   Situated in the southeast, near low-lying alluvial channels and the Bandanna hydraulic axis, this cluster will support assessment of lateral connectivity between deep aquifers and alluvium potentially connected to surface water systems.

These bore clusters enable:

- Direct measurement of potentiometric heads across multiple aquifers;
- Quantification of vertical hydraulic gradients under baseline and operational conditions;
- Site-specific testing of vertical hydraulic conductivity (K_v), using methods such as:
    - Downhole geophysics,
    - Straddle-packer permeability testing,
    - Time-series groundwater level response monitoring; and
- Validation or refinement of the hydrogeological conceptual model, based on empirical data.

The outcomes of this monitoring program will directly inform the recalibration of the site-specific MODFLOW-USG model, support improved uncertainty analysis, and enable integration of findings into the Cumulative Impact Assessment (see Section 9, WMMP 2025).

This approach reflects best-practice hydrogeological characterisation and responds directly to the IESC's advice by providing robust, defensible evidence on inter-aquifer connectivity. It ensures that drawdown predictions and impact pathways are grounded in observed site conditions and that environmental risks to GDEs, surface waters, and third-party users are rigorously assessed.

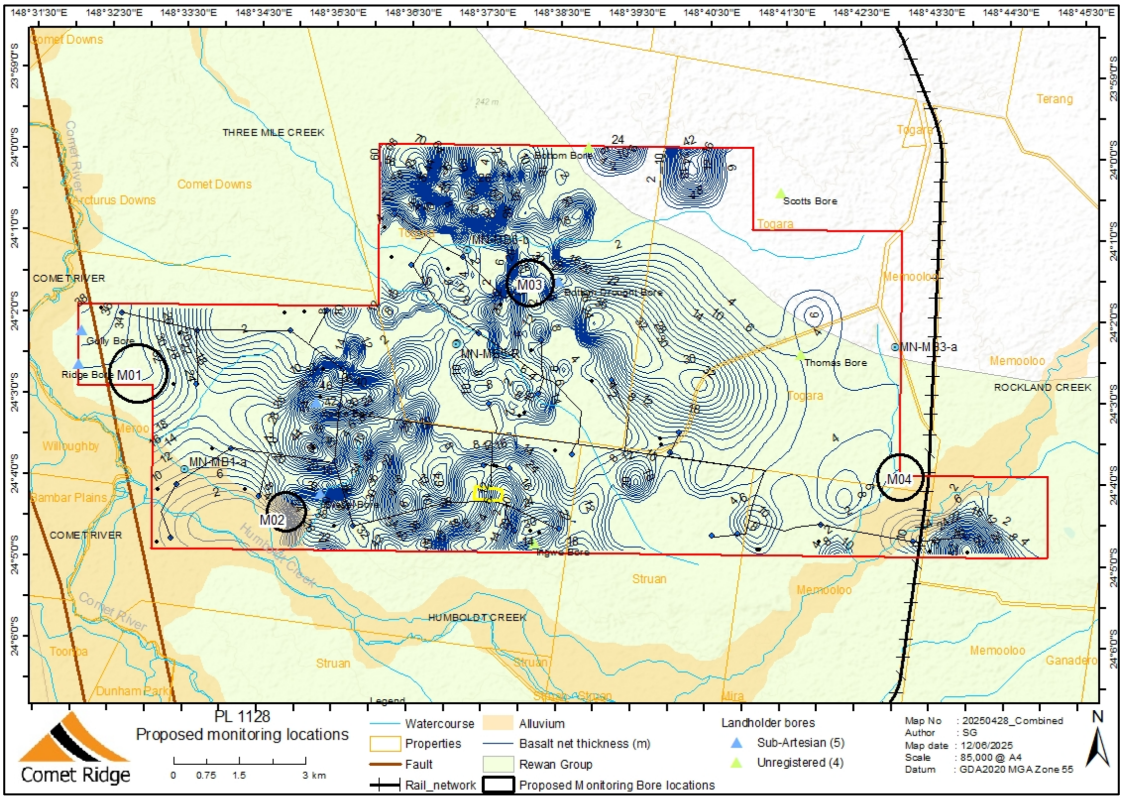

Figure 1: Existing Monitoring Locations and Proposed Nested Piezometer Locations

3.2 Response Advice Item 6

6. *The assumption that the Tertiary aquifer is hydraulically disconnected from the Bandanna Formation is supported by limited evidence, although substantial reliance is placed upon this disconnection in claiming there will be minimal impacts to surface-expression GDEs (RDM Hydro 2024a, pp. 31). Multiple lines of evidence are necessary to demonstrate a disconnection, such as information on well logs, permeability testing and hydrochemical and isotopic data. Nested observation piezometers should be installed to measure the difference in potentiometric head between the Tertiary aquifer and the Bandanna Formation. These piezometers should be located where there may be a connection or where such a connection would have adverse impacts: specifically, across geological faults (Murray and Power 2021), within the subcropping area of the Bandanna Formation, and the area closest to Comet Creek. Potentiometric head maps and depth-to-watertable maps should be revised based on the new observation data.*

The WMMP 2025 in section 8.5, outlines a robust site-specific investigation to collect multiple lines of evidence demonstrating the hydraulic characteristics of the Rewan Formation and the connectivity behaviour between the target coal seams and shallow groundwater systems.

A multi-line evidence approach is being adopted to robustly assess any potential vertical connectivity. The field work will take place within the boundaries of the PL and target hydrogeological and geological features present (faults and Rewan sub cropping). As the Arcturus fault is not interpreted to underly the PL, the M01 bore nest will collect data that will be used to inform any assessment of the fault’s hydraulic relationship with the project activities.

The site-specific investigation will include:

1. Installation of nested observation piezometers across targeted locations, including fault zones, areas where the Bandanna Formation subcrops beneath the Tertiary strata, and the vicinity of Comet Creek. These bores are designed to monitor potentiometric heads across multiple hydrostratigraphic units simultaneously.
2. Conducting in-situ hydraulic conductivity testing (e.g. slug tests, packer tests) and collecting core samples from select intervals of the Rewan Formation to quantify its role as a confining layer.
3. Acquisition and interpretation of well logs and borehole geophysical data to evaluate the Rewan's lithology, strata thickness, continuity, and identify any continuous structural features that may be correlated across boreholes or identified within existing geophysical data.
4. Collection of hydrochemical and isotopic data to fingerprint groundwater sources, differentiate recharge signatures, and assess mixing or connectivity between aquifers.

Potentiometric head data will be incorporated into updated groundwater contour maps, which will support validation or revision of the current conceptual model. This dataset will also inform the recalibration of the site-specific numerical groundwater flow model and underpin the development of defensible risk assessments for potential impacts to sensitive receptors (refer to Section 5.1 WMMP 2025).

3.3 Response Advice Item 7

7. *The baseline groundwater data are inadequate in terms of the locations, monitored aquifers and duration. They are insufficient to justify the model conceptualisation and are unable to support calibration of the model. A more complete set of groundwater monitoring data is required.*

   a. *Groundwater monitoring is limited to four active shallow bores which have only been sampled once, in August 2024 (RDM Hydro 2024b, p. 2). Additional piezometers that access and monitor all relevant geological formations are required to develop an adequate baseline (Paragraph 6).*

   b. *The proponent proposes to undertake additional groundwater monitoring until two years of baseline data have been collected. Details of this proposed monitoring (e.g. frequency, analytes) are unclear. Water level and water quality data (including metals and nutrients) should be collected across an adequate spatial and temporal coverage to capture seasonality and flow trends. Baseline data should be collected prior to the commencement of the action, and detailed plans should be developed for monitoring groundwater levels and quality for the duration of and post operations (Paragraph 20).*

A detailed monitoring plan has been included in Section 8 of the WMMP 2025 and will guide pre-operational, operational, and post-operational phases. This monitoring plan will provide spatially and temporally representative data across all relevant hydrostratigraphic units—specifically the Bandanna Formation, Rewan Formation, Tertiary Basalt, and Quaternary Alluvium.

Additional multi-level piezometer clusters will be installed across hydrogeologically and ecologically sensitive zones, including areas near landholder bores, Comet Creek, and structural features such as Arcturus Fault and Rewan subcrop margins. These bores are designed to continuously monitor water levels and sample groundwater from discrete depths to improve vertical resolution of aquifer response.

The detailed monitoring plan (Section 8 of the WMMP) will be consistent with IESC (2024) and ANZG (2018) guidance. This detailed monitoring plan is designed to capture seasonal variability and identify trends that may inform flow direction, recharge processes, aquifers interconnectivity, and background water quality. The collected dataset will support improved conceptualisation, model calibration and validation, and the development of site-specific trigger values and risk-based thresholds.

3.4 Response Advice Item 8

8. *The stratigraphic and hydrostratigraphic conceptualisation presented is a combination of the Queensland Office of Groundwater Impact Assessment (OGIA)'s Underground Water Impact Report (UWIR) regional model and the Comet Ridge geological model, which was not provided (RDM Hydro 2024a, pp. 29). Further information on the Comet Ridge geological model (the static reservoir model) should be provided, including cross-sections and maps showing the data used to develop it, so that the reliability can be assessed spatially.*

The Comet Ridge geological model is comprised of proprietary data and is commercial in confidence. The geological model was built from nearly 1,000 exploration boreholes drilled on an approximately 1km x 1km grid. Two cross-sections from the geological model are presented in the Groundwater Impact Assessment Report (RDM Hydro, 2024, pp 29).

Figure 2 shows a geological cross-section from the geological model in a down-dip profile. The section identifies the subcrop of the Rewan Formation at the eastern edge of the PL as well as the thickness of the Rewan across the entire PLA. The Rewan is approximately 25 m thick at the subcrop and increases to approximately 200 m thick across the development area of the PL. At the northern extent of CSG development The Rewan Formation is approximately 100 m thick.

The model will be updated with the results of the connectivity investigations outlined in the RCP 2025 prepared by Terra Sana Consultants (2025a) to validate the existing Comet Ridge geological model and increase the understanding of the extent and thickness of the Rewan from the subcrop to the western boundary of the PL.

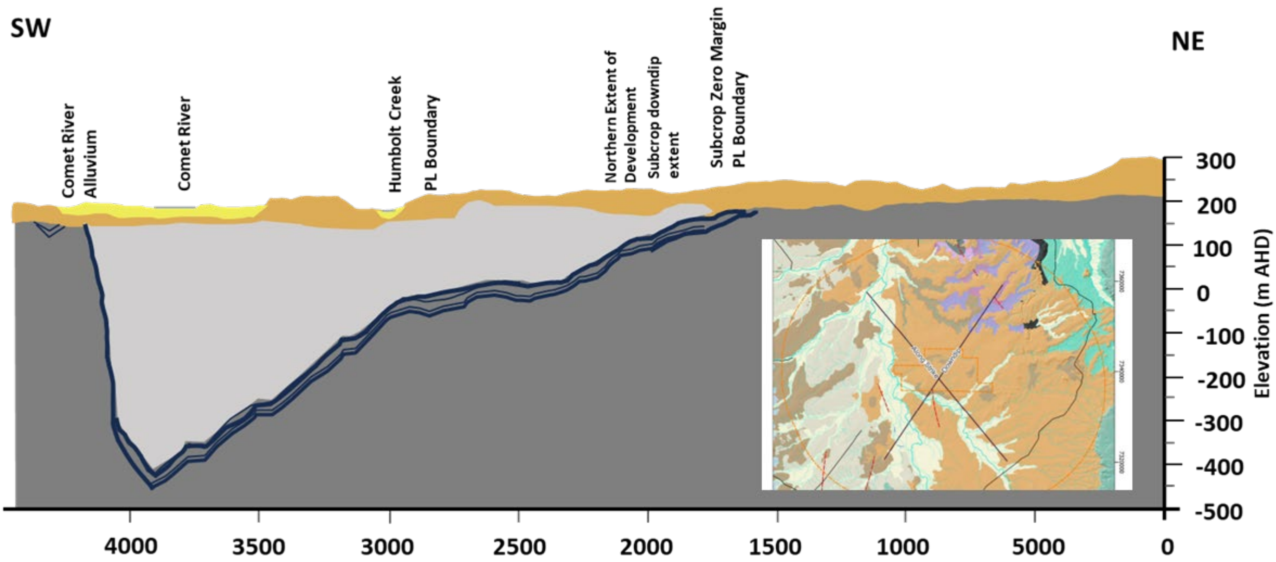

Figure 2: Geological Cross-Section from Southwest to Northeast (Down-dip)

3.5 Response Advice Item 9

9. *Groundwater drawdown impacts have been estimated using OGIA's UWIR regional model (RDM Hydro 2024a, p. 90), and a site-specific model heavily derived from OGIA's data (RDM Hydro 2024a, p. 101). The regional OGIA model is based on limited project site data and its grid spacing of 1,500 m means that its results must be interpreted with caution for features at that scale or smaller. It does not simulate the alluvial groundwater system in the project area. The site-specific model conceptualisation and calibration are severely hampered by the scarcity of groundwater data (Terra Sana 2023, pp. 20 - 21) and its uncertainty analysis does not consider the most critical parameters. The site-specific modelling may be more fundamentally flawed as it includes an attempt to directly simulate a dual-phase well test in a single-phase modelling code. The Single Well Model History Matching appears to use the recorded pressure data from the Mahalo North 1 well test as both a calibration input and a prediction. It also represents horizontal well laterals using MODFLOW drains, without mention of correcting for the focused flow to the laterals. OGIA apply cell-to-cell (Peaceman 1978) correction to vertical wells.*

   a. *Further work is required in collecting site-specific data to establish hydrological parameters to support drawdown modelling. Once additional baseline data are collected on site (Paragraphs 6 and 7), the hydrological conceptualisation and modelling should be updated to reflect this new information (at a scale appropriate for the project area, and including an improved calibration and a cumulative impact assessment).*

   b. *If the Tertiary and alluvial aquifers are demonstrated to be connected to deeper groundwater in the Bandanna Formation, then the alluvial aquifer and groundwater-surface water interactions along Humbolt Creek and the Comet River will need to be characterised. If perching of groundwater occurs, an evidence-based explanation of why it occurs should be given. Additional site-specific modelling of riparian areas and other potential GDEs would be required to better understand potential impacts from the project. This modelling should occur at a scale suitable for predicting impacts to individual GDEs and should represent the connectivity between the alluvial* *groundwater system, underlying groundwater systems and overlying surface waters and GDEs.*

To assess potential groundwater drawdown impacts, both the OGIA regional model (RDM Hydro, 2024, p. 90) and a high-resolution, site-specific numerical model (Terra Sana, 2023) have been employed. While the OGIA (2023) UWIR model provides a useful regional context, its grid resolution (1,500 m) and exclusion of the alluvial aquifer limit its applicability for predicting local-scale impacts. As such, a site-specific model has been developed to overcome these limitations and better reflect local hydrogeological conditions.

Enhanced Geological Representation

The site-specific numerical model (Terra Sana, 2023) is grounded in the Comet Ridge geological model and integrates seamlessly into the regional geological framework. It explicitly represents each of the Bandanna coal seams and intervening interburden as discrete layers, in contrast to the OGIA UWIR model, which simplifies the Bandanna Formation into two aggregated numerical layers. This refined layering is critical for accurate of seam-specific drawdown and potential for aquifer interactions.

The site-specific numerical model (Terra Sana, 2023) grid resolution of 250 m within the project area provides 36 cells for every OGIA UWIR model cell, enabling more detailed representation of geological heterogeneity, surface water features, and potential connectivity with the Quaternary Alluvium, which is not discretely simulated in the OGIA UWIR model.

Desaturation Modelling

The site-specific numerical model (Terra Sana, 2023) employs MODFLOW-USG and a modified van Genuchten in its simulations. While it does not implement dual-phase gas-water modelling, it incorporates gas-related water desaturation effects via a relative permeability function, consistent with methods recommended by Herckenrath et al. (2015). This approach captures the reduced hydraulic conductivity due to gas displacement, providing conservative yet realistic estimates of drawdown during CSG operations. Validation studies confirm that this technique yields results comparable to dual-phase simulations using ECLIPSE (Terra Sana Consultants, 2023; Section 8.7, p. 16).

Calibration and History Matching

Hydraulic properties of the Bandanna Coals were estimated using a single-well calibration model based on the Mahalo-1 Pilot well test data. The site-specific numerical model (Terra Sana, 2023) utilised grid cells as small as 3 m along the lateral pilot well to ensure detailed simulation of water pressure behaviour. The calibrated parameters were subsequently incorporated into the site-specific numerical model (Terra Sana, 2023) to simulate production scenarios.

While the IESC raised concerns regarding the use of pressure data for both calibration and prediction, it is noted that this approach was limited to the local-scale calibration model and not applied in predictive simulations. Model validation steps, including comparison with independent monitoring data, are detailed in the Mahalo North Groundwater Modelling Report (2023).

Peaceman Correction Justification

The OGIA UWIR model applies a Peaceman correction to account for coarse grid effects when simulating vertical wells. However, in the site-specific numerical model (Terra Sana, 2023), horizontal well laterals are explicitly represented within individual coal seams at higher resolution. Given the explicit layering and placement of wells, the Peaceman correction is not applicable and was therefore excluded. This omission results in conservatively higher drawdown estimates, particularly in zones surrounding the wells, aligning with precautionary principles for environmental impact prediction.

Addressing Uncertainty and Data Gaps

While limitations in site-specific baseline data were acknowledged (Terra Sana 2023), the site-specific numerical model has undergone extensive sensitivity and uncertainty analysis , with specific scenarios (Uncertainty Cases 1, 5, 6, and 9) designed to explore the influence of key hydrostratigraphic uncertainties, including:

- Fault conductivity (e.g. Arcturus Fault as a potential vertical conduit),
- Alluvium–Bandanna connectivity assumptions.

These analyses demonstrated that even under reasonably conservative parameter combinations, predicted drawdown in the alluvial and Tertiary units remained below the 0.2 m threshold.

To address the uncertainty around vertical connectivity between the Tertiary / alluvial aquifers and the deeper Bandanna Coal seams—several components of the site-specific numerical model's uncertainty analysis were designed to explore this issue (Terra Sana 2023). In the site-specific numerical model, the Arcturus Fault was represented as a 250-metre-wide zone within the Rewan Formation, effectively creating a potential hydraulic conduit between the underlying Bandanna Coals and the overlying surficial aquifers. The hydraulic properties of this fault zone were varied in the uncertainty analyses to assess its influence on potential drawdown within the alluvial aquifers. Specifically, Uncertainty Cases 1, 5, 6, and 9 examined various combinations of hydraulic parameters for the fault zone and adjacent strata—both above and below—that could plausibly increase drawdown in the alluvium (Terra Sana 2023). None of these scenarios, within the tested parameter ranges, resulted in drawdown exceeding the 0.2-metre threshold in either the alluvial or Tertiary units located above the Arcturus Fault.

4 SURFACE WATER

4.1 Response Advice Item 10

10. *The surface water assessment was limited. The proponent states that "Neither model predicted drawdown in excess of 0.2 m to the water table. There is therefore unlikely to be reduction in baseflow associated with CSG production by the Project, and hence the Project would not change the flow regime of surface water flows" (Epic 2024a, p. 120). However, due to the limited conceptualisation and baseline data of the groundwater system (Paragraph 6), the potential impact pathway of groundwater drawdown changing the frequency of ecologically relevant flow pulses and/or durations and timing of zero flow periods within Comet River and Humboldt Creek cannot be sufficiently assessed. In ephemeral streams, flow duration and timing are crucial to many aquatic animals, especially invertebrates, some fish and amphibians (Datry et al. 2017). The proponent should assess*

whether drawdown may reduce flow duration and/or alter its timing in these streams.

The Section 8.6 of WMMP 2025 proposes a Surface Water/Groundwater (SW/GW) connectivity study. This program will improve the understanding of surface water/groundwater interactions as well as building on the existing understanding of the flow regime of these ephemeral streams and the persistence of refugial pools during periods of low or no flow.

Additionally, a hydrological assessment will be undertaken to quantify whether predicted changes in groundwater levels could lead to:

- A reduction in baseflow contribution to these streams,
- Shortening or delays in flow periods during seasonal runoff events,
- Prolongation of zero-flow periods in the dry season.

This hydrological assessment will utilise the improved hydrogeological conceptualisation, historical streamflow data (where available), and expert ecological input. The findings will inform risk characterisation for aquatic ecosystems and be integrated into monitoring design and mitigation strategies. Should modelling indicate a material risk to flow regime characteristics, the proponent will develop and implement targeted TARPs, including early-warning groundwater thresholds and ecological flow monitoring to ensure the protection of flow-dependent ecological values.

4.2 Response Advice Item 11

11. *Construction of roads and gathering lines is likely to impact on surface drainage lines and overland runoff patterns in this flat landscape. Although construction of roads and gathering lines is discussed (Epic 2024a, p. 63), limited baseline data on flow regimes for local watercourses are used to support the conclusion that the project will not cause changes to surface flow regime. Baseline data of the flow regime of surface water features in and near the project area should be collected to understand ecologically important flow components (Paragraph 10) and inform assessment of potential impacts from construction and other activities.*

Section 4.1 of the Aquatic Values Assessment report (DPM Environmental 2023) identified the waterways within the Project area as ‘drainage features’. The landscape within the project area mainly consists of blade ploughed grazing pastures, sown to buffle grass.

Construction of access tracks and gathering lines will be staged over a 7-10 year period, with rehabilitation of gathering lines commencing immediately after the trenching has been backfilled.

Erosion and sediment control methods will be deployed (as per the Comet Ridge Environmental Management Plan). The WMMP 2025 includes on-going monitoring of surface water locations. TARPs as detailed in the WMMP 2025 will be implemented if any project-related impact on surface water values is identified.

4.3 Response Advice Item 12

12. *Limited baseline data for water quality are presented in the CSG Management Plan (RDM Hydro 2023). Prior to commencement of the proposed project, the proponent should collect site-specific water quality data during periods of flow to determine potential impacts of any future spills (see Paragraph 13).*

An updated WMMP has been prepared to directly address the IESC's recommendation for improved site-specific surface water quality data collection during periods of flow. This updated plan includes a targeted surface water monitoring and stormwater management program specifically designed to evaluate the potential impacts of future spills and surface runoff on downstream receptors.

As detailed in Section 8.7 and 8.8 of the WMMP 2025, the surface water quality monitoring and stormwater management program includes the following key features:

Flow-Condition Monitoring

Sampling will be undertaken during flow conditions, including after storm events and during seasonal runoff, to capture representative water quality data under conditions most relevant to contaminant mobilisation and transport. This responds directly to the IESC's request for baseline data that reflects discharge-relevant scenarios.

Monitoring Locations

Monitoring will be conducted at strategic downstream locations that could be affected by operational discharges or spills:

- Comet River (R11),
- Humboldt Creek (R4),
- Rockland Creek (R9).
- Surface Water Catchment Dam (SWCD): Positioned strategically to intercept runoff from GCF infrastructure to monitor potential contaminants from on-site runoff prior to release or overflow.
- Seepage Monitoring Bores (2) Located adjacent to tanks to detect infiltration or leakage into shallow soils and groundwater.
- Basalt Monitoring Bore (1): Positioned east of the facility to detect any downstream groundwater quality impacts in the Tertiary Basalt aquifer.

Analytical Parameters

Surface water samples will be analysed for:

- Field parameters: pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), turbidity; Major ions and salinity indicators: TDS, calcium, magnesium, sodium, potassium, chloride, sulfate; Nutrients: nitrate, ammonia, total nitrogen, total phosphorus;
- Trace metals: boron, barium, strontium, aluminium, iron, manganese, zinc; Hydrocarbons: BTEX, Total Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAHs).

Temporal Scope and Variability

Baseline sampling will occur just after the construction of the GCF and early operations, with repeat monitoring across both wet and dry seasons to characterise seasonal variability in water quality.

This approach ensures that the dataset supports robust statistical comparisons and future impact attribution.

Data Use and Integration

Baseline surface water quality data will inform:

- Development of defensible impact thresholds and trigger levels;
- Design of early-warning monitoring systems for accidental releases; and
- Input to up-date TARPs allowing for timely and proportional management responses to potential contamination events.

Ongoing refinement of the project's WMMP ensuring continuous improvement and regulatory alignment. This ensures that surface water quality risks are appropriately characterised and managed, consistent with IESC recommendations and best-practice environmental management.

4.4 Response Advice Item 13

13. *The potential for contamination of surface water and shallow alluvial groundwater from seepage, accidental spills, leaks or overtopping of produced water and brine storages is not addressed in detail. Information is needed about the design capacity of the storages, including the probability of overtopping during extreme rain events.*

To address this advice, the following actions has been committed to (refer to Section 8.8 of the WMMP 2025 and the site-specific stormwater and water balance assessment report):

Storage Design Review

The capacity and engineering design of produced water and brine storage facilities have been reassessed with daily time-step modelling for multiple scenarios including climate change and increased produced water flows to ensure compliance with Queensland regulatory standards (e.g. ESR/2019/4964). The tank sizing has been designed to cater for events greater than a 1-in-100-year ARI (Average Recurrence Interval) storm. Freeboard design criteria has been set on this basis (refer to Section 4 of the *Stormwater and water balance assessment*, Anderson Consulting 2025).

Stormwater Modelling

Anderson Consulting (2025) were engaged to prepare a site-specific stormwater and water balance assessment. This assessment was completed for a 125 year modelling period based on measured rainfall from the locale. The stormwater and water balance assessment was completed to estimate runoff volumes from a wide range of rainfall events and to test the adequacy of the proposed containment infrastructure under a range of storm scenarios. This included sensitivity testing for climate variability and cumulative water inputs (e.g. from multiple rain events).

Contingency Measures

The proponent will implement secondary containment features (e.g. bunding, diversion drains), operational controls (e.g. brine transfer or re-use protocols), and TARPs for rainfall-triggered risk of overtopping. This will be aligned with the WMMP 2025 and the overarching CSG Water Management Plan (RDM 2023).

Seepage and Liner Integrity

The design specifications and permeability of storage liners will be verified through geotechnical reports and QA/QC records. Long-term seepage monitoring infrastructure will be installed around key storages, with sampling points to assess water quality and identify potential leakage.

4.5 Response Advice Item 14

14. *If the proponent proposes to dispose of drilling cutting/mud by spreading or spraying on site (Epic 2024a, p. 149), the potential impacts of mobilisation of contaminants into downstream water resources via run-off or seepage should be assessed.*

The drilling cutting/mud will be managed in accordance with the Queensland Government (2024)*, "Information sheet - Characterisation and management of drilling fluids and cuttings in the petroleum Industry"*. In accordance with this information sheet the proponent will implement the following measures:

Undertake a Risk Assessment:

A detailed environmental risk assessment will be conducted to identify the likelihood and consequences of contaminants (e.g. hydrocarbons, metals, salts, additives) migrating to surface water bodies or shallow alluvial aquifers via runoff or leaching. This will consider factors such as soil permeability, topography, rainfall intensity, and proximity to surface water features.

Characterise Drilling Wastes:

Laboratory testing of drilling muds and cuttings will be performed to determine the concentrations of potential contaminants of concern. Parameters to be tested include pH, EC, TDS, major ions, trace metals (e.g. barium, chromium, arsenic), and organic additives or hydrocarbons. These data will inform appropriate waste categorisation and disposal decisions in accordance with the Environmental Protection (Waste Classification) Regulation 2023.

Review Soil Suitability and Site Selection:

Proposed application areas will be assessed for hydraulic conductivity, buffering capacity, slope, and distance from watercourses or drainage lines. Areas with high risk of runoff or infiltration to shallow groundwater will be excluded.

Implement Mitigation Measures:

If land application is deemed viable, mitigation controls will be adopted, including: buffer zones, application rate limits, weather-dependent spreading schedules (i.e. avoiding wet conditions), and surface runoff controls (e.g. contour banks, sediment fences).

Monitoring and Reporting:

Post-application soil and water quality monitoring will be undertaken to detect any off-site migration of contaminants. Findings will be reported as part of routine environmental monitoring and used to inform adaptive management if risks are identified.

5 ECOLOGY

5.1 Response Advice Item 15

15. *As discussed in Paragraph 6, insufficient evidence is provided for hydraulic disconnection between the Bandanna Formation and the Tertiary and alluvial aquifers. Once additional groundwater data have been collected and modelling is updated as required (see Paragraphs 6 and 7), the proponent should reassess the potential for, and likely impacts to, GDEs in and around the project area.*

Section 8 of the WMMP 2025 outlines the proposed monitoring plan and timing, and the RCP 2025 has been developed to assist in understanding the potential for hydraulic connectivity. The WMMP 2025 includes a TARP, which will be triggered if monitoring or modelling identifies impacts.

5.2 Response Advice Item 16

16. *The proponent has not characterised the alluvial aquifer system or groundwater-surface water interactions along Humbolt Creek and the Comet River. Baseline data are needed to improve and inform conceptualisations of aquatic and riparian ecosystems of the creeks, their temporal dependence on groundwater (Paragraph 17) and their use by water-dependent flora and fauna, including the EPBC Act-listed white-throated snapping turtle (Paragraph 18).*

Section 3 of the RCP 2025 includes a characterisation of the alluvial aquifer system. The potential for groundwater-surface water interaction is expressed in Section 4 of the RCP 2025. The WMMP 2025 to outline the ongoing monitoring program (Section 8). The WMMP 2025 includes a TARP (Section 7) which sets out a proactive framework for identifying and responding to deviations from baseline or expected environmental performances. Should the monitoring undertaken as part of the WMMP 2025 show a drawdown, field validation and sampling will be initiated, and appropriate further actions will be undertaken.

5.3 Response Advice Item 17

17. *Some work has been undertaken to characterise the groundwater dependence of aquatic and terrestrial ecosystems in the project area (DPM 2023, Watermark Eco 2024). However, there is currently not enough spatial and temporal data to adequately assess groundwater dependence, and there is not enough site-specific bore data (see Paragraph 7a) associated with sampling sites to understand the potential GDE-groundwater interactions. There have been no site-specific investigations of subterranean GDEs within and near the project area. To adequately characterise potential GDEs, additional work is required, as outlined below.*

    a. *The terrestrial GDE assessment has used multiple lines of evidence to assess groundwater dependence (Epic 2024b, pp. 12 - 14) but only at one sampling period. Additional sampling periods are needed to assess groundwater dependence of terrestrial vegetation over time to capture its seasonal and interannual variability, as outlined in Doody et al. (2019). Sampling should also include vegetation communities* *along Rockland Creek which are possibly groundwater dependent (e.g. RE 11.3.25), as well as additional sites in the southeast where vegetation is on alluvium and the water table is <10 m below ground level (RDM Hydro 2024a, Figure 30, p. 59).*

A follow-up GDE field assessment survey will be undertaken (currently scheduled for August 2025), which will be a repeat of the survey that was completed in August 2024. This additional field assessment will be completed during the same seasonal period, being the end of the dry season, as this is the time that GDEs (i.e. Brigalow) would most likely be drawing water from the groundwater rather than from surface water runoff. The follow-up survey aims to address annual variability and strengthen the evidence base for the absence or presence of GDEs within the project area.

b. *Ground-truthing of potential aquatic GDEs was undertaken during aquatic ecology surveys (DPM 2023). However, there is limited information about the methods used or validation of results to assess the potential for groundwater dependence. Additionally, baseline information about the extent of the alluvium and characteristics of the alluvial aquifer have not been provided (see Paragraph 16) to be able to adequately assess the likelihood of aquatic GDE-groundwater interactions, especially within- and among-year variability. Based on the mapped depth to groundwater (RDM Hydro 2024a, Figure 30, p. 59), upstream reaches of Humboldt Creek to the south of the project area may receive groundwater contributions. If the area of project drawdown in surficial aquifers is shown to extend to this area, the potential groundwater dependence of the creek should be investigated to inform assessment of potential impacts to the aquatic and riparian GDEs and water-dependent assets.*

Groundwater samples have been collected on a monthly basis since August 2024 as part of baseline monitoring. The results are summarised in Section 8.4.5 of the WMMP 2025. Following completion of the September 2025 GDE monitoring, it is proposed that monthly groundwater monitoring of the five shallow GDE observation bores will cease, subject to confirmation that no GDE related risks remain and pending agreement from relevant regulatory authorities.

The WMMP 2055 includes a TARP (Section 7) that outlines a proactive framework for identifying and responding to deviations from baseline or expected environmental performance. Should the monitoring undertaken as part of the WMMP 2025 show a drawdown in the standing groundwater level in the alluvium, field validation and sampling will be initiated, and appropriate further actions will be undertaken.

c. *The proponent acknowledges that there is the potential for stygofauna to be present within the alluvial and basalt aquifers (Epic 2024a, p. 111) but no site-specific investigations of subterranean GDEs have been undertaken within and near the project area. The IESC recommends that the proponent do a pilot survey of ten bores (as recommended by DSITIA 2015) in saturated alluvial sediments and basalt aquifers, especially in areas where drawdown may occur if these aquifers are affected by depressurisation in the Bandanna Formation. If this pilot survey yields stygofauna, the proponent should sample more comprehensively (DSITIA 2015) so that potential impacts of the project on stygofauna can be assessed and monitored.*

The WMMP 2025 includes a TARP (Section 7) that outlines a proactive framework for identifying and responding to deviations from baseline or expected environmental performance. Should the monitoring undertaken as part of the WMMP 2025 show a drawdown in the standing groundwater level in the alluvium, field validation and sampling will be initiated, and appropriate further actions will be undertaken.

d. Ground-truthing of GDEs and assessment of potential impacts should not be limited to within the project boundary and instead should be informed by predictions of drawdown within and surrounding the project site. If there is connection between the target formation and shallow aquifer systems, assessment of potential drawdown impacts should extend to where the Bandanna Formation subcrops beneath the Tertiary Strata to the northwest and southwest of the project area (RDM Hydro 2024a, Figure 12, p. 36) to identify potential impacts to the Comet River, its tributaries and associated GDEs.

Off-lease Monitoring for Cumulative Impacts using NDVI.

The collection of ground-truthed baseline data outside of the proponents' PL tenure to inform the assessment of cumulative impacts is limited for the project due to the following reasons:

- It is not possible to do fieldwork in another company’s tenures;
- The proponent does not have the right to access land outside of their tenure; and
- There are limitations with data share agreements such that the data acquisition may not be fit for purpose for the project (i.e. frequency, skill set of field personnel)

As an alternative, satellite imagery can be used to run Normalised Difference Vegetation Index (NDVI) models as a way to measure vegetation health. The NDVI is a widely used remote sensing index that quantifies vegetation health, density and coverage by analysing how plants reflect light at certain wavelengths. NDVI quantifies vegetation by measuring the difference between near-infrared (NIR) and red light (RED). NDVI is calculated using the following formula:

$$\text{NDVI} = \frac{(\text{NIR} - \text{RED})}{(\text{NIR} + \text{RED})}$$

Where:

- NIR = healthy vegetation strongly reflects
- RED = which healthy vegetation strongly absorbs for photosynthesis

The results of the above formula generate a value between -1 and +1, whereby higher NDVI values indicate healthier vegetation. General NDVI value ranges include:

- 0.6 to 0.9: Dense, healthy vegetation (e.g. forest, vigorous crops) ·
- 0.3 to 0.6: Moderate vegetation (e.g. grassland, shrubland, sparse crops) ·
- 0.1 to 0.3: Sparse or stressed vegetation
- 0 to 0.1: Bare ground, rock, built surfaces
- < 0: Water, cloud, snow, or non-vegetated surfaces

The proponent proposes to use NDVI for the project to assess cumulative impacts to ecological and groundwater values as an alternative to ground-truthed data collection outside the proponent's PL tenure. Proposed NDVI methods comrpises riparian vegetation and permanent pools of water being surveyed using NDVI. Three off-lease monitoring sites along the Comet River are proposed to be analysed using NDVI. Ground-truthed data from two on-lease sites will be used as reference sites. The locations are identified in the WMMP 2025 (Section 8.1 Table 14 and Figure 8).

It is proposed that NDVI monitoring will be undertaken annually for the project. The optimal time for this monitoring is at the end of the dry season (i.e. around October). The results of each annual monitoring event will be compiled into an annual report and compared with the previous years results to identify any changes to NDVI values over time. When comparing annual results, the proponent will have consideration to the general NDVI value ranges listed above. Negative changes to NDVI scores between years will be investigated to determine whether a correlation between project activity and groundwater use can be established. Negative changes include observations such as new browning of vegetation or drop in groundwater levels and pressure.

5.4 Response Advice Item 18

18. *Two specimens of the critically endangered white-throated snapping turtle were recorded in the Comet River downstream of the project area during the wet season field survey (DPM 2023, p. 47). This species forages in ephemeral riffle zones when streams flow but takes refuge in large slow- moving pools or isolated waterholes during the drier months. Although the project area was considered unlikely to provide suitable habitat for this turtle, its occurrence in nearby downstream receiving waters highlights the importance of protecting downstream habitats from the potential for sedimentation and other water quality impacts associated with the project (DPM 2023, p. 73). The proponent states that flows in the Comet River are unlikely to be impacted by the project (DPM 2023, p. 80). However, further information is needed to reliably assert that there will be no or negligible impacts on water quality (e.g. from spills, Paragraph 13) that may impair habitat suitability, especially if a contamination event occurs during receding flows and enters one or more refugial waterholes of the Comet River downstream of the project area.*

The WMMP 2025 provides for several targeted impact prevention and management measures designed to protect downstream aquatic habitats:

Baseline Surface Water Monitoring and Risk Identification

A baseline surface water monitoring program has been implemented to establish existing water quality conditions in the Comet River and Humboldt Creek, including near downstream sensitive receptors. Parameters include pH, EC, turbidity, TSS, nutrients, hydrocarbons, and dissolved metals (e.g. boron, barium, strontium).

Trigger Action Response Plans (TARPs)

In the event of a spill, leak, or brine overflow from site infrastructure (refer to Section 8.2), the WMMP 2025 outlines a rapid-response framework that includes:

- Trigger thresholds for early detection (based on groundwater and surface water quality);
- Incident containment protocols;
- Emergency notification and investigation procedures; and
- Surface water sampling following rainfall and flow events

This system is specifically designed to prevent contaminant migration into downstream habitats during receding flow conditions when refugial pools are most vulnerable.

Stormwater and Spill Management Controls

As detailed in Section 8.8 of the WMMP 2025, stormwater and chemical storage facilities are designed and managed to:

- Withstand extreme rainfall events (1-in-100-year ARI)
- Prevent overtopping through engineered bunding, freeboard, and diversion infrastructure
- Isolate first-flush runoff from high-risk operational areas
- Direct all runoff from brine storage and processing areas to lined containment systems with leachate detection capabilities

Contingency Measures to Protect Aquatic Fauna

Should a spill occur near the Comet River during low flow or dry conditions, the WMMP 2025 includes the TARP protocols. These actions will be accompanied by targeted ecological impact monitoring in accordance implemented in consultation with State and Commonwealth Governments.

Ongoing Ecological Risk Review

Data from the water monitoring program outlined in Section 8 of the WMMP 2025 will be used to inform adaptive risk assessments. If environmental thresholds are approached or exceeded, ecological assessments will be triggered to evaluate impacts on species such as the white-throated snapping turtle and, if required, the implementation of habitat protection measures or temporary project shut-down procedures.

5.5 Response Advice Item 19

19. *The project area is in a region with existing mines nearby (e.g. South Blackwater coal mine 10 km to the east, Rolleston open-cut mine 38 km to the south), the Mahalo CSG project to the south and cropping for wheat and cotton to the immediate north-west and west (Epic 2024a, p. 63). The proponent acknowledges that these activities may be associated with cumulative impacts to ecological and groundwater values but asserts that 'no potential or likely cumulative impacts associated with the Project and surrounding projects are predicted' (Epic 2024a, p. 3). This assertion relies on limited baseline data and conceptualisations (e.g. the assumption that drawdown in the Bandanna Formation will not affect any GDEs) and does not consider other ecological impact pathways such as accidental contamination of waters or disruption of riparian connectivity. When further baseline data have been collected and the conceptualisations refined and confirmed, the proponent should reassess potential cumulative impacts from the project and from surrounding proposed and existing projects on groundwater and surface water ecosystems in and near the project area.*

Section 9 of the WMMP 2025 outlines a program designed to address cumulative risks. Key elements relevant to cumulative impact assessment (CIA) include:

Baseline Monitoring

Site-specific groundwater and surface water monitoring has been established to capture spatial and temporal variability in key environmental values. This includes monitoring of aquifers (Bandanna, Rewan, Tertiary, and Alluvium) as well as surface water quality at Comet River, Humboldt Creek, and Rockland Creek. The program is designed to capture seasonal variation and establish defensible baselines for attributing impacts.

Cumulative Impact Assessment Framework

The CIA framework has been incorporated into the WMMP 2025, and considers:

- Combined drawdown from regional CSG operations and groundwater use;
- The potential for overlapping contaminant pathways (e.g. spills or seepage from infrastructure);
- Habitat connectivity risks (e.g. degradation of refugial pools and riparian corridors); and
- Interactions with existing water quality stressors from mining and agriculture.

The CIA will be reviewed and updated following completion of the current baseline program and integration of newly acquired field data. Impact predictions will be revised based on the updated numerical groundwater model outputs and will be benchmarked against acceptable environmental thresholds and EPBC Act requirements.

Mitigation and Adaptive Management Measures

TARPs have been designed to address both individual and cumulative risk scenarios. Where monitoring indicates potential cumulative pressures, mitigation measures such as adjusted extraction rates, increased monitoring frequency, or engineered containment improvements will be enacted. These plans are structured to be adaptive and updated in response to monitoring results and stakeholder engagement.

Off-lease Monitoring for Cumulative Impacts using NDVI

The collection of ground-truthed baseline data outside of the proponents' PL tenure to inform the assessment of cumulative impacts is limited for the project due to the following reasons:

- It is not possible to do fieldwork in another company's tenures;
- The proponent does not have the right to access land outside of their tenure; and
- There are limitations with data share agreements such that the data acquisition may not be fit for purpose for the project (i.e. frequency, skill set of field personnel)

As an alternative, satellite imagery can be used to run Normalised Difference Vegetation Index (NDVI) models as a way to measure vegetation health. The NDVI is a widely used remote sensing index that quantifies vegetation health, density and coverage by analysing how plants reflect light at certain wavelengths. NDVI quantifies vegetation by measuring the difference between near-infrared (NIR) and red light (RED). NDVI is calculated using the following formula:

$$\text{NDVI} = \frac{(\text{NIR} - \text{RED})}{(\text{NIR} + \text{RED})}$$

Where:

- NIR = healthy vegetation strongly reflects
- RED = which healthy vegetation strongly absorbs for photosynthesis

The results of the above formula generate a value between -1 and +1, whereby higher NDVI values indicate healthier vegetation. General NDVI value ranges include:

- 0.6 to 0.9: Dense, healthy vegetation (e.g. forest, vigorous crops) ·
- 0.3 to 0.6: Moderate vegetation (e.g. grassland, shrubland, sparse crops) ·
- 0.1 to 0.3: Sparse or stressed vegetation
- 0 to 0.1: Bare ground, rock, built surfaces
- < 0: Water, cloud, snow, or non-vegetated surfaces

The proponent proposes to use NDVI for the project to assess cumulative impacts to ecological and groundwater values as an alternative to ground-truthed data collection outside the proponent's PL tenure.

Proposed NDVI methods

Riparian vegetation and permanent pools of water will be surveyed using NDVI. Three off-lease monitoring sites along the Comet River are proposed to be analysed using NDVI. Ground-truthed data from two on-lease sites will be used as reference sites. The WMMP 2025, Section 8 Monitoring and Management, Figure 8 show these locations, and Table 14 discuss the monitoring frequency.

It is proposed that NDVI monitoring will be undertaken annually for the project. The optimal time for this monitoring is at the end of the dry season (i.e. around October). The results of each annual monitoring event will be compiled into an annual report and compared with the previous years results to identify any changes to NDVI values over time.

When comparing annual results, the proponent will have consideration to the general NDVI value ranges listed above. Should a change in NDVI value be observed between time periods this will trigger further investigation to be undertaken to determine the cause of change through the trigger action response plan process.

Negative changes to NDVI scores between years will be investigated to determine whether a correlation between project activity and groundwater use can be established. Negative changes include observations such as new browning of vegetation or drop in groundwater levels and pressure.

The investigation will include a comparison of NDVI scores with:

- Rainfall occurrence over the previous 12 months;
- Groundwater hydrographs for the previous 12 months; and
- Water production rates from well activities.

5.6 Response Advice Item 20

20. *The proposed mitigation, management and monitoring measures provided in Section 5.5 (Epic 2024a, pp. 65 – 69) and Section 8 (Epic 2024a, pp. 153 - 172) are not adequately detailed for the proposed project. Once further baseline information has been collected (see Paragraphs 5 to 19), a detailed impact assessment for surface water, ecology and groundwater will be needed. This work should support development of detailed mitigation*

measures and monitoring plans for surface waters, and subterranean and terrestrial GDEs that are informed by an understanding of potential impact pathways and cumulative impacts.

The WMMP 2025 has been prepared to address the mitigation, management and monitoring measures for the project. The WMMP will be regularly updated, as additional monitoring data becomes available, over time.

5.7 Response Advice Item 21

21. *Watercourse crossings will be required for the water- and gas-gathering lines, and the proponent has indicated that horizontal directional drilling could be used to reduce potential impacts in "environmentally constrained watercourse crossings" (Epic 2024a, p. 30). Horizontal directional drilling should be considered where riparian vegetation exists, given the importance of this vegetation in providing potential habitat to EPBC Act-listed species and promoting ecological connectivity in this landscape which has been largely cleared for grazing (Epic 2024a, p. 65).*

Section 4.1 of the Aquatic Values Assessment report (DPM Environmental 2023) identified the watercourses within the Project area, as 'drainage features'. None of these 'drainage features' were identified to have riparian vegetation. The only verified watercourses within the PL boundary are Humbolt Creek and Rockland Creek. If necessary, horizontal direction drilling (HDD) will be used to underbore them.

For all other 'drainage features' within the PL area, it is proposed that these will be trenched, during the dry season. HDD requires the use of a specialty drilling rig, that uses drilling fluids, generates a lot of waste (the spent drilling fluid and rock cuttings from the drilling activity), that need to be transported offsite and disposed of appropriately, and requires sourcing of water (generally from the landholders bore) for use in the drilling fluid.

Trenching a dry 'drainage feature' and backfilling immediately, can be completed quickly, and results in minimal impact and does not generate any drilling wastes.

5.8 Response Advice Item 22

22. *The proponent should develop a monitoring program of the ecological condition of terrestrial GDEs, stygofauna (if detected) in alluvial aquifers, and surface waters (riparian zones and aquatic ecosystems) to ensure that proposed project operations do not have an impact and that this lack of impact can be demonstrated. Data from this monitoring would then guide any mitigation and remediation measures for these ecosystems if needed.*

The WMMP 2025 includes a TARP (Section 7) which sets out a proactive framework for identifying and responding to deviations from baseline or expected environmental performances. Should the monitoring undertaken as part of the WMMP show a drawdown, field validation and sampling will be initiated and appropriate further actions will be undertaken.

5.9 Response Advice Item 23

23. *Limited information about locations and timings for on-going monitoring of spills and leaks for the water management system was provided. When developing the monitoring program for the water management system, the proponent could use Huynh and Hobbs (2019) as a guide. Monitoring inside the storage tanks should also be conducted including physico-*

chemical parameters and metals, including zinc, boron and strontium.

Section 7 WMMP 2025 addresses the ongoing monitoring of potential spills and leaks from the water management system, including produced water and brine storages at the GCF. This monitoring framework has been developed in alignment with the IESC (2024a) Information Guidelines and incorporates key principles from Huynh and Hobbs (2019) regarding risk-based monitoring of coal seam gas infrastructure.

The WMMP 2025 provides a robust, risk-based approach to monitoring and managing potential spills and leaks from the water management system. The integration of dedicated surface water, groundwater, and tank-based monitoring—combined with event-triggered protocols and alignment with Huynh and Hobbs (2019)—ensures that early detection and responsive mitigation actions are in place to protect downstream environmental values.

Monitoring Locations and Timing

A suite of surface water and groundwater monitoring locations has been established to serve as early detection points for potential contamination from spills, leaks, or operational overflows. As outlined in Figure 8 of the WMMP 2025 , these include:

- R11 – Comet River:
- R4 – Humboldt Creek:
- R9 – Rockland Creek:
- Surface Water Catchment Dam (SWCD): Strategically positioned to capture stormwater runoff from GCF operational areas before any potential release or overflow;
- Seepage Monitoring Bores (2 units): Installed adjacent to water storage tanks to detect early signs of infiltration into shallow subsoils or perched aquifers;
- Basalt Monitoring Bore (1 unit): Located east of the GCF to detect potential lateral migration of contaminants into the Tertiary Basalt aquifer.
- Monitoring at these sites is conducted quarterly and during rainfall-triggered events, enabling assessment of both background conditions and acute incident responses.

Storage Tank Monitoring

In accordance with best-practice recommendations (Huynh & Hobbs, 2019), the WMMP 2025 (Section 5.3.2) specifies internal monitoring of brine and produced water tanks, including:

- Physico-chemical parameters: pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, and temperature;
- Dissolved metals: Zinc, boron, and strontium, identified as potential contaminants of concern based on geochemistry and ecological risk;
- Organics and nutrients: Including BTEX compounds, PAHs, nitrate, and phosphate, to capture broader contamination profiles.

Spill and Leak Response Framework

As outlined in WMMP Section 7.1 (Trigger Action Response Plan - TARP), a multi-tiered spill detection and response framework is in place. This includes:

- Real-time tank level sensors and flow alarms for immediate detection of anomalies;
- Routine visual inspections of bunding, containment systems, and nearby drainage paths; and

- Immediate sampling and containment protocols triggered by any suspected release event.

Data Management and Adaptive Measures

All monitoring data are maintained in a secure database and evaluated on a rolling basis to:

- Detect trends or exceedances relative to baseline;
- Activate TARP protocols where necessary; and
- Support iterative refinement of the water quality management framework.

5.10 Response Advice Item 24

24. *Once detailed monitoring and mitigation measures have been defined, project-specific Trigger Action Response Plans (TARPs) should be developed for all potential impact pathways. These TARPs should be designed based on the improved project conceptualisation, and implemented to ensure timely detection of, and intervention or mitigation against, potential impacts.*

WMMP 2025 has incorporated interim project-specific TARPs for key environmental parameters and potential impact pathways. These include:

- Groundwater Monitoring: TARPs have been developed for standing water levels (SWL), pH, and electrical conductivity (EC), with clearly defined trigger thresholds based on baseline data and modelled drawdown scenarios. These include responses such as field validation, investigations into cause (e.g., extraction-induced drawdown vs. climatic variation), and potential adjustment of extraction rates;
- Surface Water Quality: Trigger levels for field parameters (e.g., turbidity, EC, pH) and laboratory analytes (e.g., metals, nutrients) have been included, with corresponding response actions such as targeted resampling, review of site drainage infrastructure, and notification to relevant regulators; and
- Brine and Produced Water Storages: Contingency measures and trigger-based actions for overtopping risks and potential leaks (e.g., brine recirculation, shutdown of RO operations during rainfall, offsite disposal) are outlined as part of operational water management.

Additional TARPs will be developed and refined as monitoring results become available and as project-specific risks are further characterised. These will be consistent with the updated conceptual site model and aligned with relevant regulatory guidance.

6 REFERENCES

Anderson Consulting, 2025, *Stormwater and water balance assessment Mahalo North*, prepared for Comet Ridge Ltd, Brisbane, Australia

Australian Government, 2025, *Australian & New Zealand Guidelines for fresh & Marine Water quality (ANZG), accessed on* 1 July 2025, from https://www.waterquality.gov.au/anz-guidelines

Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2022, *Significant impact guidelines 1.3 Coal seam gas and large coal mining developments — impacts on water resources*, accessed on 1 July 2025, from https://www.dcceew.gov.au/sites/default/files/documents/significant-impact-guidelines-1-3.pdf

DPM Environmental, 2023, *Aquatic Values Assessment*, prepared for Comet Ridge Ltd, Brisbane, Queensland.

Independent Expert Scientific Committee (IESC), 2024, *Information Guidelines Explanatory Note - Using impact pathway diagrams based on ecohydrological conceptualisation in environmental impact assessment*, accessed on 14 April 2025, from https://www.iesc.gov.au/publications/information-guidelines-explanatory-note-using-impact-pathway-diagrams-based-ecohydrological-conceptualisation-environmental-impact-assessment

IESC, 2024a, *Information Guidelines for Proponents Preparing Coal Seam Gas and Large Coal Mining Development Proposals,* accessed on 14 April 2025, from https://www.iesc.gov.au/sites/default/files/2024-02/info-guidelines-proponents-preparing-coal-seam-gas-large-coal-mining-development-proposals.pdf

Office of Groundwater Impact Assessment (OGIA), 2023, *Surat CMA UWIR groundwater model data provision to Comet Ridge for the Mahalo North Project,* Brisbane, Australia

Queensland Government, 2024, *Information Sheet - Characterisation and management of drilling fluids and cuttings in the petroleum industry,* accessed on 18 April 2025, from https://www.detsi.qld.gov.au/policies?a=272936:policy_registry/rs-is-characterisation-management-drilling-fluids-petroleum.pdf

Terra Sana Consultants, 2023, *Mahalo North Groundwater Modelling Report,* prepared for Comet Ridge Ltd, Brisbane, Australia

Terra Sana Consultants, 2025, *Water Monitoring and Management Plan 2025* (WMMP 2025), prepared for Comet Ridge Ltd, Brisbane, Australia

Terra Sana Consultants, 2025a, *Rewan Connectivity Plan 2025* (RCP 2025), prepared for Comet Ridge Ltd, Brisbane, Australia

Comet Ridge (2025), *Ecohydrological Model Mahalo North*, prepared for Comet Ridge Ltd, Brisbane, Australia