



Comet Ridge Limited

Our Ref: Galilee Basin ATP 744P

19 April 2017

Attention:
Department of Environment and Heritage Protection
GPO BOX 2454
Brisbane QLD 4001

Dear Sir/Madam,

SUBJECT: SUBMISSION OF UNDERGROUND WATER IMPACT REPORT – ATP 744P

Authority to Prospect (ATP) 744P was granted to Comet Ridge Limited for a 12 year period, effective from 1 November 2009. Comet Ridge Limited holds 100% interest in ATP 744P.

An Underground Water Impact Report (UWIR) has been prepared for ATP 744P for the purpose of meeting the requirements of Chapter 3 of the *Water Act 2000* (Qld). This report has been prepared in response to production testing undertaken at Gunn-2 well within ATP 744P within 2012 and 2013. An initial UWIR was prepared by Comet Ridge Limited and submitted to DEHP in March 2014. The initial UWIR was approved (with conditions) by DEHP and took effect on 3 April 2014. The proposed development and production activities outlined in the initial UWIR have not proceeded in the previous three year reporting period. The proposed pilot design and production testing parameters have not changed since the initial UWIR and therefore the modelling undertaken for the initial UWIR remains relevant. This amended UWIR is relevant for the reporting period 2017-2020.

Please find enclosed relevant documentation in relation to the submission of the UWIR for ATP 744P as required under Chapter 3 of the *Water Act 2000* (Qld);

- a) Underground Water Impact Report;
- b) Submissions Summary Report;
- c) Copy of submission received; and
- d) Copy of Public Notice.

We look forward to your reply on receipt of this submission and ask that you do not hesitate to contact the undersigned should you have any questions or require clarification on any aspect.

Yours faithfully,

Melanie Fitzell
Senior Geologist
Comet Ridge Limited

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18 APR 2017

BY: EHP 4006

Comet Ridge Limited
Level 3
283 Elizabeth Street
Brisbane Qld 4000
Phone: +61 7 3221 3661
Fax: +61 7 3221 3668
Info@cometridge.com.au



Comet Ridge Limited

UNDERGROUND WATER IMPACT REPORT

AUTHORITY TO PROSPECT ATP744P – GALILEE BASIN
COMET RIDGE LIMITED



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Appendix 2 – All ATP Water Level Observations

Document Revision History

Date	Version	Author	Comment
07/02/2017	1	COI	In-house review
03/03/2017	2	COI	DEHP review
14/03/2017	Consultation	COI	For public consultation
19/04/2017	Final	COI	DEHP Approval

Executive Summary

The following is an Underground Water Impact Report (UWIR) completed for the purposes of meeting the requirements of Chapter 3 of the *Water Act 2000* (Qld). The report covers previous and proposed production testing activities on Authority to Prospect 744P (ATP 744P) by Comet Ridge Limited. These activities include short term production testing that occurred during 2013 at the Gunn #2 well and also a proposed five-spot pilot production test which is proposed to commence on commission of the five-spot pilot scheme. Since submission of the initial UWIR (2014), Comet Ridge Limited have not undertaken any further production testing at the Gunn #2 well. The proposed five-spot pilot has not been drilled at the time of writing this report, however the proposed pilot may be commissioned within the next three year reporting period. The proposed pilot design and production have not changed since the initial UWIR and therefore the modelling undertaken for the initial UWIR remains relevant for the next three year reporting period and is covered in this report.

The report provides:

- a description of the hydrogeological context of the area including a description of the aquifers present and how they interact;
- an estimate of how much underground water will be required to be taken as a result of the proposed production testing activities;
- an estimate of the groundwater level impacts as a result of the proposed production testing activities as determined through a groundwater flow model;
- a description of the predicted small immediately affected area (IAA) generated by the proposed production testing activities;
- a description of environmental values, the impacts that have occurred and are likely to occur because of the exercise of underground water rights;
- a description of springs within the tenure area and surrounding area;
- a monitoring strategy to verify modelling predictions and quantify impacts; and
- a reporting strategy back to the Department of Environment and Heritage Protection (DEHP) should there have been a material change from predictions.

The key findings of the report are that:

- The shallow aquifers in the area are separated from the target coal seams by at least 300m of low permeability formation (Rewan Group);
- A small immediately affected area is predicted **only** within the coal seam (C1 seam) being targeted;
- There are no water bores sourced within the coal seams of the Betts Creek beds within the IAA;
- The coal seams are the only formation predicted to have an immediately affected area, meaning no make good obligations are triggered;
- The C1 coal seam is the only interval predicted to experience drawdown during modelling and no drawdown was predicted in the overlying or underlying aquifers or aquitards within the model extent;

- No impacts on environmental values have been identified due to the previous or future exercise of underground water rights associated with the Gunn Pilot based on the current modelling;
- There are two active landowner bores sourcing water from sandstone intervals within the Betts Creek beds located over 70km from the proposed pilot. The predicted impact from the proposed exercise of underground water rights on these wells is considered negligible due to the spatial separation from the Gunn Pilot;
- There are eight active water bores drilled for the purpose of monitoring water levels and water quality of coal seams within the Betts Creek beds. These monitoring bores are associated with coal mining operations and are located over 70km from the pilot;
- There are six active landholder bores within a 10km radius of the pilot, where water is being extracted from aquifers at least 440m above the coal seams;
- Only one active landowner bore is located within the IAA where water is sourced from the Moolayember Formation (at least 570m above the coal seams) for the purpose of stock watering; and
- There are no springs within 20km of the pilot, and the nearest springs are not sourced from the coal seams.

The initial UWIR which was prepared for ATP744P was submitted and approved by the Department of Environment and Heritage (DEHP) in April 2014. This UWIR is relevant for the reporting period 2017 to 2020. As required under the *Water Act 2000 (Qld)*, during this period Comet Ridge will undertake an annual review of the model drawdown predictions presented in this report. A summary of the review will be presented to DEHP and where applicable will provide detail on how actual drawdown (if any) deviates from model predictions presented in this report.

This UWIR presents the actual volume of water that was produced during an extended production test of a single production well, Gunn #2 well, in 2013 and modelled prediction of the amount of production water from a proposed five-spot coal seam gas pilot to be located at the Gunn Pilot location. The initial UWIR proposed the five-spot pilot would be operational in late 2014. The proposed future five-spot pilot has not been drilled or constructed at the time of writing this report, however Comet Ridge Limited may commit to the development of the pilot, which may occur within the next three year reporting period. The modelling undertaken for the initial UWIR had an arbitrary start date of production at 1 October 2014. No production testing has occurred in the last three year reporting period. The arbitrary start date for commencement of production of the pilot is assumed to be 1 October 2017 for the purposes of this report for the next three year reporting period.

Overall, no material impacts to underground water resources are predicted as a result of the production testing activities on ATP744P. The monitoring strategy will ensure that realised groundwater changes align with predictions. As knowledge of the hydrogeology in the area expands, the model will be re-run with updated information and re-submitted to the DEHP.

Introduction

ATP744P is located along the eastern margin of the Galilee Basin in central Queensland and is approximately 90km northeast of Aramac (**Figure 1**). ATP744P comprises 54 continuous blocks comprising 1350 sub-blocks. The tenure holder of ATP744P is Comet Ridge Limited (COL) which holds 100% equity in the permit and is also the operator.

The *Water Act 2000* (Qld) (Water Act) requires petroleum tenure holders to manage impacts of extraction of underground water from their production testing or production activities. To assist in achieving this, petroleum tenure holders must prepare an UWIR, which is used to proactively predict any possible impacts of the petroleum operations on underground water resources and implement monitoring and mitigation measures if necessary. An UWIR established responsibilities for resource tenure holders and ensures measures and programs are in place to respond to impacts on underground water.

The key aspects of an UWIR are:

- identify aquifers that are predicted to be impacted by resource tenure holders' exercising their underground water rights (immediately affected areas (IAA) and long term affected areas (LTAA));
- establish obligations to monitor impacts on aquifers and springs;
- where required, impose a strategy to mitigate impacts of any spring of interest;
- assist with management of impacts of the exercise of water rights by resource tenure holders; and
- where required establish underground water obligations (make good obligations of the resource tenure holder for private water bores).

A resource tenure holder is not required to prepare further UWIR's if in the following circumstances apply;

- The resource tenure is not a CMA tenure; and
- The existing approved UWIR;
 - estimated a quantity of water to be taken to be zero; and
 - did not predict a decline in the water level of an aquifer of more than the bore trigger threshold at any time.

This UWIR provides information about the relevant underground water extractions and the potential impacts on aquifers within ATP744P in relation to any future production testing of a proposed five well pilot program, to be located around Gunn #2 well, known as the Gunn Pilot. This UWIR covers the entire ATP744P block; however, it is specifically concerned with the area surrounding the proposed Gunn Pilot program (**Figure 1**).

Objective

The purpose of this document is to satisfy the requirements of section 376 of the Water Act for the proposed future production testing activities at the proposed Gunn Pilot within ATP744P in the Galilee Basin. The proposed production testing will occur in the south western leg of Comet Ridge Limited's Authority to Prospect (ATP) 744P petroleum and gas exploration permit.

Purpose

This UWIR has been prepared to describe the hydro-geological context of the project area and predict the impacts on underground water associated with the proposed Gunn Pilot. A hydro-geological conceptualisation has been prepared to assist in understanding the aquifers in the project area. A model has been prepared to predict groundwater impacts expected as a result of the proposed production testing at the Gunn Pilot. This UWIR also proposes a monitoring strategy to compliment and verify the groundwater modelling. The monitoring strategy will also be used to quantify any possible impacts and be used to refine future groundwater models.

Background

COI is a publically listed Australian energy company focussed on coal seam gas (CSG) exploration and appraisal. Based in Brisbane, the company has three permit interests within the Galilee Basin in Queensland, including 100% equity in ATP743P, ATP744P & ATP1015P. The company also has a suite of other prospective coal seam gas projects in Queensland, New South Wales and New Zealand. This UWIR relates to activities proposed to be carried out within ATP744P.

The location of ATP744P is illustrated in **Figure 1**.

Galilee Basin

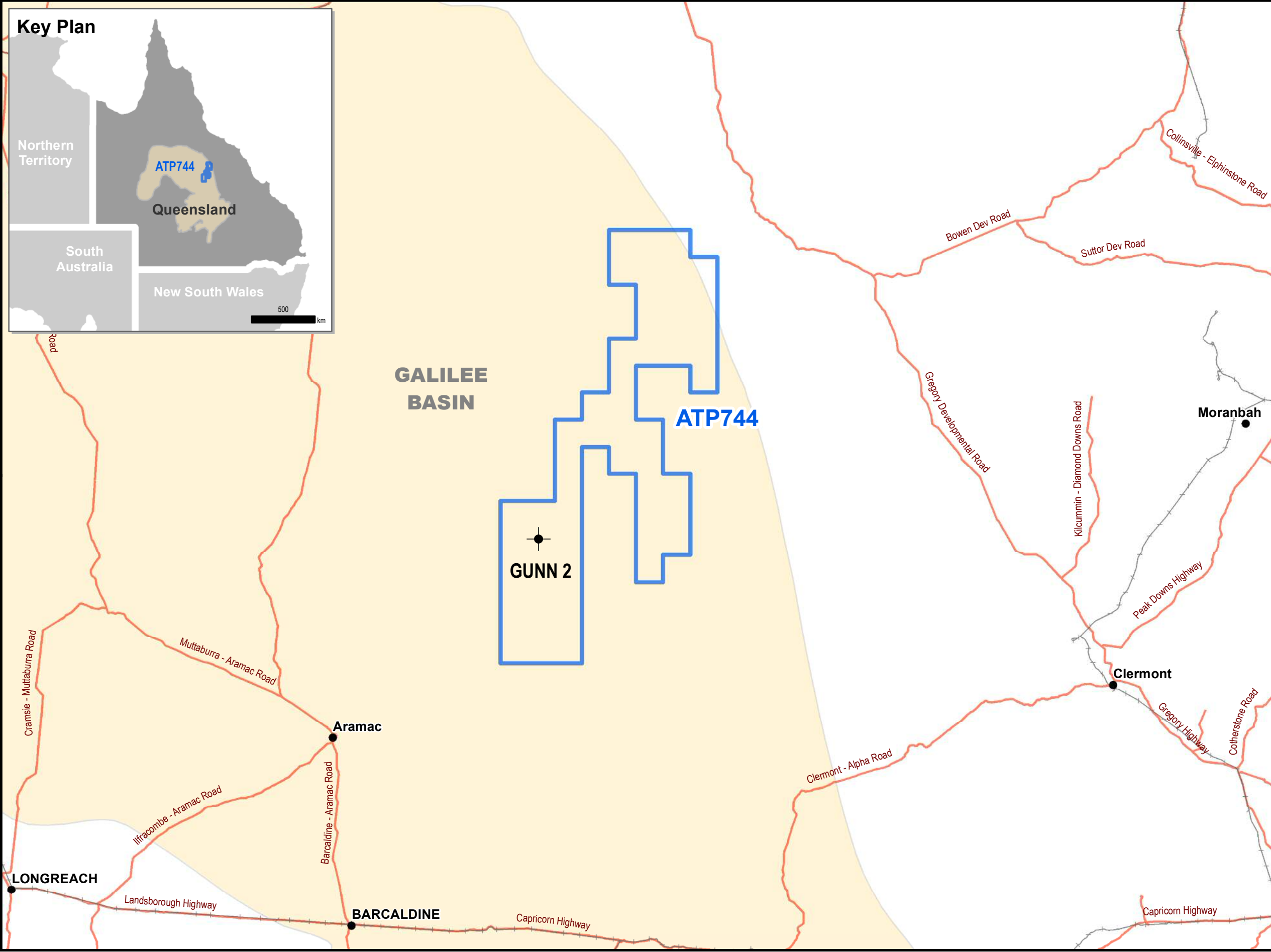
The Galilee Basin covers approximately 247,000 km², extending 700 km from Charleville in the south to near Charters Towers in the north and 550 km from Emerald in the east to Julia Creek in the northwest. The major population centre of Longreach is located to the south of the basin centre. Land use within the Galilee Basin is predominantly sheep and cattle grazing. Petroleum exploration permits are located over the eastern portion of the basin between Longreach and Pentland. Coal exploration permits cover the entire eastern and northern margins of the basin. Refer to **Figure 2** for the extents of the Galilee Basin.

Galilee Basin Operators Forum

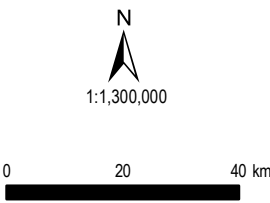
As the Galilee Basin formations and the overlying Eromanga Basin formations both have broad stratigraphic continuity over a wide area, a number of energy companies with exploration interests in the region formed a group to support a cooperative and coordinated approach to defining the hydrogeology in the area.

The Galilee Basin Operator's Forum (GBOF), of which Comet Ridge is a member, commissioned RPS Australia East Pty Ltd (RPS) to undertake a baseline water assessment report for the Galilee Basin during 2012. The RPS 'Galilee Basin - Report on the Hydrogeological Investigations' (2012) provides a technical review of all existing publicly available data and to ultimately provide the regulator and the community with the core baseline of the existing environment. This baseline information was considered in the development of this UWIR, particularly when designing the proposed monitoring plan and is referred to throughout this report. The baseline assessment report can be accessed via the GBOF website at: www.gbof.com.au.

Underground Water Impact Report



- Legend**
- Gunn 2
 - Towns
 - Railway
 - State Controlled Roads
 - Galilee Basin
 - Comet Ridge ATP744



**Figure 1:
Locality Plan**

Legislation

Statutory Requirements

A UWIR is developed to document compliance with sections 370 to 383 of the Water Act. This UWIR has also been developed in consideration of the DEHP guideline Preparing an Underground Water Impact Report or Final Report.

The initial UWIR which was prepared for ATP744P was submitted and approved with conditions by the Department of Environment and Heritage (DEHP) in April 2014. The initial UWIR took effect on 3 April 2014. This revised UWIR is due for submission within 10 business days of the three year anniversary of when the first UWIR took effect, therefore the revised UWIR is due for submission to DEHP by 19 April 2017.

The report contains:

- A description of the relevant aquifers of the area;
- The quantity of underground water produced or taken from the production testing activities already undertaken;
- An estimate of the volume of water likely to be produced from the production testing activities in the next three years;
- An analysis of movement of underground water as a result of the production testing activities;
- An analysis of likely corresponding water level changes;
- A map showing the Immediately Affected Area (IAA);
- A description of the modelling techniques used to make the predictions;
- A description of how the modelling was used to produce a map of the IAA;
- A description of environmental values;
- An assessment of the likely impacts on environmental values; and
- A groundwater monitoring strategy.

Water Act 2000

In terms of the management of impacts on underground water caused by the exercising of underground water rights by petroleum tenure holders, the requirements of the Water Act are achieved by:

- Requiring petroleum tenure holders to monitor and assess the impact of the exercise of underground water rights on water bores and to enter into 'make good' agreements with the owners of the bores
- The preparation of UWIRs that establish underground water obligations, including obligations to monitor and manage impacts on aquifers and springs;
- Establishing a management framework overseen by the Office of Groundwater Impact Assessment (OGIA) which addresses cumulative underground water impacts from multiple tenure holders in an area (e.g. the Surat Cumulative Management Area).

The Water Act gives OGIA other functions and powers for managing underground water. If a water bore has an impaired capacity as a result of CSG activities, an agreement will be negotiated with the owner of the bore about the following:

- The reason for the bore's impaired capacity;
- The measures the holder will take to ensure the bore owner has access to a reasonable quantity and quality of water for the authorised use and purpose of the bore; and
- Any monetary or non-monetary compensation payable to the bore owner for impact on the bore. If an agreement relating to a water bore is made the agreement is taken to be a 'make good' agreement for the bore.

The UWIR is required to define the IAA expected to result from CSG activities. An IAA is defined as an area where the predicted drawdown within 3 years is at least:

- 5 m for a consolidated aquifer;
- 2 m for an unconsolidated aquifer; or
- 0.2 m for a spring.

UWIRs are published to enable the community, including bore owners and other stakeholders, within the relevant area, to make submissions on the UWIR. Submissions made by bore owners will be summarised by COI, addressed as appropriate and provided to the DEHP. UWIRs are submitted for approval by DEHP. The OGIA may also advise DEHP about the adequacy of these reports. The UWIR must then remain available on the petroleum tenure holder's website.

The OGIA will maintain a database of information collected under monitoring plans carried out by petroleum tenure holders in accordance with approved UWIRs. The database will also incorporate baseline assessment data collected by petroleum tenure holders.

Public Consultation

A full 20 business day consultation process is required to be run. Submissions may be made by bore owners and other stakeholders. Comet Ridge Limited will consider all submissions and prepare a submissions summary to the Department of Environment and Heritage (DEHP) together with the UWIR.

A public consultations notice will be prepared and circulated containing the following information:

- a description of the area to which the report relates;
- where copies of the report may be obtained
- how the copies may be obtained;
- how written submissions on the report may be given;
- that submissions must be given to the responsible entity;
- that a copy of submissions must be given to the chief executive;
- the day by which submissions may be made, that is at least 20 business days after the notice is published; and
- where the submissions may be given.

Consultation will be undertaken for a minimum of 20 business days and the final UWIR will be submitted within 10 days of the three years anniversary date of the initial UWIR. COI will provide a copy of the report to any person who requests a copy.

Petroleum and Gas (Production and Safety) Act 2004

Under the *Petroleum and Gas (Production and Safety) Act 2004* the petroleum tenure holder may take or interfere with groundwater to the extent that it is necessary and unavoidable during the course of an activity authorised for the petroleum tenure. The *Petroleum and Gas (Production and Safety) Act 2004* requires tenure holders to comply with underground water obligations specified in the Water Act.

Environmental Protection Act 1994

Potential impacts on groundwater are managed through an adaptive regime through both the *Environmental Protection Act 1994* (EP Act) and the UWIR process under the Water Act.

The requirements of section 126A and 227AA of the EP Act are complimentary to the requirements for the UWIR in section 376 of the Water Act. It is anticipated that the information supplied with the environmental authority application will be utilised and built upon for the responsible entity's submission of the UWIR. Equally, any relevant information contained within an approved UWIR may be utilised as part of an environmental authority application. An environmental authority may be amended in response to the contents of an UWIR. This framework ensures there is sufficient monitoring, collection and review of information for ongoing adaptive management of groundwater impacts due to the resource sector's statutory right to take underground water.

Geological Summary

Geological Setting

The Late Carboniferous to Middle Triassic Galilee Basin (**Figure 2**) is an intracratonic, dominantly fluvial, basin that extends over an area of approximately 247,000km² in central Queensland. The following structural and depositional overview has primarily been summarised from Hawkins and Green (1993).

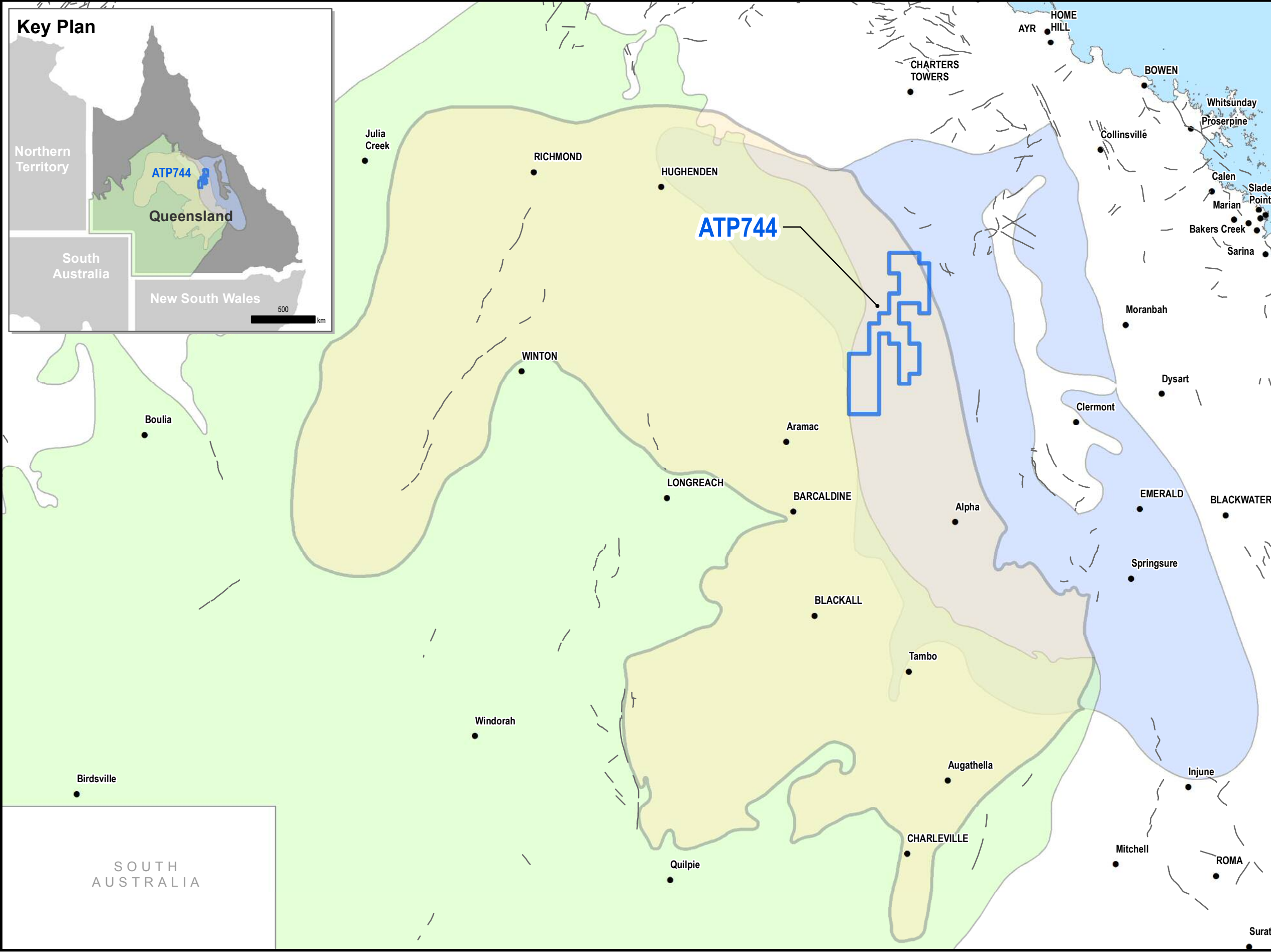
The Galilee Basin is generally divided into northern and southern areas by the east-west Barcardine Ridge. Up to 3,000m of dominantly fluvial sediments have been deposited within three main depocentres; the Koburra Trough in the east, the Lovelle Depression in the west and the Powell Depression in the south. ATP744P lies within the eastern part of the Koburra Trough.

The basin overlies the Late Devonian – Early Carboniferous Drummond Basin in the east, Devonian Adavale Basin in the south and terminates against shallow basement rocks including the Proterozoic Mount Isa Inlier in the northwest, the Early Palaeozoic Lolworth-Ravensworth Block in the northeast and early Paleozoic Maneroo Platform in the south (Hawkins and Green, 1993). Strata from the Galilee Basin is exposed along the eastern and north-eastern margin. Elsewhere the basin is unconformably overlain by Jurassic-Cretaceous sediments of the Eromanga Basin. The Eromanga Basin is largely absent over the area of ATP744P. The Late Permian-Middle Triassic strata of the Galilee Basin is continuous with the Bowen Basin across the Springsure Shelf and Nebine Ridge in the south.

Basin initiation occurred when crustal extension during the Late Carboniferous reactivated older faults in underlying basins. Quartz-rich braided-stream sediments (Lake Galilee Sandstone) were initially restricted to the Koburra Trough in east. By the Early Permian widespread fluvial and lacustrine sedimentation (Jochmus and Jericho Formations) had extended to the other depocentres in the south and west. Widespread development of peat swamps resulted in the deposition of the Aramac Coal Measures in the western part of the Koburra Trough and Lovelle Depression.

E-W compression at the end of the Early Permian resulted in reverse fault movement, uplift and erosion resulting with a basin-wide mid-Permian unconformity. Thermal subsidence and subsequent foreland loading during the Late Permian led to widespread deposition of coal-bearing sediments of the Betts Creek beds across the northern part of the basin, while distal fluvial-deltaic, coastal plain and shallow marine sediments (Bandanna Formation, Colinlea Sandstone and Black Alley Shale) were deposited in the south. Widespread fluvial sedimentation (Rewan Group) continued to be deposited into the Early Triassic. Uplift during the Middle Triassic led to deposition of quartz-rich braided stream sediments (Clematis Group, Warang Sandstone) and widespread fluvial and lacustrine sediments (Moolayember Formation). Sedimentation ended with an E-W compressional event during the Late-Triassic. Folding, uplift and widespread erosion resulted in a basin wide mid-Triassic unconformity at the top of the Galilee Basin sequence.

Underground Water Impact Report



- Legend**
- Fault
 - Galilee Basin
 - Eromanga Basin
 - Drummond Basin
 - Comet Ridge ATP744

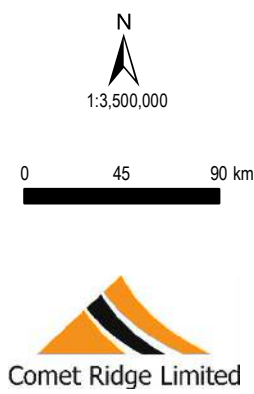


Figure 2:
Structural Elements
of the Galilee Basin

Coal development within the Galilee Basin is limited to the Permian. There are two major coal-bearing units within the basin; the Early Permian Aramac Coal Measures and the Betts Creek beds. The Aramac Coal Measures are restricted to the western Koburra Trough and Lovelle Depression. The Aramac Coal Measures have not been intersected in any exploration wells drilled within ATP744P, indicating the extent is restricted to west of the tenure area. The Late Permian Betts Creek beds are widespread throughout the northern part of the basin. The Betts Creek beds are equivalent to the Bandanna Formation in the Bowen Basin. The Aramac Coal Measures and Betts Creek beds are separated by the mid-Permian unconformity.

The stratigraphy of the Galilee Basin is shown in **Figure 3**.

BASIN	AGE	Lovelle Depression	Koburra Trough	Powell Depression
GALILEE BASIN	Triassic	Moolayember Formation		
		Clematis Group		Clematis Sandstone/ Dunda Beds
		Rewan Group		
	Permian	Betts Creek Beds		Bandana Formation
				Black Alley Shale
				Colinlea Sandstone
	Early Permian to Late Carboniferous	Aramac Coal Measures		Not present
		Jochmus Formation		
		Jericho Formation		
		Not present	Lake Galilee Sandstone	Not present
Basement		Thompson Orogeny Metasediments	Drummond Basin	Adavale Basin

Figure 3: Stratigraphy of the Galilee Basin.

ATP744P Geology

ATP744P is located in a geologically and hydro-geologically diverse area. The tenure area is located within the Koburra Trough, which is the most significant structure in the north eastern part of the basin.

Surface geology

The surface geology of the permit contains widespread Quaternary alluvium and Tertiary sediments that surround outcropping Triassic aged sediments of the Galilee Basin. The Dundas beds (correlative equivalent to Clematis Group) crop out along the eastern margin in the south east of ATP744P. The Moolayember Formation and Clematis Group crop out along the eastern margin and in the central part of the tenure area. The more extensive Warang Sandstone (basin margin facies) crops out along the western margin in the north of the tenure area. The Betts Creek beds also crop out over a small area in the north. Drummond Basin sediments crop out in the north-eastern part of the tenure area.

to the east of the margin of the Galilee Basin. Eromanga Basin sediments are absent from the tenure area and crop out to the west of the tenure area boundary (**Figure 4**)

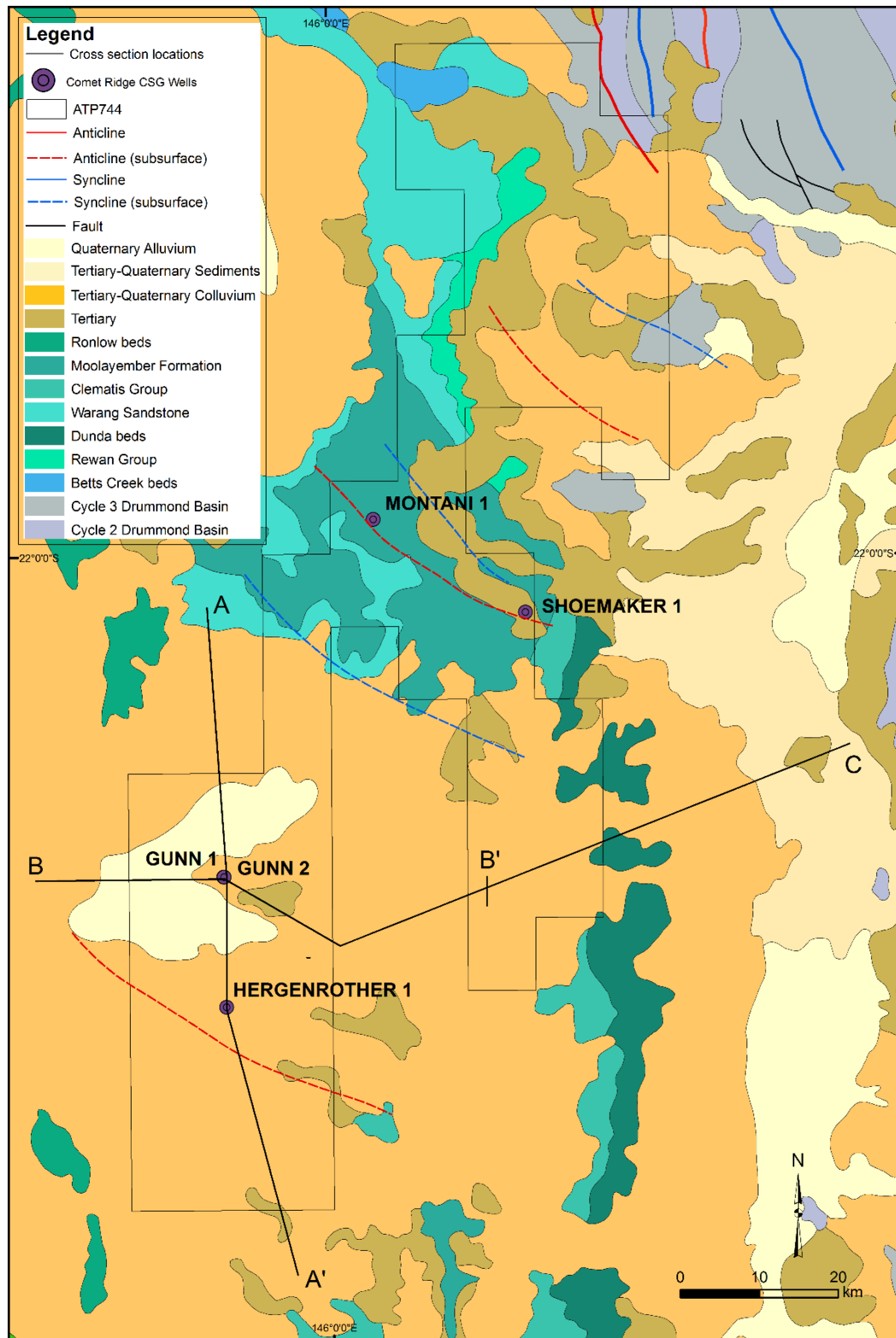


Figure 4: Surface geology map of ATP744P, showing locations of schematic cross-sections.

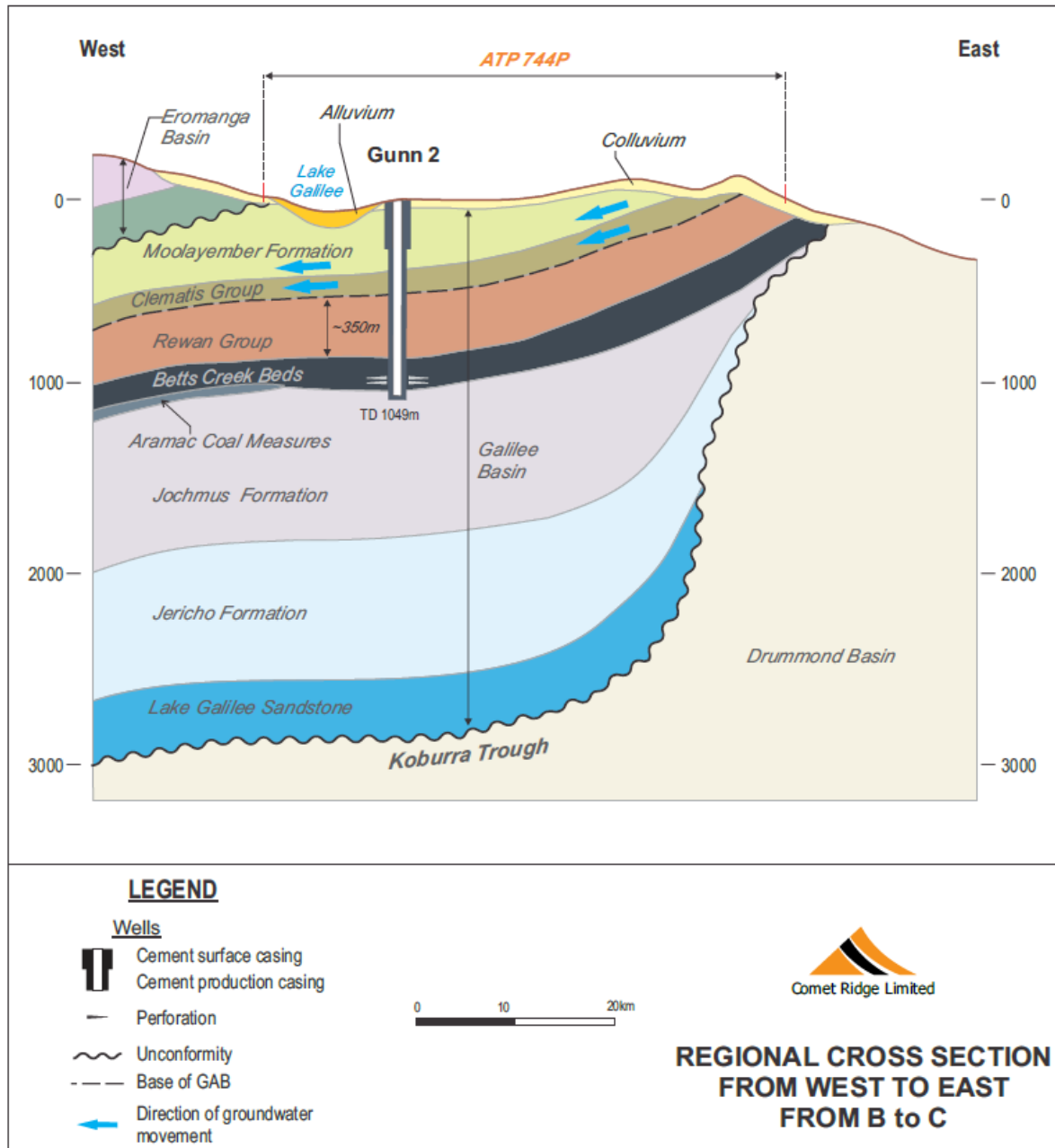


Figure 5: Regional Schematic geological cross-section from west to east across ATP744P

Subsurface geology

This section draws on information largely sourced from the RPS 'Galilee Basin - Report on the Hydrogeological Investigations' on the permit in which Comet Ridge is undertaking CSG exploration activities.

The subsurface geology comprises Late Carboniferous to Middle Triassic sediments of the Galilee Basin which unconformably overlie the Late Devonian to Early Carboniferous Drummond Basin (**Figure 5 & Figure 8**). The Drummond Basin forms basement to the Galilee Basin within the permit area. The Eromanga Basin sequence is largely absent within the bounds of the tenure.

The subsurface geology can be illustrated by stratigraphic units intersected in petroleum exploration well ENL Lake Galilee #1 (**Table 1**) (QPED, 2011).

Table 1: RPS Type stratigraphy for ATP744P – well Lake Galilee #1

Depth to formation top (m bKB)	Depth to formation bottom (m bKB)	Basin	Formation name	Age
5	53	Surficial deposits	Sediments	Cenozoic
53	354	Galilee Basin sequence	Moolayember Formation	Middle Triassic
354	460		Clematis Group	Middle Triassic
460	539		Dunda beds	Early Triassic
539	850		Rewan Group	Early Triassic
850	1,060		Betts Creek beds	Late Permian
1,060	1,815		Jochmus Formation	Late Carboniferous to Early Permian
1,815	2,578		Jericho Formation	
2,578	2,841		Lake Galilee Sandstone	
2,841	-	Drummond Basin	Natal Formation	Early Carboniferous

Target Formation

The target formation for coal seam gas exploration within ATP744P is the Betts Creek beds. The Betts Creek beds predominantly comprises high volatile bituminous coal seams that are interbedded with mudstone, siltstone, sandstone and carbonaceous shale. Seven coal seams have been interpreted within the Betts Creek beds within the tenure area including the A, B, C, C1, D, D1 and E seams (**Figure 6**). The Betts Creek beds sub-crop in the north-eastern area of ATP744P and to the east of the south-eastern leg of the permit area. Depth to top of the Betts Creek beds ranges between 0 to 1000m. The Betts Creek beds gradually deepen to the west across the permit area (**Figure 7**). In the vicinity of the proposed pilot program coal seams are greater than 800m in depth. Net thickness of coal seams ranges between 15-24m across the tenure area. The target seam for the Gunn Pilot production program is the C1 seam only. The C1 target seam has a net thickness of 3 to 8m and an average gas content $>4.0\text{m}^3/\text{t}$ on a dry ash free basis. The Early Triassic aged Rewan Group conformably overlies the Betts Creek beds. The Betts Creek beds unconformably overly the Early Permian Jochmus Formation.

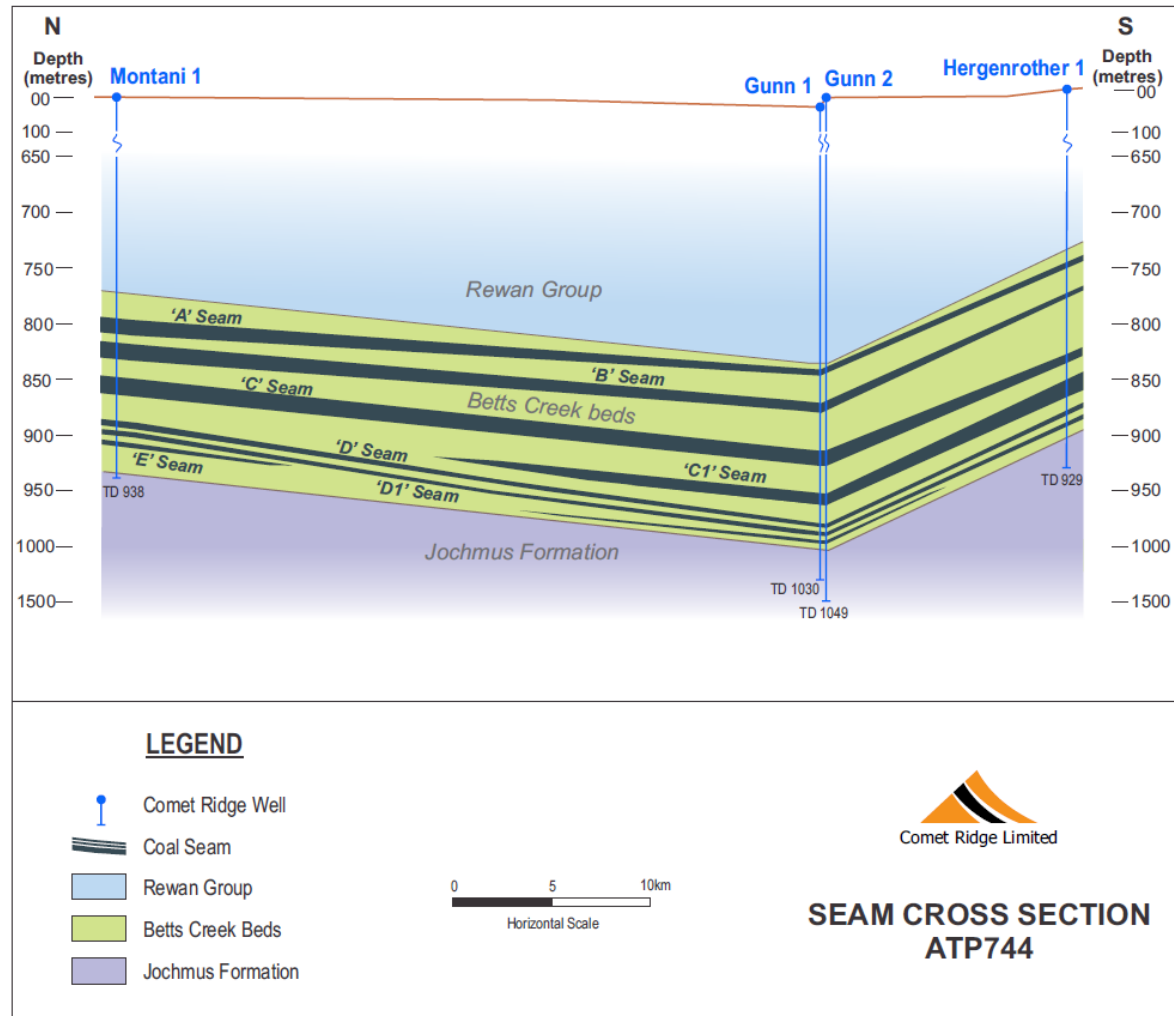
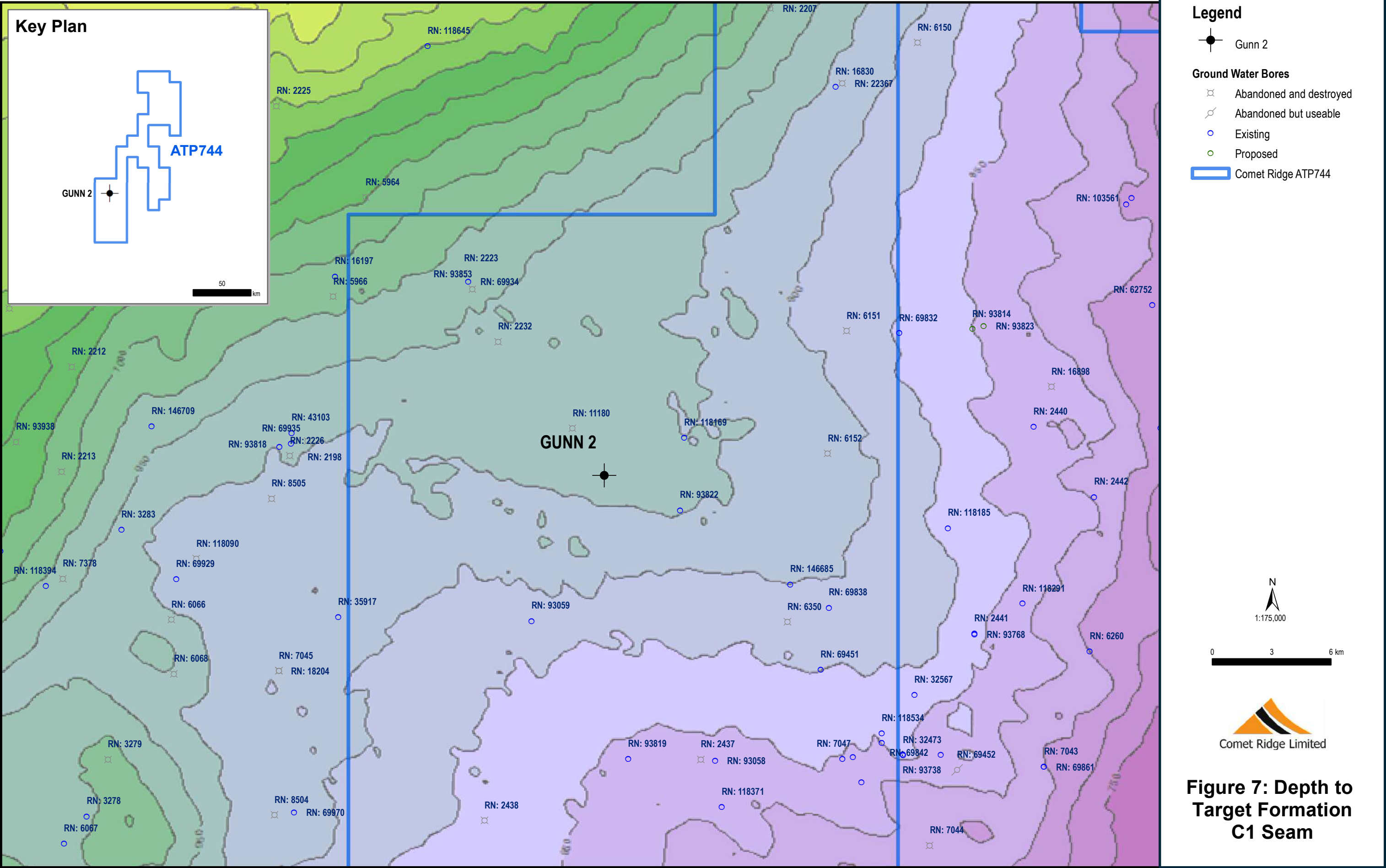


Figure 6: Schematic cross-section of coal seams within the Betts Creek beds in ATP744P

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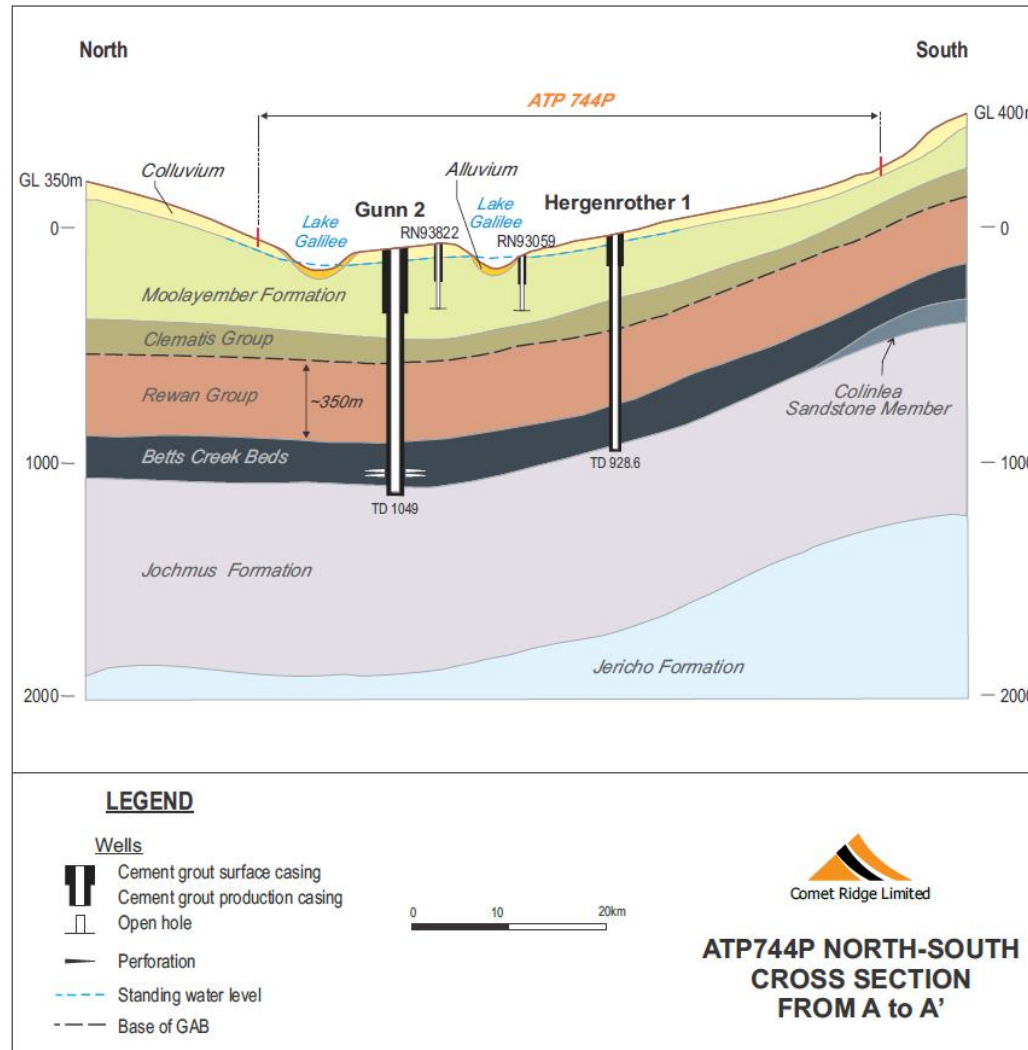


Figure 8: Schematic cross section from north to south across ATP744P showing Rewan Group separating underlying Betts Creek beds from overlying Clematis Group and Moolayember Formation by >300m

The Rewan Group mainly comprises red to green mudstone sandstone and minor volcanolithic conglomerate and is a regional significant confining unit (RPS, 2012). The Rewan Group is over 300m in thickness in the vicinity of the proposed pilot program which confines and separates the Permian Betts Creek beds from the locally significant Triassic aquifers of the Clematis Group and Moolayember Formation. **(Figure 8)**

Geological Structure

A series of NW-SE trending anticlines and synclines have been mapped on seismic surveys across the permit area and minimal faulting is observed on surface mapping **(Figure 4)**. Faulting interpreted on seismic surveys is primarily associated with basement rocks of the Drummond Basin **(Figure 10)**. Significant structural features have been mapped outside the permit area to the north-east **(Figure 4 & Figure 10)**.

Structuring associated with the Late Permian coal measures is generally broad and low relief and is associated with compressional events occurring during the mid-late Triassic. The Gunn #2 well is located on the north eastern flank of a broad anticlinal structure named the Hergenrother Nose **(Figure 7)**.

In the vicinity of the proposed pilot there is very little structure seen on seismic surveys. Small scale faults are associated with the Betts Creek beds, however these are interpreted to be confined to the coal seam interval and are not interpreted to extend into the overlying Triassic aquifers or underlying sediments **(Figure 9)**.

There are no mapped large scale faults to suggest connection between the Betts Creek beds interval with overlying Triassic aquifers of the Clematis Group or Moolayember Formations in the vicinity of the proposed Gunn Pilot **(Figure 9)** or within the tenure area **(Figure 10)**.

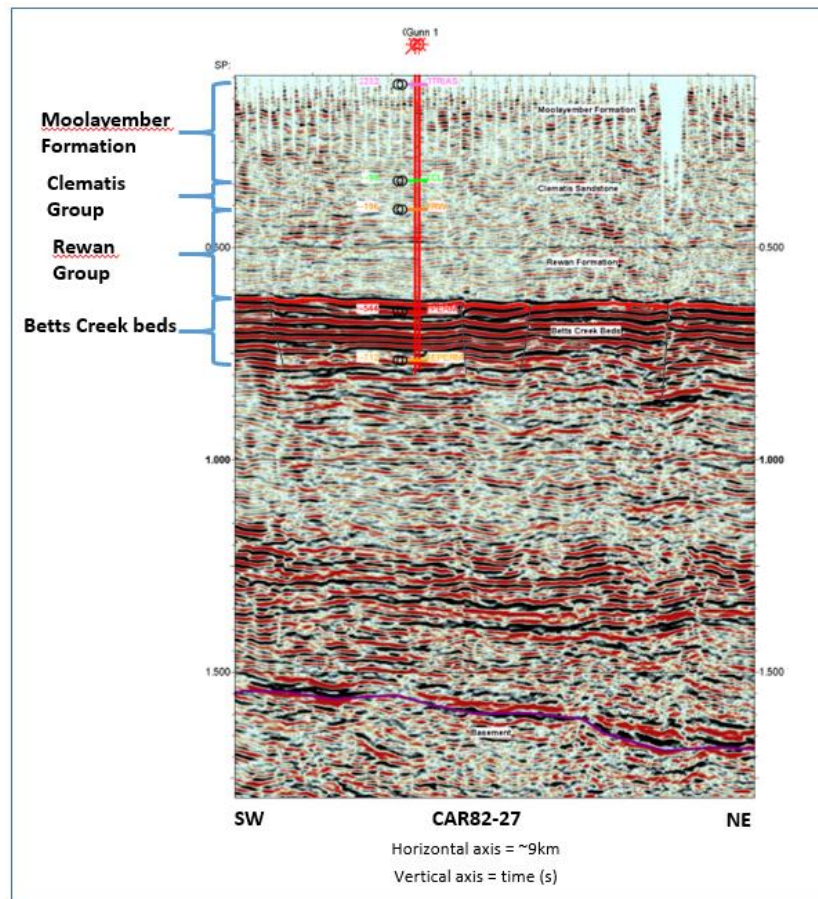


Figure 9: Northeast striking seismic line in vicinity of Gunn # 2 (Carmichael SS CAR82-27)

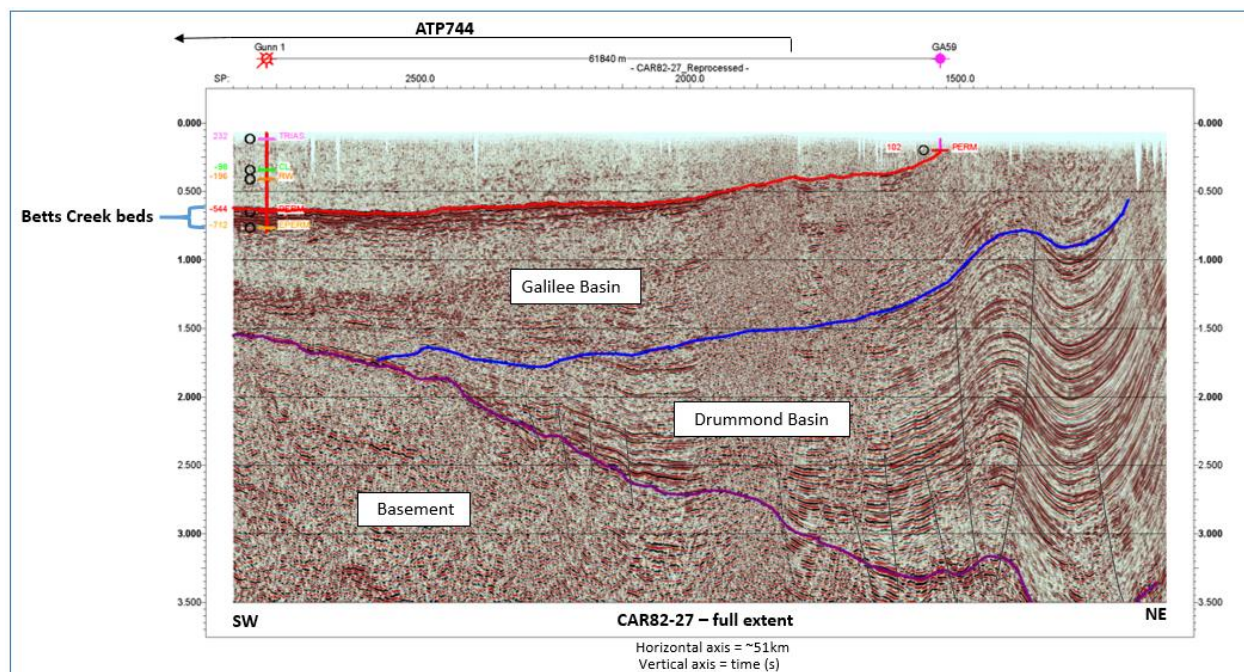


Figure 10: Northeast striking seismic line showing minimal structure and faulting within permit area (Carmichael SS CAR82-72)

Project Information

ATP744P was granted to Comet Ridge for a 12 year period, effective from 1 November 2009. Exploration activities to date have focussed on evaluating and delineating coal seam gas resources within the Betts Creek beds of the eastern Galilee Basin. Exploration activities have included four exploration wells, one appraisal well and a 252km 2D seismic survey. As a result of this exploration the Gunn Project Area has been defined in the south western leg of ATP744P (**Figure 11**)

In late 2012, Comet Ridge drilled and completed the Gunn #2 appraisal well located approximately 70m west of Gunn #1 exploration well (**Figure 11**). Gunn #2 was drilled as a twin to the Gunn #1 to undertake additional flow testing of coal seams within the Gunn Project Area. Four intervals were tested including two intervals that had not been previously tested. All four intervals demonstrated good to very good permeability.

Gunn #2 was drilled to total depth of 1050m and intersected 16.2m of net coal within the Betts Creek beds. The depth to the top of the Betts Creek beds was 835.5mRT. Six (6) individual coal intervals were intersected including A, B, C, C1, D and D1 seams.

The completion style for the well was designed to isolate the coal seams from overlying and underlying permeable sandstones within the Betts Creek beds and isolate overlying sandstone aquifers within the Clematis Group and Moolayember Formation from the Betts Creek beds. This completion also allowed perforation of the C1 seam to ensure water was only produced from the C1 seam interval.

The completion diagram for Gunn #2 is shown in **Figure 12**.

Coal seams within the Betts Creek beds are inter-bedded by sandstones and impermeable mudstones. Some sandstone intervals within the Betts Creek beds have shown to be permeable and comprise formation water.

The Clematis Group and Moolayember Formation comprise the basal part of the Great Artesian Basin (GAB) in the tenure area. Aquifers within the Clematis Group form the main groundwater source for agricultural and domestic use within the region. The Clematis Group is separated (>300m) from the underlying Betts Creek beds by a regionally significant confining unit, the Rewan Group (**Figure 8**).

The C1 seam was intersected between 950.2 and 956.8m and is bounded above and below by impermeable mudstone. The well was perforated over a four metre interval from 952.5 to 956.5m to ensure that water was only being produced from the C1 seam reservoir (**Figure 12**).

The well was completed using industry standards and in compliance with Department of Natural Resources and Mines (DNRM) Code of Practice for Well Construction with steel casing from surface to 1042.57mDT which has been pressure sealed with cement to surface. Gunn #2 completion technique has allowed:

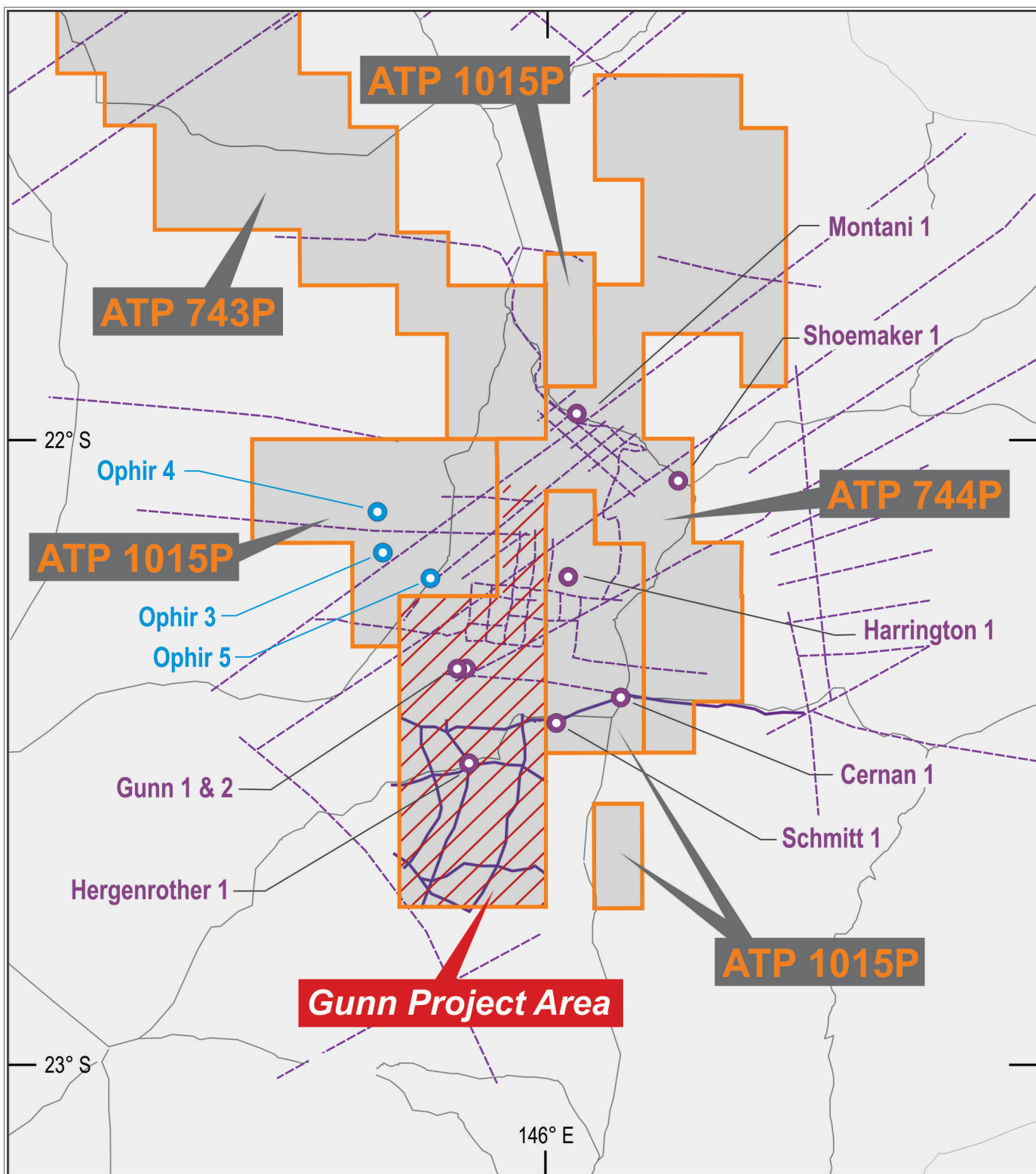
- Triassic Great Artesian Basin aquifers to be isolated behind steel casing which has been pressure sealed with cement.
- isolation of the C1 coal seam from overlying and underlying intra-bedded permeable sandstone and other coal seams within the Betts Creek beds and;

- Perforation of the C1 coal seam only to ensure water was only produced from this coal interval.

A cement bond log was run after cementing was completed evaluate the integrity of the cement with the casing of the well. The cement bond log confirms the cement job in Gunn #2 has resulted in complete isolation of the Betts Creek beds from the Clematis Group and Moolayember Formation.

An extended production test was carried out on Gunn #2 between January and February 2013 and September and October 2013. The objective of the production test was to provide information on the completion methodology for a full pilot scheme and to obtain good quality water samples from the Betts Creek beds target coal.

The UWIR also focuses on a five-spot production pilot program centred around Gunn #2 well (refer **Figure 13**). At this juncture all wells forming part of the proposed five-spot production pilot program are planned to be completed in the same style as Gunn #2. The C1 seam will be perforated and isolated from all other intervals allowing water and gas production from this interval only. Commissioning and water production from the proposed five-spot production pilot is expected to commence on completion of the drilling and construction of the pilot. Modelling for the proposed future five spot pilot has been assigned an assumed production start date of 1 October, 2017 for this reporting period. The underground water impacts of both the completed production testing on Gunn #2 and the proposed five-spot pilot have been modelled and are considered in this report.



LEGEND

-  Comet Ridge Tenement
-  Gunn Project Area
-  Comet Ridge well
-  QER well
-  Comet Ridge seismic line
-  Seismic line



0 25 50km



Figure 11
**ATP744, ATP743 & ATP1015
 TENURE
 SEISMIC & WELLS**

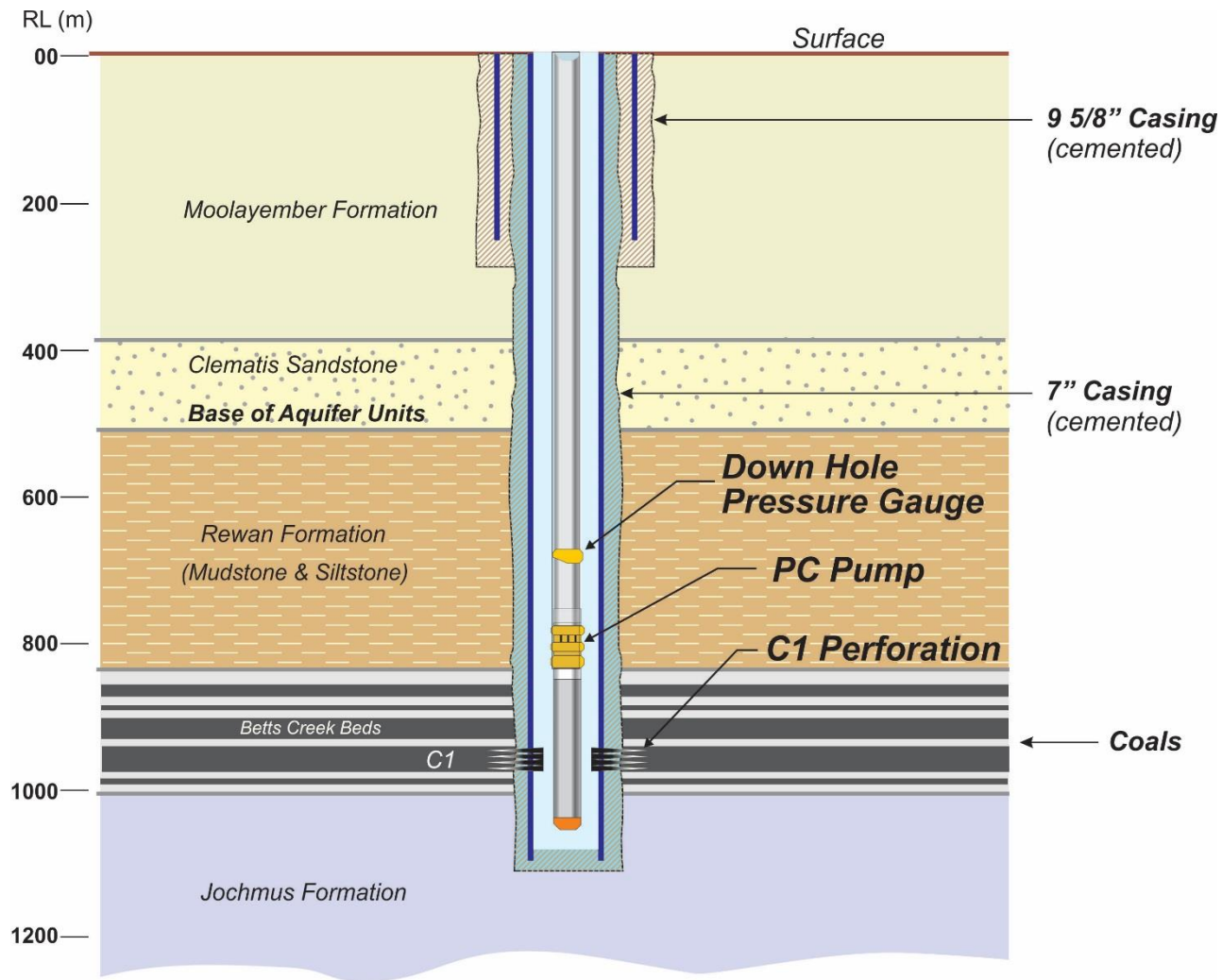
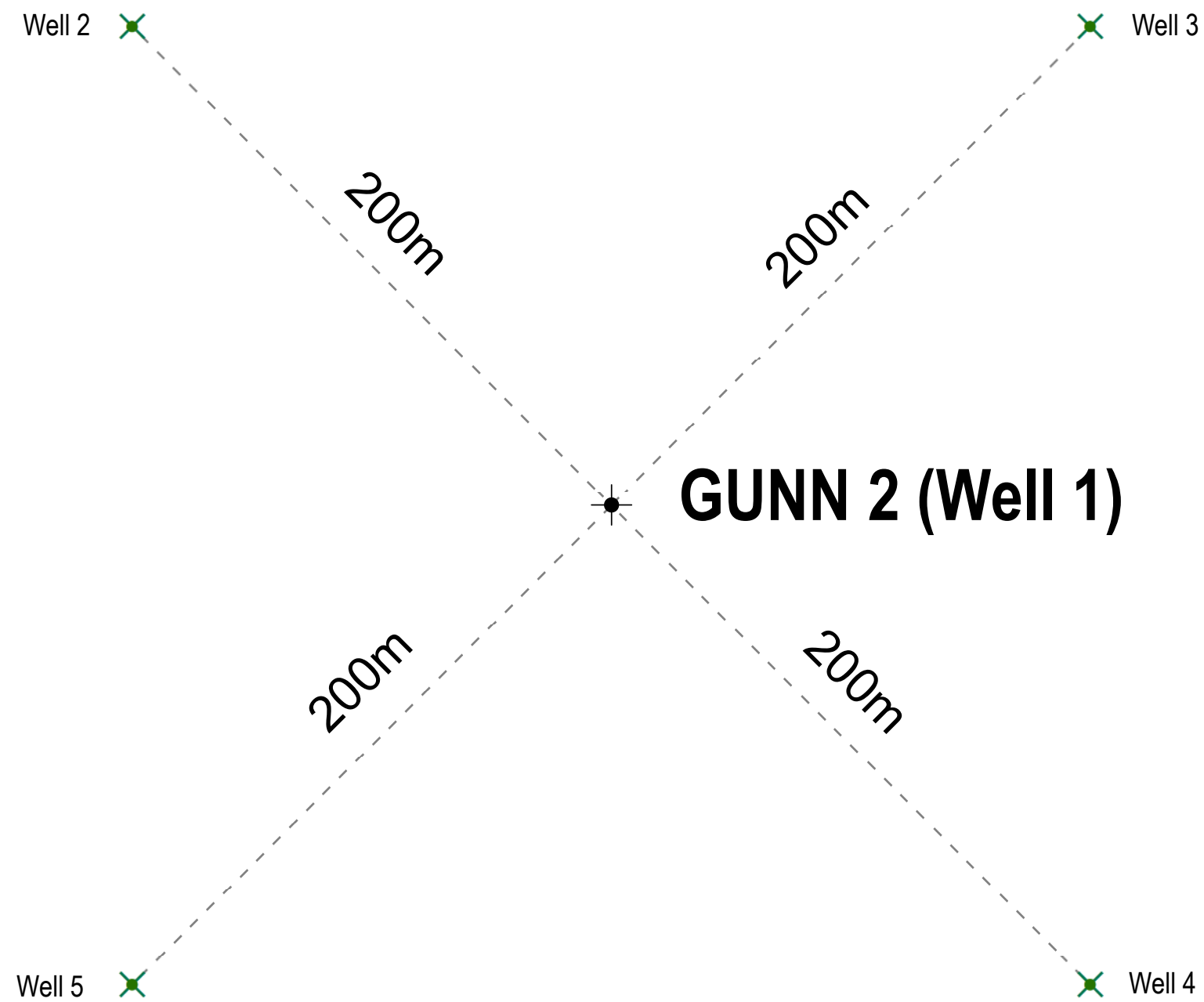
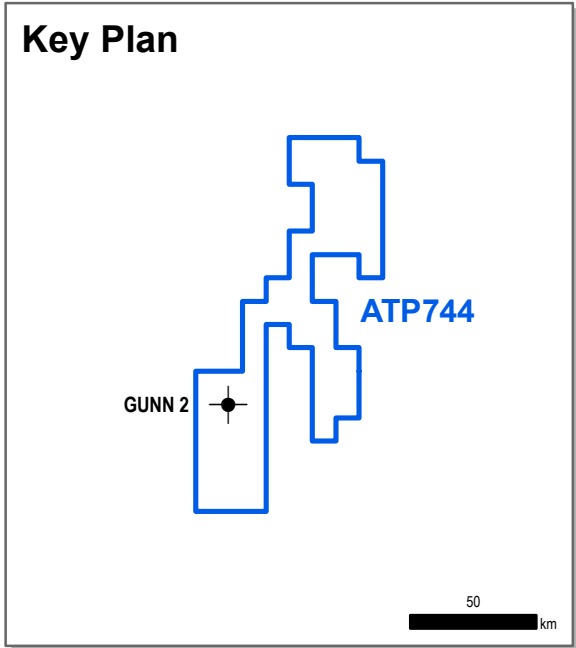


Figure 12: Gunn #2 production well completion design



- Legend**
-  Gunn 2 (Well 1)
 -  Production Test Bores
 -  Comet Ridge ATP744

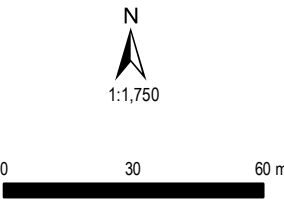


Figure 13: Gunn Pilot Well Configuration

Part A: Underground Water Extraction

Gunn #2 EPT – Quantity of water already produced

To date, production testing from the C1 coal seam of the Betts Creek beds at Gunn #2 has occurred over two periods. Water was extracted using a progressive cavity pump (PCP) set at 969.95m which was powered by a diesel generator at the surface. The volume of water produced from the well was measured using a magnetic flow meter that measured and recorded volume in barrels per day and provided a cumulative volume. This data was relayed in real time via telemetry. In addition, down hole pressure monitoring was carried out which allowed an accurate understanding of water level and therefore drawdown of the targeted seam.

Total water extracted was as follows:

- 11 January 2013 to 16 February 2013 - 8,609bbls or 1.37ML
- 9 September 2013 to 16 October 2013 - 7,553bbls or 1.2ML

Average water production was 0.034ML per day during the first production period. Total water production over both testing periods (total 81 days) was 2.57ML. During the initial testing period the water rate progressively increased over a period of several weeks, with the well reaching a stabilised production rate of approximately 400bbls/day (0.064ML/day) (**Figure 14**). Down hole pressure mimicked the water level trends during the production test. As the pump speed was increased water produced increased and standing water levels decreased as did bottom hole pressures.

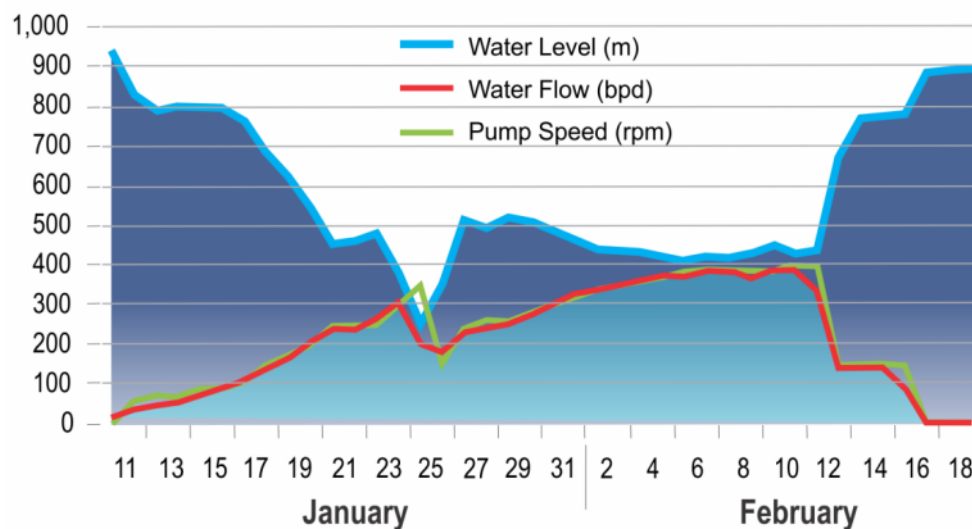


Figure 14: Gunn #2 extended production test 11 January 2013 to 16 February 2013-water level (m), water flow (bpd) and pump speed (rpm).

Gunn Pilot Reservoir Modelling – Quantity of water estimated to be produced over the next three years.

A reservoir simulation model for the proposed Gunn Pilot has been completed.

The key objectives of the simulation model were twofold:

- History matching of the Gunn #2 extended production test;
- To predict future water production rates for the proposed five-spot Gunn Pilot.

The reservoir modelling was conducted using Computer Modelling Group's (CMG) GEM simulation software. GEM is the industry's leading coal bed methane (CBM) simulator, as it can provide accurate early-time water and methane production predictions, as well as multi-component production predictions for enhanced CBM (ECBM) recovery.

The simulation was based on a 1 km by 1 km grid model for vertical wells. Grid cell size for the model was set at 20m. The top of coal was based on the top of coal for the C1 seam in the Gunn Project Area.

The pilot configuration for the modelling comprised 5 wells. The central well (Gunn #2) remains in the middle of the grid with the other 4 wells at 200m spacing's at NW, NE, SW and SE locations (**Figure 13**). Various sensitivities were run on permeability and skin parameters. The well drawdown was restricted and a minimum flowing bottom hole pressure was also set.

Start date of the proposed five spot pilot program has been assumed to be 1 October 2017 for the purposes of this three year reporting period. The simulation modelled predicted water production from the proposed Gunn Pilot over three years from the arbitrary start date.

Modelled predicted water production and cumulative water production are shown graphically in **Figure 15**. The total volume of water expected to be produced from the five wells after three years of production (1/10/2017-1/11/2020) is approximately 22 ML, refer **Table 2**.

Table 2: Estimated quantity of water to be produced in the next three years.

Year	Estimated produced water in ML per year/well					
	Well 1 (Gunn #2)	Well 2	Well 3	Well 4	Well 5	Total all wells
Oct 2017 to Oct 2018	3.08	3.86	3.96	3.96	3.86	18.70
Oct 2018 to Oct 2019	0.37	0.43	0.44	0.44	0.43	2.10
Oct 2019 to Oct 2020	0.17	0.19	0.20	0.20	0.19	0.94
Total per well	3.61	4.48	4.59	4.59	4.48	21.74

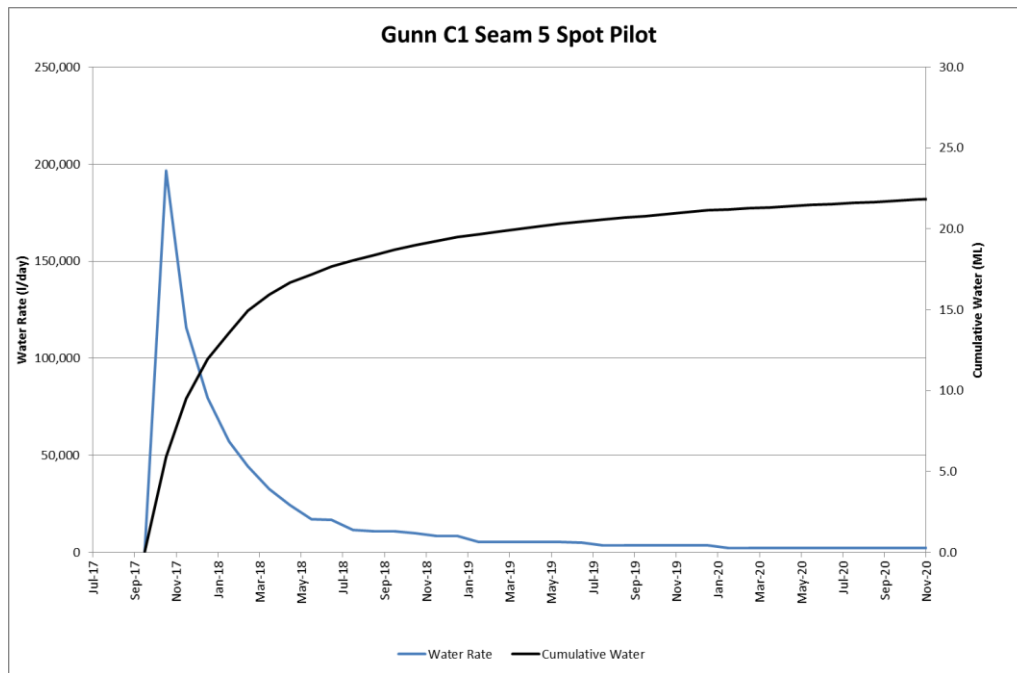


Figure 15: Modelled water rate and cumulative water production of the proposed pilot wells over three years from 1/10/2017.

Part B: Aquifer and Underground Water Flow and Levels

Hydrogeology of ATP744P

The hydrogeological significant formations of ATP744P included the following:

- the Quaternary Alluvium and Tertiary Sediments;
- Moolayember Formation, Clematis Group;
- Dunda beds;
- Rewan Group;
- Betts Creek beds;
- Jericho Formation and Jochmus Formation.

Refer to **Figure 3** and **Table 1** for additional information on the stratigraphy of these formations. Quaternary alluvium and Tertiary sediments are widespread over the tenure area. Triassic aged units of the upper Galilee Basin including intervals of the Moolayember Formation, Clematis Group and Dundas beds form part of the basal section of the Great Artesian basin (GAB) within the tenure area. The Early Triassic Rewan Group underlies these units and can be over 300m in thickness over the tenure area. The Rewan Group is considered a regionally significant confining unit (Habermehl, 1980 & Queensland Herbarium, 2017).

In ATP744P, the Betts Creek beds are the target formation for coal seam gas production. The Permian Betts Creek beds are confined and separated from the overlying Triassic age aquifers of the GAB by the Rewan Group, which is a regional aquitard. (**Figure 16**).

The lower Galilee Basin section comprises Late Carboniferous to Early Permian units of the Lake Galilee Sandstone, Jericho Formation and Jochmus Formation, respectively. The Jochmus Formation unconformably underlies the Betts Creek beds in the tenure area.

The Jericho Formation is over 750m below the Jochmus Formation and no wells within the ATP other than oil and gas exploration wells penetrate this formation. Therefore the Jericho Formation is not considered further in this report. The Lake Galilee Sandstone is also not considered further in this report. The Drummond Basin forms basement to the Galilee Basin and due to its depth is also not considered further in this report.

In the permit area, the Rewan Group separates the GAB aquifers in the upper Galilee Basin from the underlying Permian and Late Carboniferous aquifers and water-bearing units of the lower Galilee Basin (**Figure 16**).

It is considered very unlikely that the proposed five-spot pilot will directly interfere with locally significant aquifers, specifically, the Moolayember Formation and Clematis Group as they are typically separated by at least 300m from the targeted Betts Creek beds by the Rewan Group, a regionally significant confining unit. Refer **Figure 16**.

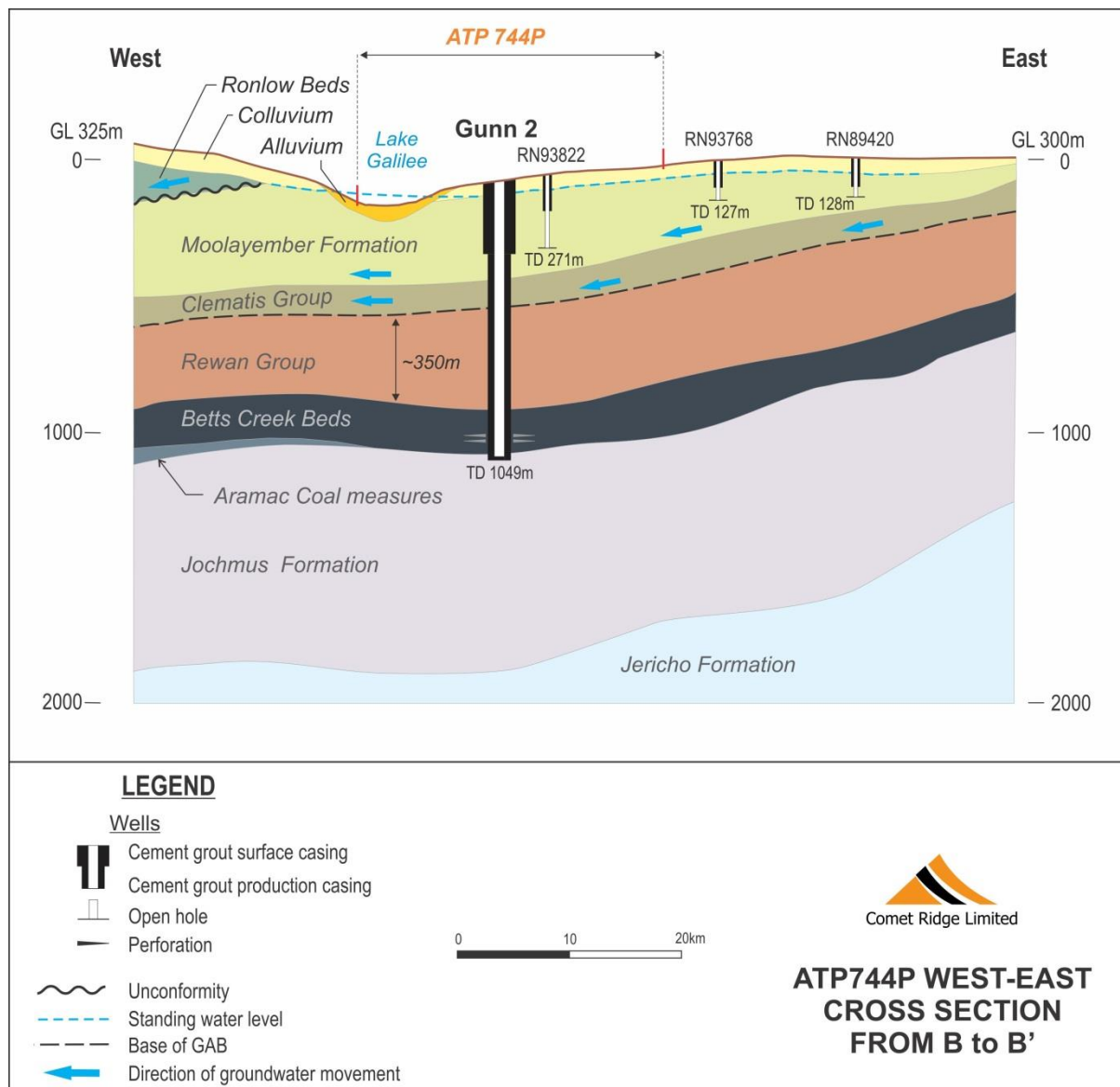


Figure 16: Schematic geological cross-section across ATP744P, showing Gunn #2 appraisal well, nearby groundwater bores and groundwater flow direction.

Aquifers

Quaternary Alluvium and Tertiary Sediments

Unconsolidated sediments were not identified in the Gunn #2 log (and therefore may not be present at the site of production testing) however, Quaternary alluvium and Tertiary sediments are generally widespread across the permit surface (RPS 2012). The Quaternary alluvium and Tertiary sediments are thin relative to the underlying sequences.

Shallow unconfined groundwater is found in the alluvial deposits along the major river systems and creeks that drain the Galilee Basin study area (RPS 2012). Tertiary sediment aquifers host some

appreciable individual supplies with both sub-artesian and artesian characteristics on the eastern margin of the Galilee study area (RPS 2012).

Moolayember Formation

The Moolayember Formation is a Middle to Late Triassic aged formation that is commonly present directly beneath the Quaternary alluvium and Tertiary sediments. The Moolayember Formation is dominantly mudstone and siltstone with interbeds of lithic sandstone and quartz sandstone (Olgers 1970). Whilst only a handful of the existing wells within the region have been assigned an aquifer it is believed that the majority of the surrounding groundwater bores are likely tapping into this formation. Refer **Tables 3 and 4** below.

Clematis Group

The Clematis Group is an Early to Middle Triassic aged formation that directly underlies the Moolayember Formation. The Clematis Group comprises fine to coarse quartzose sandstone, with conglomerate beds and interbedded siltstone and mudstone (Vine 1972).

Water can be extracted from the Triassic formations of the Galilee Basin (Moolayember Formation and Clematis Group) at relatively shallow depths (Queensland Department of Natural Resources and Mines 2005). These aquifers, where they are tapped, are accessed in the eastern portion of Galilee Basin study area where these aquifers sub crop beneath thin Quaternary alluvium and Tertiary sediments at shallow depths (RPS 2012). However, as the water quality is very variable and supplies are dominantly sub-artesian and low yielding (<1L/s) this unit has provided only stock and domestic supplies (Queensland Department of Natural Resources and Mines 2005).

Dunda beds

The Dunda beds is an Early Triassic formation that comprises lithic to quartz sandstone with thick intervals of mudstone and siltstone (Olgers 1970). The Dundas beds are considered correlative with the upper Rewan Group and are recognized to be the upper facies of the Rewan Group in outcrop areas. This formation has only been identified in the stratigraphic records for a few bores and was not identified in the vicinity of production testing.

Rewan Group

The Rewan Group is an Early Triassic aged formation that comprises lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanolithic pebble conglomerate (at base) (RPS 2012). Available literature (including descriptions of the unit from coal seam gas wells drilled within ATP744P) suggest the formation is dominated by fine grained sediments which is generally characterised as an aquitard, separating underlying Permian sediments (including the coal bearing Betts Creek beds) and the overlying sandstones of the Dundas beds and Clematis Group (Queensland Herbarium, 2017). This formation is locally more than 300 metres thick. Silicification and clay alteration has significantly reduced the porosity and permeability in this formation and no significant aquifers exist (Queensland Department of Natural Resources and Mines 2005). The Rewan was deposited in a fluvial-lacustrine environment and is considered a regionally significant confining unit.

The Triassic aquifers of the GAB are confined below by the Rewan Group (Habermehl, 1980). As a result, this formation is expected to form a barrier between the targeted Betts Creek beds and other significant aquifers of the region.

Betts Creek beds

The Late Permian Betts Creek beds comprise carbonaceous interbedded feldspathic lithic sandstone (Olgers 1970). Regionally, the Permian Betts Creek beds (and its equivalents) yield sufficient groundwater to be classified as water-bearing sediments (RPS 2012). However, fine grained low permeability strata are interspersed within the Betts Creek beds. Only two water bores have been identified to be sourced from sandstones within the Betts Creek beds within ATP744P since the initial UWIR was approved and therefore utilisation of this formation as an aquifer is considered minimal. Since the initial UWIR, eight mine monitoring bores have been drilled within coal mining permits which partially overlap the north-eastern part of ATP744P. These bores have been drilled to monitor water levels and water quality within the formation. All of the above mentioned wells are located over 70km from the proposed Gunn Pilot area.

Groundwater Bores

A review of the DNRM Groundwater Database was undertaken prior to lodgement of the initial UWIR in 2014 (Comet Ridge, 2014) to identify registered bores within the permit that have not been abandoned and destroyed. This report has included an update of the data from the DNRM Groundwater Database.

There are 106 registered water bores in ATP744P. Eighty five (85) registered/licensed bores in ATP744P have not been abandoned and destroyed (**Figure 17**).

It is believed that groundwater is primarily being used as water supply either for livestock watering or farm supply. It is believed that the groundwater is principally drawn from either Tertiary Sediments, Moolayember Formation or Clematis Group although there is currently insufficient data available to assign an aquifer to more than a handful of groundwater bores (**Appendix 1**). Despite this the Moolayember Formation and Clematis Group are considered to be the most relevant locally significant aquifers.

Within 20km of the Gunn #2 there are thirty three registered bores which have not been abandoned and destroyed. Excluding Gunn #2 nineteen of these have ground water level data and six have groundwater quality information, refer **Tables 3 and 4**. Of the six bores with groundwater quality data, only three are within ATP744P. These are active landholder bores for which a baseline assessment has been completed by Comet Ridge Limited as per requirements of the Baseline Assessment Plan for ATP744P. Refer **Table 4 and Appendix 1** for detailed information.

Groundwater Levels

As shown in **Table 3 and Appendix 2**, a limited number groundwater level observations have been recorded within ATP744P. Within 20km of Gunn #2 only a handful of bores with water level data can be assigned an aquifer (**Table 3**).

Table 3: Available Groundwater Level Data within 20km of Gunn #2

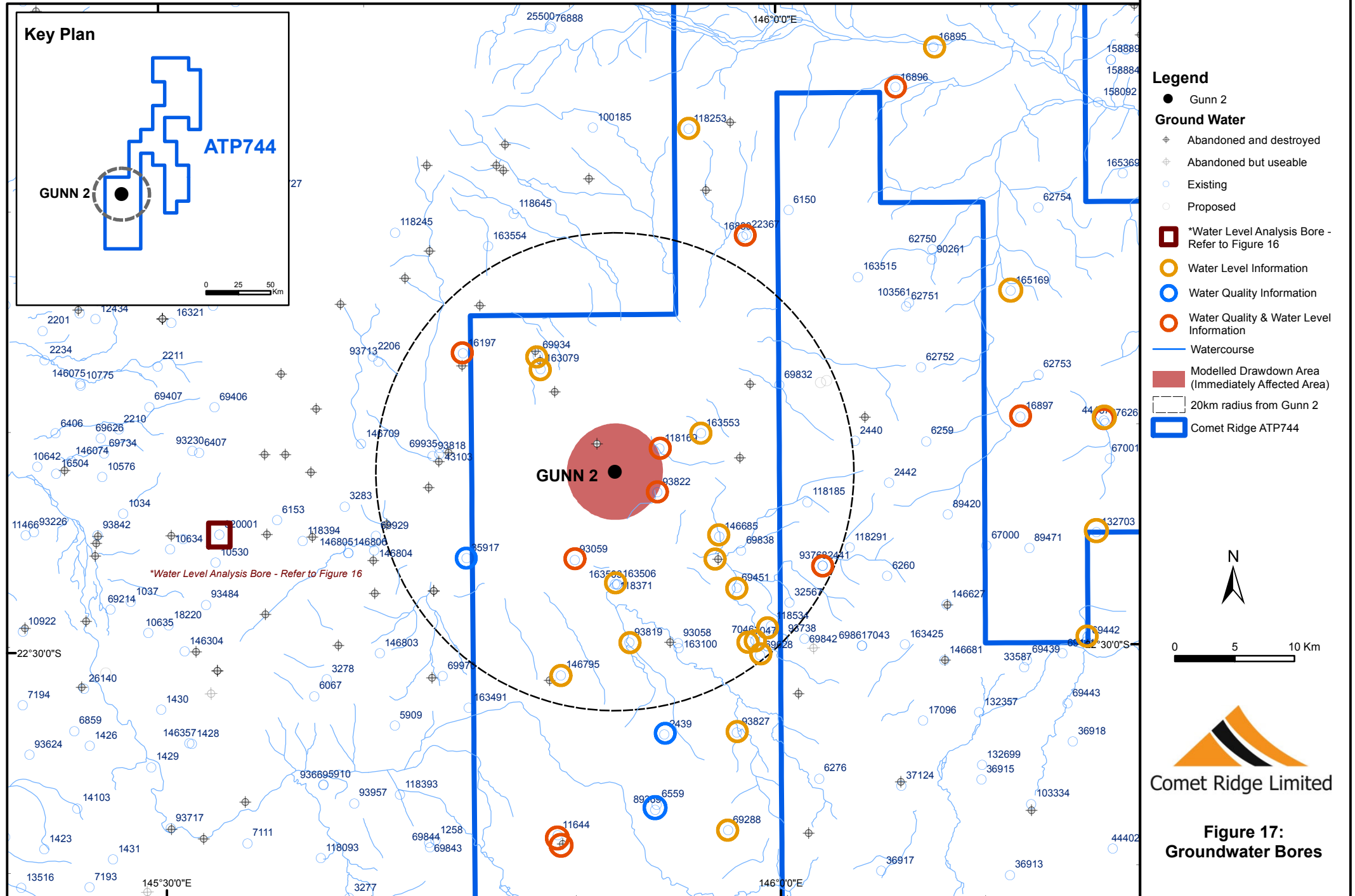
RN⁽¹⁾	Formation Name	Date	Groundwater Level (m bGL)	S.W.L (m)⁽²⁾
7046	Unknown	10/01/1983	-48.76	
7047	Unknown	10/01/1983	-33.52	
16197	Unknown	22/10/2012		-59.03
69451	Unknown	18/09/1987	-16.5	
69628	Unknown	11/01/1990	-36.58	
69934	Unknown	29/02/1992	-12.1	
93059	Moolayember Formation	26/05/2013		-9.8
93768	Unknown	09/10/2012		-42.25
93819	Clematis Group	05/07/2001		-8
93822	Moolayember Formation ⁽³⁾	10/10/2012		-60.71
118164	Unknown	06/04/2004		-54
118169	Moolayember Formation	25/05/2013		-46.95
118371	Unknown	8/06/2004		-7
146685	Clematis Group	13/08/2013		-12.6
146795	Clematis Group	02/10/2013		-30.4
163079	Unknown	12/12/2013		-18
163503	Clematis Group	05/10/2015		-7.9
163506	Moolayember Formation	09/07/2015		-6.8
163553	Clematis Group	15/08/2015		-18

⁽¹⁾ RN = DNRM Registration Number

⁽²⁾ SWL = Static Water Level. Negative values, m below ground level. Positive values, m above ground level

⁽³⁾ Interpreted aquifer by Comet Ridge Limited

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From the available data a detailed analysis of the movement of water within and between these aquifers is not possible. Additionally, as the existing information has only recorded individual water level for the different bores an analysis of change in water level and cumulative departure from average rainfall has not been undertaken. Ongoing monitoring of underground water level will be conducted, refer **Groundwater Monitoring** section below for the proposed monitoring details. As additional information becomes available, further data analysis will be undertaken and information revised.

An analysis conducted by RPS of the available groundwater level data in the general region indicates that the prevailing groundwater flow direction for ATP744P is to the west (RPS 2012). Additionally, the RPS report conducted a cumulative departure from average rainfall analysis for a number of wells within the Galilee Basin but not within ATP744P. The nearest data available for the analysis of the change in water level was conducted on RN 100320001 which is outside of ATP744P and approximately 35 km away from Gunn #2. These results are presented in **Figure 18**. It should also be noted that the aquifer RN 100320001 is sourced from within the Eromanga Basin, not the Galilee Basin.

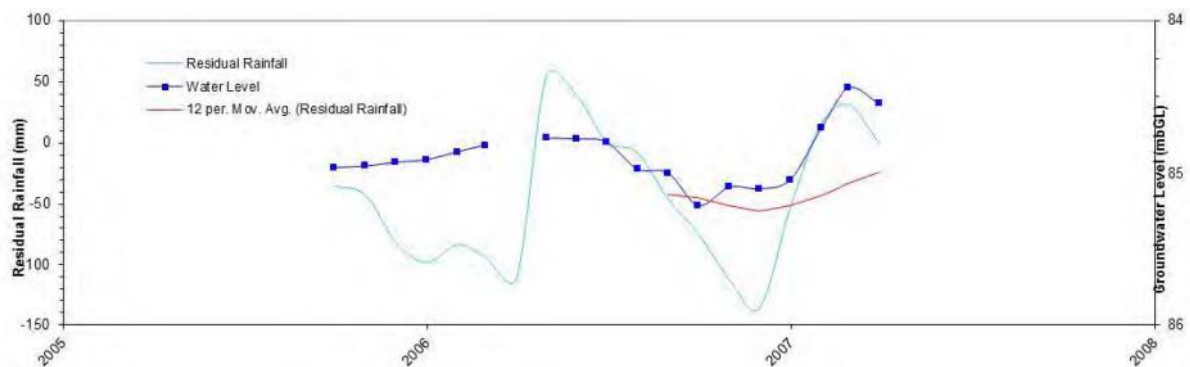


Figure 18: Cumulative departure from average rainfall, a plot of DERM Rainfall tipping gauge 600306A & (DERM GWDB bore RN 100320001 - Ronlow beds

The hydrograph for tipping gauge 600306A, attributed to the Ronlow beds, exhibits an increase in groundwater level of 0.42 m between September 2005 and March 2007. The hydrograph for this site indicates an increase in groundwater levels with an increase in residual rainfall between 2005 and 2007. However, the correlation is not close (RPS, 2012). This may also indicate that the recharging point for this aquifer is not closely located within the local area.

Table 4: Water Quality data (excluding DST samples) within 20km of Gunn #2

BAP within 20 Km Gunn #2																		
RN	Aquifer	Depth (m)	Conductivity (uS/cm)	pH	Hardness (mg/L Ca)	Alkalinity (mg/L)	SAR	TDS (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Bi-carbonate (mg/L)	Carbonate (mg/L)	Cl (mg/L)	F (mg/L)	Sulphate (mg/L)
16197	undifferentiated aquifer	514	462	7.76	<1	164		300	96	6	<1	<1	0.50	164	<1	42	0.2	<1
16197	Unknown	514	500	7.1	12	176		252.97	73.3		4.8	0		214.5		64	0.4	5
35917	Moolayember Formation		5150	7.6	800	150		4607.68	1442		256	39		183		2780	0.7	0
35917	Moolayember Formation		10000	7.2	1361	72		5767.97	1687		500	27		88		3510	0.7	0
35917	Moolayember Formation		10000	7.2	1298	8		569.62	1682		470	30		10		3510	0.7	0
93059	Moolayember Formation	246	40250	6.9	ND	122	ND	27100	8300	116	1540	1040	3.27	122	ND	14810	0.7	1230
93768	undifferentiated aquifer	127	5300	7.81	573	155		3440	902	16	114	70	0.1	155		1480	0.5	119
93822	Clematis Group ¹ / Moolayember Formation ²	271	12600	7.2	1470	61	ND	8632	2080	30	424	100	0.82	61	ND	4540	0.7	2
118169	Moolayember Formation	204	7456	7.4	ND	111	ND	3840	1500	50.5	206	30.7	0.359	111	ND	1912	0.53	78.5

RN	Aquifer	Depth (m)	Conductivity (uS/cm)	pH	Hardness (mg/L Ca)	Alkalinity (mg/L)	SAR	TDS (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	Bi-carbonate (mg/L)	Carbonate (mg/L)	Cl (mg/L)	F (mg/L)	Sulphate (mg/L)
BAP within 20 Km Gunn #2																		
Gunn #2 Sample 1	Betts Creek beds		1780	8.3	15	846	54.4	1080	484	28	6	<1	0.16	733	113	126	11	<1
Gunn #2 Sample 2	Betts Creek beds		1770	8.2	15	821	52	1050	463	20	6	<1	1.74	802	19	110	11.9	<1
Gunn #2 Sample 3	Betts Creek beds		1730	8.2	15	818	52.4	1030	466	14	6	<1	1.76	810	8	97	11.7	<1
Gunn #2 Sample 4	Betts Creek beds		1700	8.38	12	697	50.7	915	412	9	5	<1	2.5	672	24	99	11.1	<1

- (1) DNRG Groundwater Database aquifer
(2) Interpreted aquifer by Comet Ridge Limited

Groundwater Quality

Within the permit, 15 bores and 5 wells with drill stem tests (DST) have had the water quality analysed. **Figures 19 and 20** have been produced by using the available water quality data from the permit (excluding water quality from DST's). As can be seen there is insufficient consistency between the sample to assign to more than a handful of aquifers.

In the vicinity of the production test wells, the only water quality information available is from the analyses of the Gunn #2 well and the baseline assessments of the nearby landholders bores. Based on this data, the composition of the groundwater from the Betts Creek beds appears to be much fresher (EC <1780 $\mu\text{S}/\text{cm}$) than the groundwater from the Clematis Group or the Moolayember Formation (EC > 12500 $\mu\text{S}/\text{cm}$). The groundwater from the Betts Creek beds coal seam is of a Na-HCO₃ water type which is typical for coal seam water chemistry (Van Voast 2003).

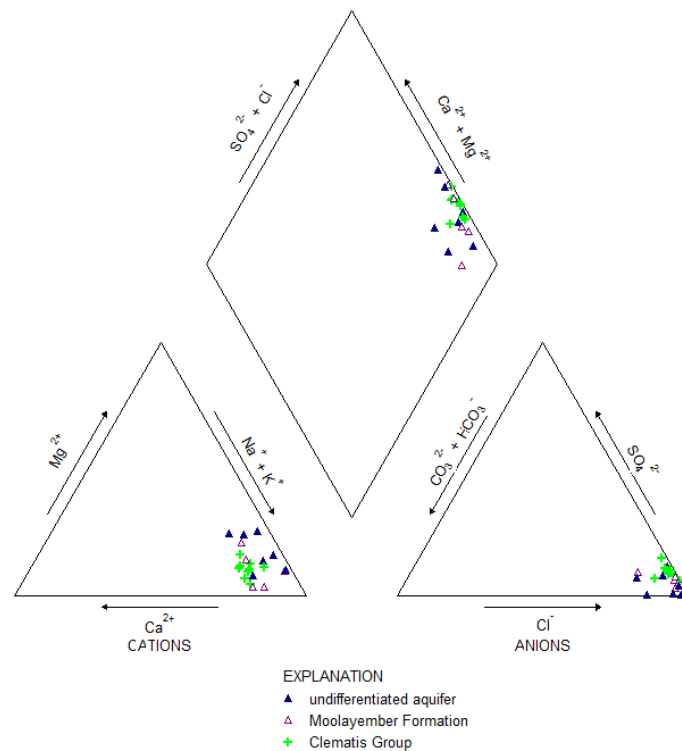


Figure 19: Piper Diagram for all available quality data within ATP 744P (excluding analysis from Gunn #2 and DST's)

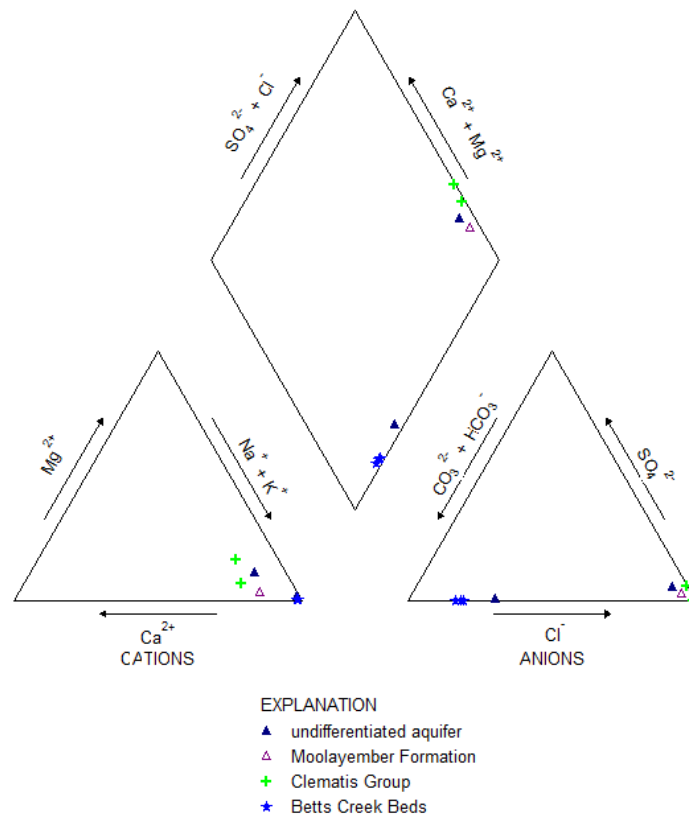


Figure 20: Piper Diagram for all available quality data from Betts Creek beds at Gunn #2 and within 20km of Gunn #2 (excluding analysis from DST's)

The available groundwater quality data also suggests a possible hydraulic connection between the groundwater in the Moolayember Formation and the Clematis Group, although the Clematis Group samples have a slightly higher salinity than the Moolayember Formation samples (RPS 2012). Further geochemical data from definitive aquifer intervals would be required to confirm the degree of hydraulic connection between these two formations.

Water chemistry of the Betts Creek beds is quite distinct from the overlying Moolayember Formation, Clematis Group and most undifferentiated aquifers in the vicinity of Gunn #2 and across the entire permit area. One sample from an undifferentiated aquifer plots with a similar water composition to that of the Betts Creek beds at Gunn #2, however a single data point is insufficient make conclusions with respect to hydraulic connectivity of the two samples. The sample from the undifferentiated aquifer is significantly fresher ($EC < 500 \mu S/cm$) than the Betts Creek beds samples. Carbonate and bicarbonate contents are similar to those from the Moolayember Formation and Clematis Group rather than the Betts Creek beds. Additional geochemical data will be required to confirm the degree of connectivity (if any) between these samples.

Springs

A review of the Queensland Springs database was undertaken in 2013 prior to the lodgement of the initial UWIR (Comet Ridge Limited, 2014). This report has included updated Version 4 of the Queensland Wetland Database. The current mapped locations of springs is shown on **Figure 21**.

Springs located in the eastern Galilee Basin comprise the Barcaldine Supergroup (DNRM, 2015).

A review of the database found one cluster of springs are located within the extent of the permit area and are understood to be discharge springs from the Moses complex (DNRM, 2015). These springs form part of a larger isolated cluster of wetlands, known as the Doongmabulla Spring complex and are associated with the Carmichael River and its tributaries (Queensland Herbarium, 2017) within and adjacent to the permit area. This group of springs is associated with the Galilee Basin, however due to limitations in available data their aquifer source is ambiguous (Queensland Herbarium, 2017). Geological mapping and intersections from Shoemaker #1 coal seam gas well located approximately 600m to the north of the spring complex suggest an association with either the Moolayember Formation or Clematis Group. Shoemaker #1 intersected the Moolayember Formation beneath a thin veneer (3.20m) of Quaternary surficial sediments. The Clematis Group underlies the Moolayember Formation and was intersected at 80.8m depth. The Moses springs comprise approximately 30 individual mound springs and contribute to riverine wetland which are associated with the springs. The Doongmabulla Springs complex is also recognised as a Nationally Important Wetland area (refer, **Figure 23**).

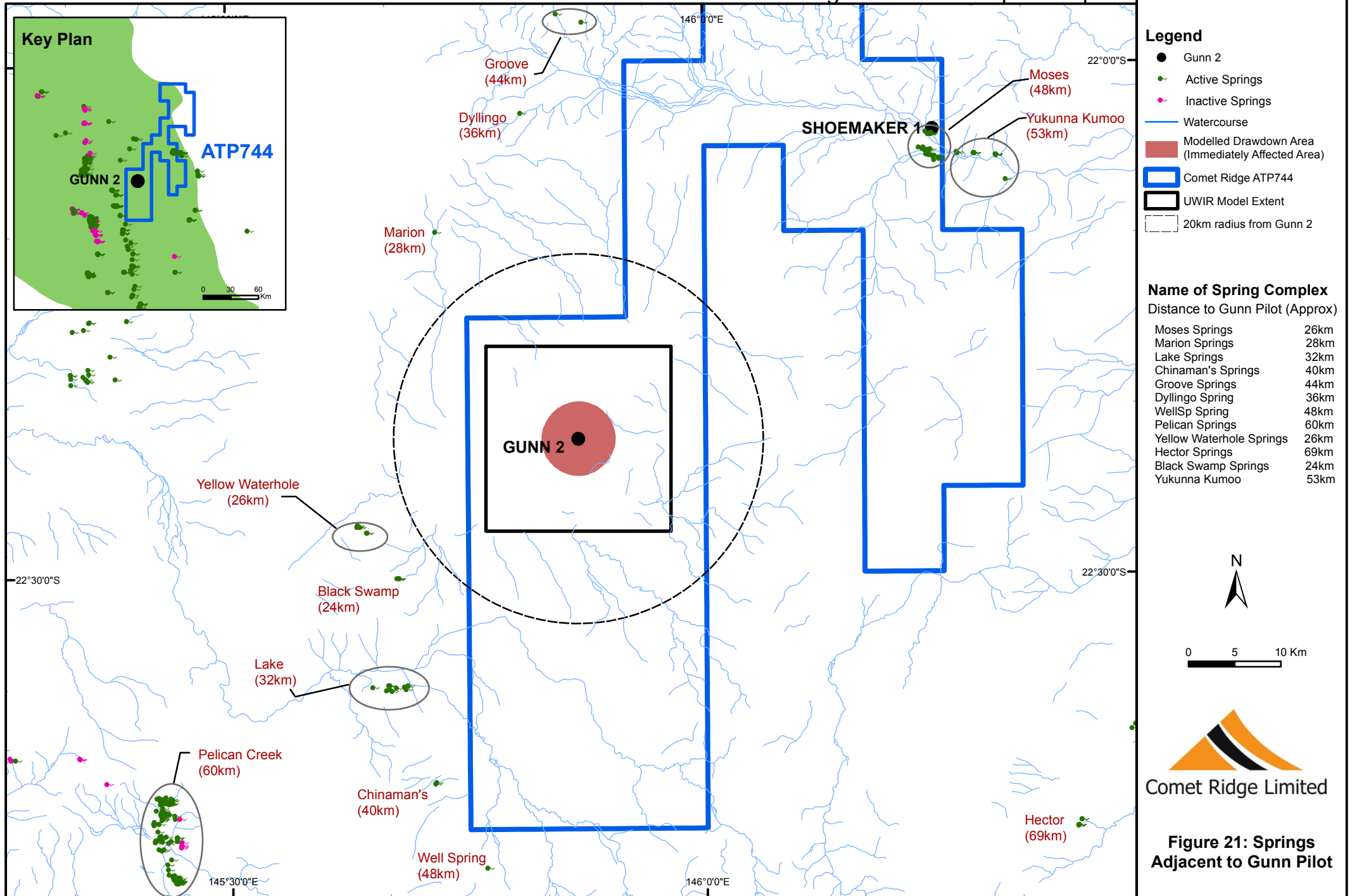
The Moses spring complex is located over 50km from the Gunn Pilot area and is considered to be sufficiently separated from the proposed production testing and as such no impacts are expected.

No documented springs are located within 20km of the Gunn Pilot. The nearest springs are understood to be recharge springs from either the Yellow Waterhole or Black Swamp (Queensland Wetland Database, 2015). It is expected that these springs are associated with the Hutton Sandstone aquifer or the Cadna-owie Formation / Hooray Sandstone aquifer system (RPS, 2012) and are west of the inferred Hutton - Rand unconformity and part of the Eromanga basin. These springs are not associated with the Betts Creek beds formation or any of the overlying aquifers.

The Eromanga Basin sequence is absent from the tenure and is not expected to be encountered during the proposed activities. There is currently no evidence of hydrogeological connection between the band of springs to the west of the permit area and the Betts Creek coal seams.

It is considered that the springs are sufficiently separated from the Gunn Pilot site that it is highly unlikely that production testing at the Gunn Pilot will result in a greater than 0.2m decline in water levels of springs and as such no impacts are expected.

Underground Water Impact Report



Part C: Groundwater Modelling

In order to understand the possible impacts of the underground water extraction associated with the already conducted production testing on the Gunn #2 well and the proposed five-spot pilot, a groundwater model has been developed. This model relies on the groundwater extraction forecasts described in **Underground Water Extraction** section above, data obtained through previous production testing and available literature of the groundwater properties of the area.

Water level data for the Galilee Basin aquifers could not be contoured because there are too few data points for the water bores associated with a formation to contour (RPS 2012). Therefore the hydraulic heads within the Galilee Basin aquifers were estimated using available data on formation depths, formation pressures and groundwater levels and developing relationships between these formation characteristics. These derived relationships were found to be consistent with equivalent relationships derived previously by (RPS, 2012) and (Dixon et al, 2010). Where measured data were available, these measurements were used to constrain the estimates. The estimated hydraulic heads were then used in the model as the 'initial hydraulic heads'.

Pressure data available for the Joe Joe Group aquifers (Aramac Coal Measures, Jochmus Formation, Jericho Formation and Lake Galilee Sandstone) indicates that the Betts Creek beds are capable of confining groundwater. However, these units are not likely to be effective aquifer seals on a regional basis (DEEDI, 2009). There is, however, evidence that the Rewan Group confines the groundwater that occurs within the Betts Creek beds and the Moolayember Formation confines the underlying Clematis Group aquifer (RPS 2012). In general, the Clematis Group exhibits higher permeabilities than the Moolayember Formation (Dixon et al 2010).

Very limited porosity and permeability data presented difficulties for estimating model constraints making it difficult to model fluid flow in the basin (Dixon et al 2010). In addition, data points show few clear trends in the distribution of porosity and permeability, with broad scatter across measurements in most of the stratigraphic units (Dixon et al 2010). Therefore, measurements of hydraulic properties from close to the production test site were used where possible. **Table 5** shows the hydraulic conductivity values that were assigned to the formations when the groundwater model was built (these parameters were adjusted during the calibration process).

Table 5: Hydraulic Conductivity Data

Formation	Hydraulic Conductivity (Horizontal)	Hydraulic Conductivity (Vertical)	Reference
Moolayember Formation	2.9×10^{-6} m/s	9.7×10^{-7} m/s	Dixon et al 2010
Clematis Group	3.6×10^{-5} m/s	3.4×10^{-6} m/s	Dixon et al 2010
Rewan Group	4.5×10^{-5} m/s	1.2×10^{-5} m/s	Dixon et al 2010
Betts Creek beds	9.7×10^{-7} m/s	9.7×10^{-7} m/s	Dixon et al 2010
Betts Creek – Target Coal Seam	5.8×10^{-5} m/s	5.8×10^{-5} m/s	Comet Formation Tests (Gunn #2)
Jochmus Formation	9.7×10^{-7} m/s	9.7×10^{-7} m/s	Dixon et al 2010

Groundwater Flow Model

MODFLOW was used to predict the extent of impacts within the target coal seam and within adjacent aquifers and aquitards. MODFLOW is a finite difference groundwater flow model, where the groundwater flow domain is discretised into rectangular or cubic block elements.

The groundwater flow model was constructed in a transient format to simulate the time period associated with proposed production testing and the proposed five-spot pilot. The time period for the groundwater flow simulations was 11/01/2016 to 1/11/2037 for the purposes of this three year reporting period.

The pumping rates applied in the model were those predicted from reservoir modelling. These pumping rates were converted to m³/sec and applied at either a daily or monthly time step, depending on the time step for the data obtained from reservoir modelling. All pumping was applied to layer 9 (the C1 coal seam).

A 20km by 20km model extent, centred on the Gunn #2 well was used for the groundwater flow model (**Figure 22**). The model grid was constructed with variable grid sizes to incorporate a finer grid in the area surrounding production testing. The grid cells ranged from 50 m by 50 m in the region of production testing to a maximum size of 500 m by 500 m.

12 layers were used in the model, including 7 layers to represent distinct coal seams within the Betts Creek Beds. Where stratigraphic surfaces were available, these were used to create the model layers. As there was not enough information available to map the depths of individual coal seams across the whole model domain, constant thicknesses were selected for layers 5-11 (**Table 6**). The thicknesses for these layers were based on measured stratigraphic data for the Gunn #2 well.

Table 6: Thickness of Model Layers

Layer	Formation	Minimum Thickness (m)	Maximum Thickness (m)	Average Thickness (m)
1	Quaternary/Tertiary	9	70	37
2	Moolayember Formation	274	381	326
3	Clematis Group	98	121	102
4	Rewan Group	312	356	341
5-11	Betts Creek beds (including the target coal seam)	197	197	197
12	Jochmus Formation	80	183	122

The major groundwater recharge areas for the GAB are located in the north, west and east where the Eromanga and Galilee basin aquifers outcrop or subcrop beneath alluvial sediments. This recharge zone is outside of the model domain. In the absence of more detailed information about recharge rates, constant recharge rates were used in the groundwater flow model. The rates selected were consistent with the GAB resource study (GABCC 1998) recommendation to use a recharge rate of 1-2% of mean annual rainfall as a basin wide average. This study pointed out that evaporation rates in the GAB typically exceed rainfall rates. Due to the uncertainty associated with this parameter, the recharge rate was varied during the calibration process.

A combination of constant head and constant flux boundary conditions was applied to specific layers in such a way that the general groundwater flow directions were maintained. Assignment of more accurate boundary conditions would require more detailed information about current hydraulic gradients in each aquifer and aquitard.

A transient calibration was carried out for the groundwater flow model using the water production test data. The parameter estimation software, PEST (Doherty 2009), was used to automatically adjust the parameters in order to improve the match between “simulated” and “observed” water levels for the production test. A large range of parameters were included in this calibration process to start with but once the model was found to be insensitive to many of the parameters, the range of parameters was refined to those shown in **Table 7**. Once the drawdown and recovery curves from the production test in 2013 were able to be simulated adequately, the model was used to predict groundwater level responses to the planned five-spot pilot.

Table 7: Calibration Parameters

Parameter	Minimum	Maximum
Horizontal Hydraulic Conductivity – Moolayember Formation (m/s)	2.90×10^{-8}	2.90×10^{-4}
Horizontal Hydraulic Conductivity – Clematis Group (m/s)	3.55×10^{-7}	3.55×10^{-3}
Horizontal Hydraulic Conductivity - Rewan Group (m/s)	4.54×10^{-7}	4.54×10^{-3}
Horizontal Hydraulic Conductivity - Betts Ck (m/s)	9.68×10^{-9}	9.68×10^{-5}
Horizontal Hydraulic Conductivity - Betts Ck A (m/s)	9.68×10^{-9}	9.68×10^{-5}
Horizontal Hydraulic Conductivity - Betts Ck B (m/s)	9.68×10^{-9}	9.68×10^{-5}
Horizontal Hydraulic Conductivity - Betts Ck C (m/s)	9.68×10^{-9}	9.68×10^{-5}
Horizontal Hydraulic Conductivity - Betts Ck C1 (m/s)	5.81×10^{-9}	5.81×10^{-5}
Horizontal Hydraulic Conductivity - Betts Ck D (m/s)	9.68×10^{-9}	9.68×10^{-5}
Horizontal Hydraulic Conductivity - Betts Ck D1 (m/s)	9.68×10^{-9}	9.68×10^{-5}
Horizontal Hydraulic Conductivity – Jochmus Formation (m/s)	9.68×10^{-9}	9.68×10^{-5}
Recharge Rate (m/s)	1.00×10^{-12}	1.00×10^{-8}
Specific Yield - Rewan Group (m/s)	1.00×10^{-3}	3.00×10^{-1}
Specific Yield - Betts Creek (m/s)	1.00×10^{-3}	3.00×10^{-1}
Specific Yield - Betts Creek C1 (m/s)	1.00×10^{-3}	3.00×10^{-1}

Results and Discussion

According to the groundwater simulations performed, only the target C1 coal seam is expected to experience drawdown therefore the IAA (areas where a pressure drawdown of greater than 5 metres is expected) is only predicted within the C1 seam. The mapped IAA is required to be predicted as at January 2020, which is within three years after the consultation day for this report (as required under the requirements of section 376(b)(iv) of the *Water Act 2000*). The predicted drawdown at January 2020 for the C1 seam of the Betts Creek beds is 96.5m at the centre of the pilot and decreases to 5m at maximum 4.13km from the centre point. The extent of the predicted 5m drawdown (IAA) in the C1 seam of the Betts Creek beds as at January 2020 is shown in **Figure 22**; this therefore represents the immediately affected area (IAA) for the C1 seam in the Betts Creek beds.

No drawdown was predicted for all other layers above and below the Betts Creek beds.

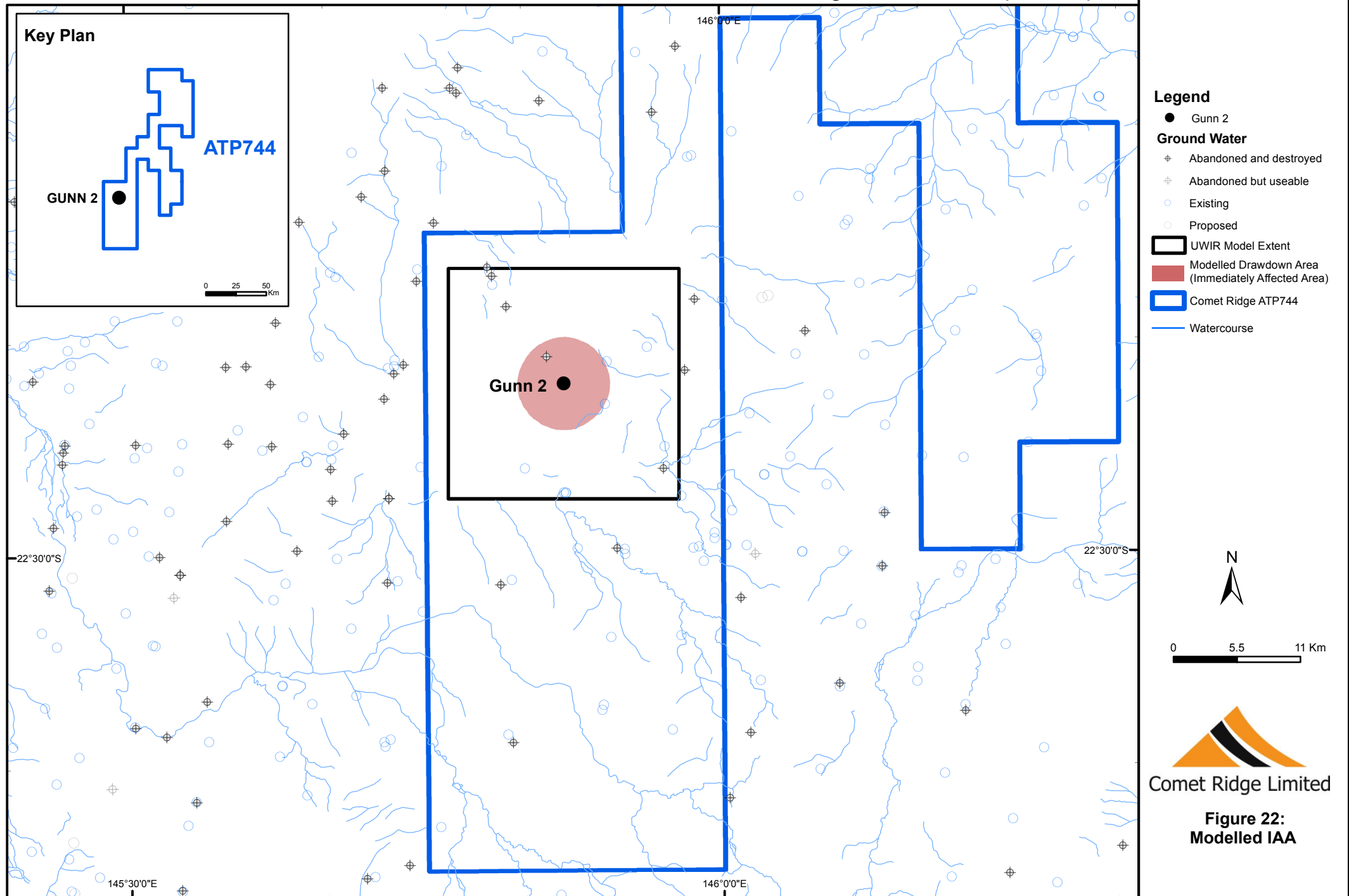
There are no private water bores present which intersect with the coal seams and are within the IAA and hence no bores are subject to make good obligations as a result of the IAA. One existing registered water bore (RN: 93822) is located within the IAA. The bore utilises water from the Moolayember Formation (at least 570m above the coal seams) for the purpose of stock watering. A baseline assessment was completed on this water bore on 10 October 2012. This water bore is included in the schedule of monitoring bores, refer to **Groundwater Monitoring** section of this report.

Due to the gradual expansion of the cone of depression which is expected to originate from the site of production testing, the predicted area of the IAA is still notable by January 2020. These drawdown impacts are, however, predicted to gradually decline by 2029. There is no IAA predicted for any other formation and there is no “long term affected area” predicted for any formation including the C1 coal seam.

The results of the groundwater modelling for this UWIR support other available hydrogeological information in suggesting that there is limited interaction between the Betts Creek beds and any other formation in the model area.

There are, however, limitations associated with the groundwater simulations performed. These relate primarily to the data availability, the decisions made during developing a conceptual model and, the assumption that the water level responses during the production test are indicative of the longer term impacts that could be expected from a five-spot pilot. For this reason, ongoing monitoring of groundwater levels within the Betts Creek beds and in the overlying formations is proposed to occur throughout the production test period.

Underground Water Impact Report



Part D: Environmental Values

Environmental Values

The environmental values of water to be enhanced or protected are outlined in Section 6 of the *Environmental Protection (Water) Policy 2009*.

For waters that are not included in Schedule 1 of the *Environmental Protection (Water) Policy 2009*; environmental values include:

- (a) for high ecological value waters—the biological integrity of an aquatic ecosystem that is effectively unmodified or highly valued;
- (b) for slightly disturbed waters—the biological integrity of an aquatic ecosystem that has effectively unmodified biological indicators, but slightly modified physical, chemical or other indicators;
- (c) for moderately disturbed waters—the biological integrity of an aquatic ecosystem that is adversely affected by human activity to a relatively small but measurable degree;
- (d) for highly disturbed waters—the biological integrity of an aquatic ecosystem that is measurably degraded and of lower ecological value than waters mentioned in paragraphs (a) to (c);
- (e) for waters that may be used for producing aquatic foods for human consumption—the suitability of the water for producing the foods for human consumption;
- (f) for waters that may be used for aquaculture—the suitability of the water for aquacultural use;
- (g) for waters that may be used for agricultural purposes—the suitability of the water for agricultural purposes;
- (h) for waters that may be used for recreation or aesthetic purposes, the suitability of the water for—
 - (i) primary recreational use; or
 - (ii) secondary recreational use; or
 - (iii) visual recreational use;
- (i) for waters that may be used for drinking water—the suitability of the water for supply as drinking water;
- (j) for waters that may be used for industrial purposes—the suitability of the water for industrial use; and
- (k) the cultural and spiritual values of the water.

Identified Environmental Values

The following environmental values have been identified in ATP744P:

- Farm water supply (i.e. use of groundwater from water bores);
- Stock watering (i.e. use of groundwater from water bores);
- Domestic Use (i.e. use of groundwater from water bores);
- Aquatic ecosystem (i.e. Lake Galilee, Moses Springs and waterways);
- Visual Appreciation (i.e. aesthetic qualities of Lake Galilee and Moses Springs); and
- Cultural Values (i.e. aesthetic qualities of Lake Galilee and Moses Springs)

All of the above listed environmental values are primarily associated with either surface water features (lakes and waterways), springs or Quaternary, Tertiary and Triassic aquifers accessed by registered groundwater bores.

Groundwater Dependant Ecosystems

Groundwater Dependant Ecosystems (GDE's) are ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services. Ecosystem dependency may vary temporally (over time) and spatially (depending on its location in the landscape). GDE's include aquifers, caves, lakes, palustrine, lacustrine and riverine wetlands including springs, rivers and vegetation that access groundwater through their roots.

Maps of the following GDE's are provided to show spatial relationship between the IAA, model extent and 20km radius from the proposed Gunn Pilot with mapped GDE's including wetlands and springs.

- Springs and watercourses adjacent to the Gunn Pilot (**Figure 21**)
- Queensland Wetland Areas – water bodies, regional ecosystems and mapped nationally important wetlands, including springs across ATP744 (**Figure 23**)
- Terrestrial Groundwater Dependant Ecosystems adjacent to the Gunn Pilot (**Figure 24**)
- Surface Groundwater Dependant Ecosystems (area, line and point data) adjacent to the Gunn Pilot (**Figure 25**)
- Potential Groundwater Dependant Aquifers adjacent to the Gunn Pilot (**Figure 26**)

No underground GDE's are mapped across the permit area or surrounding area.

Wetland areas and Nationally Important Wetlands

Wetlands are areas of permanent or periodic/intermittent inundation, with water that is static or flowing fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 metres. To be a wetland the area must have one or more of the following attributes:

- at least periodically the land supports plants or animals that are adapted to and dependent on living in wet conditions for at least part of their life cycle, or
- the substratum is predominantly undrained soils that are saturated, flooded or ponded long enough to develop anaerobic conditions in the upper layers, or
- the substratum is not soil and is saturated with water, or covered by water at some time.

The most significant surface feature in the vicinity of the Gunn Pilot project is Lake Galilee which is recognised as a nationally important wetland and comprises both lacustrine wetland system (e.g. lakes 15.8%) and palustrine wetland system (e.g. vegetated swamps – 84.2%) (**Figure 23**). Lake Galilee habitat mainly comprises arid to semi-arid grass, sedge and herb swamp, saline lake and saline swamp and tree swamp. The wetland area is primarily sourced from shallow, unconfined, unconsolidated sedimentary aquifers which are closed alluvial systems with fluctuating and intermittent flow.

Two other nationally important wetland areas are located within and adjacent to the permit including; Doongmabulla Springs and Bingeringo Aggregation (**Figure 23**). For more information on the Doongmabulla Springs complex, refer to section on **Springs**. The Bingeringo Aggregation primarily comprises both riverine wetland system (e.g. river and creek channel - 92.6%) and palustrine wetland system (e.g. vegetated swamps - 7.4%). Both of these wetland areas are between 50 and 105km from the Gunn Pilot area and therefore sufficiently separated from the project area and, as such, no impacts are expected.

Riverine wetlands have also been identified and are associated with waterways traversing the north eastern portion of the permit area. Some areas of remnant regional ecosystem comprising 1-50% wetland by area have also been mapped across the permit area (**Figure 23**).

Terrestrial groundwater dependant ecosystems in the area are primarily associated with either Tertiary Ironstone jump-ups or alluvium and sandy plains and wetlands (**Figure 24**). Tertiary Ironstone jump-ups comprise unconfined intermittent aquifers sourced from local bedrock which primarily support specific melaleuca vegetation. Unconsolidated alluvial and sandy plain systems are primarily sourced from localised shallow alluvial aquifers which generally support specific vegetation ecosystems (such as Bloodwood or Melaleuca) on old loamy and sandy soils with fluctuating or intermittent flow.

Watercourses traversing the permit area are described as either channels on sandstone ranges with fluctuating and intermittent flow sourced from unconfined consolidated sedimentary aquifers or channels on alluvia and sandy plains below 300m in elevation with fresh, intermittent flow sourced from unconfined shallow alluvial aquifers (**Figure 25**).

Mapped springs are discussed further under the **Springs** section of this report.

Potential GDE Aquifers across the permit area comprise primarily either consolidated or fractured sedimentary aquifers (Tertiary Ironstone jump-ups) or unconsolidated sedimentary aquifers (i.e. sandy plains, Quaternary Alluvium) with intermittent groundwater flow (**Figure 26**). Water quality ranges between fresh and brackish.

Impacts arising from previous exercise of underground water rights

The water that is subject to the underground water rights for ATP744P petroleum activities is within the Betts Creek beds at the proposed Gunn Pilot. The formation predominantly comprises coal seams that are inter bedded with mudstone, siltstone, sandstone and carbonaceous shale.

Two registered water bores (RN103875 & RN103876) are using water from a sandstone interval in the upper part of the Betts Creek beds for water supply (likely agricultural use) in the north-eastern part of ATP744P. Eight registered groundwater bores have intersected the Betts Creek beds which are being utilised as mine monitoring bores associated with a mineral (coal) development lease and mining lease partially overlapping the north-eastern part of ATP744P. All ten bores accessing the Betts Creek beds are located over 70km from the Gunn #2 well and are over 66km outside the IAA area and, therefore, activities proposed at the proposed Gunn Pilot are considered to have negligible impact on environmental values at the referenced bores.

The following section provides discussion that a discontinuity exists between the Betts Creek beds and overlying aquifers and the ground surface within the area of the IAA and within 20km from the Gunn #2 well.

The Gunn #2 well was completed using industry standards and in compliance with the Department of Natural Resources and Mines (DNRM) Code of Practice for Constructing and Abandoning Coal Seam Gas Wells and Associated Bores in Queensland (Edition 2, 2013).

Gunn #2 completion technique has allowed:

- Triassic GAB aquifers to be isolated behind steel casing which has been pressure sealed with cement.
- isolation of the C1 coal seam from overlying and underlying intra-bedded permeable sandstone and other coal seams within the Betts Creek beds and;
- Perforation of the C1 coal seam only, to ensure water was only produced from this coal interval.

A cement bond log was run after cementing was completed to evaluate the integrity of the cement with the casing of the well. The cement bond log confirms the cement job in Gunn #2 has resulted in complete isolation of the Betts Creek beds from the Clematis Group and Moolayember Formation aquifers.

The coals within the Betts Creek beds are entirely subsurface within the IAA and within 20km from Gunn #2 well and are separated from overlying Triassic aquifers by at least 300m of low permeability formation (Rewan Group), refer **Figure 16**. Available literature (including descriptions of the unit from coal seam gas wells drilled within ATP744P) suggest the formation is dominated by fine grained sediments which is generally characterised as an aquitard (Queensland Herbarium, 2017). For further information, refer section **Hydrology of ATP744P**.

In support of the above, the results of the groundwater modelling for this UWIR confirm that no drawdown was predicted for all other layers above and below the Betts Creek beds. The target C1 coal seam is the only layer where drawdown was modelled. Where the drawdown was greater than the 5m threshold for a confined aquifer, an immediately affected area (IAA) was mapped and only applies to the C1 seam. The results of the groundwater modelling for this UWIR support other available hydrogeological information in suggesting that there is limited interaction between the Betts Creek beds and any other formation in the model area. For more information, refer **Part C: Groundwater Modelling**.

In addition, no faults have been mapped within the IAA or within 20km from the Gunn #2 well that have been interpreted to connect the Betts Creek beds to overlying Triassic or Cenozoic aquifers or the ground surface (**Figure 2, Figure 4, Figure 9 & Figure 10**). For more information, refer section **Structural Geology**.

The Betts Creek beds crop out in the far north-east of the permit area and sub crop along and outside the eastern boundary of the permit area (**Figure 4**). These areas are located 50km to 100km from the proposed Gunn Pilot project location. These areas are considered to be sufficiently separated from the proposed production testing and, as such, negligible impacts are expected.

No underground water is being extracted from the C1 coal seam within the Betts Creek beds, to which this report relates. The actual impacts in the initial UWIR (dated 3 April 2014) were less than predicted as no water has been produced in the three years since the initial UWIR in 2014 and the IAA prediction did not eventuate.

The water within the Betts Creek beds within the IAA or 20km from the proposed pilot location is not currently used for agricultural purposes, domestic use, drinking water or industrial purposes, and therefore no impact was made on the environmental values with respect to these possible uses (**Table 8**). There are no documented cultural and spiritual values. The water is not used for any recreational purposes.

Table 8: Environmental values associated with the previous exercise of underground water rights.

Previous exercise of underground water right	Environmental Values											
	Aquatic ecosystems	Irrigation	Farm supply	Stock Watering	Aquaculture	Human Consumption	Primary Recreation	Secondary Recreation	Visual Appreciation	Drinking Water	Industrial Use	Cultural and Spiritual
Betts Creek beds within the IAA	x	x	x	x	x	x	x	x	x	x	x	x

No springs are located within the IAA or within 20km of the Gunn Pilot project. The closest springs are 24km from the Gunn Pilot area and are not sourced from the coal seams and therefore no impact on environmental values has been associated with any springs.

There is also no identifiable connection between the coal seams of the Betts Creek beds and the ground surface within the IAA or within 20km of the Gunn #2 well, therefore no known association or connection with any terrestrial or surface GDE's. No subterranean GDE's have been mapped within the IAA in ATP744P.

Environmental values identified within or adjacent to the boundary of the permit are not associated with the exercise of underground water rights from the Betts Creek beds and there are no impacts for any identified environmental values within or adjacent to the permit.

Impacts that are likely to occur for continued exercise of underground rights

For the water production envisaged in the next three years, the predicted drawdown has not changed. There are therefore no impacts likely on the environmental values in the period covered by this UWIR (April 2017 to April 2020).

Since the Betts Creek beds are currently not widely used as a water source, the impact on water users is considered to be negligible as previously indicated. However, the necessary monitoring strategies are documented under **Part E: Groundwater Monitoring** section of this document and any necessary baseline assessments on bores have or will be completed as required per ATP744P Baseline Assessment Plan. All active landowner bores within 10km of Gunn #2 well have been nominated as monitoring bores in this report, refer **Figure 27**.

Table 9: Environmental values associated with the future exercise of underground water rights.

Future exercise of underground water rights	Environmental Values											
	Aquatic ecosystems	Irrigation	Farm supply	Stock Watering	Aquaculture	Human Consumption	Primary Recreation	Secondary Recreation	Visual Appreciation	Drinking Water	Industrial Use	Cultural and Spiritual
Betts Creek beds within the IAA	x	x	x	x	x	x	x	x	x	x	x	x

As, and if, the resource tenure continues, there could be an expansion of the immediately affected area, and there may be a long-term affected area in the future, but this is not possible to predict at this time. Future development of the area is contingent upon results from the production testing that will be carried out. Nevertheless, the impact on environmental values of the water is still considered to be negligible unless the usage patterns of the water change in the future. A review of the impact of environmental values from the exercise of underground water rights will be undertaken as part of the annual review process for the UWIR.

Underground Water Impact Report

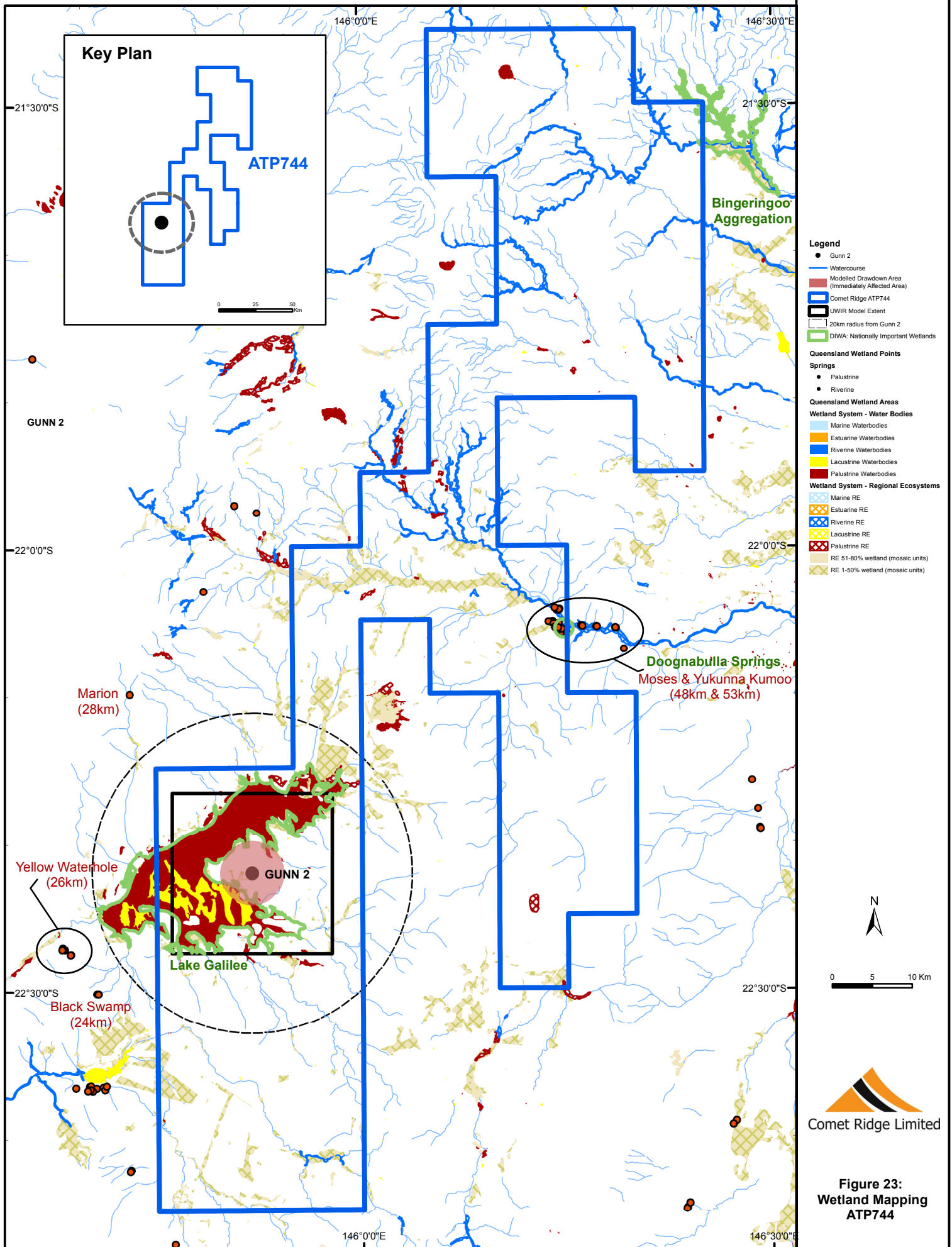
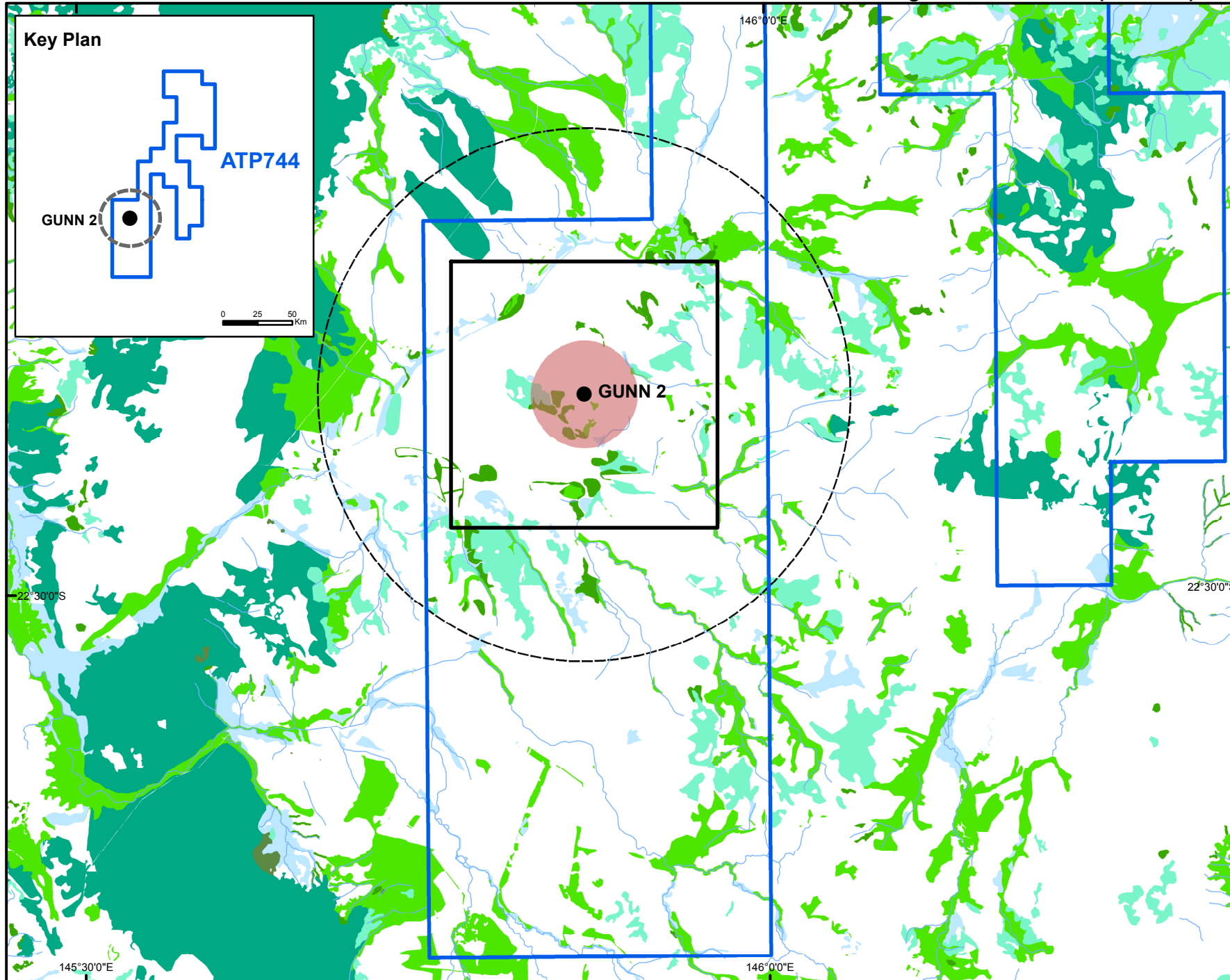


Figure 23:
Wetland Mapping
ATP744

Underground Water Impact Report



Legend

- Gunn 2
- Watercourse
- Modelled Drawdown Area (Immediately Affected Area)
- Comet Ridge ATP744
- UWIR Model Extent
- 20km radius from Gunn 2

Groundwater Dependant Ecosystems

- Terrestrial**
- 81-100% GDE, Derived GDE - high confidence
 - 81-100% GDE, Derived GDE - moderate confidence
 - 81-100% GDE, Derived GDE - low confidence
 - 01-80% GDE, Derived GDE - high confidence
 - 01-80% GDE, Derived GDE - moderate confidence
 - 01-80% GDE, Derived GDE - low confidence



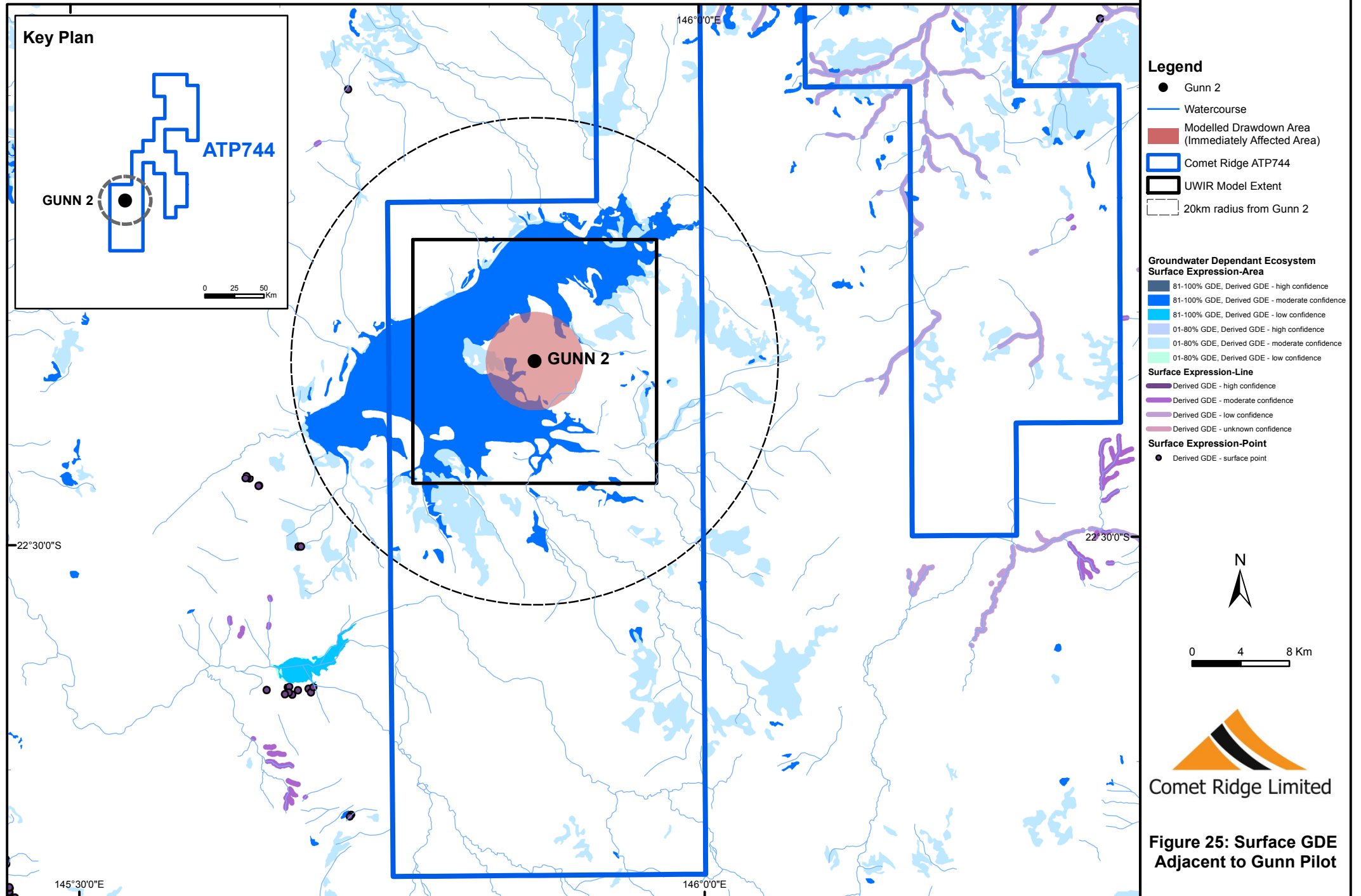
0 4 8 Km



Comet Ridge Limited

Figure 24:
Terrestrial GDE
Adjacent to Gunn Pilot

Underground Water Impact Report



Underground Water Impact Report

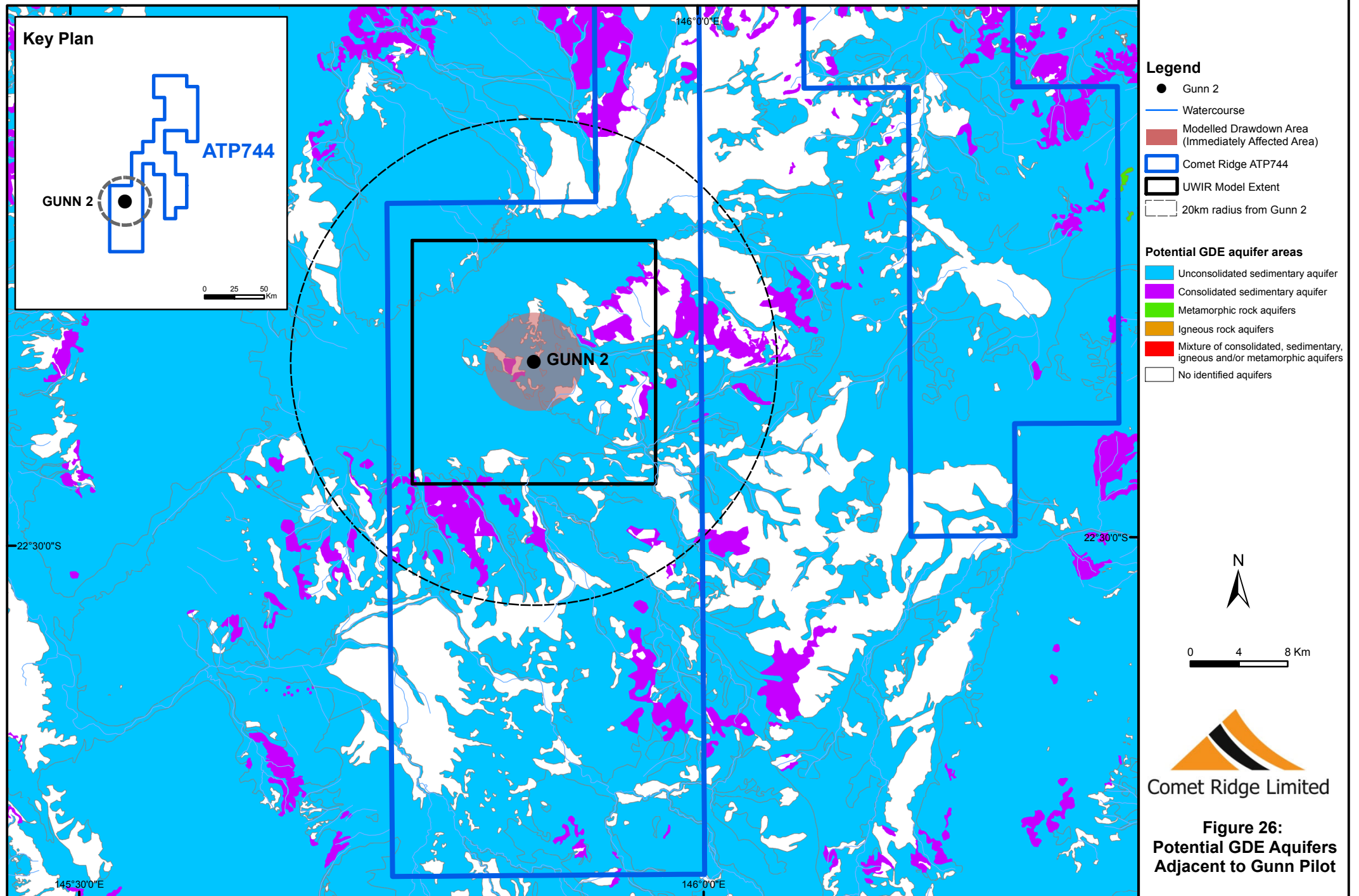


Figure 26:
Potential GDE Aquifers
Adjacent to Gunn Pilot

Part E: Groundwater Monitoring

Rationale

The underground water monitoring strategy has been developed to address the findings of this UWIR, and to accurately quantify water level and water quality changes caused by the exercise of underground water rights within ATP744P. The information obtained through the monitoring strategy will also be used to confirm and refine future iterations of the groundwater modelling.

Local registered bores are primarily drawing a water supply from the Moolayember and the Clematis aquifers. These aquifers are separated from the targeted coal seams by the Rewan Group. In addition, the production wellbores are cemented and cased to best practice to avoid aquifer cross-contamination. No anticipated impacts are predicted by the current modelling in the nearby aquifers. The monitoring of underground water within these aquifers however will continue and the information will be routinely fed back into the model to verify and improve the predictions of the modelling.

A spring management strategy is not considered to be required for this UWIR due to:

- No springs are located within 20km of the Gunn Pilot;
- No springs are located within the IAA;
- There is no known hydrological interconnection between the springs and the affected coal seams of the Betts Creek beds.

The modelling predicts that there will be an IAA within the C1 seam of the Betts Creek beds, and there is no “long term affected area” predicted as the impact reduces rapidly after production testing ceases. Specifically, the monitoring will verify that speed of impact reduction. Should there be a large discrepancy between monitoring data and the predictions generated through the model, this will provide a trigger and the model will be re-run with updated calibrations and assumptions.

Monitoring Program

Monitoring threshold criteria

Groundwater impact assessment criteria have been designed to measure the depressurisation within the coal measures and any adverse impacts that such depressurisation might induce on the adjacent aquifers or the alluvial aquifer systems.

Impact assessment criteria for existing and proposed piezometers include piezometric pressure (measured as depth to water level) and basic water quality parameters inclusive of pH, EC and metals. If routine monitoring reveals either of the following scenarios an investigation into whether the changes can be attributed to the proposed production testing will be undertaken. If the change can be attributed to the production testing activities mitigation actions will be initiated.

Scenarios

- Water Quality: Compare concentrations of analytes within **Table 11** to previous monitoring. If:
 - (a) value departs highest or lowest previous measurement by more than 25% or
 - (b) three subsequent monitoring events record an increase in one or more analytes concentrations; and
- Water Level: Compare measured water level to previous monitoring rounds. If:
 - (a) water level is lower than previous lowest measurement by >5m or
 - (b) three subsequent monitoring events record a fall in water level >1m.

Monitoring Strategy

The below strategy will monitor the water extracted from the coal seams, overlying Triassic aquifers and regional impacts of the production testing in the IAA. As there is no Long Term Affected Area predicted, baseline sampling within or outside ATP744P is not warranted. The water monitoring program is proposed to commence when the pilot has been commissioned and has commenced production testing, which is assumed to be October 2017 for the purposes of this report.

The only existing bores extending into the Betts Creek beds available for monitoring within close proximity to the maximum impact zone of the IAA are the Gunn #1 bore and the proposed additional Gunn Pilot wells. Additional monitoring is proposed within the Moolayember Formation for registered bores RN: 118169 and RN: 93822 and RN: 93059, RN: 163506 (refer **Figure 27** for location). Additional monitoring is also proposed within the Clematis Group for registered bores RN: 163503 and RN: 163553 (refer **Figure 27** for location).

A list of bores and wells proposed to be monitored with parameters to be analysed and frequency of monitoring is shown in **Table 10**.

Table 10: Groundwater monitoring strategy

Registered Bore	Aquifer	Parameters	Frequency
Gunn #1	Clematis Group	SWL, Depth, pH, EC, Chemistry ⁽¹⁾	6 monthly
Gunn Pilot Wells	Betts Creek beds	SWL, Depth, pH, EC, Chemistry ⁽¹⁾	6 monthly
RN:118169	Moolayember Formation ⁽²⁾	SWL, Depth, pH, EC, Chemistry ⁽¹⁾	6 monthly for 12months, then annually
RN: 93822	Moolayember Formation ⁽²⁾	SWL, Depth, pH, EC, Chemistry ⁽¹⁾	6 monthly for 12months, then annually
RN: 93059	Moolayember Formation ⁽²⁾	SWL, Depth, pH, EC, Chemistry ⁽¹⁾	6 monthly for 12months, then annually
RN: 163506	Moolayember Formation	SWL, Depth, pH, EC, Chemistry ⁽¹⁾	6 monthly for 12months, then annually
RN: 163503	Clematis Group	SWL, Depth, pH, EC, Chemistry ⁽¹⁾	6 monthly for 12months, then annually
RN: 163553	Clematis Group	SWL, Depth, pH, EC, Chemistry ⁽¹⁾	6 monthly for 12months, then annually

(1) Chemistry – proposed analytes are presented in **Table 11** below.

(2) Interpreted aquifer by Comet Ridge Limited

Underground Water Impact Report

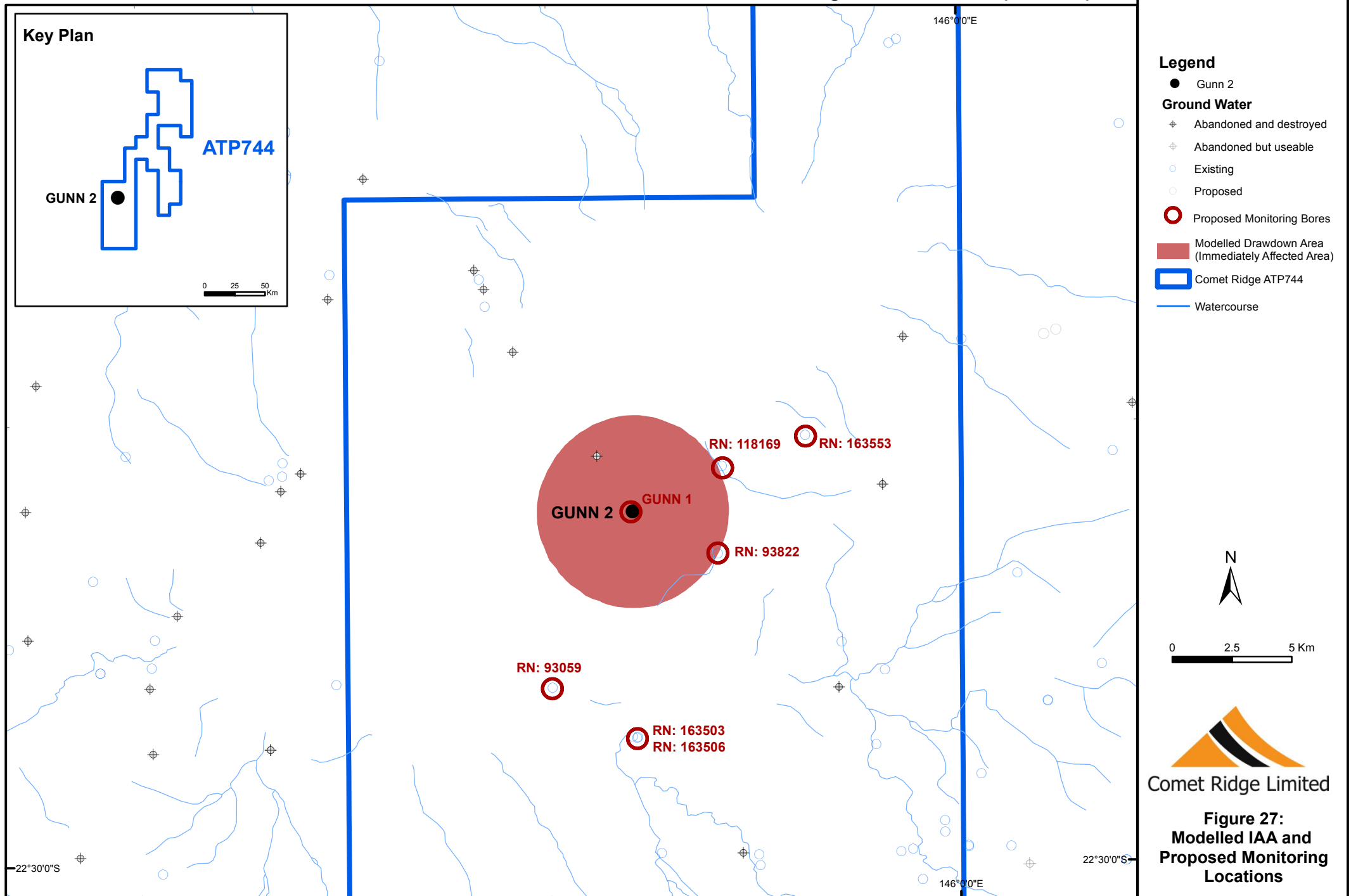


Table 11: Chemical analytes that will be sampled

Category	Parameters
Ions	Calcium Chloride Fluoride Potassium Sodium Sulphate Magnesium
Metals	Aluminium Arsenic Barium Beryllium Boron Lead Manganese Mercury Molybdenum Nickel
Alkalinity and hardness	Alkalinity – Total hardness as CaCO ₃
Dissolved Gases	Carbon dioxide Methane Hydrogen sulphide

Additional parameters may also be analysed if Comet Ridge deems prudent based on the activities occurring in the area and preliminary results. A likely list of potential analytes that will be considered is presented in **Table 12**.

Table 12: Potential analytes that will be considered for sampling

Category	Parameters
Physical (Laboratory)	Benzene Toluene Ethyl-benzene Xylene (total) Formaldehyde Ethanol Naphthalene Phenanthrene Benzo (a) pyrene Sodium hypochlorate Sodium hydroxide
Nutrients	Ammonia Nitrate as N Nitrite as N Nitrite + nitrate as N Total nitrogen as N Total phosphorus

Sampling methodology

Sampling of groundwater will use the relevant methodology outlined in the Baseline Assessment Guideline (2017) and include:

- Samples will be preserved and stored in accordance with the recognised techniques of the chosen laboratories.
- Samples will be collected using the internal pump system of the individual bore or an environmental extraction pump if none exists.

Where laboratory analysis is required, it will be carried out at a National Association of Testing Authorities accredited laboratory. Results of the assessments will be assessed against the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) and Australian Drinking Water Guidelines (2011).

QA/QC

QA/QC control measures will be implemented during the sampling program. These measures will be consistent with AS/NZ 9000, AS5667 and the Department of Environment and Heritage Protection Monitoring and Sampling Manual 2009 (version 2).

Groundwater monitoring and sampling will be conducted by a suitably qualified and experienced professional in accordance with the current edition of the DEHP's Monitoring and Sampling Manual 2009 (version 2), or subsequent updated versions; and the AS/NZ 5667.11:1998 (R2016) Australian/New Zealand Standard for Water Quality –Guidance on sampling groundwater.

An annual review of the monitoring data will be conducted once the pilot has been commissioned and has commenced production testing. The review will be conducted by a suitably qualified and experienced hydrogeologist and will include assessment of groundwater level and quality data, and the suitability of the monitoring network. All groundwater-based complaints will be investigated and a register kept of the nature of any complaints, the results of the assessment, and any actions taken. The register will be made available to the regulating authority upon request.

Review and Reporting

The accuracy of the predicted IAA will be reviewed on an annual basis once the pilot has been commissioned and has commenced production testing. This will be based on a comparison of the two six-monthly sampling round results and water production data with the groundwater model predictions and the assumptions that were used to prepare it. The results of this comparison will be provided to the DEHP within 20 business days after the comparison report has been completed. Further, the report to DEHP will highlight if there has been a material change in any of the parameters since the modelling and IAA map were generated. For the purposes of this statement, a discrepancy of more than 25% from predicted values will be treated as a material change.

A report relating to the implementation (including results) of the monitoring strategy required under section 378(1)(d) of the Water Act will be submitted annually to the Office of Groundwater Impact Assessment.

Further, records of all underground water extracted while exercising water rights will be collected on a daily basis. Water Production reports will be submitted to the Department of Natural Resources and Mines as per the requirements under the P&G Act.

The results of any further Baseline Assessments required under Chapter 3 of the Water Act will be given to the Office of Groundwater Impact Assessment in the approved form.

Part F: Spring Impact

UWIRs are required to identify springs which could be potentially affected by underground water extraction activities. For these springs where predicted water levels within the source aquifer would decline more than 0.2 metres, a spring impact management strategy is required.

A desktop review of spring inventories has been completed, searching for springs within 20 km of proposed production testing. Springs and watercourses were identified using the following sources of information, and cross-checking against project maps.

- Queensland Government Information Service (Queensland Wetland Data – Springs)
- Wetland Info Website
- Great Artesian Basin Resource Operation Plan Spring Register

Based on this data one group of springs (Moses Complex) were identified within the boundary of ATP744P, refer **Figure 21**. The Moses Complex springs are located >50km from the proposed production site. The closest spring is located approximately 24 km to the west of the area, refer **Figure 21**. Additional information and descriptions on springs have been compiled under the **Springs** sections of the report.

A spring monitoring or management strategy is not considered to be required for this UWIR due to:

- No springs are located within 20km of the Gunn Pilot;
- No springs are located within the IAA;
- There is no known hydrological interconnection between the springs and the affected coal seams of the Betts Creek beds.

References

AS/NZS 5667.11:1998 (R2016) Water quality – Sampling – Guidance on sampling of groundwaters:
<http://infostore.saiglobal.com/store/details.aspx?ProductID=387183>

Australian and New Zealand Environment and Conservation Council, 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
<http://www.environment.gov.au/water/publications/quality/pubs/nwqms-guidelines-4-vol1.pdf>

Benstead, W.L., 1973, Galilee Basin: Geological Survey of Queensland, Record 1973/20.

Comet Ridge Limited, 2013. Baseline Assessment Plan, ATP744P Queensland.

Comet Ridge Limited, 2014. Underground Water Impact Report (initial), ATP744P Queensland.

Comet Ridge Limited, 2013, Well Completion Report for CRD Gunn #2, ATP744P, Queensland. QDEX WCR No.78142

Comet Ridge Limited, 2010, Well Completion Report for CRD Gunn #1, ATP744P, Queensland. QDEX WCR No. 65521

Comet Ridge Limited, 2010, Well Completion Report for CRD Hergenrother #1 ATP744P, Queensland. QDEX WCR No. 65518

Comet Ridge Limited, 2010, Well Completion Report for CRD Shoemaker #1, ATP744P, Queensland. QDEX WCR No. 64041

Comet Ridge Limited, 2010, Well Completion Report for CRD Montani #1, ATP744P, Queensland. QDEX WCR No. 64713

Dixon, O., Draper, J.J., Grigorescu, M., Hodgkinson, J. & McKillop, M.D., 2010: Potential for carbon geostorage in the Taroom Trough, Roma Shelf and the Surat, Eromanga and Galilee Basins —Preliminary Report. Queensland Minerals and Energy Review, Department of Employment, Economic Development and Innovation.

Department of Natural Resources and Mines 2005. Hydrogeological Framework Report for the GAB WRP Area – Version 1.0

Department of Environment and Heritage Protection, 2009, Monitoring and Sampling Manual 2009, Version 2, July 2013 formal edits.

Environmental Protection (Water) Policy 2009 Version 2 December 2016:
<https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/E/EnvProWateP09.pdf>

Department of Natural Resources and Mines, 2013, Code of Practice for constructing and abandoning coal seam gas wells and associated bores in Queensland, Edition 2.
https://www.dnrm.qld.gov.au/_data/assets/pdf_file/0011/119666/code-of-practice-csg-wells-and-bores.pdf

Directory of Important Wetlands, 2005: (2 January 2005) Department of Environment and Heritage Protection.
<http://qldspatial.information.qld.gov.au/>

Fetter, C.W. 2001, Applied Hydrogeology, Prentice-Hall Inc. New Jersey.

GABCC. 1998, Background to the Great Artesian Basin, GAB resource study summary.

Habermehl, M.A., 1980. The Great Artesian Basin, Australia: BMR Journal of Australian Geology and Geophysics, 5, pages 9-38.

Hawkins, P.J., 1978, Galilee Basin – review of petroleum prospects: Queensland Government Mining Journal 79, 96-112.

Hawkins, P.J., 1982, A brief review of geological and geophysical information on the Galilee Basin: Geological Survey of Queensland Record 1982/29.

Hawkins, P.J., and Green, P.M., 1993. Exploration results, hydrocarbon potential and future strategies for the northern Galilee Basin. The APEA Journal, v.33, 280-296.

IRWM, 2013. Waterbore Baseline Assessment Report, New Bore aka Harrcass Bore, Oakvale Station – RN118169, Independent report prepared for Comet Ridge Limited.

IRWM, 2013. Waterbore Baseline Assessment Report, RN93059, Eastmere Station, Independent report prepared for Comet Ridge Limited.

IRWM, 2013. Waterbore Baseline Assessment Report, Stapleton Bore, RN93822, Eastmere Station, Independent report prepared for Comet Ridge Limited.

IRWM, 2013. Waterbore Baseline Assessment Report, New Bore aka Harrcass Bore, Oakvale Station – RN118169, Independent report prepared for Comet Ridge Limited.

IRWM, 2012. Waterbore Baseline Assessment Report, 10 Mile aka House Bore, RN93768, Wirrallee Station, Independent report prepared for Comet Ridge Limited.

IRWM, 2012. Waterbore Baseline Assessment Report, New Bore, RN16197, Fleetwood Station, Independent report prepared for QER Pty Ltd

National Health and Medical Research Council, 2011, Australian Drinking Water Guidelines 6, Version 3.3
Updated November 2016:
https://www.nhmrc.gov.au/files/nhmrc/file/publications/nhmrc_adwg_6_version_3.3_2.pdf

Olgers, F., 1970, Buchanan, Queensland: Bureau of Mineral Resources, Geology and Geophysics, Australia 1:250,000 Geological Series Map and Explanatory Notes SF/55-6.

Queensland Digital Groundwater Database (previously DERM bore database), 2017: (5 January 2017), Department of Natural Resources & Mines. <http://qldspatial.information.qld.gov.au/>

QER Pty Ltd, 2014. ATP1015, QER Ophir 5, Well Completion Report. QDEX WCR No. 99659.

Queensland Groundwater Dependant Ecosystems and Potential GDE Mapping, 2015: (16 December 2015), Department of Science, Information Technology and Innovation. <http://qldspatial.information.qld.gov.au/>

Queensland Herbarium, 2017. Doongmabulla Galilee Springs Group: Hydrogeology and ecology, Department of Science, Information Technology and innovation, Brisbane.

Queensland Herbarium, 2005. Springs of Queensland – Distribution and Assessment (Version 4.0), Department of Science, Information Technology and innovation, Brisbane.

Queensland Petroleum Exploration Data, 2011, Geological Survey Queensland: <http://mines.industry.qld.gov.au/geoscience/geoscience-wireline-log-data.htm>

Queensland Wetland Data: Version 4.0, Department of Science, Information Technology and Innovation, 2016: (16 November 2016) <http://qldspatial.information.qld.gov.au/>

RPS AUSTRALIA EAST PTY LTD, 2012, Galilee Basin Report on the Hydrogeological Investigations: <http://www.rlms.com.au/galilee26.asp>

Van Voast, W.A. 2003, Geochemical Signature of Formation Waters Associated with Coalbed Methane. AAPG Bulletin vol 87 no.4.

Vine, R.R: Compiler, 1964, Longreach 1:250,000 Geological Series – Explanatory Notes Sheet SF/53-13. Bureau of Mineral Resources, Geology and Geophysics.

Vine, R.R: Compiler, 1972, Galilee 1:250,000 Geological Series – Explanatory Notes Sheet SF/55-10. Bureau of Mineral Resources, Geology and Geophysics.

Appendix 1 – All ATP Water Quality Observations

DERM bore registration number	Permit	Identified aquifer	Depth of Sample (m)	Conductivity (uS/cm)	pH	Hardness (mg/L Ca)	Alkalinity (mg/L)	SAR	Total Dissolved Solids (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Iron (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulphate (mg/L)
2439	744	undifferentiated aquifer		6410	7.5	732	60	19.2	3834.44	1195		190	62.5		73		2234	1.05	116
5940	744	undifferentiated aquifer	203	0	7.5	3783	160	19.5	11091.5	2755.6		572	572		0	95.8	6046	0.5	1049.6
6559	744	undifferentiated aquifer		6500	7.8	719	171	19.5	3837.37	1201		110	108		208		2075	1.1	240
11644	744	Clematis Group	25	0		3268	356	45.7	19195.3	6010.3		570.6	447.6		0	213.1	9613.9	0.3	2339.5
11644	744	Clematis Group	127	0		2657	110	30.2	12013.7	3572.1		533.4	321.8		0	65.8	6751	0.3	769.3
11644	744	Clematis Group	188	0		2515	108	31.1	ND	3587.9		624.9	231.7		0	64.4	6512.2	0.3	986.7
11644	744	Clematis Group	289	0		844	81	14.8	ND	985.3		198.8	84.4		0	48.6	1833.3	0.1	307.5
11644	744	Clematis Group	289	0		639	76	18.9	3542.3	1096.8		201.6	32.9		0	45.8	1877.6	0.2	287.4
11644	744	Clematis Group	289	0	7.5	206	72	9	ND	296		48	21	12	88		512	0.25	55
11644	744	Clematis Group		4800	7.8	720	70	13.5	2918.02	830		180	65.6		85.3		1590	0.48	210
16896	744	Moolayember Formation	118	8600	6.4	1265	100	18.6	5216.49	1518		256	152		122		2970	0.5	260
16897	744	Moolayember Formation	230	1400	8	116	65	15.7	776.34	388		10	22		79		275	0.5	42
772	744	Moolayember Formation	114		7.4	5200	180		19000	5000		765	800		220		10450	1.8	1110
772	744	Moolayember Formation	158		7.6	440	115		27000	817		148	17		140		1480	0.5	14
772*	744	Lake Galilee Sandstone	2738	NA	7.3	130	285		3500	955	NA	50	NA		348	NA	1305		76
30929	744	undifferentiated aquifer		3120	7.6	162	70	18.4	1519.76	540	9	12	32.2		85		880	0.27	4.5
47637	744	undifferentiated aquifer	36	5600		1010	90	12.8	ND	932		116	175		110		2098		0
47640	744	undifferentiated aquifer		750		110	55	5.2	ND	124		6	23		67		231		
67626	744	undifferentiated aquifer		470	7.2	38	30	4.7	246.88	67	11	2.7	7.6	0.03	36.5	0	115	0.1	13.5
50066*	744	Betts Creek beds	918	NA	8	NA			NA	NA	NA	22.4	NA		NA	NA	1100		NA
50066*	744	Lake Galilee Sandstone	2597	NA	8	64			NA	NA	NA	NA	NA		NA	NA	3000		NA
62965*	744	Betts Creek beds		35700	7.3	840	1950	20	22603	1320	13700	275	36.4	33.0	1950	<10	19000	24.0	28.0
62965*	744	Betts Creek beds		17500	7.3	610	726	14	11080	796	4610	204	25.6	24.0	726	<10	7300	16	7.2
62965*	744	Betts Creek beds		11000	7.5	380	528	14	6965	622	2130	125	15.3	17.0	528	<10	3500	3.5	9.8
62965*	744	Betts Creek beds		8570	7.6	67	478	29	5426	549	1710	9.0	10.9	9.3	478	<10	2400	<0.5	8.9
63063*	744	Betts Creek beds		12000	9.3	80	1090	23	7598	470	38000	16	9.5	34	920	170	3600	<5	210
63063*	744	Betts Creek beds		38000	10.0	60	3110	71	24060	2167	20000	60	47	38	2300	810	13000	<5	540
63856*	744	Betts Creek Beds		38000	8.2	720	700	18	24060	1100	17000	240	29	22	700	<20	15000	2	160
63856*	744	Betts Creek Beds		38000	8.2	700	710	18	24060	1100	18000	230	28	22	710	<20	15000	2	160
63856*	744	Betts Creek Beds		69000	8.5	1200	1300	22	43687	1800	32000	400	61	52	1300	<20	15000	<5	1
63856*	744	Betts Creek Beds		69000	8.4	1200	1400	21	43687	1700	31000	390	61	59	1400	<20	27000	<5	300
63856*	744	Betts Creek Beds		9400	8.3	93	750	21	5952	460	2400	29	5.1	5.2	750	<20	2300	2	110
63856*	744	Betts Creek Beds		9100	8.2	95	760	20	5762	450	2400	30	4.9	4.7	760	<20	2300	2	110
63856*	744	Betts Creek Beds		86000	8.3	1300	1700	89	54451	1400	50000	420	68	170	1700	<20	35000	<0.5	410
63856*	744	Betts Creek Beds		330	7.6	77	140	7	209	26	44	21	6	<1	140	20	38	<0.5	<0.5
63857*	744	Betts Creek Beds		31000	7.4	110	880	11	19628	270	2100	36	5.5	24	880	20	12000	<5	8.1
63857*	744	Betts Creek Beds		51000	7.4	1500	980	150	32291	2400	34000	470	77	39	980	20	15000	2	14
63857*	744	Betts Creek Beds		51000	7.4	620	1100	18	32291	1000	12000	200	32	40	1100	20	18000	<5	15

DERM bore registration number	Permit	Identified aquifer	Depth of Sample (m)	Conductivity (uS/cm)	pH	Hardness (mg/L Ca)	Alkalinity (mg/L)	SAR	Total Dissolved Solids (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Iron (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulphate (mg/L)
63857*	744	Betts Creek Beds		14000	7.3	480	860	22	8864	1100	4100	160	22	20	860	20	3700	2	18
63857*	744	Betts Creek Beds		14000	7.5	500	950	21	8864	1100	4100	170	22	17	950	20	4900	<5	15
63857*	744	Betts Creek Beds		17000	7.5	680	760	21	10764	1200	4300	230	25	18	760	20	4800	<0.5	78
63857*	744	Betts Creek Beds		17000	7.5	640	1500	21	10764	1200	4600	2 10	26	1.8	1500	20	6200	1	56
63857*	744	Betts Creek Beds							35456	1500	30000	280	58		1700	20	20000		17
Within 20Km Gunn #2 (Outside ATP744)																			
16197	Outside 744	undifferentiated aquifer	514	500	7.1	12	176		252.97	73.3		4.8	0		214.5		64	0.4	5
35917	Outside 744	undifferentiated aquifer		5150	7.6	800	150	22.2	4607.68	1442		256	39		183		2780	0.7	0
35917	Outside 744	undifferentiated aquifer		10000	7.2	1361	72	19.9	5767.97	1687		500	27		88		3510	0.7	0
35917	Outside 744	undifferentiated aquifer		10000	7.1	1298	8	20.3	5697.62	1682		470	30		10		3510	0.7	0
69531*	Outside 744	Betts Creek beds		30600	6.79	450	921		19900	1740	6560	144	22	11.6	921	<1	7970	6.7	1260
BAP within 20 Km Gunn #2																			
16197	Outside 744	undifferentiated aquifer	514	462	7.76	<1	164		300	96	6	<1	<1	0.50	164	<1	42	0.2	<1
93059	744	Moolayember Formation	246	40250	6.8		122		27100	8300	116	1540	1040	3. 27	122	<1	14810	0.7	1230
93822	744	Clematis Group ¹ / Moolayember Formation ²	271	12600	7.53	1470	61		8632	2080	30	424	100	0.82	61	<1	4540	0.7	2
118169	744	Moolayember Formation	204	7456	7.29		111		3840	1500	50.5	206	30.7	0. 359	111	<1	1912	0.53	78.5
93768	Outside 744	undifferentiated aquifer	127	5300	7.81	573	155		3440	902	16	114	70	0.1	155	<1	1480	0.5	119
Gunn #2 Sample 1	744	Betts Creek beds		1780	8.26	15	846	54.4	1080	484	28	6	<1	0.16	733	113	126	11	<1
Gunn #2 Sample 2	744	Betts Creek beds		1770	8.24	15	821	52	1050	463	20	6	<1	1.74	802	19	110	11.9	<1
Gunn #2 Sample 3	744	Betts Creek beds		1730	8.26	15	818	52.4	1030	466	14	6	<1	1.76	810	8	97	11.7	<1
Gunn #2 Sample 4	744	Betts Creek beds		1700	8.38	12	697	50.7	915	412	9	5	<1	2.5	672	24	99	11.1	<1

*DST Samples

Appendix 2 – All ATP Water Level Observations

DNRM Registration Number	Formation Name	Date	Groundwater Level (m bGL)	S.W.L (m)(1)
11644	Clematis Group	20/11/1950	-29.26	
69442	Clematis Group	18/07/1986	-24	
103565	Dunda Beds	20/06/2002	-36	
6350	Moolayember Formation	1/10/1910	-7.6	
16895	Moolayember Formation	14/07/1966	-32.9	
16896	Moolayember Formation	5/07/1966	-27.43	
16897	Moolayember Formation	26/06/1966	-32	
69288	Moolayember Formation	28/01/1986	-16.2	
69628	Moolayember Formation	11/01/1990	-36.58	
5940	Unknown	1/01/1924	-66.7	
7046	Unknown	10/01/1983	-48.76	
7047	Unknown	10/01/1983	-33.52	
39801	Unknown	26/05/1975	-35.4	
47637	Unknown	4/10/1977	-4.9	
47638	Unknown	5/10/1977	-10.2	
47639	Unknown	9/11/1977	-0.3	
69451	Unknown	18/09/1987	-16.5	
69934	Unknown	29/02/1992	-12.1	
22367	Unknown	1/11/1965		-25.91
96545	Unknown	21/03/1995		30
118253	Moolayember Formation	17/02/2003		-48
118371	Clematis Group	8/06/2004		-7
118169	Moolayember	25/05/2013		-46.95
93059	Moolayember	26/05/2013		-9.8
93822	Clematis Group ⁽¹⁾ / Moolayember ⁽²⁾	10/10/2012		-60.71
44487	Clematis Group	17/10/1973		-18.3
67626	Clematis Group	24/07/1987		-12
93819	Clematis Group	05/07/2001		-8
93822	Clematis Group	08/08/2001		-16
93827	Unknown	18/08/2001		-33
103875	Betts Creek beds	28/08/2008		-51
103876	Betts Creek beds	28/08/2008		-50
103878	Tertiary - undefined	29/12/2005		-19
118164	Unknown	25/08/2003		-54
132701	Moolayember Formation	21/09/2009		-38
132703	Clematis Group	23/02/2009		-69.5
146685	Clematis Group	13/08/2013		-12.6

DNRM Registration Number	Formation Name	Date	Groundwater Level (m bGL)	S.W.L (m)(1)
146795	Clematis Group	02/10/2013		-30.4
158152	Betts Creek beds	05/06/2013		-59.35
158887	Unknown	02/08/2014		-35
158888	Moolayember Formation	30/07/2014		-45.12
163079	Unknown	12/12/2013		-18
163503	Clematis Group	05/10/2015		-7.9
163506	Moolayember Formation	09/07/2015		-6.8
163553	Clematis Group	15/08/2015		-18
165061	Betts Creek beds	03/07/2013		-71.26
165062	Betts Creek beds	03/07/2013		-71.09
165064	Betts Creek beds	15/12/2013		-33.29
165065	Betts Creek beds	21/01/2013		-33.99
165066	Rewan Group	03/07/2013		-62.19
165125	Unknown	18/07/2015		-36
165126	Unknown	27/06/2015		-18
165169	Unknown	24/10/2015		-25

- (1) DNRM Groundwater Database aquifer
(2) Interpreted aquifer by Comet Ridge Limited



COMET RIDGE LIMITED

UNDERGROUND WATER IMPACT REPORT
SUBMISSION SUMMARY

ATP 744P

April 2017

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Introduction

This report summarises submissions received by Comet Ridge Limited (*Comet Ridge*) as a result of a public consultation process in respect of the 3-year review of the Underground Water Impact Report for ATP744P (*UWIR*).

Summary of Submissions

A UWIR was prepared by Comet Ridge Limited for previous and proposed future production activities within ATP 744P as required under the *Water Act 2000* (Qld). An initial UWIR was prepared by Comet Ridge and submitted to the Department of Environment and Heritage Protection (DEHP) in March 2014. The initial UWIR for ATP744 was approved by DEHP (with conditions) and took effect on 3 April 2014. A revised UWIR is required under legislation to be prepared every three years from the approval date of the UWIR. This revised UWIR is relevant for the reporting period 2017 to 2020.

The public consultation period for the revised UWIR commenced on 15 March 2017. A public notice and a consultation version of the UWIR were published on the Comet Ridge website, also on 15 March 2017. Prior to this, a public notice was sent to all landholders with registered water bores within ATP 744P.

The public notice was published in the Longreach Leader on 10 March 2017. The Longreach Leader is the only publication circulated throughout the region within which ATP 744P is located.

A copy of the public notice is attached at the rear of this document.

The public consultation period ended on 12 April 2017.

Two public submissions were received by Comet Ridge in respect of the subject UWIR.

The following is a summary of this submission -

Both submissions were received from Brian and Lorraine Corbett (*Corbett*), the Registered Lessees of grazing properties known as Hyde Park Station (*Hyde Park*) and View Hill (*View Hill*). Both properties adjoin each other and are located within the north-eastern part of ATP744P (refer **Figure 1**).

Corbett has indicated that -

- There are eleven (11) equipped operational water bores within Hyde Park which are utilized for the purpose of providing domestic and stock water;
- There are two (2) existing and operational water bores within View Hill which are utilized for the purpose of providing stock water; and
- Should water quality and quantity from these operational bores become impaired by forecasted CSG activities, then the landholders' pastoral activities will become affected.

In essence, Corbett has concerns in respect of -

- The frequency of reporting and community consultation;
- Well construction and connectivity of aquifers and how both of these components are assessed;
- The quality and quantity on data inputs, modelling methodology, design and calibration of the groundwater model;
- The currency and quality of data within the DNRM Groundwater Database and use of this data in the UWIR process;
- Processing of produced CSG water and well construction methodologies;
- The level of detail on spring monitoring, the bore monitoring strategy and impacted bores in the UWIR; and
- Effects of CSG production should, CSG activities expand outside the proposed pilot area.

Corbett also has general concerns with respect to -

- Decline of water quality from the landholders bores and other water bores within ATP744P;
- Decline in quantity of water from the landholders bores and other water bores within ATP744P;
- Increase in methane concentration levels of bore water from landholder bores and other bores within the tenement area; and
- Impact upon short and long term grazing management practices, increased costs of production due to impairment of landholder bore water quality and supply.

Response to Submissions

Existing water bores and location of properties and possible future CSG activities

12 registered water bores are located within the bounds of Hyde Park.

Of these 12 registered water bores, 10 are listed as existing in the DNRM Groundwater Database and 9 of these existing bores lie within the boundary of ATP 744P, the subject of the UWIR.

The Corbett submission indicates there are 11 operation water bores within Hyde Park utilized for the purpose of providing domestic and stock water. There is a discrepancy with the number of existing bores indicated in the Corbett submission and the DNRM Database.

All existing water bores located within Hyde Park are all over **85km** from the proposed Gunn pilot location.

45 registered water bores are located within the bounds of View Hill.

Of these 45 registered water bores, 32 water bores are listed as existing in the DNRM Groundwater Database and 18 of these existing bores lie within the boundary of ATP 744P, the subject of the UWIR.

Corbett submission indicates there are 2 operation water bores within View Hill utilized for the purpose of providing stock water.

Of the 32 existing water bores within View Hill, 2 are existing water bores and 30 are water monitoring bores drilled within coal mining lease permits. These monitoring bores have been drilled to monitor water quality and water level changes in the Betts Creek beds and overlying aquifers with respect to coal mining activities undertaken in the area.

All 32 existing water bores within View Hill are over **65km** from the proposed Gunn pilot.

Both View Hill and Hyde Park are located over **65km** from Gunn 2 well. Previous CSG exploration undertaken by Comet Ridge strongly indicates gas content of coals is negligible where coal is at depths less than 600m (as indicated by the red line in **Figure 1**). The approximate extent of Betts Creek beds coal is shown by the orange dashed line in **Figure 1**.

All of the existing water bores utilised by the landholder on Hyde Park are outside the extent of the Betts Creek coals. Both existing bores utilised by the landowner on View Hill are within an area where coals are very shallow and have negligible gas content. This area, however, is likely suitable for coal mining activities, hence the number of bores drilled in furtherance of the proposed coal mining activities.

Montani 1 and Shoemaker 1 (**refer Figure 1**) coal seam gas wells were drilled by Comet Ridge in 2010 and results from coal desorption analysis indicated an average total DAF gas content less than $1\text{m}^3/\text{t}$, well below an economical limit for the Galilee Basin of $4\text{--}7\text{m}^3/\text{t}$. The entire area of ATP744 north of Montani 1 and Shoemaker 1 is considered uneconomic for coal seam gas exploration and production due to these negligible gas contents. Comet Ridge has no intention of extending CSG exploration or development north of either of these wells, including in respect of the entirety of View Hill and Hyde Park properties.

Due to the spatial separation of proposed activities as outlined in ATP744 UWIR, the impacts on any existing water bores located within View Hill and Hyde Park is considered to be negligible, if any, now and into the future.

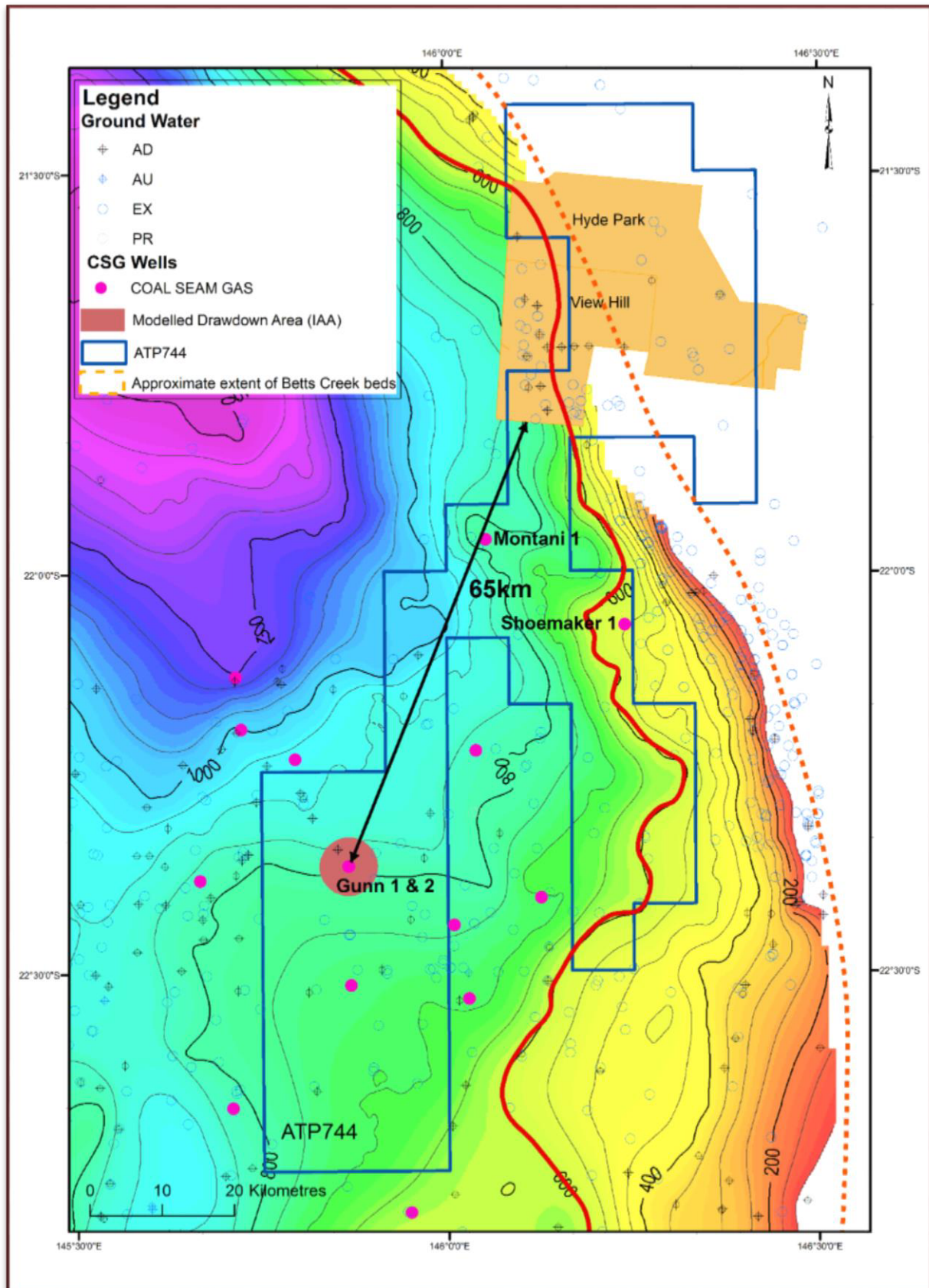


Figure 1: Location of View Hill and Hyde Park properties to Gunn 2 well and IAA of ATP744 UWIR. Also showing CSG wells and groundwater bores. Background map is depth (mGL) to top Betts Creek beds.

Well Construction, Water Quality and Groundwater Monitoring

Concerns were raised in the submission of cross-contamination between the Betts Creek beds and the Moolayember Formation and Clematis Group aquifers and, consequential, reduction in the water quality of the Moolayember Formation and Clematis Group aquifers.

In response to the concerns raised in the Corbett Submission, it should be noted that Comet Ridge will use best practise industry standards, as has always been the case with any well drilled, to drill and complete the proposed Gunn pilot wells.

Further, both the Moolayember Formation and Clematis Group aquifers will be isolated from the Betts Creek beds by 7" in diameter steel casing which will be pressure sealed by cement in accordance with the Code of Practice for Constructing and Abandoning Coal Seam Gas Wells in Queensland¹¹. On completion of the well, a cement bond log will be run to ensure zonal isolation has been achieved.

This completion style is used, specifically, to avoid cross-contamination and also to allow for perforation of the target seam, so that water and gas are only produced from the C1 target seam interval.

The Rewan Group has been identified as a regionally significant confining unit. The Clematis Group and Moolayember Formation aquifers have been identified as the primary, if not the only, aquifers used for domestic and stock use within the Immediately Affected Area (IAA) and well beyond.

The Rewan Group consists of lithic sandstone, mudstone, shale, siltstone and minor quartz sandstone. This formation is locally more than 300 metres thick. Previous studies have concluded silicification and clay alteration has significantly reduced the porosity and permeability and no significant aquifers exist within this formation. As a result, this formation is interpreted as a regionally significant confining barrier separating the Betts Creek beds from the Moolayember Formation and Clematis Group aquifers, which significantly mitigates the risk of cross-contamination between the aquifers.

A water monitoring program will be undertaken to measure changes in water quality (including pH and Iron) and water level.

These parameters will also be used to monitor cross-contamination between the Betts Creek beds and Clematis Group and Moolayember Formation aquifers.

The water monitoring strategy proposed under the UWIR will monitor the water quality and water level of the Betts Creek beds in all Gunn pilot wells, the Moolayember Formation (likely source aquifer), in four registered water bores located within 10km of the proposed pilot and the Clematis

¹¹ Department of Natural Resources and Mines, 2013, Code of Practice for constructing and abandoning coal seam gas wells and associated bores in Queensland, Edition 2.

https://www.dnrm.qld.gov.au/_data/assets/pdf_file/0011/119666/code-of-practice-csg-wells-and-bores.pdf

Group aquifer within the Gunn-1 well, which is located in the immediate vicinity of the proposed Gunn pilot and two registered water bores located within 10km of the proposed pilot.

Gunn-2 (central well in proposed Gunn pilot), and the three surrounding water bores which lie within 10km of the proposed pilot have undergone groundwater baseline assessment and the results are reported in the UWIR. Three additional water bores identified in preparation of this UWIR have been drilled within 10km of Gunn-2 within the last three years. Baseline assessments will be undertaken on these bores prior to 1 November 2017 as per approved BAP Plan for ATP744 or prior to further production testing, whichever occurs earlier.

This baseline assessment data and monitoring data will be used to evaluate any changes detected in the water level, water quality and chemistry of the Betts Creek beds, Moolayember Formation and Clematis Group aquifers pre-pilot production and during the production test period according to the monitoring schedule in the UWIR.

No water bores were impacted as a result of the production activities and no water bores were predicted to be impacted as a result of the predictions from the groundwater modelling.

While no impacts are predicted by the current modelling within the Moolayember Formation or Clematis Group aquifers from the proposed production testing, Comet Ridge will, nevertheless, monitor these aquifers during the production test phase to garner data which will feed back into the model to verify and improve predictions as well as to monitor water quality and water level in the aquifers most widely used by landholders within the tenure area.

Comet Ridge believes the monitoring program is sufficient to detect any changes in water chemistry and water level within the Moolayember Formation and Clematis Group in registered water bores within the IAA (i.e. within a ~5km radius from the centre of the proposed pilot) and in the area surrounding the IAA.

If any changes in water chemistry or water level can be attributed to the proposed production testing activities mitigation actions will be initiated.

The water monitoring program ensures that if any changes occur in water quality (incl. pH and Iron) or water level they will be detected in close proximity to the proposed pilot wells before ever extending to the existing registered water bores located on Hyde Park of View Hill.

Comet Ridge intends to strictly adhere to the groundwater monitoring program outlined in the UWIR and BAP for ATP744.

Comet Ridge will comply with all Department of Environment and Heritage Protection (DEHP) and DNRM guidelines and policies applicable to the proposed production pilot and ATP 744P activities.

Data and Groundwater Modelling

Comet Ridge is not the custodian of the DNRM Groundwater Database and therefore has no responsibility for the quality or quantity of data provided in the database. Comet Ridge has used care to extract data from the Groundwater Database that is relevant to the UWIR for ATP744P.

Information as to registered groundwater bores in Queensland is primarily obtained from the DNRM Groundwater Database. Additional data is required to be obtained from Baseline Assessments that have been undertaken as per requirements of approved Baseline Assessment Plans for relevant tenure areas. Baseline assessments have been completed on three water bores within ATP744 and this data has been incorporated into the groundwater modelling for ATP744 along with data extracted from the DNRM Groundwater Database and data obtained from production testing and additional water quality analysis (water quality analysis of produced water).

It should be noted that although baseline assessment data from water bores within ATP744, as collected by Comet Ridge, was submitted to the Office of Groundwater Assessment in late 2013, the extract of the Groundwater Database (dated February 2017) used for the revised UWIR did not incorporate any of the baseline assessed water bore data from ATP744.

Although care was taken to include all available data at the time modelling was undertaken, there are, however, limitations associated with the groundwater simulations performed. These relate primarily to the data availability, the decisions made during developing a conceptual model and, the assumption that the water level responses during the production test are indicative of the longer term impacts that could be expected from a five-spot pilot. For this reason, ongoing monitoring of groundwater levels within the Betts Creek beds and in the overlying formations is proposed to occur throughout the production test period. Any additional data acquired will be routinely fed back into the model to verify and improve the predictions of the modelling.

UWIR Compliance & Reporting

Comet Ridge is of the firm belief that all information/data requirements of an UWIR have been provided and addressed within the revised UWIR.

Comet Ridge also maintains all reporting requirements to DEHP for a UWIR have been complied with and have been submitted within the required timeframe.

Comet Ridge has engendered and maintains amicable and positive relations with the landowners with whom we have come in contact. In the second half of 2012, Comet Ridge conducted a field day where local landowners were invited to examine a drilling rig in operation and to receive briefings on various aspects of Comet Ridge's exploration activities and forward plans. Comet Ridge intends to continue engaging with the community going forward, particularly if the Gunn pilot project is commissioned.

Comet Ridge has provided all appropriate documentation as per requirements for BAP's and UWIR's, with respect to ATP744P, to relevant landholders. Baseline Assessment Reports for all baseline

assessed water bores within the designated area were provided to relevant landholder (as required by legislation). The initial UWIR report was provided to all landowners within close proximity to the proposed Gunn Pilot (not required by legislation). The initial UWIR resulted in one submission from a landholder in ATP744. Comet Ridge personnel visited this landholder to discuss the results of the UWIR and discuss any concerns/queries that landholder had in relation to the UWIR for ATP744. This landowner was completely satisfied with the explanations provided by the Comet Ridge personnel.

Legitimate Concerns

The completion technique, and water monitoring program, outlined within the UWIR will ensure the legitimate concerns outlined in the Corbett submission (listed below) are mitigated

- Changes to water quality and water levels in the Moolayember Formation and Clematis Group (from levels determined in the baseline study)
- Cross-contamination between Betts Creek beds and Moolayember Formation and Clematis Group aquifers

No guarantee can be made that water quality or water levels will not change or cross-contamination will not occur due to proposed production testing activities outlined in the UWIR. However, the predicted modelling indicates there will be no affected aquifers except the target coal seam and the water monitoring strategy has been designed to enable the initiation of a mitigation strategy if any changes are detected in the immediate/close vicinity to the proposed pilot.

Changes to UWIR due to Submissions

No changes were made to the final version of the Underground Water Impact Report submitted to the Department of Environment and Heritage Protection as a result of review and assessment of the submission received.

LYNE & CO Lawyers

PRINCIPAL: Richard Alexander Woodd Lyne

7 April 2017

Comet Ridge Limited
Level 3, 283 Elizabeth Street,
BRISBANE QLD 4000

By Email: info@cometridge.com.au

Dear Sir/Madam,

Re: Landholder: Brian Allan Corbett and Lorraine Ellen Corbett
Tenement Holder: Comet Ridge Limited
Tenement: Authority to Prospect 744
Land Asset: "View Hill", Charters Towers

I refer to the above matter and the Underground Water Impact Report dated 14 March 2017.

I confirm that I act on behalf of the Landholder, Brian Allan Corbett and Lorraine Ellen Corbett.

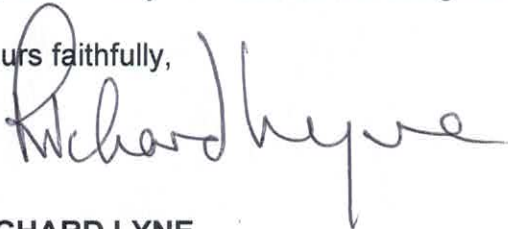
Attached to this correspondence is a copy of the Landholder's Submission to the Underground Water Impact Report dated 14 March 2017. The Landholder's submission in hard copy form will be forwarded to the designated postal address by Express Post today.

Please acknowledge receipt of the Landholder's Submission dated 7 April 2017.

Also attached with this correspondence is the Landholder's Tax Invoice in relation to legal costs incurred by the Landholder in relation to the preparation of the Landholder's Submission.

Would you kindly attend to payment of the Landholder's legal costs within seven (7) days of the date of this correspondence. Payment of the Landholder's legal expenses may be made to the designated bank account set out in the Tax Invoice.

Yours faithfully,



RICHARD LYNE
Lyne & Co. Lawyers

Liability limited by a scheme approved under Professional Standards Legislation

131 Gill Street (PO Box 1815)
Charters Towers QLD 4820

SUBMISSION – Underground Water Impact Report – ATP744P – Galilee Basin

Water Act 2000

TO: COMET RIDGE LIMITED
GPO BOX 798
Brisbane QLD 4001

SCHEDULE

UNDERGROUND WATER IMPACT REPORT – CONSULTATION VERSION

LANDHOLDER: Brian Allan Corbett and Lorraine Ellen Corbett

PROPERTY ADDRESS: “View Hill”

AREA: 36,000 hectares

REAL PROPERTY DESCRIPTION: Lot 2493 on Crown Plan PH771
Title Reference – 17665193
Pastoral Holding 12/2493

ADDRESS FOR SERVICE: Lyne & Co Lawyers, 131 Gill Street (PO Box 1815),
Charters Towers QLD 4820

TENEMENT: ATP744P

TENEMENT HOLDER: Comet Ridge Limited

TENEMENT HOLDERS ADDRESS FOR SERVICE: Level 3, 283 Elizabeth Street, Brisbane QLD 4000

SUBMISSION TO THE CHIEF EXECUTIVE

RE: Underground Water Impact Report – ATP744P – Galilee Basin

The Landholder, Brian Allan Corbett and Lorraine Ellen Corbett are the Registered Lessees of the land forming the rural property known as “View Hill” being Pastoral Holding 12/2493 located within the Isaacs Regional Council more particularly described as Lot 2493 on Crown Plan PH771 as shown on Title Reference 17665193 containing an area of 36,000 hectares.

The Landholder conducts a grazing enterprise on “View Hill” and the adjoining rural property known as “Hyde Park Station”. The Landholder has two (2) equipped water bores on “View Hill” which are utilized solely for the purpose of providing stock water.

Should the Landholder’s water quality and/or water quantity become impaired by forecasted Coal Seam Gas production activities, then the Landholders pastoral activities will become affected.

The landholder makes the following submissions in relation to the Underground Water Impact Report (‘UWIR’) dated 14/03/2017:

1. Petroleum and Gas Production

- The assessment by the Tenement Holder does not indicate the effects of the production of Coal Seam Gas if the Coal Seam Production is expanded beyond the current planning in respect of the pilot wells; and
- An assessment should be provided of the impact that could occur if the Coal Seam Gas Production were to be expanded beyond current plans. The Tenement Holder's current plans are restricted to the testing of Coal Seam Gas Production from the existing and proposed pilot wells.

2. Connectivity

- Alternative and emerging methodologies for monitoring groundwater impacts and assessing connectivity between coal seams and aquifers should be considered.

3. Connectivity Due to Pilot Wells

- Recognition within the UWIR that there may be local effects if pilot wells are poorly constructed or abandoned, and that assessment of any potential effects will continue; and
- The connectivity caused by poorly constructed pilot wells needs to be further assessed; and
- Any connectivity due the penetration of pilot wells into aquifers needs to be assessed.

4. Current Groundwater Extraction

- The UWIR does not provide any estimations of the current stock and domestic water usage levels.

5. Trends in Groundwater Levels

- The Water Level Observation Table under Appendix 2 of the UWIR includes multiple water level figures from an unidentifiable formation; it is therefore unclear whether the water levels of all formations have been attained. A more detailed analysis of water level behaviour should be provided for all formations and not just the immediate overlying and underlying formations.

6. Predictions of Groundwater Impacts

- Other modelling codes such as FEFLOW should have been considered for the construction of the regional groundwater flow model; and

- More detail should be provided on the groundwater flow model design, construction and calibration and the assumptions inherent in modelling so that stakeholders are able to assess the reliability of model predictions;

7. Model Design and Construction

- Modelling should consider the potential effects of hydraulic fracturing on the permeability of coal and other geological units; and
- Whether groundwater extraction for non-Petroleum and Gas uses has been included in the groundwater model.

8. Model Calibration

- It is unclear what groundwater level data has been used to calibrate the model;
- Information on groundwater levels in Landholder bores should be used to calibrate the model; and
- Information on pressure levels in Landholder bores should be used to calibrate the model.

9. Results of Impacts Predictions

- More information on the timing of impacts and recovery from impacts should be provided; and
- information should be included on the number of bores already impacted; and
- Information should be included on the number of bores within the tenement that will be impacted in the future.

10. Network Design

- The purpose of water quality monitoring should be better specified; and
- more monitoring is needed in the Moolayember Formation and Clematis Group.

11. Data Availability

- Data should be shared with potentially affected stakeholders.

12. Spring Impact Management System

- In addition to the Moses Springs and Doongmabulla Springs, other Groundwater Dependant Ecosystems should be included in the strategy.

13. Periodic Reporting and Review

- The UWIR should be updated more frequently than every three (3) years; and
- Frequent public meetings to report on work carried out and obtain feedback from communities are recommended.

14. State Groundwater Database

- Systems need to be in place to keep the groundwater database and movement of baseline assessments up-to-date with changes recorded.

15. Coal Seam Gas Water Extraction

- Auxiliary issues regarding Coal Seam Gas water extraction including but not limited to, the disposal of salt, the integrity of the pilot wells and the use of chemicals in the drilling process, have not been explained in the UWIR.

16. Sodium Concentration

- The Sodium Concentration levels arising from Moolayember Formation connectivity with the Clematis Group discloses high sodium levels.

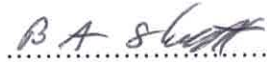
Summary

The issues that are of concern to the Landholder arising from the ATP744P activities and future Petroleum and Gas Production are:

1. Decline in water quality from Landholder's bores and other bores within the Tenement Area;
2. Decline in quantity of water from Landholder's bores and other bores within the Tenement Area;
3. Increase in methane concentration levels of bore water from Landholder's bores and other bores within the Tenement Area;
4. Impact upon grazing management practices, increased costs of production due to impairment of Landholders bore water supply; and
5. Impact upon long term viability of Landholder's grazing enterprise arising from decline in bore water quality and quantity from established Landholder bores within the Tenement Area.

**SUBMISSIONS REGARDING THE UNDERGROUND WATER IMPACT REPORT FOR
ATP744P:**

Dated this 7th day of April 2017


.....
Brian Allan Corbett


.....
Lorraine Ellen Corbett

LYNE & CO Lawyers

PRINCIPAL: Richard Alexander Woodd Lyne

7 April 2017

Comet Ridge Limited
Level 3, 283 Elizabeth Street,
BRISBANE QLD 4000

By Email: info@cometridge.com.au

Dear Sir/Madam,

Re: Landholder: Brian Allan Corbett and Lorraine Ellen Corbett
Tenement Holder: Comet Ridge Limited
Tenement: Authority to Prospect 744
Land Asset: "Hyde Park Station", Charters Towers

I refer to the above matter and the Underground Water Impact Report dated 14 March 2017.

I confirm that I act on behalf of the Landholder, Brian Allan Corbett and Lorraine Ellen Corbett.

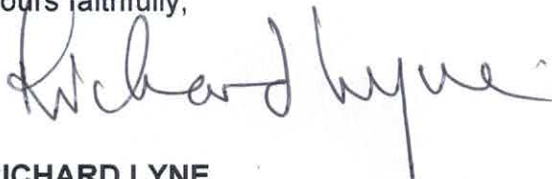
Attached to this correspondence is a copy of the Landholder's Submission to the Underground Water Impact Report dated 14 March 2017. The Landholder's submission in hard copy form will be forwarded to the designated postal address by Express Post today.

Please acknowledge receipt of the Landholder's Submission dated 7 April 2017.

Also attached with this correspondence is the Landholder's Tax Invoice in relation to legal costs incurred by the Landholder in relation to the preparation of the Landholder's Submission.

Would you kindly attend to payment of the Landholder's legal costs within seven (7) days of the date of this correspondence. Payment of the Landholder's legal expenses may be made to the designated bank account set out in the Tax Invoice.

Yours faithfully,



RICHARD LYNE
Lyne & Co. Lawyers

Liability limited by a scheme approved under Professional Standards Legislation

131 Gill Street (PO Box 1815)
Charters Towers QLD 4820

SUBMISSION – Underground Water Impact Report – ATP744P – Galilee Basin

Water Act 2000

TO: COMET RIDGE LIMITED
GPO BOX 798
Brisbane QLD 4001

SCHEDULE

UNDERGROUND WATER IMPACT REPORT – CONSULTATION VERSION

LANDHOLDER: Brian Allan Corbett and Lorraine Ellen Corbett

PROPERTY ADDRESS: “Hyde Park Station”

AREA: 60,400 hectares

REAL PROPERTY DESCRIPTION: Lot 1 on Crown Plan AY31
Title Reference – 17665194
Pastoral Holding 12/2522

ADDRESS FOR SERVICE: Lyne & Co Lawyers, 131 Gill Street (PO Box 1815),
Charters Towers QLD 4820

TENEMENT: ATP744P

TENEMENT HOLDER: Comet Ridge Limited

TENEMENT HOLDERS ADDRESS FOR SERVICE: Level 3, 283 Elizabeth Street, Brisbane QLD 4000

SUBMISSION TO THE CHIEF EXECUTIVE

RE: Underground Water Impact Report – ATP744P – Galilee Basin

The Landholder, Brian Allan Corbett and Lorraine Ellen Corbett are the Registered Lessees of the land forming the rural property known as “Hyde Park Station” being Pastoral Holding 12/2522 located within the Isaacs Regional Council more particularly described as Lot 1 on Crown Plan AY31 as shown on Title Reference 17665194 containing an area of 60,400 hectares.

The Landholder conducts a grazing enterprise on “Hyde Park Station” and the adjoining rural property known as “View Hill”. The Landholder has eleven (11) equipped water bores on “Hyde Park Station” which are utilized for the purpose of providing domestic and stock water.

Should the Landholder’s water quality and/or water quantity become impaired by forecasted Coal Seam Gas production activities, then the Landholders pastoral activities will become affected.

The landholder makes the following submissions in relation to the Underground Water Impact Report (‘UWIR’) dated 14/03/2017:

1. Petroleum and Gas Production

- The assessment by the Tenement Holder does not indicate the effects of the production of Coal Seam Gas if the Coal Seam Production is expanded beyond the current planning in respect of the pilot wells; and
- An assessment should be provided of the impact that could occur if the Coal Seam Gas Production were to be expanded beyond current plans. The Tenement Holder's current plans are restricted to the testing of Coal Seam Gas Production from the existing and proposed pilot wells.

2. Connectivity

- Alternative and emerging methodologies for monitoring groundwater impacts and assessing connectivity between coal seams and aquifers should be considered.

3. Connectivity Due to Pilot Wells

- Recognition within the UWIR that there may be local effects if pilot wells are poorly constructed or abandoned, and that assessment of any potential effects will continue; and
- The connectivity caused by poorly constructed pilot wells needs to be further assessed; and
- Any connectivity due the penetration of pilot wells into aquifers needs to be assessed.

4. Current Groundwater Extraction

- The UWIR does not provide any estimations of the current stock and domestic water usage levels.

5. Trends in Groundwater Levels

- The Water Level Observation Table under Appendix 2 of the UWIR includes multiple water level figures from an unidentifiable formation; it is therefore unclear whether the water levels of all formations have been attained. A more detailed analysis of water level behaviour should be provided for all formations and not just the immediate overlying and underlying formations.

6. Predictions of Groundwater Impacts

- Other modelling codes such as FEFLOW should have been considered for the construction of the regional groundwater flow model; and

- More detail should be provided on the groundwater flow model design, construction and calibration and the assumptions inherent in modelling so that stakeholders are able to assess the reliability of model predictions;

7. Model Design and Construction

- Modelling should consider the potential effects of hydraulic fracturing on the permeability of coal and other geological units; and
- Whether groundwater extraction for non-Petroleum and Gas uses has been included in the groundwater model.

8. Model Calibration

- It is unclear what groundwater level data has been used to calibrate the model; and
- Information on groundwater levels in Landholder bores should be used to calibrate the model; and
- Information on pressure levels in Landholder bores should be used to calibrate the model.

9. Results of Impacts Predictions

- More information on the timing of impacts and recovery from impacts should be provided; and
- Information should be included on the number of bores already impacted; and
- Information should be included on the number of bores within the tenement that will be impacted in the future.

10. Network Design

- The purpose of water quality monitoring should be better specified; and
- More monitoring is needed in the Moolayember Formation and Clematis Group.

11. Data Availability

- Data should be shared with potentially affected stakeholders.

12. Spring Impact Management System

- In addition to the Moses Springs and Doongmabulla Springs, other Groundwater Dependant Ecosystems should be included in the strategy.

13. Periodic Reporting and Review

- The UWIR should be updated more frequently than every three (3) years; and
- Frequent public meetings to report on work carried out and obtain feedback from communities are recommended.

14. State Groundwater Database

- Systems need to be in place to keep the groundwater database and movement of baseline assessments up-to-date with changes recorded.

15. Coal Seam Gas Water Extraction

- Auxiliary issues regarding Coal Seam Gas water extraction including but not limited to, the disposal of salt, the integrity of the pilot wells and the use of chemicals in the drilling process, have not been explained in the UWIR.

16. Sodium Concentration

- The Sodium Concentration levels arising from Moolayember Formation connectivity with the Clematis Group discloses high sodium levels.

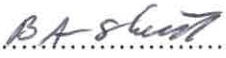
Summary

The issues that are of concern to the Landholder arising from the ATP744P activities and future Petroleum and Gas Production are:

1. Decline in water quality from Landholder's bores and other bores within the Tenement Area;
2. Decline in quantity of water from Landholder's bores and other bores within the Tenement Area;
3. Increase in methane concentration levels of bore water from Landholder's bores and other bores within the Tenement Area;
4. Impact upon grazing management practices, increased costs of production due to impairment of Landholders bore water supply; and
5. Impact upon long term viability of Landholder's grazing enterprise arising from decline in bore water quality and quantity from established Landholder bores within the Tenement Area.

**SUBMISSIONS REGARDING THE UNDERGROUND WATER IMPACT REPORT FOR
ATP744P:**

Dated this 7th day of April 2017


.....
Brian Allan Corbett


.....
Lorraine Ellen Corbett

PUBLIC NOTICE

Pursuant to Section 382 of the *Water Act 2000* Release of UNDERGROUND WATER IMPACT REPORT



In accordance with the requirements of section 381 and section 382 of the *Water Act 2000* (Water Act) **Comet Ridge Limited** has developed an underground water impact report (UWIR) for its **proposed pilot production program** within **Authority to Prospect (ATP) 744P** located approximately 90km north-east of Aramac and 145km north-east of Barcaldine in central Queensland.

You have the opportunity to review and comment on the UWIR.

From **Wednesday 15th March 2017** you can access the UWIR for **ATP744P** by visiting **Comet Ridge's** website at: <http://www.cometridge.com.au>

You can also phone **07 3221 3661** to arrange a hard copy of the report to be posted to you.

Written submissions on the UWIR may be made to **Comet Ridge Limited** and mailed to:

Comet Ridge Limited
GPO BOX 798
Brisbane QLD 4001

Your submissions must be:

In writing; and
Received by COB **Wednesday 12th April 2017**.

Please note that as required by section 382(d) of the *Water Act* copies of all received submissions must be provided to the chief executive. The submissions will be part of the assessment process for the UWIR.

For more information please phone **07 3221 3661**

