



REPORT

Groundwater Impact Assessment

Ardmore Phosphate Rock Project - Start-up Operation

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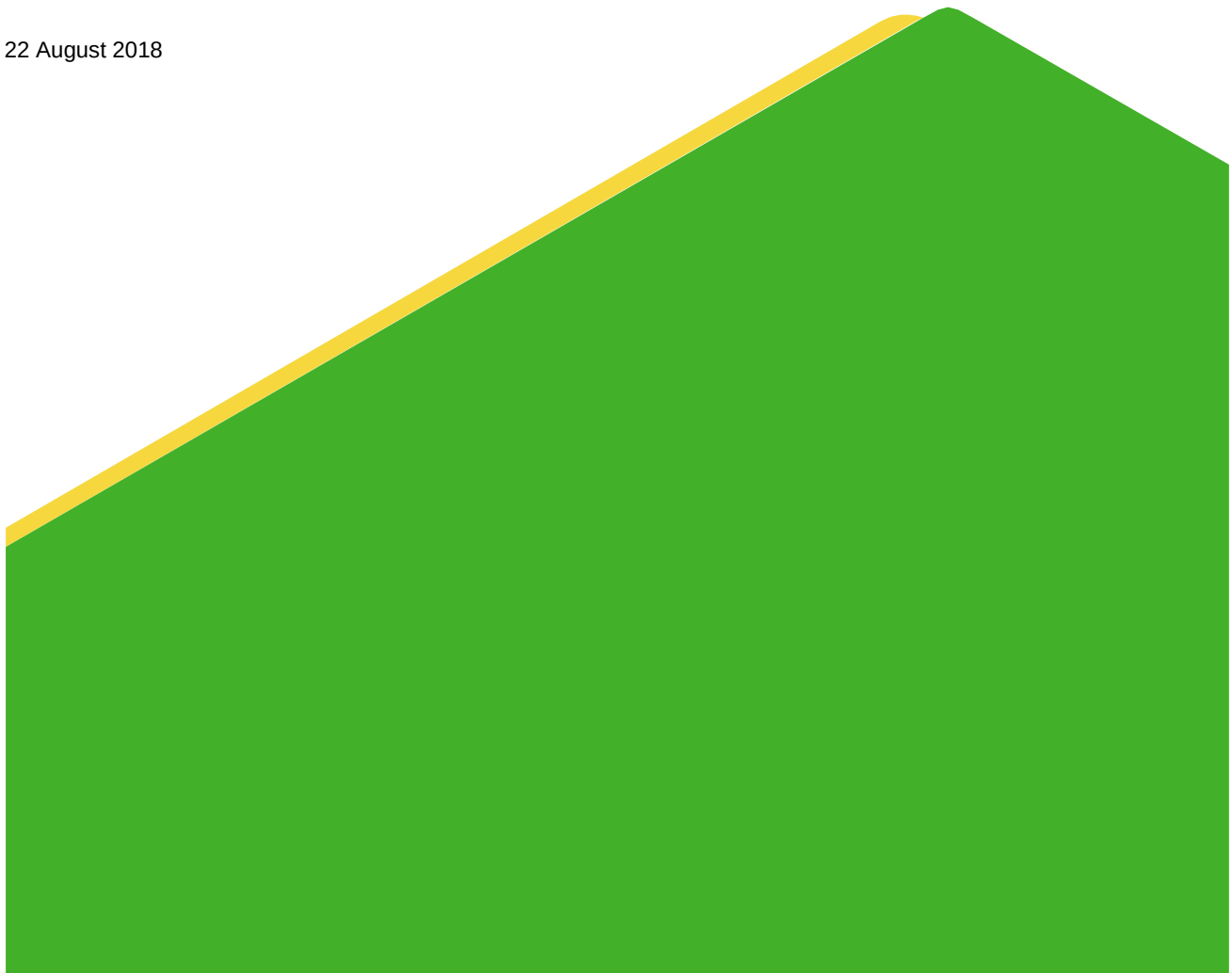
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1782517-018-R-Rev2

22 August 2018



Executive Summary

Centrex Metals Limited engaged Golder to prepare this report to provide a summary of the groundwater conditions and a groundwater impact assessment to support an application for an amendment to the current environmental authority (EA) for the Ardmore Phosphate Project Start-up Operation. The Start-up Operation will result in removal of overburden and shallow phosphate rock at shallow depth at the southern part of the Mining Lease that will not reach the water table during mining operations. Centrex is currently considering groundwater as a source for water supply during the Start-up Operation, at a proposed extraction rate of 15 L/s from one or two production wells in the Beetle Creek Formation in the northern part of the Mining Lease.

A conceptual hydrogeological model was developed based on a limited amount of historical geological and hydrogeological information coupled with relevant information available in the public domain as well as data collected from recent site investigations completed since Centrex acquired the Mining Lease in 2017. These recent investigations include drilling and installation of monitoring bores and one test pumping bore, hydraulic testing including pumping tests, and groundwater sampling and water quality analysis from all existing bores.

The conceptual model identifies the Beetle Creek Formation as being the main aquifer in the northern part of the Mining Lease and to a lesser extent the underlying Thornton Limestone, although the hydraulic properties of this unit are not well known. The aquifer is of limited aerial extent, and forms a small shallow basin that is bound on all sides by less permeable rock. This aquifer is confined where the Blazan Shale overlies the aquifer. The water table in the aquifer of the northern part of the Mining Lease is essentially horizontal with the elevation of the water table between 301.1 m AHD to 301.6 m AHD. Recharge to the Beetle Creek Formation in the vicinity of the project is thought to be low, and occurs mainly through discharge from ephemeral stream beds, where alluvium overlies the sub-cropping Beetle Creek formation, as well as minor contributions from direct infiltration to outcropping areas of the Beetle Creek formation. Field and laboratory analysis of the groundwater quality suggest that the water contained in the Beetle Creek formation and the Thornton Limestone are from a same origin and possibly hydraulically connected.

Predicted groundwater level drawdowns were calculated after 90 days of pumping at 15 L/s using the Theis radial flow equation for non-leaky confined aquifers and hydraulic properties determined from onsite testing. The drawdowns were calculated for two cases considering the most and least conservative values of transmissivity and storativity. In all cases, the 2 m drawdown cone is within 50 m of the pumping wells, due to the high formation transmissivity and short pumping duration. For the most conservative case, a 1 m drawdown contour extends approximately 820 m from the pumping wells at the end of the 90-day pumping period.

Environmental values of the groundwater have been identified in the vicinity of the Mining Lease. Seven registered groundwater bores were identified within 11 km of the Mining Lease. The closest active bore is located approximately 5 km from the site, well outside of the 1 m drawdown contour distance and likely screened in a different aquifer.

Potential subterranean, terrestrial and aquatic groundwater dependent ecosystems (GDEs) were identified using the Queensland and Australian GDE atlases. The 1 m drawdown cone does not reach the potential subterranean GDE. The Terrestrial GDE refers to vegetation that is not sustained by groundwater as the groundwater table occurs between 8 and 19 m below ground level and as such will not be impacted by drawdowns in the Beetle Creek formation. The Aquatic GDE was identified as Split Creek. This creek has been identified as an ephemeral creek and a recharge area for the shallow aquifer that will not be impacted by drawdowns in the Beetle Creek formation in the area.

Golder proposes a groundwater monitoring program that includes further hydraulic testing in the Thornton Limestone, the installation of data loggers to measure groundwater levels in all monitoring bores at regular intervals, and the collection of groundwater samples from the production bore(s) during the Start-up Operation period.

Distribution List

Gerard Bosch

Record of Issue

Company	Client Contact	Version	Date Issued	Method of Delivery
Centrex	Gerard Bosch	A	11/06/2018	Electronic copy (pdf)
Centrex	Gerard Bosch	0	09/07/2018	Electronic copy (pdf)
Centrex	Gerard Bosch	1	19/07/2018	Electronic copy (pdf)
Centrex	Gerard Bosch	2	22/08/2018	Electronic copy (pdf)

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1.0 INTRODUCTION

1.1 Background and Purpose

Centrex Metals Limited (Centrex) engaged Golder Associates Pty Ltd (Golder) to prepare this report to provide a summary of the groundwater conditions and an impact assessment to support an application for an amendment to the current environmental authority (EA) for the Ardmore Phosphate Project Start-up Operation. This report presents a summary of the hydrogeological information available in the area and a conceptual hydrogeological model of the northern zone of Ardmore Phosphate Project. This report also includes a description of the environmental values of the groundwater and the potential impacts that the Start-up Operation may generate.

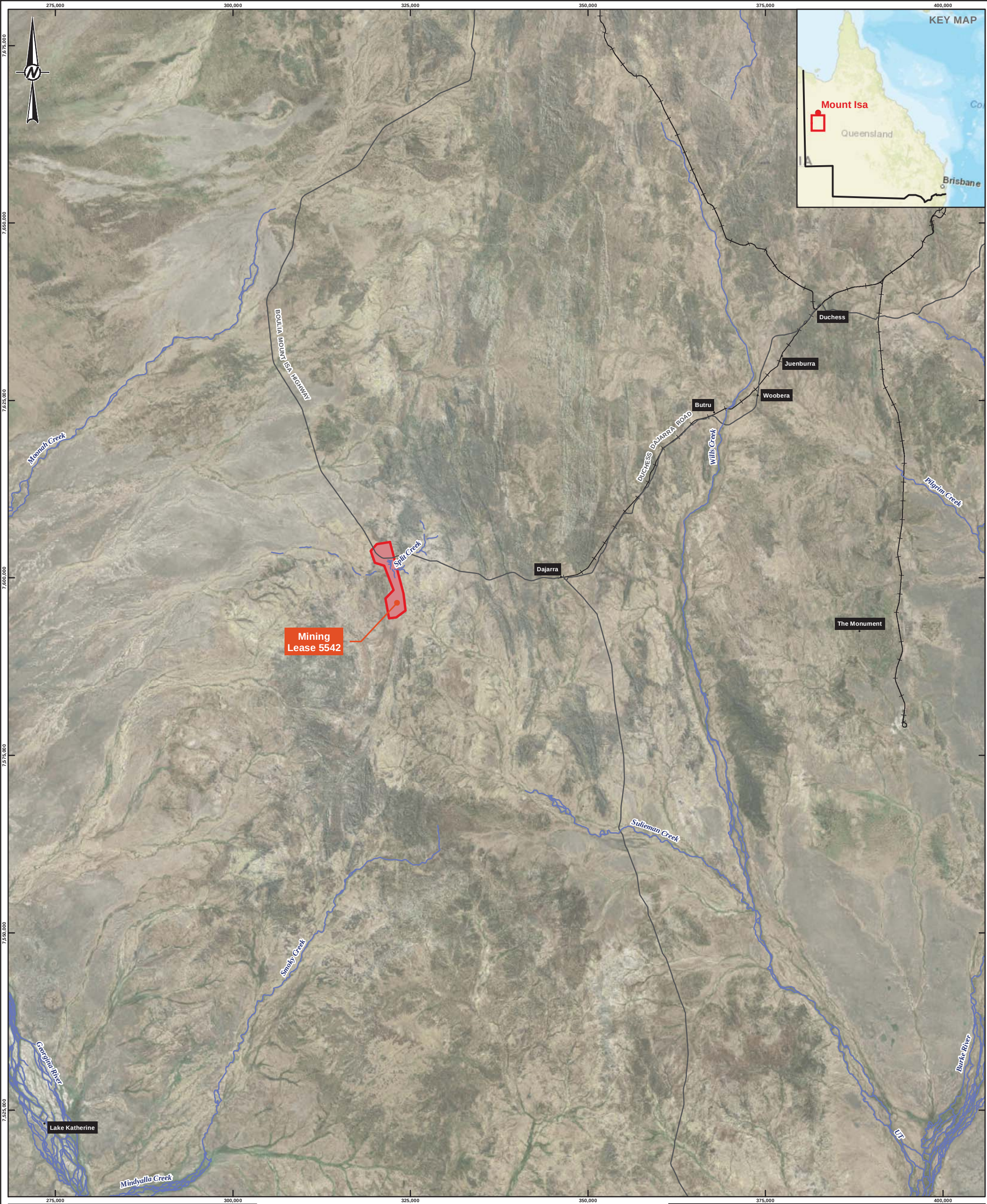
The present report will only provide a preliminary assessment of the potential groundwater impacts of the activities associated to the approximate 90 days Start-up Operation period.

1.2 Project Description Overview

Ardmore is located 128 km south of the city of Mount Isa and 23 km west of the town of Dajarra in North West Queensland. The rock deposit was previously drilled out from 1968 through to 1980 at the same time as the discovery of the Duchess Phosphate Rock Mine, which provides feed to the adjacent Phosphate Hill ammonium phosphate fertiliser plant. A Mining Lease (ML5542) for Ardmore was granted in 1975 and it has been held under common ownership with the Duchess Mine since that time, until being transferred to Centrex in June 2017. Ardmore is a smaller high-grade satellite deposit to the main operation and has until now remained undeveloped (Centrex Metals, 2017). An Environmental Authority (BRMN0037) over ML5542 is currently held by Centrex, which was issued by the administering authority, the former Department of Environment and Heritage Protection (DEHP), under standard conditions on 17 July 2017 (Centrex Metals, 2018). Centrex also holds granted Exploration Licenses EPM 26551 and EPM 26568 and an Exploration License Application EPM 26841 surrounding the Mining Lease.

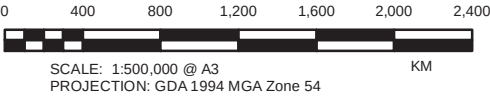
The study area of the Mining Lease (ML) encompasses 2,209 hectares, with the target high-grade phosphorite deposit occurring as a single, essentially flat lying unit within two separate areas within the ML, the “Northern Zone” with a strike extent of approximately 4.0 km (N-S) and the “Southern Zone” with a strike extent of approximately 1.6 km (E-W). The target phosphorite unit is shallow dipping, with the average depths of the hanging wall and footwall contacts being 8.3 m and 12.0 m respectively based on drilling to date (Centrex Metals, 2017).

The location of the project site is presented in Figure 1.



Legend

- Watercourses (Major)
- Split Creek (ephemeral)
- Main Roads
- Railways
- Mining Lease 5542



- REFERENCE(S)
- Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
 - Mining Lease: © State of Queensland (Department of Natural Resources and Mines) 2017.
 - Localities, Watercourses: © State of Queensland (Department of Natural Resources and Mines) 2016.
 - Main Roads: © State of Queensland (Department of Transport and Main Roads) 2017.
 - Railways: © State of Queensland (Department of Natural Resources and Mines) 2017.

CLIENT
CENTREX METALS LIMITED

PROJECT
ARDMORE PHOSPHATE ROCK PROJECT - START-UP
OPERATION

TITLE
PROJECT LOCATION MAP

	CONSULTANT	YYYY-MM-DD	22/08/2018
		DESIGNED	TM
		PREPARED	TM
		REVIEWED	JF
		APPROVED	JF

PROJECT NO. 1782517	CONTROL 018-R	REV. 2	FIGURE 01
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 25mm

1.3 Description of the Start-up Operation

The high-grade phosphorite deposit on the ML is located within two separate areas, the 'Northern Zone' and the 'Southern Zone'. Centrex propose to undertake preliminary, small-scale mining and processing operations (Start-up Operation) in the 'Southern Zone' prior to a decision to develop a full-scale operation.

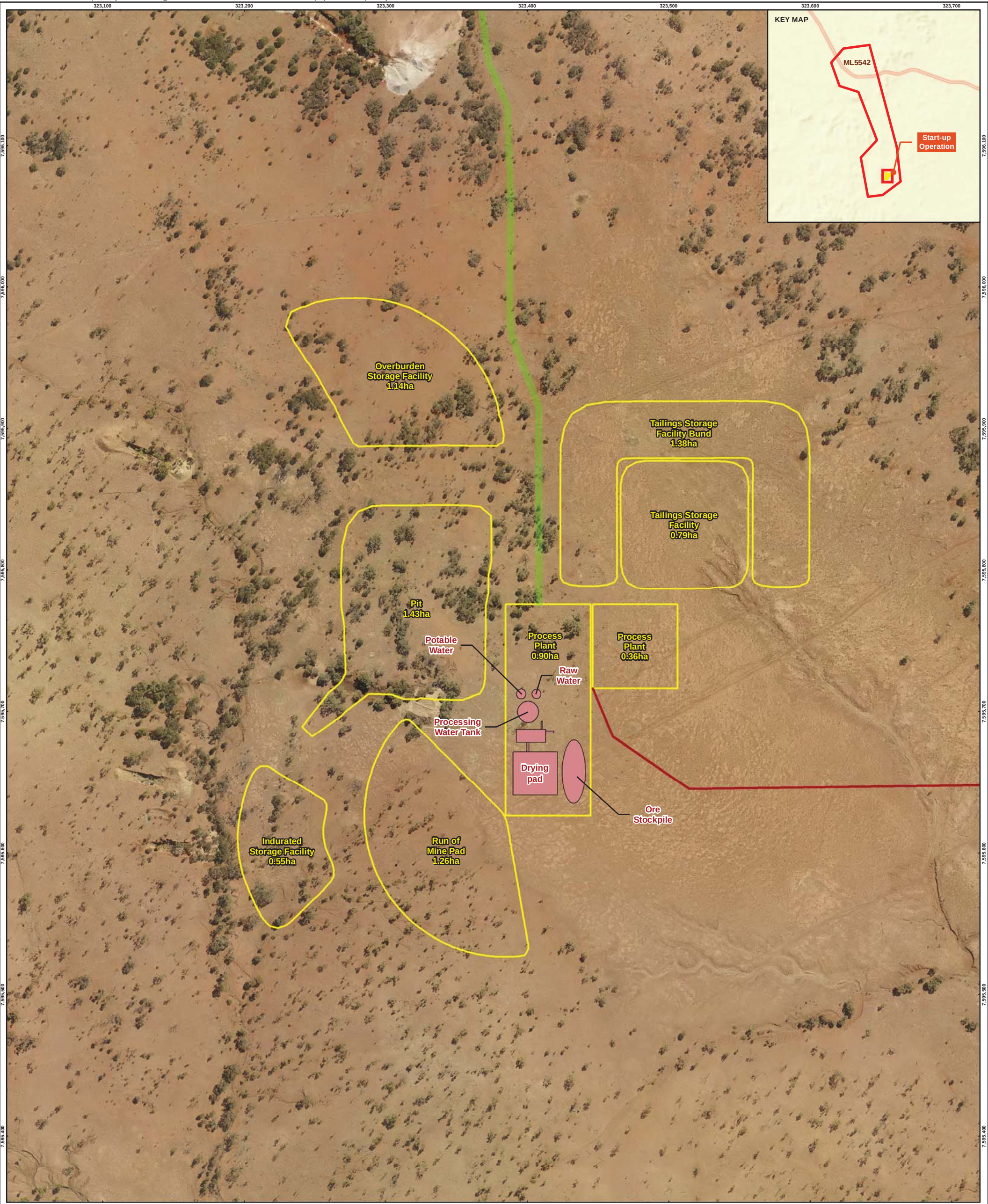
The Start-up Operation will process ore on a small scale to obtain phosphate rock concentrate samples for marketing, optimising plant configuration, developing design parameters and enhancing recovery (Figure 2). If approved to proceed, the Start-up Operation will extract 70,000 tonnes of ore using shallow open-cut strip mining over a 2 to 3 months period. Mining will include removal of overburden and shallow phosphate rock at shallow depths, and will not reach the water table during mining operations.

The Start-up Operation will include the following:

- Small scale pit
- Overburden storage
- Run of Mine (ROM) pad
- Tailings storage facility
- Processing plant (crushing, screening, drying pad)
- Office
- Onsite bores to supply water
- An onsite generator to supply power

The Start-up Operation will require approximately 12 people to be employed on a short-term basis. Concentrate will be loaded onto containers and trucked to Cloncurry for export by rail to Townsville.

Centrex is considering groundwater for water supply during the Start-up Operation, at a proposed extraction rate of 15 L/s. Centrex is currently considering extracting water from the Northern Zone of the ML from one or two production wells located in the Beetle Creek formation.



LEGEND

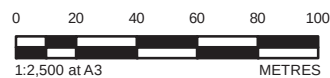
- Water Pipeline and Access Track
- Start-up Operation Access Track
- Start-up Operation
- Centrex Mining Lease
- ML5542
- Processing Plant

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT

CENTREX PHOSPHATE PTY LTD

CONSULTANT



YYYY-MM-DD	4/07/2018
DESIGNED	BG
PREPARED	BG
REVIEWED	JR
APPROVED	JR

REFERENCE(S)

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Start-up Operation, Water Pipeline and Access Track, Start-up Operation Access Track: Provided by Centrex 2018.
Processing Plant: Golder 2018.
Mining Lease: © State of Queensland (DNRM) 2018

PROJECT

CENTREX METALS LIMITED

TITLE

START-UP OPERATION CONCEPTUAL LAYOUT

PROJECT NO.	CONTROL	REV.	FIGURE
1782517	018	2	2

2.0 LEGISLATIVE FRAMEWORK

The relevant legislation for the management of groundwater from mining activities on a Mining Lease are:

- Chapter 3 of the Water Act 2000. This act defines requirements for “the management of impacts on underground water caused by the exercise of underground water rights by resource tenure holders” in Queensland. A framework is provided to cover water resource planning, water access licensing and tradeable rights.
- Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) and EPBC Amendment Act 2013. This act captures international biodiversity commitments from the U.N. Convention on biological diversity as well as Ramsar listed wetlands, and water resources.
- Environmental Protection Act 1994 (EP Act) provides a framework to protect environmental values and ensure sustainable management for an environmentally relevant activity such as mining.
- The Environmental Protection (Water) Policy 2009 (EPP (Water)) is based on the Environmental Protection Act 1994 (EP Act) and defines requirements to protect the quality of Queensland waters while supporting ecologically sustainable development.

Resource operators also have an obligation to comply with the underground water management framework under the Water Act. The underground water management framework requires that resource operators undertake a number of assessments and plans that relate to groundwater. The ‘Baseline Assessment Plan’ guideline (ESR/2016/2004) provides guidance for resource tenure holders in preparing and complying with a Baseline Assessment Plan (BAP) in accordance with sections 397 to 401 of the Water Act. A BAP identifies water bores located on a holder’s tenure and sets out a timetable for undertaking baseline assessments of those bores.

Chapter 3 of the ‘Baseline Assessment Plan’ guideline (ESR/2016/2004) requires that the ML holder must identify whether any water bores, registered or unregistered, exist on tenure. Where it can be verified that there are no water bores located in the area of a resource tenure, a BAP is not required.

A review of the registered groundwater bores has been undertaken. There are no landholder water bores within the ML and therefore a BAP is not required. Centrex will advise the chief executive of the department as early as possible that this is the case.

3.0 REVIEW OF AVAILABLE INFORMATION

Information presented in this report has been derived from a limited amount of geological and hydrogeological investigations carried out at the proposed site coupled with relevant information available in the public domain as well as data collected from recent investigations since Centrex acquired the Mining Lease in 2017.

3.1 Previous investigations

The geological setting of the phosphate deposit at Ardmore has been described in a report by Mines Exploration Proprietary Limited (MEPL) in 1977 that is complemented with the 1:100,000 geological map of Ardmore published by the Bureau of Mineral Resources, Geology and Geophysics. A hydrogeological study of the Mining Lease area was conducted by Western Mining Corporation Fertilizer (WMC) in April 2004. As part of this study, eight boreholes were drilled to evaluate groundwater conditions in the northern section of the Mining Lease. WMC suggested the presence of a potentially water bearing zone within the Beetle Creek Formation and the underlying Thornton Limestone formation. None of these boreholes were converted to groundwater monitoring bores.

Primary data sources referred to in the descriptions presented in the next sections included the following:

- M.J. Freeman. The Ardmore Rock Phosphate Deposit, NW Queensland. November 1976. Mines Exploration P/L, Report No. 1977/1 (MEPL, 1977).
- Australia 1:100,000 geological series, Sheet Number 6754.
- Ardmore Groundwater Exploration – Hydrogeological Results – Western Mining Corporation Fertilizer, April 2004 (WMC, 2004).

3.2 Recent investigations

Since having completed the acquisition of Ardmore in June 2017 Centrex has commissioned Golder to carry out a series of desktop studies and field investigations to have a better understanding of the existing hydrogeological conditions and to investigate groundwater as a potential source of water supply for future mining activities.

This new information has been presented in the following reports:

- Golder Associates. Surface and Groundwater Baseline Desktop Study, Ardmore Phosphate, 23 November 2017, 1782517-001-R-Rev1 (Golder, 2017a).
- Golder Associates. Ardmore Groundwater Investigation Factual Report on Bore Installation, Baseline and Water Supply, 27 November 2017, 1782517-005-R-Rev1 (Golder, 2017b).
- Golder Associates. Water Supply Investigation, Centrex Ardmore Phosphate, April 2018, 1782517-013-R-Rev0 (Golder, 2018a).
- Golder Associates. Results of Preliminary Regional Hydrogeological Assessment, May 2018, 1782517-012-TM-RevA (Golder, 2018b).
- Golder Associates. Assessment of Water Availability and Managed Aquifer Recharge, August 2018, 1782517-037-R-Rev0 (Golder, 2018c).

As part of exploration and ore definition drilling, Centrex has completed more than 800 boreholes on the Mining Lease, and recorded geological and lithological information. The following project spreadsheets compiling results of exploration drilling were provided by Centrex and have been viewed as part of the study scope:

- AMRC_GEOLOGY_2602.xls
- 20180501_final_for_estimate_update_est_assay_and_litho.xls
- 20180501_final_for_estimate_update_est_collar.xls
- 20180501_final_for_estimate_update_est_survey
- ARDMORE_RC COLLAR_1202.xls

The field investigations carried out by Golder included the installation of four new monitoring bores, two pilot bores and one test pumping bore, groundwater sampling and level monitoring rounds of these wells and existing bores in the study area, as well as a series of pumping tests. Centrex installed an additional monitoring well for the most recent pumping test (MB05). A geophysical survey was carried out in 2018 (Golder, 2018c) to help determine the thickness of the hydrogeological units.

The hydrogeological field investigations focused primarily on the northern part of the ML (see Figure 5) as it has been identified as comprising a water bearing unit with most groundwater extraction potential. The 2017 field investigations included the drilling of a monitoring bore in the Southern part of the ML to the base of the Beetle Creek formation (MB04) at 9.1 meters below ground level (mbgl) in 2017 that was dry. Also, based on

exploration drilling information provided by Centrex, samples presented moist conditions in the southern part of the Mining Lease between 30 and 40 meters below ground level. The water table was not intersected during drilling with maximum drilling depths between 48 and 53 meters at some locations. As such the Start-up Operation will have no impact on groundwater in the southern part of the ML. This is described further in section 6.0.

The review of information and the conceptual hydrogeological model presented in the following chapter has only been prepared for the northern part of the ML due to the potential impacts of the extraction of groundwater.

4.0 SUMMARY OF GROUNDWATER CONDITIONS

4.1 Geological and Structural Setting

The Ardmore deposit is an outlier of the Georgina Basin sedimentary rocks on the Mt Isa Block. The geological setting of the project area is a small downfaulted block of Cambrian sediments approximately 10 km long and 2 km wide with a constricted central portion. Its long axis bears north by north-west. The northern zone consists of a broad synclinal nose with the sediments dipping in towards the centre. It plunges toward the east into a boundary fault (MEPL, 1977).

The stratigraphic sequence is well-defined and includes a stable Precambrian basement. The two major Precambrian units within the study area are the Eastern Creek Volcanics and the Sybella Granite. These form a basement of crystalline rocks around the outlier and by interference, underlie the younger sediments (MEPL, 1977).

The basal sedimentary unit overlying the Precambrian basement is the Riversdale Formation that has been stated to be from the Upper Proterozoic to Lower Cambrian (MEPL, 1977). The Thornton Limestone conformably overlies the Riversdale formation with a gradational contact. This unit is overlain conformably by the Beetle Creek Formation (BCF) which is the significant phosphate containing unit in north-west Queensland.

In the area of the ML the Beetle Creek Formation is comprised of three members. The Basal Phosphorite member is a phosphatic siltstone and chert member that is overlain by the lower siltstone member. This member comprises the majority of the Beetle Creek Formation at Ardmore and is differentiated from the lower Basal Phosphorite Member by the lower grades of phosphate. The Simpson Creek Phosphorite Member overlies the Lower Siltstone Member (MEPL, 1977). This is a high-grade phosphate unit that will be the target unit for the Start-up Operation.

The Blazan Shale is the uppermost formation preserved within the Ardmore outlier and is a thinly interbedded, siliceous shale, siltstone and chert.

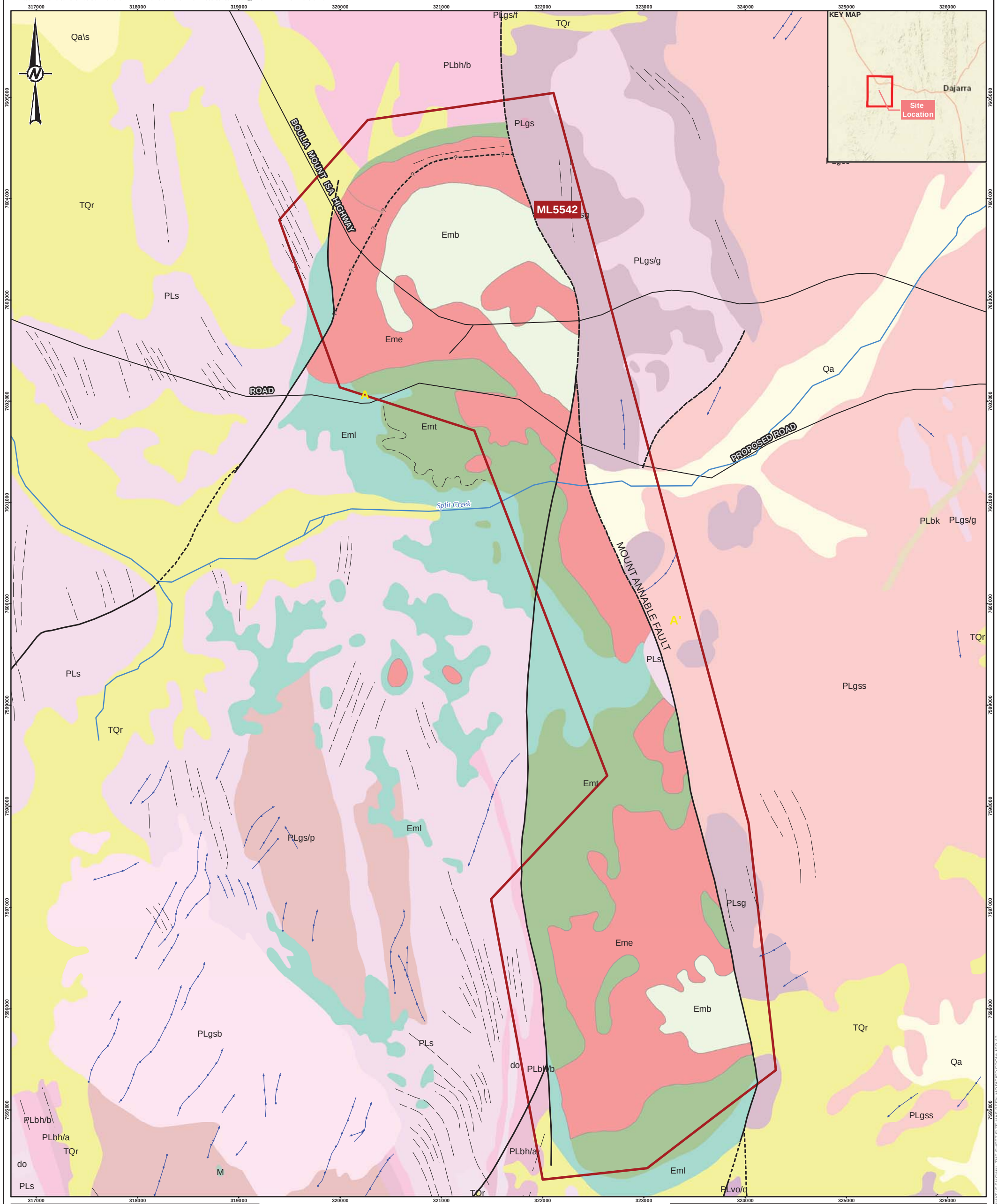
The recent investigations carried out at Ardmore have only fully penetrated the Blazan Shale and the Beetle Creek Formation and partially penetrated the Thornton Limestone (TL).

A description of the local stratigraphic units has been provided by Centrex based on MEPL (MEPL, 1977) as presented in Table 1.

The Ardmore outlier is bounded on the east and west by two faults which represent vertical movements of the order of at least 50 m in parts (MEPL, 1977). The broad structure of the Northern Zone and Southern Zone are open, shallow dipping and plunging synclines. The Southern Zone syncline has been described by MEPL (MEPL, 1977) as having a steeper north limb and a shallower, variably dipping south limb, plunging eastward into the boundary fault. The surface geology and structural map of the Mining Lease area, extracted from the 1:100,000 Ardmore geology map (Australia 1:100,000 geological series, Sheet Number 6754), is shown in Figure 3.

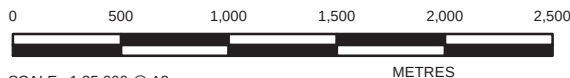
Table 1: Local Stratigraphic Units Provided by Centrex based on MEPL 1977 and the Surface Geology Map of Australia 1:100,000 Geological Series.

Age	Formation	Unit	Description	Lithological code
Cenozoic/Mesozoic	Sediments	Alluvium	Sand, silt, clay, minor gravel	Qa, Qa's, TQw
		Colluvium (residual soil)	Poorly sorted sand, silt, clay and gravel	
		Laterite (ferricrete)	Ferruginous, nodular ferricrete.	
		Silcrete	Opaline (microcrystalline) silcrete. White to grey and iron-stained in parts. Strongly indurated, microcrystalline siliceous material that forms as a result of low-temperature silicification of weathered bedrock, regolith and/or sediments near the surface.	
Lower Middle Cambrian	Blazan Shale		Thinly interbedded, siliceous shale, siltstone, and chert. Bleached and white at surface when highly weathered, and pink, purple and brown at depth where moderately weathered and dark, bituminous limestone where not weathered. Chert is common at the base of this unit. Richly fossiliferous, containing agnostid trilobites, brachiopods and sponge spicules.	Emb
	Beetle Creek Formation	Simpson Creek Phosphorite Member (SCPM)	High grade phosphate unit, comprised predominantly of medium bedded pelletal phosphorite and thin beds of colophane mudstone with some interbeds of siltstone and shale throughout. The colophane mudstone commonly divides the phosphatic sequence into two units; an upper indurated phosphorite unit and a lower friable phosphorite unit. An horizon of black chert or black chert interbedded with siltstone and shale commonly occurs at the base of the SCPM.	Eme
		Lower Siltstone Member (Chert Member)	Comprising the majority of the Beetle Creek Formation at Ardmore, this member is comprised of siliceous, phosphatic siltstone, shale, chert, and sparse thin beds of phosphorite. Thinly interbedded grey-brown pelletal phosphorite and grey-blue shale and siltstone. Several distinct black chert horizons occur. Phosphate grades recorded historically range between 0.5% and 5% P ₂ O ₅ , with some samples assaying up to 10%.	
		Basal Phosphorite Member	Phosphatic siltstone and chert, as described for the Chert Member, but differentiated from the Lower Siltstone Member by the higher grades of phosphate.	
Lower Cambrian	Thorntonia Limestone	Chert Member	Light yellow to grey, slightly phosphatic, thin to thickly bedded dolomite and minor limestone. Grey, vuggy chert occurs as beds, nodules and lenses throughout the formation. Some fossils throughout. Some convoluted bedding associated with chert nodules and algal laminations.	Emt
		Carbonate Member	Conformably overlies the Riversdale Formation with a gradational contact. Towards the top of the unit, an horizon of convoluted black and white chert occurs which was named the Chert Member by DeKeyser and Cook (1972).	
	Riversdale Formation		Red mudstones, siliceous and calcareous sandstones, conglomerates, sedimentary breccia and silty dolomite. Generally, the coarser clastic sediments predominate near the base of the unit while the finer clastics and the chemical sediments predominate in the upper sequence.	Eml
Precambrian	Sybella Granite		Pegmatitic biotite granite and muscovite-biotite granite. Several phases exist; 1) Coarse, foliated, porphyritic biotite granite with microcline phenocrysts; 2) Coarse to medium grained, massive granite; and 3) Pegmatitic and aplitic dykes.	PLgs
	Eastern Creek Volcanics		Brown to reddish-brown quartz-mica schists with contained amphibolite, quartzite, gneisses and metasediments.	ECVC



LEGEND

- | | | | |
|---|------------------------------|---|-------------------------------------|
|  | Roads and Tracks |  | Sybella Granite (PLgs) |
|  | Waterway |  | Alpha Centauri Metamorphics (PLac) |
|  | Mining Lease ML5542 |  | Briar Granite (PLgsb) |
| Rock Unit Name | |  | Bucket Hole Metavolcanics/a (PLb/a) |
|  | Qa-QLD (Qa) |  | Bucket Hole Metavolcanics/b (PLb/b) |
|  | Qals-QLD (Qa's) |  | Oroopo Metabasalt/q (PLvo/q) |
|  | TQR-QLD (TQr) |  | Saint Ronans Metamorphics (PLs) |
|  | Blazan Shale (Emb) |  | Steeles Granite (PLgss) |
|  | Beetle Creek Formation (Eme) |  | Suliegan Gneiss (PLsg) |
|  | Thorntonia Limestone (Emt) |  | do-MI (do) |
|  | Riversdale Formation (EmI) |  | Dyke or Vein |
|  | M-MI (M) |  | Fault Accurate |
|  | Lakeview Dolerite (PLbk) |  | Fault Approximate |
|  | Sybella Granite/f (PLgs/f) |  | Fault Concealed |
|  | Sybella Granite/g (PLgs/g) |  | Fault Inferred/Concealed |
|  | Sybella Granite/p (PLgs/p) |  | Trend Line |



SCALE: 1:35,000 @ A3
PROJECTION: GDA 1994 MGA Zone 54

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

2. SURFACE GEOLOGY, STRUCTURAL GEOLOGY, WATERCOURSE, BASELINE ROADS AND TRACKS, MINING TENEMENT: © STATE OF QUEENSLAND (DEPARTMENT OF NATURAL RESOURCES AND MINES) 2017.

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PROJECT
ARDMORE PHOSPHATE ROCK PROJECT - START-UP
OPERATION

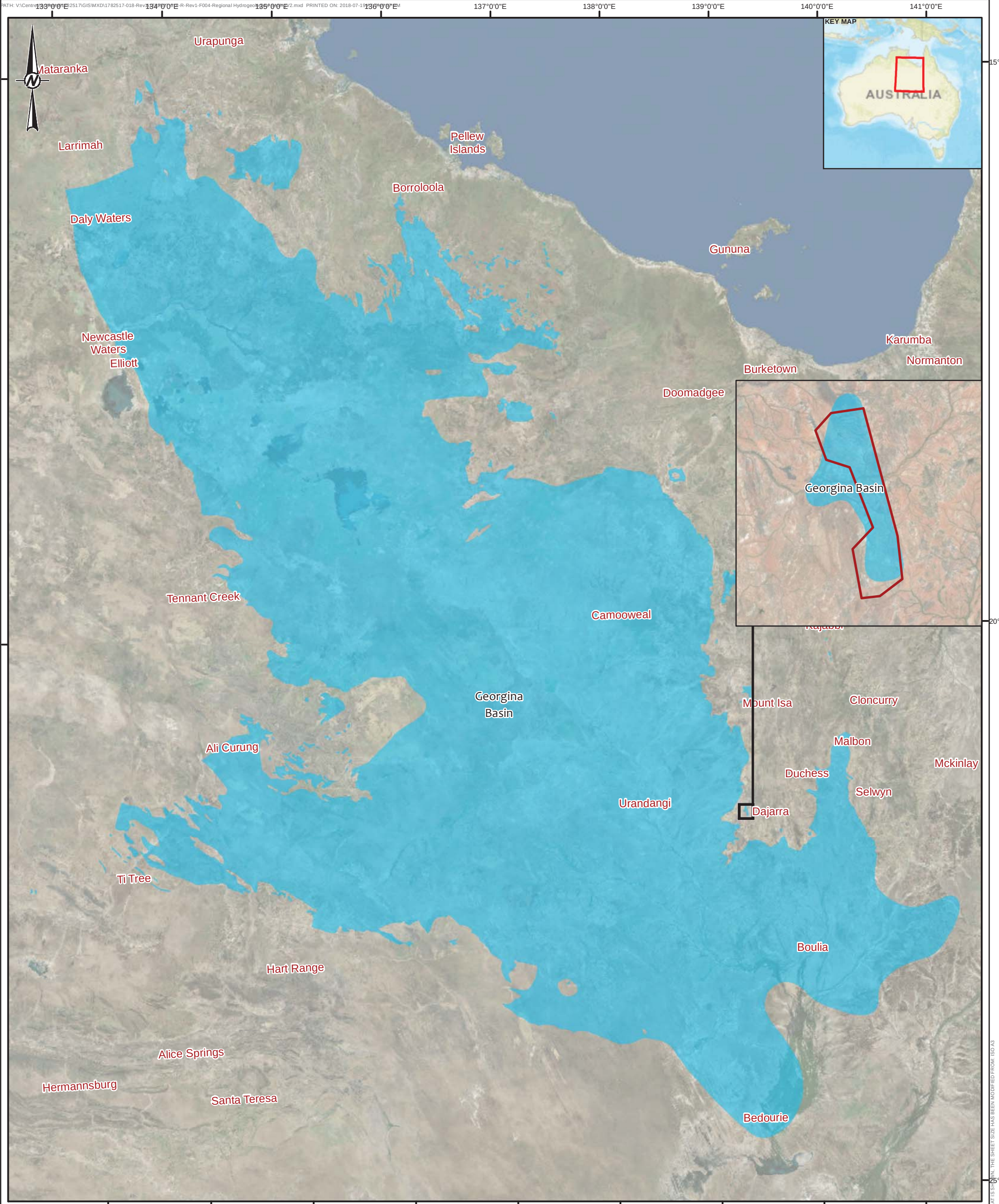
TITLE
SURFACE GEOLOGY

CONSULTANT	YYYY-MM-DD	22/08/2018
 GOLDER	DESIGNED	HG
	PREPARED	HG
	REVIEWED	JF
	APPROVED	JF

PROJECT NO.	CONTROL	REV.	FIGURE
1782517	018-R	2	3

4.2 Regional Hydrogeological Setting

The Mining Lease is located within an outlier the Georgina Basin which extends across the Queensland - Northern Territory border as presented in Figure 4. Lau *et al.* (1987) describe the basin as a large northwest-southeast trending extensional sedimentary basin and contains mainly Cambrian-Ordovician dolomite and limestone aquifers, and some sandstone aquifers around the southern margin. Tertiary aquifers occur in small overlying basins. Groundwater flow is partly northwest to an internal drainage basin and partly southeast down the Georgina Valley and ultimately beneath the Great Artesian Basin.



LEGEND

Mining Lease ML5542

Georgina Basin Geological Extent

038,00076,000114,000152,000190,000228,000266,000

METRES

SCALE: 1:3,500,000 @ A3

PROJECTION: GDA 1994 MGA Zone 54

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRIID, IGN, AND THE GIS USER COMMUNITY

2. SURFACE GEOLOGY, STRUCTURAL GEOLOGY, WATERCOURSE, BASELINE ROADS AND TRACKS, MINING TENEMENT: © STATE OF QUEENSLAND (DEPARTMENT OF NATURAL RESOURCES AND MINES) 2017.

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CENTREX METALS LIMITED

PROJECT

ARDMORE PHOSPHATE ROCK PROJECT - START-UP OPERATION

TITLE

REGIONAL HYDROGEOLOGICAL SETTING

CONSULTANT

YYYY-MM-DD

22/08/2018

DESIGNED

JEC

PREPARED

JEC

REVIEWED

TM

APPROVED

JF

PROJECT NO.

1782517

CONTROL

018-R

REV.

2

FIGURE

4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

25mm

4.3 Hydrogeological Investigations

A hydrogeological study of the Mining Lease area was conducted by WMC in April 2004. As part of this study, eight boreholes were drilled to evaluate groundwater conditions in the northern section of the Mining Lease. Standpipe piezometers were not installed in these boreholes. In their report WMC provide some descriptive information on the yield capabilities in the boreholes.

Golder was commissioned by Centrex to carry out a baseline desktop study and additional field investigations in 2017. This study included the installation of four monitoring bores, two pilot boreholes, and one test pumping bore, a pumping test and a round of groundwater sampling in selected monitoring bores. As the pump used for this pumping test could not extract enough water a second pumping test was carried out by Golder in March 2018. For this task Centrex previously installed an additional monitoring bore adjacent to the test pumping bore.

During the 2017 field investigation some of the boreholes drilled by WMC in 2004 were encountered and a water level could be measured. As the condition of the boreholes was unknown the total depth of the boreholes was not measured.

A geophysical survey (using seismic refraction) was carried out in 2018 (Golder 2018c) to assess the depth and extent of the Beetle Creek formation.

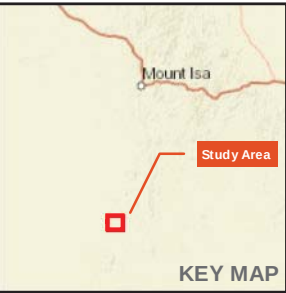
Table 2 presents the coordinates, construction details and current condition of all the boreholes and monitoring bores located in the study area and Figure 5 provides the location of the bores.

Table 2: Monitoring bores Ardmore Phosphate Rock Project

Bore ID	Easting	Northing	Surface elevation (m RL)	Depth Borehole (mbgl)	Screen interval		Gravel Pack Formation	Installation date	Current condition
					From	To			
MB01	321213	7603666	314.5	56	41.3	47.3	BCF	Nov-17	Monitoring bore
MB02	322439	7601253	310.3	27	17.9	23.9	BCF	Oct-17	Monitoring bore
MB03	321102	7602188	321.5	42	35	41	TL	Oct-17	Monitoring bore
MB04	323251	7596535	336.0	12	6.1	9.1	BCF	Oct-17	Monitoring bore
MB05	321472	7603567	315.8*	56.2	50.9*	52.9*	BCF	2018	Monitoring bore
PH1	321464	7603584	315.8	53	56.7	62.7	BCF	Oct-17	Monitoring bore
PH2	320730	7603258	313.6	38	27	33	BCF	Oct-17	Monitoring bore
TPW1	321468	7603572	316.0	59	50.9	52.9	BCF	Oct-17	Test pumping bore

Bore ID	Easting	Northing	Surface elevation (m RL)	Depth Borehole (mbgl)	Screen interval		Gravel Pack Formation	Installation date	Current condition
					From	To			
PDHA305 (WMC3)	321794	7602804	320.5	41	open hole		BCF and TL	Apr-04	Found – open hole
PDHA302 (WMC2)	320741	7603383	312.7	40	open hole		BCF	Apr-04	Found – open hole
PDHA301	320373	7603868	310.5	34	open hole		BCF and TL	Apr-04	Found – open hole
PDHA307 (WMC1)	322164	7601985	312.3	34	open hole		BCF	Apr-04	Found – open hole
PDHA311	322160	7601100	Not known	28	open hole		BCF and TL	Apr-04	Found – open hole
PDHA312	322389	7601242	310	22	open hole		BCF	Apr-04	Found – open hole
PDHA313	322190	7601276	309.8	28	open hole		TL	Apr-04	Found open hole
PDHA314	322991	7601276	311.1	22	open hole		Proterozoic Gneiss	Apr-04	Found - open hole

* Estimated information based on TPW001

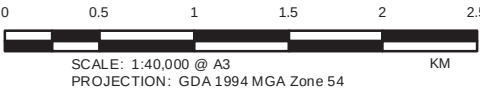


LEGEND

- Groundwater boreholes
- Monitoring bore
- Test pumping bore
- Landowner's Bore
- Watercourses (Ephemeral)

Transport

- Main Roads
- Mining Lease 5542



- REFERENCE(S)
- Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
 - GDE Data: © State of Queensland (Department of Science, Information Technology and Innovation), 2017.
 - Localities, Watercourses: © State of Queensland (Department of Natural Resources and Mines) 2016.
 - Main Roads: © State of Queensland (Department of Transport and Main Roads) 2017.
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ARDMORE PHOSPHATE ROCK PROJECT - START-UP
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TITLE
GROUNDWATER MONITORING BORES LOCATION MAP

CONSULTANT	YYYY-MM-DD	22/08/2018
	DESIGNED	TM
	PREPARED	TM
	REVIEWED	JF
	APPROVED	JF



PROJECT NO.
1782517

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018-R

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2

FIGURE
5

4.4 Hydrostratigraphic Units

Based on the regional hydrogeology and on the two drilling campaigns carried out to this date, the aquifer is thought to be mainly associated to the Beetle Creek Formation and to a lesser extent to the Thornton Limestone.

Beetle Creek Formation

The major water bearing geological unit underlying the Ardmere Phosphate proposed mining area is the Beetle Creek Formation. As described in section 4.1 this formation comprises three members. Based on the information gathered from hydrogeological drilling to date, the entire formation is considered permeable, and the Simpson Creek Phosphorite Member and the Basal Phosphorite have the highest total porosity and permeability of this formation.

This hydrostratigraphic unit is comprised of siltstone shale and chert as well as some collophane mudstone in the upper member. In the northern part of the ML, all hydrogeological boreholes except MB03 and PDHA313 target this unit. The exploration drilling that included 381 boreholes in the northern part of the ML, targeted the upper layers of the Beetle Creek formation and only fourteen boreholes fully penetrated the Beetle Creek formation. Based on exploration drilling information in the area this unit is estimated to have a thickness of up to 34 m.

The geological and drilling records have indicated that, in the northern part of the ML, this unit is semi-confined to confined by the Blazan Shale Formation.

In the southern part of the ML MB04 was drilled targeting this unit where only the lower part of this formation remains. No water was encountered during drilling and during the two monitoring rounds carried out onsite, this well was found dry.

Thornton Limestone

The Thornton Limestone has been identified as having some water bearing potential. This unit has been described as light yellow, thin to thickly bedded dolomite and minor limestone with fossils throughout. This formation has been known to generate extensive karst aquifer throughout the Georgina basin, however the importance of this aquifer within the study area is unknown.

In the northern part of the ML all boreholes drilled during the recent hydrogeological investigation have reached this unit but a monitoring well has only been installed in the Thornton Limestone at MB03. In the southwestern area of the northern part of the ML as well as in the far northern parts of the ML, outcrops of the Thornton Limestone are visible where the Blazan Shale and the BCF have been eroded.

Based on exploration drilling information and lithological information from the nearby Phosphate Hill mine close to Duchess, this unit is estimated to have a thickness of up to 30 meters approximately.

Blazan Shale

The Blazan Shale conformably overlies the Beetle Creek Formation and acts as an aquitard and locally confining unit to the underlying BCF. According to the surface geology extracted from the 1:100,000 Ardmere geology map (Australia 1:100,000 geological series, Sheet Number 6754) and presented in Figure 3, this unit is present at the surface in the centre of the northern part of the mining lease covering an area of 2 km². Based on the exploration drilling carried out to date, in the northern part of the ML this unit is present at the surface over a larger area providing confining conditions to the Beetle Creek formation. According to the exploration drilling carried out to date, the Blazan Shale has a thickness of up to 53 meters approximately.

4.5 Hydraulic Properties

4.5.1 Beetle Creek Formation

The hydraulic properties of the Beetle Creek Formation have been estimated by a series of pumping tests in the test production bore TPW01. A first series of tests carried out in October 2017 including a step rate test and a constant rate test was conducted with a maximum pumping rate of 3.5 L/s for 4 days. The pumping test was not capable of stressing the aquifer sufficiently to determine the storage value or sustainable yield from the aquifer.

A second series of tests was conducted in March 2018 in the test production bore TPW01 with a maximum pumping rate of 9 L/s during the constant rate test. The overall geometric mean value of Transmissivity (T) obtained for the Beetle Creek Aquifer in the vicinity of TPW01 was 1347.53 m²/day. Based on a saturated thickness of 20 m at TPW01 the hydraulic conductivity (K) value of the Beetle Creek Formation is approximately 67.38 m/day.

The Beetle Creek Formation Storativity (S) values for the second series of tests are in the range of 2.82E-05 to 9.79E-03, which are generally in line with properties for confined aquifers (5.0E-05 to 5.0E-03) (Freeze & Cherry, 1979).

A summary of aquifer parameters derived from both tests are presented in Table 3.

Table 3: Summary of Aquifer Parameters for the Beetle Creek Formation

Bore ID (Test)	Date	Method	T ¹ (m ² /day)	K ² (m/day)
TPW01 – pumping 4 days	October 2017	Confined (Theis/Hantush)	1296	64.80
TPW01 – pumping 4 days	October 2017	Confined (Cooper/Jacob)	1296	64.80
TPW01 – pumping 4 days	October 2017	Unconfined (Theis)	N/A	68.70
TPW01 – pumping 4 days	October 2017	Fractured (Gringarten-Witherspoon w/ vertical fracture)	1302	65.1
MB05 (Pumping)	March 2018	Confined Butler	950.5	47.53
MB05 (Recovery)	March 2018	Confined Theis Recovery	1213.80	60.69
PH01 (Pumping)	March 2018	Confined Theis	1761.00	88.05
PH01 (Recovery)	March 2018	Confined Theis Recovery	1622.90	81.15

¹: Transmissivity, ²: Hydraulic conductivity

4.5.2 Thornton Limestone Formation

The hydraulic properties of the Thornton Limestone has not been determined in the area of study through hydraulic testing as it is assumed that it has limited hydrogeological yield. Air-lift testing during the drilling

campaign describe yields of approximately 1.5 L/s at monitoring bore MB03; however, this test was completed in the open borehole.

Additional investigations may be necessary to further characterize this unit and its connection to the Beetle Creek Formation that could include a slug test in selected monitoring bores to determine a local in-situ permeability value for this unit.

4.6 Groundwater Recharge

Recharge to the Beetle Creek Formation in the vicinity of the project site is thought to occur in stream-beds, where alluvium overlies the sub-cropping Beetle Creek Formation, as well as via direct infiltration to outcropping areas of the Beetle Creek Formation.

Site specific recharge values have not been assessed in detail. The estimates of recharge presented in the following sections are extracted from Golder 2018a and based on published values and assessments from similar nearby sites.

4.6.1 Published Estimates

Scanlon *et al.* (2006) synthesised findings from approximately 140 global recharge studies in semiarid and arid regions and found that, over large areas, average recharge estimates range from 0.2 to 35 mm year, representing 0.1 – 5% of long-term average annual precipitation.

Crosbie *et al.* (2010) conducted a similar review across Australia and developed a database of 4386 recharge estimates from 172 studies throughout Australia that used one or more of ten different methods to estimate recharge. Applied to the Ardmore Phosphate Mine Site by aridity class, the geometric mean recharge is 2 mm/yr; applied by aquifer type, the geometric mean recharge is about 10 mm/yr.

In 2009, CSIRO published a study on estimation of recharge and discharge across northern Australia (Crosbie *et al.* 2009). The Ardmore Phosphate Mine Site is located just a few kilometres outside of (to the west of) the study area boundary. Their study applied three independent techniques to make comprehensive estimates of recharge: soil-vegetation-atmosphere-transfer (SVAT) models, chloride mass balances, and baseflow separation techniques. The study illustrates that for conditions near the project site (Vertosols, annual cover, rainfall less than 500 mm, Flinders-Leichhardt catchment), almost no recharge is expected.

Based on a review of published studies, a conservative estimate of recharge at the project site is approximately 2% of annual rainfall. Using annual rainfall data collected in Mount Isa (weather station 029127, BOM, 2018), the recharge rate is estimated to be approximately 9 mm/yr.

4.6.2 Local Recharge Estimates

The nearby Phosphate Hill Project estimated 4 – 11 mm annual recharge, using chloride analysis, and calculated a total annual recharge of approximately 440 ML/year to the aquifer, assuming recharge occurs over an area of 4.00E+07 m² (Hill *et al.*, 2000). The annual recharge of 4 – 11 mm is applied to the outcropping Beetle Creek Formation to obtain volumetric estimates.

4.6.3 Chloride Mass Balance

Golder 2018a also provide a preliminary estimate of recharge from chloride concentrations in groundwater if the rate of chloride deposition is known or can be estimated. The steady state chloride mass balance (CMB) approach is based upon the fact that evapotranspiration removes water but not chloride, so chloride will become concentrated in groundwater.

The resulting net recharge range is calculated at 0.7 – 2.1 mm/yr. This is an estimate of diffuse recharge and does not include point sources (e.g. recharge from ephemeral streams directly to the BCF.)

4.6.4 Summary of Estimated Recharge

A range of estimated recharge values for the Ardmere Phosphate Site are presented in Table 4.

Table 4: Recharge Estimation for Available Water Supply (extracted from Golder 2018a)

Method	Estimated annual available Recharge (mm/yr)
Literature search / Rainfall % estimate	9 mm
Phosphate Hill Range	4 mm – 11 mm
Chloride mass balance	0.7 – 2.1 mm

Each of the estimation techniques described above are approximate and subject to assumptions and limitations; however, results clearly indicate that annual recharge rates are low.

4.7 Interaction between Aquifers

The main aquifer is associated to the Beetle Creek formation. The Thornton Limestone has been identified as having some water bearing potential, however the importance of this aquifer within the study area is unknown. Additional investigations may be necessary to further characterize this unit and its connection to the Beetle Creek Formation that could include a slug test in selected monitoring bores to determine a local in-situ permeability value for this unit.

The water quality information presented in section 4.10 indicate that the groundwater in the Beetle Creek formation and Thornton Limestone have similar water chemistry and may be hydraulically connected.

4.8 Groundwater Levels and Fluctuations

Groundwater level information is available for the monitoring bores installed in 2017. Water levels have been collected during that drilling campaign as well as in March 2018 when Golder carried the second series of pumping tests in TPW01 and in May 2018 during an additional monitoring round. The water level information and a hydrograph are presented in APPENDIX A.

In October 2017 groundwater levels were also collected from three existing open holes that have been identified as being three of the boreholes drilled during the 2004 drilling campaign by WMC (see Table 2).

As there is only up to three groundwater measurements for each bore, groundwater fluctuations cannot be described. As part of the ongoing hydrogeological investigations at Ardmere, Centrex installed data-logging pressure transducers in six monitoring bores in May 2018 to measure and record the water levels every two hours.

4.9 Groundwater Flow Directions

A groundwater elevation map was created based on the stabilised water levels measured during the October 22, 2017 monitoring event, and is presented in Figure 6.

Groundwater levels measured in the monitoring bores screened in the Beetle Creek Formation show an elevation between 301.1 and 301.6 m AHD. Groundwater levels measured in the open boreholes show slightly lower groundwater elevations between 300.9 and 301.6 m AHD. These elevations may not reflect the groundwater elevation in the Beetle Creek formation as the condition of the open holes could not be confirmed.

The groundwater elevation in the monitoring bore screened in the Thornton Limestone (MB03) is at 301.6 m AHD which is similar to the groundwater elevations in the Beetle Creek Formation.

The water table in the Beetle Creek Formation in the northern part of the ML is essentially horizontal with very low hydraulic gradients.

In the southern part of the Mining Lease the only monitoring bore screened in the Beetle Creek formation is dry at 324 m AHD (9.1 mbgl). Based on information provided by Centrex from exploration boreholes, moist ground conditions were encountered between 30 and 40 meters below ground level.

4.10 Groundwater Quality

Groundwater quality was assessed based on the results of the sampling round carried out in the monitoring bores installed in 2017 as well as in the landowner bore called Frank's bore, located 6.2 km of TPW01 (see Figure 5).

The sampling round was carried out immediately after the bores were completed and includes samples collected from MB01, MB02, MB03, PH1, PH2 and Frank's bore (Golder, 2017b). All locations are presented on Figure 5.

These samples were analysed for major elements as well as for some contaminants. A summary of the groundwater results is presented in APPENDIX B. A Piper diagram is presented on Figure 7 that provides a graphical presentation of the distribution in major ions for each sample.

Field and laboratory analysis suggest that groundwater in the fractured rock aquifer of the Beetle Creek Formation in the northern portion of the ML is generally brackish to saline, with laboratory Electrical Conductivity (EC) measurements ranging between 5 800 $\mu\text{S}/\text{cm}$ (MB02) to 22 500 $\mu\text{S}/\text{cm}$ (MB01 and PH01). The groundwater in this formation is generally neutral to slightly basic and is typically Sodium-Chloride dominant. Small concentrations of some metals, including As, Cd, Cu, Ni, Pb, and V, as well as TRH were found.

Field analysis of samples collected during the development of monitoring bore MB03 indicate that groundwater in the Thornton Limestone formation in the vicinity of this monitoring bore is neutral with a pH value of 7.64 and highly saline with a laboratory Electrical Conductivity measurement of 16 500 $\mu\text{S}/\text{cm}$. The groundwater in this formation is generally neutral to slightly basic and is typically Sodium-Chloride dominant.

The concentration in major ions as presented in the Piper Diagram suggest that the water contained in the Beetle Creek formation and the Thornton Limestone are from a same origin and possibly hydraulically connected.

Water sampled from Frank's bore was generally fresh, with laboratory EC measurements less than 1 000 $\mu\text{S}/\text{cm}$ and basic pH ranging of 8.55. The dominant cation is Sodium and the dominant anion is Bicarbonate.

The concentration in major ions as presented in the Piper Diagram suggest that the water sampled from Frank's Bore is chemically different to the groundwater sampled in the northern part of the ML.

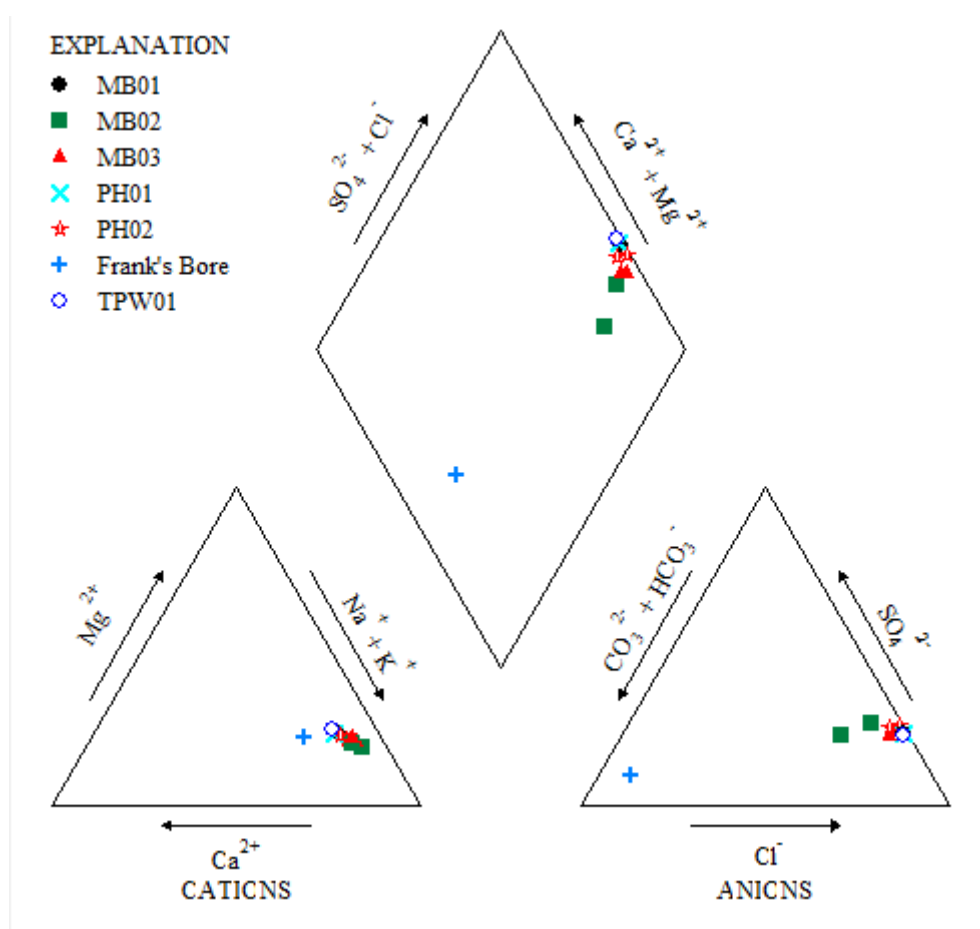


Figure 7: Piper Diagram, November 2017

4.11 Summary Conceptual Hydrogeological Model

The conceptual hydrogeological model for the northern part of the Mining Lease is shown schematically on Figure 8 and summarised in the following bullet points:

- The aquifer both beneath and within the vicinity of the northern part of the Mining Lease is primarily comprised of the Beetle Creek Formation and to a lesser extent of the Thornton Limestone underlying the Beetle Creek formation.
- The aquifer is of limited aerial extent and is bound on all sides by less permeable rock.
- This aquifer is confined where the Blazan Shale formation overlies the aquifer.
- The water table in the aquifer of the northern part of the ML is essentially horizontal with the depth to the top of the water table located 301.1 m AHD to 301.6 m AHD. Hydraulic gradients are low.
- Recharge to the Beetle Creek Formation in the vicinity of the project site is thought to occur in stream-beds, where alluvium overlies the sub-cropping Beetle Creek Formation, as well as via direct infiltration to outcropping areas of the Beetle Creek Formation.
- Recharge to the Thornton Limestone in the vicinity of the project site is thought to occur in stream-beds, where alluvium overlies the sub-cropping Thornton Limestone, as well as via direct infiltration to outcropping areas of the Thornton Limestone.

- Field and laboratory analysis suggest that groundwater in the fractured rock aquifer of the Beetle Creek Formation in the northern part of the ML is generally brackish to saline. The groundwater in this formation is generally neutral to slightly basic and is typically Sodium-Chloride dominant. Small concentrations of some metals, including As, Cd, Cu, Ni, Pb, and V, as well as TRH were found.
- Field analysis collected during the development of monitoring bore MB03 indicate that groundwater in the Thornton Limestone formation in the vicinity of this monitoring bore is highly saline and neutral to slightly basic and is typically Sodium-Chloride dominant. The concentration in major ions as presented in the Piper Diagram suggest that the water contained within the Beetle Creek Formation and the Thornton Limestone are from a same origin and possibly hydraulically connected.

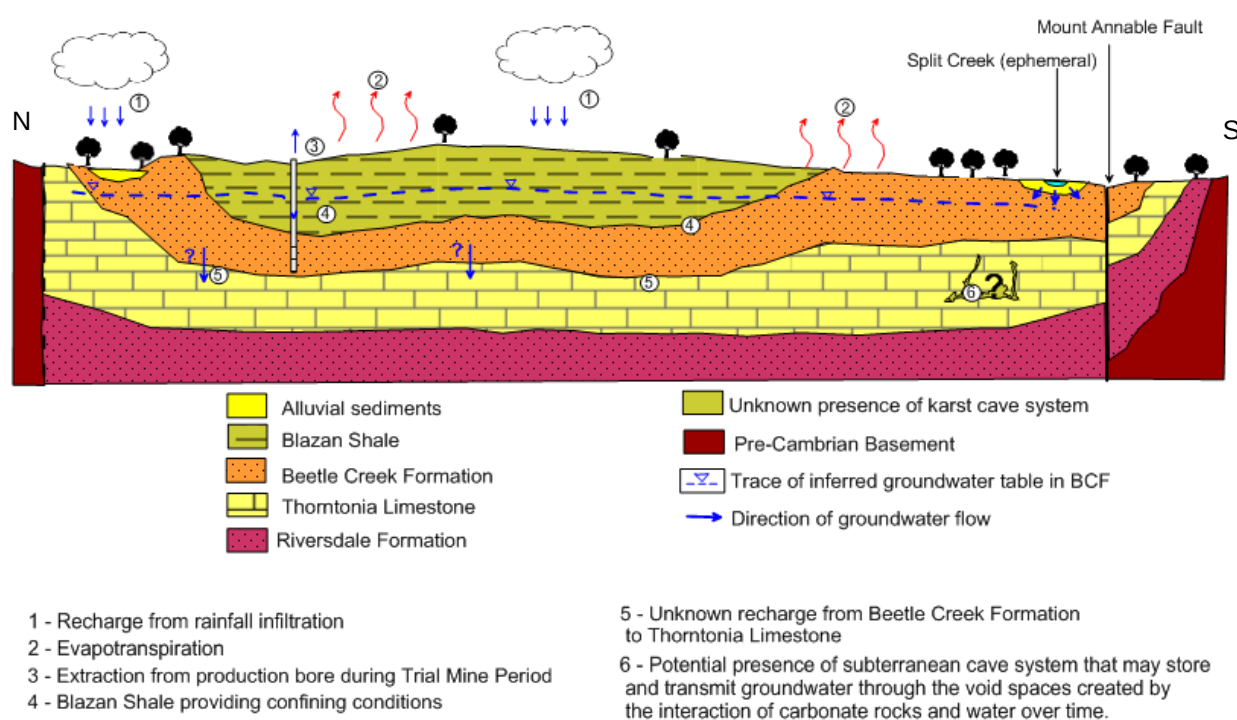


Figure 8: Conceptual Hydrogeological Cross Section N-S

5.0 ENVIRONMENTAL VALUES OF GROUNDWATER

This section identifies the environmental values of groundwater in the study area.

The Department of Environment and Heritage Protection (DEHP) defines an environmental value to be:

- A quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or
- Another quality or the environment identified and declared to be an environmental value under an environmental protection policy or regulation.

The Environmental Protection (Water) Policy 2009 (Water EPP), which is subordinate legislation under the EP Act 1994, lists the Environmental Values and Water Quality Objectives of groundwater for some waterway basins and areas of Queensland. The ML is located in a waterway basin for which such values have not been defined yet. A desktop study was carried out that identified the following Environmental Values in the vicinity of the ML:

- Registered Groundwater Bores; and
- Groundwater Dependent Ecosystems.

5.1 Registered Groundwater Bores

A registered groundwater bore search was conducted (Golder, 2018b) within 75 km from the proposed mine site using the Queensland Globe database maintained by the Department of Natural Resources, Mines and Energy (DNRM). A summary of the registered bores is presented in Table 5.

Table 5: Summary of registered bores within 75 km from the proposed mine site

Description	Number of bores
Total number of registered bores	510
Existing registered bores	318
Abandoned, still useable registered bores	4
Abandoned and destroyed bores	188
Number of bores aquifer information available	191
Number of bores bore yield information available	266
Number of bores water level information available (at least one recording)	249
Number of bores water quality information available (at least one occasion)	52

From the 510 registered bores, bore yields are reported in only 266 bores. The majority of high yielding bores are located in the south east corner of the study area, in close proximity to the Phosphate Hill Mine site. The approximate distance to this borefield from the Centrex mine site is about 75 km. The long-term monitoring of these bores indicated a decreasing groundwater level trend since July 1999 (Golder, 2018b); most likely due to dewatering activities of the operating Phosphate Hill mine.

Seven bores were identified within 11 km of the proposed mine site. A summary of the registered bores is presented in Table 6. The location of these seven registered bores is shown in Figure 9. The search identified a registered bore (bore ID 5495A) which was mapped as being located on the ML. The database indicated that

the bore was drilled in 1950 and that it has been abandoned. On ground surveys have not located the bore and the landowner advised that there are no bores (registered or unregistered used by the landowner) within the ML area.

Table 6: Summary of Registered Bores within 11 km from the Project Area

Bore ID	Distance from proposed groundwater extraction (km)	Bore Depth (m)	Drilled Date	Easting (m)	Northing (m)	Yield information	Status
5189	10	Unknown	Unknown	327677	7593150	No yield information	Decommissioned
5188	10	Unknown	30/09/1943	331373	7600251	No yield information	Decommissioned
5495A	1.5	29	10/07/1950	320024	7602481	No yield information	Abandoned. Bore does not exist / not located on the ground
5496 (Ardmore Homestead bore)	8	186.5	1919	312280	7603476	No yield information	Functional
8404	11	28	1916	332451	7602826	No yield information	Unknown
118041A (Frank's bore)	5	30	10/09/2002	315702	7603000	0.5 L/s	Functional
17915 (Suliman's bore)	12	33.5	14/04/1968	333112	7601953	1.8 L/s	Functional

Bore cards of these registered bores are attached in APPENDIX C.

5.2 Groundwater Dependent Ecosystems (GDEs)

According to the guidelines presented by the DEHP, a GDE is defined as an ecosystem 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 on groundwater may vary over time and depending on location. GDEs include aquifer, caves, lakes, palustrine wetlands, lacustrine wetlands, rivers and vegetation.

Several sources were used to identify Groundwater Dependent Ecosystem (GDEs):

- The Queensland GDE mapping layer available at <http://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/gde-background> and;
- The Australian GDE Atlas (<http://www.bom.gov.au/water/groundwater/gde/>).

The Queensland GDE mapping layer includes coverage for the Ardmore Phosphate Project for Subterranean GDE identical to the coverage provided by the Australian GDE Atlas.

The GDEs identified with the Australian GDE Atlas are shown to potentially be located in the western and southern parts of the Mining Lease and are generally of Aquatic, Subterranean and Terrestrial type. GDE locations and the identified local registered groundwater bores are presented together in Figure 9.

5.2.1 Subterranean GDEs

A Subterranean GDEs is an aquatic ecosystem occurring below the surface of the ground that supports aquatic life and can be significantly altered by changing the chemistry, volume and distribution of groundwater supply. It generally refers to stygofauna and troglafauna associated to a karstic environment. The Australian GDE Atlas indicates an area of “Derived GDE – Unknown Confidence” along the western border of the northern half of the ML. This is believed to be associated with the mapped outcrops of the Thornton Limestone, which are associated to the much larger Georgina basin limestone system.

5.2.2 Terrestrial GDEs

Terrestrial GDEs are terrestrial ecosystems dependent on the subsurface presence of groundwater accessed via their roots at depth. The terrestrial GDEs identified in the area are the “Eucalyptus spp low open woodlands often with Triodia dominated ground layer”. The Queensland GDE Atlas defines it as a moderate potential GDE.

The groundwater table in the area containing this Terrestrial GDE occurs between 8 and 19 m below ground level and as such is not sustaining these plants. Drawdowns in the groundwater levels in the BCF in the area of these GDEs will not impact them.

5.2.3 Aquatic GDEs

The aquatic GDE dataset expresses the potential for groundwater interaction for rivers, springs, and wetland ecosystems across Australia. It shows the ecosystems that rely on groundwater that has been discharged to the surface, for example, as baseflow or spring flow.

The desktop search from Atlas GDE identified Split Creek as being an aquatic GDE. The field activities carried out onsite included a walkover of the entire site and the drilling of a monitoring bore close to split Creek (MB02). Split Creek has been identified as an ephemeral creek and a recharge area for the aquifer, with the water table within the BCF in the vicinity of Split Creek located 8 meters below ground level. Split Creek has not been identified as being a spring and drawdowns in the groundwater levels in the BCF in the area of Split Creek will not impact the creek.



LEGEND

Mining Lease 5542

Watercourses (Ephemeral)

Transport

Main Roads

Registered Bores

Registered bores with yield information

Registered bores without yield information

Groundwater Dependant Ecosystems (GDEs)

Terrestrial GDE

Subterranean GDE - Unknown Confidence

012345

SCALE: 1:75,000 @ A3

PROJECTION: GDA 1994 MGA Zone 54

KM

REFERENCE(S)

1. Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

2. GDE Data: © State of Queensland (Department of Science, Information Technology and Innovation), 2017.

3. Localities, Watercourses: © State of Queensland (Department of Natural Resources and Mines) 2016.

4. Main Roads: © State of Queensland (Department of Transport and Main Roads) 2017.

5. Railways: © State of Queensland (Department of Natural Resources and Mines) 2017.

CLIENT

CENTREX METALS LIMITED

PROJECT

ARDMORE PHOSPHATE ROCK PROJECT - START-UP OPERATION

TITLE

REGISTERED BORES AND GROUNDWATER DEPENDENT ECOSYSTEMS

CONSULTANT

YYYY-MM-DD22/08/2018

DESIGNEDTM

PREPAREDJM

REVIEWEDJF

APPROVEDJF

GOLDER

PROJECT NO.1782517

CONTROL018-R

REV.2

FIGURE9

25mm

THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN. THE SHEET SIZE HAS BEEN WOODED FROM ISO A3

6.0 POTENTIAL IMPACTS

Potential adverse impacts on groundwater as the results of the Start-up Operation include:

- Contamination of local aquifer
- Groundwater extraction for process
- Potential groundwater – surface water interaction; and
- Contamination of groundwater by infiltration of surface water through mine workings

6.1 Potential Impacts of Excavation of the Pit

As described in section 3.2 the risk of impact to groundwater from proposed excavation of the pit in the southern part of the ML is minimal. This is because the Beetle Creek Formation appears to be unsaturated and the pit will not exceed 10 m depth. A bore installed to the base of the Beetle Creek Fm (MB04) at 9.1 mbgl in 2017 is dry. Based on exploration drilling information provided by Centrex moist conditions were encountered between 30 and 40 meters below ground. The water table was not intersected during drilling with maximum drilling depths between 48 and 53 meters at some locations.

6.2 Potential Impacts of Groundwater Extraction

It is understood that Centrex requires 15 L/s of water during Start-up Operations, and 600 – 650 ML per annum (equivalent to 19 L/s – 20.6 L/s) during full scale mining for a period of ten years. The total operational requirement over full scale mining operations is estimated at 6000 – 6500 ML. A further assessment of potential impacts from full scale mining will be undertaken separately and the results are not included here.

Golder 2018a estimates predicted drawdown in the pumping bores for four scenarios for the Start-up Operation period, considering two transmissivity (300 m²/day and 1760 m²/day) values and two well spacing options (10 m and 20 m). The predicted drawdown and maximum time frame for each scenario is provided in Table 7. Two pumping wells are proposed for the purposes of Start-up Operation, with pumping rates of 7.5 L/s per well.

Note that the predicted values for drawdown do not consider boundary effects, which may be encountered after prolonged pumping. Consequently, actual drawdown may be greater than the predicted values.

Table 7: Predictive Drawdown in Pumping Bores

Scenario	T (m ² /day)	Storage (S)	Number of Pumping Wells	Well Spacing (m)	Pumping Rate (L/s)	Predicted drawdown between the two pumping wells (m)
Scenario 1	300	0.004	2	10	7.5	5.6
Scenario 2	300	0.004	2	20	7.5	5.4
Scenario 3	1760	0.004	2	10	7.5	1.1
Scenario 4	1760	0.004	2	20	7.5	1.0

6.2.1 Predicted Water Level Drawdowns for Affected Aquifers

Preliminary drawdowns for various distances to the extractions wells after 90 days of pumping were calculated using Theis equation for non-leaky confined aquifers. These estimates provide an initial understanding of the potential impact that the extraction of groundwater may have on surrounding groundwater levels in the Beetle Creek Formation.

Table 8 presents the drawdown for a selection of radius after 90 days of pumping 15 l/s (i.e. life span of Start-up Operation). The first estimated drawdowns (column 2 in Table 8) considers the most conservative values of Transmissivity and Storativity (presented in Table 3) while the second estimated drawdowns (column 3 in Table 8) considers the upper limit of transmissivity values. As shown in Table 8, the extent of the 2 m drawdown contour is within 50 m of the pumping wells in both scenarios.

The extent of the drawdown is presented in Figure 10.

Table 8: Calculated Drawdowns at Various Distance from Pumping Well after 90 days of Pumping (15 L/s)

Radius (m)	Drawdown (m) for $S = 2.82 \times 10^{-5}$ and $T = 950.5 \text{ m}^2/\text{day}$	Drawdown (m) for $S = 9.79 \times 10^{-3}$ and $T = 1761.0 \text{ m}^2/\text{day}$
50	1.61	1.02
100	1.46	0.48
200	1.31	0.40
300	1.22	0.35
500	1.11	0.29
1000	0.96	0.21



LEGEND

- Inferred Groundwater Drawdown (m) - Least Conservative Scenario
- Inferred Groundwater Drawdown (m) - Most Conservative Scenario
- Extent Beetle Creek Formation Aquifer
- Watercourses (ephemeral)

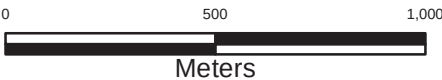
Transport

- Main Roads
- Mining Lease 5542

- Registered

Groundwater Dependant Ecosystems

- Subterranean GDE - Unknown
- Terrestrial GDE



SCALE: 1:18,000 @ A3
PROJECTION: GDA 1994 MGA Zone 54

- REFERENCE(S)
- Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community
 - GDE Data: © State of Queensland (Department of Science, Information Technology and Innovation), 2017.
 - Localities, Watercourses: © State of Queensland (Department of Natural Resources and Mines) 2016.
 - Main Roads: © State of Queensland (Department of Transport and Main Roads) 2017.
 - Railways: © State of Queensland (Department of Natural Resources and Mines) 2017.

CLIENT
CENTREX METALS LIMITED

PROJECT
ARDMORE PHOSPHATE ROCK PROJECT - START-UP
OPERATION

TITLE
EXTENT OF IMPACT OF GROUNDWATER EXTRACTION

CONSULTANT	YYYY-MM-DD	22/08/2018
	DESIGNED	TM
	PREPARED	HG
	REVIEWED	JF
	APPROVED	JF



PROJECT NO.
1782517

CONTROL
018-R

REV.
2

FIGURE
10

6.3 Impacts on Environmental Values

6.3.1 Groundwater Dependent Ecosystems (GDEs)

6.3.1.1 Aquatic GDE

As described in section 5.2.3 drawdowns in the groundwater levels in the aquifer in the area of Split Creek will not impact the creek as it is not sustained by groundwater but by rainfall. In all locations groundwater is more than 8 meters below the ground surface.

6.3.1.2 Terrestrial GDEs

As described in section 5.2.2 drawdowns in the groundwater levels in the aquifer in the area of the terrestrial GDEs will not impact the terrestrial GDEs as they are not sustained by groundwater. Groundwater is too deep for terrestrial vegetation to access.

6.3.1.3 Subterranean GDEs

Based on Figure 10 the drawdown estimated in the BCF close to the subterranean GDE from the extraction of groundwater after 90 days of pumping during Start-Up Operation is significantly below 2 m. The 1 m drawdown cone does not reach the potential subterranean GDE. No drawdown is predicted to be observed in the Thornton Limestone due to the low hydraulic conductivities in comparison to the Beetle Creek formation, so no impacts to this GDE, if present are predicted.

6.3.2 Registered Bore

The landowner bore known as Frank's bore (118041A) is located outside the extent of the aquifer in the northern part of the mining lease (Figure 10) and likely screened in another aquifer. It will not be impacted by drawdown in groundwater levels in the aquifer.

The production bore known as Sulieman bore (17915) is also located outside the extent of the aquifer (Figure 10) and will not be impacted by drawdown in groundwater levels in the aquifer.

7.0 PROPOSED GROUNDWATER MONITORING

A monitoring program is described in this section to provide more groundwater level information for the Start-up Operation.

Centrex has already implemented preliminary recommendations to improve the monitoring program, including installation of data-logging pressure transducers in six onsite monitoring bores in May 2018. These loggers will collect water level information on a periodic basis (2 hr interval) to provide a continuous water level record for the northern part of the site.

The proposed monitoring program will include the following items:

- Installing a water level logger within a tremmie pipe in the extraction bore with a measuring frequency of 15 minutes. It is also recommended that the flow rates from the extraction bores are recorded and correlated with drawdown in surrounding bores.
- Carrying out a hydraulic test (slug test) in monitoring bore MB03 screened in the Thornton Limestone Formation to provide information on the hydraulic properties of the limestone in this area.
- Golder recommends collecting a groundwater sample from the extraction bore midway through and at the end of the Start-up Operation period. Sampling will conform to detailed quality management guidelines that include procedures for sample preservation/packaging/shipping, chain of custody protocol, sample documentation, decontamination procedures. All measured data will be subjected to quality assurance and quality control objectives on data completeness, comparability, representativeness, precision and accuracy, and laboratory procedures.
- Golder recommends analysing the samples for the following suite of analytes:
 - pH, electrical conductivity and total dissolved solids;
 - major anions (bicarbonate, carbonate, chloride, sulphate) and cations (calcium, magnesium, sodium, potassium);
 - nutrients (ammonia, nitrite, nitrate, total phosphorus);
 - dissolved and total metals (aluminium, arsenic, barium, cadmium, copper, cobalt, lead, nickel, zinc, boron, strontium); and
 - total petroleum hydrocarbons, BTEX, PAHs.

8.0 IMPORTANT INFORMATION

Your attention is drawn to the document - “Important Information Relating to this Report”, which is included as an APPENDIX D of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

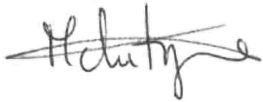
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Signature Page

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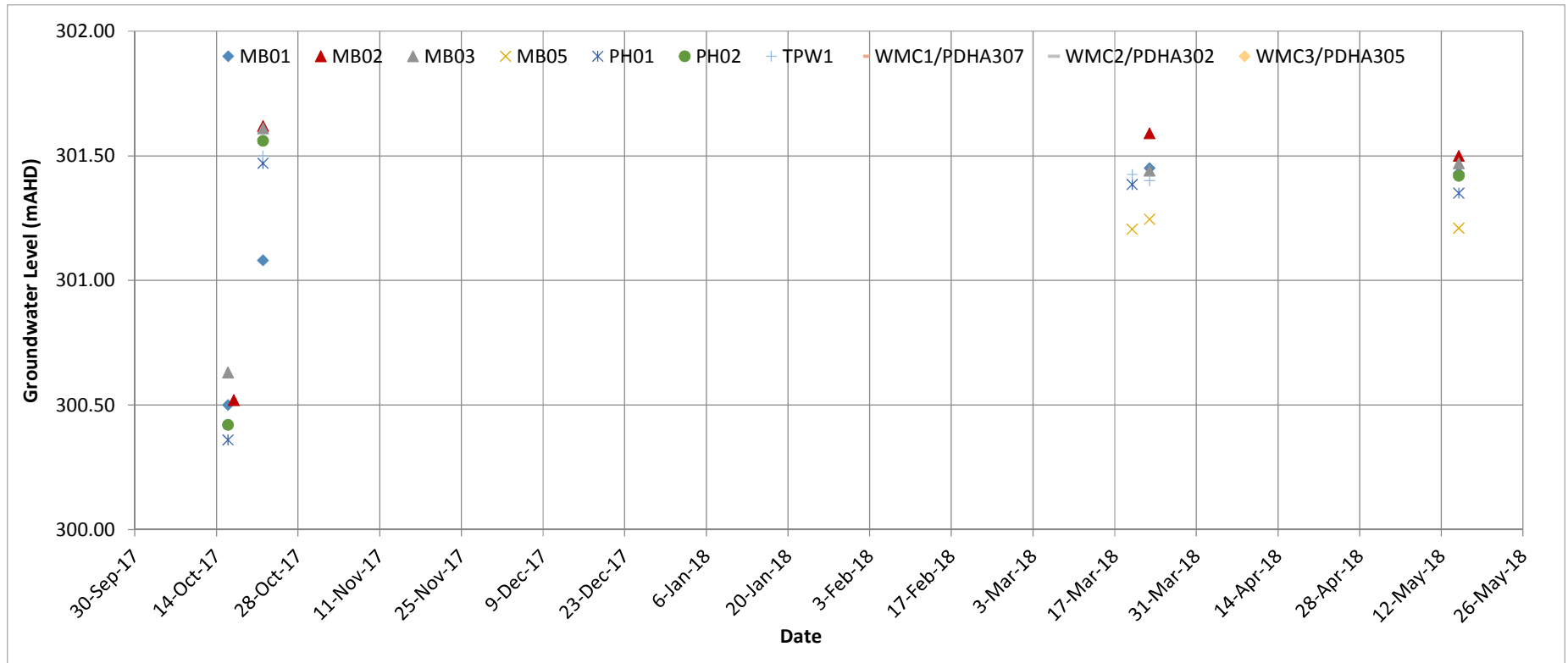
APPENDIX A

Water Level Information

Appendix A - Groundwater Levels

Bore ID	MB01			MB02			MB03			MB04			MB05			PH1			PH2			TPW1		
Surface RL	314.5			310.3			321.5			336.006			315.8			315.8			313.6			316		
Collar RL	315.6			311.39			322.53									316.95			312.4			316.55		
height casing	1.08			1.09			1.03			1.02			1.4			1.15			1.2			0.55		
	Water Level			Water Level			Water Level			Water Level			Water Level			Water Level			Water Level			Water Level		
	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL
Date																								
16-10-17		14	300.50					20.87	300.63								15.44	300.36		13.18	300.42			
17-10-17					9.78	300.52																		
22-10-17		13.42	301.08		8.68	301.62		19.89	301.61		DRY						14.33	301.47		12.04	301.56		14.5	302
20-03-18													16.00	14.60	301.21	15.57	14.42	301.39				15.125		301
23-03-18	14.15		301.45	9.8		301.59	21.09		301.44				15.96	14.56	301.25							15.15		301
15-05-18	14.17		301.43	9.89		301.50	21.06		301.47				15.99	14.59	301.21	15.60	14.45	301.35	13.38	12.18	301.42			

Bore ID	PH2			TPW1			WMC1/ PDHA307			WMC2/PDHA302			WMC3/PDHA305		
Surface RL	313.6			316			312.3			312.7			320.5		
Collar RL	312.4			316.55			312.3			312.7			320.5		
height casing	1.2			0.55			0			0			0		
	Water Level			Water Level			Water Level			Water Level			Water Level		
	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL	mbtoc	mbgl	m RL
Date															
16-10-17		13.18	300.42				11.12	11.12	301.18	11.78	11.78	300.92	18.9	18.9	301.6
17-10-17															
22-10-17		12.04	301.56		14.5	301.50									
20-03-18				15.125		301.43									
23-03-18				15.15		301.40									
15-05-18	13.38	12.18	301.42				11.79		300.51						



APPENDIX B

Groundwater Quality Information



					Sulfate (Turbidimetri c) as SO4	TRH - Total Recoverable Hydroc							BTEX							Chlorinated Hydrocarbons																																																																																																																																																																																																																																																																																																																					
mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L

	Chlorinated Hydrocarbons															Halogenated Benzenes										Halogenated Hydrocarbons					Halogenated Phenols						
	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Dibromomethane	Hexachlorobutadiene	Hexachlorocyclopentadiene	Hexachloroethane	Trichloroethene	Tetrachloroethene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	Vinyl chloride	1,2,3-trichlorobenzene	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	2-chlorotoluene	4-chlorotoluene	Bromobenzene	Chlorobenzene	Hexachlorobenzene	Pentachlorobenzene	1,2-dibromoethane	Bromomethane	Dichlorodifluoromethane	Iodomethane	Trichlorofluoromethane	2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,6-dichlorophenol	2-chlorophenol	Pentachlorophenol
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	5	50	5	50	5	5	5	2	10	2	5	5	5	5	50	5	2	2	2	2	5	5	5	5	4	2	5	50	50	5	50	1	1	1	1	1	2

Sample ID	Sampled Date	Easting	Northing																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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	Metals																	Metals																
	Arsenic (Filtered)	Barium	Barium (Filtered)	Beryllium	Beryllium (Filtered)	Boron	Boron (Filtered)	Cadmium	Cadmium (Filtered)	Calcium (Filtered)	Chromium (III+VI)	Chromium (III+VI) (Filtered)	Cobalt	Cobalt (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Magnesium (Filtered)	Manganese	Manganese (Filtered)	Mercury	Mercury (Filtered)	Nickel	Nickel (Filtered)	Phosphorus	Potassium (Filtered)	Selenium	Selenium (Filtered)	Vanadium	Vanadium (Filtered)	Zinc	Zinc (Filtered)	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
EQL	0.001	0.001	0.001	0.001	0.001	0.05	0.05	0.0001	0.0001	1	0.001	0.001	0.001	0.001	0.001	0.001	0.05	0.05	1	0.001	0.001	0.0001	0.0001	0.001	0.001	0.01	1	0.01	0.01	0.01	0.01	0.005	0.005	

Sample ID	Sampled Date	Easting	Northing																																	
ARDMORE_21102017	21-10-17	312280	7603476	<0.001	0.052	0.054	<0.001	<0.001	<0.05	<0.05	<0.0001	<0.0001	46	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	<0.05	31	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.02	3	<0.01	<0.01	<0.01	<0.01	0.133	0.135
FRANKSBORE	16-10-17	315540	7602838	<0.001	0.046	0.045	<0.001	<0.001	0.1	0.14	<0.0001	<0.0001	31	0.002	<0.001	<0.001	<0.001	0.004	0.003	0.16	<0.05	23	0.006	<0.001	<0.0001	<0.0001	0.001	<0.001	0.79	3	<0.01	<0.01	0.09	0.08	0.011	<0.005
MB01	16-10-17	321213.1	7603666.4	0.005	0.091	0.082	0.004	0.004	0.66	0.62	0.0004	0.0004	567	<0.001	<0.001	0.03	0.029	0.001	<0.001	1.9	<0.05	704	1.55	1.54	<0.0001	<0.0001	0.083	0.078	0.31	36	<0.01	<0.01	<0.01	<0.01	0.033	0.028
MB02	17-10-17	322439.1	7601253.2	<0.001	0.062	0.053	<0.001	<0.001	0.33	0.34	<0.0001	<0.0001	77	0.001	<0.001	0.001	<0.001	0.002	<0.001	0.58	<0.05	124	0.109	0.099	<0.0001	<0.0001	0.004	0.003	0.15	4	<0.01	<0.01	0.03	0.02	0.023	0.021
MB03	16-10-17	321101.9	7602187.5	<0.001	0.122	0.108	<0.001	<0.001	0.84	0.88	<0.0001	<0.0001	262	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.31	<0.05	448	0.092	0.076	<0.0001	<0.0001	0.004	0.003	0.09	16	<0.01	<0.01	0.01	<0.01	0.028	0.031
PH01	16-10-17	321463.9	7603584	0.001	0.076	0.064	0.004	0.003	0.61	0.64	<0.0001	<0.0001	552	<0.001	<0.001	0.02	0.017	0.001	<0.001	3.05	0.72	664	1.24	1.12	<0.0001	<0.0001	0.035	0.03	1.35	32	<0.01	<0.01	<0.01	<0.01	0.021	0.013
PH02	16-10-17	320729.5	7603257.7	<0.001	0.209	0.173	<0.001	<0.001	0.66	0.74	0.0005	0.0004	364	0.004	0.002	0.006	0.005	0.009	0.003	1.7	<0.05	471	0.685	0.531	<0.0001	<0.0001	0.011	0.008	2.79	22	<0.01	<0.01	0.01	<0.01	0.03	0.02
TPW01	17-10-17	321467.6	7603571.9	0.006	0.025	0.023	0.005	0.006	0.57	0.64	<0.0001	<0.0001	556	<0.001	<0.001	0.002	0.002	<0.001	<0.001	15.5	14.3	680	0.676	0.581	<0.0001	<0.0001	0.012	0.01	0.54	32	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005
QAQC - Field Duplicate (MB01)	16-10-17	321213.1	7603666.4	<0.001	0.092	0.083	0.004	0.004	0.56	0.68	0.0004	0.0004	527	<0.001	<0.001	0.03	0.026	0.001	<0.001	2	<0.05	660	1.59	1.43	<0.0001	<0.0001	0.084	0.072	0.53	33	<0.01	<0.01	<0.01	<0.01	0.031	0.026
QAQC - Trip Blank	18-10-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

	PAH/ Phenols			PAH/Phenols				Solvents					SVOCs	TPH													VOCs			
	2,4-dimethylphenol	2-methylphenol	2-nitrophenol	3-&4-methylphenol	4-chloro-3-methylphenol	Naphthalene	Phenol	Methyl Ethyl Ketone	2-hexanone (MBK)	4-Methyl-2-pentanone	Carbon disulfide	Vinyl acetate	Hexachloropropene	C10-C16	C16-C34	C34-C40	F2-NAPHTHALENE	TPH C10-C14 Fraction after Silica Cleanup	TPH C15-C28 Fraction after Silica Cleanup	TPH C29-C36 Fraction after Silica Cleanup	C10 - C14	C6 - C9	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	C10 - C40 (Sum of total)	C6-C10	cis-1,4-Dichloro-2-butene	Pentachloroethane	trans-1,4-Dichloro-2-butene
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	1	1	1	2	1	5	1	50	50	50	5	50	2	0.1	0.1	0.1	0.1	0.05	0.1	0.05	50	20	100	50	50	100	0.02	5	5	5

Sample ID	Sampled Date	Easting	Northing																															
ARDMORE_21102017	21-10-17	312280	7603476	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.05	<50	<20	<100	<50	<50	<100	<0.02	<5	<5	<5	
FRANKSBORE	16-10-17	315540	7602838	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.05	<50	<20	<100	<50	<50	<100	<0.02	<5	<5	<5	
MB01	16-10-17	321213.1	7603666.4	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	0.2	<0.1	<0.1	<0.05	<0.1	<0.05	<50	<20	130	100	230	200	<0.02	<5	<5	<5	
MB02	17-10-17	322439.1	7601253.2	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	0.15	<0.1	<0.1	<0.05	<0.1	<0.05	<50	<20	140	<50	140	150	<0.02	<5	<5	<5	
MB03	16-10-17	321101.9	7602187.5	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.05	100	<20	<100	<50	100	<100	<0.02	<5	<5	<5	
PH01	16-10-17	321463.9	7603584	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.05	<50	<20	<100	<50	<50	<100	<0.02	<5	<5	<5	
PH02	16-10-17	320729.5	7603257.7	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	0.24	<0.1	<0.1	<0.05	0.1	0.06	<50	<20	160	110	270	240	<0.02	<5	<5	<5	
TPW01	17-10-17	321467.6	7603571.9	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.05	<50	<20	<100	<50	<50	<100	<0.02	<5	<5	<5	
QAQC - Field Duplicate (MB01)	16-10-17	321213.1	7603666.4	<1	<1	<1	<2	<1	<5	<1	<50	<50	<50	<5	<50	<2	<0.1	0.17	<0.1	<0.1	<0.05	<0.1	<0.05	<50	<20	110	80	190	170	<0.02	<5	<5	<5	
QAQC - Trip Blank	18-10-17	-	-	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<20	-	-	-	-	<0.02	-	-	-	-	

APPENDIX C

Registered Bores

BORE REPORT

REG NUMBER 5188

REGISTRATION DETAILS

OFFICE Longreach	BASIN	LATITUDE 21-41-36	MAP-SCALE 254
DATE LOG RECD	SUB-AREA	LONGITUDE 139-22-12	MAP-SERIES M
D/O FILE NO.	SHIRE 2450-CLONCURRY	EASTING 331373	MAP-NO SF54-5
R/O FILE NO.	LOT	NORTHING 7600251	MAP NAME URANDANGI
H/O FILE NO.	PLAN	ZONE 54	PROG SECTION
	ORIGINAL DESCRIPTION	ACCURACY	PRES EQUIPMENT NE
		GPS ACC	
GIS LAT -21.693216292	PARISH NAME 3703-OROOPO		ORIGINAL BORE NO STRADBROKE NO 12
GIS LNG 139.370091509	COUNTY CHATSWORTH		BORE LINE -
CHECKED N			
			POLYGON
			RN OF BORE REPLACED
			DATA OWNER
FACILITY TYPE Sub-Artesian Facility	DATE DRILLED 30/09/1943		
STATUS Abandoned and Destroyed	DRILLERS NAME		
ROLES	DRILL COMPANY		
	METHOD OF CONST.		

CASING DETAILS

**** NO RECORDS FOUND ****

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	6.09	SAND AND GRAVEL
2	6.09	53.03	RED GRANITE
3	53.03	53.64	HARD GRANITE BAR

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

BORE REPORT

REG NUMBER 5188

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS**** NO RECORDS FOUND ****

BORE REPORT

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BORE REPORT

REG NUMBER 5189

REGISTRATION DETAILS

OFFICE Longreach	BASIN	LATITUDE 21-45-25	MAP-SCALE 254
DATE LOG RECD	SUB-AREA	LONGITUDE 139-20-00	MAP-SERIES M
D/O FILE NO.	SHIRE 2450-CLONCURRY	EASTING 327677	MAP-NO SF54-5
R/O FILE NO.	LOT	NORTHING 7593150	MAP NAME URANDANGI
H/O FILE NO.	PLAN	ZONE 54	PROG SECTION
	ORIGINAL DESCRIPTION STANBROKE H	ACCURACY	PRES EQUIPMENT
		GPS ACC	
GIS LAT -21.75682787	PARISH NAME 4554-THURSLEY		ORIGINAL BORE NO
GIS LNG 139.3334257	COUNTY WAVERLEY		BORE LINE -
CHECKED N			
			POLYGON
			RN OF BORE REPLACED
			DATA OWNER
FACILITY TYPE Sub-Artesian Facility	DATE DRILLED		
STATUS Abandoned and Destroyed	DRILLERS NAME		
ROLES	DRILL COMPANY		
	METHOD OF CONST.		

CASING DETAILS

**** NO RECORDS FOUND ****

STRATA LOG DETAILS

**** NO RECORDS FOUND ****

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE REPORT

REG NUMBER 5189

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS**** NO RECORDS FOUND ****

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BORE REPORT

REG NUMBER 5495

REGISTRATION DETAILS

OFFICE Longreach	BASIN 0012	LATITUDE 21-40-19	MAP-SCALE 254
DATE LOG RECD	SUB-AREA	LONGITUDE 139-15-38	MAP-SERIES M
D/O FILE NO. 17/07/A/02	SHIRE 900-BOULIA	EASTING 320024	MAP-NO SF54-5
R/O FILE NO. 17/7/A/2	LOT	NORTHING 7602481	MAP NAME URANDANGI
H/O FILE NO. L02860B	PLAN	ZONE 54	PROG SECTION
	ORIGINAL DESCRIPTION ARDMORE HOLDING	ACCURACY	PRES EQUIPMENT WL
		GPS ACC	
GIS LAT -21.67182854	PARISH NAME 1923-FRIMLEY		ORIGINAL BORE NO
GIS LNG 139.2606481	COUNTY WAVERLEY		BORE LINE -
CHECKED N			
			POLYGON
			RN OF BORE REPLACED
			DATA OWNER
FACILITY TYPE Sub-Artesian Facility	DATE DRILLED 10/07/1950		
STATUS Abandoned but Still Usable	DRILLERS NAME		
ROLES	DRILL COMPANY		
	METHOD OF CONST. CABLE TOOL		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	10/07/1950	1	Steel Casing		WT	152	0.00	29.00
A	10/07/1950	2	Open End				29.00	29.00

STRATA LOG DETAILS

**** NO RECORDS FOUND ****

STRATIGRAPHY DETAILS

SOURCE	RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
DNR	1	0.00		SYBELLA GRANITE

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
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BORE REPORT

REG NUMBER 5495

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	0.00		GNTE							FR	SYBELLA GRANITE

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
X	10/07/1950	-13.70	N		NR

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
------	------	----------------	-----	-----	--------------

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
------	------	----------------	-----	-----	--------------

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

BORE REPORT

REG NUMBER 5495

*** NO RECORDS FOUND ***

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BORE REPORT

REG NUMBER 5496

REGISTRATION DETAILS

OFFICE Longreach	BASIN 0012	LATITUDE 21-39-44	MAP-SCALE 254
DATE LOG RECD	SUB-AREA	LONGITUDE 139-11-09	MAP-SERIES M
D/O FILE NO. 17/07/A/02	SHIRE 900-BOULIA	EASTING 312280	MAP-NO SF54-5
R/O FILE NO. 17/7/A/2	LOT	NORTHING 7603476	MAP NAME URANDANGI
H/O FILE NO. L02860B	PLAN	ZONE 54	PROG SECTION
	ORIGINAL DESCRIPTION ARDMORE HOLDING	ACCURACY	PRES EQUIPMENT WL
		GPS ACC	
GIS LAT -21.662107148	PARISH NAME 1923-FRIMLEY		ORIGINAL BORE NO ARDMORE HOMESTEAD
GIS LNG 139.185926714	COUNTY WAVERLEY		BORE LINE -
CHECKED N			
			POLYGON
			RN OF BORE REPLACED
			DATA OWNER
FACILITY TYPE Sub-Artesian Facility	DATE DRILLED 01/01/1919		
STATUS Existing	DRILLERS NAME		
ROLES	DRILL COMPANY		
	METHOD OF CONST. CABLE TOOL - H K DAVIES		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	01/01/1919	1	Steel Casing		WT	203	0.00	9.10
A	01/01/1919	2	Steel Casing		WT	152	0.00	137.20
A	01/01/1919	3	Open Hole				137.20	186.50

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	186.54	NO DETAILS AVAILABLE
902			01/01/1919 SWL 400FT/121.92M

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

BORE REPORT

REG NUMBER 5496

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
X	01/01/1919	-121.92	N		NR

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
X	10/07/1950	-121.92	N		NR

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
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WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

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BORE REPORT

REG NUMBER 8404

REGISTRATION DETAILS

OFFICE Longreach	BASIN 0012	LATITUDE 21-40-12	MAP-SCALE 254
DATE LOG RECD	SUB-AREA	LONGITUDE 139-22-50	MAP-SERIES M
D/O FILE NO. 24/10/S/01	SHIRE 2450-CLONCURRY	EASTING 332451	MAP-NO SF54-5
R/O FILE NO. 24/10/S/01	LOT	NORTHING 7602826	MAP NAME URANDANGI
H/O FILE NO. 3534	PLAN	ZONE 54	PROG SECTION
	ORIGINAL DESCRIPTION URANDANGIE - DAJARRA SR	ACCURACY	PRES EQUIPMENT NE
		GPS ACC	
GIS LAT -21.669882925	PARISH NAME 3703-OROOPO		ORIGINAL BORE NO SULIMAN
GIS LNG 139.380646682	COUNTY CHATSWORTH		BORE LINE -
CHECKED N			
			POLYGON
			RN OF BORE REPLACED
			DATA OWNER
FACILITY TYPE Sub-Artesian Facility	DATE DRILLED 01/01/1916		
STATUS Abandoned and Destroyed	DRILLERS NAME		
ROLES	DRILL COMPANY		
	METHOD OF CONST. CABLE TOOL		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	01/01/1916	1	Steel Casing		WT	152	0.00	28.00

STRATA LOG DETAILS

**** NO RECORDS FOUND ****

STRATIGRAPHY DETAILS

SOURCE	RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
DNR	1			EASTERN CREEK VOLCANICS

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD CTR (l/s)	CONDIT	FORMATION NAME
1	0.00								XX	EASTERN CREEK VOLCANICS

BORE REPORT

REG NUMBER 8404

<u>PUMP TEST DETAILS PART 1</u>															
PIPE	DATE	REC RN OF NO. PUMP-BORE		TOP (m)	BOTTOM (m)	DIST (m)	METH	TEST TYPES	PUMP TYPE		SUCTION SET (m)	Q PRIOR TO TEST (l/s)	DUR OF Q PR (min)	PRES ON ARRIV (m)	Q ON ARRIV (l/s)
A	01/01/1937	20 8404				0.00	F/F	FR							

<u>PUMP TEST DETAILS PART 2</u>																
PIPE	DATE	REC	TEST DUR (mins)	SWL (m)	RECOV. TIME (mins)	RESID. DD (m)	MAX DD or P RED (m)	Q at MAX DD (l/s)	TIME TO MAX DD (mins)	Max Q (l/s)	CALC STAT HD (m)	DESIGN YIELD (l/s)	DESIGN BP (m)	SUCT. SET (m)	TMSY (m2/DAY)	STOR
A	01/01/1937	20														

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

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BORE REPORT

REG NUMBER 17915

REGISTRATION DETAILS

OFFICE Longreach	BASIN 0012	LATITUDE 21-40-41	MAP-SCALE 254
DATE LOG RECD	SUB-AREA	LONGITUDE 139-23-13	MAP-SERIES M
D/O FILE NO. 24/10/S/01	SHIRE 2450-CLONCURRY	EASTING 333112	MAP-NO SF54-5
R/O FILE NO. 24/10/S/1	LOT	NORTHING 7601953	MAP NAME URANDANGI
H/O FILE NO. G03539	PLAN	ZONE 54	PROG SECTION
	ORIGINAL DESCRIPTION URANDANGIE-DAJARRA S/R	ACCURACY	PRES EQUIPMENT WL
		GPS ACC	
GIS LAT -21.677938387	PARISH NAME 3703-OROOPO		ORIGINAL BORE NO SULIEMAN SRF
GIS LNG 139.387035579	COUNTY CHATSWORTH		BORE LINE -
CHECKED N			
			POLYGON
			RN OF BORE REPLACED
			DATA OWNER
FACILITY TYPE Sub-Artesian Facility	DATE DRILLED 14/04/1968		
STATUS Existing	DRILLERS NAME		
ROLES	DRILL COMPANY		
	METHOD OF CONST. CABLE TOOL		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	14/04/1968	1	Steel Casing		WT	203	0.00	33.50
A	14/04/1968	2	Perforated or Slotted Casing		AP			33.50

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	2.44	GRAVEL & RED SOIL
2	2.44	8.53	GREEN CLAY
3	8.53	19.81	HARD GREEN SHALE
4	19.81	20.73	BASALT & BOUNDLER
5	20.73	31.09	HARD GREEN SHALE
6	31.09	32.00	BLACK BASALT BOULDER
7	32.00	33.53	WATER BED

BORE REPORT

REG NUMBER 17915

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
8			S.W.L. 65FT
9			D.D.L. 68FT
10			SUPPLY 1440GPH
902			14/04/1968 SWL -19.80 M TMP NUL C
903			14/04/1968 DISCH 157.2 M3D BAILER
910	30.00	33.00	QUALITY DESCRIPT/CONDUCT: POTABLE

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	30.00	33.00	LMST							FR	

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

BORE REPORT

REG NUMBER 17915

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
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X	14/04/1968	-19.80	N		NR
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WATER LEVEL DETAILS

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
------	------	----------------	-----	-----	--------------

PIPE	DATE	MEASURE (m)	N/R	RMK	MEAS TYPE
------	------	----------------	-----	-----	--------------

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS**** NO RECORDS FOUND ****

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**** End of Report. Produced: 22/06/2018 02:22:31 PM ****

BORE REPORT

REG NUMBER 118041

REGISTRATION DETAILS

OFFICE Longreach	BASIN 0012	LATITUDE 21-40-01	MAP-SCALE 254
DATE LOG RECD	SUB-AREA	LONGITUDE 139-13-08	MAP-SERIES M
D/O FILE NO. 515/0071	SHIRE 900-BOULIA	EASTING 315702	MAP-NO SF54-5
R/O FILE NO.	LOT 4	NORTHING 7603000	MAP NAME URANDANGI
H/O FILE NO.	PLAN SP117500	ZONE 54	PROG SECTION
	ORIGINAL DESCRIPTION	ACCURACY SKET	PRES EQUIPMENT
		GPS ACC	
GIS LAT -21.666749162	PARISH NAME 1320-CRANLEY		ORIGINAL BORE NO ARDMORE BORE
GIS LNG 139.218871557	COUNTY WAVERLEY		BORE LINE -
CHECKED Y			
			POLYGON
			RN OF BORE REPLACED
			DATA OWNER
FACILITY TYPE Sub-Artesian Facility	DATE DRILLED 10/09/2002		
STATUS Existing	DRILLERS NAME B NORRIE		
ROLES	DRILL COMPANY NORRI DRILLING SERVICES		
	METHOD OF CONST. ROTARY AIR		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	10/09/2002	1	Polyvinyl Chloride			200	0.00	3.00
A	10/09/2002	2	Polyvinyl Chloride			150	0.00	30.00

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.00	TOPSOIL
2	1.00	17.00	WEATHERED SHALE
3	17.00	60.00	SHALE ROCK
4	60.00	202.00	BLACK GRANITE

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

BORE REPORT

REG NUMBER 118041

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	16.00		SHLE			N		0.51	Y	PS	OHARA SHALE

AQUIFER DETAILSPUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

BORE REPORT

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APPENDIX D

Important Information Relating to this Report

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