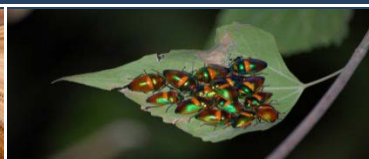




# Appendix F2 Ground Water Report



Sherwin Iron (NT) Pty Ltd  
Sherwin Creek Iron Ore Project  
Environmental Impact Statement



2013



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# **Ground Water Assessment**

## **Implications for Mine Water Management**

**Deposit C Sherwin Creek Iron Ore project  
Sherwin Iron Ltd**

**Revision No 1  
November 2013**

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**Leaders in Environmental Practice**

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## Report

|                   |                                                                                                                            |
|-------------------|----------------------------------------------------------------------------------------------------------------------------|
| <b>Title:</b>     | Ground Water Assessment<br>Implications for Mine Water Management                                                          |
| <b>File:</b>      | PES11009                                                                                                                   |
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| <b>Client:</b>    | EcOz Environmental Services on behalf of Sherwin Iron Ltd                                                                  |
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| <b>Synopsis:</b>  | This document details the ground water investigation and assessment at the proposed Sherwin Creek Iron Project, Deposit C. |

## Document Control

| Revision No | Date             | Author(s)            | Reviewer(s)              |
|-------------|------------------|----------------------|--------------------------|
| 1           | 27 November 2013 | Edgardo Alarcón León | Carel van der Westhuizen |

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- Appendix A: Bore Construction Details.
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- Appendix C: Bore and Slug Test Data.
- Appendix D: Water Quality Laboratory Data and Certificates.

Note: Raw data has been excluded from the Appendices. The data can be obtained by contacting [eco2@eco2.com.au](mailto:eco2@eco2.com.au) requesting 'Sherwin Iron Ground Water Data' or by calling (08) 8981 1100 and requesting the same.

# Executive Summary

## Background

Pendragon Environmental Solutions Pty Ltd was engaged by EcOz Environmental Services, on behalf of Sherwin Iron Ltd, to undertake a ground water investigation and assessment at the Sherwin Creek Iron Ore Project approximately 450km south-east of Darwin and 120km east of Mataranka in the Northern Territory.

## Objectives

The objectives of this investigation and assessment were to:

- Ascertain the hydrogeological characteristics of the ground water regime underlying and in proximity to the project to assess potential impacts from open pit mining and processing by crushing and screening.
- Locate sources for ground water supplies to the proposed camp and mine.

## Scope of Works

The scope of works included:

- Obtain and review all relevant geologic, hydrological, hydrogeological maps, reports and data.
- Direct and supervise drilling of ground water bores in accordance with the Minimum Construction Requirements for Water Bores in Australia (National Water Commission, 2012).
- Direct and assess bore testing to ascertain the extent of aquifers and their characterization in terms of their hydraulic parameters and consequently the extent of the zone that may be impacted by mining. Undertake surveys of ground water levels to ascertain flow directions and velocities.
- Obtain ground water samples to ascertain the ambient quality of ground water.
- Interpret and assess field and laboratory data gathered during the above programs to ascertain potential preferential pathways and enable a prediction of the potential impacts of mining and processing on the surrounding and downstream environments.
- Compile a technical report, including conclusions and recommendations, particularly with reference to ongoing monitoring during operations such that mine rehabilitation and closure can be achieved without residual impacts.

## Methodologies

A conceptual model was developed based upon published and relevant geological, hydrological, hydrogeological data and reports, complemented with the observations and data gathered during geological exploration.

The conceptual model was subsequently validated by bore drilling, testing and sampling and detailed assessment of the data gathered.

## Salient Findings

Drilling, testing and sampling of bores indicated:

- A permeable and ephemeral shallow system with water lenses trapped in silty-clays overlying extremely weathered sandstones, highly localised within alluvial-debris fans located at the outlets of numerous small creek channels and gullies that may contain Groundwater Dependent Ecosystems (GDEs).
- Underlying the shallow system is a sequence of interlayered siltstones, sandstones, shales and localised

mudstones in which ground water is encountered between 20m and 67m below surface. Larger ground water yields are encountered in the iron-rich weathered and fractured sandstones deeper than 45m below surface.

- There is a thick sequence of siltstones overlying a very hard bluish dolerite that acts as the lower boundary of the confining system.
- Observations during bore testing indicate that recoveries of ground water levels during testing were slow which constrains long-term sustainable bore yields.
- Ground water qualities are deemed suitable for most uses/users:
  - Circumneutral to slightly alkaline pHs ranging from 5.84 to 8.99.
  - Most ground waters have relatively small concentrations of major ions with only one sample (SPB03) having elevated chloride (108mg/L) and sodium (178mg/L).
  - The trace elements are generally well below their assessment levels.
  - Hydrogeochemical assessments indicate the presence of three types of ground water: the first is a calcium-carbonate type of water indicating recently recharged waters which occur across the low lying ground to the west and south-west of the proposed open pit. The second is a sodium-bicarbonate type which indicates ion-exchange waters to the north and north-west of the proposed open pit (between bores SPB02 and SPB03). The third group is a sodium-chloride type which indicates end-point (saline/brackish) waters across high lying ground and below the proposed mine pit. These waters have lower pHs than elsewhere and slight salinity indicating slow and little recharge, if any.

## **Risk Assessment**

The risk assessment with mitigation and management measures are summarised below:

### **Risk Assessment, Mitigation and Management Options.**

| Impacts                                                                                                                                                                               | Potential Risk | Proposed Mitigation/Control and Recommended Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Residual Risk |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|                                                                                                                                                                                       | Rank           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Rank          |
| Ground and Surface Water: General                                                                                                                                                     |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |
| Mine influx and dewatering.                                                                                                                                                           | None           | Ground water occurs below depth of mining.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | None          |
| Hydraulic connectivity with streams, including GDEs; stream diversions will not be required.                                                                                          | None           | Different ground water systems at GDEs and open pit; ground water levels below stream beds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | None          |
| Spills and sediment loads in storm runoff impacting ground water quality                                                                                                              | L              | Terrain impermeable with deep ground water levels.<br>Implement Emergency/Water Management Plans.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | L             |
| Acid Mine Drainage (Pendragon Environmental Solutions, 2013b)                                                                                                                         | H              | Refer AMD investigation and assessment: small isolated and localised zones of PAF materials.<br><br>Implement PAF Management Plan: encapsulate, cover and contain by appropriate investigation, engineering design and construction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | L             |
| Exploration for Ground Water Supplies and Exploitation                                                                                                                                |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |
| Groundwater exploration and exploitation impact-ing: <ul style="list-style-type: none"><li>▪ Aquifer yield.</li><li>▪ Ground water level drawdown.</li><li>▪ Water quality.</li></ul> | M              | Absence of users.<br><br>Water demand/requirement relatively small.<br><br>Sufficient exploration/exploitation targets/zones for geophysical exploration, bore drilling, testing and sampling.<br><br>Model to ascertain potential impacts; set operational controls for ground water exploitation and requirements for closure.<br><br>Monitor bore yields, ground water level behaviour and water quality: implement Ground Water Manage-ment and Monitoring Plan.<br><br>Develop appropriate contingency measures upon completion of detailed design.<br><br>Provide and implement additional/new measures/treatment trains, if and where required, to remediate and prevent further and possible future impacts to ensure that closure objectives are met. | L             |

| Impacts                                                                                                        | Potential Risk | Proposed Mitigation/Control and Recommended Management                                                                                                                                                                                                                                                                                                                | Residual Risk |
|----------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|                                                                                                                | Rank           |                                                                                                                                                                                                                                                                                                                                                                       | Rank          |
| Open Pit Mining                                                                                                |                |                                                                                                                                                                                                                                                                                                                                                                       |               |
| Seepage from open pit impacting water quality.                                                                 | H              | Terrain relatively impermeable; deep ground water levels with small isolated and localised zones of PAF materials, low aquifer/bore yields.<br><br>Deficit water balance: evaporation exceeds rainfall; limited infiltration/recharge.<br><br>Geochemical modelling to set appropriate closure criteria. Implement PAF and Water Management Plans.<br><br>Monitoring. | L             |
| Plant and Infrastructure                                                                                       |                |                                                                                                                                                                                                                                                                                                                                                                       |               |
| Seepage from ROM, stockpiles, WRDs, surface impoundments impacting water quality.                              | M              | Terrain relatively impermeable; deep ground water levels. Partial backfilling of open pit.<br><br>Employ appropriate <i>best practice</i> engineering design and construction.<br><br>Monitoring.                                                                                                                                                                     | L             |
| Rehabilitation and Closure                                                                                     |                |                                                                                                                                                                                                                                                                                                                                                                       |               |
| Impact: <ul style="list-style-type: none"><li>▪ Ground water levels.</li><li>▪ Ground water quality.</li></ul> | L<br><br>L     | Mining/processing undertaken with the view to minimize residual impacts after mining.<br><br>Return of ground water levels to pre-mining levels.<br><br>Migration of rain falling into partially backfilled open pit.<br><br>Monitoring with appropriate corrective action if and where required.                                                                     | None<br><br>L |
| Notes: Rank: S denotes Significant, M Moderate and L Low.                                                      |                |                                                                                                                                                                                                                                                                                                                                                                       |               |

## Conclusions

Bore drilling, testing and sampling indicated:

- A permeable and ephemeral shallow ground water regime with water lenses trapped in silty-clays overlying extremely weathered sandstone, highly localised within alluvial-debris fans located at the outlets of numerous small creek channels and gullies. These systems are sufficiently far, albeit downstream of the mine not to be impacted by mining and processing.
- The shallow system is underlain by a sequence of interlayered weathered and fractured siltstones, sandstones, shales and localised mudstones in which ground water is encountered between about 20m below surface (lower lying terrain) and 70m below surface (across higher lying terrain and the open pit). Below this there is a thick sequence of siltstones overlying a very hard bluish dolerite that acts as the lower boundary of the confining system. Ground water strikes were generally small and resultant ground water levels below the depth of mining. The hydraulic parameters and yields of the aquifers are low, indicative of the relative impermeability of the terrain.

Mine influx and hydraulic connectivity with surface water resources, including GDEs, are not considered risks and will not be impacted by mining and processing. In the absence of ground water influx, dewatering to facilitate open pit mining will not be required. Similarly, potential acid forming (PAF) bodies are relatively small, isolated and largely confined to the north-west of the proposed open pit. Consequently the risks of AMD and particularly leachate from exposing potential acid forming (PAF) materials and/or PAF waste materials impacting ground water are considered low taking cognisance of the prescribed management of these zones and materials. The remaining potential risks and impacts with regard to ground water pertain to:

- Ground water abstraction (availability and sustainability) for potable and mine water supplies in the absence of other users.
- Infiltration of rain water from a partially backfilled open pit during mining and post closure.

Currently, available sources may yield up to 42.5ML/a over the short term. Medium to long term sustainable

yields equate to between 12ML/a and 26ML/a. Further geophysical exploration, across three target zones south, west and north of the mine coupled with drilling, testing and sampling of bores are currently being planned to facilitate characterisation of the potential of aquifers in proximity to the mine and potential impacts by the exploitation of ground water to water level drawdown, aquifer yield and water quality.

### **Recommendations**

It is recommended that drilling, testing and sampling for ground water supplies continue, following completion of geophysical surveys, in areas where moderate to large ground water yields are likely to occur:

- South-west of the camp site near bore SPB07.
- North-west of the proposed open pit near bores SEMB3 and SPB06.
- South-south-east of the proposed open pit near exploration bore RR0071.

Undertake modelling to ascertain/set operational controls for ground water exploitation i.e. sustainable safe yield, allowable drawdown and distance to zero drawdown.

Provide suitably located shallow and deep bores around the mine and infrastructure e.g. WRDs, ROM, stockpiles subsequent to construction and implement a ground water monitoring plan.

# 1. Introduction

Pendragon Environmental Solutions Pty Ltd was engaged by EcoZ Environmental Services, on behalf of Sherwin Iron Ltd, to undertake a ground water investigation and assessment, including drilling, testing and sampling of bores, to ascertain the hydrogeological characteristics of the ground water regime underlying Deposit C of the proposed iron ore mine project located at Sherwin Creek approximately 450km south-east of Darwin and 120km east of Mataranka (Figure 1).



Figure 1: Location Sherwin Creek Iron Ore Project.

## 1.1 Scope of Works

The scope of works included (reference should also be made to Section 1.3):

- Obtain and review all relevant geological, hydrological, hydrogeological maps, reports and data.
- Direct and supervise drilling of ground water bores in accordance with the Minimum Construction Requirements for Water Bores in Australia (National Water Commission, 2012).
- Direct and assess bore testing to ascertain the extent of aquifers and their characterization in terms of their hydraulic parameters and consequently the extent of the zone that may be impacted by mining. Undertake surveys of ground water levels to ascertain flow directions and velocities.
- Obtain ground water samples to ascertain the ambient quality of ground water.
- Interpret and assess field and laboratory data gathered during the above programs to ascertain potential preferential pathways and enable a prediction of the potential impacts of mining and processing on the surrounding and downstream environments.
- Compile a technical report, including conclusions and recommendations, particularly with reference to ongoing monitoring during operations such that mine rehabilitation and closure can be achieved without residual impacts.

## 1.2 Water Demand/Requirement

The total water demand/requirement for potable water and mining and processing has been estimated at 50ML/a or 3L/s (Table1).

**Table 1: Potable and Mine Water Requirements.**

| Water Demand/Requirement DSO Mining 3Mt/a       | ML/a      | L/s        |
|-------------------------------------------------|-----------|------------|
| Camp Site (100 occupants)                       | 11        | 0.7        |
| Mine Offices/Workshop/Site (65 personnel)       | 4         | 0.2        |
| <b>Total Potable Water Requirement</b>          | <b>15</b> | <b>0.9</b> |
| <b>Mine Water Requirement</b>                   |           |            |
| Crushing and Screening                          | 3         | 0.2        |
| Workshop/Wash Bays                              | 15        | 0.9        |
| Haul Road/Open Pit Mining/ROM                   | 17        | 1.0        |
| <b>Total Mine Operational Water Requirement</b> | <b>35</b> | <b>2.1</b> |

Sherwin Iron Ltd indicated that these requirements would have to be met from ground water sources at or close to the proposed new Sherwin Creek Iron Ore Project.

## 1.3 EIS Requirements

In December 2012, the then Deputy Chief Executive of the NT EPA determined that the Sherwin Iron Ore Project required formal assessment under the NT Environmental Assessment Act (EA Act) at the level of an Environmental Impact Statement (EIS). Issues of concern contributing to the decision included:

The proposal impacts on “sensitive environments such as **major waterways, significant ground water resources, significant natural features and conservation reserves.**”

The NT EPA requested Sherwin Iron Ltd to provide information on the quantity, quality, source (dam, surface water, ground water), storage and infrastructure requirements for water use, including a water balance, for both construction and operational aspects of the project. With regard to the hydrology and water quality Sherwin Iron Ltd should:

- be fully aware of the risks to existing surface and ground water resources and quality associated with all aspects of the project; and
- prevent and mitigate risks to surface and ground water quality and adequately address the ground water resource.

In general, the overall environmental objective is to ensure that surface water and groundwater resources and quality are protected both now and in the future, such that ecological health and land uses, and the health, welfare and amenity of people are maintained.

To achieve this, Sherwin Iron Ltd must (with specific reference to ground water):

- Provide a description of site and regional ground water resources, quality and significance in the vicinity of the deposits to be mined and their connectivity with surface waters.
- Describe site and regional hydrogeology to enable the prediction of potential impacts of the proposal on

*vegetation adjacent to mining areas, including drawdown cones and pollution pathways.*

- *Indicate the location of ground water bores for the project with respect to any ground water dependent natural features or users.*

The proposed activities should be assessed to *provide an estimate of the risk to ground water resources in the vicinity of the site and regionally.* In particular discuss:

- *Potential impacts to adjacent areas and vegetation from ground water drawdown as a result of pit dewatering and extraction.*
- *Potential impacts to ground and surface water systems from spills, leachate from potential acid forming waste material and sediment loads in stormwater runoff.*
- *Any other potential impacts on surface and groundwater quality and hydrological features.*

To manage any impact on the hydrological features, *preventative, management and treatment strategies to minimise the impacts of the project* should be developed. In particular, Sherwin Iron should provide details on:

- *Measures to safeguard surface and ground water resources and their dependant ecological communities including options for minimising water use, management and treatment of clean and contaminated water including site stormwater, erosion and sediment control measures, and maintaining environmental flows.*
- *Proposed surface and ground water monitoring programs.*

## 2. Site Characteristics and Conceptual Model

### 2.1 Climate

The climate is semi tropical with a mild dry season (May to October) followed by a hot and humid wet season (November to April) often with monsoonal rains or cyclones. The average annual rainfall is 815mm (Ngukurr Rainfall Station, Figure 2). The average annual pan evaporation is 2,406mm.

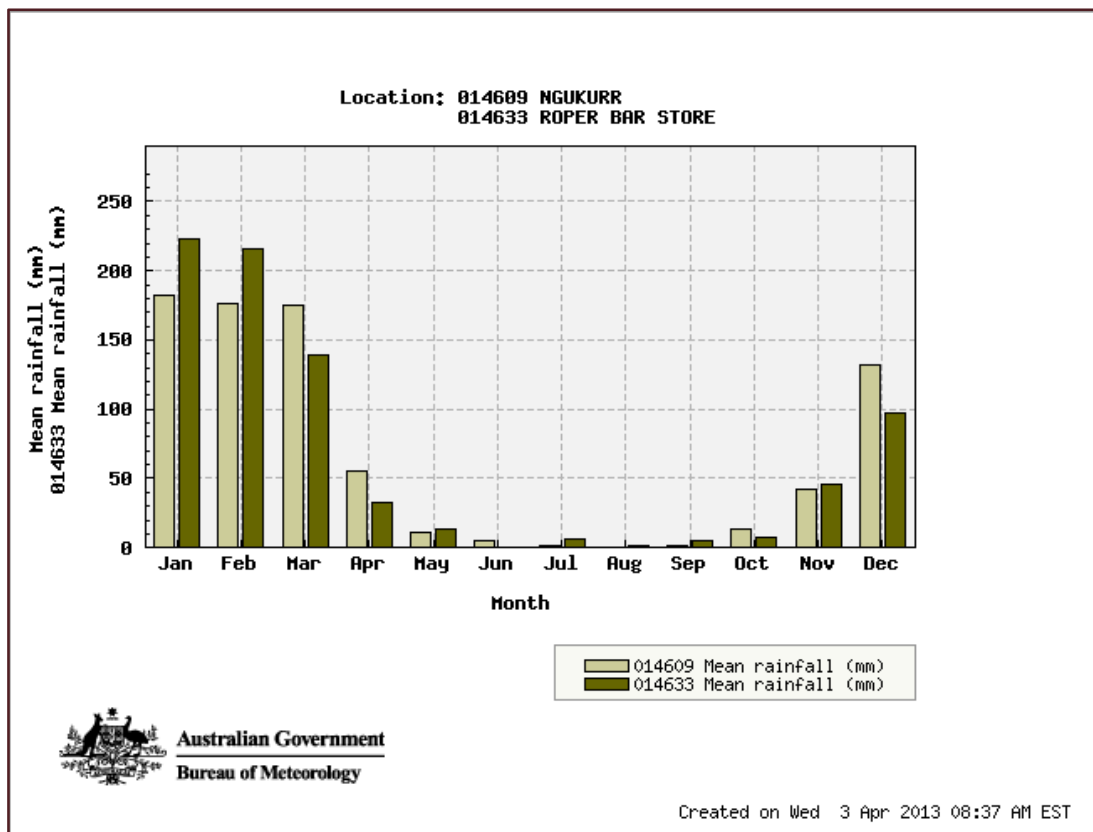


Figure 2: Monthly Rainfall at Ngukurr and Roper Bar.

### 2.2 Topography

The main topographic features are low escarpments formed by sequences of sandstones, siltstones and mineralised zones. Away from the escarpments, outcrops are scarce and limited to occasional boulders, rubble and sands of the underlying sub-outcrop.

The eastern perimeter of the proposed open pit borders a ridge line running roughly north to south at ~RL125m (Figure 3). The proposed accommodation camp is to the west at RL ~65m and the lowest point on the proposed haul road is at ~RL 45m. Slopes across the site vary from flat areas at <1% to some of the existing natural channel banks at 50%. The mine site drains predominantly to the west whilst Sherwin Creek drains from south to north into the Roper River some 8km north-east of the mine.

### 2.3 Hydrological Catchments

Deposit C falls entirely within the Roper River Catchment and is partly located within the Daly Roper Water Control District (WCD). The open pit and associated infrastructure (Figure 3) are located at the heads of several unnamed tributaries of Sherwin Creek.

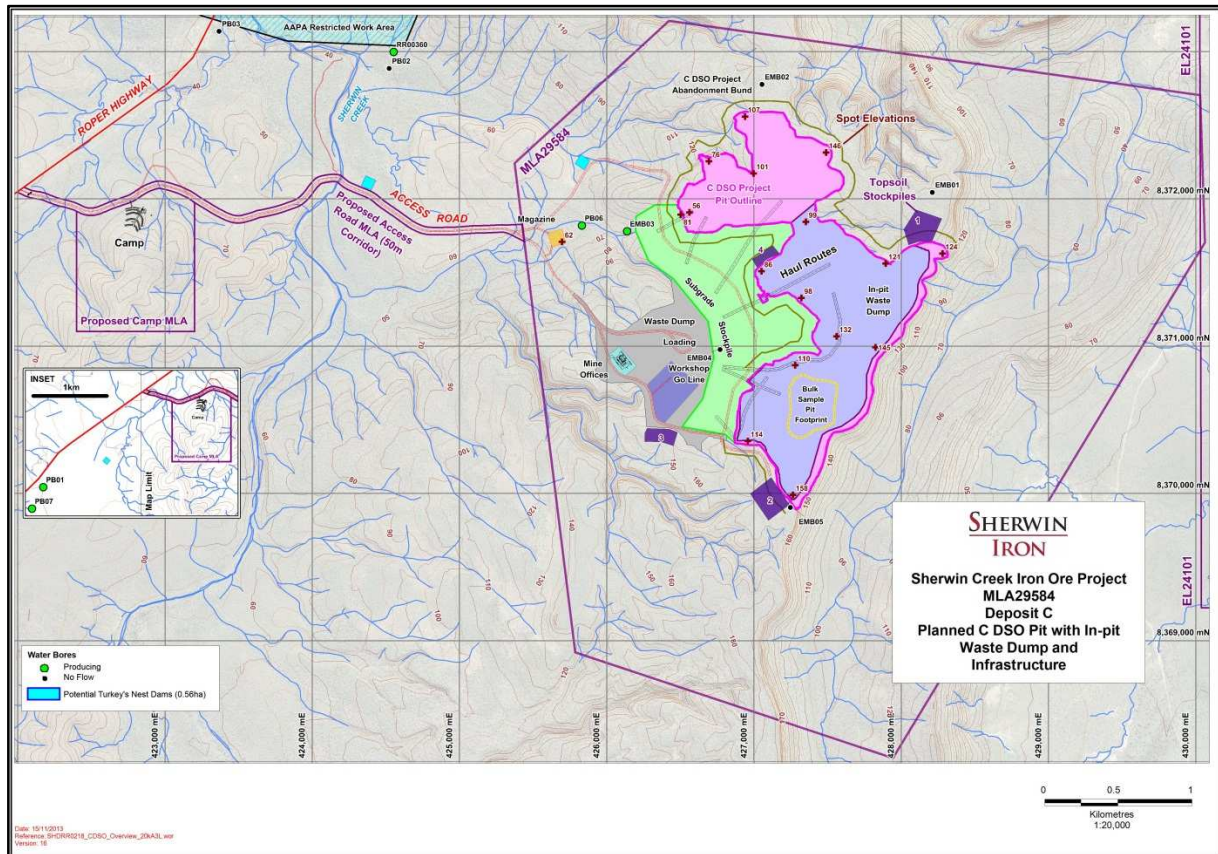


Figure 3: Drainage.

Rivers and streams within the catchments are both perennial (Roper River) and intermittent (Sherwin Creek). Typically, the drainage systems deplete to form isolated pools and waterholes during the dry season. Creeks and minor streams flow only in the wet season between December and May (Pendragon Environmental Solutions, 2013a) during which access by road may be restricted.

## 2.4 Geology

### 2.4.1 Regional Geology

The sequences of the Vizard, Nathan and Roper Groups, separated by unconformities, dominate the broad regional geology of the area (Figure 4). The Vizard Group is at the base of the Macarthur Basin (outcropping within the region) and comprises stromatolitic dolomites of the St Vidgeon Formation which are overlain by the Nagi Formation of interbedded quartz sandstone and siltstones (Neumann et al., 2007). The upper part of the basin is formed by the Mantangula, the Limmen Sandstone and the Mainoru formations of the Roper Group.

The mine site area is underlain by Quartz sandstone with interbedded micaceous mudstone, shale and locally ironstone of the Roper Group. These formations are situated on the flank of the east-west trending Urapunga tectonic ridge, separating the Batten and Walker troughs of the McArthur Basin. North-south trending structures of the Showell Fault Zone, with some extending north-west to south-east, display a thrust component (Figure 4).

Ironstones are prominent on the local stratigraphic level (Sherwin Creek and Hodgson Downs). A variety of marginal, shallow and deep marine shelf environments reflect alternating basin-wide sea level rises and falls. Tholeiitic dolerite and gabbro sills intruded the Roper Group soon after deposition ceased and before regional deformation.



## 2.4.2 Local Geology

The terrain is predominantly flat to undulating and blanketed with thin Quaternary soils. The cyclic sandstone and mudstone shallow marine sequence is up to 2,000m thick in the area and has been intruded by tholeiitic dolerite sills (Derim Derim Dolerite), up to 50m thick, prior to regional deformation.

MLA29584 (Deposit C) contains the Maiwok Sub Group. At the base is the Velkerri Formation, a mudstone and siltstone that is variably grey to black indicative of high carbon content. Overlying the Velkerri Formation is the Moroak Sandstone, a quartz-rich unit characterised by thin to medium bedding, fine grained and interbedded with siltstone and mudstone. The Sherwin Formation overlies this unit as an interbedded fine grained sandstone, siltstone and mudstone with distinct pisolitic ironstone units at several stratigraphic horizons. Mudstone of the Sherwin Formation, in addition to extensive pisolitic ironstone lenses, outcrops in MLA29584.

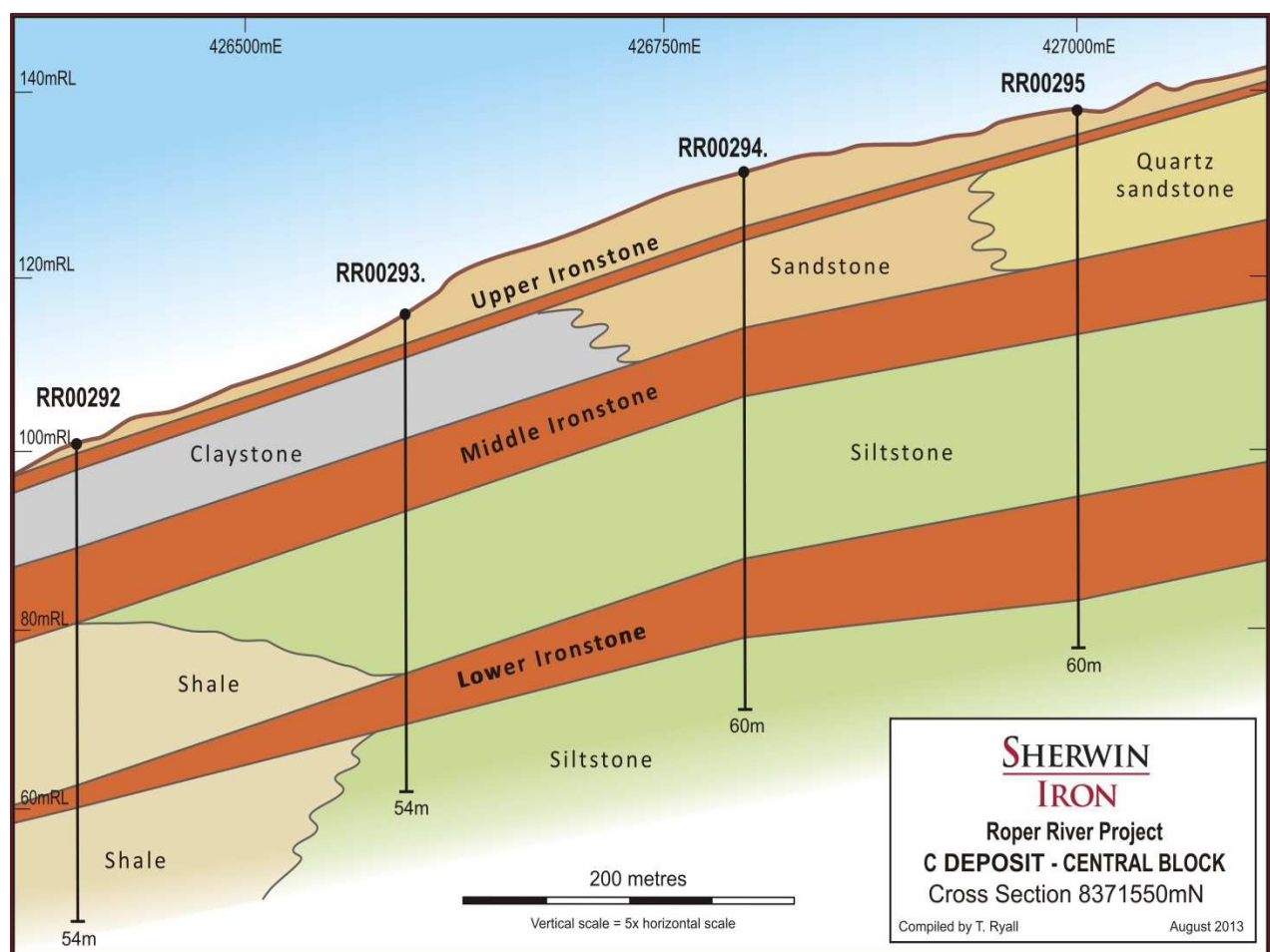


**Figure 5: Cross Section through the centre of Deposit C.**

The overlying Kyalla Formation outcrops across Deposit C and comprises interbedded siltstone, mudstone and very fine grained quartz sandstone, often showing desiccation cracks. The Upper, Middle and Lower Ironstone beds are well represented at Sherwin Creek. The Upper Ironstone (hematite) is typically 1m to 2m thick, the Middle Ironstone layer is 8m to 12m thick and the Lower Ironstone (the highest iron grade) usually between 6m and 8m thick (Figure 5) across the centre of Deposit C and the open pit.

Dolerite sills, up to 50m or more in thickness, intruded locally between the Lower Ironstone and the overlying basal oolitic hematite of the Middle Ironstone. The dolerite outcrops as low-relief medium to coarse grained, variably altered and weathered rounded boulders with a composition dominated by plagioclase, clinopyroxene and Fe-Ti oxides.

## 2.5 Earlier Work

Ground water reserves in the region are extensive and are responsible for surface water flows in the Roper River during the dry season (Kraatz, 2004). The McArthur Basin covers an extensive area dominated by fractured and weathered sedimentary rocks supporting local to large scale aquifers where discharges are typically less than 5km from the recharge zones (Tickell, 2008). Recharge mechanisms in the McArthur Basin fractured rock aquifers have not been investigated; however, they are considered to be lower than that of the limestone/carbonate aquifers (URS, 2010) in the region which receive seasonal recharge between 0mm and 300mm at an average of 90mm (Jolly, 2002). The Tindall Limestone aquifer to the south of the Roper River has a mean annual recharge estimated at between 5mm and 20 mm with the most likely long term mean annual recharge between 10mm and 15mm (Jolly *et al.*, 2004).

The Kilkarindji Volcanic Group, which comprises basalts, minor quartz, sandstones, siltstone, sedimentary breccia limestone and chert are the main lithological units (URS, 2010) at Sherwin Creek. The main aquifer in this region is found within sandstone units (Bukalorkmi Sandstones) with some minor water bodies in the fractured basalt (URS, 2010).

Ground water levels, within the vicinity of the proposed new open pit at Deposit C, are on average deeper than 25m below surface (Table 2). It is anticipated that ground water was encountered at depths deeper than the ground water level in a semi-confined to confined flow regime typical of fractured rock aquifers and thus the current ground water levels represents a piezometric head.

**Table 2: Ground Water Levels (Exploration Bores, Deposit C).**

| Exploration Hole ID | Depth (mBGL) | RL (mAHD) | GWL (mAHD) |
|---------------------|--------------|-----------|------------|
| RR00368             | 13.0         | 156.6     | 143.5      |
| RR00369             | 11.5         | 150.1     | 138.6      |
| RR00374             | 10.5         | 140.6     | 130.0      |
| RR00375             | 15.5         | 174.2     | 158.6      |
| RR00377             | 20.0         | 171.5     | 151.4      |
| RR00378             | 31.0         | 162.4     | 131.4      |
| RR00379             | 32.5         | 164.6     | 132.1      |
| RR00380             | 11.5         | 155.5     | 143.9      |
| RR00381             | 20.5         | 164.7     | 144.2      |
| RR00382             | 15.0         | 164.6     | 149.5      |
| RR00385             | 29.5         | 152.7     | 123.2      |
| RR00386             | 30.0         | 153.3     | 123.3      |
| RR00388             | 19.5         | 153.4     | 133.8      |
| RR00392             | 5.5          | 153.0     | 147.4      |
| RR00396             | 5.0          | 154.5     | 149.4      |
| RR00397             | 6.0          | 154.5     | 148.5      |
| RR00398             | 6.0          | 155.7     | 149.7      |
| RR00419             | 19.5         | 154.5     | 134.9      |
| RR00420             | 26.0         | 165.7     | 139.6      |
| RR00421             | 37.5         | 153.7     | 116.2      |
| RR00422             | 34.5         | 145.0     | 110.5      |
| RR00425             | 37.5         | 142.6     | 105.1      |
| RR00426             | 36.5         | 149.4     | 112.8      |
| RR00427             | 26.5         | 148.7     | 122.2      |
| RR00429             | 25.0         | 165.5     | 140.5      |
| RR00430             | 37.5         | 168.3     | 130.7      |
| RR00432             | 40.0         | 144.5     | 104.5      |
| RR00433             | 30.5         | 147.3     | 116.7      |
| RR00434             | 28.5         | 146.8     | 118.2      |

| Exploration Hole ID | Depth (mBGL) | RL (mAHD) | GWL (mAHD) |
|---------------------|--------------|-----------|------------|
| RR00435             | 27.5         | 146.6     | 119.0      |
| RR00439             | 28.5         | 161.8     | 133.3      |
| RR00440             | 30.5         | 159.4     | 128.8      |
| RR00441             | 29.5         | 154.8     | 125.3      |
| RR00443             | 29.5         | 144.4     | 114.9      |
| RR00444             | 17.5         | 136.1     | 118.5      |
| RR00445             | 20.5         | 143.8     | 123.3      |
| RR00446             | 37.0         | 153.2     | 116.1      |
| RR00447             | 33.5         | 139.7     | 106.1      |
| RR00451             | 40.5         | 126.2     | 85.6       |
| RR00452             | 46.0         | 145.0     | 98.9       |
| RR00453             | 26.0         | 131.7     | 105.7      |
| Average             | 25.1         | 152.6     | 127.5      |
| Maximum             | 46.0         | 174.2     | 158.7      |
| Minimum             | 5.0          | 126.2     | 85.7       |

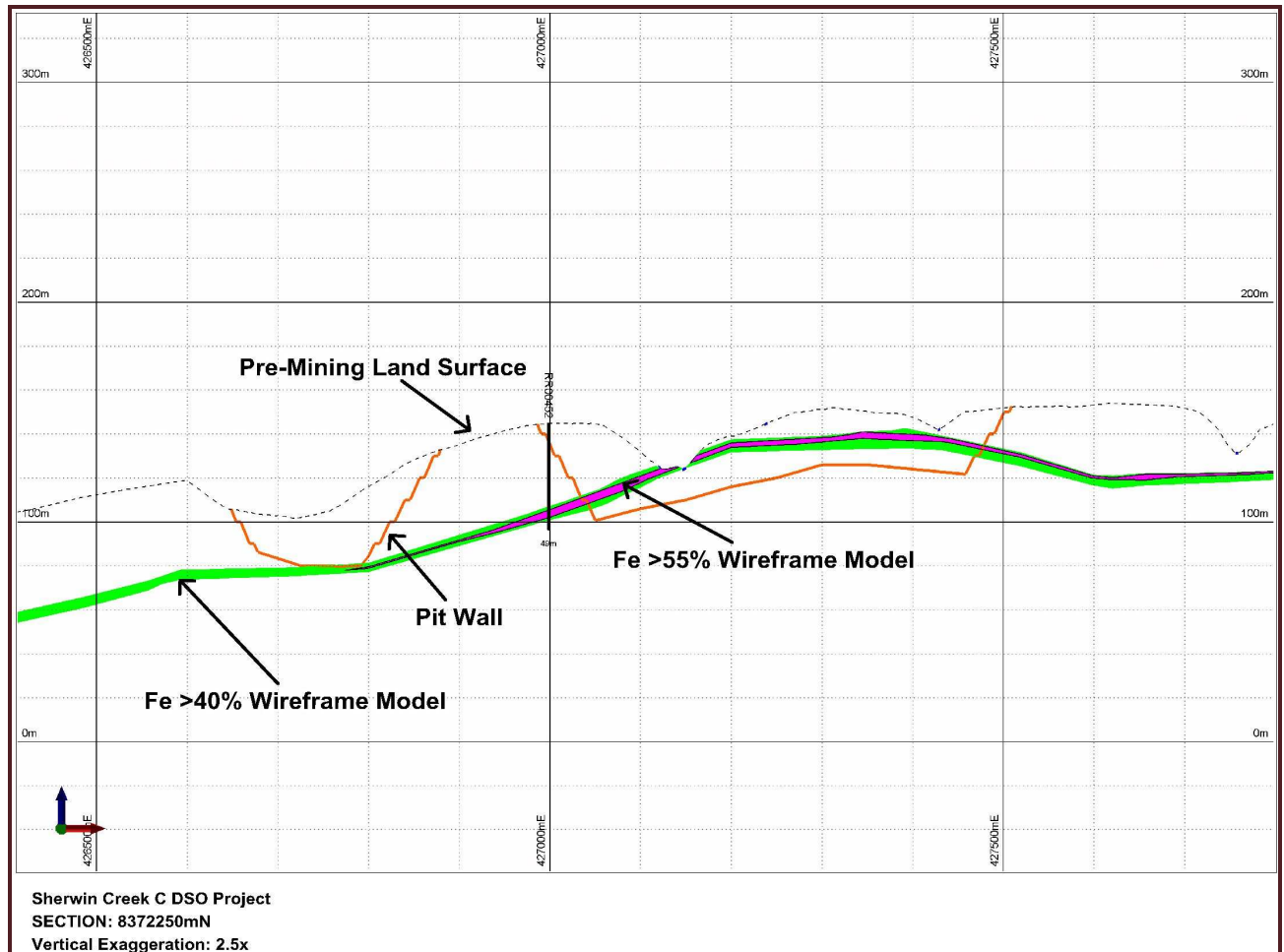


**Figure 7: Cross Section Open Pit Mining.**

Sherwin Iron Ltd intends commencing mining and crushing/screening operations of 1.5Mt during 2014 increasing to 3.0 Mtpa until scheduled completion in 2020.

Deposit C will be mined in stages, commencing in the south and moving north. Initially waste rocks will be placed on an external waste rock dump (WRD). As mining progresses, waste will be placed in the mine out sections of the open pit, minimising the total disturbance of operations.

## 2.7 Conceptual Model

The salient features of a conceptual model, based upon the physical characteristics of the site, coupled with earlier geological and hydrogeological descriptions of the area and observations during exploration at Deposit C, are:

- Ground water is below the floor of the open pit deeper than 40m below surface. As such ground water influx during mining is unlikely. The primary impact upon the underlying ground water resources pertain to infiltrating rain waters through the floor of the open pit (Figure 8).
- Within the mining area ground water yields are expected to be low and consequently the hydraulic parameters of the weathered and fractured sedimentary rocks would also be low. Fracture zones, which contain secondary porosity with little storage capacity for recharge, are expected to be shallow and thus possess little potential to host significant aquifer systems.
- Groundwater flow is likely to be towards the north-western side of the proposed open pit based upon the local and regional trends of the geological structure.

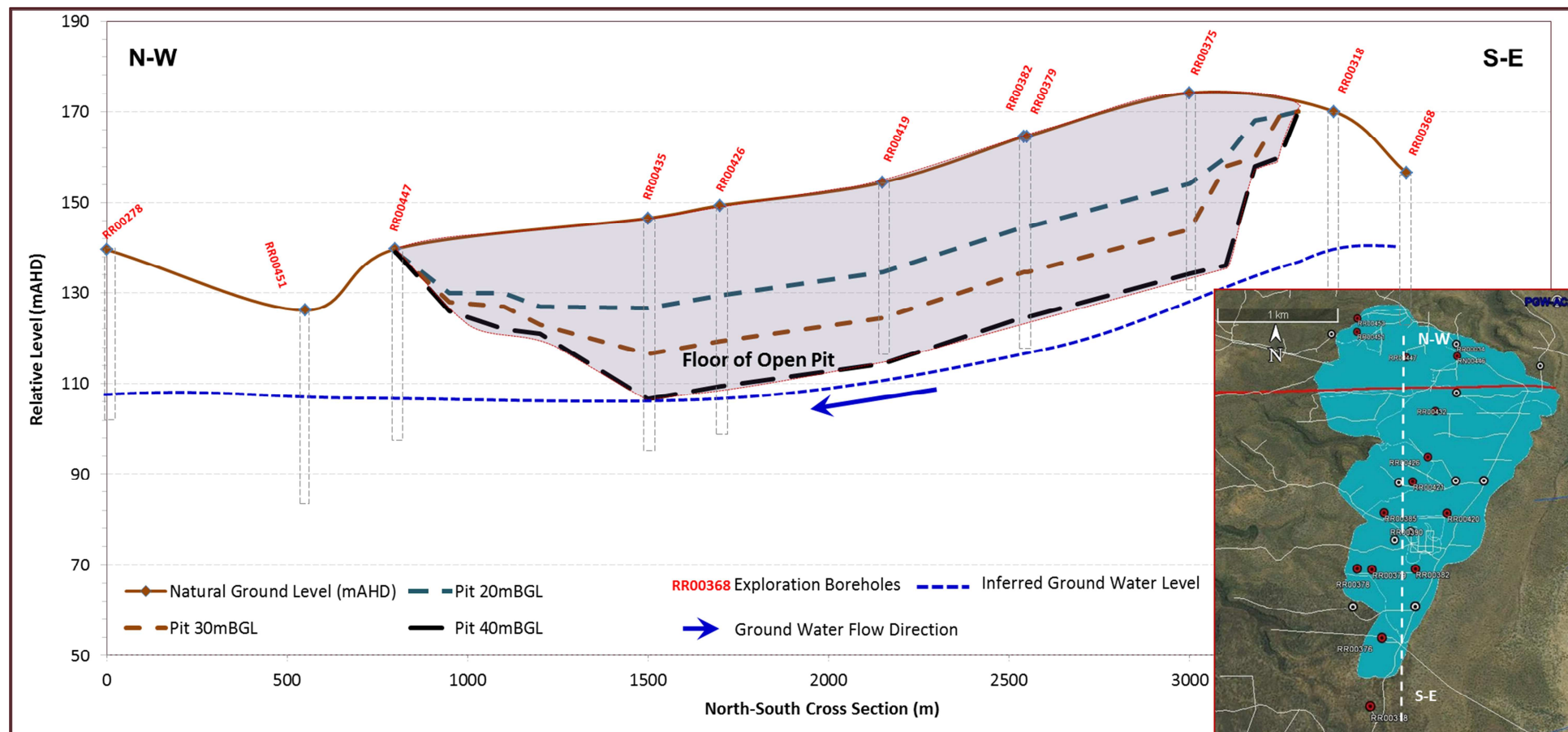


Figure 8: Conceptual Model.

### 3. Ground Water Investigation

In addition to a review of published information and exploration data, detailed ground water investigations and assessments included drilling, testing and sampling of bores to facilitate:

- Hydraulic and chemical characterization of the ground water regime at Deposit C with the view to validate the conceptual model, to quantify mine influx and the extent of the zone likely to be impacted upon by mining and processing, if any, and the potential of the aquifers to meet the water demand.
- A detailed assessment of potential impacts and risks to ground water.
- Monitoring during mining operations with the aim to ensure rehabilitation and closure is achieved with no residual impacts.

Bores were located in- and outside the proposed footprint of the mine to investigate and subsequently monitor potential impacts from mining and processing (Figure 9). The distribution of drilling locations around the site is considered suitable to gather representative data for a detailed assessment and to facilitate early detection of any adverse effects from mining on ground water resources. The monitoring data, along with responsive and sustainable management of operations, will help ensure that the local beneficial use of ground water is not compromised. The data obtained during this investigation provided useful baseline information prior to the commencement of construction and operations at the site and will assist in ascertaining the quantity and quality of the local groundwater regime, and most importantly, establish a benchmark for assessing any medium to long term trends and variability in ground water quality.

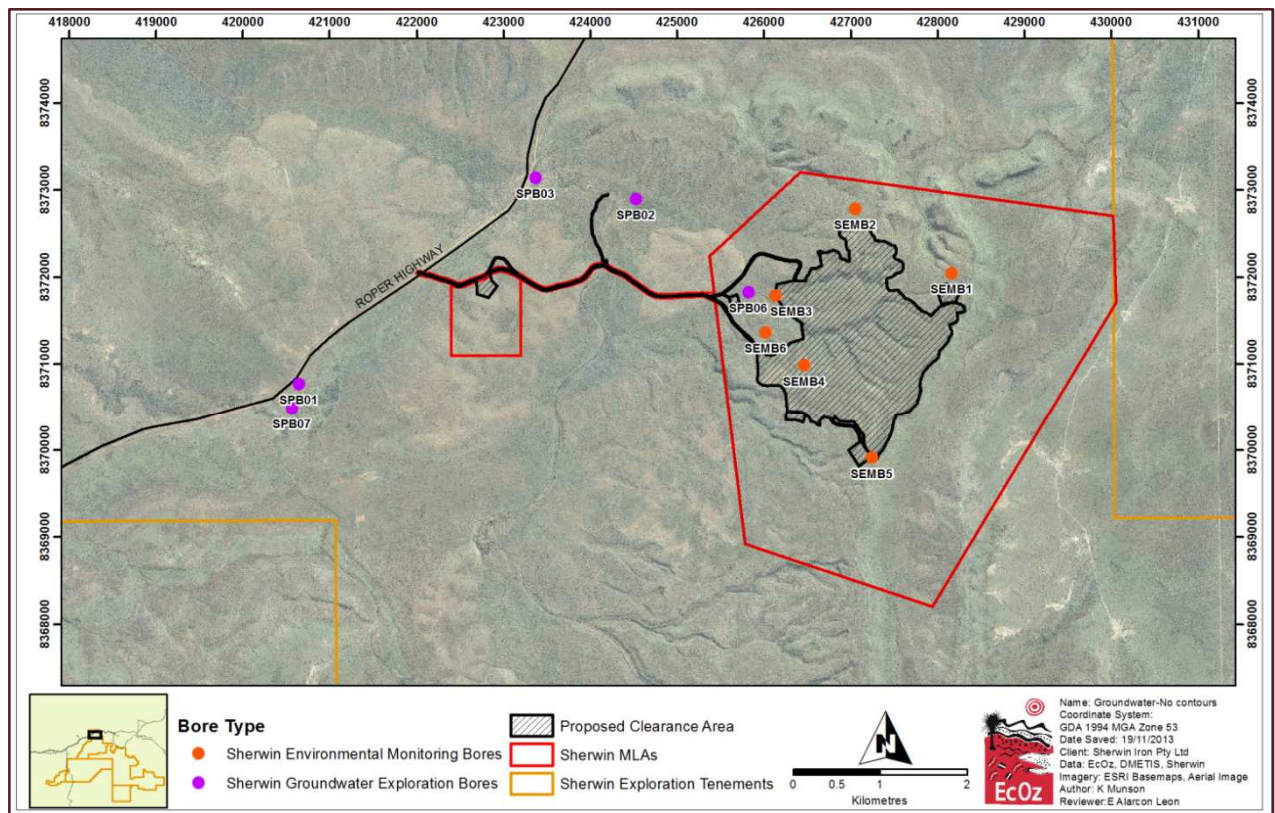


Figure 9: Bore Locations.

#### 3.1 Bore Drilling

The bores were constructed in accordance with the Minimum Construction Requirements for Water Bores in

Australia, 3<sup>rd</sup> Edition (National Water Commission, 2012).

The drilling program was supervised by an experienced hydrogeologist to direct bore drilling methodologies and advise on construction and materials such as the type, location and length of casings and screens and subsequent development to remove drilling muds and fines, to record observations and collect all relevant data and to prepare detailed bore construction logs (Appendix A). The information gathered included locations, photographs, descriptors of the underlying geology, the identification and depth of the various subsurface layers, water-bearing zones, ground water levels and field measurements of permeability and ground water quality.

The locations and elevations of the bores were accurately surveyed including the levels of standing water to ascertain the direction of ground water flow. The data gathered during drilling operations is summarized in Table 3 whilst detailed lithological descriptions and construction logs may be found in Appendices A and B. The bore test data and interpretations may be found in Appendix C.

The construction of the environmental monitoring bores (EMBs) employed RC adapted drilling equipment whilst the ground water exploration bores (GEBs) used an Atlas Rotemec 1302 water well drilling rig.

The drilling and construction of the EMBs included:

- The bores were drilled at 165mm diameter after which 150mm solid and slotted PVC casings were inserted.
- The annulus between the casing and bore wall was filled (gravel pack) with clean washed gravel (>3mm) followed by bentonite and concrete.
- All bores were completed with a concrete plinth (0.5m by 0.5m by 0.5m deep) and lockable cover to an elevation some 0.8m above ground level to prevent surface water entering the bore.
- Bores were developed subsequently by airlift until the water was clean and free of fines.

The drilling and construction of the GEBs included:

- The bores were drilled at 205mm diameter to an average depth of 6m for the installation of a solid steel collar. Drilling continued at 165mm after which 150mm solid and slotted steel casings were inserted.
- The annulus between the casing and bore wall was backfilled with clean drill cuttings followed by concrete.
- All bores were completed with a concrete plinth (0.5m radius and 0.5m deep) and lockable cover to an average of some 0.6m above ground level to prevent surface water entering the bore.
- Bores were developed subsequently by airlift until the water was clean and free of fines.

During drilling, samples of the drill cuttings were obtained at 3m intervals to prepare detailed descriptions of the lithology and bore construction logs. Changes in moisture content of the drill cuttings, penetration rates, depths at which ground water was encountered and ground water levels were observed and recorded (Appendix A).

## 3.2 Ground Water Strikes

Ground water was encountered between 9m and 65m below surface (Tables 3 and 4). The deepest water-bearing zones occur across the higher lying ground at the proposed open pit; the shallow water-bearing zones occur to the west across lower lying ground particularly at bores SPB02 and SPB03 (Figures 10 and 11). Shallow ground water occurrences are confined within surficial (up to 10m deep) sequences of regolith, alluvial and extremely weathered sandstones with interbedded siltstones. Below this alluvial system there is

**Table 3: Summary of Drilling Data.**

| Bore ID | Bore Location Details |         |          | Bore Construction |                                    |    |                      | Ground Water Measurements        |            |                |                | Airlift Yields | Notes                                                                       |
|---------|-----------------------|---------|----------|-------------------|------------------------------------|----|----------------------|----------------------------------|------------|----------------|----------------|----------------|-----------------------------------------------------------------------------|
|         | Zone                  | Easting | Northing | Depth of Bore     | Screen (mbgl)                      |    | Elevation (Nov 2013) | Depth to Water Strikes           | Height TOC | GWL (from TOC) | GWL (from TOC) |                |                                                                             |
|         |                       | mEast   | mNorth   | mbgl              | from                               | to | mAHD                 | mbgl                             | mAHD       | m              | mAHD           | L/s            |                                                                             |
| SEMB1   | 53L                   | 0428210 | 8372051  | 50                | 26                                 | 50 | 161.85               | 47                               | 162.69     | 50.07          | 112.62         | <0.01          | Shale underlying clay.                                                      |
| SEMB2   | 53L                   | 0427053 | 8372785  | 50                | 26                                 | 50 | 145.95               | 37                               | 146.80     | 36.60          | 110.20         | 0.20           | Fractured siltstones.                                                       |
| SEMB3   | 53L                   | 0426138 | 8371788  | 55                | 15.5                               | 50 | 72.06                | 16.5, 23                         | 73.08      | 4.33           | 68.75          | 1.33           | Fractures in Sherwin Ironstone.                                             |
| SEMB4   | 53L                   | 0426769 | 8370984  | 40                | 15.5                               | 40 | 139.91               | 23.5                             | 140.62     | 22.90          | 117.72         | 0.01           |                                                                             |
| SEMB5   | 53L                   | 0427246 | 8369913  | 50                | 26                                 | 50 | 173.14               | 43                               | 174.04     | 45.80          | 128.24         | <0.01          | Weathered clay.                                                             |
| SEMB6   | 53L                   | 0425985 | 8370537  | 55                | 19                                 | 55 | 99.00                | 25                               | 99.81      | 16.27          | 83.54          | 0.10           | Weathered sandstone.                                                        |
| SPB01   | 53L                   | 0420649 | 8370767  | 27                | 15                                 | 21 | 51.45                | 13 to 18                         | 52.17      | 9.57           | 42.60          | 0.45           | Alluvial conglomerates, grey siltstone and quartz.                          |
| SPB02   | 53L                   | 0424522 | 8372893  | 100               | 88                                 | 94 | 47.21                | 26, 34, 37, 51                   | 48.07      | 2.25           | 45.82          | 0.50           | Fractured iron rich sandstones, siltstones and shales.                      |
| SPB03   | 53L                   | 0423366 | 8373145  | 75                | 63                                 | 69 | 37.97                | 34.5, 48.5, 51, 67               | 38.65      | 0.50           | 38.15          | <0.01          |                                                                             |
| SPB06   | 53L                   | 0425830 | 8371827  | 75                | 63                                 | 69 | 63.14                | 25, 26, 40.5, 43.5, 53.5, 61, 67 | 63.74      | 3.46           | 60.28          | 0.22           |                                                                             |
| SPB07   | 53L                   | 0420495 | 8370476  | 75                | Two sets (21 to 27) and (45 to 51) |    | 49.30                | 9, 15                            | 49.79      | 6.50           | 43.29          | 1.0            | Alluvial conglomerates overlying highly weathered and fractured sandstones. |

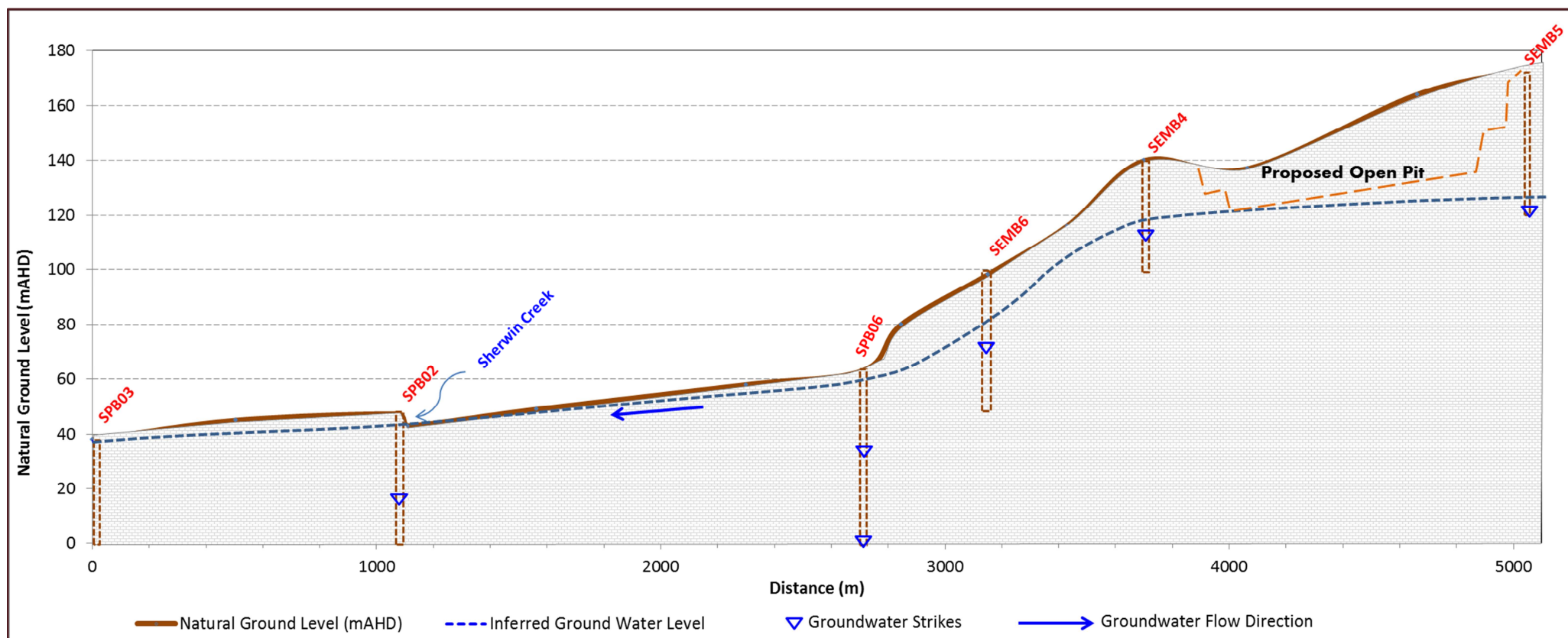


Figure 10: Cross Section SPB03 - SEMB5.

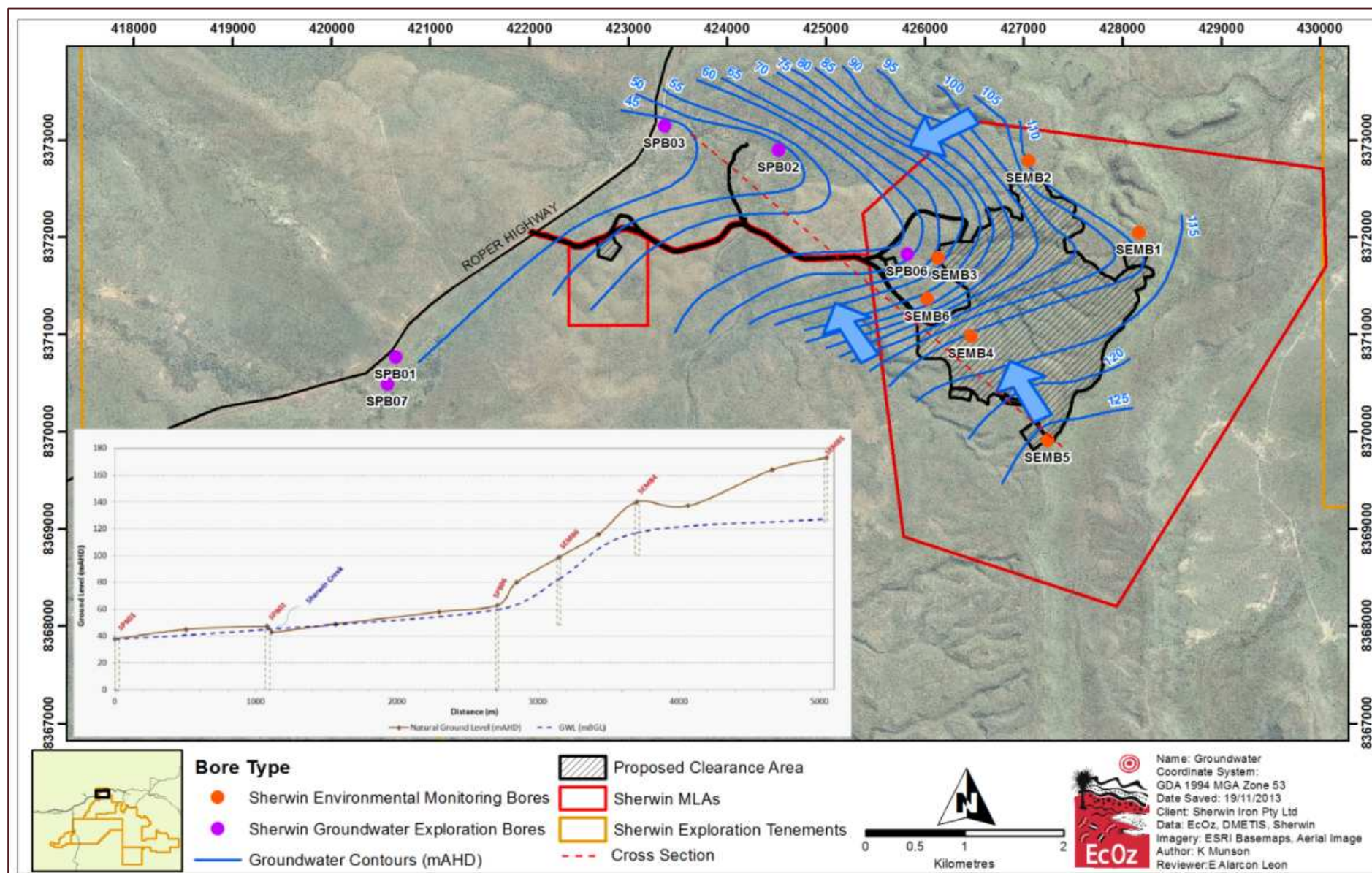


Figure 11: Ground Water Contours.

a distinct separation and confining layer, overlying the deep aquifer system, comprising slightly to unweathered, bluish siltstone with fine grained sandstone extending on average to 20m below surface. Underlying this confining layer is a sequence of interlayered and fractured siltstones, sandstones, shales and localised mudstones in which ground water is encountered between about 20m and 70m below surface. The main aquifer zone is confined to the iron rich weathered sandstones at about 45m below surface. Underlying the aquifer is a substantial and thick sequence of siltstones overlying a very hard bluish sequence of dolerite.

### 3.3 Ground Water Levels

Ground water levels in the east-south-east of the site are deep. Shallow, almost at the surface, ground water levels occur in the west-north-west, particularly near bores SPB03 and SPB02 (Figures 10 and 11). The shallow ground water levels appear to be perched in alluvial conglomerates fed by drainage from higher lying ground. Hydraulic heads suggest that ground water drains in a westerly direction (Figures 10 and 11). Ground water level fluctuations have not been ascertained yet; the ground water monitoring program aims at determining the extent of seasonal variability and the lag between recharge (rainfall) and ground water level responses. Nevertheless, visual and topographical observations and assessments to date suggest that ground water will drain slowly, imitating local and regional topography, in a semi-confined to confined fractured flow regime with secondary porosity receiving little recharge across higher lying ground.

### 3.4 Bore/Aquifer Testing

#### 3.4.1 Hydraulic Properties

Bore testing was undertaken by means of slug and pump testing in order to calculate the hydraulic parameters of the aquifers. Testing entails pumping water out or injecting water (slug) into a bore whilst the water level drawdown or rise is measured. This information is inserted into models employing ground water flow equations to calculate the key hydraulic parameters, including hydraulic conductivity (K) and transmissivity (T-values).

Bore test data (Appendix C) was interpreted and assessed using Aquifer Test 2013.1 Software which employs traditional analytical solutions and techniques such as Theis, Hantush, Neuman, Boulton, etc. (Appendix C).

Calculated K and T values are tabulated in Table 4. The hydraulic properties seem to express two distinctive ground water systems occurring across Deposit C.

Specific observations are:

- In general, hydraulic conductivities range from a minimum of  $9.1\text{E-}4\text{m/d}$  to a maximum of  $4.4\text{E-}2\text{m/d}$ . The highest conductivity was observed at bore SEMB3 indicating the presence of a significant fracture which seems to be localised.
- Hydraulic conductivities by slug testing in the SEMB and SPB bores range between  $7.2\text{E-}8\text{m/d}$  and  $1.02\text{E-}4\text{m/d}$ .
- Hydraulic conductivity at bore SPB07, located about 2,800m south-west of the camp site is  $7.4\text{E-}1\text{m/d}$  in a shallow ground water system within alluvial and highly weathered sediments. In contrast, bores SPB02 and SPB03, in shallow layered alluvial sediments, have very low conductivities in the order of  $9.1\text{E-}4\text{m/d}$ .

Values for hydraulic conductivities and transmissivities (Table 4) are generally low indicating that the sedimentary basin is relatively impervious and heterogenous, storing and transmitting relatively small quantities of water. However, where fracture systems prevail at depth, albeit localised, ground water flows

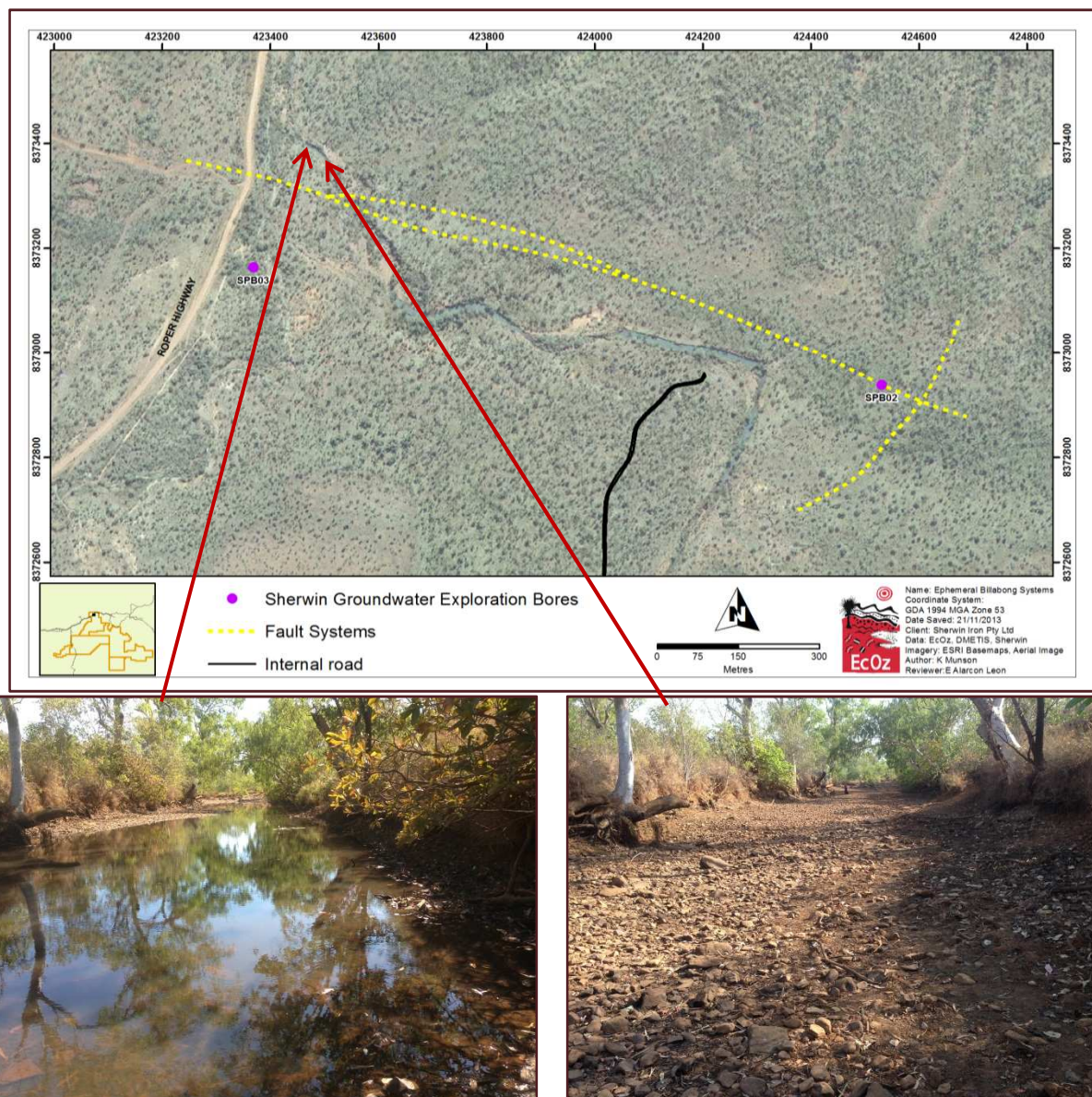
Table 4: Hydraulic Parameters.

| Pump Testing                                                |                                                                                                                                                                       |                                                        |                       |                   |                             |                             |                               |                                               |                 |                                                                                            |                   |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------|-------------------|-----------------------------|-----------------------------|-------------------------------|-----------------------------------------------|-----------------|--------------------------------------------------------------------------------------------|-------------------|
|                                                             | Hydraulic conductivity (K)                                                                                                                                            |                                                        |                       | Average K         | Transmissivity (T)          |                             |                               | Average T                                     | Storativity (S) |                                                                                            | Aquifer Thickness |
|                                                             | Boulton                                                                                                                                                               | Hantush                                                | Papadopoulos & Cooper |                   | Boulton                     | Hantush                     | Papadopoulos & Cooper         |                                               | Hantush         | Papadopoulos & Cooper                                                                      |                   |
|                                                             | m/s                                                                                                                                                                   |                                                        |                       |                   | m²/s                        |                             |                               |                                               | [-]             |                                                                                            |                   |
| SEMB3                                                       | 6.00E-02                                                                                                                                                              | 2.01E-02                                               | 5.71E-02              | 4.57E-02          | 8.40E-01                    | 2.81E-01                    | 2.81E-01                      | 4.67E-01                                      | 3.70E-02        | 2.28E-07                                                                                   | 40.5              |
| SPB01                                                       | Will be tested during the next stage of geophysical survey, drilling and pump testing. However this borehole is located at the same system at which SPB07 is located. |                                                        |                       |                   |                             |                             |                               |                                               |                 |                                                                                            |                   |
| SPB02                                                       | 1.58E-08                                                                                                                                                              | 1.20E-08                                               | 3.70E-09              | 1.05E-08          | 1.20E-06                    | 1.20E-06                    | 2.81E-07                      | 8.94E-07                                      | 3.83E-03        | 1.00E-07                                                                                   | 30                |
| SPB03                                                       | Not Tested. Was going to be decommissioned but it was adapted as a monitoring bore. Airlift yield was extremely low <0.01L/s.                                         |                                                        |                       |                   |                             |                             |                               |                                               |                 |                                                                                            | 30                |
| SPB07                                                       | 1.64E-06                                                                                                                                                              | 1.38E-05                                               | 1.04E-05              | 8.60E-06          | 1.97E-05                    | 1.65E-04                    | 1.25E-05                      | 6.57E-05                                      | 5.06E-03        | 9.90E-01                                                                                   | 12                |
| Slug Testing                                                |                                                                                                                                                                       |                                                        |                       |                   |                             |                             |                               |                                               |                 |                                                                                            |                   |
| Bore ID                                                     | K                                                                                                                                                                     |                                                        |                       | Average K         | Aquifer Thickness           | T                           |                               |                                               | Average T       |                                                                                            |                   |
|                                                             | Hvorslev                                                                                                                                                              | Bouwer and Rice                                        | Copper and Jacobs     |                   |                             | Hvorslev                    | Bouwer and Rice               | Copper and Jacobs                             |                 |                                                                                            |                   |
|                                                             | m/s                                                                                                                                                                   |                                                        |                       |                   |                             | m                           | m²/s                          |                                               |                 |                                                                                            |                   |
| SEMB1                                                       |                                                                                                                                                                       |                                                        | 1.085E-06             | 1.08E-06          | 27.0                        |                             |                               | 2.928E-05                                     | 2.93E-05        |                                                                                            |                   |
| SEMB2                                                       |                                                                                                                                                                       |                                                        | 1.308E-05             | 1.31E-05          | 29.0                        |                             |                               | 3.793E-04                                     | 3.79E-04        |                                                                                            |                   |
| SEMB4                                                       | 8.04E-08                                                                                                                                                              | 6.35E-08                                               |                       | 7.20E-08          | 27.0                        | 2.17E-06                    | 1.71E-06                      |                                               | 1.94E-06        |                                                                                            |                   |
| SEMB5                                                       | 6.59E-09                                                                                                                                                              | 5.20E-09                                               | 3.568E-06             | 1.19E-06          | 27.0                        | 1.78E-07                    | 1.40E-07                      | 9.633E-05                                     | 3.22E-05        |                                                                                            |                   |
| SEMB6                                                       | 1.89E-07                                                                                                                                                              | 3.00E-08                                               | 9.157E-07             | 3.78E-07          | 39.0                        | 7.37E-06                    | 1.17E-06                      | 3.571E-05                                     | 1.48E-05        |                                                                                            |                   |
| SPB06                                                       | 1.20E-04                                                                                                                                                              | 8.31E-05                                               |                       | 1.02E-04          | 50.0                        | 6.00E-03                    | 4.16E-03                      |                                               | 5.08E-03        |                                                                                            |                   |
| FC Method: Estimation of the Sustainable Yield of Key Bores |                                                                                                                                                                       |                                                        |                       |                   |                             |                             |                               |                                               |                 |                                                                                            |                   |
|                                                             |                                                                                                                                                                       | Maximum influence of boundaries at long time (Q = L/s) |                       |                   |                             |                             |                               |                                               |                 |                                                                                            |                   |
| Bore Id                                                     | Pump Test Flow (L/s)                                                                                                                                                  | No boundaries (Infinite Homogeneous Aquifer)           | No-flow (Best Case)   | No-flow (Average) | Closed no-flow (Worst Case) | Average Q Sustainable (L/s) | With Standard Deviation (L/s) | Recommended Abstraction Rate (m³/y) - 24h/day | Assumptions     |                                                                                            |                   |
| SEMB3                                                       | 1.0                                                                                                                                                                   | 1.08                                                   | 1.00                  | 0.76              | 0.41                        | 0.81                        | 0.59                          | 25,777                                        |                 |                                                                                            |                   |
| SPB07                                                       | 0.8                                                                                                                                                                   | 0.20                                                   | 0.11                  | 0.07              | 0.04                        | 0.11                        | 0.09                          | 3,490                                         |                 |                                                                                            |                   |
|                                                             |                                                                                                                                                                       |                                                        |                       |                   |                             |                             |                               |                                               |                 | Infiltration 3% = 24mm/year; fracture sedimentary stratification (sandstones/siltstones)   |                   |
|                                                             |                                                                                                                                                                       |                                                        |                       |                   |                             |                             |                               |                                               |                 | Infiltration 10% = 81.5mm/year; alluvial groundwater system (conglomerates and fine sands) |                   |

are larger.

On the basis of these observations, the aquifer systems underlying the proposed open pit is characterised by:

- A permeable and ephemeral shallow system. The pedological column, particularly at the north-western end of Deposit C, contains some lenses of fresh ground water trapped locally in silty-clays overlying extremely weathered sandstone (~6m thick). These conditions do not extend across the footprint of the proposed open pit and are highly localised within the alluvial-debris fans located at the outlets of numerous small creek channels and gullies. The vertical extent of these lenses ranges from 10m to about 18m below surface. Thicker stratifications may be found around bores SPB02 and SPB03 which form a localised perched water system that seasonally discharge into the billabongs (Figure 12).



Photograph: 28 August 2013.

Photograph: 8 October 2013.

**Figure 12: Billabongs at Bores SPB02 and SPB03.**

- Underlying the shallow system, separated by a confining layer of siltstone and mudrocks, there is a sequence of interlayered siltstones, sandstones, shales and localised mudstones in which ground water is encountered. This deeper aquifer system is characteristic of the footprint of the proposed open pit and extends to the north and south across higher lying ground.

The above observations and assessments indicate that mining to about 40m below surface would not interfere with the deeper fractured aquifers.

### 3.4.2 Sustainable Ground Water Yields

Observations indicate that recoveries of the highest yielding bores were in the order of 75%. The highest rates of recoveries were observed in bores SPB01, SPB06, SPB07 and SEMB3. The sustainability of the ground water yields in bores SPB07 and SEMB3 were assessed using the FC-Method which is commonly used to evaluate the sustainable yield of a borehole by using derivatives, boundary information and error propagation (van Tonder, *et al* 2001).

Assumptions made during the assessment pertain to recharge and given the aquifer characteristics, recharge was conservatively set at 3% of the mean annual precipitation across the proposed open pit and 10% within the lower lying areas where conglomerate alluvial gravels occur near the surface.

The calculated average sustainable yields (Q, L/s) for bores SEMB3 and SPB07 are 0.8L/s and 0.1L/s respectively. Recommended abstraction rates equate to 25ML/yr for bore SEMB3 and 3.5ML/yr. for bore SPB07 (Tables 4 and 5).

**Table 5: Pump Test Flow Rates, Recovery and Calculated Sustainable Yields.**

| Bore ID                                                                                                                                                                                                                                                                  | Airlift Flow Rate (L/s) | Pump Flow Rate (L/s) | Recovery (%) | Medium Term Sustainable Yield (L/s) | Long Term Sustainable Yield (FC Method) (L/s) |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------|--------------|-------------------------------------|-----------------------------------------------|
| SEMB1                                                                                                                                                                                                                                                                    | <0.01                   | Slug Tests           | -            | -                                   | No Calculations                               |
| SEMB2                                                                                                                                                                                                                                                                    | 0.20                    |                      | 50           | 0.10                                |                                               |
| SEMB3                                                                                                                                                                                                                                                                    | 1.3                     | 1.0                  | 75           | 0.90                                | 0.81                                          |
| SEMB4                                                                                                                                                                                                                                                                    | 0.10                    | Slug Tests           | 50           | -                                   | No Calculations                               |
| SEMB5                                                                                                                                                                                                                                                                    | <0.01                   |                      | -            | -                                   |                                               |
| SEMB6                                                                                                                                                                                                                                                                    | 0.10                    |                      | 75           | 0.10                                |                                               |
| SPB01                                                                                                                                                                                                                                                                    | 0.45                    | No Test              | 97           | 0.40                                |                                               |
| SPB02                                                                                                                                                                                                                                                                    | 0.50                    | 0.3                  | 50           | 0.10                                |                                               |
| SPB03                                                                                                                                                                                                                                                                    | <0.1L/s                 | No Test              | 50           | -                                   |                                               |
| SPB06                                                                                                                                                                                                                                                                    | 0.22                    | Slug Test            | 90           | 0.20                                |                                               |
| SPB07                                                                                                                                                                                                                                                                    | 1.0                     | 0.8                  | 97           | 0.65                                | 0.11                                          |
| The medium term sustainable yield is the rate of abstraction for an average of 12 hours per day for a period less than 6 months whilst the long term sustainable yield is the rate of abstraction for an average of 12 hours per day for a period greater than 6 months. |                         |                      |              |                                     |                                               |

### 3.5 Groundwater Dependant Ecosystems (GDEs)

Ground water dependant ecosystems are ecosystems which have their species composition and their natural ecological processes determined by ground water (ARMCANZ and ANZECC, 1996). This also refers to ecosystems that may vary in the degree of their dependency on ground water, from having no apparent dependency through to being entirely dependent on it.

Field observations indicate an ephemeral surface water regime in which streams dry out completely each year early in the dry season (Figure 12). The area is relatively flat (~44mAHD) but bound to the north by elevated ground (up to about 130mAHD). Within the area there appears to be a fault zone striking east-west (Figure 12) which is covered by relatively thin alluvial regolith materials which in turn overly interbedded sequences of highly weathered sandstone and siltstones (Figure 13) and a layer of extremely weathered yellow saturated claystone about ~3.0m thick. This layer is likely to be the main source of water for vegetation around the billabongs. Seasonal recharge into this perched water system is most likely to occur by runoff and underflow from the nearby elevated ground to the north.

Surface water features, including the billabongs, as evidenced by the photographs in Figure 12, are highly dependent on rainfall-runoff during the wet season with little or no flow during the dry season when vegetation relies on the underlying shallow perched ground water system. In general, ground water levels, albeit shallow and perched, remain primarily below the level of the streambed (Figure 13).

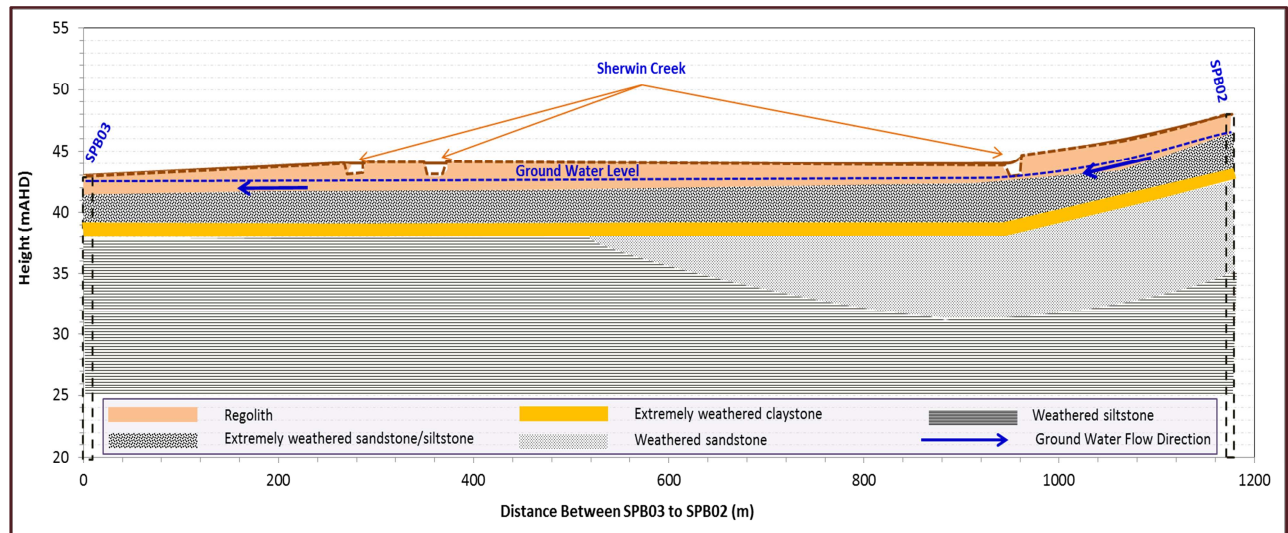


**Figure 13: Cross Section SPB03 - SPB02.**

Open pit mining will not impact on the shallow, perched ground water system and/or the billabongs and GDEs as this system is well below the pit and absent at the pit itself.

## 3.6 Ground Water Quality

### 3.6.1 Ground Water Quality

The pH of ground water is generally circumneutral to slightly alkaline ranging from 5.84 to 8.99. The lowest pH was recorded in bore SEMB2, which is located to the north of the proposed open pit. Ground waters from bores SEMB3, SEMB6, SPB07 have circumneutral pHs whilst the waters from bores SPB01, SPB02 and SPB06 have an average pH greater than 8.6. Electrical conductivities (EC) range between 98 $\mu$ S/cm and 1,110 $\mu$ S/cm averaging 464 $\mu$ S/cm (Table 6 and Appendix D). The highest EC was recorded in a sample from bore SPB01 whilst the lowest was in a sample from bore SEMB02.

Most of the ground waters do not have large concentrations of major anions and cations. Only water from bore SPB03 has elevated concentrations of chloride (108mg/L) and sodium (178mg/L) indicating slight salinity (Table 6). Most of the trace elements are well below their assessment levels for drinking water (NHMRC/NRMMC 2011, Table 6). However arsenic in SEMB6 and SPB02, manganese in all samples, nickel in SPB02 and SPB06, lead and zinc in SEMB03 and SPB07 are somewhat elevated and may exceed their assessment levels marginally.

No significant variability in water quality was observed during the pump tests: pH and other key analytes such as TDS and EC remained unchanged over the duration of the test.

### 3.6.2 Physical and Chemical Assessment

Ground water, on the basis of concentrations of calcium and magnesium, can be classified as ranging from very soft to very hard (Table 7).

Table 6: Ground Water Quality.

| Sherwin Mine Ground Water Quality           |         |      | Assessment Levels   |                     | Sample Type: Ground Water |         |         |         |         |        |       |        |       |        |        |
|---------------------------------------------|---------|------|---------------------|---------------------|---------------------------|---------|---------|---------|---------|--------|-------|--------|-------|--------|--------|
|                                             |         |      | NHMR/NRMMC          | ANZECC              | Sampling Date: Year 2013  |         |         |         |         |        |       |        |       |        |        |
|                                             |         |      | (2011) <sup>1</sup> | (2000) <sup>2</sup> | 6-Sep                     | 30-Aug  | 27-Oct  | 27-Oct  | 27-Oct  | 12-Sep | 9-Nov | 15-Oct | 7-Nov | 12-Oct | 25-Oct |
| Analyte                                     | Unit    | LOR  |                     | 95% <sup>3</sup>    | SEMB02                    | SEMB03a | SEMB03b | SEMB03c | SEMB03d | SEMB06 | SPB01 | SPB02  | SPB03 | SPB06  | SPB07  |
| <b>Field Measurement</b>                    |         |      |                     |                     |                           |         |         |         |         |        |       |        |       |        |        |
| pH Value                                    | pH Unit |      |                     |                     | 5.84                      | 7.39    |         |         |         | 6.74   | 8.25  | 8.99   | 8.58  | 8.32   | 6.50   |
| Electrical Conductivity                     | µS/cm   |      |                     |                     | 98                        | 311.2   |         |         |         | 220.6  |       | 446    | 1880  | 339.1  |        |
| Total Dissolved Solids                      | mg/L    |      |                     |                     | 63.8                      | 202.3   |         |         |         | 141.8  |       |        |       |        |        |
| Salinity                                    | ppt     |      |                     |                     | 0.1                       | 0.1     |         |         |         | 0.1    | 0.54  | 0.2    | 0.94  | 0.23   | 0.3    |
| Dissolved Oxygen                            | %       |      |                     |                     | 98.5                      | 87      |         |         |         | 65     |       | 72.9   |       | 76.1   |        |
| Temperature                                 | °C      |      |                     |                     | 27.8                      | 30.2    |         |         |         | 30.2   |       | 33.5   |       | 30.5   |        |
| <b>Laboratory Measurement</b>               |         |      |                     |                     |                           |         |         |         |         |        |       |        |       |        |        |
| pH Value                                    | pH Unit | 0.01 |                     | 6.0-8.5             | 5.84                      | 7.39    | 7.02    | 6.97    | 7.01    | 6.74   | 8.27  | 8.02   | 9.12  | 8.1    | 7.66   |
| Electrical Conductivity @ 25°C              | µS/cm   | 1    |                     | 10000               | 98                        | 311.2   | 387     | 342     | 347     | 220.6  | 1110  | 336    | 896   | 339    | 714    |
| Total Dissolved Solids (Calc.)              | mg/L    | 1    |                     | 100                 | 638                       | 223     | 252     | 222     | 226     | 141.8  | 722   | 218    | 582   | 220    | 464    |
| Total Hardness as CaCO <sub>3</sub>         | mg/L    | 1    |                     |                     | 4                         | 133     | 115     | 114     | 113     | 87     | 386   | 50     | <1    | 105    | 204    |
| <b>Alkalinity</b>                           |         |      |                     |                     |                           |         |         |         |         |        |       |        |       |        |        |
| Hydroxide Alkalinity as CaCO <sub>3</sub>   | mg/L    | 1    |                     |                     | <1                        | <1      | <1      | <1      | <1      | <1     | <1    | <1     | <1    | <1     | <1     |
| Carbonate Alkalinity as CaCO <sub>3</sub>   | mg/L    | 1    |                     |                     | <1                        | <1      | <1      | <1      | <1      | <1     | <1    | <1     | 57    | <1     | <1     |
| Bicarbonate Alkalinity as CaCO <sub>3</sub> | mg/L    | 1    |                     |                     | 1                         | 105     | 142     | 116     | 117     | 85     | 459   | 107    | 173   | 112    | 298    |
| Total Alkalinity as CaCO <sub>3</sub>       | mg/L    | 1    |                     |                     | 1                         | 105     | 142     | 116     | 117     | 85     | 459   | 107    | 230   | 112    | 298    |
| <b>Anions</b>                               |         |      |                     |                     |                           |         |         |         |         |        |       |        |       |        |        |
| Acidity as CaCO <sub>3</sub>                | mg/L    | 1    |                     |                     |                           |         | 79      | 52      | 54      |        | 11    | 5      | <1    | <1     | 31     |
| Sulfate as SO <sub>4</sub> - Turbidimetric  | mg/L    | 1    |                     | 400                 | 4                         | 7       | 5       | 6       | 6       | 3      | 4     | 9      | 7     | 3      | 3      |
| Chloride                                    | mg/L    | 1    | 250                 | 400                 | 21                        | 24      | 27      | 28      | 28      | 13     | 52    | 24     | 108   | 29     | 38     |
| <b>Cations</b>                              |         |      |                     |                     |                           |         |         |         |         |        |       |        |       |        |        |
| Calcium                                     | mg/L    | 1    |                     |                     | <1                        | 2       | 5       | 3       | 4       | 2      | 54    | 5      | <1    | 4      | 34     |
| Magnesium                                   | mg/L    | 1    |                     |                     | 1                         | 31      | 25      | 26      | 25      | 20     | 61    | 9      | <1    | 23     | 29     |
| Sodium                                      | mg/L    | 1    |                     | 300                 | 16                        | 15      | 14      | 15      | 15      | 10     | 82    | 49     | 178   | 17     | 64     |

| Sherwin Mine Ground Water Quality |      |        | Assessment Levels |                  | Sample Type: Ground Water |                     |         |         |         |         |         |         |         |         |        |
|-----------------------------------|------|--------|-------------------|------------------|---------------------------|---------------------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
|                                   |      |        | NHMRC/NRMMC       | ANZECC           | Sampling Date: Year 2013  |                     |         |         |         |         |         |         |         |         |        |
|                                   |      |        |                   |                  | (2011) <sup>1</sup>       | (2000) <sup>2</sup> | 6-Sep   | 30-Aug  | 27-Oct  | 27-Oct  | 27-Oct  | 12-Sep  | 9-Nov   | 15-Oct  | 7-Nov  |
| Analyte                           | Unit | LOR    |                   | 95% <sup>3</sup> | SEMB02                    | SEMB03a             | SEMB03b | SEMB03c | SEMB03d | SEMB06  | SPB01   | SPB02   | SPB03   | SPB06   | SPB07  |
| Potassium                         | mg/L | 1      |                   |                  | 2                         | 2                   | 1       | 1       | 1       | 7       | 4       | 6       | 3       | 4       | 3      |
| Dissolved Metals                  |      |        |                   |                  |                           |                     |         |         |         |         |         |         |         |         |        |
| Arsenic                           | mg/L | 0.001  |                   |                  | <0.001                    | 0.001               | 0.002   | 0.001   | 0.002   | 0.002   | <0.001  | <0.001  | 0.001   | <0.001  | <0.001 |
| Boron                             | mg/L | 0.05   |                   |                  | <0.05                     | 0.09                | 0.11    | 0.11    | 0.11    | <0.05   | 0.13    | 0.12    | 0.5     | 0.09    | 0.09   |
| Barium                            | mg/L | 0.001  |                   |                  | 0.004                     | 0.006               | 0.01    | 0.008   | 0.008   | 0.018   | 0.012   | 0.007   | 0.002   | 0.008   | 0.013  |
| Beryllium                         | mg/L | 0.001  |                   |                  | <0.001                    | <0.001              | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001 |
| Cadmium                           | mg/L | 0.0001 |                   |                  | <0.0001                   | <0.0001             | 0.0004  | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 |
| Cobalt                            | mg/L | 0.001  |                   |                  | 0.003                     | 0.001               | <0.001  | <0.001  | <0.001  | 0.001   | 0.001   | <0.001  | <0.001  | <0.001  | <0.001 |
| Chromium                          | mg/L | 0.001  |                   |                  | <0.001                    | <0.001              | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001 |
| Copper                            | mg/L | 0.001  |                   |                  | <0.001                    | <0.001              | <0.001  | <0.001  | <0.001  | <0.001  | 0.001   | 0.006   | <0.001  | 0.002   | <0.001 |
| Manganese                         | mg/L | 0.001  |                   |                  | 0.18                      | 0.099               | 0.153   | 0.129   | 0.135   | 0.457   | 0.137   | 0.099   | 0.013   | 0.089   | 0.462  |
| Nickel                            | mg/L | 0.001  |                   |                  | 0.001                     | <0.001              | 0.001   | <0.001  | <0.001  | 0.002   | 0.007   | 0.004   | <0.001  | 0.002   | <0.001 |
| Lead                              | mg/L | 0.001  |                   |                  | <0.001                    | <0.001              | 0.002   | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001  | <0.001 |
| Selenium                          | mg/L | 0.01   |                   |                  | <0.01                     | <0.01               | <0.01   | <0.01   | <0.01   | <0.01   | <0.01   | <0.01   | <0.01   | <0.01   | <0.01  |
| Vanadium                          | mg/L | 0.01   |                   |                  | <0.01                     | <0.01               | <0.01   | <0.01   | <0.01   | <0.01   | 0.02    | <0.01   | <0.01   | <0.01   | <0.01  |
| Zinc                              | mg/L | 0.005  |                   |                  | <0.005                    | <0.005              | 10.5    | 0.475   | 1.34    | <0.005  | 0.009   | <0.005  | 0.005   | <0.005  | 0.252  |
| Total Metals <sup>4</sup>         |      |        |                   |                  |                           |                     |         |         |         |         |         |         |         |         |        |
| Arsenic                           | mg/L | 0.001  | 0.01              | 0.024            | 0.001                     | 0.002               | 0.003   | 0.002   | 0.002   | 0.027   | 0.002   | 0.021   | 0.005   | 0.009   | <0.001 |
| Boron                             | mg/L | 0.05   | 4                 | 0.37             | <0.05                     | 0.08                | 0.1     | 0.12    | 0.1     | 0.05    | 0.16    | 0.13    | 0.59    | 0.1     | 0.1    |
| Barium                            | mg/L | 0.001  | 2                 | -                | 0.017                     | 0.01                | 0.018   | 0.009   | 0.013   | 0.131   | 0.061   | 0.133   | 0.07    | 0.162   | 0.017  |
| Beryllium                         | mg/L | 0.001  | 0.06              | -                | <0.001                    | <0.001              | <0.001  | <0.001  | <0.001  | 0.006   | <0.001  | 0.002   | <0.001  | 0.003   | <0.001 |
| Cadmium                           | mg/L | 0.0001 | 0.002             | 0.0002           | <0.0001                   | <0.0001             | 0.0006  | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0006 |
| Cobalt                            | mg/L | 0.001  | -                 | -                | 0.005                     | 0.003               | <0.001  | <0.001  | <0.001  | 0.048   | 0.014   | 0.033   | 0.005   | 0.024   | <0.001 |
| Chromium                          | mg/L | 0.001  | 0.05              | 0.001            | 0.001                     | <0.001              | 0.012   | <0.001  | <0.001  | 0.02    | 0.008   | 0.027   | 0.007   | 0.031   | 0.001  |
| Copper                            | mg/L | 0.001  | 2                 | 0.0014           | <0.001                    | <0.001              | 0.014   | 0.001   | 0.003   | 0.009   | 0.019   | 0.274   | 0.006   | 0.037   | 0.008  |
| Manganese                         | mg/L | 0.001  | 0.1               | 1.9              | 0.346                     | 0.156               | 0.197   | 0.142   | 0.146   | 3.7     | 2.28    | 2.43    | 1.12    | 0.809   | 0.412  |
| Nickel                            | mg/L | 0.001  | 0.02              | 0.011            | 0.002                     | <0.001              | 0.004   | <0.001  | <0.001  | 0.012   | 0.014   | 0.079   | 0.007   | 0.035   | 0.002  |

| Sherwin Mine Ground Water Quality |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        | Assessment Levels   |                     | Sample Type: Ground Water |         |         |         |         |        |         |         |         |         |         |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------------|---------------------|---------------------------|---------|---------|---------|---------|--------|---------|---------|---------|---------|---------|
|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        | NHMRC/NRMMC         | ANZECC              | Sampling Date: Year 2013  |         |         |         |         |        |         |         |         |         |         |
|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        | (2011) <sup>1</sup> | (2000) <sup>2</sup> | 6-Sep                     | 30-Aug  | 27-Oct  | 27-Oct  | 27-Oct  | 12-Sep | 9-Nov   | 15-Oct  | 7-Nov   | 12-Oct  | 25-Oct  |
| Analyte                           | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | LOR    |                     | 95% <sup>3</sup>    | SEMB02                    | SEMB03a | SEMB03b | SEMB03c | SEMB03d | SEMB06 | SPB01   | SPB02   | SPB03   | SPB06   | SPB07   |
| Lead                              | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.001  | 0.01                | 0.0034              | <0.001                    | <0.001  | 0.01    | <0.001  | 0.002   | 0.006  | 0.008   | 0.014   | 0.005   | 0.009   | 0.016   |
| Selenium                          | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.01   | 0.01                | 0.011               | <0.01                     | <0.01   | <0.01   | <0.01   | <0.01   | <0.01  | <0.01   | <0.01   | <0.01   | <0.01   | <0.01   |
| Vanadium                          | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.01   | -                   | -                   | <0.01                     | <0.01   | <0.01   | <0.01   | <0.01   | 0.04   | 0.11    | 0.04    | 0.01    | 0.03    | 0.02    |
| Zinc                              | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.005  | 3                   | 0.008               | <0.005                    | 0.01    | 13.5    | 1.39    | 1.37    | 0.045  | 1.65    | 0.69    | 0.127   | 0.103   | 3.52    |
| Dissolved Mercury                 | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.0001 |                     |                     |                           |         | <0.0001 | <0.0001 | <0.0001 |        | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Total Recoverable Mercury         | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.0001 | 0.001               |                     |                           |         | <0.0001 | <0.0001 | <0.0001 |        | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| <i>Others</i>                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |                     |                     |                           |         |         |         |         |        |         |         |         |         |         |
| Fluoride                          | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.1    |                     |                     |                           |         | 0.2     | 0.2     | 0.2     |        | 1.4     | 1.2     | 0.5     | 0.3     | 0.6     |
| Ammonia as N                      | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.01   |                     |                     |                           |         | 0.03    | 0.04    | 0.04    |        | 0.04    | 0.4     | 0.23    | 0.16    | 0.36    |
| Nitrite as N                      | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.01   |                     |                     |                           |         | <0.01   | <0.01   | <0.01   |        | <0.01   | <0.01   | <0.01   | <0.01   | 0.02    |
| Nitrate as N                      | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.01   |                     |                     |                           |         | <0.01   | <0.01   | <0.01   |        | 0.12    | 0.08    | 0.02    | <0.01   | 0.4     |
| Nitrite + Nitrate as N            | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.01   |                     | 11                  | 0.24                      | <0.01   | <0.01   | <0.01   | <0.01   | 0.01   | 0.12    | 0.08    | 0.02    | <0.01   | 0.42    |
| Total Kjeldahl Nitrogen as N      | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.1    |                     |                     | <0.1                      | <0.1    | 0.1     | 0.1     | 0.1     | 0.7    | 0.1     | 1.1     | 0.2     | 0.4     | 0.7     |
| Total Nitrogen as N               | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.1    |                     |                     | 0.2                       | <0.1    | 0.1     | 0.1     | 0.1     | 0.7    | 0.2     | 1.2     | 0.2     | 0.4     | 1.1     |
| Total Phosphorus as P             | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.01   |                     |                     | <0.01                     | 0.02    | 0.01    | 0.02    | 0.03    | 0.07   | 0.08    | 0.33    | 0.03    | 0.05    | 0.01    |
| Reactive Phosphorus as P          | mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.01   |                     |                     |                           |         | <0.01   | <0.01   | <0.01   |        | <0.01   | <0.01   | <0.01   | <0.01   | <0.01   |
| <i>Ionic Balance</i>              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |                     |                     |                           |         |         |         |         |        |         |         |         |         |         |
| Total Anions                      | meq/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.01   |                     |                     | 0.7                       | 2.92    | 3.7     | 3.23    | 3.25    | 2.13   | 10.7    | 3.15    | 7.79    | 3.12    | 7.09    |
| Total Cations                     | meq/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.01   |                     |                     | 0.83                      | 3.35    | 3.82    | 3.34    | 3.36    | 2.36   | 11.4    | 3.28    | 7.82    | 2.95    | 6.94    |
| Ionic Balance                     | %                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.01   |                     |                     |                           |         | 1.57    | 1.55    | 1.63    |        | 2.98    | 1.92    | 0.15    |         | 1.05    |
| <b>Note:</b>                      | <p>1. NHMRC and ARMCANZ (2011). Australian Drinking Water Guidelines.</p> <p>2. ANZECC and ARMCANZ (2000). Australian Water Quality Guidelines for Fresh and Marine Water Quality.</p> <p>3. Values are 'triggers' for slightly moderately disturbed ecosystems. Values applicable to high conservation/ecological value systems and highly disturbed ecosystems are available in ANZECC and ARMCANZ (2000).</p> <p>4. All values above the Australian Drinking Water Guidelines are highlighted in yellow colour.</p> |        |                     |                     |                           |         |         |         |         |        |         |         |         |         |         |

**Table 7: Hardness Characterisation.**

| Sample ID | Total Hardness (mg/L CaCO <sub>3</sub> ) | Classification  | Alkalinity | TDS/EC Ratio | Water Type                               |
|-----------|------------------------------------------|-----------------|------------|--------------|------------------------------------------|
| SEMB2     | 5.4                                      | Very Soft       | 1.7        | 6.51         | Na+K, Cl+SO <sub>4</sub>                 |
| SEMB3a    | 132.6                                    | Slightly Hard   | 86.9       | 0.72         | Ca+Mg, HCO <sub>3</sub> +CO <sub>3</sub> |
| SEMB3b    | 115.4                                    | Slightly Hard   | 117.3      | 0.65         | Ca+Mg, HCO <sub>3</sub> +CO <sub>3</sub> |
| SEMB3c    | 114.5                                    | Slightly Hard   | 96.0       | 0.65         | Ca+Mg, HCO <sub>3</sub> +CO <sub>3</sub> |
| SEMB3d    | 112.9                                    | Slightly Hard   | 96.8       | 0.65         | Ca+Mg, HCO <sub>3</sub> +CO <sub>3</sub> |
| SEMB6     | 87.3                                     | Moderately Soft | 70.5       | 0.64         | Ca+Mg, HCO <sub>3</sub> +CO <sub>3</sub> |
| SPB01     | 386.0                                    | Very Hard       | 377.2      | 0.65         | Ca+Mg, HCO <sub>3</sub> +CO <sub>3</sub> |
| SPB02     | 49.5                                     | Very Soft       | 88.6       | 0.65         | Na+K, HCO <sub>3</sub> +CO <sub>3</sub>  |
| SPB03     | 3.3                                      | Very Soft       | 237.0      | 0.65         | Na+K, HCO <sub>3</sub> +CO <sub>3</sub>  |
| SPB06     | 104.7                                    | Slightly Hard   | 92.7       | 0.65         | Ca+Mg, HCO <sub>3</sub> +CO <sub>3</sub> |
| SPB07     | 204.3                                    | Hard            | 245.2      | 0.65         | Ca+Mg, HCO <sub>3</sub> +CO <sub>3</sub> |

### 3.6.3 Hydrogeochemical Assessment

Hydrogeochemical processes were evaluated using a Piper Diagram (Figure 14). Ground waters, according to their water quality affinity were classified into three groups (Table 7). The first is Ca(HCO<sub>3</sub>)<sub>2</sub> type of water,

Indicating recently recharged waters with alkaline earths and weak acidic anions exceeding both alkali metals and strong acidic anions respectively; these waters occur across the low lying ground to the west and south-west of the proposed open pit. The second is a NaHCO<sub>3</sub> type which indicates ion-exchange waters to the north and north-west of the proposed open pit (between bores SPB02 and SPB03). The third group is a NaCl type which indicates end-point (saline/brackish) waters across high lying ground and below the proposed mine pit. These waters have lower pHs than elsewhere and slight salinity indicating slow and little recharge, if any.

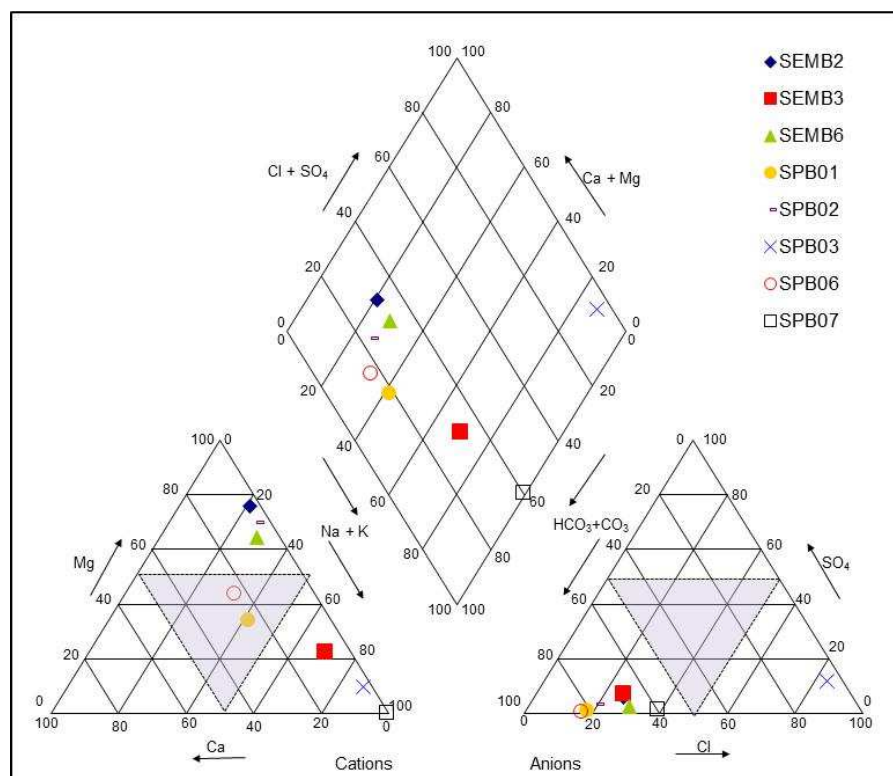


**Figure 14: Piper Diagram.**

## 4. Risk Assessment

### 4.1 Risk Assessment Methodology

To ascertain which factors may impact on environmentally sensitive receptors and which may require on-going management, a risk assessment was undertaken in accordance with the Australian Standard AS4360: Risk Management Standard. The hierarchy of risk controls considered are:

- **Elimination:** stop using the equipment, or stop undertaking the procedure/activity causing the risk.
- **Substitution:** use an alternative substance, equipment or process which poses less risk.
- **Isolation:** separate receivers from the source of the risk.
- **Engineering controls:** reduce exposure to the risk by making physical changes to equipment, procedures or the environment.
- **Change work practices:** adopt procedures which minimise exposure to the risk.

#### Risk Likelihood Classification.

| Level | Likelihood      | Description                                                                                                           | Criteria |
|-------|-----------------|-----------------------------------------------------------------------------------------------------------------------|----------|
| A     | Rare:           | Practically impossible, will only occur in exceptional circumstances. Has never occurred in the industry.             | 0-1%     |
| B     | Unlikely:       | Could occur at some time but highly unlikely. Has occurred in the industry previously.                                | 1-10%    |
| C     | Moderate:       | Might occur at some time. Has occurred in associated companies previously.                                            | 11-50%   |
| D     | Likely:         | Known to occur or will probably occur in most circumstances. Has occurred several times/year in associated companies. | 51-90%   |
| E     | Almost Certain: | Common or repeating occurrence. Is expected to occur several times/year in any associated business.                   | 91-100%  |

#### Risk Consequence Classification.

| Level | Consequence   | Description                                                                                                                                                                                                      |
|-------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Insignificant | No measurable impact on the environment.<br>No injuries.<br>Low-nil financial loss.                                                                                                                              |
| 2     | Minor         | Minor, temporary environmental impact.<br>No publicity likely and no stakeholder concerns.<br>First aid treatment required.<br>Medium-low financial loss.                                                        |
| 3     | Moderate      | Substantial temporary or permanent minor, localised environmental damage.<br>Stakeholder enquires (this may include government, unions or public).<br>Medical attention required.<br>High-medium financial loss. |
| 4     | Major         | Substantial or permanent environmental damage.<br>Prosecution possible.<br>Loss of company credibility and high stakeholder interest.<br>Permanent injuries.<br>High financial loss.                             |
| 5     | Catastrophic  | Widespread severe and permanent environmental damage.<br>Major stakeholder and media interest.<br>Prosecution likely.<br>Permanent injury or death.<br>Extreme financial loss.                                   |

### Risk Assessment Matrix.

| Likelihood |                                       | Consequence   |       |          |       |              |
|------------|---------------------------------------|---------------|-------|----------|-------|--------------|
|            |                                       | 1             | 2     | 3        | 4     | 5            |
|            |                                       | Insignificant | Minor | Moderate | Major | Catastrophic |
| E          | Almost certain                        | 11            | 16    | 20       | 23    | 25           |
| D          | Likely                                | 7             | 12    | 17       | 21    | 24           |
| C          | Probable                              | 4             | 8     | 13       | 18    | 22           |
| B          | Unlikely                              | 2             | 5     | 9        | 14    | 19           |
| A          | Rare                                  | 1             | 3     | 6        | 10    | 15           |
|            | Extreme risk, intolerable.            |               |       |          |       |              |
|            | High risk, intolerable or tolerable.  |               |       |          |       |              |
|            | Medium risk, tolerable or acceptable. |               |       |          |       |              |
|            | Low risk, acceptable.                 |               |       |          |       |              |

## 4.2 Risk Assessment

Layouts for open pit mining and processing of DSO ore at Sherwin Creek Iron Ore appear in Figure 6. The proposed mine will have accommodation, offices and workshops, open pit, a processing (crushing and screening) plant, run-of-mine (ROM) pad and a waste rock dumps (WRDs). The camp is proposed to be located approximately 3km from the mine adjacent to the access road and consists of transportable buildings common in remote mining operations. The ore is to be hauled by road to Darwin. There is a 5.5 km access road from the plant to the Roper Highway.

In the context of the proposed activities, the risks, potential impacts and mitigation, control and management measures in relation to ground water are briefly discussed below and summarized in Table 8. From the above investigations and assessments it is apparent that:

- Mine influx and hydraulic connectivity of ground water to surface water resources, including GDEs, are not considered risks and will not be impacted by mining and processing. Dewatering to facilitate open pit mining will not be required and no safeguards or management measures are required therefore.
- Stream diversions are not required for mining and processing (Pendragon Environmental Solutions, 2013a). Measures to safeguard surface water including options for minimising water use, management and treatment of clean and contaminated water including site stormwater, erosion and sediment control measures, and maintaining environmental flows are addressed in the Water Management Plan. None of these issues are likely to impact the deep ground water levels and water quality.
- Ground water levels are deep and the relative impermeability of the terrain provide some protection against potential impacts from spills and sediment loads (leaching of metals) in stormwater runoff.
  - Acid mine drainage investigations and assessments (Pendragon Environmental Services, 2013b) indicated that potential acid forming (PAF) bodies are relatively small, isolated and largely confined to the north-west of the proposed open pit. Consequently the risks of AMD and particularly leachate from potential acid forming waste material impacting ground water are considered low and will not be considered further in this document.

The remaining potential risks and impacts pertain to:

- Ground water abstraction (availability and sustainability) for potable and mine water supplies in the absence of other users.
- Infiltration of rain water from a partially backfilled open pit during mining and post closure.

Water demand/requirements appear in Table 1 indicating, taking cognisance of several water savings such as the latest technology in crushing and screening and using polymers on the haul roads to suppress dust, a potable water demand of 15ML/a and a total mine operational water requirement of 35ML/a, totalling 50ML/a. Currently available sources (airlift, non-sustainable short term, less than 3 months, yields from bores SEMB3, SPB01, SPB02 and SPB07; Table 3) yield up to 42.5ML/a. However, medium term (less than 6 months) sustainable yields equate to about 26ML/a, whilst long-term sustainable (greater than 6 months) yields from bores SEMB03 and SPB07 equate to about 12ML/a. Further geophysical exploration, across three target zones south, west and north of the mine (fracture systems to the south and north and limestone aquifers further north-east), coupled with drilling, testing and sampling are currently being planned to facilitate characterisation of the potential of aquifers in proximity to the mine and potential impacts by the exploitation of ground water to water level drawdown, aquifer yield and water quality.

The environmental objective is to ensure that ground water quality and quantity are maintained, and consequently the health, welfare and amenity of other users and land uses are not impaired, with the view to:

- Maintain the ambient quality of water sources.
- Prevent contaminated mine waters to enter water sources and migrate off-site.
- Monitor potential impacts by implementing a comprehensive ground water monitoring program.

Consideration should thus be given to:

- Mine infrastructure such as plant, workshops, ore stockpiles and WRDs are to be constructed and operated in accordance with best practice to inhibit infiltration and treat potentially contaminated waters prior to overflow into the nearest stream to maintain environmental flows.
- Monitoring of bore yields and ground water level behaviour (i.e. rapidly declining yields and water levels may indicate large-scale dewatering) and water quality in production and monitoring bores.
- Develop appropriate contingency measures to ascertain the cause of the impact (declining yield and/or deteriorating water quality) by site specific investigations and detailed assessment of monitoring data to determine the most appropriate preventative and remediation action. Where current measures and treatment trains are inadequate, provide and implement additional and/or new measures and treatment trains to remediate and prevent further and possible future impacts to ensure that the closure objectives of the mine are met.
- Ascertain and set ranges for ground water exploitation i.e. sustainable safe yield, allowable drawdown and distance to zero drawdown.

**Table 8: Risk Assessment, Mitigation and Management Options.**

| Impacts                                                                                                 | Potential Risk |            |      | Proposed Mitigation/Control and Recommended Management                                                                                            | Residual Risk    |            |      |
|---------------------------------------------------------------------------------------------------------|----------------|------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------|------|
|                                                                                                         | Consequence    | Likelihood | Rank |                                                                                                                                                   | Consequence      | Likelihood | Rank |
| Ground and Surface Water: General                                                                       |                |            |      |                                                                                                                                                   |                  |            |      |
| Mine influx and dewatering.                                                                             | No risk        |            |      | Ground water occurs below depth of mining.                                                                                                        | No residual risk |            |      |
| Hydraulic connectivity with streams, including GDEs.<br>(note: stream diversions will not be required). | No risk        |            |      | Separate ground water systems, ground water levels below stream beds.<br><br>Refer Water Management Plan for details pertaining to surface water. | No residual risk |            |      |

| Impacts                                                                                                                        | Potential Risk |            |      | Proposed Mitigation/Control and Recommended Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Residual Risk |            |      |
|--------------------------------------------------------------------------------------------------------------------------------|----------------|------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------|------|
|                                                                                                                                | Consequence    | Likelihood | Rank |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Consequence   | Likelihood | Rank |
| Spills and sediment loads in storm runoff:<br>▪ Impact on water quality                                                        | B              | 2          | L    | Terrain impermeable with deep ground water levels.<br><br>Implement: Emergency/Water Management Plan.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               | L          |      |
| Acid Mine Drainage                                                                                                             | D              | 3          | H    | Refer AMD assessment: small isolated and localised zones of PAF materials.<br><br>Implement PAF Management Plan: encapsulate/cover and contain by appropriate investigation, engineering design and construction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               | L          |      |
| <b>Exploration for Ground Water Supplies and Exploitation</b>                                                                  |                |            |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |            |      |
| Groundwater exploration and exploitation impacting:<br>▪ Aquifer yield.<br>▪ Ground water level draw-down.<br>▪ Water quality. | B              | 3          | M    | Water demand/requirement relatively small; taking cognisance of water savings strategies.<br><br>Absence of users.<br><br>Sufficient exploration/exploitation targets/zones available.<br><br>Undertake geophysical exploration, bore drilling, testing and sampling.<br><br>Modelling to ascertain potential impacts; set operational controls and requirements for closure.<br><br>Ascertain/set operational controls for ground water exploitation i.e. sustainable safe yield, allowable drawdown and distance to zero drawdown.<br><br>Monitor bore yields, ground water level behaviour and water quality: develop and implement Ground Water Management and Monitoring Plan.<br><br>Develop appropriate contingency measures.<br><br>Where measures and treatment trains are inadequate, provide and implement additional and/or new measures and treatment trains to remediate and prevent further and possible future impacts to ensure that closure objectives are met. |               | L          |      |
| <b>Open Pit Mining</b>                                                                                                         |                |            |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |            |      |
| Seepage from open pit:<br>▪ Impact on water quality.                                                                           | D              | 3          | H    | Terrain relatively impermeable; deep ground water levels with small isolated and localised zones of PAF materials.<br><br>Deficit water balance: evaporation exceeds rainfall; limited infiltration.<br><br>Geochemical modelling to provide appropriate closure criteria.<br><br>Implement PAF and Water Management Plans.<br><br>Monitoring.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               | L          |      |
| <b>Plant and Infrastructure</b>                                                                                                |                |            |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |            |      |
| Seepage from ROM, stockpiles, WRDs, surface impoundments:<br>▪ Impact on water quality.                                        | D              | 2          | M    | Terrain relatively impermeable; deep ground water levels.<br><br>Partial backfilling of open pit.<br><br>Employ appropriate <i>best practice</i> engineering design and construction.<br><br>Monitoring.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               | L          |      |
| <b>Rehabilitation and Closure</b>                                                                                              |                |            |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |            |      |
| Impact on:<br>▪ Ground water levels.                                                                                           | B              | 2          | L    | Mining/processing undertaken with the view to minimize residual                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               | None       |      |

| Impacts                                                               | Potential Risk |            |      | Proposed Mitigation/Control and Recommended Management                                                                                                                                                                | Residual Risk |            |      |
|-----------------------------------------------------------------------|----------------|------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------|------|
|                                                                       | Consequence    | Likelihood | Rank |                                                                                                                                                                                                                       | Consequence   | Likelihood | Rank |
| <ul style="list-style-type: none"><li>Ground water quality.</li></ul> | B              | 2          | L    | impacts after mining.<br>Return of ground water levels to pre-mining levels.<br>Migration of rain falling into partially backfilled open pit.<br>Monitoring with appropriate corrective action if and where required. | None to L     |            |      |
| Notes: Rank: S denotes Significant, M Moderate and L Low.             |                |            |      |                                                                                                                                                                                                                       |               |            |      |

## 5. Conclusions and Recommendations

### 5.1 Conclusions

Bore drilling, testing and sampling indicated:

- A permeable and ephemeral shallow ground water regime with water lenses trapped in silty-clays overlying extremely weathered sandstone, highly localised within alluvial-debris fans located at the outlets of numerous small creek channels and gullies. These systems are sufficiently far, albeit downstream of the mine not to be impacted by mining and processing.
- The shallow system is underlain by a sequence of interlayered weathered and fractured siltstones, sandstones, shales and localised mudstones in which ground water is encountered between about 20m below surface (lower lying terrain) and 70m below surface (across higher lying terrain and the open pit). Below this there is a thick sequence of siltstones overlying a very hard bluish dolerite that acts as the lower boundary of the confining system. Ground water strikes were generally small and resultant ground water levels below the depth of mining. The hydraulic parameters of the aquifers are low indicative of the relative impermeability of the terrain.

Mine influx and hydraulic connectivity with surface water resources, including GDEs, are not considered risks and will not be impacted by mining and processing. Dewatering to facilitate open pit mining will not be required. Similarly, potential acid forming (PAF) bodies are relatively small, isolated and largely confined to the north-west of the proposed open pit. Consequently the risks of AMD and particularly leachate from potential acid forming waste material impacting ground water are considered low.

The larger potential risks and impacts pertain to:

- Ground water abstraction (availability and sustainability) for potable and mine water supplies in the absence of other users.
- Infiltration of rain water from a partially backfilled open pit during mining and post closure.

Currently, available sources may yield up to 42.5ML/a over the short term. Medium to long term sustainable yields equate to between 12ML/a and 26ML/a. Further geophysical exploration, across three target zones south, west and north of the mine coupled with drilling, testing and sampling of bores are currently being planned to facilitate characterisation of the potential of aquifers in proximity to the mine and potential impacts by the exploitation of ground water to water level drawdown, aquifer yield and water quality.

### 5.2 Recommendations

It is recommended that drilling, testing and sampling for ground water supplies continue, following completion of geophysical surveys, in areas where moderate to large ground water yields occur:

- South-west of the camp site near bore SPB07.
- North-west of the proposed open pit near bores SEMB3 and SPB06.
- South-south-east of the proposed open pit near exploration bore RR0071.

Undertake modelling to ascertain/set operational controls for ground water exploitation i.e. sustainable safe yield, allowable drawdown and distance to zero drawdown.

Provide suitably located shallow and deep bores around the mine and infrastructure e.g. WRDs, ROM, stockpiles subsequent to construction and implement a ground water monitoring plan.

## 6. Ground Water Monitoring Program

A ground water monitoring plan is to be implemented. The sampling locations, frequencies of water level monitoring and collection of samples, as well as the parameters to be measured and the testing to be undertaken on the water samples by laboratory as well as on-site field testing for internal operational control and management are detailed below:

**Table 9: Ground Water Monitoring.**

| Ground Water Monitoring and Quality |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Responsibility</b>               | Sherwin Iron Ltd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Policy</b>                       | <p>Initiate and maintain monitoring of the ground water regime (water quality and water levels) at appropriate locations throughout construction and thereafter until closure.</p> <p>Minimise the risk of contaminated waters and effluents to leave the mine at any time including during flood events not exceeding a frequency of 1 in 100 years.</p> <p>All water (including rain and storm runoff) is to be treated appropriately and shall not be contained, infiltrated and/or released into the environment unless such meet water quality standards and can take place under controlled conditions.</p>                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Performance Criteria</b>         | <p>The default Ground Water Investigation Levels (GILs) Schedule B1 National Environment Protection (Assessment of Site Contamination) Measure 2011 which combines the Australian Drinking Water Guidelines (NHMRC and NRMCC, 2011) and the guidelines for 95% species protection levels (hardness modified) (ANZECC and ARMCANZ, 2000) will be adopted as trigger values for ground water quality initially.</p> <p>Site-specific trigger values are to be developed when there is sufficient data available from baseline monitoring and reference sites.</p> <p>In addition to the above, water shall have no visible surface films, oils and greases, Total Petroleum Hydrocarbons, litter or suspended matter.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Implementation Strategy</b>      | <b>General</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>The following will be undertaken to facilitate the effective implementation of the management plan:</p> <ul style="list-style-type: none"> <li>▪ Maintain site diaries and monitoring data in hard copy and electronic format.</li> <li>▪ Schedule sampling events appropriately as required.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                     | <b>General Conduct and Reporting</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>Samplers shall undertake the following:</p> <p>Liaise with mine and plant managers frequently regarding construction and operations activities and treatment regimes to facilitate appropriate sampling and validation programs.</p> <p>Keep a detailed record of observations and measurements made during sampling events.</p> <p>Baseline or investigative monitoring undertaken during establishment of the bores and then at the end of the current dry season and again at the end of the next wet season. The main purpose of this monitoring is to gather baseline data prior to operations to further characterise the quality of the local groundwater, and most importantly, establish a benchmark for assessing any medium to long term trends and variability in groundwater quality.</p> |
| <b>Monitoring</b>                   | <b>Activity</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p>Sampling ground water monitoring bores.</p> <p>Note: ensure that surface water quality monitoring is undertaken and that data will be available for interpretive purposes particularly at the open pit, plant, WRDs and streams up- and downstream of the mine.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

| Ground Water Monitoring and Quality |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                     | <b>Parameters</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Rainfall.</p> <p>Depth to ground water level.</p> <p>Abstraction from bores.</p> <p>Hydrochemical:</p> <p>General field <i>in situ</i> (field) water quality measurements: pH, Temperature, Electrical Conductivity (<math>\mu\text{S}/\text{cm}</math>), Salinity, Dissolved Oxygen, Oxidation Reduction Potential including observations such as odour, colour, etc.)</p> <p>For analyses by a NATA accredited laboratory:</p> <p>Total Dissolved Solids (TDS, mg/L).</p> <p>Total Alkalinity (Talk, mg/L).</p> <p>Total Acidity (TAc, mg/L).</p> <p>Major anions (Cl, <math>\text{SO}_4</math>, <math>\text{CO}_3/\text{HCO}_3</math>, <math>\text{NO}_3\text{-N}</math>; mg/L).</p> <p>Major cations (Ca, Mg, Na and K; mg/L).</p> <p>Dissolved metals (Al, As, B, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn, Fe; <math>\mu\text{g}/\text{L}</math>).</p> |
|                                     | <b>Where</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Ground water production and monitoring bores (Figure 11).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                     | <b>Frequency</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b>Construction and operations:</b></p> <p>Rainfall: daily.</p> <p>Depth to ground water level: monthly for the first two years to better understand the impacts of wet and dry seasons at the site; quarterly or bi-annually thereafter.</p> <p>Hydro-chemical: ground water: quarterly and or seasonally (bi-annually).</p> <p><b>Post Closure:</b></p> <p>Depth to ground water level: bi-annually for two years.</p> <p>Hydro-chemical: ground water: seasonally (bi-annually) for two years.</p>                                                                                                                                                                                                                                                                                                                                              |
| <b>Compliance</b>                   | Monitoring data are to be assessed annually to ensure compliance with performance criteria.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Reporting</b>                    | <p>Records all monitoring results shall be kept on site for inspection and review by DME.</p> <p>Tabulations and graphs are to be compiled with brief notes on exceptions; these shall be included in any site audits to be undertaken. The data and information gathered during these monitoring programs are to be used to assess potential impacts of operations on downstream water qualities using comparisons against ambient water qualities, including surface water quality, and relevant standards and guidelines, trend diagrams, etc.</p> <p>Records and reports, including a final summary, are to be included in the Annual Environmental Review.</p> <p>Where a potential non-conformance event with potential environmental impacts has occurred, the DME shall be notified (by telephone to be followed by facsimile or e-mail within 24 hours) of the nature of the event, the measures implemented to prevent recurrence and any outcomes.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Incident/Failure</b>             | Examination of works for evidence of deteriorating water quality.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Corrective Action</b>            | <p>Variations by more than 10% trigger further assessment, re-sampling to ascertain repeatability and, if required, site investigations to ascertain cause, impact, remediation and preventative action.</p> <p>Corrective actions will be ascertained and implemented immediately where an identified action or situation has the potential to impact on ground water.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Contingency Plan</b>             | <p>At all times during construction and operations, plant, equipment and chemicals are to be operated, handled and maintained in strict accordance with the specifications of manufacturers to ensure that potential non-conformances and hazardous situations are inhibited.</p> <p>Controls are to be implemented to ensure immediate response should the need arise.</p> <p>Ensure adequate treatment facilities and materials are available for emergency situations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## Ground Water Monitoring and Quality

### Complaints

Complaints from the general public and/or neighbours will be treated with respect. A Complaints Register shall be maintained and complaints will be referred to the appropriate site manager who will direct an appropriate course of action relating to the concern. The Register shall be included in audits and shall record the date and time of the complaint, the name and contact details of the person raising the complaint, the nature of the complaint, the action taken, the details of the person responsible for action and resolution of complaint including actions taken to prevent recurrence.

## Abbreviations/Acronyms

|         |                                                                          |
|---------|--------------------------------------------------------------------------|
| ANZECC  | Australian and New Zealand Environment and Conservation Council          |
| ARMCANZ | Agriculture and Resource Management Council of Australia and New Zealand |
| ASLP    | Australian Standard Leaching Procedures                                  |
| DEHWA   | Commonwealth Department of the Environment, Water, Heritage and the Arts |
| DME     | Northern Territory Department of Mines and Energy                        |
| GDE     | Groundwater Dependent Ecosystem                                          |
| LoR     | Limit of Reporting                                                       |
| MMP     | Mining Management Plan                                                   |
| NAF     | Non acid forming                                                         |
| NLC     | Northern Land Council                                                    |
| PAF     | Potential Acid Forming                                                   |
| WMP     | Water Management Plan                                                    |

|    |           |
|----|-----------|
| ha | hectare   |
| hr | hour      |
| km | kilometre |
| m  | metre     |
| yr | year      |
| s  | second    |

## References

Australian and New Zealand Environment Conservation Council (ANZECC 2000): *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Volume 1, Chapters 1 – 7, National Water Quality Management Strategy. Canberra, ACT.

Australian/New Zealand Standard (1998): *Water Quality – Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*. AS/NZS 5667.1:1998.

ARMCANZ and ANZECC (1996): National Principles for the Provision of Water for Ecosystems: Sustainable Landuse and Water Resource Management Committee Subcommittee of Water Resources, Occasional Paper SWR No 3, Canberra.

Jolly P, Knapton A., Tickell S., (2004): Water Availability from the Aquifer in the Tindall Limestone South of the Roper River Natural Systems, Division of Conservation and Natural Resources Group, Department of Infrastructure, Planning and Environment Report No. 34/2004D.

Jolly, P. (2002): Daly River Catchment Water Balance. Department of Lands, Planning and Environment, Technical Report No. 10/2002. Northern Territory Government. Darwin, NT. Available from: <http://www.ipe.nt.gov.au/whatwedo/dalyregion/reports/Jolly2.pdf>. (The Department of Lands, Planning and Environment is now part of the Department of Infrastructure, Planning and Environment).

Kraatz, M. (2004): Roper River Catchment Natural Resource Management. A report prepared for the Roper River Landcare Group.

National Water Commission, (2012): Minimum Construction Requirements for Water Bores in Australia, 3<sup>rd</sup> Edition. National Uniform Drillers Licensing Committee. 146pp.

Neumann, N.L., Fraser, G.L. (Eds.) (2007): Geochronological synthesis and Time-Space plots for Proterozoic Australia. Geoscience Australia Record 2007/06.

NHMRC, NRMCC (2011): Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

Pendragon Environmental Solutions, 2013a: Surface Water Assessment Deposit C Sherwin Creek Iron Ore Project, Sherwin Iron Ltd, Revision No 1.

Pendragon Environmental Solutions, 2013b: Acid Mine/Metalliferous Drainage (AMD), Implications for Mine Waste Management Deposit C Sherwin Creek Iron Ore Project, Sherwin Iron Ltd, Revision No 2.

Sherwin Iron Ltd Exploration Program 2013.

Tickell, S., (2008): Groundwater, Explanatory notes to the Groundwater Map of the Northern Territory. Northern Territory Government Department of Natural Resources, Environment, the Arts and Sport. Technical Report No 12/2008D.

Van Tonder, Gerrit, Kunstmann, Herald, Xu, Yongxin (2001) FC-Program. Institute for Groundwater Studies. University of the Free Statet, Bloemfontein, South Africa.

## Appendices

Appendix A: Bore Logs and Construction Details.

Appendix B: Summary of Groundwater investigations.

Appendix C: Slug Test Data.

Appendix D: Water Quality Laboratory Data and Certificates.

Appendix A:  
Bore Logs and Construction Details

|                                                                                                                              |                                |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
|------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------------|---------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------|-------------------------------------------|---------------------------------|-----------------------------------|-----------------|--|
|  <div>EcOz<br/>Environmental Services</div> |                                | Project: Sherwin EIS Monitoring Bores |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
|                                                                                                                              |                                | BORE RN:                              | N/A                                         | Datum:                                               | GDA94                                                                      | Easting:                                | 428210                                    |                                 |                                   |                 |  |
|                                                                                                                              |                                |                                       |                                             | Zone:                                                | Zone 53L                                                                   | Northing:                               | 8372051                                   |                                 |                                   |                 |  |
|                                                                                                                              |                                | Project:                              | Sherwin EIS                                 | Drilled by:                                          | Cheyne Drilling                                                            | Elevation AHD (Ground):                 | 161.85                                    |                                 |                                   |                 |  |
|                                                                                                                              |                                | Reference:                            | Monitoring Bores                            | Logged by:                                           | Casey Hawkey (EcOz)                                                        | Elevation AHD (Ground Water):           |                                           |                                 |                                   |                 |  |
|                                                                                                                              |                                | Bore No                               | EMB1                                        | Start Date:                                          | 11/9/2013                                                                  | Ground Water Level (mbgl):              |                                           |                                 |                                   |                 |  |
| Depth                                                                                                                        |                                | Bore Details                          |                                             | Depth                                                | Lithological Description                                                   | Remarks and Observations                | Hardness (1-10)<br>Oxidation (1-5)        |                                 |                                   |                 |  |
| (mbgl)                                                                                                                       | (mAHD)                         |                                       |                                             | (m)                                                  |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 0.0                                                                                                                          | 161.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 1.0                                                                                                                          | 160.85                         | CEMENT                                | CEMENT                                      | 0-2m                                                 | Regolith                                                                   | Very weathered iron rich sandstone      |                                           |                                 |                                   |                 |  |
| 2.0                                                                                                                          | 159.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 3.0                                                                                                                          | 158.85                         |                                       |                                             | 2-5m                                                 | Weathered sandstone and siltstone with some layers of coarse quartz grains |                                         |                                           |                                 |                                   |                 |  |
| 4.0                                                                                                                          | 157.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 5.0                                                                                                                          | 156.85                         |                                       |                                             |                                                      |                                                                            | Iron rich - purple/red                  |                                           |                                 |                                   |                 |  |
| 6.0                                                                                                                          | 155.85                         |                                       |                                             |                                                      |                                                                            | Brown colouring                         |                                           |                                 |                                   |                 |  |
| 7.0                                                                                                                          | 154.85                         |                                       |                                             | 6-13m                                                | sandstone, siltstone, clay                                                 | Tan colouring - greater clay proportion |                                           |                                 |                                   |                 |  |
| 8.0                                                                                                                          | 153.85                         |                                       |                                             |                                                      |                                                                            | Golden Brown - High clay content        |                                           |                                 |                                   |                 |  |
| 9.0                                                                                                                          | 152.85                         |                                       |                                             |                                                      |                                                                            | Dark brown                              |                                           |                                 |                                   |                 |  |
| 10.0                                                                                                                         | 151.85                         |                                       |                                             |                                                      |                                                                            | Tan colouring - greater clay proportion |                                           |                                 |                                   |                 |  |
| 11.0                                                                                                                         | 150.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 12.0                                                                                                                         | 149.85                         |                                       |                                             |                                                      |                                                                            | Brown colouring                         |                                           |                                 |                                   |                 |  |
| 13.0                                                                                                                         | 148.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 14.0                                                                                                                         | 147.85                         |                                       |                                             |                                                      |                                                                            | 13-16m                                  | sandstone, siltstone, clay and grey shale | White and Yellow                |                                   |                 |  |
| 15.0                                                                                                                         | 146.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           | Large pieces of white sandstone |                                   |                 |  |
| 16.0                                                                                                                         | 145.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           | 16-18m                          | Weathered sandstone and siltstone | Brown colouring |  |
| 17.0                                                                                                                         | 144.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 18.0                                                                                                                         | 143.85                         | B                                     | B                                           | 18-25m                                               | Highly weathered siltstone and clay                                        | Brown colouring                         |                                           |                                 |                                   |                 |  |
| 19.0                                                                                                                         | 142.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 20.0                                                                                                                         | 141.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 21.0                                                                                                                         | 140.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 22.0                                                                                                                         | 139.85                         |                                       |                                             |                                                      |                                                                            |                                         | Lower clay proportion                     |                                 |                                   |                 |  |
| 23.0                                                                                                                         | 138.85                         |                                       |                                             |                                                      |                                                                            |                                         | Lower clay proportion                     |                                 |                                   |                 |  |
| 24.0                                                                                                                         | 137.85                         |                                       |                                             |                                                      |                                                                            |                                         | contains large sandstone pieces           |                                 |                                   |                 |  |
| 25.0                                                                                                                         | 136.85                         |                                       |                                             |                                                      |                                                                            |                                         | brown/red                                 |                                 |                                   |                 |  |
| 26.0                                                                                                                         | 135.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           | 25-30m                          | Weathered siltstone and shale     | some sandstone  |  |
| 27.0                                                                                                                         | 134.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 28.0                                                                                                                         | 133.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 29.0                                                                                                                         | 132.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 30.0                                                                                                                         | 131.85                         |                                       | coarse grained quartz pieces                |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 31.0                                                                                                                         | 130.85                         | 30-36m                                | Iron rich weathered sandstone and siltstone | purple/red                                           |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 32.0                                                                                                                         | 129.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 33.0                                                                                                                         | 128.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 34.0                                                                                                                         | 127.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 35.0                                                                                                                         | 126.85                         |                                       |                                             |                                                      | large sandstone pieces                                                     |                                         |                                           |                                 |                                   |                 |  |
| 36.0                                                                                                                         | 125.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 37.0                                                                                                                         | 124.85                         | 37-38m                                | siltstone and clays                         | Golden Brown                                         |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 38.0                                                                                                                         | 123.85                         | 38-39m                                | Iron rich highly weathered sandstone        | purple/red                                           |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 39.0                                                                                                                         | 122.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 40.0                                                                                                                         | 121.85                         | 39-43m                                | Sandstone and siltstone and clay            | golden brown                                         |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 41.0                                                                                                                         | 120.85                         |                                       |                                             | large coarse grained quartz pieces - brown colouring |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 42.0                                                                                                                         | 119.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 43.0                                                                                                                         | 118.85                         |                                       |                                             | clay - gold/brown                                    |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 44.0                                                                                                                         | 117.85                         | 43-44m                                | Shale and siltstone                         |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 45.0                                                                                                                         | 116.85                         |                                       |                                             | 44-50m                                               | Grey shale                                                                 | Blue/grey                               |                                           |                                 |                                   |                 |  |
| 46.0                                                                                                                         | 115.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 47.0                                                                                                                         | 114.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 48.0                                                                                                                         | 113.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 49.0                                                                                                                         | 112.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| 50.0                                                                                                                         | 111.85                         |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| Ground Water Description                                                                                                     |                                |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
| Key:                                                                                                                         |                                | Ground Water Description              |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |
|                                                                                                                              | Solid casing with lockable cap | Field Measurements:                   |                                             | Units:                                               | Sample Observations:                                                       | Casing height: 0.84m                    |                                           |                                 |                                   |                 |  |
|                                                                                                                              | Fill                           | pH:                                   |                                             | pH units                                             | Date:                                                                      |                                         |                                           |                                 |                                   |                 |  |
|                                                                                                                              | Gravel                         | Electrical Conductivity:              |                                             | mS/cm                                                | Colour:                                                                    |                                         |                                           |                                 |                                   |                 |  |
| B                                                                                                                            | Bentonite seal                 | Salinity:                             |                                             | ppt                                                  | Sheen:                                                                     |                                         |                                           |                                 |                                   |                 |  |
|                                                                                                                              | Screen with bottom end         | Dissolved Oxygen:                     |                                             | %                                                    | Odour:                                                                     | SWL: 50.97m                             |                                           |                                 |                                   |                 |  |
| ▼                                                                                                                            | Ground Water Level             | Turbidity:                            |                                             | NTU                                                  | Silt:                                                                      | TOC 12/9/13                             |                                           |                                 |                                   |                 |  |
| ▽                                                                                                                            | Water Strike                   | Temperature:                          |                                             | °C                                                   | Filtration:                                                                |                                         |                                           |                                 |                                   |                 |  |
| Indicate additional ground water level measurements here:                                                                    |                                |                                       |                                             |                                                      |                                                                            |                                         |                                           |                                 |                                   |                 |  |

|                                                                                                                              |        |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
|------------------------------------------------------------------------------------------------------------------------------|--------|---------------------------------------|------------------------------------------|----------------------------------|------------------------------------------------------------|-------------------------------------|-----------------------------------------|----------------------|-----------------|--|--|
|  <div>EcOz<br/>Environmental Services</div> |        | Project: Sherwin EIS Monitoring Bores |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
|                                                                                                                              |        | BORE RN:                              | N/A                                      | Datum:                           | GDA94                                                      | Easting:                            | 427053                                  |                      |                 |  |  |
|                                                                                                                              |        |                                       |                                          | Zone:                            | Zone 53L                                                   | Northing:                           | 8372785                                 |                      |                 |  |  |
|                                                                                                                              |        | Project:                              | Sherwin EIS                              | Drilled by:                      | Cheyne Drilling                                            | Elevation AHD (Ground):             | 145.95                                  |                      |                 |  |  |
|                                                                                                                              |        | Reference:                            | Monitoring Bores                         | Logged by:                       | Casey Hawkey (EcOz)                                        | Elevation AHD (Ground Water):       |                                         |                      |                 |  |  |
| Bore No                                                                                                                      | EMB2   | Start Date:                           | 6/9/2013                                 | Ground Water Level (mbgl):       |                                                            |                                     |                                         |                      |                 |  |  |
| Depth                                                                                                                        |        | Bore Details                          |                                          | Depth                            | Lithological Description                                   |                                     | Remarks and Observations                |                      | Hardness (1-10) |  |  |
| (mbgl)                                                                                                                       | (mAHD) |                                       |                                          | (m)                              |                                                            |                                     |                                         |                      | Oxidation (1-5) |  |  |
| 0.0                                                                                                                          | 145.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 1.0                                                                                                                          | 144.95 | CEMENT                                | CEMENT                                   | 0-2m                             | Regolith                                                   |                                     | Very weathered, red and brown colouring |                      |                 |  |  |
| 2.0                                                                                                                          | 143.95 |                                       |                                          | 2-4m                             | Grey sandstone with coarse grained quartz sandstone layers |                                     |                                         |                      |                 |  |  |
| 3.0                                                                                                                          | 142.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 4.0                                                                                                                          | 141.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 5.0                                                                                                                          | 140.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 6.0                                                                                                                          | 139.95 |                                       |                                          | 4-10m                            | Highly weathered grey sandstone                            |                                     | Purple/red                              |                      |                 |  |  |
| 7.0                                                                                                                          | 138.95 |                                       |                                          |                                  |                                                            |                                     | Brown                                   |                      |                 |  |  |
| 8.0                                                                                                                          | 137.95 |                                       |                                          |                                  |                                                            |                                     | Purple/red                              |                      |                 |  |  |
| 9.0                                                                                                                          | 136.95 |                                       |                                          |                                  |                                                            |                                     | With some clay - Tan colour             |                      |                 |  |  |
| 10.0                                                                                                                         | 135.95 |                                       |                                          |                                  |                                                            |                                     | Dark brown                              |                      |                 |  |  |
| 11.0                                                                                                                         | 134.95 |                                       |                                          |                                  | Tan                                                        |                                     |                                         |                      |                 |  |  |
| 12.0                                                                                                                         | 133.95 | 10-23m                                | Grey sandstone/siltstone, shale and clay |                                  | Brown and Tan                                              |                                     |                                         |                      |                 |  |  |
| 13.0                                                                                                                         | 132.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 14.0                                                                                                                         | 131.95 |                                       |                                          |                                  | Tan                                                        |                                     |                                         |                      |                 |  |  |
| 15.0                                                                                                                         | 130.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 16.0                                                                                                                         | 129.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 17.0                                                                                                                         | 128.95 |                                       |                                          |                                  | Light red - some iron                                      |                                     |                                         |                      |                 |  |  |
| 18.0                                                                                                                         | 127.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 19.0                                                                                                                         | 126.95 |                                       |                                          |                                  | iron weathered - significant proportion of clay            |                                     |                                         |                      |                 |  |  |
| 20.0                                                                                                                         | 125.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 21.0                                                                                                                         | 124.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 22.0                                                                                                                         | 123.95 |                                       | B                                        | B                                | 23-24m                                                     | Layers of quartz (coarse) sandstone |                                         | Cream colour         |                 |  |  |
| 23.0                                                                                                                         | 122.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 24.0                                                                                                                         | 121.95 | 24-37m                                |                                          |                                  | Grey siltstone and sandstone                               |                                     | Dark brown                              |                      |                 |  |  |
| 25.0                                                                                                                         | 120.95 |                                       |                                          |                                  |                                                            |                                     | Large proportion of clay - Golden Brown |                      |                 |  |  |
| 26.0                                                                                                                         | 119.95 |                                       |                                          |                                  |                                                            |                                     | Less clay - red colouring               |                      |                 |  |  |
| 27.0                                                                                                                         | 118.95 |                                       |                                          |                                  |                                                            |                                     | With slate fragments                    |                      |                 |  |  |
| 28.0                                                                                                                         | 117.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 29.0                                                                                                                         | 116.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 30.0                                                                                                                         | 115.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 31.0                                                                                                                         | 114.95 |                                       |                                          |                                  |                                                            |                                     | Clays - Golden Brown                    |                      |                 |  |  |
| 32.0                                                                                                                         | 113.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 33.0                                                                                                                         | 112.95 |                                       |                                          |                                  |                                                            |                                     | Dark brown                              |                      |                 |  |  |
| 34.0                                                                                                                         | 111.95 |                                       |                                          | Brown/Red with lots of clay      |                                                            |                                     |                                         |                      |                 |  |  |
| 35.0                                                                                                                         | 110.95 |                                       |                                          | Iron rich with clay - Purple/red |                                                            |                                     |                                         |                      |                 |  |  |
| 36.0                                                                                                                         | 109.95 | 37-40m                                | Fractured siltstone                      |                                  | Dark brown. Water strike 0.2L/s                            |                                     |                                         |                      |                 |  |  |
| 37.0                                                                                                                         | 108.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 38.0                                                                                                                         | 107.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 39.0                                                                                                                         | 106.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 40.0                                                                                                                         | 105.95 | 40-42m                                | Siltstone                                |                                  | Red/brown                                                  |                                     |                                         |                      |                 |  |  |
| 41.0                                                                                                                         | 104.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 42.0                                                                                                                         | 103.95 | 42-50m                                | Blue shale                               |                                  | Grey/blue                                                  |                                     |                                         |                      |                 |  |  |
| 43.0                                                                                                                         | 102.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 44.0                                                                                                                         | 101.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 45.0                                                                                                                         | 100.95 |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 46.0                                                                                                                         | 99.95  |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 47.0                                                                                                                         | 98.95  |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 48.0                                                                                                                         | 97.95  |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 49.0                                                                                                                         | 96.95  |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| 50.0                                                                                                                         | 95.95  |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| Ground Water Description                                                                                                     |        |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| Key:                                                                                                                         |        | Solid casing with lockable cap        |                                          | Field Measurements:              |                                                            | Units:                              |                                         | Sample Observations: |                 |  |  |
|                                                                                                                              |        | Fill                                  |                                          | pH:                              |                                                            | 5.84                                |                                         | Date:                |                 |  |  |
|                                                                                                                              |        | Gravel                                |                                          | Electrical Conductivity:         |                                                            | 98.0                                |                                         | Colour:              |                 |  |  |
| B                                                                                                                            |        | Bentonite seal                        |                                          | Salinity:                        |                                                            | 0.1                                 |                                         | Sheen:               |                 |  |  |
|                                                                                                                              |        | Screen with bottom end                |                                          | Dissolved Oxygen:                |                                                            | 98.5                                |                                         | Odour:               |                 |  |  |
| ▼                                                                                                                            |        | Ground Water Level                    |                                          | Turbidity:                       |                                                            |                                     |                                         | Silt:                |                 |  |  |
| ▽                                                                                                                            |        | Water Strike                          |                                          | Temperature:                     |                                                            | 27.8                                |                                         | Filtration:          |                 |  |  |
|                                                                                                                              |        |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |
| Indicate additional ground water level measurements here TDS 0.0638g/L                                                       |        |                                       |                                          |                                  |                                                            |                                     |                                         |                      |                 |  |  |

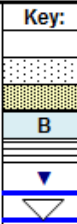
|  <div>EcOz<br/>Environmental Services</div> |              | Project: Sherwin EIS Monitoring Bores |                            |              |                                                                                                                                         |                               |                                    |
|------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------------------|----------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------------------------|
|                                                                                                                              |              | BORE RN:                              | N/A                        | Datum:       | GDA94                                                                                                                                   | Easting:                      | 426138                             |
|                                                                                                                              |              | Zone:                                 | Zone 53L                   | North:       | 8371788                                                                                                                                 | North:                        | 8371788                            |
|                                                                                                                              |              | Project:                              | Sherwin EIS                | Drilled by:  | Cheyne Drilling                                                                                                                         | Elevation AHD (Ground):       | 72.06                              |
|                                                                                                                              |              | Reference:                            | Monitoring Bores           | Logged by:   | Emma Smith (EcOz)                                                                                                                       | Elevation AHD (Ground Water): |                                    |
|                                                                                                                              |              | Bore No                               | EMB3                       | Start Date:  | 29/8/2013                                                                                                                               | Ground Water Level (mbgl):    |                                    |
| Depth<br>(mbgl)                                                                                                              | Depth<br>(m) | Bore Details                          |                            | Depth<br>(m) | Lithological Description                                                                                                                | Remarks and Observations      | Hardness (1-10)<br>Oxidation (1-5) |
| 0.0                                                                                                                          | 72.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 1.0                                                                                                                          | 71.06        | C<br>E<br>M<br>E<br>N<br>T            | C<br>E<br>M<br>E<br>N<br>T | 0-2m         | Red-brown regolith                                                                                                                      |                               |                                    |
| 2.0                                                                                                                          | 70.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 3.0                                                                                                                          | 69.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 4.0                                                                                                                          | 68.06        |                                       |                            | 2-6m         | yellow regolith                                                                                                                         |                               |                                    |
| 5.0                                                                                                                          | 67.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 6.0                                                                                                                          | 66.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 7.0                                                                                                                          | 65.06        | B                                     | B                          | 6-8m         | red-brown iron rich sandstone                                                                                                           | weathered                     |                                    |
| 8.0                                                                                                                          | 64.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 9.0                                                                                                                          | 63.06        |                                       |                            | 8-11m        | grey sandstone with thin interbedded iron rich sandstone layers                                                                         |                               |                                    |
| 10.0                                                                                                                         | 62.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 11.0                                                                                                                         | 61.06        |                                       |                            | 11-13m       | grey sandstone and grey siltstone                                                                                                       |                               |                                    |
| 12.0                                                                                                                         | 60.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 13.0                                                                                                                         | 59.06        | B                                     | B                          | 13-14m       | grey/black siltstone                                                                                                                    |                               |                                    |
| 14.0                                                                                                                         | 58.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 15.0                                                                                                                         | 57.06        |                                       |                            | 14-19m       | grey/black sandstone and grey/black siltstone with minor thin interbeds of iron rich sandstone                                          | Water strike 0.11L/sec        |                                    |
| 16.0                                                                                                                         | 56.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 17.0                                                                                                                         | 55.06        |                                       |                            | 19-20m       | grey siltstone                                                                                                                          |                               |                                    |
| 18.0                                                                                                                         | 54.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 19.0                                                                                                                         | 53.06        | B                                     | B                          | 20-23m       | grey siltstone interbedded with grey fine grained sandstone and very minor iron rich thin sandstone beds                                |                               |                                    |
| 20.0                                                                                                                         | 52.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 21.0                                                                                                                         | 51.06        |                                       |                            | 23-30m       | grey siltstone with minor grey sandstone layers and some minor thin grey/black shale layers                                             | Water strike: 1.33L/sec       |                                    |
| 22.0                                                                                                                         | 50.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 23.0                                                                                                                         | 49.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 24.0                                                                                                                         | 48.06        |                                       |                            | 30-42m       | Grey siltstone with minor grey, thin sandstone layers and some minor grey/black thin shale layers with minor pyrite (hardly noticeable) | Noticable pyrite              |                                    |
| 25.0                                                                                                                         | 47.06        | B                                     | B                          |              |                                                                                                                                         |                               |                                    |
| 26.0                                                                                                                         | 46.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 27.0                                                                                                                         | 45.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 28.0                                                                                                                         | 44.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 29.0                                                                                                                         | 43.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 30.0                                                                                                                         | 42.06        |                                       |                            | 42-46m       | Iron rich sandstone - Sherwin Ironstone formation                                                                                       |                               |                                    |
| 31.0                                                                                                                         | 41.06        | B                                     | B                          |              |                                                                                                                                         |                               |                                    |
| 32.0                                                                                                                         | 40.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 33.0                                                                                                                         | 39.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 34.0                                                                                                                         | 38.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 35.0                                                                                                                         | 37.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 36.0                                                                                                                         | 36.06        |                                       |                            | 46-55m       | Grey siltstone with minor grey, thin sandstone layers and some minor grey/black thin shale layers with minor pyrite (hardly noticeable) | No noticeable pyrite          |                                    |
| 37.0                                                                                                                         | 35.06        | B                                     | B                          |              |                                                                                                                                         |                               |                                    |
| 38.0                                                                                                                         | 34.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 39.0                                                                                                                         | 33.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 40.0                                                                                                                         | 32.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 41.0                                                                                                                         | 31.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 42.0                                                                                                                         | 30.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 43.0                                                                                                                         | 29.06        | B                                     | B                          |              |                                                                                                                                         |                               |                                    |
| 44.0                                                                                                                         | 28.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 45.0                                                                                                                         | 27.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 46.0                                                                                                                         | 26.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 47.0                                                                                                                         | 25.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 48.0                                                                                                                         | 24.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 49.0                                                                                                                         | 23.06        | B                                     | B                          |              |                                                                                                                                         |                               |                                    |
| 50.0                                                                                                                         | 22.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 51.0                                                                                                                         | 21.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 52.0                                                                                                                         | 20.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 53.0                                                                                                                         | 19.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 54.0                                                                                                                         | 18.06        |                                       |                            |              |                                                                                                                                         |                               |                                    |
| 55.0                                                                                                                         | 17.06        | B                                     | B                          |              |                                                                                                                                         |                               |                                    |
|                                                                                                                              |              |                                       |                            |              |                                                                                                                                         |                               |                                    |
|                                                                                                                              |              |                                       |                            |              |                                                                                                                                         |                               |                                    |
|                                                                                                                              |              |                                       |                            |              |                                                                                                                                         |                               |                                    |
|                                                                                                                              |              |                                       |                            |              |                                                                                                                                         |                               |                                    |
|                                                                                                                              |              |                                       |                            |              |                                                                                                                                         |                               |                                    |

| Key:                                                                                |                                | Ground Water Description                                                |       |          |  |                      |                      |
|-------------------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------|-------|----------|--|----------------------|----------------------|
|  | Solid casing with lockable cap | Field Measurements:                                                     |       | Units:   |  | Sample Observations: |                      |
|  | Fill                           | pH:                                                                     | 7.39  | pH units |  | Date:                | Casing height: 1.02m |
|  | Gravel                         | Electrical Conductivity:                                                | 311.2 | µS/cm    |  | Colour:              |                      |
|  | Bentonite seal                 | Salinity:                                                               | 0.1   | ppt      |  | Sheen:               |                      |
|  | Screen with bottom end         | Dissolved Oxygen:                                                       | 87    | %        |  | Odour:               | SWL: 3.78 mbgl       |
|  | Ground Water Level             | Turbidity:                                                              |       | NTU      |  | Silt:                | 1/9/13               |
|  | Water Strike                   | Temperature:                                                            | 30.2  | °C       |  | Filtration:          |                      |
|                                                                                     |                                | Indicate additional ground water level measurements here TDS: 0.2023g/L |       |          |  |                      |                      |

|                                                                                                                              |        |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
|------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------------|--------------------------------------|--------------------------------------------|------------------------------------|--|
|  <div>EcOz<br/>Environmental Services</div> |        | Project: Sherwin EIS Monitoring Bores                              |                                              |                                                                 |                                      |                                            |                                    |  |
|                                                                                                                              |        | BORE RN: N/A                                                       |                                              | Datum: GDA94                                                    |                                      | Easting: 426469                            |                                    |  |
|                                                                                                                              |        |                                                                    |                                              | Zone: Zone 53L                                                  |                                      | Northing: 8370984                          |                                    |  |
|                                                                                                                              |        | Project: Sherwin EIS                                               |                                              | Drilled by: Cheyne Drilling                                     |                                      | Elevation AHD (Ground): 139.91             |                                    |  |
|                                                                                                                              |        | Reference: Monitoring Bores                                        |                                              | Logged by: Casey Hawkey (EcOz)                                  |                                      | Elevation AHD (Ground Water):              |                                    |  |
|                                                                                                                              |        | Bore No: EMB4                                                      |                                              | Start Date: 4/9/2013                                            |                                      | Ground Water Level (mbgl):                 |                                    |  |
| Depth                                                                                                                        |        | Bore Details                                                       |                                              | Depth                                                           | Lithological Description             | Remarks and Observations                   | Hardness (1-10)<br>Oxidation (1-5) |  |
| (mbgl)                                                                                                                       | (mAHD) |                                                                    |                                              | (m)                                                             |                                      |                                            |                                    |  |
| 0.0                                                                                                                          | 139.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 1.0                                                                                                                          | 138.91 | C<br>E<br>M<br>E<br>N<br>T                                         | C<br>E<br>M<br>E<br>N<br>T                   | 0-2m                                                            | Iron rich sandstone                  | Very weathered, purple and brown colouring |                                    |  |
| 2.0                                                                                                                          | 137.91 |                                                                    |                                              | 2-4m                                                            | Grey sandstone                       | Yellow and brown colouring                 |                                    |  |
| 3.0                                                                                                                          | 136.91 |                                                                    |                                              | 4-9m                                                            | Grey siltstone with sandstone layers | Yellow colouring                           |                                    |  |
| 4.0                                                                                                                          | 135.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 5.0                                                                                                                          | 134.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 6.0                                                                                                                          | 133.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 7.0                                                                                                                          | 132.91 | 9-13m                                                              | Iron rich grey sandstone                     | Dark grey and brown                                             |                                      |                                            |                                    |  |
| 8.0                                                                                                                          | 131.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 9.0                                                                                                                          | 130.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 10.0                                                                                                                         | 129.91 |                                                                    |                                              | with some siltstone and clay -<br>Some iron present grey/purple |                                      |                                            |                                    |  |
| 11.0                                                                                                                         | 128.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 12.0                                                                                                                         | 127.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 13.0                                                                                                                         | 126.91 |                                                                    |                                              | 13-16m                                                          | Iron rich sandstone                  | Purple/brown                               |                                    |  |
| 14.0                                                                                                                         | 125.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 15.0                                                                                                                         | 124.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 16.0                                                                                                                         | 123.91 | 16-17m                                                             | Grey sandstone                               | Golden brown                                                    |                                      |                                            |                                    |  |
| 17.0                                                                                                                         | 122.91 | 17-23m                                                             | Iron rich sandstone                          | Brown/Purple colouring                                          |                                      |                                            |                                    |  |
| 18.0                                                                                                                         | 121.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 19.0                                                                                                                         | 120.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 20.0                                                                                                                         | 119.91 |                                                                    |                                              | With some clays - dark brown                                    |                                      |                                            |                                    |  |
| 21.0                                                                                                                         | 118.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 22.0                                                                                                                         | 117.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 23.0                                                                                                                         | 116.91 | 23-25m                                                             | Iron rich sandstone with clays and siltstone | Red brown colouring. Water strike <0.1 L/s                      |                                      |                                            |                                    |  |
| 24.0                                                                                                                         | 115.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 25.0                                                                                                                         | 114.91 | 25-33m                                                             | Grey siltstone and shale                     | Grey                                                            |                                      |                                            |                                    |  |
| 26.0                                                                                                                         | 113.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 27.0                                                                                                                         | 112.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 28.0                                                                                                                         | 111.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 29.0                                                                                                                         | 110.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 30.0                                                                                                                         | 109.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 31.0                                                                                                                         | 108.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 32.0                                                                                                                         | 107.91 |                                                                    |                                              | Light grey                                                      |                                      |                                            |                                    |  |
| 33.0                                                                                                                         | 106.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 34.0                                                                                                                         | 105.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 35.0                                                                                                                         | 104.91 | 33-40m                                                             | Grey siltstone and shale with grey sandstone |                                                                 |                                      |                                            |                                    |  |
| 36.0                                                                                                                         | 103.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 37.0                                                                                                                         | 102.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 38.0                                                                                                                         | 101.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 39.0                                                                                                                         | 100.91 |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| 40.0                                                                                                                         | 99.91  |                                                                    |                                              |                                                                 |                                      |                                            |                                    |  |
| Key:                                                                                                                         |        | Ground Water Description                                           |                                              |                                                                 |                                      |                                            |                                    |  |
|                                                                                                                              |        | Solid casing with lockable cap                                     | Field Measurements:                          | Units:                                                          | Sample Observations:                 | Casing height: 0.71m                       |                                    |  |
|                                                                                                                              |        | Fill                                                               | pH:                                          | pH units                                                        | Date:                                |                                            |                                    |  |
|                                                                                                                              |        | Gravel                                                             | Electrical Conductivity:                     | mS/cm                                                           | Colour:                              |                                            |                                    |  |
|                                                                                                                              |        | B                                                                  | Salinity:                                    | ppt                                                             | Sheen:                               |                                            |                                    |  |
|                                                                                                                              |        | Screen with bottom end                                             | Dissolved Oxygen:                            | %                                                               | Odour:                               | SWL: 22.90m                                |                                    |  |
|                                                                                                                              |        | Ground Water Level                                                 | Turbidity:                                   | NTU                                                             | Silt:                                | TOC 08/9/13                                |                                    |  |
|                                                                                                                              |        | Water Strike                                                       | Temperature:                                 | °C                                                              | Filtration:                          |                                            |                                    |  |
|                                                                                                                              |        | Water strike did not yield sufficient water for sample to be taken |                                              |                                                                 |                                      |                                            |                                    |  |

|                                                                                   |        |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
|-----------------------------------------------------------------------------------|--------|--------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------|--------|-------------------------------------------------------------|-----------------------------------------|--------------------------|--|------------------------------------|--|-------------------------------|--|---------|--|
|  |        | EcOz<br>Environmental Services |                                                                                           | Project: Sherwin EIS Monitoring Bore |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
|                                                                                   |        |                                |                                                                                           | BORE RN:                             |        | N/A                                                         |                                         | Datum:                   |  | GDA94                              |  | Easting:                      |  | 427246  |  |
|                                                                                   |        |                                |                                                                                           |                                      |        |                                                             |                                         | Zone:                    |  | Zone 53L                           |  | Northing:                     |  | 8369913 |  |
|                                                                                   |        |                                |                                                                                           | Project:                             |        | Sherwin EIS                                                 |                                         | Drilled by:              |  | Cheyne Drilling                    |  | Elevation AHD (Ground):       |  | 173.14  |  |
|                                                                                   |        |                                |                                                                                           | Reference:                           |        | Monitoring Bores                                            |                                         | Logged by:               |  | Casey Hawkey (EcOz)                |  | Elevation AHD (Ground Water): |  |         |  |
|                                                                                   |        |                                |                                                                                           | Bore No                              |        | EMB5                                                        |                                         | Start Date:              |  | 5/9/2013                           |  | Ground Water Level (mbgl):    |  |         |  |
| Depth                                                                             |        | Bore Details                   |                                                                                           | Depth                                |        | Lithological Description                                    |                                         | Remarks and Observations |  | Hardness (1-10)<br>Oxidation (1-5) |  |                               |  |         |  |
| (mbgl)                                                                            | (mAHD) |                                |                                                                                           | (m)                                  |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 0.0                                                                               | 173.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 1.0                                                                               | 172.14 | C<br>E<br>M<br>E<br>N<br>T     |                                                                                           | C<br>E<br>M<br>E<br>N<br>T           | 0-2m   | Regolith                                                    | Very weathered, red and brown colouring |                          |  |                                    |  |                               |  |         |  |
| 2.0                                                                               | 171.14 |                                |                                                                                           |                                      | 2-4m   | Grey sandstone with coarse grained quatz sandstone layers   | white to yellow colouring               |                          |  |                                    |  |                               |  |         |  |
| 3.0                                                                               | 170.14 |                                |                                                                                           |                                      | 4-9m   | Highly weather grey siltstone and sandstone with some clays | Iron rich, red and brown colouring      |                          |  |                                    |  |                               |  |         |  |
| 4.0                                                                               | 169.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 5.0                                                                               | 168.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 6.0                                                                               | 167.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 7.0                                                                               | 166.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 8.0                                                                               | 165.14 |                                |                                                                                           |                                      | 9-13m  | Iron rich grey sandstone                                    | Red and brown colouring                 |                          |  |                                    |  |                               |  |         |  |
| 9.0                                                                               | 164.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 10.0                                                                              | 163.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 11.0                                                                              | 162.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 12.0                                                                              | 161.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 13.0                                                                              | 160.14 | 13-19m                         | Grey siltstone with coarse quartz sandstone layers                                        | Grey/white                           |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 14.0                                                                              | 159.14 |                                |                                                                                           | Brown/yellow                         |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 15.0                                                                              | 158.14 |                                |                                                                                           | Brown/Red                            |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 16.0                                                                              | 157.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 17.0                                                                              | 156.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 18.0                                                                              | 155.14 | 19-23m                         | Grey siltstone with coarse quartz sandstone layers with shale                             | Red colour                           |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 19.0                                                                              | 154.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 20.0                                                                              | 153.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 21.0                                                                              | 152.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 22.0                                                                              | 151.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 23.0                                                                              | 150.14 | 23-25m                         | Grey siltstone with coarse quartz sandstone layers with shale and some mudstone fragments | Red/Brown                            |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 24.0                                                                              | 149.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 25.0                                                                              | 148.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 26.0                                                                              | 147.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 27.0                                                                              | 146.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 28.0                                                                              | 145.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 29.0                                                                              | 144.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 30.0                                                                              | 143.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 31.0                                                                              | 142.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 32.0                                                                              | 141.14 |                                |                                                                                           |                                      | 25-39m | Grey siltstone                                              | Some clays                              |                          |  |                                    |  |                               |  |         |  |
| 33.0                                                                              | 140.14 | Grey                           |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 34.0                                                                              | 139.14 | Some coarse grained sandstone  |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 35.0                                                                              | 138.14 | Red/Grey                       |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 36.0                                                                              | 137.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 37.0                                                                              | 136.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 38.0                                                                              | 135.14 | Red                            |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 39.0                                                                              | 134.14 | Significant clay               |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 40.0                                                                              | 133.14 | 39-46m                         | Golden Clay                                                                               | Yellow                               |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 41.0                                                                              | 132.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 42.0                                                                              | 131.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 43.0                                                                              | 130.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 44.0                                                                              | 129.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 45.0                                                                              | 128.14 | 46-50m                         | Grey siltstone                                                                            | Grey/blue                            |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 46.0                                                                              | 127.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 47.0                                                                              | 126.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 48.0                                                                              | 125.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 49.0                                                                              | 124.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |
| 50.0                                                                              | 123.14 |                                |                                                                                           |                                      |        |                                                             |                                         |                          |  |                                    |  |                               |  |         |  |

|                                                                                     |      |                                |                                                           |  |          |                      |                |
|-------------------------------------------------------------------------------------|------|--------------------------------|-----------------------------------------------------------|--|----------|----------------------|----------------|
|  | Key: | Ground Water Description       |                                                           |  |          |                      |                |
|                                                                                     |      | Solid casing with lockable cap | Field Measurements:                                       |  | Units:   | Sample Observations: | Casing height: |
|                                                                                     |      | Fill                           | pH:                                                       |  | pH units | Date:                | 0.90m          |
|                                                                                     |      | Gravel                         | Electrical Conductivity:                                  |  | mS/cm    | Colour:              |                |
|                                                                                     | B    | Bentonite seal                 | Salinity:                                                 |  | ppt      | Sheen:               |                |
|                                                                                     |      | Screen with bottom end         | Dissolved Oxygen:                                         |  | %        | Odour:               | SWL: 45.80m    |
|                                                                                     | ▼    | Ground Water Level             | Turbidity:                                                |  | NTU      | Silt:                | TOC 08/9/13    |
|                                                                                     | ▽    | Water Strike                   | Temperature:                                              |  | °C       | Filtration:          |                |
|                                                                                     |      |                                | Indicate additional ground water level measurements here: |  |          |                      |                |

| <br>EcOz<br>Environmental Service |                  | Project: Sherwin EIS Monitoring Bores |                     |                               |                                                    |                                               |                                                                    |                                 |  |
|--------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------|---------------------|-------------------------------|----------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------|---------------------------------|--|
|                                                                                                                    |                  | BORE RN:                              | N/A                 | Datum:                        | GDA94                                              | Easting:                                      | 426032                                                             |                                 |  |
|                                                                                                                    |                  |                                       |                     | Zone:                         | Zone 53L                                           | Northing:                                     | 8371369                                                            |                                 |  |
|                                                                                                                    |                  | Project:                              | Sherwin EIS         | Drilled by:                   | Cheyne Drilling                                    | Elevation AHD (Ground):                       | 98.23                                                              |                                 |  |
| Reference:                                                                                                         | Monitoring Bores | Logged by:                            | Casey Hawkey (EcOz) | Elevation AHD (Ground Water): |                                                    |                                               |                                                                    |                                 |  |
| Bore No                                                                                                            | EMB6             | Start Date:                           | 11/9/2013           | Ground Water Level (mbgl):    |                                                    |                                               |                                                                    |                                 |  |
| Depth                                                                                                              |                  | Bore Details                          |                     | Depth                         | Lithological Description                           |                                               | Remarks and Observations                                           | Hardness (1-10)                 |  |
| (mbgl)                                                                                                             | (mAHD)           |                                       |                     | (m)                           |                                                    | Oxidation (1-5)                               |                                                                    |                                 |  |
| 0.0                                                                                                                | 98.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 1.0                                                                                                                | 98.23            | C<br>E<br>M<br>E<br>N<br>T            |                     | 0-3m                          | Regolith                                           | Highly weathered grey siltstone and sandstone |                                                                    |                                 |  |
| 2.0                                                                                                                | 98.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 3.0                                                                                                                | 95.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 4.0                                                                                                                | 94.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 5.0                                                                                                                | 93.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 6.0                                                                                                                | 92.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 7.0                                                                                                                | 91.23            |                                       |                     | 6-15m                         | Siltstone and sandstone                            | Brown                                         | Clays present - Yellow colouring                                   |                                 |  |
| 8.0                                                                                                                | 90.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 9.0                                                                                                                | 89.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 10.0                                                                                                               | 88.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 11.0                                                                                                               | 87.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 12.0                                                                                                               | 86.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 13.0                                                                                                               | 85.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 14.0                                                                                                               | 84.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 15.0                                                                                                               | 83.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 16.0                                                                                                               | 82.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 17.0                                                                                                               | 81.23            | B                                     | B                   | 15-16m                        | Sticky blue/grey clay                              | Grey/Blue                                     |                                                                    |                                 |  |
| 18.0                                                                                                               | 80.23            |                                       |                     | 16-19m                        | Iron rich highly weathered siltstone and sandstone | Red/Purple                                    |                                                                    |                                 |  |
| 19.0                                                                                                               | 79.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 20.0                                                                                                               | 78.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 21.0                                                                                                               | 77.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 22.0                                                                                                               | 76.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 23.0                                                                                                               | 75.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 24.0                                                                                                               | 74.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 25.0                                                                                                               | 73.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 26.0                                                                                                               | 72.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 27.0                                                                                                               | 71.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 28.0                                                                                                               | 70.23            |                                       |                     | 20-24m                        | Iron rich sandstone and siltstone                  | Red/purple                                    |                                                                    |                                 |  |
| 29.0                                                                                                               | 69.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 30.0                                                                                                               | 68.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 31.0                                                                                                               | 67.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 32.0                                                                                                               | 66.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 33.0                                                                                                               | 65.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 34.0                                                                                                               | 64.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 35.0                                                                                                               | 63.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 36.0                                                                                                               | 62.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 37.0                                                                                                               | 61.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 38.0                                                                                                               | 60.23            |                                       |                     | 24-28m                        | Grey siltstone and sandstone                       | Grey - water strike < 0.1L/s                  | Red/purple                                                         | some shale - blue/grey          |  |
| 39.0                                                                                                               | 59.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 40.0                                                                                                               | 58.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 41.0                                                                                                               | 57.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 42.0                                                                                                               | 56.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 43.0                                                                                                               | 55.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 44.0                                                                                                               | 54.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 45.0                                                                                                               | 53.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 46.0                                                                                                               | 52.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 47.0                                                                                                               | 51.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 48.0                                                                                                               | 50.23            |                                       |                     | 28-55m                        | Grey shale                                         | blue/grey                                     | Iron rich weathered sandstone and siltstone - Red/purple blue/grey | Minor amounts of pyrite present |  |
| 49.0                                                                                                               | 49.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 50.0                                                                                                               | 48.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 51.0                                                                                                               | 47.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 52.0                                                                                                               | 46.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 53.0                                                                                                               | 45.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 54.0                                                                                                               | 44.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |
| 55.0                                                                                                               | 43.23            |                                       |                     |                               |                                                    |                                               |                                                                    |                                 |  |

|                                                                                     | Key:                           | Ground Water Description                                                |        |                      |             |                        |
|-------------------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------|--------|----------------------|-------------|------------------------|
|                                                                                     |                                | Field Measurements:                                                     | Units: | Sample Observations: |             |                        |
|  | Solid casing with lockable cap | pH:                                                                     | 6.74   | pH units             | Date:       | Casing height: 0.62m   |
|  | Fill                           | Electrical Conductivity:                                                | 220.6  | µS/cm                | Colour:     |                        |
|  | Gravel                         | Salinity:                                                               | 0.1    | ppt                  | Sheen:      | SWL: 16.27 TOC 12/9/13 |
|  | Bentonite seal                 | Dissolved Oxygen:                                                       | 65     | %                    | Odour:      |                        |
|  | Screen with bottom end         | Turbidity:                                                              |        | NTU                  | Silt:       |                        |
|  | Ground Water Level             | Temperature:                                                            | 30.2   | °C                   | Filtration: |                        |
|  | Water Strike                   | Indicate additional ground water level measurements here TDS: 0.1418g/L |        |                      |             |                        |

|                                                                                     |                                |                                                                                     |                  |                               |                                                          |                                    |         |
|-------------------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------------------|------------------|-------------------------------|----------------------------------------------------------|------------------------------------|---------|
|    | EcOz<br>Environmental Services | Project: Sherwin EIS Production Bores                                               |                  |                               |                                                          |                                    |         |
|                                                                                     |                                | BORE RN:                                                                            | RN038259         | Datum:                        | GDA94                                                    | Easting:                           | 420649  |
|                                                                                     |                                |                                                                                     |                  | Zone:                         | Zone 53L                                                 | Northing:                          | 8370767 |
|                                                                                     |                                | Project:                                                                            | Sherwin EIS      | Drilled by:                   | AllWell Drilling                                         | Elevation AHD (Ground):            | 51.45   |
|                                                                                     |                                | Reference:                                                                          | Production Bores | Logged by:                    | Alan Davy (AllWell Drilling)                             | Elevation AHD (Ground Water):      | 44.96   |
|                                                                                     |                                | Bore No                                                                             | SPB01            | Start Date:                   | 8/11/2013                                                | Ground Water Level (mbgl):         | 2.25    |
| Depth                                                                               |                                | Bore Details                                                                        | Depth            | Lithological Description      | Remarks and Observations                                 | Hardness (1-10)<br>Oxidation (1-5) |         |
| (mbgl)                                                                              | (mAHD)                         |                                                                                     | (m)              |                               |                                                          |                                    |         |
| 0.0                                                                                 | 51.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 1.0                                                                                 | 50.45                          |    | 0-3m             | Clayey Topsoil                |                                                          |                                    |         |
| 2.0                                                                                 | 49.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 3.0                                                                                 | 48.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 4.0                                                                                 | 47.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 5.0                                                                                 | 46.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 6.0                                                                                 | 45.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 7.0                                                                                 | 44.45                          |    | 3-12m            | Breccia                       |                                                          |                                    |         |
| 8.0                                                                                 | 43.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 9.0                                                                                 | 42.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 10.0                                                                                | 41.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 11.0                                                                                | 40.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 12.0                                                                                | 39.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 13.0                                                                                | 38.45                          |  | 12-15m           | Grey Siltstone                | Water bearing beds from 13-18m with flow rate of 0.4 L/s |                                    |         |
| 14.0                                                                                | 37.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 15.0                                                                                | 36.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 16.0                                                                                | 35.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 17.0                                                                                | 34.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 18.0                                                                                | 33.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 19.0                                                                                | 32.45                          |  | 15-18m           | Bands of siltstone and quartz |                                                          |                                    |         |
| 20.0                                                                                | 31.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 21.0                                                                                | 30.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 22.0                                                                                | 29.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 23.0                                                                                | 28.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 24.0                                                                                | 27.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 25.0                                                                                | 26.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 26.0                                                                                | 25.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
| 27.0                                                                                | 24.45                          |                                                                                     |                  |                               |                                                          |                                    |         |
|                                                                                     |                                |                                                                                     |                  |                               |                                                          |                                    |         |
| Key:                                                                                |                                | Ground Water Description                                                            |                  |                               |                                                          |                                    |         |
|  | Solid casing with lockable cap | Field Measurements:                                                                 |                  | Units:                        | Sample Observations:                                     |                                    |         |
|  | Steel Collar                   | pH:                                                                                 | 8.25             | pH units                      | Date:                                                    |                                    |         |
|  | Cement                         | Electrical Conductivity:                                                            |                  | mS/cm                         | Colour:                                                  |                                    |         |
|  | Gravel                         | Salinity:                                                                           | 0.54             | ppt                           | Sheen:                                                   |                                    |         |
|  | Bentonite seal                 | Dissolved Oxygen:                                                                   |                  | %                             | Odour:                                                   |                                    |         |
|  | Screen with bottom end         | Turbidity:                                                                          |                  | NTU                           | Silt:                                                    |                                    |         |
|  | Ground Water Level             | Temperature:                                                                        |                  | °C                            | Filtration:                                              |                                    |         |
|  | Water Strike                   | Air lifted and bore was dry after 20 mins. Flow rate less than 0.05L/s.             |                  |                               |                                                          |                                    |         |



| <div></div> <div>EcOz Environmental Services</div> |                                | Project: Sherwin EIS Production Bores |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------------|-------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------|
|                                                                                                                                     |                                | BORE RN:                              | RN038480                                                                      | Datum:                        | GDA94                                                                                                                                  | Easting:                                                        | 423366                                  |
|                                                                                                                                     |                                | Zone:                                 | Zone 53L                                                                      | Drilled by:                   | AllWell Drilling                                                                                                                       | Northing:                                                       | 8373145                                 |
|                                                                                                                                     |                                | Project:                              | Sherwin EIS                                                                   | Logged by:                    | Will Riddell (EcOz)                                                                                                                    | Elevation AHD (Ground):                                         | 37.97                                   |
| Reference:                                                                                                                          | Production Bores               | Logged by:                            | Will Riddell (EcOz)                                                           | Elevation AHD (Ground Water): | 37.47                                                                                                                                  |                                                                 |                                         |
| Bore No                                                                                                                             | SPB03                          | Start Date:                           | 8/10/2013                                                                     | Ground Water Level (mbgl):    | 0.50                                                                                                                                   |                                                                 |                                         |
| Depth                                                                                                                               |                                | Bore Details                          |                                                                               | Depth                         | Lithological Description                                                                                                               | Remarks and Observations                                        | Hardness (1-10)<br>Oxidation (1-5)      |
| (mbgl)                                                                                                                              | (mAHD)                         |                                       | (m)                                                                           |                               |                                                                                                                                        |                                                                 |                                         |
| 0.0                                                                                                                                 | 37.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 1.0                                                                                                                                 | 36.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 2.0                                                                                                                                 | 35.97                          |                                       |                                                                               | 0-3m                          | Reddish to orange, fine san regolith.                                                                                                  | Red/orange to dark grey top soils.                              |                                         |
| 3.0                                                                                                                                 | 34.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 4.0                                                                                                                                 | 33.97                          |                                       |                                                                               | 3-6m                          | Grey dark to brown, alluvial conglomerate with rounded to subrounded brownish ferricretes.                                             |                                                                 |                                         |
| 5.0                                                                                                                                 | 32.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 6.0                                                                                                                                 | 31.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 7.0                                                                                                                                 | 30.97                          |                                       |                                                                               | 6-9m                          | Bluish to dark siltstone interbedded with whitish to pale grey claystone.                                                              |                                                                 |                                         |
| 8.0                                                                                                                                 | 29.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 9.0                                                                                                                                 | 28.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 10.0                                                                                                                                | 27.97                          |                                       |                                                                               | 9-12m                         | Finely interbedded greyish to bluish siltstone, claystone and iron oxides.                                                             | Iron oxides are very moist.                                     |                                         |
| 11.0                                                                                                                                | 26.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 12.0                                                                                                                                | 25.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 13.0                                                                                                                                | 24.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 14.0                                                                                                                                | 23.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 15.0                                                                                                                                | 22.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 16.0                                                                                                                                | 21.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 17.0                                                                                                                                | 20.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 18.0                                                                                                                                | 19.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 19.0                                                                                                                                | 18.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 20.0                                                                                                                                | 17.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 21.0                                                                                                                                | 16.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 22.0                                                                                                                                | 15.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 23.0                                                                                                                                | 14.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 24.0                                                                                                                                | 13.97                          |                                       |                                                                               | 12-36m                        | Dark grey, weathered to fresh siltstone.                                                                                               |                                                                 | Lens of water @ 35m                     |
| 25.0                                                                                                                                | 12.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 26.0                                                                                                                                | 11.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 27.0                                                                                                                                | 10.97                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 28.0                                                                                                                                | 9.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 29.0                                                                                                                                | 8.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 30.0                                                                                                                                | 7.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 31.0                                                                                                                                | 6.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 32.0                                                                                                                                | 5.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 33.0                                                                                                                                | 4.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 34.0                                                                                                                                | 3.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 35.0                                                                                                                                | 2.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 36.0                                                                                                                                | 1.97                           |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 37.0                                                                                                                                | 0.97                           |                                       |                                                                               | 36-39m                        | Whitish to grey arkose sandstone                                                                                                       | Weathering increases with depth.                                |                                         |
| 38.0                                                                                                                                | -0.03                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 39.0                                                                                                                                | -1.03                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 40.0                                                                                                                                | -2.03                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 41.0                                                                                                                                | -3.03                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 42.0                                                                                                                                | -4.03                          |                                       |                                                                               | 39-45m                        | Bluish to grey fresh siltstone.                                                                                                        | Layering is very fine.                                          |                                         |
| 43.0                                                                                                                                | -5.03                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 44.0                                                                                                                                | -6.03                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 45.0                                                                                                                                | -7.03                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 46.0                                                                                                                                | -8.03                          |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 47.0                                                                                                                                | -9.03                          |                                       |                                                                               | 45-48m                        | Grey to whitish, weathered sandstone                                                                                                   | Weathered decreases with depth.                                 |                                         |
| 48.0                                                                                                                                | -10.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 49.0                                                                                                                                | -11.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 50.0                                                                                                                                | -12.03                         |                                       |                                                                               | 48-51m                        | Bluish to grey fractured siltstone interbedded with weathered to very weathered arkose sandstone.                                      | bluish grey                                                     | ns of water @ 49                        |
| 51.0                                                                                                                                | -13.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 52.0                                                                                                                                | -14.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 53.0                                                                                                                                | -15.03                         |                                       |                                                                               | 51-54m                        | Interbedded weathered sandstone and bluish siltstone and iron oxides.                                                                  | Iron oxides are very moist and dark red.                        | lens of water @ 51-52m, approx. 0.01L/S |
| 54.0                                                                                                                                | -16.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 55.0                                                                                                                                | -17.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 56.0                                                                                                                                | -18.03                         |                                       |                                                                               | 54-57m                        | Interbedded fresh siltstone with weathered and coarsely fractured sandstone.                                                           | Coloration ranges from bluish (siltstones) to grey (sandstones) | water strike @ 55m, approx. 0.1 L/S     |
| 57.0                                                                                                                                | -19.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 58.0                                                                                                                                | -20.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 59.0                                                                                                                                | -21.03                         |                                       |                                                                               | 57-60m                        | Dark blue to dark fresh siltstone interbedded with a fine layers of blackish shale.                                                    | Shales contains fine layers of mudstone.                        |                                         |
| 60.0                                                                                                                                | -22.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 61.0                                                                                                                                | -23.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 62.0                                                                                                                                | -24.03                         |                                       |                                                                               | 60-63m                        | Blackish shale interbedded with thinly layered weathered mudstone                                                                      | Mudstones are normally dark blue/ black.                        |                                         |
| 63.0                                                                                                                                | -25.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 64.0                                                                                                                                | -26.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 65.0                                                                                                                                | -27.03                         |                                       |                                                                               | 63-66m                        | Weathered and coarsely fractured sandstone interbedded with thin layers of shale.                                                      |                                                                 |                                         |
| 66.0                                                                                                                                | -28.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 67.0                                                                                                                                | -29.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 68.0                                                                                                                                | -30.03                         |                                       |                                                                               | 66-69m                        | Bluish to grey finely layered fresh siltstone                                                                                          |                                                                 |                                         |
| 69.0                                                                                                                                | -31.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 70.0                                                                                                                                | -32.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 71.0                                                                                                                                | -33.03                         |                                       |                                                                               | 69-72m                        |                                                                                                                                        |                                                                 |                                         |
| 72.0                                                                                                                                | -34.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 73.0                                                                                                                                | -35.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| 74.0                                                                                                                                | -36.03                         |                                       |                                                                               | 72-75m                        | Bluish to grey fresh siltstone interbedded with slightly weatahred greyish sandstone. Quartz veins appears are among sandstone layers. |                                                                 |                                         |
| 75.0                                                                                                                                | -37.03                         |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| Ground Water Description                                                                                                            |                                |                                       |                                                                               |                               |                                                                                                                                        |                                                                 |                                         |
| Key:                                                                                                                                | Solid casing with lockable cap |                                       | Field Measurements:                                                           | Units:                        | Sample Observations:                                                                                                                   |                                                                 |                                         |
|                                                  | Steel Collar                   |                                       | pH:                                                                           | 8.58                          | pH units                                                                                                                               | Date:                                                           |                                         |
|                                                  | Cement                         |                                       | Electrical Conductivity:                                                      | 1.88                          | mS/cm                                                                                                                                  | Colour:                                                         |                                         |
|                                                  | Gravel                         |                                       | Salinity:                                                                     | 0.94                          | ppt                                                                                                                                    | Sheen:                                                          |                                         |
|                                                  | Bentonite seal                 |                                       | Dissolved Oxygen:                                                             |                               | %                                                                                                                                      | Odour:                                                          |                                         |
|                                                  | Screen with bottom end         |                                       | Turbidity:                                                                    |                               | NTU                                                                                                                                    | Silt:                                                           |                                         |
|                                                  | Ground Water Level             |                                       | Temperature:                                                                  |                               | °C                                                                                                                                     | Filtration:                                                     |                                         |
|                                                  | Water Strike                   |                                       | Indicate additional ground water level measurements here flow rate = 0.05 L/S |                               |                                                                                                                                        |                                                                 |                                         |

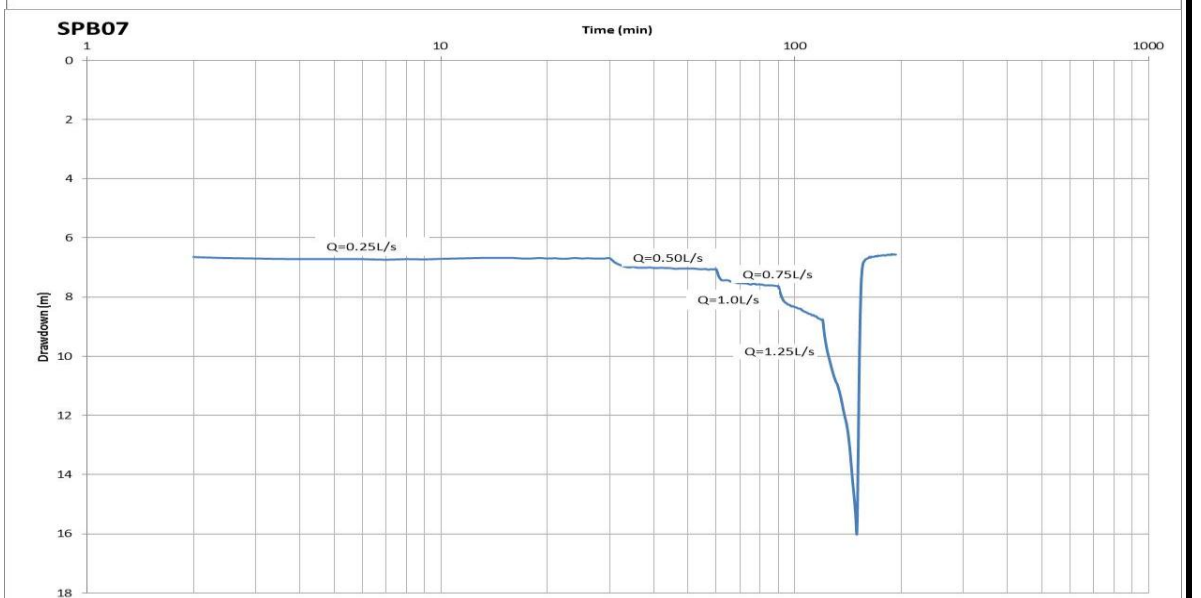
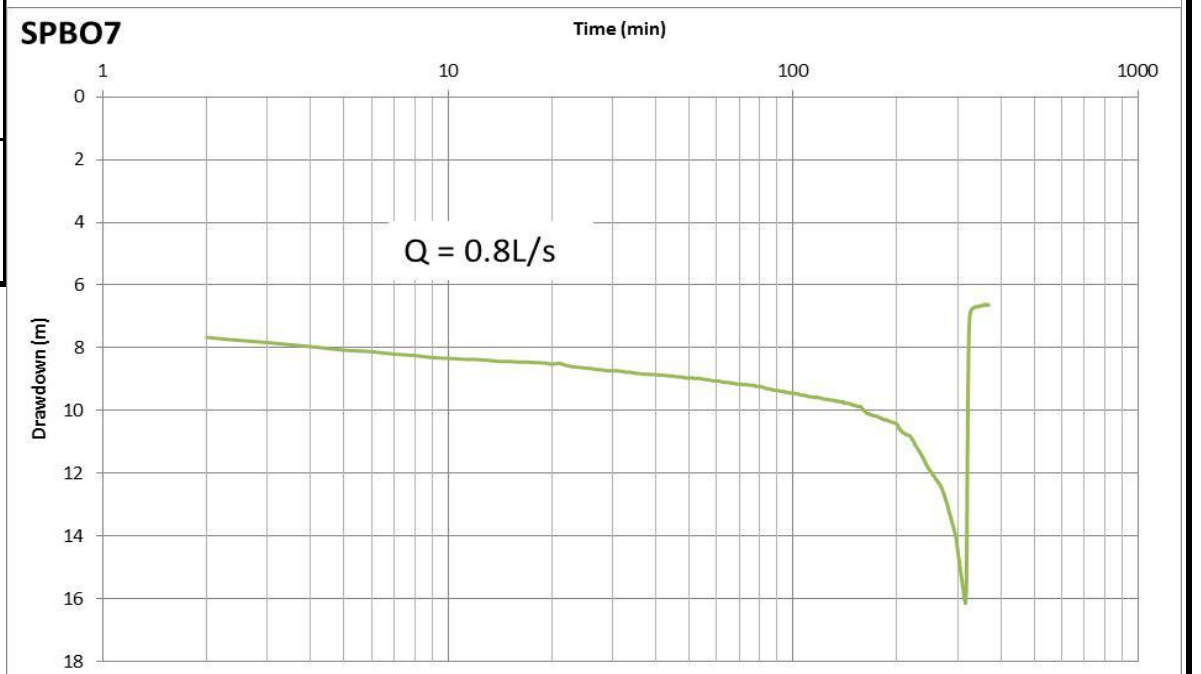
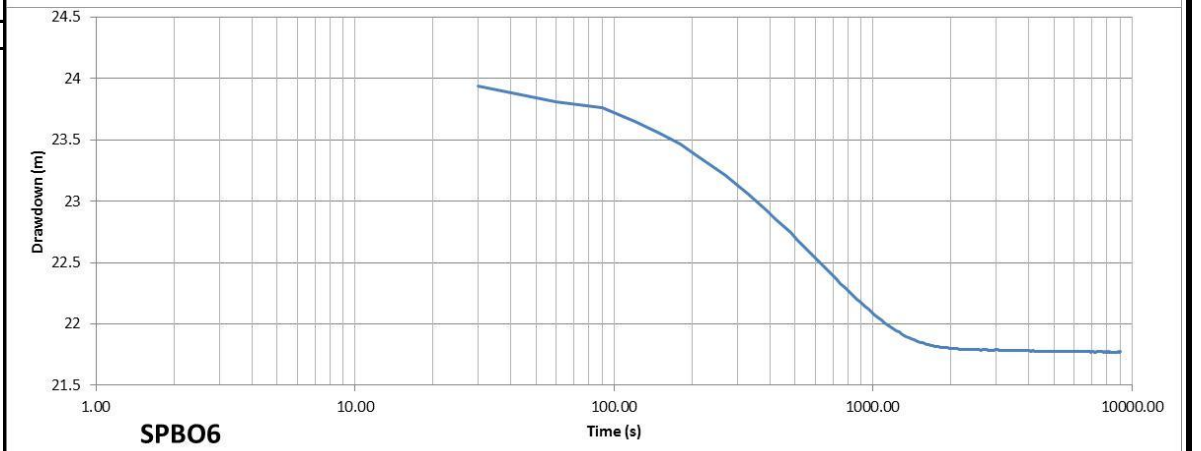
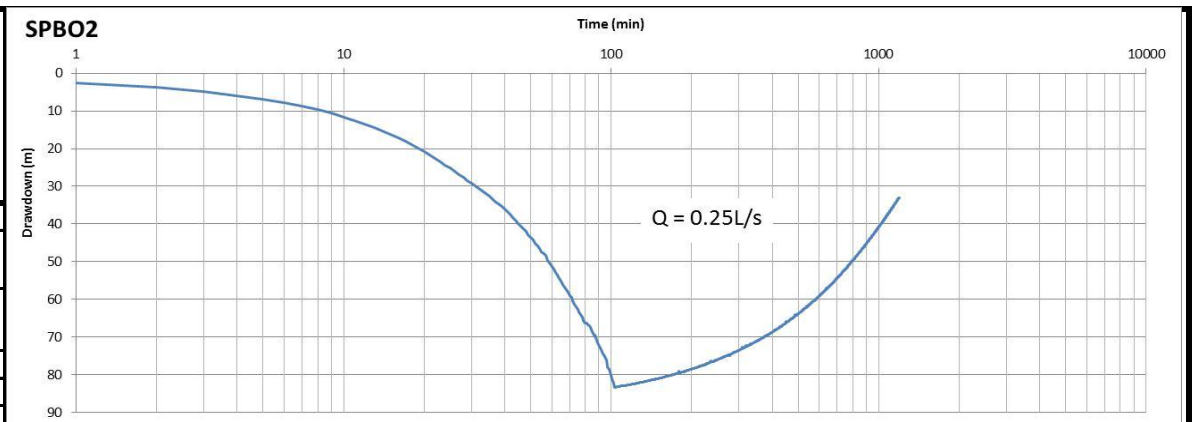
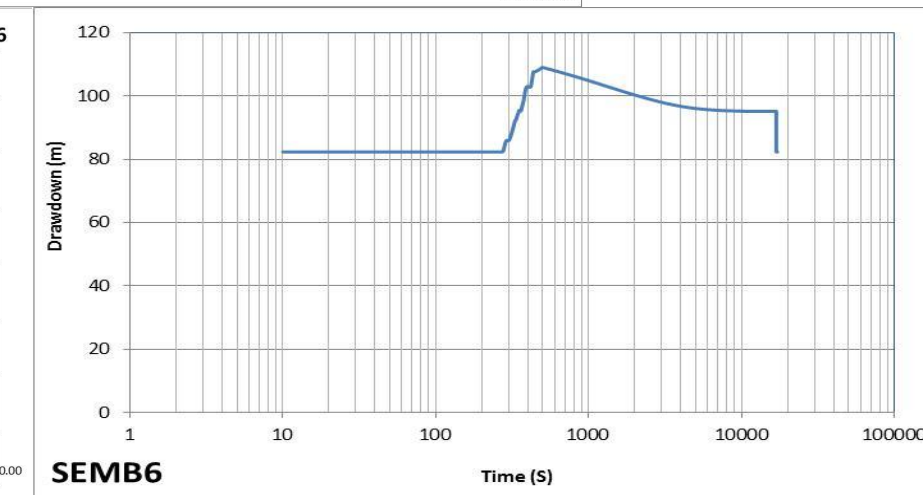
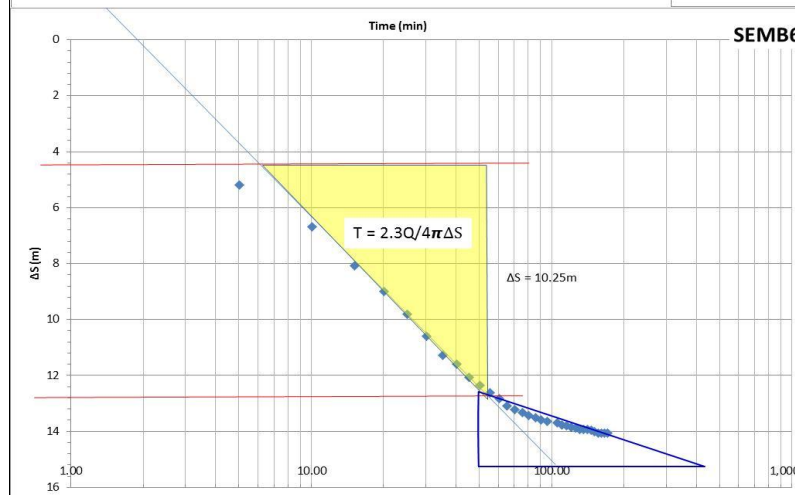
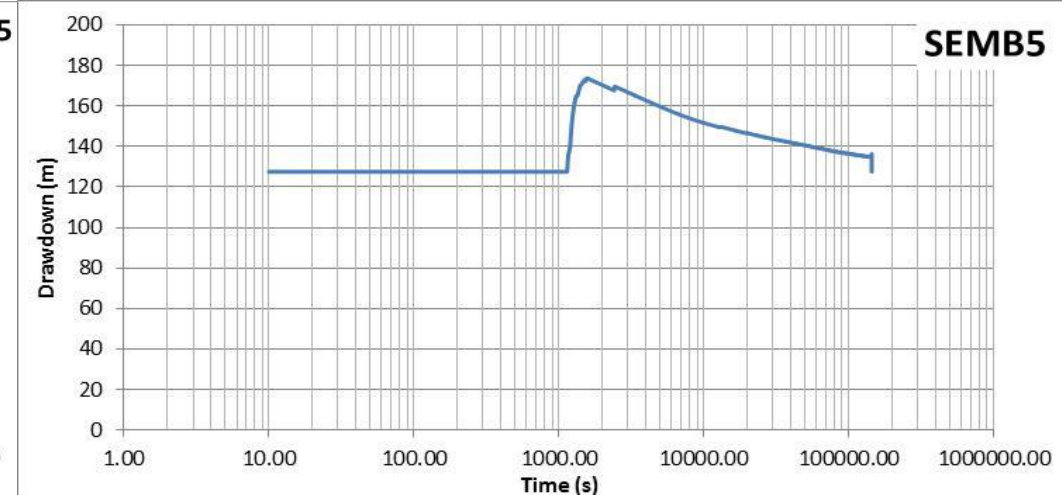
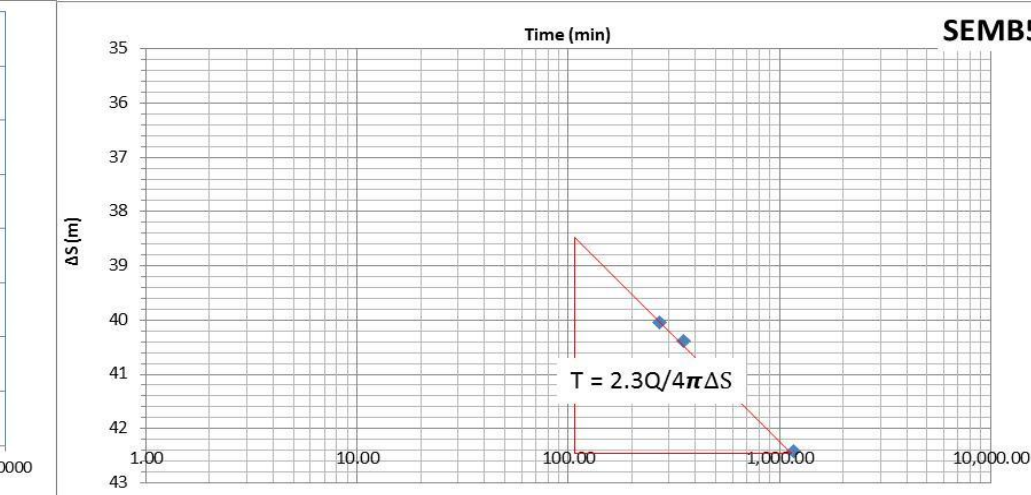
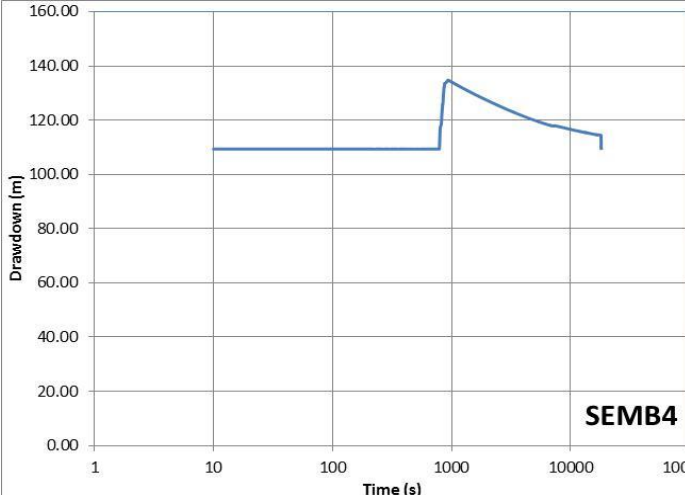
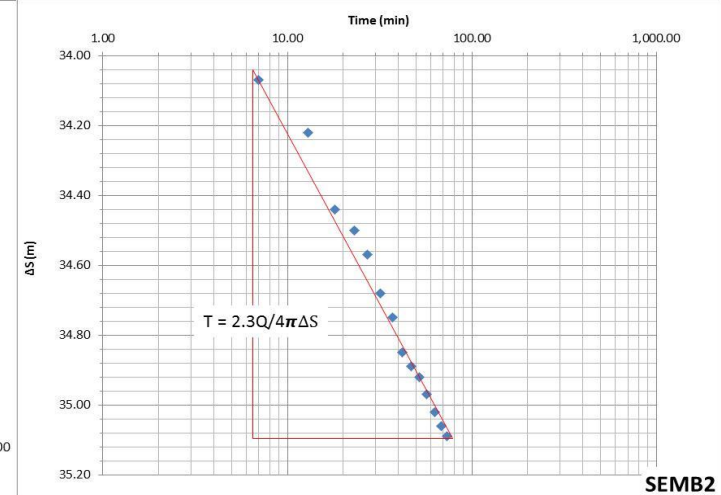
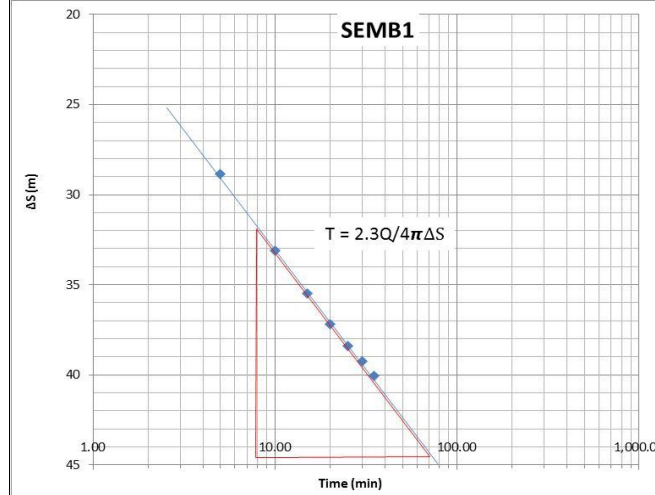
| <div></div> <div>EcOz<br/>Environmental Services</div> |                  | Project: Sherwin EIS Production Bores |                                                                               |                               |                                                                                           |                                                               |                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------|-------------------------------------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------------|
|                                                                                                                                         |                  | BORE RN:                              | RN038254                                                                      | Datum:                        | GDA94                                                                                     | Easting:                                                      | 425830                             |
|                                                                                                                                         |                  |                                       |                                                                               | Zone:                         | Zone 53L                                                                                  | Northing:                                                     | 8371827                            |
|                                                                                                                                         |                  | Project:                              | Sherwin EIS                                                                   | Drilled by:                   | AllWell Drilling                                                                          | Elevation AHD (Ground):                                       | 63.14                              |
| Reference:                                                                                                                              | Production Bores | Logged by:                            | Will Riddell (EcOz)                                                           | Elevation AHD (Ground Water): | 42.80                                                                                     |                                                               |                                    |
| Bore No                                                                                                                                 | SPB06            | Start Date:                           | 10/10/2013                                                                    | Ground Water Level (mbgl):    | 6.50                                                                                      |                                                               |                                    |
| Depth                                                                                                                                   |                  | Bore Details                          |                                                                               | Depth                         | Lithological Description                                                                  | Remarks and Observations                                      | Hardness (1-10)<br>Oxidation (1-5) |
| (mbgl)                                                                                                                                  | (mAHD)           |                                       |                                                                               | (m)                           |                                                                                           |                                                               |                                    |
| 0.0                                                                                                                                     | 63.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 1.0                                                                                                                                     | 62.14            |                                       |                                                                               | 0 - 3m                        | Dark red ferricrete and sandy regolith overlying thin ironstone layers.                   | Ferricretes are rounded to subrounded and coarse to boulders. |                                    |
| 2.0                                                                                                                                     | 61.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 3.0                                                                                                                                     | 60.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 4.0                                                                                                                                     | 59.14            |                                       |                                                                               | 3-6m                          | Pale cream to yellowish, extremely weathered sandstone interbedded with whitish claystone | Claystone are thickening with depth and are very moist.       |                                    |
| 5.0                                                                                                                                     | 58.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 6.0                                                                                                                                     | 57.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 7.0                                                                                                                                     | 56.14            |                                       |                                                                               | 6-9m                          |                                                                                           |                                                               |                                    |
| 8.0                                                                                                                                     | 55.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 9.0                                                                                                                                     | 54.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 10.0                                                                                                                                    | 53.14            |                                       |                                                                               | 10-11m                        | Pale grey to grey highly weathered claystone                                              |                                                               |                                    |
| 11.0                                                                                                                                    | 52.14            |                                       |                                                                               | 11-12m                        | Dark grey to bluish very weathered siltstone                                              | Layering is very fine.                                        |                                    |
| 12.0                                                                                                                                    | 51.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 13.0                                                                                                                                    | 50.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 14.0                                                                                                                                    | 49.14            |                                       |                                                                               | 12-24m                        | Bluish to dark grey, very weathered to weathered siltstone                                | Moist at 21-24m                                               |                                    |
| 15.0                                                                                                                                    | 48.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 16.0                                                                                                                                    | 47.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 17.0                                                                                                                                    | 46.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 18.0                                                                                                                                    | 45.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 19.0                                                                                                                                    | 44.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 20.0                                                                                                                                    | 43.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 21.0                                                                                                                                    | 42.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 22.0                                                                                                                                    | 41.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 23.0                                                                                                                                    | 40.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 24.0                                                                                                                                    | 39.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 25.0                                                                                                                                    | 38.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 26.0                                                                                                                                    | 37.14            |                                       |                                                                               | 24-27m                        | Bluish to grey weathered and fractured siltstone                                          | Lenses of water at 25 to 25.5m and at 26 to 26.5m             |                                    |
| 27.0                                                                                                                                    | 36.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 28.0                                                                                                                                    | 35.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 28.0                                                                                                                                    | 35.14            |                                       |                                                                               | 27-28m                        | Ironstone                                                                                 |                                                               |                                    |
| 29.0                                                                                                                                    | 34.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 30.0                                                                                                                                    | 33.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 31.0                                                                                                                                    | 32.14            |                                       |                                                                               | 28.5-31m                      | Bluish to dark grey, weathered siltstone.                                                 | Moist                                                         |                                    |
| 32.0                                                                                                                                    | 31.14            |                                       |                                                                               | 31-32m                        |                                                                                           | Dry                                                           |                                    |
| 33.0                                                                                                                                    | 30.14            |                                       |                                                                               | 32-33m                        |                                                                                           | Moist                                                         |                                    |
| 34.0                                                                                                                                    | 29.14            |                                       |                                                                               | 33-34m                        | Dark red to reddish ironstone (iron oxides)                                               | Moist                                                         |                                    |
| 35.0                                                                                                                                    | 28.14            |                                       |                                                                               | 34-35m                        | Bluish to dark blue fractured and weathered shale                                         | Moist                                                         |                                    |
| 36.0                                                                                                                                    | 27.14            |                                       |                                                                               | 35-36m                        | Dark red to reddish ironstone (iron oxides)                                               |                                                               |                                    |
| 37.0                                                                                                                                    | 26.14            |                                       |                                                                               | 36-37m                        | Bluish to dark grey, weathered siltstone.                                                 |                                                               |                                    |
| 38.0                                                                                                                                    | 25.14            |                                       |                                                                               | 37-38m                        | Dark red to reddish ironstone (iron oxides)                                               |                                                               |                                    |
| 39.0                                                                                                                                    | 24.14            |                                       |                                                                               | 38-39m                        | Bluish to dark grey, weathered siltstone.                                                 |                                                               |                                    |
| 40.0                                                                                                                                    | 23.14            |                                       |                                                                               | 39-41m                        | Dark red to reddish ironstone (iron oxides)                                               |                                                               |                                    |
| 41.0                                                                                                                                    | 22.14            |                                       |                                                                               | 41-42m                        | Bluish to dark grey, weathered siltstone.                                                 |                                                               |                                    |
| 42.0                                                                                                                                    | 21.14            |                                       |                                                                               | 42-45m                        | Bluish to dark grey, weathered siltstone interbedded with whitish sandstone               |                                                               | water strike @44m                  |
| 43.0                                                                                                                                    | 20.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 44.0                                                                                                                                    | 19.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 45.0                                                                                                                                    | 18.14            |                                       |                                                                               | 45-48m                        | Bluish to dark grey, weathered siltstone interbedded with finely layered mudstone         | Sooty black                                                   |                                    |
| 46.0                                                                                                                                    | 17.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 47.0                                                                                                                                    | 16.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 48.0                                                                                                                                    | 15.14            |                                       |                                                                               | 48-51m                        | Bluish to dark grey, weathered siltstone finely interbedded with some shale and sandstone | Dark grey to black, high content of organic matter            |                                    |
| 49.0                                                                                                                                    | 14.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 50.0                                                                                                                                    | 13.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 51.0                                                                                                                                    | 12.14            |                                       |                                                                               | 51-60m                        | Bluish to dark grey, weathered siltstone interbedded with whitish sandstone               |                                                               | lens of water @54m                 |
| 52.0                                                                                                                                    | 11.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 53.0                                                                                                                                    | 10.14            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 54.0                                                                                                                                    | 9.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 55.0                                                                                                                                    | 8.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 56.0                                                                                                                                    | 7.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 57.0                                                                                                                                    | 6.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 58.0                                                                                                                                    | 5.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 59.0                                                                                                                                    | 4.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 60.0                                                                                                                                    | 3.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 61.0                                                                                                                                    | 2.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 62.0                                                                                                                                    | 1.14             |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 63.0                                                                                                                                    | 0.14             |                                       |                                                                               | 60-63m                        | Dark red to reddish ironstone (iron oxides)                                               | purple to dark red                                            | Water strike @60.5-61m, 0.25 L/S   |
| 64.0                                                                                                                                    | -0.86            |                                       |                                                                               | 63-66m                        | Reddish ironstone interbedded with greyish coarse fined sandstone                         |                                                               |                                    |
| 65.0                                                                                                                                    | -1.86            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 66.0                                                                                                                                    | -2.86            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 67.0                                                                                                                                    | -3.86            |                                       |                                                                               | 66-67m                        | Bluish to dark grey, weathered siltstone and greyish sandstone.                           |                                                               |                                    |
| 68.0                                                                                                                                    | -4.86            |                                       |                                                                               | 67-69m                        | Bluish to dark grey, weathered siltstone and finely bedded sandstone                      | Fracture zone, water strike                                   |                                    |
| 69.0                                                                                                                                    | -5.86            |                                       |                                                                               | 69-70m                        | Coarse to medium grain size finely bedded greyish sandstone                               |                                                               |                                    |
| 70.0                                                                                                                                    | -6.86            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 71.0                                                                                                                                    | -7.86            |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 72.0                                                                                                                                    | -8.86            |                                       |                                                                               | 70-72m                        | Bluish to dark grey, weathered siltstone                                                  |                                                               |                                    |
| 73.0                                                                                                                                    | -9.86            |                                       |                                                                               | 72-75m                        | Bluish to dark grey, weathered siltstone interbedded with greyish sandstone               |                                                               |                                    |
| 74.0                                                                                                                                    | -10.86           |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| 75.0                                                                                                                                    | -11.86           |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
| Key:                                                                                                                                    |                  |                                       |                                                                               |                               |                                                                                           |                                                               |                                    |
|                                                                                                                                         |                  | Solid casing with lockable cap        | Field Measurements:                                                           | Units:                        | Sample Observations:                                                                      |                                                               |                                    |
|                                                                                                                                         |                  | Steel Collar                          | pH:                                                                           | 8.32                          | pH units                                                                                  | Date:                                                         |                                    |
|                                                                                                                                         |                  | Cement                                | Electrical Conductivity:                                                      | 339.1                         | µS/cm                                                                                     | Colour:                                                       |                                    |
|                                                                                                                                         |                  | Gravel                                | Salinity:                                                                     | 0.23                          | ppt                                                                                       | Sheen:                                                        |                                    |
|                                                                                                                                         |                  | Bentonite seal                        | Dissolved Oxygen:                                                             | 76.1                          | %                                                                                         | Odour:                                                        |                                    |
|                                                                                                                                         |                  | Screen with bottom end                | Turbidity:                                                                    |                               | NTU                                                                                       | Silt:                                                         |                                    |
|                                                                                                                                         |                  | Ground Water Level                    | Temperature:                                                                  | 30.5                          | °C                                                                                        | Filtration:                                                   |                                    |
|                                                                                                                                         |                  | Water Strike                          | Indicate additional ground water level measurements here flow rate = 0.22 L/S |                               |                                                                                           |                                                               |                                    |

| <div></div> <div>EcOz<br/>Environmental Services</div> |                  | Project: Sherwin EIS Production Bores |                    |                               |                                                                                                                                                                     |                                             |                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------|--------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------------------|
|                                                                                                                                         |                  | BORE RN:                              | RN038256           | Datum:                        | GDA94                                                                                                                                                               | Easting:                                    | 420495                             |
|                                                                                                                                         |                  |                                       |                    | Zone:                         | Zone 53L                                                                                                                                                            | Northing:                                   | 8370476                            |
|                                                                                                                                         |                  | Project:                              | Sherwin EIS        | Drilled by:                   | AllWell Drilling                                                                                                                                                    | Elevation AHD (Ground):                     | 49.30                              |
| Reference:                                                                                                                              | Production Bores | Logged by:                            | Helen Dwyer (EcOz) | Elevation AHD (Ground Water): | 42.80                                                                                                                                                               |                                             |                                    |
| Bore No                                                                                                                                 | SPB07            | Start Date:                           | 17/10/2013         | Ground Water Level (mbgl):    | 6.50                                                                                                                                                                |                                             |                                    |
| Depth<br>(mbgl)                                                                                                                         |                  | Bore Details                          |                    | Depth<br>(m)                  | Lithological Description                                                                                                                                            | Remarks and Observations                    | Hardness (1-10)<br>Oxidation (1-5) |
|                                                                                                                                         | (mAHD)           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 0.0                                                                                                                                     | 49.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 1.0                                                                                                                                     | 48.30            |                                       |                    | 0-3m                          | Light brown clay and dark brown coarse sandy gravel underlain fine to coarse sandy reddish soils.                                                                   |                                             |                                    |
| 2.0                                                                                                                                     | 47.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 3.0                                                                                                                                     | 46.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 4.0                                                                                                                                     | 45.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 5.0                                                                                                                                     | 44.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 6.0                                                                                                                                     | 43.30            |                                       |                    | 3-12m                         | Brecciated, coarse gravelly soils overlying extremely weathered sandstone, siltstone and claystone. Colour of materials range from dark brown to brown to purple.   | Water strike at 9m, approximately 0.016L/s. |                                    |
| 7.0                                                                                                                                     | 42.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 8.0                                                                                                                                     | 41.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 9.0                                                                                                                                     | 40.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 10.0                                                                                                                                    | 39.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 11.0                                                                                                                                    | 38.30            |                                       |                    | 12-21m                        | Dark grey/blue to black fractured siltstone. Some quartz bands at 18m. This is overlying and fractured zone at which blue/black mudstone pebbles are found (~ 21m). | Water strike at 15m, approximately 1L/s.    |                                    |
| 12.0                                                                                                                                    | 37.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 13.0                                                                                                                                    | 36.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 14.0                                                                                                                                    | 35.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 15.0                                                                                                                                    | 34.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 16.0                                                                                                                                    | 33.30            |                                       |                    | 21-24m                        | Black fractured shale overlying and finely interbedding with bluish siltstone layers.                                                                               |                                             |                                    |
| 17.0                                                                                                                                    | 32.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 18.0                                                                                                                                    | 31.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 19.0                                                                                                                                    | 30.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 20.0                                                                                                                                    | 29.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 21.0                                                                                                                                    | 28.30            |                                       |                    | 26.0                          | 23.30                                                                                                                                                               |                                             |                                    |
| 22.0                                                                                                                                    | 27.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 23.0                                                                                                                                    | 26.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 24.0                                                                                                                                    | 25.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 25.0                                                                                                                                    | 24.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 26.0                                                                                                                                    | 23.30            |                                       |                    | 27.0                          | 22.30                                                                                                                                                               |                                             |                                    |
| 27.0                                                                                                                                    | 22.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 28.0                                                                                                                                    | 21.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 29.0                                                                                                                                    | 20.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 30.0                                                                                                                                    | 19.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 31.0                                                                                                                                    | 18.30            |                                       |                    | 32.0                          | 17.30                                                                                                                                                               |                                             |                                    |
| 32.0                                                                                                                                    | 17.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 33.0                                                                                                                                    | 16.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 34.0                                                                                                                                    | 15.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 35.0                                                                                                                                    | 14.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 36.0                                                                                                                                    | 13.30            |                                       |                    | 37.0                          | 12.30                                                                                                                                                               |                                             |                                    |
| 37.0                                                                                                                                    | 12.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 38.0                                                                                                                                    | 11.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 39.0                                                                                                                                    | 10.30            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 40.0                                                                                                                                    | 9.30             |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 41.0                                                                                                                                    | 8.30             |                                       |                    | 42.0                          | 7.30                                                                                                                                                                |                                             |                                    |
| 42.0                                                                                                                                    | 7.30             |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 43.0                                                                                                                                    | 6.30             |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 44.0                                                                                                                                    | 5.30             |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 45.0                                                                                                                                    | 4.30             |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 46.0                                                                                                                                    | 3.30             |                                       |                    | 47.0                          | 2.30                                                                                                                                                                |                                             |                                    |
| 47.0                                                                                                                                    | 2.30             |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 48.0                                                                                                                                    | 1.30             |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 49.0                                                                                                                                    | 0.30             |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 50.0                                                                                                                                    | -0.70            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 51.0                                                                                                                                    | -1.70            |                                       |                    | 52.0                          | -2.70                                                                                                                                                               |                                             |                                    |
| 52.0                                                                                                                                    | -2.70            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 53.0                                                                                                                                    | -3.70            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 54.0                                                                                                                                    | -4.70            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 55.0                                                                                                                                    | -5.70            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 56.0                                                                                                                                    | -6.70            |                                       |                    | 57.0                          | -7.70                                                                                                                                                               |                                             |                                    |
| 57.0                                                                                                                                    | -7.70            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 58.0                                                                                                                                    | -8.70            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 59.0                                                                                                                                    | -9.70            |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 60.0                                                                                                                                    | -10.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 61.0                                                                                                                                    | -11.70           |                                       |                    | 62.0                          | -12.70                                                                                                                                                              |                                             |                                    |
| 62.0                                                                                                                                    | -12.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 63.0                                                                                                                                    | -13.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 64.0                                                                                                                                    | -14.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 65.0                                                                                                                                    | -15.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 66.0                                                                                                                                    | -16.70           |                                       |                    | 67.0                          | -17.70                                                                                                                                                              |                                             |                                    |
| 67.0                                                                                                                                    | -17.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 68.0                                                                                                                                    | -18.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 69.0                                                                                                                                    | -19.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 70.0                                                                                                                                    | -20.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 71.0                                                                                                                                    | -21.70           |                                       |                    | 72.0                          | -22.70                                                                                                                                                              |                                             |                                    |
| 72.0                                                                                                                                    | -22.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 73.0                                                                                                                                    | -23.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 74.0                                                                                                                                    | -24.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |
| 75.0                                                                                                                                    | -25.70           |                                       |                    |                               |                                                                                                                                                                     |                                             |                                    |

| Ground Water Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                                                           |                          |      |          |                      |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------------------------|--------------------------|------|----------|----------------------|--|
| <div><br/><br/><br/><br/><br/><br/><br/></div> | Key:         | Solid casing with lockable cap                            | Field Measurements:      |      | Units:   | Sample Observations: |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              | Steel Collar                                              | pH:                      | 6.5  | pH units | Date:                |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              | Cement                                                    | Electrical Conductivity: |      | mS/cm    | Colour:              |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              | Gravel                                                    | Salinity:                | 0.28 | ppt      | Sheen:               |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              | Bentonite seal                                            | Dissolved Oxygen:        |      | %        | Odour:               |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              | Screen with bottom end                                    | Turbidity:               |      | NTU      | Silt:                |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              | Ground Water Level                                        | Temperature:             |      | °C       | Filtration:          |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Water Strike | Indicate additional ground water level measurements here: |                          |      |          |                      |  |

Appendix B:  
Summary of Groundwater Investigations

| Bore location Details |       |          | Bore and Natural Ground Details |            |               | Drilling, Bore Construction Details and Groundwater Levels (below TOC) |                     |                                  |                                                                                   |                   |                  |            |              |                |                | Pumping/Slug Test Details      |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    | Notes           |
|-----------------------|-------|----------|---------------------------------|------------|---------------|------------------------------------------------------------------------|---------------------|----------------------------------|-----------------------------------------------------------------------------------|-------------------|------------------|------------|--------------|----------------|----------------|--------------------------------|------------------------------------------------------------------|---------------------|-----------------------------------------|-----------------------|-----------------------------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------|-----------------|
| Bore ID               | Zone  | Easting  | Northing                        | Bore Depth | Screen (mBGL) | Elevation                                                              | Water Strikes Depth | Aquifer Lithology                | Yield at water strike                                                             | Casing height     | Elevation (mAHD) | Height TOC | GWL          | GWL (from TOC) | Airlift Yields | Pump Testing Flow Rate/s (L/s) | Step Number                                                      | Slug Water Rate L/s | Duration Slug Water Dissipation (min)   | Recharge/Recovery (%) | Optimum Flow Rate, Medium Term Sustainability (L/s) | FC Method Long Term Sustainable Yield (L/s)                      |                                                                    |                 |
|                       | mEast | mNorth   | mbgl                            | from       | to            | mAHD                                                                   |                     |                                  | mBGL                                                                              | L/sec             | m                | mAHD       | from TOC (m) | mAHD           | L/s            |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  |                                                                                   |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
| SEMB1                 | 53L   | 428210.0 | 8372051.1                       | 50         | 26            | 50                                                                     | 161.85              | 47                               | Fractured siltstone                                                               | Moisture          | 0.84             | 161.85     | 162.69       | 50.0           | 112.7          | <0.01                          | Slug Test                                                        | 3.0                 | Data Recovered equates to 35 and 73min. | -                     | -                                                   | No Calculations                                                  | Moisture in shale underlying golden clay                           |                 |
| SEMB2                 | 53L   | 427053.3 | 8372784.6                       | 50         | 26            | 50                                                                     | 145.95              | 37                               | Fractured siltstone                                                               | 0.2               | 0.85             | 145.95     | 146.8        | 36.6           | 110.2          | 0.20                           |                                                                  |                     |                                         | 50                    | 0.10                                                |                                                                  | Fracture zone at the Siltstones                                    |                 |
| SEMB3                 | 53L   | 426137.7 | 8371788.2                       | 55         | 15.5          | 50                                                                     | 72.06               | 16.5                             | Sandstone and siltstone with minor iron rich sandstone                            | 0.11              | 1.02             | 72.06      | 73.08        | 4.3            | 68.8           | 1.33                           | 1.0                                                              | Steady Test         | 75                                      | 0.90                  | 0.81                                                | Infiltration 3% = 24mm/year; Fracture sedimentary stratification |                                                                    |                 |
| SEMB4                 | 53L   | 426768.9 | 8370984.1                       | 40         | 15.5          | 40                                                                     | 139.91              | 23                               | Siltstone with sandstone and minor shale                                          | 1.33              | 0.71             | 139.91     | 140.62       | 22.9           | 117.7          | 0.10                           | Slug Test                                                        | 3.0                 | 303.7                                   | 50                    | -                                                   | No Calculations                                                  | Moisture in iron rich sandstones.                                  |                 |
| SEMB5                 | 53L   | 427246.2 | 8369913.3                       | 50         | 26            | 50                                                                     | 173.14              | 43                               | Golden clay                                                                       | Moisture          | 0.90             | 173.14     | 174.04       | 45.8           | 128.2          | <0.01                          |                                                                  |                     |                                         | -                     | -                                                   |                                                                  | Moisture in clays                                                  |                 |
| SEMB6                 | 53L   | 426032.2 | 8371369.1                       | 55         | 19            | 55                                                                     | 98.23               | 25                               | Siltstone and sandstone                                                           | <0.1              | 0.62             | 98.23      | 98.85        | 16.3           | 82.6           | 0.14                           | No Test                                                          |                     | 285.2                                   | 75                    | 0.10                                                |                                                                  | Weathered sandstone                                                |                 |
| SPB01                 | 53L   | 420648.7 | 8370767.1                       | 21         | 15            | 21                                                                     | 51.45               | 13 to 18                         | Siltstone                                                                         | 0.4               | 0.72             | 51.45      | 52.17        | 9.6            | 42.6           | 0.50                           |                                                                  |                     |                                         | 97                    | 0.40                                                |                                                                  | Grey siltstone and quartz.                                         |                 |
| SPB02                 | 53L   | 424522.2 | 8372893.1                       | 100        | 88            | 94                                                                     | 47.21               | 26, 34, 37, 51                   | Siltstone and sandstone layers with discrete shale layer                          | Seepage, 0.5      | 0.86             | 47.21      | 48.07        | 2.3            | 45.8           | 0.05                           | 0.25                                                             | Steady Test         |                                         | 50                    | 0.10                                                | No Calculations                                                  | Moisture layers among iron rich sandstones, siltstones and shales. |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Interbedded layers of sandstone, iron oxides, siltstone and shales                |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Ironstone and sandstone and deeps into sandstone with mudstone and siltstone.     |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
| SPB03                 | 53L   | 423366.2 | 8373145.2                       | 75         | 63            | 69                                                                     | 37.97               | 34.5, 48.5, 51, 55, 67           | Interbedded and fractured siltstone, shale and mudstones                          | Moisture, Seepage | 0.69             | 37.97      | 38.66        | 0.5            | 38.2           | <0.1                           | No Test                                                          |                     |                                         | 50                    | -                                                   |                                                                  |                                                                    | No Calculations |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Weathered to fresh siltstone                                                      |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Fractured siltstone interbedded with weathered to very weathered arkose sandstone |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Interbedded weathered sandstone and bluish siltstone and iron oxides              |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
| SPB06                 | 53L   | 425830.4 | 8371827.1                       | 75         | 63            | 69                                                                     | 63.14               | 25, 26, 40.5, 43.5, 53.5, 61, 67 | Interbedded fresh siltstone with weathered and coarsely fractured sandstone       | Moisture          | 0.6              | 63.14      | 63.74        | 3.5            | 60.3           | 0.22                           | Slug Test                                                        | 3.0                 | 150.5                                   | 90                    | 0.20                                                | No Calculations                                                  | Moisture layers among iron rich sandstones, siltstones and shales. |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Fresh siltstone                                                                   |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Weathered and fractured siltstone                                                 |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Weathered and fractured siltstone                                                 |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
| SPB07                 | 53L   | 420495.4 | 8370476.3                       | 75         | 21            | 27                                                                     | 49.30               | 9, 15                            | Ironstone (iron oxides)                                                           | Moisture          | 0.25             |            |              |                |                |                                | Step Test (0.25, 0.5, 0.75, 1.0, 1.25 L/s); Steady Test (0.8L/s) |                     |                                         | 97                    | 0.65                                                | 0.11                                                             | Infiltration 10% = 81.5mm/year; alluvial groundwater system        |                 |
|                       |       |          |                                 |            | 45            | 51                                                                     |                     |                                  | Weathered siltstone interbedded with sandstone                                    |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Weathered siltstone interbedded with sandstone                                    |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Ironstone (iron oxides)                                                           |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
| SPB07                 | 53L   | 420495.4 | 8370476.3                       | 75         |               |                                                                        | 49.30               | 9, 15                            | Weathered siltstone and sandstone                                                 | Moisture          | 0.016            | 0.48       | 49.3         | 49.78          | 6.5            | 43.3                           | 1.00                                                             | 0.8                 |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Gravelly soils overlying extremely weathered sandstone, siltstone and claystone   |                   |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |
|                       |       |          |                                 |            |               |                                                                        |                     |                                  | Fractured siltstone                                                               | 1.0               |                  |            |              |                |                |                                |                                                                  |                     |                                         |                       |                                                     |                                                                  |                                                                    |                 |

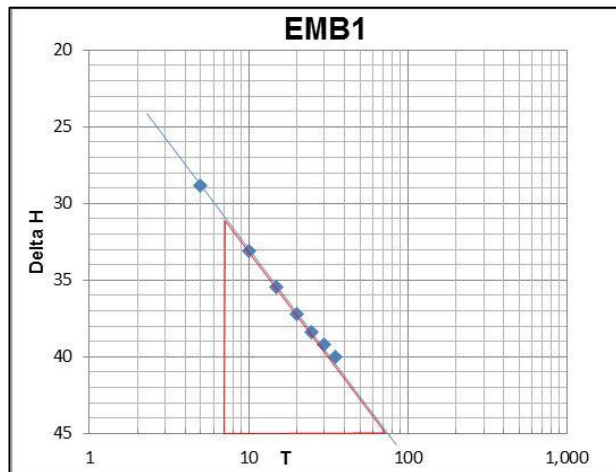


Appendix C:  
Slug Test Data

## Slug Test Data SEMB1

| Bore ID        | SEMB1      | Notes                                                                                                  |
|----------------|------------|--------------------------------------------------------------------------------------------------------|
| SWL to TOC     | 50.97      | Test abandoned after 10,000 litres couldn't fill casing. Casing could be heard gurgling during filling |
| Casing Height  | 0.87m      |                                                                                                        |
| Diver Depth    |            |                                                                                                        |
| Start Date     | 12/09/2013 |                                                                                                        |
| Start Time     | 16:30      |                                                                                                        |
| Time Submerged |            |                                                                                                        |
| Stop Date      | 12/09/2013 |                                                                                                        |
| Stop Time      |            |                                                                                                        |

| Date       | Time  | min   | SWL from TOC (m) |
|------------|-------|-------|------------------|
| 12/09/2013 | 17:40 | 0.00  | 19               |
| 12/09/2013 | 17:45 | 5.00  | 28.87            |
| 12/09/2013 | 17:50 | 10.00 | 33.1             |
| 12/09/2013 | 17:55 | 15.00 | 35.47            |
| 12/09/2013 | 18:00 | 20.00 | 37.2             |
| 12/09/2013 | 18:05 | 25.00 | 38.39            |
| 12/09/2013 | 18:10 | 30.00 | 39.24            |
| 12/09/2013 | 18:15 | 35.00 | 40.05            |



$$T = 2.3Q/4\pi\Delta S$$

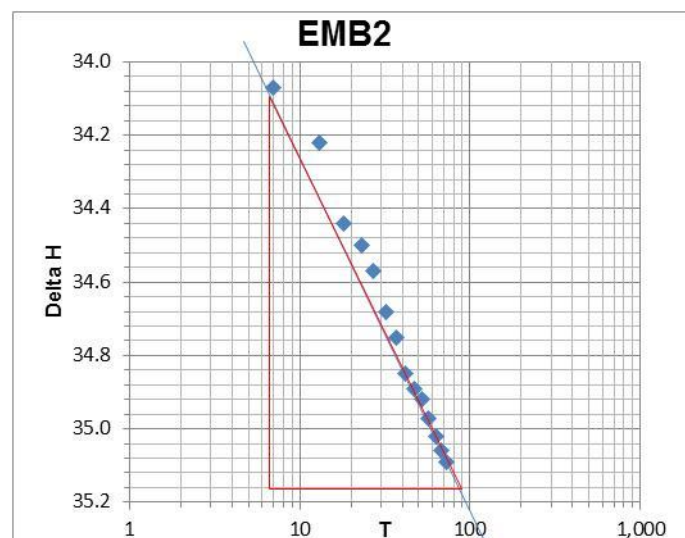
$$S = 2.25Tt_0/r^2 = 2.3Qt_0/1.78\pi r^2\Delta S$$

$$T = Kb$$

## Slug Test Data SEMB2

| Bore ID        | SEMB2      | Notes                                                                                                                                       |
|----------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| SWL to TOC     | 36.06      | Test abandoned after 12,000 litres couldn't fill casing. Water pumped in at 3L/s for 2 hours. Casing could be heard gurgling during filling |
| Casing Height  | 0.65m      |                                                                                                                                             |
| Diver Depth    |            |                                                                                                                                             |
| Start Date     | 10/09/2013 |                                                                                                                                             |
| Start Time     | 9:28       |                                                                                                                                             |
| Time Submerged |            |                                                                                                                                             |

| Stop Date  | 10/09/2013 |       |                  |
|------------|------------|-------|------------------|
| Stop Time  |            |       |                  |
| Date       | Time       | min   | SWL from TOC (m) |
| 10/09/2013 | 11:47      | 0.00  | 33.63            |
| 10/09/2013 | 11:54      | 7.00  | 34.07            |
| 10/09/2013 | 12:00      | 13.00 | 34.22            |
| 10/09/2013 | 12:05      | 18.00 | 34.44            |
| 10/09/2013 | 12:12      | 23.00 | 34.5             |
| 10/09/2013 | 12:16      | 27.00 | 34.57            |
| 10/09/2013 | 12:21      | 32.00 | 34.68            |
| 10/09/2013 | 12:26      | 37.00 | 34.75            |
| 10/09/2013 | 12:31      | 42.00 | 34.85            |
| 10/09/2013 | 12:36      | 47.00 | 34.89            |
| 10/09/2013 | 12:41      | 52.00 | 34.92            |
| 10/09/2013 | 12:46      | 57.00 | 34.97            |
| 10/09/2013 | 12:52      | 63.00 | 35.02            |
| 10/09/2013 | 12:57      | 68.00 | 35.06            |
| 10/09/2013 | 13:02      | 73.00 | 35.09            |

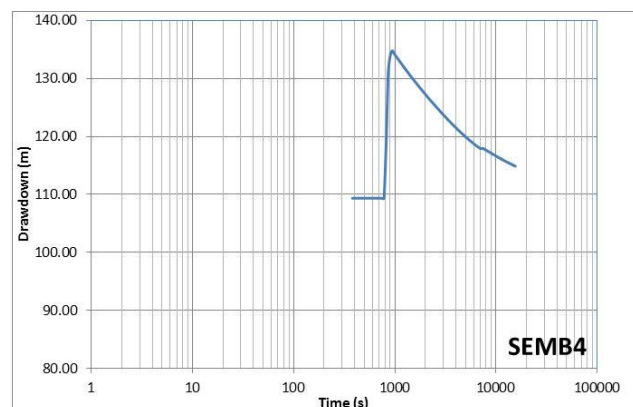


$$T = 2.3Q/4\pi\Delta S$$

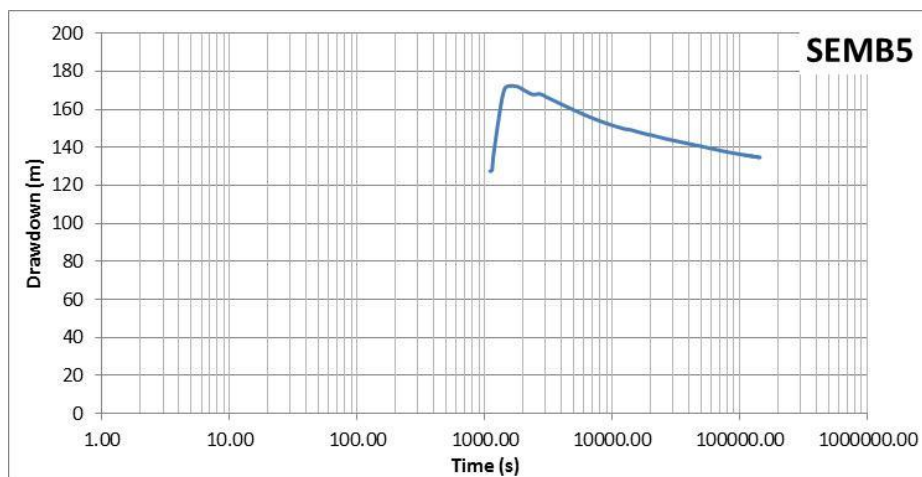
$$S = 2.25Tt_0/r^2 = 2.3Qt_0/1.78\pi r^2\Delta S$$

$$T = Kb$$

### Slug Test Data SEMB4



| Date       | h:m:s   | Time (s)  |           | mH2O | ΔmH2O | GWL (mAHD) |
|------------|---------|-----------|-----------|------|-------|------------|
| 10/09/2013 | 40:44.0 | 143490.00 | 141925.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 40:49.0 | 143495.00 | 141930.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 40:54.0 | 143500.00 | 141935.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 40:59.0 | 143505.00 | 141940.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 41:04.0 | 143510.00 | 141945.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 41:09.0 | 143515.00 | 141950.00 | 1738 | 730   | 134.81     |
| 10/09/2013 | 41:14.0 | 143520.00 | 141955.00 | 1739 | 729   | 134.82     |
| 10/09/2013 | 41:19.0 | 143525.00 | 141960.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 41:24.0 | 143530.00 | 141965.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 41:29.0 | 143535.00 | 141970.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 41:34.0 | 143540.00 | 141975.00 | 1738 | 729   | 134.81     |
| 10/09/2013 | 41:39.0 | 143545.00 | 141980.00 | 1738 | 730   | 134.81     |

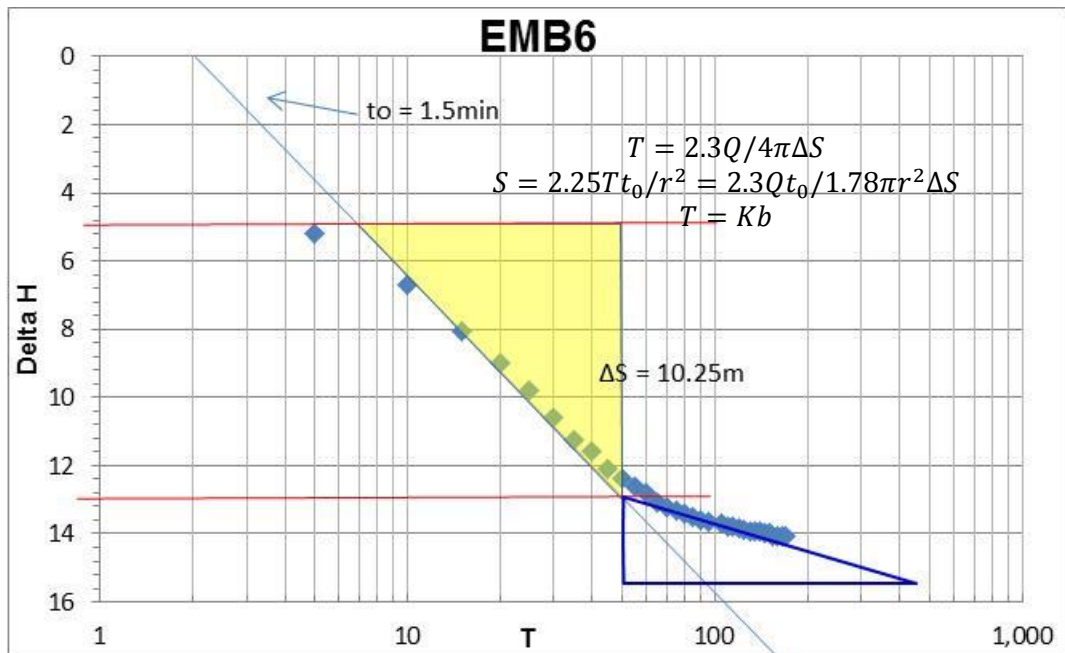


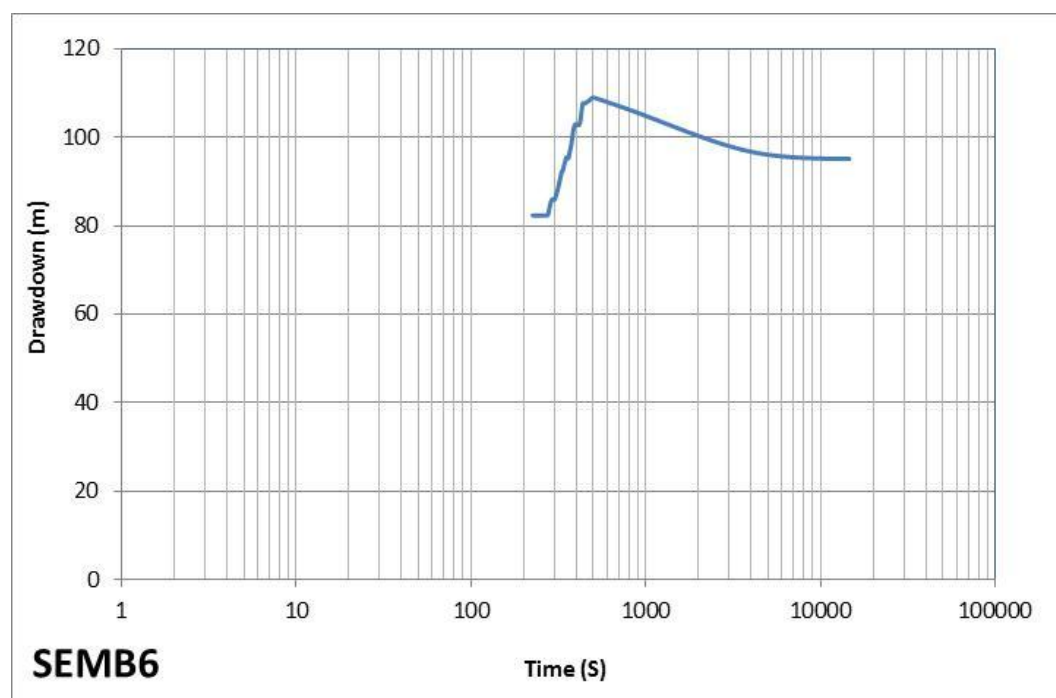
### Slug Test Data SEMB6

|                       |            |                      |            |              |
|-----------------------|------------|----------------------|------------|--------------|
| <b>Bore ID</b>        | SEMB6      | <b>Casing Height</b> | 0.81m      | <b>Notes</b> |
| <b>SWL to TOC</b>     | 16.27m     | <b>Diver Depth</b>   | 25.0m      |              |
| <b>Start Date</b>     | 12/09/2013 | <b>Stop Date</b>     | 12/09/2013 |              |
| <b>Start Time</b>     | 10:34      | <b>Stop Time</b>     | 15:18      |              |
| <b>Time Submerged</b> | 10:42      |                      |            |              |

| Date       | Time  | min   | SWL from TOC (m) |
|------------|-------|-------|------------------|
| 12/09/2013 | 10:47 | 0.00  | 3.56             |
| 12/09/2013 | 10:52 | 5.00  | 5.18             |
| 12/09/2013 | 10:57 | 10.00 | 6.7              |
| 12/09/2013 | 11:02 | 15.00 | 8.08             |
| 12/09/2013 | 11:07 | 20.00 | 9                |
| 12/09/2013 | 11:12 | 25.00 | 9.81             |
| 12/09/2013 | 11:17 | 30.00 | 10.61            |
| 12/09/2013 | 11:22 | 35.00 | 11.27            |
| 12/09/2013 | 11:27 | 40.00 | 11.6             |
| 12/09/2013 | 11:32 | 45.00 | 12.08            |
| 12/09/2013 | 11:37 | 50.00 | 12.36            |
| 12/09/2013 | 11:42 | 55.00 | 12.63            |

|            |       |        |       |
|------------|-------|--------|-------|
| 12/09/2013 | 11:47 | 60.00  | 12.82 |
| 12/09/2013 | 11:52 | 65.00  | 13.1  |
| 12/09/2013 | 11:57 | 70.00  | 13.23 |
| 12/09/2013 | 12:02 | 75.00  | 13.33 |
| 12/09/2013 | 12:07 | 80.00  | 13.43 |
| 12/09/2013 | 12:12 | 85.00  | 13.5  |
| 12/09/2013 | 12:17 | 90.00  | 13.58 |
| 12/09/2013 | 12:22 | 95.00  | 13.63 |
| 12/09/2013 | 12:27 | 105.00 | 13.7  |
| 12/09/2013 | 12:32 | 110.00 | 13.77 |
| 12/09/2013 | 12:37 | 115.00 | 13.8  |
| 12/09/2013 | 12:42 | 120.00 | 13.85 |
| 12/09/2013 | 12:47 | 125.00 | 13.89 |
| 12/09/2013 | 12:52 | 130.00 | 13.92 |
| 12/09/2013 | 12:57 | 135.00 | 13.93 |
| 12/09/2013 | 13:02 | 140.00 | 13.94 |
| 12/09/2013 | 13:12 | 145.00 | 13.96 |
| 12/09/2013 | 13:22 | 150.00 | 14    |
| 12/09/2013 | 14:22 | 155.00 | 14.05 |
| 12/09/2013 | 14:37 | 160.00 | 14.05 |
| 12/09/2013 | 14:52 | 165.00 | 14.06 |
| 12/09/2013 | 15:15 | 170.00 | 14.06 |

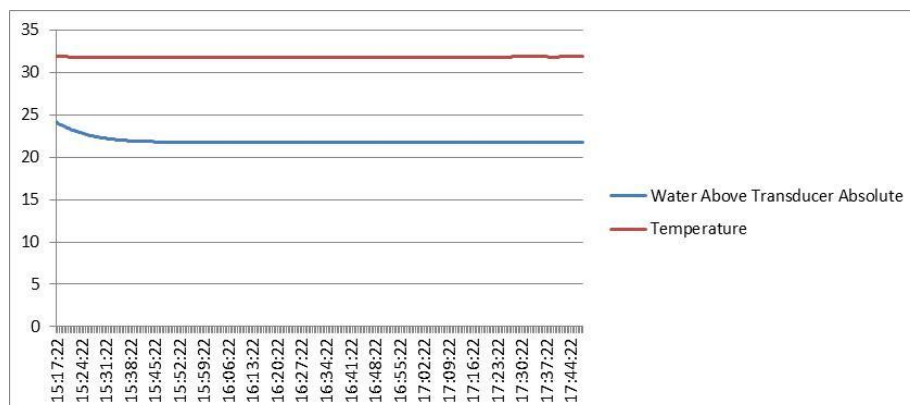
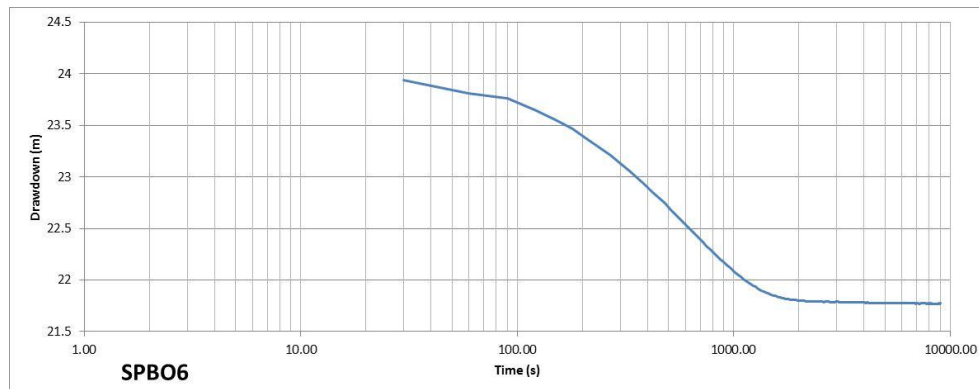




| Date       | Real time   | cumulative Time (s) | cmH2O | $\Delta$ (cmH2O) | GWL (mAHD) |
|------------|-------------|---------------------|-------|------------------|------------|
|            |             |                     |       |                  | 82.33      |
| 12/09/2013 | 10:38:11 AM | 225                 | 1017  | -0.01            | 82.32      |
| 12/09/2013 | 10:38:16 AM | 230                 | 1018  | -0.01            | 82.32      |
| 12/09/2013 | 10:38:21 AM | 235                 | 1018  | -0.01            | 82.32      |
| 12/09/2013 | 10:38:26 AM | 240                 | 1018  | -0.02            | 82.31      |
| 12/09/2013 | 10:38:31 AM | 245                 | 1017  | -0.02            | 82.31      |
| 12/09/2013 | 10:38:36 AM | 250                 | 1017  | -0.02            | 82.31      |
| 12/09/2013 | 10:38:41 AM | 255                 | 1017  | -0.03            | 82.3       |
| 12/09/2013 | 10:38:46 AM | 260                 | 1016  | -0.02            | 82.31      |
| 12/09/2013 | 10:38:51 AM | 265                 | 1017  | -0.02            | 82.31      |
| 12/09/2013 | 10:38:56 AM | 270                 | 1017  | -0.02            | 82.31      |
| 12/09/2013 | 10:39:01 AM | 275                 | 1017  | 0.14             | 82.47      |
| 12/09/2013 | 10:39:06 AM | 280                 | 1033  | 1.5              | 83.83      |
| 12/09/2013 | 10:39:11 AM | 285                 | 1169  | 2.91             | 85.24      |
| 12/09/2013 | 10:39:16 AM | 290                 | 1310  | 3.6              | 85.93      |
| 12/09/2013 | 10:39:21 AM | 295                 | 1379  | 3.6              | 85.93      |
| 12/09/2013 | 10:39:26 AM | 300                 | 1379  | 3.57             | 85.9       |
| 12/09/2013 | 10:39:31 AM | 305                 | 1376  | 4.29             | 86.62      |
| 12/09/2013 | 10:39:36 AM | 310                 | 1448  | 5.29             | 87.62      |
| 12/09/2013 | 10:39:41 AM | 315                 | 1548  | 6.36             | 88.69      |
| 12/09/2013 | 10:39:46 AM | 320                 | 1655  | 7.55             | 89.88      |
| 12/09/2013 | 10:39:51 AM | 325                 | 1774  | 8.79             | 91.12      |
| 12/09/2013 | 10:39:56 AM | 330                 | 1898  | 9.89             | 92.22      |
| 12/09/2013 | 10:40:01 AM | 335                 | 2008  | 10.21            | 92.54      |
| 12/09/2013 | 10:40:06 AM | 340                 | 2040  | 11.35            | 93.68      |
| 12/09/2013 | 10:40:11 AM | 345                 | 2154  | 12.15            | 94.48      |
| 12/09/2013 | 10:40:16 AM | 350                 | 2234  | 13.1             | 95.43      |
| 12/09/2013 | 10:40:21 AM | 355                 | 2329  | 13.05            | 95.38      |
| 12/09/2013 | 10:40:26 AM | 360                 | 2324  | 12.93            | 95.26      |
| 12/09/2013 | 10:40:31 AM | 365                 | 2312  | 14.05            | 96.38      |
| 12/09/2013 | 10:40:36 AM | 370                 | 2424  | 15.14            | 97.47      |
| 12/09/2013 | 10:40:41 AM | 375                 | 2533  | 16.34            | 98.67      |
| 12/09/2013 | 10:40:46 AM | 380                 | 2653  | 17.98            | 100.31     |
| 12/09/2013 | 10:40:51 AM | 385                 | 2817  | 19.5             | 101.83     |
| 12/09/2013 | 10:40:56 AM | 390                 | 2969  | 20.31            | 102.64     |
| 12/09/2013 | 10:41:01 AM | 395                 | 3050  | 20.63            | 102.96     |
| 12/09/2013 | 10:41:06 AM | 400                 | 3082  | 20.58            | 102.91     |
| 12/09/2013 | 10:41:11 AM | 405                 | 3077  | 20.54            | 102.87     |
| 12/09/2013 | 10:41:16 AM | 410                 | 3073  | 20.48            | 102.81     |
| 12/09/2013 | 10:41:21 AM | 415                 | 3067  | 20.43            | 102.76     |
| 12/09/2013 | 10:41:26 AM | 420                 | 3062  | 21.17            | 103.5      |
| 12/09/2013 | 10:41:31 AM | 425                 | 3136  | 22.65            | 104.98     |

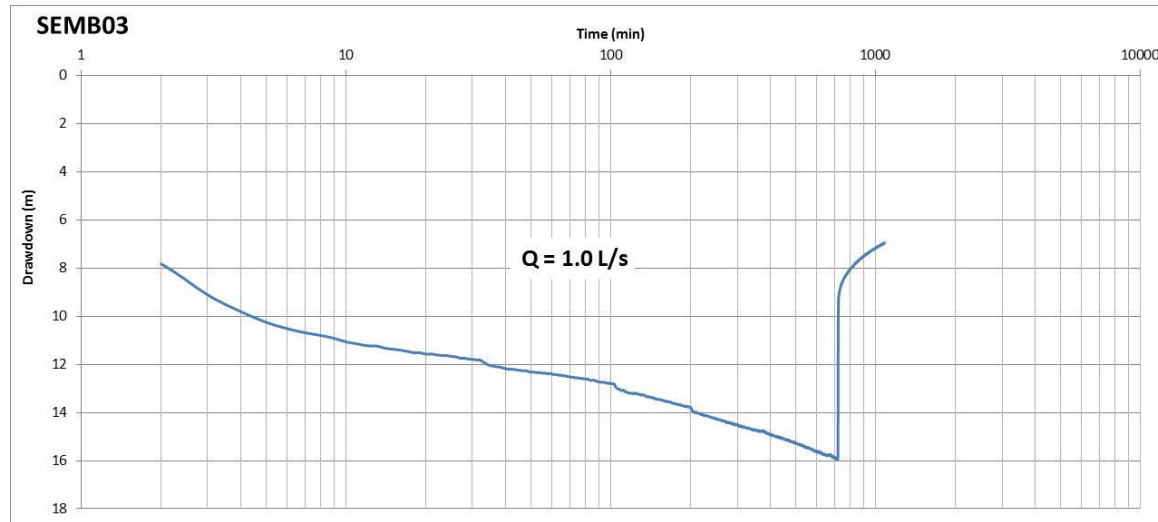
| Date       | Real time  | cumulative Time (s) | cmH2O | $\Delta$ (cmH2O) | GWL (mAHD) |
|------------|------------|---------------------|-------|------------------|------------|
| 12/09/2013 | 2:34:56 PM | 14430               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:01 PM | 14435               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:06 PM | 14440               | 2298  | 12.8             | 95.13      |
| 12/09/2013 | 2:35:11 PM | 14445               | 2299  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:16 PM | 14450               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:21 PM | 14455               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:26 PM | 14460               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:31 PM | 14465               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:36 PM | 14470               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:41 PM | 14475               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:35:46 PM | 14480               | 2298  | 12.78            | 95.11      |
| 12/09/2013 | 2:35:51 PM | 14485               | 2297  | 12.78            | 95.11      |
| 12/09/2013 | 2:35:56 PM | 14490               | 2297  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:01 PM | 14495               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:06 PM | 14500               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:11 PM | 14505               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:16 PM | 14510               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:21 PM | 14515               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:26 PM | 14520               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:31 PM | 14525               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:36 PM | 14530               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:41 PM | 14535               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:46 PM | 14540               | 2298  | 12.78            | 95.11      |
| 12/09/2013 | 2:36:51 PM | 14545               | 2297  | 12.79            | 95.12      |
| 12/09/2013 | 2:36:56 PM | 14550               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:37:01 PM | 14555               | 2298  | 12.78            | 95.11      |
| 12/09/2013 | 2:37:06 PM | 14560               | 2297  | 12.79            | 95.12      |
| 12/09/2013 | 2:37:11 PM | 14565               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:37:16 PM | 14570               | 2298  | 12.78            | 95.11      |
| 12/09/2013 | 2:37:21 PM | 14575               | 2297  | 12.79            | 95.12      |
| 12/09/2013 | 2:37:26 PM | 14580               | 2298  | 12.79            | 95.12      |
| 12/09/2013 | 2:37:31 PM | 14585               | 2298  | 12.78            | 95.11      |
| 12/09/2013 | 2:37:36 PM | 14590               | 2297  | 12.79            | 95.12      |
| 12/09/2013 | 2:37:41 PM | 14595               | 2298  | 12.79            | 95.12      |

## Slug Test Data SPB06

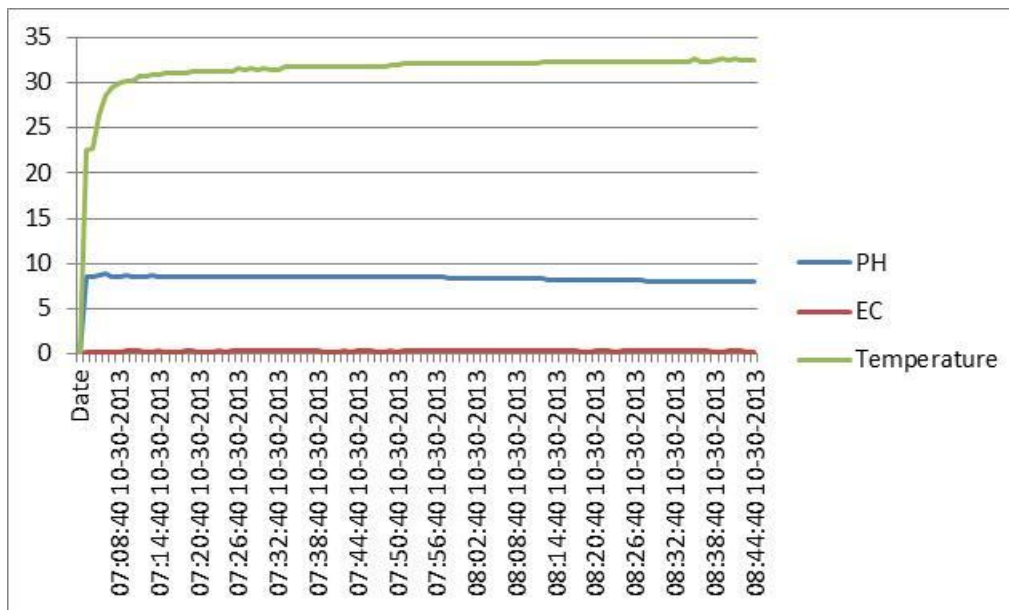
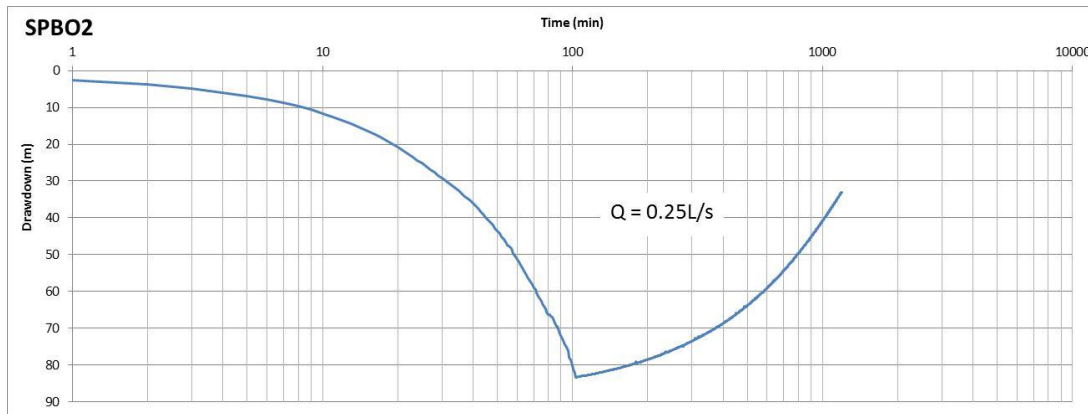


Appendix C:  
Pump Testing Data

## Pump Test Data SEMB3



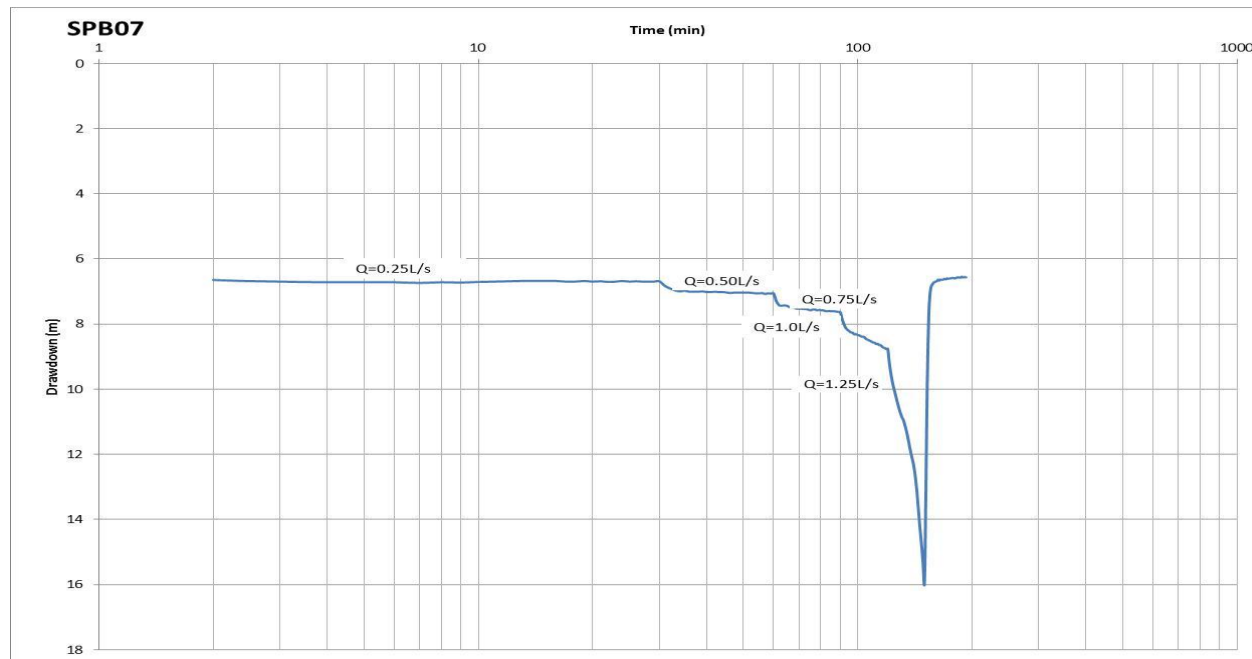
| B A Pump Testing Job Details |                       |                         |                   |                                                                                                                                                                                                                                                        |                     |      |       |             |
|------------------------------|-----------------------|-------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|-------|-------------|
| Bore ID                      | EMB03                 | Date                    | 27-Oct-13         | Comments                                                                                                                                                                                                                                               |                     |      |       |             |
| Test Type                    | Constant Rate 1.0 l/s |                         |                   | PH probe was started giving erratic readings during test, manual measurements taken from 10:20am till end of test with hand held meter. Discharge cloudy with considerable amount of fine white particle (clay?). PB06 monitored for duration of test. |                     |      |       |             |
| Initial SWL                  | 4.559 m               | TOC Height              | 0.420 m           |                                                                                                                                                                                                                                                        |                     |      |       |             |
| Total Volume Pumped          | 45,286 L              | Pump Depth (Meters)     | 49.5 m            |                                                                                                                                                                                                                                                        |                     |      |       |             |
| Casing Inside Diameter       | 0.155 m               | Pump Outside Diameter   | 0.050 m           |                                                                                                                                                                                                                                                        |                     |      |       |             |
| Pump Length                  | 1.5 m                 | Column Oustide Diameter | 0.089 m           |                                                                                                                                                                                                                                                        |                     |      |       |             |
|                              |                       |                         |                   |                                                                                                                                                                                                                                                        |                     |      |       |             |
| Date                         | SWL From TOC          | Flow Rate               | Desired Flow Rate |                                                                                                                                                                                                                                                        | Date                | PH   | EC    | Temperature |
| 06:28:12 10-27-2013          | 4.56                  | 0.00                    | 1.00              |                                                                                                                                                                                                                                                        | 06:28:12 10-27-2013 | 6.96 | 0.32  | 23.87       |
| 06:29:12 10-27-2013          | 6.14                  | 0.82                    | 1.00              |                                                                                                                                                                                                                                                        | 06:29:12 10-27-2013 | 6.97 | 0.33  | 23.87       |
| 06:30:12 10-27-2013          | 7.83                  | 1.00                    | 1.00              |                                                                                                                                                                                                                                                        | 06:30:12 10-27-2013 | 6.85 | 0.33  | 28.52       |
| 06:31:12 10-27-2013          | 9.12                  | 1.02                    | 1.00              |                                                                                                                                                                                                                                                        | 06:31:12 10-27-2013 | 6.60 | 0.35  | 30.67       |
| 06:32:12 10-27-2013          | 9.81                  | 1.01                    | 1.00              | 06:32:12 10-27-2013                                                                                                                                                                                                                                    | 6.53                | 0.33 | 31.29 |             |
| 06:33:12 10-27-2013          | 10.26                 | 1.00                    | 1.00              | 06:33:12 10-27-2013                                                                                                                                                                                                                                    | 6.51                | 0.33 | 31.53 |             |
| 06:34:12 10-27-2013          | 10.52                 | 0.99                    | 1.00              | 06:34:12 10-27-2013                                                                                                                                                                                                                                    | 6.48                | 0.33 | 31.73 |             |
| 06:35:12 10-27-2013          | 10.69                 | 1.00                    | 1.00              | 06:35:12 10-27-2013                                                                                                                                                                                                                                    | 6.44                | 0.33 | 31.76 |             |
| 06:36:12 10-27-2013          | 10.80                 | 1.04                    | 1.00              | 06:36:12 10-27-2013                                                                                                                                                                                                                                    | 6.41                | 0.32 | 31.73 |             |
| 06:37:12 10-27-2013          | 10.92                 | 1.02                    | 1.00              | 06:37:12 10-27-2013                                                                                                                                                                                                                                    | 6.38                | 0.32 | 31.73 |             |

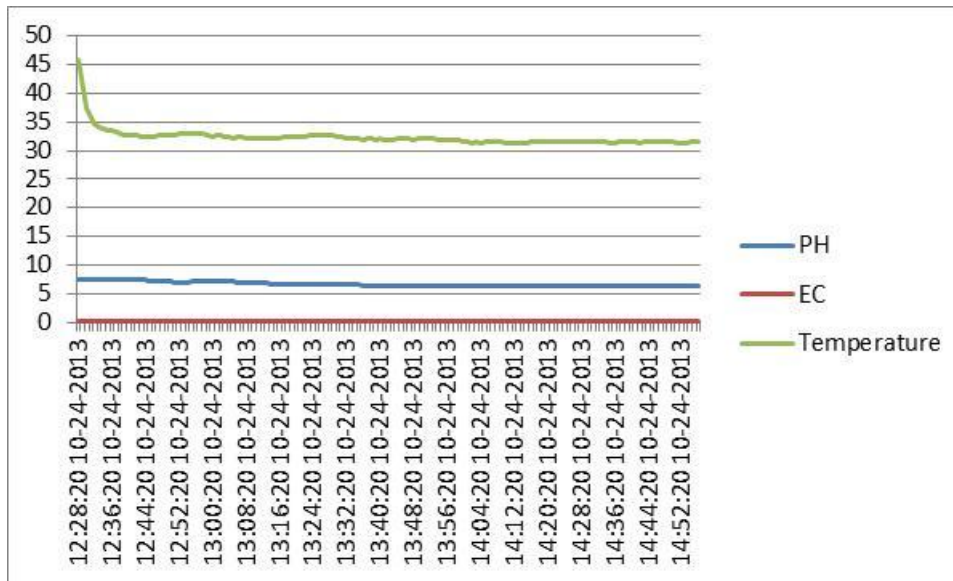


| B A Pump Testing Job Details |                        |            |           |                                                |  |  |  |
|------------------------------|------------------------|------------|-----------|------------------------------------------------|--|--|--|
| Bore ID                      | PB02                   | Date       | 30-Oct-13 | Comments                                       |  |  |  |
| Test Type                    | Constant Rate 0.25 l/s |            |           | Bore ran out of water after 1 hr 42 min. Water |  |  |  |
| Initial SWL                  | 2.250 m                | TOC Height | 0.00 m    |                                                |  |  |  |

| B A Pump Testing Job Details |       |      |           |          |  |  |  |  |
|------------------------------|-------|------|-----------|----------|--|--|--|--|
| Bore ID                      | PB02  | Date | 30-Oct-13 | Comments |  |  |  |  |
| 02:44:40 10-31-2013          | 33.41 | 0.00 | 0.00      |          |  |  |  |  |
| 02:45:40 10-31-2013          | 33.35 | 0.00 | 0.00      |          |  |  |  |  |
| 02:46:40 10-31-2013          | 33.33 | 0.00 | 0.00      |          |  |  |  |  |
| 02:47:40 10-31-2013          | 33.28 | 0.00 | 0.00      |          |  |  |  |  |
| 02:48:40 10-31-2013          | 33.24 | 0.00 | 0.00      |          |  |  |  |  |
| 02:49:40 10-31-2013          | 33.21 | 0.00 | 0.00      |          |  |  |  |  |
| 02:50:40 10-31-2013          | 33.17 | 0.00 | 0.00      |          |  |  |  |  |
| 02:51:40 10-31-2013          | 33.12 | 0.00 | 0.00      |          |  |  |  |  |
| 02:52:40 10-31-2013          | 33.09 | 0.00 | 0.00      |          |  |  |  |  |
| 02:53:40 10-31-2013          | 33.06 | 0.00 | 0.00      |          |  |  |  |  |
| 02:54:40 10-31-2013          | 33.03 | 0.00 | 0.00      |          |  |  |  |  |
| 02:55:40 10-31-2013          | 32.98 | 0.00 | 0.00      |          |  |  |  |  |

### Pump Test Data SPB07 (Step Flow Test)

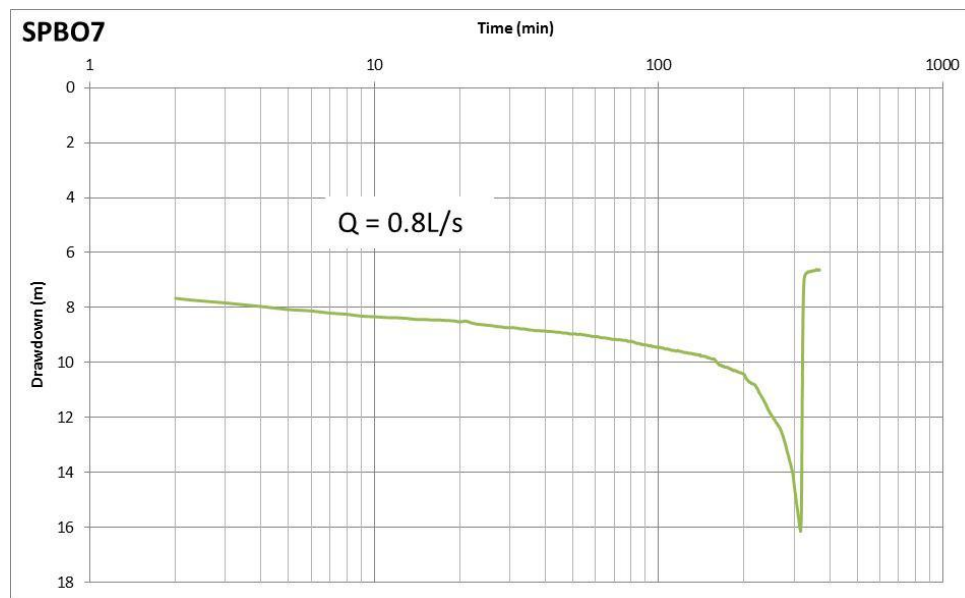


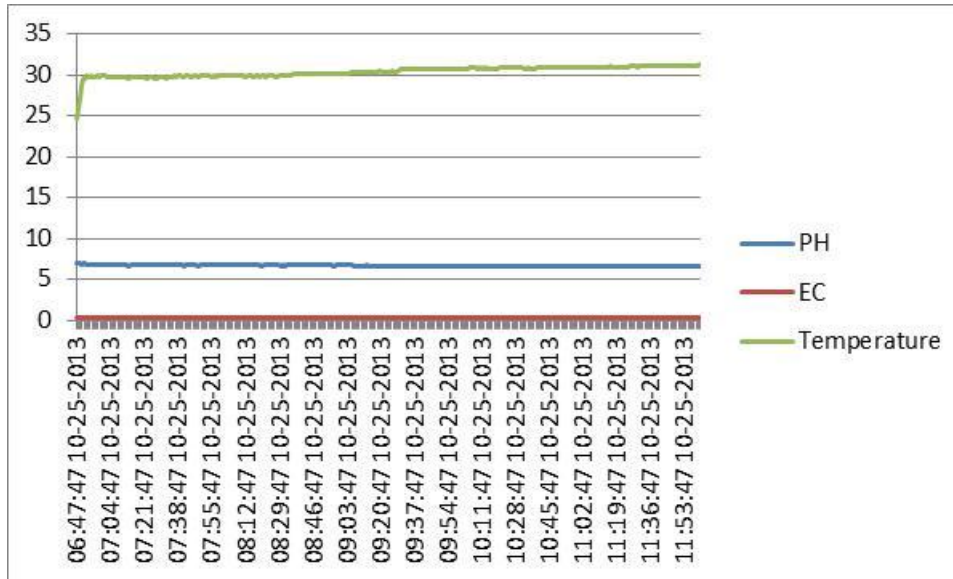


| B A Pump Testing Job Details |                                          |                         |                   |          |                     |     |     |             |
|------------------------------|------------------------------------------|-------------------------|-------------------|----------|---------------------|-----|-----|-------------|
| Bore ID                      | PB07                                     | Date                    | 24-Oct-13         | Comments |                     |     |     |             |
| Test Type                    | Step Test 0.25, 0.5, 0.75, 1.0, 1.25 l/s |                         |                   |          |                     |     |     |             |
| Initial SWL                  | 6.500m                                   | TOC Height              | 0.000m            |          |                     |     |     |             |
| Total Volume Pumped          | 6810 L                                   | Pump Depth (Meters)     | 19.5 m            |          |                     |     |     |             |
| Casing Inside Diameter       | 0.155 m                                  | Pump Outside Diameter   |                   |          |                     |     |     |             |
| Pump Length                  | 1.5 m                                    | Column Oustide Diameter | 0.089 m           |          |                     |     |     |             |
| Date                         | SWL From TOC                             | Flow Rate               | Desired Flow Rate |          | Date                | PH  | EC  | Temperature |
| 12:28:20 10-24-2013          | 6.46                                     | 0.01                    | 0.25              | 0.0      | 12:28:20 10-24-2013 | 7.5 | 0.3 | 45.9        |
| 12:29:20 10-24-2013          | 6.47                                     | 0.22                    | 0.25              | 1.0      | 12:29:20 10-24-2013 | 7.6 | 0.3 | 40.8        |
| 12:30:20 10-24-2013          | 6.65                                     | 0.25                    | 0.25              | 2.0      | 12:30:20 10-24-2013 | 7.5 | 0.3 | 37.4        |
| 12:31:20 10-24-2013          | 6.70                                     | 0.25                    | 0.25              | 3.0      | 12:31:20 10-24-2013 | 7.5 | 0.3 | 35.7        |
| 12:32:20 10-24-2013          | 6.72                                     | 0.25                    | 0.25              | 4.0      | 12:32:20 10-24-2013 | 7.5 | 0.3 | 34.6        |
| 12:33:20 10-24-2013          | 6.72                                     | 0.24                    | 0.25              | 5.0      | 12:33:20 10-24-2013 | 7.5 | 0.3 | 34.0        |
| 12:34:20 10-24-2013          | 6.72                                     | 0.28                    | 0.25              | 6.0      | 12:34:20 10-24-2013 | 7.5 | 0.3 | 33.7        |
| 12:35:20 10-24-2013          | 6.74                                     | 0.28                    | 0.25              | 7.0      | 12:35:20 10-24-2013 | 7.5 | 0.3 | 33.5        |
| 12:36:20 10-24-2013          | 6.72                                     | 0.29                    | 0.25              | 8.0      | 12:36:20 10-24-2013 | 7.5 | 0.3 | 33.5        |

| B A Pump Testing Job Details |      |      |           |          |  |  |  |  |
|------------------------------|------|------|-----------|----------|--|--|--|--|
| Bore ID                      | PB07 | Date | 24-Oct-13 | Comments |  |  |  |  |
| 15:37:20 10-24-2013          | 6.56 | 0.00 | 0         | 189.0    |  |  |  |  |
| 15:38:20 10-24-2013          | 6.57 | 0.00 | 0         | 190.0    |  |  |  |  |
| 15:39:20 10-24-2013          | 6.56 | 0.00 | 0         | 191.0    |  |  |  |  |
| 15:40:20 10-24-2013          | 6.56 | 0.00 | 0         | 192.0    |  |  |  |  |
| 15:41:20 10-24-2013          | 6.57 | 0.00 | 0         | 193.0    |  |  |  |  |

## Constant Flow Test





| B A Pump Testing Job Details |                       |                         |                   |                                   |                     |      |      |             |
|------------------------------|-----------------------|-------------------------|-------------------|-----------------------------------|---------------------|------|------|-------------|
| Bore ID                      | PB07                  | Date                    | 25-Oct-13         | Comments                          |                     |      |      |             |
| Test Type                    | Constant Rate 0.8 l/s |                         |                   | Test aborted as ran out of water. |                     |      |      |             |
| Initial SWL                  | 6.559 m               | TOC Height              | 0.00 m            |                                   |                     |      |      |             |
| Total Volume Pumped          | 15,053 L              | Pump Depth (Meters)     | 19.5 m            |                                   |                     |      |      |             |
| Casing Inside Diameter       | 0.155 m               | Pump Outside Diameter   |                   |                                   |                     |      |      |             |
| Pump Length                  | 1.50 m                | Column Outside Diameter | 0.089 m           |                                   |                     |      |      |             |
|                              |                       |                         |                   |                                   |                     |      |      |             |
| Date                         | SWL From TOC          | Flow Rate               | Desired Flow Rate | 0.0775                            | Date                | PH   | EC   | Temperature |
| 06:47:47 10-25-2013          | 6.56                  | 0.78                    | 0.8               |                                   | 06:47:47 10-25-2013 | 6.97 | 0.31 | 24.69       |
| 06:48:47 10-25-2013          | 7.23                  | 0.80                    | 0.8               |                                   | 06:48:47 10-25-2013 | 6.95 | 0.30 | 27.25       |
| 06:49:47 10-25-2013          | 7.66                  | 0.82                    | 0.8               |                                   | 06:49:47 10-25-2013 | 6.92 | 0.31 | 28.76       |
| 06:50:47 10-25-2013          | 7.83                  | 0.80                    | 0.8               |                                   | 06:50:47 10-25-2013 | 6.96 | 0.31 | 29.58       |
| 06:51:47 10-25-2013          | 7.96                  | 0.81                    | 0.8               |                                   | 06:51:47 10-25-2013 | 6.94 | 0.30 | 29.61       |
| 06:52:47 10-25-2013          | 8.07                  | 0.84                    | 0.8               |                                   | 06:52:47 10-25-2013 | 6.92 | 0.31 | 29.88       |
| 06:53:47 10-25-2013          | 8.12                  | 0.80                    | 0.8               |                                   | 06:53:47 10-25-2013 | 6.89 | 0.31 | 29.82       |
| 06:54:47 10-25-2013          | 8.20                  | 0.81                    | 0.8               |                                   | 06:54:47 10-25-2013 | 6.86 | 0.31 | 29.85       |

Appendix D:  
Water Quality Laboratory Data and Certificates