

Hera Project, via Nymagee



Groundwater Assessment

Prepared by

The Impax Group

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Hera Project, via Nymagee

Groundwater Assessment

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EXECUTIVE SUMMARY

This report presents the findings of a Groundwater Assessment of the proposed Hera Project ("the Project"). The report was prepared for R.W. Corkery and Co. Pty. Limited on behalf of YTC Resources Ltd ("the Proponent").

The site of the proposed mining, processing and associated activities for the Project ("the Project Site") would be located at "The Peak", a property located approximately 4.4km south of Nymagee, NSW (**Figure 1**).

The Project would involve the excavation of ore and waste rock from an underground mine. The underground mine would be accessed by a surface portal and decline. Sub-level open stope mining techniques would be used to remove targeted ore zones. The underground mine has a maximum proposed depth of approximately 550m below ground level (bgl) and underground mining is planned to last for a period of approximately 7 years.

Ore would be transported to the surface for processing to produce a final product of gold d'oré and a base metals concentrate. In addition, some waste rock would also be transported to the surface for temporary storage before being transported back underground to backfill void space. The remaining waste rock material would be transported directly to open voids and would not be brought to the surface.

The tailings left at completion of the ore processing would be placed in a dedicated tailings storage facility (TSF). The Project Site would be rehabilitated at the completion of mining, which is estimated to be undertaken for a period of approximately 9 years (including post mining rehabilitation). **Section 2** provides further information on the proposed activities of the Project.

The area that is the subject of this groundwater assessment ("the Study Area") is the area within a 10km radius from the proposed Project Site.

The objectives of this assessment were to:

- identify and describe legislation and guidelines that are relevant to the protection of groundwater resources in NSW;
- identify and describe the groundwater resources in the vicinity of the Project Site
- identify mining activities that have potential to impact on the quality and/or quantity of groundwater available at and adjacent to the Project Site; and
- assess potential impacts to groundwater at the Project Site and quantify these impacts, where possible.

In order to meet the project objectives outlined above, The Impax Group completed the following.

- A review of legislation relevant to groundwater management to identify potential constraints on the Hera Project was conducted.
- A review of available groundwater bore data and geological information to assess the location and characteristics of groundwater aquifers located within and surrounding the Project Site, and to establish a conceptual model of groundwater processes within and surrounding the Project Site (the "Study Area"). This review was also undertaken to assess groundwater quality and potential beneficial uses of groundwater within the groundwater Study Area.
- Identification of available groundwater bore data to identify groundwater users within the Study Area
- Assessment of potential beneficial uses of groundwater within the Study Area.
- Assessment of the potential impacts to groundwater quality within the Study Area.
- Assessment of the potential impacts on the availability of groundwater to other groundwater users within the Study Area.
- Assessment of potential impacts to groundwater dependant ecosystems.
- Estimation of the volume of groundwater that would need to be removed from the underground mine to keep the mine free of water.
- Assessment of the recovery and long term steady state groundwater conditions around the underground mine after the cessation of mining.

Based on the results of groundwater review and groundwater modelling undertaken as part of the nominated scope of works, The Impax Group concludes the following.

- Near surface soil and alluvium at the Project Site is typically less than 3m deep. Significant groundwater resources have not been identified in near surface soils or shallow alluvium at the Project Site.
- Groundwater is typically encountered in fractured rock aquifer(s) underlying the proposed Project Site. Groundwater is typically encountered at the interface of weathered sandstone / siltstone profile and underlying hard siltstone and sandstone basement. The uppermost water bearing zone is typically encountered at a depth of approximately 70m bgl and in some bores water bearing features were identified to a depth of approximately 130m bgl.
- The measured EC of groundwater from bores located at the site indicates that groundwater at the Project Site is generally not suitable for human consumption. Groundwater at the Project Site is suitable for watering all but the most sensitive types of livestock. The measured EC in some bores indicates that groundwater could potentially be used for irrigation of salt tolerant crops and for fresh water aquaculture; however, limited yields are likely to preclude these potential beneficial uses.

- Three non-Project-related registered groundwater bores were identified within 10km of the Project Site. These bores were registered for "stock" use.
 - GW017385 is located approximately 2,400m north of the centre of the proposed underground.
 - GW017386 is located approximately 3,100m south of the proposed centre of the underground mine, and is 650m from the nearest groundwater production bore (WB11).
 - GW018014 is located approximately 10,300m southwest of the proposed centre of the underground mine and 8,300m from the nearest groundwater production bore (WB11).
- Drilling observations and results of aquifer pumping tests indicate that there may be several discrete aquifers at the site, rather than one regional scale aquifer.
- The results of pumping tests indicate that the aquifer has "dual porosity". Initial groundwater yields are typically relatively high due to the presence of transmissive fractures; however, as the transmissive fractures are dewatered the rate of groundwater recharge appears to be limited by the permeability of less transmissive fractures and the surrounding rock matrix.
- The water demand of the proposed mine is approximately 5.3L/s (or 167ML/yr). Water will be sourced from groundwater inflow into the proposed decline and underground mine, from surface water sources, and/or from a field of groundwater production bores located to the southeast, south and west of the proposed mine.
- Based on the results of aquifer pumping tests it was estimated that up to 466ML/yr may be extracted from the existing groundwater production bore field. At the time this report was prepared groundwater licencing conditions for the groundwater production bores were pending.
- Analytical modelling indicates that approximately 12L/s to 93L/s of groundwater will flow into the proposed underground once it has reached its maximum depth of 550m bgl. Based on the modelling the resulting cone of depression would extend to a distance of between 5.9km and 15.9km from the centre of the underground. Qualitative assessment of available groundwater information suggests that this is a conservative estimate (i.e. it is likely to overestimate the actual drawdown impacts). In the likely event that a zero-recharge aquifer boundary is present within a 2km radius of the underground actual groundwater inflows are predicted to be less than 1.5L/s and drawdown impacts would be restricted to the area within the zero recharge boundary.
- A qualitative assessment of subsurface conditions based on observations from recently completed aquifer pumping tests indicates that a zero recharge aquifer boundary condition is likely to be encountered relatively close to the proposed underground. In this event aquifer drawdown would be limited to the area within the aquifer boundary and actual groundwater inflows would be much less than the predicted 12L/s to 93L/s. It is anticipated that the Proponent would have to supplement water supplied from dewatering the underground with water sourced from surface dams and the existing groundwater bore field.

- In the case where drawdown impacts propagate a sufficient distance to adversely impact on the closest non-Project related bores, the Proponent would ensure that an alternative supply of water is provided. Alternatively, the impacted bore may be deepened or a mutually agreeable arrangement would be negotiated.
- Dewatering will be required for the duration of the proposed 7 year mine life. Some of the remaining void space in the mine will be reinstated with waste rock. It is estimated that approximately 850,000m³ of void space will remain in the underground at the completion of mining and rehabilitation works. Analytical modelling indicates that groundwater would return to pre-mining levels within 20 to 100 years of cessation of mining depending on the actual average aquifer permeability. Analytical modelling indicates that where the lateral extent of drawdown impacts are significant (high average K) aquifer recover would be relatively fast. Where the lateral extent of drawdown impacts are limited (low average K or presence of zero-recharge boundary conditions) aquifer recovery would be relatively slow.
- Residual drawdown within the decline and underground would result in groundwater flow toward the underground. As such, any changes in groundwater chemistry or quality within the open cuts would not impact on groundwater quality within the surrounding fractured rock.
- Surface activities have the greatest potential to impact on groundwater quality. The absence of a significant groundwater resource in near surface soils or shallow alluvium at the Project Site means there is little risk of mining processes impacting on groundwater quality.
- Chemical and fuel storages at the Project Site would be above ground and appropriately bunded to minimise potential for groundwater contamination to occur.
- The ore body and waste rock located adjacent to the ore body has potential to generate acid when exposed to the atmosphere and water. The Proponent proposes to manage potentially acid generating waste rock appropriately to minimise any potential groundwater impacts at the site. The bulk concentrate produced at the mine will be stored appropriately to minimise potential for leaching of acid, heavy metals and cyanide.
- Leachate from the mine tailings may contain traces of heavy metals and cyanide from ore treatment process, and may also be potentially acid forming. The tailing storage facility has been designed, and would operate, in a manner which would prevent leachate entering groundwater aquifers.
- Groundwater dependant ecosystems were not identified on, or in the vicinity of the Project Site. Standing water levels are such that there are unlikely to be any naturally occurring springs within 10km of the proposed Project Site.
- A groundwater monitoring plan would be implemented at the Project Site once mining commences. The proposed plan would include regular monitoring of water levels, field water quality parameters and basic water chemistry in existing groundwater production bores and/or piezometers at the site.

1. INTRODUCTION

1.1 BACKGROUND

This report presents the findings of a Groundwater Assessment of the proposed Hera Project ("the Project"). The report was prepared for R.W. Corkery and Co. Pty. Limited on behalf of YTC Resources Ltd ("the Proponent").

The site of the proposed mining, processing and associated activities for the Project ("the Project Site") would be located at "The Peak", a property located approximately 4.4km south of Nymagee, NSW (**Figure 1**).

The Project would involve the excavation of ore and waste rock from an underground mine. The underground mine will be accessed by a surface portal and decline. Sub-level open stope mining techniques would be used to remove targeted ore zones. The underground mine has a maximum proposed depth of approximately 550m below ground level (bgl) and underground mining is planned to last for a period of approximately 7 years.

Ore would be transported to the surface for processing to produce a final product of gold d'oré and a base metals concentrate. In addition, some waste rock would also be transported to the surface for temporary storage before being transported back underground to backfill void space. The remaining waste rock material would be transported directly to open voids and would not be brought to the surface.

The tailings left at completion of the ore processing would be placed in a dedicated tailings storage facility (TSF). The Project Site would be rehabilitated at the completion of mining, which is estimated to be undertaken for a period of approximately 10 years (including post mining rehabilitation). **Section 2** provides further information on the proposed activities of the Project.

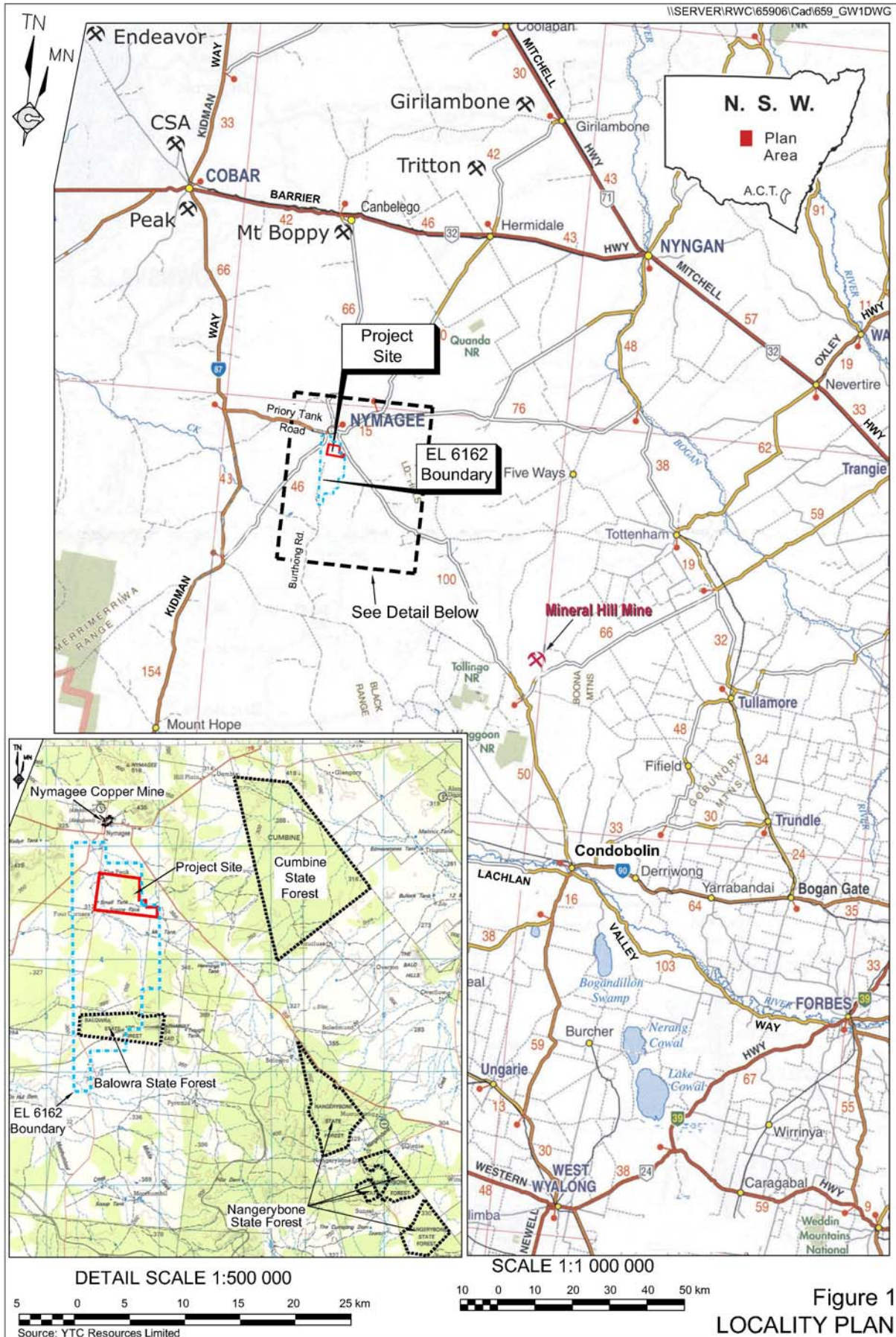
1.2 STUDY AREA

The area that is the subject of this groundwater assessment ("the Study Area") is the area within a 10km radius from the proposed Project Site.

1.3 OBJECTIVES

The objectives of this assessment were to:

- identify and describe legislation and guidelines that are relevant to the protection of groundwater resources in NSW;
- identify and describe the groundwater resources in the vicinity of the Project Site
- identify mining activities that have potential to impact on the quality and/or quantity of groundwater available at and adjacent to the Project Site; and
- assess potential impacts to groundwater at the Project Site and quantify these impacts, where possible.



Note: A colour version of this figure is available on the Project CD.

In order to meet the project objectives outlined above, The Impax Group completed the following.

- A review of legislation relevant to groundwater management to identify potential constraints on the Hera Project was conducted.
- A review of available groundwater bore data and geological information to assess the location and characteristics of groundwater aquifers located within and surrounding the Project Site, and to establish a conceptual model of groundwater processes within and surrounding the Project Site (the "Study Area"). This review was also undertaken to assess groundwater quality and potential beneficial uses of groundwater within the groundwater Study Area.
- Identification of available groundwater bore data to identify groundwater users within the Study Area
- Assessment of potential beneficial uses of groundwater within the Study Area.
- Assessment of the potential impacts to groundwater quality within the Study Area.
- Assessment of the potential impacts on the availability of groundwater to other groundwater users within the Study Area.
- Assessment of potential impacts to groundwater dependant ecosystems.
- Estimation of the volume of groundwater that would need to be removed from the underground mine to keep the mine free of water.
- Assessment of the recovery and long term steady state groundwater conditions around the underground mine after the cessation of mining.

2. PROPOSED DEVELOPMENT

2.1 PRE-APPROVED MINING ACTIVITIES

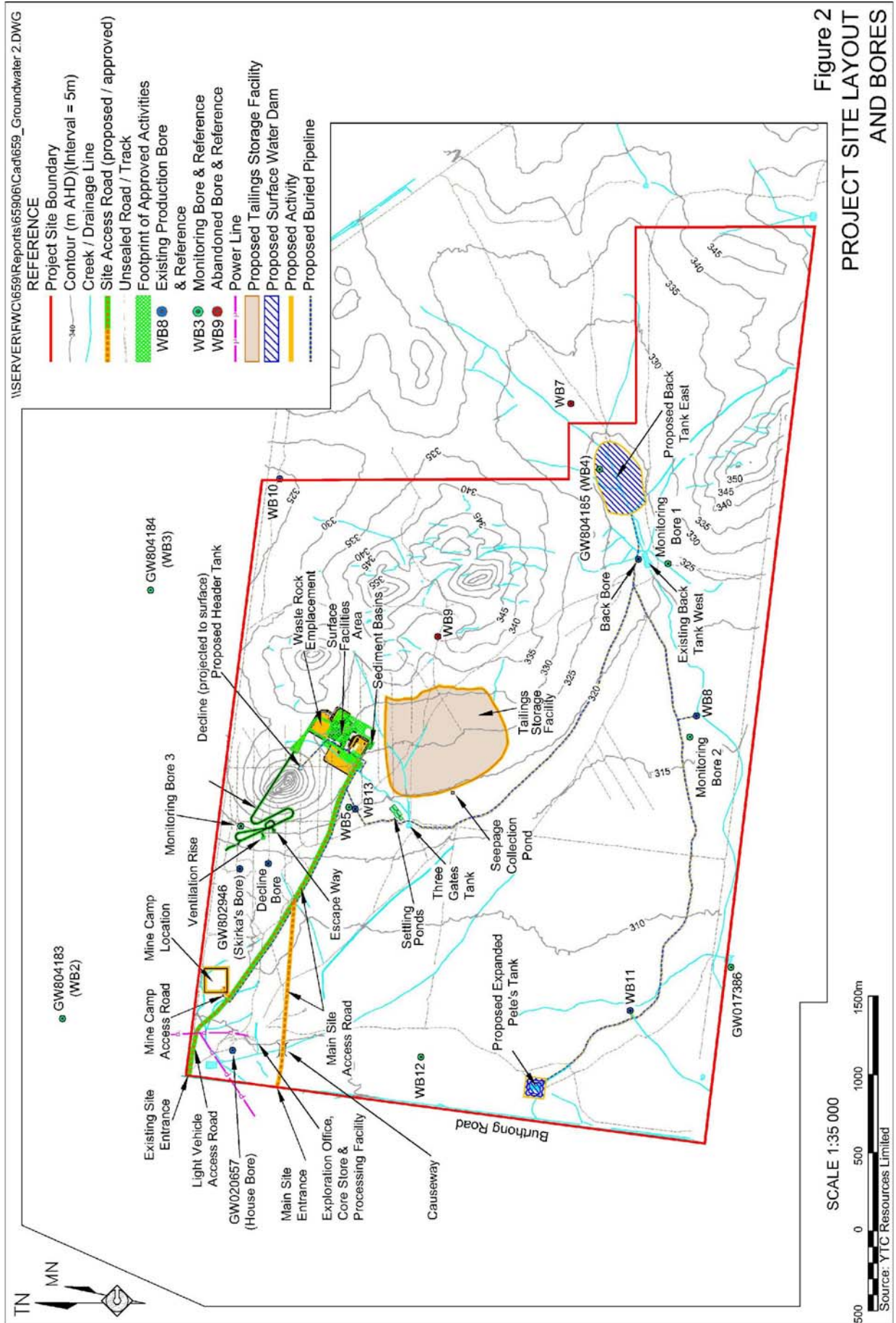
As identified in Section 1.7 of the *Environmental Assessment*, a number of components of the Hera Project have been previously approved. These include the following (**Figure 2**).

- Construction and use of infrastructure required for an underground mine including a box cut, portal and decline, magazine and ventilation rises.
- Construction and use an integrated ore stockpile area and temporary Waste Rock Emplacement.
- Installation and use of one or more diesel generators within the power station and the associated Fuel Storage and Recycling Area.
- Construction and use of site offices, ablutions facilities, vehicle parking, workshop, laydown area and associated infrastructure.
- Establishment of on-site communications facilities.

- Construction and use of water management structures.
- Construction and use of an access road (referred to in this document as the Light Vehicle Access Road). For the purposes of this application, the Light Vehicle Access Road would be used by light vehicles only.

The Project would include the following activities which would require approval (**Figure 2**).

- Extraction of waste rock and ore material, using underground sublevel open-stope mining methods at the maximum rate of material would be approximately 350 000t per year for approximately 5.5 years.
- Construction and use of a Surface Facilities Area that would incorporate a range of approved infrastructure, including expanded site offices for the Proponent and Contractors, ablutions facilities, vehicle parking, power station, fuel storage, refuelling area, workshop and laydown areas.
- Construction and use of a Processing Plant within the Surface Facilities Area comprising crushing and grinding, gravity separation, flotation, leach and gold recovery circuits and ancillary infrastructure to produce approximately 33 000oz of gold, 74 000oz of silver, 10 000t of lead and 10 000t of zinc per year.
- Construction and use of a temporary Waste Rock Emplacement, incorporating an acid rock drainage encapsulation area and an associated Leachate Management Pond.
- Construction and use of a Tailings Storage Facility with the associated Seepage Collection Pond.
- Construction of a Mine Camp and Mine Camp Access Road for mine personnel.
- Construction and use of a surface water harvesting system, including expansion of Pete's Tank and construction of Back Tank East and associated water reticulation system.
- Construction and use of the Main Site Access Road and the associated intersection to allow site access from Burthong Road by light and heavy vehicles.
- Transportation of concentrate from the Project Site to the Proponent's customers via public roads surrounding the Project Site.
- Construction and use of ancillary infrastructure, including soil stockpiles, core storage yards, internal roads and tracks, and sediment and erosion management structures not already approved.
- Construction and rehabilitation of a final landform that would be geotechnically stable and suitable for an end land use of agriculture or nature conservation.



2.2 PROPOSED MINING ACTIVITIES

The Project would include the following activities which would require approval (**Figure 2**).

- Extraction of waste rock and ore material using underground sublevel open-stope mining methods.
- Construction and use of a surface facilities area that would incorporate a range of approved infrastructure, including expanded Proponent's and Contractor's site offices, ablutions facilities, vehicle parking, power station, fuel storage and refuelling area and workshop and laydown areas.
- Construction and use of a processing plant within the surface facilities area comprising crushing and grinding, gravity separation, flotation, leach and gold recovery circuits and ancillary infrastructure.
- Construction and use of a temporary Waste Rock Emplacement, incorporating an acid rock drainage encapsulation area.
- Construction and use of a Tailings Storage Facility.
- Construction of a Mine Camp to house mine personnel.
- Construction and use of a surface water harvesting system, including expansion of Pete's Tank and construction of Back Tank East and associated water reticulation system.
- Construction and use of the Main Site Access Road and the associated intersection to allow site access from Burthong Road.
- Transportation of concentrate from the Project Site to the Proponent's customers via public roads surrounding the Project Site.
- Construction and use of ancillary infrastructure, including soil stockpiles, core storage yards, internal roads and tracks, and sediment and erosion management structures not already approved.
- Construction and rehabilitation of a final landform that would be geotechnically stable and suitable for a final land use of agriculture or nature conservation.

It is noted that during the life of the Project, the Proponent proposes to undertake additional exploration drilling to further define the mineralisation identified to date, and to identify any additional resources, both within and in the vicinity of the Project Site. Extraction of additional mineralisation does not form a part of this application, and would be the subject of a subsequent application.

2.3 WATER SUPPLY AND CONSUMPTION

Operational water requirements, namely water for processing operations, dust suppression, underground operations and workshop wash down purposes are estimated to be approximately 187ML per year.

This water would be obtained in priority order from the following sources (**Figure 2**).

- i) Groundwater sourced from dewatering operations within the proposed mine.
- ii) Stormwater run-off stored in the Three Gates Tank either following treatment in the settling ponds or captured directly.

- iii) Stormwater run-off stored in the proposed expanded Pete's Tank or the proposed Back Tank East. These dams would store approximately 20ML and 90ML of water, respectively.
- iv) Groundwater sourced primarily from four bores located within the Project Site namely, Back Bore and Bores WB8, WB11 and WB13. At the time of preparation of this report groundwater extraction licences for the subject groundwater bores were being considered by the NSW Office of Water (NOW).

It is likely that water from within the surface water storage dams would be available only intermittently. As a result, the Project would rely entirely on water sources i) and iv) for all operational water requirements during extended dry periods.

Groundwater would be sourced principally from the proposed underground mine, with additional water sourced from the four bores, namely Back Bore and Bores WB8, WB11 and WB13 (**Figure 2**).

Groundwater within the proposed underground mine would be pumped to the surface and stored within either the Header Tank or the Raw Water Dam (**Figures 2 and 3**). The rate of extraction would depend on the inflow to the underground workings.

Groundwater from Back Bore and Bores WB8, WB11 and WB13 would be extracted as needed and/or in accordance with the groundwater extraction licence conditions for the bores.

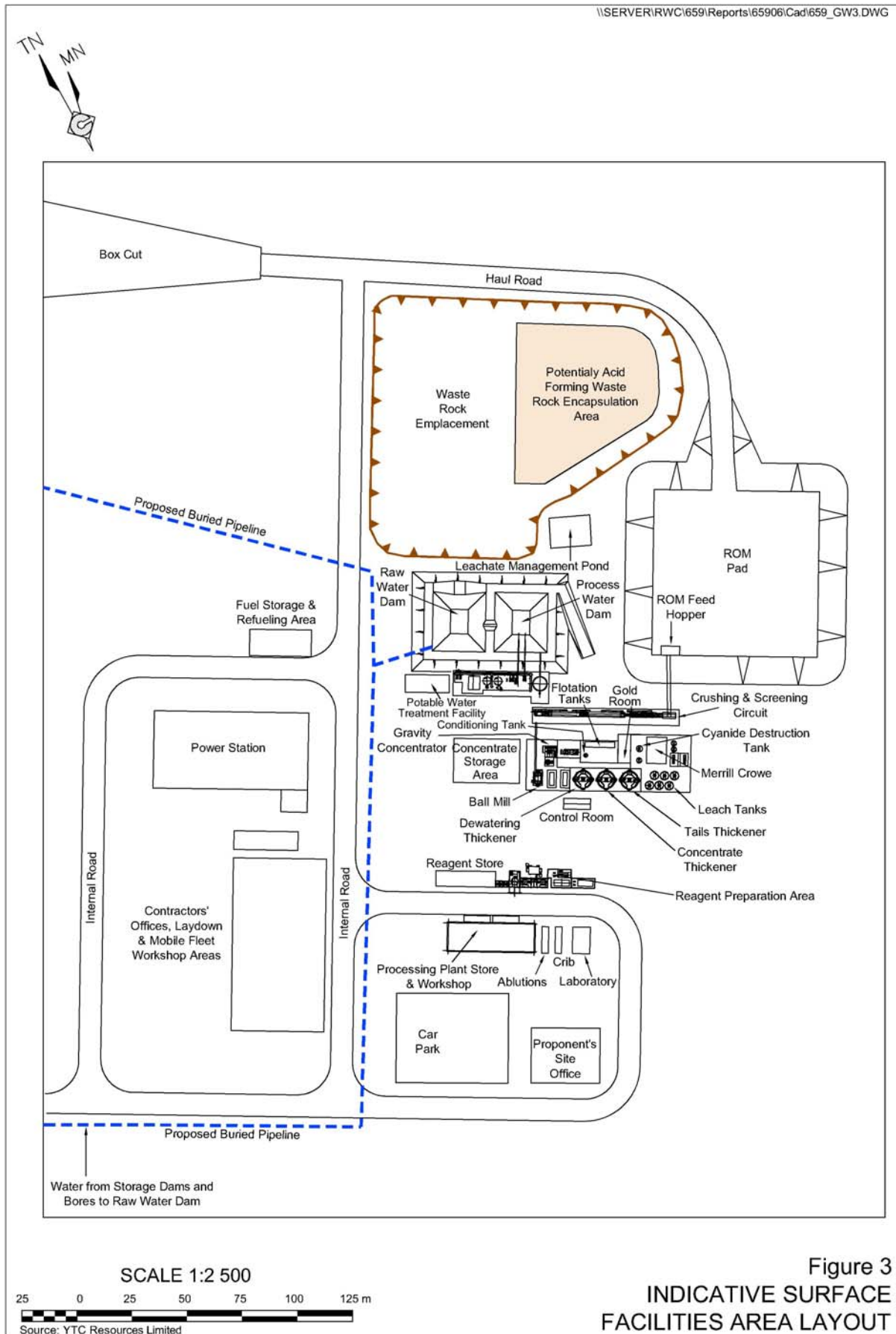
Groundwater and surface water for mining-related purposes would be pumped to the Raw Water Dam via a proposed pipeline (**Figure 2**). The proposed pipeline would be constructed of polypipe and buried. The pipeline route would, wherever practicable, follow established tracks and would only disturb areas that are currently disturbed. Where the proposed pipeline route cannot be located along existing tracks, care would be taken to ensure that no vegetation more than 3m high would be disturbed.

In August 2010 the NSW Office of Water (NOW) informed the Proponent that they intended to issue three groundwater licences for the Project Site. The groundwater licences were numbered 85BL243254, 85BL256001 and 85BL256002. Draft conditions for the licences allowed extraction of up to 147ML/yr. A maximum of 95ML/yr could be extracted from the proposed decline and underground mine, a maximum of 47ML/yr could be extracted from the Back Bore and a maximum of 5 ML/yr could be extracted from Skirka's Bore (**Figure 2**).

On 9 September 2010 the Proponent requested that the issue of the groundwater licences be deferred pending the results of further aquifer testing. The Impax Group completed a comprehensive groundwater exploration drilling programme in late 2010 and early 2011, including six aquifer pumping tests. The Proponent has submitted the aquifer pumping test results to NOW for assessment and has requested the following.

- The conditions of the original licences be amended to allow extraction of the 147ML/yr of groundwater from the licensed groundwater works (Skirka's Bore, Back Bore and Decline) as well as newly installed groundwater bores (WB8, WB10, WB11 and WB13).
- That the total allowable extraction amount be increased by 100ML/yr to 150ML/yr based on the results of more comprehensive aquifer testing.

At the time this report was prepared NOW were assessing the submission but had not yet made a determination on the Proponents requests.



Note: A colour version of this figure is available on the Project CD.

3. GROUNDWATER LEGISLATION AND GUIDELINES

3.1 REGULATORY AND LEGISLATIVE INSTRUMENTS & GUIDELINES

The Impax Group completed an evaluation of legislation and regulatory instruments that may be relevant to the Hera Project. These are as follows.

- *Water Act 1912*. Groundwater extraction or groundwater interference due to mining operations is currently regulated under Part 5 of the *Water Act 1912*. This act was supplemented on 19 December 2008 to include an embargo on the issuing of new groundwater extraction licences within the Murray-Darling Basin. The embargo is discussed in more detail in **Section 3.3**.
- *Water Management Act 2000*. Under this Act a Water Access Licence (WAL) is required to extract or interfere with groundwater in areas where a Water Sharing Plan (WSP) is in place. The Project Site is not located within an area covered by a WSP so the *Water Management Act 2000* is not relevant to the groundwater related aspects of the Project.
- Water Sharing Plan (WSP). At the time this report was prepared the Project Site was not subject to a WSP.
- *Guidelines for Groundwater Protection in Australia (ARMCANZ and ANZECC 1995)*. This guideline provides a framework for preventing groundwater contamination in Australia.
- *NSW State Groundwater Policy and Framework Document (NSW Department of Land and Water Conservation 1997)*. The Framework document sets out the overall direction of groundwater management in NSW and provides broad objectives and principles to guide groundwater management. The document refers to the specific policy documents listed below which outline the objectives and principles of minimising impacts to groundwater quality and quantity, and impacts to groundwater dependant ecosystems.
- *NSW State Groundwater Quantity Protection Policy (NSW Department of Land and Water Conservation 1998)*. Builds on the concepts outlined in the framework document (see above) and provides more detail and guidance on how to manage and protect groundwater quantity.
- *NSW State Groundwater Quality Protection Policy (NSW Department of Land and Water Conservation 1998)*. Builds on the concepts outlined in the framework document (see above) and provides more detail and guidance on how to manage and protect groundwater quality.
- *NSW State Groundwater Dependant Ecosystems Policy (NSW Department of Land and Water Conservation 2002)*. This policy is specifically designed to protect valuable ecosystems which rely on groundwater for survival. It aims to maintain or restore the ecological processes and biodiversity of groundwater dependent ecosystems for the benefit of present and future generations.

- *Guidelines for Fresh and Marine Water Quality (ANZECC 2000)*. These guidelines would be adopted to assess groundwater quality, potential beneficial use of groundwater at the Project Site, and to assess potential impacts to groundwater quality from operation of the Hera Project.
- *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales (NSW EPA 2003)*. These guidelines would be adopted where sampling and analysis of groundwater samples is required as part of this assessment and during groundwater monitoring.

3.2 GROUNDWATER WORK LICENCE

Under the *NSW Water Act 1912*, any excavation or borehole that intersects groundwater is regarded as a groundwater work and must be licenced as such by NOW. The proposed decline and underground mine would intersect groundwater and would therefore require a groundwater work licence.

Any groundwater monitoring wells installed at the Project Site would also require a groundwater work licence.

All existing groundwater works at the site were registered, or were in the process of being registered, at the time this report was prepared.

3.3 MURRAY-DARLING BASIN GROUNDWATER EMBARGO

On 19 December 2008 an embargo was made under the *Water Act 1912* to prohibit the issuing of new groundwater extraction licences within the Murray-Darling Basin (subject to a number of exceptions). The embargo applies to areas within the Murray-Darling Basin which are not already subject to a WSP. Therefore, this embargo applies to the Project Site, which is located within the Murray Darling Basin but outside an area already subject to a water sharing plan or similar water sharing regulation.

Groundwater licence applications were originally lodged by the former owner of the Project Site (Triako Resources Ltd) prior to the implementation of the embargo. As such, the embargo has not been applied to the groundwater licence applications, which were being assessed by NOW at the time this report was prepared.

The embargo would apply to any future requests for additional groundwater licences and/or an additional extraction allowance. The Special Supplement outlining the conditions of the embargo is presented in **Appendix 1**. Schedule 2 of the supplement lists circumstances that may give rise to an exemption from the embargo. These include the following.

- A licence may be granted for a monitoring or test bore installed for groundwater investigation and environmental management purposes.

- A licence can be granted for water supply for a person where the Minister determines that a failure to supply the water would cause a prohibitively high social, economic or national security cost and the supply of water will cause no more than minimal environmental harm to any aquifer, or its dependant ecosystems.
- A licence may be granted for a dewatering activity provided that the annual extraction does not exceed 10ML per annum.
- A licence may be granted to use saline water where the salinity level exceeds 14,000mg/L (this equates to an electrical conductivity of approximately 21000 μ S/cm).
- Bores on property where there is an existing licence under Part 5 of the *Water Act 1912* and there is no increase in entitlement.

The groundwater embargo only applies to the issuing of new groundwater licences. If additional groundwater licences are required at the Project Site the embargo will apply. If additional groundwater is required at the site the Proponent could purchase any existing groundwater entitlement valid for extraction of groundwater from fractured rock aquifers located within the Lachlan Fold Belt.

4. EXISTING ENVIRONMENT

4.1 SURROUNDING LAND USES

The Project Site is surrounded by agricultural land used for grazing purposes.

The village of Nymagee is located approximately 4.4km to the north of the site. The village consists of residential dwellings, a hotel / public bar and a police station.

4.2 GEOLOGY

The Project Site is located entirely within the Nymagee 1:100,000 Geological Sheet. A detailed account of the geology within this area is presented within MacRae (1987) and an overview is presented within the *Environmental Assessment* that accompanies the application for project approval. The setting, structure and mineralisation of the Cobar Basin region has been summarised by NSW Geological Survey publications, including Glen (1991 and 1994), Glen et al. (1996), Suppel and Gilligan (1993) and Gilligan and Byrne (1994).

The geology of the Project Site and the regional geology are shown in **Figure 4**. The regional geology is associated with the Girilambone Group, Silurian Granitoids, the Mouramba Group, the Lower Amphitheatre Group and Shume Formation.

The Girilambone Group comprises a predominantly sedimentary sequence of rhythmically bedded fine to coarse-grained quartz sandstone with lesser quartzo-feldspathic sandstone, siltstone and chert. Minor amounts of intercalated basic volcanics, conglomerate and marl are also present (Suppel and Gilligan, 1993).

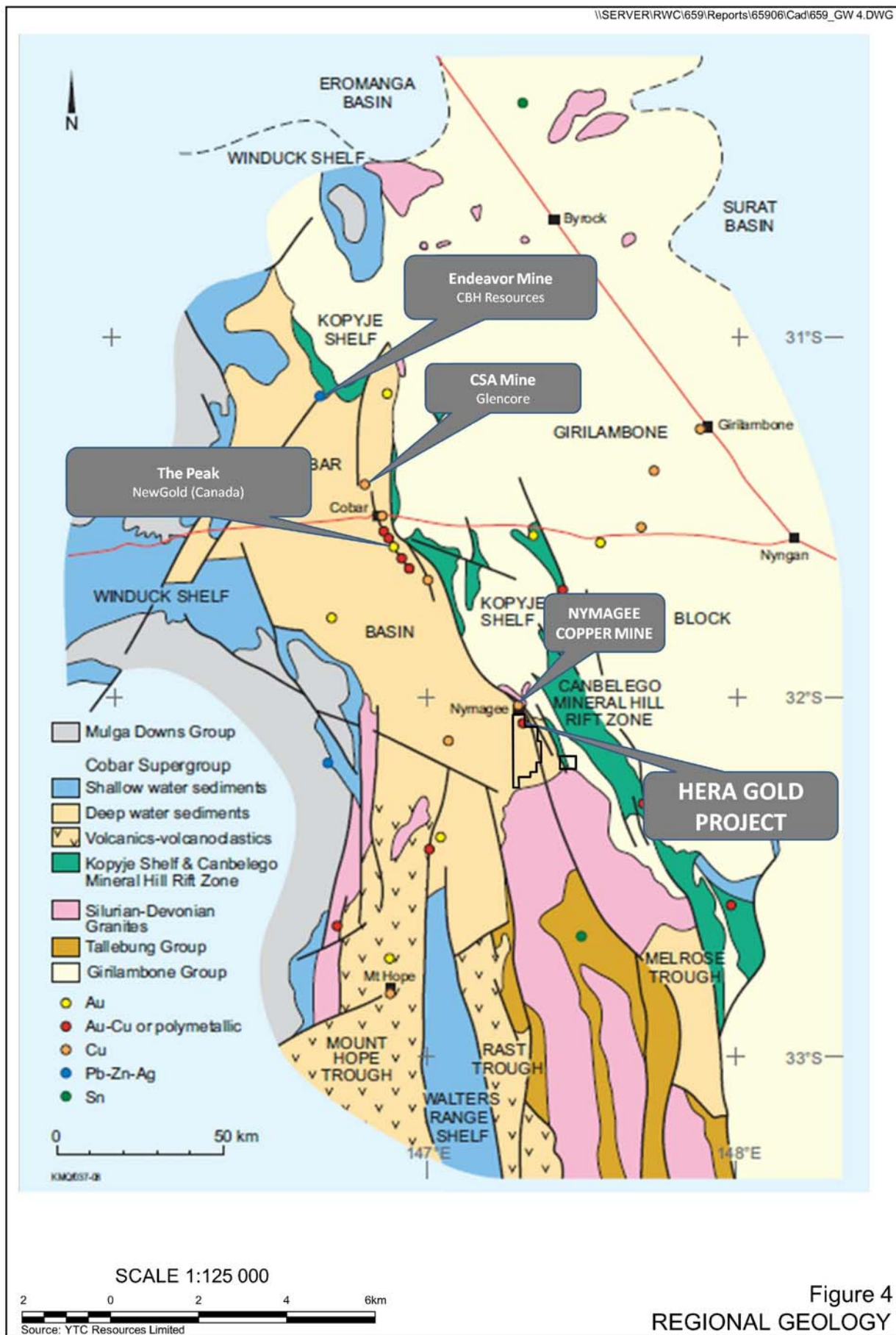


Figure 4
REGIONAL GEOLOGY

Two major granitoid bodies intrude the Girilambone Group within the Nymagee area. The Nymagee Igneous Complex occurs to the north and northeast of Nymagee and the Erimeran Granite is located to the southeast and south of Nymagee. Both of these granitoid bodies have been categorized “S-type” (MacRae, 1987) and are described as porphyritic, medium to coarse-grained biotite granites or adamellites (Suppel and Gilligan, 1993).

The Mouramba Group is the eastern-most component of the Cobar Basin and comprises shallow-water sediments with minor volcanics. Two units are described as follows.

- The Burthong Formation consists of a sequence of very fine to medium sandstone to inter-bedded sandstone and siltstone (MacRae, 1987). Several volcanic horizons occur in the more eastern parts and the Hathaway Conglomerate Member, a polymict arkosic conglomerate, occurs in the southern area of Burthong Formation outcrop.
- The Roset Sandstone overlies the Burthong Formation and comprises thick-bedded, cross-bedded and ripple cross-laminated sandstone. The Roset Sandstone is interpreted to have a lensoidal character with inter-fingering between the Roset Sandstone and the underlying Burthong Formation.

The Lower Amphitheatre Group is the western-most or younger portion of the Cobar Basin and comprises inter-bedded fine to medium grained sandstone and siltstone. The unit is typically medium-bedded (5 cm to 30 cm) with a turbiditic character. Sedimentary features include massive, parallel laminations, ripple cross laminations and graded bedding (MacRae, 1987).

The Shume Formation is the interface between the Upper Amphitheatre and the Winduck Shelf and comprises inter-bedded silicified sandstone and minor siltstone. The unit is typically massive, sandstone dominant and forms prominent ridges. The Shume Formation has been correlated to the Biddabirra Formation (MacRae, 1987) and contains minor porphyritic volcanics to the west of the Nymagee licence areas.

An interpretation of local geology is presented as **Figure 5**.

4.3 STRUCTURAL GEOLOGY

Over the period of exploration and definition of the Hera Deposit considerable effort has been made to define the structural elements of the Hera Orebody. The dominant structural elements of the deposit are shown in **Figure 6**. The north northwest trending structures are traced for some 700m along strike. The Main Lens is interpreted to be separated by an east-west trending offset fault which has largely been annealed with quartz infill.

Figure 6 shows the main ore structures in red, the Decline and Mine layout (Pink) and diamond drilling results. The diamond drilling results are coloured by Rock Quality Designation (RQD) %. Bright colours indicate zones of fracturing or blockiness which is interpreted to indicate main structural corridors.

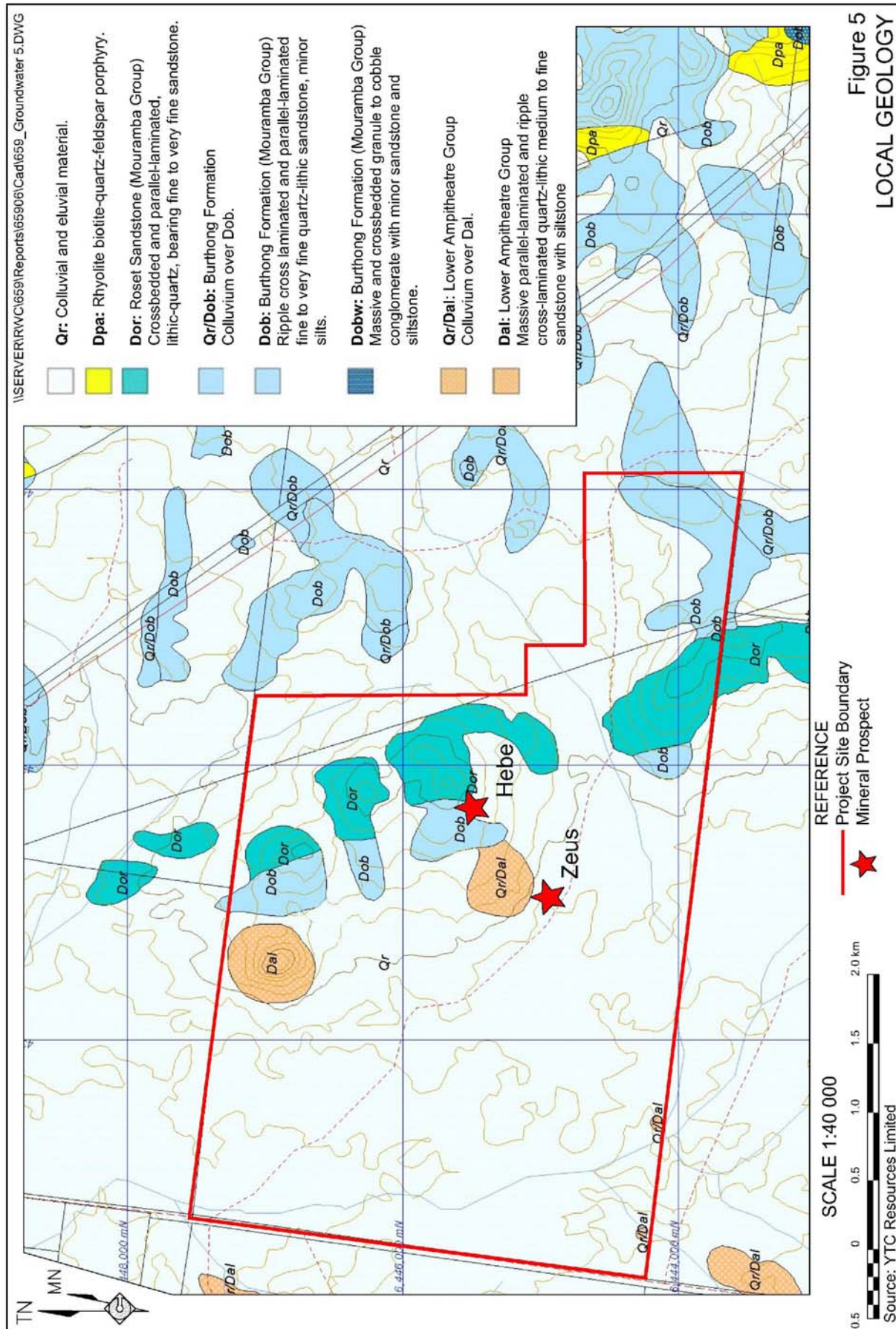


Figure 5
LOCAL GEOLOGY

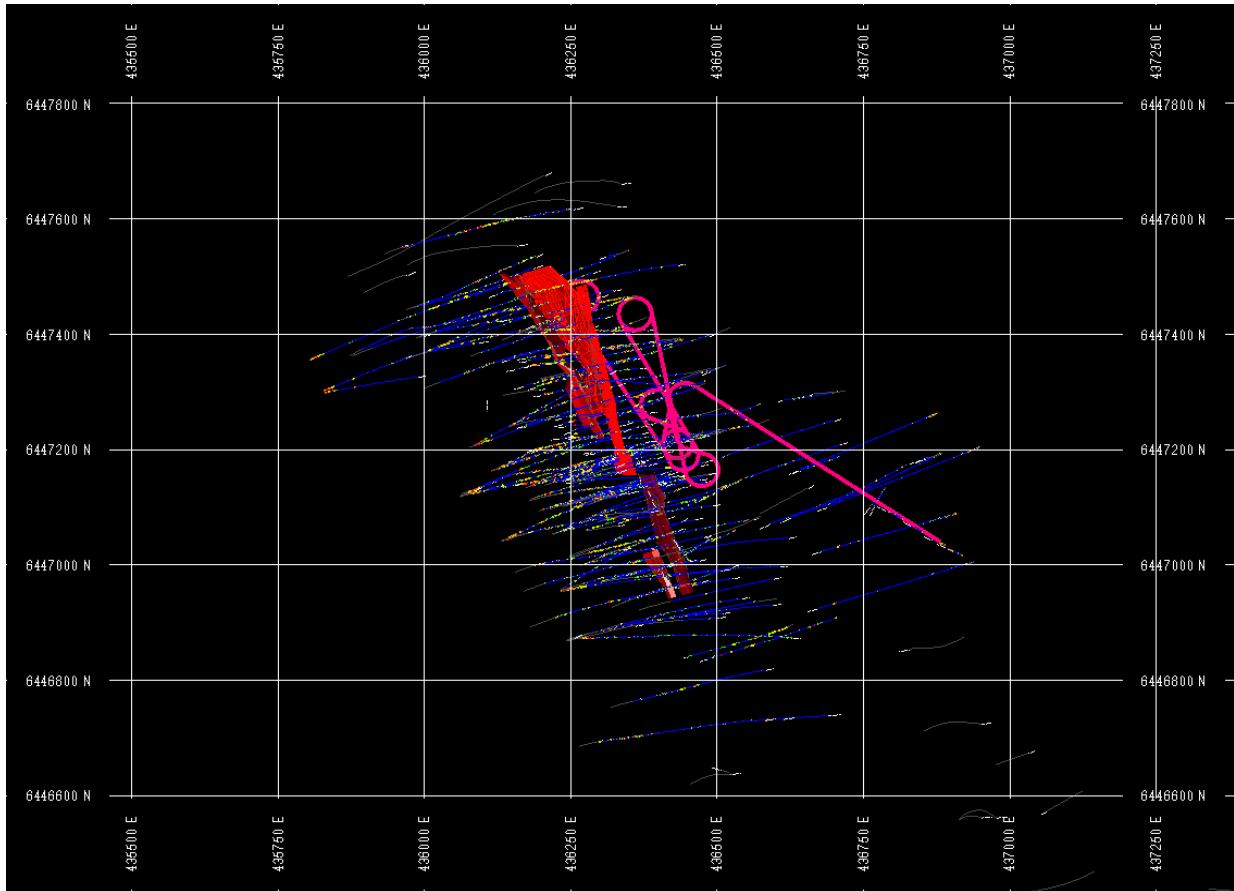


Figure 6 Structural Elements around the Hera Deposit

By utilising the geotechnical parameters of drillcore in particular the RQD which is a proxy for rock fragmentation it is possible to identify some key bounding fault structures approximately 250m either side of the main Ore Structures. These strike approximately parallel to the identified ore bodies. To the south, it is apparent the structures terminate or are significantly offset to either the East or West. To the north the structural definition is not fully defined but geological evidence would suggest immediately beyond the limit of the known orebody the structures are less well defined.

Thus we can interpret a potential zone of structural disruption of approximately 500m wide (east to west) and approximately 1000m long (north to south).

Further support for this structural model and the assumptions made for the zone of structural connectivity is provided by the structural interpretation made from aeromagnetic data, geological data and topographic models as shown in **Figure 7**. Zone 6 is the Hera deposit zone.

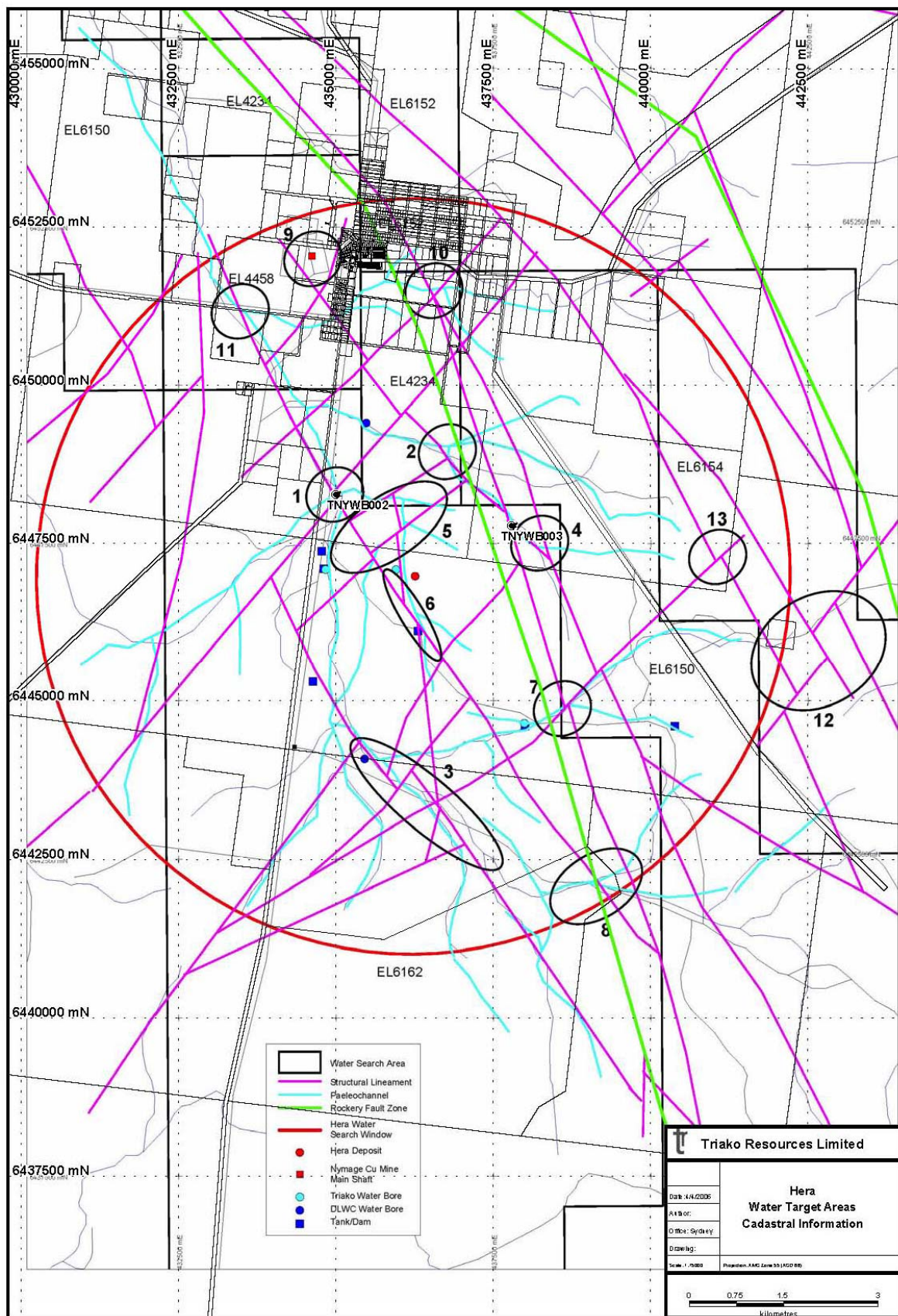


Figure 7 Interpretation of Structural Lineament in the Vicinity of the Mine Site

4.4 TOPOGRAPHY AND DRAINAGE

Areas immediately surrounding the Project Site are typically flat to gently undulating, with elevations ranging from approximately 300m AHD to 380m AHD (**Figure 8**). A number of small hills with a maximum elevation of more than 400m AHD occur to the north, northwest, south and northeast at distances of between 4km and 10km from the Project Site boundary. Slopes on the flanks of the small hills may be as steep as 1:10 (V:H).

A number of indistinct, ephemeral, unnamed creeks and drainages occur in the vicinity of the Project Site (**Figure 8**). Drainages to the south, west, north and immediately east of the Project Site within the Box Creek Catchment all typically flow to the northwest. Drainages further east within the Grahway Pangee Creek Catchment typically flow to the east while drainages in the Crowal Creek Catchment typically flow to the southwest.

The western and south-western sections of the Project Site are typically gently west-sloping, with elevations approximately 303m AHD to 320m AHD and slopes of 1:80 (V:H) or less (**Figure 9**). The southern section of the Project Site is dominated by a small hill with a maximum elevation of approximately 355m AHD and slopes of up to 1:10 (V:H). The northeastern section of the Project Site is dominated by a series of four hills with maximum elevations from south to north of approximately 368m AHD, 363m AHD, 358m AHD and 375m AHD. Maximum slopes on these hills may be as steep as 1:2 (V:H).

An unnamed creek flows from east to west through an open valley between the hills in the northeastern section of the Project Site and those in the southeastern section. This creek line is ephemeral and has been dammed to form Back Tank at the narrowest section of the open valley. This creek flows to the southwest corner of the site and then follows the eastern boundary past Pete's Tank and drains into the House Dam.

4.5 CLIMATE

Meteorological data (temperature and humidity, rainfall and evaporation) were sourced from the following Bureau of Meteorology stations for the calculations of monthly averages of climatic parameters presented in **Table 1**.

- Cobar MO NSW – Open station (1962 – present)
- Cobar Post Office NSW – Closed (1881 – 1965)

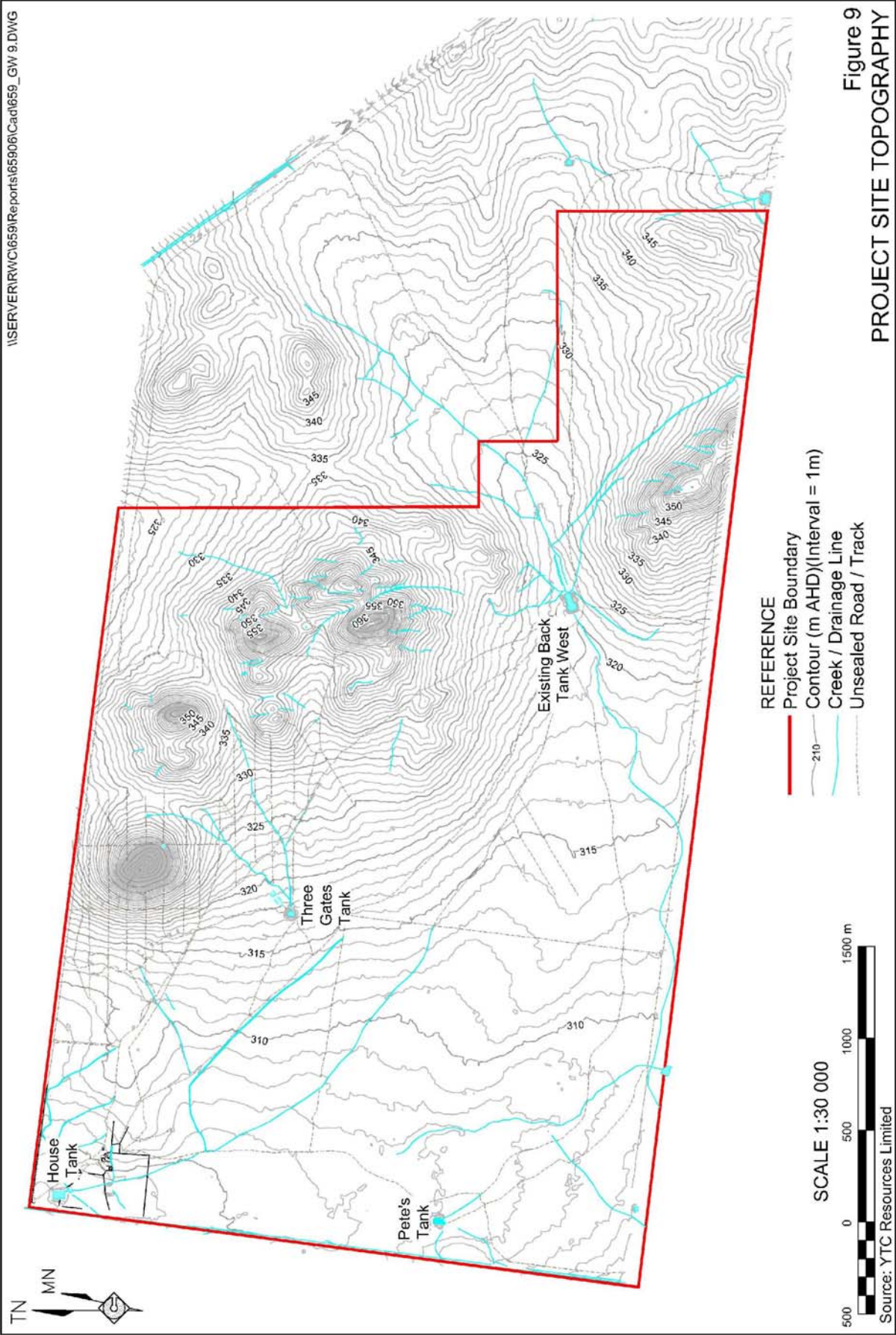
These meteorological stations are located approximately 90 km to the northwest of the Project Site. Data from both stations were combined to obtain average temperature and rainfall data for the period 1881 to 2009.

4.5.1 Temperature

The Cobar region is characterised by a mild to hot climate. January is the hottest month, with a maximum mean temperature of 35°C. July is the coldest month with a mean maximum temperature of 16°C and a minimum temperature of 4°C.



Note: A colour version of this figure is available on the Project CD.



Note: A colour version of this figure is available on the Project CD.

Table 1
Climate Data

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Temperature (°C)													
Mean maximum temperature	35	34	31	26	20	17	16	18	22	27	30	33	
Mean minimum temperature	20	19	17	12	8	6	4	6	9	12	16	18	
Rainfall (mm)													
Mean rainfall	38.6	39.1	32.0	26.2	30.1	29.6	25.7	28.5	23.6	32.2	31.5	35.8	373
Highest rainfall	239.6	281.2	238.1	201.4	144	103.6	102.4	114.4	104.6	130.5	157.1	157.8	799.7
Lowest rainfall	1.4	0	0	0	0	0.3	0.2	0	0	0	0.4	1.4	116.3
Highest daily rainfall	113.3	89.7	114.3	71.4	59.4	43.4	44.6	56.9	44.4	52.6	56.6	78.7	114.3
Evaporation (1975 to 2010)													
Mean Daily Evaporation	11.5	10	8.2	5.3	3.1	2.1	2.3	3.4	5.4	7.4	9.5	11.2	6.6
Note Temperature and rainfall data were sourced from Cobar MO station for the months of May 1962 – December 2009, and from the Cobar Post Office station for the months of February 1881 – December 1965													
Source: Bureau of Meteorology Stations – Cobar MO NSW (Station No.: 0428027) & Cobar Post Office (Station No. 0428237)													

4.5.2 Rainfall and Evaporation

Mean annual rainfall is 373mm, with rainfall distributed reasonably evenly throughout the year, the mean monthly rainfall in the range 23.6mm to 39.1mm. However, rainfall is extremely variable, with infrequent, high intensity rainfall events and maximum daily rainfall values are between 2 and 3.5 times average monthly rainfall values. On average 69 rain days occur per year, with 4 to 7 rain days experienced each month on average.

The driest year on record was 1982 when 116.3mm of rain was recorded. By contrast, the wettest year on record was 1891 when 799.7mm of rain was recorded.

Mean daily evaporation varies through the year, from 11.5mm/day in January to 2.1mm/day in June. Annual average evaporation is 2,409mm/year.

5. GROUNDWATER DATA

5.1 INTRODUCTION

The Impax Group completed a review of available groundwater bore information for the area located within a 10km radius of the Project Site. This included a review of the registered groundwater bore database, which is maintained by the NSW Office of Water, and supplementary information collected during preliminary groundwater studies of the Project Site undertaken by Geoterra Pty Ltd.

5.2 NSW OFFICE OF WATER REGISTERED BORE DATABASE

The Impax Group conducted a search of the NOW Registered Groundwater Bore database (www.nratlas.nsw.gov.au) on 8 June 2011. A total of 9 registered groundwater works were identified within an approximate 10km radius of the Project Site.

Registered groundwater bore locations relative to the Project Site are presented in **Figure 10**.

Information obtained from groundwater bore work summary forms is summarised in **Table 2**. Groundwater work summary forms are presented in **Appendix 2**.

Of the 9 registered groundwater works identified, 4 were bores located within the Project Site. These included the house bore (GW020657), Skirka's Bore (GW802946), the original Back Bore (GW020656), and WB4 (GW804185). These bores are all Project-related. GW020656 was the original "Back Bore" which was replaced with a new bore (the current Back Bore) in 2005.

Five of the identified registered bores were located off the site. These included WB2 (GW804183) and WB3 (GW804184), which were groundwater exploration bores advanced by Triako Resources Ltd on the property located to the north of the Project Site. At the time this report was prepared WB2 was an open hole. WB3 had been converted to a 50mm diameter piezometer.

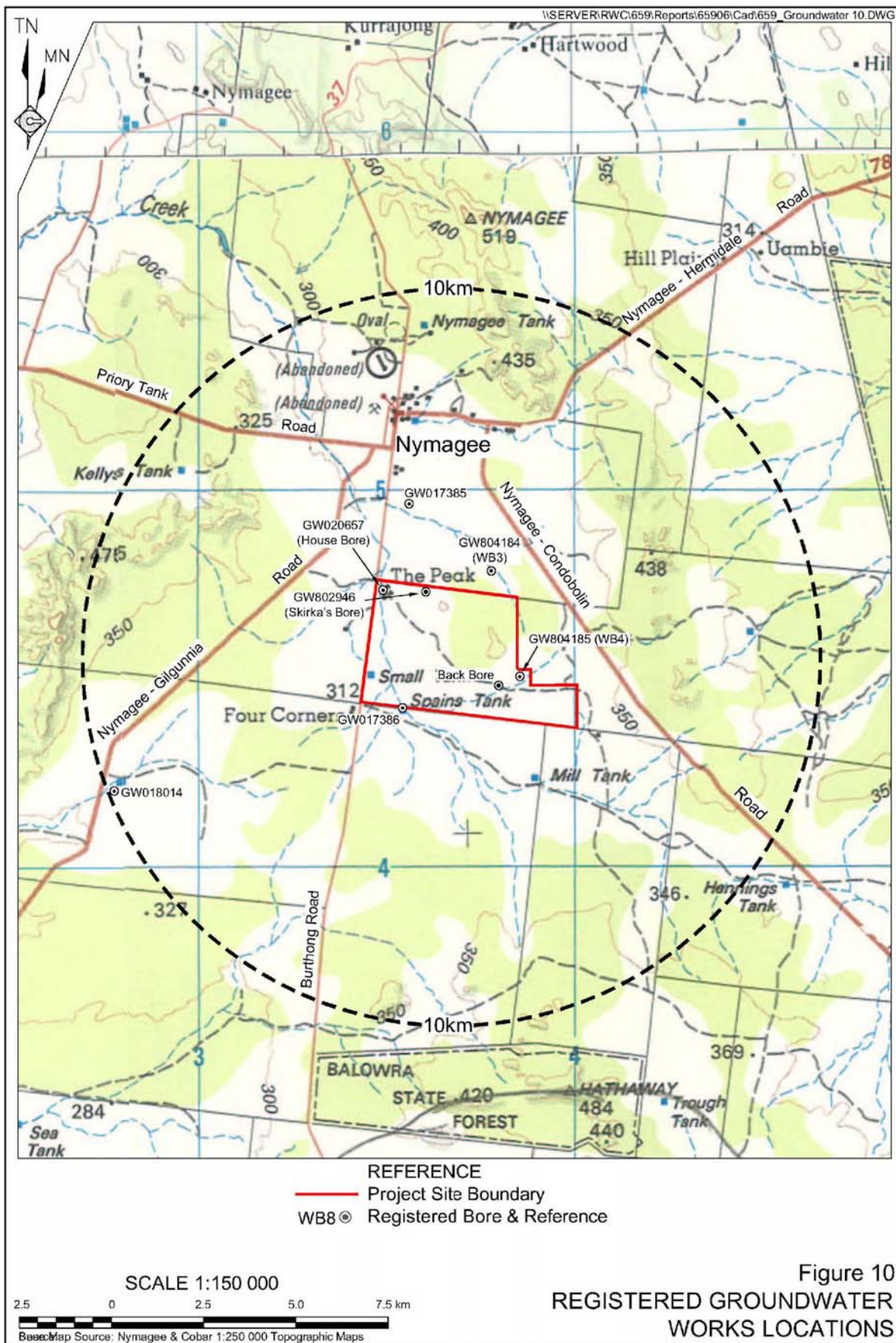
Three privately owned bores were identified within the search area.

- Registered bore GW017385 is located on the property to the north of the Project Site, approximately 2000m from the nearest site boundary. This bore was registered for "Stock" watering.
- Registered bore GW017386 is located on the property to the south of the Project Site, approximately 50m from the nearest site boundary. This bore was registered for "Stock" watering.
- Registered bore GW018014 is located to the southwest of the Project Site, approximately 7400m from the nearest boundary. This bore was registered for "Stock" watering.

The bores identified in the search of the NOW database were all less than 120m deep.

Groundwater was encountered in each of the registered bores in "siltstone", "slate", "schist" and "quartzite" at depths ranging from 19m to 120m bgl. Groundwater yields were recorded as ranging from 0.25L/s to 2.5L/s. Groundwater quality descriptions ranged from "good" to as high as 7000ppm of total dissolved solids (TDS). Borehole lithology was typified by shallow clayey soils underlain by "slate", "schist", "sandstone" and "siltstone".

Based on NOW registered groundwater bore information for registered bores located within 10km of the Project Site, the siltstones and sandstones of the Lower Amphitheatre Group in the west and Burthong Formation in the east provide a minor groundwater source from basement aquifers. The bores located away from the Project Site were registered for "Stock" watering or as "monitoring bores".



Note: A colour version of this figure is available on the Project CD.

Table 2
Summary of NOW Registered Groundwater Bores Located Within 10km of the Project Site

Bore ID	Depth (m)	SWL (m)	Water Bearing Zone	Yield (L/s)	Lithology	EC/TDS (ppm)	Date Installed
GW017385	61	46.6	19.2-19.2m (Schist) 50.3-50.3m (Slate)	0.51	Loam Sandy (0-1m) Schist (1-46m) Slate (46-61m)	500-1000	1959
GW017386	100.9	58.2	85.3-85.3m (Slate)	0.25	Clay (0-2m) Slate Soft (2-30m) Slate Hard (30-101m)	1000-3000	1960
GW018014	82.9	15.2	70.1-70.1m (Quartzite)	0.51	Clay (0-2m) Quartzite Soft (2-24m) Quartzite Solid (24-83m)	3000-7000	1960
GW020656 (Original Back Bore)	74.1	55.8	68.6-68.6m (Slate)	0.63	Clay (0-2m) Slate (2-34m) Quartzite (34-46m) Slate (46 - 74m)	"Good"	1963
GW020657 (House Bore)	74.1	54.3	59.7-59.7m (Slate)	0.63	Clay (0-2m) Slate (2-46m) Quartzite (46-48m) Slate (48-74m)	"Good"	1963
GW802946 (Skirka's Bore)	85	65	72-76m (Siltstone)	1.1	Alluvium (0-10m) Silcrete (10-12m) Kaolinitic Clay (12-25m) Siltstone (25-85m)	-	2004
GW804183 (WB2)	108	100	88-102m (Siltstone) 102-108m (Siltstone)	2.5	Gravel (0-5m) Siltstone (5-108m)	-	2005
GW804184 (WB3)	108	-	74-90m (Siltstone)	0.6	Gravel (0-2m) Clay (2-8m) Siltstone (8-108m)	-	2005
GW804185 (WB4)	120	52.8	88-120m (Siltstone)	1	Clay (0-4m) Sandstone / Siltstone (4-30m) Siltstone (30-120m)	-	2005

5.3 HERA PROJECT PRELIMINARY GROUNDWATER DATA

Initial hydrogeological studies and management plans for the Project Site were undertaken by Geoterra Pty Ltd on behalf of the former Project Site owner (Triako Resources Limited). Results of these studies are outlined in the following reports:

- Hydrogeological Assessment of Skirka's Bore at "The Peak" Station, Nymagee, NSW, Geoterra Pty Ltd, 25 October 2005.
- Hera Project Groundwater Status Report, Nymagee, NSW, Geoterra Pty Ltd, 31 May 2006.
- Hera Project Groundwater Management Plan, Nymagee, NSW, Geoterra Pty Ltd, 11 May 2007.

The works undertaken by Geoterra Pty Ltd on behalf of Triako Resources Ltd included the following:

- Supervision of the drilling of several groundwater exploration boreholes, and a replacement of the Back Bore.
- Sampling and analysis of groundwater from several groundwater bores and/or groundwater exploration bores.

- A 24 hour aquifer pumping test at Skirka's Bore.
- Submission of the original groundwater licence application for extraction of groundwater from the proposed Decline, Skirka's Bore and Back Bore.

A copy of the Geoterra Pty Ltd Groundwater Management Plan is presented as **Appendix 3**. A copy of the Geoterra Pty Ltd reports are presented as **Appendix 4**. The reports formed the basis for the granting of groundwater extraction licence for extraction of up to 147ML/yr. The grant was made by the NOW on 19 August 2010. A copy of the granted licences is presented as **Appendix 5**.

Results of aquifer pumping tests conducted at the site were reported by The Impax Group in May 2011 (The Impax Group, 2011).

5.4 PROJECT SITE BORES

The Proponent oversaw the installation of three additional observation bores (Observation Bore 1, Observation Bore 2 and Observation Bore 3) and one additional test bore at the Project Site in October 2010. These bores were installed for use during the Back Bore and Decline Bore pumping tests.

Further test bore drilling to identify additional groundwater resources at the Project Site was conducted by The Impax Group in February and March 2011. Seven groundwater exploration boreholes were advanced at the site. Four of the boreholes were converted into 125mm diameter production bores, one borehole was converted to a 50mm diameter piezometer and two boreholes were abandoned.

5.4.1 Test Bore Licences

Monitoring Bore and Test Bore licences were obtained in accordance with NOW requirements prior to the commencement of drilling works.

Groundwater works licence numbers are summarised in **Table 3**.

Table 3
Groundwater Monitoring and Test Bore Licence Details

Licence Number:	Works Permitted
85BL256061	Installation of Observation Bore 1
85BL256062	Installation of Observation Bore 2
85BL256063	Installation of Observation Bore 3
85BL256001	Installation of Decline Bore
85BL256083	Drilling / Installation of WB7-WB13

5.4.2 Groundwater Exploration Hole Locations

Groundwater exploration hole locations are shown in **Figure 2**. Hole coordinates are presented in **Table 4**.

Table 4
Groundwater Exploration Hole Locations

Bore ID:	Easting	Northing
WB7	439171	6445583
WB8	437115	6444465
WB9	437653	6446153
WB10	438459	6447005
WB11	435231	6444889
WB12	434958	6446287
WB13	436525	6446629

5.4.3 Groundwater Exploration Hole Geology

Drill cuttings were collected at one metre intervals throughout each borehole to allow the geology to be logged. The geology encountered in each exploration hole is outlined in the test bore logs presented as **Appendix 6**. The following presents a summary of those results.

Near surface soils consisted of red-brown clayey sandy loam. This was typically underlain by weathered shale or siltstone from a depth of 1m to 3m bgl. The weathered shale / siltstone was typically light brown or yellow brown in the upper 30m grading to greeny-grey colour and eventually to a grey colour above bedrock. Bedrock was encountered at depths ranging from 43m bgl to 95m bgl. Bedrock consisted of grey fine grained sandstone and siltstone. Quartz fragments were typically returned in drill cuttings after weak zones or fractures were encountered.

The uppermost water bearing zones were encountered at depths ranging from 73m to 99m bgl. In the more productive holes (WB8, WB11 and WB13), groundwater yields increased with depth as more fracturing was encountered. In less productive holes (WB10 and WB12) groundwater yield did not increase after the initial groundwater bearing zone was encountered even though additional zones of fracturing were encountered. Groundwater was typically encountered near the interface of the weathered rock and bedrock. Higher groundwater yield was typically identified in holes with a deep weathered profile. Bedrock was encountered at relatively shallow depths in WB7 and WB9 and these holes were dry.

Groundwater yields during drilling ranged from nil (WB7 and WB9) to in excess of 7.5L/s (WB8).

5.4.4 Production Bore Construction Details

Bores were constructed of 125mm Class 12 uPVC blank and screen, with the exception of WB12, which was completed with 50mm diameter uPVC screen and blank. Screens were machine slotted with a 2mm aperture. The borehole annulus was backfilled with 5mm to 7mm Macquarie River gravel from the bottom of the borehole to above the uppermost water bearing zone. A bentonite seal was placed above the gravel pack.

Test bore logs and/or bore construction details for all newly installed production bores are presented as **Appendix 6**. Bore construction details are summarised in **Table 5**.

Table 5
Groundwater Exploration Hole Construction Details

Bore ID:	Hole Depth	Well Depth	Screened Interval	Gravel Pack Interval
Decline Bore	150m	148m	136-148m	50-150m
WB7	103m	No Construction	No Construction	No Construction
WB8	140m	140m	98-104m 110-122m 128-134m	79-140m
WB9	115m	No Construction	No Construction	No Construction
WB10	120m	90m	72-84m	66-90m
WB11	144m	122m	98-116m	82-122m
WB12	136m	96m	84-96m	70-96m
WB13	136m	108m	90-102m	80-108m

5.4.5 Water Quality - During Drilling

During the installation of the new production bores The Impax Group monitored the groundwater yield, groundwater Electrical Conductivity (EC) and groundwater pH at the change of each rod. The measured EC and pH were consistent throughout each hole and were generally within the same range across the Project Site. Water quality results are summarised in **Table 6**. Water quality was not monitored during the installation of the Decline Bore.

Table 6
Groundwater Quality in Groundwater Exploration Boreholes

Bore ID:	Range of EC	Range of pH
WB8	5600-5800µS/cm	7.8-8.0
WB10	4700-5800µS/cm	7.7-7.9
WB11	5600-5800µS/cm	7.7-7.9
WB12	5600-5800µS/cm	7.7-7.9
WB13	5600-5800µS/cm	7.7-7.9

Groundwater quality in existing bores is outlined in the Geoterra (2006) report presented as **Appendix 4**.

5.4.6 Existing Production Bore Construction Details

Prior to the commencement of the 2010/2011 aquifer testing programme the Project Site featured the following production bores.

- The House Bore.
- The Back Bore.
- Skirka's Bore.

Construction details of the existing groundwater production bores are summarised in **Table 7**.

Table 7
Construction Details - Existing Groundwater Bores

Bore ID:	Hole Depth	Well Depth	Screened Interval	Gravel Pack Interval
Back Bore	120m	120m	108-114m	86-114m
Skirka's Bore	85m	85m	71-77m	71-85m
House Bore	74m	74m	Open Hole Below 30m	Open Hole Below 30m

5.4.7 Observation Bore Construction Details

Prior to the testing of the Back Bore and the Decline Bore additional observation bores were installed at the Project Site. Observation Bore 1 was installed approximately 160m to the south of the Back Bore. Observation Bore 2 was installed approximately 800m west of the Back Bore. Observation Bore 3 was installed approximately 250m northeast of the Decline Bore. The boreholes were advanced to a depth of 150m bgl. The observation bores were constructed with 50mm diameter Class 9 uPVC casing. Each observation bore featured 12m of screen at the base. The borehole annulus was filled with 3mm to 5mm Macquarie River gravel from the base of the borehole to a depth of approximately 50m bgl. The annulus was then sealed with bentonite pellets.

In addition to Observation Bores 1, 2 and 3 the Project Site and surrounds also featured several open holes from an earlier groundwater exploration programme. These included the following.

- WB2.
- WB3.
- WB4.
- WB5.

WB2 and WB3 are located on the property to the north of the Project Site. WB2 is an open hole with no casing. WB3, WB4 and WB5 were cased with 50mm uPVC prior to the testing of the Back Bore and the Decline Bore. The location of all production and observation bores are shown on **Figure 2**.

The Impax Group also monitored groundwater levels within GW017386 (referred to as the "Neighbour's Bore" in The Impax Group (2011) pumping test report) during testing of WB8, WB11 and WB13. GW017386 was an unequipped open hole with steel surface casing. Construction details for the GW017386 were obtained from the database of registered groundwater works, which is maintained by NOW.

Observation bore details are summarised in **Table 8**.

Table 8
Construction Details - Existing Groundwater Bores

Bore ID:	Hole Depth	Well Depth	Screened Interval	Gravel Pack
WB2	108m	Open Hole	Open Hole	Open Hole
WB3	108m	108m	88-108m	50-120m
WB4	120m	120m	114-120m	50-120m
WB5	150m	150m	144-150m	50-150m
Observation Bore 1	150m	150m	138-150m	50-150m
Observation Bore 2	150m	150m	138-150m	50-150m
Observation Bore 3	150m	150m	138-150m	50-150m
Neighbours Bore (GW017386)	101m	101m	Open Hole Below 41m	Open Hole Below 41m

5.5 STANDING WATER LEVELS

Relative bore elevations, standing water levels (SWL) and relative groundwater levels are presented in **Table 9**.

Table 9
Construction Details - Existing Groundwater Bores

Bore ID:	Collar Elevation (m AHD)	Approximate SWL (m bgl)	Approximate SWL Elevation (m AHD)
Skirka's Bore	322m	63m	259m
Decline Bore	322m	63m	259m
Back Bore	321m	63m	258m
WB2	316m	54m	262m
WB3	322m	45m	277m
WB4	325m	53m	272m
WB5	320m	71m	249m
WB8	317m	70m	247m
WB10	326m	55m	271m
WB11	308m	63m	245m
WB12	306m	60m	246m
WB13	320m	71m	249m
Observation Bore 1	322m	63m	259m
Observation Bore 2	317m	69m	248m
Observation Bore 3	325m	71m	254m
Neighbours Bore (GW017386)	310m	52m	258m

The standing water level of groundwater at the Project Site ranges from approximately 245m AHD to 277m AHD. Relative elevations of borehole collars range between 306m AHD and 325m AHD. In general, groundwater elevation is highest to the east Hera Deposit (WB4, WB10 and WB3) and lowest in the southwest corner of the Project Site (WB8, Observation Bore 2, WB11, WB12).

The data presented in **Table 9** shows that there are some relatively large variations in groundwater elevation over relatively short horizontal distances at the site. For example, the groundwater elevation in the vicinity of the Back Bore and Observation Bore 1 is approximately 258m AHD, whilst the groundwater elevation at WB8 and Observation Bore 2 is approximately 248m AHD, or 10m lower. These bores are located approximately 800m from each other and surface elevations between the two areas only vary by approximately 5m. The groundwater elevation between GW017386 and WB11 varies by approximately 13m even though the two bores are located within 1km of each other and have similar surface elevations. Similarly, the relative elevation of groundwater in the area around WB13 and WB5, and the area around Skirka's Bore and the Decline Bore varies by approximately 10m even though these areas are located relatively close to each other, have similar surface elevations, and are located in a similar part of the landscape.

The variation in groundwater elevations indicates that there may be several discrete or semi-discrete aquifer systems across the Project Site. The site is typically characterised by northwest to southeast trending structures that are close to vertical. Based on the variation in observed groundwater elevations across the study area it is possible that groundwater flow occurs primarily along a northwest / southeast plane with little connectivity in the southwest to northeast plane.

5.6 WATER QUALITY MONITORING

The Impax Group collected groundwater samples from several groundwater bores located within or close to the Project Site in November 2010. Bores sampled included WB3, WB4, WB5, Back Bore, House Bore, Observation Bore 2 and Observation Bore 3 (**Figure 2**).

Each bore was purged prior to sampling to ensure samples were indicative of groundwater from the adjacent aquifer. Samples were collected from the Back Bore using the fitted submersible pump during aquifer testing. Samples from the House Bore were also collected using the fitted submersible pump. Samples were removed from all other bores by air lifting. This purging and sampling method is not ideal for groundwater sampling, however, given the depth of boreholes and the diameter of bore casing it was the only feasible way to collect water samples.

Bores were purged for a period of at least 1 hour prior to sampling. Field water quality parameters were measured at regular intervals during purging to assess when the bore had been adequately purged. Once the bore was purged, samples of the groundwater were collected in appropriate laboratory supplied containers. Samples were placed on ice in an esky immediately after sampling. Samples were shipped by express courier to LabMark Environmental Laboratories (Sydney) for analysis. Samples were analysed for major cations, major anions, nutrients, physical parameters, total cyanide, free cyanide and weak acid dissociable (WAD) cyanide.

Measured field parameters are summarised in **Table 10**.

Table 10
Field Water Quality Parameters

Bore ID	Dissolved Oxygen (ppm)	EC (uS/cm)	pH	Redox (mV)	Temp (°C)
Back Bore	2.42	3010	6.68	+193	23.2
House Bore	8.57	2550	7.24	+121	23.1
WB3	7.01	5240	8.01	+46	22.5
WB4	7.17	5350	8.34	+92	22.1
WB5	8.03	3540	8.58	+57	20.5
Observation Bore 2	7.45	5110	8.21	+74	22.9
Observation Bore 3	6.56	4460	8.03	+25	22.9

As shown in **Table 6** and **Table 10** measured electrical conductivity (EC) of groundwater in the vicinity of the Project Site ranges between 2500µS/cm and 5800µS/cm. In most of the sampled bores, and the exploration bores installed in 2011 (WB7 - WB13), the EC was typically between 5000 µS/cm and 6000 µS/cm. EC was lowest in the House Bore and Back Bore.

Measured pH ranged from 6.7 to 8.6 but was generally in the range between 7.7 and 8.2 indicating mildly alkaline conditions within the aquifer. The measured pH values in the House Bore and Back Bore were lower than those in all other bores.

Measured dissolved oxygen (DO) ranged from 2.42ppm to 8.57ppm. DO values were typically elevated due to the use of air lifting to purge wells and obtain samples. The measured DO in the Back Bore is most likely to reflect conditions within the aquifer as it was sampled using a submersible pump.

The measured redox potential ranged from +25mV to +193mV indicating groundwater is oxidised.

Measured groundwater temperature ranged from 20.5°C to 23.2°C. Temperature was measured ex-situ and is likely to have varied due to ambient temperature changes.

Laboratory Analytical Results are summarised in **Table 11**.

5.7 CURRENT GROUNDWATER USE

The groundwater bores identified within the Project Site are registered for "industrial / stock" use, "stock" use or groundwater "monitoring". Bores located on privately owned land within 10km of the Project Site are registered for "stock" watering and "monitoring".

At the time this report was prepared, the House Bore was used by the Proponent for bathing and sanitation as well as irrigating a small area around the existing homestead.

Table 11
Summary of Analytical Results

Analyte	Observation Bore 2	Observation Bore 3	WB3	WB4	WB5	Back Bore	House Bore
Lab pH (pH units)	8.1	8.1	8.1	8.0	8.4	7	7.5
Field pH (pH units)	8.21	8.03	8.01	8.34	8.58	6.68	7.24
Lab EC (µS/cm)	5490	4640	5650	5800	3910	3170	2740
Field EC (µS/cm)	5110	4460	5240	5350	3540	3010	2550
TDS	3650	2310	2790	2560	1810	2210	2010
TSS	54	10	528	<5	984	<5	8
Chloride	922	1070	1340	1420	692	576	484
Sulphate	990	408	400	393	662	224	190
Calcium	197	162	195	224	159	104	26
Magnesium	253	208	221	240	182	121	47
Sodium	696	553	700	690	439	393	455
Potassium	40	26.8	29.4	28.6	27.6	17.3	27.9
Total Cyanide	<0.005	0.005	0.005	<0.005	<0.005	<0.005	<0.005
Free Cyanide	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO ₂ as N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO ₃ as N	0.01	0.01	0.04	0.13	0.01	0.89	2.94
Ammonia	0.1	0.06	0.1	0.24	0.34	<0.01	<0.01
Total N	<0.1	<0.1	<0.1	0.1	1.8	0.9	2.9
Ortho Phosphate	0.009	0.005	0.008	0.017	0.032	0.03	0.024
Total Phosphorous	<0.01	0.01	<0.01	0.01	0.05	0.03	0.03

All results expressed in mg/L unless stated otherwise.

5.8 POTENTIAL BENEFICIAL GROUNDWATER USE

Groundwater salinity is the only measure of groundwater quality information available for the majority of bores used in this assessment. Groundwater salinity is a simple way to assess potential beneficial uses of groundwater.

5.8.1 Drinking Water

The *National Water Quality Management Strategy, Australian Drinking Water Guidelines (2004)* provide aesthetic based guidelines for total dissolved solids (TDS). These are presented in **Table 12**. The aesthetic guidelines refer to the TDS concentration which affects the taste or palatability of drinking water. These guidelines are not based on potential to cause adverse impacts to human health.

Measured EC for bores located within the study area ranged from 2550 µS/cm to 5800 µS/cm. The results indicate that groundwater within the existing bore network at the Project Site is not suitable for use as drinking water without treatment.

Table 12
Palatability of Drinking Water According to TDS Concentration

TDS	EC Equivalent	Drinking Water Quality
<80ppm	<120µS/cm	Excellent
80-500ppm	120-750µS/cm	Good
500-800ppm	750-1200µS/cm	Fair
800-1000ppm	1200-1500µS/cm	Poor
>1000ppm	>1500µS/cm	Unacceptable

5.8.2 Irrigation

The ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) provide salinity thresholds for a broad range of commonly grown crops and host soil types (sand, loam and clay). Salinity thresholds for crops grown in clay soils range from 700µS/cm to 4,200µS/cm.

Based on the existing EC data for groundwater bores located at the Project Site groundwater from selected bores (in particular the House Bore and Back Bore) may be suitable to irrigate the most salt tolerant crops. However, groundwater from most bores at the Project Site would not be suitable for irrigation of crops.

5.8.3 Stock Water

The ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) provide typical salinity tolerance thresholds of common livestock. These are summarised in **Table 13**.

Table 13
Tolerance of Livestock to TDS in Drinking Water

Livestock Type	Stock Will Drink Without Loss of Production	Loss of Production and Decline in Animal Condition and Health Expected
Beef Cattle	4000-5000ppm	5000-10000ppm
Dairy Cattle	2500-4000ppm	4000-7000ppm
Sheep	5000-10000ppm	10000-13000ppm
Horses	4000-6000ppm	6000-7000ppm
Pigs	4000-6000ppm	6000-8000ppm
Poultry	2000-3000ppm	3000-4000ppm

Using a conversion factor of $EC = 1.5 \times TDS$ the measured TDS of groundwater from bores at the Project Site ranges from approximately 1600ppm to 4000ppm. Based on the measured EC (and TDS) groundwater from bores at the site would be considered suitable as drinking water for all livestock except poultry.

5.8.4 Discharge to Surface Water

The *ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)* provides a range of default trigger values for electrical conductivity in slightly disturbed river ecosystems located in Southeast Australia. The trigger value range provided for "Lowland Rivers" is 125µS/cm to 2200µS/cm.

Based on measured EC groundwater from bores at the Project Site would not be suitable to be discharged to surface water.

5.8.5 Freshwater Aquaculture

The *ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)* indicates that a salinity of <3000ppm is desired for the protection of freshwater aquaculture species.

Based on measured EC, groundwater from those bores with relatively low EC (House Bore and Back Bore) may be suitable for use in freshwater aquaculture. However, groundwater from other bores at the Project Site would not be suitable for fresh water aquaculture.

5.8.6 Industry

The availability of groundwater for other industry must be considered as part of this assessment. There are no relevant water quality guidelines for industrial use of groundwater. Whilst good quality water is usually required to protect infrastructure, water treatment plants can be used to achieve the desired water quality.

At present, there are no groundwater reliant industries located within the groundwater Study Area and agricultural use of groundwater is limited.

6. AQUIFER TESTING

Six aquifer pumping tests were conducted at the site between November 2010 and March 2011. Bores tested included the Back Bore, Decline Bore, WB8, WB11 and WB13 (**Figure 2**).

6.1 PUMPING TEST PROGRAMME

The timing of pumping tests conducted at the Project Site is outlined in **Table 14**.

6.2 PUMPING TEST METHODOLOGY

The Impax Group collected water level data for a period of at least 24 hours prior to commencing each pumping test to establish pre-test standing water levels.

Table 14
Pumping Test Dates

Bore ID:	Pumping Period
Back Bore	2 November 2010 - 9 November 2010
Decline Bore	13 December 2010 - 21 December 2010
WB8	1 March 2011 - 7 March 2011
WB10	8 March 2011 - 9 March 2011
WB11	11 March 2011 - 17 March 2011
WB13	19 March 2011 - 22 March 2011

The test bore was pumped using a Grundfos submersible pump. A diesel powered generator was used to supply power to the pump during each test.

Each bore was pumped for a brief period prior to the pumping test to assess the pumping rate for each test. For all but two of the pumping tests, the bore was pumped at the maximum possible flow rate. The Impax Group observed drawdown vs time for a range of pumping rates to determine the ideal pumping rate for the Decline Bore pumping test and the WB10 test.

A stopwatch was used to monitor the duration of the pumping test. All measurements were recorded based on the time displayed by the stopwatch to ensure consistency.

A data logging pressure transducer was installed at the bottom of each pumping bore prior to each test commencing. Loggers were typically set up to record water levels every 2 minutes for the duration of pumping and recovery period. The logger recorded changes in water level during the tests. A 25mm diameter poly pipe was installed above the pump in the pumping bore to enable manual drawdown readings during the pumping tests.

Water level loggers were installed in key observation bores during each pumping test. Data loggers were typically setup to record the water level every five minutes. Manual readings were recorded at all observation bores as regularly as possible for the duration of the pumping test.

The pumping rate was monitored regularly during each pumping test. The flow rate was measured by timing how long the discharge took to fill a container of known volume.

At the completion of pumping the aquifer was allowed to recover. Aquifer recovery was monitored for at least the same period of time as the pumping test was conducted.

Sources of potential interference were noted prior to and during each pumping test. Potential sources of interference included:

- Drawdown and recovery associated with use of groundwater by other drilling crews at the Project Site.
- Extraction of groundwater during drilling of additional groundwater exploration bores. Water flows during drilling were up to 7.5L/s.
- Drawdown and recovery associated with other recent pumping tests.

6.3 PUMPING TEST ANALYSIS

Pumping test results were analysed using a range of methods. Drawdown data during pumping was assessed using the Cooper and Jacob (1946) method. Recovery data was analysed using the Thies Recovery method. Where drawdown was observed in an observation bore the distance drawdown method was also used to assess the results.

The safe yield for each tested bore was estimated using the observed rate of drawdown from the pumping test to estimate the pumping rate which could be sustained for long term pumping. The following formula (Fetter, 1994) is used to estimate the safe yield:

$$\text{Available Drawdown} = (S_{100} + 4\Delta s) \frac{Q_{\text{Safe}}}{Q_{\text{Test}}}$$

Where:

Available Drawdown = depth between the SWL and pump intake

S₁₀₀ = drawdown after 100 minutes of pumping

Δs = drawdown difference per log cycle of time

Q_{Test} = Pumping Rate during the pumping test

Q_{Safe} = Estimated safe pumping rate (1,000,000min continuous pumping)

This equation assumes that after 100 minutes of pumping drawdown occurs in a linear fashion for the next 4 log cycles of time (for 1,000,000 minutes or 1.9 years) and that the magnitude of drawdown is directly proportional to the pumping rate. The Impax Group also calculated the safe pumping rate assuming continuous pumping for 5 log cycles of time after 100 minutes (i.e. for 10,000,000min or 19 years).

The methods used to assess the pumping test data are based on the following assumptions:

- The water bearing strata is confined.
- The aquifer is infinite in radial extent.
- The aquifer is homogenous and isotropic.
- Groundwater recharge does not occur and therefore steady state conditions will never be reached.
- The pumping bore has fully penetrated the aquifer.
- There is no interference from extraction of water from the aquifer at other locations.

6.4 BACK BORE PUMPING TEST RESULTS

Drawdown and recovery plots for the Back Bore and Observation Bore 1 are presented in **Appendix 7**. Pumping test details and data assessment results are summarised in **Table 15**.

Table 15
Pumping Test Details - Back Bore

Bore ID:	Back Bore
Bore Depth:	120m
Screened Interval:	108-114m
SWL:	63m
Available Drawdown:	40m
Pumping Duration:	7.1 Days - 10230min
Start Date:	2 November 2010
End Date:	9 November 2010
Average Pumping Rate:	3.8L/s
Drawdown at 100min:	3.3m
Maximum Drawdown:	9.05m
Maximum Drawdown in Observation Bores:	Observation Bore 1 - 4.26m No drawdown in other observation bores.
% Recovery (Pumping Period)	68%
ΔS^1 - Pumping Data	9.0m
ΔS^1 - Recovery Data	9.0m
ΔS^1 - Pumping Data - Observation Bore 1	6.0m
ΔS^1 - Recovery Data - Observation Bore 1	9.0m
Calculated Transmissivity:	6.7m ² /day
Calculated Storativity (Observation Bore 1)	6.7 x 10 ⁻⁴
Calculated Storativity (Distance Drawdown Method):	1.3 x 10 ⁻⁷
Estimated Safe Yield (1,000,000min):	3.9L/s
Estimated Safe Yield (10,000,000min):	3.1L/s

The Back Bore was pumped at an average rate of approximately 3.8L/s for the duration of the test. The test ran for a period of 10230 minutes or 7.1 days.

Drawdown within the Back Bore was logarithmic for the first 1000 minutes of pumping. After 1000 minutes of pumping, drawdown continued in a linear fashion, indicating that the cone of depression may have encountered a zero-recharge boundary. Alternatively, the drawdown behaviour may have been indicative of dual porosity system, where initial drawdown is the response of the relatively large and permeable fractures adjacent to the bore screen. The late time drawdown behaviour may be indicative of the permeability of the actual rock matrix and/or the permeability of minor fractures which recharge the large fractures.

The Impax Group monitored water levels in the Back Bore, Observation Bore 1, WB4, Observation Bore 2 and WB5 during the test (**Figure 2**). It should be noted that WB7 through WB13 had not been installed at the time the Back Bore pumping test was conducted. Drawdown was observed in Observation Bore 1 and the response to pumping was generally consistent with that of the Back Bore. Drawdown was not observed in any other monitoring bore.

Aquifer parameters were assessed using late time drawdown and recovery data to account for potential dual porosity effects observed during the pumping test. The late time drawdown and recovery behaviour was likely to more accurately reflect the average aquifer properties and was considered the most appropriate for assessment of the sustainable pumping rate.

The standing water level within the Back Bore had only recovered approximately 68% after 10230 minutes of recovery indicating that the ability for the aquifer to recover could limit the sustainable extraction rate.

6.5 DECLINE BORE PUMPING TEST RESULTS

Drawdown and recovery plots for the Decline Bore and Skirka's Bore are presented as **Appendix 7**. Pumping test details and data assessment results are summarised in **Table 16**.

Table 16
Pumping Test Details - Decline Bore

Bore ID:	Decline Bore
Bore Depth:	148m
Screened Interval:	136-148m
SWL:	63m
Available Drawdown:	40m
Pumping Duration:	7 Days - 10800min
Start Date:	13 December 2010
End Date:	21 December 2010
Average Pumping Rate:	0.75L/s
Drawdown at 100min:	9.0m
Maximum Drawdown:	NA - See discussion below
Maximum Drawdown in Observation Bores:	Skirka's Bore - 1.31m No drawdown in other observation bores.
% Recovery (Pumping Period)	NA - See discussion below
ΔS^1 - Pumping Data	NA - See discussion below
ΔS^1 - Recovery Data	3.9m
ΔS^1 - Pumping Data - Skirka's Bore	2.4m
ΔS^1 - Recovery Data - Skirka's Bore	1.4m
Calculated Transmissivity:	3.0m ² /day
Calculated Storativity (Skirka's Bore)	9.0 x 10 ⁻⁴
Calculated Storativity (Distance Drawdown):	NA - See discussion below
Estimated Safe Yield (1,000,000min):	1.2L/s
Estimated Safe Yield (10,000,000min):	1.1L/s

A step drawdown test was conducted to assess the ideal pumping rate for the test. The Decline Bore was pumped at an average rate of approximately 0.75L/s for the duration of the test. The flow rate ranged from 1.0L/s to 0.6L/s during the first 48 hours of pumping but was steady at 0.75L/s for the last 5 days of pumping. The test ran for a period of 10800 minutes or 7.5 days.

The maximum drawdown in the Decline Bore was up to 50m while the maximum observed drawdown in Skirka's Bore (located approximately 100m to the west) was 1.31m. Drawdown was very sensitive to minor changes in the flow rate. Based on the observed drawdown behaviour it was concluded that the bore casing was inefficient due to incorrect placement of the screen. Drawdown observed within the Decline Bore was not considered representative of the surrounding aquifer and was not suitable for analysis. Late time recovery data for the decline bore was considered indicative of aquifer response and was used to estimate aquifer properties.

The Impax Group monitored water levels in Skirka's Bore, Observation Bore 3, WB2, WB3 and WB5 during the test. Drawdown was observed in Skirka's Bore. Drawdown was not observed in any other monitoring bore.

Aquifer parameters were assessed using late time recovery data from the Decline Bore, and late time pumping and recovery data from Skirka's Bore.

6.6 WB8 PUMPING TEST RESULTS

Drawdown and recovery plots for WB8 and Observation Bore 2 are presented as **Appendix 7**. Pumping test details and data assessment results are summarised in **Table 17**.

Table 17
Pumping Test Details - WB8

Bore ID:	WB8
Bore Depth:	140m
Screened Interval:	98-134m
SWL:	70m
Available Drawdown:	35m
Pumping Duration:	6 Days - 8630min
Start Date:	1 March 2011
End Date:	7 March 2011
Average Pumping Rate:	2.2L/s
Drawdown at 100min:	2.2m
Maximum Drawdown:	3.8m
Maximum Drawdown in Observation Bores:	Observation Bore 2 - 1.34m Neighbours Bore - 0.47m No drawdown in other observation bores.
% Recovery (Pumping Period)	88%
ΔS^1 - Pumping Data	1.8m
ΔS^1 - Recovery Data	1.7m
ΔS^1 - Pumping Data - Observation Bore 2	1.4m
ΔS^1 - Recovery Data - Observation Bore 2	1.4m
Calculated Transmissivity:	19.3m ² /day
Calculated Storativity (Observation Bore 2)	1.7 x 10 ⁻³
Calculated Storativity (Distance Drawdown):	2.8 x 10 ⁻⁵
Estimated Safe Yield (1,000,000min):	8.2L/s
Estimated Safe Yield (10,000,000min):	6.9L/s

WB8 was pumped at an average rate of approximately 2.2L/s. The pumping rate dropped to approximately 1.9L/s during the first 1000 minutes of the test due to interference from the cable hanging the water level logger. The discharge rate picked up to 2.2L/s for the last 5 days of the test. The test ran for a period of 8630 minutes or 6 days.

Drawdown within WB8 followed a logarithmic trend for the duration of the test. The rate of drawdown vs log time increased after 1000 minutes of pumping. The drawdown behaviour is inferred to indicate that the aquifer has dual porosity, where initial drawdown is the response of the relatively large and permeable fractures adjacent to the bore screen. The late time drawdown behaviour may be indicative of the permeability of the actual rock matrix and/or the permeability of minor fractures which recharge the large fractures.

The Impax Group monitored water levels in Observation Bore 2, Observation Bore 1 and the Neighbours Bore during the test. It should be noted that WB9 through WB13 had not been installed at the time the WB8 pumping test was conducted. Drawdown was observed in Observation Bore 2 and in the Neighbours Bore. Drawdown was not observed in Observation Bore 1. Based on observations during the WB8 test and the Back Bore test it is unlikely that there is any significant hydraulic connection between these bores.

Aquifer parameters were assessed using late time drawdown and recovery data to account for potential dual porosity effects observed during the pumping test. The late time drawdown and recovery behaviour was likely to more accurately reflect the average aquifer properties and was considered the most appropriate for assessment of the sustainable pumping rate.

A distance vs drawdown analysis was also conducted using maximum drawdown observations from WB8, Observation Bore 2 and the Neighbours Bore.

The standing water level within WB8 had recovered approximately 88% after 8630 minutes of recovery.

6.7 WB10 PUMPING TEST RESULTS

Drawdown and recovery plots for WB10 are presented as **Appendix 7**. Pumping test details and data assessment results are summarised in **Table 18**.

A step drawdown test was undertaken to determine the pumping rate for the test. WB10 was pumped at an average rate of approximately 0.5L/s. The pumping rate was approximately 0.7L/s for the first 20 minutes of the test. The flow rate was adjusted to 0.6L/s from 20 minutes to 270 minutes and dropped further to 0.5L/s for the remainder of the test. The test ran for a period of 1620 minutes or 1.1 days.

Late drawdown data was used to assess the aquifer parameters as the early drawdown data was influenced by changes in the pumping rate. Late time recovery data was also used as early recovery data was influenced by backflow of water from the discharge line in the 5 minutes following pump shutdown.

Table 18
Pumping Test Details - WB10

Bore ID:	WB10
Bore Depth:	90m
Screened Interval:	72-84m
SWL:	58m
Available Drawdown:	14m
Pumping Duration:	1.1 Days - 1620min
Start Date:	8 March 2011
End Date:	9 March 2011
Average Pumping Rate:	0.5L/s
Drawdown at 100min:	10.0m
Maximum Drawdown:	16.47m
Maximum Drawdown in Observation Bores:	No drawdown in observation bores.
% Recovery (Pumping Period)	98%
ΔS^1 - Pumping Data	4.1m
ΔS^1 - Recovery Data	6.2m
Calculated Transmissivity:	1.3m ² /day
Calculated Storativity	NA
Estimated Safe Yield (1,000,000min):	0.2L/s
Estimated Safe Yield (10,000,000min):	0.2L/s

Monitoring bores were not used during the WB10 test.

The standing water level within the WB10 had recovered approximately 98% after 1620 minutes of recovery.

6.8 WB11 PUMPING TEST RESULTS

Drawdown and recovery plots for WB11 are presented as **Appendix 7**. Pumping test details and data assessment results are summarised in **Table 19**.

WB11 was pumped at an average rate of approximately 2.0L/s which was consistent throughout the test. The test ran for a period of 8640 minutes or 6 days.

Drawdown within WB11 followed a logarithmic trend for the duration of the test. The rate of drawdown vs log time increased after 1000 minutes of pumping. The drawdown behaviour is inferred to indicate that the aquifer has dual porosity, where initial drawdown is the response of the relatively large and permeable fractures adjacent to the bore screen. The late time drawdown behaviour may be indicative of the permeability of the actual rock matrix and/or the permeability of minor fractures which recharge the large fractures.

The Impax Group monitored water levels in WB8, Observation Bore 1, Observation Bore 2, the Neighbours Bore and WB12 during the test.

Table 19
Pumping Test Details - WB11

Bore ID:	WB11
Bore Depth:	122m
Screened Interval:	98-116m
SWL:	63m
Available Drawdown:	35m
Pumping Duration:	6 Days - 8640min
Start Date:	11 March 2011
End Date:	17 March 2011
Average Pumping Rate:	2.0L/s
Drawdown at 100min:	12.5m
Maximum Drawdown:	16.3m
Maximum Drawdown in Observation Bores:	Neighbours Bore - 0.56m No drawdown in other observation bores. Possible slowed recovery in WB8 and Observation Bore 2.
% Recovery (Pumping Period)	93%
ΔS^1 - Pumping Data	3.1m
ΔS^1 - Recovery Data	3.0m
Calculated Transmissivity:	10.2m ² /day
Calculated Storativity (Distance Drawdown):	2.8 x 10 ⁻⁴
Estimated Safe Yield (1,000,000min):	2.8L/s
Estimated Safe Yield (10,000,000min):	2.5L/s

The water level within the Neighbours Bore dropped from 52.12m at the commencement of the test to 52.55m at the end of pumping. It should be noted that the Neighbours Bore had not recovered from the WB8 pumping test. Prior to the WB8 test the water level within the Neighbours Bore was 51.45m. The Neighbours Bore was observed to drop further in the weeks following the test. On 13 April 2011 (approximately 27 days after pumping ceased at WB11) the water level within the Neighbours Bore was 54.11m. The cause of the gradual downward trend in water levels in the Neighbours Bore was not known.

During the WB11 test, Observation Bore 2 and WB8 were recovering from the WB8 test. Drawdown within these bores did not increase during the WB11 test, however, the rate of recovery may have been slowed due to pumping at WB11. Drawdown was not observed in Observation Bore 1 or WB12.

Aquifer parameters were assessed using late time drawdown and recovery data to account for potential dual porosity effects observed during the pumping test. The late time drawdown and recovery behaviour was likely to more accurately reflect the average aquifer properties and was considered the most appropriate for assessment of the sustainable pumping rate.

A distance vs drawdown analysis was also conducted using maximum drawdown observations from WB11 and the Neighbours Bore.

The standing water level within WB11 had recovered approximately 93% after 8640 minutes of recovery.

6.9 WB13 PUMPING TEST RESULTS

Drawdown plots for WB13 and WB5 are presented as **Appendix 7**. Pumping test details and data assessment results are summarised in **Table 20**.

WB13 was pumped at an average rate of approximately 1.7L/s which was consistent throughout the test. The test ran for a period of 4620 minutes or 3.2 days.

Drawdown within WB13 followed a logarithmic trend for the duration of the test. The rate of drawdown vs log time increased after 1000 minutes of pumping. The drawdown behaviour is inferred to indicate that the aquifer has dual porosity, where initial drawdown is the response of the relatively large and permeable fractures adjacent to the bore screen. The late time drawdown behaviour may be indicative of the permeability of the actual rock matrix and/or the permeability of minor fractures which recharge the large fractures.

The Impax Group monitored water levels in WB5, the Decline Bore, Skirka's Bore and Observation Bore 3 during the test.

Drawdown within WB5 (located approximately 5m from WB13) was consistent with that observed in WB13. The water level within Skirka's Bore and the Decline Bore rose during the pumping period. The rising standing water levels in Skirka's Bore and the Decline Bore are inferred to have been related to recovery following water supply pumping from Skirka's Bore in the days leading up to the test. The water level within Observation Bore 3 did not change during the test.

Water level recovery within WB13 was not monitored manually as a water level logger had been installed prior to the test. The water level logger was lost in the process of removing the pump from the bore. As such recovery data is not available for WB13.

Aquifer parameters were assessed using late time drawdown data for WB13 and WB5 to account for potential dual porosity effects observed during the pumping test. The late time drawdown and recovery behaviour was likely to more accurately reflect the average aquifer properties and was considered the most appropriate for assessment of the sustainable pumping rate.

The standing water level within WB11 had recovered approximately 99% by 13 April 2011 (approximately 21 days after pumping ceased).

Table 20
Pumping Test Details - WB13

Bore ID:	WB13
Bore Depth:	108m
Screened Interval:	90-102m
SWL:	72m
Available Drawdown:	18m
Pumping Duration:	3.2 Days - 4620min
Start Date:	19 March 2011
End Date:	22 March 2011
Average Pumping Rate:	1.7L/s
Drawdown at 100min:	1.8m
Maximum Drawdown:	6.2m
Maximum Drawdown in Observation Bores:	WB5 - 5.8m No drawdown in other observation bores.
% Recovery (Pumping Period)	NA - See discussion in text
ΔS^1 - Pumping Data	5.4m
ΔS^1 - Recovery Data	NA - See discussion in text
ΔS^1 - Pumping Data - WB5	5.6m
ΔS^1 - Recovery Data - WB5	NA - See discussion in text
Calculated Transmissivity:	4.8m ² /day
Calculated Storativity (WB5)	NA - See discussion in text
Calculated Storativity (Distance Drawdown):	NA - See discussion in text
Estimated Safe Yield (1,000,000min):	1.3L/s
Estimated Safe Yield (10,000,000min):	1.0L/s

6.10 DISCUSSION OF PUMPING TEST RESULTS

6.10.1 Safe Yields

The Impax Group used the results of the aquifer pumping tests to estimate the long term safe yield for each bore using the method outlines in **Section 6.3**. The estimates are presented in **Table 21**.

Table 21
Estimated Safe Yields

Bore ID	Estimated Safe Yield (1,000,000min Continuous Pumping)	Estimated Safe Yield (10,000,000min Continuous Pumping)
Back Bore	3.9L/s or 122ML/yr	3.1L/s or 97ML/yr
Decline Bore	1.2L/s or 37ML/yr	1.1L/s or 34ML/yr
WB8	8.2L/s or 258ML/yr	6.9L/s or 217ML/yr
WB10	0.2L/s or 6ML/yr	0.2L/s or 6ML/yr
WB11	2.8L/s or 88ML/yr	2.5L/s or 78ML/yr
WB13	1.3L/s or 41ML/yr	1.0L/s or 31ML/yr
TOTAL	17.6L/s or 555ML/yr	14.8L/s or 466ML/yr

In calculating the safe yields presented in **Table 21** it is assumed that drawdown impacts from other pumping bores are negligible. In reality it is possible that drawdown from an individual production bore may impact on other pumping bores. In this case the actual safe yield of the bores may be less than those stated in **Table 21**.

Observations made during pumping test suggest that pumping from the Back Bore will not impact on standing water levels within WB8, WB11, WB13 or the Neighbours Bore. Similarly pumping from WB8, WB11, WB13 or the Neighbours Bore should not impact on water levels within the Back Bore.

There is expected to be some interaction between WB8 and WB11. Pumping from these bores appeared to impact on water levels within the Neighbours Bore indicating that all three bore are hydraulically connected.

Pumping from WB8 and WB11 is not expected to impact on water levels within WB13 and vice versa.

Drawdown was not observed in Skirka's Bore or the Decline Bore during pumping from WB13. Similarly pumping from the Decline Bore did not impact on water levels within WB5 (and therefore WB13). However, it is possible that these bores are hydraulically connected and that drawdown impacts will present following longer term pumping from WB13 and/or the underground mine.

The existing groundwater extraction licences for the Project Site (85BL243254, 85BL256001 and 85BL256002) allow extraction of up to 147ML/yr as follows.

- A maximum of 95ML/yr can be extracted from the proposed underground mine.
- A maximum of 47ML/yr can be extracted from the Back Bore.
- A maximum of 5 ML/yr can be extracted from Skirka's Bore.

A copy of the existing extraction licences is presented as **Appendix 5**.

The calculated safe yields indicate that the existing maximum groundwater extraction limit of 147ML/yr should be achievable from the Back Bore, the decline and Skirka's Bore. However, if 147ML/yr is not available from these sources pumping test results indicate that the newly installed groundwater bores should be capable of providing 147ML/yr of groundwater. The results also demonstrate that additional groundwater could be extracted from the Project Site.

6.10.2 Zero-Recharge Aquifer Boundaries and Dual Porosity

The drawdown observed in most of the bores tested increased on the log time scale after 1000 minutes of pumping. The increased rate of drawdown vs log time may be an indication of the following.

- The cone of depression encountered a zero-recharge or low-recharge boundary condition.
- The aquifer has a dual porosity. That is, water is present within large permeable fractures but recharge of groundwater into the large fractures is limited to flow through the solid aquifer matrix (rock) or through minor fractures with much lower permeability.

In each case the limiting factor is the ability for the large fractures to recover through inflows from the less permeable surrounding material. The Impax Group took these factors into account when analysing the pumping test data. The Impax Group estimated aquifer parameters using late time drawdown and recovery data as this was most likely to provide an indication of the average aquifer properties and the most conservative results.

In the event that zero-recharge boundaries are present in close proximity to the production bores actual safe yields may be significantly lower than those predicted within this report. In this case bores may be pumped dry within a relatively short time frame, with little or no impact to water levels in surrounding bores. Recharge to the bore would then be dependent on localised recharge primarily from rainfall.

The Back Bore pumping test may indicate the presence of zero-recharge boundaries at the Project Site. Late time drawdown in this bore occurred in a linear fashion suggesting that available storage was being depleted with little or no recharge from surrounding formation. Drawdown was not observed in observation bores located approximately 600m to the east and 800m west of the Back Bore. Residual drawdown in the Back Bore only recovered to 66% after the bore was allowed to recover for the same duration as the pumping period. The Back Bore had fully recovered approximately 3 months after the pumping test. If the Back Bore has little or no connection to a regional scale aquifer the available yield will be significantly less than estimated in this report. However, the bore could be used to its full capacity without impacting on water levels within surrounding bores.

The results of pumping at WB8 and WB11 differed from those at the Back Bore, with drawdown observed a significant distance from the pumping bore and approximately 90% recovery over the same period as pumping. The results for WB8 and WB11 indicate the aquifer intercepted at these locations has better connectivity to an aquifer with larger extent. These bores are more likely to provide a steady and reliable source of groundwater.

7. MINE DEWATERING

7.1 ANALYTICAL MODEL - MARINELLI AND NICCOLI (2000)

The assessment of likely groundwater seepage rates into the proposed decline and underground mine and the radius of influence on groundwater levels of dewatering was undertaken using equations developed by Marinelli and Niccoli (2000).

Discussions with NOW indicated that an analytical model would be acceptable to assess potential groundwater impacts given the relatively low risk site location and setting. The site is located a significant distance from any permanent surface water bodies, groundwater use within the study area is limited and the potential for groundwater related development within the study area is limited by the water quality.

The analytical method of Marinelli and Niccoli requires a simplification of the hydrogeological environment and is used to provide a 'broad' range of potential drawdown and mine inflow. The equations calculate groundwater inflow from the adjacent aquifer through the walls and base of the underground workings separately, based on the conceptual model presented in **Figure 11**.

The Impax Group measured the distance around the outer edge of the underground workings and decline. The perimeter was found to be approximately 1550m, which is approximately the same as the circumference of a circle with a radius of 250m. In order to apply the Marinelli and Niccoli (2000) method to the completed underground the underground and decline were represented as an open excavation in the shape of a circular cylinder, with radius of 250m and with vertical walls approximately 550m high.

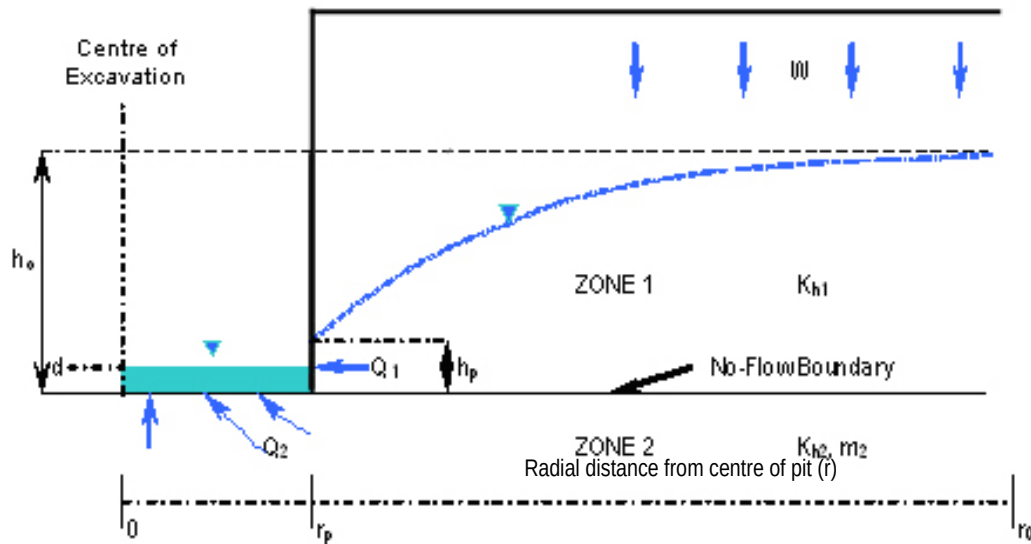


Figure 11 Underground Inflow Analytical Model

Groundwater inflows were calculated for Zone 1 and Zone 2 using the following equations:

Zone 1

$$Q_1 = W \pi (r_o^2 - r_p^2) \quad m^3 / day$$

Zone 2

$$Q_2 = 4 r_p \left\langle \frac{K_{h2}}{m_2} \right\rangle (h_o - d)$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

The extent of drawdown due to the nett groundwater inflow then allows for determination of the radius of influence of the inflow on the water table by iteration from the following equation:

$$h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

where:

- k_{h1} – hydraulic conductivity value for the aquifer in Zone 1
- h_o – saturated thickness of aquifer
- W – rainfall recharge rate
- h_p – the height of the aquifer seepage face in the open excavation
- r_p – equivalent radius of pit as a cylinder
- K_{h2} – horizontal hydraulic conductivity value for the aquifer in Zone 2
- k_{v2} – vertical hydraulic conductivity values for the aquifer
- D – depth of water level in base of pit

For Zone 1 the analytical solution considers steady-state, unconfined, horizontal, radial flow and assumes that:

- The underground walls are approximated as a circular cylinder.
- Groundwater flow is horizontal; the Dupuit-Forchheimer approximation is used to account for changes in saturated thickness due to depression of the water table.
- The static (pre-mining) water table is approximately horizontal.
- Uniform distributed recharge occurs across the site as a result of surface infiltration from rainfall; all recharge within the radius of influence (cone of depression), of the excavation is assumed to be captured by the excavation.
- Groundwater flow toward the excavation is axially symmetric.
- The aquifer is infinite in extent (i.e. - the cone of depression does not encounter any zero recharge boundaries).

7.2 ASSUMPTIONS AND CONCEPTUAL SITE MODEL

7.2.1 Aquifer Parameters

Estimated aquifer permeability results calculated from the results of aquifer pumping tests conducted by Geoterra Pty Ltd in 2005 and The Impax Group in 2010 and 2011 are summarised in **Table 22**. The average effective aquifer permeability is calculated by dividing the aquifer transmissivity by the thickness of exposed (screened and/or gravel packed) aquifer adjacent to the bore.

The average effective aquifer permeability calculated from the results of aquifer pumping tests ranged from 4.5×10^{-7} m/s to 5.1×10^{-6} m/s. The average of all calculated effective aquifer permeability values was 3.0×10^{-6} m/s.

Table 22
Estimated Aquifer Permeability

Borehole ID	Calculated Transmissivity (m ² /day)	Aquifer Thickness (m)	Average Effective Aquifer Permeability (m/day)	Average Effective Aquifer Permeability (m/s)
Back Bore	6.7	52	0.129	1.5 x 10 ⁻⁶
Decline Bore	3	78	0.038	4.5 x 10 ⁻⁷
WB8	19.3	55	0.351	4.1 x 10 ⁻⁶
WB10	1.3	17	0.076	8.9 x 10 ⁻⁷
WB11	10.2	23	0.443	5.1 x 10 ⁻⁶
WB13	4.8	12	0.400	4.6 x 10 ⁻⁶
Skirka's Bore	5	13	0.385	4.5 x 10 ⁻⁶
Average	-	-	0.260	3.0 x 10⁻⁶

The calculated values of effective aquifer permeability are likely to overestimate the actual average effective permeability of the formation adjacent to the decline and underground. The data set is biased as production bores were only installed in groundwater bores with relatively good groundwater yields. During the 2011 groundwater exploration programme two out of seven boreholes drilled did not encounter groundwater. Aquifer tests were not conducted on these boreholes. Similarly, during 2005 and 2006 groundwater exploration programme, several bores were observed to have low yields and permeability tests were not conducted on these bores.

In addition, groundwater bores that were tested were restricted to the upper 150m of the subsurface which is inferred to have a higher average permeability than deeper strata. There is no quantitative data with which to assess the permeability of the deeper strata.

7.2.2 Site Conceptual Model

The proposed decline and underground mine would be advanced to a maximum depth of approximately 550m bgl. The decline would provide vehicular access to the underground workings. The decline spirals to depth and would typically be located within 200m of the targeted ore bodies.

Underground mining would commence at a depth of approximately 150m bgl and would reach a maximum depth of 550m bgl.

Available groundwater data indicates that the standing water level is approximately 60m bgl in the vicinity of the proposed underground. The uppermost water bearing zone in Skirka's Bore was encountered at a depth of approximately 72m bgl (250m AHD).

Groundwater is likely to be encountered at depths greater than 70m (below 250m AHD) during the excavation of the decline and the underground mine. Groundwater inflow would be collected within the decline and underground mine and pumped to the surface for use in mining-related operations. Some groundwater will also be used underground and would not be returned to the surface. No pre-mining dewatering activities would be undertaken.

The requirement to dewater the underground workings would be dependent on the underground water balance. The underground workings would not receive any significant rainwater inflow. Water input to the underground would be comprised solely of groundwater inflow. Water outputs from the underground would be comprised of groundwater discharge (dewatering) and through evaporation, which will primarily be related to losses through the underground ventilation system.

The standing water level within the vicinity of the underground workings would need to be lowered by up to approximately 490m below the pre-mining level to allow mining to occur safely. Observations from existing groundwater bores indicate that groundwater is typically encountered in fracture systems intercepted between depths of 70m and 150m bgl. There are no groundwater bores at the site which extend below 150m bgl.

Observations during groundwater bore installation works indicated that the formation became much harder below a depth of approximately 130m bgl. The Decline Bore (located in the vicinity of the Hera Deposit) encountered water bearing strata between 70m and 80m bgl. The borehole was extended to a depth of approximately 150m bgl, however, there was no observable increase in groundwater yield in the lower 70m of the borehole.

Groundwater conditions within the upper 150m of the subsurface are well understood as a result of comprehensive round of groundwater exploration drilling, installation of several new groundwater production bores and several aquifer pumping tests conducted at the site in late 2010 and early 2011. The results of aquifer tests have allowed aquifer properties to be estimated. In addition, and perhaps more importantly, The Impax Group made many qualitative observations during aquifer testing which are important in developing a conceptual model of subsurface conditions at the site. Important observations made during the aquifer testing works include the following:

- Standing water levels vary across relatively short distances at the site indicating that there may be several discrete aquifers at the site, rather than one regional scale fractured rock aquifer.
- Based on observed drawdown during the testing of the Back Bore and WB8 there is unlikely to be any significant hydraulic connection between these bores even though they are located within 800m of each other. This is further evidence that there may be several discrete aquifers located across the Project Site, rather than one larger regional scale aquifer.
- Similarly, drawdown was not observed in Skirka's Bore or the Decline Bore during the pumping test conducted on WB13, even though these bores were located relatively close together.
- Anecdotal information provided by on-site mining geologists indicates that the formation becomes tighter with depth.
- Fracturing was encountered in all groundwater exploration bores. In some boreholes (WB7 and WB9) fractures did not yield groundwater. In other boreholes fracturing yielded relatively good water supply.
- Results of aquifer testing of most bores at the site indicate that the aquifer(s) at the site exhibit dual porosity or zero or low recharge boundaries. Groundwater is typically encountered in transmissive fractures, however, after pumping for extended periods an increased rate of drawdown appears to indicate that the rate of groundwater recharge to the transmissive fracturing limits the bore yield, and is a more likely indicator of average formation permeability.

Based on available information The Impax Group believes the decline will encounter water bearing strata at a depth of approximately 70m bgl. Initial groundwater inflows to the decline may be relatively high until stored water from within the breached fracture is drained and inflows become more reliant on seepage of groundwater through less significant fractures and the rock matrix. Water bearing strata is likely to be encountered between depth of 70m and 250m bgl. Below a depth of 250m groundwater inflows are likely to decrease with depth as the formation becomes tighter. Groundwater will flow into the decline and underground workings, where it will be collected and pumped to the surface for use in the mine processes.

7.2.3 Model Inputs – Pre-Mining Phase

The decline would be partially constructed prior to the commencement of ore extraction operations. In summary, the decline is a tunnel approximately 5m wide and 5m high. Groundwater will not be needed for processing operations during the initial construction of the decline as those operations would not have commenced.

Given the smaller footprint of the decline compared to the completed mine, initial inflows to the decline are predicted to be less than those in the completed mine.

In order to assess potential inflows to the decline during the initial construction phase the Impax Group relied on the following assumptions:

- It was assumed the decline could be represented as an open circular cylinder with radius of 5m and vertical walls 200m high.
- It was assumed that the bulk of groundwater inflow to the decline would be via seepage from the walls between depths of 60m and 200m bgl.
- It was assumed that groundwater inflows from the base of the decline would be negligible.
- Groundwater inflow to the underground and drawdown in water level was undertaken for hydraulic conductivity values ranging from 5×10^{-8} m/s to 5×10^{-6} m/s. Results of aquifer pumping tests conducted at the site indicate that the average permeability of the formation between a depth of 60m and 200m bgl was likely to range between 3×10^{-7} m/s and 3×10^{-6} m/s. The hydraulic permeability values adopted are assumed to reflect the upper limit for the fractured rock mass. Thus they could be considered conservative and are considered to represent a worst case scenario.

The inputs used in the estimates were as follows:

k_{h1}	hydraulic conductivity for zone 1	=	5×10^{-8} m/s to 5×10^{-6} m/s
k_{h2}	hydraulic conductivity for zone 2	=	5×10^{-8} m/s to 5×10^{-6} m/s
k_{v2}	vertical hydraulic conductivity zone 2	=	5×10^{-8} m/s to 5×10^{-6} m/s
h_o	saturated thickness of aquifer	=	190m
W	rainfall recharge to aquifer	=	1% of annual rainfall or 3.7mm/yr
h_p	the height of seepage face in the decline	=	10m
r_p	equivalent radius of decline as a cylinder	=	5m
d	assumed depth of water level in base of decline	=	0m

7.2.4 Model Inputs – Completed Mine Phase

In order to obtain an approximate indication of potential groundwater inflows to the underground, and to assess the potential magnitude and extent of drawdown impacts The Impax Group relied the following assumptions:

- It was assumed to underground mine and decline could be represented by an open circular cylinder with radius of 250m and vertical walls 550m high.
- It was assumed that the bulk of groundwater inflow to the underground would be via seepage from the walls of the underground and decline between depths of 60m and 250m bgl.
- It was assumed that groundwater inflows from the lower 300m of the walls and from the base of the underground would be negligible.
- Groundwater inflow to the underground and drawdown in water level was undertaken for hydraulic conductivity values ranging from 5×10^{-8} m/s to 5×10^{-6} m/s. Results of aquifer pumping tests conducted at the site indicate that the average permeability of the formation between a depth of 60m and 250m bgl was likely to range between 3×10^{-7} m/s and 3×10^{-6} m/s. The hydraulic permeability values adopted are assumed to reflect the upper limit for the fractured rock mass. Thus they could be considered conservative and are considered to represent a worse case scenario.

The inputs used in the estimates were as follows:

k_{h1}	hydraulic conductivity for zone 1	=	5×10^{-8} m/s to 5×10^{-6} m/s
k_{h2}	hydraulic conductivity for zone 2	=	5×10^{-8} m/s to 5×10^{-6} m/s
k_{v2}	vertical hydraulic conductivity zone 2	=	5×10^{-8} m/s to 5×10^{-6} m/s
h_o	saturated thickness of aquifer	=	190m
W	rainfall recharge to aquifer	=	1% of annual rainfall or 3.7mm/yr
h_p	the height of seepage face in the underground	=	10m
r_p	equivalent radius of mine as a cylinder	=	250m
d	assumed depth of water level in base of mine	=	0m

7.3 ANALYTICAL ESTIMATE OF GROUNDWATER INFLOW

7.3.1 Pre-mining Phase

Table 23 shows the estimated inflow to the decline versus depth of decline assuming the average aquifer permeability is 4.5×10^{-7} m/s.

7.3.2 Completed Mine

Figure 12 shows a plot of estimated groundwater inflow and the estimated extent of the cone of depression versus a range of average permeability values.

Table 23
Estimated Groundwater Inflow Versus Decline Depth (assuming $K = 4.5 \times 10^{-7}$ m/s)

Depth of Decline (m bgl)	Drawdown Required (m)	Estimated Inflow (L/s)	Radius of Influence (m)
60m	0m	0.0L/s	0m
80m	20m	0.1L/s	520m
100m	40m	0.4L/s	1080m
120m	60m	0.9L/s	1590m
140m	80m	1.6L/s	2100m
160m	100m	2.4L/s	2570m
180m	120m	3.4L/s	3050m
200m	140m	4.6L/s	3520m

Assuming the effective hydraulic conductivity range for the rock mass is between 3×10^{-7} m/s and 3×10^{-6} m/s the analytical method indicates the following:

- Theoretical groundwater inflows are expected to be between 12L/sec and 93L/sec; and
- The theoretical extent of drawdown (ie - radius of the cone of depression) will be between 5880m and 15850m from the centre of the proposed underground mine.

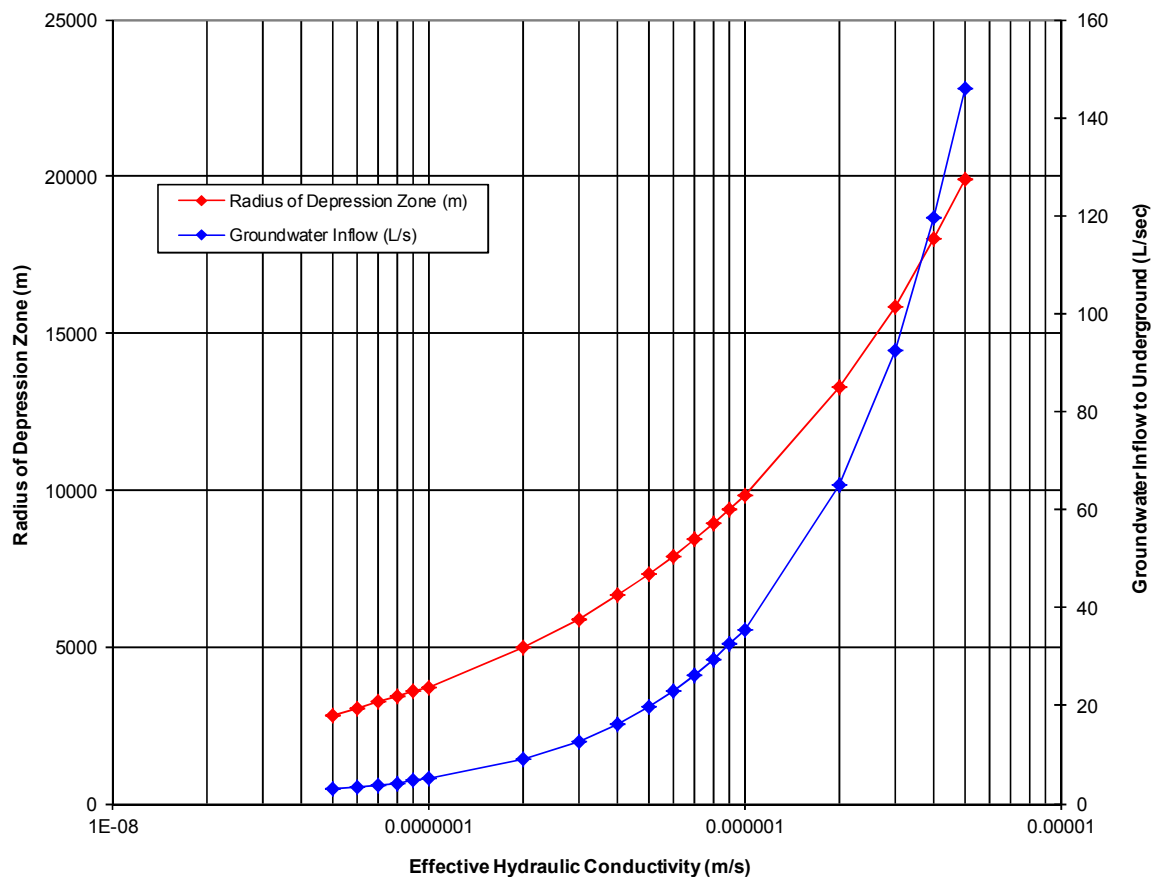


Figure 12 **Estimated Groundwater Inflow and Extent of Cone of Depression Versus Average Aquifer Permeability**

7.4 ANALYTICAL ESTIMATE OF GROUNDWATER DRAWDOWN

Figure 13 shows a plot of the estimated drawdown versus distance from the centre of the underground for permeability values of 3×10^{-7} m/s, 8×10^{-7} m/s and 3×10^{-6} m/s.

Using the highest estimate of aquifer permeability (3×10^{-6} m/s) it is estimated that the cone of depression would reach a distance of 15,880m from the centre of the underground. The estimated drawdown 5km, 10km and 15km from the centre of the underground would be 19.2m, 4.2m and 0.1m respectively.

Assuming an aquifer permeability of 8×10^{-7} m/s it is estimated that the cone of depression would reach a distance of 8,950m from the centre of the underground. The estimated drawdown 5km from the centre of the underground would be 7.5m.

Assuming an aquifer permeability of 3×10^{-7} m/s it is estimated that the cone of depression would reach a distance of 5,880m from the centre of the underground. The estimated drawdown 5km from the centre of the underground would be 0.8m.

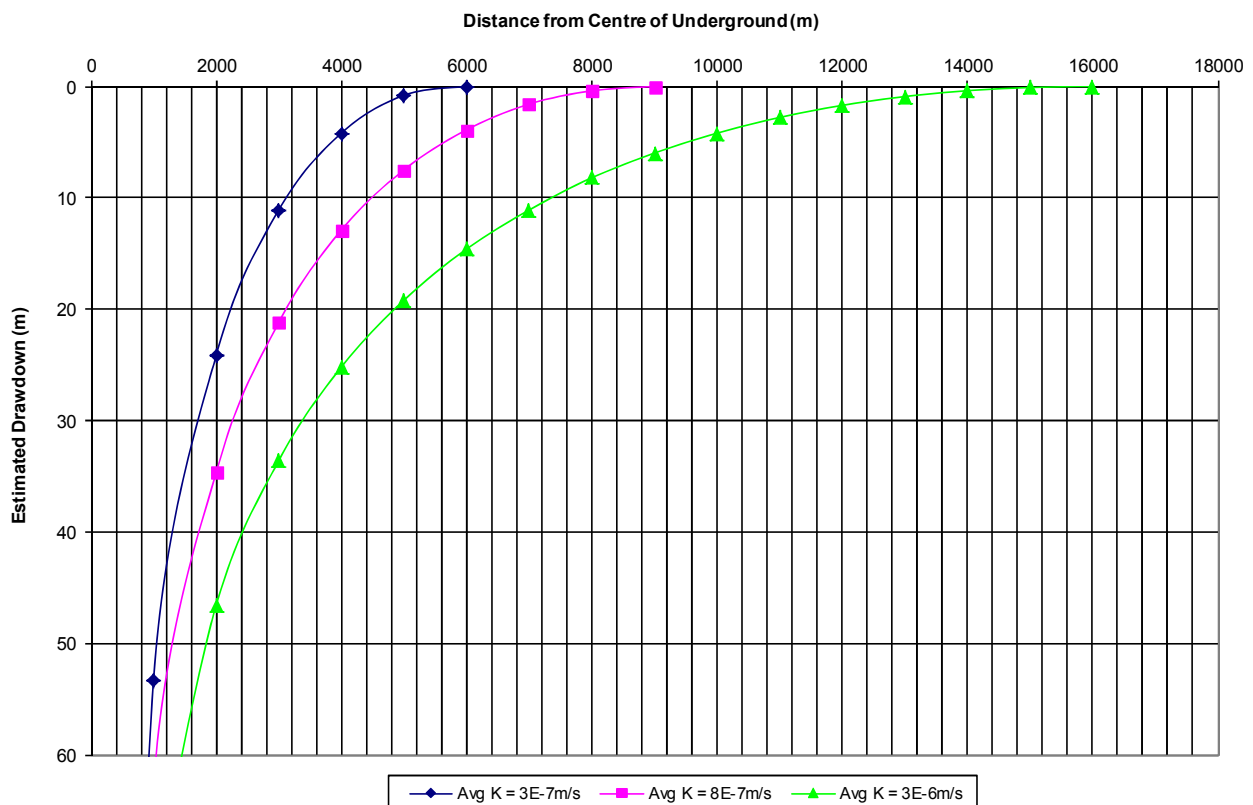


Figure 13 Estimated Drawdown Versus Distance

7.5 LIMITATIONS OF THE ANALYTICAL ASSESSMENT

The Marinelli and Niccoli (2000) method adopted for the analytical assessment is based on the assumption that the aquifer is infinite in lateral extent. The method assumes that drawdown will propagate laterally until equilibrium is reached between water discharging into the underground and water recharging the aquifer (assumed to be 1% of the rainfall falling within the cone of depression). The analytical method does not factor in the likely presence of zero recharge aquifer boundary conditions relatively close to the proposed underground.

In addition, the estimates obtained using the Marinelli and Niccoli (2000) method are representative of steady state conditions at the completion of the underground mine. The analytical estimate of groundwater inflow assumes the underground and decline are in their end of life status. That is that the underground and decline have been completed to the proposed maximum depth of 550m bgl.

7.6 QUALITATIVE ASSESSMENT OF GROUNDWATER INFLOW

As outlined in **Section 7.5**, the analytical assessment presented does not account for aquifer boundary conditions. As groundwater is removed from the decline and the proposed underground mine, drawdown will propagate out from the mine until it reaches equilibrium or reaches a zero recharge boundary. Based on the observations during the pumping tests an aquifer boundary may be encountered within 1000m of the underground, which is within the extent of drawdown predicted by the analytical assessment. In this case the standing water level within the underground would be lowered relatively quickly and the rate of inflow would be limited to local groundwater recharge (i.e. assumed to be 1% of rainfall that falls within the aquifer boundary or cone of depression).

In reality it is likely that relatively high groundwater inflow may be encountered when the decline first penetrates the uppermost water bearing fractures. In the initial stages of excavation, groundwater within relatively transmissive fractures is expected to discharge relatively quickly (i.e. within approximately 24 hours). Initial inflows may be at the higher end of those presented in **Section 7.3.1** for a day or two after water bearing strata is encountered. It is inferred that groundwater inflow will decrease with time as the highly permeable water filled fractures depressurise relatively quickly and longer term inflows become dependent on water released from less permeable fractures and the low permeability rock matrix.

Longer term inflows to the underground and decline are identified in **Section 7.3.2**. In the likely event that the cone of depression reaches a zero recharge aquifer boundary relatively close to the underground, inflows would be significantly less than those presented in **Section 7.3.2** and would reflect the rate of groundwater recharge within the limit of the cone of depression.

Table 24 presents estimated groundwater recharge for cone of depression with various radii, assuming the average rate of aquifer recharge is 3.7mm/yr (1% of average annual rainfall).

Results of aquifer pumping tests conducted at the site and knowledge of structural lineaments adjacent to the Hera Deposit (refer to **Section 4.3**) it is likely that zero recharge boundary will be encountered within a 1000m radius of the underground. In this case long term groundwater inflow to the underground would be as little as 0.4L/s.

Table 24
Estimated Groundwater Inflow Versus Radius of Cone of Depression

Radius of Cone of Depression (m)	Area of Cone of Depression (m ²)	Estimated Recharge (m ³ /yr)	Estimated Recharge (L/s)
1000	3141593	11624	0.4
2000	12566371	46496	1.5
3000	28274334	104615	3.3
4000	50265482	185982	5.9
5000	78539816	290597	9.2
6000	113097336	418460	13.3
7000	153938040	569571	18.1
8000	201061930	743929	23.6
9000	254469005	941535	29.9
10000	314159265	1162389	36.9

7.7 QUALITATIVE ASSESSMENT OF GROUNDWATER DRAWDOWN

The analytical estimates of drawdown presented in **Section 7.4** assume that the aquifer is infinite in lateral extent. Results of several pumping tests conducted at the site indicate that there may be several localised aquifers across the Project Site as opposed to one larger regional scale aquifer. If this is the case it is inferred that the cone of depression would encounter a zero recharge aquifer boundary relatively close to the proposed underground mine. Drawdown would be greater than predicted in **Section 7.4** for areas within the aquifer boundary, and negligible outside the aquifer boundary.

7.8 RESIDUAL DRAWDOWN AFTER MINING

Once mining is completed, the underground workings and decline would be sealed. As such, there would be no ongoing groundwater losses from the underground and decline.

Groundwater inflows into the final void were estimated using a spreadsheet modelled based on the Darcy Equation:

$$Q = KiA \text{ m}^3/\text{day}$$

The Impax Group relied on the following assumptions to assess groundwater recovery after mining:

- The underground mine and decline were approximated by assuming they were a circular cylinder with 250m radius and vertical walls 550m high.
- The proponent has indicated that the remaining void space within the underground and decline after mining will be approximately 850,000m³. The average effective porosity of remaining rock material within the footprint of the underground and decline was assumed to be 5%. Based on this assumption the effective pore space within the footprint of the underground and decline was calculated to be 6,250,000m³. Assuming even distribution of pore space the calculated total pore space below a depth of 60m was 5,570,000m³.

- Groundwater inflow was through aquifer(s) encountered between depths of 60m and 250m bgl. It is assumed that groundwater inflow would occur at a constant "steady state" until groundwater filled the lower 300m of void space within underground and decline. At this point groundwater elevation would increase above the base of the aquifer. The hydraulic gradient would decrease and therefore the rate of groundwater inflow would also decrease above a depth of 250m bgl.
- Groundwater level recovery was estimated using three values of effective permeability K . Similar to the cone of depression predictions, groundwater recovery was assessed for K values of 3×10^{-7} m/s, 8.5×10^{-7} m/s and 3×10^{-6} m/s.
- The hydraulic gradient (i) was determined iteratively for each time step based on the estimated groundwater elevation in the underground mine and decline and the radius of the cone of depression. The regional pre-mining groundwater level was assumed to be 60m bgl for the duration of the simulation which is equivalent to the general pre-mining groundwater level measured in Skirka's Bore and the Decline Bore. The radius of the cone of depression was calculated using the methods outlined in **Section 7.1**.
- The area of exposed aquifer (A) within the underground and decline was assumed to be constant. The area of exposed aquifer was assumed to be $298,300\text{m}^2$ (the surface area of a circular cylinder between depths of 60m and 250m bgl).
- It was assumed that average rainfall occurred during the recovery period and that groundwater recharge represented 1% of average annual rainfall.
- It was assumed there were no groundwater losses from the underground and decline during the recovery period.

The model simulation was undertaken as yearly time steps until full aquifer recovery was observed.

The calculated rates of groundwater recovery are presented in **Figure 14**.

It is estimated that it will take between 20 years ($K = 3 \times 10^{-7}$ m/s) and 100 years ($K = 3 \times 10^{-6}$ m/s) for water levels within the underground and decline to recover to pre-mining levels.

Analytical modelling indicates that where the lateral extent of drawdown impacts are significant (high average K) aquifer recover would be relatively fast. Where the lateral extent of drawdown impacts are limited (low average K or boundary conditions encountered) aquifer recovery would be relatively slow.

8. POTENTIAL GROUNDWATER IMPACTS

8.1 INTRODUCTION

This section of the assessment outlines the potential impacts to the availability and quality of groundwater to surrounding users and the environment as a result of the Project.

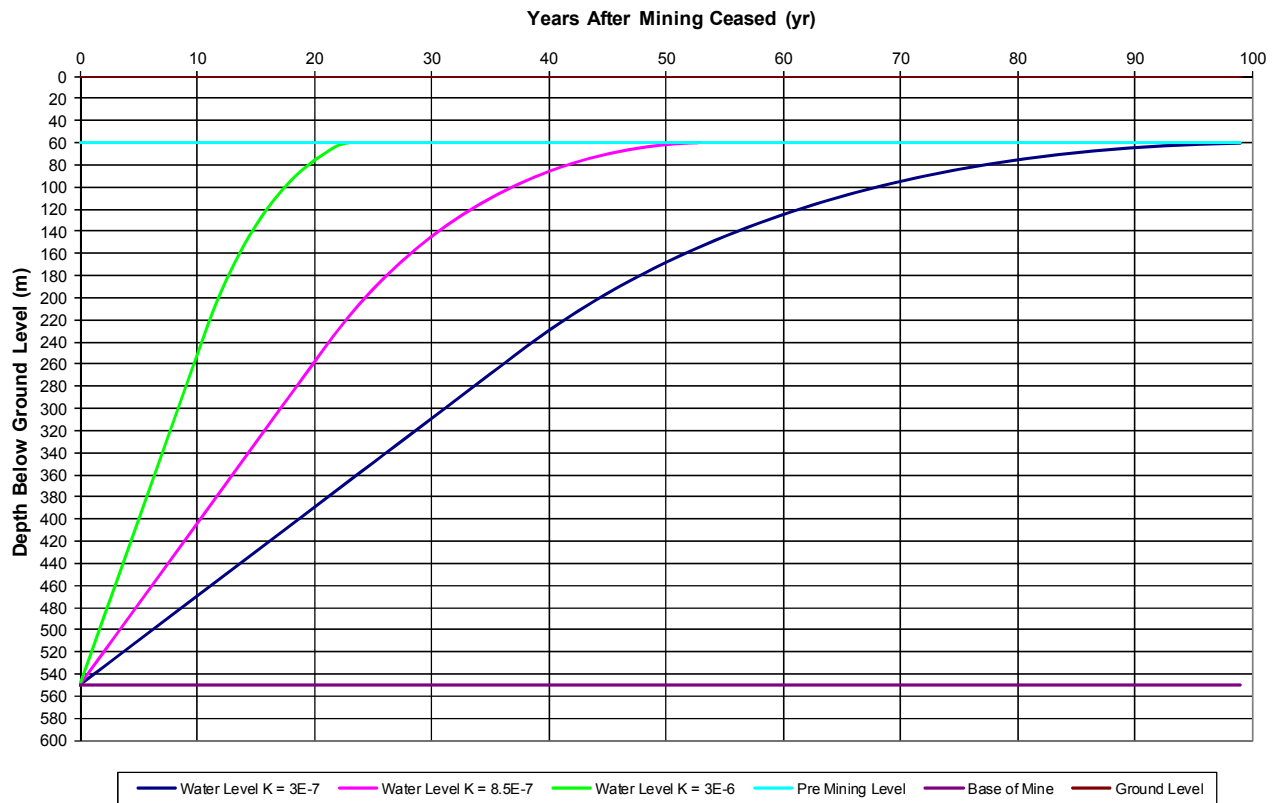


Figure 14 Calculated Water Level Recovery within Underground

8.2 GROUNDWATER

Shallow groundwater resources have not been identified and are unlikely to exist within the vicinity of the Project Site. Based on existing data the uppermost water bearing zone in the vicinity of the proposed underground mine is approximately 70m bgl.

The nearest identified groundwater receptors are the registered bores that were identified from the NOW registered groundwater work database. Of the bores identified only three, namely registered bores GW017385, GW017386 and GW018014, are used for beneficial purposes and are non-Project related. These are all registered for "stock" use.

The nearest non-Project related registered bore to the proposed underground mine is GW017385, which is located approximately 2,400m north of the centre of the proposed underground.

Registered bore GW017386 is located approximately 3,100m south of the proposed centre of the underground mine, and is 650m from the nearest groundwater production bore (WB11).

Registered bore GW018014 is located approximately 10,300m southwest of the proposed centre of the underground mine and 8,300m from the nearest groundwater production bore (WB11).

Assessment of existing water quality data suggests that groundwater beneath the Project Site is mostly suitable for stock watering only. Groundwater from some bores may be suitable for irrigation of the most salt tolerant crops or for use in fresh water aquaculture. However, groundwater yields from the bores with highest water quality are unlikely to support significant irrigation or freshwater aquaculture.

Groundwater dependent ecosystems are discussed in **Section 8.4**.

8.3 GROUNDWATER QUANTITY

As detailed in **Section 7**, water would be removed from the proposed decline and underground mine during mining operations. If necessary, groundwater would also be extracted from one or more groundwater production bores located to the southeast, south and southwest of the proposed underground mine.

Analytical modelling presented in **Section 7.4** indicates that the radius of the cone of depression related to dewatering of the underground may range between 5.9km and 15.9km from the centre of the underground. However, as stated in **Section 7.7**, it is likely that an aquifer boundary condition will be encountered within a radius of 2000m from the underground mine.

In either case, the potential impacts to other groundwater users are considered to be not significant. In the case where drawdown impacts propagate a sufficient distance to adversely impact on the closest non-Project related bores, the Proponent would ensure that an alternative supply of water is provided. Alternatively, the impacted bore may be deepened or a mutually agreeable arrangement would be negotiated. The Proponent notes that these bores are not currently in use and have not been used for some time as the properties on which they occur are not stocked. In the case where groundwater inflows are restricted by the presence of zero recharge aquifer boundary, drawdown impacts are unlikely to propagate far from the mine, and would therefore not impact on bores beyond that boundary. In this situation it may be necessary to extract groundwater from the existing groundwater bore field. Similarly, in this case the inferred extent of drawdown impacts from the bore field would be limited to the extent of the aquifer in which they are located.

As noted in **Section 6.10.3**, the final groundwater extraction licence will reference Geoterra's (2006) *Groundwater Management Plan (Appendix 3)*, which stipulates that the Proponent has an obligation to minimise drawdown impacts to other groundwater users surrounding the Project Site, to reinstate the impacted groundwater users supply, and/or to come to some other form of arrangement that is agreed to by the Proponent and the impacted groundwater user.

The existing draft groundwater extraction licence for the Decline, Skirka's Bore and Back Bore allows extraction of groundwater for mining related use only and stipulates that the groundwater licence is not transferable. It is envisaged that the final groundwater extraction licence will contain similar conditions and restrictions. As such, groundwater extraction would only take place during the operation of the mine.

Once mining is completed there would be no further losses from the underground workings and it is estimated that groundwater levels within the impacted aquifer(s) would recover over a period of 20 - 100 years after mining is completed depending on the average aquifer permeability (K) and lateral extent of drawdown impacts. In the likely event that zero-recharge boundary conditions are present in close proximity to the underground and decline groundwater recharge within the impacted area would rely on direct groundwater recharge from rainfall. The recovery time may be significantly longer than predicted, however, in this case drawdown impacts would be restricted to the area inside the zero recharge boundary only.

8.4 GROUNDWATER DEPENDANT ECOSYSTEMS

The Impax Group did not identify any groundwater dependant ecosystems on or in the vicinity of the Project Site.

Groundwater was typically encountered at depths greater than 70m bgl across the Project Site, with standing water levels ranging from 50-70m bgl. Taking the surface elevation into account the relative elevation of groundwater at the site ranged from 245m AHD to 277m AHD. Surrounding topography is typically well above these elevations. Based on these observations it is unlikely that groundwater encountered in the underground mine and/or the groundwater bore field would discharge to the surface within the Study Area.

The lowest part of the Project Site is the northwest corner which has a surface elevation of approximately 305m AHD. The surface topography within the study area is typically above an elevation of 300m AHD. The nearest location with a surface elevation of 277m or less AHD is along Box Creek, approximately 14 km northwest of the Project Site.

Based on the observed difference between the relative groundwater elevation at the site, and the surface elevation of surrounding landscape it is unlikely that groundwater in the fractured rock aquifer supports any surface based groundwater dependant ecosystems.

8.5 GROUNDWATER QUALITY

The main potential sources of groundwater contamination within the proposed Project Site would be as follows.

- Spillage of fuel, chemicals and/or reagents.
- Leaching of acid from waste rock.
- Leaching of acid, heavy metals and cyanide from tailings.
- Leaching of acid and heavy metals from the concentrate.
- Formation of acid from exposed rock beneath the surface

With the exception of underground operation of machinery most activities with potential to impact on groundwater will be conducted at the surface. Near surface soils beneath the Project Site would be the primary receptor of any contamination, should it occur. Surface soils within the Project Site are typically less than 3m deep. Groundwater was not identified in any near surface soils or alluvium within the Project Site during the 2011 groundwater exploration drilling programme.

The deep fractured rock aquifer within the Project Site is not vulnerable to contamination associated with spills or discharge of acid, chemicals or reagents at the surface. The uppermost water bearing strata is encountered at least 70m bgl. This provides a buffer against accidental release of contaminants from the surface. It is envisaged that any significant spill of potentially hazardous material could be remediated prior to having any significant impacts on groundwater quality.

Dewatering of the decline and underground would create a groundwater flow gradient toward the underground during the operation of the mine. Any significant impacts to groundwater would be contained on site, and potentially recovered by dewatering. If groundwater contamination did occur it would be unlikely to propagate far from the source and would be unlikely to affect groundwater quality outside the Project Site.

Whilst the risk of groundwater quality decline is low, the Proponent would comply with all relevant industry guidelines to ensure the potential for degradation of groundwater quality at the Project Site is minimised.

8.5.1 Storage and Handling of Chemicals

Hazardous and non-hazardous chemicals to be used within the Project Site would be managed in accordance with the specifications of the Material and Safety Data Sheets and *Hydrocarbon Chemical and Reagent Management Plan*.

In summary, however, the following measures would be implemented to prevent adverse environmental impacts associated with storage and use of reagents and chemicals within the Project Site.

- All chemicals would be stored and used in accordance with the manufacturer's instructions and the relevant Material Safety Data Sheets.
- All liquid chemicals would be stored within an impermeable bunded area with a capacity of at least 110% of the capacity of the largest container.
- Chemicals with the potential to react with each other would not be stored in the same area to prevent any reactions between them in the event of a spill.
- Only the minimum volume of chemicals required for the ongoing operation of the Project would be stored within the Project Site.
- Material Safety Data Sheets and appropriate spill management equipment would be available in the vicinity of all chemical storage areas.
- A *Hydrocarbon, Chemical and Reagent Management Plan*, including emergency management procedures, would be developed and implemented throughout the life of the Project.
- Personnel who will use chemicals would be provided with the appropriate training in the proper handling techniques.

Refuelling for more mobile equipment would be undertaken in designated bunded areas outside of the underground. Refuelling of less mobile equipment would be undertaken at the work site by a dedicated service vehicle. Spill kits would be kept on site to mitigate any spills from machinery working within the underground. Spill response procedures would be documented in an Environmental Management Plan for the site.

8.5.2 Storage of Waste Rock

During initial mining operations, material that contains insufficient metaliferous minerals to justify processing would be extracted and placed within the temporary waste rock emplacement (**Figure 2**). Once mining operations have progressed sufficiently, waste rock material would typically be placed within completed stopes underground and would not be brought to the surface. In addition, waste rock material stockpiled within the temporary waste rock emplacement would be transported back underground and placed within completed stopes.

Rock and samples from drill core in the vicinity of the proposed exploration decline, boxcut, ventilation rise and the ore body have been analysed and characterised for acid rock drainage (ARD) potential, specifically to determine the Net Acid Production Potential (NAPP) and Net Acid Generation (NAG) characteristic (Geoterra (2006); Triako Resources Limited (2006)).

Conclusions reached on the acid rock generation characteristics from the assessments conducted to date are as follows.

- Samples tested showed low acid neutralisation potential.
- Waste rock from the boxcut, ventilation rises and exploration decline, being predominantly unweathered siltstone, have low NAPP and NAG values and have been characterised as non-acid forming to uncertain.
- The ore body samples or samples acquired close to the ore body are potentially acid forming due to the sulfide contents of these samples.

Using the ARD assessment of all samples analysed it was conservatively estimated (Triako Resources Limited 2006) that approximately 30% of the waste rock recovered during various activities would be Potentially Acid Forming and the remaining approximately 70% would be non-acid Forming.

Given the potentially acid forming nature of some of the waste rock, the temporary waste rock emplacement would be designed and constructed to minimise acid generation and prevent the discharge of any low pH leachate formed. Once transported underground oxidation of potentially acid forming material to form a low pH leachate would be minimised through the exclusion of oxygen.

In order to avoid the generation of any acidic leachate from the stockpiled waste rock and to manage any leachate generated, the following management measures would be implemented.

- All waste rock material would be classified as non-acid forming or potentially acid forming prior to extraction and transportation to the surface.
- The temporary waste rock emplacement would be constructed in two cells. One cell would be for non-acid forming waste rock, while the second would be for potentially acid forming waste rock.
- The potentially acid-forming waste rock encapsulation area would be constructed in a manner that would prevent potentially acidic leachate from being discharged.
- Water quality monitoring and visual inspections of the leachate management pond would be undertaken regularly during the life of the emplacement to identify any issues with the proposed management measures.

The Proponent anticipates that approximately 280 000m³ of waste rock would be generated during the life of the Project. Approximately 140 000m³ of waste rock material would be used during site establishment operations and a further 100 000m³ of waste rock would be used during stope backfilling operations. As a result, there would be no waste rock surplus during the life of the Project and no waste rock material would remain on the surface at the completion of mining operations.

8.5.3 Storage of Tailings

The location of the Tailings Storage Facility is shown on **Figure 2**. The Proponent anticipates that the tailings storage facility would be a “prescribed” dam and would be listed in Schedule 1 of the *Dams Safety Act 1978*. As a result, the facility would be constructed in accordance with the requirements of the NSW Dams Safety Committee.

Clean water diversion structures would be constructed up-slope of the facility to ensure that clean water does not flow onto the Tailings Storage Area. A seepage collection system, including collection trench and pond and automated pumping system would be established down slope of the Tailings Storage Facility. A series of monitoring piezometers would be installed at strategic locations in the vicinity of the facility to enable monitoring of the quality of the groundwater in the vicinity of the facility.

Tailings material, in the form of thickened slurry, would be pumped from the processing plant and discharged to the Tailings Storage Facility from a series of spigots or outlets along the embankment. The tailings solids would settle from the slurry and a proportion of the water would flow to a decant pond in the eastern section of the facility from where it would be collected and returned to the processing plant for reuse.

8.5.4 Storage of Concentrate

The bulk concentrate produced by the mine process would have the potential to form acid leachate under certain conditions. This issue would be managed by storing the concentrate under cover and on a concrete-sealed surface. All water draining from the concentrate stockpiles would be directed to a sump and ultimately returned to the process water system.

8.5.5 In-situ Acid Generation

There is potential for acid to be generated by the oxidation of sulphur rich material in the ore once it is exposed to the atmosphere within the underground.

Acid can only form when sulphur rich material is exposed to the atmosphere through excavation and/or lowering of the water table. In the event that acid was generated within the underground impacts would be localised. Dewatering of the underground will create a gradient toward the underground mine so potentially impacted groundwater would remain on site. Once the water level within the underground recovers to pre-mining levels acid generation is expected to be minimal.

9. GROUNDWATER MONITORING

There are several groundwater bores and piezometers at the site that would be suitable for monitoring purposes during the operation of the mine and rehabilitation of the Project Site.

The Proponent would monitor groundwater levels and water quality at key locations to assess potential drawdown impacts on other groundwater users.

9.1 OBJECTIVES OF GROUNDWATER MONITORING

Groundwater monitoring would be undertaken to assess impacts to groundwater levels and groundwater quality in the vicinity of the underground mine open cuts and the Tailings Storage Facility.

The objectives of the proposed groundwater monitoring program would be to:

- establish baseline groundwater conditions at the Mine Site, from which potential future impacts can be assessed;
- obtain data that can be used to assess mining-related impacts to groundwater levels and groundwater quality in the vicinity of the Mine Site; and
- identify unforeseen groundwater problems through the use of trigger levels as early as possible to enable procedures to be changed or improved to prevent significant degradation of groundwater resources at the Mine Site.

9.2 MONITORING BORE LOCATIONS

The Proponent will utilise the existing network of deep bores and piezometers for monitoring purposes. Equipped production bores would be used to monitor groundwater quality, where possible. Piezometers would be used to monitor groundwater levels and for groundwater quality monitoring where no alternatives are available.

In addition, shallow piezometers would be installed around the perimeter of the Tailings Storage Facility to detect leakages.

9.3 MONITORING BORE DESIGN

Construction details for the existing production bore and piezometer network are presented in **Section 5**.

The monitoring bores installed around the Tailings Storage Facility would be constructed to a depth of approximately 5m bgl. The bores would be constructed of 50mm Class 18 PVC and would consist of a 3m length of screen (2-5m bgl) and a 3m length of blank (1m above ground level to 2m bgl). The annulus surrounding the bore casing would be filled with gravel pack (washed 2mm sand) from the base of the hole to a depth of approximately 1m bgl. The remainder of the annulus would be sealed with bentonite, to minimise potential for surface water to 'short circuit' into the bore. An above ground steel monument would be concreted in place over each of the bore heads to protect them from UV light and vehicular traffic.

Based on the observed absence of groundwater in near surface soils at the Project Site, the shallow monitoring bores around the Tailings Storage Facility are expected to be dry, when installed. The bores would only fill with water if the adjacent soils became saturated. This could occur as a result of a significant rainfall event or as a result of leachate leakage from the Tailings Storage Facility.

9.4 MONITORING PROGRAM

The Proponent has already conducted baseline monitoring of selected bores and piezometers and the results of this work are outlined in **Section 5.6**.

The Proponent would conduct groundwater quality monitoring on an annual basis. Bores monitored would include the House Bore, Back Bore, WB3, WB8, WB10, WB11 and WB13. Annual monitoring would include measurement of standing water levels (SWLs), measurement of water quality parameters (pH, EC, dissolved oxygen (DO) and redox potential) and laboratory analysis of samples for major cations, major anions, nutrients, physical parameters, total cyanide, free cyanide and WAD cyanide

Regular monitoring of shallow bores located adjacent to the Tailings Storage Facility would commence as soon as the facility is in use. The shallow bores would be gauged for the presence of water on a monthly basis. If water is identified field water quality parameters would be measured to assess whether the water was leachate from the tailings storage facility or rainwater. Laboratory analysis may also be necessary where water is identified.

Groundwater levels would be monitored on a monthly basis using the existing network of piezometers. These would include WB3, Observation Bore 1, Observation Bore 2, Observation Bore 3, WB4, WB5 and WB12. Water levels would also be monitored in production bores when or where possible. Production bores that would be monitored would include Skirka's Bore, Decline Bore, Back Bore, WB8, WB10, WB11 and WB13. The Proponent would also monitor water levels in the non-project related groundwater bores GW017385 and GW017386 if access is made available by the owner of these bores.

9.5 REPORTING

A report outlining the results of groundwater monitoring and analysis would be prepared on an annual basis and included in the Annual Environmental Management Report (AEMR).

9.6 EVALUATION AND REVIEW

Based on the available information, the proposed mining and associated activities of the Tomingley Gold Project are not expected to have any significant impact on the groundwater quality, groundwater dependant ecosystems or other registered users of groundwater located within the Study Area. The groundwater monitoring program provides a safeguard against any impacts that have not been anticipated in this assessment. If significant unforeseen groundwater impacts are identified during routine monitoring mining operations at the Project Site, the mining operation and/or monitoring program would be amended to prevent further degradation of groundwater resources. In addition, any unforeseen or unexpected impacts to other groundwater users would be managed in accordance with the Geoterra (2006) *Groundwater Management Plan*.

The relevance and completeness of the groundwater monitoring program would be reviewed as part of each AEMR. If the recommended groundwater monitoring plan is not sufficient it may be necessary to expand the plan.

10. CONCLUSIONS

Based on the results of groundwater review and groundwater modelling undertaken as part of the nominated scope of works, The Impax Group concludes the following.

- Near surface soil and alluvium at the Project Site is typically less than 3m deep. Significant groundwater resources have not been identified in near surface soils or shallow alluvium at the Project Site.
- Groundwater is typically encountered in fractured rock aquifer(s) underlying the proposed Project Site. Groundwater is typically encountered at the interface of weathered sandstone / siltstone profile and underlying hard siltstone and sandstone basement. The uppermost water bearing zone is typically encountered at a depth of approximately 70m bgl and in some bores water bearing features were identified to a depth of approximately 130m bgl.
- The measured EC of groundwater from bores located at the site indicates that groundwater at the Project Site is generally not suitable for human consumption. Groundwater at the Project Site is suitable for watering all but the most sensitive types of livestock. The measured EC in some bores indicates that groundwater could potentially be used for irrigation of salt tolerant crops and for fresh water aquaculture; however, limited yields are likely to preclude these potential beneficial uses.
- Three non-Project-related registered groundwater bores were identified within 10km of the Project Site. These bores were registered for "stock" use.
 - GW017385 is located approximately 2,400m north of the centre of the proposed underground.
 - GW017386 is located approximately 3,100m south of the proposed centre of the underground mine, and is 650m from the nearest groundwater production bore (WB11).
 - GW018014 is located approximately 10,300m southwest of the proposed centre of the underground mine and 8,300m from the nearest groundwater production bore (WB11).
- Drilling observations and results of aquifer pumping tests indicate that there may be several discrete aquifers at the site, rather than one regional scale aquifer.
- The results of pumping tests indicate that the aquifer has "dual porosity". Initial groundwater yields are typically relatively high due to the presence of transmissive fractures; however, as the transmissive fractures are dewatered the rate of groundwater recharge appears to be limited by the permeability of less transmissive fractures and the surrounding rock matrix.

- The water demand of the proposed mine is approximately 5.3L/s (or 167ML/yr). Water will be sourced from groundwater inflow into the proposed decline and underground mine, from surface water sources, and/or from a field of groundwater production bores located to the southeast, south and west of the proposed mine.
- Based on the results of aquifer pumping tests it was estimated that up to 466ML/yr may be extracted from the existing groundwater production bore field. At the time this report was prepared groundwater licencing conditions for the groundwater production bores were pending.
- Analytical modelling indicates that approximately 12L/s to 93L/s of groundwater will flow into the proposed underground once it has reached its maximum depth of 550m bgl. Based on the modelling the resulting cone of depression would extend to a distance of between 5.9km and 15.9km from the centre of the underground. Qualitative assessment of available groundwater information suggests that this is a conservative estimate (i.e. it is likely to overestimate the actual drawdown impacts). In the likely event that a zero-recharge aquifer boundary is present within a 2km radius of the underground actual groundwater inflows are predicted to be less than 1.5L/s and drawdown impacts would be restricted to the area within the zero recharge boundary.
- A qualitative assessment of subsurface conditions based on observations from recently completed aquifer pumping tests indicates that a zero recharge aquifer boundary condition is likely to be encountered relatively close to the proposed underground. In this event aquifer drawdown would be limited to the area within the aquifer boundary and actual groundwater inflows would be much less than the predicted 12L/s to 93L/s. It is anticipated that the Proponent would have to supplement water supplied from dewatering the underground with water sourced from surface dams and the existing groundwater bore field.
- In the case where drawdown impacts propagate a sufficient distance to adversely impact on the closest non-Project related bores, the Proponent would ensure that an alternative supply of water is provided. Alternatively, the impacted bore may be deepened or a mutually agreeable arrangement would be negotiated.
- Dewatering will be required for the duration of the proposed 7 year mine life. Some of the remaining void space in the mine will be reinstated with waste rock. It is estimated that approximately 850,000m³ of void space will remain in the underground at the completion of mining and rehabilitation works. Analytical modelling indicates that groundwater would return to pre-mining levels within 20 to 100 years of cessation of mining depending on the actual average aquifer permeability. Analytical modelling indicates that where the lateral extent of drawdown impacts are significant (high average K) aquifer recover would be relatively fast. Where the lateral extent of drawdown impacts are limited (low average K or presence of zero-recharge boundary conditions) aquifer recovery would be relatively slow.
- Residual drawdown within the decline and underground would result in groundwater flow toward the underground. As such, any changes in groundwater chemistry or quality within the open cuts would not impact on groundwater quality within the surrounding fractured rock.

- Surface activities have the greatest potential to impact on groundwater quality. The absence of a significant groundwater resource in near surface soils or shallow alluvium at the Project Site means there is little risk of mining processes impacting on groundwater quality.
- Chemical and fuel storages at the Project Site would be above ground and appropriately bunded to minimise potential for groundwater contamination to occur.
- The ore body and waste rock located adjacent to the ore body has potential to generate acid when exposed to the atmosphere and water. The Proponent proposes to manage potentially acid generating waste rock appropriately to minimise any potential groundwater impacts at the site. The bulk concentrate produced at the mine will be stored appropriately to minimise potential for leaching of acid, heavy metals and cyanide.
- Leachate from the mine tailings may contain traces of heavy metals and cyanide from ore treatment process, and may also be potentially acid forming. . The tailing storage facility has been designed, and would operate, in a manner which would prevent leachate entering groundwater aquifers.
- Groundwater dependant ecosystems were not identified on, or in the vicinity of the Project Site. Standing water levels are such that there are unlikely to be any naturally occurring springs within 10km of the proposed Project Site.
- A groundwater monitoring plan would be implemented at the Project Site once mining commences. The proposed plan would include regular monitoring of water levels, field water quality parameters and basic water chemistry in existing groundwater production bores and/or piezometers at the site.

11. REFERENCES

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Appendices

(Total No. of pages including blank pages = 144)

- Appendix 1 NSW Groundwater Shortages Zones Order No 2 2008
- Appendix 2 Registered Groundwater Works Summary Forms
- Appendix 3 Hera Project Groundwater Management Plan Nymagee, NSW (Geoterra, 2007)
- Appendix 4 Hydrogeological Assessment of Skirka's Bore at "The Peak" Station, Nymagee, NSW (Geoterra, 2005)
- Appendix 5 Draft Groundwater Extraction Licences
- Appendix 6 Groundwater Exploration Borehole Logs
- Appendix 7 Aquifer Pump Test Data

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Appendix 1

NSW Inland Groundwater Shortages Zones Order No.2 2008

(Total No. of pages including blank pages = 6)

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12944

SPECIAL SUPPLEMENT

19 December 2008

WATER ACT 1912

Order under section 113A

Embargo on any further applications for Part 5 Water Licences

New South Wales Inland Groundwater Shortage Zones Order No. 2 2008

PURSUANT to section 113A of the Water Act 1912, I, David Harriss, having delegated authority from the Water Administration Ministerial Corporation, upon being satisfied that the Water Shortage Zones specified in Schedule 1 are unlikely to have more water available than is sufficient to meet the requirements of the licensees of the bores situated within the Water Shortage Zones, and the other requirements determined for water from the Water Shortage Zones, do, by this order, place an embargo to prevent any further applications for licences being made under Part 5 of the Water Act 1912 with respect to the Water Shortage Zones specified in Schedule 1, except as specified in Schedule 2 of this Order.

Any terms that are defined in Schedule 3 of this Order have the meanings set out in that Schedule.

This Order takes effect on and from the date it is published in the NSW Government Gazette and remains in force until this Order is revoked by a subsequent Order published in the NSW Government Gazette.

This Order repeals any previous Orders made under section 113A of the Water Act 1912 for those water shortage zones specified in Schedule 1 of this Order.

Dated at Sydney this Eighteenth day of December 2008.

DAVID HARRISS,
Deputy Director General,
NSW Department of Water and Energy
Signed for the Water Administration Ministerial Corporation
(by delegation).

Note:

In accordance with s. 113A(6) of the Water Act 1912 this order does not apply to:

- a) an application for a renewal of a licence, or
- b) an application for a licence for a bore to replace some other licensed bore that the applicant has ceased to use, or
- c) an application for a licence for a bore to produce water to satisfy a water allocation arising from the transfer of a water allocation under section 117J.

SCHEDULE 1

Water Shortage Zones

This order applies to any groundwater located within those parts of the State of New South Wales falling within the eastern boundary of the Murray Darling Basin and the Queensland, South Australian and Victorian borders as shown by the shaded areas in Map 1, except for:

1. groundwater within those groundwater management areas and parishes listed in Table 1; and
2. groundwater within the water sources to which the following water sharing plans apply:
 - a) Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003
 - b) Water Sharing Plan for the Lower Gwydir Groundwater Sources 2003
 - c) Water Sharing Plan for the Lower Lachlan Groundwater Sources 2003
 - d) Water Sharing Plan for the Lower Macquarie Groundwater Sources 2003
 - e) Water Sharing Plan for the Lower Murray Groundwater Sources 2003
 - f) Water Sharing Plan for the Lower Murrumbidgee Groundwater Sources 2003
 - g) Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources 2008.

SCHEDULE 2

Exemptions

Applications for licences under Part 5 of the Water Act 1912 can continue to be made for the following purposes:

1. A bore to supply water for stock watering or domestic consumption.
2. Water supply for town water supply by a water supply authority, or a council or county council exercising water supply functions under Division 2 or Part 3 of Chapter 6 of the Local Government Act 1993.
3. Water supply for community recreational facilities located on public land up to 5 megalitres per annum.
4. Monitoring and test bores for groundwater investigation and/or environmental management purposes.
5. Bores for environmental management purposes including control of saline water table mounds.

19 December 2008

SPECIAL SUPPLEMENT

12945

6. Water supply for Aboriginal cultural purposes provided that the annual extraction does not exceed 10 megalitres per annum.
7. Bores on property where there is an existing licence under Part 5 of the Water Act 1912 and there is no increase in entitlement.
8. Bores providing water supply for emergency services including, but not limited to fire fighting.
9. Conversion to a test bore licence where a test bore licence is currently in force and was granted on or before 1 July 2007. This exemption expires on 30 June 2009.
10. Bores required for integrated development where general terms of approval with respect to such bores have been provided by the Department of Water and Energy prior to the commencement of this Order and for which a development consent has been granted.
11. Water supply for a person where the Minister determines that a failure to supply the water would cause a prohibitively high social, economic or national security cost and the supply of the water will cause no more than minimal environmental harm to any aquifer, or its dependent ecosystems.
12. A dewatering activity provided that the annual extraction does not exceed 10 megalitres per annum.
13. Water supply for the purpose of dust suppression in the construction of a public road provided that the annual extraction does not exceed 10 megalitres per annum.
14. Bores for the use of saline water where the salinity level exceeds 14,000 milligrams per litre (ppm).
15. Water supply for teaching purposes up to 3 megalitres per annum.

SCHEDULE 3

Dictionary

Development consent: has the same meaning as defined in the Environmental Planning and Assessment Act 1979;

Domestic consumption: has the same meaning as defined in section 52 of the Water Management Act 2000;

Groundwater management areas: Area defined by maps held by the Department of Water and Energy and for the purposes of this order includes all groundwater below the ground surface within these mapped boundaries;

Integrated development: has the same meaning as defined in the Environmental Planning and Assessment Act 1979;

Murray Darling Basin: has the same meaning as defined in section 4 of the Water Act 2007 (Cth);

Public land: has the same meaning as defined in the Local Government Act 1993 Dictionary;

Public road: has the same meaning as defined in the Roads Act 1993;

Recreational facilities: includes, but is not limited to parks, playgrounds, ovals, sporting grounds, golf courses and gymnasiums but excludes any commercial operations relating to those activities;

Stock watering: has the same meaning as defined in section 52 of the Water Management Act 2000;

Table 1

Ground Water Management Area (GWMA)	GMMA No.
Peel Valley Alluvium	005
Upper Macquarie Alluvium	009
Cudgegong Valley Alluvium	10
Upper Lachlan Alluvium	11
Mid Murrumbidgee Alluvium	13
Billabong Creek Alluvium	14
Upper Murray Alluvium	15
Lower Murray Alluvium (d/s Corowa)	16 (shallow)
Coolaburragundy-Talbrager Valley	19
Bell Valley Alluvium	20
Belubula Valley Alluvium	21
Border Rivers Alluvium	22
Miscellaneous Alluvium of Barwon Region	23
Lower Darling Alluvium	45
Upper Darling Alluvium	46

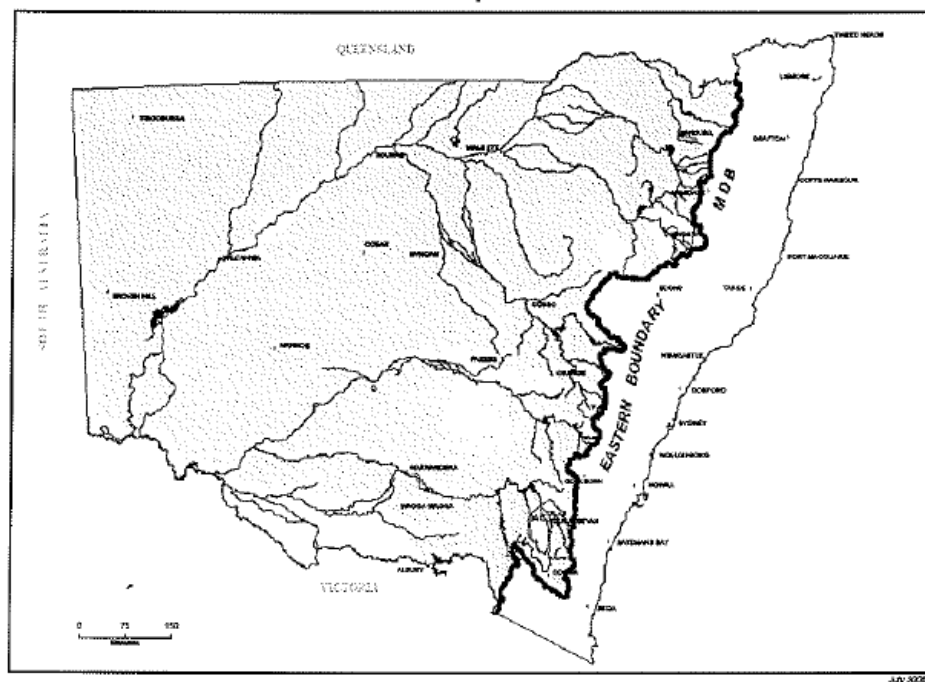
12946

SPECIAL SUPPLEMENT

19 December 2008

Bungendore Alluvium	54
Great Artesian Basin Alluvial	63
Castlereagh Alluvium	66
Orange Basalt	801
Young Granite	802
Yass Catchment	806
Peel Valley Fractured Rock	819
Parishes	
The Parishes of Goran, Brothers, Howes Hill, Calala, Merrigula, Tamarang, Trinkey, Coolanbilla, Springfield, Weston, Doona, Mema, Rodd, Pringle, Lawson, Moredevil, Coomoo Coomoo, Yarraman and Kickerbell in the County of Pottinger, all being within the Oxley Basin.	Part 608
The Parishes of Windy, Telford, Hudson and Moan in the County of Bucklan, all being within the Oxley Basin.	Part 608
The Parishes of Galambine, Wilbertree, Eurundury and Bumberra in the County of Phillip, all being within the Lachlan Fold Belt.	Part 811

Map 1



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Appendix 2

Registered Groundwater Works Summary Forms

(Total No. of pages including blank pages = 22)

Note: A copy of Appendix 2 is available on the Project CD

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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[Print Report](#)

[Works Details](#) [Site Details](#) [Form A](#) [Licensed](#) [Construction](#) [Water Bearing Zones](#) [Drillers Log](#)

Work Requested -- GW017385

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW017385
LIC-NUM	85BL009246
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1959-11-01
FINAL-DEPTH (metres)	61.00
DRILLED-DEPTH (metres)	61.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	KENMURE
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details [\(top\)](#)

REGION	85 - FAR WEST
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6449587.00
EASTING	435579.00
LATITUDE	32 5' 17"
LONGITUDE	146 19' 2"
GS-MAP	0048E1

Groundwater Works Summary

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AMG-ZONE 55
 COORD-SOURCE GD.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY MOURAMBA
 PARISH invalid code
 PORTION-LOT-DP WLL 3577

Licensed [\(top\)](#)

COUNTY MOURAMBA
 PARISH NIL
 PORTION-LOT-DP

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.50	41.30	152			Suspended in Clamps

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S-W- L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
19.20	19.20	0.00	Fractured						(Unknown)
50.30	50.30	0.00	Fractured	46.60		0.51			501-1000 ppm

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.91	0.91	Loam Sandy		
0.91	45.72	44.81	Schist Water Bearing		
45.72	60.96	15.24	Slate Hard Water Supply		

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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Work Requested -- GW017386

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW017386
LIC-NUM	85BL009245
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1960-05-01
FINAL-DEPTH (metres)	100.90
DRILLED-DEPTH (metres)	100.90
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	KENMURE
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details [\(top\)](#)

REGION	80 - MACQUARIE-WESTERN
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6444260.00
EASTING	435560.00
LATITUDE	32 8' 10"
LONGITUDE	146 19' 0"
GS-MAP	0048E1

Groundwater Works Summary

Page 2 of 2

AMG-ZONE 55
 COORD-SOURCE PR.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY MOURAMBA
 PARISH invalid code
 PORTION-LOT-DP WLL 5381

Licensed [\(top\)](#)

COUNTY MOURAMBA
 PARISH NIL
 PORTION-LOT-DP

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.50	41.00	152			Suspended in Clamps

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S-W- L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
85.30	85.30	0.00	Fractured	58.20	0.25				1001-3000 ppm

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	2.44	2.44	Clay		
2.44	30.48	28.04	Slate Yellow		
30.48	100.89	70.41	Slate Hard Water Supply		

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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Work Requested -- GW018014

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW018014
LIC-NUM	85BL010154
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1960-07-01
FINAL-DEPTH (metres)	82.90
DRILLED-DEPTH (metres)	82.90
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	FOUR CORNERS
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details [\(top\)](#)

REGION	80 - MACQUARIE-WESTERN
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6441804.00
EASTING	427586.00
LATITUDE	32 9' 28"
LONGITUDE	146 13' 55"
GS-MAP	0048E1

Groundwater Works Summary

Page 2 of 2

AMG-ZONE 55
 COORD-SOURCE PR.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY MOURAMBA
 PARISH invalid code
 PORTION-LOT-DP WLL 2335

Licensed [\(top\)](#)

COUNTY MOURAMBA
 PARISH NIL
 PORTION-LOT-DP

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.50	26.90	152			Suspended in Clamps

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S-W- L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
70.10	70.10	0.00	Fractured	15.20	0.51				3001-7000 ppm

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL COMMENT
0.00	1.83	1.83	Clay Gravel	
1.83	24.38	22.55	Quartzite Soft	
24.38	82.91	58.53	Quartzite Solid Water Supply	

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Groundwater Works Summary

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Work Requested -- GW020656

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW020656
LIC-NUM	85BL013602
AUTHORISED-PURPOSES	STOCK
INTENDED-PURPOSES	STOCK
WORK-TYPE	Bore
WORK-STATUS	Abandoned Bore
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1963-09-01
FINAL-DEPTH (metres)	74.10
DRILLED-DEPTH (metres)	74.10
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	THE PEAK
GWMA	811 - CENTRAL WEST FRACTURED ROCKS
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details [\(top\)](#)

REGION	85 - FAR WEST
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6444799.00
EASTING	438098.00
LATITUDE	32 7' 53"
LONGITUDE	146 20' 37"
GS-MAP	0048E1

Groundwater Works Summary

Page 2 of 2

AMG-ZONE 55
 COORD-SOURCE GD.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY MOURAMBA
 PARISH ROSET
 PORTION-LOT-DP 664/761702

Licensed [\(top\)](#)

COUNTY MOURAMBA
 PARISH ROSET
 PORTION-LOT-DP 664 761702

Construction [\(top\)](#)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
 ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.50	11.70	152			(Unknown)

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S-W- L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
68.60	68.60	0.00	Fractured	55.80	0.63				Good

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL COMMENT
0.00	1.83	1.83	Clay Gravel	
1.83	33.53	31.70	Slate Yellow	
33.53	45.72	12.19	Quartzite	
45.72	74.07	28.35	Slate Quartzite Bands	Water Supply

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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Work Requested -- GW020657

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW020657
LIC-NUM	85BL013603
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	GENERAL USE
WORK-TYPE	Bore open thru rock
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1963-10-01
FINAL-DEPTH (metres)	74.10
DRILLED-DEPTH (metres)	74.10
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	THE PEAK
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details [\(top\)](#)

REGION	80 - MACQUARIE-WESTERN
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6447273.00
EASTING	434964.00
LATITUDE	32 6' 32"
LONGITUDE	146 18' 38"
GS-MAP	0048E1

Groundwater Works Summary

Page 2 of 2

AMG-ZONE 55
 COORD-SOURCE GD.,ACC.MAP
 REMARK

Form-A [\(top\)](#)

COUNTY MOURAMBA
 PARISH invalid code
 PORTION-LOT-DP WLL 2455

Licensed [\(top\)](#)

COUNTY MOURAMBA
 PARISH ROSET
 PORTION-LOT-DP 664 761702

Construction [\(top\)](#)

Negative depths indicate Above Ground Level; H-Hole; P-Pipe; OD-Outside Diameter;
 ID-Inside Diameter; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	-0.60	36.00	152			(Unknown)

Water Bearing Zones [\(top\)](#)

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK-CAT- DESC	S-W- L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
59.70	59.70	0.00	Unconsolidated	54.30		0.63			Good

Drillers Log [\(top\)](#)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL COMMENT
0.00	1.52	1.52	Clay Stoney	
1.52	45.72	44.20	Slate	
45.72	47.85	2.13	Quartzite	
47.85	74.07	26.22	Slate Quartzite Bands	Water Supply

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Groundwater Works Summary

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Work Requested -- GW802946

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW802946
LIC-NUM	85BL242084
AUTHORISED-PURPOSES	INDUSTRIAL STOCK
INTENDED-PURPOSES	INDUSTRIAL STOCK
WORK-TYPE	Bore - GAB
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	Rotary - Percussion (Down Hole Hammer)
OWNER-TYPE	Mines
COMMENCE-DATE	
COMPLETION-DATE	2004-03-05
FINAL-DEPTH (metres)	85.00
DRILLED-DEPTH (metres)	85.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	THE PEAK / HERA PROJECT
GWMA	811 - CENTRAL WEST FRACTURED ROCKS
GW-ZONE	-
STANDING-WATER-LEVEL	65.00
SALINITY	
YIELD	1.10

Site Details [\(top\)](#)

REGION	85 - FAR WEST
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6447266.00
EASTING	436108.00
LATITUDE	32 6' 33"
LONGITUDE	146 19' 22"
GS-MAP	

Groundwater Works Summary

Page 2 of 3

AMG-ZONE 55
COORD-SOURCE GPS - Global Positioning System
REMARK

Form-A ([top](#))

COUNTY MOURAMBA
PARISH ROSET
PORTION-LOT-DP 664/761702

Licensed ([top](#))

COUNTY MOURAMBA
PARISH ROSET
PORTION-LOT-DP 664 761702

Construction ([top](#))

Negative depths indicate Above Ground Level; H-Hole; P-Pipe; OD-Outside Diameter;
 ID-Inside Diameter; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	85.00	203.5			Rotary - Percussor (Down Hole Hammer)
1	1	Casing	PVC Class 9	0.50	85.00	150	140		Glued; Seated on Bottom; Open End
1	1	Opening	Slots - Vertical	71.00	77.00	150			ABS; (Unknown) Glued
1		Annulus	Waterworn/Rounded	71.00	85.00				Graded; GS: 7-7mm

Water Bearing Zones ([top](#))

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S-W- L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
72.00	76.00	4.00		65.00	1.10			1.00	

Drillers Log ([top](#))

FROM	TO	THICKNESS	DESC	GEO-MATERIAL COMMENT
0.00	10.00	10.00	Alluvium: Oxidised Sandstone fragments	
10.00	12.00	2.00	Silcrete: Cherty	
12.00	25.00	13.00	Kaolinitic Clay: Tertiary?	

Groundwater Works Summary

Page 3 of 3

25.00	56.00	31.00	Siltstone : Total Oxidation
56.00	75.00	19.00	Siltstone : Partial Oxidation
75.00	85.00	10.00	Siltstone : Fresh, Pyritic

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Groundwater Works Summary

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Work Requested -- GW804183

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW804183
LIC-NUM	85BL256062
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	Equipped - bore used for obs
CONSTRUCTION-METHOD	Rotary - Percussion - Foam Injection
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2005-09-01
FINAL-DEPTH (metres)	108.00
DRILLED-DEPTH (metres)	108.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	KENMURE
GWMA	811 - CENTRAL WEST FRACTURED ROCKS
GW-ZONE	-
STANDING-WATER-LEVEL	100.00
SALINITY	5000.00
YIELD	2.50

Site Details [\(top\)](#)

REGION	85 - FAR WEST
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6448596.00
EASTING	435066.00
LATITUDE	32 5' 49"
LONGITUDE	146 18' 43"
GS-MAP	

Groundwater Works Summary

Page 2 of 2

AMG-ZONE 55
COORD-SOURCE GIS - Geographic Information System
REMARK

Form-A ([top](#))

COUNTY MOURAMBA
PARISH ROSET
PORTION-LOT-DP 1730//763521

Licensed ([top](#))

COUNTY MOURAMBA
PARISH ROSET
PORTION-LOT-DP 1730 763521

Construction ([top](#))

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	108.00	152			Rotary - Percussion - Foam Injection
1	1	Casing	PVC Class 12	0.00	6.00	150	146		Driven into Hole
1		Annulus	Bentonite/Grout	0.00	6.00	152	150		

Water Bearing Zones ([top](#))

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S-W-L	D-D-L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
88.00	102.00	14.00		100.00	100.00	0.80		1.00	
102.00	108.00	6.00		1000.00	100.00	1.70		1.00	

Drillers Log ([top](#))

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	5.00	5.00	Gravel, transported soil		
5.00	108.00	103.00	Siltstone		

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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[Print Report](#)

[Works Details](#) [Site Details](#) [Form A Licensed Construction](#) [Water Bearing Zones](#) [Drillers Log](#)

Work Requested -- GW804184

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW804184
LIC-NUM	85BL256061
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	Equipped - bore used for obs
CONSTRUCTION-METHOD	Rotary - Percussion - Foam Injection
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2005-09-01
FINAL-DEPTH (metres)	108.00
DRILLED-DEPTH (metres)	108.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	HILLVIEW STATION
GWMA	811 - CENTRAL WEST FRACTURED ROCKS
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	0.60

Site Details [\(top\)](#)

REGION	85 - FAR WEST
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6448036.00
EASTING	438014.00
LATITUDE	32° 6' 8"
LONGITUDE	146° 20' 35"
GS-MAP	

Groundwater Works Summary

Page 2 of 2

AMG-ZONE 55
COORD-SOURCE GIS - Geographic Information System
REMARK

Form-A ([top](#))

COUNTY MOURAMBA
PARISH ROSET
PORTION-LOT-DP 4705/767869

Licensed ([top](#))

COUNTY MOURAMBA
PARISH ROSET
PORTION-LOT-DP 4705 767869

Construction ([top](#))

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	108.00	150			Rotary - Percussion - Foam Injection
1	1	Casing	PVC Class 12	0.00	6.00	150	146		Driven into Hole
1		Annulus	Bentonite/Grout	0.00	6.00	152	150		

Water Bearing Zones ([top](#))

FROM- DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S- W- L	D- D- L	YIELD	TEST-HOLE- DEPTH (metres)	DURATION	SALINITY
74.00	90.00	16.00				0.20		1.00	
90.00	108.00	18.00				0.40		1.00	

Drillers Log ([top](#))

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	2.00	2.00	Gravel/transported Soil		
2.00	8.00	6.00	Clay		
8.00	108.00	100.00	Siltstone		

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Groundwater Works Summary

For information on the meaning of fields please see [Glossary](#)
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[Works Details](#) [Site Details](#) [Form A Licensed Construction](#) [Water Bearing Zones](#) [Drillers Log](#)

Work Requested -- GW804185

Works Details [\(top\)](#)

GROUNDWATER NUMBER	GW804185
LIC-NUM	85BL256063
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	Equipped - bore used for obs
CONSTRUCTION-METHOD	Down Hole Hammer
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2005-09-01
FINAL-DEPTH (metres)	120.00
DRILLED-DEPTH (metres)	120.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	THE PEAK
GWMA	811 - CENTRAL WEST FRACTURED ROCKS
GW-ZONE	-
STANDING-WATER-LEVEL	52.78
SALINITY	
YIELD	1.00

Site Details [\(top\)](#)

REGION	85 - FAR WEST
RIVER-BASIN	425 - DARLING RIVER
AREA-DISTRICT	
CMA-MAP	8133
GRID-ZONE	55/2
SCALE	1:100,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6444485.00
EASTING	439535.00
LATITUDE	32 8' 4"
LONGITUDE	146 21' 32"
GS-MAP	

Groundwater Works Summary

Page 2 of 3

AMG-ZONE 55
COORD-SOURCE GIS - Geographic Information System
REMARK

Form-A ([top](#))

COUNTY MOURAMBA
PARISH ROSET
PORTION-LOT-DP 664//761702

Licensed ([top](#))

COUNTY MOURAMBA
PARISH ROSET
PORTION-LOT-DP 664 761702

Construction ([top](#))

Negative depths indicate Above Ground Level; H-Hole; P-Pipe; OD-Outside Diameter; ID-Inside Diameter; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity

HOLE- NO	PIPE- NO	COMPONENT- CODE	COMPONENT- TYPE	DEPTH- FROM (metres)	DEPTH- TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	120.00	150			Down Hole Hammer
1	1	Casing	PVC Class 12	-0.30	108.00	50	46		Riveted an Glued; Seated on Bottom; Er cap PVC Class 12; Mechanica Slotted; SL 25mm; A: 2mm; Riveted an Glued
1	1	Opening	Slots - Horizontal	108.00	114.00	50			
1		Annulus	Concrete	0.00	6.00	150	50		
1		Annulus	Waterworn/Rounded	100.00	120.00	150	50		Graded; G: 2-5mm

Water Bearing Zones ([top](#))

FROM- DEPTH (metres)	TO- DEPTH (metres)	THICKNESS (metres)	ROCK- CAT- DESC	S-W- L	D- D- L	YIELD	TEST- HOLE- DEPTH (metres)	DURATION	SALINITY
88.00	120.00	32.00		52.78	1.00				

Drillers Log ([top](#))

Groundwater Works Summary

Page 3 of 3

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	2.00	2.00	Soil, residual red brown, silty		
2.00	4.00	2.00	Clay, red brown		
4.00	5.00	1.00	Sandstone, weathered, orange brown		
5.00	6.00	1.00	Siltstone, weathered, orange brown		
6.00	20.00	14.00	Sandstone, weathered, orange brown		
20.00	25.00	5.00	Siltstone, moderately weathered		
25.00	30.00	5.00	Sandstone, moderately weathered, orange brown green		
30.00	38.00	8.00	Siltstone, slightly weathered, orange brown, green		
38.00	50.00	12.00	Siltstone, slightly weathered, orange green brown		
50.00	62.00	12.00	Siltstone, fresh, dark green black		
62.00	64.00	2.00	Siltstone, weakly weathered, dark green brown		
64.00	120.00	56.00	Siltstone, fresh, dark green black		

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Appendix 3

Hera Project Groundwater Management Plan, Nymagee, NSW (Geoterra, 2007)

(Total No. of pages including blank pages = 24)

Note: A copy of Appendix 3 is available on the Project CD

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**CBH RESOURCES LTD
HERA PROJECT
GROUNDWATER MANAGEMENT PLAN**
Nymagee, NSW

TR5-R2
11 MAY, 2007

GeoTerra Pty Ltd ABN 82 117 674 941

77 Abergeldie Street Dulwich Hill NSW 2203

Phone: 02 9560 6583 Fax: 02 9560 6584 Mobile 0417 003 502 Email: geoterra@iinet.net.au

TR5-R2 (11 MAY, 2007)

2

GeoTerra

Authorised on behalf of Geoterra Pty Ltd:	
Name:	Andrew Dawkins
Signature:	
Position:	Managing Geoscientist
Date:	11.05.2007

Date	Rev.	Comments
09.05.2007		Initial Draft
11.05.2007	Final	Incorporate CBH Resources comments

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TR5-R2 (11 MAY, 2007)

GeoTerra

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GeoTerra**9. REFERENCES**

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Figure 1 Groundwater Levels

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Drawing 1 Groundwater Monitoring Locations

Drawing 2 Hera Project Site Layout

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Table 1 CBH Resources Ltd Bore and Piezometer Licences

Table 2 Hera Project Bore and Piezometer Summary

Table 3 Hera Project DNR Bore / Piezometer Licensing

Table 4 Private Bores within 5km of "The Peak"

Table 5 "The Peak" Dams

Table 6 Bore Water Chemistry (major ions)

Table 7 Bore Water Chemistry (metals)

Table 8 Groundwater Monitoring Method and Frequency

Table 9 Groundwater Quality Monitoring Parameters

Table 10 Groundwater Criteria – Major Ions and Nutrients

Table 11 Groundwater Criteria - Metals

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1. INTRODUCTION

This Groundwater Management Plan (GMP) for the CBH Resources Ltd Hera Decline ("the Project") is prepared in compliance with a verbal request from the NSW Department of Water and Energy, and includes a:

- Groundwater Monitoring Program,
- Groundwater Management Program, and a;
- Bore Impact Management Program

The decline is planned to provide underground access to investigate the Main Lens North and the Main Lens South within the Hera Project underground gold and base metal deposit, which is located on "The Peak" property, approximately 5km south of Nymagee in NSW.

The Skirka's, Back and House bores on "The Peak" are currently used to provide a water supply for mineral exploration within the Hera Project area, and are proposed to be used to provide a water supply for the proposed decline and ongoing mineral exploration activities.

The proponents (CBH Resources Ltd) have either been previously granted or have recently applied to the NSW Department of Natural Resources (now the Department of Water and Energy – DWE) as shown in **Table 1** for the following groundwater related licences under the Water Act, 1912 and the Water Management Act, 2000 (Aquifer Interference Provisions).

TABLE 1 CBH RESOURCES LTD BORE AND PIEZOMETER LICENCES

Component	Use	Volume (ML/yr)	Application Date
Hera Decline	Mining	31 – 95	9/03/2007
Skirka's Bore (TNYWB1)	Mining	18.5	2/03/2006
Back Bore (TNYWB6)	Mining	18.5	20/03/2007
TNYWB2 & 3	Groundwater Monitoring	Not Applicable	12/08/2005
TNYWB4 & 5	Groundwater Monitoring	Not Applicable	9/03/2007
House Bore	Stock / Domestic	1.5	1963 (approved)

For the purpose of this plan, the "Site" is defined as the proposed decline and its associated groundwater drawdown area, including bores on adjacent properties that may be affected by the Project as well as the associated water management components of the site that directly relate to the proposed decline.

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These features are shown in **Drawings 1 and 2** and include the;

- Boxcut and the Decline as well as their associated surface infrastructure,
- Skirka's Bore / Back Bore / House Bore and associated water storage dams on "The Peak" property,
- Groundwater monitoring piezometers TNYWB2, 3, 4 and 5 on "The Peak",
- The private bore GW17385 on the "Kenmure" property, which is approximately 3.5km south-west of the "Back Bore", and
- The private bore GW17386 on the "Kenmure" property, which is approximately 6.0km north-northwest of "Skirka's Bore" and the proposed Decline

All other components relating directly to surface water management issues of the Project are being addressed under separate cover.

Operation of the Groundwater Management Plan needs a high level of management input to ensure the Project operates within its requirements and associated water licences.

An essential part of the management plan is monitoring all groundwater pumping volumes using reliable flow meters, monitoring of groundwater levels in pumped, monitoring and private bores and monitoring of groundwater quality.

This information is necessary for periodical reviews of the groundwater management system and to support any updates/changes to licences. The groundwater management and monitoring program will be conducted in accordance with all licence conditions from the Department of Planning and the Department of Water & Energy.

Measures will be used to minimise and manage the impacts on the groundwater system in the vicinity of the Project, including the aquifers, groundwater users, and, if present, groundwater dependent ecosystems.

1.1 Groundwater Management Categories

For management purposes, groundwater within the Project area has been divided into the following classes;

(Unaffected) groundwater from bores that are undisturbed or not adversely affected through operation of the Project,

(Process) groundwater pumped from the Decline and water supply bores on "The Peak", which is stored in surface water dams within "The Peak", is brackish to saline and could potentially contain pollutants following discharge from the Decline.

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2. OBJECTIVES

The principal objectives of the groundwater management plan are as follows.

- (i) To ensure a sufficient water supply for the Project through pumping from groundwater bores and the Decline within "The Peak"
- (ii) To achieve a dry operation within the Decline and activities directly associated with the Project exploration
- (ii) To collect and store all process water within "The Peak"
- (iii) To maximise the use of "process" water for Project related activities and minimise the necessity to harvest "clean" surface water
- (iv) To ensure that all "Process " water is detained in dedicated surface water storage dams
- (v) Except as may be expressly provided by a DECC or DWE Licence, the Applicant shall ensure that no off site discharge of saline groundwater or process water occurs from the Project Site.
- (vii) To ensure all relevant groundwater quality criteria are met
- (viii) To minimise impacts on the availability of groundwater in adjacent bores, and to;
- (ix) Establish a method of assessing the level of impact on groundwater supplies in adjacent private bores that is attributable to the Project.

The general objective of the GMP is to assess any physical and / or chemical impacts of the Project within and adjacent to the Project area, and the GMP has been prepared as outlined in the following sections.

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3. MONITORING SITE DESCRIPTIONS

Groundwater in the Project Area is sourced from fractured basement aquifers in siltstone, schist, shale, slate and sandstone lithologies within the Lower Amphitheatre Group and Burthong Formation.

The groundwater sources are not listed as vulnerable aquifers under the current Aquifer Risk Assessment Report (DLWC, 1998). However, they are covered, as appropriate, by the generic State Groundwater Policy (DLWC, 1997), Groundwater Quality Protection Policy (DLWC, 1998) and Groundwater Dependent Ecosystem Policy (DLWC, 2002).

Bore and piezometer locations are shown in Drawings 1 and 2.

Monitoring of groundwater levels and water chemistry in the Project area has been conducted since October 2005.

3.1 Project Groundwater Bores and Piezometers

The current status of groundwater bores and piezometers associated with the Project area, both within and outside "The Peak" property are summarised in Table 2.

TABLE 2 HERA PROJECT BORE AND PIEZOMETER SUMMARY

Bore / Piezometer	Alluvium mbgl	Total Depth m	First Aquifer mbgl	Yield L/sec	SWL mbgl Range To	Lithology	EC µS/cm	pH
Skirka's Bore (TNYWB1)	25(?)	85	72	1.4	60.00 – 68.00	Siltstone	4970 - 6480	7.16
TNYWB2 (piezo)	8	108	88	2.5	51.00 - 53.60	Siltstone	4360 -6500	8.11
TNYWB3 (piezo)	6	108	62	0.6	43.00 – 50.00	Siltstone	4310 - 5830	7.01
TNYWB4 (piezo)	-	120	78	0.08	52.77 – 52.84	Siltstone	-	-
TNYWB5 (piezo)	-	150	96	1.5	71.00 – 71.52	Siltstone	-	-
Back Bore (TNYWB6)	0.5	121	88.5	6	62.80 - 63.06	Siltst / sast	4140	7.52
House Bore	1.5	74.1	59.7	0.4 - 1	51.54 - 69.35	Slate / qzte	3320 - 3820	7.40

3.1.1 Bore Licensing

The following bore licensing actions with the DWE (Dubbo Office) have occurred for production and test monitoring bores at the Project site as shown in Table 3.

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TABLE 3 HERA PROJECT DNR BORE / PIEZOMETER LICENSING

Bore	DNR Licence No. (80BL)	DNR GW No.	Authorised Purpose	Extraction Licence Volume (ML/yr)	Application Date	Grant Date
House	013603	20657	Stock	1.5	Not Avail.	Not Avail.
TNYWB1 (Skirka's)	242084	Pending	Industrial / Stock	1.5	Not Avail.	17/02/2004
TNYWB1 (Skirka's)	Pending	Pending	Mining	18.5	02/03/2006	Pending
TNYWB2	Pending	Pending	Monitoring	Not Applicable	12/08/2005	Pending
TNYWB3	Pending	Pending	Monitoring	Not Applicable	12/08/2005	Pending
TNYWB4	Pending	Pending	Monitoring	Not Applicable	05/03/2007	Pending
TNYWB5	Pending	Pending	Monitoring	Not Applicable	05/03/2007	Pending
Back (old)	013602	20656	Stock / Domestic	1.5	Not Avail.	Not Avail.
TNYWB6 (Back New)	Pending	Pending	Mining	18.5	05/03/2007	Pending
Hera Decline	Pending	Pending	Mining	31-95	02/03/2007	Pending

NOTE: * Skirka's bore application modified from 48.5 to 18.5ML/yr to facilitate licence processing time on 2/3/06

Modification to 18.5ML/yr production bore license from stock / domestic bore for Skirka's / Back Bores will override the original 1.5ML/yr extraction allocation

3.2 Private Bores

Eleven DWE registered bores and one well are located within a 30km x 30km area centred on "The Peak", with the bores and well being used mainly for stock and / or domestic use.

The two closest bores within 5km of "the Peak" are shown in **Table 4** and **Drawing 1**.

TABLE 4 PRIVATE BORES WITHIN 5km OF "THE PEAK"

Bore	Distance From The Nearest "Peak" Bore	Total Depth m	Aquifer mbgl	Yield L/sec	SWL mbgl (Sep 05)	EC μ S/cm	Date
GW17385	3.1km (from Skirka's Bore)	61	19 - 53	0.51	46.6 -52*	501 - 1000	1959
GW17386	2.5km (from Back Bore)	100.9	85.3	0.3	58.2*	1001-3000	1960

Note: * bore swl measured at time of installation, all other readings were collected on 9 Sept 2005

TR5-R2 (11 MAY, 2007)



3.3 Streams

The area is generally dry, and contains ephemeral creeks that flow during and after flood events.

The main watercourses in the Project area are the headwaters of Box Creek, which originates to the south of "The Peak" property and subsequently flows to the north. Box Creek then turns to a westerly direction to the west and north of Nymagee and subsequently flows northwest.

The westerly flowing Crowl Creek has its headwaters to the south of "The Peak".

Box Creek joins Crowl Creek to the west of the Nymagee 100:000 sheet and disappears as a soak to the north of Ivanhoe.

3.3.1 Water Storage Dams

"The Peak" currently has eight dams on site as shown in **Table 5** and **Drawing 3**.

TABLE 5 "THE PEAK" DAMS

DAM	Capacity (ML)
House	10.6
Office	2.1
3 Gates	2.1
Back Tank	14.3
Pete's	3.8
East	2.1
Dam 1	0.7
Dam 2	0.1
TOTAL	35.8

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4. GROUNDWATER MANAGEMENT STRATEGY

The general principles and strategies behind the GMP are to:

- Process and unaffected groundwater will not be discharged off-site under design conditions and will be collected and re-used on site in preference to better quality water;
- Process water supply will be drawn in order of preference from the poorest to the better quality water sources on site;
- Contingencies including regular inspections will be provided to prevent the accidental discharge of saline/dirty or contaminated water; and
- Monitoring will be conducted to confirm the GMP is operating as designed and meets target criteria, licence conditions and commitments made during the approval process.

5. MONITORING

The monitoring program is designed to provide a database that enables comparison of the impacts of the Project area to those predicted in the CBH Resources Ltd Hera Decline Review of Environmental Factors.

It specifically deals with:

- Impacts on groundwater levels and bore yields on neighbouring bores;
- Impacts on any other beneficial users;
- Impacts of the development on groundwater quality, and;
- Any impacts on groundwater dependent ecosystems.

The monitoring undertaken will involve water level monitoring, bore yield monitoring and groundwater quality sampling from bores and piezometers within the Project area on a weekly, quarterly and annual basis. The location of all groundwater monitoring points are presented on **Figure 1**.

The results from current groundwater level and groundwater quality monitoring are shown in **Figure 1** and **Tables 6** and **7**.

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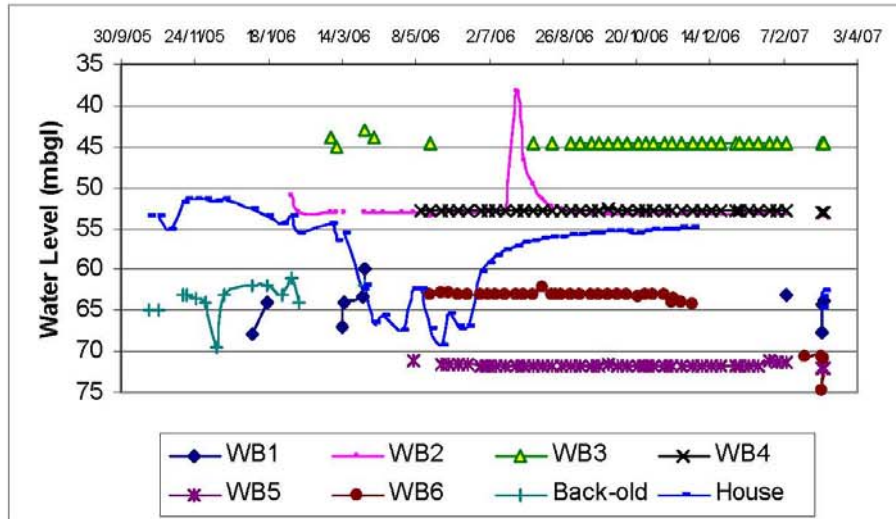


FIGURE 1 Groundwater Levels

TABLE 6 BORE WATER CHEMISTRY – Major Ions (mg/L)

Bore	Ph	EC uS/cm	TDS	Na	Ca	K	Mg	Cl	F	NO3	SO4	HCO3	Tot P	Tot N
Skirka's (June 05)	7.16	4970	3875*	631	235	26	270	1580	–	–	–	383	–	–
Back (old) June 05	7.21	1420	1105*	163	36	8	39	192	–	–	–	375	–	–
Back (New) June 06	7.6	3620	2300	540	105	28	135	850	0.35	–	305	660	<0.1	0.5
House (June 05)	7.40	3320	2590*	537	41	25	70	917	–	–	–	420	–	–
TNWB2	8.11	4360	3380	803	96	35	179	1650	1.2	0.533	752	–	0.04	–
TNWB3	7.01	4310	3400	626	149	30	207	1780	0.4	0.036	446	–	0.10	–
ANZECC (sheep)	6.5 – 8.0 ⁺	125-2200 ⁺	5000	–	1000	–	–	–	–	400	1000	–	0.005 ⁺	–

Note: ⁺ ANZECC 2000 default trigger values (SE Australian Lowland River)

* TDS calculated from EC

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TABLE 7 BORE WATER CHEMISTRY – Major Metals (mg/L)

Bore	Cu	Pb	Zn	Cd	Fe	Fe ²⁺	Mn	Sb	As	Cd	Cr	Co	Ni	Se
Skirka's (June 05)	0.005	<0.001	0.019	<0.0001	–	–	–	<0.001	0.001	<0.0001	<0.001	0.003	0.023	<0.01
Back Old (June 05)	<0.001	<0.001	0.02	0.0002	–	–	–	<0.001	0.002	0.0002	<0.001	<0.001	<0.001	<0.01
Back New (June 06)	<0.001	<0.001	0.003	<0.0002	<0.01	–	0.07	<0.001	<0.01	0.0002	<0.01	<0.01	<0.01	<0.01
House (June 05)	0.004	0.002	0.013	<0.0001	–	–	–	<0.001	0.002	<0.0001	<0.001	<0.001	0.002	<0.01
TNWB2	0.008	0.011	0.037	0.0008	0.23	<0.05	–	0.148	0.003	0.0008	<0.001	–	0.036	<0.01
TNWB3	0.008	0.003	0.067	0.0008	0.10	0.17	–	<0.001	<0.001	0.0008	<0.001	–	0.008	<0.01
ANZECC (sheep)	0.4	0.1	20	0.01	–	–	–	–	0.5	0.01	1	1	1	0.02

Table 8 presents the parameters to be measured, frequency of monitoring and sampling method, with monitoring to continue for a period of up to 1 year after the decline and associated exploration studies are completed.

The frequency of monitoring will be reassessed after the decline is completed as it may be possible, depending on results, to lengthen the interval between readings.

The frequency of monitoring and the pollutants to be monitored may be varied by the DECC once the variability of the groundwater quality is established.

TABLE 8 GROUNDWATER MONITORING METHOD AND FREQUENCY

Monitoring Parameter	Group	Sampling Method	Frequency	Units
Standing Water Level	Project Bores	logger / dip meter	twice daily / weekly	mbgl
	Private Bores	dip meter	quarterly	mbgl
Water Quality	Project Bores (Field)	Pumped sample	Quarterly	mg/L
	Project Bores (Lab)	Pumped sample	Yearly	mg/L
	Private Bores	Pumped sample	Yearly	mg/L

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5.1.1 Standing Water Level

Water level transducers and loggers in piezometers surveyed to the Australian Height Datum are used to assess the 12 hourly variation in the standing water level of TNYWB2, 4 and 5.

Downloading and re-initiation of the loggers along with manual water level measurement is taken at approximately quarterly intervals, along with assessment of field chemical parameters (pH and EC).

Manual water level monitoring in all available piezometers and bores within the Project area is conducted once weekly to augment the water level logger data.

Where unobstructed internal bore access is possible, periodic measurement of standing water levels will be measured in each private bore.

5.1.2 Standing Water Trigger Levels

Standing water levels are expected to naturally vary by up to 15% in bores that are not being pumped or in piezometers that are not adjacent to pumped bores.

Any reduction in standing water level greater than this will require further investigation to assess the cause and significance of the effect on adjacent private bores.

5.1.3 Groundwater Quality

Table 9 indicates the groundwater quality monitoring parameters that will be assessed.

TABLE 9 GROUNDWATER QUALITY MONITORING PARAMETERS

SUITE	ANALYTES
Project (Field)	EC, pH
Project (Lab)	TDS, Na, K, Ca, Mg, F, Cl, SO ₄ , HCO ₃ , NO ₃ , Total N, Total P, hardness Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr (Totals)
Private	(EC, pH) + TDS, Na, K, Ca, Mg, F, Cl, SO ₄ , HCO ₃ , NO ₃ , Total N, Total P, hardness Cu, Pb, Zn, Ni, Fe, Mn, As, Se, Cd, Cr (Totals)

Bores and piezometers will be purged prior to sampling until pH and salinity measurements have become stable, which usually involves the removal of at least three bore volumes of groundwater.

Samples will be collected and placed in appropriately preserved containers and kept on ice. Samples will be transported on ice under chain of custody documentation and arrive at the laboratory within appropriate holding times.

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5.1.4 Groundwater Quality Trigger Levels

The Project area groundwater is too saline for any potable or irrigation beneficial purpose, however the ANZECC 2000 irrigation and livestock guidelines will be used as default trigger levels.

Groundwater monitoring to date has assessed that none of the guidelines shown in **Tables 10 and 11** have been exceeded to date.

Trigger levels for EC and pH are set so that a variation of greater than 15% of the background EC value or 0.5 pH units will trigger further investigation.

The trigger levels will be assessed against a benchmark of the natural conditions which have been, and are being established through the monitoring program.

TABLE 10 GROUNDWATER CRITERIA – MAJOR IONS AND NUTRIENTS

	pH	TDS	Na	Ca	Cl	F	SO ₄	NO ₃	Hardness as CaCO ₃
Irrigation	6 - 8.5	-	-	-	-	2	-	25-125 (N)	>60-350
Livestock	-	<4000/5000	-	-	-	2	-	-	-

TABLE 11 GROUNDWATER CRITERIA – METALS (MG/L)

	Cu	Pb	Zn	Ni	Fe	Mn	As	Se	Cd	Cr
Irrigation	5	5	5	2	10	10	2.0	0.05	0.05	1
Livestock	1 / 0.4	0.1	20	1	-	-	0.5	0.02	0.01	1

NOTE: irrigation criteria for short term trigger values (< 20 years of application)

Livestock criteria for beef / sheep

5.1.5 Hydraulic Characteristics of Neighbouring Bores

The proponent will seek landholder approval to undertake hydraulic testing of private bores within 5km of the Project Area (GW17385 and GW17386).

Subject to approval, the bores will be assessed via a constant rate pump out test of 6 hours minimum duration, or if internal bore access constraints apply and pumping / water level measurement is not possible, a falling head test will be used to establish the hydraulic performance under current conditions for each bore.

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Where unobstructed internal bore access is possible, the tests will aim to establish each bores' current;

- Aquifer hydraulic conductivity
- Field water quality (pH, EC), and
- Yield
- Bore depth

An initial test will be conducted within 6 months of granting bore licences to CBH Resources Ltd.

A subsequent test will be conducted, if requested by a bore owner, for comparison to the initial assessment to determine if any adverse changes have occurred in the tested parameters.

5.1.6 Private Bore Hydraulic Characteristic Trigger Levels

If, following an independent audit review, it is the opinion of the auditor that there is a greater than 2.5m change and ongoing declining trend in groundwater levels or greater than 10% reduction in yield which is not attributable to climatic conditions or a change in an owners pattern of use of a private bore, then the landholder will be approached to arrange re-testing of their bore.

5.1.7 Rainfall and Evaporation

The proponent will maintain a rainfall gauge on site and will measure daily rainfall.

Daily evaporation will be determined from the nearest registered Bureau of Meteorology weather station.

5.2 Groundwater Contingencies

The proponent recognises that a change in the beneficial use of the water should not occur as a consequence of its exploration or mining related activities.

5.2.1 Periodic Review of Performance

An independent audit review will be conducted annually through the life of the Decline to assess trends in the monitored groundwater data.

In the event that routine monitoring indicates that a trigger has been reached or is being approached, the proponent will commission a hydrogeologist to review the data, with the outcomes of that review, including any recommendations, being subject to discussion and agreement with the DWE.

A trigger of pH or EC would initially lead to an increase in the analytes monitored and/or frequency of sampling to confirm the magnitude and extent of the change in water chemistry and verify the change is a consequence of mining.

Should the standing water level trigger be achieved in any bore, the proponent will notify the affected landowner(s) and, if it is the hydrogeologist's opinion that the reduction is a consequence of the proponent's activities, mitigation measures identified in **Section 9.4** will be initiated.

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An independent authority may also be used where a dispute arises as to the cause of the change, given that groundwater yield and quality can be affected by non-mining or exploration related factors such as bore siltation, aquifer depletion due to extended droughts, over extraction by bore owners, bacterial infection, fertilizer contamination etc.

5.2.2 Adverse Impact on Groundwater Users

In the event of any reported adverse impacts on the standing water level, bore yield or bore water quality in an adjacent private bore (GW 17385 or GW17386), the cause will be investigated and if it is related to the proponents activities, either;

- the affected bore will be deepened,
- an alternative water source will be provided, or;
- an alternative arrangement suitable to both parties will be proposed.

5.2.3 Groundwater Dependent Ecosystems

The proposed decline and pumping from water supply bores will lower groundwater levels, however, there are no groundwater dependent ecosystems in the vicinity of the Project area.

5.3 Groundwater Mitigation Measures

5.3.1 Groundwater (General)

Groundwater dewatered from the underground decline would be piped via aboveground pipes to a series of settling ponds and then pumped back underground for use in drilling as required. The remainder, if any, will be stored in the settling ponds for evaporation.

The drilling undertaken to date indicates that there would be minimal volumes of groundwater intercepted by the exploration decline. In the unlikely event that a prolonged or large rainfall event caused the settling ponds to overflow, the water would be diluted by the rainfall and any overflow would still be within the catchment of Three Gates Tank. Overflow would then be even further diluted as it reaches that dam and is not anticipated to impact on water quality. Water monitoring will be undertaken to ensure this is the case, and if results indicate otherwise, a contingency area has been nominated for the construction of additional settling ponds as required to increase the storage capacity and minimise the opportunity for overflow.

The group of five separate settling ponds are located adjacent to Three Gates Tank and cover an area of approximately 0.79ha.

Apart from potentially high salinity, the dewatered water is anticipated to be within the criteria for stock drinking water as indicated by current bore water quality monitoring.

5.3.2 Groundwater (Hydrocarbon / Contaminant Spill)

If a major liquid hydrocarbon/contaminant spill occurs, the proponent will implement the following 3-phase remediation plan.

Recovery

Recover as much as possible at the source by pumping the contaminant from the surface and excavating contaminated materials and stockpiling them on site under cover and on

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an impermeable surface (eg a high density polyethylene sheet). This material will later be bio-remediated on site and/or transported to an approved waste depot.

Source Control

Begin hydraulic control of the source to prevent spreading of contamination. This will involve digging one or more holes close to the centre of the spill area, and pumping from these holes to create a cone of depression with a hydraulic gradient towards the holes. This will prevent movement of contamination away from the area of the spill.

Treatment

If necessary, install boreholes to remove and treat contaminated groundwater. Any contaminated surface water or groundwater recovered will be treated on site prior to release (or use for processing or dust suppression) under a DECC licence.

No solid potential contaminants will be used on the site in sufficient quantity as to require development of a specific contingency plan. However, any spillages of such materials, eg explosives, will immediately be cleaned up and disposed of in an appropriate manner approved by DECC.

Notwithstanding the measures identified above, the Mine recognises that the potential remains for changes in groundwater quality to occur which may or may not be a consequence of potential contaminants used on the mine site.

Should such a situation be demonstrated by monitoring, appropriate measures to mitigate impacts on groundwater quality will be developed in consultation with the DWE, with the nature of the "appropriate solution(s)", eg pumping and treatment, isolation or remediation, being dependent on the nature of the issue.

5.3.3 Private Bore Groundwater Yield

In the event that monitoring identifies a reduction in the yield or available drawdown within a bore which is in excess of the identified trigger level and is a consequence of the proponents activities, the project manager will enter into negotiations with the affected landowner/s with the intent of formulating an agreement which provides for one or a combination of:

- re-establishment of the available drawdown in the affected bore(s) through bore deepening;
- establishment of additional bores to provide a yield at least equivalent to the affected bore prior to the proponents activities;
- provision of access to alternative sources of water, or
- compensation to reflect increased water extraction costs, eg due to lowering pumps or installation of additional or alternative pumping equipment.

6. REPORTING

The groundwater monitoring results and interpretations will be reported in the project's AEMR that outlines trends in surface water quantity or quality as well as standing groundwater levels and quality.

The report will be completed by a suitably qualified hydrologist / hydrogeologist, whose appointment has been approved by the Director-General.

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The assessment of trends will not only consider the ANZECC trigger levels but also any natural variations that occur.

It will include;

- a basic statistical analysis (mean, range, variance, standard deviation) of the results for the parameters measured in the piezometers and bores, and;
- an interpretation of the results and trends in water quality and water levels at the ground water monitoring points supported by graphs and contour plots;

The report will provide an interpretation and review of the results in relation to trigger criteria and predictions made in the REF. It will outline an interpretation of the project water balance identifying the volume and make-up of decline inflows and bore pumping records compared to the proponent's Water Access Licences.

An electronic copy of the report will be forwarded to the DWE.

7. REVIEW AND MODIFICATION OF THE GMP

The monitoring data will be reviewed annually as well as at strategic milestones in the project life including:

- After the decline is installed;
- Annual AEMR reporting periods, and;
- Cessation of exploration activities.

The GMP will be modified periodically to reflect changes in the exploration program, monitoring results and review of the community and government authority issues.

All modifications will be made only after consultation with the DWE and DoP.

8. RESPONSIBILITIES AND ACCOUNTABILITIES

The Site Project Manager is responsible for:

- acting as the interface for groundwater issues between government authorities, private industry, contractors, community groups and the wider community;
- maintaining an groundwater monitoring program to gauge the effects of exploration operations on the Project groundwater system;
- development of an annual report detailing the results of key performance indicators developed for each monitoring location;
- developing solutions to any unplanned events that may potentially result in or cause negative impacts; and
- implementation of the Groundwater Management Plan

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9. REFERENCES

- ANZECC & ARMCANZ, 2000 An Introduction to the Australian and New Zealand Guidelines For Fresh and Marine Water
- Geoterra, 2005 Hydrogeological Assessment of Skirka's Bore at "The Peak" Station
- Geoterra Pty Ltd, 2006 Hera Project Groundwater Status Report
- Geoterra Pty Ltd, 2007 Hera Project Back Bore Production Bore Licence Application and Water Status Report

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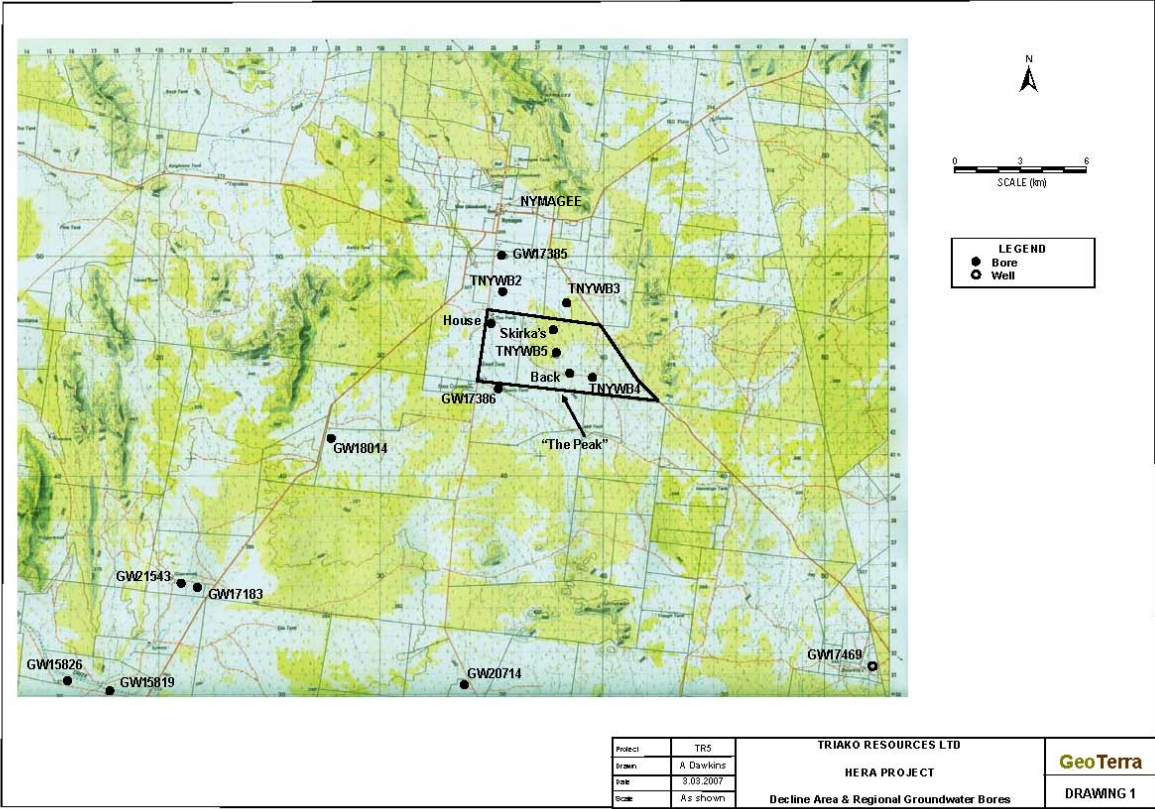
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TRIAKO RESOURCES LIMITED
Exploration Decline at Hera Deposit

6 - 4

REVIEW OF ENVIRONMENTAL FACTORS
Section 6 - Figures
Report No 659/07

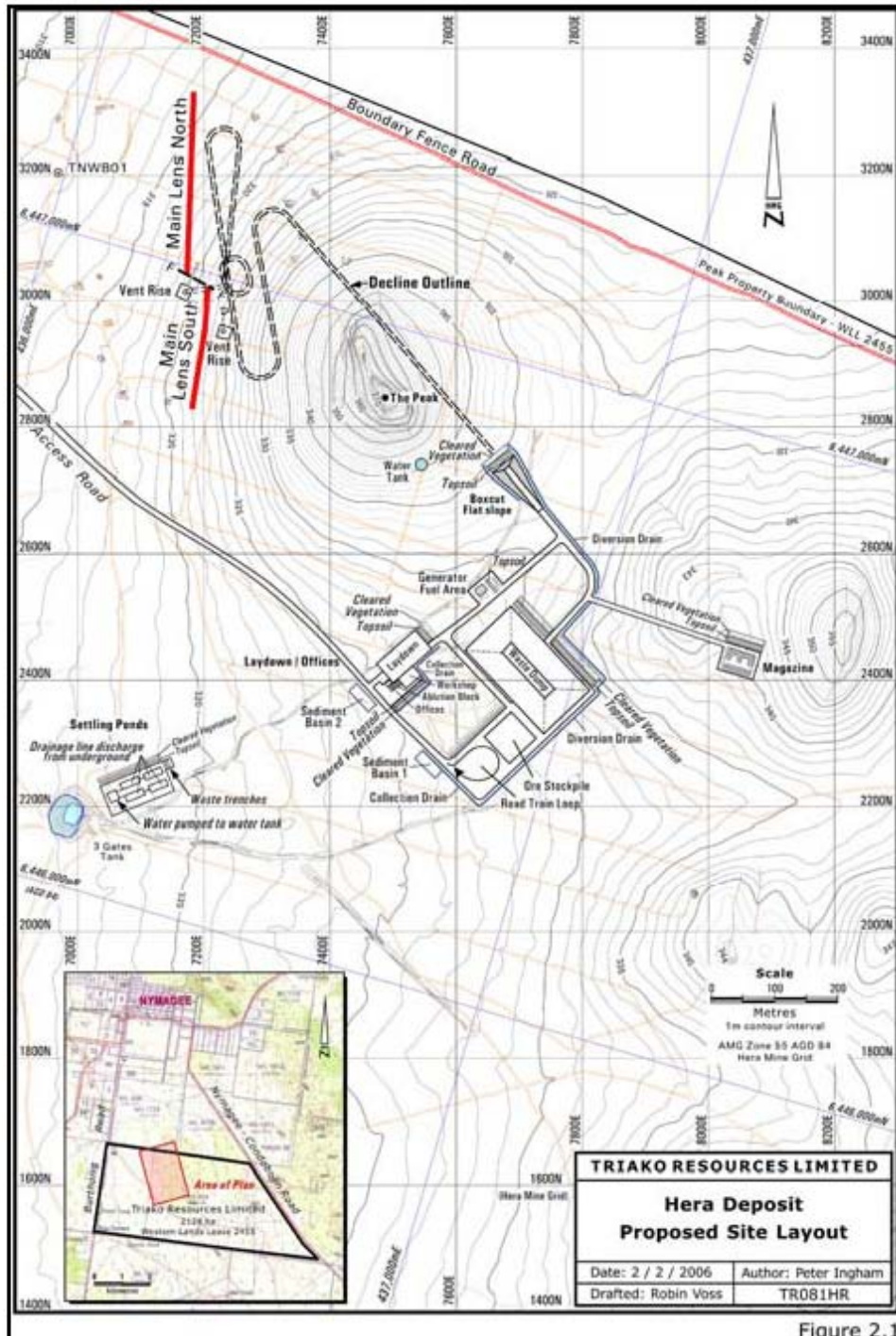


Figure 2.1

Appendix 4

Hydrogeological Assessment of Skirka's Bore at "The Peak" Station, Nymagee, NSW (Geoterra, 2005)

(Total No. of pages including blank pages = 48)

Note: A copy of Appendix 4 is available on the Project CD

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TRIAKO RESOURCES LTD
HYDROGEOLOGICAL ASSESSMENT OF
SKIRKA'S BORE AT
"The Peak" STATION
Nymagee, NSW

TR2-R1A
25 October, 2005

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TR2-R1A (25 October, 2005)

GeoTerra

Triako Resources Ltd
PO Box 1048
NORTH SYDNEY NSW 2060

Attention: Peter Ingham

Peter,

RE: HYDROGEOLOGICAL ASSESSMENT OF "The Peak" STATION

Please find enclosed a copy of the above mentioned report.

Yours Faithfully

GeoTerra



Andrew Dawkins

Managing Geoscientist (MAusIMM CP-Enviro)

Distribution:	Original	Geoterra
	1 electronic copy	Triako Resources Ltd
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Appendix B	Pump Test Results
Appendix C	Laboratory Analyses

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1. INTRODUCTION

This document provides a hydrogeological assessment of "The Peak" Station, which is located approximately 4km south of Nymagee in NSW.

The report is based on the results of;

- a Department of Natural Resources (DNR) registered bore data search,
- a 24 hour pump out and recovery test of "Skirka's Bore",
- Discussions with DNR regional staff, and;
- Laboratory analysis of groundwater from bores on "The Peak" property

1.1 Proposed Groundwater Use

For the purpose of this application, groundwater from "Skirka's Bore – TNWB1 (GW80BL 242084) is proposed to be used to provide a water supply to support exploration and assessment of the proposed "Hera" gold and base metal underground mine, which is located within "The Peak" property.

The bore is proposed to be pumped at 1.5L/sec (47.5ML/year).

2. OBJECTIVE

The objective of this report is to provide a preliminary interpretation of the hydrogeology and potential groundwater supply issues for the subject property.

It is intended to provide an initial assessment of groundwater management and to outline the potential effects on the local environment and community through groundwater extraction from Skirka's Bore.

3. STUDY AREA FEATURES

The study area is situated approximately 5km south of Nymagee in central western NSW as shown in **Figure 1**, which is approximately 630 km west-northwest of Sydney by road and 96 km southeast of Cobar.

3.1 Land Use

The dominant land use in the area is sheep grazing, with a carrying capacity of about 1 sheep per 6 to 10 hectares with minor cattle grazing.

Cropping for wheat, oats and barley is less common throughout the area, with logging of White Cypress Pine conducted on a small scale.

Access within the area via all-weather roads and property tracks is generally good, with property tracks providing good access in dry weather (MacRae, G.P. 1984).

3.2 Property Ownership

"The Peak" (Western Land Lease 5381) is owned by Triako Resources Ltd, who acquired the property on 11/1/2005.

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3.3 Licensed Wells and Bores

The study area is within the DNR "Far West Region" with the producing aquifers comprising the Central West and / or Far West Fractured Rock aquifer. At this stage, distinction between the Central West and the Far West region has not been defined by DNR.

DNR Far West Region officers indicate there are no known Groundwater Management Areas covering the study area.

Eleven DNR registered bores and one well are located within the 30km x 30km study area as shown in Figure 1, with the bores and well being used mainly for stock and / or domestic use.

Three of the eleven bores are present on "The Peak" property, which contains the Hera prospect, with one bore on the adjoining property to the south near "Spains Tank".

The DNR database indicates bore yields range from 0.25L/sec to 1.1L/sec, with standing water levels ranging from 15.2mbgl to 62mbgl in bores from 25.9m to 110m deep.

The bores were installed between 1958 and 2004, however no DNR data is publicly available for bores or wells that may have been installed between 1985 and 2004.

Following a regional geological and structural geology desk top assessment of the Nymagee region (Triako Resources Ltd, 2005) two additional groundwater exploration bores were installed by Triako Resources Ltd in 2005 as shown in Table 1, with all data from the study area shown in Appendix A.

TABLE 1 DNR Registered Bore Summary

Bore	Alluvium mbgl	Total Depth m	Aquifer mbgl	Yield L/sec	SWL mbgl (Sep 05)	Lithology	EC μ S/cm	Date
GW17385	1	61	19 - 53	0.51	46.6 - 52*	Schist / slate	501 - 1000	1959
GW17386 (Spain's Tank)	2.4	100.9	85.3	0.3	58.2*	slate	1001-3000	1960
GW20656 (Back Bore)	1.8	74.1	68.6	1	55.8*	Slate / quartzite	1420	1963
GW20657 (House Bore)	1.5	74.1	59.7	0.4 - 1	52.51	Slate / quartzite	3320 - 3820	1963
WL80BL242084 (TNWB1-Skirka's)	25	85	72 - 76	1.4	63.72	siltstone	4970 - 6480	03/04
WL80BL-TBA (TNWB2)	5	108	88 - 108	2.5	>100 TBA	siltstone	4360 - 6500	09/05
WL80BL-TBA (TNWB3)	6	108	62 - 108	0.6	TBA	siltstone	4310 - 5830	09/05

Note: * bore swl measured at time of installation, all other readings were collected on 9 Sept 2005

TNWB2 and TNWB3 test bore licence applications were submitted to DNR on 18 August 2005

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3.3.1 Skirka's Bore

Skirka's Bore currently has an Industrial and Stock Bore License (80BL 242084) that was issued on 17 February 2004 for an annual extraction limit of 1.5ML/year

3.4 Site Geomorphology

"The Peak" is contained within the Cobar peneplain, which has a general elevation of greater than 250m above mean sea level, reaching a maximum elevation of 519m at Nymagee Trig. Station.

The majority of the area is flat to gently undulating and underlain by rocks of the Cobar Supergroup, particularly the Mouramba Group and parts of the Amphitheatre Group. The basement rocks of the Girilambone Group and marginal parts of the Erimeran Granite are also areas of essentially low relief.

Northeast of Nymagee, the prominent northerly trending range is the highest on the Nymagee 100:000 map sheet and is mainly formed by granite of the Nymagee Igneous Complex. A southern extension is formed from conglomerate of the Burthong Formation and Devonian porphyry intrusives. West and southwest of Nymagee, numerous northerly elongate strike ridges of sandstone and quartzite of the Shume Formation dominate the landscape (MacRae, G.P. 1984).

3.5 Rainfall and Evaporation

The climate in the Nymagee area is semi-arid and characterised by uniform rainfall distribution with a low median annual rainfall (250-500 mm).

Records from Nymagee, indicate median annual rainfalls of 394mm per year, with the 400mm median isohyet passing meridionally through the centre of the Nymagee 1:100,000 sheet with the dominant feature being its low and unreliable rainfall.

January is the hottest month, with the daily maximum varying from 35.0°C at Cobar, 34.1°C at Nyngan and 32.8°C at Condobolin (MacRae, G.P. 1984).

3.6 Surface Hydrology

The area is generally dry, and contains ephemeral creeks that flow during and after flood events. The main watercourses in the study area are Box Creek, which has its headwaters to the south of "The Peak" property, where it flows north. Box Creek then turns to a westerly direction to the west and north of Nymagee and subsequently flows northwest.

The westerly flowing Crowl Creek has its headwaters to the south of "The Peak".

Box Creek joins Crowl Creek to the west of the Nymagee 100:000 sheet and disappears as a soak to the north of Ivanhoe.

Five dams are present in the vicinity of "The Peak" with the approximately 12ML capacity "Spain's Tank" located just off the property to the south and "Mill Tank" further to the south.

"The Peak" contains two unnamed tanks with a storage capacity of approximately 12ML near the house and the 3ML "Small Tank" on the property's western boundary.

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3.7 Regional Geology

The study area is essentially covered by up to approximately 30m of Quaternary alluvium which, from west to east, contains outcrops of the westerly dipping Lower Amphitheatre Group, the Burthong Formation and the overlying Roset Sandstone as shown in Figure 2.

The Quaternary alluvium contains north south oriented palaeochannel sediments along the main creek lines, which have been measured at up to approximately 10m deep in the Hera prospect.

The following geological description of the Hera project area is from (MacRae, G.P. 1984)

Lower Amphitheatre Group (Dal)

The lower Amphitheatre Group is defined as medium-bedded (generally 5 to 30 cm), interbedded fine to medium sandstone and siltstone, with minor interlaminated and interbedded siltstone and fine sandstone at the base. The unit is predominantly turbiditic in character.

The lower Amphitheatre Group conformably overlies and is inferred to interfinger with the Burthong Formation and Roset Sandstone, with the boundary placed at the first interlaminated siltstone and fine sandstone, or massive siltstone.

It is a poorly outcropping zone which is a folded sequence of interbedded sandstones and siltstones with a zone of interlaminated siltstones and lesser sandstone at the base.

South from the vicinity of the Nymagee mine to the southern margin of the sheet it is generally only seen in borrow pits and erosion gullies.

The remainder of the lower Amphitheatre Group comprises interbedded sandstones and siltstones. The sandstones are generally fine grained, but some medium sandstone beds are also present and graded beds are generally medium grained at the base. Sandstone beds vary in thickness from 10 to 30 cm in massive and graded horizons.

The basal lower Amphitheatre Group lacks any ripple cross lamination, in contrast to the Burthong Formation and the thin-bedded parts of the Roset Sandstone. This boundary is not generally exposed.

Burthong Formation (Dob)

The Burthong Formation is a meridional to submeridional-trending unit extending the full length of the Nymagee 1:100,000 sheet. In the north the unit occurs to the east of Nymagee village and outcrop varies from poor to good, with the best exposures being to the southeast of Nymagee and south of Burthong Creek.

The formation is predominantly west to northwest dipping and younging, apart from localized folding in places near the base.

The Burthong Formation varies from basal or near-basal arkosic conglomerate to quartz-lithic medium to very fine grained sandstone and lesser siltstone. Locally quartz-rich sandstone is dominant. The basal part of the formation mainly consists of arkosic granule to pebble conglomerate. Elsewhere the base is marked by siltstone and sandstone with minor arkosic conglomerate lenses.

It is a relatively uniform sequence of silty very fine to medium sandstone to interbedded sandstone and siltstone. Basal or near-basal arkosic conglomerate, quartz-rich medium sandstone, and rhyolitic volcanics are all given member status.

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It contains five members: the Whitlock Conglomerate Member, Kruge Conglomerate Member, Hathaway Conglomerate Member, Dryden Sandstone Member and Guapa Tank Rhyodacite Member.

Distinctive lithologies not given member status but differentiated by letter symbol are tuffs (Dobt), volcanics (Dobv) and arkosic conglomerate (Doba).

Higher in the sequence is a massive, 10m thick bed of quartzo-feldspathic coarse sandstone, while to the north there are crossbedded sandstone lenses similar to the Roset Sandstone. Such sandstone lenses become more common in the upper part of the Burthong Formation in the south and probably indicate a gradual change in sedimentation culminating in the Roset Sandstone.

Volcanics

Several localized volcanic horizons occur within the Burthong Formation as rhyolitic crystal tuffs, vitric tuffs, and lavas, and are mainly restricted to the base of the sequence. To the east of Nymagee, rhyolite lava occurs as a small lens enclosed by tuffaceous fine sandstone.

The Guapa Tank Rhyodacite Member is intercalated with the lower part of the Burthong Formation.

The poorly exposed boundary between the Roset Sandstone and the Burthong Formation is placed where thinly bedded, rippled, fine to very fine sandstones become dominant. The boundary between the Burthong Formation and the lower Amphitheatre Group is poorly exposed, with the boundary placed where ripple cross laminated fine to very fine sandstones of the Burthong Formation are succeeded by massive to finely laminated siltstones and finely inter laminated siltstones and very fine-grained sandstone.

Roset Sandstone (Dor)

The Roset Sandstone comprises two distinct lithofacies -- a thicker bedded, coarse-grained crossbedded and parallel - laminated lithofacies which is interbedded with a thinner bedded, finer grained ripple cross laminated lithofacies.

It crops out poorly around Nymagee and northeast, east, and southeast of "The Peak" property. Outcrop is generally good throughout the distribution of the unit, which generally forms sandstone strike ridges varying from low to moderate hills.

It is a westerly to northwesterly dipping and facing unit of interbedded, thick and thin-bedded medium to very fine grained sandstones with minor siltstone and claystone, and a conglomerate horizon (Wilkerboon Conglomerate Member) in the south. The sandstones are off-white, pale grey and brown in colour, and quartzose to quartz-lithic, but locally somewhat feldspathic, in composition. Silicification is developed in the thick-bedded sandstones.

The formation comprises thick-bedded fine to medium-grained sandstones with crossbedding, parallel-laminations, and minor rippled surfaces interbedded with thin-bedded ripple cross laminated and parallel-laminated fine to very fine grained sandstone. The thin-bedded part of the sequence is similar to the Burthong Formation.

The Roset Sandstone is quite variable in thickness. The lensoidal nature of the sandstone units results in an irregular interfingering boundary with the underlying Burthong Formation. The unit has a minimum thickness of about 20m, just east of the Nymagee

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mine, which probably represents the northern extremity of the Roset Sandstone.

The base and top of the Roset Sandstone are placed at the first and last laterally persistent sandstone bed of 20 cm or greater thickness. This sandstone bed may or may not be part of a thicker sandstone unit.

There is some interfingering with the Burthong Formation due to local lensing of thick-bedded sandstones.

Where the Lower Amphitheatre Group overlies the Roset Sandstone the boundary is placed where finely laminated or massive siltstones and lesser interlaminated siltstones and very fine-grained sandstones overlie thick-bedded sandstones.

3.8 Structural Geology

Two major, generally north-northwesterly trending faults have been identified in the vicinity of the Hera prospect, with the Rookery Fault being a high-angle reverse fault and the Ironbark Fault as shown in Figure 2.

In general, the northwesterly to north-northwesterly trending faults tend to offset other faults on the Nymagee sheet.

Folding generally trends north-northwesterly to northerly. In general, folds on the Nymagee sheet are planar with little or no plunge, and vary from tight to open.

On the Nymagee 1:100,000 sheet, faults and lineaments can be grouped into three sets based on orientation: a northerly to north-northwesterly, east-northeasterly to northeasterly and a west-northwesterly to northwesterly set.

As mentioned previously, the north to north-northwesterly set is represented by two major faults. However, the other two sets are represented by minor inferred faults.

In the northern part of the sheet, three probable splay faults, identified by shearing and the offset of rock units, occur to the east of the Rookery Fault. West of Nymagee, a Landsat lineament aligned subparallel to the Rookery Fault suggests another possible fault.

Movement of the Rookery Fault on the Nymagee sheet is thought to be west-block-up, and the Ironbark Fault, immediately east of the Rookery Fault, is east-block-up, at least in the southern part of the extent of this fault where the porphyry intrusives (Dpa) occur. Movement on the two other faults to the east is probably west-block-up (MacRae, G.P. 1984).

The Rookery fault is interpreted by the Triako geologist (Randell, J pers comm) to be a series of splays / faults which are not easily located on the property and that geophysics may assist in determining its location.

3.9 Study Area Hydrogeology

No major or significant groundwater resource has been utilised in the region, with limited bores intermittently used to supply up to 1.4L/sec from siltstone, schist or slate formations which do not provide a good target for high quality or high flow rate groundwater resources.

There is no groundwater level or quality monitoring data available from the DNR database.

The main water resource in the region is from surface runoff captured in "Turkey's Nest" dams.

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4. FIELD INVESTIGATION PROGRAM

One twenty four hour constant rate drawdown and 24 hour recovery test was conducted on Skirka's Bore at a constant rate of 1.4L/sec between 9 and 11 September 2005.

The test monitored drawdown and recovery in the bore itself, with no piezometers being available for distance / drawdown observation.

The investigation program was conducted as shown in Table 2.

TABLE 2 TEST PARAMETERS

	Skirka's Bore
Pre test SWL	63.72 mbgl
SWL after 24 hours	72.16 mbgl
Recovery after 24 hours	to 65.17 mbgl
Extraction rate	1.38 L/sec
Pump depth	N.A.
Total well depth	85 mbgl
Bore Diameter	150mm
Test Pump	Submersible

Monitoring of groundwater levels in the bore was conducted as shown in Appendix A.

4.1 Water Chemistry

Samples of the extracted water from Skirka's Bore were collected and analysed for field pH and EC as the pump out test progressed.

Prior to the test, "Skirka's", "Back" and "House" bores were bailed and the samples analysed in a NATA approved laboratory, whilst samples were also collected at the end of drilling TNWB2 and TNWB3 as shown in Table 3, Table 4 and Appendix C.

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TABLE 3 BORE WATER CHEMISTRY – Major Ions (mg/L)

Bore	pH	EC uS/cm	TDS	Na	Ca	K	Mg	Cl	F	NO3	SO4	HCO3	Tot P
Skirka's (June 05)	7.16	4970	3875*	631	235	26	270	1580	–	–	–	383	–
Back (June 05)	7.21	1420	1105*	163	36	8	39	192	–	–	–	375	–
House (June 05)	7.40	3320	2590*	537	41	25	70	917	–	–	–	420	–
TNWB2	8.11	4360	3380	803	96	35	179	1650	1.2	0.533	752	–	0.04
TNWB3	7.01	4310	3400	626	149	30	207	1780	0.4	0.036	446	–	0.10
ANZECC (sheep)	6.5 – 8.0*	125-2200*	5000	–	1000	–	–	–	–	400	1000	–	0.005*

Note: * ANZECC 2000 default trigger values (SE Australian Lowland River)

* TDS calculated from EC

TABLE 4 BORE WATER CHEMISTRY – Major Metals (mg/L)

Bore	Cu	Pb	Zn	Cd	Fe	Fe ²⁺	Sb	As	Cd	Cr	Co	Ni	Se
Skirka's (June 05)	0.005	<0.001	0.019	<0.0001	–	–	<0.001	0.001	<0.0001	<0.001	0.003	0.023	<0.01
Back (June 05)	<0.001	<0.001	0.02	0.0002	–	–	<0.001	0.002	0.0002	<0.001	<0.001	<0.001	<0.01
House (June 05)	0.004	0.002	0.013	<0.0001	–	–	<0.001	0.002	<0.0001	<0.001	<0.001	0.002	<0.01
TNWB2	0.008	0.011	0.037	0.0008	0.23	<0.05	0.148	0.003	0.0008	<0.001	–	0.036	<0.01
TNWB3	0.008	0.003	0.067	0.0008	0.10	0.17	<0.001	<0.001	0.0008	<0.001	–	0.008	<0.01
ANZECC (sheep)	0.4	0.1	20	0.01	–	–	–	0.5	0.01	1	1	1	0.02

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5. DATA INTERPRETATION

5.1 Regional Hydrogeology

Based on DNR groundwater bore data within or near to "The Peak", the siltstones and sandstones of the Lower Amphitheatre Group in the west and Burthong Formation in the east provide a minor groundwater source from low yielding basement aquifers for limited stock and domestic use.

The subject area has a variable depth of alluvium / colluvium which can be up to 10m deep.

The nearest extraction point to Skirka's Bore (which is not on "The Peak") is GW17385 at approximately 2.5km to the north. The next nearest registered extraction point is GW17386 at approximately 3km to the south as shown in **Figure 1**.

Recently measured standing water levels and historic DNR data indicates groundwater levels in the vicinity range from 46m to 63.72m below surface.

Published and investigated data for the regional bores indicates yields range from 0.25L/sec to 2.5L/sec.

5.2 Regional Groundwater Flow

Groundwater is anticipated to have a low gradient regional flow pattern from southeast to northwest in sympathy with the regional ground elevations.

5.3 Pump Out Test

Drawdown in Skirka's Bore gradually progressed from 63.72mbgl to around 64.9mbgl as "free" water was drawn from the well casing, before asymptotically flattening out to a final level of 72.16mbgl after 24 hours pumping.

Recovery was initially relatively gradual then flattened out to end at 64.74mgl after 24 hours, indicating 1.02m of dewatering had occurred due to the pumping.

5.4 Aquifer Transmissivity and Storativity

Assessment of the bore's hydraulic parameters was conducted using the "Jacob Straight Line Analysis" method using the mid to late stage drawdown and recovery data between 100 and 1000 minutes from data plotted on a semi logarithmic plot of drawdown or recovery versus time as shown in **Appendix B**.

As there were no observation piezometers or wells used in the test, it was not possible to derive the unconfined aquifer's storativity, however it has been derived from standard published data for siltstones (Driscoll, F.G 1995) as shown in **Table 5**.

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TABLE 5 PUMP TEST RESULTS

STAGE	Time Period (mins)	TRANSMISSIVITY (m ² /day)	STORATIVITY*
DRAWDOWN	10 - 100	10.4	10 ⁻⁵
	100 - 1000	5.9	10 ⁻⁵
RECOVERY	10 - 100	27.3	-
	100 - 1000	4.2	-

NOTE: Storativity estimated from published data

5.5 Groundwater Yield

The pumping tests indicated a low groundwater yield for the pumped bore, with the drawdown able to be sustained significantly beyond the 24 hour test period.

Based on interpretation of the test data, it is estimated that a flow of approximately 1.5L/sec could be obtained for extended periods on the assumption that barrier conditions are not encountered and interference effects from other bores or the proposed underground workings are not significant.

5.6 Extraction Area of Influence and Potential Impact on Nearby Bores

At present, properties to the north and south of "The Peak" do not regularly use or rely on groundwater for use on their land.

The potential extraction area of influence for each well has been calculated using the non-equilibrium well equation with results shown in Table 6 calculated using the average drawdown transmissivity test flow rates and derived parameters for the bore, assuming pumping extends for 24 hours a day for 4 months.

TABLE 6 POTENTIAL GROUNDWATER DRAWDOWN

Distance From Skirka's Bore (m)	Drawdown (m)
2000	5.03
3000	4.01

The data indicates that the proposed extraction at the test flow rate is sustainable and is not anticipated to have significant adverse effects on nearby bores over an extended period, on the basis there are no significant interference effects between the bore and surrounding bores or the proposed workings and no barrier boundary effects.

The actual drawdown will depend on the duration and regularity of pumping.

In order to analytically interpret the test pumping results, it is necessary to assume that the aquifer;

- is uniform and the hydraulic conductivity is the same in all directions
- has uniform thickness and infinite areal extent
- receives no recharge, and that

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- the pumped bore / well penetrates and receives water from the full thickness of the aquifer
- water in the aquifer is instantaneously released under pumping
- the bore / well is 100% efficient
- all water pumped from the bore comes from aquifer storage
- laminar flow exists in the well / bore and aquifer, and
- the water table has no slope

In reality, it is not likely that all the above assumptions are correct, and therefore the analytical interpretation should be regraded as indicative only and should not be taken to indicate the actual conditions that will be encountered during pumping.

Long term groundwater extraction will respond to;

- the regional nature of the aquifer
- bore efficiency
- changes in water levels due to seasonal recharge effects, and
- regional groundwater extraction in the subject aquifer

Operation of Skirka's Bore will draw down the regional piezometric surface during extraction, however due to the observed test recovery data, water levels are anticipated to return to at or near their original levels on the assumption that a sustainable extraction rate is used and the drawdown is regularly monitored.

5.7 Groundwater Chemistry

No regional data on alluvial groundwater salinity or pH is available from the DNR data base.

5.7.1 Salinity and Major Ions

The bore water was measured by field meters and laboratory analysis to have a salinity between 4970uS/cm and 6480uS/cm, which exceeds the ANZECC 2000 SE Australian Lowland Freshwater River guidelines, but not the ANZECC Primary Industry (sheep) criteria.

Only total phosphorous exceeds the ANZECC 2000 SE Australian Lowland River criteria in two exploration bores outside of Skirka's Bore, however as there are no major water courses in the area and these bores are not proposed to be pumped at this stage, this is not significant.

5.7.2 pH

Groundwater pH ranged from 6.20 to 7.16, which is within the SE Australian Lowland River guidelines.

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5.7.3 Metals

No metal analyses exceeds the ANZECC 2000 criteria for Primary Industry (sheep).

5.8 Potential Impact of Extraction on Groundwater Dependent Ecosystems

As there are no known groundwater dependent ecosystems in the vicinity of "The Peak" and it is not anticipated there will be any adverse effect on potential groundwater dependent ecosystems through extraction from Skirka's Bore.

6. CONCLUSIONS

The study site is contained within the low yielding, steeply dipping siltstones of the Lower Amphitheatre Group, with two privately owned, DNR registered bores that are not owned by Triako Resources Ltd located within 5km of the subject wells.

Based on a 24 hour extraction test, the proposed total extraction of 1.5L/sec from Skirka's Bore for 24 hours a day over 4 months from the Lower Amphitheatre Group siltstone is considered potentially sustainable on the basis of the assumptions outlined in the report, and is not anticipated to adversely affect the adjoining groundwater users or groundwater dependent ecosystems of the local area.

Approximately 1.45m of dewatering was indicated after 24 hours of pumping and 24 hours of recovery.

At the proposed 1.5L/sec pumping rate and proposed 4 month pumping duration, between 4.0m and 5.0m of drawdown may be noted in bores up to 3km from Skirka's Bore, with the nearest bore located at approximately 2.5km to the north of the bore.

Skirka's Bore groundwater quality does not conform to the ANZECC 2000 Lowland River criteria for salinity, however it does conform to the ANZECC 2000 Primary Industry (sheep) criteria.

The water should not be allowed to enter surface water stream systems.

7. WATER MANAGEMENT, MONITORING, REPORTING AND CONTINGENCY PLANS

It is recommended that monthly water level monitoring is conducted on Skirka's Bore along with weekly water level monitoring of the "Back" and "House" bores on "The Peak" property to enable measurement of the ongoing response to pumping Skirka's Bore as well as seasonal and rainfall / recharge relationships to groundwater level.

Salinity and pH of the groundwater in Skirka's Bore should be monitored every three months with a hand held electrolytical conductivity and pH meter in the field, or through laboratory analysis.

Water levels in all monitored bores should be recorded after each monitoring event and kept in a central registry at the Triako Resources Ltd field office.

Extraction from Skirka's Bore should conform to the current NSW State Groundwater policies and legislation, which in essence outline that the groundwater resource shall be managed in order to sustain the environmental, social and economic uses for the people

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of NSW.

No disposal of waste water should occur into the local streams.

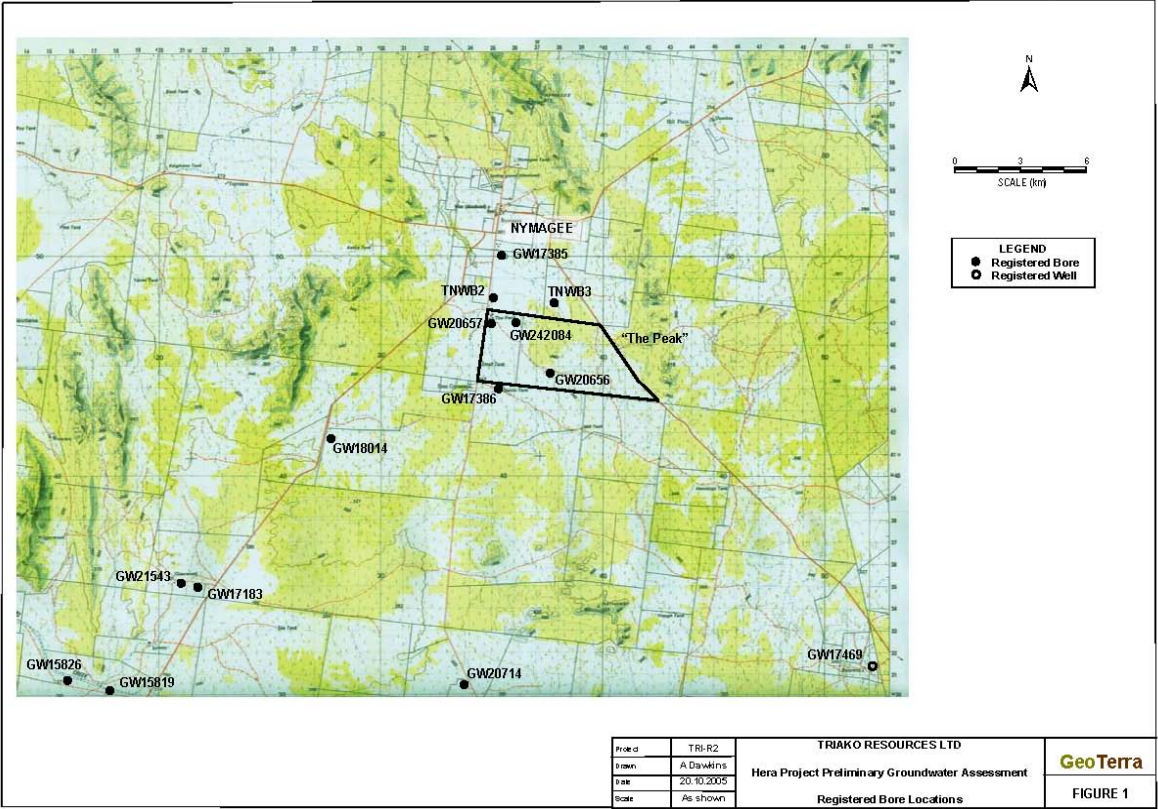
8. REFERENCES

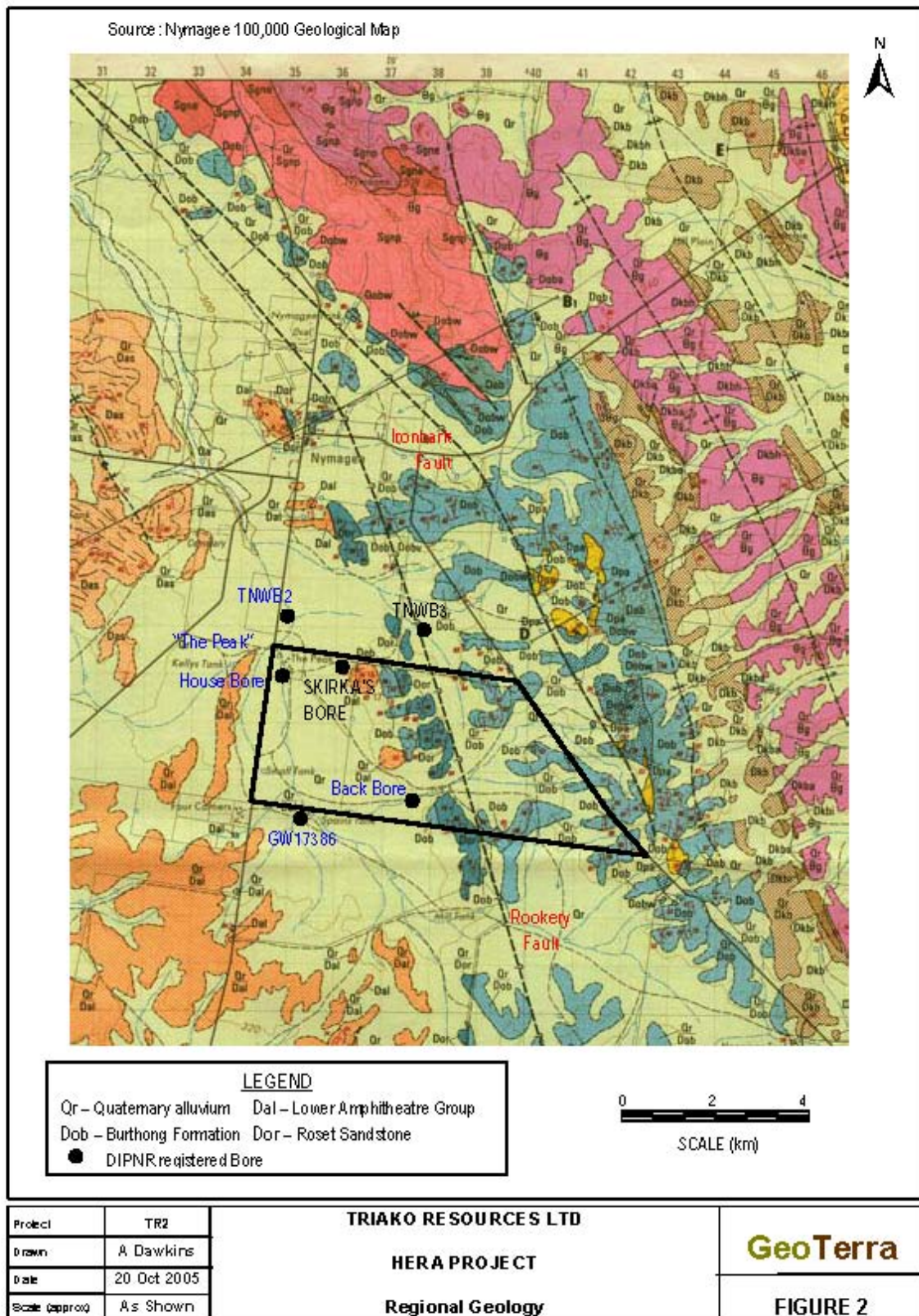
- Driscoll, F.G. 1995 Groundwater and Wells, Second Edition, Johnson Screens
Triako, 2005 Hera Deposit Water Search, internal memorandum (16 June 2005)

LIMITATIONS

This report was prepared in accordance with the scope of services set out in the contract between Geoterra and the client, or where no contract has been finalised, the proposal agreed to by the client. To the best of our knowledge the report presented herein accurately reflects the client's requirements when it was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. Assessment of aquifer characteristics in this report are made based on limited data, and actual subsurface conditions may differ substantially from those assessed. Conclusions and recommendations in the report are based on extrapolations from limited data and no responsibility can be accepted for limitations to pumping periods and/or yields encountered under conditions that differ from those assessed. In preparing this report, Geoterra has relied upon information and documentation provided by the client and / or third parties. Geoterra did not attempt to independently verify the accuracy or completeness of that information. To the extent that the conclusions and recommendations in this report are based in whole or in part on such information, they are contingent on its validity. Geoterra assume the client will make their own enquiries in regard to conclusions and recommendations made in this document.

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APPENDIX A

DNR BORE SEARCH RESULTS

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	E	N	Depth	Aquifer	SWL	Yield	Alluvium	Lithol.	EC	Purpose	Property	License	Date	Name	An. Vol
"Peak"				Mbgl		L/sec						80BL			
20656	437981	6444615	74.1	68.6	62	0.63	1.83	Slate	1001 - 3000	stock	The Peak	13602	1963	Back	
20657	434839	6447103	74.1	59.7	54.3	0.63	1.52	slate	good	Dom / Stk	The Peak	13603	1963	House	
42084	435993	6444783	85	72-76	65	1.1	25	siltstone		Ind / stock	(Hay)	242084	2004	Skirka	1.5ML
REGIONAL															
15819	417446	6430657	25.9												1958
15820	416205	6430742	50.3							stock	Lowan	9580	1958		
17183	421561	6435084	91.4	36 / 84	48.8	0.1 / 0.63		Sast/slate	>14000	stock	Glenwood	7830	1958		
17385	435477	6449403	61	19 / 53	46.6	0.51		slate	501 - 1000	stock	Kenmure	9246	1959		
17386	435452	6444083	100.9	85.3	58.2	0.25	2.44	slate	1001 - 3000	stock	Kenmure	9245	1960		
18014	427473	6441624	82.9	70.1	15.2	0.51		Quartzite	3001-7000	stock	4 Corners	10154	1960		
20714	433835	6430411	110.3	42.7 / 106.7	36.6	0.1 / 0.11		quartzite	salty	stock	Vauckse	13477	1963		
21543	420737	6435232	75.6	48.8 / 67.1	45.7	0.08 / 0.51		slate	>14000	stock	Glenwood	13899	1963		
TNWB2			108	88 - 108		2.5	5	Siltstone	4360 - 6500	Explor					2005
TNWB3			108	62 - 108		0.6	6	Siltstone	4310 - 5830	explor					2005
WELLS															
17469	452069	6431168	4.6	1.5 - 2.1				alluvium	good	Dom.	Balowra	8351			

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APPENDIX B

PUMPING TEST RESULTS

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			0.41 m bgl	s/up mbtoc	DDWN m AHD			mm	mm
			Skirkas	Skirkas	Skirkas	mins	cum min	cum dwn	incrmtl ddwn
7/9/05	13.200	0.1	-63.72	64.13	306.03	0.0	0.1	0.01	0
	13.205	0.6	-64.06	64.47		0.5	0.6	-0.33	-0.34
	13.210	1.6	-64.27	64.68		1.0	1.6	-0.54	-0.21
	13.220	2.6	-64.44	64.85		1.0	2.6	-0.71	-0.17
	13.300	3.6	-64.66	65.07		1.0	3.6	-0.93	-0.22
	13.240	4.6	-64.77	65.18		1.0	4.6	-1.04	-0.11
	13.250	5.6	-64.89	65.30		1.0	5.6	-1.16	-0.12
	13.260	6.6	-65.02	65.43		1.0	6.6	-1.29	-0.13
	13.280	7.6	-65.24	65.65		1.0	7.6	-1.51	-0.22
	13.290	8.6	-65.34	65.75		1.0	8.6	-1.61	-0.10
	13.300	9.6	-65.43	65.84		1.0	9.6	-1.70	-0.09
	13.350	14.6	-65.80	66.21		5.0	14.6	-2.07	-0.37
	13.400	19.6	-66.11	66.52		5.0	19.6	-2.38	-0.31
	13.450	24.6	-66.34	66.75		5.0	24.6	-2.61	-0.23
	13.500	29.6	-66.56	66.97		5.0	29.6	-2.83	-0.22
	14.150	54.6	-67.35	67.76		25.0	54.6	-3.62	-0.79
	14.260	120.6	-67.62	68.03		66.0	120.6	-3.89	-0.27
	14.410	135.6	-67.83	68.24		15.0	135.6	-4.10	-0.21
	16.020	297.6	-69.01	69.42		162.0	297.6	-5.28	-1.18
	16.550	350.6	-69.52	69.93		53.0	350.6	-5.79	-0.51
	17.570	412.6	-69.97	70.38		62.0	412.6	-6.24	-0.45
	19.570	532.6	-70.23	70.64		120.0	532.6	-6.50	-0.26
	23.550	772.6	-70.76	71.17		240.0	772.6	-7.03	-0.53
8/9/05	6.020	1139.6	-71.59	72.00		367.0	1139.6	-7.86	-0.83
	7.550	1252.6	-71.80	72.21		113.0	1252.6	-8.07	-0.21
	10.150	1392.6	-71.98	72.39		140.0	1392.6	-8.25	-0.18
	12.300	1527.6	-72.08	72.49		135.0	1527.6	-8.35	-0.10
	16.150	1752.6	-72.16	72.57		225.0	1752.6	-8.43	-0.08

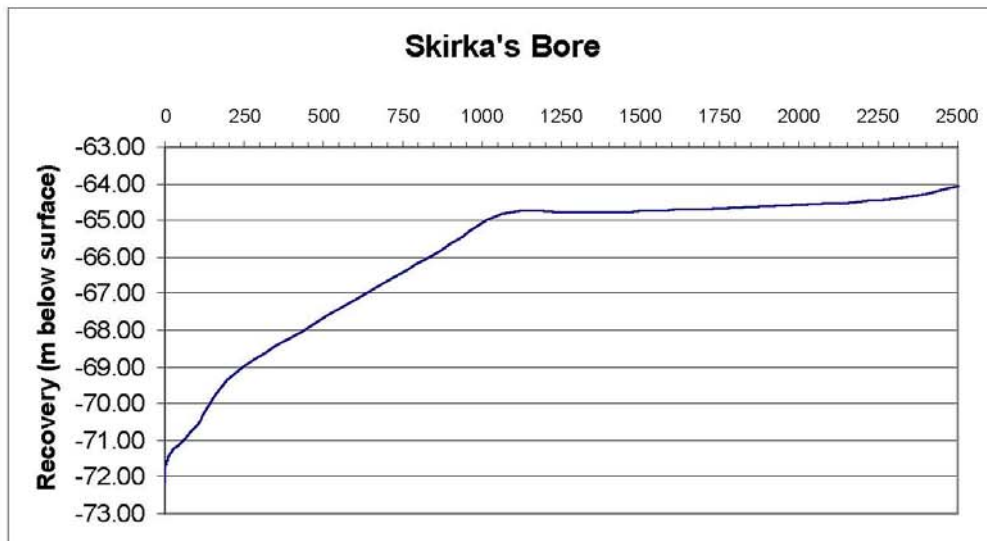
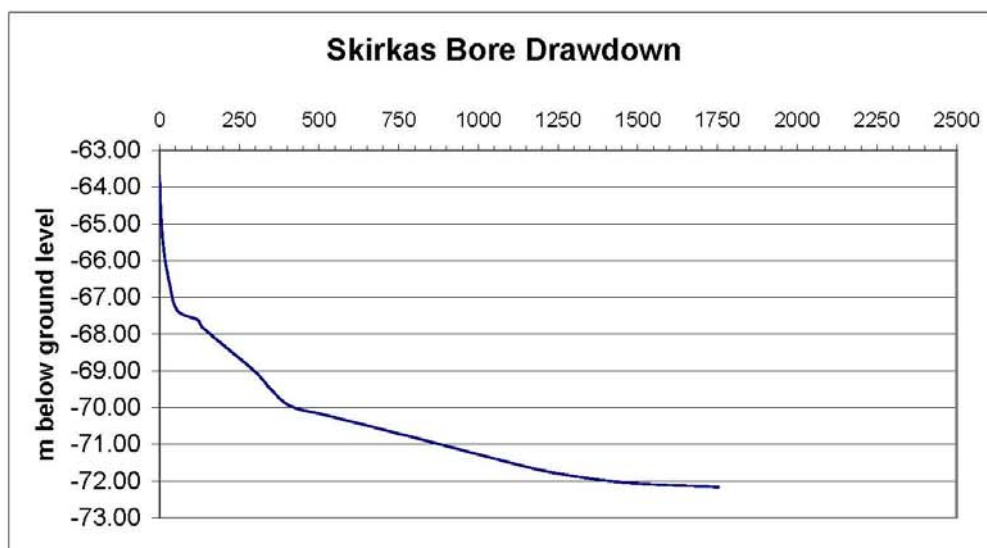
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			m bgl	mbtoc	m AHD	RECOV.			
			Skirka's	Skirka's	Skirka's	mins		cum recov	incrmtl recov
8/9/05	16.150	0.0	-72.16	72.57	297.59	0.0	0.0	0.01	0.01
	16.160	1.0	-71.88	72.29		1.0	1.0	-0.27	-0.28
	16.170	2.0	-71.77	72.18		1.0	2.0	-0.38	-0.11
	16.210	6.0	-71.64	72.05		4.0	6.0	-0.51	-0.13
	16.220	7.0	-71.60	72.01		1.0	7.0	-0.55	-0.04
	16.230	8.0	-71.57	71.98		1.0	8.0	-0.58	-0.03
	16.240	9.0	-71.54	71.95		1.0	9.0	-0.61	-0.03
	16.250	10.0	-71.51	71.92		1.0	10.0	-0.64	-0.03
	16.260	11.0	-71.49	71.90		1.0	11.0	-0.66	-0.02
	16.270	12.0	-71.46	71.87		1.0	12.0	-0.69	-0.03
	16.280	13.0	-71.44	71.85		1.0	13.0	-0.71	-0.02
	16.290	14.0	-71.42	71.83		1.0	14.0	-0.73	-0.02
	16.300	15.0	-71.41	71.82		1.0	15.0	-0.74	-0.01
	16.350	20.0	-71.34	71.75		5.0	20.0	-0.81	-0.07
	16.400	25.0	-71.26	71.67		5.0	25.0	-0.89	-0.08
	16.450	30.0	-71.20	71.61		5.0	30.0	-0.95	-0.06
	18.000	105.0	-70.59	71.00		75.0	105.0	-1.56	-0.61
10/9/05	20.000	225.0	-69.14	69.55		120.0	225.0	-3.01	-1.45
	6.000	825.0	-66.07	66.48		600.0	825.0	-6.08	-3.07
	10.000	1065.0	-64.81	65.22		240.0	1065.0	-7.34	-1.26
	14.000	1305.0	-64.76	65.17		240.0	1305.0	-7.39	-0.05
11/9/05	18.000	1545.0	-64.72	65.13		240.0	1545.0	-7.43	-0.04
	6.000	2265.0	-64.42	64.83		720.0	2265.0	-7.73	-0.30
	10.000	2505.0	-64.07	64.48		240.0	2505.0	-8.08	-0.35

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APPENDIX C

LABORATORY ANALYSES

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Matrix:	WATER	REG	REG	REG
Workorder:	ES0504406	1	2	3
Project name/number:		B1	B2	B3
Project site:		Skirkas	Back	House
Purchase order number:		31/05/2005	31/05/2005	31/05/2005

Analyte grouping / Analyte	CAS Number	Units	LOR			
Chloride	16887-00-6	mg/L	1	1630	128	997
Calcium	7440-70-2	mg/L	1	234	29	44
Magnesium	7439-95-4	mg/L	1	274	32	77
Sodium	7440-23-5	mg/L	1	646	144	588
Potassium	7109/7440	mg/L	1	31	9	32
Antimony	7440-36-0	mg/L	0.001	0.003	<0.001	<0.001
Arsenic	7440-38-2	mg/L	0.001	0.035	0.001	0.002
Bismuth	7440-69-9	mg/L	0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	0.0001	0.0013
Chromium	7440-47-3	mg/L	0.001	0.007	<0.001	<0.001
Cobalt	7440-48-4	mg/L	0.001	0.004	<0.001	<0.001
Copper	7440-50-8	mg/L	0.001	0.026	0.001	0.004
Lead	7439-92-1	mg/L	0.001	0.045	<0.001	0.001
Nickel	7440-02-0	mg/L	0.001	0.035	<0.001	0.002
Selenium	7782-49-2	mg/L	0.01	<0.010	<0.010	<0.010
Silver	7440-22-4	mg/L	0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	mg/L	0.005	0.359	0.022	0.014
Gold	7440-57-5	mg/L	0.001	<0.001	<0.001	<0.001
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001

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Matrix:	WATER	REG	REG	REG
Workorder:	ES0504822	3	4	5
Project name/number:		NB1	NB2	NB3
Project site:		Skirka's	Back	House
Purchase order number:		14/06/2005	14/06/2005	14/06/2005

Analyte grouping /	CAS	Units	LOR			
Analyte	Number					
Chloride	16887-00-6	mg/L	1	1580	192	917
Calcium	7440-70-2	mg/L	1	235	36	41
Magnesium	7439-95-4	mg/L	1	270	39	70
Sodium	7440-23-5	mg/L	1	631	163	537
Potassium	7709/7440	mg/L	1	26	8	25
Antimony	7440-36-0	mg/L	0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	mg/L	0.001	0.001	0.002	0.002
Bismuth	7440-69-9	mg/L	0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	0.0002	<0.0001
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	mg/L	0.001	0.003	<0.001	<0.001
Copper	7440-50-8	mg/L	0.001	0.005	<0.001	0.004
Lead	7439-92-1	mg/L	0.001	<0.001	<0.001	0.002
Nickel	7440-02-0	mg/L	0.001	0.023	<0.001	0.002
Selenium	7782-49-2	mg/L	0.01	<0.010	<0.010	<0.010
Silver	7440-22-4	mg/L	0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	mg/L	0.005	0.019	0.02	0.013
Gold	7440-57-5	mg/L	0.001	<0.001	<0.001	<0.001
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001	<0.0001

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Matrix:	WATER			REG	REG
Workorder:	ES0508144			1	2
Project name/number:	TR2			WBT2	WBT3
Purchase order number:				27/09/2005	27/09/2005
EA005: pH					
pH Value	12408-02-5	pH Unit	0.01	8.11	7.01
EA010P: Conductivity by PC Titrator					
Electrical Conductivity @ 25°C		µS/cm	1	4360	4310
EA015: Total Dissolved Solids					
Total Dissolved Solids @180°C	GIS-210-010	mg/L	1	3380	3400
ED040F: Dissolved Major Anions					
Sulphate as SO4 2-	14808-79-8	mg/L	1	752	446
ED045G: Chloride Discrete analyser					
Chloride	16887-00-6	mg/L	1	1650	1780
ED093F: Dissolved Major Cations					
Calcium	7440-70-2	mg/L	1	96	149
Magnesium	7439-95-4	mg/L	1	179	207
Sodium	7440-23-5	mg/L	1	803	626
Potassium	7709/7440	mg/L	1	35	30
EG020T: Total Metals by ICP-MS					
Antimony	7440-36-0	mg/L	0.001	0.148	<0.001
Arsenic	7440-38-2	mg/L	0.001	0.003	<0.001
Bismuth	7440-69-9	mg/L	0.001	<0.001	<0.001
Cadmium	7440-43-9	mg/L	0.0001	0.0008	0.0008
Chromium	7440-47-3	mg/L	0.001	<0.001	<0.001
Copper	7440-50-8	mg/L	0.001	0.008	0.008
Lead	7439-92-1	mg/L	0.001	0.011	0.003
Manganese	7439-96-5	mg/L	0.001	0.006	0.074
Nickel	7440-02-0	mg/L	0.001	0.036	0.008
Selenium	7782-49-2	mg/L	0.01	<0.010	<0.010
Silver	7440-22-4	mg/L	0.001	<0.001	<0.001
Zinc	7440-66-6	mg/L	0.005	0.037	0.067
Iron	7439-89-6	mg/L	0.05	0.23	0.1
Gold	7440-57-5	mg/L	0.001	<0.001	<0.001
EG035T: Total Mercury by FIMS					
Mercury	7439-97-6	mg/L	0.0001	<0.0001	<0.0001
EG051G: Ferrous Iron by Discrete Analyser					
Ferrous Iron		mg/L	0.05	<0.05	0.17
EK040P: Fluoride by PC Titrator					
Fluoride	16984-48-8	mg/L	0.1	1.2	0.4
EK057G: Nitrite as N by Discrete Analyser					
Nitrite as N		mg/L	0.01	0.013	<0.010
EK058G: Nitrate as N by Discrete Analyser					
Nitrate as N	14797-55-8	mg/L	0.01	0.533	0.036
EK059G: NOX as N by Discrete Analyser					
Nitrite + Nitrate as N		mg/L	0.01	0.546	0.036
EK067G: Total Phosphorous-As P by Discrete Analyser					
Total Phosphorus as P		mg/L	0.01	0.04	0.1



TRIAKO RESOURCES LTD
HERA PROJECT
GROUNDWATER STATUS REPORT
Nymagee, NSW

TR4-R1
31 MAY, 2006

GeoTerra Pty Ltd ABN 82 117 674 941

77 Abergeldie Street Dulwich Hill NSW 2203

Phone: 02 9560 6583 Fax: 02 9560 6584 Mobile: 0417 003 502 Email: geoterra@iinet.net.au

TR4-R1 (31 May, 2006)

GeoTerra

Triako Resources Ltd
PO Box 1048
NORTH SYDNEY NSW 2060

Attention: Peter Ingham

Peter,

RE: HERA PROJECT GROUNDWATER STATUS REPORT

Please find enclosed a copy of the above mentioned report.

Yours Faithfully

GeoTerra PTY LTD



Andrew Dawkins

Managing Geoscientist (MAusIMM CP-Enviro)

Distribution:	Original	Geoterra Pty Ltd
	1 electronic copy	Triako Resources Ltd (Sydney Office)
	1 electronic copy	Triako Resources Ltd (Hera Project Site)

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1. INTRODUCTION

This document provides a status report on groundwater related issues at the Hera Project following field work conducted by Andrew Dawkins of Geoterra between 12 and 14 May, 2006, as well as field work conducted by Triako field staff to May 31, 2006.

The report outlines groundwater related activities that have occurred since our last report on Skirka's Bore (TR2-R1A – 25 Oct. 2005)

2. OVERVIEW OF ACTIVITIES

Since October 2005 the following groundwater related activities have occurred at Hera;

- Application to the Department of Natural Resources (DNR) for an 18.5 ML/year production bore licence at Skirka's Bore
- Application to DNR for Test Monitoring Bore Licences (TNYWB02 and 03) on 12 August 2005
- Submission of "Form A" bore completion details for TNYWB02 and TNYWB03 to the DNR on 25 October 2005
- Commencement of groundwater level monitoring in the Back Bore and House Bore on 25 October 2005 followed by Skirka's Bore (6 Jan. 2006) TNYWB2 (4 Feb. 2006) and TNYWB3 (6 March 2006)
- Drilling of groundwater test bores TNYWB4 (to 120m) and TNYWB5 (to 150m) on "The Peak" property in mid April 2006, followed by installation of 50mm Class 9 PVC piezometers and groundwater level monitoring to May 31, 2006
- Collapse of the pump assembly in the "Back Bore" in early March 2006
- Site visit by Andrew Dawkins and redrilling of a replacement "Back Bore" between 12 and 14 May, 2006

The current status of groundwater bores and piezometers relevant to the Hera Project is summarised in **Table 1**.

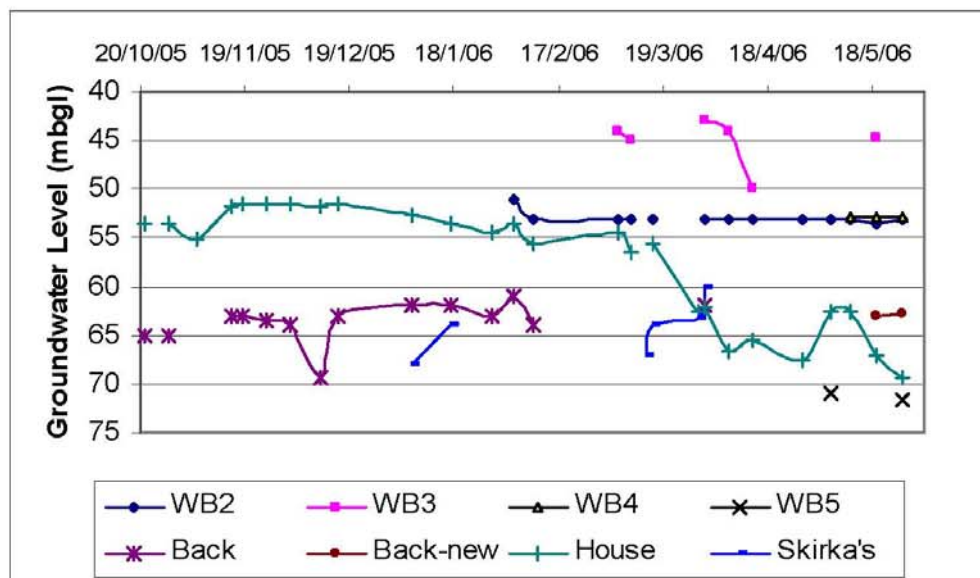
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TABLE 1 HERA GROUNDWATER BORE SUMMARY

Bore	Alluvium mbgl	Total Depth m	First Aquifer mbgl	Yield L/sec	SWL mbgl Range To 31 May 2006	Lithology	EC μ S/cm	pH	Date
GW17385	1	61	19 - 53	0.51	46.60 – 52.0*	Schist / slate	501 - 1000	-	1959
GW17386 (Spain's Tank)	2.4	100.9	85.3	0.3	58.20*	Slate	1001-3000	-	1960
GW20656 (Back Bore)	1.8	74.1	68.6	1	61.00 - 69.45	Slate / quartzite	1420	7.21	1963
Back Bore (new)	0.5	121	88.5	6	62.80 - 63.06	Siltst / limon. fine sandstone	4140	7.52	05/06
GW20657 (House Bore)	1.5	74.1	59.7	0.4 - 1	51.54 - 69.35	Slate / quartzite	3320 - 3820	7.40	1963
(Skirka's)	25	85	72	1.4	60.00 – 68.00	Siltstone	4970 - 6480	7.16	03/04
TNYWB2	8	108	88	2.5	51.00 - 53.60	Siltstone	4360 - 6500	8.11	09/05
TNYWB3	6	108	62	0.6	43.00 – 50.00	Siltstone	4310 - 5830	7.01	09/05
TNYWB4	-	120	78	0.08	52.77 – 52.84	Siltstone	-	-	04/06
TNYWB5	-	150	96	1.5	71.00 – 71.52	Siltstone	-	-	04/06

Note: * bore swl from DNR database



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3. STATUS REPORTS

3.1 Skirka's Bore

An application for a 47.5ML/year production bore licence was submitted on 25 October 2005 to Edwina Carter at the DNR Dubbo office, which was modified to 18.5ML/year on 2 March 2006 following advice that applications over 19ML/year required significantly more time to review and additional processes to be approved.

The application has been very slow to be processed by the DNR, and has been chased on numerous occasions between 2 March and May 31 2006.

To date, the application has not been licensed, and the DNR is not indicating when it will be processed.

3.2 TNYWB2 and TNYWB3

Test monitoring bore applications were despatched to Edwina Carter at the DNR on 12 August 2005, with TNYWB3 drilling supervised by Geoterra and completed by September 10 2005. The DNR completion forms (Form A) were despatched to DNR on 25 October 2005.

TNYWB2 was drilled by RC on 20 August 2005 and supervised by Triako field staff.

The DNR had not processed both applications by 8 May 2006, and when chased, indicated they could not find the applications, which had been officially received by them on 18 August 2005.

On resending the applications, the DNR indicated a letter of "permissive occupancy" was required by the landowners, and these were despatched to DNR by Triako on 18 May 2006.

Final processing of the applications is pending as of 31 May 2006.

3.3 TNYWB4 and TNYWB5

Two additional RC groundwater test bores were drilled under Triako supervision in mid April 2005, with TNYWB4 drilled to 120m with a maximum flow of 0.08L/sec and TNYWB5 drilled to 150m with a maximum flow of 1.5L/sec.

The first water flow was recorded at 78m in TNYWB4 (with 0.1L/sec at 102m) and at 96m in TNYWB5 (with 1.5L/sec at 108m) using the reverse circulation drilling method.

At the time of Geoterra's field inspection, TNYWB5 had collapsed.

3.4 Back Bore

The pump assembly in the Back Bore fell into the bore in early March 2006, which could not be retrieved and the bore was abandoned.

A 10" replacement bore was drilled approximately 10m north of the old bore to 121m depth, which was cased to 116m below surface as the bottom 4.8m of the open hole was filled with collapsed material.

Groundwater flow in the new bore was airlift tested at approximately 6L/sec, whilst the old "Back Bore" flowed at 1L/sec.

Water quality of the new bore has similar pH (old 7.21, new 7.52) however the salinity is higher in the replacement bore (1420µS/cm - old, 4140µS/cm - new).

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3.5 Groundwater Levels and Piezometer Installation

Manual groundwater level monitoring has been incrementally started on "The Peak" and two northern bores (TNYWB2, 3) since 21 October 2005.

During the Geoterra site visit, it was established that TNYWB3 had not been recently monitored due to a locked gate and that TNYWB5 had not been cased after drilling and had collapsed.

In addition, water levels were being monitored to the nearest metre, and it was requested that the level be recorded to the nearest centimetre.

A 50mm Class 9PVC piezometer with the bottom 10m slotted (110 -120mbgl) and sand pack was installed in TNYWB4 on 25 May 2006.

During cleaning out the collapsed bore in TNYWB5, HQ rods were dropped down the hole between 150mbgl and 90mbgl. As a result, Class 9, 50mm PVC casing with the bottom 10m slotted could only be installed between surface and the top of the rods.

3.6 Water Level Loggers

A 5m sensitivity water level transducer / logger was installed in TNYWB2 on 13 May 2006.

Water level loggers have been despatched to site for installation by site staff in the new Back Bore and piezometer TNYWB4.

Loggers are not installed in Skirka's or the House Bore as there is a high potential for the logger assemblies to become caught in the bore.

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4. RECOMMENDED ACTIONS

4.1 Skirka's Bore

Progress of the DNR application should be chased up as the DNR is not progressing the application.

A logger / transducer assembly should be placed in Skirka's Bore following installation of a black irrigation poly pipe with a minimum internal diameter of 40mm in the bore when the assembly is next taken out and replaced.

Weekly manual dipmeter readings of standing water levels in the bore should continue until that time.

4.2 TNYWB2 and TNYWB3

The test monitoring bore applications should be chased up as the DNR has not completed their processing of the applications.

4.3 TNYWB4 and TNYWB5

Test monitoring bore applications and Form A's should be completed for the two bores.

In order to achieve this, the drilling and water intersection records should be despatched to Geoterra for completion and despatch of the relevant forms to the DNR.

4.4 Back Bore

The store pump assembly should be replaced to a minimum depth of 80m.

It is important to ensure that a black poly irrigation pipe be installed along with the pump assembly that is suitable for a 40mm water level logger to be installed inside the bore casing. This tube will allow the installation and safe retrieval of the logger instrumentation.

When a production bore licence suitable for the new higher 6L/sec flow rate is required, an application should be sent to the DNR for the required annual water volume. In order to complete the production bore application, a minimum 24 hour pump out test and accompanying hydrogeological report will be required for the DNR to process the licence.

To assist granting the licence, it will be important to provide regional groundwater level monitoring data to enable assessment of the regional drawdown effects from the pumped bores (Back, House, Skirka's).

In addition, records should be kept of both the operation time and duration of all three pumps so that an interpretation of pumping influence on water levels can be determined.

4.5 Groundwater Level Monitoring

In order to assist with future production bore licences and to provide suitable groundwater water level monitoring data for EIS assessment, it is important that the current weekly manual monitoring be continued with groundwater levels read in all bores.

In addition, it is recommended that bores to the south and north of "The Peak" (GW17385 and GW17386) be included in the suite to provide water level data that is distant from the three pumped bores to enable "background" variations to be assessed.

The windmill near the "House Tank" should be investigated to establish if it was set up to pump out of the dam or if it is a suitable groundwater level monitoring point. If it is suitable

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for groundwater level monitoring, it should be added to the monitoring suite.

Two additional loggers have been despatched for installation in the Back Bore (new) and TNYWB4. All three loggers should be removed, downloaded and replaced every 2 months.

Depending on budget and project management limitations, it would be an advantage for future environmental and planning approval assessments for water level loggers to also be installed in TNYWB3, TNYWB5, GW17385 and GW17386.

Loggers should also be installed in Skirka's and the House Bore when suitable protective tubing can be installed in the bore casing.

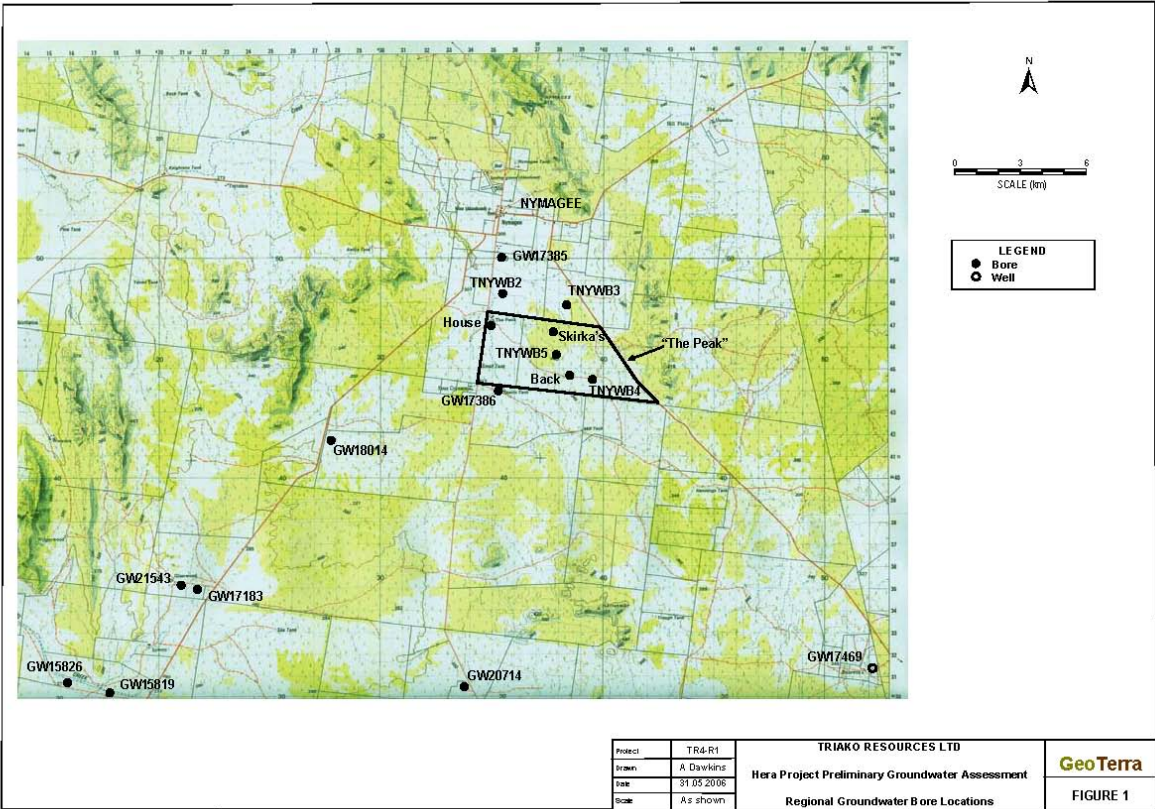
5. REFERENCES

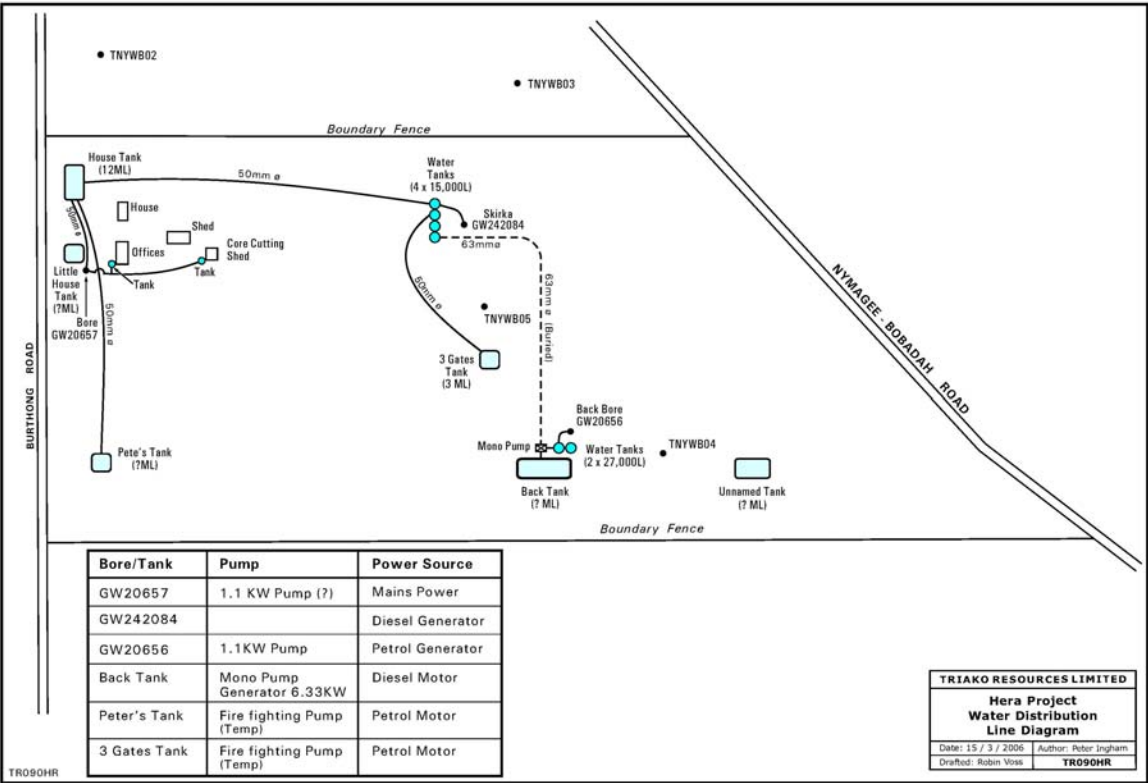
Geoterra, 2005 Hydrogeological Assessment of Skirka's Bore at "The Peak" Station

LIMITATIONS

This report was prepared in accordance with the scope of services set out in the contract between Geoterra and the client, or where no contract has been finalised, the proposal agreed to by the client. To the best of our knowledge the report presented herein accurately reflects the client's requirements when it was printed. However, the application of conditions of approval or impacts of unanticipated future events could modify the outcomes described in this document. Assessment of aquifer characteristics in this report are made based on limited data, and actual subsurface conditions may differ substantially from those assessed. Conclusions and recommendations in the report are based on extrapolations from limited data and no responsibility can be accepted for limitations to pumping periods and/or yields encountered under conditions that differ from those assessed. In preparing this report, Geoterra has relied upon information and documentation provided by the client and / or third parties. Geoterra did not attempt to independently verify the accuracy or completeness of that information. To the extent that the conclusions and recommendations in this report are based in whole or in part on such information, they are contingent on its validity. Geoterra assume the client will make their own enquiries in regard to conclusions and recommendations made in this document.

Geoterra accept no responsibility for any consequences arising from any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to Geoterra. The findings contained in this report are the result of discrete / specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site in question. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points. Interpretations and recommendations provided in this report are opinions provided for our Client's sole use in accordance with the specified brief. As such they do not necessarily address all aspects of water, soil or rock conditions on the subject site. The responsibility of Geoterra is solely to its client and it is not intended that this report be relied upon by any third party. This report shall not be reproduced either wholly or in part without the prior written consent of Geoterra.





APPENDIX A

GROUNDWATER MONITORING DATA



HERA GROUNDWATER LEVELS (mbgl)								
	WB2	WB3	WB4	WB5	Back	Back-new	House	Skirka's
21/10/2005					65.00		53.54	
25/10/2005								
26/10/2005								
28/10/2005					65.00			
28/10/2005							53.54	
5/11/2005							55.04	
15/11/2005					63.00		51.84	
18/11/2005					63.00		51.54	
25/11/2005					63.50		51.54	
2/12/2005					64.00		51.54	
11/12/2005					69.45		51.74	
16/12/2005					63.00		51.54	
6/01/2006					62.00		52.54	68.00
17/01/2006					62.00		53.54	64.00
29/01/2006					63.00		54.54	
4/02/2006	51.00				61.00		53.54	
10/02/2006	53.00				64.00		55.54	
6/03/2006	53.00	44.00					54.54	
10/03/2006	53.00	45.00					56.54	
14/03/2006								67.00
16/03/2006	53.00						55.54	64.00
29/03/2006							62.54	63.23
31/03/2006	53.00	43.00			62.00		62.04	60.00
7/04/2006	53.00	44.00					66.54	
14/04/2006	53.00	50.00					65.54	
28/04/2006	53.00						67.54	
6/05/2006	53.00			71.00			62.54	
12/05/2006	53.04		52.79				62.54	
19/05/2006	53.60	44.63	52.84			63.06	67.14	
27/05/2006	53.05		52.77	71.52		62.80	69.35	

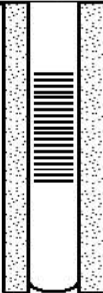
APPENDIX B
BACK BORE (new) DRILL LOG

Client: Triako Resources		Borehole: Back Bore		GeoTerra 77 Abergeldie Street Dulwich Hill NSW 2203 ph 02 9560 6583 fax 02 9560 6584 email geoterra@iinet.net.au
Project: Hera		North/East: n/a		
Location: Nymagee		Logged by: A Dawkins		
Job No: TR3				

Depth	Symbol	Lithology	Well Data	Remarks
		Ground Surface		
0		<i>SOIL - Residual red brown silty</i>		hole drilled 10" cased 6" C9 PVC
1		<i>SILTSTONE - wthrd orgn brn to grn gry</i>		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44		<i>SILTSTONE - partially wthrd - brn grn blk</i>		
45				
46				
47				
48		<i>SILTSTONE - drilled as fine chips</i>		
49				
50				

Drilled By: Central West Water Drillers	Hole Size: 10"
Drill Method: Open hammer	Ground RL: n/a
Drill Date: 13 May 2006	Sheet: 1 of 3

Client: Triako Resources Project: Hera Location: Nymagee Job No: TR3 Borehole: Back Bore North/East: n/a Logged by: A Dawkins				
GeoTerra 77 Abergeldie Street Dulwich Hill NSW 2203 ph 02 9560 6583 fax 02 9560 6584 email geoterra@iinet.net.au				
Depth	Symbol	Lithology	Well Data	Remarks
51				
52				
53				
54				
55				
56		SILTSTONE - dk grn blk		
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72		SILTSTONE dk grn blk + minor qtz vein		
73				
74				
75				
76		SILTSTONE - dk grn blk		
77				
78				
79				
80				
81		SILTSTONE dk grn blk + minor qtz veins		
82		SILTSTONE - dk grn blk		
83				
84				
85				
86				
87				
88				
89		SILTSTONE / FINE Limonitic SANDSTONE		88.5m water returns - 3.5L/sec
90				89.5m - 5L/sec airlift
91		SILTST silicic / FINE SANDSTONE - limonit		91m - 6L/sec 7.69pH 4.05mS/cm
92				
93		FINE SANDST limonitic / SILTST		
94		FINE SANDSTONE limonitic		
95				
96				
97		SILTSTONE / FINE SANDSTONE dk grn blk		
98				
99				
100				98m 6L/s 7.69pH 4.03mS/cm
Drilled By: Central West Water Drillers Drill Method: Open hammer Drill Date: 13 May 2006			Hole Size: 10" Ground RL: n/a Sheet: 2 of 3	

Client: Triako Resources			Borehole: Back Bore		GeoTerra 77 Abergeldie Street Dulwich Hill NSW 2203 ph 02 9560 6583 fax 02 9560 6584 email geoterra@inet.net.au	
Project: Hera			North/East: n/a			
Location: Nymagee			Logged by: A Dawkins			
Job No: TR3						
Depth	Symbol	Lithology	Well Data	Remarks		
101		SILTSTONE - dk gm blk		106m 6L/s 7.67pH 3.99mS/cm		
102		FINE SANDST / SILTSTONE dk gm blk				
103		SILTSTONE dk gm blk				
104		SILTSTONE dk gm blk				
105		SILT / FINE SANDST dk gm blk				
106		SILTSTONE dk gm blk				
107		SILTSTONE dk gm blk				
108		SILTSTONE dk gm blk				
109		SILTSTONE dk gm blk fine chips				
110		SILTSTONE dk gm blk				
111		SILTSTONE dk gm blk				
112		SILTSTONE dk gm blk	112m 6L/s 7.66pH 4.03mS/cm			
113		SILTSTONE dk gm blk				
114		SILTSTONE dk gm blk				
115		SILTSTONE dk gm blk				
116		SILTSTONE fine chips dk gm blk				
117		SILTSTONE dk gm blk				
118		SILTSTONE dk gm blk				
119		SILTSTONE dk gm blk				
120		SILTSTONE dk gm blk				
121		SILTSTONE dk gm blk	121m 6L/s 7.52pH 4.14mS/cm			
122		End of Borehole				
123						
124						
125						
126						
127						
128						
129						
130						
131						
132						
133						
134						
135						
136						
137						
138						
139						
140						
141						
142						
143						
144						
145						
146						
147						
148						
149						
150						
Drilled By: Central West Water Drillers			Hole Size: 10"			
Drill Method: Open hammer			Ground RL: n/a			
Drill Date: 13 May 2006			Sheet: 3 of 3			

Appendix 5

Draft Groundwater Extraction Licences

(Total No. of pages including blank pages = 12)

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Office
of Water

Attn: Dean Frederickson
YTC Resources Pty Limited
P O Box 7077
ORANGE NSW 2800

Contact: Angus Foster
Our Ref: 85BL243254
85BL256001
85BL256002

Dear Sir,

**RE: three applications for mining bore licenses lodged by Triako Resources Limited
located within Lot 664 DP 761602, Parish of Roset, County of Mouramba.**

The NSW Office of Water has decided to grant the applications originally lodged by Triako Resources Limited and issue three licenses subject to the attached conditions.

You should be aware that the conditions proposed to be attached to this license may be varied at some time in the future if in the opinion of the Department such variations become necessary.

Your attention is drawn to Conditions (10) to (12) on applications 85BL243254 & 85BL256002 and Conditions (10) to (15) on application 85BL256002 which restrict the amount of water and the rate that be extracted from the various works.

Your particular attention is drawn to Conditions (11) & (12) on applications 85BL243254 & 85BL256001 and Conditions (14) & (15) on application 85BL256002. Condition (11) on applications 85BL243254 & 85BL256001 and Condition (14) on the third states that the entitlement granted is for the life of the project and is not transferrable. Any additional entitlement required in the future over and above what has been granted will need to be purchased from the open market. This additional entitlement will remain fully tradeable.

Condition (12) on applications 85BL243254 & 85BL256001 and (15) on application 85BL256002 refers to the bore impact mitigation or management plan described in the GeoTerra's consultants report of 11 May 2007. Should an impact occur and the impact is not mitigated, the NSW Office of Water does have the power under the Act to suspend the operation of any licence until such time it is mitigated.

In regard to condition (4) the discharge of polluted waters into a river or a lake is contrary to the *Protection of the Environment Operations Act 1997* and can lead to prosecution and penalty unless done in a way that complies with an approval under that Act. Therefore, where a drainage disposal scheme is part of your development under this water license, you may also require an approval under the *Protection of the Environment Operations Act 1997*.

Please advise the Department of any submission you wish to make within twenty-eight (28) days from the date of this letter. If no submission is made within that period the Department will then take action to issue the license.

Yours faithfully

Richard Wheatley
A/Licensing Manager
Macquarie – Western

19/8/10

209 Cobra Street P O Box 717 Dubbo NSW 2830
Phone 02 6884 2560 Fax 02 6884 0096 Website www.water.nsw.gov.au

SCHEDULE**APPLICATION NO:** 85BL243254

<u>Works</u>	<u>Portion or Lot/Section/DP</u>	<u>Parish</u>	<u>County</u>
1 x Bore	664//761702	Roset	Mouramba

Purpose
Water supply for mining purposes

<u>Details of Land to be Irrigated</u>		
<u>Portion or Lot/Section/DP</u>	<u>Parish</u>	<u>County</u>
Area: Hectares		

85BL243254

Department of Water and Energy

CONDITIONS STATEMENT

85BL243254

(1) THE LICENSEE SHALL ALLOW NSW OFFICE OF WATER OR ANY PERSON AUTHORISED BY IT, FULL AND FREE ACCESS TO THE WORKS, EITHER DURING OR AFTER CONSTRUCTION, FOR THE PURPOSE OF CARRYING OUT INSPECTION OR TEST OF THE WORKS AND ITS FITTINGS AND SHALL CARRY OUT ANY WORK OR ALTERATIONS DEEMED NECESSARY BY THE DEPARTMENT FOR THE PROTECTION AND PROPER MAINTENANCE OF THE WORKS, OR THE CONTROL OF THE WATER EXTRACTED AND FOR THE PROTECTION OF THE QUALITY AND THE PREVENTION FROM POLLUTION OR CONTAMINATION OF SUB-SURFACE WATER.

(2) IF A WORK IS ABANDONED AT ANY TIME THE LICENSEE SHALL NOTIFY NSW OFFICE OF WATER THAT THE WORK HAS BEEN ABANDONED AND SEAL OFF THE AQUIFER BY:-

(A) BACKFILLING THE WORK TO GROUND LEVEL WITH CLAY OR CEMENT AFTER WITHDRAWING THE CASING (LINING); OR

(B) SUCH METHODS AS AGREED TO OR DIRECTED BY NSW OFFICE OF WATER.

(3) THE LICENSEE SHALL NOT ALLOW ANY TAILWATER/DRAINAGE TO DISCHARGE INTO OR ONTO:-

- ANY ADJOINING PUBLIC OR CROWN ROAD;
- ANY OTHER PERSONS LAND;
- ANY CROWN LAND;
- ANY RIVER, CREEK OR WATERCOURSE;
- ANY NATIVE VEGETATION AS DESCRIBED UNDER THE NATIVE VEGETATION CONSERVATION ACT 1997;
- ANY WETLANDS OF ENVIRONMENTAL SIGNIFICANCE.

(4) WORKS USED FOR THE PURPOSE OF CONVEYING, DISTRIBUTING OR STORING WATER TAKEN BY MEANS OF THE LICENSED WORK SHALL NOT BE CONSTRUCTED OR INSTALLED SO AS TO OBSTRUCT THE REASONABLE PASSAGE OF FLOOD WATERS FLOWING INTO OR FROM A RIVER.

(5) DURING THE FIRST YEAR OF ISSUE OF THIS LICENSE THE VOLUMETRIC ALLOCATION IS DIRECTLY PROPORTIONAL FROM THE DATE OF ISSUE OF THE LICENSE TO THE END OF THE IRRIGATION YEAR.

(6) NSW OFFICE OF WATER SHALL HAVE THE RIGHT DURING THE CURRENCY OF THIS LICENSE TO VARY AT ANY TIME THE VOLUMETRIC ALLOCATION, OR THE RATE AT WHICH THIS ALLOCATION IS TAKEN.

(7) THE LICENSEE SHALL INSTALL TO THE SATISFACTION OF NSW OFFICE OF WATER IN RESPECT OF LOCATION, TYPE AND CONSTRUCTION AN APPLIANCE(S) TO MEASURE THE QUANTITY OF WATER EXTRACTED FROM THE WORKS. THE APPLIANCE(S) TO CONSIST OF EITHER A MEASURING WEIR OR WEIRS WITH AUTOMATIC RECORDER, OR METER OR METERS OF THE DETHRIDGE TYPE, OR SUCH OTHER CLASS OF METER OR MEANS OF MEASUREMENT AS MAY BE APPROVED BY NSW OFFICE OF WATER. THE APPLIANCE(S) SHALL BE MAINTAINED IN GOOD WORKING ORDER AND CONDITION. A RECORD OF ALL WATER EXTRACTED FROM THE WORKS SHALL BE KEPT AND SUPPLIED TO THE DEPARTMENT UPON REQUEST. THE LICENSEE WHEN REQUESTED MUST SUPPLY A TEST CERTIFICATE AS TO THE ACCURACY OF THE APPLIANCE(S) FURNISHED EITHER BY THE MANUFACTURER OR BY SOME PERSON DULY QUALIFIED.

(8) WATER EXTRACTED FROM THE BORE SHALL NOT BE USED FOR THE PURPOSE OF IRRIGATION OF GRASSES OR PASTURES WHICH ARE NOT SOWN GRASSES OR PASTURES.

(9) LOCATION OF LAND ON WHICH WATER MAY BE USED:-

85BL243254

LOT/DP: LOT 664 DP 761702 (WLL2455)
PARISH : ROSET
COUNTY : MOURAMBA

(10) THE VOLUME OF GROUNDWATER EXTRACTED FROM THE WORKS AUTHORISED BY THIS LICENSE AND BY LICENSE(S) 85BL256001 & 85BL256002 SHALL NOT EXCEED 147 MEGALITRES IN ANY 12 MONTH PERIOD COMMENCING 1ST JULY.

(11) NOTWITHSTANDING CONDITION (10), THE AMOUNT THAT MAY BE EXTRACTED FROM THIS WORK (SKIRKAS' BORE REF: TNYWB1) MAY NOT EXCEED FIVE (5) MEGALITRES.

(12) THE ALLOCATION IN CONDITION (10) IS FOR THE LIFE OF THE MINE AND ON CESSATION OF MINE THE ALLOCATION SHALL BE REVOKED. IN ANY CASE, THE ALLOCATION IS NOT TRADABLE.

(13) THE ALLOCATION IN CONDITION (10) IS SUBJECT TO THE BORE IMPACT MANAGEMENT PLAN DESCRIBED IN SECTION 5.2.2 OF THE GEOTERRA CONSULTANTS REPORT (TR5-R2) DATED THE 11 MAY 2007.

IN THE EVENT OF ANY ADVERSE IMPACT, THE LICENSEE IS TO PROVIDE IMPACT MITIGATION AND PROVIDE ALTERNATE WATER SUPPLY TO THE IMPACTED BORE USERS WHICH MAY INCLUDE A NEW BORE AT NO COST TO THE AFFECTED USERS.

End Of Conditions

SCHEDULE

APPLICATION NO: 85BL256001

<u>Works</u>	<u>Portion or Lot/Section/DP</u>	<u>Parish</u>	<u>County</u>
1 x Excavation	664//761702	Roset	Mouramba

Purpose
Water supply for mining purposes

Details of Land to be Irrigated

<u>Portion or Lot/Section/DP</u>	<u>Parish</u>	<u>County</u>
----------------------------------	---------------	---------------

Area: Hectares

85BL256001

Department of Water and Energy

CONDITIONS STATEMENT

85BL256001

(1) THE LICENSEE SHALL ALLOW NSW OFFICE OF WATER OR ANY PERSON AUTHORISED BY IT, FULL AND FREE ACCESS TO THE WORKS, EITHER DURING OR AFTER CONSTRUCTION, FOR THE PURPOSE OF CARRYING OUT INSPECTION OR TEST OF THE WORKS AND ITS FITTINGS AND SHALL CARRY OUT ANY WORK OR ALTERATIONS DEEMED NECESSARY BY THE DEPARTMENT FOR THE PROTECTION AND PROPER MAINTENANCE OF THE WORKS, OR THE CONTROL OF THE WATER EXTRACTED AND FOR THE PROTECTION OF THE QUALITY AND THE PREVENTION FROM POLLUTION OR CONTAMINATION OF SUB-SURFACE WATER.

(2) IF A WORK IS ABANDONED AT ANY TIME THE LICENSEE SHALL NOTIFY NSW OFFICE OF WATER THAT THE WORK HAS BEEN ABANDONED AND SEAL OFF THE AQUIFER BY:-

(A) BACKFILLING THE WORK TO GROUND LEVEL WITH CLAY OR CEMENT AFTER WITHDRAWING THE CASING (LINING); OR

(B) SUCH METHODS AS AGREED TO OR DIRECTED BY NSW OFFICE OF WATER.

(3) THE LICENSEE SHALL NOT ALLOW ANY TAILWATER/DRAINAGE TO DISCHARGE INTO OR ONTO:-

- ANY ADJOINING PUBLIC OR CROWN ROAD;
- ANY OTHER PERSONS LAND;
- ANY CROWN LAND;
- ANY RIVER, CREEK OR WATERCOURSE;
- ANY NATIVE VEGETATION AS DESCRIBED UNDER THE NATIVE VEGETATION CONSERVATION ACT 1997;
- ANY WETLANDS OF ENVIRONMENTAL SIGNIFICANCE.

(4) WORKS USED FOR THE PURPOSE OF CONVEYING, DISTRIBUTING OR STORING WATER TAKEN BY MEANS OF THE LICENSED WORK SHALL NOT BE CONSTRUCTED OR INSTALLED SO AS TO OBSTRUCT THE REASONABLE PASSAGE OF FLOOD WATERS FLOWING INTO OR FROM A RIVER.

(5) DURING THE FIRST YEAR OF ISSUE OF THIS LICENSE THE VOLUMETRIC ALLOCATION IS DIRECTLY PROPORTIONAL FROM THE DATE OF ISSUE OF THE LICENSE TO THE END OF THE IRRIGATION YEAR.

(6) NSW OFFICE OF WATER SHALL HAVE THE RIGHT DURING THE CURRENCY OF THIS LICENSE TO VARY AT ANY TIME THE VOLUMETRIC ALLOCATION, OR THE RATE AT WHICH THIS ALLOCATION IS TAKEN.

(7) THE LICENSEE SHALL INSTALL TO THE SATISFACTION OF NSW OFFICE OF WATER IN RESPECT OF LOCATION, TYPE AND CONSTRUCTION AN APPLIANCE(S) TO MEASURE THE QUANTITY OF WATER EXTRACTED FROM THE WORKS. THE APPLIANCE(S) TO CONSIST OF EITHER A MEASURING WEIR OR WEIRS WITH AUTOMATIC RECORDER, OR METER OR METERS OF THE DETHRIDGE TYPE, OR SUCH OTHER CLASS OF METER OR MEANS OF MEASUREMENT AS MAY BE APPROVED BY NSW OFFICE OF WATER. THE APPLIANCE(S) SHALL BE MAINTAINED IN GOOD WORKING ORDER AND CONDITION. A RECORD OF ALL WATER EXTRACTED FROM THE WORKS SHALL BE KEPT AND SUPPLIED TO THE DEPARTMENT UPON REQUEST. THE LICENSEE WHEN REQUESTED MUST SUPPLY A TEST CERTIFICATE AS TO THE ACCURACY OF THE APPLIANCE(S) FURNISHED EITHER BY THE MANUFACTURER OR BY SOME PERSON DULY QUALIFIED.

(8) LOCATION OF LAND ON WHICH WATER MAY BE USED:-

LOT/DP: LOT 664 DP 761702
PARISH : ROSET
COUNTY : MOURAMBA

85BL256001

(9) THE VOLUME OF GROUNDWATER EXTRACTED FROM THE WORKS AUTHORISED BY THIS LICENSE AND BY LICENSE(S) 85BL243254 & 85BL256002 SHALL NOT EXCEED 147 MEGALITRES IN ANY 12 MONTH PERIOD COMMENCING 1ST JULY.

(10) NOTWITHSTANDING CONDITION (8), THE MAXIMUM AMOUNT OF WATER EXTRACTED FROM THE DECLINE IS 95 MEGALITRES PER ANNUM.

(11) THE ALLOCATION IN CONDITION (9) IS FOR THE LIFE OF THE MINE AND ON CESSATION OF MINE THE ALLOCATION SHALL BE REVOKED. IN ANY CASE, THE ALLOCATION IS NOT TRADABLE.

(12) THE ALLOCATION IN CONDITION (10) IS SUBJECT TO THE BORE IMPACT MANAGEMENT PLAN DESCRIBED IN SECTION 5.2.2 OF THE GEOTERRA CONSULTANTS REPORT (TR5-R2) DATED THE 11 MAY 2007.

IN THE EVENT OF ANY ADVERSE IMPACT, THE LICENSEE IS TO PROVIDE IMPACT MITIGATION AND PROVIDE ALTERNATE WATER SUPPLY TO THE IMPACTED BORE USERS WHICH MAY INCLUDE A NEW BORE AT NO COST TO THE AFFECTED USERS.

End Of Conditions

SCHEDULE**APPLICATION NO: 85BL256002**

<u>Works</u>	<u>Portion or Lot/Section/DP</u>	<u>Parish</u>	<u>County</u>
1 x Bore	664//761702	Roset	Mouramba

Purpose

Water supply for mining purposes

Details of Land to be Irrigated

<u>Portion or Lot/Section/DP</u>	<u>Parish</u>	<u>County</u>
Area: Hectares		

85BL256002

Department of Water and Energy
CONDITIONS STATEMENT
85BL256002

- (1) THE LICENSEE SHALL WITHIN TWO (2) MONTHS OF COMPLETION OR AFTER THE ISSUE OF THE LICENCE IF THE WORK IS EXISTING, FURNISH TO NSW OFFICE OF WATER:-
- (A) DETAILS OF THE WORK AS SET OUT IN THE FORM "A" (MUST BE COMPLETED BY A DRILLER, DULY LICENSED IN NEW SOUTH WALES).
- (B) A PLAN SHOWING ACCURATELY THE LOCATION OF THE WORK IN RELATION TO PORTION AND PROPERTY BOUNDARIES,
- (C) DETAILS OF ANY PUMPING TESTS CARRIED OUT,
- (D) DETAILS OF ANY WATER ANALYSIS.
- (2) THE LICENSEE SHALL ALLOW NSW OFFICE OF WATER OR ANY PERSON AUTHORISED BY IT, FULL AND FREE ACCESS TO THE WORKS, EITHER DURING OR AFTER CONSTRUCTION, FOR THE PURPOSE OF CARRYING OUT INSPECTION OR TEST OF THE WORKS AND ITS FITTINGS AND SHALL CARRY OUT ANY WORK OR ALTERATIONS DEEMED NECESSARY BY THE DEPARTMENT FOR THE PROTECTION AND PROPER MAINTENANCE OF THE WORKS, OR THE CONTROL OF THE WATER EXTRACTED AND FOR THE PROTECTION OF THE QUALITY AND THE PREVENTION FROM POLLUTION OR CONTAMINATION OF SUB-SURFACE WATER.
- (3) IF A WORK IS ABANDONED AT ANY TIME THE LICENSEE SHALL NOTIFY NSW OFFICE OF WATER THAT THE WORK HAS BEEN ABANDONED AND SEAL OFF THE AQUIFER BY:-
- (A) BACKFILLING THE WORK TO GROUND LEVEL WITH CLAY OR CEMENT AFTER WITHDRAWING THE CASING (LINING); OR
- (B) SUCH METHODS AS AGREED TO OR DIRECTED BY NSW OFFICE OF WATER.
- (4) THE LICENSEE SHALL NOT ALLOW ANY TAILWATER/DRAINAGE TO DISCHARGE INTO OR ONTO:-
- ANY ADJOINING PUBLIC OR CROWN ROAD;
 - ANY OTHER PERSONS LAND;
 - ANY CROWN LAND;
 - ANY RIVER, CREEK OR WATERCOURSE;
 - ANY NATIVE VEGETATION AS DESCRIBED UNDER THE NATIVE VEGETATION CONSERVATION ACT 1997;
 - ANY WETLANDS OF ENVIRONMENTAL SIGNIFICANCE.
- (5) WORKS USED FOR THE PURPOSE OF CONVEYING, DISTRIBUTING OR STORING WATER TAKEN BY MEANS OF THE LICENSED WORK SHALL NOT BE CONSTRUCTED OR INSTALLED SO AS TO OBSTRUCT THE REASONABLE PASSAGE OF FLOOD WATERS FLOWING INTO OR FROM A RIVER.
- (6) DURING THE FIRST YEAR OF ISSUE OF THIS LICENSE THE VOLUMETRIC ALLOCATION IS DIRECTLY PROPORTIONAL FROM THE DATE OF ISSUE OF THE LICENSE TO THE END OF THE IRRIGATION YEAR.
- (7) NSW OFFICE OF WATER SHALL HAVE THE RIGHT DURING THE CURRENCY OF THIS LICENSE TO VARY AT ANY TIME THE VOLUMETRIC ALLOCATION, OR THE RATE AT WHICH THIS ALLOCATION IS TAKEN.
- (8) THE LICENSEE SHALL INSTALL TO THE SATISFACTION OF NSW OFFICE OF WATER IN RESPECT OF LOCATION, TYPE AND CONSTRUCTION AN APPLIANCE(S) TO MEASURE THE QUANTITY OF WATER EXTRACTED FROM THE WORKS. THE APPLIANCE(S) TO CONSIST OF EITHER A MEASURING WEIR OR

85BL256002

WEIRS WITH AUTOMATIC RECORDER, OR METER OR METERS OF THE DETHRIDGE TYPE, OR SUCH OTHER CLASS OF METER OR MEANS OF MEASUREMENT AS MAY BE APPROVED BY NSW OFFICE OF WATER. THE APPLIANCE(S) SHALL BE MAINTAINED IN GOOD WORKING ORDER AND CONDITION. A RECORD OF ALL WATER EXTRACTED FROM THE WORKS SHALL BE KEPT AND SUPPLIED TO THE DEPARTMENT UPON REQUEST. THE LICENSEE WHEN REQUESTED MUST SUPPLY A TEST CERTIFICATE AS TO THE ACCURACY OF THE APPLIANCE(S) FURNISHED EITHER BY THE MANUFACTURER OR BY SOME PERSON DULY QUALIFIED.

(9) LOCATION OF LAND ON WHICH WATER MAY BE USED:-

LOT/DP: 664/761702
PARISH : ROSET
COUNTY : MOURAMBA

(10) THE VOLUME OF GROUNDWATER EXTRACTED FROM THE WORKS AUTHORISED BY THIS LICENSE AND BY LICENSE(S) 85BL243254 & 85BL256001 SHALL NOT EXCEED 147 MEGALITRES IN ANY 12 MONTH PERIOD COMMENCING 1ST JULY.

(11) THE RATE AT WHICH WATER MAY BE EXTRACTED FROM THESE WORKS SHALL NOT EXCEED 3.5 LITRES PER SECOND.

(12) THE PUMP INTAKE LEVEL (SUCTION LEVEL) MUST REMAIN WITHIN 90 METRES FROM THE GROUND LEVEL.

(13) NOTWITHSTANDING CONDITIONS (10) AND (11), THE EXTRACTION FROM THIS BORE ("BACK BORE" REF: TNYWB6) SHOULD NOT EXCEED 47 MEGALITRES PER YEAR.

(14) THE ALLOCATION IN CONDITION (10) IS FOR THE LIFE OF THE MINE AND ON CESSATION OF MINE THE ALLOCATION SHALL BE REVOKED. IN ANY CASE, THE ALLOCATION IS NOT TRADABLE.

(15) THE ALLOCATION IN CONDITION (10) IS SUBJECT TO THE BORE IMPACT MANAGEMENT PLAN DESCRIBED IN SECTION 5.2.2 OF THE GEOTERRA CONSULTANTS REPORT (TR5-R2) DATED THE 11 MAY 2007.

IN THE EVENT OF ANY ADVERSE IMPACT, THE LICENSEE IS TO PROVIDE IMPACT MITIGATION AND PROVIDE ALTERNATE WATER SUPPLY TO THE IMPACTED BORE USERS WHICH MAY INCLUDE A NEW BORE AT NO COST TO THE AFFECTED USERS.

End Of Conditions

Appendix 6

Groundwater Exploration Borehole Logs

(Total No. of pages including blank pages 10)

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Borehole ID: WB7

Project No.: 2010-0040

Project Name: Groundwater Exploration Drilling

Client: YTC Resources Limited

Site Address: "The Peak", Nymagee, NSW



ph: 1300 451 121
fax: (02) 6885 3382

i: www.theimpaxgroup.com.au
e: admin@theimpaxgroup.com.au

SUBSURFACE PROFILE				WATER	CONSTRUCTION	
Depth (m)	Symbol	Description	Depth/Elev.	Water Observations	Well Diagram	Materials Used
-5						
0		Ground Surface	0.0			
3		Clayey Sandy Loam Red-brown, dry, some fine to coarse gravel	3.0			
5		Quartz Hard, dry				
10		Weathered Shale / Siltstone Light brown with occasional pinky brown bands, dry soft				
15						
20						
25						
30						
35						
40						
45			46.0			
50		Weathered Shale / Siltstone Greeny-grey, dry, soft				
55						
60			61.0			
65		Sandstone / Siltstone Grey, hard, dry.				
70		Some minor fracturing encountered between 84m and 103m but no groundwater inflow. Quartz typically encountered with fracturing or weak zones.				
75						
80						
85				Minor moisture from fractured zone at 84m but no inflow.		
90						
95						
100						
103			103.0			
105		HOLE ENDED AT 103M				
110						

Drilled By: The Impax Group

Drill Method: Rotary Air Hammer

Drill Date: 24-25 February 2011

Hole Size: 140mm

Datum:

Sheet: 1 of 1

Borehole ID: WB8**Project No.:** 2010-0040**Project Name:** Groundwater Exploration Drilling**Client:** YTC Resources Limited**Site Address:** "The Peak", Nymagee, NSWph: 1300 451 121
fax: (02) 6885 3382i: www.theimpaxgroup.com.au
e: admin@theimpaxgroup.com.au

SUBSURFACE PROFILE				WATER	CONSTRUCTION	
Depth (m)	Symbol	Description	Depth/Elev.	Water Observations	Well Diagram	Materials Used
-5		Ground Surface	0.0			Steel Stickup Monument
0		Clayey Sandy Loam Red-brown, dry, some fine to coarse gravel	3.0			
5		Weathered Shale / Siltstone Red-brown, dry, soft	8.0			
10		Weathered Shale / Siltstone Light brown, dry, soft	12.0			
15		Weathered Shale / Siltstone Red-brown, dry, soft	21.0			
20		Weathered Siltstone / Shale White, dry, soft				
25		Weathered Siltstone / Shale Yellow, dry, soft				
30						
35			36.0			125mm Class 12 UP VC Casing
40		Weathered Siltstone / Shale Greyey-yellow-brown, dry, soft		EC similar throughout and ranged 5.6-5.8mS/cm		
45						
50		Weathered Siltstone / Shale Grey, dry, soft	48.0	pH similar throughout and ranged 7.85-7.96		
55						
60						
65						
70						
75						
80				Water Strike 85m		Bentonite Seal (77 - 79m)
85			85.0	Yield = 1L/s		
90		Sandstone / Siltstone Grey, hard, featuring fractures or weak zones from 85m to 132m. Large fragment of quartz returned in drill cuttings in fractured zones		Yield = 1L/s		5-7mm Graded River Gravel (79-140m)
95				Yield = 1.4L/s		
100				Yield = 2L/s		2mm Machine Slotted Screen (85-104m)
105				Yield = 2.8L/s		
110				Yield = 5.5L/s		2mm Machine Slotted Screen (110-122m)
115				Yield = 7.5L/s		
120				Yield = 7.5L/s		2mm Machine Slotted Screen (128-134m)
125				Yield = >7.5L/s		
130						
135						
140		HOLE ENDED AT 140M	140.0	Yield = >7.5L/s		PVC End Cap (140m)
145						

Drilled By: The Impax Group**Drill Method:** Rotary Air Hammer**Drill Date:** 26-27 February 2011**Hole Size:** 200mm**Datum:****Sheet:** 1 of 1

Borehole ID: WB9

Project No.: 2010-0040

Project Name: Groundwater Exploration Drilling

Client: YTC Resources Limited

Site Address: "The Peak", Nymagee, NSW



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SUBSURFACE PROFILE				WATER	CONSTRUCTION	
Depth (m)	Symbol	Description	Depth/Elev.	Water Observations	Well Diagram	Materials Used
-5						
0		Ground Surface	0.0			
3		Clayey Sandy Loam Red-brown, dry, some fine to coarse gravel	3.0			
5		Weathered Shale / Siltstone Brown, dr, soft	5.0			
10		Weathered Shale / Siltstone Light brown, dry, soft				
15		Weathered Shale / Siltstone Yellow, dry, soft				
20			20.0			
25		Weathered Shale / Siltstone Yellow-brown, dry, soft				
30						
35			35.0			
40		Weathered Shale / Siltstone Grey, dry, soft				
45			43.0			
50		Sandstone / Siltstone Grey, hard, dry.				
55		Some minor fracturing encountered between 85m and 100m but no groundwater inflow. Quartz typically encountered with fracturing or weak zones.				
60						
65						
70						
75						
80						
85						
90						
95						
100						
105						
110						
115		HOLE ENDED AT 115m	115.0			
120						

Hole abandoned. No casing installed.

Minor moisture from fractured zone at 85m but no inflow.

Drilled By: The Impax Group
Drill Method: Rotary Air Hammer
Drill Date: 28 February 2011

Hole Size: 200mm
Datum:
Sheet: 1 of 1

Borehole ID: WB10**Project No.:** 2010-0040**Project Name:** Groundwater Exploration Drilling**Client:** YTC Resources Limited**Site Address:** "The Peak", Nymagee, NSW
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SUBSURFACE PROFILE				WATER	CONSTRUCTION	
Depth (m)	Symbol	Description	Depth/Elev.	Water Observations	Well Diagram	Materials Used
-5						
0		Ground Surface	0.0			Steel Pickup Monument
2			2.0			
5		Clayey Sandy Loam Red-brown, dry, some fine to coarse gravel				
10		Weathered Shale / Siltstone Light yellow-brown, dry, soft				
38			38.0			125mm Class 12 uPVC Casing
40		Weathered Shale / Siltstone Light grey-brown, dry, soft		EC was 4.7mS/cm at 79m. EC ranged 5.6-5.8mS/cm from 80-120m.		
54			54.0	pH similar throughout and ranged 7.7-7.9 throughout		
55		Weathered Shale / Siltstone Grey, soft. Dry above 73m. Water flow below 73m.				Bentonite Seal (64 - 66m)
80			80.0	Water Strike 73m		5-7mm Graded River Gravel (64 - 90m)
85		Sandstone / Siltstone Grey, hard, featuring fractures or weak zones from 80m to 120m.		Yield = 0.6L/s		2mm Machine Slotted Screen (72 - 84m)
90				Yield = 0.6L/s		PVC End Cap (90m)
95				Yield = 0.6L/s		
100				Yield = 0.6L/s		
105				Yield = 0.6L/s		
110				Yield = 0.6L/s		
115				Yield = 0.6L/s		
120		HOLE ENDED AT 120M	120.0	Yield = 0.6L/s		Pilot hole was 140mm. Hole reamed to 200mm diameter to a depth of 90m bgl. Casing seated on base of 200mm hole.
125						

Drilled By: The Impax Group**Drill Method:** Rotary Air Hammer**Drill Date:** 1-2 March 2011**Hole Size:** 200mm**Datum:****Sheet:** 1 of 1

Borehole ID: WB11

Project No.: 2010-0040

Project Name: Groundwater Exploration Drilling

Client: YTC Resources Limited

Site Address: "The Peak", Nymagee, NSW



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SUBSURFACE PROFILE				WATER	CONSTRUCTION
Depth (m)	Symbol	Description	Depth/Elev.	Water Observations	Well Diagram
-5		Ground Surface	0.0		
0		Clayey Sandy Loam Red-brown, dry, some fine to coarse gravel	3.0		
5		Weathered Shale / Siltstone Light yellow-brown, dry, soft			
10					
15					
20					
25					
30		Weathered Shale / Siltstone Greeny-grey, dry, soft	30.0		
35					
40				EC ranged 5.6-5.8mS/cm from 100-144m.	
45					
50		Weathered Shale / Siltstone Grey, soft, dry	48.0	pH similar throughout and ranged 7.7-7.9 throughout	
55					
60					
65					
70					
75					
80					
85			85.0		
90		Sandstone / Siltstone Grey, hard.			
95		Dry above 99m. Significant fracturing or weak zones encountered 99 - 130m bgl. Quartz fragments in cuttings were significant fracturing encountered.			
100				Water Strike 99m	
105				Yield = 2L/s	
110				Yield = 3L/s	
115				Yield = 5L/s	
120				Yield = 5L/s	
125				Yield = 5L/s	
130				Yield = 5L/s	
135				Yield = 5L/s	
140				Yield = 5L/s	
145		HOLE ENDED AT 144M	144.0	Yield = 5L/s	
150					

Drilled By: The Impax Group

Drill Method: Rotary Air Hammer

Drill Date: 7-9 March 2011

Hole Size: 200mm

Datum:

Sheet: 1 of 1

Borehole ID: WB12**Project No.:** 2010-0040**Project Name:** Groundwater Exploration Drilling**Client:** YTC Resources Limited**Site Address:** "The Peak", Nymagee, NSW
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SUBSURFACE PROFILE				WATER	CONSTRUCTION	
Depth (m)	Symbol	Description	Depth/Elev.	Water Observations	Well Diagram	Materials Used
-5						
0		Ground Surface	0.0			Steel Pickup Monument
3		Clayey Sandy Loam Red-brown, dry, some fine to coarse gravel	3.0			
5		Weathered Shale / Siltstone Light yellow-brown, dry, soft				
10						
15						
20						
25						
30						50mm Class 12 uPVC Casing
35						
40			42.0	EC ranged 5.6-5.8mS/cm from 90-124m.		
45		Weathered Shale / Siltstone Light grey-yellow-brown, dry, soft		pH ranged 7.7-7.9 from 90-124m		
50						
55						
60		Weathered Shale / Siltstone Grey, soft, dry	60.0			Bentonite Seal (80 - 82m)
65						
70						
75						
80						
85						3-5mm Graded River Gravel (70 - 96m)
90		Sandstone / Siltstone Grey, hard.	90.3	Water Strike 90m		1mm Machine Slotted Screen (84 - 96m)
95		Water inflow below 90m. Some fracturing or weak layers encountered 90-130m but no significant increase in inflow after water strike at 90m.		Yield = 0.4L/s		PVC End Cap (96m)
100				Yield = 0.4L/s		
105				Yield = 0.4L/s		
110				Yield = 0.4L/s		
115				Yield = 0.4L/s		
120				Yield = 0.4L/s		3-5mm Graded River Gravel (96 - 136m)
125				Yield = 0.4L/s		
130						
135			136.0			
140		HOLE ENDED AT 136M				

Drilled By: The Impax Group**Drill Method:** Rotary Air Hammer**Drill Date:** 10-11 March 2011**Hole Size:** 140mm**Datum:****Sheet:** 1 of 1

Borehole ID: WB13

Project No.: 2010-0040

Project Name: Groundwater Exploration Drilling

Client: YTC Resources Limited

Site Address: "The Peak", Nymagee, NSW



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SUBSURFACE PROFILE				WATER	CONSTRUCTION	
Depth (m)	Symbol	Description	Depth/Elev.	Water Observations	Well Diagram	Materials Used
-5		Ground Surface	0.0			Steel Stickup Monument
0		Clayey Sandy Loam Red-brown, dry, some fine to coarse gravel	3.0			
5		Weathered Shale / Siltstone Light yellow-brown, dry, soft				
10						
15						
20						
25						
30			33.0			125mm Class 12 uPVC Casing
35		Weathered Shale / Siltstone Greeny-grey, dry, soft				
40				EC ranged 5.6-5.8mS/cm from 96-136m.		
45						
50		Weathered Shale / Siltstone Grey, soft, dry	50.0	pH similar throughout and ranged 7.7-7.9 throughout		
55						
60						
65						
70						
75						
80						Bentonite Seal (78-80m)
85						
90						5.7mm Graded River Gravel (80-108m)
95			96.0	Water Strike 96m		2mm Machine Slotted Screen (90-102m)
100		Sandstone / Siltstone Grey, hard.		Yield = 3.5L/s		PVC End Cap (108m)
105		Significant fracturing or weak zones encountered 96 - 108m bgl. Quartz fragments in cuttings were significant fracturing encountered.		Yield = 3.5L/s		
110				Yield = 3.5L/s		
115				Yield = 3.5L/s		
120				Yield = 3.5L/s		
125				Yield = 3.5L/s		
130				Yield = 3.5L/s		
135			136.0	Yield = 3.5L/s		
140		HOLE ENDED AT 136M				Pilot hole was 140mm. Hole reamed to 200mm diameter to a depth of 108m bgl. Casing seated on base of 200mm hole.

Drilled By: The Impax Group

Drill Method: Rotary Air Hammer

Drill Date: 7-9 March 2011

Hole Size: 200mm

Datum:

Sheet: 1 of 1

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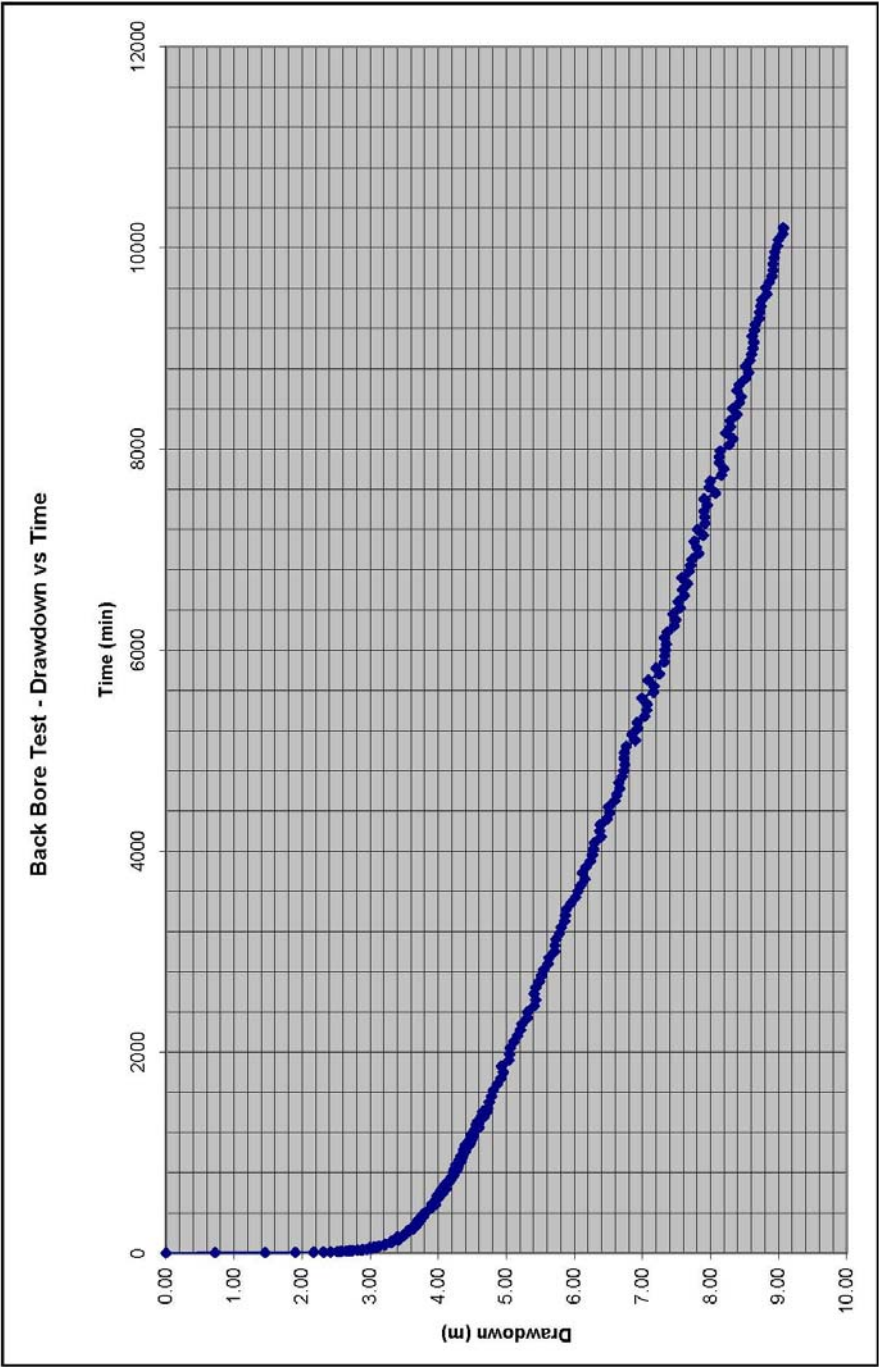
Appendix 7

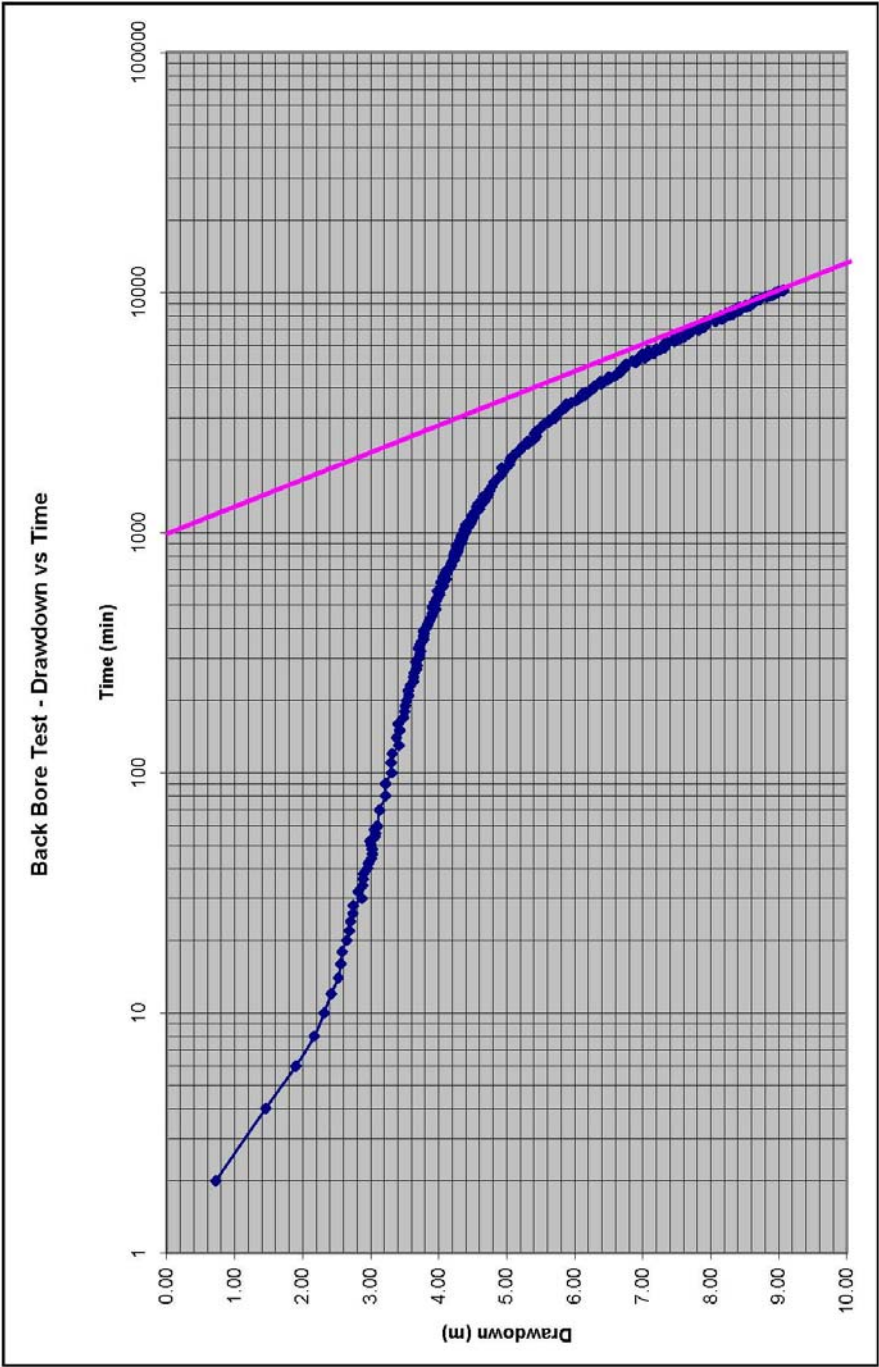
Aquifer Pump Test Data

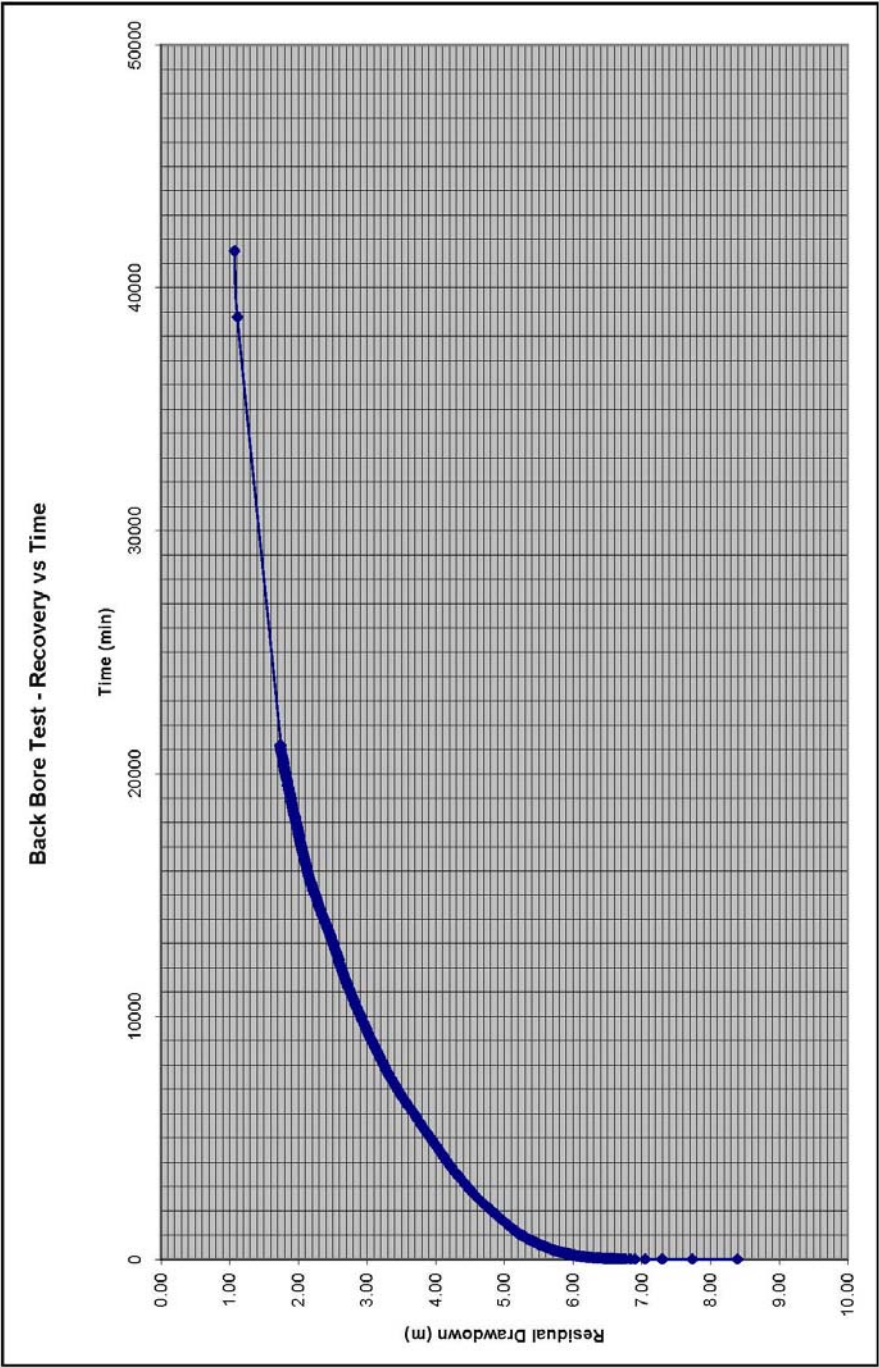
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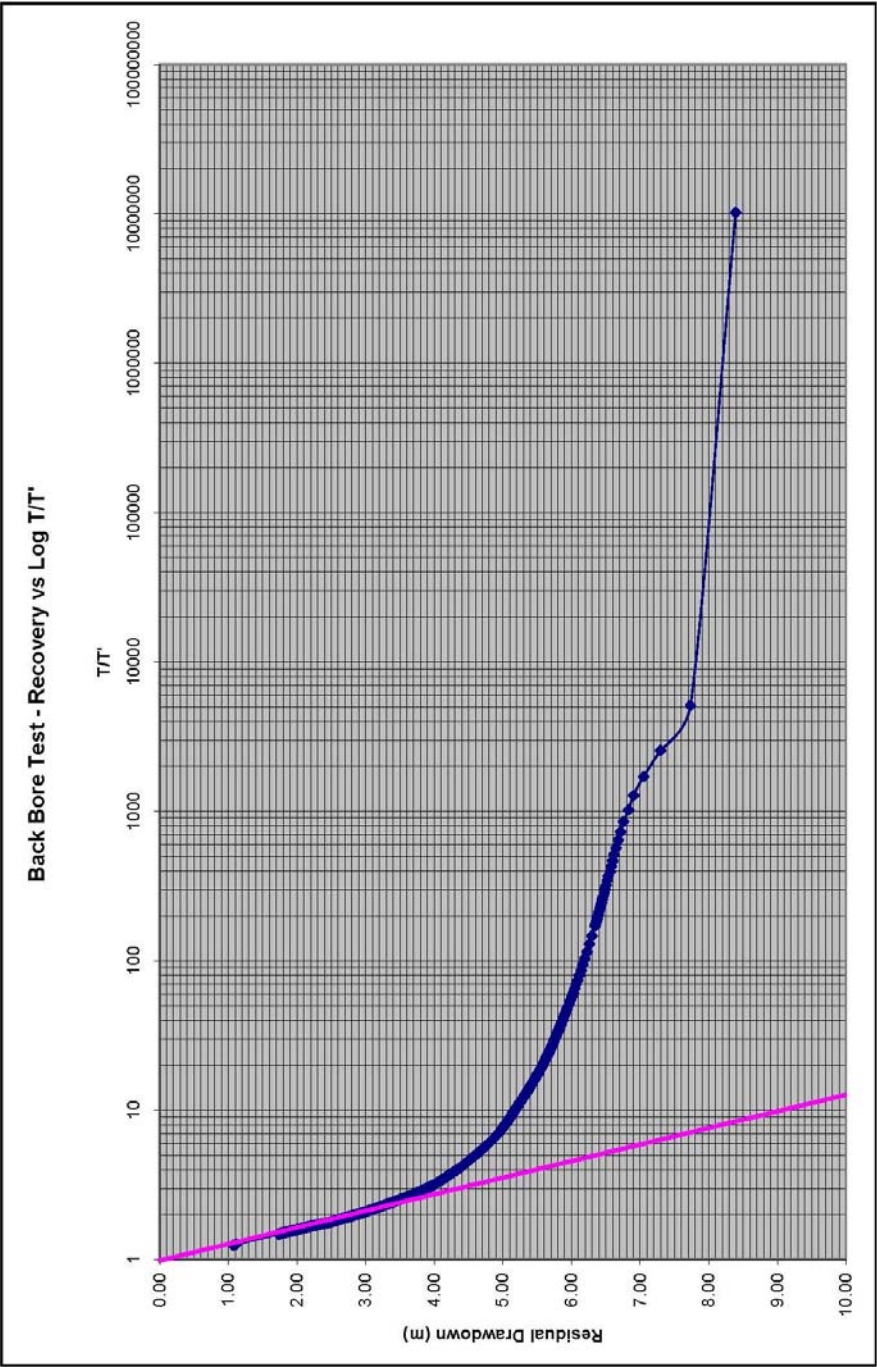
Note: A copy of Appendix 7 is available on the Project CD

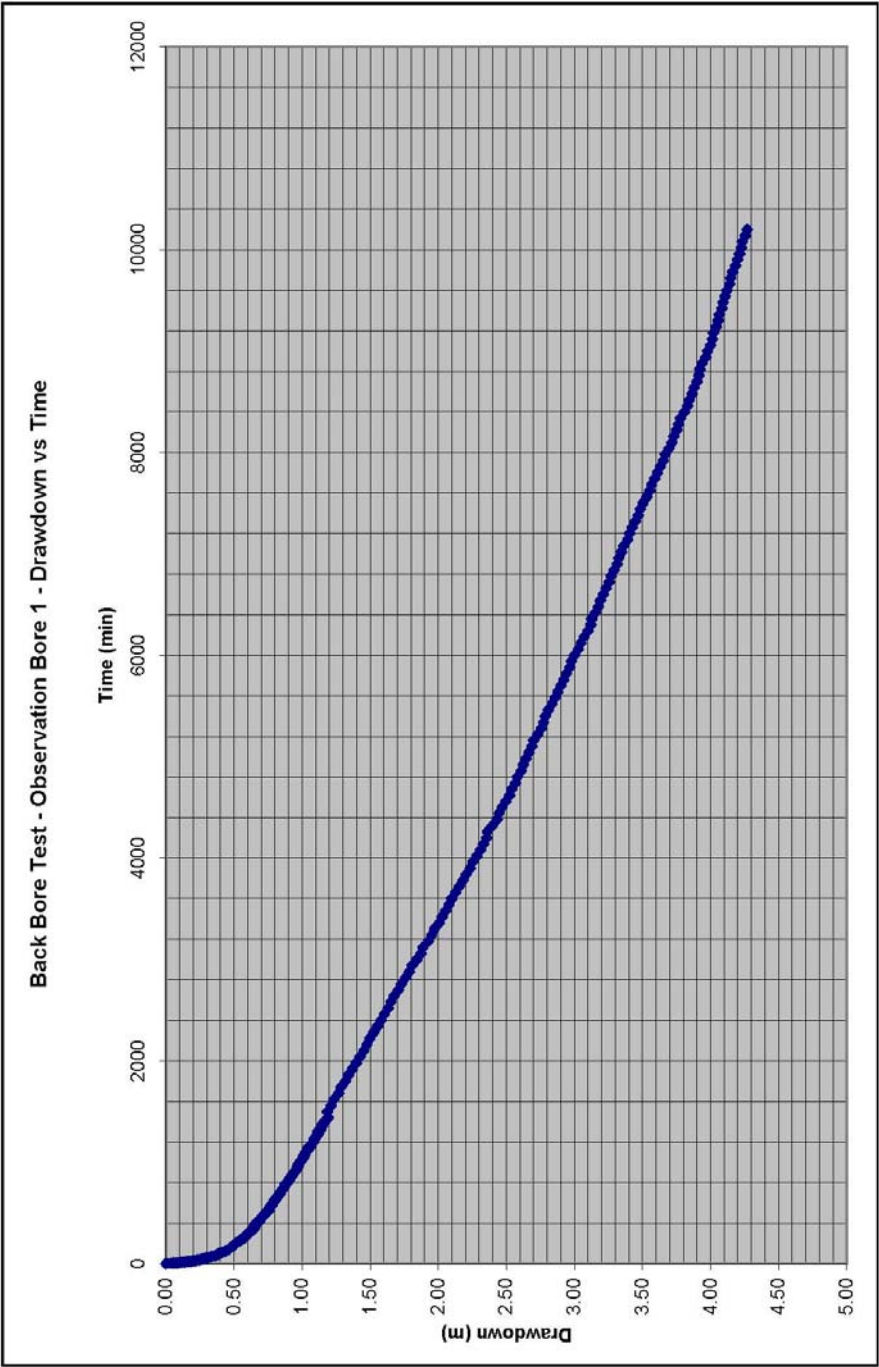
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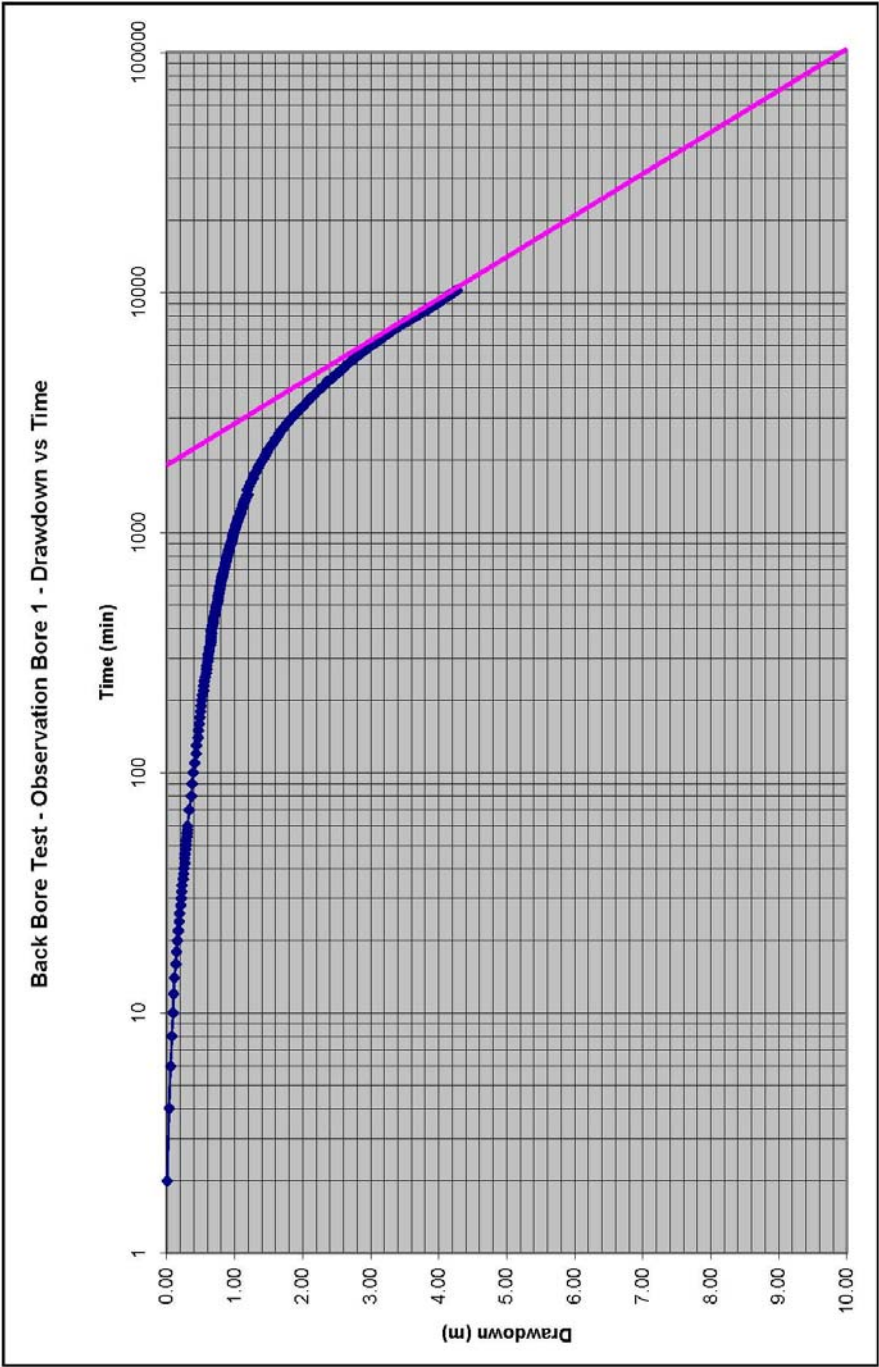


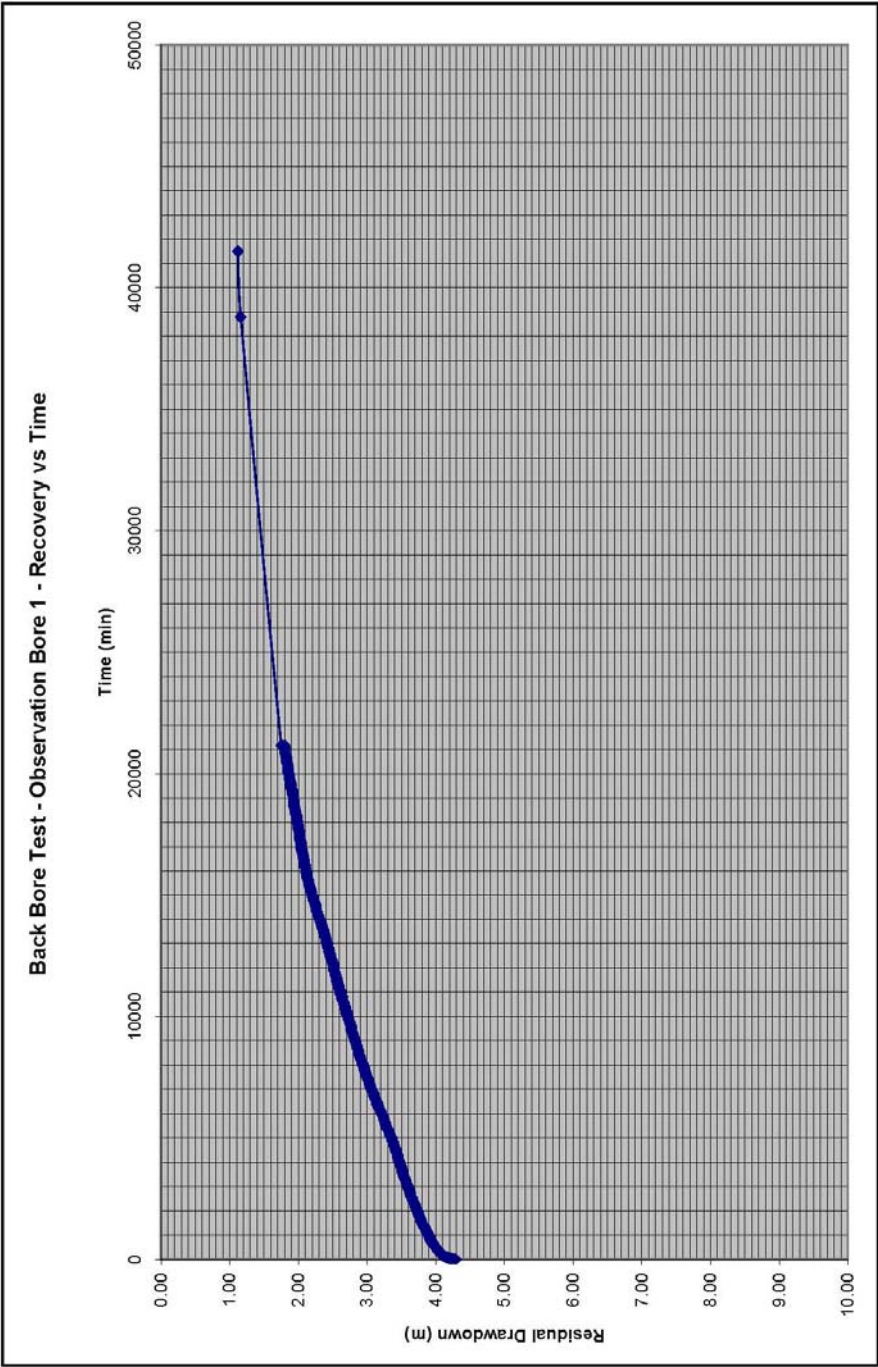


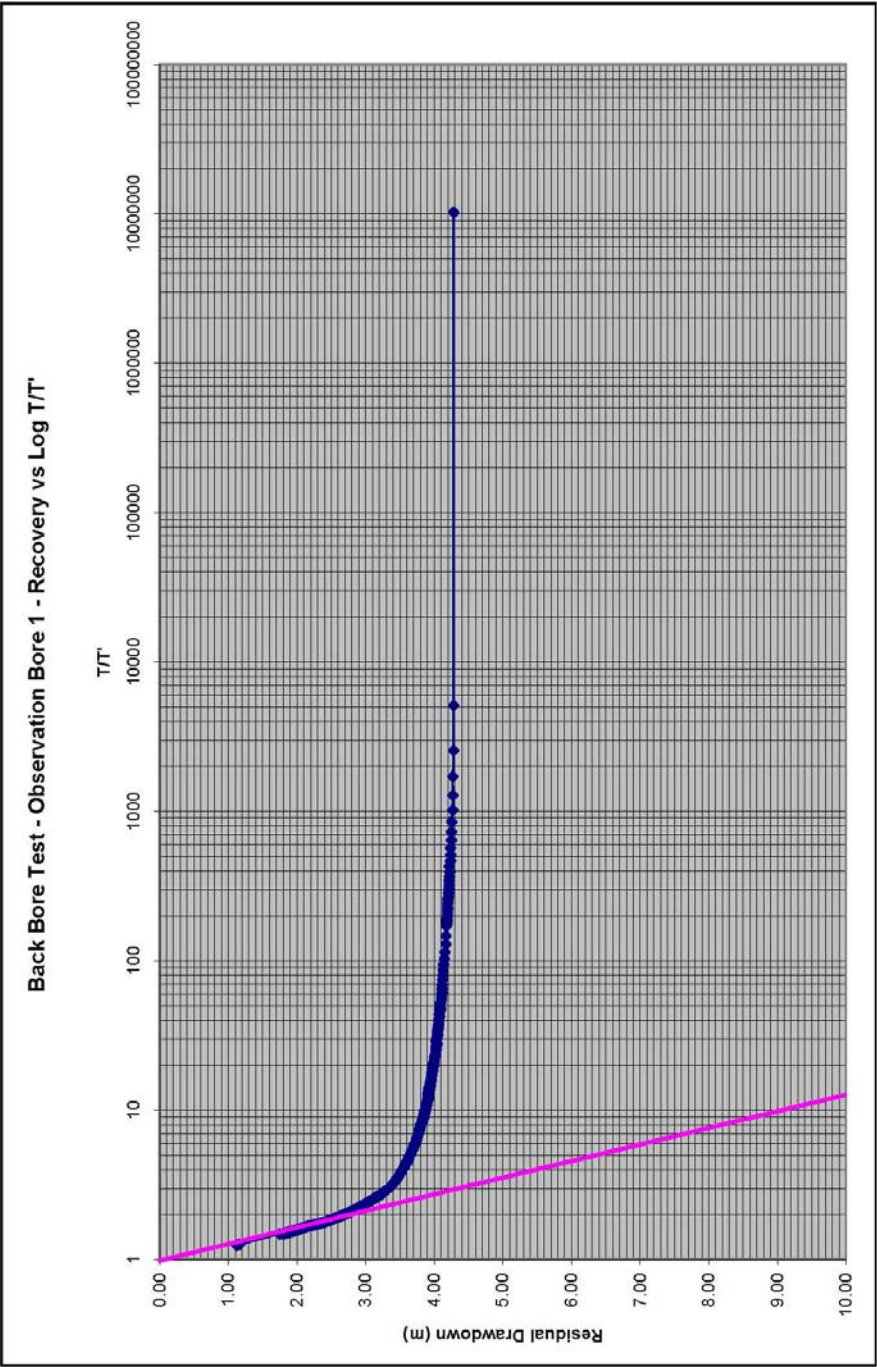


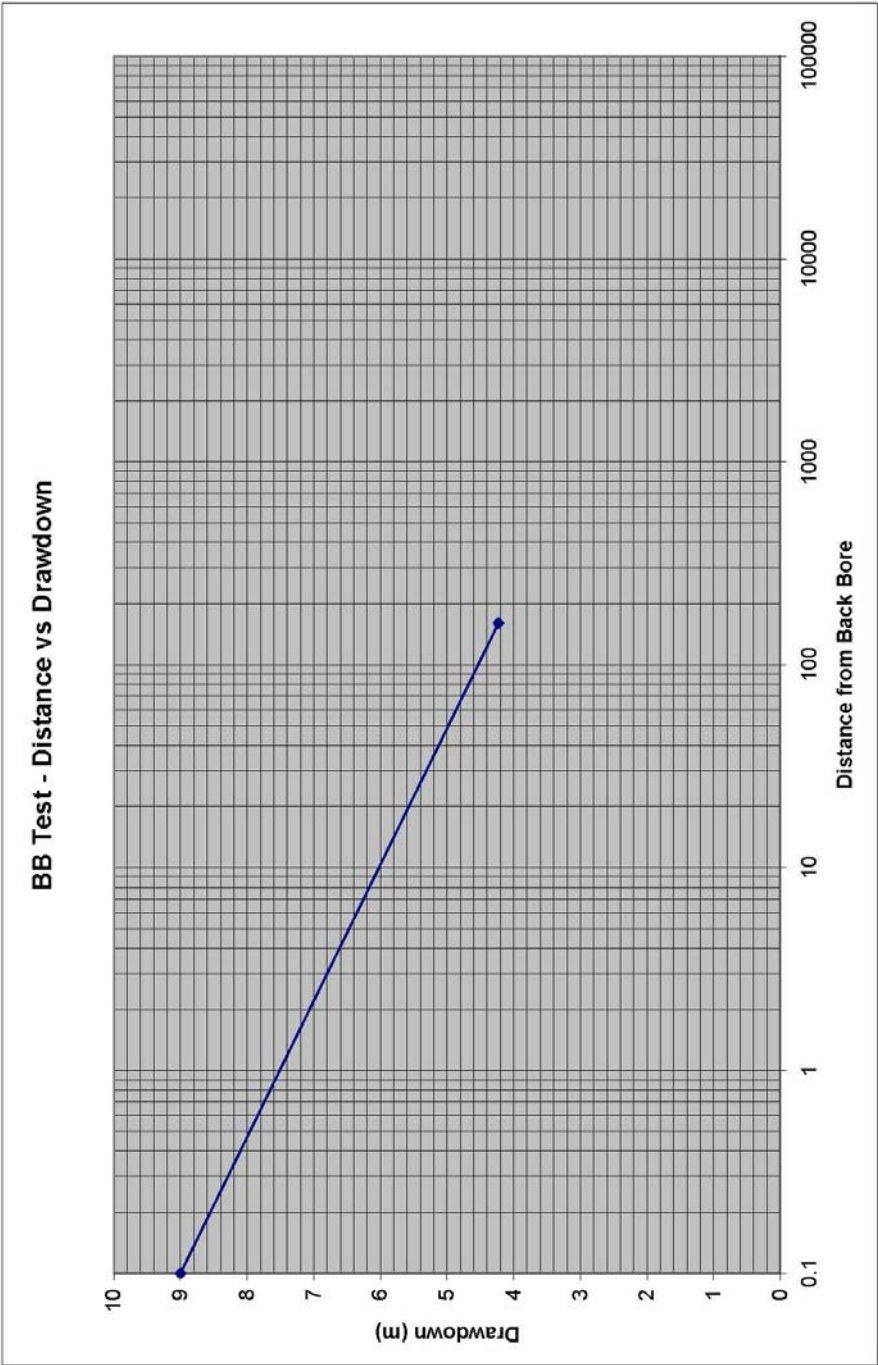


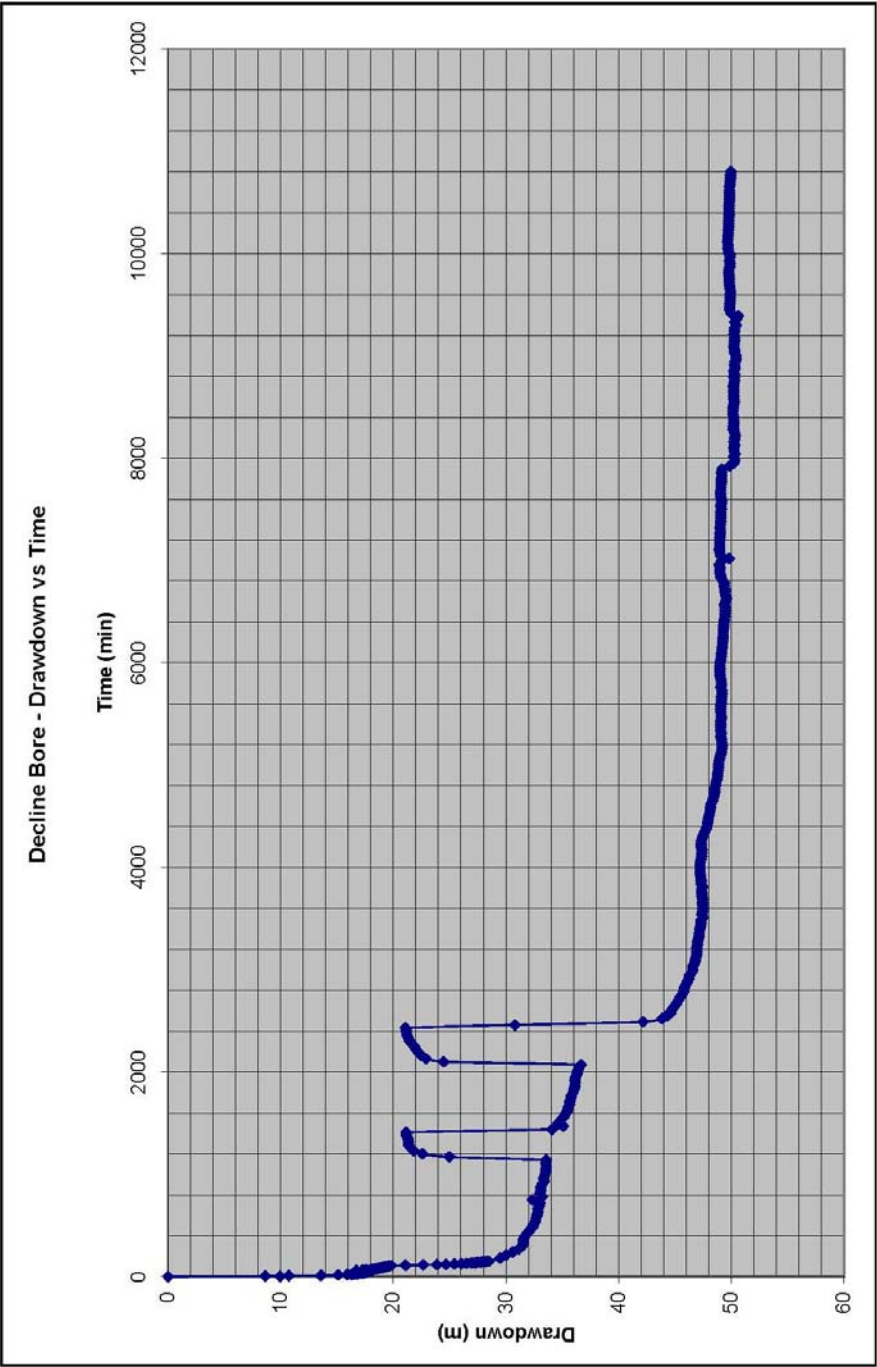


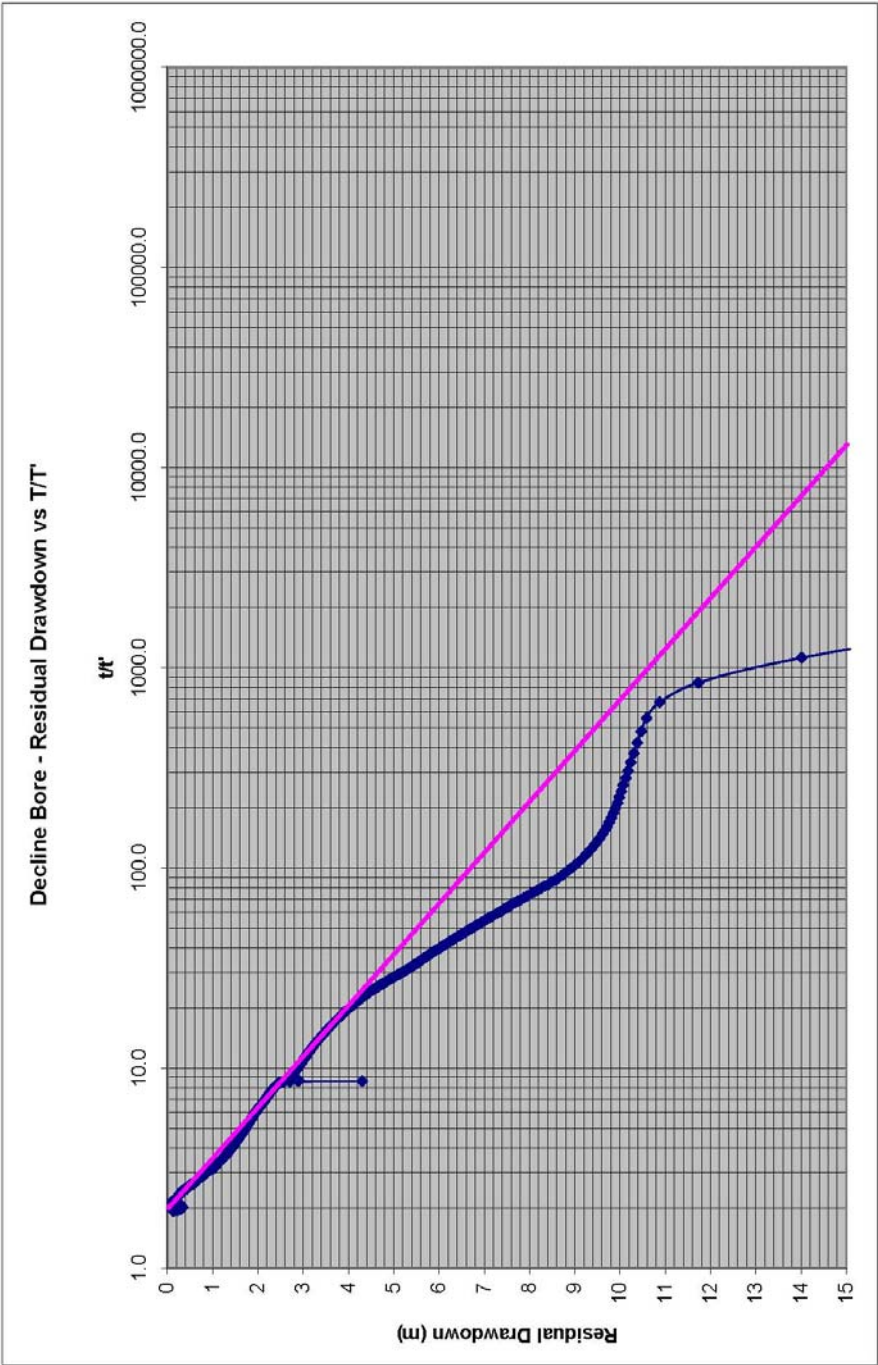


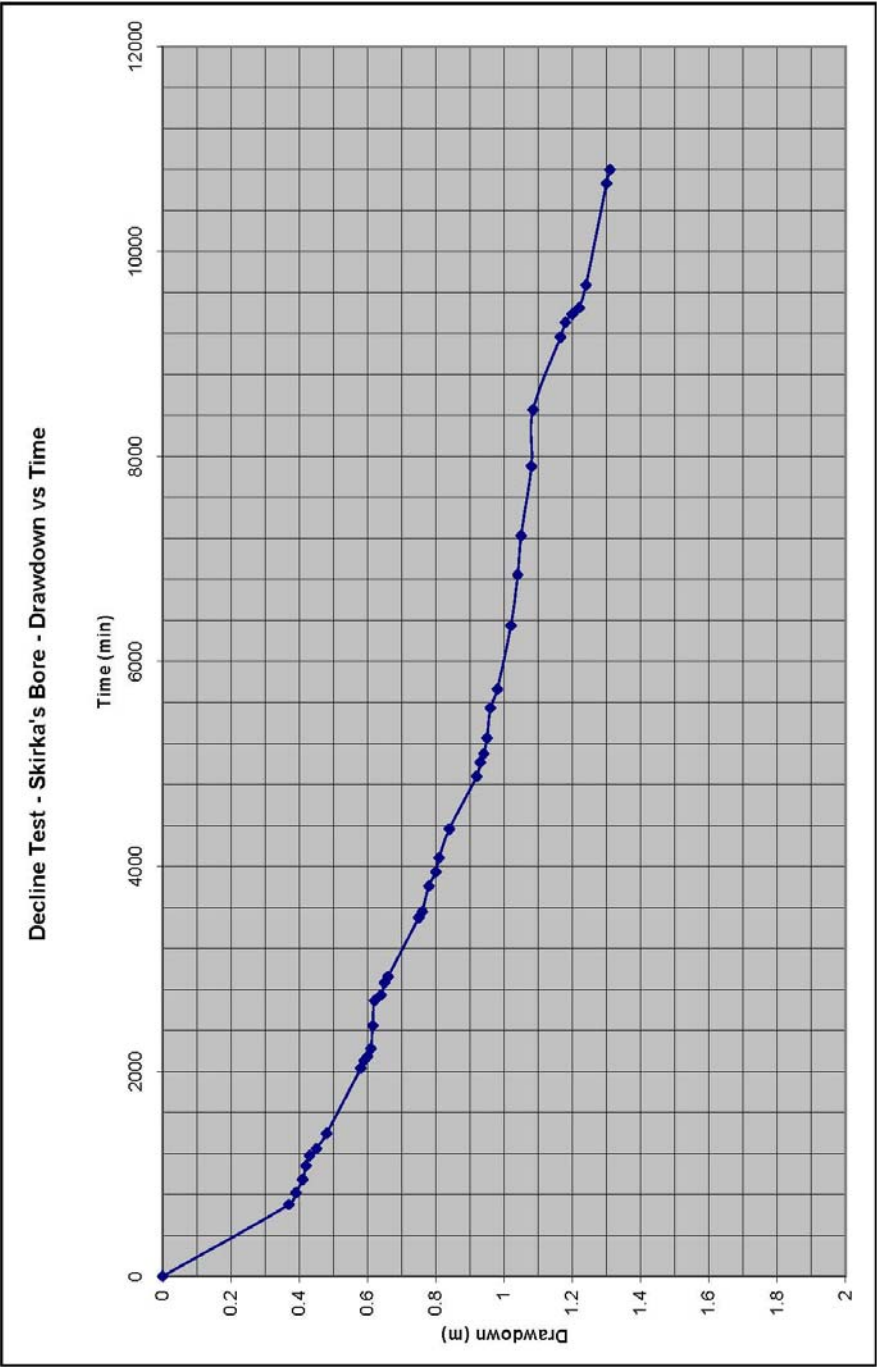


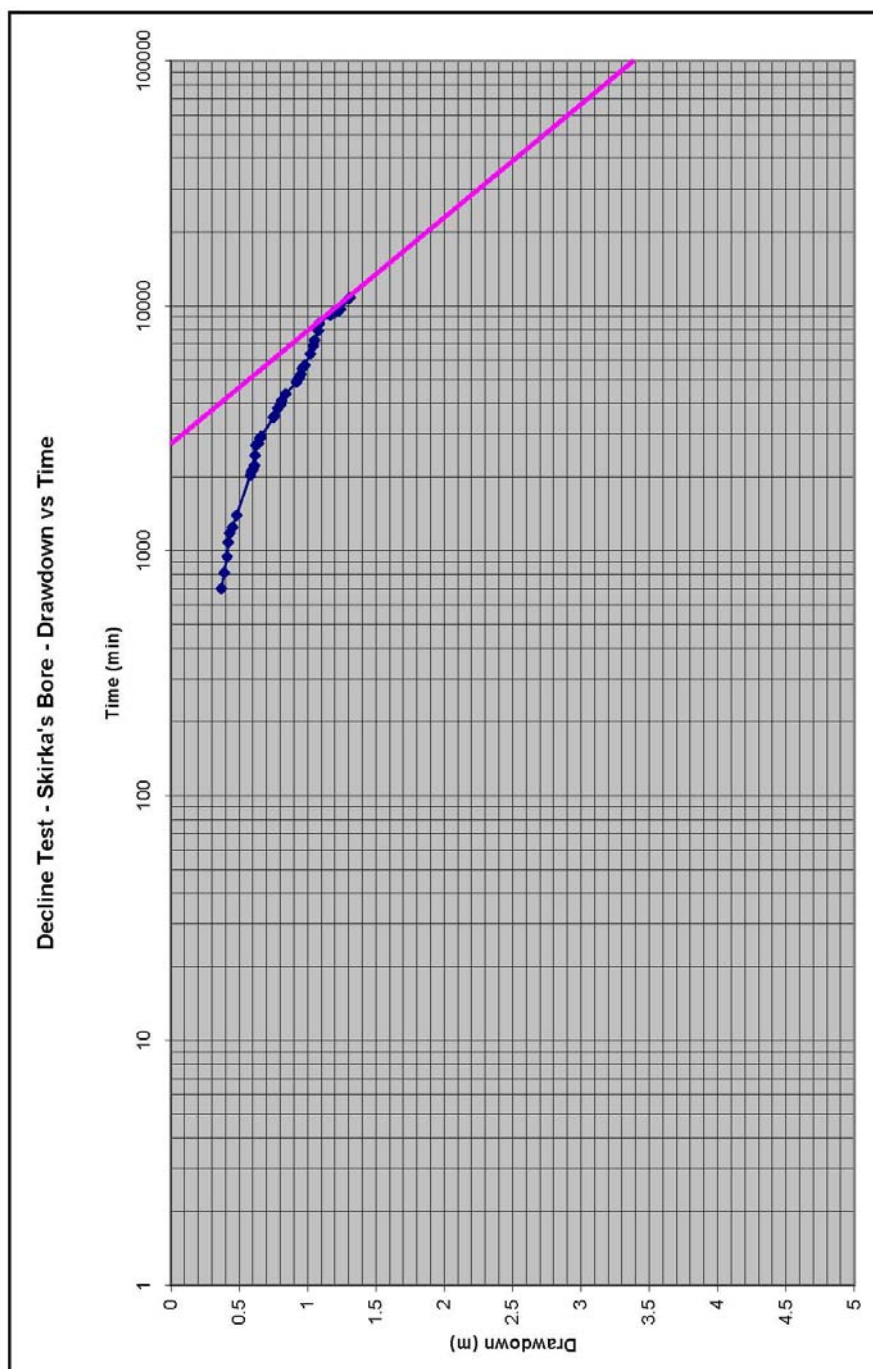


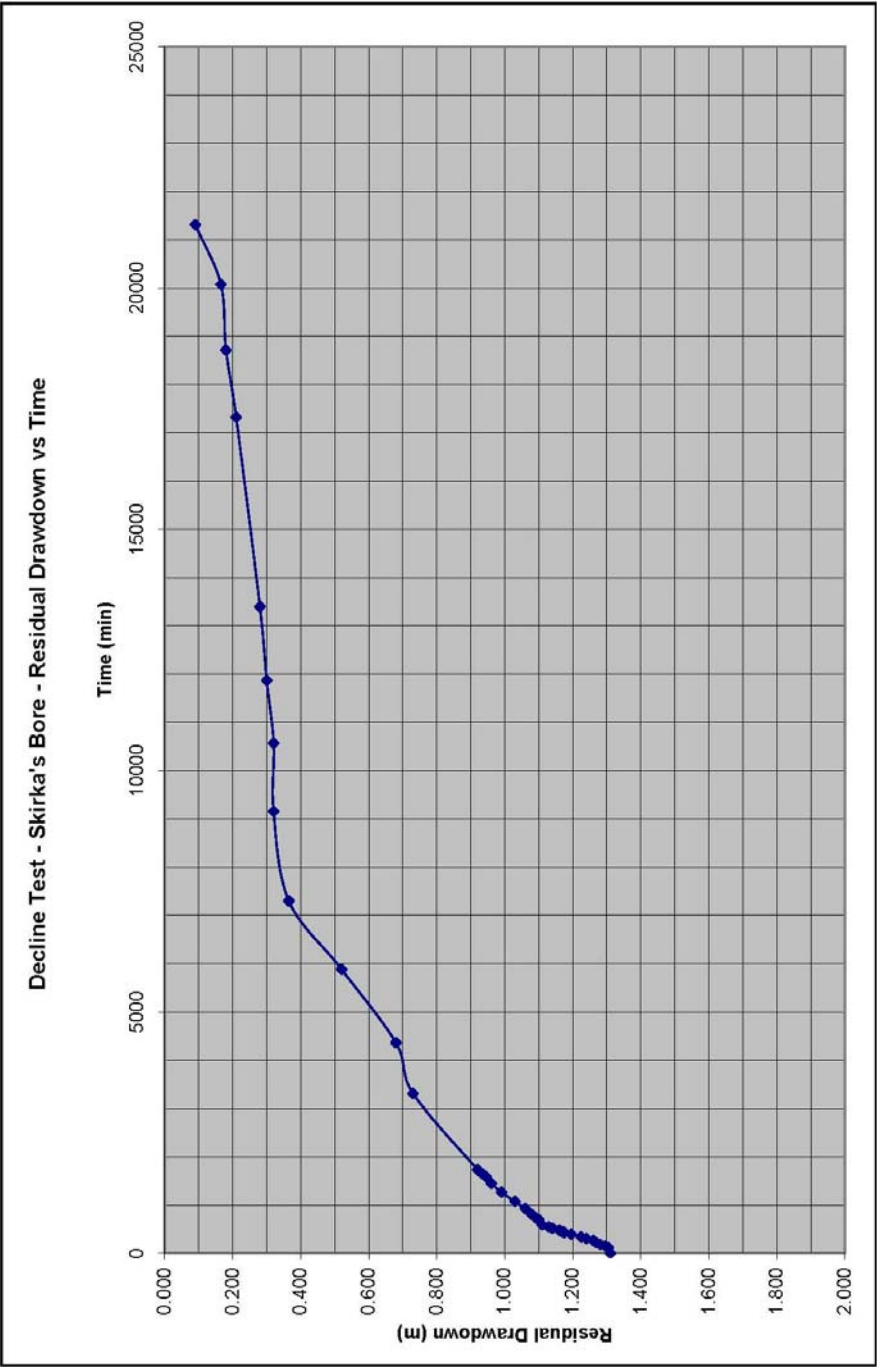


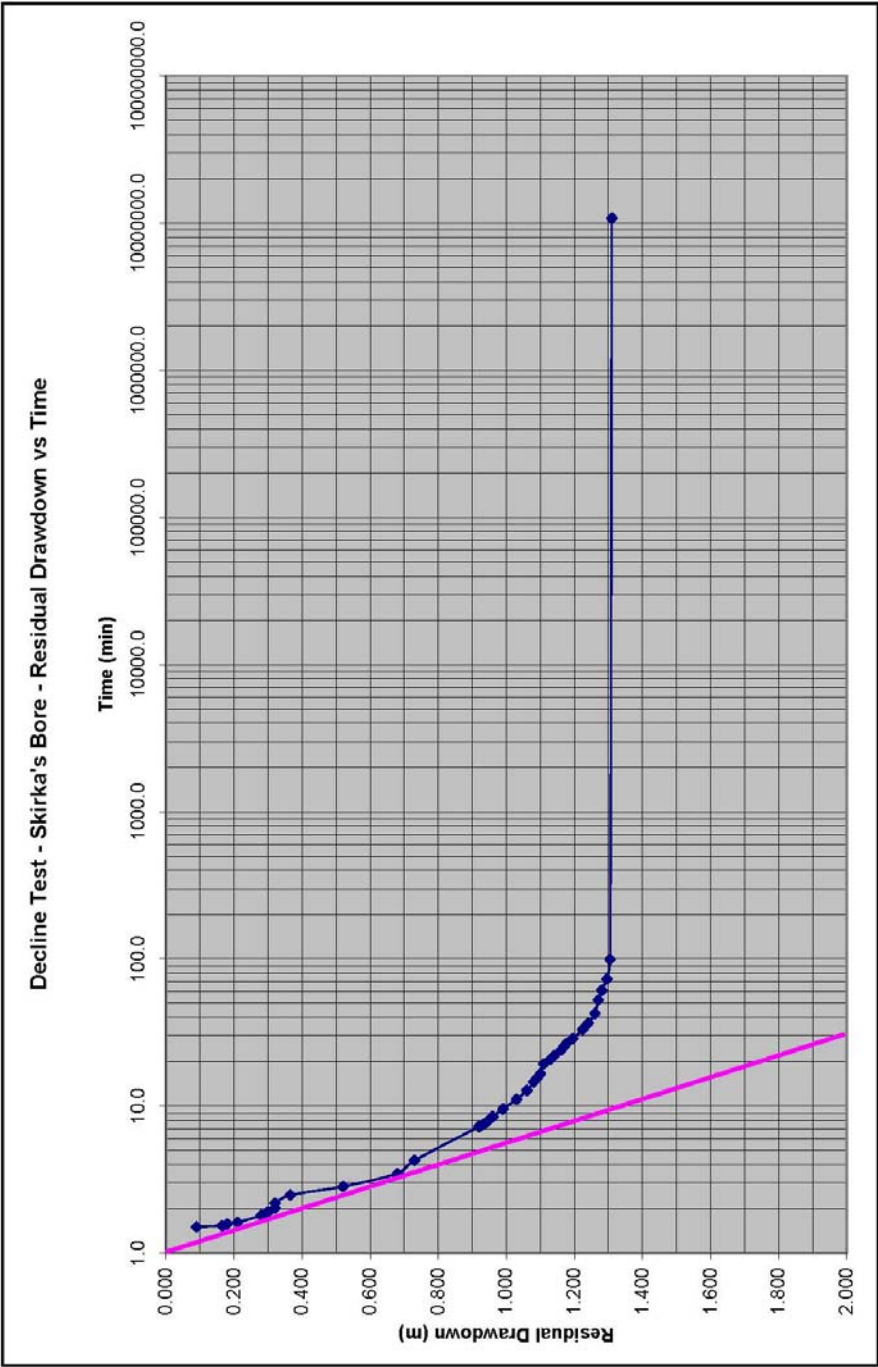


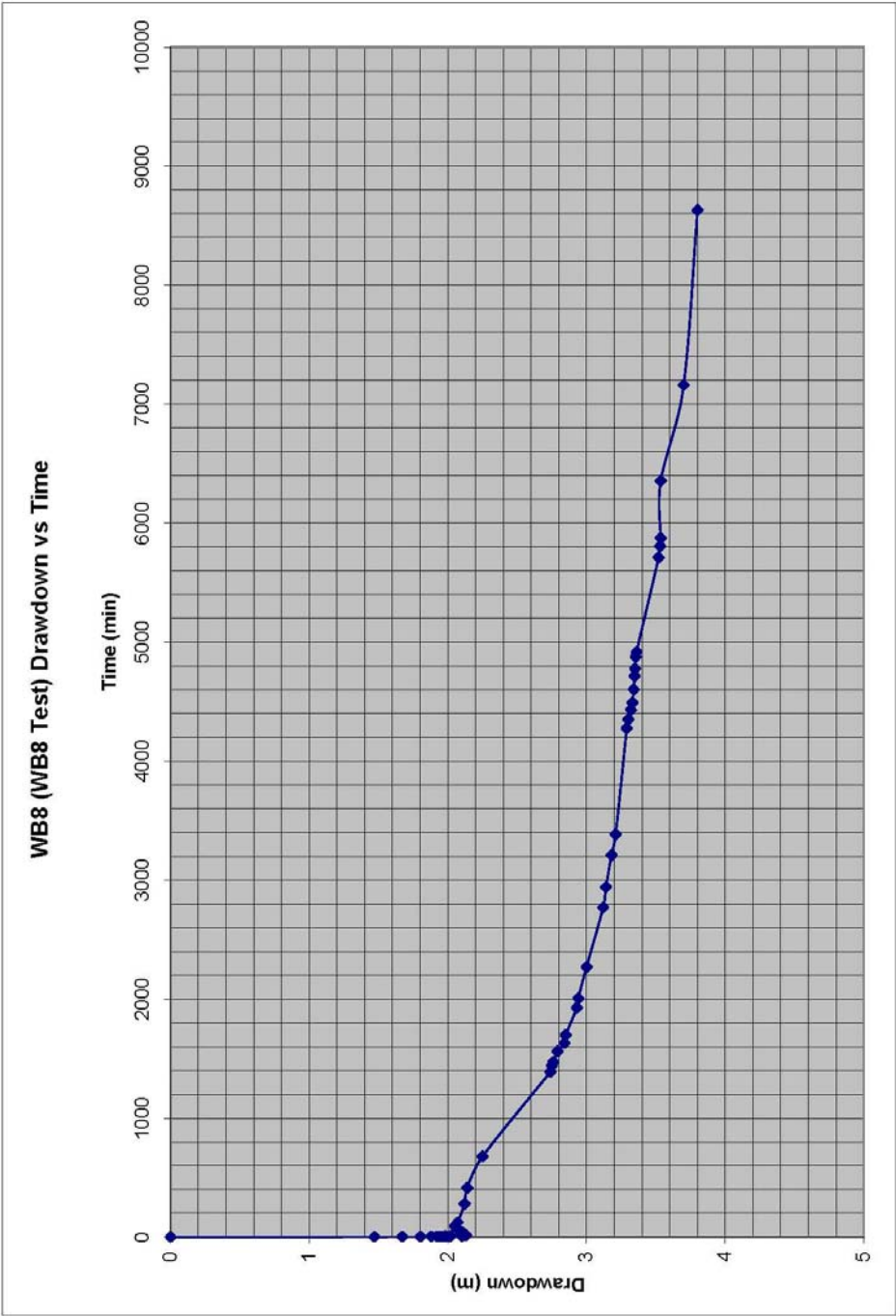


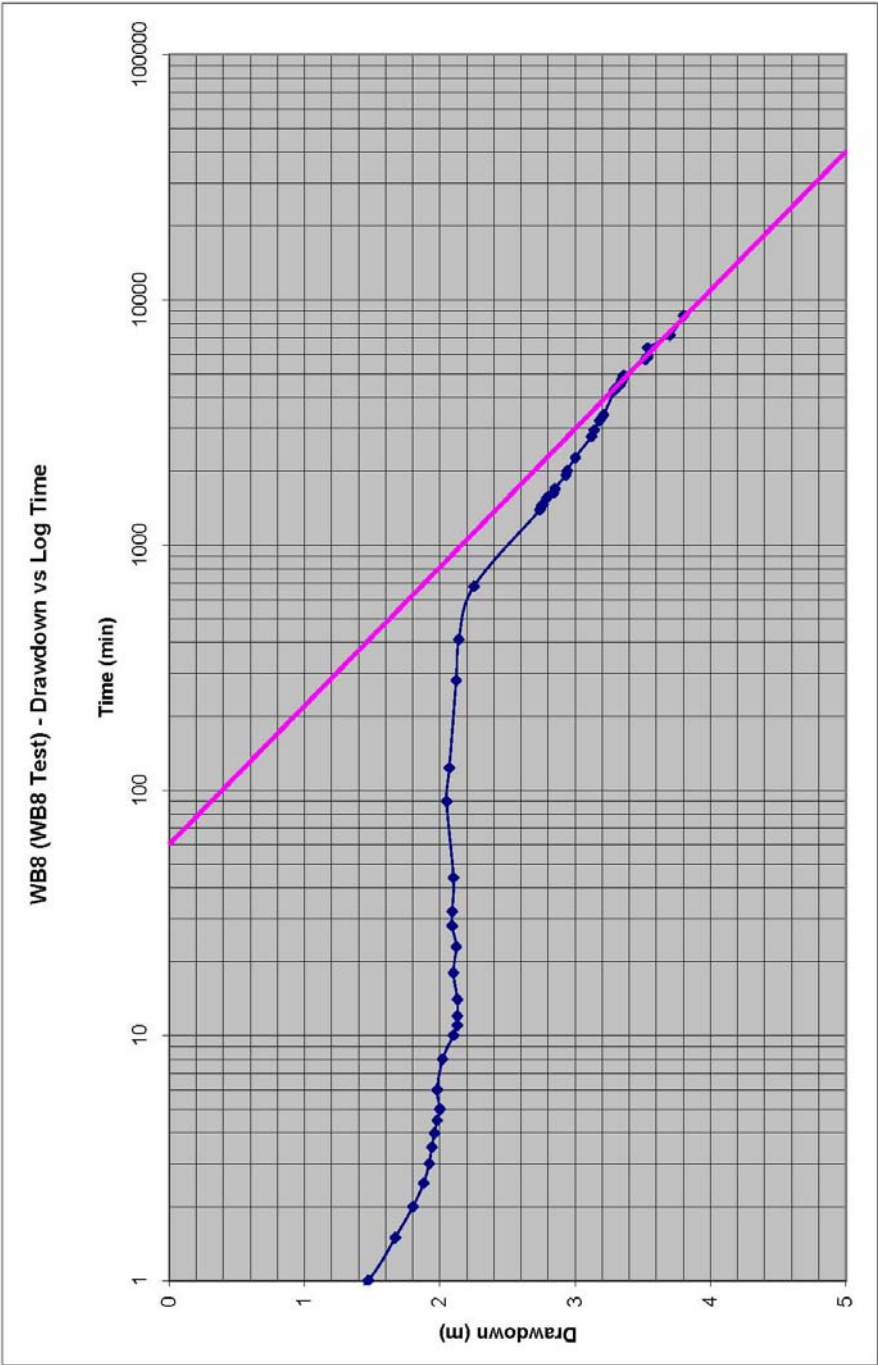


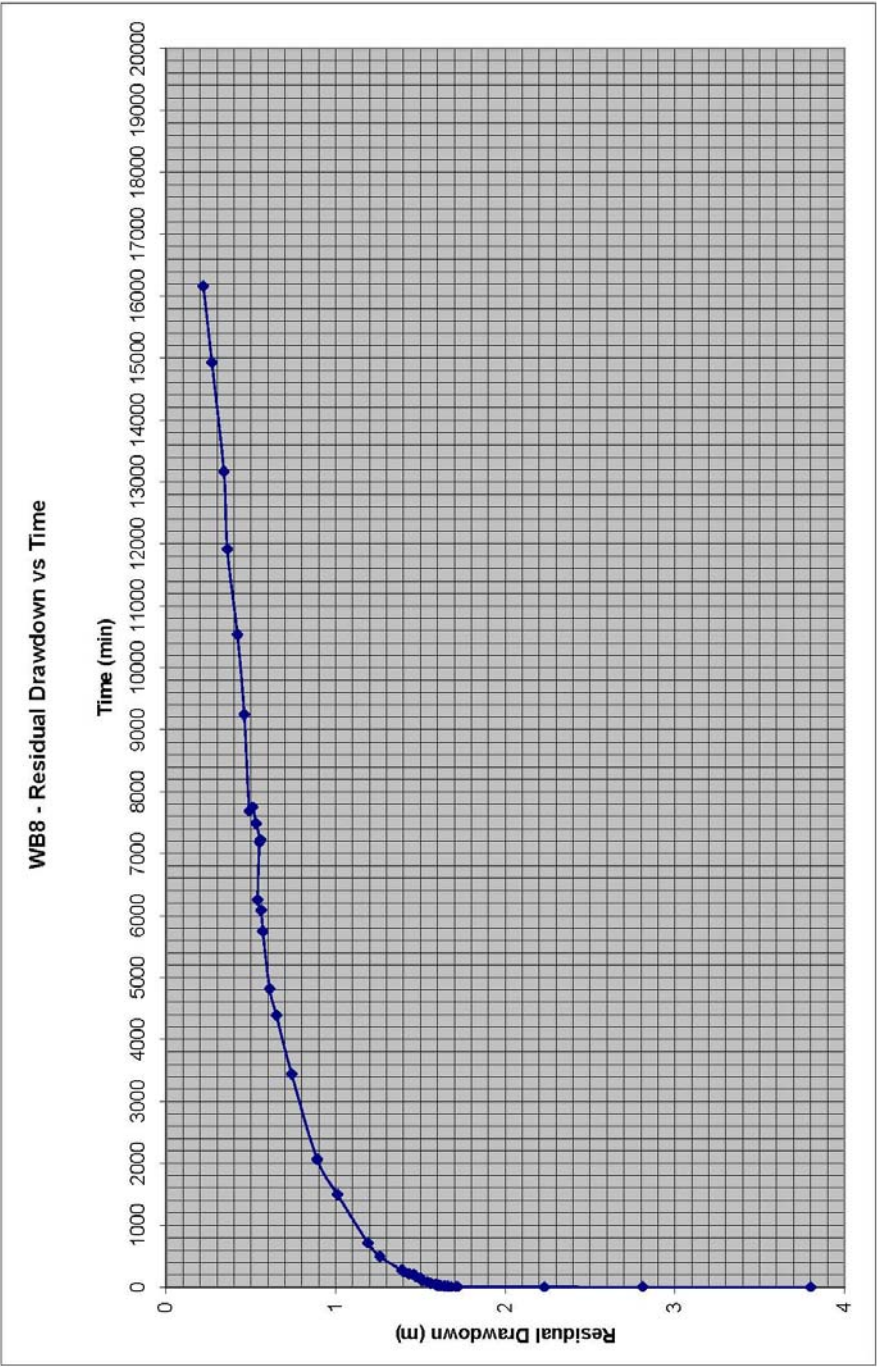


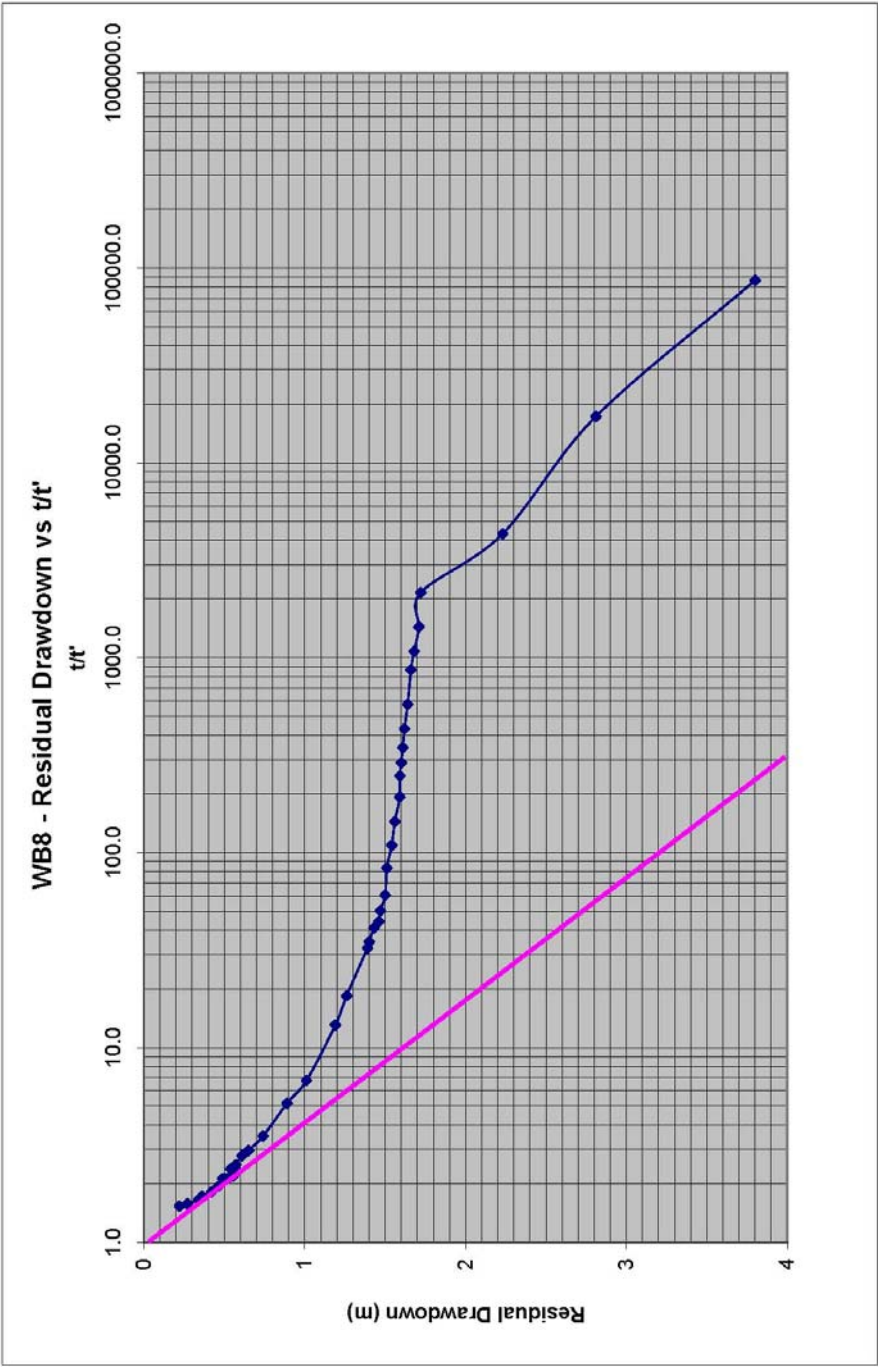


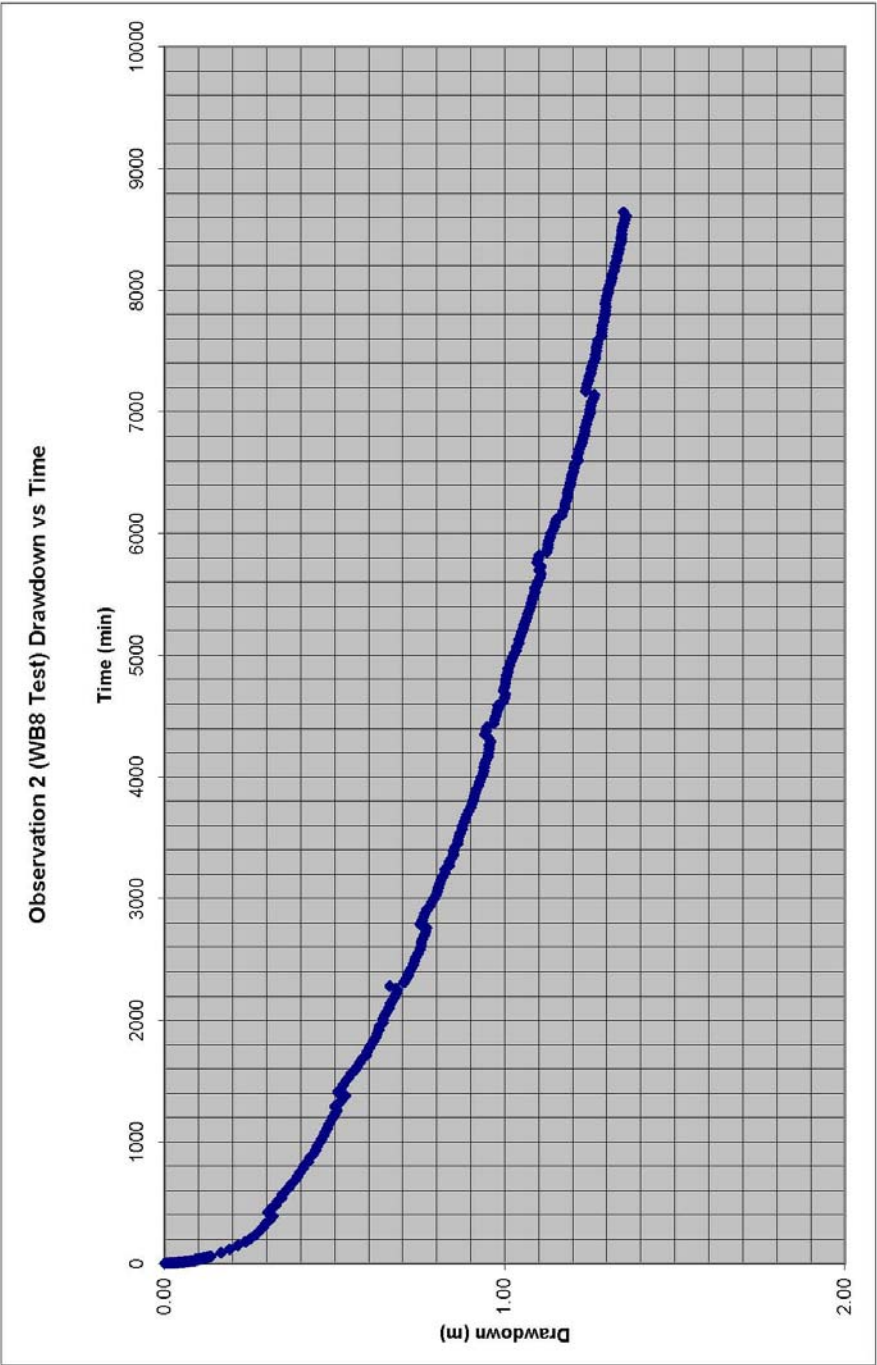


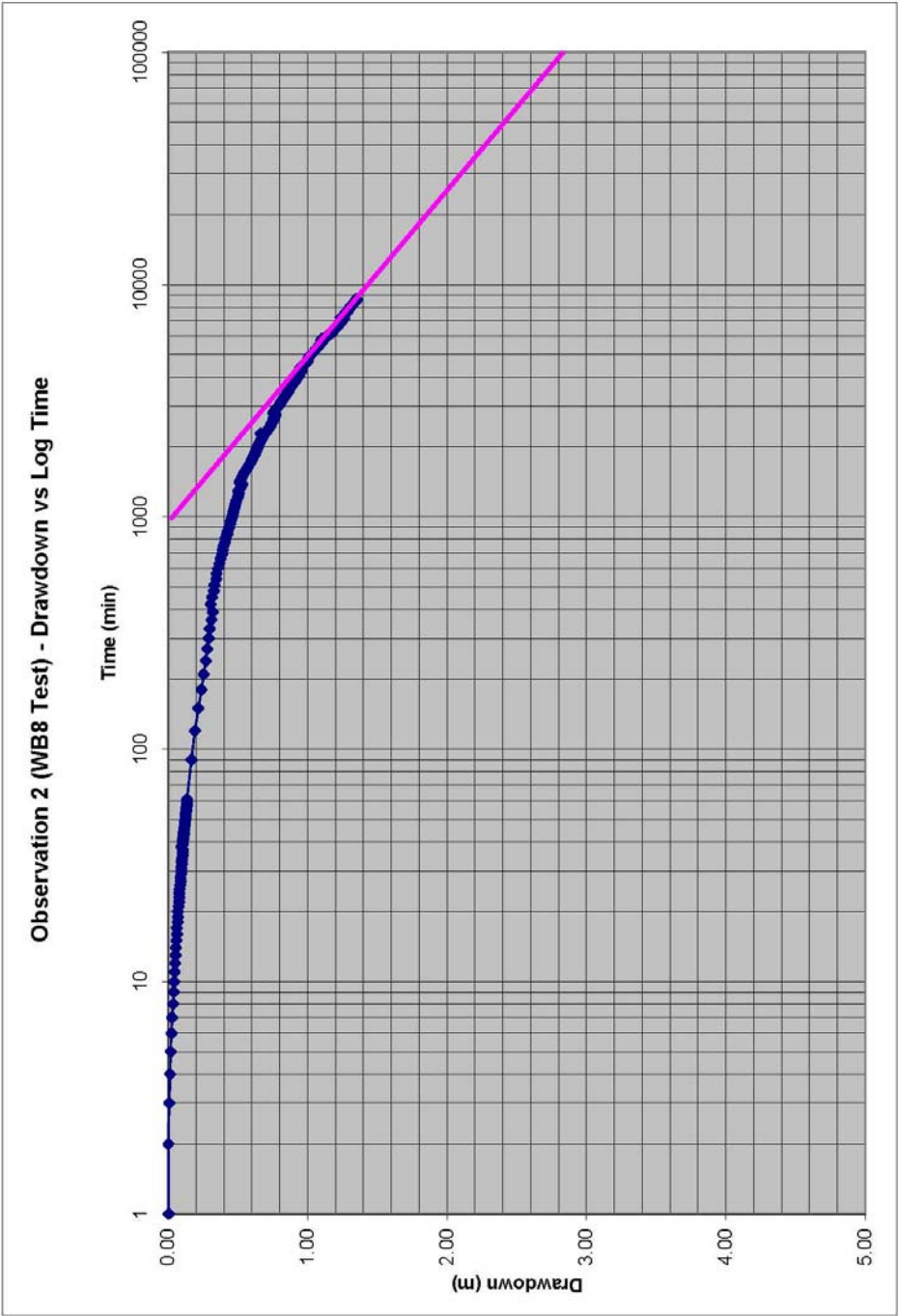


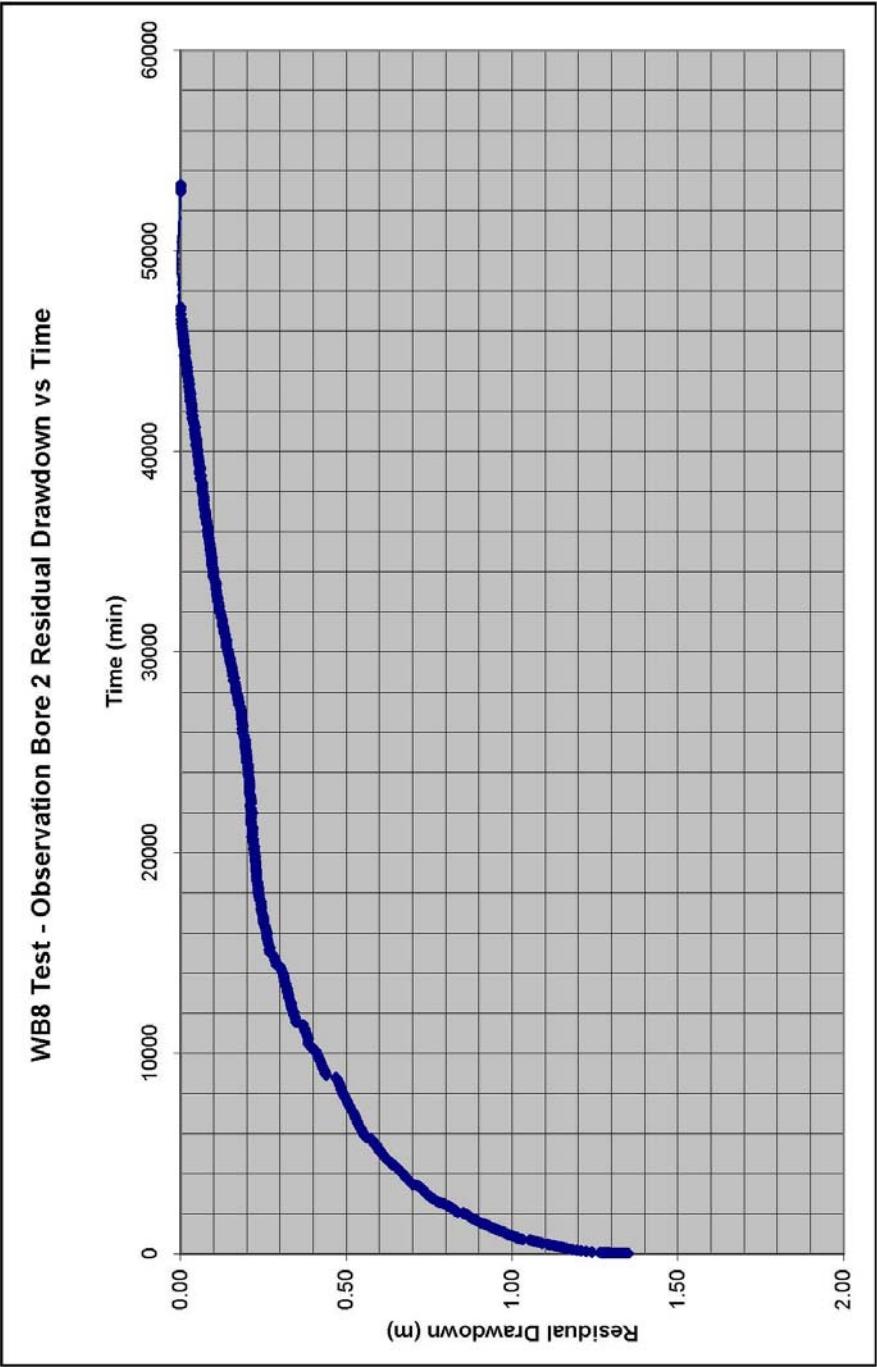


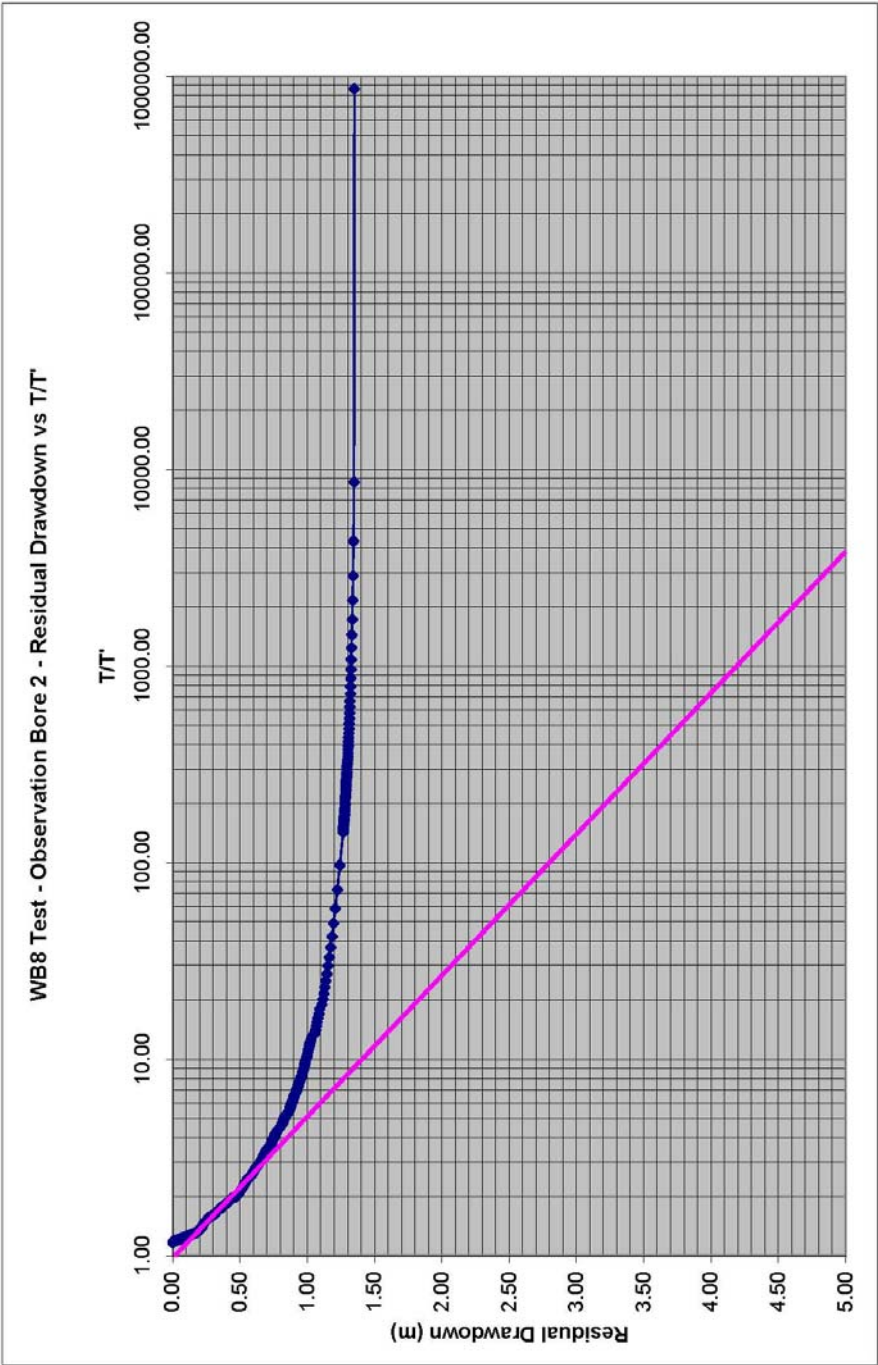


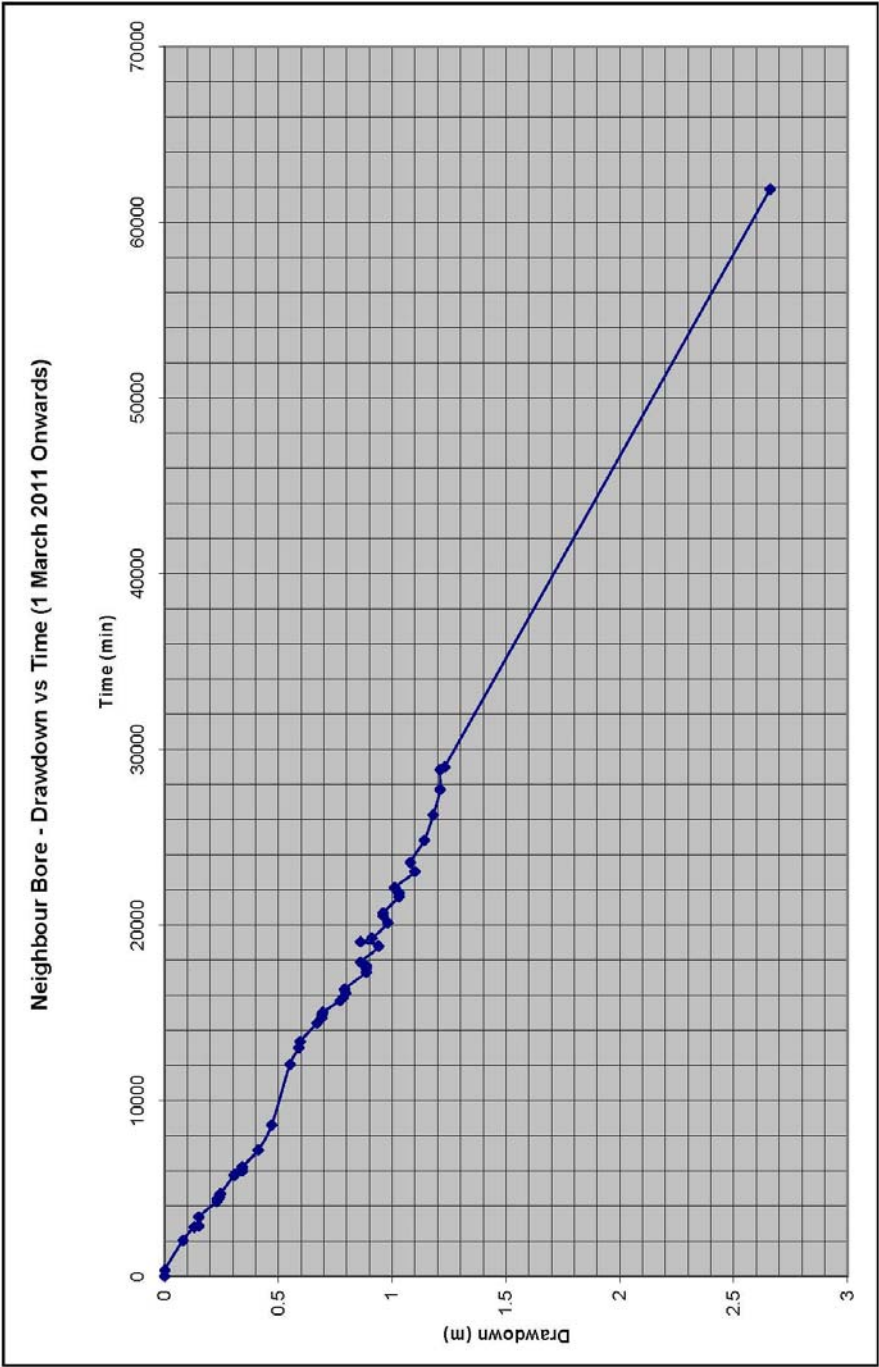


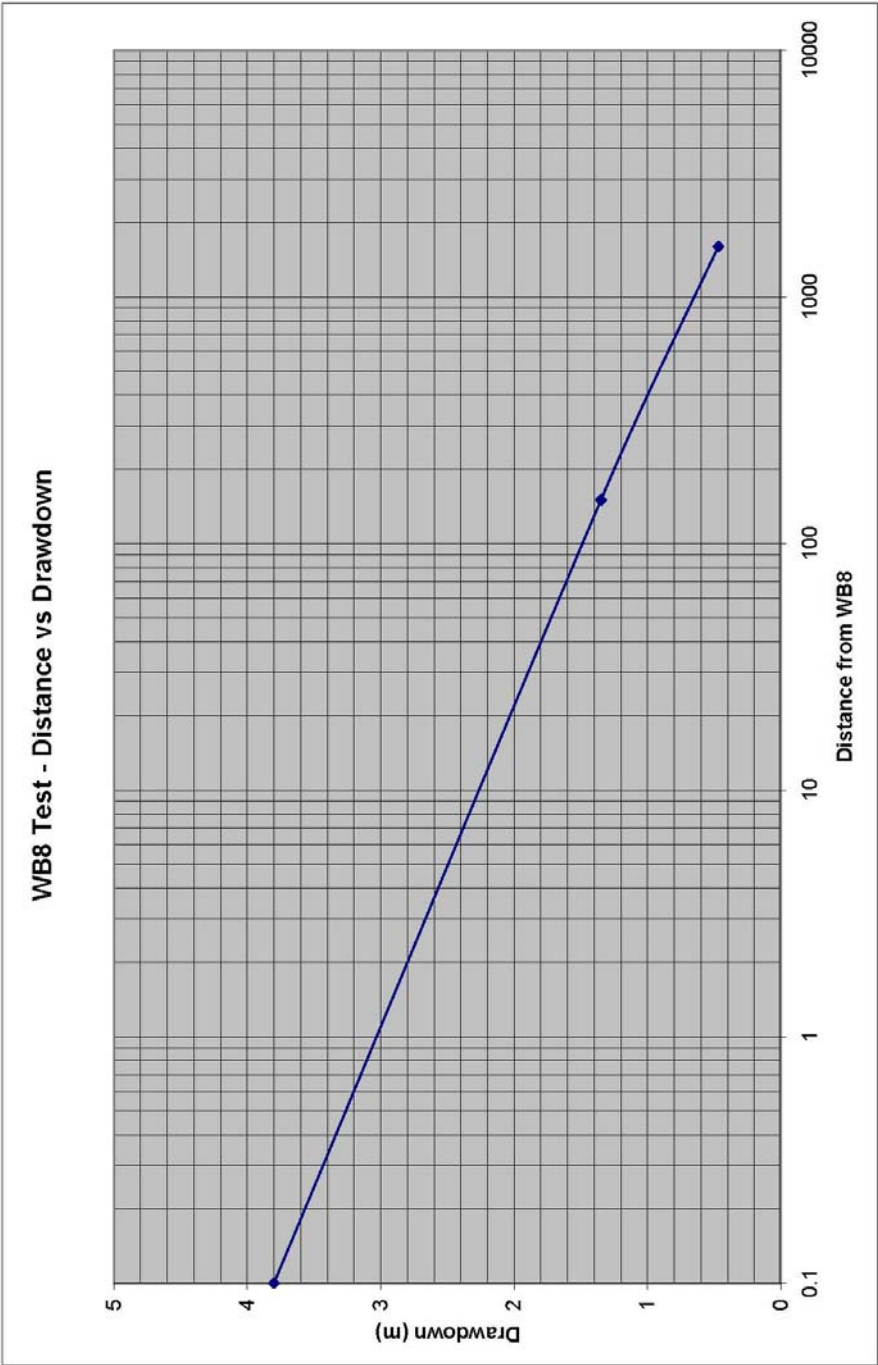


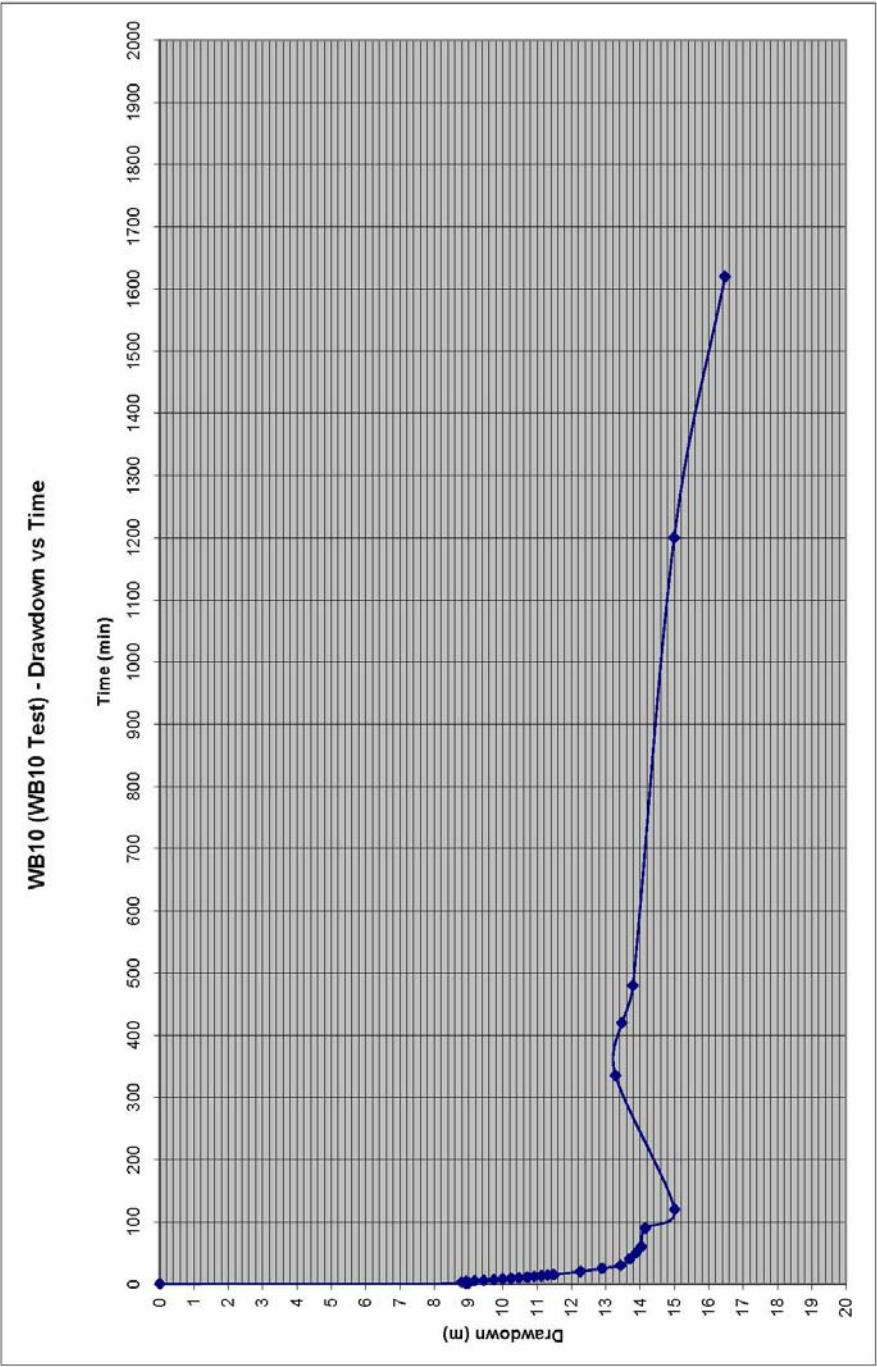


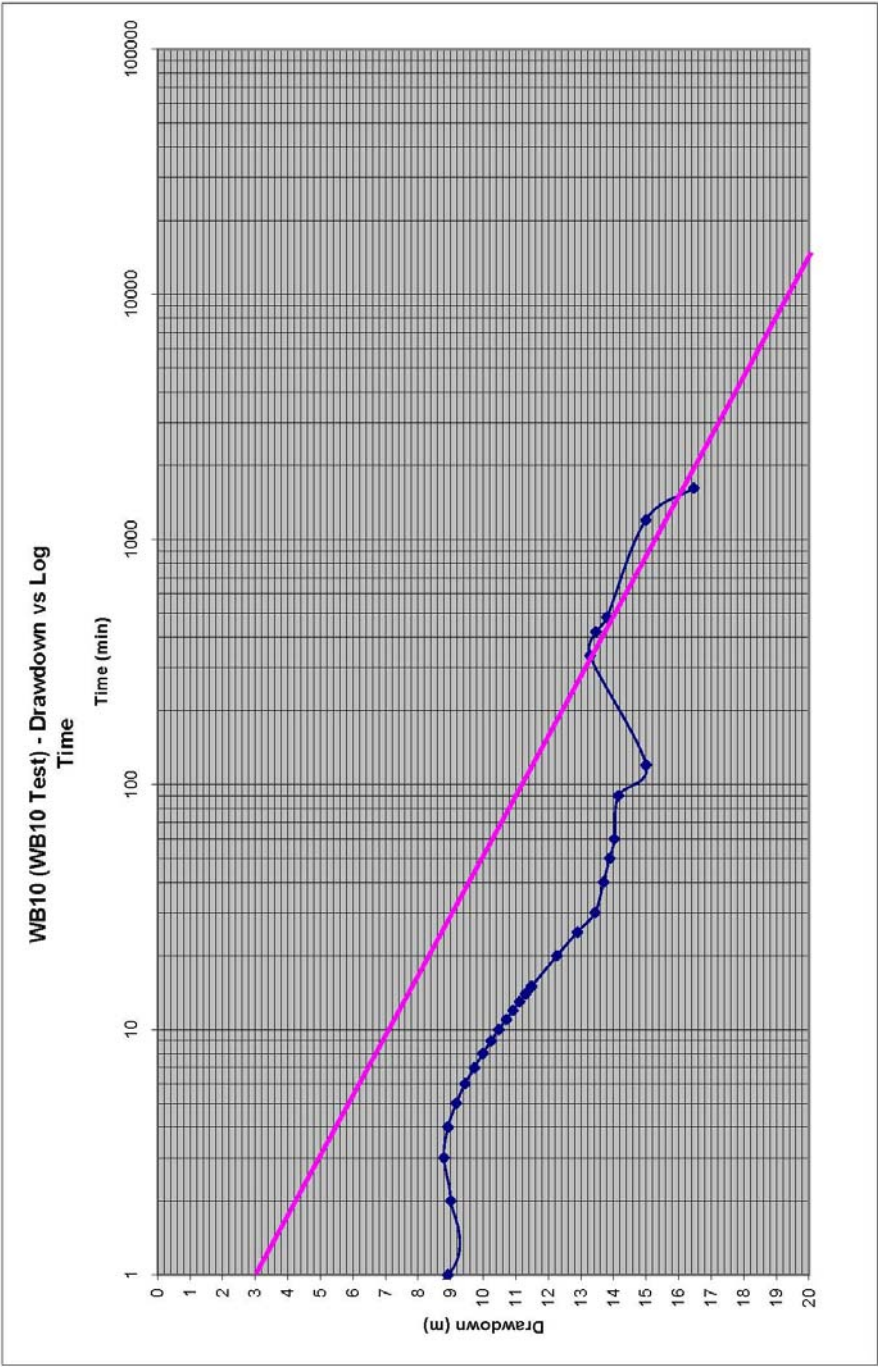


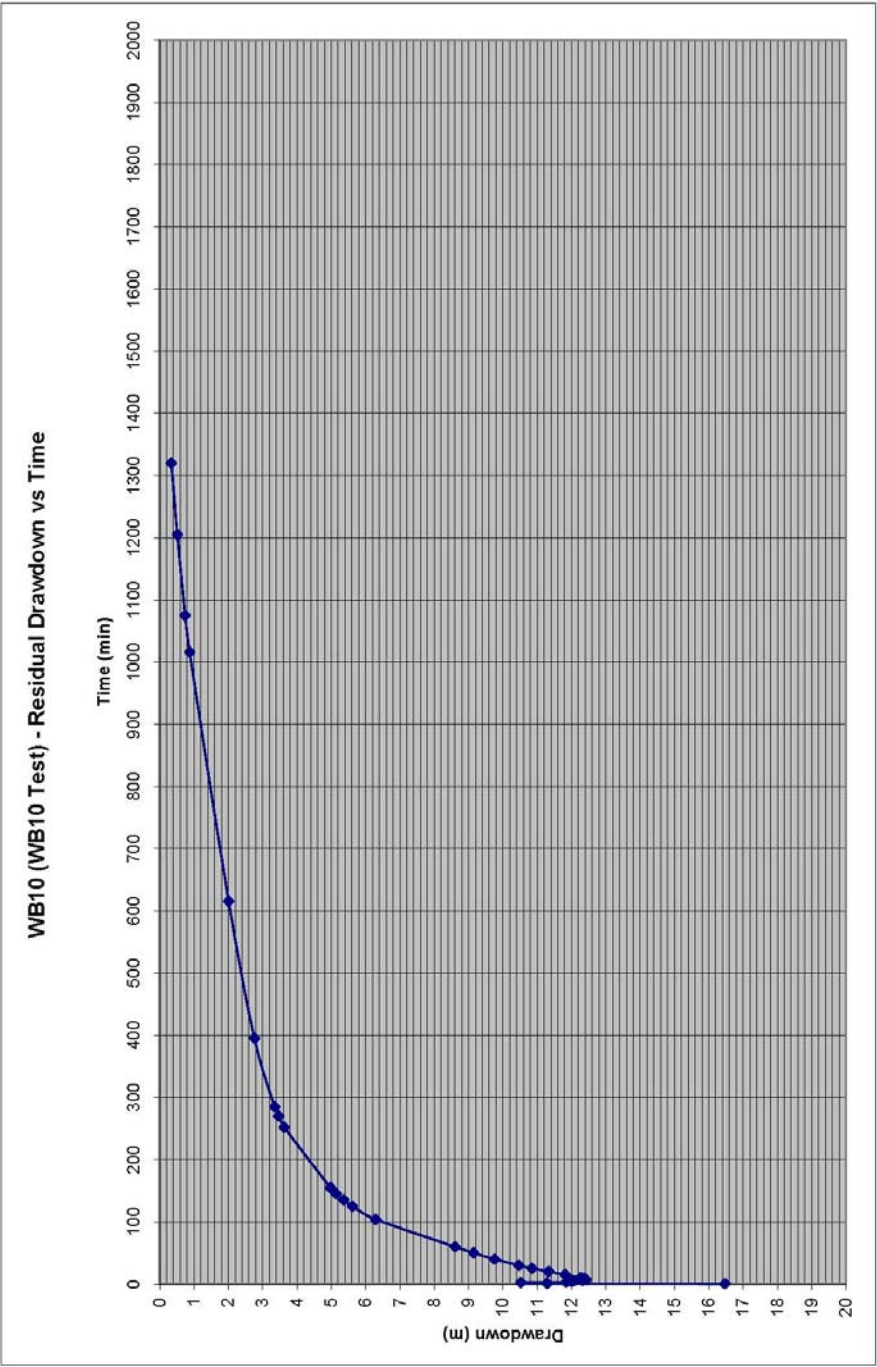


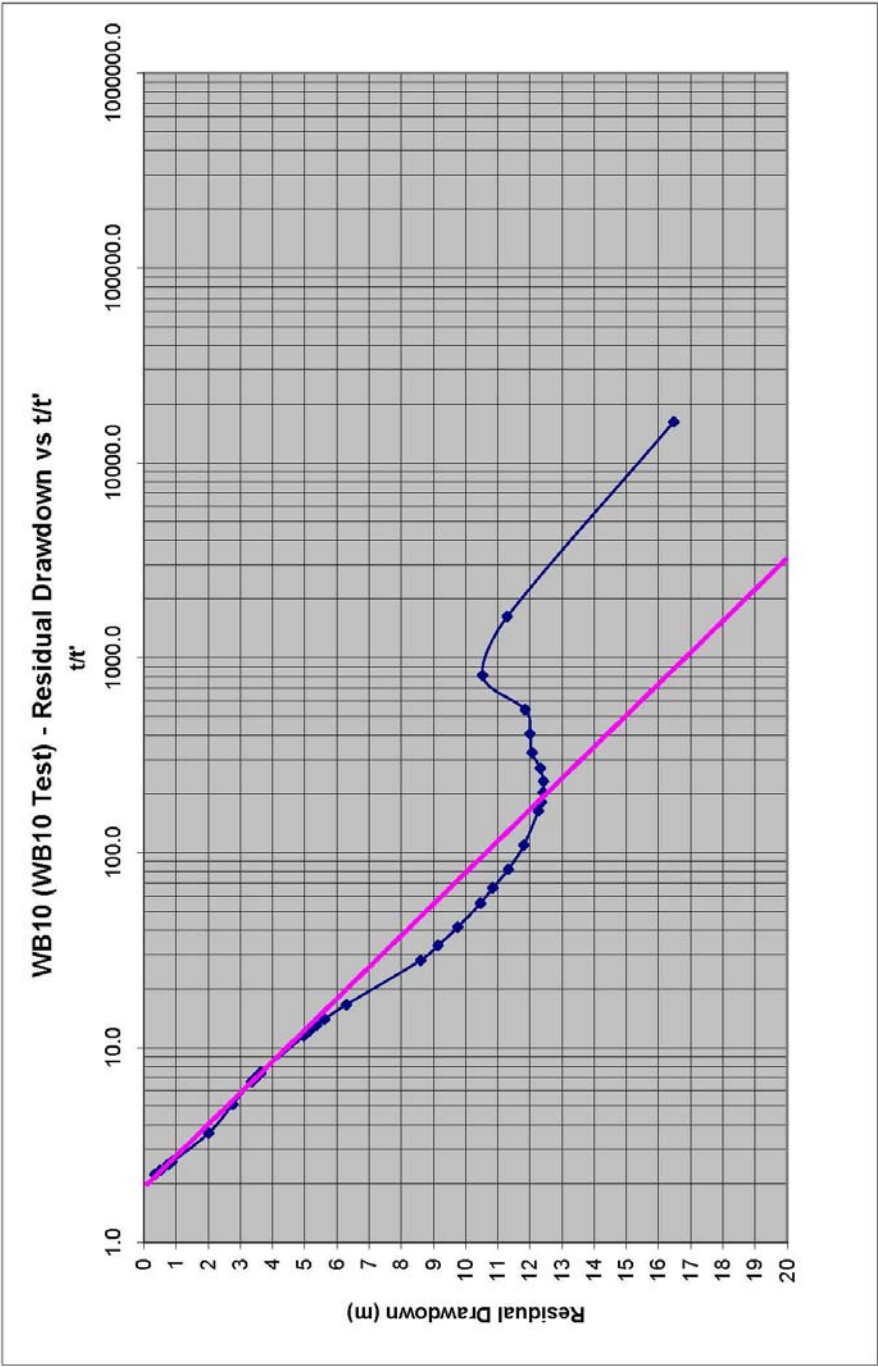


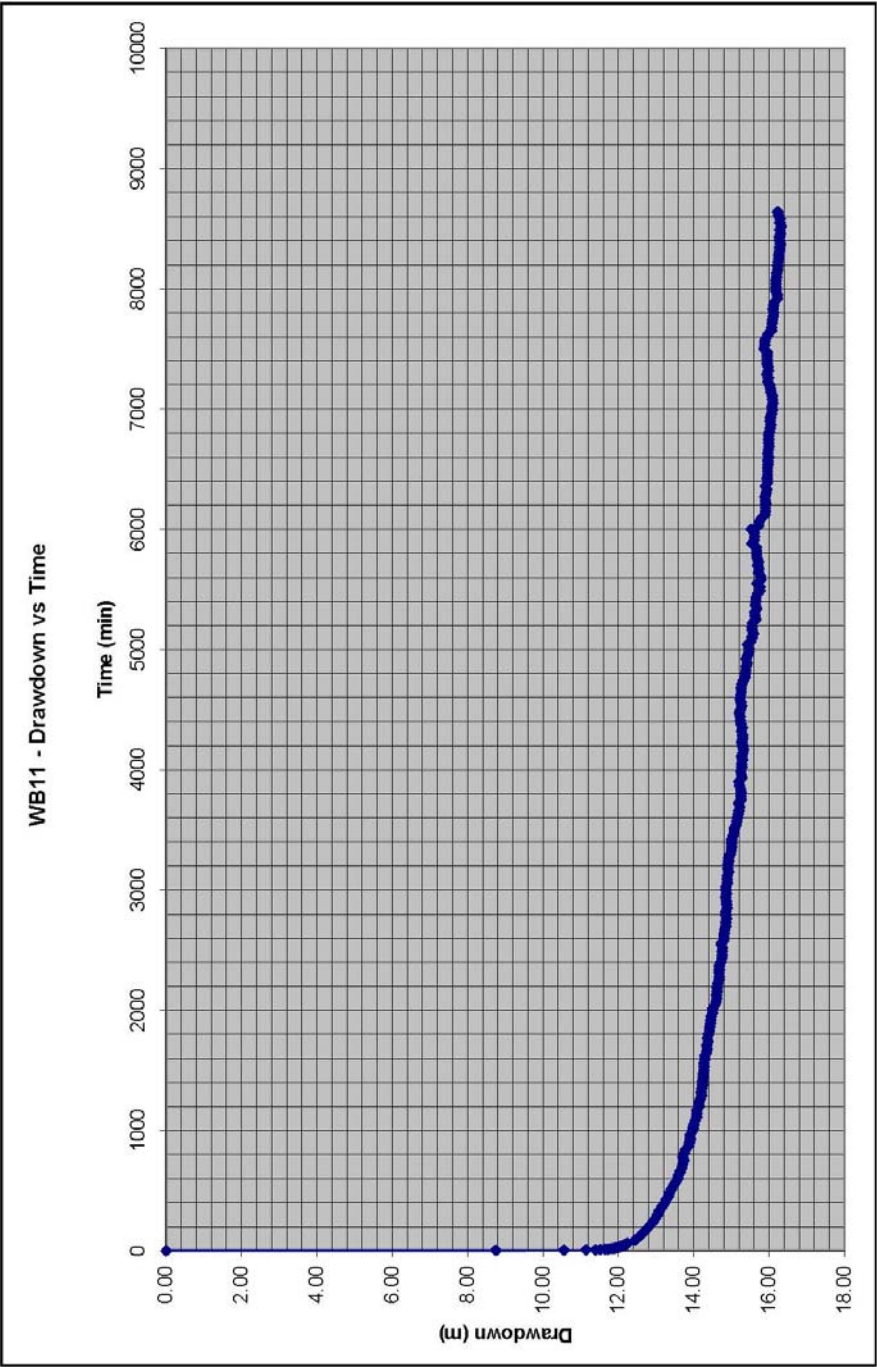


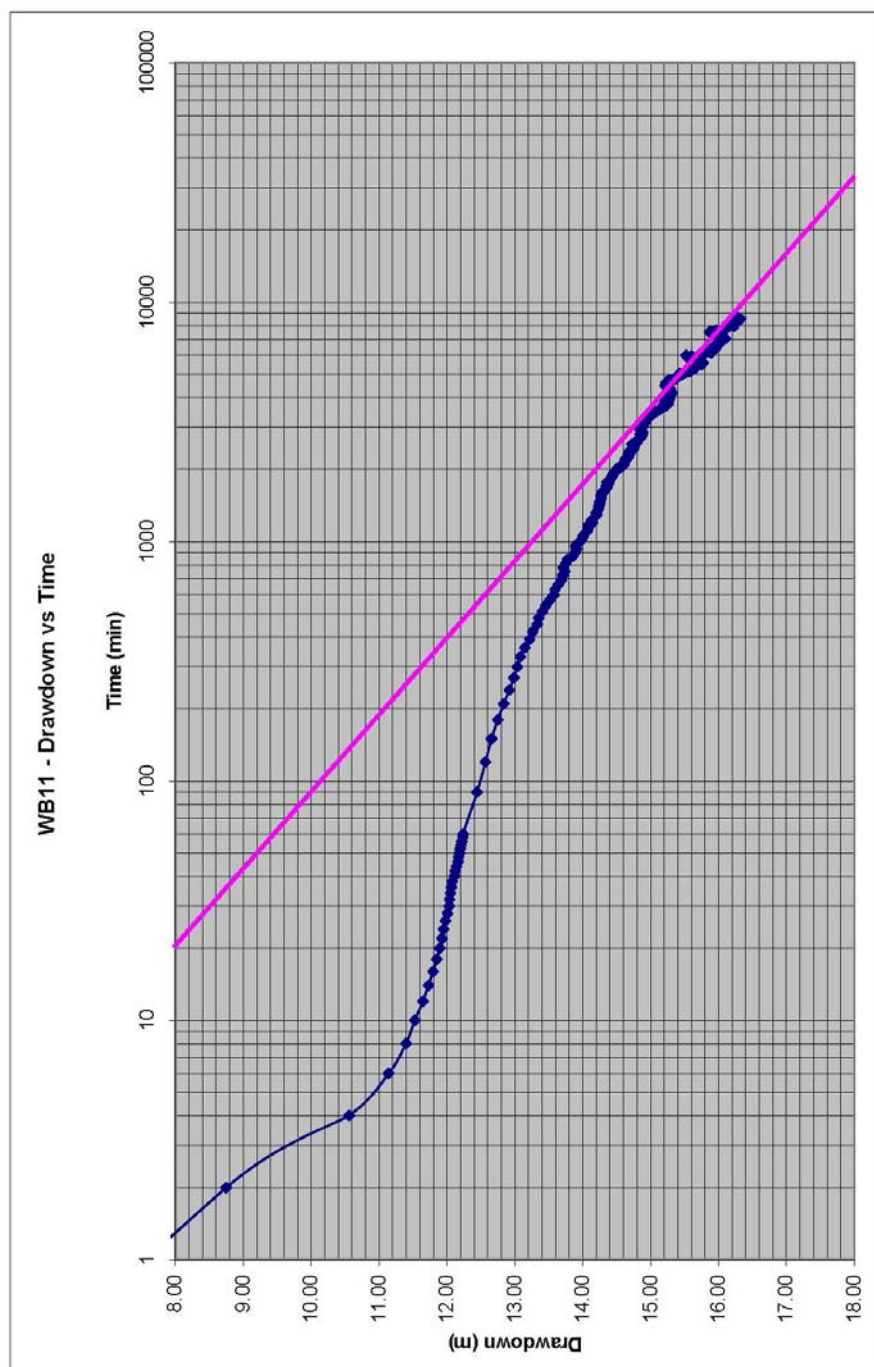


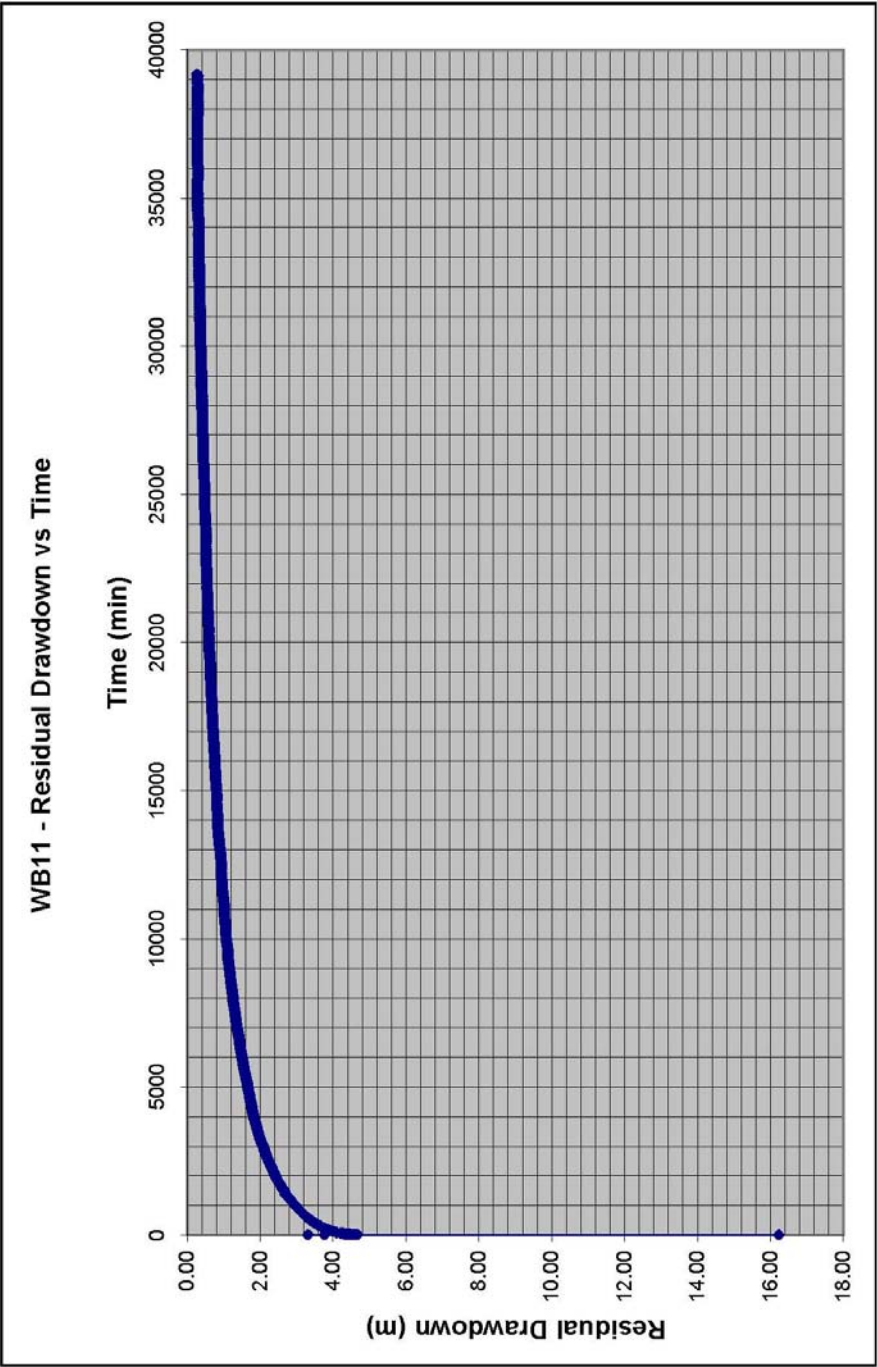


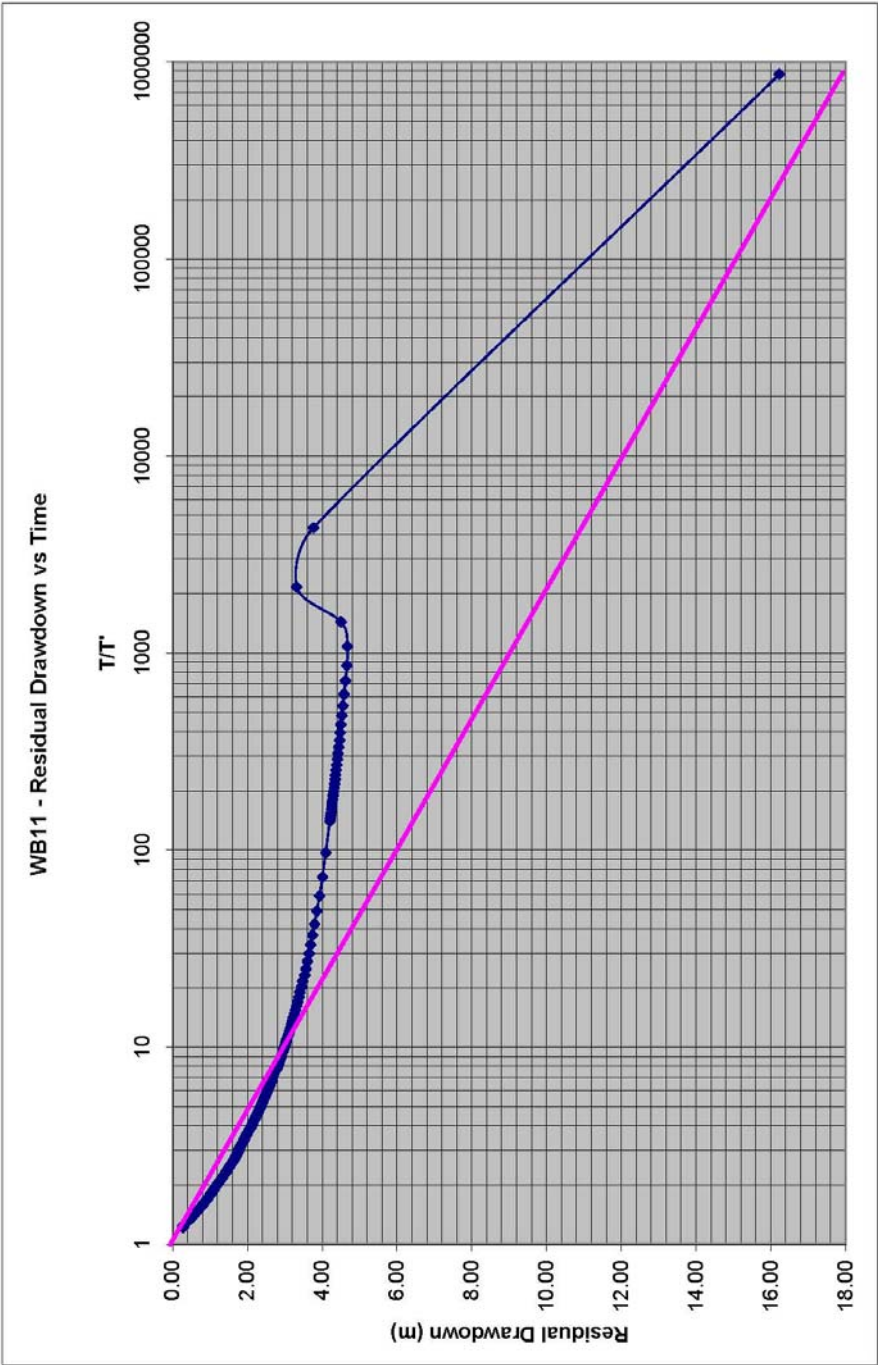


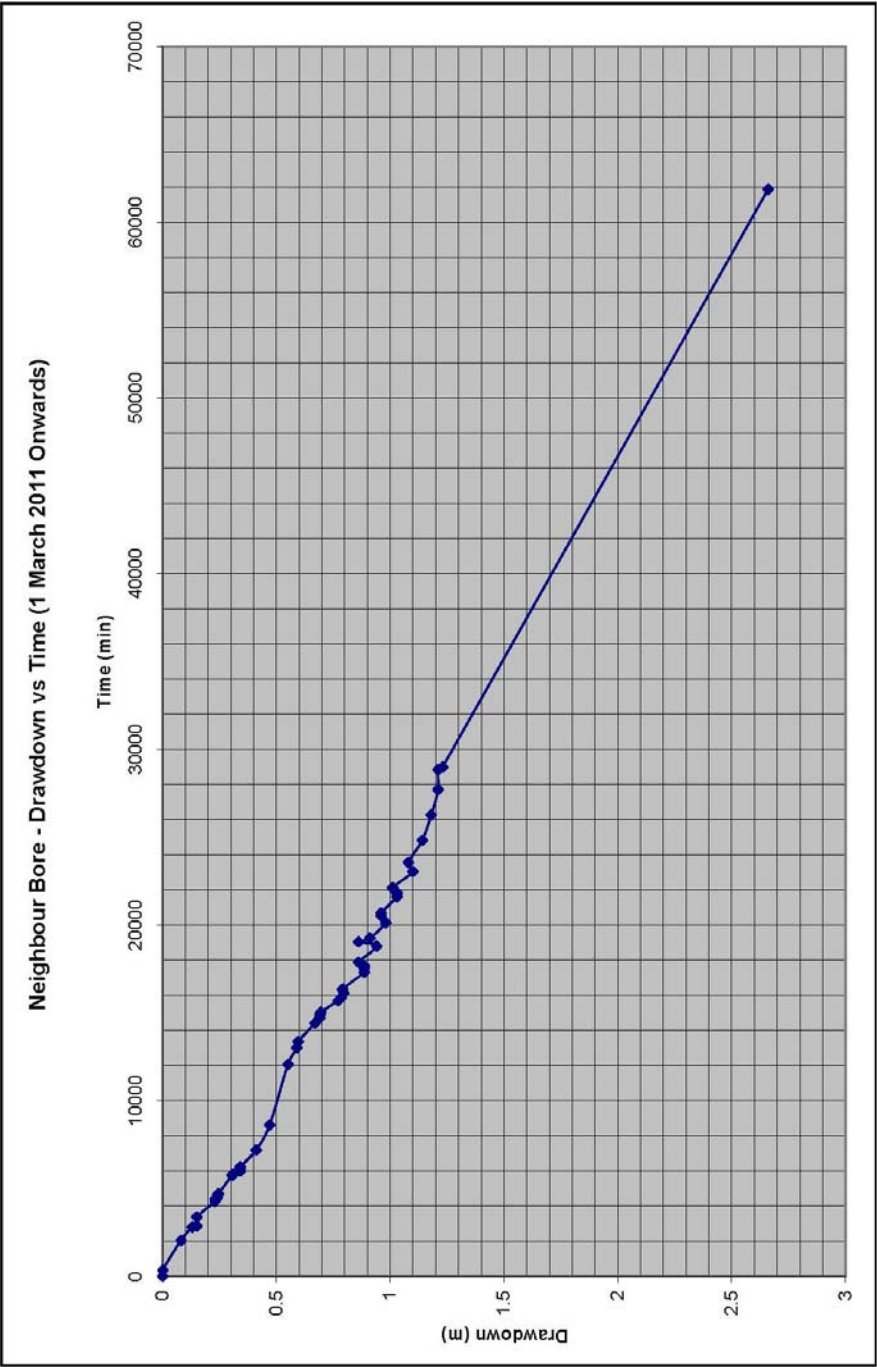


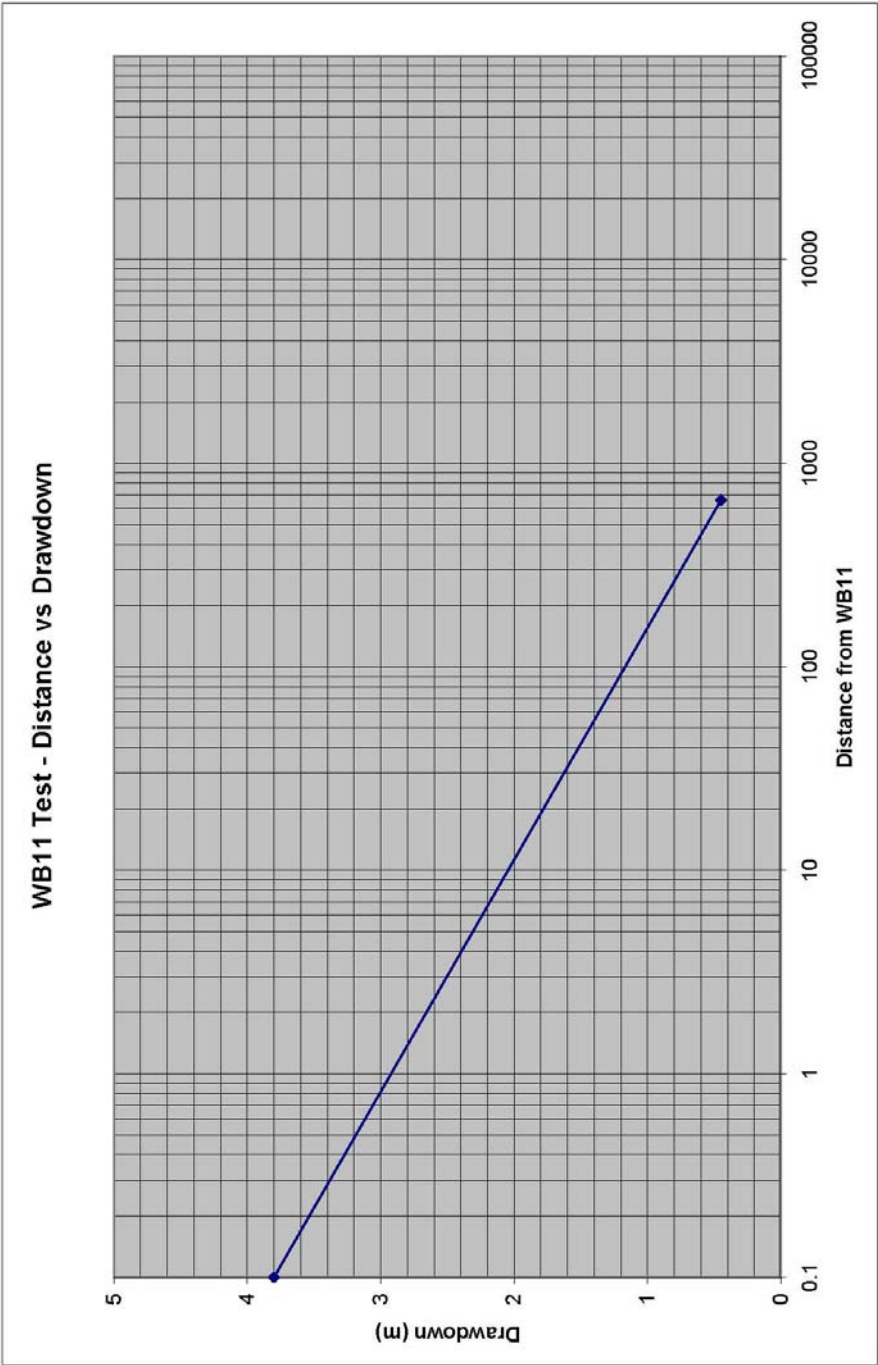


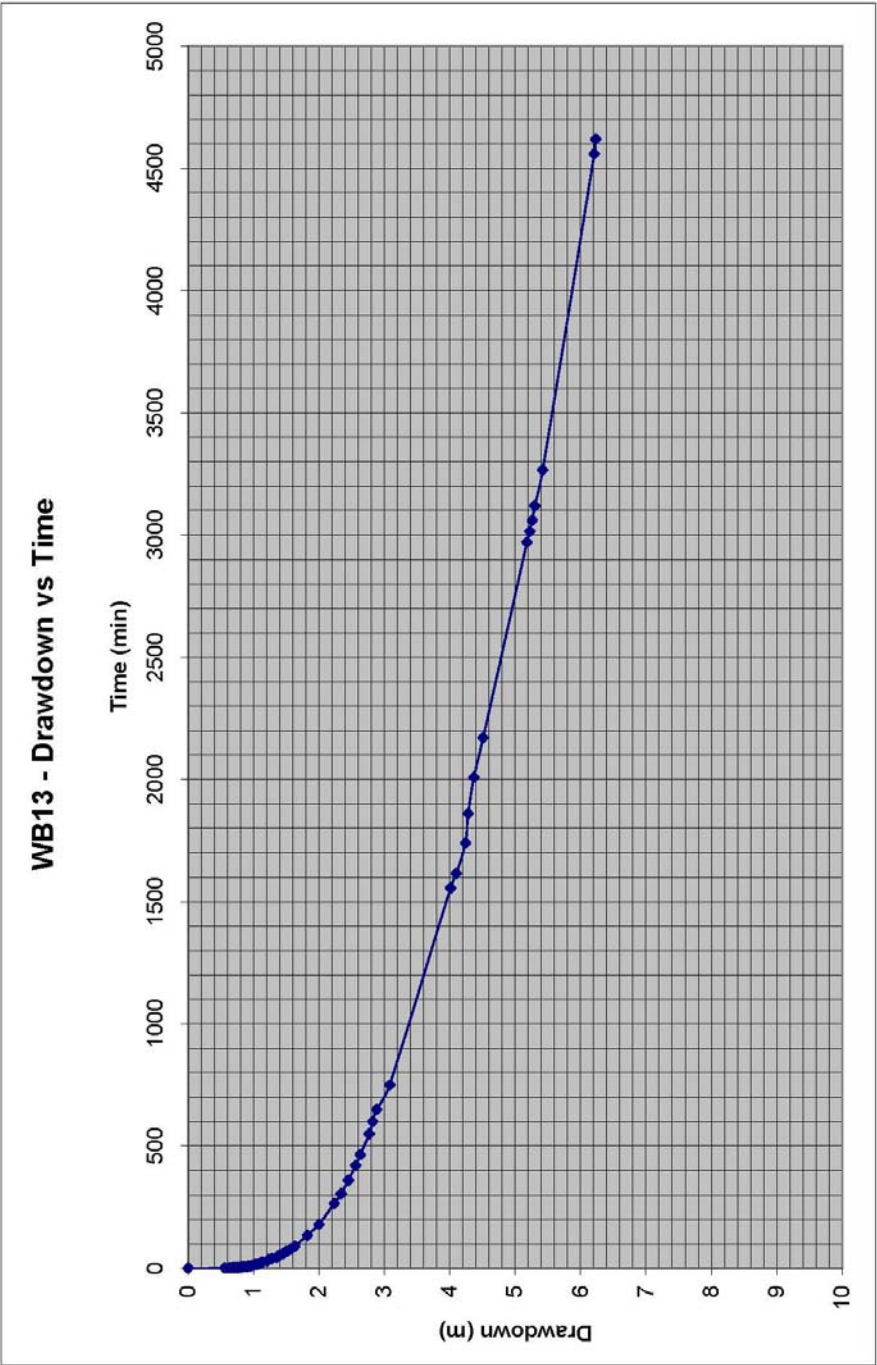


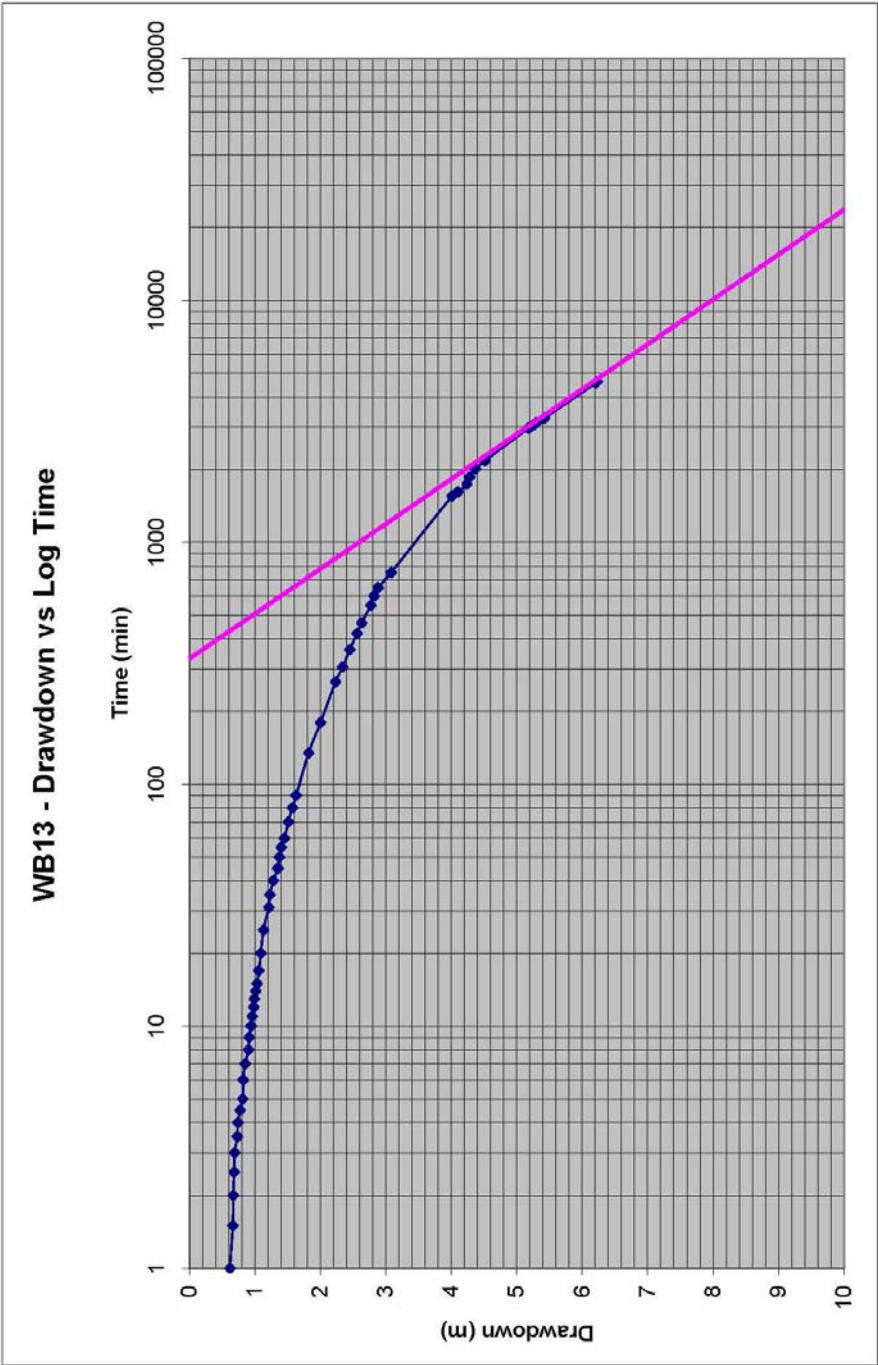


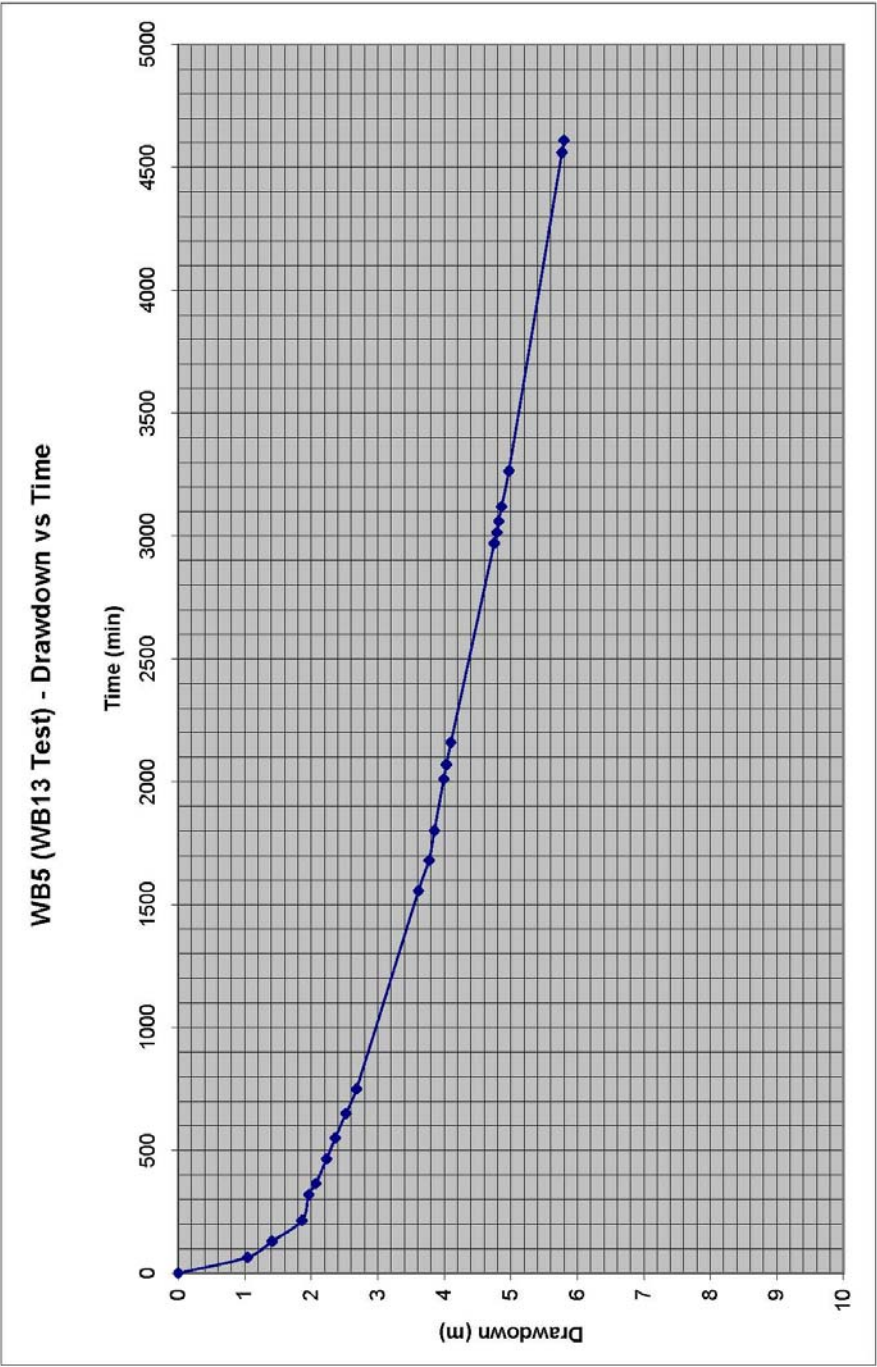


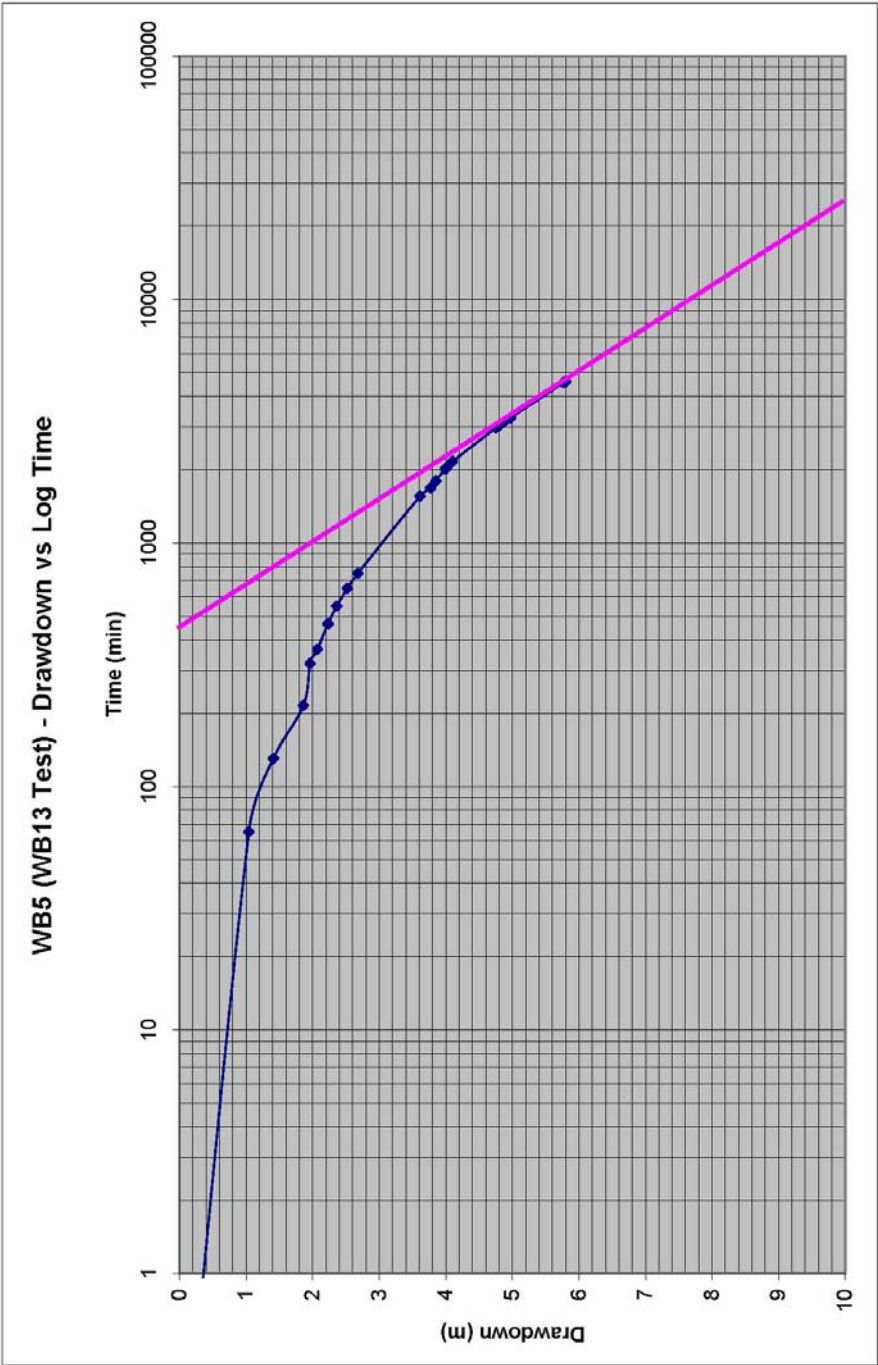












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