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Hydrogeology Investigations

(Bore Drilling, Sampling, Testing and Modelling)

Rover 1

Westgold Resources Limited

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Executive Summary

Westgold Resources Limited (WRL) released an assessment detailing the commercial viability of their Rover 1 project. The total resource was estimated at 5.3Mt at 2.1g/t Au, 2.2g/t Ag, 1.0% Cu and 0.1% Bi and Co respectively. The majority of the resource occurs between 300m and 600m below the surface. Development at various mines in the Tennant Creek area entails drilling from the surface followed by underground development and drilling to determine ore reserves. At the Warrego deposit, the largest in the Tennant Creek Field, underground drill grid patterns vary between 20m and 40m. At the Gecko Anomaly 1 deposit drill grid spacing average 10m by 15m, while at White Devil over half the deposit was drilled at between 5m and 10m. Portions of the Rover 1 deposit have dimensions and metal zonings similar to these deposits.

To increase current confidence levels in resource estimates and determining parameters for converting resources to ore and complete the feasibility study, Westgold intends constructing a surface box cut approximately 492m long, 150m at its widest, 10m at its narrowest and 65m depth with a 1:9 gradient ramp at the footwall. A spiral decline, approximately 5.5m by 5.5m from the footwall to about -100mAHD will extend from the proposed box cut. The scope of works for this report, with particular reference to continuing exploration and underground drilling from the proposed decline into all three mineralised zones: the Jupiter and Western and Southern Zones, includes:

- Direct and supervised drilling and implementation of groundwater monitoring bores and/or production/dewatering bores in accordance with the Minimum Construction Requirements for Water Bores in Australia (Land and Water Biodiversity Committee, 2003).
- Determination of the hydrological and hydrogeological features and parameters characterizing the ground water regime and investigation of hydraulic features of Rover 1 underlying aquifer systems.
- Technical report indicating the need for implementation of groundwater monitoring and sampling programs in relation to statutory and operational requirements.

The above scope of works was to be achieved by means of bore drilling, testing and sampling.

Earlier characterization of the hydrological and hydrogeological regimes at Rover 1 was based upon pre-existing data and information, exploration drilling and ground water monitoring. The locations of the bores were selected employing topographical, aerial photography, geological information and mapping and proposed box cut and decline layouts.

The bore testing program was implemented to obtain data and principally facilitate investigations to ascertain aquifer hydraulic parameters. Data is also foreseen to be used to define aquifer behaviour upon box cut and decline development and define capacities and the long term sustainability of water resources to further inform ground water management during mining.

The basal formation of the Wiso Basin at Rover 1, the Montejinni Limestone, is approximately 60m thick and consists of a lower half of basal conglomerates and sandstones grading upwards into a predominant sandstone sequence. A 60m thick portion of the Hooker Creek Formation overlies the Montejinni Limestone and extends to the surface. The layer underlying surface regolithic and ferruginous pisolites are an extremely weathered sequence of interlayered sandstones with significant presence of siltstones and dolomites and siltstones with minor sandstones and dolomites. Locally this sequence underlay and overlay extremely weathered thinly layered dolomitic materials. Underlying this sequence is extremely weathered to weathered siltstone interlayered with minor weathered sandstones and fresher mudstones. Structural features are limited and restricted to layering partings with occasional random jointing. However some of the localised coarse sandstones and conglomerates in addition to fractured zones provide well defined primary and secondary porosities which host significant yields of ground water.

The salient findings of the bore drilling and testing program and water quality sampling at the Rover 1 are:

- The proposed new box cut to a depth of 65m below surface will be constructed in the sediments of the Hooker Creek Formation, which have been weathered from rock to soil and which overlies the Montejinni Limestone. Weathering profiles appear simple and display advancement from weathered rock at the surface to progressively fresher rock at depth comprising a sequence of sandstones with significant occurrences of siltstones and dolomites. Inter-layered, slightly weathered sandstone and mudstone sequences are also significant.
- The deeper, particularly between about 90m and 120m below surface, confined sedimentary sequences contain relatively large quantities of ground water. However, inspections of drill cores and photos revealed that these sequences are subject to heterogeneity and limited in areal extent and as such that they may not sustain large yields over a prolonged period of time.
- Ground water levels are close to the surface between 4.6m and 8.1m below natural ground level.
- Hydraulic conductivities across the dominant lithologies averages 2.9E+00m/d ranging from a minimum of 3.2E-02m/d to a maximum of 2.2E+01m/d. The lower hydraulic conductivities pertain to the siltstone-sandstone with minor layering of mudstone in Bore DS1-60 and the highest pertain to the siltstone-sandstone and dolomite with minor mudstone sequence in Bore DS5-90.
- Drawdown curves and analysis by various methods indicate that the shallow, up to 60m, bores are in unconfined aquifer types. The deeper bores between 90m and 120m penetrated confined aquifer systems, though more than one method, particularly analyses by the Hantush method, indicate that these are confined leaky aquifer systems.
- Groundwater quality at the site is poor, particularly in the deeper confining aquifers, with several parameters exceeding their NHMRC/NRMMC (2011) guideline values rendering these unsuitable as potable water supplies. Behaviour of fingerprint cations indicates waters are hosted within dolomitic environments and these in contact with flowing waters will tend to release readily available cations with time. Salinity concentrations of these waters would also tend to increase with time.
- Aquifer test analyses during modelling suggest heterogeneity which may influence the influx volumes estimated by the flow model particularly over the long term. The model is based on general assumptions that should be confirmed during further investigations. Additional information will assist in optimising the model as an on-going, expandable management tool, which would form the basis of the ground water management plan. Calibration was undertaken and the sensitivity analysis revealed that the model output is particularly sensitive to hydraulic conductivity. Nevertheless, modelling has proven valuable in forward planning and design of the proposed box cut and decline.

The 2011 exploration drilling, testing and sampling investigations improved the hydrogeological understanding and monitoring data base at the Rover 1 deposits and provided parameters to facilitate preliminary characterization and meaningful and detailed ground water modelling of the aquifers in immediate proximity of Rover 1. Greater confidence and more accurate direction to the mitigation and management of potential impacts as a result of the construction of the box cut and spiral decline is also achieved. To further improve and calibrate a multi-layered site-wide conceptual and numerical ground water model during final design and construction will require:

- Further drilling to investigate the extent of the deeper confined aquifers around the proposed decline. Discharging bores are to be tested at a rate no less than 80 per cent of their measured airlift yields. These drilling, testing and sampling programs are to coincide with the drilling to ascertain further geotechnical parameters for detailed design.
- Given the high yielding characteristics of deep bores, the dewatering requirements (including alternative scenarios) are to be ascertained further employing the preliminary multi-layered ground water model devised during the current investigations.

The flow model represents a *worst case* scenario based on available information and should be

updated as more ground water level, hydrochemical and geological data becomes available to confirm that assumptions made are valid and to optimise the model as an ongoing, expandable management tool which would form the basis of the ground water management plan. Calibration of the model and the sensitivity analysis should be repeated and verified with changes to the temporal and spatial properties in order to run for longer or shorter time intervals and/or increased or decreased distances. Further investigations should aim to verify compartmentalisation/heterogeneity due to geological structures and/or extent of weathering/fracturing. The model should be run for longer time periods (2 to 5 years) once more information is available to determine the duration it will take to deplete the storage in the surrounding aquifers especially in the high hydraulic conductivity zones.

- Implement a quarterly ground water quality monitoring program.

1. Introduction

1.1. Scoping Study and Mineral Resources

Westgold Resources Limited (WRL) released an assessment detailing the commercial viability of their Rover 1 project. The mineral resource estimate was based on a total of 134 drill holes, 34 by Peko and 100 by Westgold and whilst the drill spacing is variable, it approximates a grid of 40m. The total resource was estimated at 5.3Mt at 2.1g/t Au, 2.2g/t Ag, 1.0% Cu and 0.1% Bi and Co respectively. The majority of the resource occurs between 300m and 600m below the surface.

In a review of the development of various mines in the Tennant Creek area it was ascertained that the general approach in developing deposits entailed drilling from the surface followed by underground development and drilling to determine ore reserves. At the Warrego deposit, the largest in the Tennant Creek Field, underground drill grid patterns vary between 20m and 40m. At the Gecko Anomaly 1 deposit drill grid spacing average 10m by 15m, while at White Devil over half the deposit was drilled at between 5m and 10m. Portions of the Rover 1 deposit have dimensions and metal zonings similar to these deposits.

1.2. Purpose

To increase current confidence levels in resource estimates and determining parameters for converting resources to ore, and hence to complete the feasibility study, Westgold intends constructing a surface box cut approximately 492m long, 150m at its widest, 10m at its narrowest and 65m depth with a 1:9 gradient ramp at the footwall. A spiral decline, approximately 5.5m by 5.5m from the footwall to about -100mAHD extends from the proposed box cut. Continued exploration and underground drilling will be undertaken from the decline into all three mineralised zones: the Jupiter and Western and Southern Zones (Figures 1 and 2). The size of the box cut has been determined by geotechnical studies of the highly weathered material into which it is being constructed.

The construction of the proposed decline and further exploratory and operational activities would imply regulatory groundwater and surface water compliance by Westgold.

Accordingly, the primary objectives of the hydrogeological investigations within the Rover 1 area are to:

- Describe the in situ geological and interpret hydrogeological characteristics and regimes underlying the Rover 1 site.
- Ascertain the hydraulic properties of the underlying weathered and fractured geological strata.

1.3. Scope of Works

The scope of this work was to:

- Obtain and review all relevant geologic, hydrologic and geomorphologic maps, reports and data.
- Direct and supervise drilling and implementation of groundwater monitoring bores and/or production/dewatering bores in accordance with the Minimum Construction Requirements for Water Bores in Australia (Land and Water Biodiversity Committee, 2003).
- Implement a bore sampling and testing program to assess ground water quality and determine the hydraulic characteristics of the aquifers.

- Ground water modelling to ascertain influx into the box cut and spiral decline.
- Compile a report on the investigations and provide recommendations pertaining to the ongoing characterization of ground water for operations.

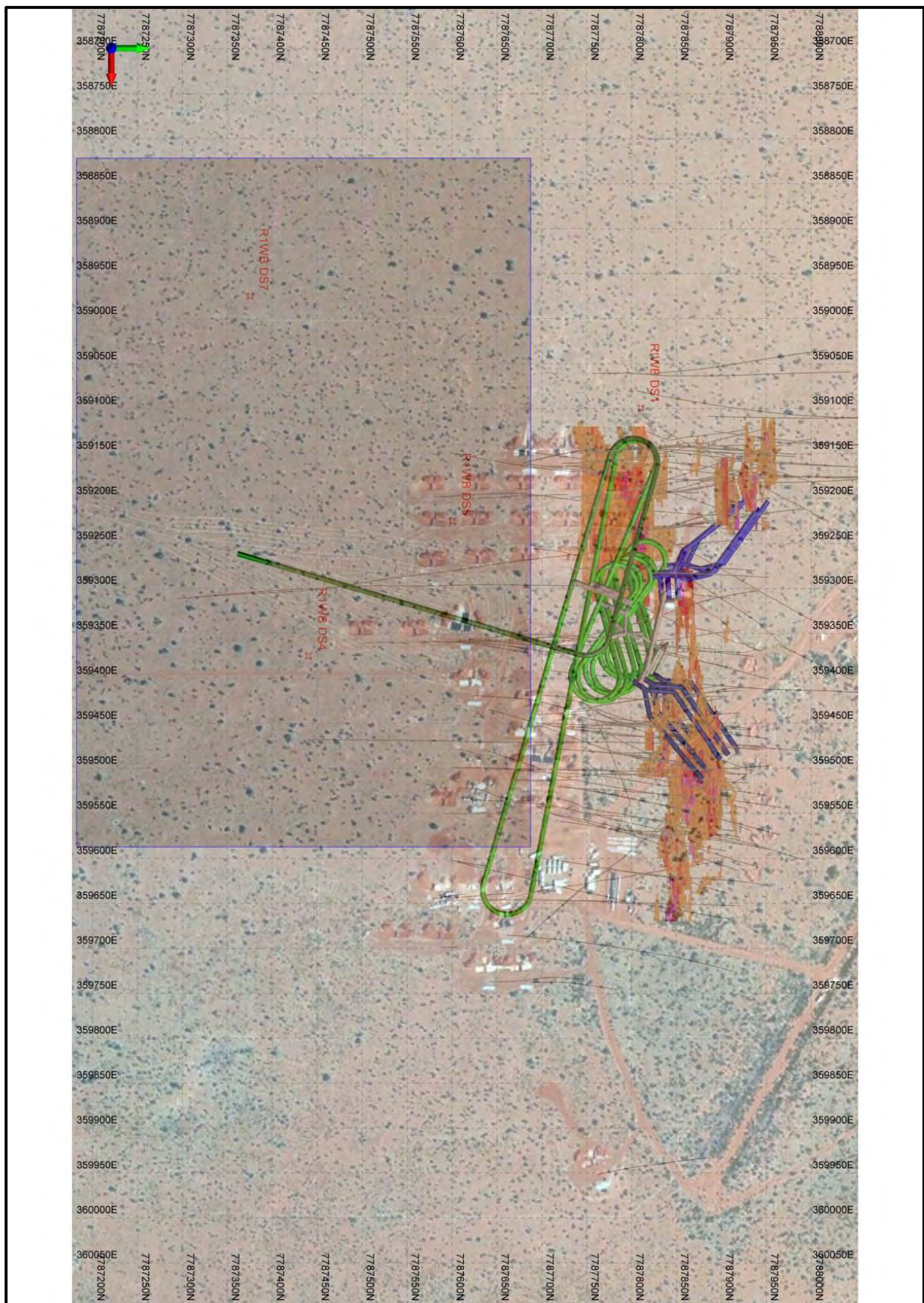


Figure 1: Mineralisation Zones and Proposed Decline at Rover 1.

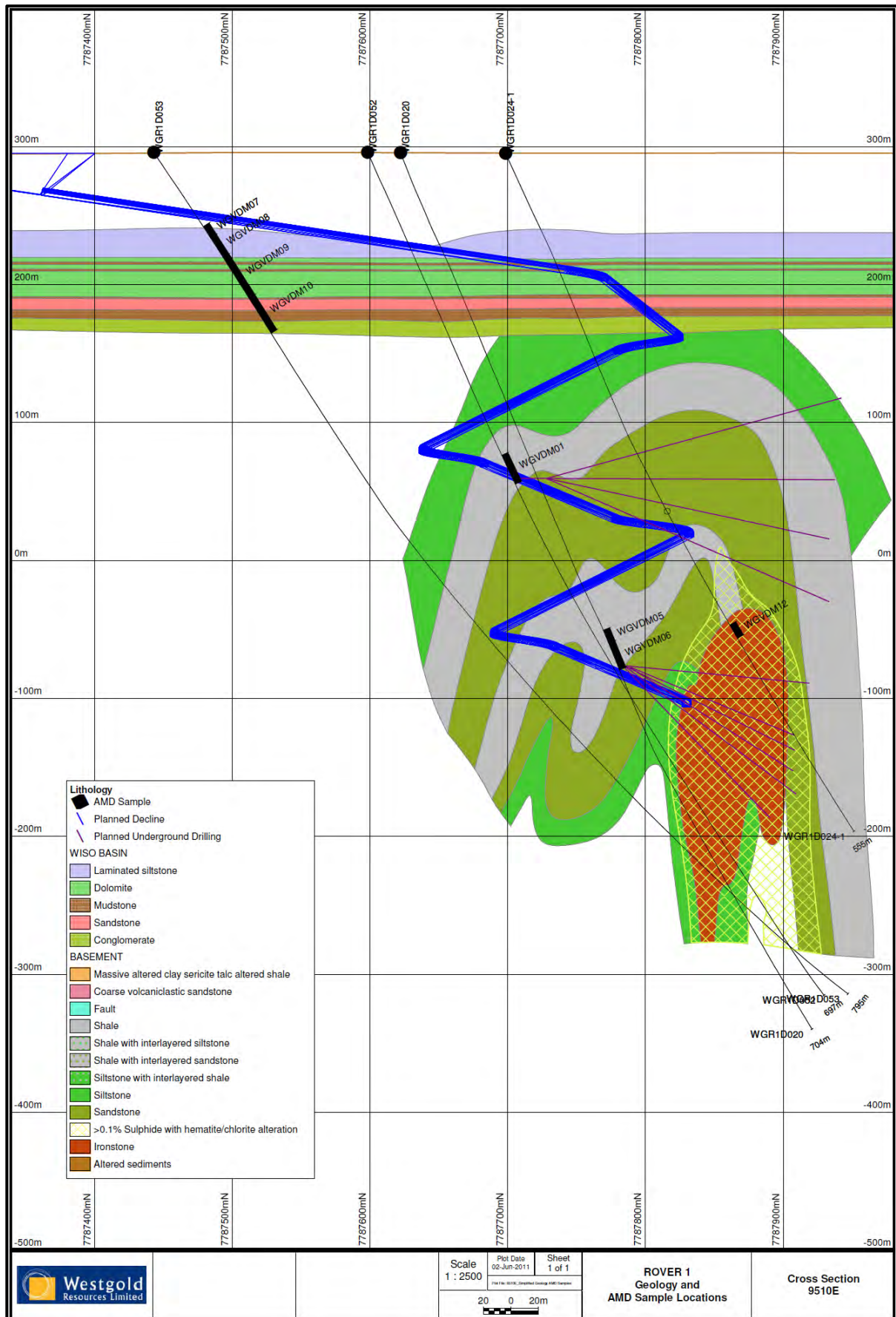


Figure 2: Cross Section of Decline showing Indicative Drill Pattern along Section 9510E.

2. Physical Characteristics

2.1. Location

The Rover 1 Project is located within the Rover Field, a geological region some 80km south-west of Tennant Creek (Figure 3). The field is an extension of the Tennant Creek Gold Field with identical type and similar aged rocks that host gold, copper, bismuth and cobalt (Au-Cu-Bi-Co) mineralisation associated with magnetite and hematite ironstones at a vertical depth between 300m and 600m below surface.



Figure 3: Location.

2.2. Climate

Although there is some local variability (Figure 4), Rover 1 climatic conditions approximates that of Tennant Creek which is situated in the tropics and has two distinct seasons. The wet season (Figure 5) prevails between December and March during which 66% of the average annual rainfall of 470mm takes place. Rainfall occurs as showers and storms which develop from moisture brought in by large heat lows. Heavy falls occur if the monsoon trough migrates into the central Northern Territory assisted by seasonal tropical cyclones in the Gulf of Carpentaria and/or Indian Ocean.

Evaporation rates in Tennant Creek are least during the colder winter months of May to August (Figure 5). September through to April have evaporation rates that exceed 10mm per day. The average annual evaporation (Class A Pan) and annual actual evapotranspiration rates approximate 3,600mm and 400mm respectively.

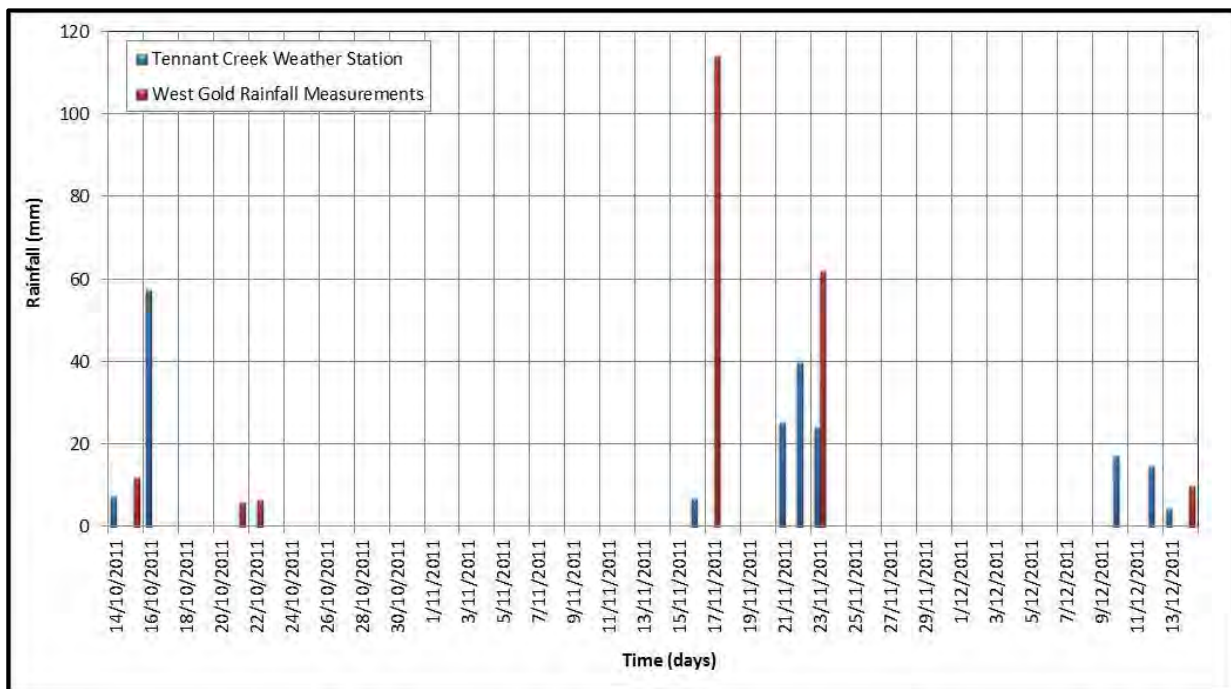


Figure 4: Daily Rainfall (mm) (measured at Tennant Creek and West Gold).

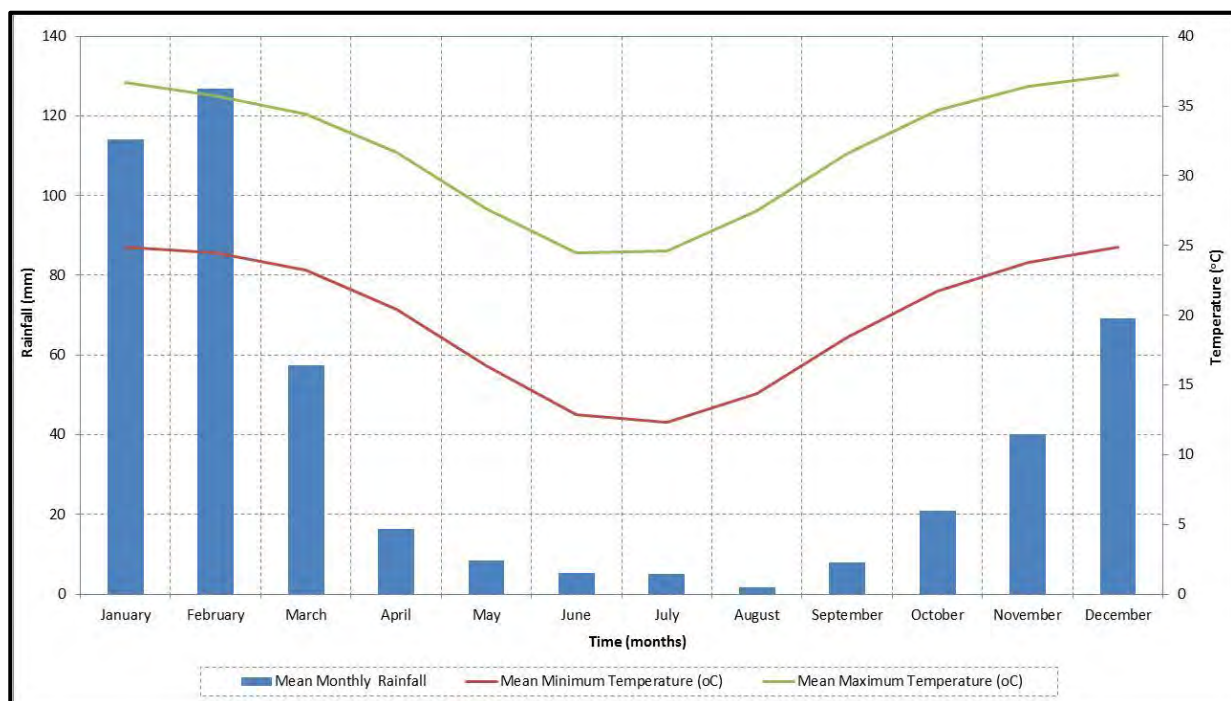


Figure 5: Rainfall and Temperature.

2.3. Hydrology and Drainage

The Wiso Basin incorporates the eastern part of the Tanami Desert which contains several unconnected drainage catchments. On a regional scale, the basin is characterized by ridges and hills. The ranges constitute a north-west trending watershed with temporary discontinuous creeks draining to the north, east

and south-west. On the western and south-western sides of the Davenport Ranges are several rivers, including the Skinner and Murray Creeks, which joins a flood out. Flood studies indicated that during wet seasons and large flood events several of these creeks become interconnected.

The Rover 1 area has a low relief blanketed by laterised/regolithic soils and windblown sands with growths of spinifex grass, low shrubs and patches of dense vegetation such as mulgas and medium sized gums. Surface soils of the region are red earths, red sandy loams and red earthy sands with a gravel or stony crust on regolithic rises. Falling head permeability tests of soils around and within the region indicate that surface soils are very low to practically impermeable (DRET, 2009). As a consequence local low relief channels and flat ill-defined drainage lines provide pathways for ephemeral drainage systems which are frequently flooded during high intensity rainfall events:



Figure 6: Access Road to the Mine Camp (flooded following a 62mm rain event).

2.4. Geology

2.4.1. Regional Geology of the Wiso Basin

The Wiso Basin in the area of Rover 1 is a relatively undeformed, sequence of marine and non-marine silici-clastic and carbonate Cambrian sediments (Ahmad et al 2009). The sequence varies from 120m to 300m thick with the only post depositional event being a tilt of several degrees to the west.

The geological sequence between Explorer 108, Explorer 142 and Rover 1 (Figure 7) includes a laminated siltstone that occurs consistent across the deep strata. Below this siltstone all localities have a dolomitic sequence with conglomerate and sandstone above the unconformity with the underlying basement.

Lithological variations within the stratigraphical columns include:

- At Explorer 108 the basal conglomerate consists of angular weathered sediments in a matrix of dolomite shedding off the basement topographic high.
- At Explorer 142 the thin basal conglomerate comprises angular to sub-angular sediments, including fragments of ironstone, derived from the immediate area.
- At Rover 1 a 26m thick sequence of basal conglomerate with overlying mudstone and sandstone is thought to have developed from the proximal Kelly High. Comparatively the conglomerate fragments are well rounded and do not represent locally occurring basement rocks.

Above the laminated siltstone at Explorer 108 and Explorer 142 is a 50m to 80m thick dolomitic unit comprising of dolomites and dolomitic sandstones and siltstones. Above the dolomite is a generally monotonous sequence of either mudstone or sandstone. Whilst there are no drill cores for this section at Rover 1, drill cuttings suggest a similar dolomitic unit which has undergone extreme weathering.

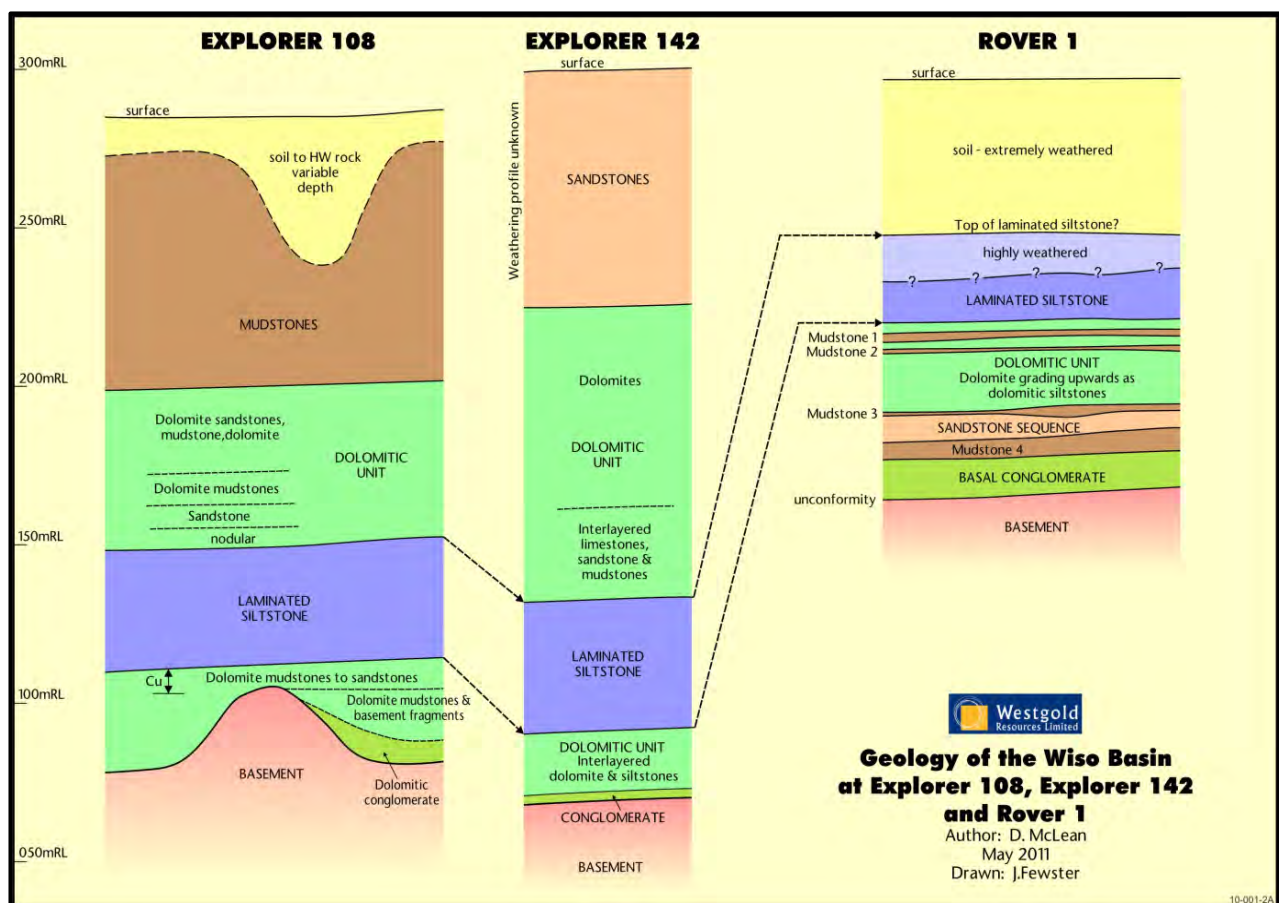


Figure 7: Cross Section of the Wiso Basin.

2.4.2. Geology of the Wiso Basin at Rover 1

The basal formation of the Wiso Basin at Rover 1, the Montejinni Limestone (Figure 8), is approximately 56m thick and consists of a lower half of basal conglomerates and sandstones grading upwards into a predominant sandstone sequence. A 6m thick mudstone layer (mudstone 4) divides the basal conglomeritic sequence from the overlying sandstones. A 1m thick mudstone (mudstone 3) overlies the sandstones.

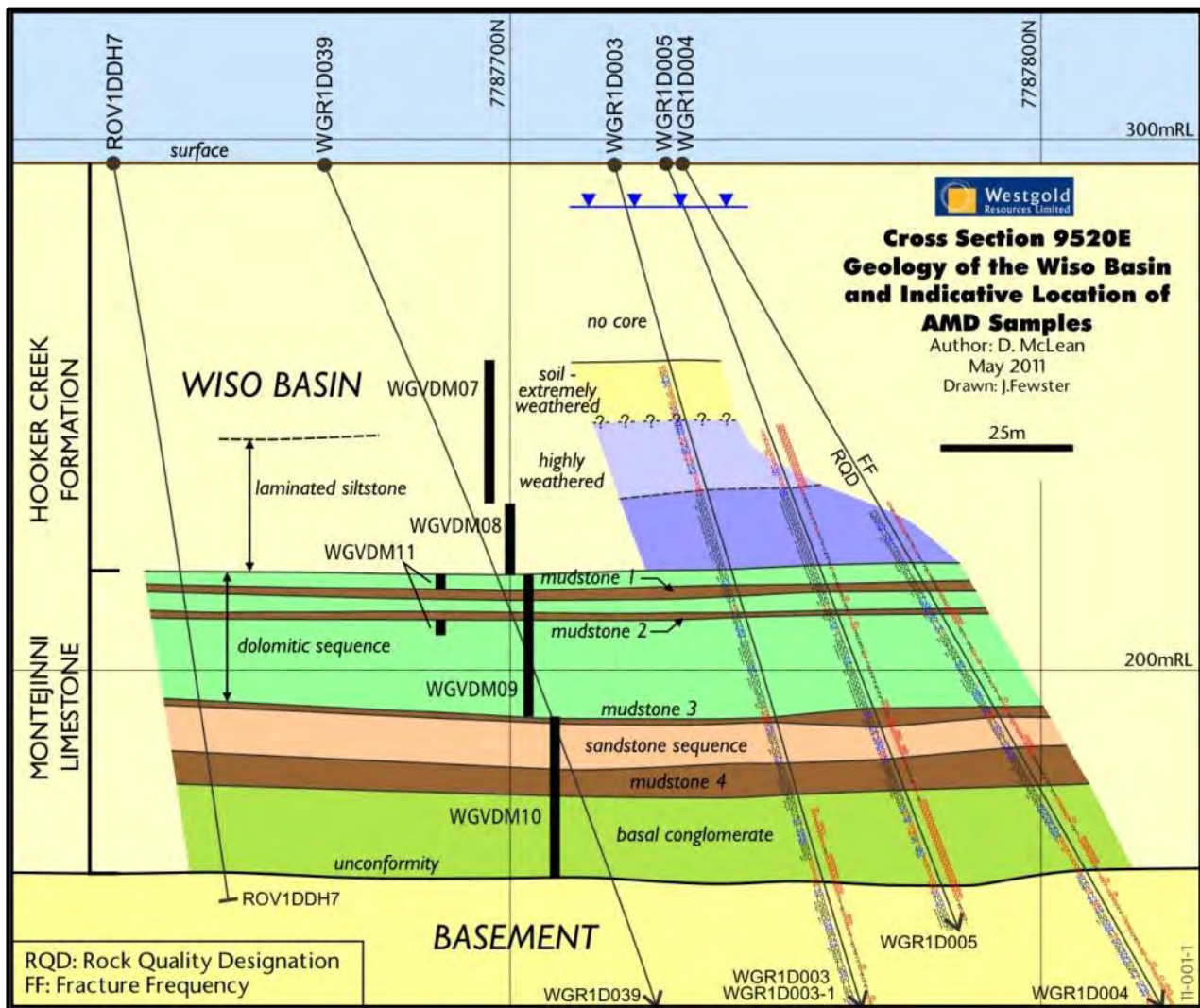


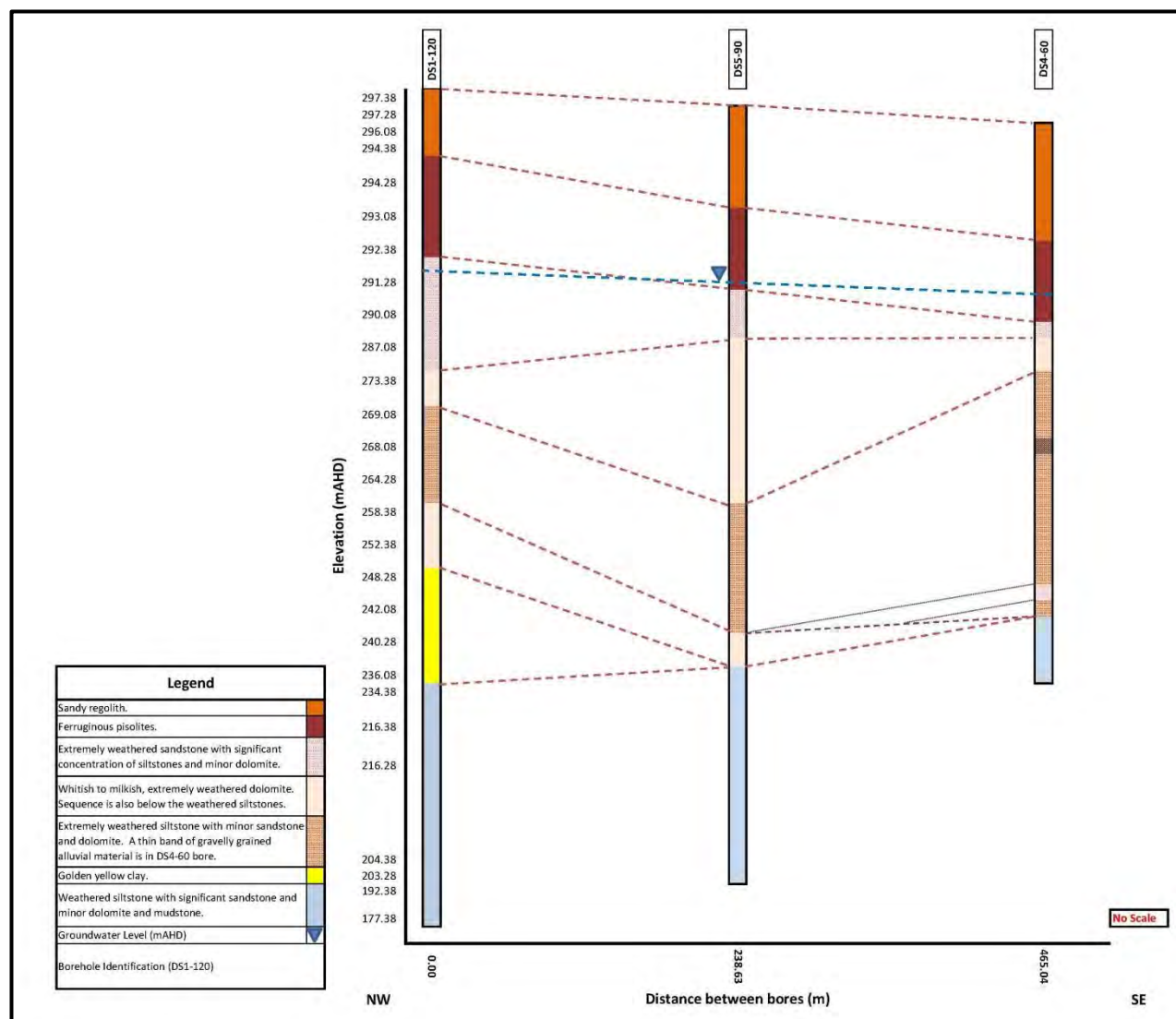
Figure 8: Cross Section 9520E.

The upper half of the Montejinni Limestone is a fossiliferous sequence of dolomite grading towards dolomitic siltstones and dolomitic sandstones in the upper and lower portions respectively. Occurring near the top are two mudstone layers (mudstone 1 and 2: mudstone 1 is 2m thick while mudstone 2 is poorly developed in some areas and less than 1m thick) and two thin layers of dolomite (1.9m and 0.3m thick). These layers are relatively consistent over the Rover 1 area.

A 75m thick portion of the Hooker Creek Formation overlies the Montejinni Limestone and extends to the surface. The top 60m to 65m consists of sediments which have been weathered and decomposed from rock to soil. The layer underlying surface regolithic and ferruginous pisolites are an extremely weathered sequence of interlayered sandstones with significant presence of siltstones and dolomites and siltstones with minor sandstones and dolomites (reference should also be made to Appendix A: Bore Data). Locally this sequence under and overlays extremely weathered thinly layered dolomitic materials (Figure 9). Whilst the upper dolomites are relatively thick ranging from 5.0m to about 25.0m, the lower sequence thins from the north-west to the south-east. Underlying this sequence is extremely weathered to weathered siltstone interlayered with minor weathered sandstones and fresher mudstones. Weathering profiles in this sequence are simpler showing single advancements from weathered rock at the top to progressively fresher rock at depth.

The layers described above prevail across the Rover 1 area and other than diagenesis and natural

weathering, the rocks have not been subjected to any further geological processes. Structural features are limited and restricted to layering partings with occasional random jointing. However some of the localised coarse sandstones and conglomerates in addition to fractured zones provide well defined primary and secondary porosities which host significant yields of ground water.



3. The Hydrogeology at Rover 1

3.1. Regional Hydrogeology

Although there is an absence of hydrogeological studies, regionally the Wiso Basin is described to contain semi-confined aquifer systems with yields up to 20L/s. The Wiso Basin aquifer is reported to be interconnected with the Georgina Basin aquifer through the Cambrian Limestone formations (Knapton, 2009, Figure 10). This system represents the source of the majority of the base flow in the Roper River.

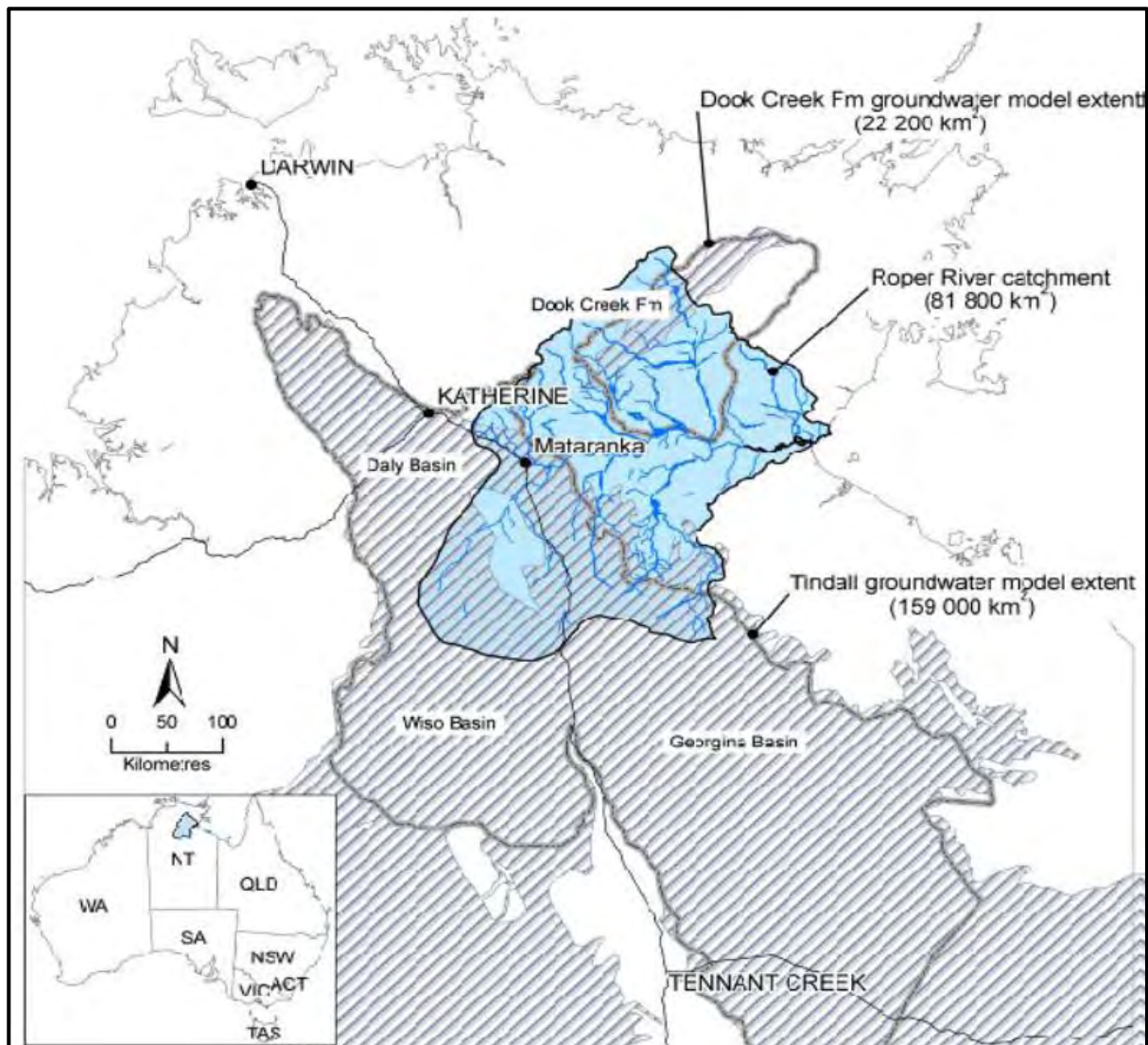


Figure 10: Location of the Roper River Catchment with respect to the major Ground Water Basins.
(from: Knapton, 2009).

Ground water investigations within the region, particularly near Tennant Creek, indicate that ground water is predominantly associated with the superficial sediments of the Warramunga Group rocks and decomposed igneous rocks of the Cabbage Gum Basin (Bracewell, et al, 1962). Whilst the sedimentary aquifers associated with the Warramunga Group have been reported as low yielding and were classified as *aquicludes*, the granitic rocks aided by joint patterns and potential leakage from overlying sediments, appear to be more significant albeit their low transmissivities and storage coefficients. Recharge occurs

predominantly by concentration of rainfall on depression zones where fracture zones prevail.

3.2. Bore Drilling and Hydraulic Testing

3.2.1. Bore Drilling

A total of seven investigative and environmental monitoring bores (EMBs) were constructed at four drill sites (DS) around the proposed box cut, decline and waste rock dump (WRD) at Rover 1:

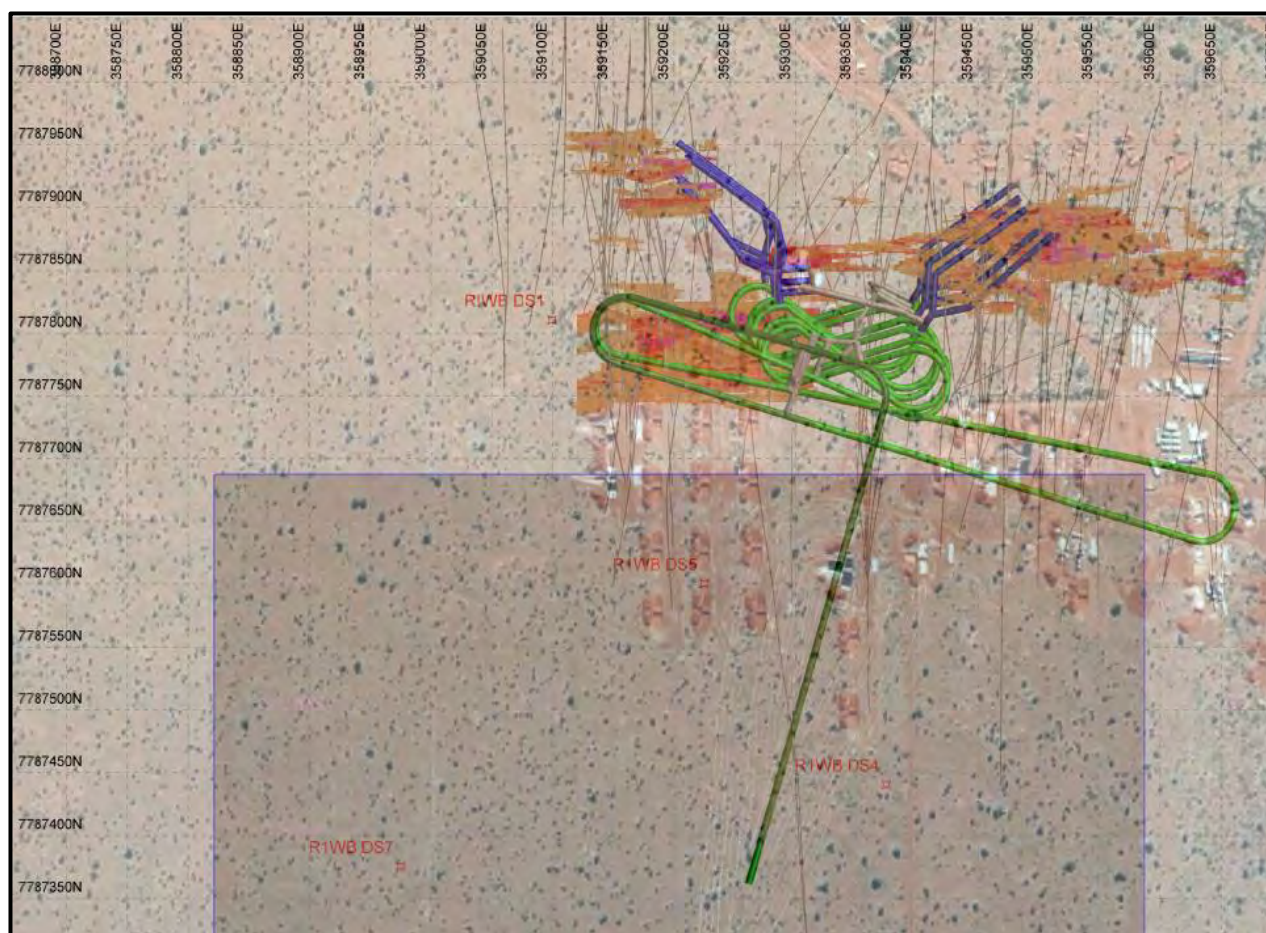


Figure 11: Bore Locations.

The bores were constructed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (LWBC, 2003), and were screened to capture all intersected water strikes (Table 1). Detailed lithological descriptions and construction logs appear in Appendix A whilst a summary of the drilling and bore test data and interpretations may be found in Appendix B. The construction of bores employed an air rotary percussion technique drilling the first 6.0m (12m for DS1-120) of the bore at 250mm to install a 208mm diameter solid steel casing grouted in place with cement. Once the steel casing was installed, a 203mm diameter drill bit was used to continue drilling and install 150mm solid Class 12 PVC casings with screens across the primary water bearing zones. The bore annulus between the PVC screen and bore wall was filled with coarse sand (gravel pack) to 1.0m above the screen, a bentonite seal of 0.5m was provided and the annulus above the seal was filled with sand and cement grout up to ground level. Bores were developed subsequently by airlift prior to the installation of a steel well head with a cement collar to prevent surface water entering the bore. During drilling, samples of the drill cuttings were obtained at 3m intervals and used to prepare detailed lithological descriptions and bore construction logs (Appendix A). Changes in moisture content of the drill cuttings, depths at which ground water were encountered; ground

water levels and airlift yields were observed and recorded.

Table 1: Summary of Drilling Data.

Drill Site	Location Site	Borehole ID's		Depth (m)	Proposed Use				
DS1	Proposed Decline	DS1-60, DS1-90 and DS-120		60, 90 and 120	Investigative, monitoring and dewatering				
DS4	Proposed Box Cut	DS4-60		60	Investigative, monitoring and dewatering				
DS5	Proposed Box Cut	DS5-60, DS5-90		60 and 90	Investigative, monitoring and dewatering				
DS7	Waste Rock Dump (WRD)	DS7-60		60	Investigative and monitoring				
Bore ID	Coordinates		Elevation	Elevation ToC	Screen (mbgl)		Ground Water Level	Average Sustainable Yield and Flow Rate	Depths to Water Strikes (Primary)
	mE	mN	mAHD	mAHD	From	To	mbgl	L/s	mbgl
DS1-60	53K 359061	7787797	297.38	298.11	30	60	8.13	0.4 and 1.3	12, 31, 40, 53 and 60
DS1-90	53K 359080	7787804	297.38	298.06	60	90	6.24	1.0 and 2.7	12, 30, 37, 45, 58, 76 and 87
DS1-120	53K 359098	7787812	297.38	298.18	66	120	6.57	5.2 and 10.0	11, 28, 38, 48, 51, 60, 69, 73, 80, 87, 97, 117 and 119
DS4-60	53K 359376	7787440	296.08	296.81	30	60	5.96	0.3 and 1.1	8, 26, 34, 48 and 55
DS5-60	53K 359205	7787594	297.28	297.98	30	60	7.35	0.4 and 3.0	10, 32, 37 and 45
DS5-90	53K 359227	7787597	297.28	298.03	64	90	4.60	10.0 and 11.0	9, 33, 79 and 81
DS7-60	53K 358976	7787373	296.83	297.51	30	60	6.05	0.3 and 0.6	9, 32, 34, 42 and 53
Note: The primary aquifers are highlighted in yellow.									

3.2.2. Bore Airlift Yields and Hydraulic Testing

Airlift water yields during bore development range from 0.7L/s to about 25.5L/s (Table 2). The lowest airlift yield was measured at bore DS7-60 whilst the highest was observed in bore DS5-90.

Bore sampling and test programs were devised, taking cognisance of the airlift yields, to obtain water qualities and to facilitate interpretation of aquifer properties, specifically hydraulic conductivity (K, m/d), transmissivity (T, m²/d) and storativity (S, no dimensions).

Bores DS1-120 and DS-90 were subjected to both step and constant rate discharge tests, whilst bores DS1-60, DS1-90, DS4-60, DS5-60 and DS7-60 were subjected to constant rate discharge tests only (Table 2). Discharge rates for bores DS1-60, DS1-120, DS4-60 and DS5-60 were adjusted from airlift yields to approximate estimated optimum and sustainable test discharge rates. The highest flow rate that could be achieved with the equipment available at the time was used to test bore DS5-90. Although the pumps were equipped with an automatic flow rate sensor, discharge rates were constantly measured for accuracy using a bucket and stopwatch.

3.3. Hydrogeology of Rover 1

3.3.1. Water Strikes

Average natural ground height datum at the site is at about 297mAHD. Shallow water strikes were found at about 9m below ground level (288mAHD) and deep water strikes at about 119m below surface (178mAHD; refer Table 1). Near surface water bodies to about 60m are separated by about 15m from the intermediate set of water strikes (~63m to 93m depth). The deepest set of water strikes at between 110m and 120 m below surface is separated by a confining layer about 20.0m thick.

Table 2: Bore Test Details.

Bore ID	Airlift Yields (L/s)	Pump Test Discharge Flow Rates							Observation (monitored) bores			Maximum Drawdown (m)	Test Duration Times (min)	Observations during pump testing
		Step Tests (L/s)				Constant Rates (L/s)							[Dewatering Time, Recovery Time*]	
						1	2	3						
DS1-60	2.5					2.20	1.50	1.30	DS4-60, DS5-60	DS5-60, DS4-60	DS4-60, DS5-60	39.14, 40.61, 36.60	[10, 29], [134, 45], [343, 107]	Air bubbles observed passing through equipment during test. 2.20 L/s and 1.5 L/s are preliminary flow rates. Sustainable flow rate is 1.3 L/s.
DS1-90	6.6					3.00			DS4-60, DS5-90			68.57	[721, 358]	Large amount of air bubbles was observed at about 360min of test. This decreased to the end of the test.
DS1-120	14.1					9.00	10.0		DS4-60, DS5-90	DS1-60, DS1-90		38.29	[720, 179], [485, 296]	Bucket test carried out during test confirmed flow rate logged. Water samples taken, scanned and attached.
		3.00	6.00	9.00	12.0				DS1-60, DS1-90			32.67	[120, 240, 480; 189]	Carried out step test as per three first steps. Unable to increase flow to 12l/s as line shaft speed already at max speed. Maintained (fourth flow rate) pump rate at 9l/s.
DS4-60	2.2					1.00	0.80		DS1-60, DS5-60	DS1-60, DS5-60		44.30, 19.80	[212, 99], [422, 342]	Pump ran for approximately for 3 hours 32min at 1.0 L/s and bore ran out of water. At 0.8L/s air bubbles passing through equipment during the test. After three hours of pumping milky/silty water was observed to discharge. Flow rate checked with bucket test and compared with flow meter.
DS5-60	6					3.00	2.00		DS4-60, DS7-60	DS4-60, DS7-60		35.58, 17.41	[149, 85], [482, 444]	At 3.0 L/s bore pumped for 1hr 30min and water flow reading became unstable. Then bore pumped at 2.0 L/s. Air bubbles observed passing throughout lay-flat hose. During recovery air flow was detected throughout small hole in collar.
DS5-90	25.5	5.00	10.0	15.0					DS4-60, DS5-60			5.36	[120, 240, 450, 450]	Observed significant amount of gravel passing through equipment for first half of test, a minimal amount was observed in the last half of test.
						11.00			DS1-120, DS1-90			5.34	[720, 359]	Tried to adjust flow by manual control. Flow meter reading is not constant - gravel passing through equipment.
DS7-60	0.7					0.60			DS4-60, DS5-60			41.37	[581, 503]	Flow rate was periodically calibrated using bucket test. Flow meter readings are slightly higher than actual flow as meter was working outside its range. Ran out of water - pump stopped at 581min and recovered.

*Recovery time refers only to times at which about 90% of recovery was observed. Full length of recovery test is presented in Appendix B.

3.3.2. Ground Water Levels

Ground water levels are close to the surface between 4.6m and 8.1m below natural ground level (Table 3 and Figure 12 overleaf). Bores V1, V2 and V3 are monitoring bores at Rover 1 Camp Site having ground water levels between 5.8m and 10.1m below ground level.

Table 3: Ground Water Levels.

Bore ID	Coordinates		Elevation	Top of Casing (ToC)		Ground Water Level (11 December 2011)	
	mE	mS	mAHD	(magl)	mAHD	(bToC mbgl)	(bToC mAHD)
DS1-60	53K 359061	7787797	297.375	0.735	298.110	8.130	289.98
DS1-90	53K 359080	7787804	297.375	0.685	298.060	6.242	291.82
DS1-120	53K 359098	7787812	297.375	0.805	298.180	6.569	291.61
DS4-60	53K 359376	7787440	296.075	0.732	296.807	5.957	290.85
DS5-60	53K 359205	7787594	297.275	0.705	297.980	7.345	290.64
DS5-90	53K 359227	7787597	297.275	0.758	298.033	4.601	293.43
DS7-60	53K 358976	7787373	296.833	0.680	297.513	6.045	291.47
V1	53K 359538	7787694					287.85
V2	53K 359304	7787677					288.18
V3	53K 359319	7787853					286.25
Average			297.083	0.729	297.812	6.413	290.21
Maximum			297.375	0.805	298.180	8.130	293.43
Minimum			296.075	0.680	296.807	4.601	286.25

Previous observations at V1, V2 and V3 indicate that the ground water level fluctuate by between 0.45m and 2.24m around the average and respond to high rainfall-recharge, albeit with a lag of about one month. Rainfall events less than 30mm do not cause recharge significant enough to trigger an immediate rise in ground water levels (Figure 13).

3.3.3. Hydraulic Parameters

Bore test data was assessed to calculate the aquifer hydraulic parameters using Aquifer Test 2011.11 software. Methods employed include Theis with Jacob's correction, Hantush, Boulton and Papadopoulos and Cooper (Table 4). To simplify the assessment, shallow ground water level conditions were assumed to be unconfined. The deep aquifers were assumed to be confined, homogeneous and isotropic.

Falling head permeability tests in soils around and within the region provided permeability values in the range between 5.44E-5m/d and 1.03E-1m/d which indicate surface soils are very low to practically impermeable (DRET 2009). Hydraulic conductivities (Table 4) in the deeper dominant lithologies have an average K value of 2.90E0m/d ranging from a minimum of 3.18E-2m/d to a maximum of 2.15E1m/d. The lower hydraulic conductivities pertain to the sequence of siltstone, sandstone with minor layering of mudstones in bore DS1-60 (Tables 4 and 5); whilst the highest was recorded in the sequence of siltstones, sandstones and dolomites in Bore DS5-90. The latter are sequentially found below a sequence of extremely weathered dolomitic materials underlying a very coarse to gravelly grained ironstone band.

Drawdown curve analysis by the various methods indicates that most of the bores in the shallow aquifer system to average depth of 60m below natural ground level are unconfined aquifer types. Bores DS1-90, DS5-90 and DS51-120 are located within confined aquifer systems.

During bore testing, DS5-90 did not significantly dewater (maximum drawdown ~ 5.35m) indicating water flow towards the well remained horizontal with little or no vertical flow. Drawdown in observation bores

DS1-90 and DS1-120, 238.6m from bore DS5, were minimal at 0.59m and 0.86m respectively.

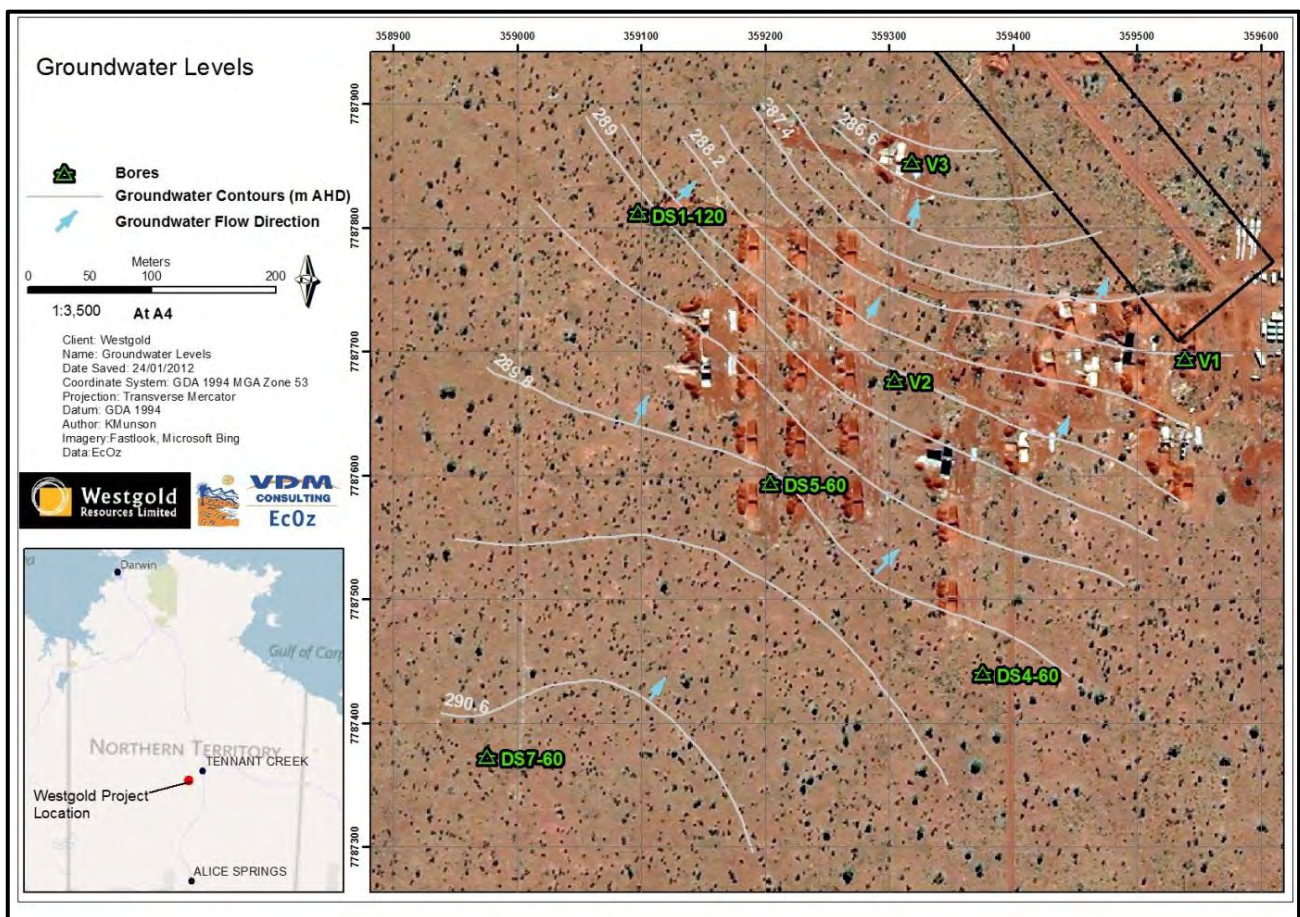


Figure 12: Ground Water Levels in December 2011.

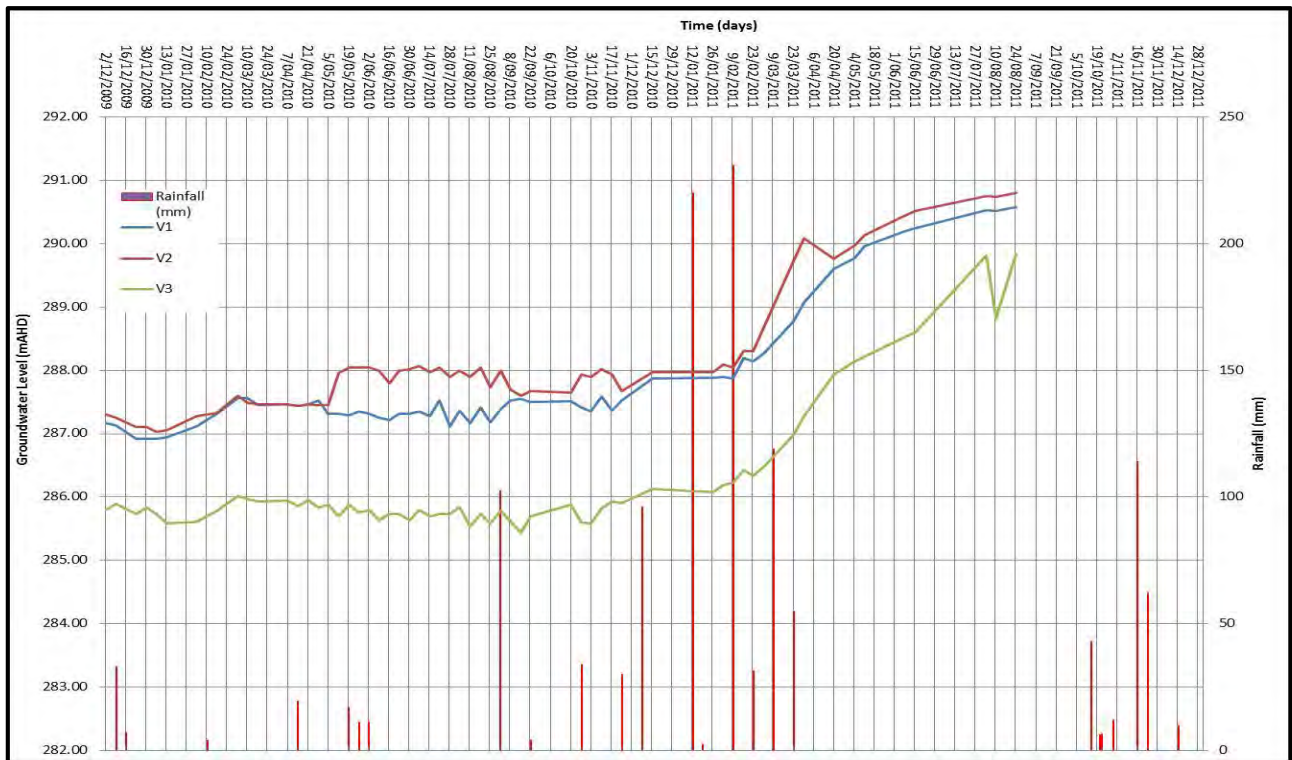


Figure 13: Ground Water Levels in Bores V1, V2 and V3 (Camp Site).

Table 4: Hydraulic Parameters.

Bore ID	Flow Rate	Theis with Jacob Correction			Hantush				Boulton			Papadopoulos and Cooper		Average			Aquifer Type / Isotropy
		K	T	s[-]	K	T	s[-]	Leakage factor	K	T	s [-]	K	T	K	T	s [-]	
	L/s	m/d	m ² /d		m/d	m ² /d		(m)	m/d	m ² /d		m/d	m ² /d	m/d	m ² /d		
DS1-60	1.3	2.76E-02	1.49E+00	5.00E-01	1.29E-02	6.97E-01	5.00E-01	2.11E-01	1.85E-02	1.00E+00	5.00E+0	6.80E-02	1.95E+00	3.18E-02	1.28E+00	2.00E+00	Unconfined / Anisotropic
DS1-90	3.0				2.59E-02	8.56E-01	2.13E-01	9.95E+00	3.19E-01	1.05E+01	5.21E-02	2.08E-01	6.87E+00	1.84E-01	6.08E+00	1.33E-01	Confined / Leaky / Anisotropic
		Agarwal Skin Ks = 3.01E-1; T = 9.92E0, S = 2.18E-10															
DS1-120	3, 6 & 9	1.91E+00	1.09E+02	1.00E-04	2.12E+00	1.21E+02	8.78E-06	3.71E+03	1.41E+00	8.06E+01	1.06E-03	1.41E+00	8.061	1.71E+00	7.97E+01	3.90E-04	Confined / Isotropic
	10	8.12E-01	4.63E+01	3.78E-05	1.29E-01	7.35E+00	5.00E-01	2.92E+01	2.89E-01	1.65E+01	4.88E-01	1.94E-01	1.10E+01	3.56E-01	2.03E+01	3.29E-01	Confined / Leaky / Isotropic
	Average	1.36E+00	7.77E+01	6.89E-05	1.12E+00	6.42E+01	2.50E-01	1.87E+03	8.50E-01	4.86E+01	2.45E-01	8.02E-01	9.53E+00	1.03E+00	5.00E+01	1.65E-01	
DS4-60	1.0	3.70E-02	2.00E+00	6.58E-02	2.47E-02	1.33E+00	1.12E-01	1.24E+01	2.47E-02	1.33E+00	1.12E-01	3.01E-01	1.62E+01	9.69E-02	5.22E+00	9.66E-02	Unconfined
	0.8	2.69E-02	1.45E+00	1.90E-01	2.20E-02	1.19E+00	1.30E-01	5.36E-01				7.37E-02	3.98E+00	4.09E-02	2.21E+00	1.60E-01	Unconfined / Confined
	Average	3.20E-02	1.73E+00	1.28E-01	2.34E-02	1.26E+00	1.21E-01	6.47E+00				1.87E-01	1.01E+01	6.89E-02	3.71E+00	1.28E-01	
DS5-60	2.0	1.34E-01	7.26E+00	2.01E-01	8.72E-02	4.71E+00	4.68E-01	1.27E+00	9.52E-02	5.14E+00	5.00E-01	9.15E-02	4.94E+00	1.02E-01	5.51E+00	3.90E-01	Leaky / Unconfined / Anisotropic
DS5-90	5, 10 & 15	2.12E+01	6.99E+02	3.24E-02	1.64E+01	5.40E+02	3.33E-01	4.92E+03				2.68E+01	8.84E+02	2.15E+01	7.08E+02	1.83E-01	Confined / Leaky / Isotropic
	11	5.33E+00	1.76E+02	5.00E-01	4.85E+00	1.60E+02	3.33E-01	2.68E+03	5.05E+00	1.67E+02	5.00E-01	4.72E+00	1.56E+02	4.99E+00	1.65E+02	4.44E-01	Leaky / Isotropic; Confined / Anisotropic
	Average	1.33E+01	4.38E+02	2.66E-01	1.06E+01	3.50E+02	3.33E-01	3.80E+03	5.05E+00	1.67E+02	5.00E-01	1.58E+01	5.20E+02	1.32E+01	4.36E+02	3.14E-01	
DS7-60		3.88E-02	1.36E+00	5.00E-01	2.87E-02	1.01E+00	3.79E-01	3.41E+03	2.87E-02	1.01E+00	9.96E-02			3.21E-02	1.13E+00	3.26E-01	Unconfined

Table 5: Lithology in relation to Screen Location.

Bore ID	Screen		Lithology	Dominant lithology
	From	To		
DS1-60	267.32	237.32	Siltstones, sandstones and minor mudstone	Sandstone
DS1-90	237.38	207.38	Siltstone with minor sandstone, dolomite and mudstone	Siltstone
DS1-120	231.38	177.38	Siltstone with minor sandstone, dolomites and mudstone	Siltstone
DS4-60	266.08	236.08	Siltstone with minor sandstone dolomite and ironstones	Siltstone
DS5-60	267.28	237.28	Siltstones, sandstones and minor dolomites and mudstones	Siltstone/Sandstone
DS5-90	233.28	203.28	Siltstone, sandstones, dolomites and minor mudstone	Siltstone
DS7-60	266.83	236.83	Siltstone, sandstones, dolomites and minor ironstones	Siltstone/Dolomite
Distance between Drill Sites				
From		To	m	
DS1		DS4	465.0	
DS1		DS5	238.6	
DS1		DS7	450.5	
DS4		DS5	227.7	
DS4		DS7	406.1	
DS5		DS7	315.7	

The deep aquifer system (DS1-120) is indicated as a leaky confined aquifer system in the Hantush analysis indicating overlying aquifer systems leak water during discharge. Observation bores DS1-90 and DS1-60, located about 20m and 40m from DS1-120, displayed significant drawdowns at 15.77m and 3.7m respectively. Screened overlying materials in Bore DS1-120 comprise extremely weathered clays among lenses of extremely weathered sandstone and thinly bedded mudstones. Within these layers a series of water strikes were recorded and these extend to about 97.0m below natural ground level. The confining layer separating this system from the overlying intermediate aquifer system has an average thickness of about 10.0m.

3.3.4. Aquifer Types

Taking due cognisance of observations of the geological materials encountered during drilling and bore construction, coupled with ground water level behaviour and bore and aquifer testing, the aquifers underlying Rover 1 may be described as:

Table 6: Aquifer Types at Rover 1.

Geology	Depth (m)	Lithological description ^(*)
Wiso Basin	0 - 15	Localised aquitard systems among the regolith overlying to the ferruginous pisolites and extremely weathered sandstone with significant siltstones and minor dolomites.
	15 – 60	Extremely weathered rock comprising sandstone, siltstone and minor dolomite, dominated by secondary porosity and permeability. Whilst porosity may be moderate to high, drainage appears low. Vertical and horizontal permeabilities are calculated be low but these would vary where sandy and clay horizons prevail. This system underlies localised lenses of alluvial sands and therefore this is locally interconnected with the overlying aquitard systems.
	60 – 80	Laminated siltstone with minor sandstone and dolomite, highly weathered (decompose to a silt clay) at the top and weathered to slightly unweathered rock below 70m. Progressive downward change from slightly weathered to slightly weathered fractured rock with porosity and permeability along bedding planes with negligible cross cutting. Under natural conditions, these are effectively closed with little weathering. Although pump test data indicate overlying aquifer system may be locally leaking downwards, the siltstone at the lowest of this sequence can be regarded as a confining layer.
	80 – 104	Laminated siltstone with dolomite and dolomitic sandstone with several interbedded mudstones. Fracture porosities and permeability are enhanced in zones where vughs occur within the lithologies. The interbedded fresher siltstones and mudstones with very low vertical and horizontal permeabilities are relatively thin (less than 2m) and hence on regional scale may not act as confining layers.
	104 – 113	Sequences of siltstone, sandstone and minor mudstone and conglomerate with high porosity and moderate permeability where cement has been weathered out; confined aquifers with a relatively low storage coefficient. Note: Previous information reported that in some exploration holes i.e. WGR1D048 there was no dissolution of the rock matrix. The basal conglomerate may store locally large quantities of groundwater.
	113 – 120	Fine interlayering of siltstones and mudstones fresh rocks extends to depth having very low porosities and permeability and acts as a confining layer.
	120 – 132	The same as between 104m to 113m.
Basement Rocks	below 132	Basement rocks below the Wiso Basin have generally RQDs of 0 across 3m to 10m. These rocks have no or very little iron staining and decomposition. No known aquifers exist within the basement rocks. Joints are closed and do not exhibit any form of alteration which may store and/or convey groundwater.
(*) Lithological description attained during the drilling program was adapted to descriptions recorded during various exploration activities.		

3.4. Ground Water Quality

3.4.1. Previous Investigations

Ground water quality at Rover 1 was indicated as *poor* with several parameters exceeding their guidelines (NHMRC/NRMMC, 2011) thereby rendering these sources as unsuitable for potable water supplies:

- TDS between 1,250mg/L and 2,800mg/L exceeds the guideline concentration of 500mg/L.
- Nitrate between 56mg/L and 123mg/L exceeds the guideline concentration of 50mg/L.
- Fluoride between 2.3mg/L and 2.5mg/L exceeds the guideline concentration of 1.5mg/L.
- Ground water hardness (Total Hardness >180mg/L CaCO₃) ranges from of being of good quality to show increasing scaling problems and pH varies between 7.8 and 8.0.

- The composition of ground water in the Wiso Basin aquifer systems, in terms of principal cations and anions are:
 - Cations: $\text{Na} > \text{Mg} > \text{K} > \text{Ca}$.
 - Anions: $\text{Cl} : \text{HCO}_3 > \text{SO}_4$ (44m), $\text{HCO}_3 > \text{Cl} > \text{SO}_4$ (60m) and $\text{Cl} > \text{SO}_4 > \text{HCO}_3$ (102m).
- The large sodium, together with large SO_4 , K and NO_3 concentrations, suggest that salinity in the aquifer is derived from a combination of:
 - Mixing of recharge with aquifer storage as suggested by the large Na/Cl (>0.7) and SO_4/Cl (>0.5) ratios
 - Ion exchange, during which Na in the bedrock is exchanged for Ca, and leaching of contamination by salts as suggested by the large Na, SO_4 , K and NO_3 concentrations

Figure 14 displays a distinct NaCl character indicative of weathering of the siltstones (dolomitic geological environment) from a marine environment. In general, ground water is classified as having high to very high salinities (C3 to C4) with low to very high sodium hazards (S1 to S4).

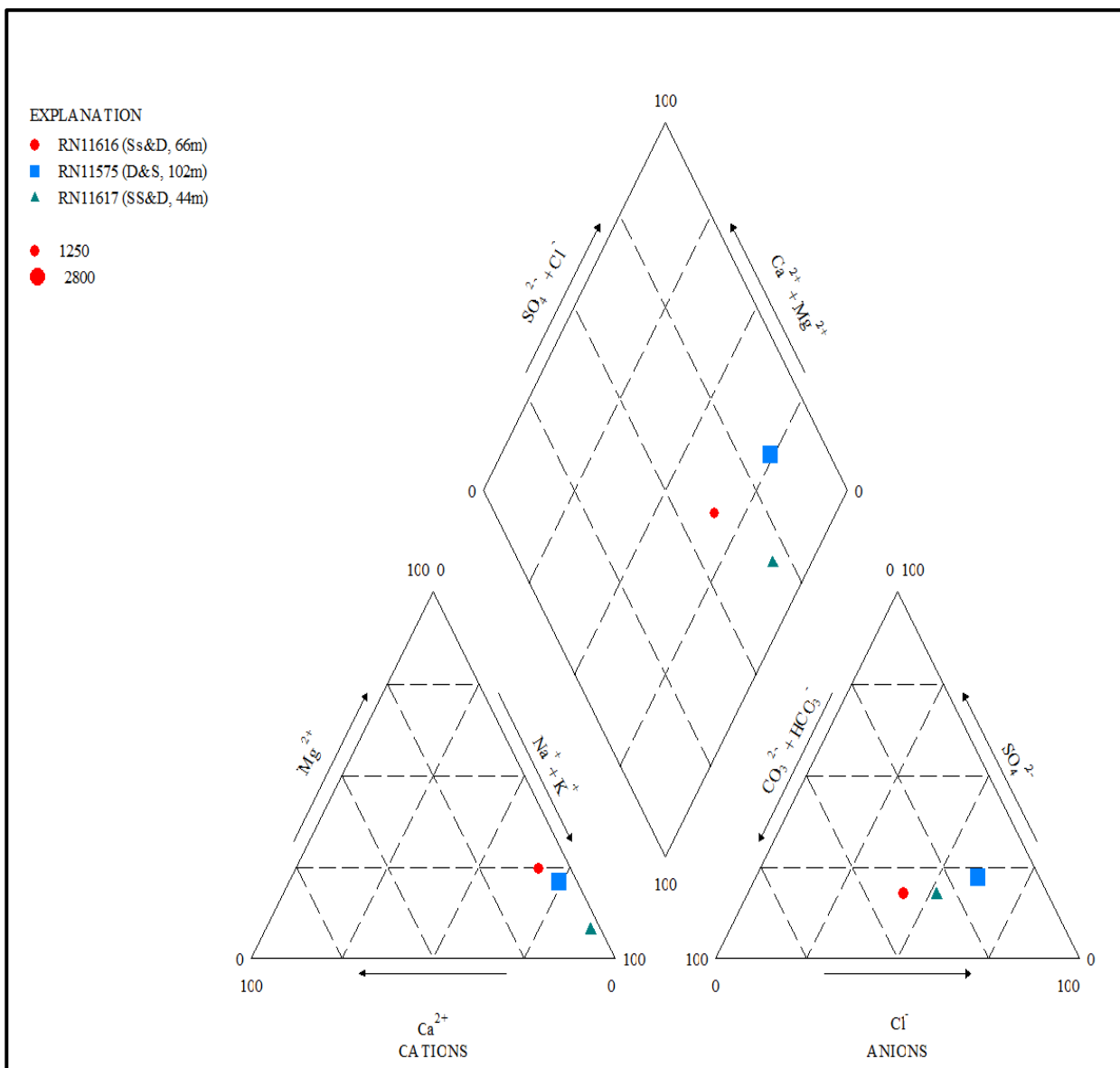


Figure 14: Piper Diagram showing Ground Water Quality.

3.4.2. Bore Test Water Quality

Water quality data obtained during the bore test program appear in Table 7 whilst the detailed laboratory certificates may be found in Appendix C.

Table 7: Ground Water Quality at Rover 1.

Sample Date and ID				29/12/2011	03/01/2012	19/12/2011	27/12/2011	12/01/2012	25/12/2011
Analyte	Units	ADWG, 2011	ANZECC 2000 Long Term Irrigation Water	DS1-60	DS1-90	DS1-120	DS5-60	DS5-90	DS7-60
Field Data									
Temperature	(°C)	-	-	28.9	32.3	33.9	30.7	33.7	28.4
pH	Units	6.5 - 8.5	6.0 - 8.5	7.73	7.37	7.15	7.38	7.05	7.70
Electrical Conductivity	mS/cm	-	-	2.00	4.55	5.15	4.49	2.97	1.87
TDS	ppm	500	-	1,000	2,280	2,590	2,330	6,230	920
Calculated									
Hardness as CaCO ₃	mg/L	200	-	330	487	620	460	703	301
Laboratory Analysis									
Total Alkalinity as CaCO ₃	mg/L	-	-	332	351	338	352	346	429
Acidity as CaCO ₃	mg/L	-	-	10	24	4	<1	7	3
Sulfate as SO ₄	mg/L	250 - 500	-	142	411	514	383	600	133
Chloride	mg/L	250	<175 for sensitive plants to >700 for tolerant species	303	859	1,060	759	1,190	177
Calcium	mg/L	-	-	37	44	53	48	58	32
Magnesium	mg/L	-	-	58	92	119	83	136	54
Potassium	mg/L	-	-	100	123	133	131	141	95
Sodium	mg/L	-	<115 for sensitive plants to >460 for tolerant species	226	556	656	510	756	178
Nitrate	mg/L	50	-	26.8	10.6	8.9	17.0	9.8	23.6
Heavy Metals									
Arsenic	mg/L	0.01	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Cadmium	mg/L	0.002	0.01	0.0005	0.0002	0.0002	<0.0001	0.0002	<0.0001
Chromium	mg/L	0.05	0.1	<0.001	<0.001	<0.001	0.003	<0.001	<0.001
Copper	mg/L	2 - 3	0.2	0.002	0.002	0.012	0.003	0.026	0.002
Nickel	mg/L	0.02	0.2	0.005	<0.001	<0.001	0.001	0.006	0.017
Lead	mg/L	0.01	2	0.003	<0.001	0.003	0.001	0.002	<0.001
Zinc	mg/L	3	2	1.38	9.97	0.952	0.394	0.693	0.094
Mercury	mg/L	0.001	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Hardness: <60 mg/L CaCO ₃ soft but possibly corrosive; 60–200 mg/L CaCO ₃ good quality; 200–500 mg/L CaCO ₃ increasing scaling problems; >500 mg/L CaCO ₃ severe scaling. TDS: 0-600 mg/L good; 600-900 mg/L fair; 900-1200 mg/L poor; >1200 mg/L unacceptable. In bold are exceedances to the NHMRC/NRMMC (2011) assessment levels.									

In general water quality can be described as having circum-neutral pH with elevated TDS and EC. TDS ranges between 920mg/L and 6,230 mg/L, whilst EC varies between 1.87mS/cm and 5.15mS/cm which classifies as non-potable ranging from poor to unacceptable (NHMRC/NRMMC, 2011).

Major cations, including calcium, magnesium, potassium and sodium, are relatively high with sodium between 178mg/L and 756mg/L the dominant ion. Sulfate and chloride are present at concentrations ranging from 133mg/L to 600mg/L for sulfates and from 177mg/L to 1,190mg/L for chloride. Chloride concentrations with the exception of the lowest concentration in Bore DS7-60 exceed the NHMRC/NRMMC assessment levels in all bores. Whilst acidity as CaCO₃ are relatively low ranging between 1mg/L and 24mg/L, total alkalinity as CaCO₃ is relatively high ranging between 332mg/L and 429mg/L. Hardness as CaCO₃ ranges from about 301mg/L to 703mg/L and most of the waters may be classified as hard to very hard with increasing to severe scaling.

With the exception of one sample in which the zinc concentrations is very high (9.97mg/L Bore DS1-90), the majority of trace metals are marginally above or below the NHMRC/NRMMC (2011) assessment levels.

During bore discharge tests, pH and electrical conductivity generally decreased (Figure 15). pH from a slight early increase to a weak alkaline environment decrease to remain circum-neutral, slightly above neutrality. Decreases in EC were dominant in waters at DS1 with slight increases at DS4 and DS7.

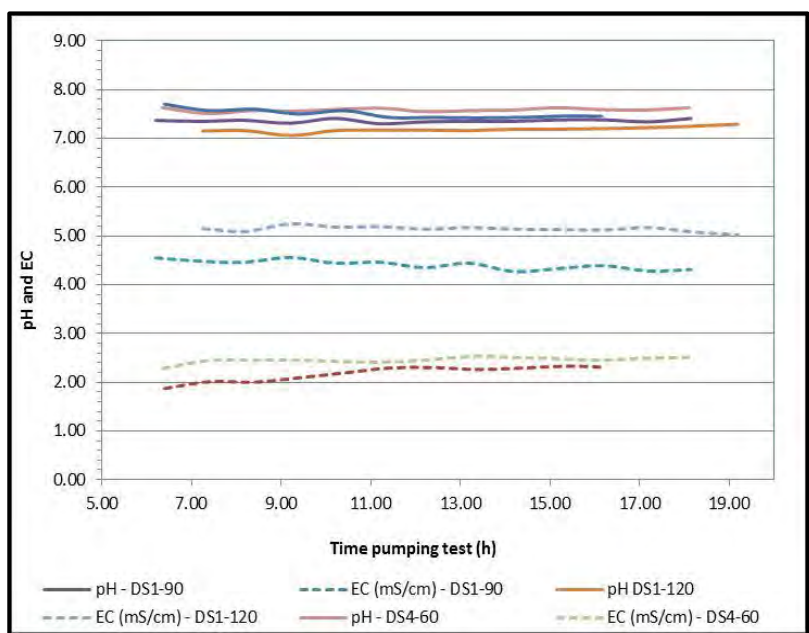


Figure 15: pH and EC Behaviour during Pumping Tests.

Sodium and calcium concentrations in Bores DS1-120 and DS7-60 have a tendency to increase with time, whilst in the other bores, including DS5-60 and DS5-90, a decreasing trend was observed (Figure 16). Behaviour of the fingerprint cations indicates waters are hosted within a dolomitic environment which will, under dynamic conditions, tend to release readily available ions with time. Salinities of these waters would also tend to increase with time. Sulfate behaved in a similar fashion particularly in the deep bores. Overall ion behaviour are indicative of waters hosted or travelling through weathered dolomitic environments which would tend to contribute large concentrations of key fingerprint ions such as calcium, magnesium and sodium into the aqueous system.

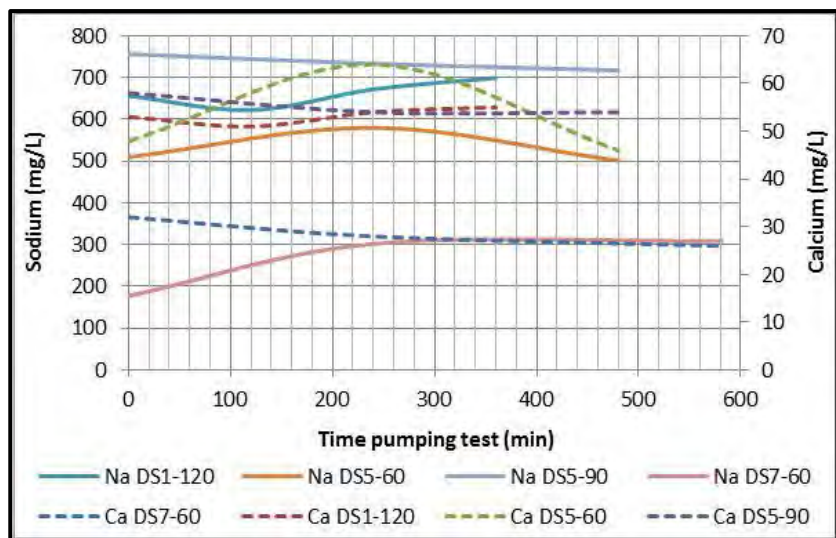


Figure 16: Calcium and Sodium behaviour with Time.

4. Ground Water Modelling

4.1. Introduction

To ascertain influx of ground water into the proposed box cut and decline, the scope of work consisted of:

- Develop/construct a numerical model of the ground water regime within the area of impact.
- Assess the potential impact due to and, extent of dewatering in the surrounding environment.
- Detail the results of models and/or predictive tools used, including inputs, sensitivity analyses, justification of any assumptions used in the development of the model(s), and general conformance with the Northern Territory Natural Resources, Environment, The Arts and Sport (NRETAS) groundwater flow modelling guidelines.

4.2. Data Sources and Deficiencies

The numerical model was developed based upon:

- Geological and hydrogeological maps.
- Geological and lithological information from the drilling program.
- Digital layouts of the box cut and decline.
- Rainfall, evaporation and ground water level data.
- Bore test data and interpretations.

Considering the large, previously hydrogeological unexplored area of interest, the current set of tested ground water bores provides only a very limited spatial coverage. Figure 17 indicates the regional setting of the model domain, while Figure 18 represents a simplified layout of the box cut and decline.



Figure 17: Regional Layout Plan with Model Domain Area (5km²; Google Earth, 2012).



Figure 18: Simplified Layout of Proposed Box Cut (30m deep) and Decline (Google Earth, 2012).

Whilst cognisance was taken of the aquifer test analyses using the Aquifer Test software, further interpretations were undertaken using the FC Method software developed by the Institute for Groundwater Studies at the University of the Free State and the Department of Water Affairs in South Africa (Appendix D). Hydraulic conductivities for the 3D flow model for the area were calculated from the interpreted information. Table 8 summarises the data interpretation:

Table 8: Summary of Aquifer Test Data and Parameters.

Borehole ID	Sustainable Yield (L/s)	Transmissivity (m/d)	Storativity
DS1_60	0.4	1	5×10^{-3}
DS4_60	0.3	1	5×10^{-3}
DS5_60	0.4	8	5×10^{-3}
DS7_60	0.3	1	5×10^{-3}
DS1_90	1.0	1	5×10^{-3}
DS5_90	10.0	131	5×10^{-3}
DS1-120	5.2	5	5×10^{-3}

Note: The sustainable yield is recommended for a 24hr/day for a period of 2 years. However, with the limited area covered by the boreholes, ground water levels should be monitored fortnightly should these bores be used as a source of water for drinking and/or processing.

4.3. Conceptual Model

Table 6: Aquifer Types at Rover 1 was used as basis for the geological components of the conceptual model (Figure 19):

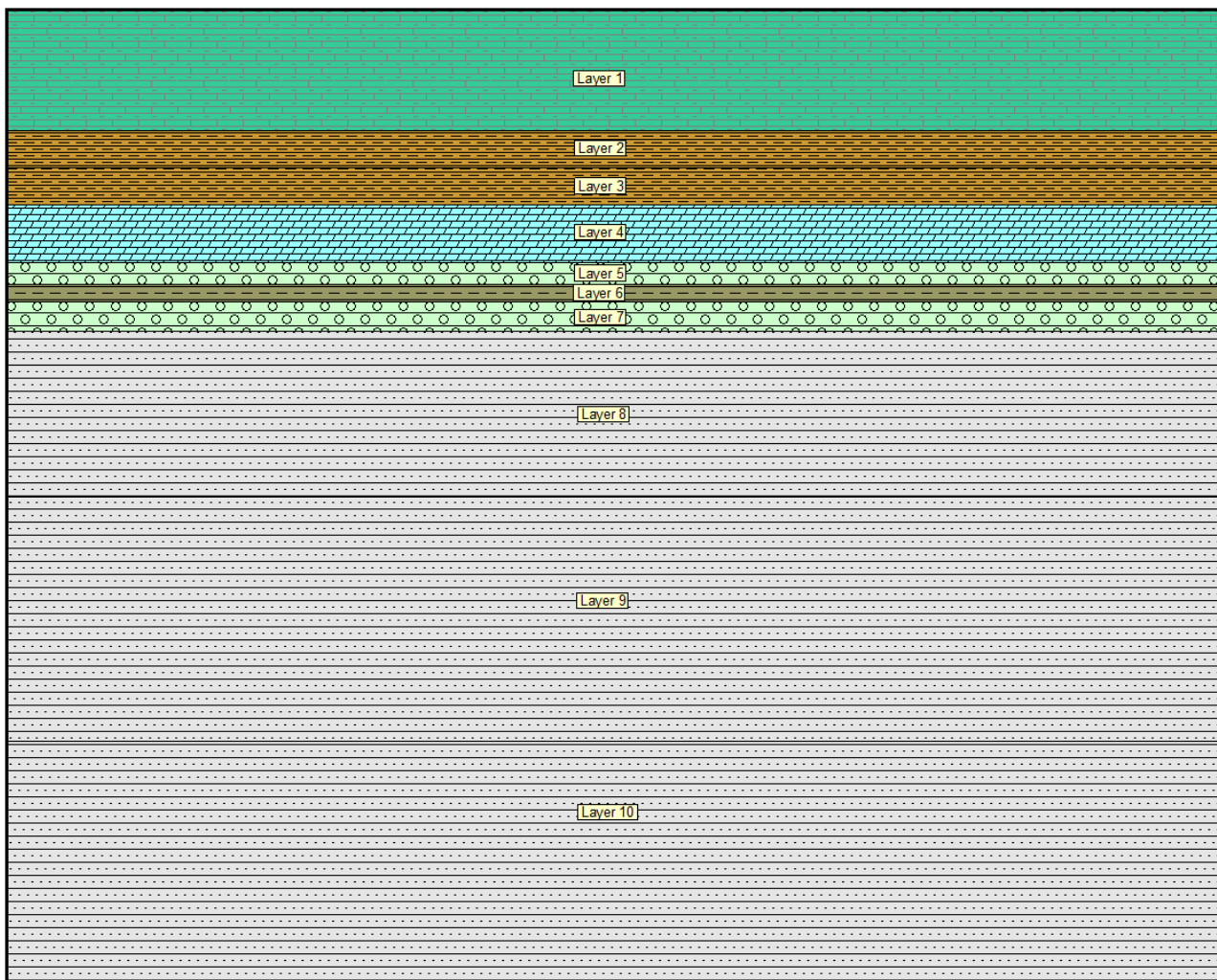


Figure 19: Simplified Geological Conceptual Model.

A conceptual model of 10 layers was decided upon: **model layers do not necessarily correspond to geological layers i.e. a geological layer can consist of more than one model layer.** This allows for constant head nodes to be applied at different depths within a geological layer in accordance with the physical development of the box cut and decline over time. Other considerations include the effect of possible numerical oscillation due to great variation in spatial grid.

The spiral decline posed a problem in the sense that the Feflow software could not import the electronic information in such a way that the void could be assigned an individual zone in the model. It was decided therefore to approximate the decline by a simplified vertical shaft.

A primary consideration when estimating ground water volumes entering the box cut and spiral decline was the area through which flow will take place. The box cut was kept the same shape and size as the most peripheral contour that was provided electronically (Figure 18). The depth of the box cut was assigned a value of 65m below ground level, approximately 232mAHD. From the layout plans and electronic information, the length of the decline, from where it exits the box cut to final depth at approximately -100mAHD, was measured as 1,121 m. The width and height were provided as 5.5 m; thus the area through which flow would take place was calculated as 24,662m². In order to simplify this to a vertical shaft of more or less 345m deep, the width and breadth was calculated as 15.5 m by 15.5 m, which totals an area of 24,800m² exposed to ground water flow.

The box cut and decline will be developed in time:

Table 9: Model Stages and Time Frames.

Stage	Depth Elevation (mAHD)	Depth Elevation (mbgl)	Duration (days)
1	232.0	65	60
2	97.0	200	90
3	-3.0	300	90
4	-102.5	400	90

4.4. Model Parameters

Model parameters were based upon the hydraulic parameters ascertained from aquifer testing to a depth of maximum 120m below ground level. Layers situated at greater depths were assigned values for the different parameters based upon the physical descriptors in Table 10 including *typical values* for specific geological formations found in different literature sources. Qualified *guesses* from experienced professionals (Profs. G. J. van Tonder and G. Steyl at the Institute for Groundwater Studies, University of the Free State, South Africa) acknowledged as experts in the field of fractured rock aquifers were also taken into consideration.

Table 10: Conceptual Model Description and Parameters.

Geological Layer	Model Layer	Thickness (m)	Depth (mbgl)	Elevation (mAHD)	Recharge (mm/a)	Hydraulic Conductivity (m/d)	Specific Storage (/m)
Extremely weathered rock comprising siltstone and dolomite	1	50	50	297 to 247	10	0.10	0.0010
Laminated siltstone, highly weathered (decompose to a silt clay) at the top and hard rock below 70m	2	15	65	247 to 232	0	0.03	0.0004
	3	15	80	232 to 217	0	0.03	0.0004
Dolomite and dolomitic sandstone with several interbedded mudstones	4	24	104	217 to 193	0	2.08	0.0021
Sequences of sandstone and conglomerate with high porosity and moderate permeability where cement has been weathered out; confined aquifers with a relatively low storage coefficient	5	9	113	193 to 184	0	1.11	0.0056
Mudstones having very low porosities and permeabilities and acts as a confining layer	6	7	120	184 to 177	0	0.14	0.0007
Sequences of sandstone and conglomerate with high porosity and moderate permeability where cement has been weathered out; confined aquifers with a relatively low storage coefficient	7	12	132	177 to 165	0	0.83	0.0042
Basement rocks below the Wiso Basin have generally RQDs of 0 across 3m to 10m	8	68	200	165 to 97	0	0.003	0.0001
	9	100	300	97 to -3	0	0.003	0.0001
	10	100	400	-3 to 103	0	0.003	0.0001

4.5. Numerical Model

4.5.1. Network, Initial Setup and Calibration

The model network was generated by making use of the 3D finite element ground water model software Feflow, developed by the German based DHI WASY Institute for Water Resources Planning and Systems Research GmbH.

The basic premise upon which all numerical models is based, is that the area under investigation can be discretized into smaller areas, also referred to as elements. In the case of Rover 1, the area was discretized into 393,860 elements (39,386 elements per model layers), with 217,074 nodal positions (19,734 nodes times 11 slices). Different zones and layers were assigned in order to compensate for hydrogeological differences in characteristics across the area due to geology and/or gradients at depth (Figure 20). The model grid was not rotated since the natural flow occurs from south to north in the model domain.

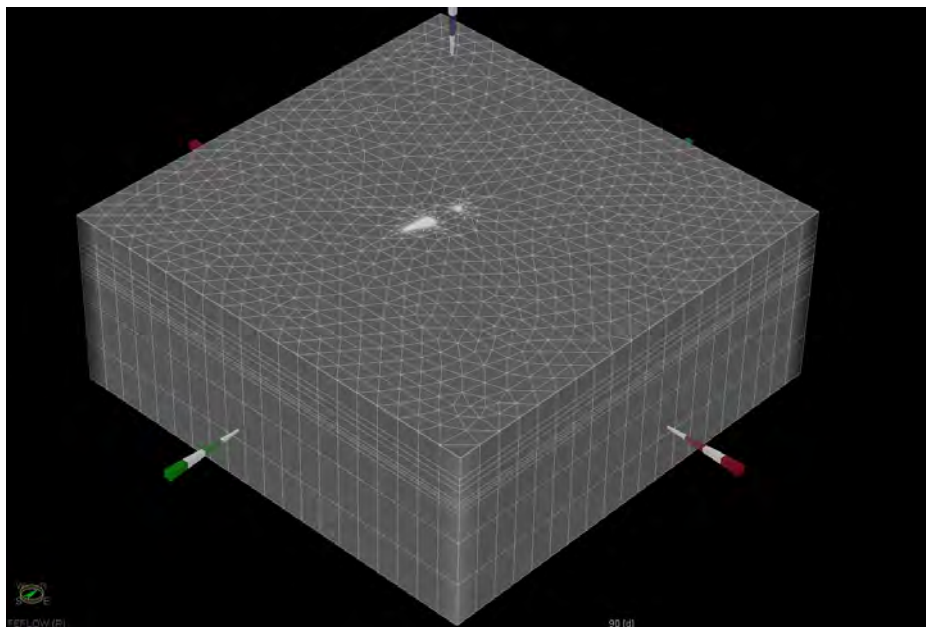


Figure 20: The Finite Element Mesh Constructed for Rover 1.

Owing to the largely flat topographical model domain, the first slice of the model was assigned a value of 297mAHD across the whole area and the thickness of the successive layers (Table 10) were subtracted from slice 1 to a final elevation of -103mAHD approximately 400 m below surface elevation, which is the final elevation specified for the spiral decline:

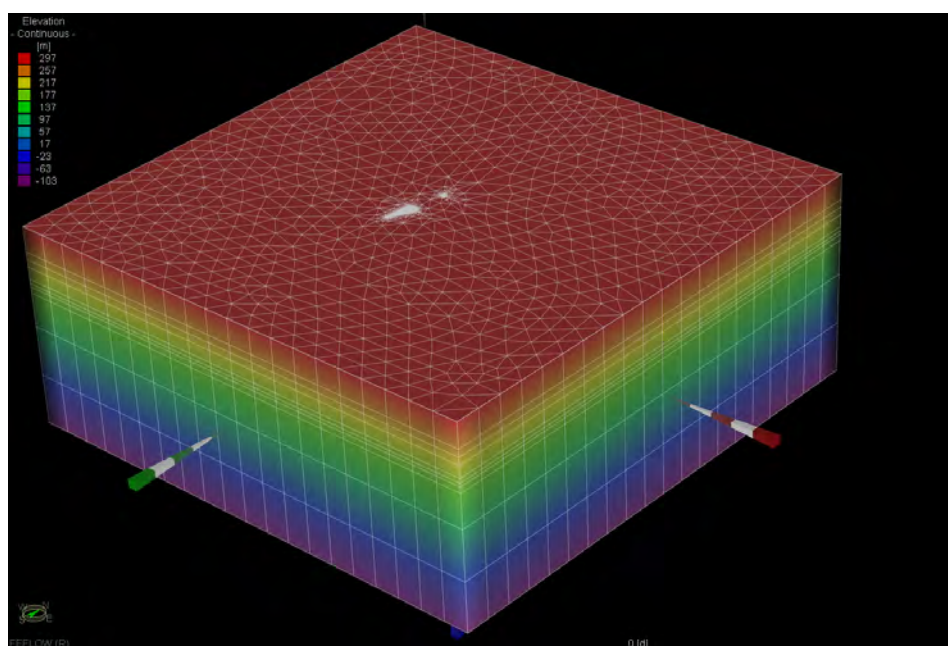


Figure 21: Elevations Assigned to the Different Slices.

4.5.2. Ground Water Level Interpolation

Figure 22 depicts the topographic elevations vs. measured ground water elevations for the 7 boreholes that were used to calculate model parameters. As is typical in a geological environment where dolomites are present as well as deeper confining layers, the correlation is poor. However, although the correlation was poor, the initial heads was interpolated by making use of the Akima Interpolation Method due to a lack of piezometric information across the area.

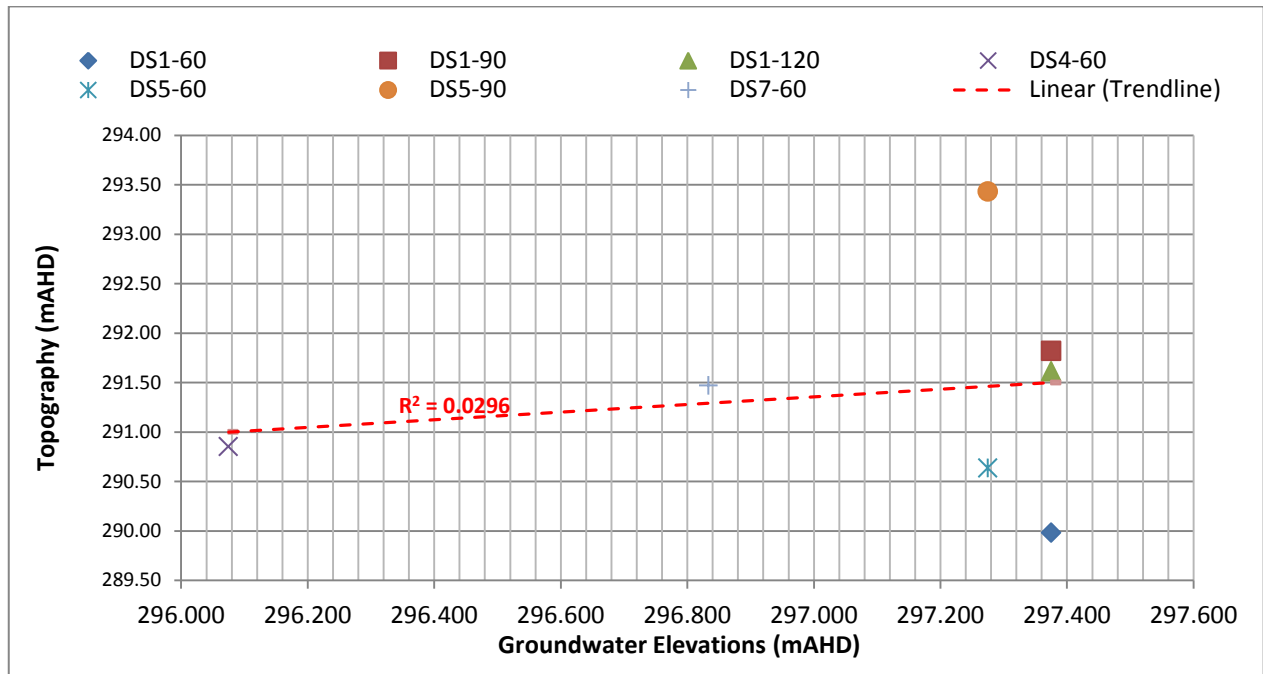


Figure 22: Topography versus Ground Water Elevation.

After the initial hydraulic heads were interpolated, constant head nodes were assigned to the northern and southern borders of the model domain (Figure 23) for all the slices. A value of 292mAHD was assigned to the southern constant head boundary, while a value of 287mAHD was assigned to the northern constant head boundary. The model was run in steady state to calibrate the initial hydraulic heads across the area (Figure 24).

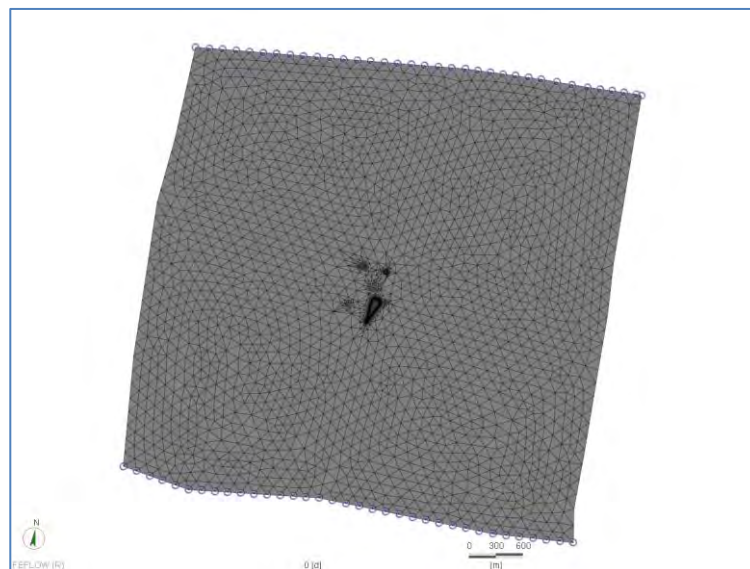


Figure 23: Boundary Conditions to Calibrate Initial Hydraulic Heads.

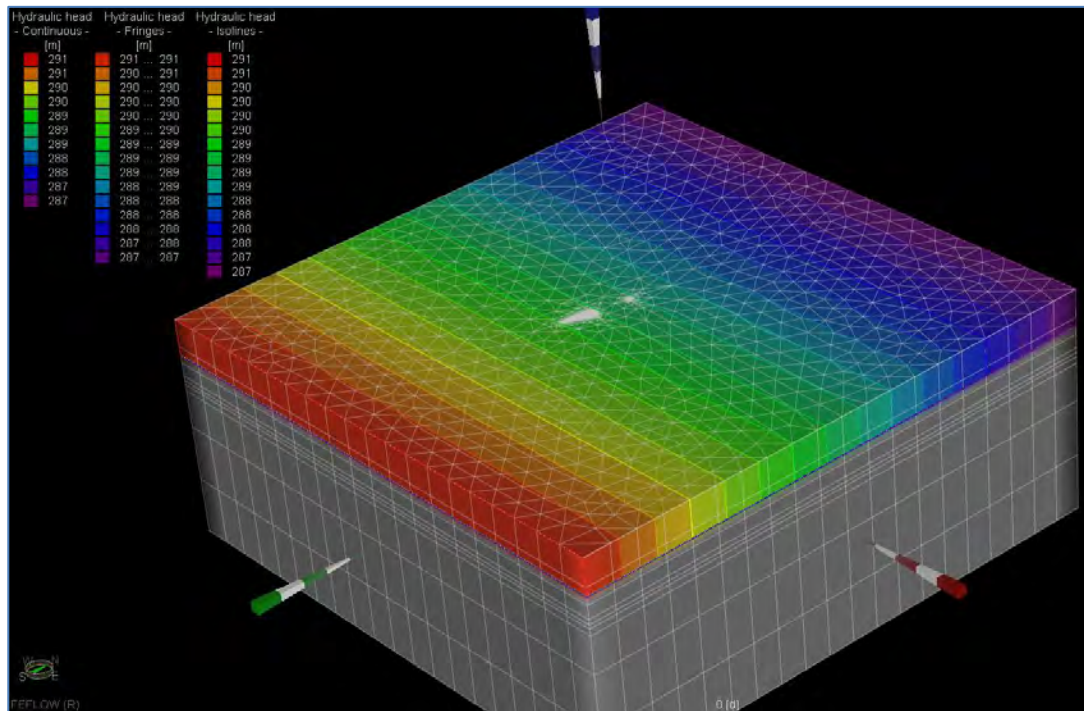


Figure 24: Smoothed Initial Hydraulic Heads for Layers 1 to 3 (Steady State).

Owing to the confining layers indicated at levels 217mAHD and 165mAHD (Figure 25), layers 4 to 6 were assigned an initial hydraulic head value of 217mAHD (top of confining layer 4) and layers 7 to 10 were assigned an initial value of 165mAHD (top of confining layer 7). Conceptually it was thought to reflect the existing ground water regimes at these levels, in combination with mining activities, the best and that the effect of the advancing decline void on the surrounding groundwater environment would be localised as it continues downwards.

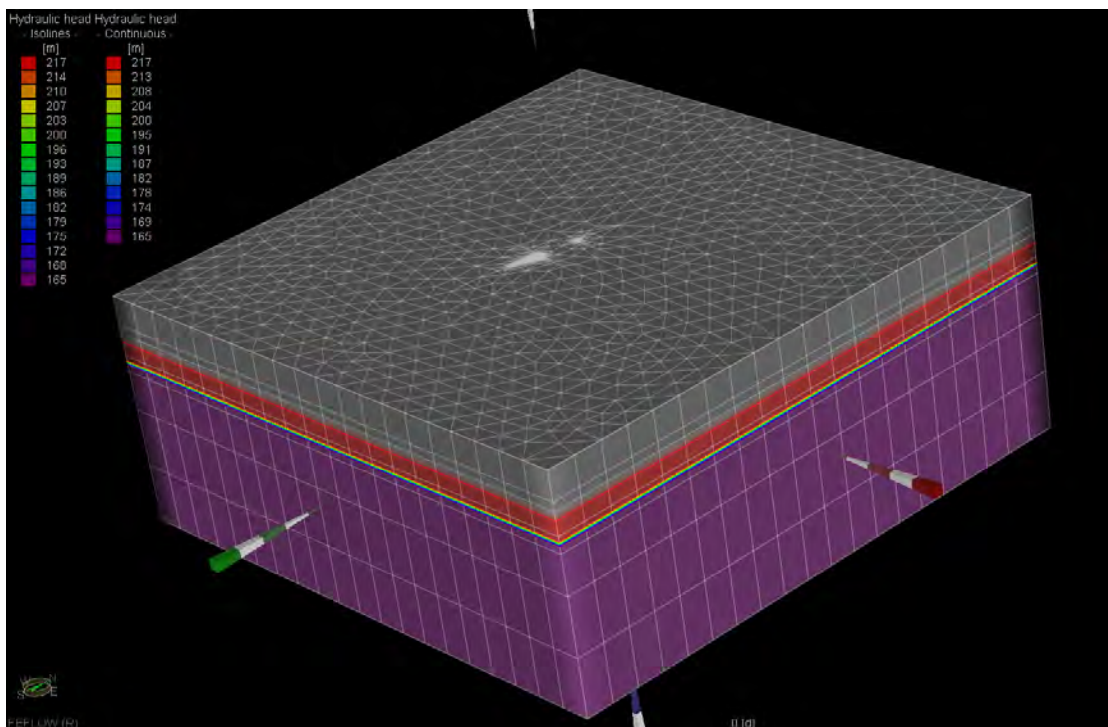


Figure 25: Initial Hydraulic Heads Assigned to Layers 4 to 10.

4.5.3. Methodology and Flow Modelling

The following assumptions were made:

- Ground water levels mimic topography for the first slice and all layers beneath will have the same initial head value.
- Provision has been made for limiting influxes when the decline is grouted or sealed during construction.
- By assigning constant head values around the entire model border, the worst case scenario effects are supported.
- The complex geological conditions were simplified and input data was generated by means of analysing aquifer test data supported by detailed lithological information.

The influxes into the pit were simulated by assigning the bottom of the pit, as per the proposed mining plan (Table 9), as a constant head and running the model at the gradient under confined conditions. Output of each stage was then used as input for the next stage. The hydraulic head and impact zones will be illustrated by means of a cross section striking north to south across the model domain (Figure 26).

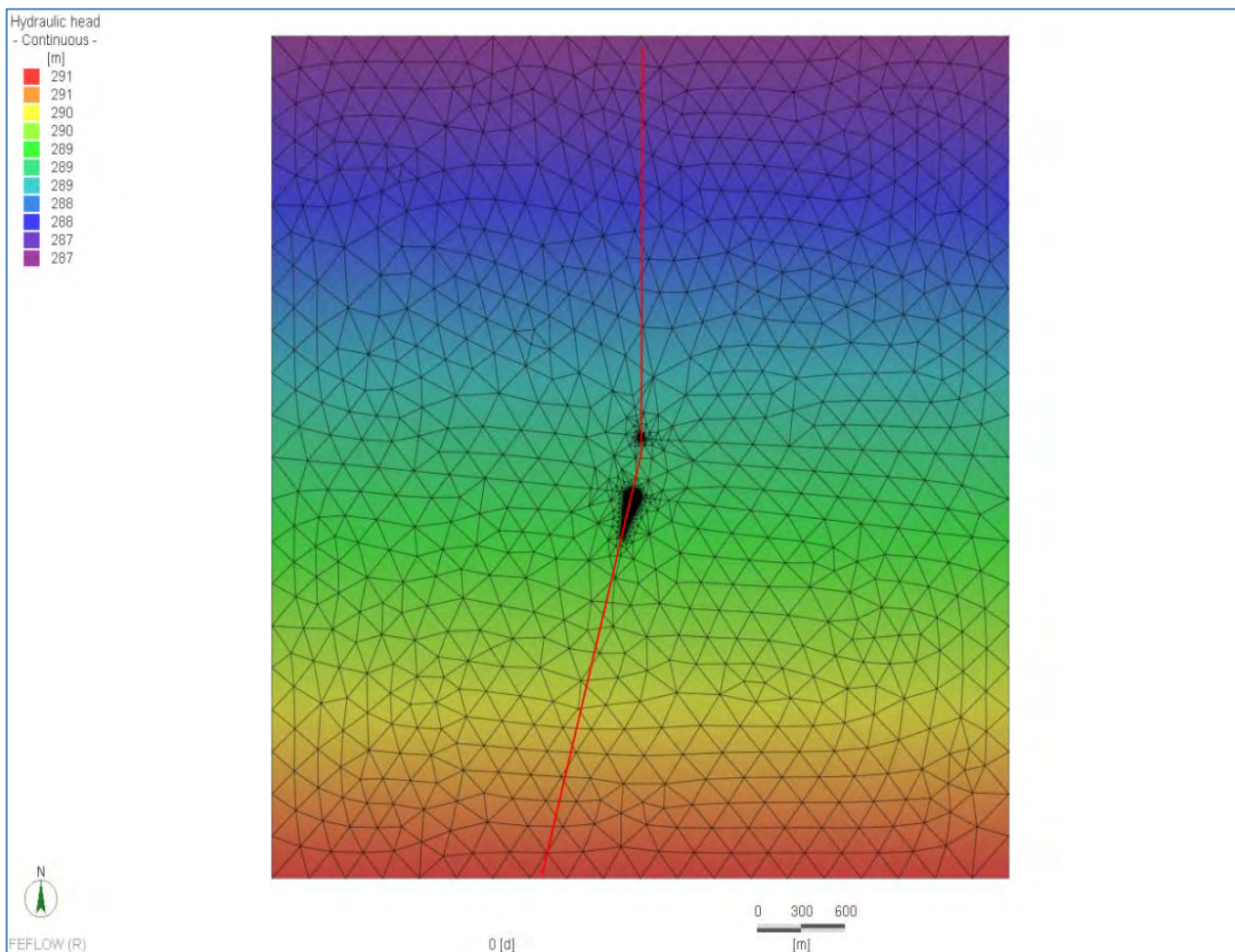


Figure 26: Position and Strike of Cross Section.

The hydraulic head and impact zones for the four stages and time frames indicated in Table 9 are illustrated overleaf in Figures 27 to 31.

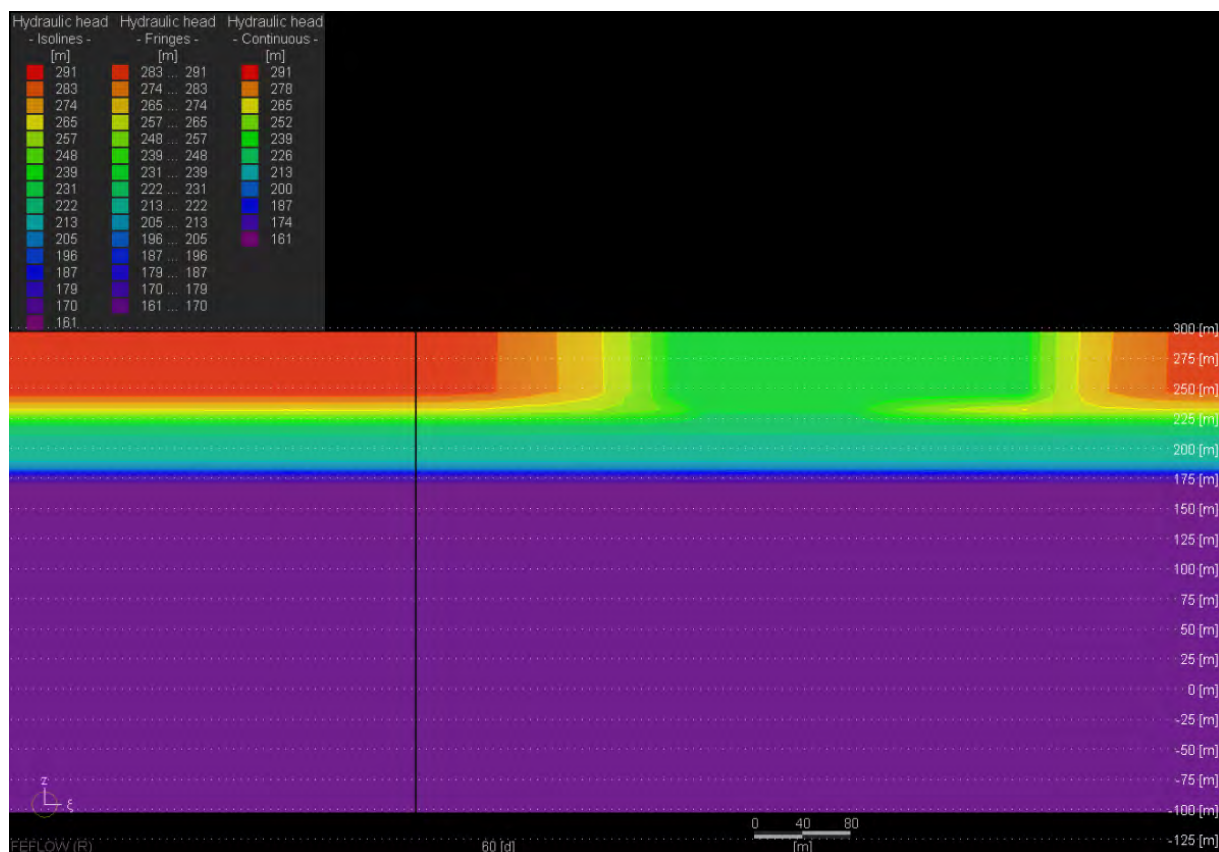


Figure 27: Simulated Hydraulic Heads for Stage 1 Box Cut to 65mbgl (232mAHD).

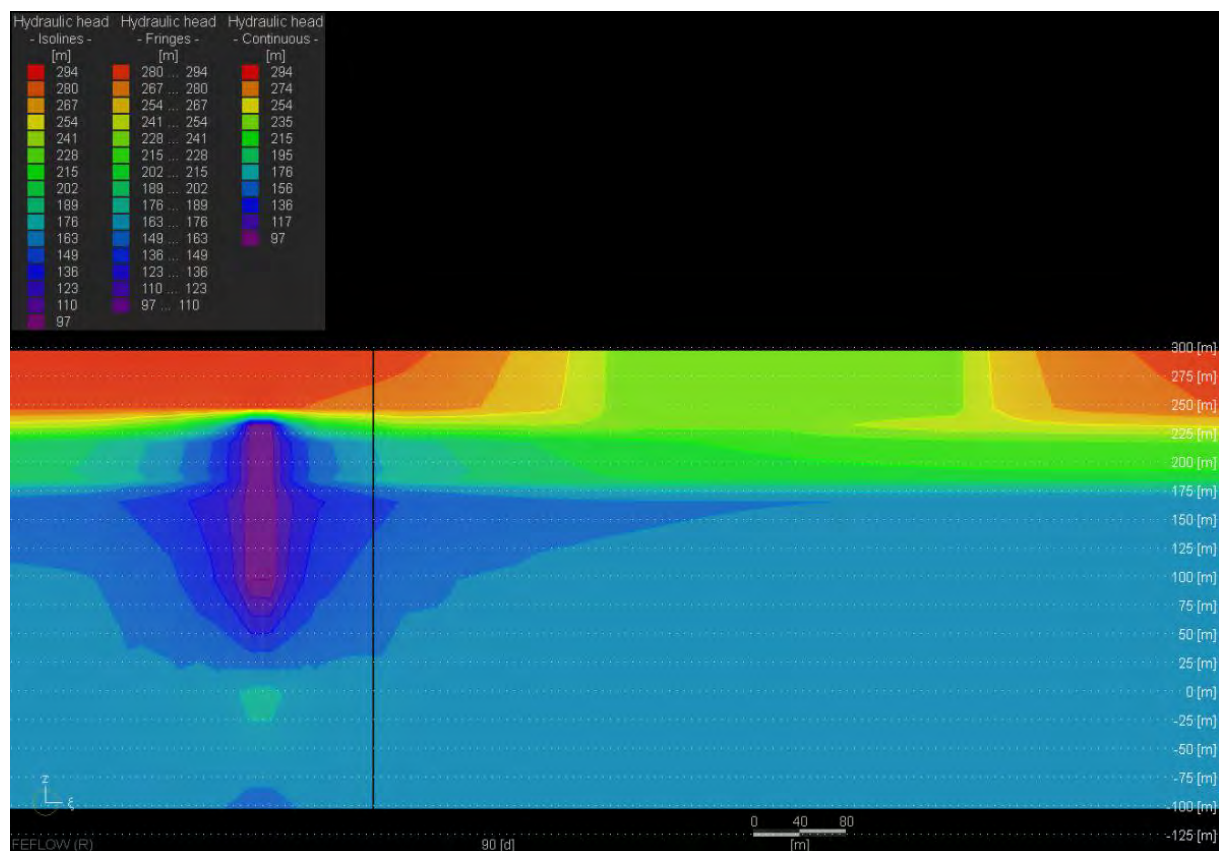


Figure 28: Simulated Hydraulic Heads for Stage 2: Box Cut (232mAHD) and Decline (97mAHD).

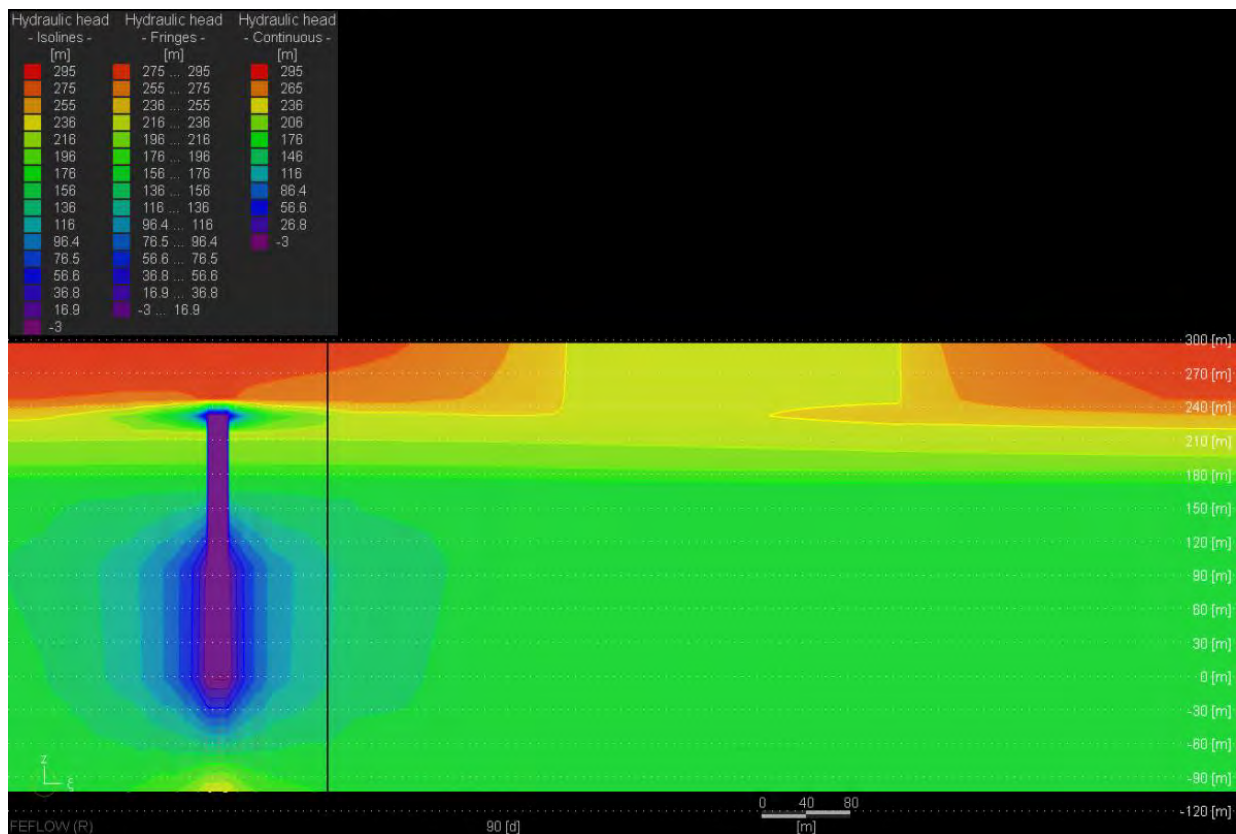


Figure 29: Simulated Hydraulic Heads for Stage 3: Box Cut (232mAHD) and Decline (-3mAHD).

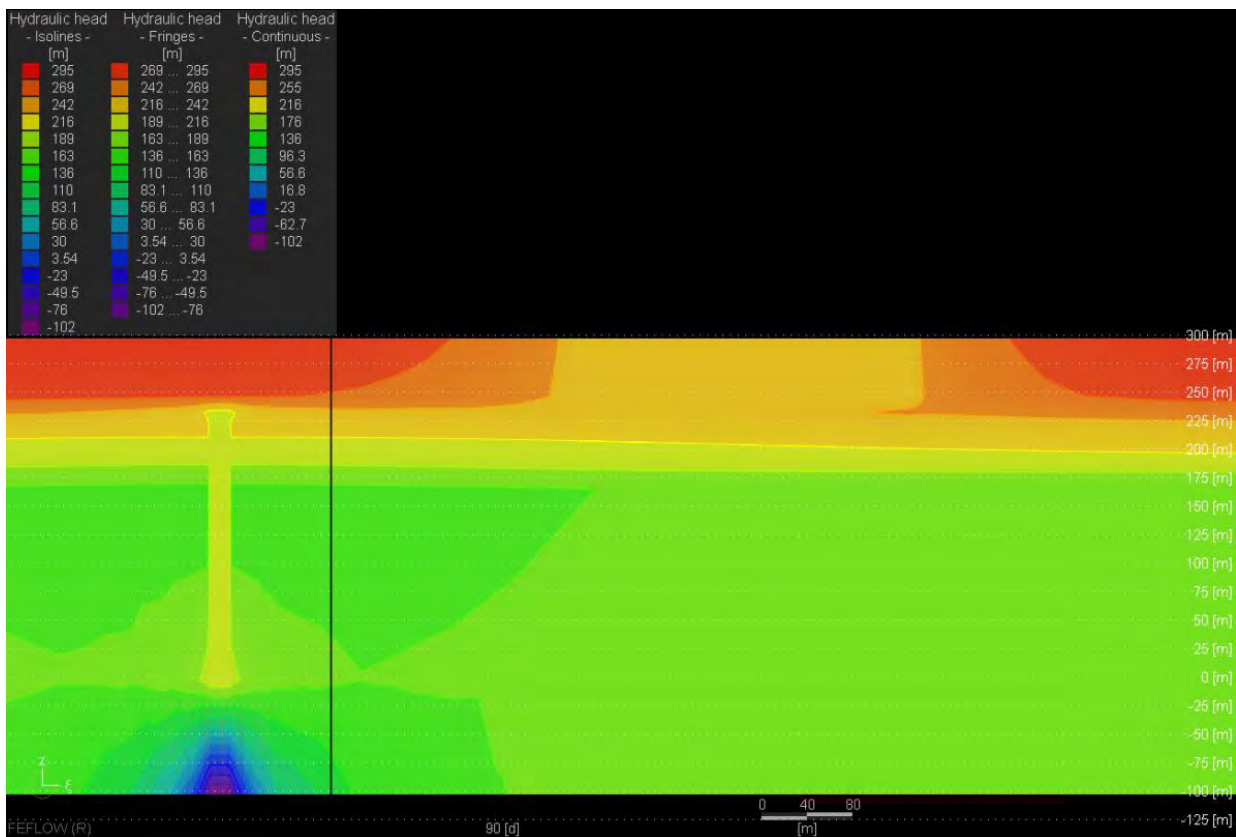


Figure 30: Simulated Hydraulic Heads for Stage 4: Box Cut (232mAHD) and Decline (-103mAHD).

4.5.4. Predicted Inflows into Box Cut and Decline

Table 11 summarises the predicted inflows into the box cut and decline over a time span of 330 days. The volumes range between 1,285m³/day and 14,619m³/day. The larger fluxes are associated with the higher hydraulic conductivities associated with model layer 4 (dolomite). However, recent assessments of drill core data suggest that **the local aquifer is highly heterogeneous and that these highly conductive zones appear to be localised and of limited extent** in the area surrounding the box cut and decline. Sealing of these layers during the construction phase will mitigate any large and long term flows into the decline.

Table 11: Summary of Influxes into the Box Cut and Decline.

Stage	Time	Box Cut		Decline		Cumulative Total	
	(days)	(m ³ /day)	(L/s)	(m ³ /day)	(L/s)	(m ³ /day)	(L/s)
1	60	2,318	27	-	-	2,318	27
2	90	1,660	19	14,619	169	16,279	188
3	90	1,401	16	8,848	102	26,528	307
4	90	1,285	15	9,372	108	37,185	430

It should be noted that the box cut fluxes decrease with time as storage in the surrounding aquifers is depleted especially the high hydraulic conductivity zone.

Two scenarios were investigated:

- Scenario 1: the decline is not sealed as it descends in depth.
- Scenario 2: where the primary fluxes of the decline are grouted and/or sealed during construction to prevent and/or minimize inflows.

Predicted volumes by the model indicate large differences in the total influxes to be expected (Table 12 and Figure 31) and that sealing/grouting of the highly conductive zones will dramatically reduce influxes (influx may therefore be controlled by selective sealing/grouting):

Table 12: Comparison between Scenarios 1 (Unsealed) and Scenario 2 (Sealed Decline).

Scenario	Stage	Total Inflow	
		(m ³ /day)	(L/s)
1: No Sealing of Decline	1	2,318	27
	2	16,279	188
	3	26,528	307
	4	37,185	430
2: Sealing of Decline	1	2,318	27
	2	16,279	188
	3	1,921	22
	4	1,365	16

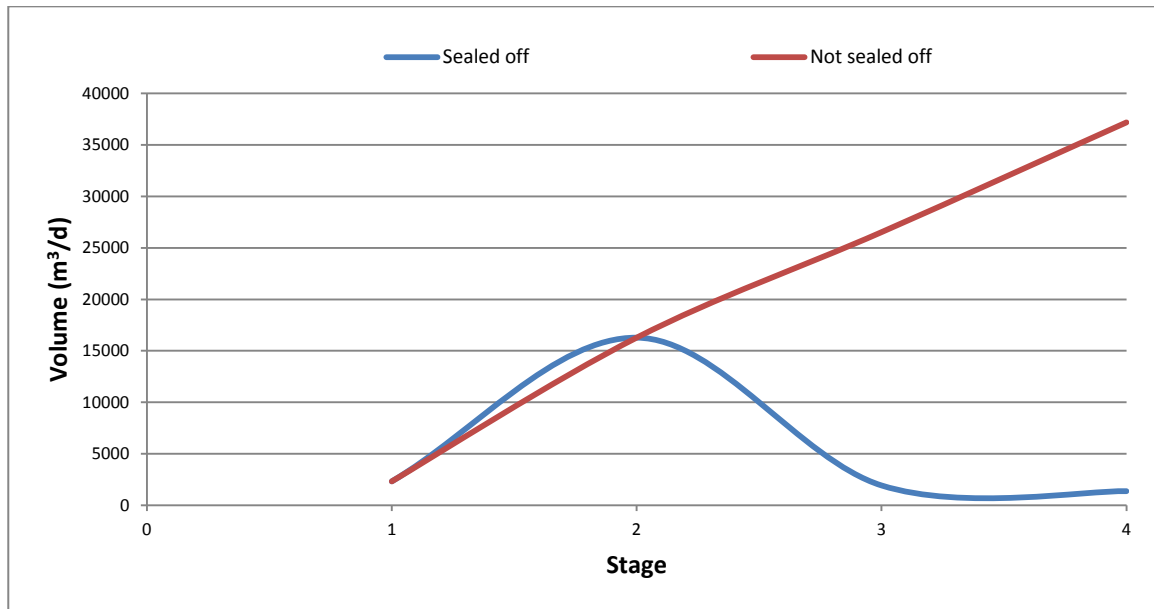


Figure 31: Graph Indicating Predicted Inflows for Scenarios 1 and 2.

4.5.5. The High Transmissive Zone

Subsequent to modelling, aquifer heterogeneity and the high transmissive zone potentially causing large ground water yields into a future decline were investigated further by inspecting drill cores and photos. These identified that between the siltstone/dolomite boundary a small gritty and porous mudstone exists that varies in height, competency and dolomitic alteration across the prospect:

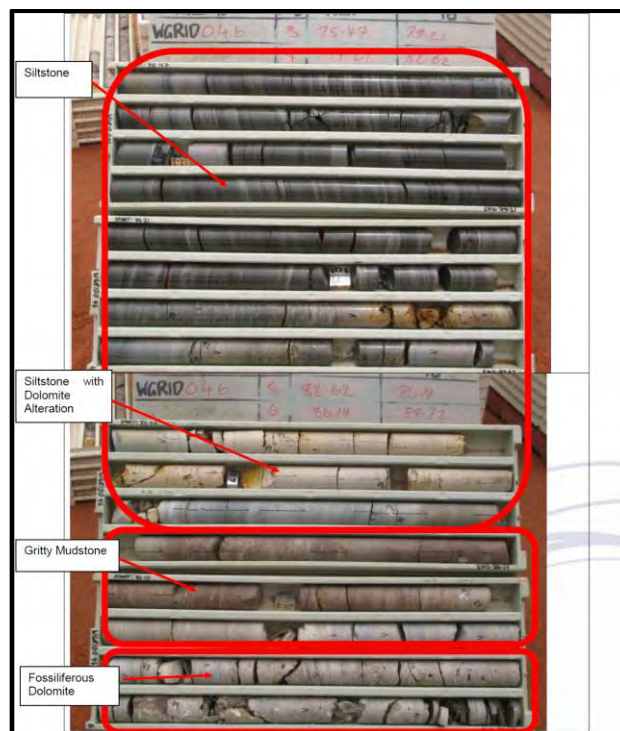


Figure 32: Gritty Mudstone between Impermeable Siltstone/Fossiliferous Dolomite.

The gritty mudstone has been identified as the most probable host rock for the aquifer as it shows high levels of weathering and has usually resulted in regular and prominent core loss during drilling. Weathering on the upper and lower contacts of the siltstone and dolomite respectively indicate little to no penetration of ground water into these units besides when fracturing occurs. In total 23 of the 56 parent holes at Rover 1 were inspected:

Table 13: Width of Weathered Zones between the Siltstone–Mudstone–Dolomite Contact.

Hole_ID	mFrom	mTo	Weathering (m)
WGR1D001	92.2	92.4	0.2
WGR1D002	89.5	92.5	3.0
WGR1D003	90.0	90.0	0.0
WGR1D004	93.4	93.7	0.3
WGR1D005	90.0	90.0	0.0
WGR1D006	78.7	81.7	3.0
WGR1D007	78.8	79.7	0.9
WGR1D009	80.0	80.5	0.5
WGR1D011	94.3	96.5	2.2
WGR1D042	81.0	84.5	3.5
WGR1D044	82.0	85.6	3.6
WGR1D045	90.0	90.0	0.0
WGR1D046	90.0	90.0	0.0
WGR1D047	90.0	90.0	0.0
WGR1D048	90.0	90.0	0.0
WGR1D049	90.0	90.0	0.0
WGR1D050	90.0	90.0	0.0
WGR1D051	90.0	90.0	0.0
WGR1D052	91.5	96.0	4.5
WGR1D053	98.5	106.0	7.5
WGR1D054	90.0	90.0	0.0
WGR1D055	90.0	94.0	4.0
WGR1D056	81.2	90.0	8.8
Note: a default value of 90.0 used in mFrom and mTo when no weathering was observed. Weathering is an estimated thickness due to core losses across this zone.			

For the most part, the gritty mudstone between the siltstone and dolomite has only minor weathering and is most likely a poor conduit for ground water storage. However, to the south of Rover 1, the weathering profile expands to thicknesses up to 9m. The reasons for this increase in weathering are uncertain, however it appears that the gritty mudstone thickened and was subject to dolomitic alteration prior to weathering. Bedding textures within this weathered unit suggest that it is the gritty mudstone and not an additional lithology unit (Figure 32).

Intercept thicknesses of weathering were mapped and contoured (Figure 33) indicating a small weathered basin directly above the DS5_90 that strikes west-north-west with a diameter of approximately 500m (+1m weathering contour). This suggests that the thickening of the weathered zone is most likely related to a slumping of the gritty mudstone and that occurrences of increased weathering are likely sporadic, confined

and limited in areal extent and will not be intersected by the current design path for the decline.

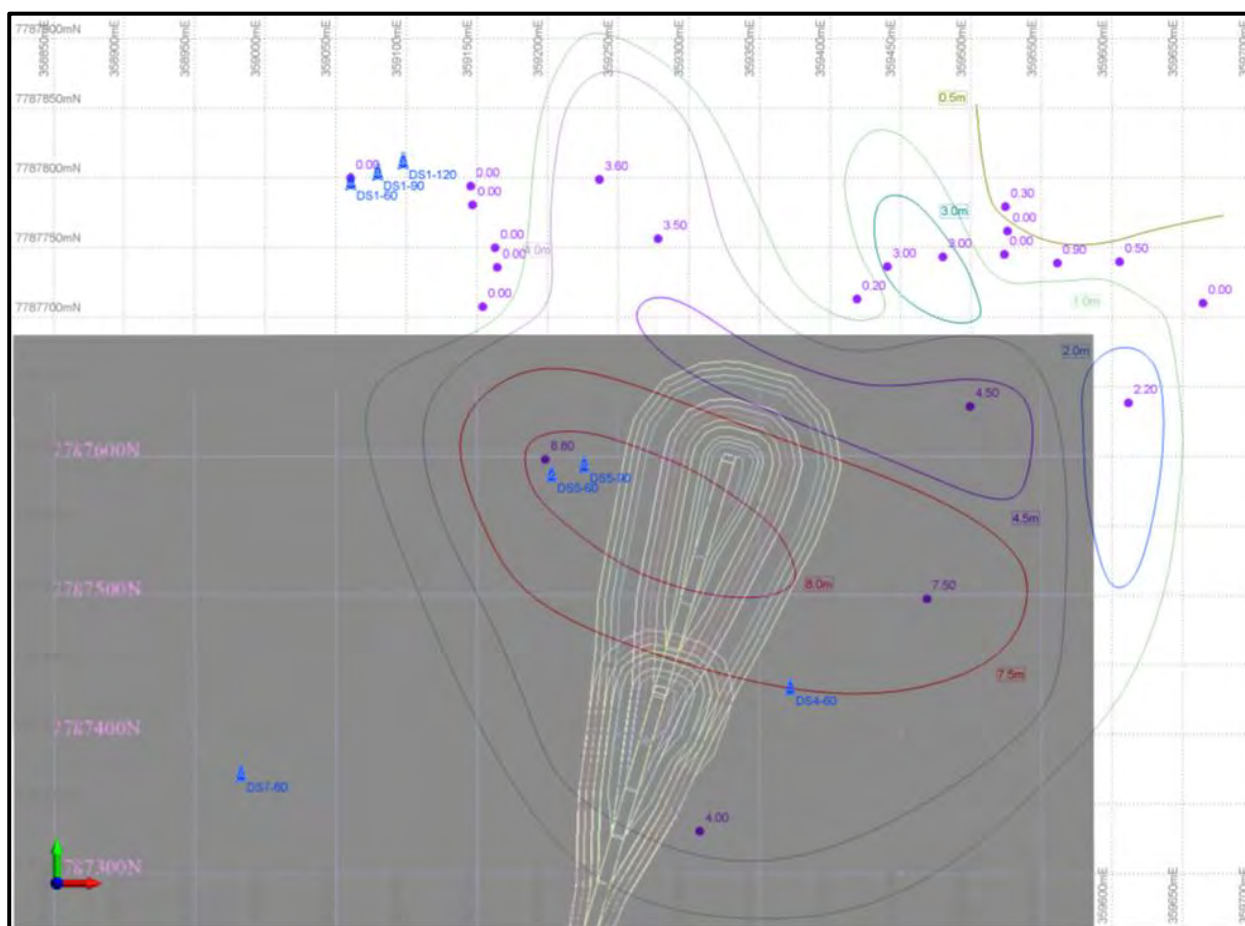


Figure 33: Gritty Mudstone between Impermeable Siltstone/Fossiliferous Dolomite.

4.6. Sensitivity Analysis

The aim of a sensitivity analysis is to determine the effect of a specific parameter on the output of a model. The model was run for each of the stages and one parameter at a time was changed within expected and acceptable ranges i.e. doubled and then halved. All the other parameters were kept constant and the effect on the volume of flow was recorded. Table 13 summarises the results of the sensitivity analysis. Only the total volumes for Scenario 2 were recorded and compared.

4.6.1. Parameter Changes

Hydraulic Conductivity

The horizontal hydraulic conductivities K_{xx} and K_{yy} were doubled and halved for each of the stages, while the vertical hydraulic conductivity (K_{zz}) was kept constant for each of the model runs.

Specific Storage

As with the hydraulic conductivities, the specific storage (S_s) for each of the layers were doubled and then halved.

Recharge

Recharge via rainfall is only applicable to the first layer of the model but the effect of increasing the annual

recharge by a factor two and a factor 0.5 was investigated for each of the stages. No other recharge boundaries were inserted in the model for any of the deeper layers.

4.6.2. Results of the Sensitivity Analysis

The results for the sensitivity analysis are presented in Figures 32 to 34 and Table 13. The model predictions were most sensitive to changes in the horizontal hydraulic conductivity and least sensitive to rainfall, which was expected due to the fact that recharge will not impact upon confining layers with large hydraulic conductivities.

A doubled horizontal hydraulic conductivity value has the effect of increasing inflow volumes by 60% to 84 %, which is considered as a high sensitivity according to acceptable standards with regard to RPD. A reducing factor of 0.5 only reduces the volume between 36% and 47% which rates the effect as a moderate sensitivity. Predicted volumes did not change dramatically when the specific storage parameter was doubled or halve. The sensitivity of the model for this parameter can thus be considered to be low or not sensitive at all. With regard to recharge, the model was not sensitive at all as was expected.

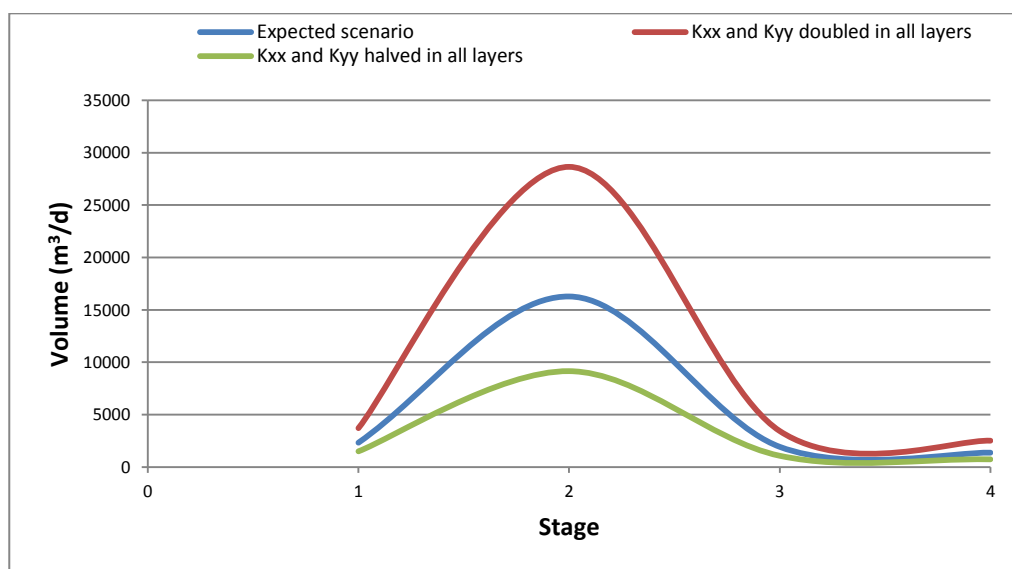


Figure 34: Sensitivity Analysis: Horizontal Hydraulic Conductivity.

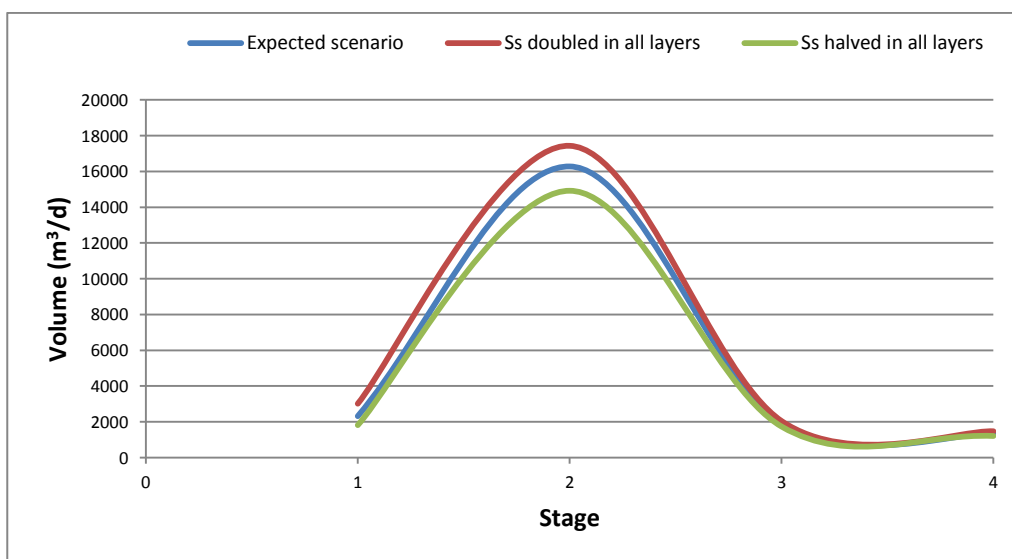


Figure 35: Sensitivity: Specific Storage.

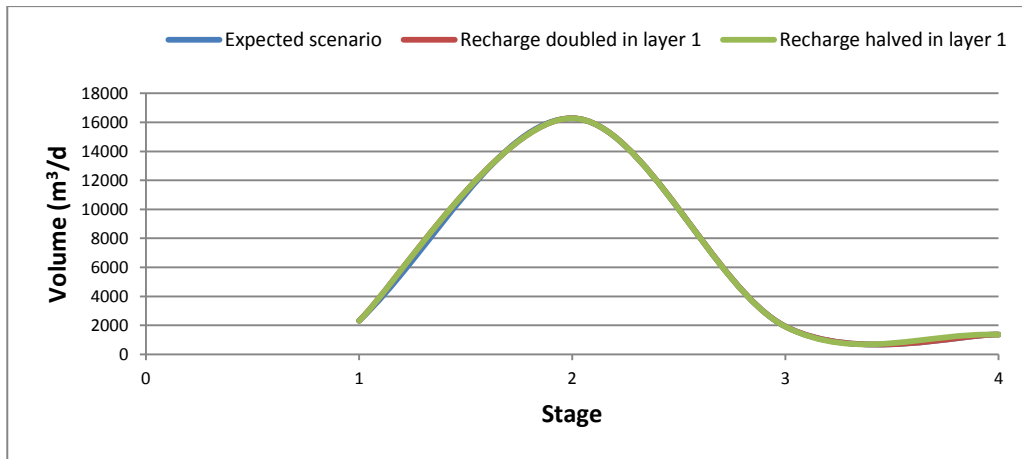


Figure 36: Sensitivity: Recharge in Layer 1.

Table 14: Results of the Sensitivity Analysis.

Parameter	Stage	Total Inflow	RPD*	Interpretation
		(m³/day)	%	
Scenario 2	1	2,318	-	-
	2	16,276	-	-
	3	1,921	-	-
	4	1,365	-	-
K_{xx} and K_{yy} doubled in all layers	1	3,708	60	High sensitivity
	2	28,652	76	High sensitivity
	3	3,429	79	High sensitivity
	4	2,509	84	High sensitivity
K_{xx} and K_{yy} halved in all layers	1	1,493	-36	Moderate sensitivity
	2	9,148	-44	Moderate sensitivity
	3	1,068	-44	Moderate sensitivity
	4	730	-47	Moderate sensitivity
S_s doubled in all layers	1	3,016	30	Moderate sensitivity
	2	17,430	7	Not sensitive
	3	2,047	7	Not sensitive
	4	1,473	8	Not sensitive
S_s halved in all layers	1	1,816	-22	Low sensitivity
	2	14,918	-8	Not sensitive
	3	1,738	-10	Not sensitive
	4	1,210	-11	Low sensitivity
Recharge doubled in Layer 1	1	2,321	0	Not sensitive
	2	16,282	0	Not sensitive
	3	1,924	0	Not sensitive
	4	1,365	0	Not sensitive
Recharge halved in Layer 1	1	2,317	0	Not sensitive
	2	16,278	0	Not sensitive
	3	1,912	0	Not sensitive
	4	1,361	0	Not sensitive

5. Conclusions and Recommendations

5.1. Conclusions

To further the detailed design of their proposed exploration decline, Westgold Resources Limited, upon obtaining approval of their Mining Management Plan (MMP), intends construction of a box cut and decline from where exploration drilling will continue. Key observations relevant to the construction of the decline pertain to:

- The proposed new box cut to a depth of 65m below surface will be constructed in the sediments of the Hooker Creek Formation, which have been weathered from rock to soil and which overlies the Montejinni Limestone. Weathering profiles appear simple and display advancement from weathered rock at the surface to progressively fresher rock at depth comprising a sequence of sandstones with significant occurrences of siltstones and dolomites. Inter-layered, slightly weathered sandstone and mudstone sequences are also significant.
- The deeper, particularly between about 90m and 120m below surface, confined sedimentary sequences contain relatively large quantities of ground water. However, inspections of drill cores and photos revealed that these sequences are subject to heterogeneity and limited in areal extent and as such that they may not sustain large yields over a prolonged period of time.
- Ground water levels are close to the surface between 4.6m and 8.1m below natural ground level.
- Hydraulic conductivities across the dominant lithologies averages $2.9\text{E}+00\text{m/d}$ ranging from a minimum of $3.2\text{E}-02\text{m/d}$ to a maximum of $2.2\text{E}+01\text{m/d}$. The lower hydraulic conductivities pertain to the siltstone-sandstone with minor layering of mudstone in Bore DS1-60 and the highest pertain to the siltstone-sandstone and dolomite with minor mudstone sequence in Bore DS5-90.
- Drawdown curves and analysis by various methods indicate that the shallow, up to 60m, bores are in unconfined aquifer types. The deeper bores between 90m and 120m penetrated confined aquifer systems, though more than one method, particularly analyses by the Hantush method, indicate that these are confined leaky aquifer systems.
- Groundwater quality at the site is poor, particularly in the deeper confining aquifers, with several parameters exceeding their NHMRC/NRMMC (2011) guideline values rendering these unsuitable as potable water supplies. Behaviour of fingerprint cations indicates waters are hosted within dolomitic environments and these in contact with flowing waters will tend to release readily available cations with time. Salinity concentrations of these waters would also tend to increase with time.
- Aquifer test analyses during modelling suggest heterogeneity which may influence the influx volumes estimated by the flow model particularly over the long term. The model is based on general assumptions that should be confirmed during further investigations. Additional information will assist in optimising the model as an ongoing, expandable management tool, which would form the basis of the ground water management plan. Calibration was undertaken and the sensitivity analysis revealed that the model output is particularly sensitive to hydraulic conductivity. Nevertheless, modelling has proven valuable in forward planning and design of the proposed box cut and decline.

5.2. Recommendations

Exploration drilling, testing and sampling provided information to facilitate preliminary characterization and modelling of the aquifers in immediate proximity of Rover 1. To further improve and calibrate a multi-layered site-wide conceptual and numerical ground water model during final design and construction will require:

- Further drilling to investigate the extent of the deeper confined aquifers around the proposed decline. Discharging bores are to be tested at a rate no less than 80 per cent of their measured airlift yields. These drilling, testing and sampling programs are to coincide with the drilling to ascertain further geotechnical parameters for detailed design.
- Given the high yielding characteristics of deep bores, the dewatering requirements (including alternative scenarios) are to be ascertained further employing the preliminary multi-layered ground water model devised during the current investigations.

The flow model represents a *worst case* scenario based on available information and should be updated as more ground water level, hydrochemical and geological data becomes available to confirm that assumptions made are valid and to optimise the model as an on-going, expandable management tool which would form the basis of the ground water management plan. Calibration of the model and the sensitivity analysis should be repeated and verified with changes to the temporal and spatial properties in order to run for longer or shorter time intervals and/or increased or decreased distances. Further investigations should aim to verify compartmentalisation/heterogeneity due to geological structures and/or extent of weathering/fracturing. The model should be run for longer time periods (2 to 5 years) once more information is available to determine the duration it will take to deplete the storage in the surrounding aquifers especially in the high hydraulic conductivity zones.

- Implement a quarterly groundwater quality monitoring program.

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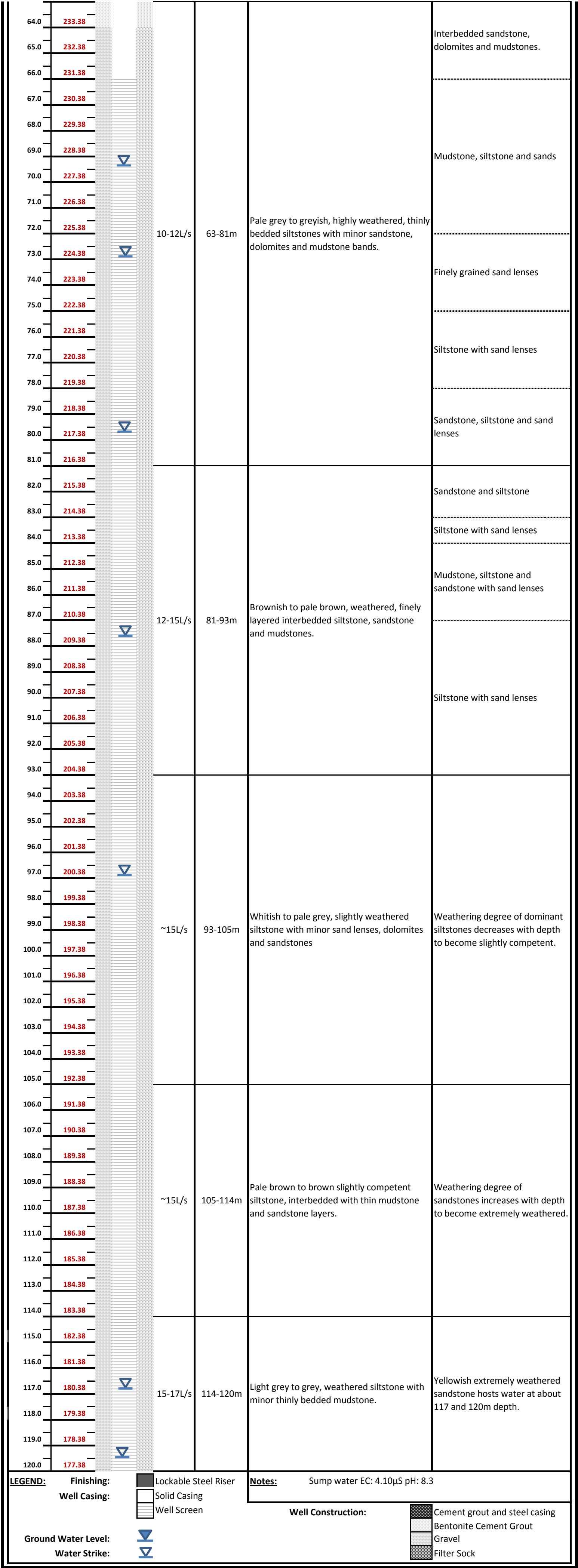
APPENDIX A

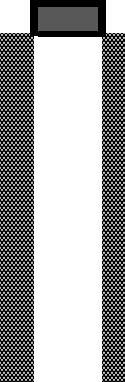
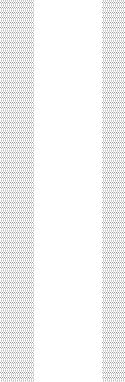
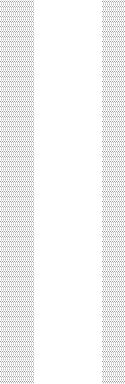
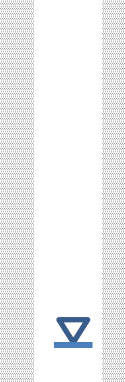
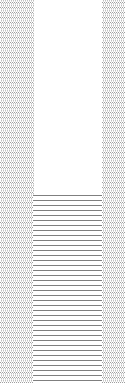
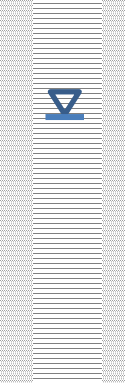
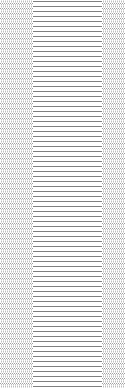
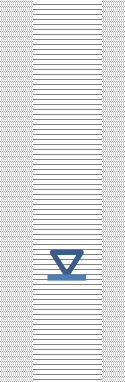
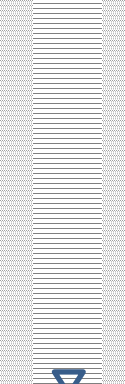
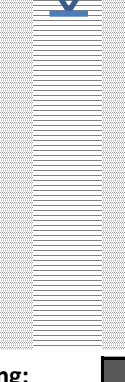
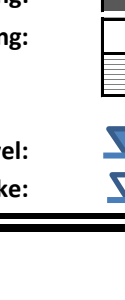
Bore Construction Logs

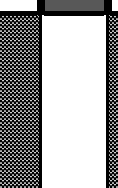
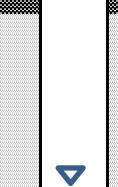
		Third Floor, Winlow House, 75 Woods St, Darwin NT 0800		Tel No: (08) 8981-1100 Fax No: (08) 8981-1102		BORE ID: DS1(60)	
Project:		Date: 11/12/11			Standing Water Level (TOC): 8.13 mbTOC		
Reference:		Drilled By: Trevor Hughes Drilling			Elevation (TOC): 298.11 mAHD		
Client: West Gold		Method: Rotary Air			Elevation (GL): 297.32 mAHD		
Northing: 359061		Logged By: CH			Elevation (Ground Water Level from TOC): 289.98 mAHD		
Easting: 7787797		Datum: 53 K					
Zone:							
Depth mbgl 0.0		Well Construction		Water / MC (%)	Depth (m)	Lithological Description	Remarks and Observations
RL (m) 297.32							
1.0				10%	0-3m	Reddish to brownish, highly weathered, sandy regolith.	Weathering is uniform. Fine lenses of finely to coarsely grained sand is observed in profile.
2.0							
3.0							
4.0				5%	3-12m	Gravelly, cemented ferruginous pisolites	
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0				Clay with lenses of finely grained sands			
16.0							
17.0				Clays with ironstone bands			
18.0							
19.0				Clay with lenses of fine to medium grained sands			
20.0							
21.0							
22.0							
23.0							
24.0							
25.0				1.0L/s	27-39m	Yellowish to pale red, extremely weathered siltstones with lenses of highly weathered sandstones and alluvial sands.	Sandstone, ironstone and dolomites are finely layered and sequentially interbedded.
26.0							
27.0							
28.0							
29.0							
30.0							
31.0							
32.0							
33.0							
34.0							
35.0							
36.0							
37.0							
38.0							
39.0							
40.0							
41.0							
42.0							
43.0				2.0L/s	45-60m	Yellowish to pale yellow, extremely weathered clay material among lenses of sandstone and thinly bedded mudstones.	Thinly bedded mudstones and thinly layered, highly weathered siltstones are increasing with depth
44.0							
45.0							
46.0							
47.0							
48.0							
49.0							
50.0							
51.0							
52.0							
53.0							
54.0							
55.0							
56.0							
57.0							
58.0							
59.0							
60.0							
297.32							
296.32							
295.32							
294.32							
293.32							
292.32							
291.32							
290.32							
289.32							
288.32							
287.32							
286.32							
285.32							
284.32							
283.32							
282.32							
281.32							
280.32							
279.32							
278.32							
277.32							
276.32							
275.32							
274.32							
273.32							
272.32							
271.32							
270.32							
269.32							
268.32							
267.32							
266.32							
265.32							
264.32							
263.32							
262.32							
261.32							
260.32							
259.32							
258.32							
257.32							
256.32							
255.32							
254.32							
253.32							
252.32							
251.32							
250.32							
249.32							
248.32							
247.32							
246.32							
245.32							
244.32							
243.32							
242.32							
241.32							
240.32							
239.32							
238.32							
237.32							
LEGEND:		Finishing:		Notes:			
		Well Casing:		7mm gravel, 570m from camp, sump water EC: 2.74µS pH: 8.39			

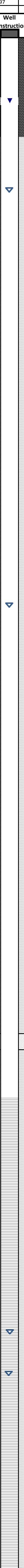
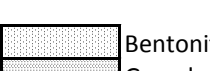
[illegible]

		Third Floor, Winlow House, 75 Woods St, Darwin NT 0800		Tel No: (08) 8981-1100 Fax No: (08) 8981-1102		BORE ID: DS1-120					
Project:		Date: 7/12/2011		Standing Water Level (TOC): 6.57 mbTOC							
Reference:		Drilled By: Trevor Hughes Drilling		Elevation (TOC): 298.18 mAHD							
Client: West Gold		Method: Rotary Air		Elevation (GL): 297.38 mAHD							
Northing: 359098		Logged By: CH		Elevation (Ground Water Level from TOC): 291.61 mAHD							
Easting: 7787812		Datum: 53 K									
Zone:											
Depth mbgl		Well Construction		Water / MC (%)		Depth (m)		Lithological Description		Remarks and Observations	
0.0											
1.0				10%		0-3m		Reddish to brownish, highly weathered, sandy regolith.		Weathering is uniform. Fine lenses of finely to coarsely grained sand is observed in profile.	
2.0											
3.0											
4.0								Gravelly, cemented ferruginous pisolites			
5.0											
6.0				5%		3-9m		Yellowish to pale grey, extremely weathered sandstone with lenses of silts and alluvial sands.		Weathering degrees decreases with depth	
7.0											
8.0											
9.0											
10.0											
11.0											
12.0				25%							
13.0											
14.0											
15.0								Yellowish to pale grey/whitish, extremely weathered sandstone, siltstones and lenses of dolomites.		Fine lenses of siltstones are below and above dolomites. Clayey material with lenses of alluvial sand is observed between 9 and 14.0m depth. Among these layers there is a highly localised lenses of water. Whitish to milkish colour dolomite particles are dominant between 21.0m to 24.0m depth.	
16.0											
17.0											
18.0											
19.0											
20.0				15%							
21.0											
22.0											
23.0								Yellowish to pale grey, extremely weathered dolomitic clay with fine to medium grain size sand lenses.			
24.0											
25.0											
26.0										Fine lenses of clays, fine grained sand and extremely weathered dolomites.	
27.0											
28.0											
29.0											
30.0											
31.0											
32.0				1.6L/s		24-39m		Pale grey to light grey, extremely weathered siltstone with some finely grained layers of sandstone.		Fine layers of reddish ironstone, sandstone, fine to medium grained sand and extremely weathered clays.	
33.0											
34.0											
35.0											
36.0											
37.0										Milkish colour, finely layered quartz sandstones and reddish ironstones with abundant extremely weathered dolomites.	
38.0											
39.0											
40.0										Sandstones, dolomites and clay	
41.0											
42.0				3.5L/s		39-45m		Whitish to pale grey, extremely weathered dolomitic material with minor lenses of extremely weathered yellowish quartz sandstones and ironstone bands.		Quartz sandstone	
43.0											
44.0										Iron rich clay	
45.0											
46.0										Golden clay - containing ironstone and silt stone	
47.0											
48.0										Sandstone lenses	
49.0											
50.0											
51.0											
52.0											
53.0											
54.0				6.0-6.5L/s		45-63m		Yellowish to pale yellow, extremely weathered clay material among lenses of sandstone and thinly bedded mudstones.		Golden clay and lenses of fine sand	
55.0											
56.0											
57.0											
58.0											
59.0											
60.0											
61.0											
62.0										Clays, mudstone and sand lenses	
63.0											



		Third Floor, Winlow House, 75 Woods St, Darwin NT 0800		Tel No: (08) 8981-1100 Fax No: (08) 8981-1102		BORE ID: DS4(60)		
Project:		Date: 9/12/2011			Standing Water Level (TOC): 5.96 mbTOC			
Reference:		Drilled By: Trevor Hughes Drilling			Elevation (TOC): 296.81 mAHD			
Client: West Gold		Method: Rotary Air			Elevation (GL): 296.08 mAHD			
Northing: 359376		Logged By: CH			Elevation (Ground Water Level from TOC): 290.85 mAHD			
Easting: 7787440		Datum: 53 K Zone:						
Depth magl 0.0		Well Construction		Water / MC (%)	Depth (m)	Lithological Description		Remarks and Observations
1.0 295.08				10%	0-3m	Reddish to brown, weathered, finely grained regolith.		
2.0 294.08				10%	3-6m	Brownish to yellowish, gravelly, cemented ferruginous pisolites with layers of fine sand and yellowish clay bands.		
3.0 293.08								
4.0 292.08								
5.0 291.08				0.9L/s	6-9m	White, extremely weathered fine to medium grained sandstone with minor siltstones and finely grained dolomites with fine bands of clays.		
6.0 290.08								
7.0 289.08								
8.0 288.08				0.9L/s	9-27m	Whitish to greyish, extremely weathered, fine layers of finely to coarsely grained dolomite with thin layers of ironstone and minor sandstones.		
9.0 287.08								
10.0 286.08								
11.0 285.08				0.9L/s	9-27m	Yellowish weathered clays with lenses of coarse sand.		
12.0 284.08								
13.0 283.08								
14.0 282.08				0.9L/s	9-27m	Whitish to pale yellow coarsely grained dolomites with fine lenses of finely grained sand.		
15.0 281.08								
16.0 280.08								
17.0 279.08				0.9L/s	9-27m	Light grey to whitish to brownish, extremely weathered, interbedded sequence of siltstones, sandstones, dolomites and ironstones. Siltstone is dominant in this sequence.		
18.0 278.08								
19.0 277.08								
20.0 276.08				0.9L/s	9-27m	Highly weathered, whitish interbedded sequence of sandstone, dolomites and ironstone.		
21.0 275.08								
22.0 274.08								
23.0 273.08				0.9L/s	9-27m	Thin layers of coarse grained sandstones and ironstones		
24.0 272.08								
25.0 271.08								
26.0 270.08				0.9L/s	9-27m	Yellowish to pale white dolomite with lenses of yellowish clay and thin ironstone beds.		
27.0 269.08								
28.0 268.08								
29.0 267.08				1.35L/s	28-54m	Reddish to brown, extremely weathered, gravelly ferruginous pisolites.		
30.0 266.08								
31.0 265.08								
32.0 264.08				1.35L/s	28-54m	Whitish to yellowish clay with minor layers of finely grained sand and extremely weathered ironstone		
33.0 263.08								
34.0 262.08								
35.0 261.08				1.35L/s	28-54m	Extremely weathered, coarsely grained ironstone with minor thin layers of clays and sands.		
36.0 260.08								
37.0 259.08								
38.0 258.08				1.35L/s	28-54m	Creamy to pale yellow to whitish extremely weathered clay.		
39.0 257.08								
40.0 256.08								
41.0 255.08				2.0L/s	28-54m	Extremely weathered, coarsely grained ironstone with minor thin layers of clays and sands.		
42.0 254.08								
43.0 253.08								
44.0 252.08				2.0L/s	28-54m			
45.0 251.08								
46.0 250.08								
47.0 249.08				2.0L/s	28-54m			
48.0 248.08								
49.0 247.08								
50.0 246.08				2.0L/s	28-54m			
51.0 245.08								
52.0 244.08								
53.0 243.08				2.2L/s	55-60m			
54.0 242.08								
55.0 241.08								
56.0 240.08				2.2L/s	55-60m	Light grey to grey, finely		

		Third Floor, Winlow House 75 Woods St, Darwin NT 0800 Date: Started - 6th December 2011		Tel No: (08) 8981-1100 Fax No: (08) 8981-1102		BORE ID: DS5 60m	
Project: West Gold		Drilled By: TREVOR HUGHES DRILLING		Depth to Ground Water (TOC): 7.35 mbTOC			
Reference:		Method: ROTARY AIR		Elevation (TOC): 297.98 mAHd			
Client: West Gold		Logged By: EM		Elevation (GL): 297.275 mAHd			
Northing: 7787594		Easting: 359205		Elevation (Ground Water Level from TOC): 290.64 mAHd			
Datum:		Projection: 53K					
Depth		Well Construction		Water / MC	Depth (m)	Lithological Description	Remarks and Observations
mbgl 0.0	RL (m) 297.28						
1.0	296.28			10%	0 - 3m	Reddish to brown, extremely weathered coarse grained unconsolidated regolith.	
2.0	295.28						
3.0	294.28						
4.0	293.28			15%		Brownish to yellowish, gravelly, cemented ferruginous pisolites with layers of fine sand and yellowish clay bands.	
5.0	292.28			30%	3-27m	White, extremely weathered fine to medium grained sandstone with minor siltstones and dolomite.	Rock fragments fizz on contact with HCl acid, some thin layers more clay-rich than others
6.0	291.28						
7.0	290.28						
8.0	289.28						
9.0	288.28						
10.0	287.28						
11.0	286.28						
12.0	285.28						
13.0	284.28						
14.0	283.28						
15.0	282.28						
16.0	281.28						
17.0	280.28		White, extremely weathered, fine to medium grained dolomite.				
18.0	279.28						
19.0	278.28						
20.0	277.28						
21.0	276.28						
22.0	275.28						
23.0	274.28						
24.0	273.28						
25.0	272.28						
26.0	271.28						
27.0	270.28						
28.0	269.28						
29.0	268.28						
30.0	267.28						
31.0	266.28						
32.0	265.28						
33.0	264.28						
32.0	265.28						
33.0	264.28						
34.0	263.28						
35.0	262.28						
36.0	261.28						
37.0	260.28						
38.0	259.28						
39.0	258.28						
40.0	257.28						
41.0	256.28						
42.0	255.28						
43.0	254.28						
44.0	253.28						
45.0	252.28						
46.0	251.28						
47.0	250.28						
48.0	249.28						
49.0	248.28						
50.0	247.28						
51.0	246.28						
52.0	245.28						
53.0	244.28						
54.0	243.28						
55.0	242.28						
56.0	241.28						
57.0	240.28						
58.0	239.28						
59.0	238.28						
60.0	237.28						
Bottom of borehole.							
LEGEND:		w/L: Water logged		Notes:			
Finishing:		 Lockable Steel Riser					
Well Casing:		 Solid Class 12x150 PVC Casing		 Cement grout and steel casing			
		 Well Screen		Well Construction:		 Bentonite	
		 Groundwater strike				 Gravel	
		 Groundwater level					

		Third Floor, Winlow House 75 Woods St, Darwin NT 0800 Date: Started - 4th December 2011		Tel No: (08) 8981-1100 Fax No: (08) 8981-1102		BORE ID: DS5 90m
Project: West Gold		Drilled By: TREVOR HUGHES DRILLING		Depth to Ground Water (TOC): 4.60 mbTOC		
Reference:		Method: ROTARY AIR		Elevation (TOC): 298.03 mAHD		
Client: West Gold Pty		Logged By: EM		Elevation (GL): 297.275 mAHD		
Northing: 7787597		Easting: 359227		Elevation (Ground Water Level from TOC): 293.43 mAHD		
Date:		Projection: S3K				
Depth mbgl 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0 36.0 37.0 38.0 39.0 40.0 41.0 42.0 43.0 44.0 45.0 46.0 47.0 48.0 49.0 50.0 51.0 52.0 53.0 54.0 55.0 56.0 57.0 58.0 59.0 60.0 61.0 62.0 63.0 64.0 65.0 66.0 67.0 68.0 69.0 70.0 71.0 72.0 73.0 74.0 75.0 76.0 77.0 78.0 79.0 80.0 81.0 82.0 83.0 84.0 85.0 86.0 87.0 88.0 89.0 90.0 91.0 92.0 93.0 94.0	Well Construction 	Water / MC 0.1L/s 1.5L/s 25L/s Specul active yield >25L/s	Depth (m) 0 - 3m 10 - 15m 6-9m 9-33m 33-49m 49-54m 54-57m 57-81m 81-94m Bottom of borehole.	Lithological Description Reddish to brown extremely weathered coarse grained unconsolidated regolith. Brownish to yellowish, gravelly, cemented ferruginous siltolites with layers of fine sand and yellowish clay bands. White, extremely weathered fine to medium grained sandstone with minor siltstones and dolomite. White, extremely weathered dolomite fine to medium grained, weathering to brown clay White, highly weathered fine to medium grained siltstone with minor and thin layers of dolomites, sandstones and dark red fine grained ironstone. Some layers of sandstone, particularly those underlying the iron bands, are very coarse grained (almost conglomerate). Reddish to brown laminated siltstone with some thin white sandstone and dolomite layers. Between 54 to 57m deep, sequence is dominated by highly to extremely weathered dolomite. Grey, fine grained sandstone with intermittent thin layers of coarser grained whitish dolomites, sandstone and brow siltstone/mudstone. Siltstone is dominant in this sequence. Brown laminated siltstone with some thin whitish coarse grained sandstone and greyish thin mudstone layers	Remarks and Observations Clay content are extent at the top of this sequence and decreases with depth There is localised bands of extremely weathered siltstones and abundant fine layers of finely grained dolomites. Sandstones and siltstones are thinly layered and highly weathered. Significant yielding water strike is located at about 79 and this, due to the coarser nature of rock chips, appears is a fractured zone.	
LEGEND:						
Finishing:		Water logged		Notes:		
Well Casing:		Well Construction:				
 Solid Class 12x150 PVC Casing		 Well Screen		 Cement grout and steel casing		
 Groundwater strike		 Bentonite		 Gravel		
 Groundwater level						

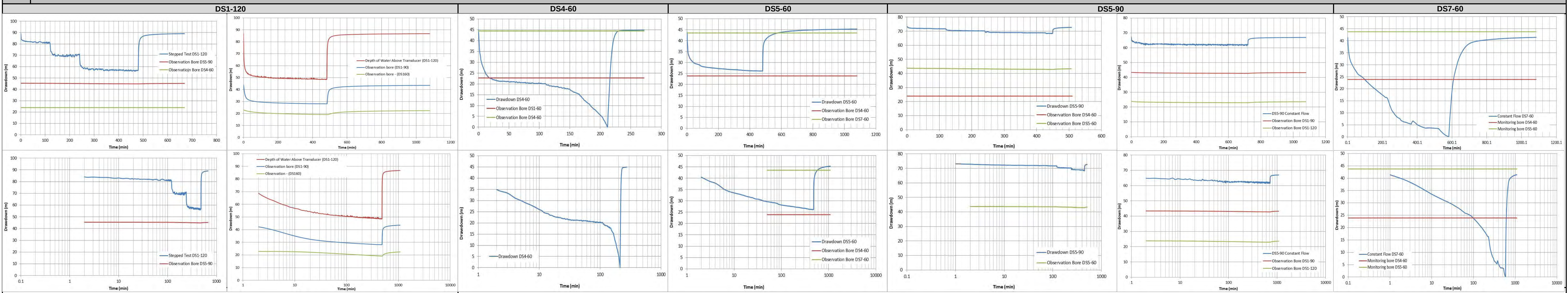
		Third Floor, Winlow House, 75 Woods St, Darwin NT 0800		Tel No: (08) 8981-1100 Fax No: (08) 8981-1102		BORE ID: DS7 (60)					
Project:		Date: 7/12/2011		Standing Water Level (TOC):		6.05 mbTOC					
Reference:		Drilled By: Trevor Hughes Drilling		Elevation (TOC):		297.51 mAHD					
Client: West Gold		Method: Rotary Air		Elevation (GL):		296.83 mAHD					
Northing: 358983		Logged By: CH		Elevation (Ground Water Level from							
Easting: 7787374		Datum: 53 K		Zone:		TOC: 291.47 mAHD					
Depth		Well Construction		Water / MC (%)		Depth (m)		Lithological Description		Remarks and Observations	
mbgl		RL (m)									
0.0		296.83									
1.0		295.83				0-3m		Reddish to brownish, extremely weathered finely grained regolith. Lenses of finely grained sand are abundant.			
2.0		294.83		10%							
3.0		293.83									
4.0		292.83						Gravelly cemented ferruginous pisolites with thinly bedded dolomitic materials.			
5.0		291.83									
6.0		290.83		5-10%		3-9m		Yellowish to pale white, finely grained well sorted sandy clays		Lenses of finely to coarsely grained, greyish sand throughout	
7.0		289.83									
8.0		288.83									
9.0		287.83									
10.0		286.83									
11.0		285.83		25%							
12.0		284.83									
13.0		283.83								Coarser grained lenses of finely grained sands and silts	
14.0		282.83									
15.0		281.83									
16.0		280.83									
17.0		279.83									
18.0		278.83									
19.0		277.83								Extremely weathered, greyish, finely grained siltstone with coarsely grained dolomites	
20.0		276.83									
21.0		275.83		30%		9-33m		Whitish to milkish, extremely weathered siltstone with abundant dolomite layers.			
22.0		274.83									
23.0		273.83									
24.0		272.83									
25.0		271.83									
26.0		270.83									
27.0		269.83								Greyish, coarse grained sand and yellowish clays throughout.	
28.0		268.83									
29.0		267.83									
30.0		266.83									
31.0		265.83									
32.0		264.83		0.4L/s							
33.0		263.83									
34.0		262.83		0.45L/s						Highly weathered, reddish to brownish thinly bedded ironstone, sandstone and dolomites.	
35.0		261.83									
36.0		260.83									
37.0		259.83									
38.0		258.83									
39.0		257.83									
40.0		256.83								Gray to white interbedded siltstone and dolomite deepen into hardened pisolitic ironstones.	
41.0		255.83				33-48m		Reddish to brownish to greyish, highly weathered to weathered, finely to coarsely grained siltstones interbedded with minor sandstones and ironstone bands.			
42.0		254.83									
43.0		253.83									
44.0		252.83								Banded pisolitic ironstone with thin layers of whitish clays among siltstones.	
45.0		251.83									
46.0		250.83		0.75L/s							
47.0		249.83									
48.0		248.83									
49.0		247.83								Finely layered siltstones with thin ironstone bands.	
50.0		246.83									
51.0		245.83									
52.0		244.83									
53.0		243.83				48-57m		Whitish to milkish, extremely weathered dolomite with minor and thinly bedded layers of siltstones and ironstones.		Whitish to pale yellow, finely grained and layered siltstones.	
54.0		242.83									
55.0		241.83									
56.0		240.83									
57.0		239.83									
58.0		238.83									
59.0		237.83		0.80L/s		57-60m		Gray to whitish, weathered, finely grained siltstones with minor sandstone bands.		Thin layers of greyish to dark grey, finely grained sandstones.	
60.0		236.83									
LEGEND:		Finishing:		Lockable Steel Riser		Notes:		Sump water EC: 2.58µS pH: 8.88			
		Well Casing:		Solid Casing							
				Well Screen							
						Well Construction:		Cement grout and steel casing			
								Bentonite Cement Grout			
								Gravel			
								Filter Sock			
		Ground Water Level:									
		Water Strike:									

APPENDIX B

Summary of Bore Drilling and Testing Data

Appendix B: Summary of Drilling and Borehole Test Data																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Investigative and Monitoring Boreholes November - December 2011																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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Borehole Number	Coordinates		Ground Elevation (mAHd)	Top of Casing (ToC) (maglinAHd)	Bore Depth (m)	Depth of Water		Screen Interval (mAHd)	Airlift Yield (L/s)	Lithology/ Aquifer Type	Ground Water Level (below ToC)				Available Maximum Drawdown (m)	Observation Borehole	Test Details										General Comments																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
						Strikes (mbgl)	(mAHd)				After Drilling (mbngl)	Before Bore Test (mbngl)	11-Dec-11 (mAHd)	Step Number			Discharge Rate (L/s)	Duration of Discharge (min)	Maximum Drawdown (m)	Drawdown Utilised (%)	Duration of Recovery (min)	Recovery (%)	Q/st (L/s/m)	Preliminary Estimates T=Kd (m²/day)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	(m)	(m)																							(m)	(m)		(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)

Notes: All bores were drilled with an internal diameter of 203mm with PVC casing to the top of the PVC screen. The top 6m (12m for the 120m depth) cased with solid steel (250mm ID). A cement grout seal extending from near surface (about 1m depth) to TOC, bentonite (1m thick) with its bottom some 1m above the screen sand pack, and coarse sand across and to 1m above screen (refer Detailed Bore Construction Logs).



APPENDIX C

Water Quality Laboratory Certificates



Environmental Division

QUALITY CONTROL REPORT

Work Order	: EP1200207	Page	: 1 of 7
Client	: ECOZ ENVIRONMENTAL SERVICES	Laboratory	: Environmental Division Perth
Contact	: MS EMMA MURRAY	Contact	: Scott James
Address	: PO BOX 381 DARWIN NT, AUSTRALIA 0801	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: emma.murray@vdmgroup.com.au	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 08 89811100	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 89811102	Facsimile	: +61-8-9209 7600
Project	: West Gold Mine	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 12-JAN-2012
C-O-C number	: ----	Issue Date	: 18-JAN-2012
Sampler	: Emma & Casey	No. of samples received	: 16
Order number	: ----	No. of samples analysed	: 16
Quote number	: BN/717/11		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Canhuang Ke	Metals Instrument Chemist	Perth Inorganics
Chas Tucker	Inorganic Chemist	Perth Inorganics
Cicelia Bartels	Metals Instrument Chemist	Perth Inorganics

Environmental Division Perth
Part of the **ALS Laboratory Group**

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A Campbell Brothers Limited Company



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
= Indicates failed QC



Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: WATER

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 2125123)									
EP1200203-006	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	112	111	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	112	111	0.0	0% - 20%
EP1200207-008	D5760	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	429	432	0.5	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	429	432	0.5	0% - 20%
ED038A: Acidity (QC Lot: 2125166)									
EP1200207-001	D5560_1	ED038: Acidity as CaCO3	----	1	mg/L	<1	<1	0.0	No Limit
EP1200207-010	D51120-11	ED038: Acidity as CaCO3	----	1	mg/L	4	4	0.0	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2127090)									
EP1200028-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	2	1	0.0	No Limit
EP1200207-010	D51120-11	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	521	516	1.0	0% - 20%
ED045G: Chloride Discrete analyser (QC Lot: 2127089)									
EP1200028-002	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	52	53	0.0	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 2127088)									
EP1200028-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	9	9	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	2	2	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	39	40	3.0	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	2	2	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2124587)									
EP1200207-001	D5560_1	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.003	0.001	64.2	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.003	0.004	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.394	0.394	0.0	0% - 20%
EP1200207-009	D5160	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0005	0.0005	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.002	0.003	62.8	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.003	0.002	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.005	0.005	0.0	No Limit

Page : 4 of 7
 Work Order : EP1200207
 Client : ECOZ ENVIRONMENTAL SERVICES
 Project : West Gold Mine



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2124587) - continued									
EP1200207-009	D5160	EG020A-F: Zinc	7440-66-6	0.005	mg/L	1.38	1.33	3.7	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2124589)									
EP1200207-004	D51120	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0002	0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.012	0.012	0.0	0% - 50%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.003	0.003	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.952	0.912	4.4	0% - 20%
EP1200207-014	D5760_2	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.006	0.007	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.016	0.016	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 2124586)									
EP1200207-001	D5560_1	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EP1200207-009	D5160	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 2124588)									
EP1200207-004	D51120	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EP1200207-014	D5760_2	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result			LCS	Low
ED037P: Alkalinity by PC Titrator (QCLot: 2125123)								
ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-00 1	1	mg/L	<1	----	----	----	----
ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	----	----	----	----
ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	200 mg/L	95.6	92	108
ED038A: Acidity (QCLot: 2125166)								
ED038: Acidity as CaCO3	----	1	mg/L	----	20 mg/L	103	85	119
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2127090)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	92.2	85	130
ED045G: Chloride Discrete analyser (QCLot: 2127089)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	1000 mg/L	102	78	130
ED093F: Dissolved Major Cations (QCLot: 2127088)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	105	88	112
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	103	88	112
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	105	85	111
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	107	84	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 2124587)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.100 mg/L	91.4	79	111
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1000 mg/L	93.1	81	109
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.100 mg/L	90.9	81	109
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.100 mg/L	88.4	79	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.100 mg/L	88.5	80	108
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.100 mg/L	87.7	79	109
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.100 mg/L	93.1	79	113
EG020F: Dissolved Metals by ICP-MS (QCLot: 2124589)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.100 mg/L	92.4	79	111
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1000 mg/L	92.2	81	109
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.100 mg/L	93.2	81	109
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.100 mg/L	89.3	79	111
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.100 mg/L	92.9	80	108
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.100 mg/L	91.1	79	109
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.100 mg/L	95.7	79	113
EG035F: Dissolved Mercury by FIMS (QCLot: 2124586)								



Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result		LCS	Low	High
EG035F: Dissolved Mercury by FIMS (QCLot: 2124586) - continued								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.0100 mg/L	105	75	123
EG035F: Dissolved Mercury by FIMS (QCLot: 2124588)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.0100 mg/L	104	75	123



Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%) MS	Recovery Limits (%) LowHigh	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number				
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2127090)							
EP1200028-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	100 mg/L	103	70	130
ED045G: Chloride Discrete analyser (QCLot: 2127089)							
EP1200028-002	Anonymous	ED045G: Chloride	16887-00-6	250 mg/L	114	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2124587)							
EP1200207-002	D5560_2	EG020A-F: Arsenic	7440-38-2	0.200 mg/L	95.5	70	130
		EG020A-F: Cadmium	7440-43-9	0.0500 mg/L	91.4	70	130
		EG020A-F: Chromium	7440-47-3	0.200 mg/L	77.5	70	130
		EG020A-F: Copper	7440-50-8	0.200 mg/L	82.7	70	130
		EG020A-F: Lead	7439-92-1	0.200 mg/L	80.6	70	130
		EG020A-F: Nickel	7440-02-0	0.200 mg/L	84.6	70	130
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	# Not Determined	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2124589)							
EP1200207-005	D51120_1	EG020A-F: Arsenic	7440-38-2	0.200 mg/L	96.2	70	130
		EG020A-F: Cadmium	7440-43-9	0.0500 mg/L	89.0	70	130
		EG020A-F: Chromium	7440-47-3	0.200 mg/L	81.6	70	130
		EG020A-F: Copper	7440-50-8	0.200 mg/L	82.8	70	130
		EG020A-F: Lead	7439-92-1	0.200 mg/L	81.0	70	130
		EG020A-F: Nickel	7440-02-0	0.200 mg/L	87.9	70	130
		EG020A-F: Zinc	7440-66-6	0.200 mg/L	81.7	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2124586)							
EP1200207-002	D5560_2	EG035F: Mercury	7439-97-6	0.0100 mg/L	97.2	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2124588)							
EP1200207-005	D51120_1	EG035F: Mercury	7439-97-6	0.0100 mg/L	95.8	70	130



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EP1200207	Page	: 1 of 6
Client	: ECOZ ENVIRONMENTAL SERVICES	Laboratory	: Environmental Division Perth
Contact	: MS EMMA MURRAY	Contact	: Scott James
Address	: PO BOX 381	Address	: 10 Hod Way Malaga WA Australia 6090
	DARWIN NT, AUSTRALIA 0801		
E-mail	: emma.murray@vdmgroup.com.au	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 08 89811100	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 89811102	Facsimile	: +61-8-9209 7600
Project	: West Gold Mine	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 12-JAN-2012
Sampler	: Emma & Casey	Issue Date	: 18-JAN-2012
Site	: ----		
Quote number	: BN/717/11	No. of samples received	: 16
		No. of samples analysed	: 16

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Canhuang Ke	Metals Instrument Chemist	Perth Inorganics
Chas Tucker	Inorganic Chemist	Perth Inorganics
Cicelia Bartels	Metals Instrument Chemist	Perth Inorganics

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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				D5560_1	D5560_2	D5560_3	D51120	D51120_1
				27-DEC-2011 14:47	27-DEC-2011 06:35	27-DEC-2011 18:20	19-DEC-2011 09:20	19-DEC-2011 19:20
Compound	CAS Number	LOR	Unit	EP1200207-001	EP1200207-002	EP1200207-003	EP1200207-004	EP1200207-005
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO ₃	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO ₃	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO ₃	71-52-3	1	mg/L	352	346	352	338	341
Total Alkalinity as CaCO ₃	----	1	mg/L	352	346	352	338	341
ED038A: Acidity								
Acidity as CaCO ₃	----	1	mg/L	<1	<1	2	4	20
ED041G: Sulfate (Turbidimetric) as SO₄ 2- by DA								
Sulfate as SO ₄ - Turbidimetric	14808-79-8	1	mg/L	383	447	320	514	492
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	759	933	755	1060	1040
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	48	64	46	53	51
Magnesium	7439-95-4	1	mg/L	83	115	81	119	112
Sodium	7440-23-5	1	mg/L	510	580	501	656	622
Potassium	7440-09-7	1	mg/L	131	136	128	133	117
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0012	<0.0001	0.0002	<0.0001
Chromium	7440-47-3	0.001	mg/L	0.003	0.001	0.003	<0.001	0.001
Copper	7440-50-8	0.001	mg/L	0.003	0.005	0.003	0.012	0.008
Nickel	7440-02-0	0.001	mg/L	0.001	0.010	0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	0.001	0.004	<0.001	0.003	<0.001
Zinc	7440-66-6	0.005	mg/L	0.394	1.52	0.376	0.952	0.310
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK063: Inorganic Nitrogen as N (Ammonia + NO_x)								
^ Inorganic Nitrogen as N	----	0.01	mg/L	17.0	14.0	17.7	8.89	8.85
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	36.4	42.5	35.0	47.4	46.4
Total Cations	----	0.01	meq/L	34.8	41.4	34.0	44.4	41.8
Ionic Balance	----	0.01	%	2.34	1.41	1.41	3.26	5.21



Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				D51120_2	D51120_3	D5760	D5160	D51120-11
				20-DEC-2011 07:25	19-DEC-2011 17:10	25-DEC-2011 06:40	29-DEC-2011 06:40	19-DEC-2011 13:15
Compound	CAS Number	LOR	Unit	EP1200207-006	EP1200207-007	EP1200207-008	EP1200207-009	EP1200207-010
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	334	335	429	332	340
Total Alkalinity as CaCO3	----	1	mg/L	334	335	429	332	340
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	32	5	3	10	4
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	504	518	133	142	521
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	1040	1050	177	303	1060
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	54	55	32	37	55
Magnesium	7439-95-4	1	mg/L	120	125	54	58	122
Sodium	7440-23-5	1	mg/L	672	699	178	226	676
Potassium	7440-09-7	1	mg/L	134	140	95	100	134
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.002	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	<0.0001	0.0005	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.010	0.012	0.002	0.002	0.009
Nickel	7440-02-0	0.001	mg/L	0.003	<0.001	0.017	0.005	<0.001
Lead	7439-92-1	0.001	mg/L	0.002	<0.001	<0.001	0.003	0.001
Zinc	7440-66-6	0.005	mg/L	0.910	0.371	0.094	1.38	0.500
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK063: Inorganic Nitrogen as N (Ammonia + NOx)								
^ Inorganic Nitrogen as N	----	0.01	mg/L	8.49	8.68	23.6	26.8	8.72
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	46.5	47.1	16.3	18.1	47.5
Total Cations	----	0.01	meq/L	45.2	47.0	16.2	19.0	45.6
Ionic Balance	----	0.01	%	1.40	0.10	0.38	2.34	2.08



Analytical Results

Sub-Matrix: WATER

Client sample ID

Client sampling date / time

				D5590	D5590-1	D5760_1	D5760_2	D5590_3
				12-JAN-2012 10:30	11-DEC-2011 12:30	25-DEC-2011 12:40	25-DEC-2011 16:19	11-DEC-2011 17:50
Compound	CAS Number	LOR	Unit	EP1200207-011	EP1200207-012	EP1200207-013	EP1200207-014	EP1200207-015
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO ₃	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO ₃	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO ₃	71-52-3	1	mg/L	346	340	384	380	347
Total Alkalinity as CaCO ₃	----	1	mg/L	346	340	384	380	347
ED038A: Acidity								
Acidity as CaCO ₃	----	1	mg/L	7	25	16	<1	4
ED041G: Sulfate (Turbidimetric) as SO₄ 2- by DA								
Sulfate as SO ₄ - Turbidimetric	14808-79-8	1	mg/L	600	562	206	208	526
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	1190	1190	274	277	1130
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	58	54	28	26	54
Magnesium	7439-95-4	1	mg/L	136	134	43	41	128
Sodium	7440-23-5	1	mg/L	756	733	302	309	717
Potassium	7440-09-7	1	mg/L	141	140	87	84	134
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.006	0.006	<0.001
Copper	7440-50-8	0.001	mg/L	0.026	0.015	0.002	0.002	0.014
Nickel	7440-02-0	0.001	mg/L	0.006	<0.001	0.002	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	0.002	0.002	<0.001	<0.001	0.002
Zinc	7440-66-6	0.005	mg/L	0.693	0.448	0.018	0.016	0.223
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK063: Inorganic Nitrogen as N (Ammonia + NO_x)								
^ Inorganic Nitrogen as N	----	0.01	mg/L	9.83	10.0	21.6	21.1	21.3
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	53.0	52.1	19.7	19.7	49.8
Total Cations	----	0.01	meq/L	50.6	49.2	20.3	20.3	47.8
Ionic Balance	----	0.01	%	2.33	2.85	1.50	1.29	1.98



Analytical Results

Sub-Matrix: **WATER**

Client sample ID

D5190

Client sampling date / time

03-JAN-2012 06:30

Compound	CAS Number	LOR	Unit	EP1200207-016				
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO ₃	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO ₃	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO ₃	71-52-3	1	mg/L	351	----	----	----	----
Total Alkalinity as CaCO ₃	----	1	mg/L	351	----	----	----	----
ED038A: Acidity								
Acidity as CaCO ₃	----	1	mg/L	24	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO₄ 2- by DA								
Sulfate as SO ₄ - Turbidimetric	14808-79-8	1	mg/L	411	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	859	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	44	----	----	----	----
Magnesium	7439-95-4	1	mg/L	92	----	----	----	----
Sodium	7440-23-5	1	mg/L	556	----	----	----	----
Potassium	7440-09-7	1	mg/L	123	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	0.0002	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	0.002	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	9.97	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK063: Inorganic Nitrogen as N (Ammonia + NO_x)								
^ Inorganic Nitrogen as N	----	0.01	mg/L	10.6	----	----	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	39.8	----	----	----	----
Total Cations	----	0.01	meq/L	37.1	----	----	----	----
Ionic Balance	----	0.01	%	3.53	----	----	----	----

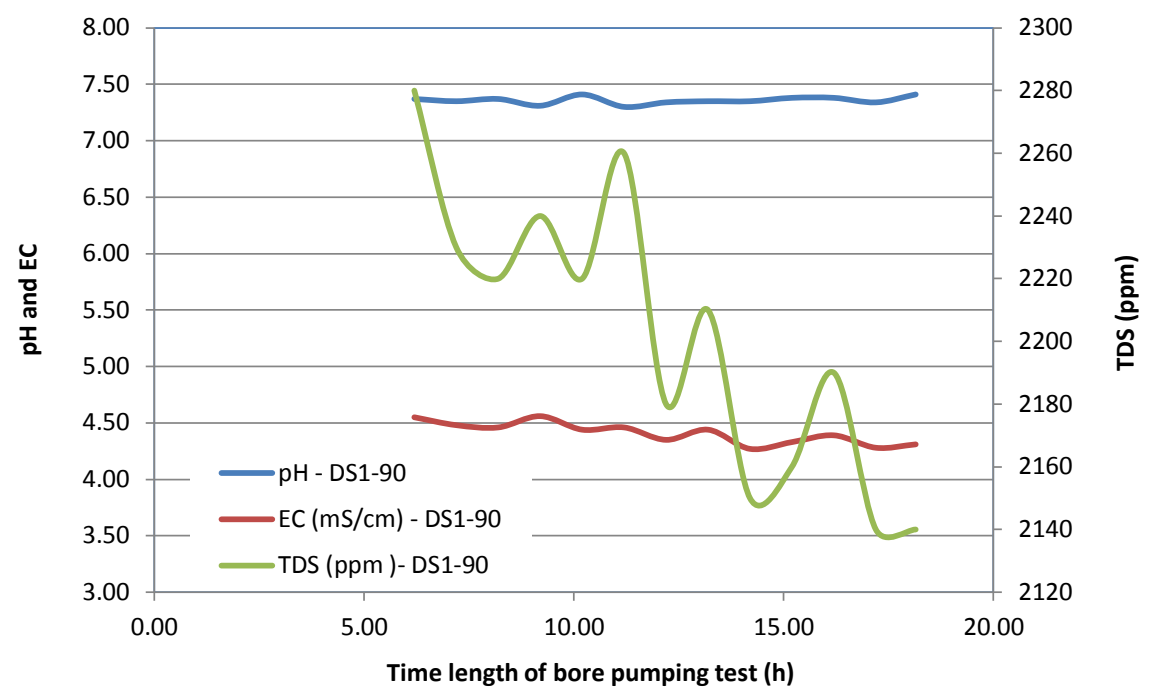
Field Water Quality Assessment

DS1-60 Date: 29/12/2011

Time	PH	EC/MS	TDS/PPT	Temp
6.40	7.73	2.00	1.00	28.90
Test ran out of water after short time recovery.				
New test started at 7.24am at 1.5 1/5				
7.30				
8.30				
9.29				
10.35				
11.30				
12.30				
12.55pm Test stopped due to air in water.				
New test started 1.30 1/5				
14.00	7.59	2.07	1.05	32.40
15.00	7.52	2.66	1.32	32.30
16.00	7.52	2.72	1.36	32.50
17.00	7.46	2.75	1.38	32.60
18.00	7.55	2.80	1.39	32.50
18.57	7.58	2.75	1.37	32.10

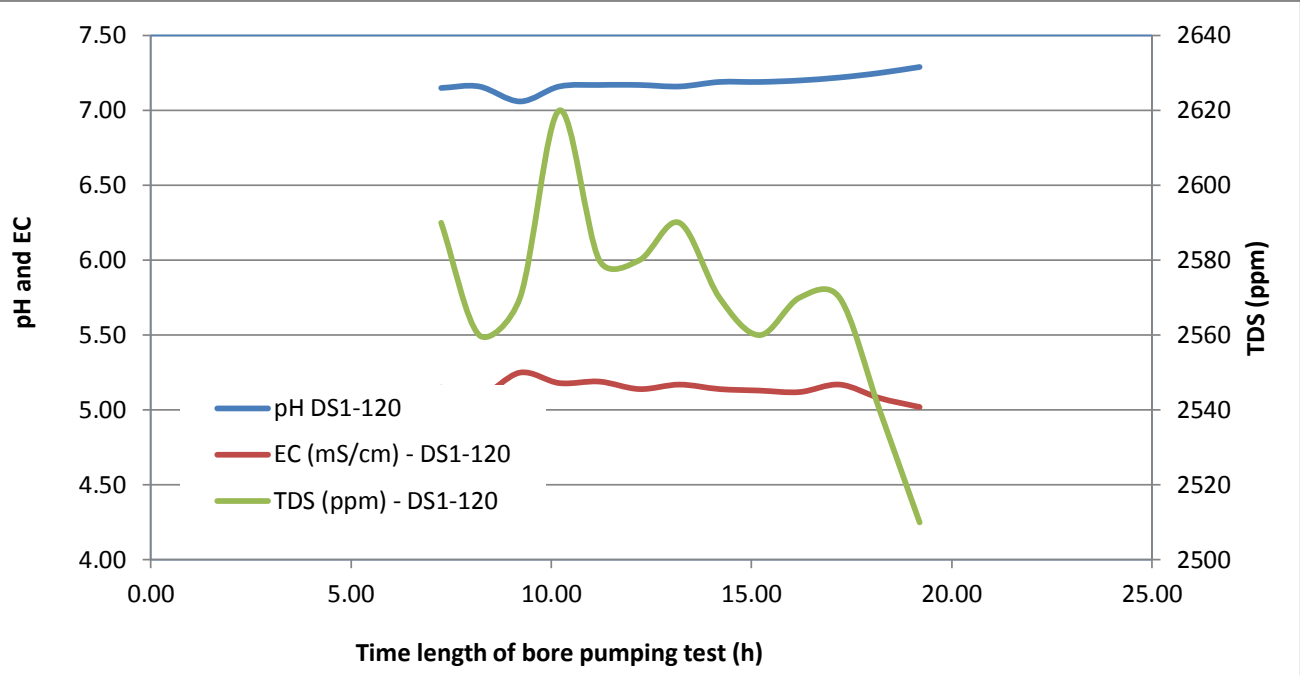
DS1-90 Date: 2/01/2012

Time	PH	EC/MS	TDS (ppm)	Temp
6.20	7.37	4.55	2.28	2280.00
7.20	7.35	4.48	2.23	2230.00
8.20	7.37	4.46	2.22	2220.00
9.20	7.31	4.56	2.24	2240.00
10.20	7.41	4.44	2.22	2220.00
11.20	7.30	4.46	2.26	2260.00
12.20	7.34	4.35	2.18	2180.00
13.20	7.35	4.44	2.21	2210.00
14.20	7.35	4.27	2.15	2150.00
15.20	7.38	4.33	2.16	2160.00
16.20	7.38	4.39	2.19	2190.00
17.20	7.34	4.28	2.14	2140.00
18.15	7.41	4.31	2.14	2140.00



DS1-120 Date: 20/12/2011

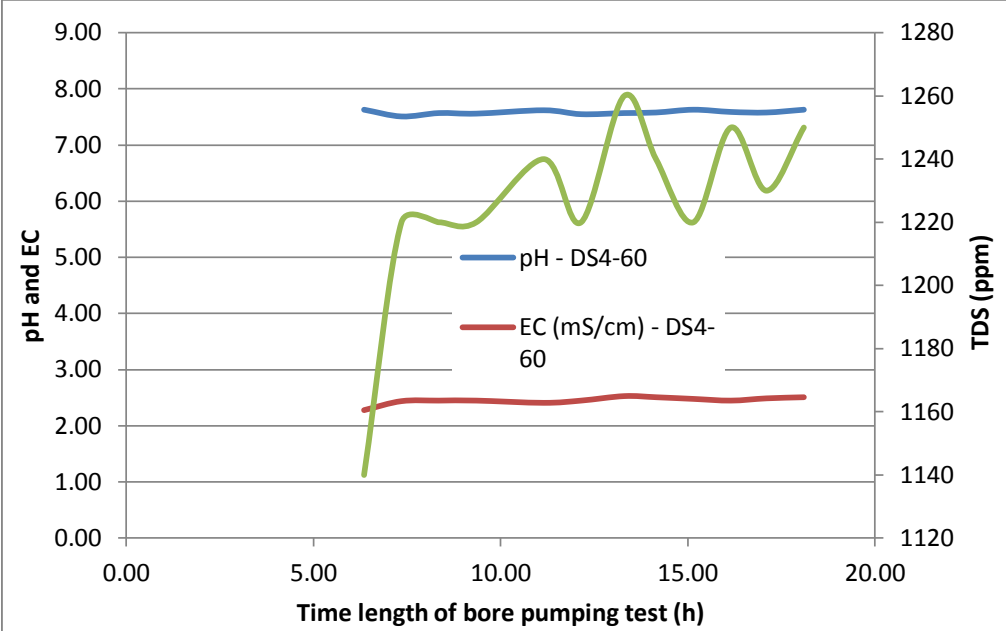
Time	PH	EC/MS	TDS/PPT	TDS (ppm)	Temp
7.25	7.15	5.15	2.59	2590	33.90
8.20	7.16	5.09	2.56	2560	34.00
9.22	7.06	5.25	2.57	2570	34.40
10.20	7.16	5.18	2.62	2620	34.30
11.20	7.17	5.19	2.58	2580	34.20
12.20	7.17	5.14	2.58	2580	34.70
13.20	7.16	5.17	2.59	2590	34.60
14.20	7.19	5.14	2.57	2570	34.40
15.20	7.19	5.13	2.56	2560	34.50
16.20	7.20	5.12	2.57	2570	34.30
17.20	7.22	5.17	2.57	2570	34.20
18.20	7.25	5.08	2.54	2540	34.00
19.20	7.29	5.02	2.51	2510	33.00



DS4-60 Date: 31/12/2011

Time	PH	EC/MS	TDS/PPT	Temp
6.35	7.63	2.28	1.14	31.00
7.35	7.51	2.44	1.22	31.30
8.35	7.57	2.45	1.22	31.60
9.35	7.56	2.45	1.22	31.90
Ran out of water.				
Observed milky water at discharge @ 9.30am				
11.10	New test 0.8 L/S			
11.15	7.62	2.41	1.24	33.60
12.15	7.55	2.45	1.22	32.20
13.30	7.57	2.53	1.26	32.20
14.15	7.58	2.51	1.24	32.20
15.15	7.63	2.48	1.22	32.30
16.15	7.59	2.45	1.25	31.90
17.10	7.58	2.49	1.23	32.20
18.10	7.63	2.51	1.25	32.00

Time	PH	EC/MS	TDS/PPT	TDS ppm	Temp
6.35	7.63	2.28	1.14	1140	31.00
7.35	7.51	2.44	1.22	1220	31.30
8.35	7.57	2.45	1.22	1220	31.60
9.35	7.56	2.45	1.22	1220	31.90
11.15	7.62	2.41	1.24	1240	33.60
12.15	7.55	2.45	1.22	1220	32.20
13.30	7.57	2.53	1.26	1260	32.20
14.15	7.58	2.51	1.24	1240	32.20
15.15	7.63	2.48	1.22	1220	32.30
16.15	7.59	2.45	1.25	1250	31.90
17.10	7.58	2.49	1.23	1230	32.20
18.10	7.63	2.51	1.25	1250	32.00



DS5-60 Date: 27/12/2011

Time	PH	EC/MS	TDS/PPT	Temp
6.35	7.38	4.49	2.33	30.70
7.35	7.36	4.15	2.07	32.10
8.35	7.40	4.07	2.03	32.00
9.20	Test Stopped			
New test started at 10.40 21/5 8hr test.				
10.45	7.36	4.09	2.06	32.40
11.45	7.38	3.93	1.96	32.40
12.42	7.38	3.95	1.97	32.50
13.43	7.41	3.97	2.00	32.70
14.47	7.46	3.99	1.98	32.10
15.43	7.40	3.93	1.97	32.40
16.40	7.41	3.96	1.98	32.60
17.40	7.42	3.99	1.98	32.40
18.20	7.43	3.98	1.99	32.40

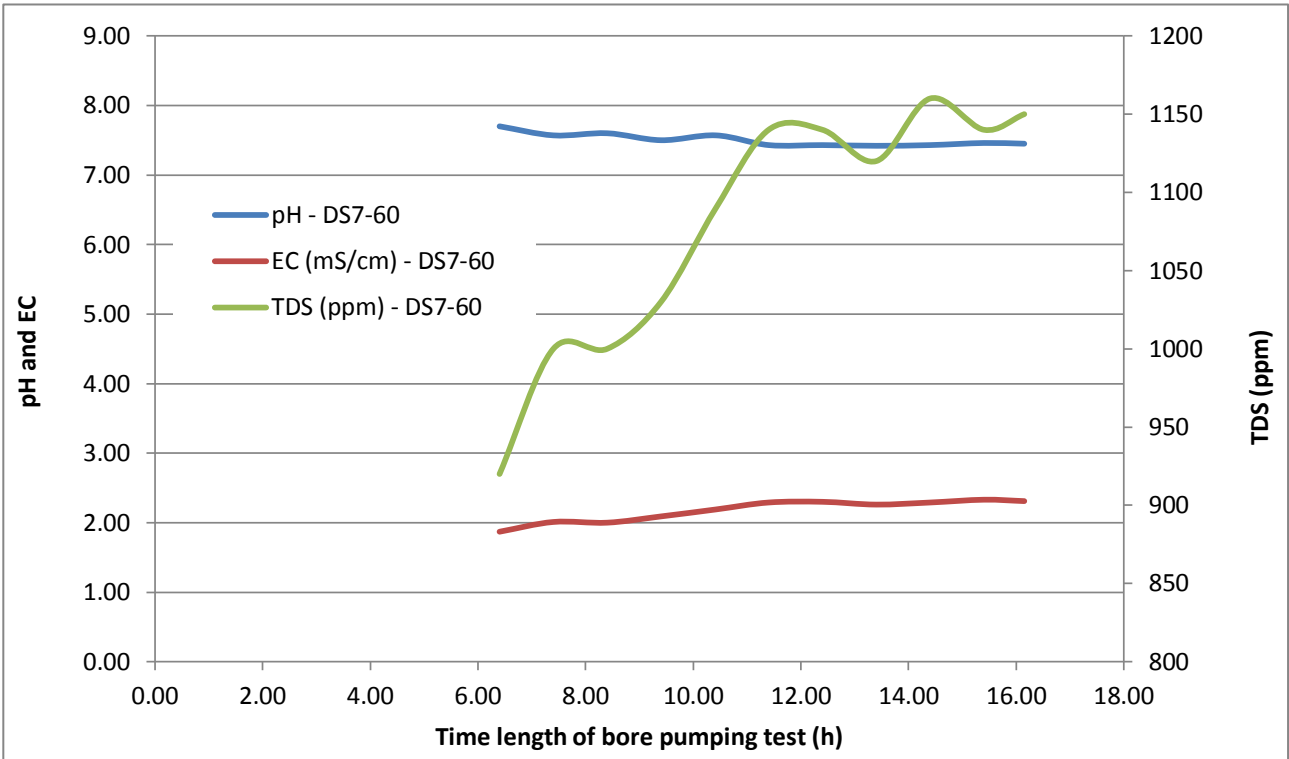
DS590 Date: 11/12/2011

5 lit
10 lit 2 Hour per step
15lit
Max lit

Time	PH	PPT	MS	Temp
10.28	7.05	2.97	6.23	33.70
11.40	7.25	2.85	5.75	34.10
12.27	7.26	2.87	5.67	33.90
13.25	7.20	2.81	5.66	34.10
14.25	7.20	2.80	5.66	34.30
15.28	7.30	2.87	5.59	34.40
16.30	7.73	2.80	5.62	33.70
17.30	7.40	2.77	5.54	32.90

DS7-60 Date: 25/12/2011

Time	PH	EC (mS/cm)	TDS/PPT	TDS (ppm)	Temp
6.40	7.70	1.87	0.92	920.00	28.40
7.40	7.57	2.01	1.00	1000.00	32.50
8.40	7.60	2.00	1.00	1000.00	32.80
9.40	7.50	2.09	1.03	1030.00	33.20
10.42	7.57	2.19	1.09	1090.00	35.50
11.40	7.43	2.29	1.14	1140.00	34.90
12.40	7.43	2.30	1.14	1140.00	34.10
13.40	7.42	2.26	1.12	1120.00	33.40
14.40	7.43	2.29	1.16	1160.00	33.70
15.40	7.46	2.33	1.14	1140.00	33.60
16.15	7.45	2.31	1.15	1150.00	34.00
16.19	Ran out of water				



APPENDIX D

Modelling Data Files

MODEL AQUIFER TEST ANALYSIS

Seven boreholes were tested while drawdowns were recorded in the abstraction borehole as well as in observation boreholes. The boreholes are DS1_60, DS1_90, DS1_120, DS4_60, DS5_60, DS5_90 and DS7_60.

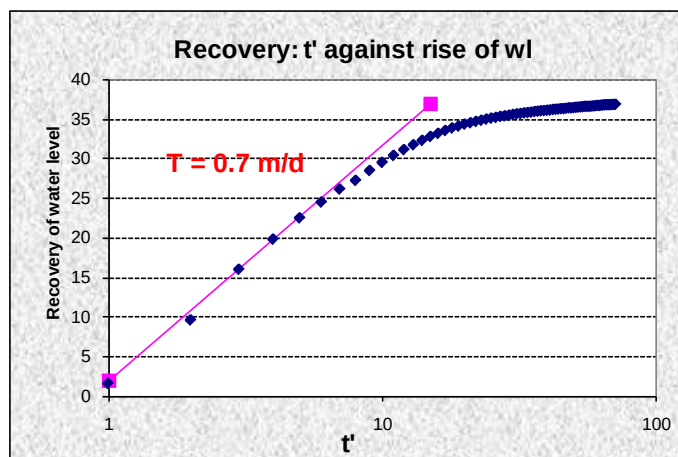
DS1_60

DATA sheet: Enter general info and data of constant rate pumping test and recovery (optional)												
Country:	Australia	Main		Geology:	Sandstone, Dolomite, Mudstone							
Region:	Northern Territory			Depth of BH:	60							
Owner:	WestGold	Diagnostic Plots	Derivative	Water strikes:	30, 40, 58, 59.5							
X-coord:	359061			Date of Test:	2011/12/29							
Y-coord:	7787797	Sust_Q		Contractor:	B A Pump Testing (Elevation 297.375 mAHD)							
CONSTANT RATE TEST DATA: enter values in cells which are coloured light yellow												
Borehole:	DS1-60				Other info:							
Distance from Rest WL to main water strike (m) =	45	S _{max} =	36.9	Recom AD =	40.8							
Q (l/s) =	1.3	Recovery data				T (m ² /d) : Logan eq.						
t (min)	s (m)	avg s	avg s'	avg T	avg S	Time t'	Res s	l/t'	Wl rise	s'	Rec T	3.7

Summary of input of BH DS1_60

Summary		Main		DS1-60							
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m ² /d)		Late T (m ² /d)		S		AD used	
☒	Basic FC	0.22	0.15	1		0.9		5.00E-03		40.8	
☐	Advanced FC			1		0.9		1.00E-03		40.8	
☐	FC inflection point	0.00	0.00							8.0	
☒	Cooper-Jacob	0.54	0.35			0.9		5.00E-03		40.8	
☐	FC Non-Linear									40.8	
☐	Barker	0.06	0.01	K _f =	100		S _s =	1.60E-04		40.8	
	Average Q _{sust} (l/s)	0.38	0.22	b =	0.19	Fractal dimension n =		1.54			

Summary of interpreted drawdown data for DS1_60



t' vs. recovery BH DS1_60

The recovery data supports the transmissivity value (T) of 1 m/d yielded by interpretation of the abstraction data.

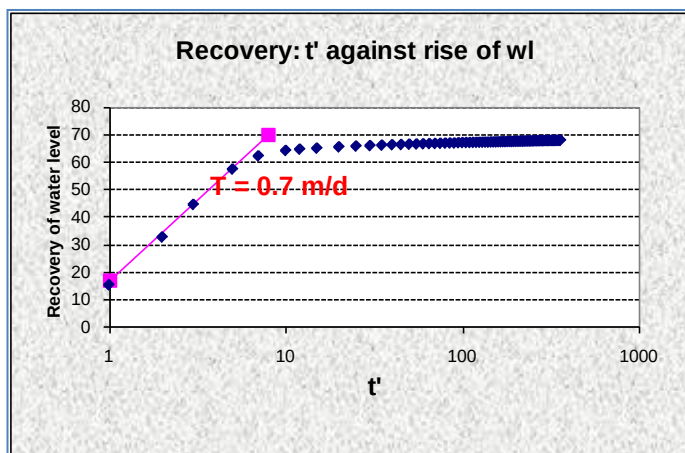
DS1_90

DATA sheet: Enter general info and data of constant rate pumping test and recovery (optional)												
Country:	Australia	Main		Geology:	Sandstone, Dolomite, Mudstone							
Region:	Northern Territory			Depth of BH:	90							
Owner:	WestGold	Diagnostic Plots	Derivative	Water strikes:	30, 37.5, 45.5, 58, 75.5, 87.5							
X-coord:	359080.00			Date of Test:	2011/01/02							
Y-coord:	7787804.00	Sust_Q		Contractor:	BA Pump Testing (Elevation: 297.38 mAHD)							
CONSTANT RATE TEST DATA: enter values in cells which are coloured light yellow												
Borehole:	DS1-90				Other info:							
Distance from Rest WL to main water strike (m) =	70	S _{max} =	68.7	Recom. AD =	69.3							
Q (l/s) =	2.7	Recovery data			T (m ² /d) : Logan eq.							
t (min)	s (m)	avg s'	avg s''	avg T	avg S	Time t'	Res_s	t/t'	WL rise	s'	Rec. T	4.1

Summary of input of BH DS1_90

Summary			Main	DS1-90					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m ² /d)		Late T (m ² /d)		S	AD used
☒	Basic FC	0.86	0.43	1		2.4		5.00E-03	69.3
☐	Advanced FC			1		2.4		1.00E-03	69.3
☐	FC inflection point	1.17	0.47						8.0
☒	Cooper-Jacob	1.16	0.75			1.1		5.00E-03	69.3
☐	FC Non-Linear								69.3
☐	Barker	0.08	0.00	K _f =	87		S _s =	1.00E-07	69.3
	Average Q _{sust} (l/s)	1.01	0.21	b =	2.04	Fractal dimension n =		1.38	

Summary of interpreted drawdown data for DS1_90



t' vs. recovery BH DS1_90

The recovery data supports the transmissivity value (T) of 1 m/d yielded by the interpretation of the abstraction data.

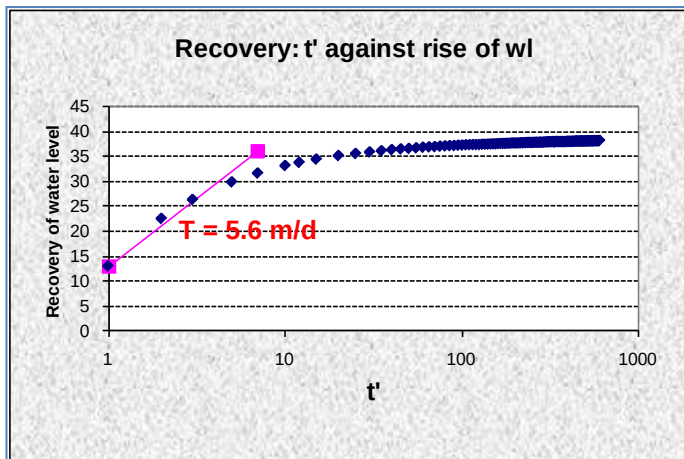
DS1_120

DATA sheet: Enter general info and data of constant rate pumping test and recovery (optional)											
Country:	Australia		Main		Geology:	Sandstone, Dolomite, Mudstone					
Region:	Northern Territory				Depth of BH:	120					
Owner:	WestGold		Diagnostic Plots	Derivative	Water strikes:	28, 38.5, 48, 51, 60, 69.5, 73, 79.5, 87.5, 97, 11					
X-coord:	359098.00		Sust_Q		Date of Test:	2011/01/04					
Y-coord:	7787812.00				Contractor:	BA Pump Testing (Elevation: 297.38)					
CONSTANT RATE TEST DATA : enter values in cells which are coloured light yellow											
Borehole:		DS1-120					Other info:				
Distance from Rest WL to main water strike (m) =			91	S _{max} =	38.5	Recom. AD=	59.2				
Q (l/s)=		10		Recovery data					T (m ² /d) : Logan eq.		
t (min)	s (m)	avg.s'	avg.s''	avg.T	avg.S	Time t'	Res.s	t/t'	WI rise	s'	Rec.T
											27.4

Summary of input of BH DS1_120

Summary			Main	DS1-120					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m²/d)		Late T (m²/d)		S	AD used
☒	Basic FC	6.88	2.70	5		29.9		5.00E-03	59.2
☐	Advanced FC			5		29.9		1.00E-03	59.2
☐	FC inflection point	0.00	0.00						8.0
☒	Cooper-Jacob	3.49	2.26			5.0		5.00E-03	59.2
☐	FC Non-Linear								59.2
☐	Barker	6.66	2.52	K _f =	95		S _s =	1.60E-04	59.2
	Average Q _{sust} (l/s)	5.19	2.40	b =	0.10	Fractal dimension n =		2.08	

Summary of interpreted drawdown data for DS1_120



t' vs. recovery BH DS1_120

The recovery data supports the transmissivity value (T) of 5 m/d yielded by the interpretation of the abstraction data.

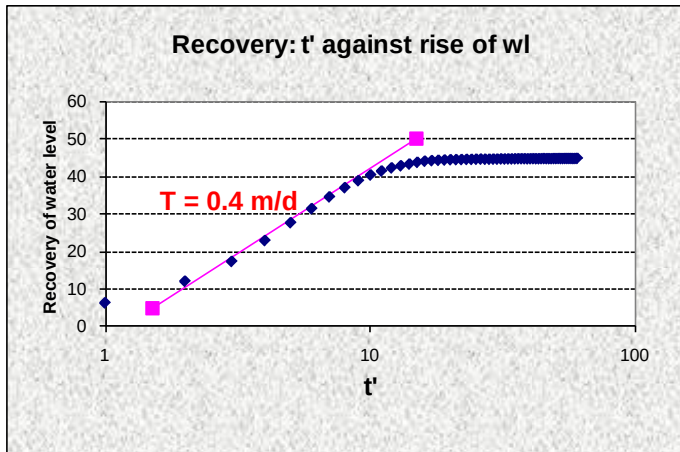
DS4_60

DATA sheet: Enter general info and data of constant rate pumping test and recovery (optional)												
Country:	Australia	Main		Geology:	Sandstone, Dolomite, Mudstone							
Region:	Northern Territory			Depth of BH:	60							
Owner:	WestGold	Diagnostic Plots	Derivative	Water strikes:	26.5, 34.5, 48, 55							
X-coord:	359376.00			Date of Test:	2011/12/31							
Y-coord:	7787440.00	Sust_Q		Contractor:	BA Pump Testing (Elevation: 296.08)							
CONSTANT RATE TEST DATA : enter values in cells which are coloured light yellow												
Borehole:	DS4-60				Other info:							
Distance from Rest WL to main water strike (m) = 28 s_{max} = 45 Recom. AD = 28.0												
Q (l/s)=	1.1	Recovery data				T (m ² /d) : Logan eq.						
t (min)	s (m)	avg s'	avg s''	avg T	avg S	Time t'	Res_s	t/t'	WL rise	s'	Rec_T	2.6

Summary of input of BH DS4_60

Summary			Main	DS4-60					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m²/d)		Late T (m²/d)		S	AD used
☒	Basic FC	0.09	0.06	1		0.5		5.00E-03	28.0
☐	Advanced FC			1		0.5		1.00E-03	28.0
☐	FC inflection point	0.16	0.11						27.0
☒	Cooper-Jacob	0.54	0.35			1.3		5.00E-03	28.0
☐	FC Non-Linear								28.0
☐	Barker	0.08	0.05	K _f =	168		S _s =	1.60E-04	28.0
	Average Q _{sust} (l/s)	0.31	0.32	b =	0.28	Fractal dimension n =		1.63	

Summary of interpreted drawdown data for DS4_60



t' vs. recovery BH DS4_6

The recovery data and supports the transmissivity value (T) of 1 m/d yielded by the interpretation of the abstraction data.

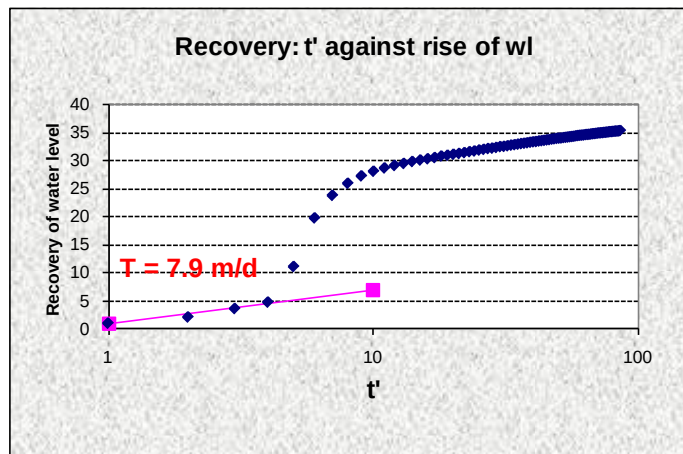
DS5_60

DATA sheet: Enter general info and data of constant rate pumping test and recovery (optional)												
Country:	Australia	Main		Geology:	Sandstone, Dolomite, Mudstone							
Region:	Northern Territory			Depth of BH:	60							
Owner:	WestGold	Diagnostic Plots	Derivative	Water strikes:	31, 36, 44							
X-coord:	359205.00			Date of Test:	2011/12/27							
Y-coord:	7787594.00	Sust_Q		Contractor:	BA Pump Testing (Elevation: 297.275 mAHD)							
CONSTANT RATE TEST DATA : enter values in cells which are coloured light yellow												
Borehole:	DS5-60				Other info:							
Distance from Rest WL to main water strike (m) = 28 s_{max} = 37.6 Recom. AD = 28.0												
Q (l/s) =	3	Recovery data				T (m ² /d) : Logan eq.						
t (min)	s (m)	avg s'	avg s''	avg T	avg S	Time t'	Res_s	t/t'	WL rise	s'	Rec_T	8.4

Summary of input of BH DS_60

Summary			Main	DS5-60					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m²/d)		Late T (m²/d)		S	AD used
☒	Basic FC	0.06	0.05	8		0.4		5.00E-03	28.0
☐	Advanced FC			8		0.4		1.00E-03	28.0
☐	FC inflection point	0.00	0.00						8.0
☒	Cooper-Jacob	0.73	0.48			1.9		5.00E-03	28.0
☐	FC Non-Linear								28.0
☐	Barker	0.20	0.29	K _f =	124		S _s =	1.60E-04	28.0
	Average Q _{sust} (l/s)	0.40	0.47	b =	0.22	Fractal dimension n =		1.78	

Summary of interpreted drawdown data for DS5_60



t' vs. recovery BH DS5_60

The recovery data and supports the transmissivity value (T) of 8 m/d yielded by the interpretation of the abstraction data.

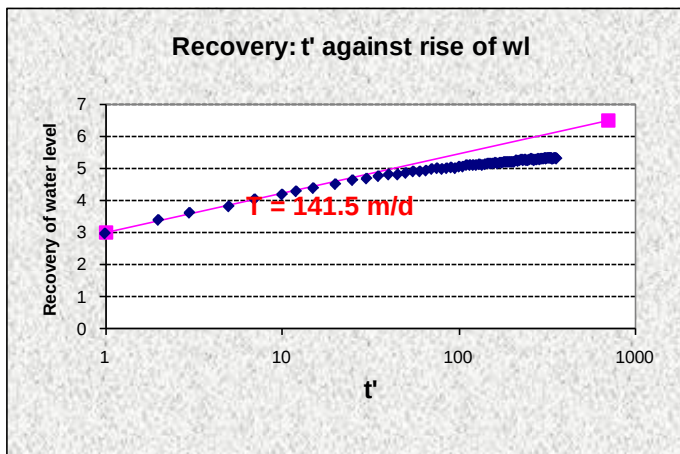
DS5_90

DATA sheet: Enter general info and data of constant rate pumping test and recovery (optional)												
Country:	Australia		Main		Geology:	Sandstone, Dolomite, Mudstone						
Region:	Northern Territory				Depth of BH:	90						
Owner:	WestGold		Diagnostic Plots	Derivative	Water strikes:	33.5, 79, 81.5						
X-coord:	359227.00		Sust_Q		Date of Test:	2011/12/23						
Y-coord:	7787587.00				Contractor:	BA Pump Testing (Elevation: 297.275 mAHD)						
CONSTANT RATE TEST DATA : enter values in cells which are coloured light yellow												
Borehole:		DS5-90					Other info:					
Distance from Rest WL to main water strike (m) =			75	S _{max} =	5.62	Recom. AD =	20.5					
Q (l/s)=		11	Recovery data					T (m ² /d) : Logan eq.				
t (min)	s (m)	avg s'	avg s''	avg T	avg S	Time t'	Res_s	t/t'	WI rise	s'	Rec_T	206.4

Summary of input of BH DS5_90

Summary			Main	DS5-90					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m²/d)		Late T (m²/d)		S	AD used
☒	Basic FC	1.47	1.28	131		8.9		5.00E-03	20.5
☐	Advanced FC			131		8.9		1.00E-03	20.5
☐	FC inflection point	0.00	0.00						8.0
☒	Cooper-Jacob	18.57	12.02			119.1		5.00E-03	20.5
☐	FC Non-Linear								20.5
☐	Barker	8.56	14.60	K _f =	91		S _s =	1.60E-04	20.5
	Average Q _{sust} (l/s)	10.02	12.09	b =	0.24	Fractal dimension n =		2.21	

Summary of interpreted drawdown data for DS5_90



t' vs. recovery BH DS5_90

The recovery data and supports the transmissivity value (T) of 131 m/d yielded by the interpretation of the abstraction data.

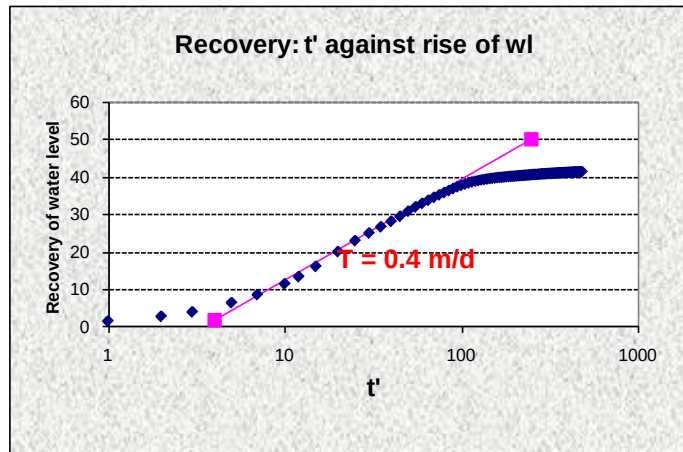
DS7_60

DATA sheet: Enter general info and data of constant rate pumping test and recovery (optional)												
Country:	Australia	Main		Geology:	Sndstone, Dolomite, Mudstone							
Region:	Northern Territory			Depth of BH:	60							
Owner:	WestGold	Diagnostic Plots	Derivative	Water strikes:	32, 34, 42, 53							
X-coord:	358983.00			Date of Test:	2011/12/25							
Y-coord:	7787374.00	Sust_Q		Contractor:	AB Pump Testing (Elevation: 296.83 mAHD)							
CONSTANT RATE TEST DATA : enter values in cells which are coloured light yellow												
Borehole:	DS7-60				Other info:							
Distance from Rest WL to main water strike (m) = 33 s_{max} = 41.3 Recom. AD = 33.0												
Q (l/s)=	0.6	Recovery data				T (m ² /d) : Logan eq.						
t (min)	s (m)	avg s'	avg s''	avg T	avg S	Time t'	Res_s	t/t'	WL rise	s'	Rec_T	1.5

Summary of input of BH DS7_60

Summary			Main	DS7-60					
Applicable	Method	Sustainable yield (l/s)	Std. Dev	Early T (m²/d)		Late T (m²/d)		S	AD used
☒	Basic FC	0.03	0.02	1		0.1		5.00E-03	33.0
☐	Advanced FC			1		0.1		1.00E-03	33.0
☐	FC inflection point	0.07	0.05						25.0
☒	Cooper-Jacob	0.58	0.38			1.2		5.00E-03	33.0
☐	FC Non-Linear								33.0
☐	Barker	0.01	0.00	K _f =	283		S _s =	1.60E-04	33.0
	Average Q _{sust} (l/s)	0.31	0.39	b =	1.19	Fractal dimension n =		1.14	

Summary of interpreted drawdown data for DS7_60



t' vs. recovery BH DS7_60

The recovery data and supports the transmissivity value (T) of 1 m/d yielded by the interpretation of the abstraction data.

Summary of Aquifer Testing and Parameters

Table 1 summarises the data interpretation of the seven boreholes.

Table 1: Summary of aquifer testing and parameters

Borehole ID	Sustainable Yield (L/s)	Transmissivity (m/d)	Storativity
DS1_60	0.38	1	5×10^{-3}
DS4_60	0.31	1	5×10^{-3}
DS5_60	0.4	8	5×10^{-3}
DS7_60	0.31	1	5×10^{-3}
DS1_90	1.01	1	5×10^{-3}
DS5_90	10.02	131	5×10^{-3}
DS1-120	5.19	5	5×10^{-3}

Note that the sustainable yield is recommended for 24hr/day for a period of 2 years.