Mulga Rock Uranium Project - Public Environmental Review - December 2015
Appendix D - Hydrological Processes / Inland Waters Environmental Quality

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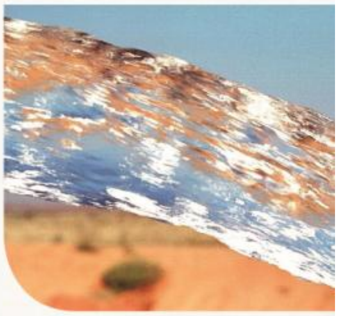

MULGA ROCK URANIUM PROJECT

RESULTS OF HYDROGEOLOGICAL INVESTIGATIONS AND NUMERICAL MODELLING, MULGA ROCK URANIUM PROJECT

REPORT FOR VIMY RESOURCES LTD

OCTOBER 2015

Rockwater
HYDROGEOLOGICAL AND ENVIRONMENTAL CONSULTANTS

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15-002a	PHW	JRP	29/05/2015
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1 INTRODUCTION

The Mulga Rock Uranium Project (MRUP) lies approximately 240km east-north-east of Kalgoorlie-Boulder in the Shire of Menzies (Figure 1). The area is remote, located on the western flank of the Great Victoria Desert, comprising a series of large, generally parallel sand dunes, with inter-dunal swales and broad flat plains.

Access to the Project area is limited and is only possible using four-wheel-drive vehicles. The nearest residential town to the Project is Laverton which lies approximately 200km to the north-west. Other regional residential communities include Pinjin Station homestead located approximately 100km to the west, Coonana Aboriginal community situated approximately 130km to the south-south-west, Kanandah Station homestead positioned approximately 150km to the south-east and the Tropicana Gold Mine lying approximately 110km to the north-east of the Project (Figure 2).

The MRUP covers approximately 102,000 hectares on granted mining tenure (primarily M39/1080 and M39/1081) within Unallocated Crown Land. It includes two distinct mining centres, Mulga Rock East (MRE) comprising the Princess and Ambassador resources, and Mulga Rock West (MRW) comprising the Emperor and Shogun resources, which are approximately 20km apart (Figure 3). MRE contains over 65% of the total recoverable uranium and is of a higher grade than MRW. Mining will commence at MRE, which will include the location of the processing plant. Up to 4.5 Million tonnes per annum (Mtpa) of ore will be mined using traditional open cut techniques, crushed, beneficiated and then processed at an acid leach and precipitation treatment plant to produce, on average, 1,360 tonnes of uranium oxide concentrate (UOC) per year over the life of the Project. The anticipated Life-of-Mine (LOM) is up to 16 years, based on the currently identified resource.

This report presents the results of geological and hydrogeological investigations in the planned mining area, as well as numerical modelling to determine dewatering pumping rates and the potential impacts of groundwater reinjection, to support an application to the Department of Water (DoW) for licences to take and reinject water. The model can also be used to assess the impacts of tailings disposal.

2 PREVIOUS INVESTIGATIONS

There are many publications describing palaeodrainages and palaeochannel aquifers in Western Australia such as the one that hosts the Mulga Rock deposits. These include Van der Graaff *et al.* (1977); de Broekert and Sandiford (2005); Magee (2009); and English *et al.* (2012).

GRC (1984) reviewed all available data for PNC Exploration Pty Ltd (PNC) which held the Mulga Rock Uranium Project then, and carried out hydrogeological assessments for the mine water supply, dewatering of the Emperor, Shogun and Ambassador deposits, and potential environmental impacts.

Following the above study, a programme of drilling, bore construction and test-pumping was completed, and a reconnaissance was made for a source of low-salinity water (GRC, 1985). Six additional sites were drilled to explore for low-salinity water (GRC, 1986), but with little success.

Douglas *et. al*. (1993) completed a detailed investigation of the hydrochemistry of groundwater from the Ambassador deposit as well as the chemistry and mineralogy of the lignite.

Rockwater (2010, and 2013) conducted dewatering and water-supply investigations for the MRUP. This report updates and expands the information contained in those reports. Rockwater (2015) prepared a separate report on the planned low-salinity (Kakarook North) borefield.

3 HYDROGEOLOGICAL SETTING

3.1 CLIMATE

The MRUP is located in the Great Victoria Desert and has an arid climate with hot dry summers and cool to mild winters. The nearest long-term climate station is at Edjudina (BoM Station 012027), 145 km to the west of the Ambassador deposit. Average rainfall data for the station (1900 to 2014) are given in Table 1.

Table 1: Average Monthly Rainfall (mm) Edjudina (BoM Station 012027)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
22.4	28.2	26.1	19.6	22.0	22.1	19.2	16.7	9.7	11.8	14.0	12.8	222.6

Most of the rain falls in irregular thunderstorm events or during the passage of the remnants of cyclones, with some frontal systems in winter. Daily rainfalls have been up to 98 mm (in February). No other climate data are available for the station.

The MRUP has maintained climate stations at the airstrip and at the Emperor and Shogun deposits since March 2009. A suite of climatic measurements has been made including rainfall, maximum and minimum air temperature, and pan evaporation.

Rainfall at the MRUP airstrip from 2010 to November 2014 can be compared with those at Edjudina in Table 2.

Table 2: Comparison of Annual Rainfall, Edjudina and Mulga Rock Airstrip

Year	Total Rainfall (mm)	
	Edjudina	Mulga Rock Airstrip
2010	222	173
2011	503	433
2012	337	129
2013	284	170
2014 to Nov.	469	160

The comparison in annual rainfall amounts over the period shown in Table 2 suggests that the climate at the MRUP is substantially drier than at Edjudina. Monthly rainfall data for the three MRUP climate stations are shown in Table 3. These also show a general decrease in rainfall from west (Emperor) to east (Airstrip).

Pan evaporation at the MRUP airstrip station from Dec-13 to Nov-14 was significantly lower than the average for Kalgoorlie (Luke, Burke and O'Brien, 1988), as shown in Table 4.

Table 3: Monthly Rainfall (mm) at the MRUP Climate Stations

Month	Airstrip					Emperor					Shogun				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
January	9.3	58.7	23.6	15.2	65.7	0	108.2	55.4	20.8	128.8	3	105.8	62.6	15.2	116.6
February	10.3	191.3	13.7	7.5	31.3	12.6	252.4	23	3.8	51.8	15	247.4	21.6	10.2	49.2
March	5.9	9.3	20.7	36.6	3.3	3.6	17	47.4	70	11.8	11.2	18.2	48.8	58.2	12.2
April	31.3	20.3	0.7	8.6	0.9	38.2	28.8	0.2	14.6	21.4	53	33.8	0.2	16.6	12
May	8	11.2	2.6	18.7	17.2	7.3	17.4	2.6	18.2	38.4	9.1	19.8	3	31	31.6
June	7.8	57.2	6.9	4.5	4.6	7.8	85.2	10	5.8	6.6	9.6	82.2	13.2	7.2	7.2
July	8.8	21	2.1	8.1	2.5	13.2	38.4	2.4	14.7	4	12	36.2	3.4	13	4
August	55.1	1.9	0.6	2.1	0.4	86.8	3	1.4	3.4	1.2	79.2	3	0.8	1.8	1.2
September	27.4	2.1	0.6	5.8	5.1	36.4	5.6	1	13.2	7.6	36.2	4	0.8	10	6.8
October	1.5	36.7	3.8	0.9	9	0.6	61.4	9.4	1.2	19.2	1.8	59.2	6.4	2.8	17.4
November	1.9	12.2	35.1	47.9	21.6	2	24.4	48	65.4	30	1	24.2	50.8	57.2	32
December	7.7	12.7	17.5	15	N/A	7.4	28.8	53.8	16.8	N/A	9	22.8	28.4	16	N/A
Annual Total	175	434.6	127.9	170.9	161.6	215.9	670.6	254.6	247.9	320.8	240.1	656.6	240	239.2	290.2

Table 4: Comparison between Average Pan Evaporation at Kalgoorlie and the MRUP (2014)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
MRUP (2014)	306	280	225	211	150	91	81	90	140	206	255	276	2309
Kalgoorlie (Av.)	431	346	306	199	133	93	103	130	181	271	326	424	2943

Maximum and minimum air temperatures at the three MRUP weather stations are shown with monthly rainfalls in Figure 4. The temperatures are very similar at all three stations. In 2014, average maximum air temperatures ranged from 18.6 ^oC in June to 34.6 ^oC in January; and average minimum temperatures ranged from 1.1 ^oC in July to 18.0 ^oC in January.

3.2 REGIONAL GEOLOGICAL SETTING

Mineral exploration holes drilled by Vimy and its predecessor PNC, as well as other companies including Uranerz and Paladin, have shown that the Mulga Rock palaeodrainage is about 8 to 10km wide. The eastern arm of the palaeochannel is probably continuous over a length of at least 65 km, and is interpreted in plans and sections in Uranerz (1986) to be hydraulically connected to a trunk palaeochannel that follows Ponton Creek to the south and is downstream of the confluence of the Lake Raeside, Lake Rebecca and Roe palaeochannels (Fig. 5).

The palaeodrainage skirts a southerly extension of the Gunbarrel Basin, which contains sediments of Carboniferous to Pleistocene age, and is bounded by crystalline rocks of the Yilgarn Craton of Archaean age to the west and the Albany Fraser Province of Proterozoic age to the east (Fig. 5).

3.3 LOCAL GEOLOGY

The geology of the eastern part of the MRUP, from information provided by Vimy, can be summarised as follows.

Ambassador is a sediment-hosted uranium deposit. This deposit, together with the other MRUP deposits, occurs within the Narnoo Basin, a local name for the host structure. The mineralisation is primarily in geochemically reduced sediments of Eocene age, preserved within a complex set of sedimentary troughs overlying an extensive paleodrainage referred to as the Mulga Rock palaeochannel, which is probably an isolated oxbow channel of the Lake Raeside regional paleodrainage.

The reduced sediments that contain the Ambassador and other deposits are part of a sedimentary package named the Narnoo Basin Sequence. This sequence consists of multiple fining-upwards units including sandstone, claystone (typically carbonaceous) and lignite which were deposited in alluvial and lacustrine environments.

Sedimentation within the Eocene palaeochannel is interpreted as a transgressive sequence. The lowest part of the sequence is dominated by medium to coarse, marginally carbonaceous sands. These sands are mostly devoid of clay and are highly transmissive to groundwater flow. The central portion of the sequence is dominated by fine textured, organic-rich sediments (highly carbonaceous fine sands, lignitic clays and lignite) containing humic macerals of low reflectance (huminite). These fine textured, sediments occur at and near the maximum flooding surface of the transgression. The upper portion of the sediments are dominated by stacked beds of reverse graded (upward coarsening) sands that represent the progradational portion of the transgression.

The main sequence of Late Eocene lacustrine sediments correlates regionally with the third-order transgressive sequences of the Tortachilla cycle (~39 Ma) whilst the youngest Late Eocene sediment correlates with the Tuketja (~36 Ma) transgressive cycle.

Cretaceous sediments are dominant in the north-eastern part of the Ambassador deposit and also occur around the deposit margins. Although superficially similar to the late-Eocene palaeochannel sediments, they do not have the regular transgressive sequence of the later sediments and are characterised by beds of black, mature forms of carbonaceous material such as inertinite and glassy vitrinite. The Cretaceous sediments are probably remnants of a formerly deeply buried sequence that covered much of southern Australia prior to the Late Cretaceous (Albian-Maastrichtian) uplift.

Overlying the Narnoo Basin Sequence is a succession of oxidised sediments which at Ambassador are about 36 to 55 m thick. Pre-Cretaceous and Eocene basement in the Ambassador area consists of a Carboniferous sedimentary succession, as well as Paleoproterozoic metasediments to the east of the Gunbarrel fault. The Carboniferous sediments are assigned to the Paterson Formation and understood to be part of the Gunbarrel Basin.

Mineralisation is believed to have formed via biogenic processes, through the fixation of metals in solution that were mobilised in the course of repeated weathering episodes, resulting in the leaching of the upper part of the Eocene and thick sections of Cretaceous sediments up-gradient of the deposits. This weathering is akin to acid-sulphate weathering processes, oxidising sulphides and organic matter and organic carbon resulting in very aggressive groundwater conditions (low pH and elevated temperature), and thereby mobilising metals and metalloids (including silica) from the overburden. The remnant, highly altered material is typically strongly bleached and characterised by a kaolinite fraction of notably high crystallinity (due to dissolution and recrystallisation of the clay).

The uranium mineralisation is assumed to be similar in nature to that studied at Ambassador via multiple recent spectral, mineralogical, deportment and metallurgical studies, showing that the bulk of the uranium is in a hexavalent ionic state and adsorbed onto organic matter, with a negligible fraction contained in refractory minerals.

Similarly, the majority of base metals in the deposits are expected to be bound to organic matter, with a significant fraction in sulphate phases and a lesser fraction in supergene sulphide phases.

3.4 HYDROGEOLOGY

The water table at the Ambassador deposit is 29 m to 49 m deep, and generally lies within fine-grained, carbonaceous sediments of Eocene age; and in the north-east, of Cretaceous age. The mineralised zones are mainly just below the water table, but some extend down into the coarse-grained sediments towards the base of the palaeochannel (see the geological sections in Appendix I).

Reduced groundwater levels within the palaeochannel that have been measured at various times are shown in Fig. 6, with values shown for representative bores that were used to calibrate the groundwater model described in Section 5 below. They show that in most of the Narnoo Basin/paleochannel the water table is very flat, at an elevation of about 288 to 290 m AHD, and that there is very little flow into the basin (or recharge) and out of the basin (discharge). Hydraulic gradients suggest there is minor flow into the basin from the north-eastern tributary that includes the Ambassador deposit; and a small component of flow into the basin from the north-west.

Limited data suggest there is flow from north to south in the western arm under a low hydraulic gradient. There is also indicated to be flow to the south in the eastern arm, south of about 6655000 mN – the steeper hydraulic gradient there is attributed to a narrowing of the channel containing coarse-grained sediments and lower transmissivity as indicated by Uranerz Section 92,500 N, which is at about 6655700 mN (GDA) (Appendix I). There, much of the channel is filled with fine-grained sediments.

Water-level measurements taken in April 2014 in the Ambassador area (Fig. 7) show that the water table is very flat in Ambassador East at about 299 m AHD; and with a low hydraulic gradient from 291 m to 293 m AHD in Ambassador West. There is a relatively steep gradient between these two parts of Ambassador due to the presence of a high of Permian sediments separating the Eocene sediments in each area. This is shown by the Long Section N30 in Appendix I.

Seasonal and annual water-level variations are very small, showing there is very little recharge to the aquifer and no extraction or significant flow out of the basin. Groundwater levels were monitored every one to three months in 38 bores in the Ambassador area from 2010 to 2014. Most of the August 2012 measurements were in error, presumably due to a faulty probe. Without those measurements, the range in water-level fluctuations in the bores was from 0.05 m to 0.76 m, and averaged 0.25 m. The higher ranges probably included some measurement errors and the impacts of pumping for sampling, and so the actual range and average would have been lower.

The results of pumping tests of three bores screened in the basal Eocene palaeochannel sediments (Section 4) indicate that these sediments are moderately to highly permeable, with hydraulic conductivities ranging from 9 to 140 m/d. The low value is typical of these sediments where tested elsewhere in the Eastern Goldfields. The high values at bores NWB1 and 2 in the planned injection area reflect the local gravels screened by the bores. Hydrogeological sections through these bores are presented in Figs 8 and 9. The section lines are shown in Fig. 6.

The fine-grained sediments higher in the palaeochannel, generally associated with the mineralised zones, will have low hydraulic conductivity as shown by the results of slug tests (Section 4.3).

The groundwater is unconfined at the water table, but confined below by the fine-grained sediments above and within the basal sands and gravels.

3.5 GROUNDWATER CHEMISTRY

Douglas *et. al*. (1993) concluded that groundwater at the MRUP differs from that in other Yilgarn palaeochannels, having low oxidation potentials with anomalous isotope effects and low concentrations of a number of trace elements. All of these differences were attributed to the high organic content of sediments at the site. They also noted that groundwater at Ambassador, in a tributary palaeochannel, is geochemically distinct from that in the main palaeochannel, which includes the Emperor and Shogun deposits. The main palaeochannel contains groundwater that is more saline, depleted in K, Ca and Sr, and enriched in Al, Fe and Mn relative to Ambassador. Conversely, Ambassador groundwater is significantly enriched in dissolved HCO_3, PO_4, Ba, U and W; and is depleted in dissolved Si. This is consistent with younger groundwater flowing down the Ambassador channel into the main palaeochannel system.

Douglas *et. al*. (1993) also state that the geochemistry of groundwater in the Ambassador mineralized zone may relate to interactions between groundwater and solid organic matter, and/or the inflow of water from a different source. The latter possibility is supported by the lower salinity at Ambassador.

The chemistry of water samples taken from each of the project areas is discussed below. Salinities are shown in Fig. 10, pH in Fig. 11, and a trilinear (Piper) diagram showing major ion composition is given in Fig. 12. Water from all the MRUP deposits is of similar ionic composition (Fig. 12), although the water from Ambassador tends to have proportionately higher sodium and chloride and lower magnesium and sulphate than water from some of the other deposits.

3.5.1 Ambassador/Princess

Water samples have been analysed at various times for different suites of parameters from 97 drillholes in total at the Ambassador and Princess deposits. The results of all the analyses are given in Appendix II, and the results from some of the separate sampling events for the Ambassador deposit are described below.

1984 to 1991 Samples

Water samples collected from Bores 1 and 7 at the end of pumping tests in 1984 were analysed for major components (GRC, 1985). Water samples airlifted from 13 drillholes in and near the Ambassador deposit in 1990 and 1991 were also analysed for major components as well as a wide range of metals and rare earth elements (Douglas *et. al*. 1993).

The results of the major component analyses and some other common elements are given in Table 5.

The analyses show that the water ranges in salinity from 7,500 to 37,600 mg/L TDS. It is moderately acidic to neutral with pH ranging from 4.3 to 7.0 (generally 5.5 to 6.6); and is of a sodium chloride type with elevated magnesium and sulphate. Metals and other elements that were analysed for (most are not shown in Table 5) were generally at low concentrations. Exceptions were moderate concentrations of iron in several holes (up to 16 mg/L); and high bromine concentrations (up to 23 mg/L). Uranium concentrations were mostly below the limit of detection (0.002 mg/L), with a maximum of 0.038 mg/L.

Oxidation potentials (Eh) range from -167 to 335 mV and are generally greater than 100 mV indicating potentially oxidising conditions. It is likely that the low pH in hole CD1515 resulted from oxidation of sulphides, and increased rates of oxidation will almost certainly occur when the lignite is dewatered.

The areal distribution of the salinity data for all the deposits and sampling programmes is shown in Figure 10. Salinity increases to the south-west in the direction of groundwater flow, mostly from 20,000 to 40,000 mg/L TDS. Salinity also tends to increase with sample depth with moderate correlation, although the main water-bearing zones in each hole have not been identified.

Two holes, CD1366 and CD1409, had much lower salinities than in the other holes. Douglas *et. al*. (1993) consider that this resulted from contamination with rainwater in CD1366; and CD1409 has a high bicarbonate concentration and low sulphate that suggests that the water is young and that there is a high rate of recharge from rainfall/runoff.

Table 5: Results of Major Component Analyses (and Common Metals) 1984

Hole/Bore	pH	Eh (mV)	TDS (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	NO3 (mg/L)	Fe (mg/L)	Mn (mg/L)	Br (mg/L)	Sr (mg/L)	Si (mg/L)
Bore 1	6.5	ND	37,609	11,100	260	800	1,400	19,800	89	4,150	10	12.8	ND	ND	ND	ND
RC1148	5.98	129	22,678	6,800	248	532	742	11,800	86	2,490	ND	0.4	0.2	23.1	6.9	21
Bore 7	5.8	ND	36,771	11,000	250	770	1,280	19,600	10	3,850	11	16.2	ND	ND	ND	ND
RC1213	5.46	148	12,506	3,769	138	246	350	6,730	24	1,250	ND	0.46	0.22	10.6	3.3	21
RC1152	5.91	143	19,522	5,645	231	450	700	10,400	30	2,060	ND	0.15	0.13	20.7	6.3	22
RC1151	6.36	144	14,784	4,392	169	319	467	7,810	104	1,560	ND	0.88	0.24	15	4	15.4
RC1419	6.85	173	14,535	4,185	204	300	522	7,430	283	1,730	ND	6.3	0.05	20.3	3.4	6.3
CD1500	6.01	293	18,459	5,276	207	415	651	9,820	107	2,020	ND	1.02	0.27	16.6	4.1	4
CD1498	6.58	335	32,875	9,646	383	858	1,176	16,600	303	4,040	ND	0	0.06	23.3	11.6	7.6
CD1247	7.01	213	26,887	7,939	308	626	856	14,000	382	2,950	ND	0.19	0.05	20.4	5.1	4.6
CD1515	4.27	147	35,984	11,278	250	708	1,212	19,000	0	3,520	ND	0.18	1.34	14.7	7.9	2.8
RC1216	6.45	9	25,376	7,717	249	515	681	13,400	339	2,630	ND	5.1	0.17	13	4.1	1.6
RC1177	6.58	171	27,343	8,236	263	683	754	14,200	191	3,090	ND	7.8	0.28	15.1	5.9	3.2
CD1409	6.58	-167	7,519	2,285	66	174	262	4,070	1,231	56	ND	0.22	0.6	3.3	1.7	2.9
CD1366	6.46	80	8,461	2,271	84	461	290	4,210	ND	1,140	ND	0.34	0.32	4.9	2.2	4.6

Samples from 2010 to 2014

Water samples were airlifted from 10 holes in the Ambassador deposit in March 2010 and analysed for major components and a range of other elements and metals (Table 6). Many other holes in the area were sampled in 2012 to 2014 (Appendix II). The results are similar to the 1984 analyses, with salinity ranging from 700 to 80,000 mg/L TDS; pH 3.0 to 8.0; and Fe <0.2 to 56 mg/L. Salinities within the Princess and Ambassador deposits generally range from 20,000 to 30,000 mg/L TDS. Most of the higher salinities, around 60,000 mg/L TDS, are for drillholes about 5 km west of Ambassador but are included with the Ambassador data here.

Minor elements and metals other than iron that were analysed for were generally at low concentrations or below the limits of detection, including uranium. There were some elevated metal concentrations in holes that had low pH. Bromine concentrations ranged from 3 to 23 mg/L; and strontium 2 to 12 mg/L.

Water samples taken from the Princess deposit have been measured in the field in 2012 and 2013 for salinity and pH. The water is acidic, with pH generally ranging from 5.0 to 6.5. Lower pHs of around 3 have been measured in one hole, NNA5623. Salinities are lower than most at Ambassador, ranging from 8,700 to 21,400 mg/L TDS, as the deposit is up-gradient of Ambassador.

3.5.2 Emperor and Shogun Deposits

Water samples have been collected and analysed from 161 drillholes in these deposits, mostly in 1984 and 2012.

Groundwater salinity at Emperor and Shogun ranged from 13,000 to 139,700 mg/L TDS (GRC, 1984) with the highest salinities in the south, and the lowest salinities towards the margins of the palaeochannel to the north or west (Fig. 10) suggesting possible recharge in these areas of less-saline water. The salinity increases with depth, and is generally more saline than at the Ambassador deposit.

The water from the bores at Emperor and Shogun is more acidic than at Ambassador, with pH of 3.8 to 5.0. It is of sodium chloride type with moderately high magnesium and sulphate concentrations.

The Piper trilinear diagram indicates that the portions of the major ions are similar to seawater (Fig. 12). Of the water samples collected from drillholes in 2012 to 2014 (Appendix II) many had low pH in the range 3 to 4 (minimum 2.9 and maximum 6.2), and salinity ranging from 6,100 to 95,500 mg/L TDS. Most salinities are greater than 50,000 mg/L TDS.

Table 6: Results of Major Component Analyses (and Other Elements and Metals) 2010

Hole/Bore	Units	NNA5027	NNA5198	NNA5393	NNA5127	NNA5140	NNA5086	NNA5103	NNA5199	NNA5155	NNA5107
Hole/Sample Depth		82	64	73	65	51	75	66	55	51	69
Date Analysed		26/03/2010	26/03/2010	26/03/2010	26/03/2010	26/03/2010	26/03/2010	26/03/2010	26/03/2010	26/03/2010	26/03/2010
pH	pH Units	4.1	3.5	4.2	5.5	6.4	6.8	4.3	4.2	6.7	4.8
Conductivity @25^{o}C	µS/cm	17780	23060	31200	31400	27420	47800	41700	45000	28390	44700
TDS (Calculated)	mg/L	10668	13836	18720	18840	16452	28680	25020	27000	17034	26820
Soluble Iron, Fe	mg/L	0.844	50.813	6.526	0.203	<0.2	<0.2	0.76	5.885	<0.2	<0.2
Sodium, Na	mg/L	3038	4116	5748	5710	4898	8651	7602	8197	5087	8130
Potassium, K	mg/L	101	128	185	187	171	349	257	316	180	292
Calcium, Ca	mg/L	197	274	416	463	357	604	580	614	362	620
Magnesium, Mg	mg/L	301	336	548	531	422	900	772	833	488	834
Chloride, Cl	mg/L	5311	7558	11235	10922	8689	17219	13693	16462	9677	15717
Carbonate, CO_3	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate, HCO_3	mg/L	<5	<5	<5	49	9	32	<5	<5	31	<5
Sulphate, SO_4	mg/L	1355	1633	2237	2227	1751	3317	2875	3273	1827	3553
Nitrate, NO_3	mg/L	0.35	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cation/Anion balance	%	-2.5	-5	-6.3	-5.2	-2.1	-6.3	-1.9	-6.9	-4.6	-5.8
Sum of Ions (calc.)	mg/L	10303	14045	20368	20089	16297	31071	25778	29695	17652	29147
Soluble Arsenic, As	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.01	<0.01	<0.005	<0.01
Soluble Boron, B	mg/L	1.252	1.011	1.611	1.409	1.208	2.712	1.722	2.126	1.352	1.688
Soluble Barium, Ba	mg/L	0.038	0.052	0.035	0.055	0.07	0.051	0.066	0.094	0.053	0.067
Soluble Beryllium, Be	mg/L	<0.005	0.02	0.005	<0.005	<0.005	<0.01	<0.01	<0.01	<0.005	<0.01
Soluble Cadmium, Cd	mg/L	<0.0005	0.001	0.003	0.024	0.0009	0.007	0.013	<0.001	<0.0005	0.319
Soluble Chromium, Cr	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	0.013	<0.01	<0.005	<0.01
Soluble Copper, Cu	mg/L	0.032	0.021	0.018	0.013	0.024	0.018	0.628	0.016	0.005	1.904
Soluble Cobalt, Co	mg/L	0.075	0.719	1.052	0.625	0.148	0.199	3.958	0.653	0.026	2.292
Soluble Lead, Pb	mg/L	0.015	0.041	<0.005	<0.005	0.006	<0.01	0.345	<0.01	<0.005	3.077
Soluble Molybdenum, Mo	mg/L	<0.005	<0.005	<0.005	0.012	0.035	<0.01	<0.01	<0.01	0.008	<0.01
Soluble Manganese, Mn	mg/L	3.208	1.367	1.021	1.246	0.532	1.964	1.608	1.299	0.562	2.345
Soluble Nickel, Ni	mg/L	0.055	1.153	1.888	0.627	0.181	0.377	3.83	1.719	0.023	2.905
Antimony, Sb	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.01	<0.01	<0.005	<0.01
Soluble Tin, Sn	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.01	<0.01	<0.005	<0.01
Soluble Selenium, Se	mg/L	<0.005	0.007	<0.005	0.009	<0.005	<0.01	0.104	<0.01	<0.005	<0.01
Soluble Zinc, Zn	mg/L	0.08	6.647	3.252	0.266	0.162	0.918	5.256	7.779	0.074	12.888
Soluble Uranium	mg/L	<0.005	<0.005	0.028	0.032	<0.005	<0.01	0.019	<0.01	<0.005	0.068
Vanadium	mg/L	<0.005	<0.005	<0.005	<0.005	0.009	<0.01	<0.01	<0.01	<0.005	<0.01
Soluble Mercury, Hg	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Iron concentrations range from <0.05 mg/L to 55 mg/L in recent samples (below the limit of reporting in 2014) and up to 190 mg/L in the 1984 samples. Prior to 2014, bromine (four analyses) ranged from 23 to 71 mg/L; and strontium 7.7 and 8.8 mg/L (two samples). In 2014 these elements were below the limit of reporting in all seven samples analysed. Other elements and metals that were analysed were at low levels or below levels of detection. Uranium was above the level of detection in five samples, with one high value (0.35 mg/L) from the Shogun costean in 1983. One sample from drillhole MSW002 had an anomalously high zinc concentration (26 mg/L) in May 2012, but was low (0.76 mg/L) in the October 2012 sample.

3.5.3 Reinjection Area

Water samples were analysed from 17 bores in the Reinjection Area in 2014 and 2015 – with two to four samples analysed from 12 of the bores. The results are included in Appendix II.

The water is moderately acidic, with pH ranging from 4.0 to 6.9, and is generally between 4.5 and 5.0. It is of a sodium chloride type, with relatively high magnesium and sulphate concentrations. Salinity ranges from 20,000 to 73,000 mg/L TDS and averages 51,500 mg/L TDS; generally significantly higher than for groundwater in the Ambassador/Princess area.

There is a good correlation between sample depth and salinity (Fig. 13). Seepage from in-pit tailings will infiltrate to shallow groundwater of similar salinity to that at the Ambassador deposit. The zone where any seepage would reach the water table includes reactive carbon-rich layers that will tend to fix any metals in the leachate.

Where analysed, metals and trace elements in groundwater in the injection area were at low levels or below the limits of reporting. There were some elevated boron concentrations of 4.2 to 7.2 mg/L in seven of the bores.

4 BORE CONSTRUCTION AND PUMPING TESTS

Many mineral exploration holes and holes drilled to delineate the deposits have been cased with 50 mm uPVC casing and are used for groundwater-level and water quality monitoring. In addition, a number of production bores have been drilled in the project area for potable and process water supply, dewatering testing, and for road construction. These are described below and production bore locations are shown in Figure 14.

4.1 DRILLING AND BORE CONSTRUCTION

GRC (1985) supervised the construction and testing of seven bores (MRWB1–7) in the project area for PNC in 1984; four of these were low-yielding, including MRWB5 which was used to determine the vertical permeability of sediments beneath the mineralised zone at Shogun. Details of that bore and the higher-yielding bores are given in Table 7.

Bore MRWB6 near the Emperor deposit has collapsed, and was replaced by two bores MSWB02 and 03 constructed to provide water for road construction (MWES, 2011) for the Tropicana Gold Project.

Bores NWB1 and NWB2 were constructed as test-injection bores, south of the Ambassador deposit in the palaeochannel sediments. Construction details and logs for these bores are given in Appendix III.

Table 7: Summary of Production Bore Details

Bore	mE	mN	RLGL	Date	TD (mbgl)	Casing	Screened	Aquifer	SWL	TDS
	(MGA)		mAHD	Drillled			Interval (m)	Depth	(mbtc)	(mg/L)
MRWB4	557595	6691810		1984	71	130 mm uPVC	63-67.5	45.5-71	31.9	69,500
MRWB5	563440	6687600		1984	67	195 mm uPVC	44.2-46.2	44-62	30.2	59,100
MRWB6	557176	6690643	316	1984	74.5	195mm uPVC	58.5-70.5m	56-70.5	27.9	89,300
MRWB7	575480	6679975		1984	100	195 mm uPVC	68.5-92.5	65-97.5	34.0	36,800
MSWB02	557225	6690545	316	2011	72	155mm uPVC	54-72m	54-72m	28.3	90,000
MSWB03	556958	6690702	317	2011	78	155mm uPVC	54-76m	54-76m	29.1	91,000
NWB1	575552	6671190	328.2	2015	108	155 mm uPVC	36-42; 66-102	60-104	40.0	58,000
NWB2	575363	6670210	346.1	2015	114	155 mm uPVC	30-48; 84-102	74-114	57.9	65,000

4.2 PUMPING TESTS

The bores listed in Table 7 have all been test-pumped to determine pumping capacities and aquifer parameters. The PNC and Tropicana bore tests are described in GRC (1985) and MWES (2011), respectively, and the parameters derived from the test results are given in Table 8.

The tests on bores NWB1 and NWB2 are described below and the results are summarised in Table 8. The pumping test plots are included in Appendix III.

Table 8: Results of Pumping and Recovery Tests

Bore	mE	mN	Rec. Yield	T	KH	KV	SC
	(MGA)		(kL/d)	(m^2/d)	(m/d)	(m/d)	
MRWB4	557595	6691810	150	15	3.5		
MRWB5	563440	6687600	0	ND	ND	0.01-0.03	0.00025
MRWB6	557176	6690643	2100	450	37.5		
MRWB7	575480	6679975	3400	210	9		0.0002
MSWB02	557225	6690545	690	2330, 819	129, 45.5		ND
MSWB03	556958	6690702	690	1050	47.5		ND
NWB1	575552	6671190	1000*	4900, 5500	136-161		0.0004-0.0054
NWB2	575363	6670210	1000*	2500-5300	69-147		0.0002, 0.0009

* Yield limited by casing diameter

4.2.1 Bore NWB1

Bore NWB1, which intersects basal palaeochannel sands, was test-pumped by Harrington Drilling from 15th to 18th March 2015.

The initial test was a step-rate test with four one-hour steps at 430, 620, 790 and 920 kL/d. The purpose of the test was mainly to select a suitable rate for the constant-rate test, although that rate was limited by the capacity of the pump. The results were also analysed to determine bore efficiency: the efficiency decreased from 48 % in step 1 with a pumping rate of 430 kL/d to 30 % in step 4 with a pumping rate of 920 kL/d. A summary of the results is given in Appendix III.

The bore was then pumped at 1,210 kL/d for 48 hours. Water levels were monitored in the pumped bore; in bore NGW37 located 78 m to the south; and in NGW54C located 56 m north of NWB1. Drawdowns could not be monitored in NWB1 for the first 200 minutes of the test due to a bend in the access tube, and then fluctuated around 0.5 m to the end of the test. The drawdowns in the two monitoring bores followed straight-line trends on a semi-logarithmic scale for the first 800 minutes, typical of a laterally extensive aquifer. The drawdowns then stabilised, with minor fluctuations, indicating inter-aquifer leakage (Appendix III).

At the end of the test, water-level recovery was monitored in the three bores for a period of 80 minutes (NWB1) to 120 minutes (monitoring bores).

Drawdown and recovery plots for the bores are included in Appendix III. They were analysed using the Jacob method and Theis recovery method to determine aquifer transmissivity (T) and storativity (S). The transmissivity values were divided by the total screened interval in NWB1 (36 m) to determine average hydraulic conductivity (K) of the screened interval, which includes sand beds and any interbedded clayey layers. The results are given in Table 9.

Table 9: Results of Pumping and Recovery Tests, NWB1

Obs. Bore	Distance	Constant Rate Test		Recovery Test		K Av. (m/d)	
	(m)	T (m^2/d)	S	T (m^2/d)	S	CR Test	Recovery
NWB1	0	ND	ND	5,400	ND	ND	150
NGW37	75.5	5,500	0.0005	5,800	0.0054	153	161
NGW54C	52	4,900	0.0004	8500??	0.013??	136	ND

The results indicate that the aquifer is highly permeable, and more permeable near NWB1 and NGW37 than at NGW54C. The aquifer is confined with low values of storativity.

Measurements of salinity, temperature and pH were made on the pumped water at the start of the constant-rate test, and then every four hours. The results are given in Table 10.

Table 10: Physico-Chemical Measurements made during NWB1 Test

Time Since Test Start (Hours)	TDS (mg/L)	Temp (°C)	pH
0	65,400	23.7	3.90
3	68,600	23.5	3.79
7	69,200	24.2	3.98
11	69,200	23.3	3.97
15	69,100	21.8	3.99
19	70,700	20.5	3.99
23	68,600	22.3	4.01
27	68,800	23.8	4.02
31	67,600	24.0	3.98
35	67,800	23.2	3.97
39	68,700	22.6	4.02
43	69,200	21.7	4.07
47	68,400	21.7	4.07

The results show that both pH and salinity fluctuated during the test, but possibly increased overall. The results of the laboratory analyses show that salinity was slightly lower at the end of the test than at the start.

Water samples taken at the beginning and end of the test were analysed by SGS laboratories. Salinity decreased slightly from 66,000 mg/L TDS at the start to 65,000 mg/L TDS at the end. The water was of a sodium chloride type; with elevated magnesium, sulphate and boron concentrations. Metal concentrations were low or below the reporting limits. Laboratory pH values were 4.0 (start) and 4.1 (end) showing the water to be acidic.

4.2.2 Bore NBW2

Bore NWB2, which also intersects basal palaeochannel sands, was test-pumped by Harrington Drilling from 12th to 15th March 2015.

The initial test was a step-rate test with four one-hour steps at 340, 600, 770 and 940 kL/d. The purpose of the test was mainly to select a suitable rate for the constant-rate test, although again that rate was limited by the capacity of the pump. Groundwater levels rose during the first step indicating the bore was still being developed. The results were analysed to determine bore efficiency: the efficiency decreased from 51 % in step 1 with a pumping rate of 340 kL/d to 28 % in step 4 with a pumping rate of 940 kL/d. A summary of the results is given in Appendix III.

The bore was then pumped at 950 kL/d for 48 hours. Water levels were monitored in the pumped bore; in bore NGW30 located 52 m to the south; and in NGW55 located 23 m north of NWB2. The water-level in the production bore drew down relatively rapidly in the first five minutes, and then declined very gradually to only about 0.3 m at the end of the test. Drawdowns in the two monitoring bores were relatively steep for the first 50 minutes, and then were very flat before steepening slightly towards the end of the test (Appendix III). These results show that the aquifer is highly permeable, and that the rate of drawdown was reduced by inter-aquifer leakage.

At the end of the test, water-level recovery was monitored in the three bores over a period of 60 minutes.

Drawdown-time and recovery plots for the bores are included in Appendix III. They were analysed using the Jacob method and Theis recovery method to determine aquifer transmissivity (T) and storativity (S). The transmissivity values were divided by the total screened interval in NWB2 (36 m) to determine average hydraulic conductivity (K) of the screened interval. The results are given in Table 11.

Table 11: Results of Pumping and Recovery Tests, NWB2

Obs Bore	Distance	Constant Rate Test		Recovery Test		K Av. (m/d)	
	(m)	T (m^2/d)	S	T (m^2/d)	S	CR Test	Recovery
NWB2	0	2,500	ND	3,500	ND	69	97
NGW30	49.5	5,300	0.0002	ND	ND	147	ND
NGW55	32	4,500	0.0009	3,800	ND	125	106

The results indicate that the aquifer is highly permeable, particularly near NGW30 and to a lesser degree, NGW55. The aquifer is confined with low values of storativity.

Measurements of salinity, temperature and pH were made on the pumped water at the start of the constant-rate test, and then every four hours. The results are given in Table 12.

Table 12: Physico-Chemical Measurements made during NWB1 Test

Time Since Test Start (Hrs)	TDS (mg/L)	Temp (°C)	pH
0.5	61,700	22.6	3.82
4	60,200	25.2	3.97
8	60,200	25.4	3.93
12	62,000	23.3	4.02
16	62,100	22.7	4.07
20	61,100	21.0	4.11
24	62,000	22.8	4.06
28	58,600	26.1	4.03
32	59,700	25.7	3.98
36	60,100	24.4	4.07
40	61,600	23.9	4.13
44	61,500	23.1	4.08
48	61,300	23.4	4.08

The results show that both pH and salinity fluctuated during the test, and pH possibly increased overall. The results of the laboratory analyses show that salinity was slightly lower at the end of the test than at the start.

Water samples taken at the beginning and end of the test were analysed by SGS laboratories. Salinity decreased slightly from 59,000 mg/L TDS at the start to 58,000 mg/L TDS at the end. The water was of a sodium chloride type; with elevated magnesium, sulphate and boron concentrations. Metal concentrations were low or below the reporting limits. Laboratory pH values were 4.5 (start) and 4.4 (end) showing the water to be acidic.

4.3 SLUG TESTS AND LOW-FLOW PUMPING TESTS

Fifty-five slug (falling-head) permeability tests, and five low-flow recovery tests following pumping for sampling, were conducted by Vimy on monitoring bores in the Ambassador/Princess area.

The slug tests consisted of introducing a slug of water, generally 20 litres, and monitoring the rate of water level decline using pressure transducers and data loggers. The data were analysed using the method of Bouwer and Rice (1976).

The low-flow recovery tests consisted of monitoring water-level recovery following pumping. The results were analysed using the method of Theis (1935).

The results of the tests are given in Table 13. Where there was no measurable water-level recovery during the tests, the permeability (hydraulic conductivity, K) is recorded as being very low. Where the water-level recovery was too rapid to be measured during the slug tests, the permeability was recorded as being high (> 5 m/d).

5 NUMERICAL GROUNDWATER MODELLING

A numerical groundwater model was constructed of the planned mining and re-injection areas, and run to estimate the dewatering requirements and the impacts of pumping, re-injection and tailings seepage. It is based on the conceptual hydrogeological model, described below.

5.1 CONCEPTUAL HYDROGEOLOGICAL MODEL

The Mulga Rock deposits lie within an oxbow basin/palaeochannel that remains after the capture of three trunk palaeochannels by the Ponton Creek palaeochannel.

The Mulga Rock palaeochannel is probably still hydraulically connected to the Ponton Creek palaeochannel some 65 km to the south along the eastern arm.

The water table is about 50 m deep, and is overlain by mainly fine-grained sediments, except along the eastern arm south of Ambassador where there is a substantial thickness of unsaturated sand (e.g. Figs. 8 and 9). The mineralised zones are mainly just below the water table and in fine-grained carbonaceous sediments. Sand and gravel beds of Eocene age become more common towards the base of the palaeochannel. These basal sands and gravel have moderate to high permeability and form the main zone of groundwater flow.

The water table is very flat-lying in the “Narnoo Basin” which contains the Mulga Rock deposits, showing there is little groundwater flow into, and out of the basin. Hydraulic gradients indicate there is probably minor groundwater flow into the basin from the north-west and north, and from the north-east along a tributary channel which contains the Ambassador deposit. The flow in Eocene sands along the tributary channel is greatly restricted by a basement high between the western and eastern parts of the Ambassador deposit.

Table 13: Results of Slug and Low-Flow Pumping (Recovery) Tests

Bore	mE	mN	Test Type	Open depth	SWL	K	Model Layer
				(m)	(m bgl)	(m/d)	
NND5029	575965	6681554	Low-flow rec	52.5	36.91	0.2	1,2
NND5030	575544	6681137	Low-flow rec	54.1	35.37	>0.3	1,2
NND5031	579499	6682610	Low-flow rec	54.7	33.66	0.007	1,2
NNA5198	575539	6682048	Low-flow rec	51.7	35.92	0.003	1,2
NNA5227	576237	6680967	Low-flow rec	41.4	27.84	V. Low	1,2
NNA5177	576185	6682159	Slug Test	43.7	39.61	V Low	1
NNA5178	576216	6682140	Slug Test	41.6	39.11	0.01	1
NNA5198	575539	6682048	Slug Test	55.7	35.38	0.02	1,2
NNA5200	578614	6682405	Slug Test	39.6	37.10	V Low	1
NNA5201	578623	6682398	Slug Test	42.5	37.67	V Low	1
NNA5209	577232	6682510	Slug Test	40.8	40.85	0.00	1
NNA5210	577308	6682464	Slug Test	41.9	41.19	High	1
NNA5211	577374	6682425	Slug Test	41.0	40.60	?	1
NNA5213	577174	6682539	Slug Test	43.0	41.85	0.02	1
NNA5214	577099	6682591	Slug Test	43.1	43.11	High	1
NNA5215	577027	6682625	Slug Test	58.3	43.35	V Low	1,2
NNA5219	577144	6682792	Slug Test	41.5	33.47	V Low	1
NNA5220	577210	6682754	Slug Test	41.5	35.78	V Low	1
NNA5221	576271	6681162	Slug Test	42.3	33.87	V Low	1
NNA5222	576337	6681123	Slug Test	38.7	37.67	V Low	1
NNA5226	576155	6681009	Slug Test	43.1	35.58	V Low	1
NNA5227	576236	6680967	Slug Test	41.4	38.64	V Low	1
NNA5228	576293	6680926	Slug Test	45.9	38.94	V Low	1
NNA5229	576367	6680885	Slug Test	45.0	36.92	V Low	1
NNA5230	576434	6680844	Slug Test	38.1	36.75	0.07	1
NNA5231	576556	6680766	Slug Test	38.9	31.11	V Low	1
NNA5232	576493	6680799	Slug Test	26.8	19.35	V Low	1
NNA5234	576019	6680570	Slug Test	42.8	36.78	0.05	1
NNA5235	575004	6679932	Slug Test	52.9	39.34	0.11	1,2
NNA5236	574933	6679974	Slug Test	46.2	38.37	0.18	1
NNA5238	574792	6680063	Slug Test	40.5	40.49	High	1
NNA5239	574714	6680104	Slug Test	55.3	41.39	V Low	1,2
NNA5240	574645	6680151	Slug Test	50.3	40.29	0.25	1
NNA5289	579988	6682770	Slug Test	31.0	30.88	0.04	1
NNA5301	580153	6682866	Slug Test	29.9	22.61	V Low	1
NNA5321	579933	6682698	Slug Test	40.9	32.06	V Low	1
NNA5465	575179	6680575	Slug Test	40.3	32.70	0.27	1
NNA5589	580088	6684614	Slug Test	40.8	42.59	0.38?	1
NNA5614	578964	6683963	Slug Test	48.0	41.38	0.11	1
NNA5623	578774	6684324	Slug Test	46.0	42.46	0.15	1
NNA5628	579432	6683938	Slug Test	47.5	37.62	0.07	1
NNA5630	579451	6684166	Slug Test	44.5	44.50	V Low	1
NNA5634	579135	6684302	Slug Test	45.4	43.75	0.16	1
NNA5639	579741	6684370	Slug Test	53.2	48.48	0.08	1
NNA5641	579005	6683723	Slug Test	60.8	44.64	0.13	1,2
NNA5644	578770	6683872	Slug Test	50.1	44.87	0.17	1
NNA5647	578838	6683579	Slug Test	42.0	39.19	V Low	1
NNA5740	579643	6684560	Slug Test	53.5	41.99	0.32	1,2
NNA5749	579238	6683679	Slug Test	40.6	36.23	0.19	1
NNA5753	578490	6684007	Slug Test	52.5	43.25	0.12	1
NND5028	576087	6681735	Slug Test	47.6	37.30	0.61	1
NND5029	575965	6681554	Slug Test	52.3	36.81	1.28	1,2
NND5030	575544	6681137	Slug Test	55.6	35.30	1.91	1,2
NND5032	578632	6682382	Slug Test	51.5	38.50	1.10	1,2
NND5033	579138	6682819	Slug Test	49.1	40.83	2.72	1
NND5034	576399	6681300	Slug Test	46.0	39.85	2.15	1
NND5035	576053	6682472	Slug Test	46.4	37.30	1.71	1
NND5036	576591	6682391	Slug Test	50.7	39.24	1.16	1
NND5037	578682.0	6682609	Slug Test	44.6	35.90	0.97	1
NND5038	579231	6682522	Slug Test	51.4	39.26	2.30	1,2
NND5039	579796	6682656	Slug Test	51.2	34.04	1.05	1,2
NND5040	580034	6682734	Slug Test	43.6	32.93	0.32	1
NND5041	580092	6682899	Slug Test	37.8	32.67	0.32	1
NND5077	576148	6682189	Slug Test	49.8	39.67	V Low	1
NND5078	577076	6682606	Slug Test	53.2	48.60	1.52	1

Groundwater possibly flows from the basin to the south along the western arm of the palaeochannel; and probably also south along the eastern arm, although the flow rate is low and is restricted by the mainly fine-grained sediments in at least part of the palaeochannel (Section Line 92,500 N, Uranerz 1986), about 25 km south of Ambassador.

Groundwater in the palaeochannel is saline to hypersaline and generally acidic, and contains low metal concentrations.

5.2 DESCRIPTION OF NUMERICAL MODEL

A numerical groundwater model has been constructed of the Mulga Rock palaeochannel. It consists of a rectangular grid of 142 rows, 104 columns and three layers covering an area of 45 km east–west by 65 km north–south (Fig. 15). Cell sizes are 500 m by 500 m in general, and 250 m by 250 m in the Ambassador area.

Layer 1 represents fine-grained sediments near the water table; Layer 2 consists of interbedded sands and clays and admixtures; and Layer 3 the basal sand/gravel. The base of Layer 3 i.e. the base of the palaeochannel (Eocene sediments) and the top of the Eocene sediments were defined from data provided by Vimy for the numerous holes drilled for the Mulga Rock Uranium Project; and from the Uranerz geological sections.

The model was utilises Processing Modflow Pro version 8.0.2 (Simcore Software, 2010), which includes Modflow, finite difference groundwater modelling software designed by the U.S. Geological Survey (McDonald and Harbaugh, 1988).

5.3 MODEL PARAMETERS

The model was initially set up with parameters determined from the pumping and slug tests; and assumed values based on grain sizes and our experience in modelling similar hydrogeological environments. The parameters, particularly horizontal hydraulic conductivity of the main aquifer, Layer 3, were varied in the calibration of the model. Parameters adopted on calibration of the model are given in Table 14.

Table 14: Adopted Aquifer Parameters

Parameter	Units	Layer 1	Layer 2	Layer 3
Horiz. Hydraulic Cond.	m/d	0.02-0.7	0.2-9	0.2-140
Vert. Hydraulic Cond.	m/d	0.01	0.1	0.5
Specific Yield	v/v	0.05	0.1	0.1
Storage Coefficient	v/v	NA	0.0004	0.0004
Recharge	m/d	0, 0.000001		

Horizontal hydraulic conductivity values were predominantly 0.1 m/d in Layer 1, 1 m/d in Layer 2, and 9 m/d in Layer 3. Values in Layer 1 in the Ambassador area were altered to utilise the results of the low-flow pumping tests and slug tests described in Section 4.3 above. In Layer 2, a variety of values were used in the Ambassador area depending on sand content in the zones to be mined, and the results of slug tests from deeper drillholes; and a low value of 0.2 m/d was adopted for the basement high between the two parts of the deposit. In Layer 3, there were higher values (70–140 m/d) in the planned injection area; and some lower values in the southern part of the eastern arm, and in the north-eastern tributary channel, particularly at the basement high at Ambassador as for Layer 2.

Recharge was assumed to be zero for much of the modelled area, except for a very low rate of 0.000001 m/d on the north-western edge of the basin and in part of the north-eastern tributary.

5.4 MODEL CALIBRATION

The model was first calibrated in steady-state mode to groundwater levels measured at various times in representative bores/holes over the Mulga Rock area. This was achieved by varying horizontal hydraulic conductivity of the main, basal sand aquifer (Layer 3), and to a much lesser degree, recharge in small areas in the north-west and north-east. The parameters adopted for the minor aquifers/aquitards and aquicludes of Layers 1 and 2 have negligible impact on the calibration; and storativity (specific yield and storage coefficient) is not part of a steady-state simulation.

A comparison between measured and model-calculated water levels is shown in Figure 16. There is a close correspondence and the root mean square error for all the calibration bores is 2.22 %, much lower than the 5 % limit recommended in the 2000 groundwater modelling guidelines (Middlemis, 2000), and 5 % or 10 % (if achievable) given in the more-recent guidelines (Barnett et. al., 2012).

The model was then calibrated in transient mode by simulating the bore NWB1 and 2 pumping tests. For the early data, (the first 10 to 60 minutes) a good match was achieved between calculated and observed drawdowns in the monitoring bores during the tests (Figs. 17 to 20) with a confined storage coefficient of 0.0008, at the upper end of the range of values indicated from the pumping test results. Although all the calculated drawdowns are within 0.16 m of the measured values, there is a divergence in the later stages of the test as the calculated values cannot replicate the reduced drawdowns resulting from inter-aquifer leakage, and they are also increased by the impact of boundaries to the aquifer. With long-term pumpage the effects of leakage are expected to disappear and the palaeochannel boundaries will increase the rate of drawdown.

5.5 MODEL SIMULATION AND RESULTS

The mine water balance dated 18 May 2015 has the following key components:

- Pit Dewatering flows to the processing plant are 96.8 kL/hr (2,323 kL/d);
- Water pumped from (low-salinity) borefield is 151.7 kL/hr (3,641 kL/d)
- Extraction from Tropicana mine's bore located in the Emperor pit (MSWB02) was included at a rate of 50 kL/d (the average for the period (July 2011 to November 2014); and
- Tailings seepage is 28.6 kL/hr (686 kL/d).

Any excess water from dewatering, plus 2.2 kL/hr reject water from the desalination plant, will be reinjected at the borefield south of Ambassador.

The mine plan for the Ambassador and Princess deposits is as shown in Fig. 21 and mine plans for the Emperor and Shogun deposits are shown in Fig. 22, and each area was subdivided into assumed annual pit areas. Modflow's Drain package was used to simulate dewatering with annual stress periods, with drain elevations set at the elevations of the planned base of mining which is presented in Fig. 23 for the Ambassador and Princess deposits and in Fig. 24 for the Emperor and Shogun deposits. Drain conductances are based on horizontal hydraulic conductivity values at the drain positions and model cell sizes.

Modflow's Well package was used to simulate: (1) tailings seepage from previously mined pits; (2) reinjection in years where average dewatering flows exceeded 2,323 kL/d and (3) extraction from the Tropicana bore.

Model-calculated average flows for each year are given in Table 15.

The results indicate that the maximum dewatering flows will be in Year 10 when an area is mined down to 255 m AHD on the western side of Ambassador West. There are also relatively high flows in Year 3 when a low area is mined on the northern side of Ambassador East. In those years, surplus water will be injected. In the other years all dewatering water will be used for processing ore or dust suppression.

Table 15: Calculated Dewatering Flows and Injection Rates

Year	Annual Dewatering Vol. (kL)	Av. Flow (kL/d)	Av. Injected (kL/d)	Dewatering Location
1	105,846	290	0	Princess & Ambassador
2	411,761	1,128	0	
3	1,419,378	3,889	1,566	
4	89,190	244	0	
5	800,239	2,192	0	
6	486,206	1,332	0	
7	91,326	250	0	
8	115,725	317	0	
9	58,490	160	0	
10	1,497,545	4,103	1,780	
11	73,520	201	0	
12	103,414	283	0	Emperor
13	486,181	1,332	0	
14	607,460	1,664	0	
15	633,905	1,737	0	Emperor & Shogun
16	395,128	1,083	0	

Model-calculated groundwater level drawdowns at the end of Year 10 are shown in Figs 25 and 26 for model Layers 1 (surficial) and 3 (basal Eocene sand), respectively. They indicate drawdowns around the area of active mining will extend about 3.6 km to the south, with a low mound in the area of tailings seepage. The rise in water levels around the reinjection borefield is less than 1 m. At the end of Year 16, drawdowns are around the western mining area (the Emperor and Shogun deposits), with drawdowns extending about 3.9 km to the south of the Emperor pit and negligible drawdown at the Shogun deposit due to the relatively shallow depth of mining (Figs. 27 and 28). Maximum model-calculated drawdowns at each mining location and at the injection borefield are also presented in Figure 29 and show that the effects of dewatering will be localised during mining.

The model was then run to simulate the movement of conservative particles in the groundwater from a point at the southern end of the mining area (representing tailings seepage), and from the southern injection bore NWB2. The movement from both points would be very slow due to the low hydraulic gradients, with the groundwater only moving 2.8 km and 2.2 km, respectively, in 1,000 years (Fig. 30). In an expected worst case with double the horizontal hydraulic conductivities, and with 1,816 kL/d injected via NWB2 in the second-to-last year of mining, the distances travelled in 1,000 years would be 9 km and 4 km, respectively (Fig. 30).

5.6 SENSITIVITY ANALYSIS

The modelling described in Section 5.5 above was repeated to determine the impact on dewatering flow rates of the various model parameters. The value of each parameter was doubled and then halved in turn, which is about the expected maximum variation that is likely to occur.

The results are given in Table 16. They show that the model is most sensitive to horizontal hydraulic conductivity (KH) followed by specific yield (SY) and vertical hydraulic conductivity (KV). It is insensitive to the confined storage coefficient, recharge and drain conductance.

Table 16: Results of Sensitivity Analysis

Case	Total Volume Pumped (kL)	Difference	
		(kL)	%
Adopted	7,375,314	0	0
KH*2	9,914,636	2,539,323	34.4%
KH/2	5,588,461	-1,786,853	-24.2%
KV*2	8,369,283	993,970	13.5%
KV/2	6,381,852	-993,462	-13.5%
SY*2	9,594,769	2,219,456	30.1%
SY/2	6,066,511	-1,308,803	-17.7%
SC*2	7,442,535	67,222	0.9%
SC/2	7,366,360	-8,954	-0.1%
Rech.*2	7,403,267	27,953	0.4%
Rech./2	7,386,573	11,260	0.2%
Drain Cond.*2	7,339,324	-35,990	-0.5%
Drain Cond./2	7,353,616	-21,698	-0.3%

In a likely worst case with double the adopted horizontal hydraulic conductivities, dewatering flows could be 34% higher overall than the calculated flows, and up to 50 % higher in the high-flow years when mining intersects the deep Eocene sands.

5.7 DISCUSSION OF MODELLING RESULTS

Although the model is well calibrated to steady-state conditions, aquifers in the area have not been stressed except by short-term pumping tests, and so there are few data available for transient calibration. The modelling results should, therefore, be taken as best estimates – actual dewatering pumping rates could be significantly different to those predicted.

Groundwater levels and pumping rates should be closely monitored once mining and dewatering commences, and the data used after six to twelve months of pumping to re-calibrate the model and to update the predictions.

6 POTENTIAL ENVIRONMENTAL RECEPTORS

6.1 QUEEN VICTORIA SPRING

The Queen Victoria Spring Nature Reserve lies down-gradient of the MRUP: the northern boundary of the reserve is 14 km south of the planned injection borefield and 24 km south of the Ambassador deposit.

The Queen Victoria Spring was first encountered by a European by Giles in September 1875 (Giles, 1889). At that time, it was “150 yards in circumference and two to three feet deep and was surrounded by numerous native wells”. He believed it to be a permanent body of water that was supplied by drainage of the sand hills that surround it, and that rests on a substratum of impervious clay.

The presence of numerous wells is a good indication that the spring was not a permanent feature. In April 1896, Carnegie (1898) visited the spring and found that it and all the native wells were dry. He managed to obtain sufficient water by digging a shallow well in the base of the spring.

The spring was said by Giles to be surrounded by clumps of “funereal pines”, presumably sheoaks that would have been sustained by this shallow, perched groundwater.

The spring can be seen as a small oval-shaped depression on Google Earth at 555170 mE, 6633710 mN at an elevation of about 323 m AHD, and looks to have been dry when the image was taken on 4 October 2013.

The spring is interpreted to be a local, ephemeral, perched water source, located 14 km from the nearest water injection site for the MRUP. It is not, therefore, an environmental receptor that could be impacted by the planned mining at Mulga Rock.

6.2 PALAEOCHANNEL AQUIFER

The palaeochannel aquifer and overlying sediments contain saline to hypersaline groundwater. The water table is too deep, and the groundwater too saline to support vegetation; and it is very unlikely that there will be any other users of the groundwater within the area that could be impacted during mining and within 1,000 years thereafter.

Groundwater at the planned injection borefield has salinity of about 60,000 mg/L TDS, compared with about 20,000 to 30,000 mg/L TDS at the Ambassador and Princess deposits. Provided the pH is similar, any excess water that is reinjected should be of better quality than the receiving water.

Groundwater in the planned mining areas has the potential to become more acidic – this should be addressed in environmental investigations; as well as any treatment required for tailings, and for water to be reinjected.

7 CONCLUSIONS

Most of the sediments to be mined are fine-grained and of low permeability, and so dewatering flow rates will be low. Some high dewatering flows will be required when deep mineralised zones associated with Eocene sands are mined. Much or all of the dewatering water will be used in the processing plant. This will be supplemented by low-salinity water from the Kakarook North borefield and water recycled from the in-pit beneficiation plant.

Any water reinjected into the palaeochannel aquifer is expected to be of lower salinity than the receiving water, and should be of better quality provided the pH is controlled if necessary.

Seepage from in-pit tailings will infiltrate to groundwater of similar salinity to that at the Ambassador deposit. The zone where seepage would reach the water table includes reactive carbon-rich layers that will tend to fix any metals in the leachate.

The results of numerical groundwater flow and flow-path modelling indicate that the impacts of dewatering, tailings seepage and any reinjection will be localised during mining, and should not extend further than three to four kilometres south of the mining area or the reinjection borefield within 1,000 years of the end of mining. Even in a worst case, any water introduced to the palaeochannel aquifer is indicated to not extend further than 4 km south of the injection borefield over that period due to very low hydraulic gradients.

Dated: **29 October 2015** **Rockwater Pty Ltd**

M.Taylor

M J Taylor
Senior Hydrogeologist

P H Wharton
Principal

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FIGURES

FIGURE 1

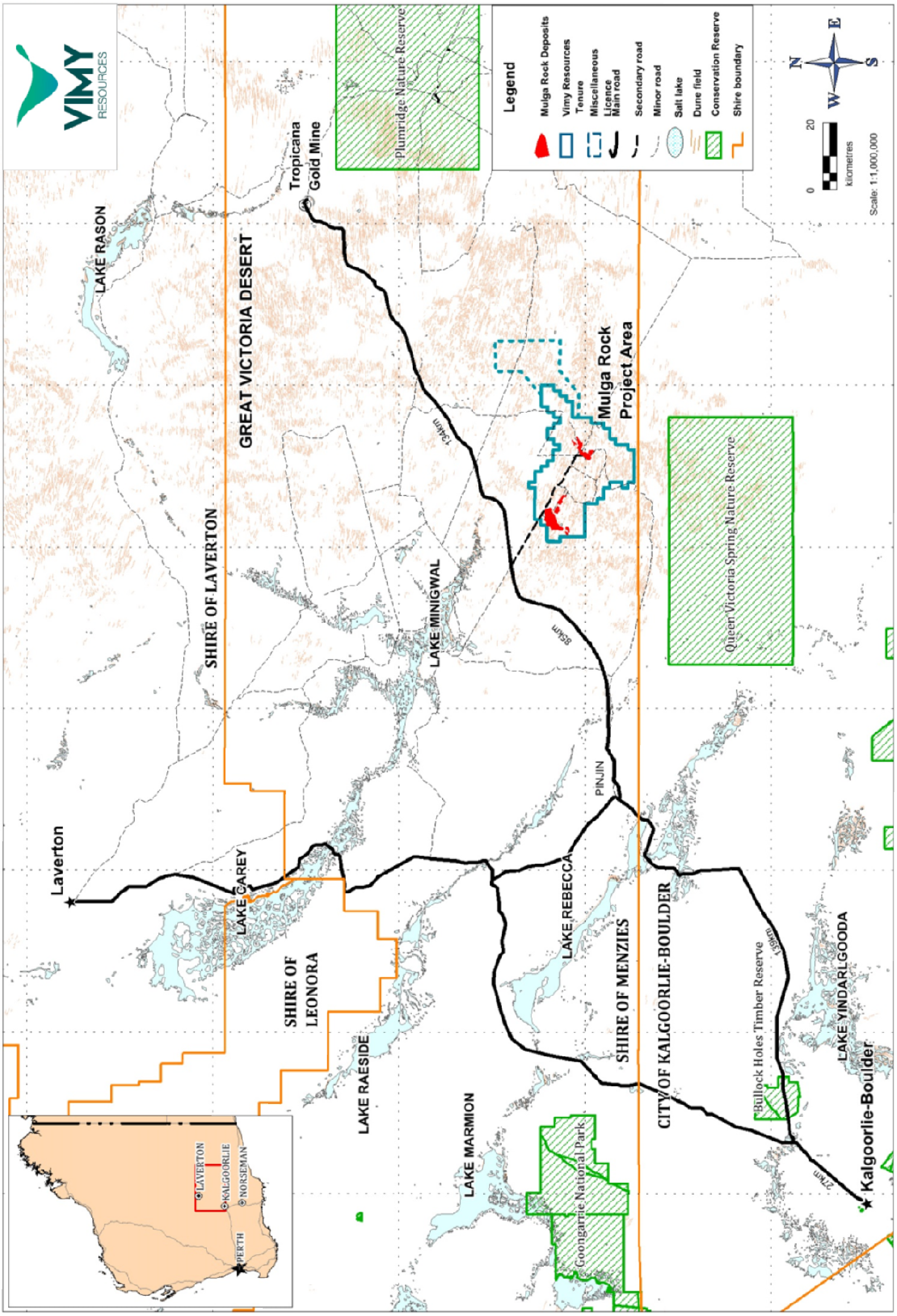


figure 1.srf

CLIENT: Vimy Resources PROJECT: Mulga Rock DATE: June 2015 Dwg No: 345.0/15/1-1	LOCATION OF THE MULGA ROCK URANIUM PROJECT Rockwater Pty Ltd

FIGURE 2

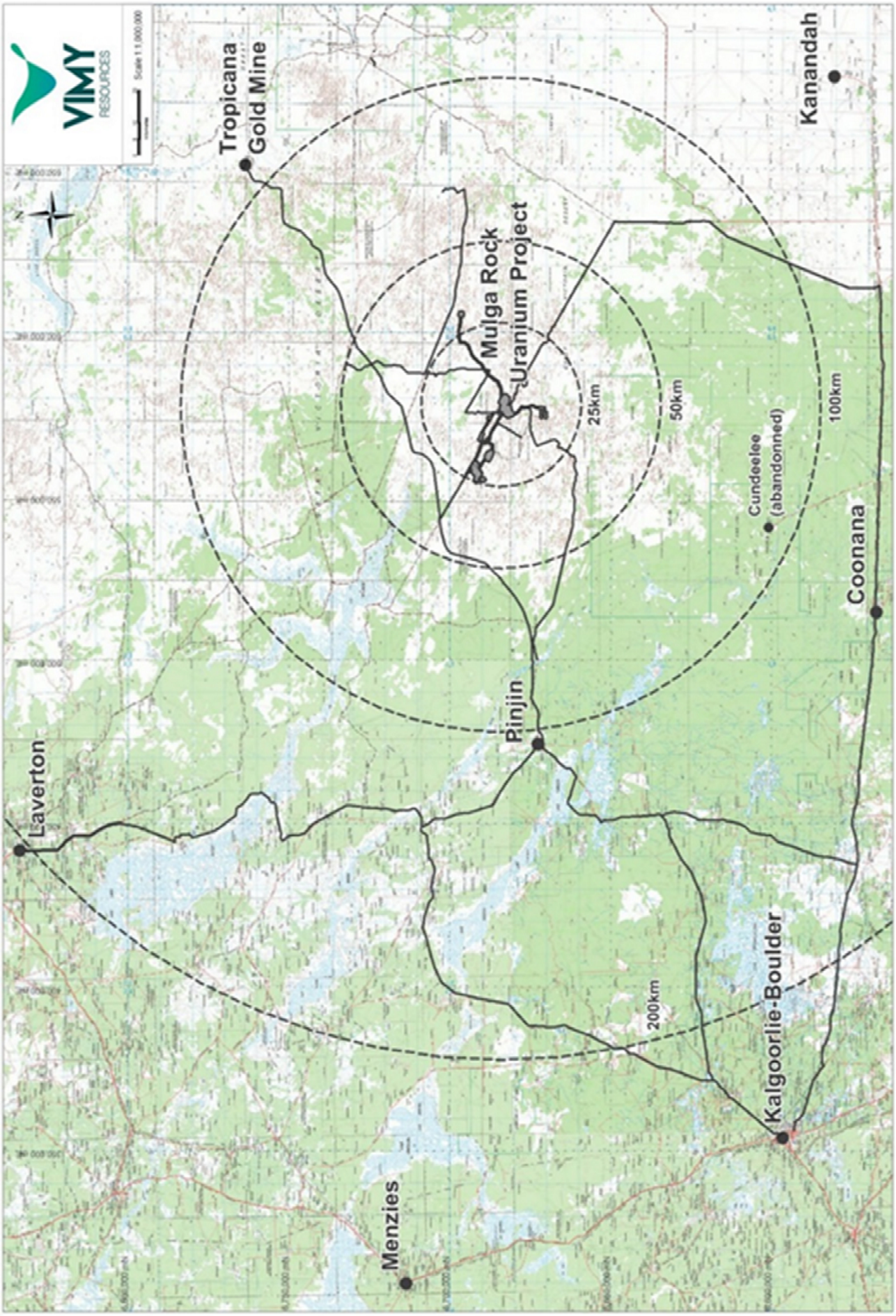


figure 1.srf

CLIENT: Vimy Resources PROJECT: Mulga Rock DATE: June 2015 Dwg No: 345.0/15/1-2	MRUP AND NEARBY COMMUNITIES Rockwater Pty Ltd

FIGURE 3

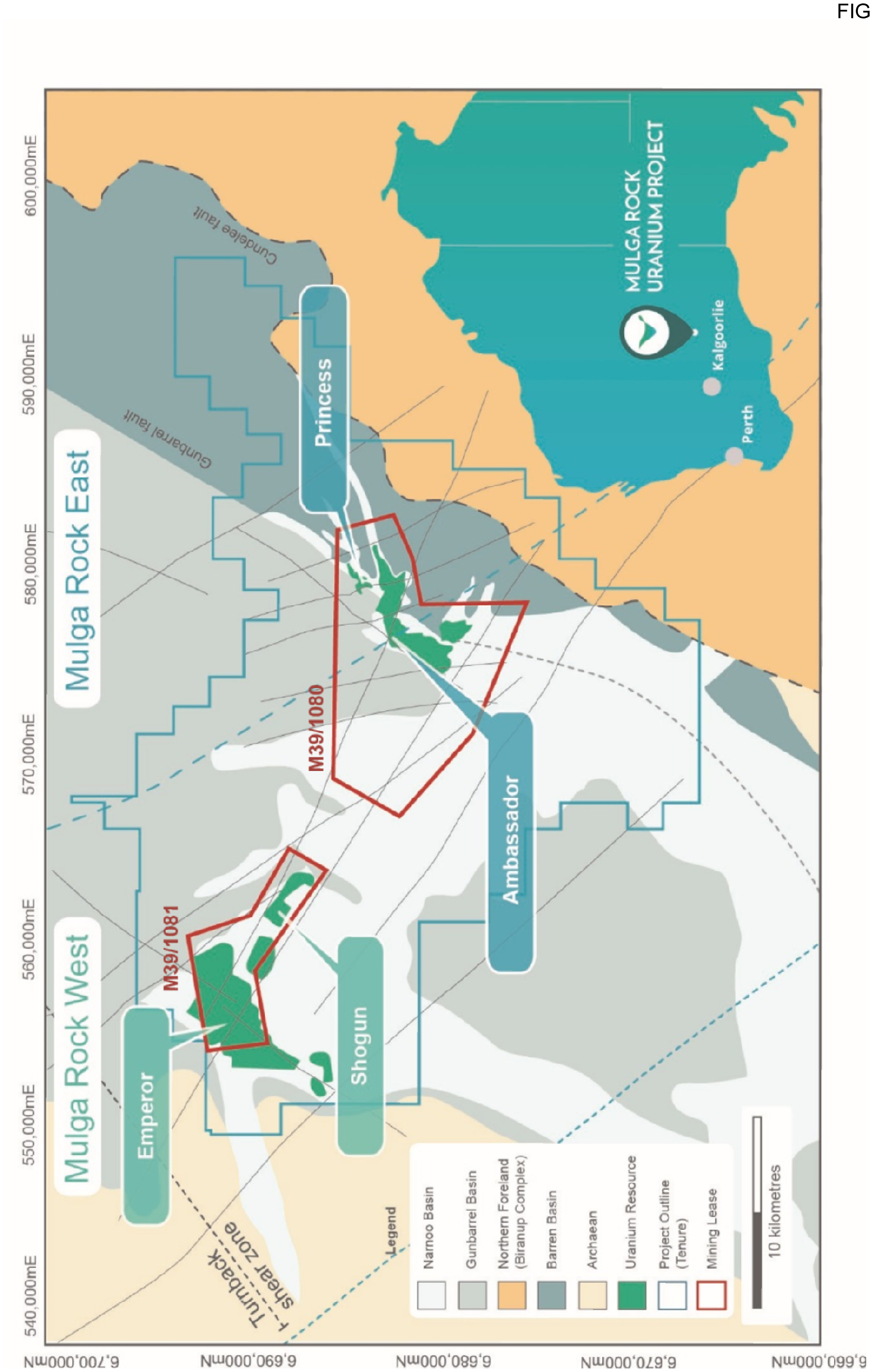
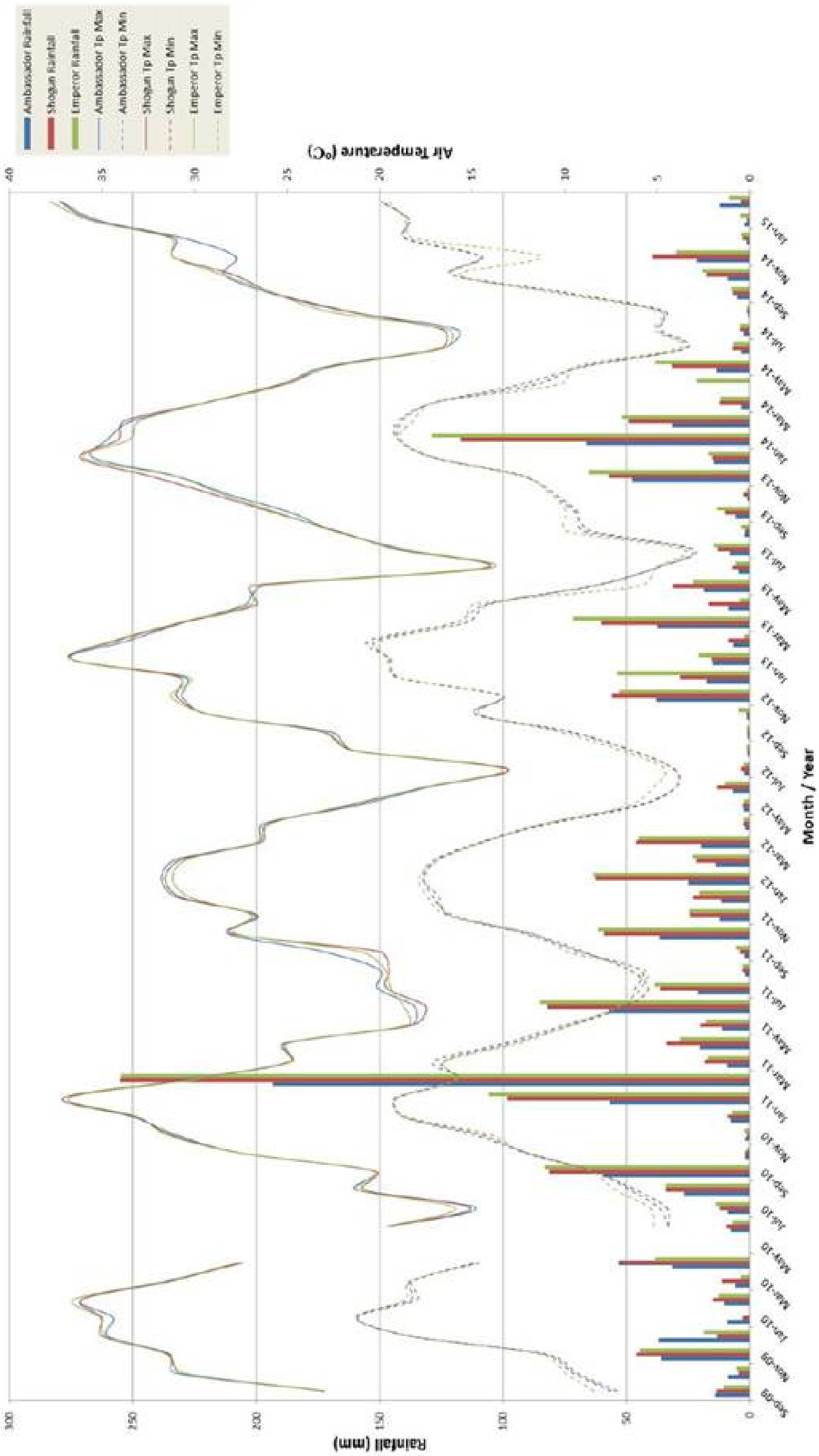


figure 3.srf

CLIENT: Vimy Resources PROJECT: Mulga Rock DATE: June 2015 Dwg No: 345.0/15/1-3	MRUP MINING CENTRES AND ASSOCIATED RESOURCES Rockwater Pty Ltd

Figure 4



rainfalls & temp.srf

CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

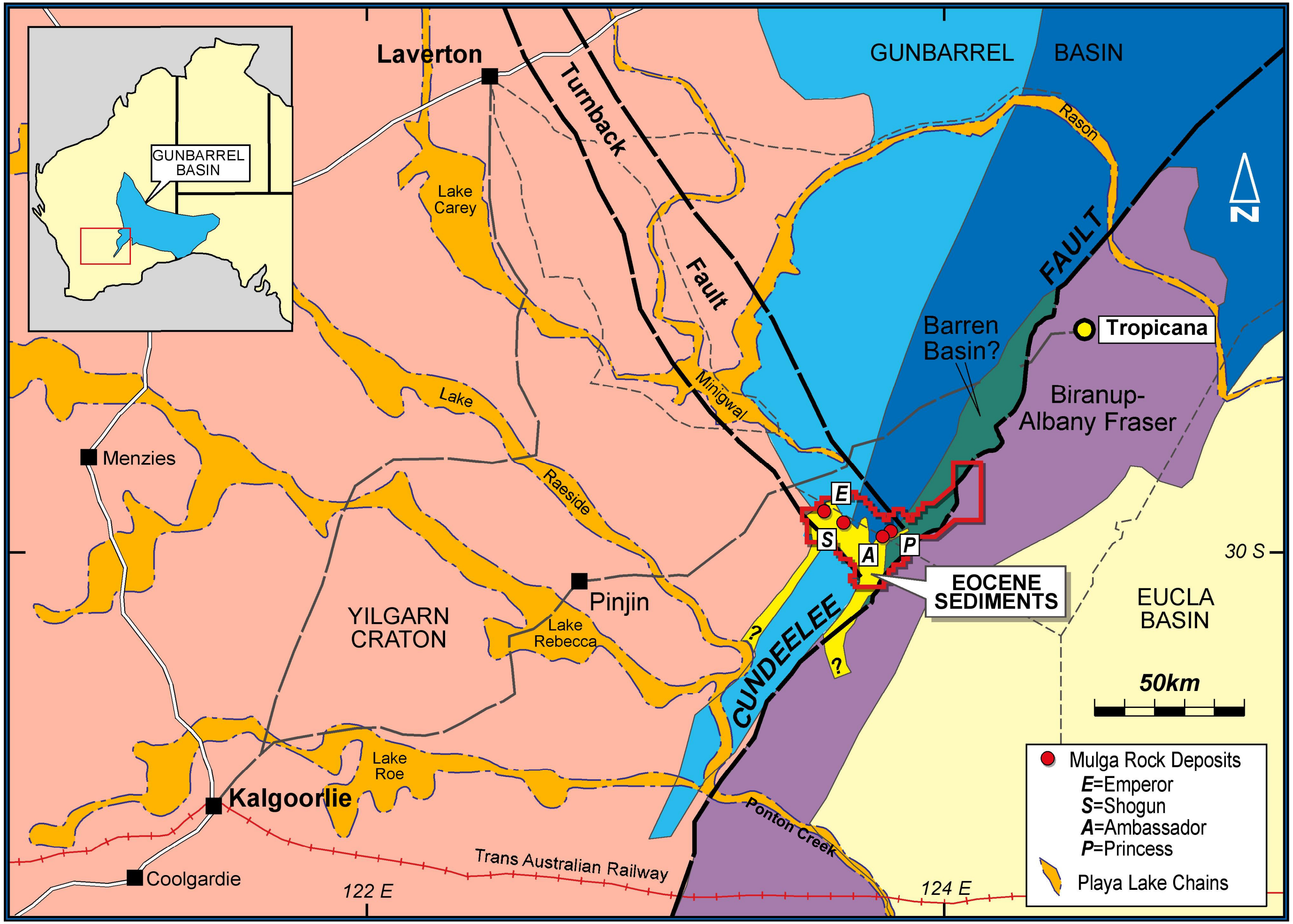
DATE: May 2015

Dwg No: 345.0/15/2-4

MAXIMUM & MINIMUM TEMPERATURES, AND MONTHLY RAINFALLS, MULGA ROCK WEATHER STATIONS

Rockwater Pty Ltd

geological setting.srf



CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

DATE: May 2015

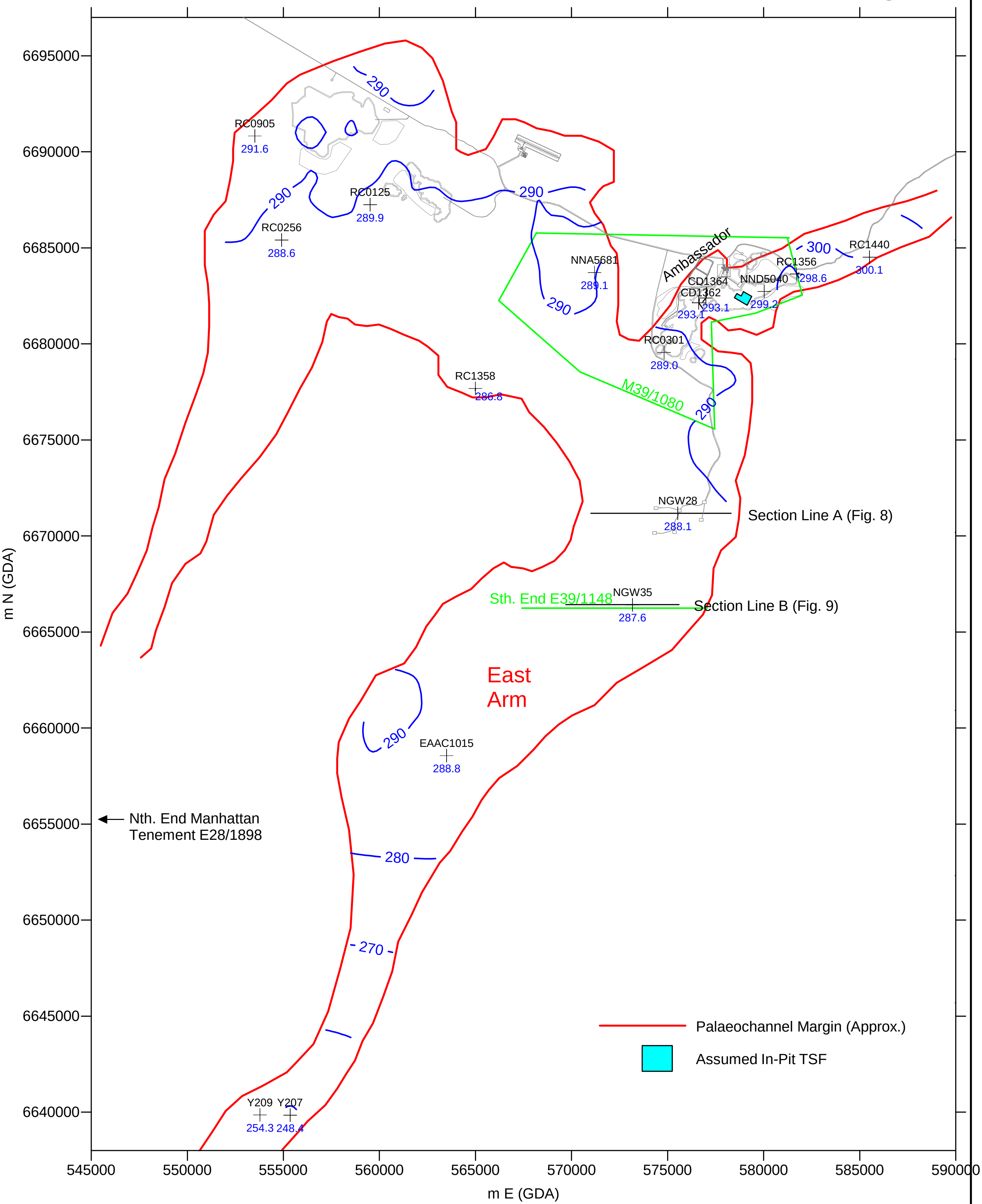
Dwg No: 345.0/15/2-5

REGIONAL GEOLOGICAL SETTING

Rockwater Pty Ltd

Figure 5

Figure 6



Surfer/15-02 Rev2d/Fig6. rlwls & calib bores.srf

CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

DATE: October 2015

Dwg No: 345.0/15/2-6

REDUCED GROUNDWATER LEVELS (m AHD) MEASURED IN ALL BORES AT VARIOUS TIMES (CONTOURS), AND IN CALIBRATION BORES (POST VALUES)

Rockwater Pty Ltd

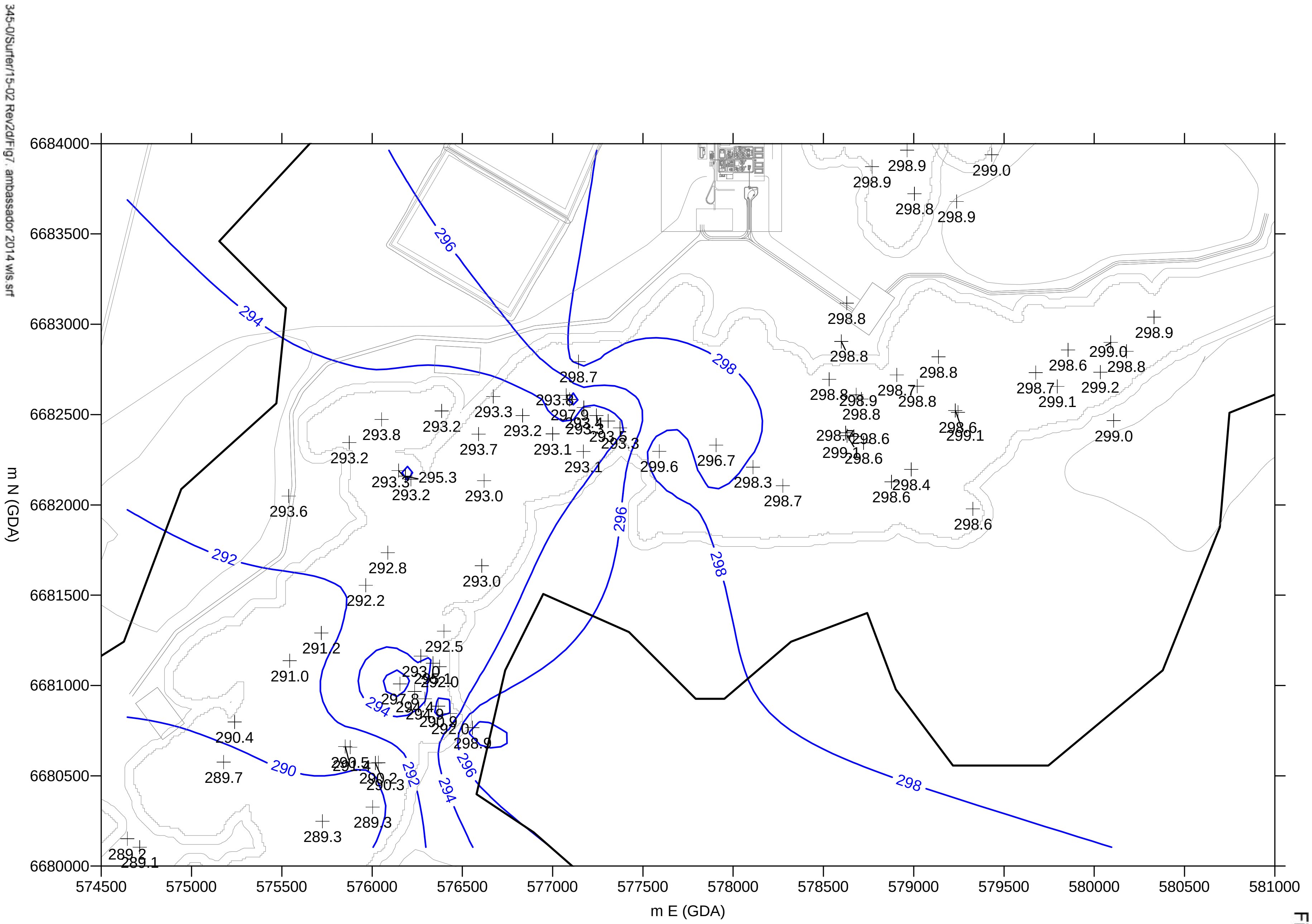


Figure 7

CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

DATE: October 2015

Dwg No: 345.0/15/2-7

GROUNDWATER LEVELS (m AHD) MEASURED

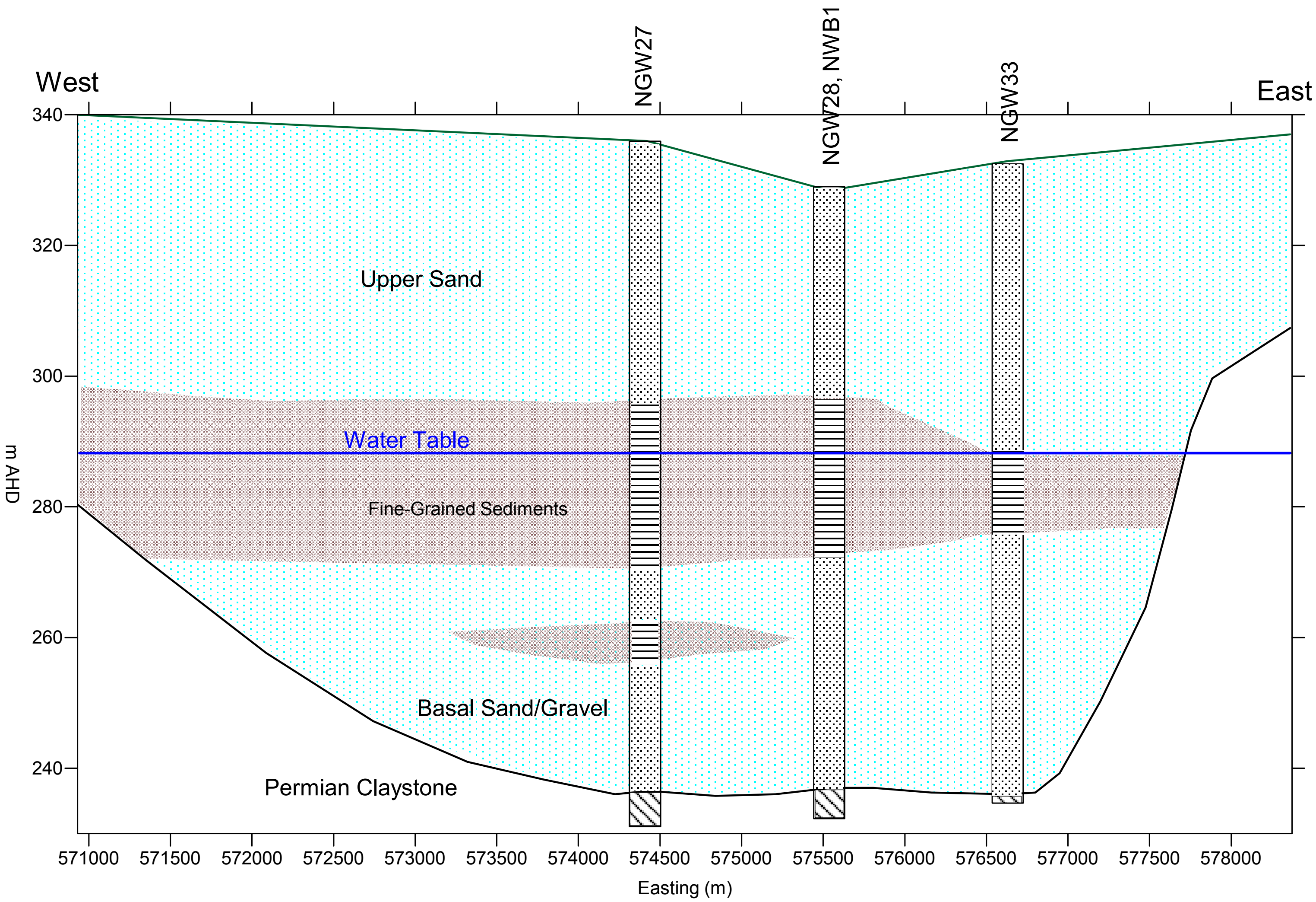
APRIL 2014, AMBASSADOR DEPOSIT

Rockwater Pty Ltd

CLIENT: Vimy Resources
PROJECT: Mulga Rock Hydrogeology
DATE: April 2015
Dwg No: 345.0/15/2-8

section Line A.srf

HYDROGEOLOGICAL CROSS-SECTION
INJECTION BOREFIELD AT NWB1 (LINE A)



40 X Vertical Exaggeration

Figure 8

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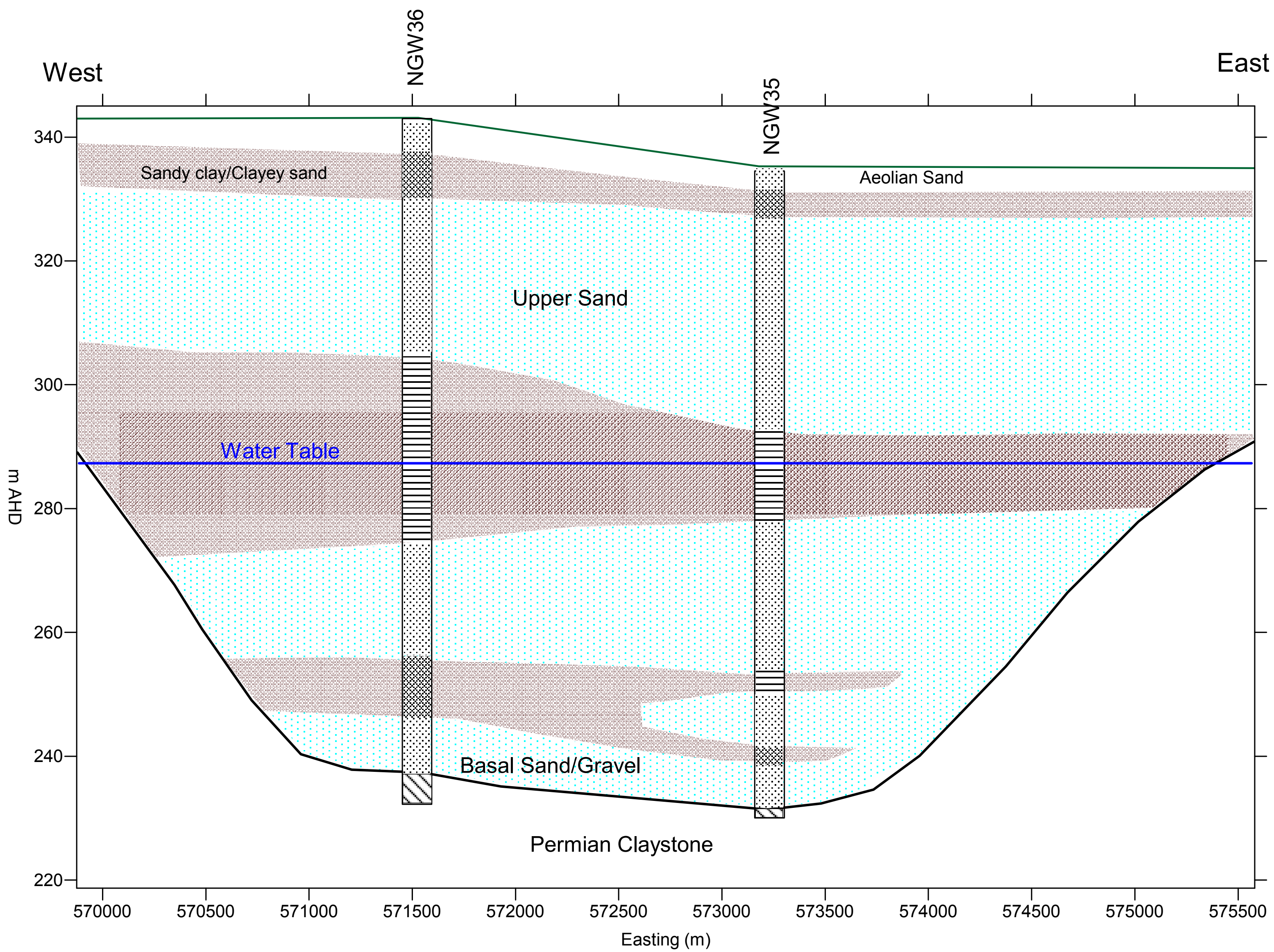
section Line B.srf



30 X Vertical Exaggeration

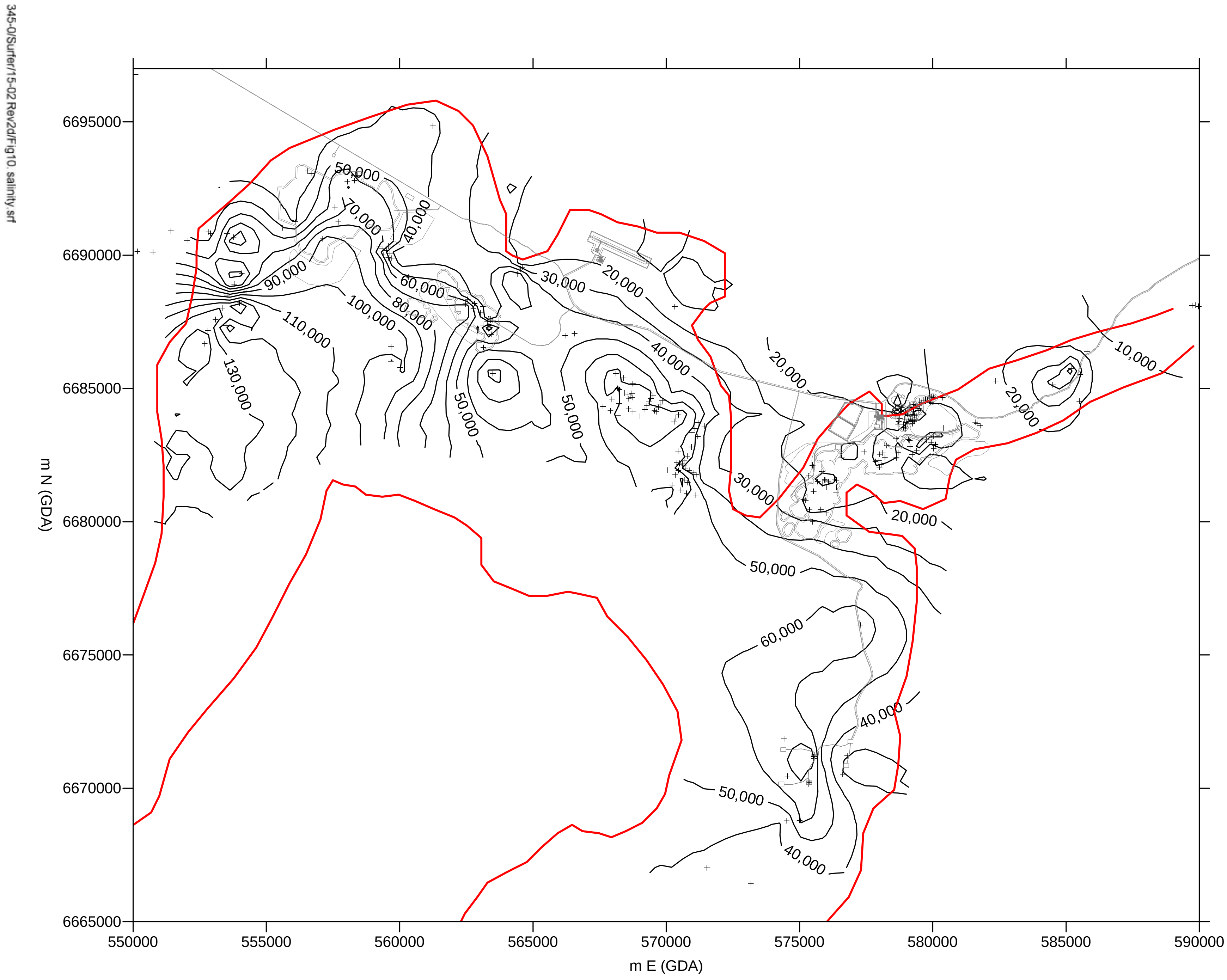
Figure 9

CLIENT: Vimy Resources
PROJECT: Mulga Rock Hydrogeology
DATE: April 2015
Dwg No: 345.0/15/2-9

HYDROGEOLOGICAL CROSS-SECTION
SOUTH OF INJECTION BOREFIELD, LINE B

Rockwater Pty Ltd

CLIENT: Vimy Resources
PROJECT: Mulga Rock Hydrogeology
DATE: October 2015
Dwg No: 345.0/15/2-10



SALINITIES (mg/L TDS) MEASURED AT VARIOUS TIMES

Figure 10

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CLIENT: Vimy Resources
PROJECT: Mulga Rock Hydrogeology
DATE: October 2015
Dwg No: 345.0/15/2-11

345-0/Surfer/15-02 Rev2d/Fig11. pH.srf

PH MEASURED AT VARIOUS TIMES

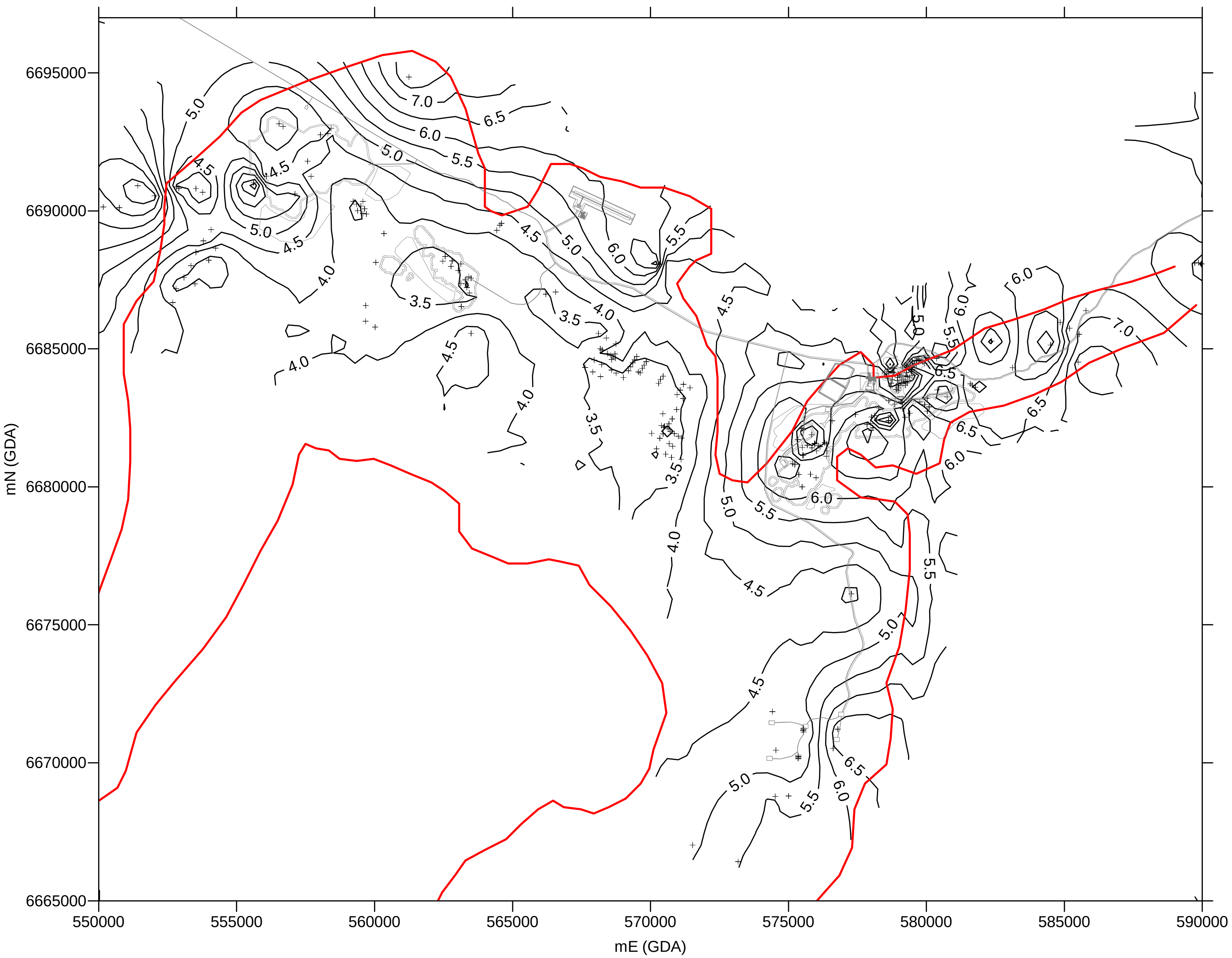

Figure 11

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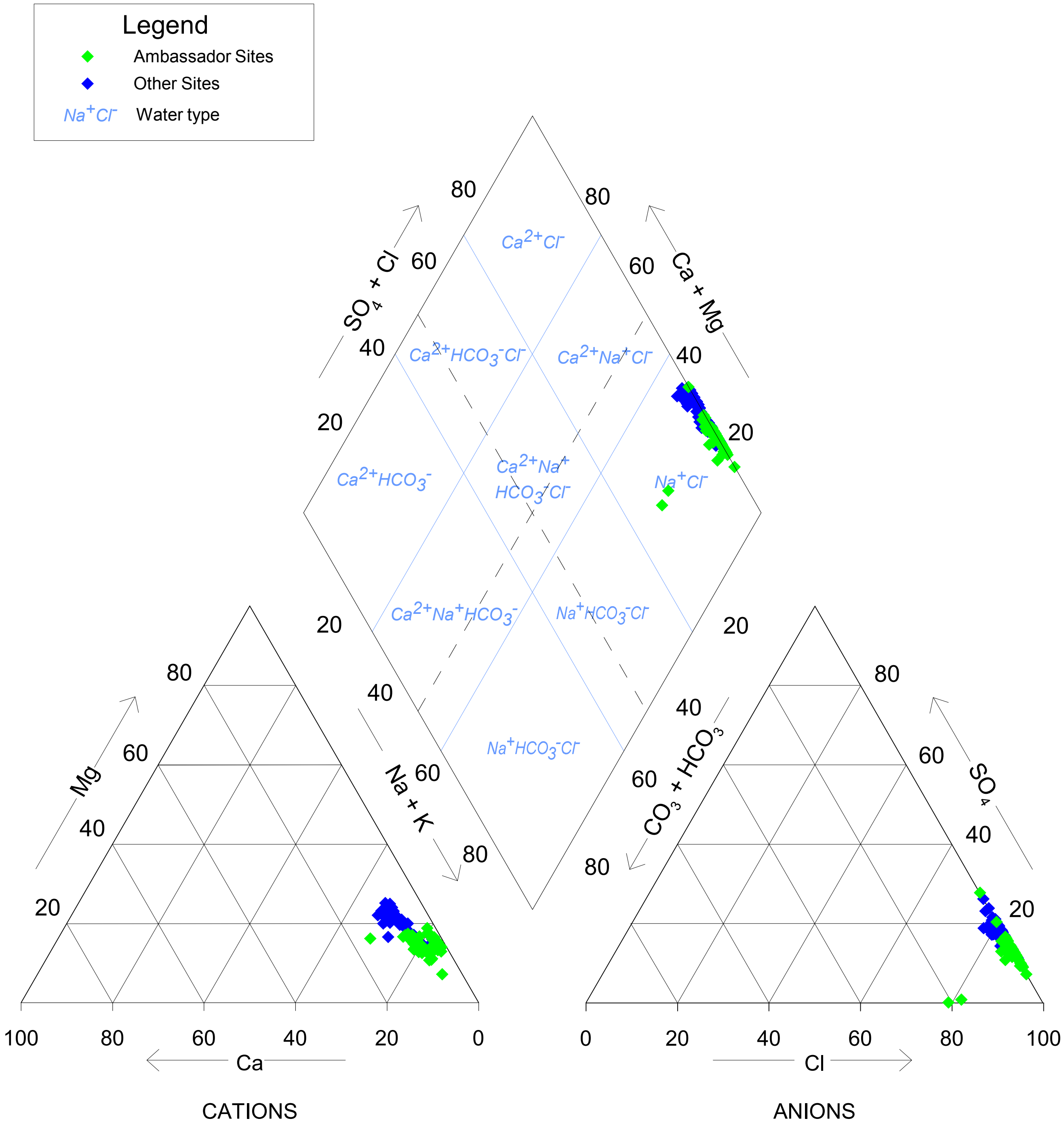
Figure 12



Piper Ambassador.grf

CLIENT:	Vimy Resources Ltd
PROJECT:	Mulga Rock Hydrogeology
DATE:	May 2015
Dwg. No:	345-0/15/02-12

PIPER DIAGRAM
OF GROUNDWATER SAMPLES
MULGA ROCK DEPOSITS

Rockwater PROPRIETARY LIMITED

Client: Vimy Resources
Project: Mulga Rock
Date: May 2015
Dwg. No: 345-0/15/2-13

injection tds vs depth.grf

REINJECTION AREA: SALINITY VERSUS SAMPLING DEPTH

Rockwater Pty Ltd

Figure 13

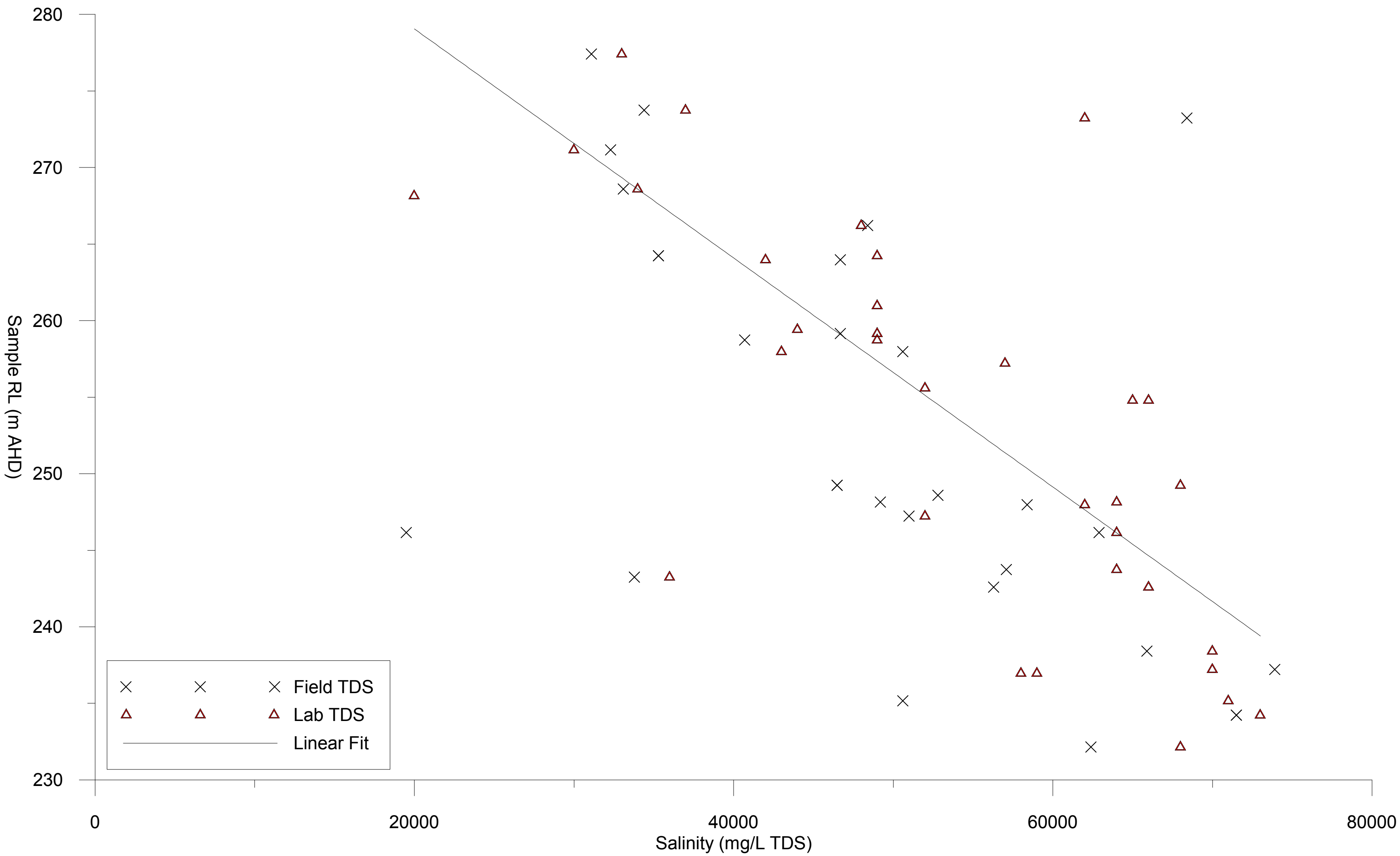
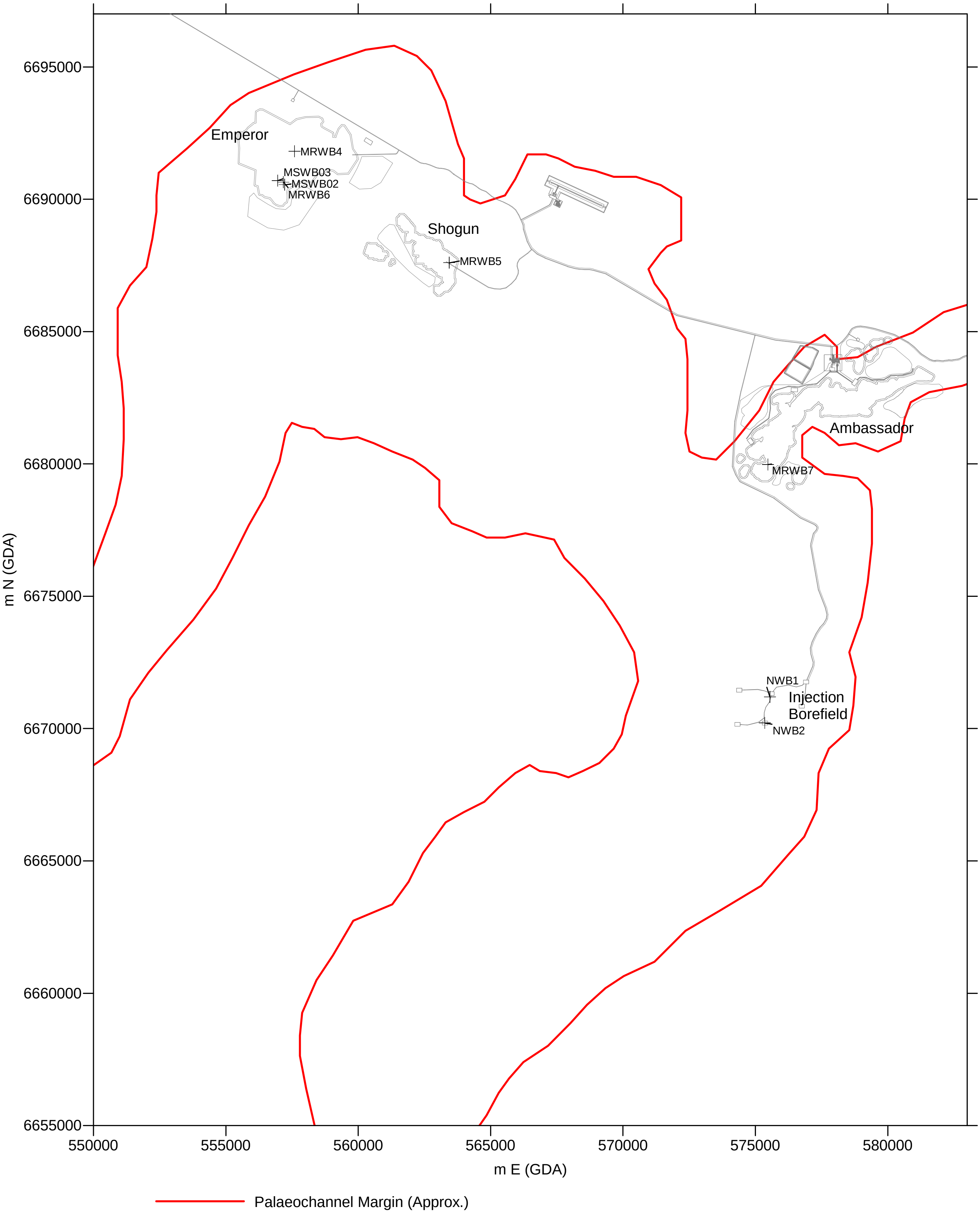


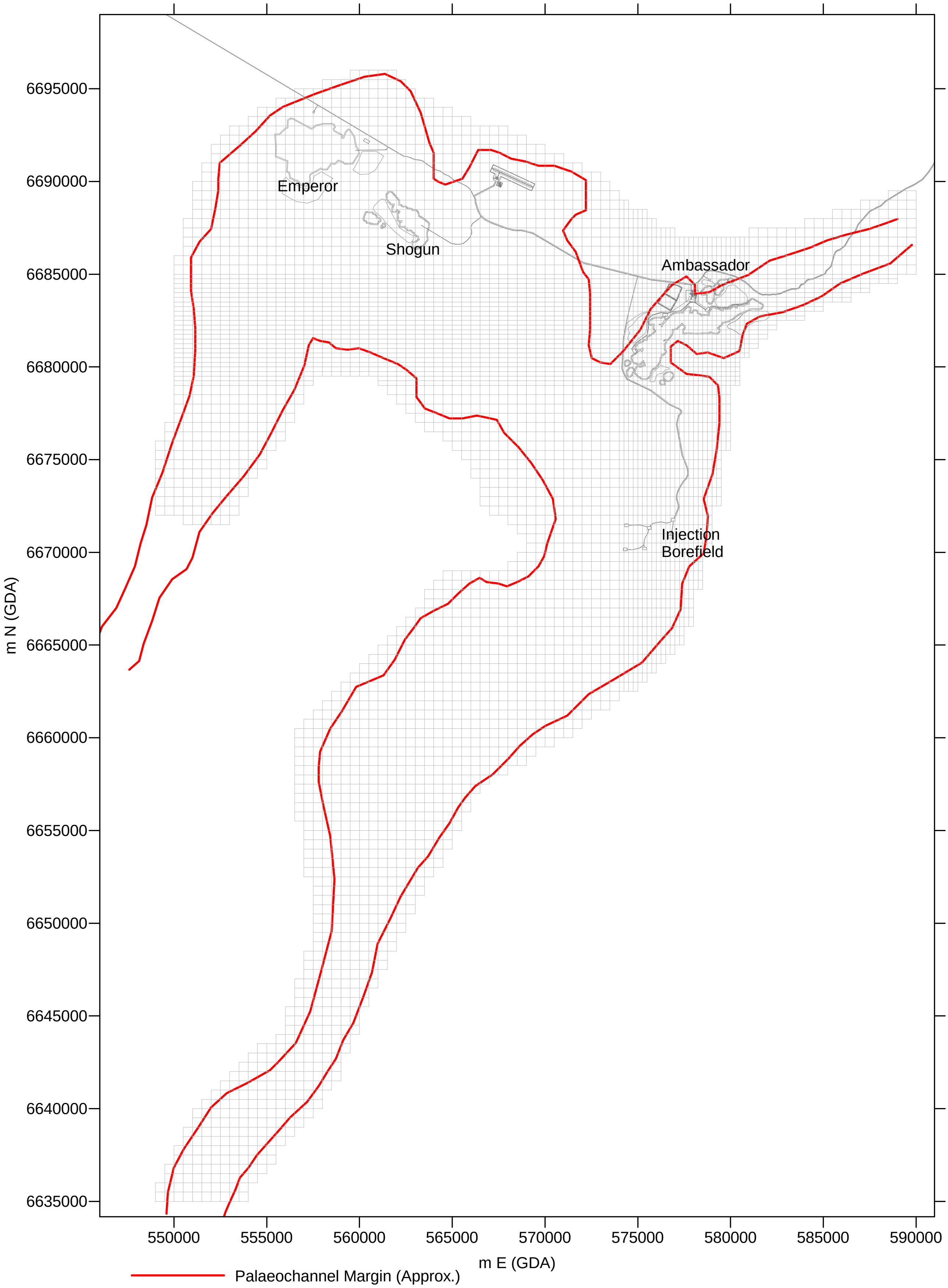
Figure 14



345-0/Surfer/15-02 Rev2d/Fig14. production bores.srf

CLIENT: Vimy Resources PROJECT: Mulga Rock Hydrogeology DATE: October 2015 Dwg No: 345.0/15/2-14	PRODUCTION BORE LOCATIONS Rockwater Pty Ltd

Figure 15



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CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

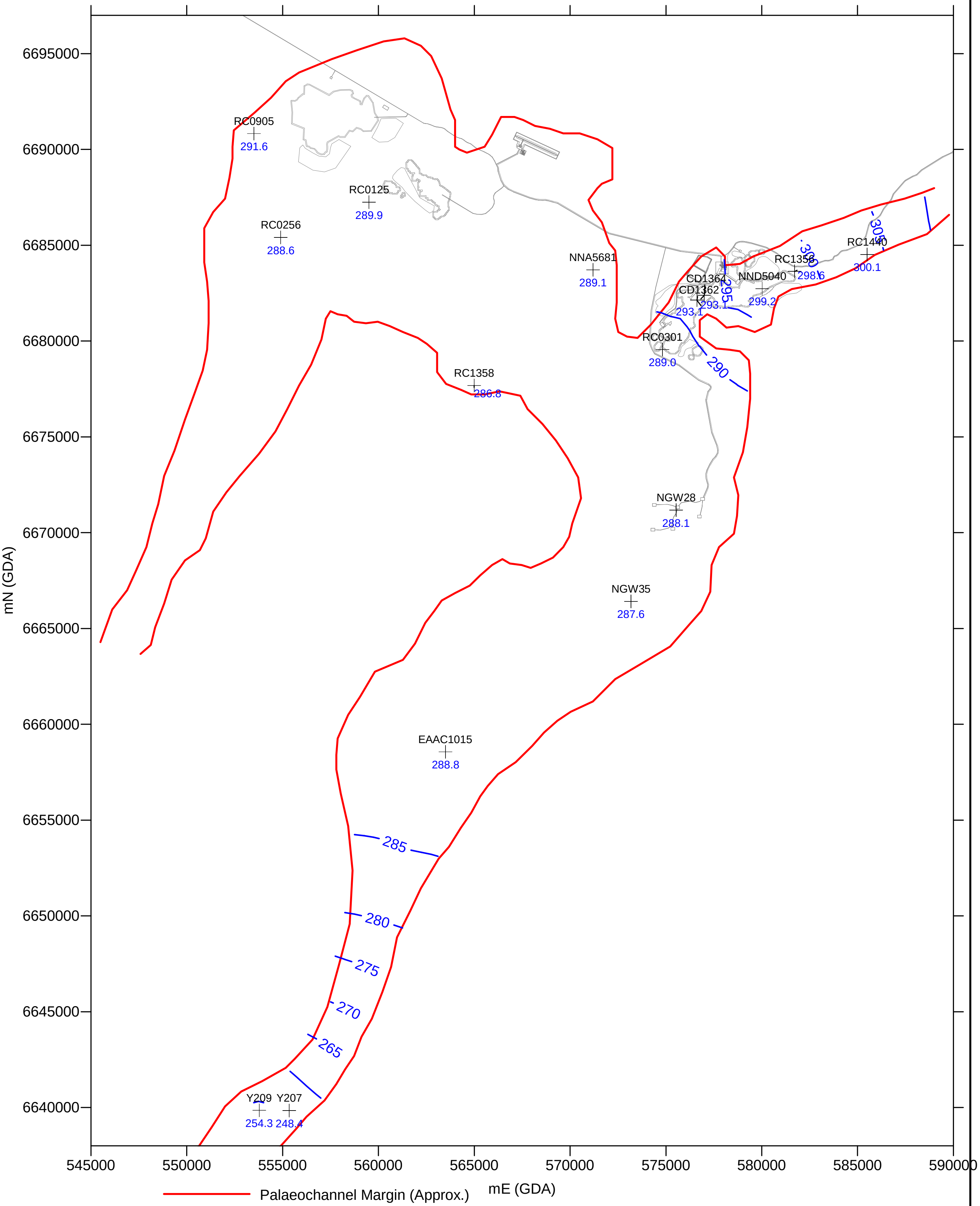
DATE: October 2015

Dwg No: 345.0/15/2-15

MODEL GRID

Rockwater Pty Ltd

Figure 16



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CLIENT: Vimy Resources PROJECT: Mulga Rock Hydrogeology DATE: October 2015 Dwg No: 345.0/15/2-16	COMPARISON BETWEEN GROUNDWATER LEVELS (m AHD) MEASURED AT VARIOUS TIMES (POST VALUES), AND MODEL-CALCULATED LEVELS (CONTOURS) Rockwater Pty Ltd

Client: Vimy Resources
Project: Mulga Rock Hydrogeology
Date: March 2015
Dwg. No: 345-0/15/1-17

BORE NBW1 PUMPING TEST
AT 1,210 KL/d, 16/3/15
DRAWDOWNS IN NGW37

Rockwater Pty Ltd

nbw1 ngw37.grf

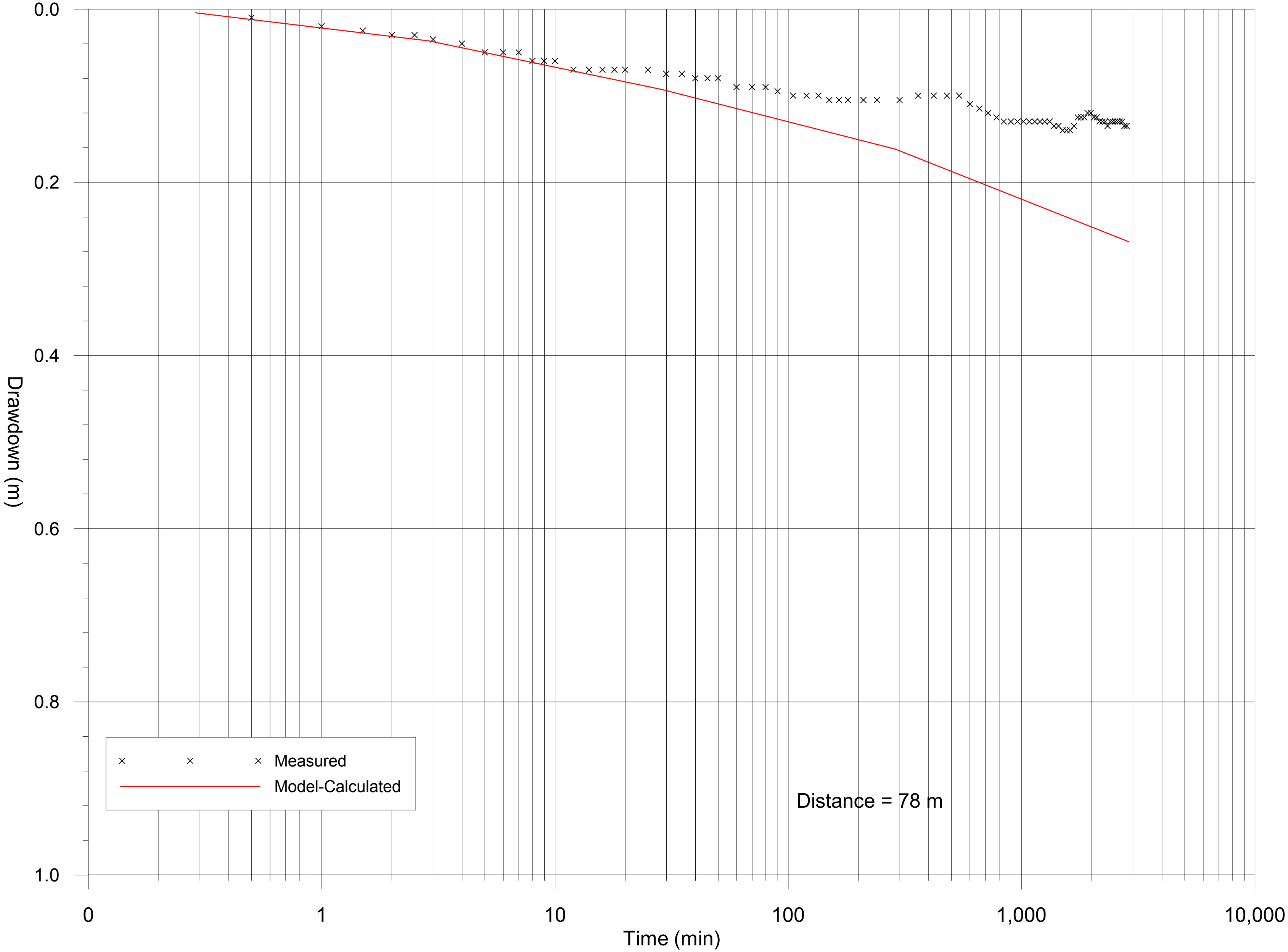


Figure 17

Client: Vimy Resources

Project: Mulga Rock Hydrogeology

Date: March 2015

Dwg. No: 345-0/15/1-18

BORE NBW1 PUMPING TEST

AT 1,210 KL/d, 16/3/15

DRAWDOWNS IN NGW54C

Rockwater Pty Ltd

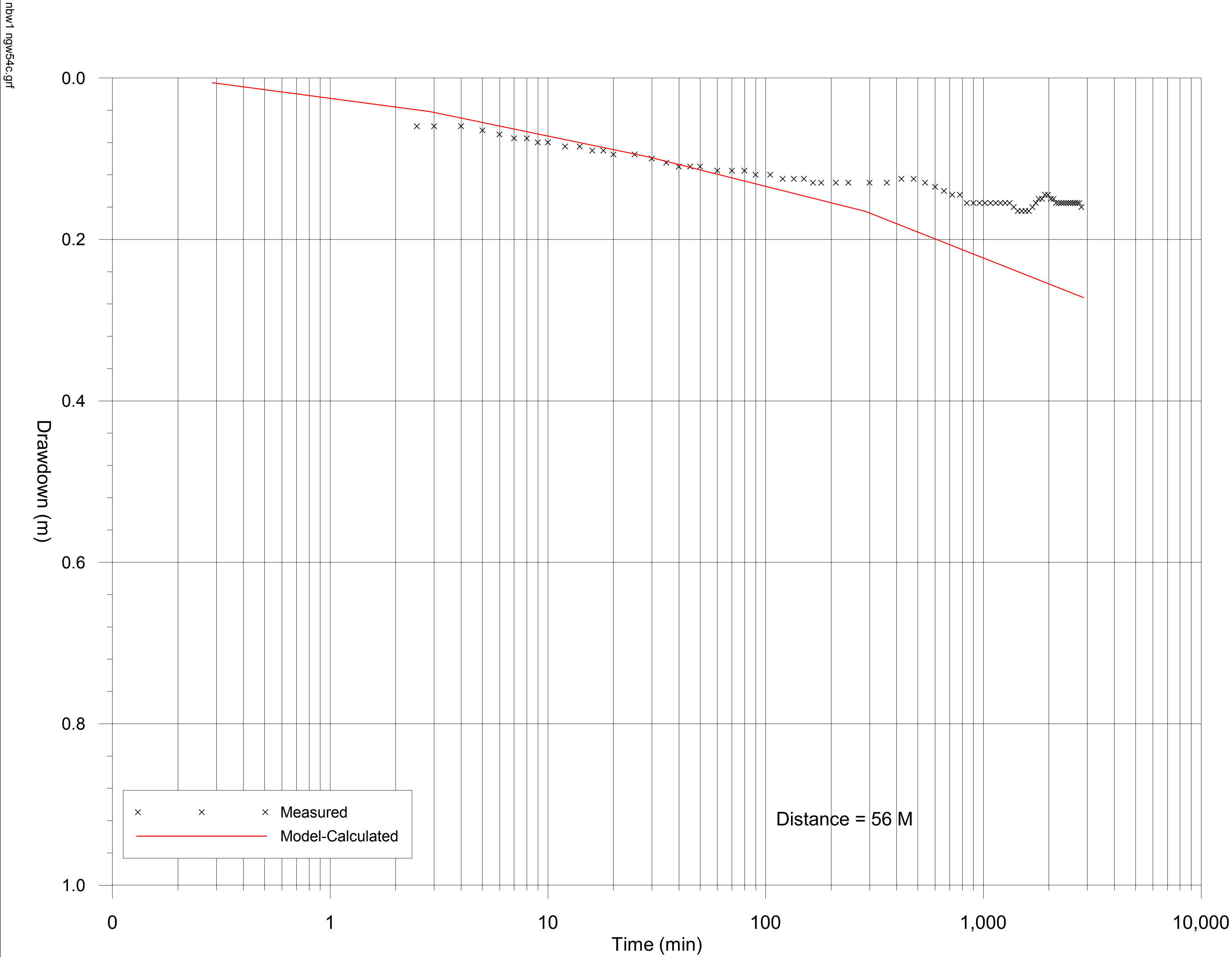


Figure 18

Client: Vimy Resources
Project: Mulga Rock Hydrogeology
Date: March 2015
Dwg. No: 345-0/15/1-19

BORE NBW2 PUMPING TEST
AT 950 KL/d, 13/3/15
DRAWDOWNS IN NGW30

Rockwater Pty Ltd

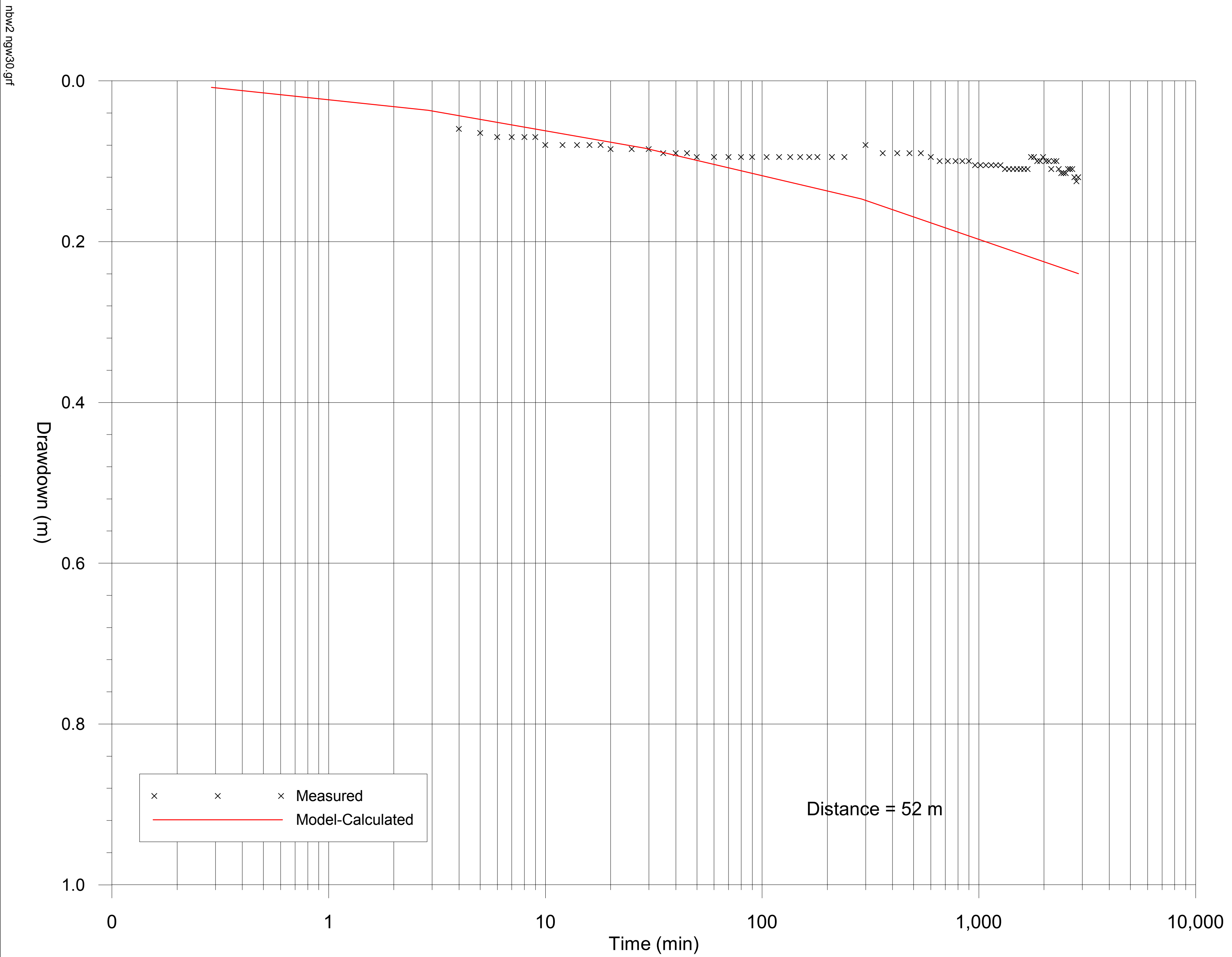
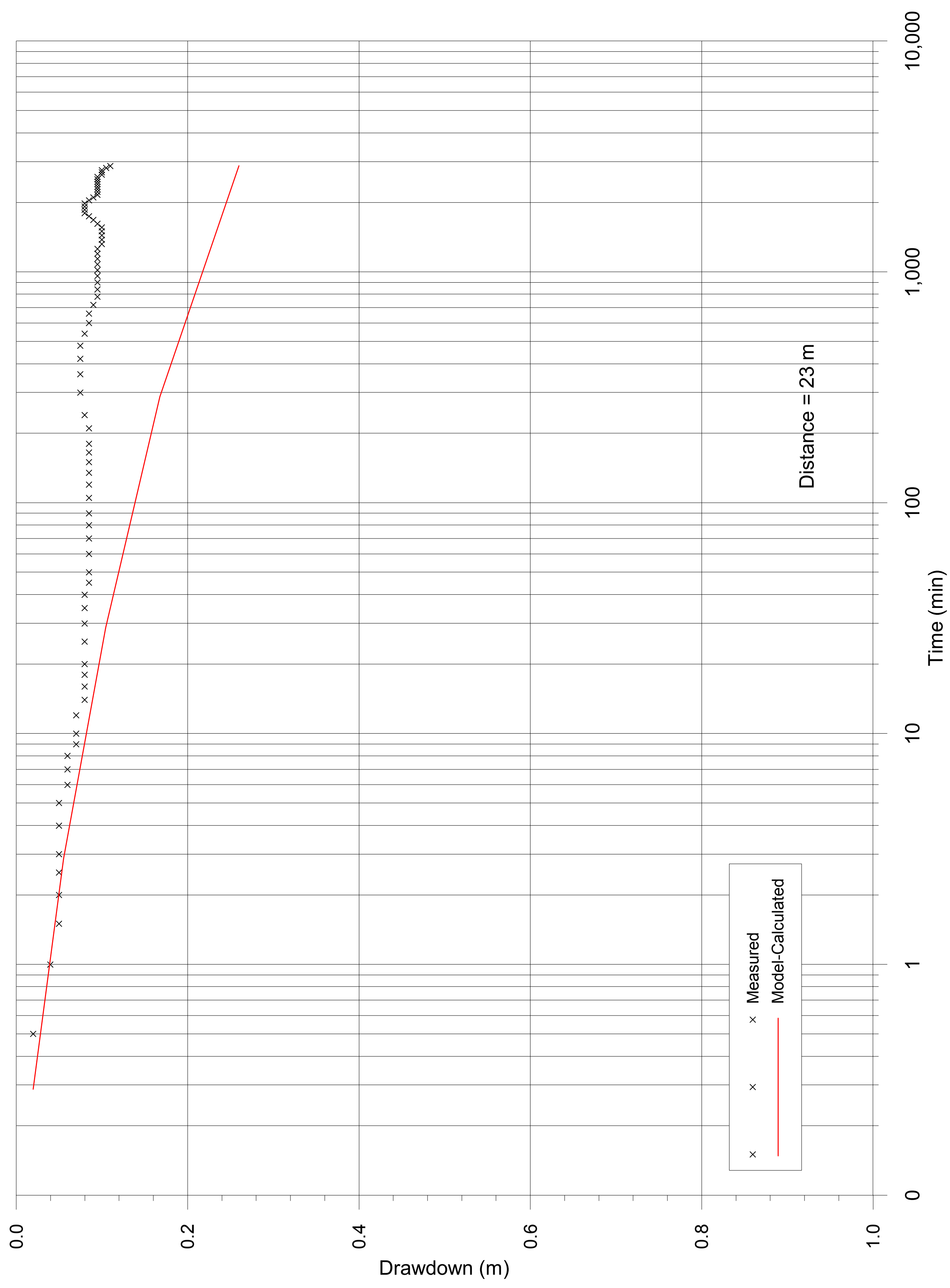


Figure 19

Figure 20



nbw2 ngw55.grf

Client: Vimy Resources

Project: Mulga Rock Hydrogeology

Date: March 2015

Dwg. No: 345-0/15/1-20

BORE NBW2 PUMPING TEST

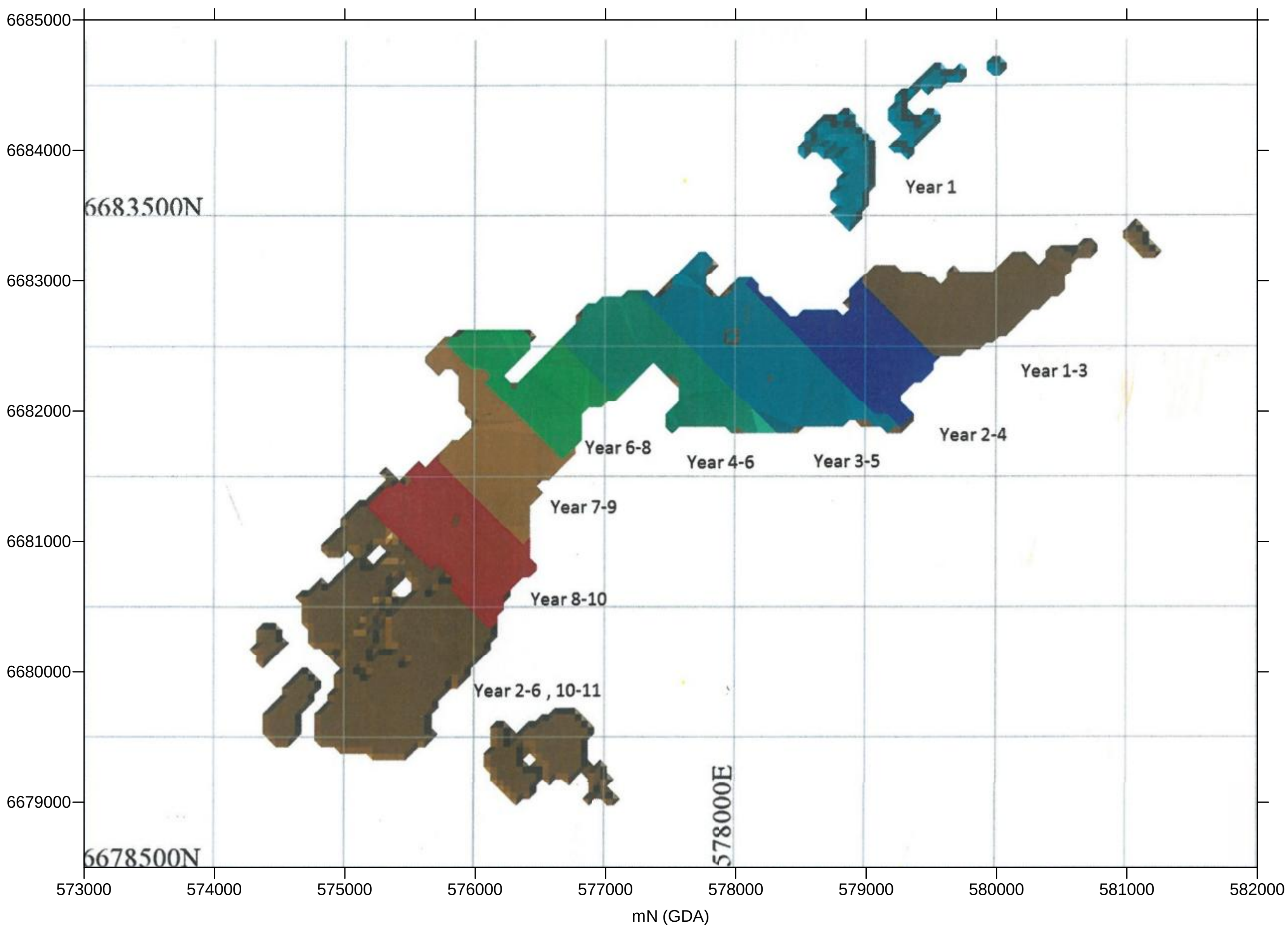
AT 950 KL/d, 13/3/15

DRAWDOWNS IN NGW55

Rockwater Pty Ltd

CLIENT: Vimy Resources
PROJECT: Mulga Rock Hydrogeology
DATE: October 2015
Dwg No: 345.0/15/2-21

345-0/Surfer/15-02 Rev2c/Fig21. Mining Areas Y1-Y11.srf

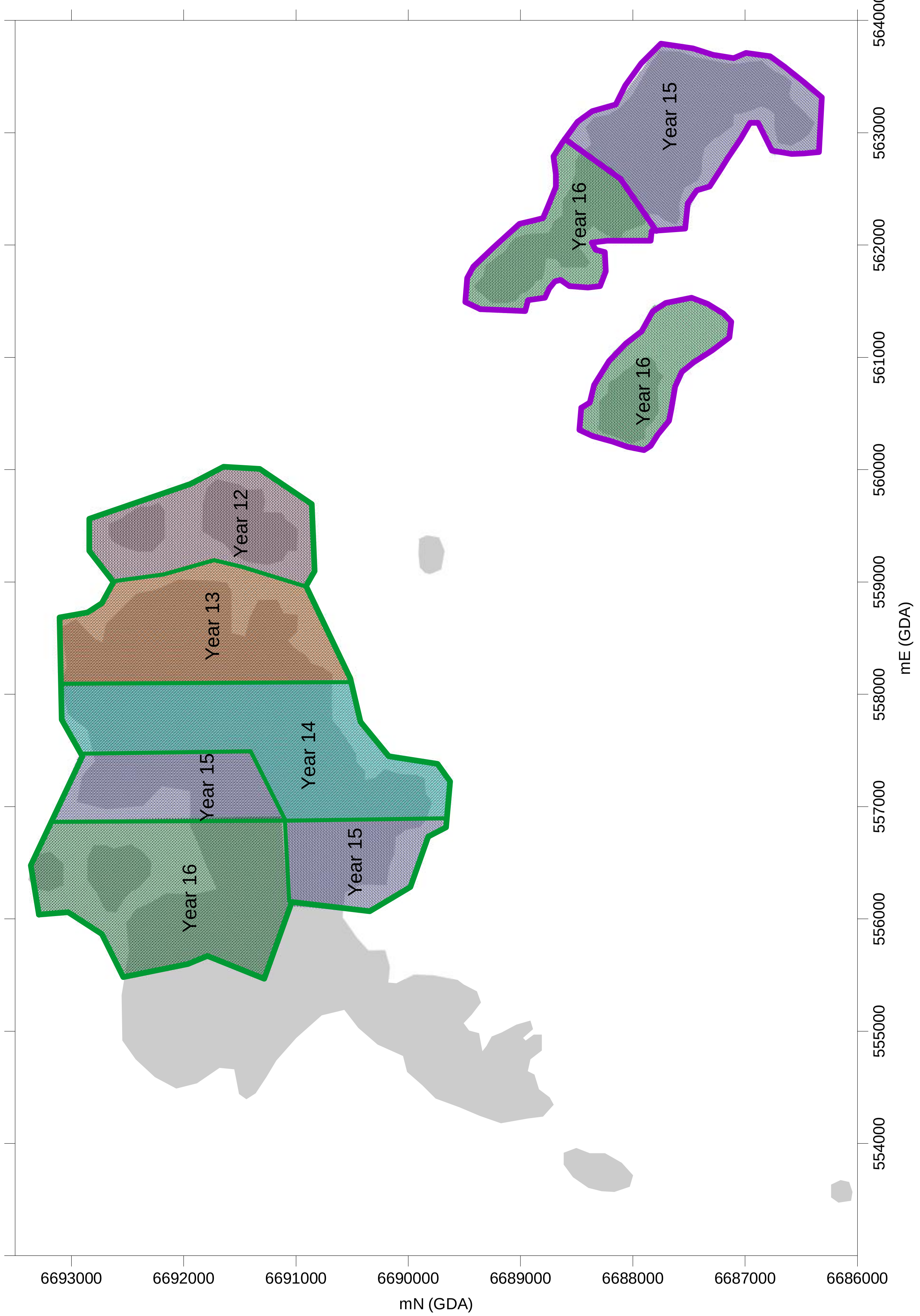


MINE PLAN, AMBASSADOR AND PRINCESS DEPOSITS

Rockwater Pty Ltd

Figure 21

Figure 22



345-0/Surfer/15-02 Rev2c/Fig22. Mining Areas Y12-Y16.srf

CLIENT: Vimy Resources
PROJECT: Mulga Rock Hydrogeology
DATE: October 2015
Dwg No: 345.0/15/2-22

MINE PLAN,
EMPEROR AND SHOGUN DEPOSITS

Rockwater Pty Ltd

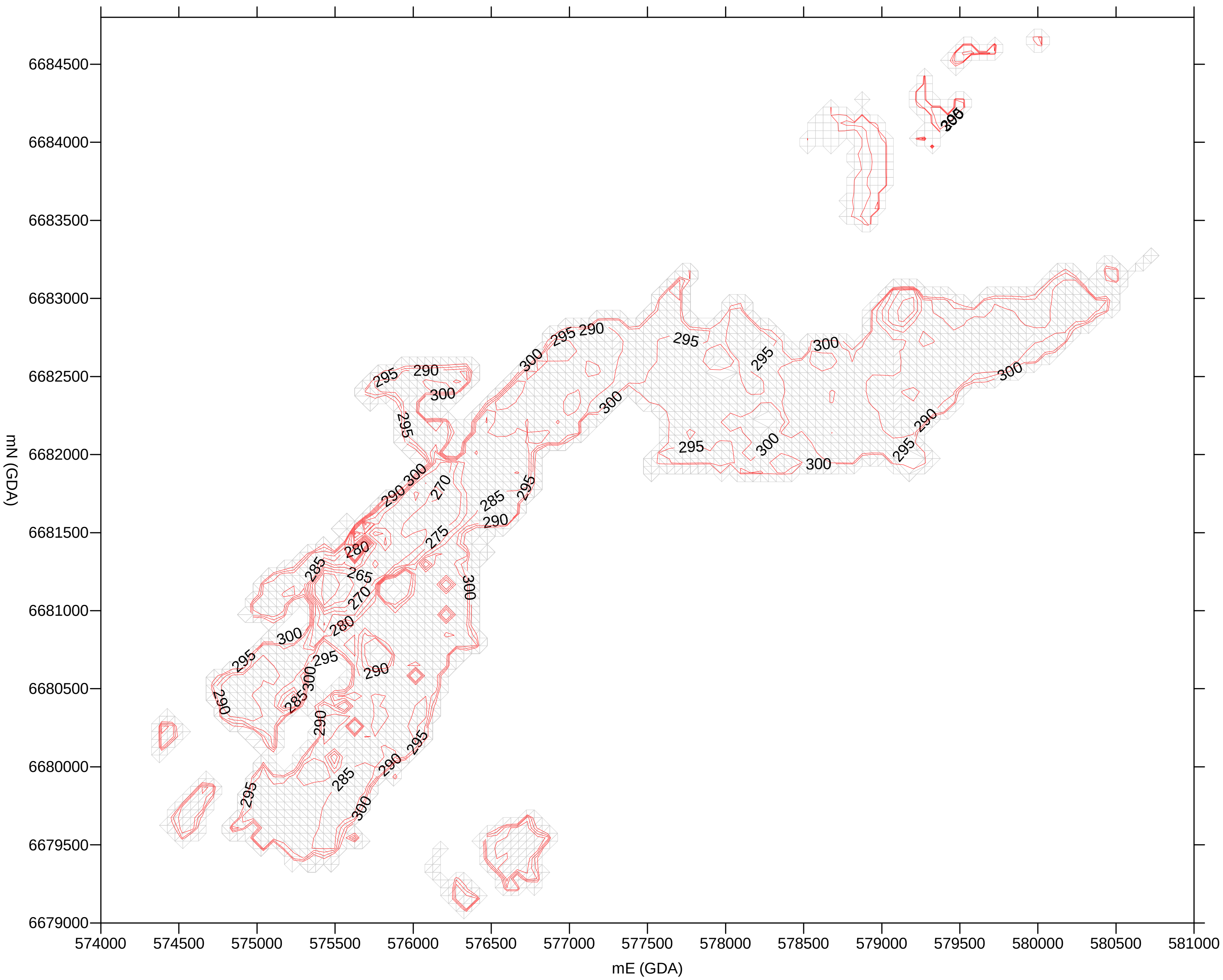
CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

DATE: October 2015

Dwg No: 345.0/15/2-23

345-0/Surfer/15-02 Rev2c/Fig23_mining base.srf



PLANNED BASE OF MINING (m AHD),
AMBASSADOR AND PRINCESS DEPOSITS

Figure 23

Rockwater Pty Ltd

Figure 24

345-0/Surfer/15-02 Rev2c/Fig24. mining base1.srf

CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

DATE: October 2015

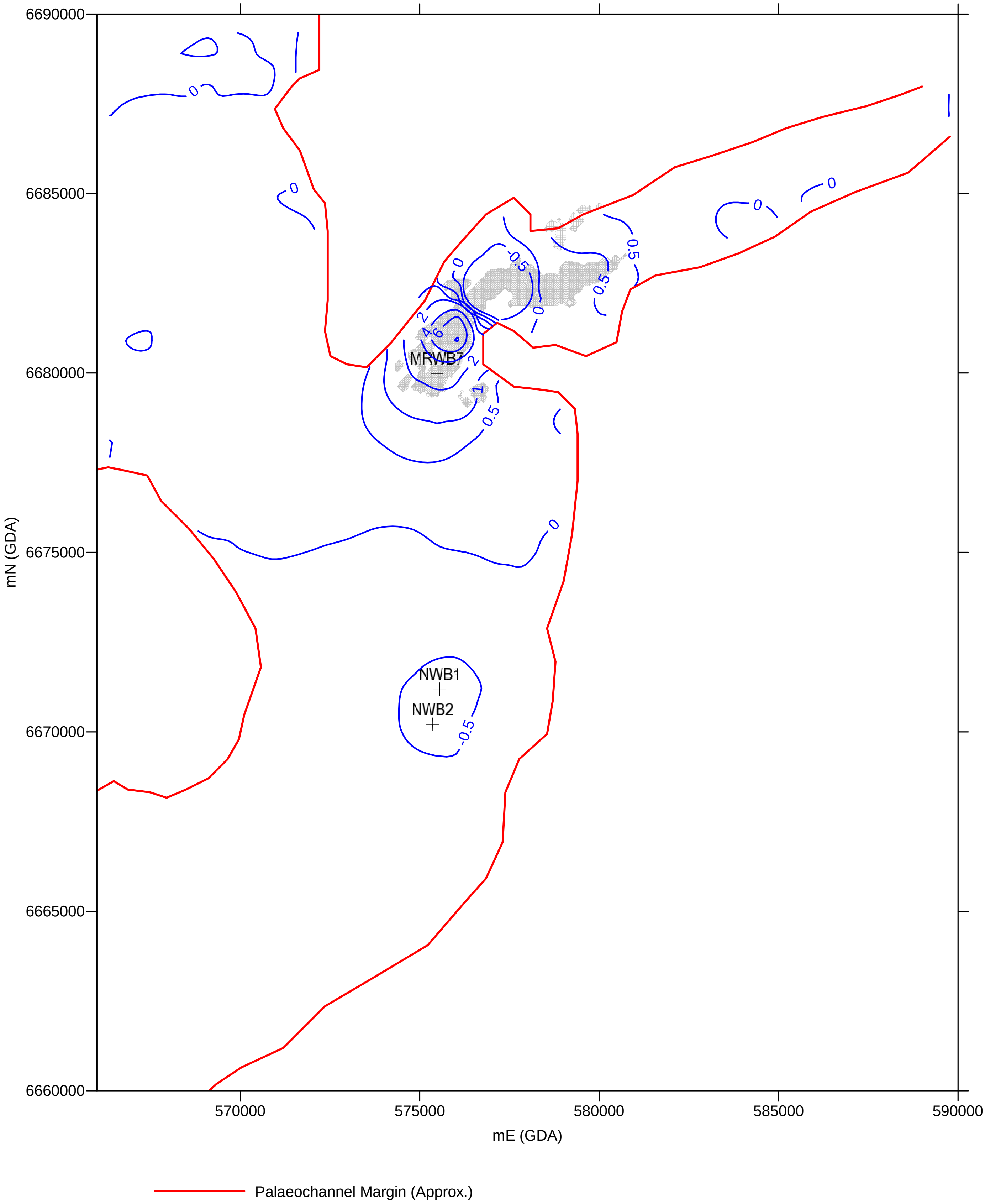
Dwg No: 345.0/15/2-24

PLANNED BASE OF MINING (m AHD),

EMPEROR AND SHOGUN DEPOSITS

Rockwater Pty Ltd

Figure 25



345-0/Surfer/15-02 Rev2c/Fig25. L1Y10DD.srf

CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

DATE: October 2015

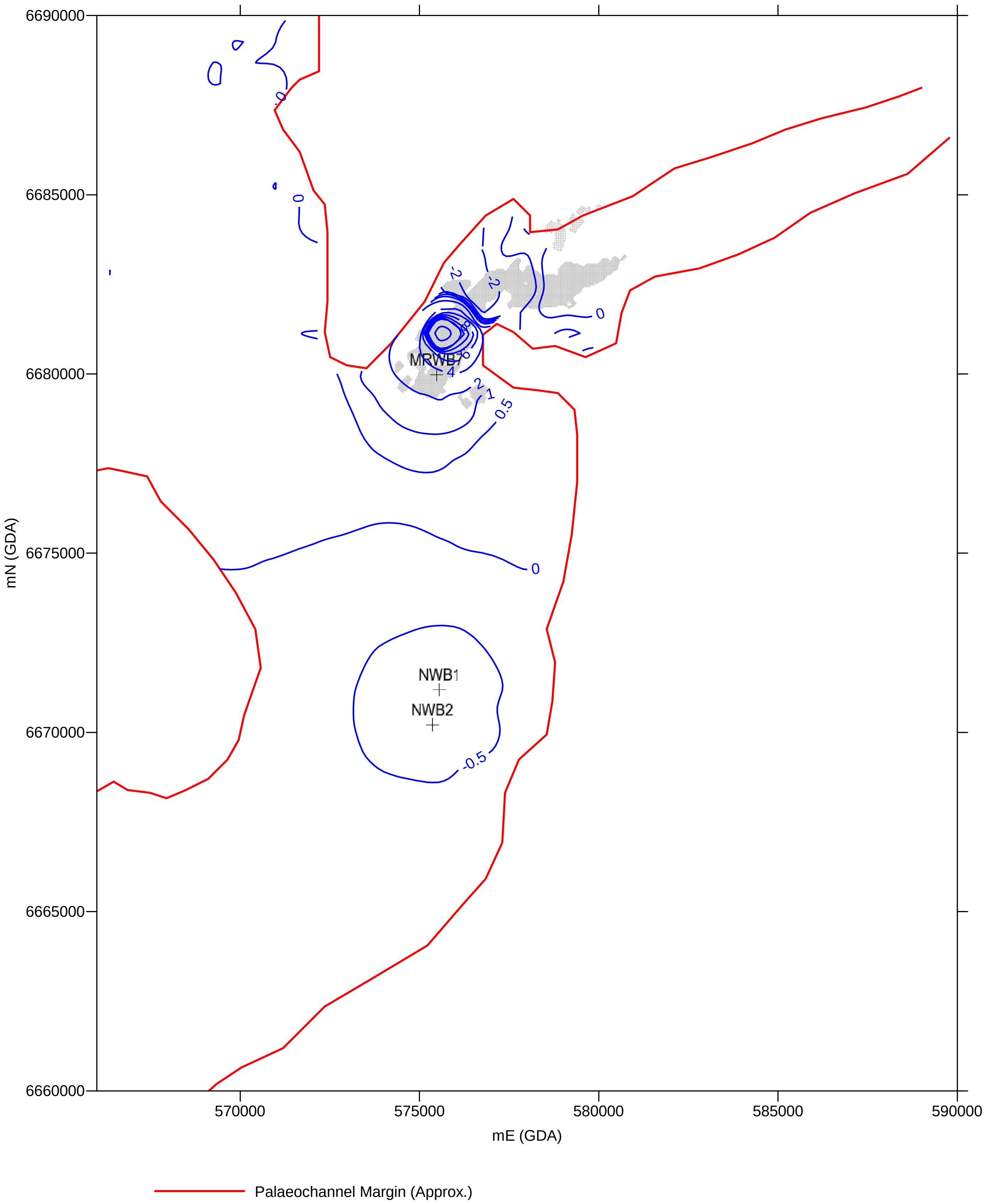
Dwg No: 345.0/15/2-25

MODEL-CALCULATED DRAWDOWNS (m)

LAYER 1, END OF YEAR 10

Rockwater Pty Ltd

Figure 26



345-0/Surfer/15-02 Rev2c/Fig26. L3Y10DD.srf

CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

DATE: October 2015

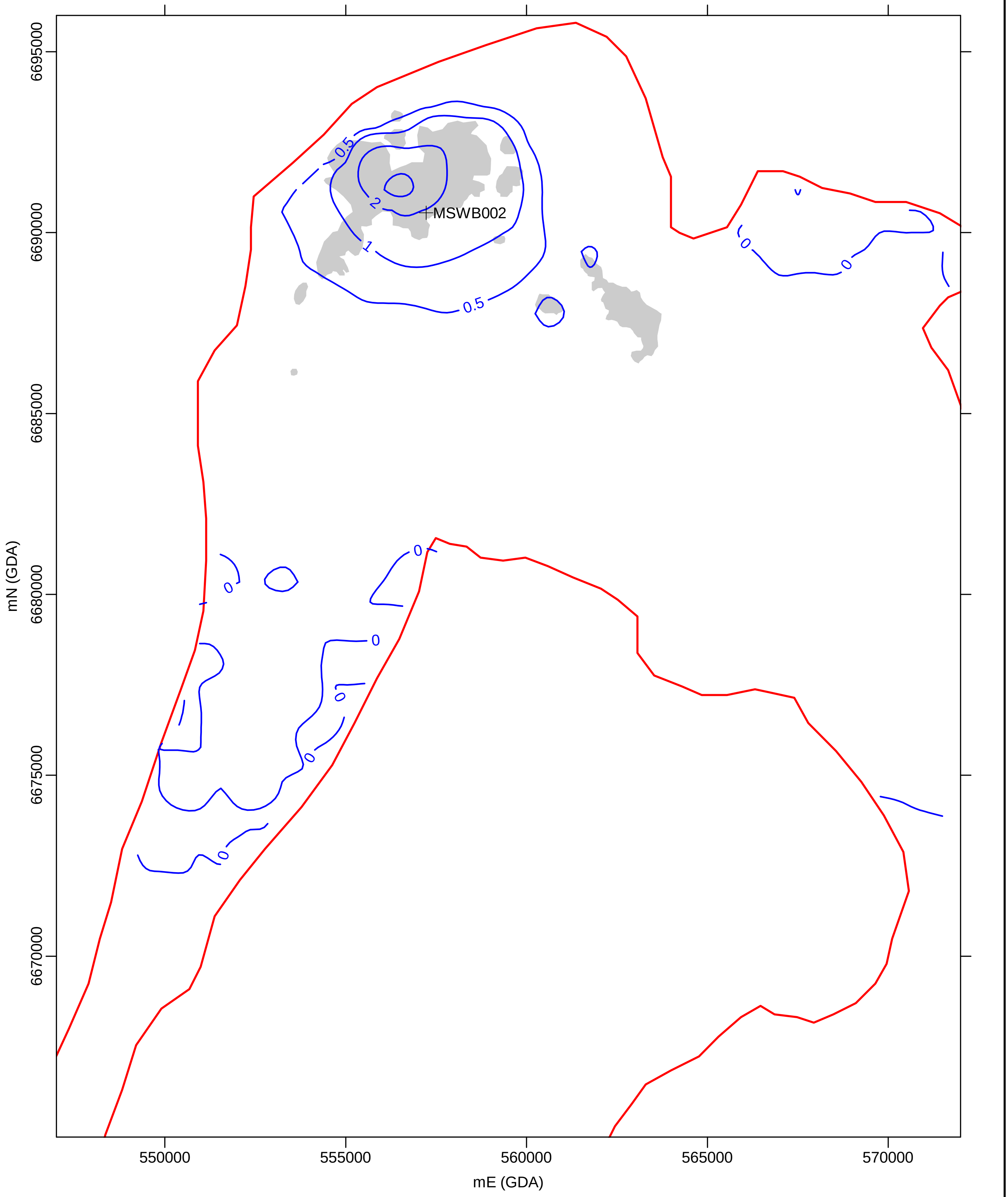
Dwg No: 345.0/15/2-26

MODEL-CALCULATED DRAWDOWNS (m)

LAYER 3, END OF YEAR 10

Rockwater Pty Ltd

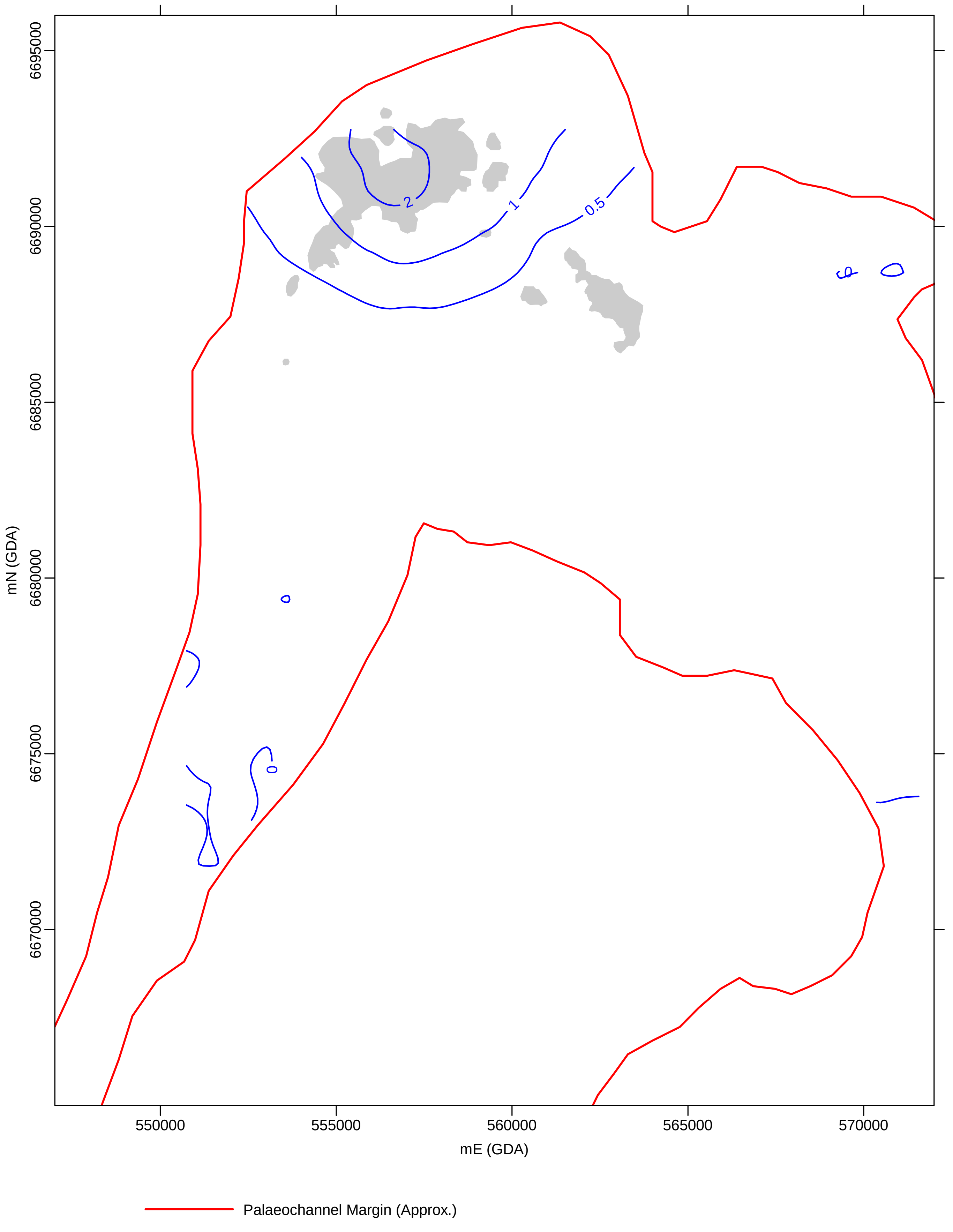
Figure 27



345-0/Surfer/15-02 Rev2c/Fig27. L1Y16DD

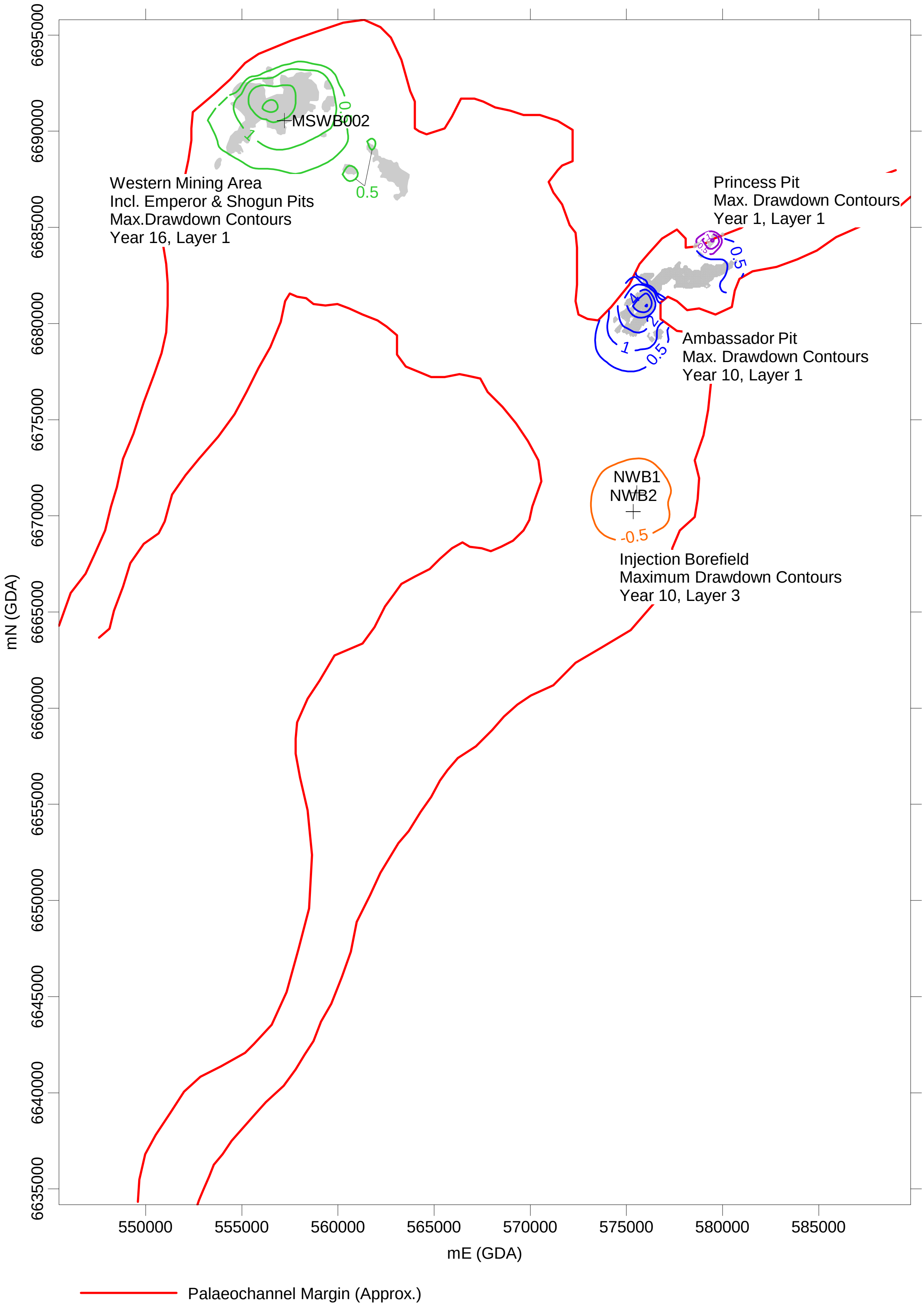
CLIENT: Vimy Resources PROJECT: Mulga Rock Hydrogeology DATE: October 2015 Dwg No: 345.0/15/2-27	MODEL-CALCULATED DRAWDOWNS (m) LAYER 1, END OF YEAR 16 Rockwater Pty Ltd

Figure 28



345-0/Surfer/15-02 Rev2c/Fig28. L3Y16DD

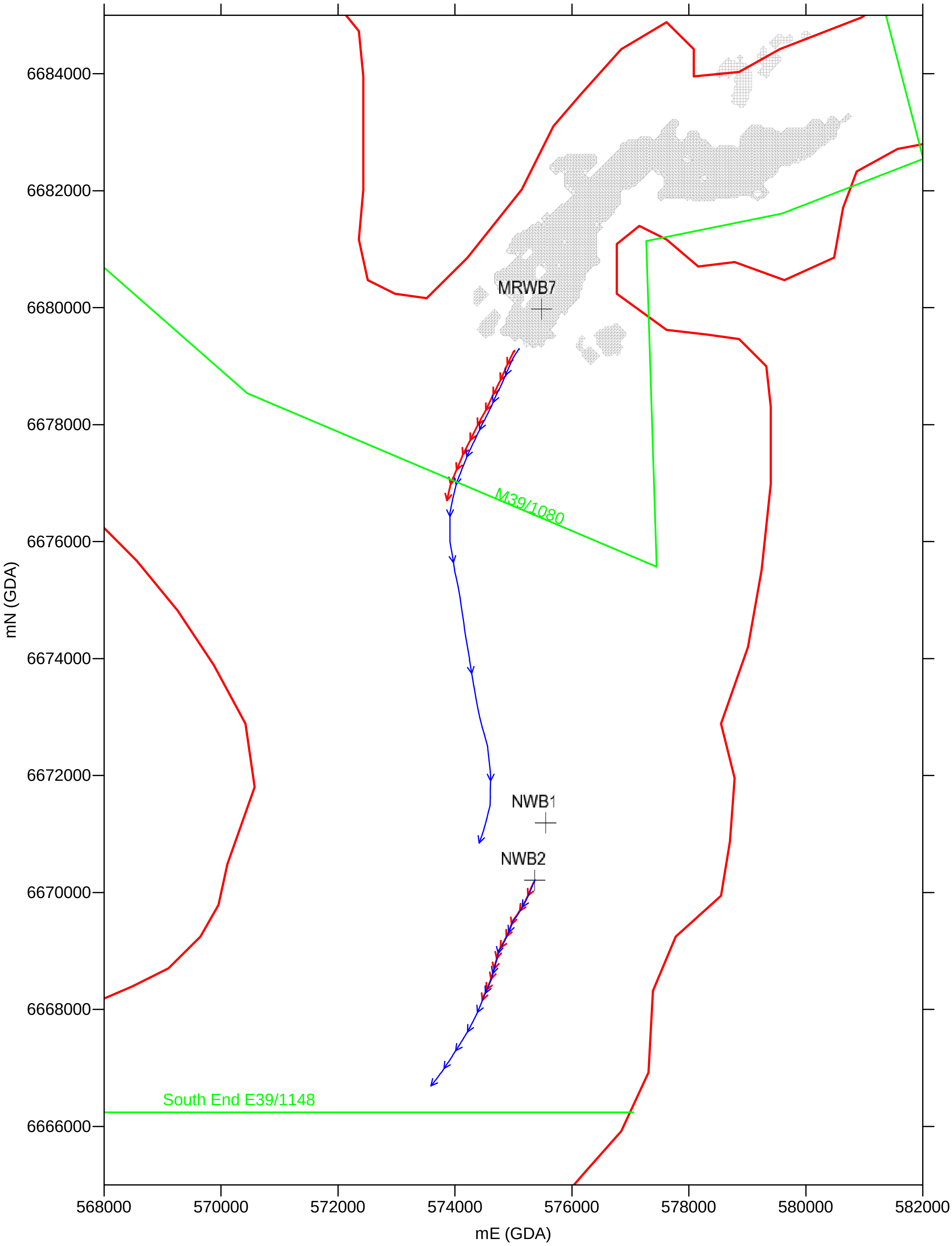
CLIENT: Vimy Resources PROJECT: Mulga Rock Hydrogeology DATE: October 2015 Dwg No: 345.0/15/2-28	MODEL-CALCULATED DRAWDOWNS (m) LAYER 3, END OF YEAR 16 Rockwater Pty Ltd



345-0/Surfer/Rpt 15-002 Rev2c/Fig29. Max DD & Mounding.srf

CLIENT: Vimy Resources PROJECT: Mulga Rock Hydrogeology DATE: October 2015 Dwg No: 345.0/15/2-29	MODEL-CALCULATED MAXIMUM DRAWDOWNS (m) DURING 16 YEAR LoM Rockwater Pty Ltd

Figure 30



Each Arrow-Head Represents 100 Years Flow
(1,000 Years Total Flow Shown)

Adopted Case

Worst Case

Surfer/15-02 Rev2c/Fig30. Flowpaths2.srf

CLIENT: Vimy Resources

PROJECT: Mulga Rock Hydrogeology

DATE: October 2015

Dwg No: 345.0/15/2-30

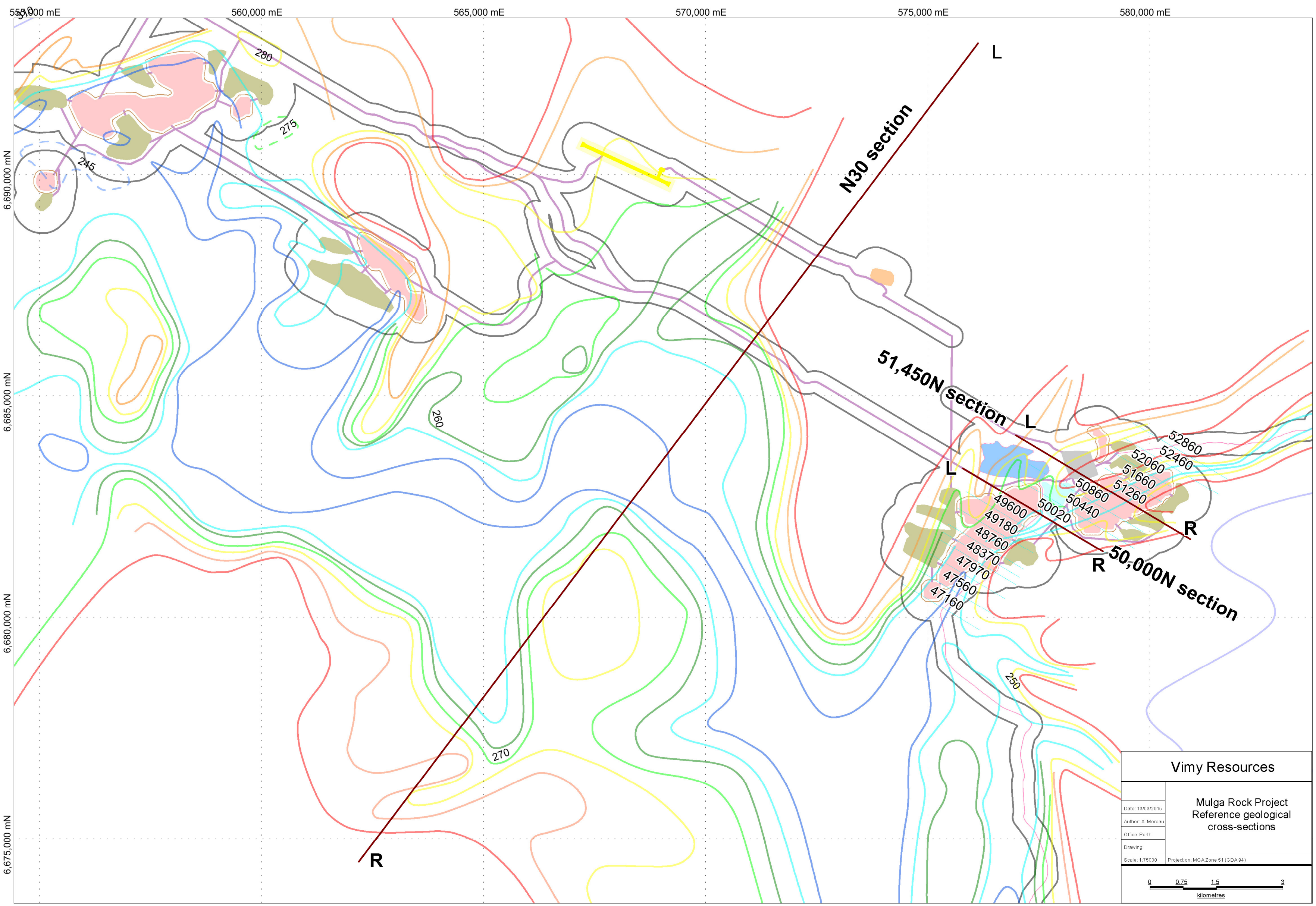
MODEL-CALCULATED FLOWPATHS

FOR1,000 YEARS FROM

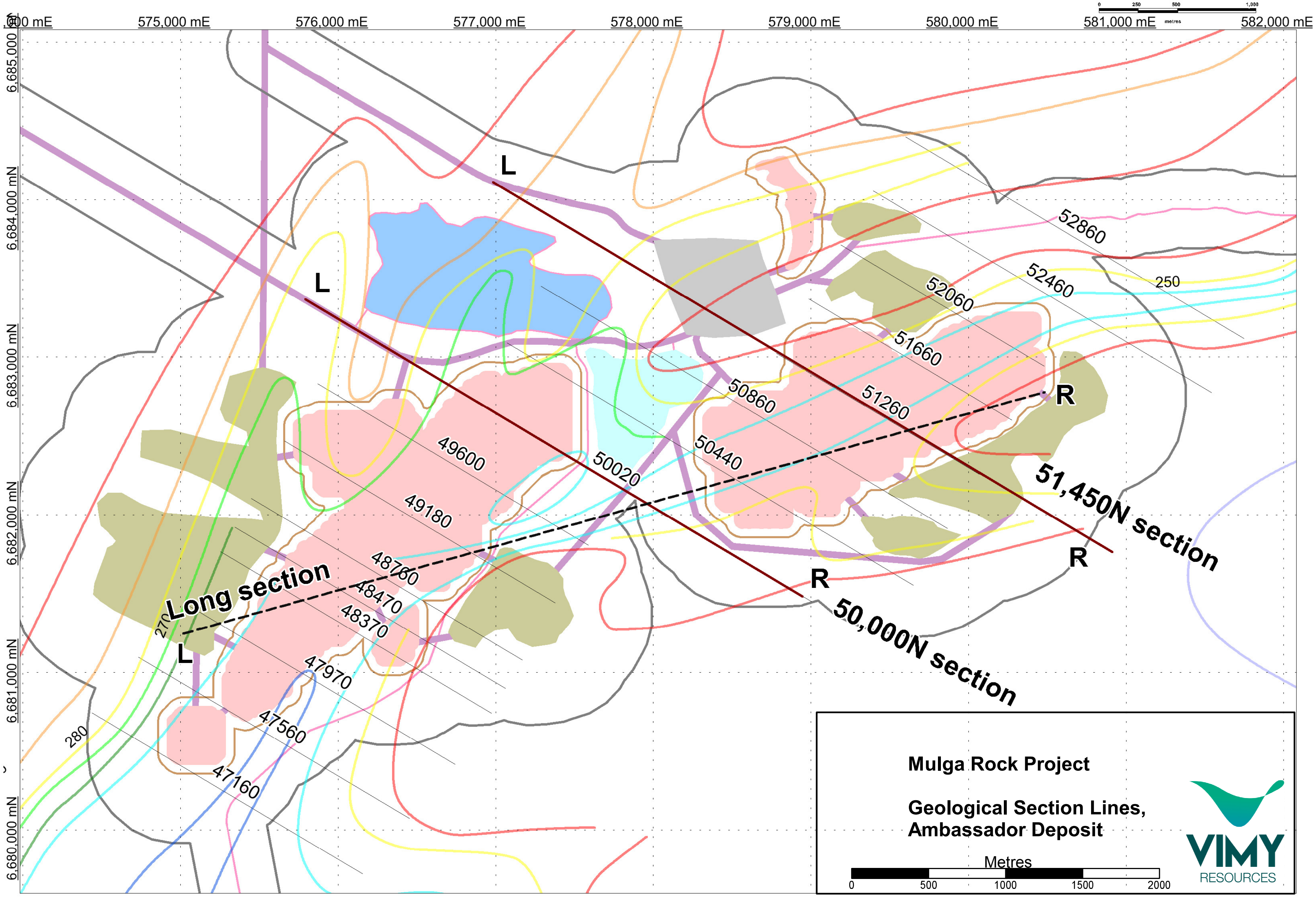
THE END OF MINING (LAYER 3)

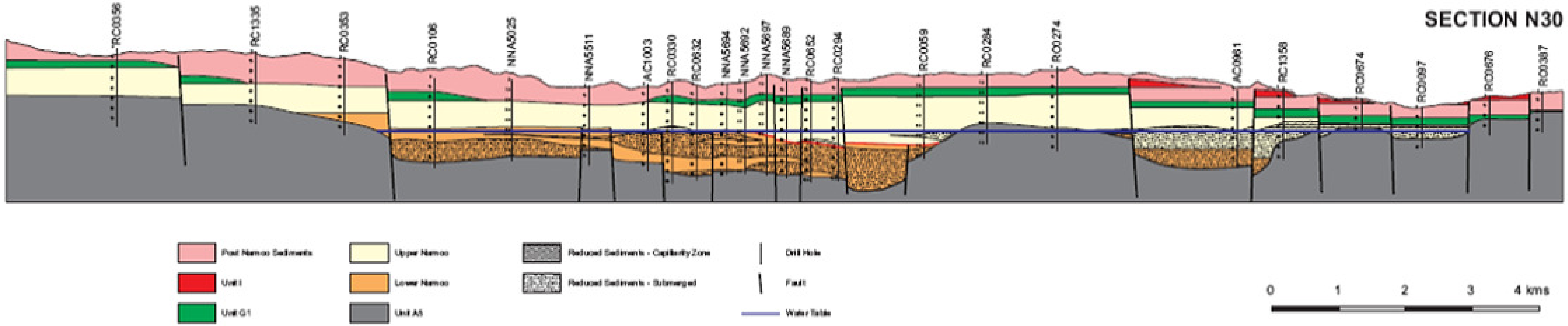
Rockwater Pty Ltd

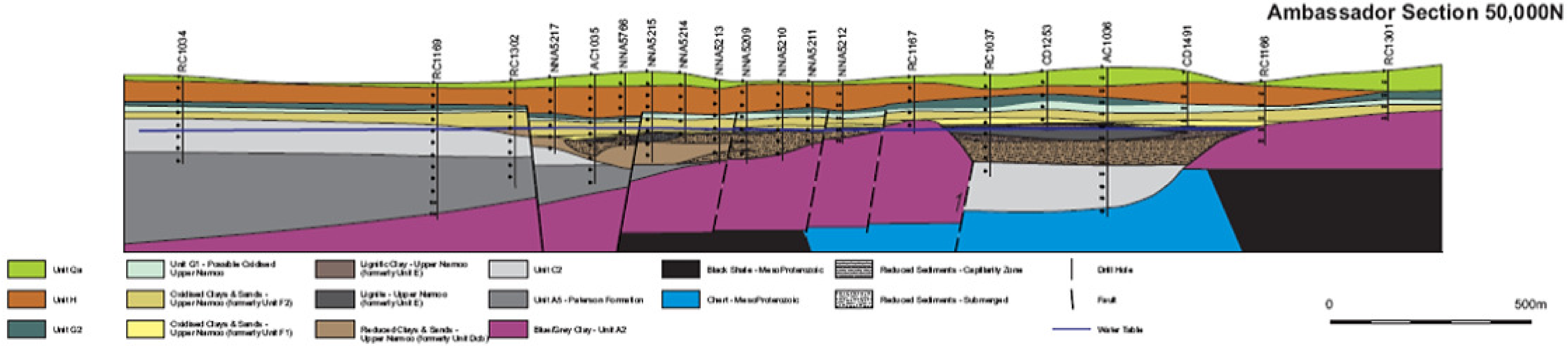
APPENDIX I
GEOLOGICAL SECTIONS

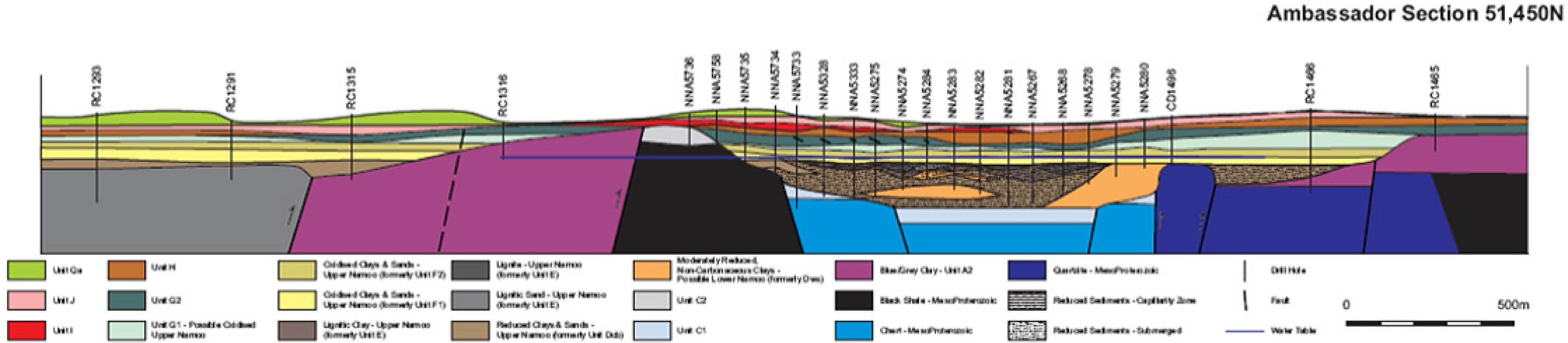


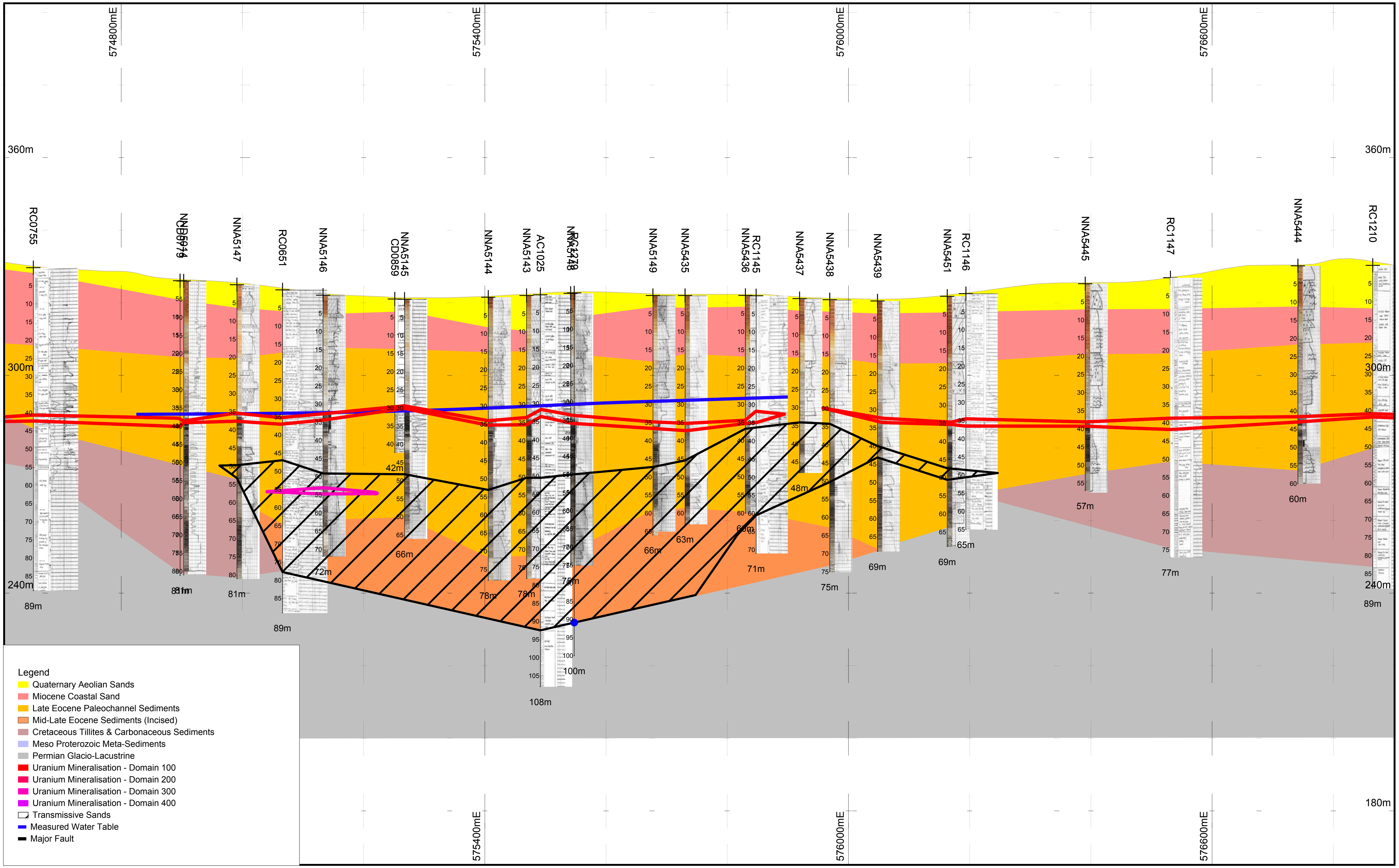
555,000 mE
560,000 mE
565,000 mE
570,000 mE
575,000 mE
580,000 mE
6,690,000 mN
6,685,000 mN
6,680,000 mN
6,675,000 mN
280
275
245
260
270
250
N30 section
51,450N section
50,000N section
L
R
52860
52460
52060
51660
51260
50860
50440
50020
49600
49180
48760
48370
47970
47560
47160
Vimy Resources
Date: 13/03/2015
Author: X. Moreau
Office: Perth
Drawing:
Scale: 1:75000
Mulga Rock Project
Reference geological
cross-sections
Projection: MGA Zone 51 (GDA 94)
0
0.75
1.5
3
kilometres


575,000 mE
576,000 mE
577,000 mE
578,000 mE
579,000 mE
580,000 mE
581,000 mE
582,000 mE
6,685,000 mN
6,684,000 mN
6,683,000 mN
6,682,000 mN
6,681,000 mN
6,680,000 mN
L
R
Long section
50,000N section
51,450N section
52860
52460
52060
51660
51260
50860
50440
50020
49600
49180
48760
48470
48370
47970
47560
47160
250
270
280
Mulga Rock Project
Geological Section Lines,
Ambassador Deposit
Metres
0
500
1000
1500
2000
VIMY
RESOURCES


SECTION N30
Post Namoo Sediments
Unit I
Unit G1
Upper Namoo
Lower Namoo
Unit A5
Reduced Sediments - Capillarity Zone
Reduced Sediments - Submerged
Drill Hole
Fault
Water Table
0 1 2 3 4 kms


Ambassador Section 50,000N
Unit Qa
Unit H
Unit G2
Unit G1 - Possible Oxidised Upper Namoo
Oxidised Clays & Sands - Upper Namoo (formerly Unit F2)
Oxidised Clays & Sands - Upper Namoo (formerly Unit F1)
Lignitic Clay - Upper Namoo (formerly Unit E)
Lignite - Upper Namoo (formerly Unit E)
Reduced Clays & Sands - Upper Namoo (formerly Unit Dcb)
Unit C2
Unit A5 - Paterson Formation
Blue/Grey Clay - Unit A2
Black Shale - MesoProterozoic
Chert - MesoProterozoic
Reduced Sediments - Capillarity Zone
Reduced Sediments - Submerged
Drill Hole
Fault
Water Table
0 500m


Ambassador Section 51,450N
Unit Qa
Unit J
Unit I
Unit H
Unit G2
Unit G1 - Possible Oxidised Upper Namoo
Oxidised Clays & Sands - Upper Namoo (formerly Unit F2)
Oxidised Clays & Sands - Upper Namoo (formerly Unit F1)
Lignitic Clay - Upper Namoo (formerly Unit E)
Lignite - Upper Namoo (formerly Unit E)
Lignitic Sand - Upper Namoo (formerly Unit E)
Reduced Clays & Sands - Upper Namoo (formerly Unit Dcb)
Moderately Reduced, Non-Carbonaceous Clays - Possible Lower Namoo (formerly Dws)
Unit C2
Unit C1
Blue/Grey Clay - Unit A2
Black Shale - MesoProterozoic
Chert - MesoProterozoic
Quartzite - MesoProterozoic
Reduced Sediments - Capillarity Zone
Reduced Sediments - Submerged
Drill Hole
Fault
Water Table
0 500m



VIMY RESOURCES

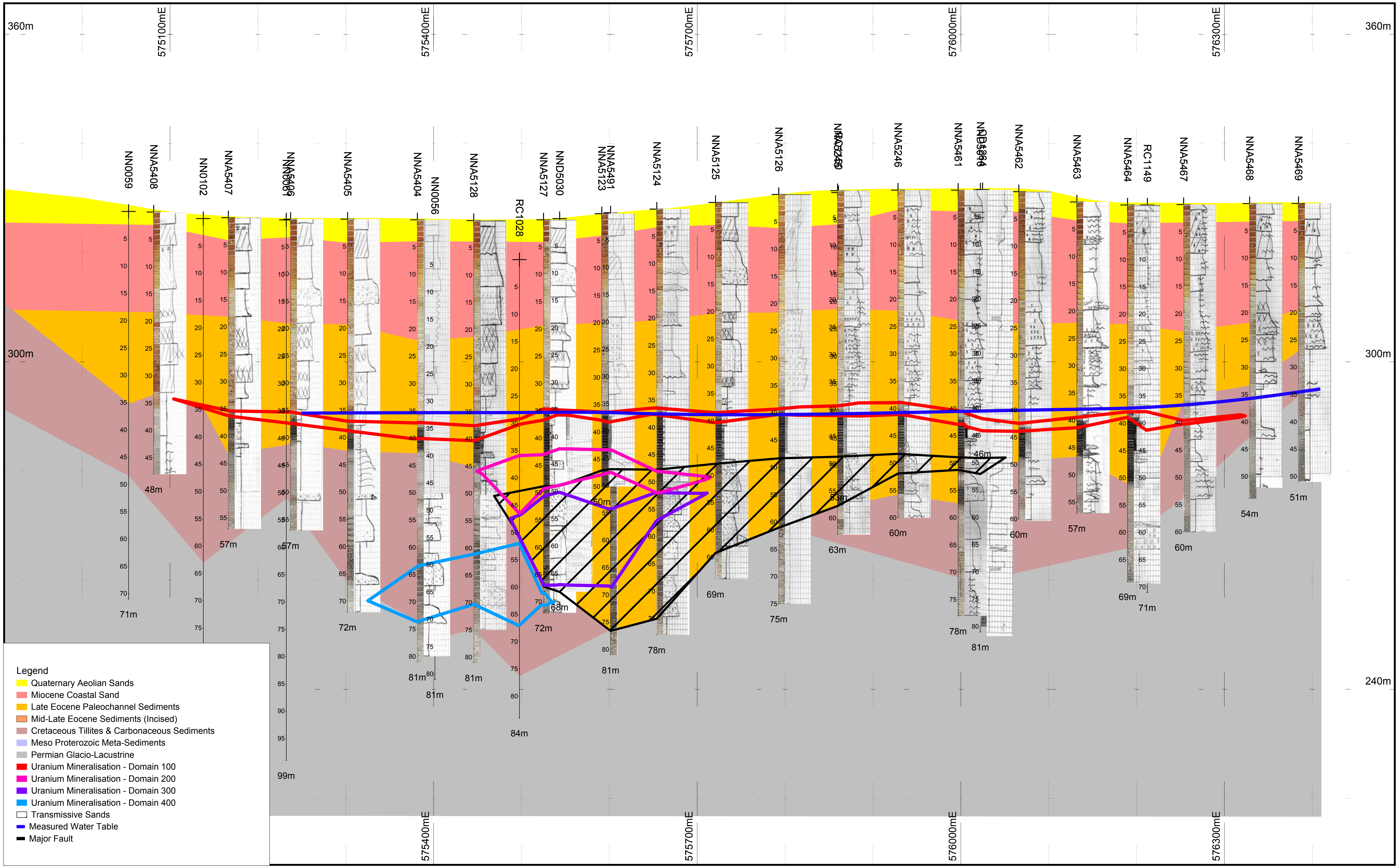
X Scale = 1 : 7047.34
Y Scale = 1 : 1009.47

Plot Date	Sheet
22-Apr-2015	1 of 1

Plot File: 47060N_Hydrology

100 0 100m

Ambassador West Local Northing - 47060N



VIMY RESOURCES

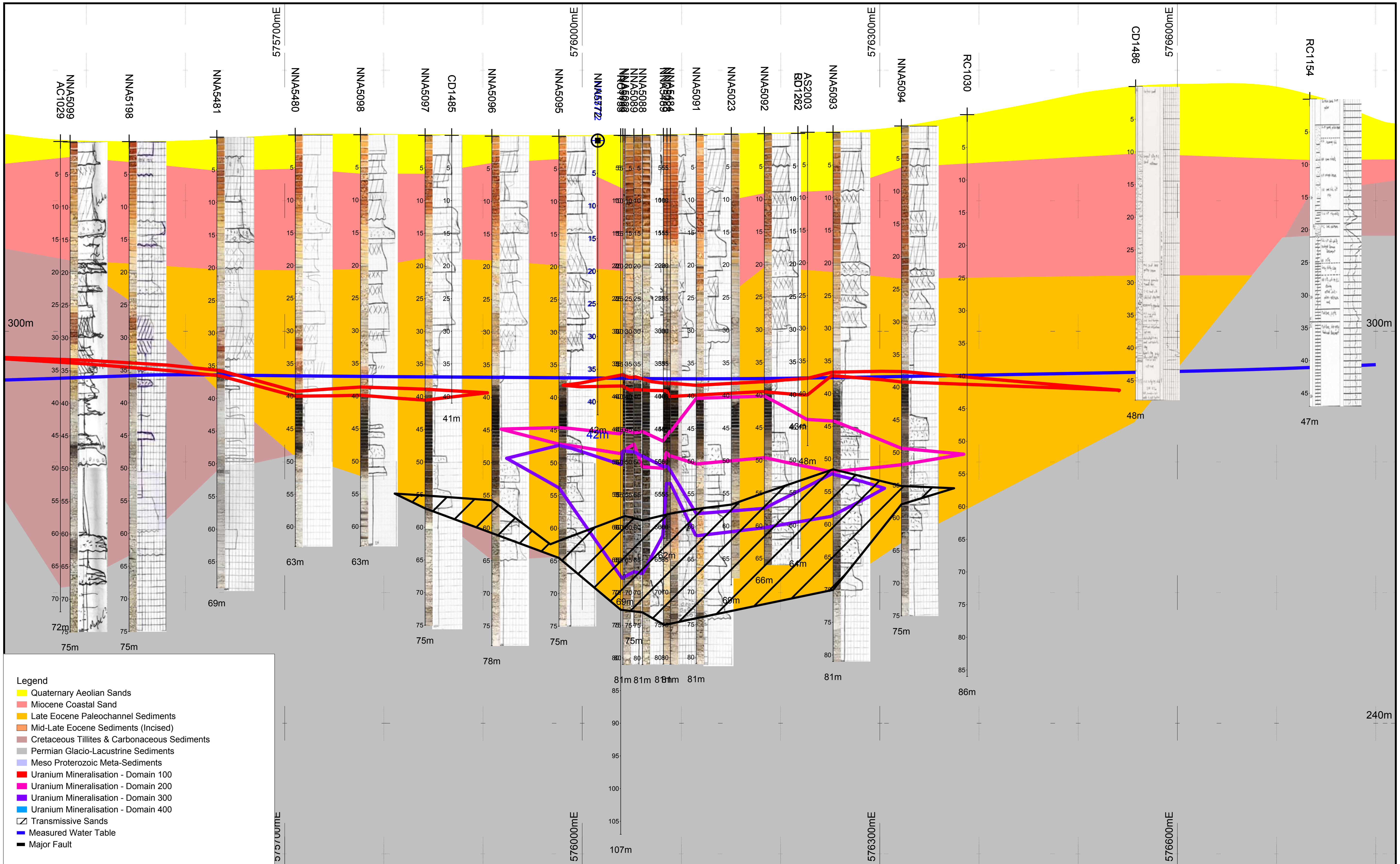
X Scale = 1 : 4856.47
Y Scale = 1 : 671.29

Plot Date	Sheet
22-Apr-2015	1 of 1

Plot File: 47970N_Hydrology

100 0 100m

Ambassador West
Local Northing - 47970N

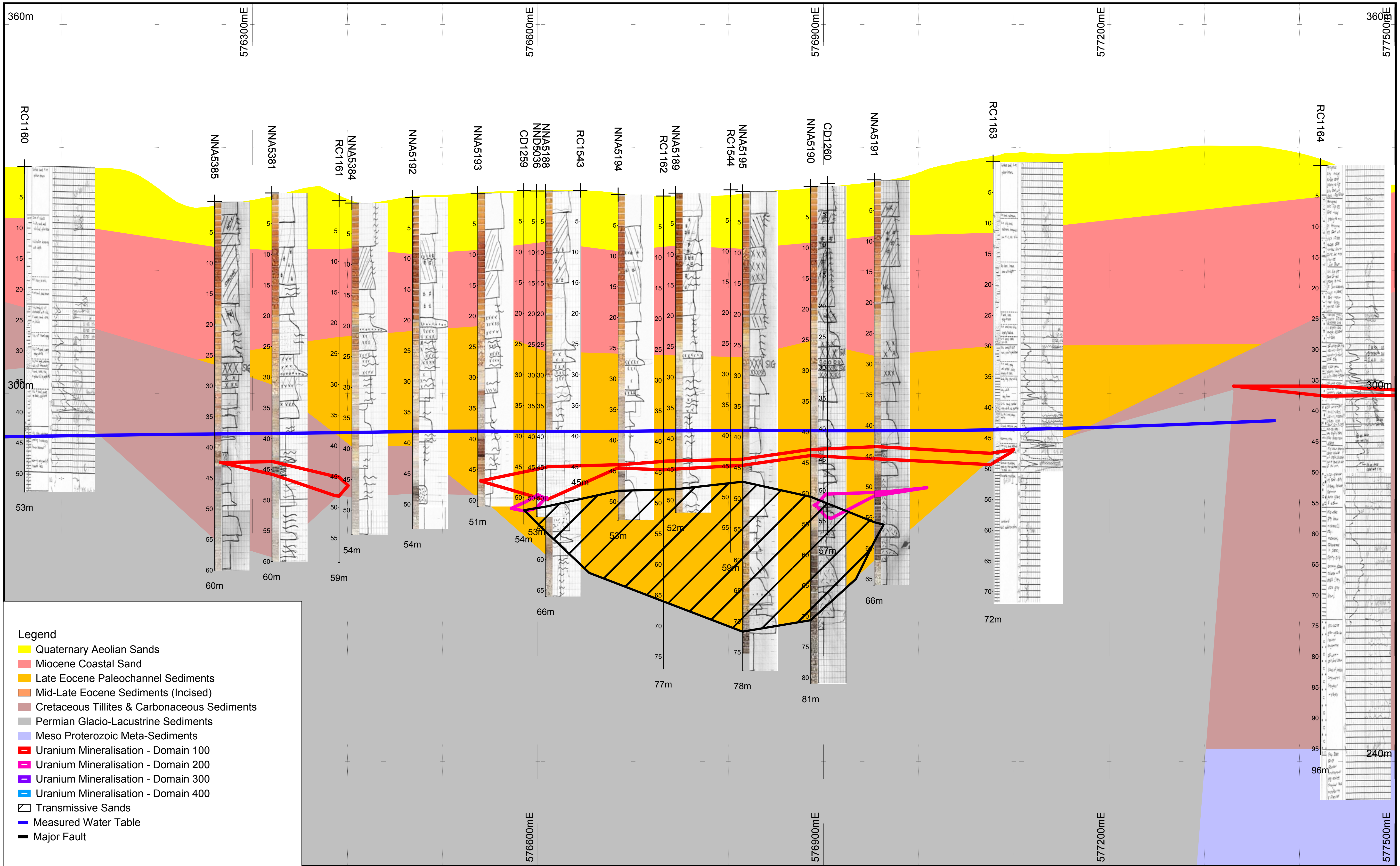


Legend
- Quaternary Aeolian Sands
- Miocene Coastal Sand
- Late Eocene Paleochannel Sediments
- Mid-Late Eocene Sediments (Incised)
- Cretaceous Tillites & Carbonaceous Sediments
- Permian Glacio-Lacustrine Sediments
- Meso Proterozoic Meta-Sediments
- Uranium Mineralisation - Domain 100
- Uranium Mineralisation - Domain 200
- Uranium Mineralisation - Domain 300
- Uranium Mineralisation - Domain 400
- Transmissive Sands
- Measured Water Table
- Major Fault

VIMY RESOURCES

X Scale = 1 : 4305.41 Y Scale = 1 : 561.08	Plot Date 22-Apr-2015	Sheet 1 of 1
	Plot File: 48760N_Hydrology	
100	0	100m

Ambassador West
Local Northing - 48760N



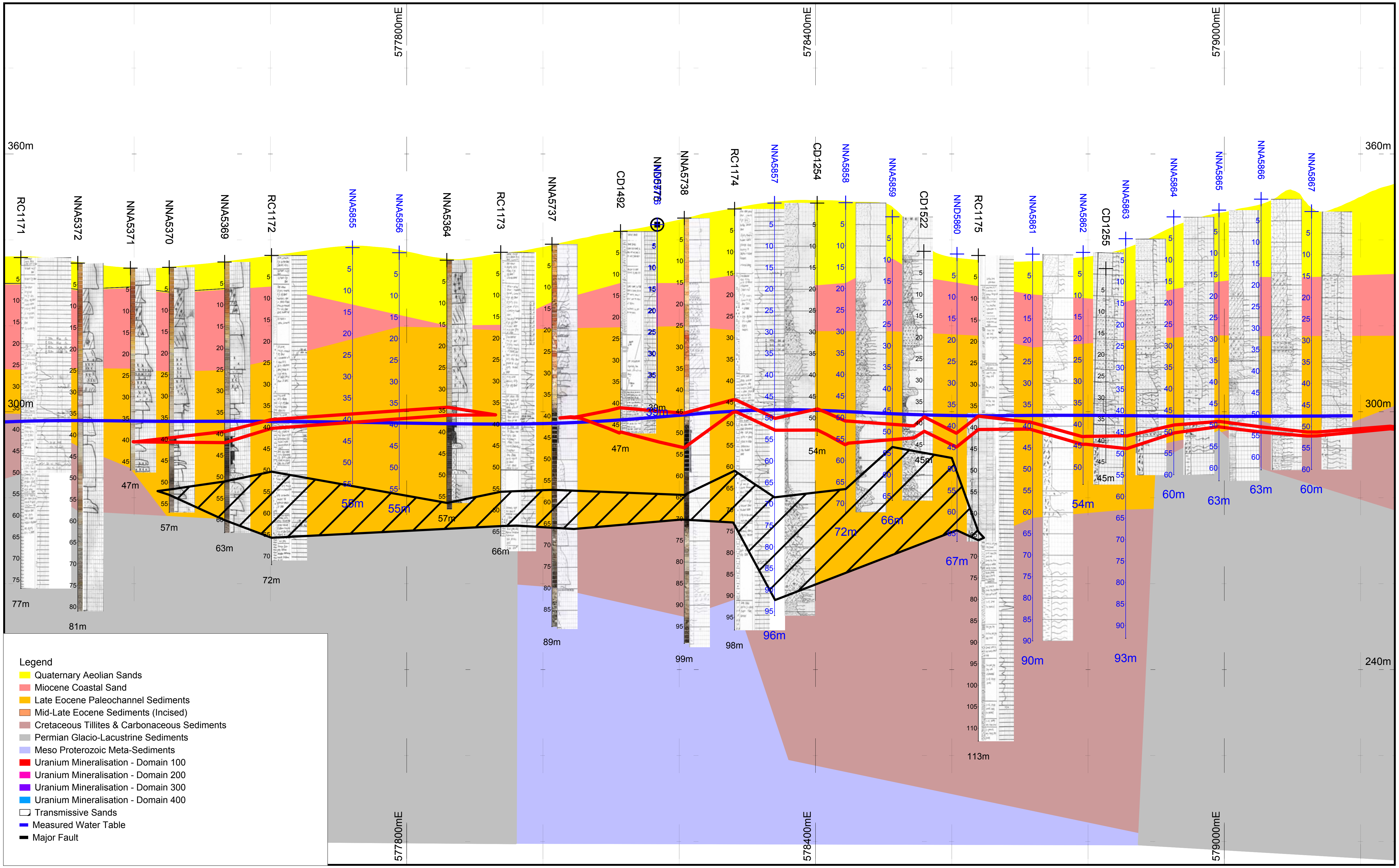
VIMY RESOURCES

X Scale = 1 : 4485.38
Y Scale = 1 : 597.08

Plot Date	Sheet
22-Apr-2015	1 of 1
Plot File: 49600N_Hydrology	

100 0 100m

Ambassador West
Local Northing - 49600N



VIMY RESOURCES

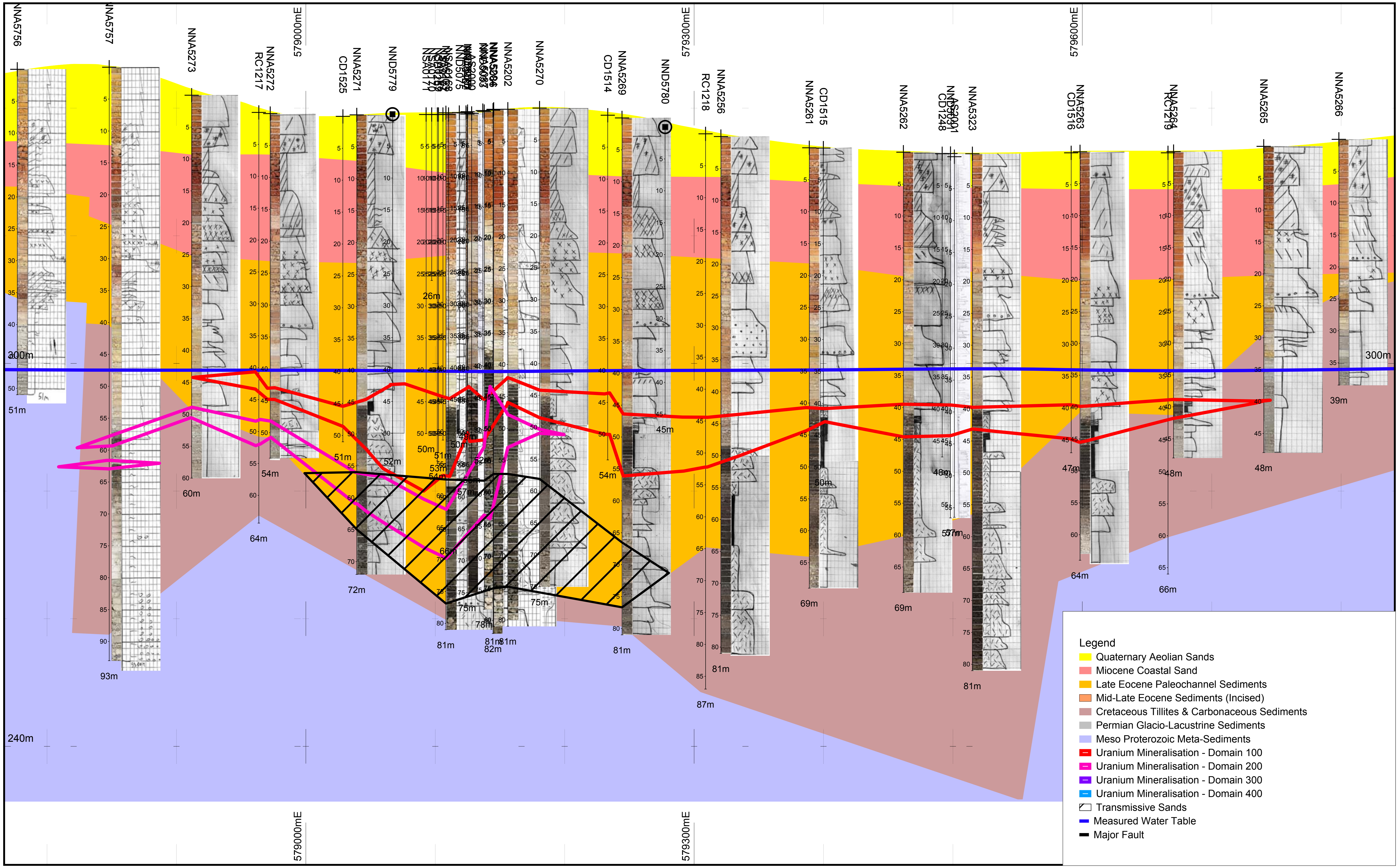
X Scale = 1 : 6262.94
Y Scale = 1 : 852.59

Plot Date	Sheet
22-Apr-2015	1 of 1

Plot File: 50440N_Hydrology

100 0 100m

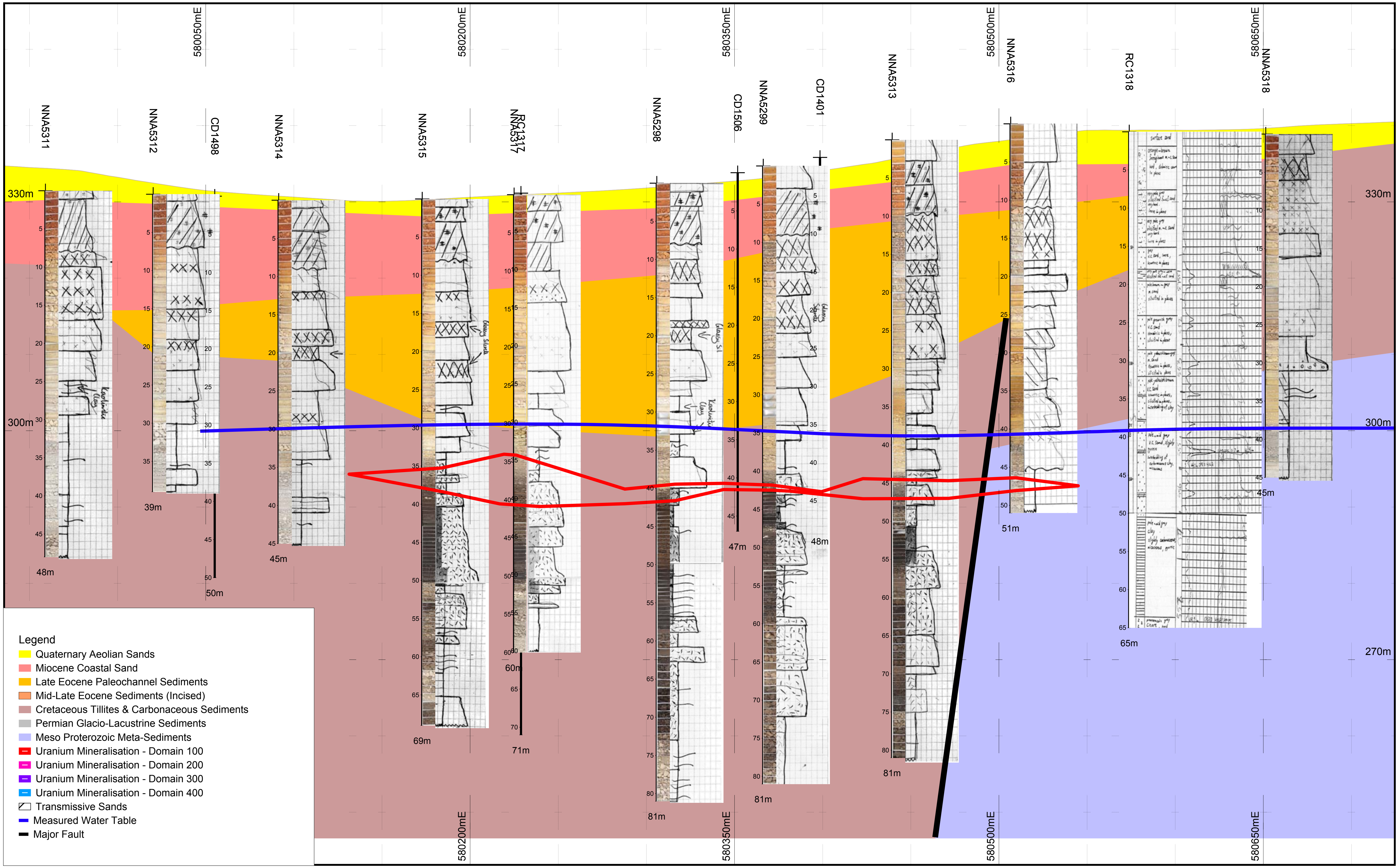
Ambassador West to East Local Northing - 50440N



VIMY RESOURCES

X Scale = 1 : 3270.37 Y Scale = 1 : 574.07	Plot Date 22-Apr-2015	Sheet 1 of 1
	Plot File: 51250N_Hydrology	
50 0 50m		

Ambassador East
Local Northing - 51250N



VIMY RESOURCES

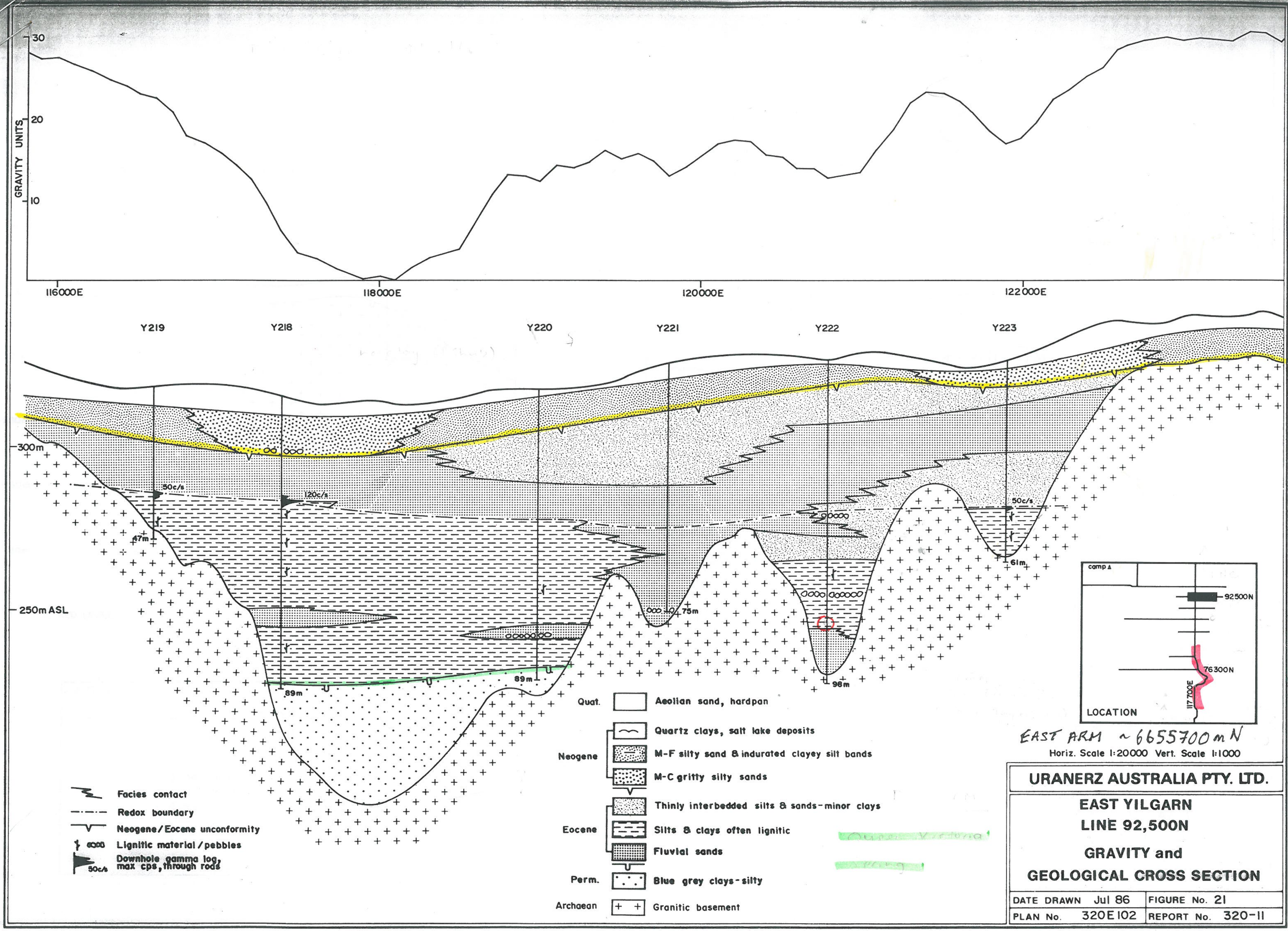
X Scale = 1 : 2400.93
Y Scale = 1 : 480.19

Plot Date	Sheet
21-Apr-2015	1 of 1

Plot File: 52060N_Hydrology2

50 0 50m

Ambassador East
Local Northing - 52060N



GRAVITY UNITS
30
20
10
116000E
118000E
120000E
122000E
Y219
Y218
Y220
Y221
Y222
Y223
300m
250m ASL
50c/s
120c/s
50c/s
47m
89m
89m
75m
98m
61m
Quat.
Aeolian sand, hardpan
Neogene
Quartz clays, salt lake deposits
M-F silty sand & indurated clayey silt bands
M-C gritty silty sands
Eocene
Thinly interbedded silts & sands-minor clays
Silts & clays often lignitic
Fluvial sands
Perm.
Blue grey clays-silty
Archaean
Granitic basement
Facies contact
Redox boundary
Neogene/Eocene unconformity
Lignitic material/pebbles
Downhole gamma log, max cps, through rods
50c/s
camp
92500N
76300N
117700E
LOCATION
EAST ARM ~6655700mN
Horiz. Scale 1:20000 Vert. Scale 1:1000
URANERZ AUSTRALIA PTY. LTD.
EAST YILGARN
LINE 92,500N
GRAVITY and
GEOLOGICAL CROSS SECTION
DATE DRAWN Jul 86
FIGURE No. 21
PLAN No. 320E102
REPORT No. 320-11

APPENDIX II
RESULTS OF CHEMICAL ANALYSES

APPENDIX II-a
Emperor and Shogun Raw Water Chemistry Data

Area	Hole ID	Date Sampled	GDA East	GDA North	Ca	Mg	Na	K	Cl	HCO3	SO4	NO3	RL	Sample DEPTH	Sample RL	T.F.R.	TDS	Cond	pH
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m AHD	m	m AHD	mg/L	mg/L	µS/cm	
EMP + SHO	AC1139	27/3/1984	550163	6690138	483	1,635	14,880	453	25,420	15	3,844	14.4	351.8					73,500	6.70
EMP + SHO	AC1138	27/3/1984	550748	6690109	488	1,585	14,880	448	25,210	37	3,522	16.6	346.7					73,900	7.10
EMP + SHO	AC1051		551420	6690908									346.2	65	281.2	45,760	45,760		7.82
EMP + SHO	AC1050		552025	6690548									342.4	53	289.4	52,670	52,670		7.75
EMP + SHO	AC1204	8/07/1984	552690	6686672	535	3,995	45,000	935	75,620	<0.6	13,600	2.8	325.9	75	250.9	146,900	146,900	229,600	4.03
EMP + SHO	AC1203	8/07/1984	552809	6687176	535	3,945	44,380	925	73,840	<0.6	13,480	2	328.1	?		139,500	139,500	218,000	3.27
EMP + SHO	AC0865	25/1/1984	552822	6690867	561	2,030	21,550	625	34,440	<.6	7,542	2.2	335.6	64.5	271.1			103,700	4.20
EMP + SHO	AC0865	25/1/1984	552822	6690867	661	2,355	28,050	670	44,590	<.6	7,302	2	335.6	73	262.6			128,800	3.80
EMP + SHO	NNA5707	Feb-12	552911	6690815									334.4	60	274.4		43,552	77,649	4.54
EMP + SHO	AC1201	8/07/1984	553097	6687579	535	3,895	44,380	925	74,550	<0.6	13,440	0.5	322.3	71.5	250.8	138,900	138,900	217,000	3.44
EMP + SHO	AC1200	8/07/1984	553353	6688015	535	3,745	40,630	805	68,870	<0.6	13,090	0.7	320.9	53.5	267.4	135,900	135,900	212,400	3.57
EMP + SHO	AC1202	8/07/1984	553492	6687354	560	2,895	28,500	540	48,990	<0.6	9,262	1.1	319.4	74	245.4	99,200	99,200	155,000	3.65
EMP + SHO	NNA5708	Feb-12	553528	6690810									334.7	72	262.7		67,522	117,939	3.50
EMP + SHO	AC1198	8/07/1984	553529	6688496	350	2,645	27,000	535	46,150	<0.6	8,178	1	320.0	58	262.0	92,160	92,160	144,000	3.87
EMP + SHO	NNA5709	Feb-12	553775	6690673									332.6	59	273.6		39,387	70,424	3.68
EMP + SHO	NNA5709	Feb-12	553775	6690673									332.6	95	237.6		95,487	164,689	3.34
EMP + SHO	AC1196	8/07/1984	553797	6688914	268	1,098	11,750	328	19,880	2	2,890	0.9	318.6	58	260.6	41,470	41,470	64,800	5.16
EMP + SHO	AC1199	8/07/1984	553996	6688207	535	3,895	43,130	925	72,420	<0.6	13,020	0.9	312.8	60	252.8	142,100	142,100	222,000	3.20
EMP + SHO	AC1195	8/07/1984	554080	6689319	318	1,323	13,750	358	23,080	1	3,846	0.4	323.4	41.5	281.9	48,640	48,640	76,000	4.69
EMP + SHO	AC1197	8/07/1984	554243	6688648	340	2,395	25,500	535	42,600	<0.6	6,467	2.1	313.9	53.5	260.4	85,500	85,500	133,600	3.65
EMP + SHO	CD0737	27/9/1982	555622	6691014	232	947	10,800	224	17,680	121	2,460	0.1	324.6					55,600	7.60
EMP + SHO	AC1246		556088	6691253									327.5	46.8	280.7	37,630	37,630		3.77
EMP + SHO	NNA5710	Feb-12	556539	6693155									334.9	60	274.9		35,732	64,559	3.60
EMP + SHO	NNA5711	Feb-12	556682	6693055									335.4	60	275.4		34,797	62,434	3.48
EMP + SHO	MSWB003	16/02/2012	556958	6690702	340	1,800	19,000	580	31,000	4	4,000	<0.1	318.4	78	240.4		57,000	94,000	5.00
EMP + SHO	MSWB003	24/07/2012	556958	6690702									318.4	78	240.4		57,000	78,000	4.80
EMP + SHO	MSWB003	20/08/2012	556958	6690702									318.4	78	240.4		55,000	76,000	4.70
EMP + SHO	MSWB003	17/09/2012	556958	6690702									318.4	78	240.4		56,000	83,000	4.70
EMP + SHO	MSWB003	28/10/2012	556958	6690702	600	1,500	16,000	610	26,000	6	2,800		318.4	78	240.4		57,000	82,000	4.80
EMP + SHO	MSWB003	26/11/2012	556958	6690702									318.4	78	240.4		58,000	81,000	4.50
EMP + SHO	MSWB003	22/01/2013	556958	6690702									318.4	78	240.4		52,000	74,000	4.50
EMP + SHO	CD0735	27/11/1984	557121	6690615	550	550	28,100	695	48,200	<5	8,560	20	317.5					105,000	4.10
EMP + SHO	CD0735	Late 1990-Mid 1991	557121	6690615	457	3,269	30,342	685	50,900	155	9,570		317.5				95,423		5.82
EMP + SHO	MSWB001	17/02/2012	557176	6690643	480	2,500	26,000	880	40,000	<1	5,600	<1	317.3	74.5	242.8		78,000	124,900	4.40
EMP + SHO	MSWB001	24/07/2012	557176	6690643									317.3	74.5	242.8		79,000	102,100	4.00
EMP + SHO	MSWB001	20/08/2012	557176	6690643									317.3	74.5	242.8		72,000	100,000	3.90
EMP + SHO	MSWB001	17/09/2012	557176	6690643									317.3	74.5	242.8		79,000	108,130	3.90
EMP + SHO	MSWB001	28/10/2012	557176	6690643	420	2,300	23,000	870	40,000	<5	5,100		317.3	74.5	242.8		75,000	108,766	4.20
EMP + SHO	MSWB001	26/11/2012	557176	6690643									317.3	74.5	242.8		81,000	110,000	3.90
EMP + SHO	MSWB001	22/01/2013	557176	6690643									317.3	74.5	242.8		75,000	96,000	3.80
EMP + SHO	MSWB002	14/11/2011	557225	6690545									317.0	72	245.0		86,000	130,000	4.00
EMP + SHO	MSWB002	22/01/2012	557225	6690545	470	2,900	28,000	1,000	45,000	4	7,600	<2	317.0	72	245.0		88,000	168,000	5.20
EMP + SHO	MSWB002	16/02/2012	557225	6690545	510	3,200	32,000	860	45,000	2	7,700	<0.1	317.0	72	245.0		87,000	142,200	5.80
EMP + SHO	MSWB002	18/03/2012	557225	6690545									317.0	72	245.0		88,000	153,600	5.70
EMP + SHO	MSWB002	15/04/2012	557225	6690545									317.0	72	245.0		88,000	143,000	6.00
EMP + SHO	MSWB002	14/05/2012	557225	6690545	470	2,500	25,000	920	4,700	5	7,700	<0.1	317.0	72	245.0		89,000	144,400	5.80
EMP + SHO	MSWB002	14/05/2012	557225	6690545						5			317.0	72	245.0				
EMP + SHO	MSWB002	28/06/2012	557225	6690545									317.0	72	245.0		87,000	146,400	6.00
EMP + SHO	MSWB002	24/07/2012	557225	6690545									317.0	72	245.0		90,000	108,400	6.00
EMP + SHO	MSWB002	20/08/2012	557225	6690545									317.0	72	245.0		86,000	108,400	5.70
EMP + SHO	MSWB002	17/09/2012	557225	6690545									317.0	72	245.0		89,000	117,884	6.00
EMP + SHO	MSWB002	28/10/2012	557225	6690545	440	2,600	25,000	930	46,000	21	6,300		317.0	72	245.0		81,000	113,272	5.70
EMP + SHO	MSWB002	22/01/2013	557225	6690545									317.0	72	245.0		81,000	103,170	6.20
EMP + SHO	RC0885		557572	6691797									321.4			78,000	83,600		
EMP + SHO	RC0502		557575	6691799									321.4	67	254.4	76,670	76,670		4.15
EMP + SHO	RC0502	15/7/1983	557575	6691799	600	2,350	21,800	464	37,060	4	6,300	0.7	321.4					117,200	5.10
EMP + SHO	RC0502	25/11/1983	557575	6691799	504	2,150	22,900	509	39,050	<.6	6,949	2.1	321.4					120,200	3.90
EMP + SHO	RC0502	31/10/1984	557575	6691799	620	620	21,800	515	37,400	<5	6,790	18	321.4					87,000	4.00
EMP + SHO	RC0502	Late 1990-Mid 1991	557575	6691799	511	1,930	19,066	444	32,900	24	5,920		321.4				60,854		5.11
EMP + SHO	CD0723	27/9/1982	557699	6691244	252	1,160	14,400	251	22,930	<.6	3,070	0.2	316.7					71,200	4.00
EMP + SHO	NNA5699	Feb-12	559222	6690338									315.7	63	252.7		76,107	132,644	3.34
EMP + SHO	NNA5700	Feb-12	559348	6690242									314.9	42	272.9		80,102	139,359	3.51
EMP + SHO	NNA5700	Feb-12	559348	6690242									314.9	69	245.9		33,012	59,289	3.45
EMP + SHO	NNA5703	Feb-12	559383	6690004									308.0	34	274.0		10,317	19,509	2.97
EMP + SHO	NNA5703	Feb-12	559383	6690004									308.0	58	250.0		74,577	130,349	3.43
EMP + SHO	NNA5701	Feb-12	559502	6690171									312.7	24	288.7		6,067	11,689	3.95
EMP + SHO	NNA5701	Feb-12	559502	6690171									312.7	60	252.7		73,982	128,734	3.29
EMP + SHO	NNA5702	Feb-12	559580	6690341									315.8	30	285.8		23,237	42,459	3.60
EMP + SHO	NNA5702	Feb-12	559580	6690341									315.8	68	247.8		70,582	123,209	3.65
EMP + SHO	NNA5705	Feb-12	559580	6689903									308.0	36	272.0		29,272	52,829	2.89
EMP + SHO	NNA5705	Feb-12	559580	6689903									308.0	57	251.0		74,577	128,989	3.29
EMP + SHO	NNA5698	Feb-12	559640	6690073									309.0	39	270.0		38,537	68,894	3.57
EMP + SHO	NNA5698	Feb-12	559640	6690073									309.0	45	264.0		39,047	69,999	3.55
EMP + SHO	AC1192	8/07/1984	559672	6685994	475	2,545	25,000	500	41,890	1	7,399	1.4	318.0	60	258.0	85,500	85,500	133,600	3.98
EMP + SHO	AC1191	8/07/1984	559685	6686563	485	3,195	34,500	675	56,090	1	10,330	1.2	318.5	71	247.5	113,400	113,400	177,200	3.56
EMP + SHO	NNA5704	Feb-12	559709	6689880									308.2	36	272.2		28,932	52,404	3.50
EMP + SHO	AC1193	8/07/1984	560019	6685786	460	3,095	30,500	595	51,120	1	10,100	1	323.3	68	255.3	104,700	104,700	163,600	3.85
EMP + SHO	RC1194	8/07/1984	560043	6688135	475	2,595	23,500	445	39,050	1	8,100	1.5	312.8	?		81,280	81,280	127,000	3.70
EMP + SHO	AC0891	25/1/1984	560339	6689173	636	1,030	11,030	292	17,470	<.6	4,562	4.6	308.2	35.5	272.7			56,400	4.00
EMP + SHO	RC1329	1985	561251	6694849	710	1,200	12,350	250	21,160	166	3,870	12.3	349.2	Composite			41,340		7.90
EMP + SHO	RC1329	28/10/1985	561251	6694849									349.2	65	284.2		51,200	80,000	6.70
EMP + SHO	RC1329	28/10/1985	561251	6694849									349.2	75	274.2		40,768	63,700	6.20
EMP + SHO	NNA5719	Feb-12	562475	6688171									317.8	48	269.8		52,732	93,374	3.22
EMP + SHO	NNA5719	Feb-12	562475	6688171									317.8	69	248.8		72,962	127,374	2.99
EMP + SHO	NNA5713	Feb-12	562564	6688343									318.4	42	276.4		35,562	64,134	3.54
EMP + SHO	NNA5713	Feb-12	562564	6688343									318.4	51	267.4		44,657	79,434	3.41
EMP + SHO	NNA5718	Feb-12	562769	6687990									323.3	69	254.3		73,472	128,394	3.17
EMP + SHO	NNA5718	Feb-12	562769	6687990									323.3	78	245.3		76,787	133,834	2.91
EMP + SHO	NNA5714	Feb-12	562817	6688183									319.2	45	274.2		43,552	77,564	3.63
EMP + SHO	NNA5717	Feb-12	563038	6687833									326.1	60	266.1		53,667	95,074	3.35
EMP + SHO	NNA5717	Feb-12	563038	6687833									326.1	60	266.1		54,942	96,604	3.45
EMP + SHO	Shogun Costean	13/12/1983	563112	6687494	1,020	1,275	12,750	317	22,150	<.6	4,618	1.5	292.0					69,700	3.40
EMP + SHO	NNA5715	Feb-12	563130	6688070									319.8	51	268.8		32,672	58,609	3.51
EMP + SHO	NNA5724	Feb-12	563130	6687367									318.6	45	273.6		37,872	70,207	3.46

Hole ID	Date Sampled	ORP	Hard	Alkalinity	OH	Fe	Al	F	Si	Br	I	U	Th	Au	As_Sol	Ba_Sol	Cd_Sol	Cr_Sol	Cu_Sol	Co_Sol	Pb_Sol	Mn_Sol	Ni_Sol	Sb_Sol	Sr	Zn	V_Sol	W
		mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/L	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
AC1139	27/3/1984					1.8																						
AC1138	27/3/1984					2.6																						
AC1051												<5	<5															
AC1050												<5	6															
AC1204	8/07/1984					190						<5	<5															
AC1203	8/07/1984					140						<5	9															
AC0865	25/1/1984					110		0.7	35			30																
AC0865	25/1/1984					2.6		0.8	25			30																
NNA5707	Feb-12																											
AC1201	8/07/1984					34.5						<5	<5															
AC1200	8/07/1984					26						<5	<5															
AC1202	8/07/1984					11						7	7															
NNA5708	Feb-12																											
AC1198	8/07/1984					10						<5	<5															
NNA5709	Feb-12																											
NNA5709	Feb-12																											
AC1196	8/07/1984					2.9						<5	<5															
AC1199	8/07/1984					27						<5	6															
AC1195	8/07/1984					2.1						<5	<5															
AC1197	8/07/1984					18						<5	<5															
CD0737	27/9/1982					1.2		0.3	<2																			
AC1246												<5	<5															
NNA5710	Feb-12																											
NNA5711	Feb-12																											
MSWB003	16/02/2012		8200	4	<1	13											<0.1		<0.25		<0.01	0.67						
MSWB003	24/07/2012																											
MSWB003	20/08/2012																											
MSWB003	17/09/2012																											
MSWB003	28/10/2012		6800	6	<5	9.6	3.9								<0.05		<0.01		<0.01	0.05	<0.03		0.09			0.23		
MSWB003	26/11/2012																											
MSWB003	22/01/2013																											
CD0735	27/11/1984					6.8																						
CD0735	Late 1990-Mid 1991	108				50	0.8		3.3	71.4	0.94	<2		0.004		0.025		<0.002	0.012	<0.005	0.008	1.8	0.02	<0.005	8.8	0.015	<0.002	<0.0015
MSWB001	17/02/2012		12000	<1	<1	13											0.0033		0.006		0.85	2.8						
MSWB001	24/07/2012																											
MSWB001	20/08/2012																											
MSWB001	17/09/2012																											
MSWB001	28/10/2012		11000	<5	<5	0.25	8.2								<0.05		<0.01		<0.01	0.01	0.54		0.02			0.08		
MSWB001	26/11/2012																											
MSWB001	22/01/2013																											
MSWB002	14/11/2011																											
MSWB002	22/01/2012		13000		<1	10											0.002		9.6		0.56	1						
MSWB002	16/02/2012		15000	2	<1	83											<0.1		3		0.021	1.4						
MSWB002	18/03/2012																											
MSWB002	15/04/2012																											
MSWB002	14/05/2012		12000	5	<5	13									<0.03		0.009		2.6	0.011	0.18	0.98	0.68			26		
MSWB002	14/05/2012			5	<5																							
MSWB002	28/06/2012																											
MSWB002	24/07/2012																											
MSWB002	20/08/2012																											
MSWB002	17/09/2012																											
MSWB002	28/10/2012		12000	21	<5	34	1.6								<0.05		<0.01		0.14	<0.01	<0.03		<0.02			0.76		
MSWB002	22/01/2013																											
RC0885																												
RC0502												10	<5															
RC0502	15/7/1983					7.9		0.2	25																			
RC0502	25/11/1983					22						15																
RC0502	31/10/1984					7																						
RC0502	Late 1990-Mid 1991	108				39	0.7		10.7	30.9	0.63	<2		0.002		0.026		0.012	0.004	<0.005	0.017	0.95	0.07	<0.005	7.7	0.155	<0.002	<0.0015
CD0723	27/9/1982					2.1		0.6	<2																			
NNA5699	Feb-12																											
NNA5700	Feb-12																											
NNA5700	Feb-12																											
NNA5703	Feb-12																											
NNA5703	Feb-12																											
NNA5701	Feb-12																											
NNA5701	Feb-12																											
NNA5702	Feb-12																											
NNA5702	Feb-12																											
NNA5705	Feb-12																											
NNA5705	Feb-12																											
NNA5698	Feb-12																											
NNA5698	Feb-12																											
AC1192	8/07/1984					22						<5	<5															
AC1191	8/07/1984					19						<5	<5															
NNA5704	Feb-12																											
AC1193	8/07/1984					23.5						<5	5															
RC1194	8/07/1984					22						<5	<5															
AC0891	25/1/1984					16		0.2	40			<10																
RC1329	1985					<0.05						<5	<5															
RC1329	28/10/1985																											
RC1329	28/10/1985																											
NNA5719	Feb-12																											
NNA5719	Feb-12																											
NNA5713	Feb-12																											
NNA5713	Feb-12																											
NNA5718	Feb-12																											
NNA5718	Feb-12																											
NNA5714	Feb-12																											
NNA5717	Feb-12																											
NNA5717	Feb-12																											
Shogun Costean	13/12/1983					1.6						350	<5															
NNA5715	Feb-12																											
NNA5724	Feb-12																											

APPENDIX II-a

Emperor and Shogun Raw Water Chemistry Data

Area	Hole ID	Date Sampled	GDA East	GDA North	Ca	Mg	Na	K	Cl	HCO3	SO4	NO3	RL	Sample DEPTH	Sample RL	T.F.R.	TDS	Cond	pH	ORP	Hard	Alkalinity	OH	Fe	Al	F	Si	Br	I	U	Th	Au	As_Sol	Ba_Sol	Cd_Sol	Cr_Sol	Cu_Sol	Co_Sol	Pb_Sol	Mn_Sol	Ni_Sol	Sb_Sol	Sr	Zn	V_Sol	W
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m AHD	m	m AHD	mg/L	mg/L	µS/cm		mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/L	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
EMP + SHO	NNA5731	Feb-12	563142	6686527									323.2	69	254.2		39,472	72,707	3.74																											
EMP + SHO	NNA5731	Feb-12	563142	6686527									323.2	69	254.2		40,372	74,607	3.63																											
EMP + SHO	NNA5722	Feb-12	563289	6687498									319.7	48	271.7		41,852	74,589	3.39																											
EMP + SHO	RC0472		563318	6687355									317.7	73	244.7	84,930	84,930		4.33											<5	<5															
EMP + SHO	RC0472	5/07/1982	563318	6687355	595	2,500	26,000	460	41,610	<.6	10,500	2.2	317.7					127,200	4.40					20		0.4				7																
EMP + SHO	RC0472	7/01/1982	563318	6687355	605	3,040	27,400	470	45,440	<.6	11,500	2.2	317.7					136,500	4.00					2.1		0.7	5																			
EMP + SHO	RC0472	25/11/1983	563318	6687355	578	2,600	26,600	539	44,870	<.6	9,416	2.4	317.7					140,400	3.80					36																						
EMP + SHO	RC0472	23/10/1984	563318	6687355	650	650	26,050	560	44,400	<5	9,110	11	317.7					99,000	4.10					21.4																						
EMP + SHO	RC0472	Late 1990-Mid 1991	563318	6687355	582	2,871	25,594	506	43,200	12	9,000		317.7				81,839		5.28	167				30	2		4.4	46.4	0.52	<2		0.009		0.026		0.077	0.013	0.011	0.004	1.45	0.07	<0.005	10.1	0.035	<0.002	<0.0015
EMP + SHO	NNA5725	Feb-12	563348	6687218									316.7	69	247.7		71,572	129,107	3.18																											
EMP + SHO	RC0162	18/11/1984	563414	6687607	790	790	18,200	410	31,500	<5	6,150	18	319.2					75,000	3.80					18.5																						
EMP + SHO	RC0162	Late 1990-Mid 1991	563414	6687607	697	1,640	15,653	338	27,900	15	5,410		319.2				51,725		5.47	152				55	0.1		14.7	22.5	0.3	<2		<0.001		0.032		0.002	0.007	<0.005	0.022	1.64	0.01	<0.005	9.7	0.18	<0.002	<0.0015
EMP + SHO	RC0162	28/02/2013	563414	6687607	690	840	9,200	280	19,000	<5	3,900		319.2				37,500	49,000	3.80	151													<0.1		<0.005	<0.025	<0.025		<0.1		0.05					
EMP + SHO	WB5-10S	30/11/1984	563414	6687597	850	850	16,700	370	28,800	<5	6,380	24	319.1					66,000	3.50					22.8																						
EMP + SHO	WB5-50S	30/11/1984	563414	6687557	640	640	8,550	220	15,300	<5	2,850	50	319.2					40,000	3.30					24.3																						
EMP + SHO	NNA5727	Feb-12	563439	6687019									320.5	43	277.5		45,172	82,807	3.56																											
EMP + SHO	NNA5727	Feb-12	563439	6687019									320.5	75	245.5		66,072	119,807	3.28																											
EMP + SHO	NNA5720	Feb-12	563503	6687552									318.5	51	267.5		45,932	81,729	3.43																											
EMP + SHO	RC1343	1985	564471	6708311									407.3	75	332.3		48,330		7.00											<5	<5															
EMP + SHO	AC0987	25/11/1983	564600	6689549	294	410	4,375	120	7,313	<.6	1,826	1.3	342.0	68.5	273.5			25,400	4.20					1.8																						
EMP + SHO	RC1134	27/3/1984	566215	6686977	543	378	4,350	93	7,526	1	1,903	6.6	323.2	56.5	266.7			23,600	3.30					160																						
EMP + SHO	RC1131	27/3/1984	566569	6687057	438	358	4,150	123	7,029	1	1,570	2.7	328.2	59.5	268.7			24,900	3.80					11																						
EMP + SHO	NNA5685	Feb-12	567629	6684321									337.5	64	273.5		58,372	106,107	3.56																											
EMP + SHO	NNA5686	Feb-12	567916	6684162									339.9	69	270.9		58,372	105,807	2.84																											
EMP + SHO	NNA5686	Feb-12	567916	6684162									339.9	99	240.9		71,972	129,807	3.42																											
EMP + SHO	NNA5682	Feb-12	567959	6684595									334.5	84	250.5		64,760	117,089	3.27																											
EMP + SHO	NNA5682	Feb-12	567959	6684595									334.5	108	226.5		76,160	136,989	3.29																											
EMP + SHO	NNA5696	Feb-12	568118	6685554									325.9	66	259.9		69,380	124,776	3.51																											
EMP + SHO	NNA5696	Feb-12	568118	6685554									325.9	78	247.9		74,480	133,191	3.21																											
EMP + SHO	NNA5690	Feb-12	568179	6684995									334.0	82	252.0		73,072	131,707	4.35																											
EMP + SHO	NNA5687	Feb-12	568194	6683993									339.1	69	270.1		71,372	128,707	3.53																											
EMP + SHO	NNA5683	Feb-12	568236	6684431									334.7	69	265.7		76,572	137,907	3.32																											
EMP + SHO	NNA5683	Feb-12	568236	6684431									334.7	69	265.7		67,460	122,389	3.36																											
EMP + SHO	NNA5683	Feb-12	568236	6684431									334.7	94	240.7		74,760	134,689	3.38																											
EMP + SHO	NNA5683	Feb-12	568236	6684431									334.7	105	229.7		73,172	131,907	3.68																											
EMP + SHO	NNA5691	Feb-12	568250	6684953									332.7	66	266.7		61,672	112,007	3.40																											
EMP + SHO	NNA5695	Feb-12	568400	6685387									326.0	66	260.0		65,725	118,231	3.42																											
EMP + SHO	NNA5662	Jan-12	568448	6684831									331.4	75	256.4		73,572	132,307	3.76																											
EMP + SHO	NNA5662	Jan-12	568448	6684831									331.4	75	256.4		73,572	132,807	6.58																											
EMP + SHO	NNA5663	Jan-12	568576	6684753									332.2	78	254.2		82,172	147,507	5.87																											
EMP + SHO	NNA5663	Jan-12	568576	6684753									332.2	93	239.2		77,370	138,376	3.05																											
EMP + SHO	NNA5684	Feb-12	568591	6684228									334.8	63	271.8		58,072	105,407	3.36																											
EMP + SHO	NNA5684	Feb-12	568591	6684228									334.8	99	235.8		78,872	142,007	3.41																											
EMP + SHO	NNA5667	Jan-12	568597	6684605									330.2	78	252.2		76,072	137,007	3.27																											
EMP + SHO	NNA5664	Jan-12	568651	6684709									331.3	90	241.3		78,135	139,651	2.99																											
EMP + SHO	NNA5664	Jan-12	568651	6684709									331.3	90	241.3		77,372	139,107	2.91																											
EMP + SHO	NNA5666	Jan-12	568713	6684811									333.5	90	243.5		78,730	140,671	3.41																											
EMP + SHO	NNA5666	Jan-12	568713	6684811									333.5	90	243.5		79,410	141,521	3.28																											
EMP + SHO	NNA5665	Jan-12	568729	6684664									332.3	78	254.3		73,972	133,507	5.45																											
EMP + SHO	RC1135	25/1/1984	568749	6685177	536	1,680	15,550	342	24,990	1	5,200	1.8	330.2	59.5	270.7			76,900	4.10					8		1.5	20			35																
EMP + SHO	NNA5688	Feb-12	568760	6684118									332.0	48	284.0		40,972	75,507	3.66																											
EMP + SHO	NNA5688	Feb-12	568760	6684118									332.0	84	248.0		73,872	133,407	3.32																											
EMP + SHO	NNA5689	Feb-12	569024	6683961									337.4	57	280.4		62,672	113,807	3.56																											
EMP + SHO	NNA5689	Feb-12	569024	6683961									337.4	90	247.4		74,972	135,207	3.40																											
EMP + SHO	NNA5697	Feb-12	569206	6684206									341.1	93	248.1		74,565	133,361	3.12																											
EMP + SHO	NNA5668	Jan-12	569272	6684346									337.8	84	253.8		75,072	135,507	2.94																											
EMP + SHO	NNA5668	Jan-12	569272	6684346									337.8	84	253.8		80,772	145,107	3.05																											
EMP + SHO	NNA5692	Feb-12	569358	6684490									334.5	66	268.5		34,240	63,551	3.86																											
EMP + SHO	NNA5692	Feb-12	569358	6684490									334.5	87	247.5		66,672	120,607	3.56																											
EMP + SHO	NNA5693	Feb-12	569429	6684615									332.7	63	269.7		32,740	60,951	4.26																											
EMP + SHO	NNA5693	Feb-12	569429	6684615									332.7	84	248.7		75,160	134,381	3.50																											
EMP + SHO	NNA5694	Feb-12	569502	6684721									331.8	75	256.8		68,105	122,226	3.85																											
EMP + SHO	NNA5694	Feb-12	569502	6684721									331.8	84	247.8		72,865	130,641	3.67																											
EMP + SHO	NNA5670	Feb-12	569567	6684161									337.9	48	289.9		53,072	93,034	3.69																											
EMP + SHO	NNA5670	Feb-12	569567	6684161									337.9	90	247.9		70,582	123,549	2.83																											
EMP + SHO	NNA5671	Feb-12	569633	6684125									338.7	60	278.7		57,577	101,534	3.48																											
EMP + SHO	NNA5671	Feb-12	569633	6684125									338.7	90	248.7		77,127	134,344	2.97																											
EMP + SHO	NNA5672	Feb-12	569705	6684284									337.9	57	280.9		23,047	44,074	6.31																											
EMP + SHO	NNA5672	Feb-12	569705	6684284									337.9	69	268.9		55,962	98,389	2.86																											
EMP + SHO	NNA5672	Feb-12	569705	6684284									337.9	91	246.9		62,167	109,184	3.03																											
EMP + SHO	NNA5673	Feb-12	569777	6684402									334.8	90	244.8		78,402	136,129	2.85																											
EMP + SHO	NNA5675	Feb-12	569848	6684533									336.5	69	267.5		66,247	115,899	2.69																											
EMP + SHO	NNA5675	Feb-12	569848	6684533									336.5	90	246.5		42,617	76,034	3.67																											

Year Sampled	Bore/Hole	mE	mN	RLGL (m AHD)	Sampled (m)	pH	TDS (mg/L)	Cl (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Fe (mg/L)	CO3 (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	NO3 (mg/L)	As (mg/L)	Au (mg/L)	B (mg/L)	Ba (mg/L)	Be (mg/L)	Br (mg/L)	C (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Co (mg/L)	F (mg/L)	Hg (mg/L)	I (mg/L)	Pb (mg/L)	Mo (mg/L)	Mn (mg/L)	Ni (mg/L)	S (mg/L)	Sb (mg/L)	Si (mg/L)	Sn (mg/L)	Se (mg/L)	Sr (mg/L)	Th (mg/L)	U (mg/L)	Zn (mg/L)	Zr (mg/L)
Emperor:																																													
2014	NNA6007	558040	6692755	323.91	52	4.1	40000	22000	12000	370	400	1100	0		0	3300	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NNA6007	558040	6692755	323.91	76	4.5	86000	47000	26000	650	530	3300	0		0	10000	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NNA6010	558308	6692800	324.06	63	4.3	42000	27000	15000	440	560	1300	0		0	4300	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NNA6010	558308	6692800	324.06	69	4.4	73000	39000	22000	560	530	2600	0		0	8300	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NNA6011	558431	6692991	325.92	69	4.5	49000	28000	16000	470	660	1300	0		0	4200	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
Shogun:																																													
2045	EAAC1015	563503	6685556	337.10	63	4.9	13000	7500	4400	160	190	390		<1	<5	1500		0							0	0	0.009					0.001			0.089									0.23	
2014	NNA6002	564433	6689290		52	3.9	71000	37000	22000	560	560	2500	0		0	7800	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NNA6003	564546	6689474	337.37	63	5.0	14000	7400	4400	150	260	380	0		0	1700	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0

0 = Below limit of reporting

APPENDIX II-b
Ambassador and Princess Raw Water Chemistry Data

Hole ID	Date Sampled	GDA East	GDA North	Ca	Mg	Na	K	Cl	HCO3	SO4	NO3	RL	Sample DEPTH	Sample RL	T.F.R.	TDS	TSS	Co	pH	ORP	PO4	Fe	Al	F	Si	Br	I	U	Th	Au	As_Sol	B_Sol	Ba_Sol	Be_Sol	Cd_Sol	Cr_Sol	Cs	Cu_Sol	Co_Sol	Pb_Sol	Mo_Sol	Mn_Sol	Ni_Sol	Sb_Sol	Sn_Sol	Se_Sol	Sr	Ti	Y	Zn	Zr_Sol	V_Sol	W	Hg_Sol
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m AHD	m	m AHD	mg/L	mg/L	mg/L	µS/cm		mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/L	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RC1351	1985	584431	6685188	760	1,350	13,600	245	22,440	<0.6	4,455	6.1	340.8	87	253.84		44,670			4.35			<0.05						<5	<5
RC1346	1985	584985	6685883	432	725	7,100	225	11,640	6	2,665	6.1	332.5	87	245.52		24,190			5.50			<0.05						<5	<5
RC1330	1985	585325	6685673	985	1,700	17,600	450	30,100	32	6,285	8.6	323.3	101	222.33		59,710			7.05			<0.05						<5	<5
RC1347	1985	585662	6685477	447	800	8,100	250	13,630	98	2,925	5.8	329.3	41	288.28		26,770			7.00			<0.05						<5	<5
RC0065	15/05/1980	577282	6676116	980	1,400	11,250	228	19,596	154	4,144	7.1	322.8							7.30			0.25			34.00			6.00	10.00
RC0471B	30/06/1981	575160	6680830	570	409	4,725	103	7,669	61	2,333	0.1	324.3							7.10			5.50
RC0471B	Jan-82	575160	6680830	415	490	5,730	154	9,621	40	2,430	<.1	324.3						31,550	7.00			2.20		0.60	22.00
RC0471B	Mar-82	575160	6680830	365	465	5,650	147	9,088	41	2,068	0.5	324.3						29,800	7.00			2.50
RC0471B	25/11/1983	575160	6680830	434	500	5,800	159	9,443	45	2,176	0.7	324.3						32,300	7.40			0.50
AC1029	25/11/1983	575486	6682117	314	380	4,225	110	7,100	5	1,453	0.6	329.0	62.5	266.5				23,300	6.40			0.50						10.00
RC1030	25/11/1983	576390	6681554	378	530	5,225	194	9,017	76	2,087	1.0	333.2	53	280.2				23,300	6.40			0.25						<5
AC1036	25/11/1983	578005	6682047	574	850	8,300	399	14,770	336	3,000	3.0	346.7	65	281.7				46,300	7.90			3.10						<5
AC1036	25/11/1983	578005	6682047	688	950	9,100	359	16,260	234	3,067	2.0	346.7	83	263.7				51,100	7.80			2.00						<5
AC1036	25/11/1983	578005	6682047	1,185	1,250	17,500	419	22,580	295	4,000	1.8	346.7	121	225.7				68,700	7.90			0.80						<5
RC1040	25/11/1983	580398	6683508	494	750	6,800	259	12,000	245	3,000	1.2	335.6	64	271.647				38,600	8.00			0.40						<5
AC1048	25/11/1983	582366	6685275	414	540	5,550	209	9,514	159	2,444	1.6	341.9	56	285.903				31,600	7.70			0.40						45.00
AC0991	1/12/1983	570324	6688067	250	324	2,600	98	4,686	26	1,032	0.9	339.6	57.5	282.1				15,150	7.30			<.1		1.70	25.00				11.00
AC0991	1/12/1983	570324	6688067	270	334	2,800	100	5,055	18	1,280	0.6	339.6	82.5	257.1				16,250	7.30			<.1		1.10	140.00				7.00
RC0065	11/04/1984	577282	6676116	800	1,400	11,100	260	19,800	89	4,150	10.0	322.8						52,000	6.50			12.80
AC1232	8/7/1984	579769	6683072	618	1,048	10,000	295	17,400	210	3,566	0.2	329.0	32	297.001	37,760	37,760		59,000	7.64			0.80						10.00	6.00
AC1233	8/7/1984	580108	6682893	592	872	9,000	248	15,620	138	2,881	0.1	331.9	53	278.931	33,280	33,280		52,000	7.28			1.50						9.00	8.00
AC1237	8/7/1984	580755	6683258	492	772	6,625	222	12,070	257	2,543	0.1	332.3	95	237.261	25,280	25,280		39,500	7.96			0.80						6.00	5.00
RC1279	Jul-84	575498	6679995	770	770	11,000	250	19,600	10	3,850	11.0	322.3						49,000	5.80			16.20
RC0471B	24/11/1984	575160	6680830	490	490	5,260	170	9,220	45	1,900	8.0	324.3						29,000	6.50			20.80
RC1351	28/10/1985	584431	6685188									340.8	79	261.84		31,808		49,700	5.10
RC1346	28/10/1985	584985	6685883									332.5	81	251.52		26,368		41,200	6.10
RC1346	28/10/1985	584985	6685883									332.5	83	249.52		25,920		40,500	6.20
RC1330	28/10/1985	585325	6685673									323.3	89	234.33		38,272		59,800	7.70
RC1347	28/10/1985	585662	6685477									329.3	41	288.28		36,416		56,900	6.70
RC1440	26/8/1986	585410	6684608	399	700	6,250	235	10,150	238	2,480	4.6	330.0	101	229	20,540	20,540		32,100	7.90			<0.05
NNA5099	Sep-09	575491	6682104	300	390	4,500	130	7,900	100	1,800	<0.2	329.0	63	266.0		15,000	360	23,000	6.80			0.86
NNA5097	Sep-09	575843	6681879	320	470	4,500	150	13,000		3,200	<0.2	330.0	75	255.0			1,096,240					56.00
NNA5100	Sep-09	575948	6681571	610	850	8,100	270	16,000	170	3,800	<0.2	329.0	69	260.0		28,000	10,000	40,000	7.10			0.42
NNA5102	Sep-09	576088	6681490	510	710	6,800	220	13,000	80	3,900	<0.2	328.9	64	264.9		28,000	930	35,000	7.00			<0.4
NNA5094	Sep-09	576323	6681593	540	860	7,600	220	22,000		6,900	0.3	331.4	70	261.4			870,000					51.00
NNA5198	11/06/2010	575539	6682048									329.0						21,500	
N5029	Jul-10	575965	6681554									329.0	50	279.0				19,400	
N5030	Aug-10	575544	6681137									326.2	50	276.2				19,960	
N5040	21/12/2010	580034	6682734									332.1	44	288.118				43,600	
N5041	21/12/2010	580092	6682899									331.6	34	297.639				20,500	
NNA5529	1/12/2011	570045	6681930									343.2	72	271.2		58,372		106,107	3.57
NNA5529	1/12/2011	570045	6681930									343.2	93	250.2		66,172		120,007	2.57
NNA5528	40878	570226	6681372									339.0	65	274.0		54,160		99,089	3.77
NNA5530	Dec-11	570341	6681754									346.2	73	273.2		51,672		94,107	3.38
NNA5530	1/12/2011	570341	6681754									346.2	114	232.2		74,372		133,707	2.84
NNA5520	Dec-11	570404	6682215									338.7	87	251.7		60,625		109,391	3.05
NNA5520	1/12/2011	570404	6682215									338.7	87	251.7		60,370		109,136	4.21
NNA5542	Dec-11	570452	6682644									333.7	72	261.7		59,372		107,707	2.94
NNA5535	1/12/2011	570464	6681915									340.5	63	277.5		49,260		90,089	4.02
NNA5538	1/12/2011	570482	6682151									341.6	63	278.6		64,172		116,407	3.42
NNA5538	1/12/2011	570482	6682151									341.6	90	251.6		69,372		125,407	3.04
NNA5538	1/12/2011	570482	6682151									341.6	108	233.6		77,572		139,507	2.82
NNA5537	40878	570510	6682197									337.4	54	283.4		31,740		59,051	4.59
NNA5537	Dec-11	570510	6682197									337.4	87	250.4		65,833		119,335	2.70
NNA5524	Dec-11	570554	6681178									346.9	87	259.9		61,390		110,836	3.46
NNA5524	1/12/2011	570554	6681178									346.9	106	240.9		71,080		127,836	3.13
NNA5519	1/12/2011	570616	6682159									335.9				64,705		116,361	3.33
NNA5531	1/12/2011	570663	6682093									337.5	54	283.5		21,360		40,389	5.06
NNA5531	1/12/2011	570663	6682093									337.5	54	283.5		21,560		40,489	4.42
NNA5531	1/12/2011	570663	6682093									337.5	57	280.5		42,060		77,289	3.98
NNA5531	1/12/2011	570663	6682093									337.5	90	247.5		66,540		120,351	3.14
NNA5518	1/12/2011	570670	6682280									334.8	81	253.8		66,830		120,186	3.30
NNA5522	1/12/2011	570677	6681559									343.2	110	233.2		68,530		123,246	3.40
NNA5522	1/12/2011	570677	6681559									343.2	110	233.2		73,160		131,789	3.18
NNA5539	1/12/2011	570716	6682008									336.2	87	249.2		65,772		119,007	3.33
NNA5526	1/12/2011	570766	6681060									348.8	78	270.8		50,960		93,189	4.58
NNA5526	1/12/2011	570766	6681060									348.8	87	261.8		58,060		105,489	3.18
NNA5536	1/12/2011	570792	6682462									331.0	66	265.0		54,940		99,851	3.28
NNA5536	1/12/2011	570792	6682462									331.0	84	247.0		64,960		117,489	3.43
NNA5523	1/12/2011	570808	6681472									346.5	?			69,890		125,286	3.22
NNA5532	1/12/2011	570869	6681924									336.6	60	276.6		48,460		88,689	4.29
NNA5532	1/12/2011	570869	6681924									336.6	78	258.6		58,060		105,489	2.92
NNA5543	1/12/2011	570953	6682801									330.8	69	261.8		56,472		102,907	3.11
NNA5543	1/12/2011	570953	6682801									330.8	78	252.8		53,972		98,507	3.39
NNA5533	1/12/2011	571012	6681831									333.9	60	273.9		48,360		88,589	3.15
NNA5533	1/12/2011	571012	6681831									333.9	75	258.9		51,840		94,851	3.21
NNA5527	1/12/2011	571110	6680995									344.7	73	271.7		53,072		96,807	3.49
NNA5527	1/12/2011	571110	6680995									344.7	78	266.7		57,772		105,307	3.52
NNA5534	1/12/2011	571128	6681767									336.0	51	285.0		30,360		56,689	3.63
NNA5544	1/12/2011	571189	6683192									328.2	66	262.2		44,272		81,507	2.69
NNA5544	1/12/2011	571189	6683192									328.2	81	247.2		46,672		85,707	3.93
NNA5544	1/12/11	571189	6683192									328.2	81	247.2		45,972		84,407	3.71
NNA5545	1/12/2011	571431	6683581									327.2	69	258.2		43,933		80,635	5.33
NNA5545	1/12/2011	571431	6683581									327.2	75	252.2		38,133		70,535	3.32
NNA5556	1/12/11	578483	6684129									340.0	51	289.0		16,572		31,607	5.24
NNA5556	1/12/2011	578483	6684129									340.0	51	289.0		16,072		30,607	5.88
NNA5551	Dec-11	578602	6684253									339.6	39	300.6		19,033		36,035	6.41
NNA5551	Dec-11	578602	6684253									339.6	57	282.6		19,533		37,135	4.14
NNA5551	Dec-11	578602	6684253									339.6	57	282.6		19,433		36,835	4.09
NNA5552	Dec-11	578732	6684182									340.6	57	283.6		18,833		35,635	4.27
NNA5552	Dec-11	578732	6684182									340.6	57	283.6		18,933		36,035	5.21
NNA5549	Dec-11	578793	6684148									339.9	57	282.9		20,072		38,107	5.99
NNA5549	Dec-11	578793	6684148									339.9	57	282.9		19,472		36,907	5.48
NNA5553	Dec-11	578833	6684131									339.8	45	294.8		20,333		38,635	4.25
NNA5561	Dec-11	578951	6683851									340.2	54	286.2		19,433		36,735	5.72
NNA5561	Dec-11	578951	6683851									340.2	54	286.2		18,933		35,835	5.65
NNA5554	Dec-11	578979	6684070									340.5	57	283.5		18,333		34,835	6.11
NNA5554	Dec-11	578979	6684070									340.5	57	283.5		17,433		33,335	6.18
NNA5547	Dec-11	579046	6684026									340.4	54	286.4		20,533		38,835	4.25
NNA5563	Dec-11	579093	6683761									340.8	60	280.8		19,733		37,735	6.07
NNA5563	Dec-11	579093	6683761									340.8	60	280.8		21,033		39,835	5.56
NNA5555	1/12/11	579115	6683986									339.6	54	285.606		20,333		38,635	5.76
NNA5555	1/12/11	579115	6683986									339.6	60	279.606		16,033		30,535	5.98
NNA5555	1/12/11	579115	6683986									339.6	60	279.606		15,133		29,235	4.92
NNA5575	1/12/11	579273	6684398									340.8	54	286.773		19,753		37,471	5.35
NNA5575	1/12/11	579273	6684398									340.8	54	286.773		19,653		37,271	4.77
NNA5568	1/12/11	579285	6684138									342.7	60	282.697		20,833		39,635	4.99
NNA5568	1/12/11	579285	6684138									342.7	66	276.697		18,933		36,035	5.33
NNA5568	1/12/11	579285	6684138									342.7	66	276.697		18,833		35,835	5.98
NNA5577	1/12/11	579366	6684344									341.1	57	284.143		21,672		40,507	6.05
NNA5577	1/12/11	579366	6684344									341.1	66	275.143		23,153		43,471	6.72
NNA5577	1/12/11	579366	6684344									341.1	66	275.143		22,153		41,971	6.40
NNA5574	1/12/11	579417	6684305									342.6	75	267.626		22,253		42,071	6.69
NNA5574	1/12/11	579417	6684305									342.6	75	267.626		23,853		44,971	6.63
NNA5571	1/12/11	579487	6684030									347.4	66	281.382		17,633		33,535	4.24
NNA5571	1/12/11	579487	6684030									347.4	66	281.382		17,333		33,135	4.51
NNA5514	1/12/11	579499	6684522									349.9	74	275.94		21,355		40,116	7.12
NNA5515	1/12/11	579569	6684476									350.1	80	270.118		24,245		45,301	7.54
NNA5516	1/12/11	579640	6684432									350.2	70	280.208		21,865		41,136	6.92
NNA5581	1/12/11	579670	6684634									340.0	54	285.967		20,253		38,471	5.58
NNA5581	1/12/11	579670	6684634									340.0	60	279.967		19,053		36,171	4.77
NNA5581	1/12/11	579670	6684634									340.0	60	279.967		19,653		37,271	5.61
NNA5578	1/12/11	579728	6684603									339.4	57	282.364		21,453		40,471	5.92
NNA5580	1/12/11	579809	6684554									339.0				20,353		38,671	6.25
NNA5580	1/12/11	579809	6684554									339.0				21,053		40,071	5.50
NNA5582	1/12/11	579963	6684689									341.9	54	287.893		23,972		45,307	4.21
NNA5582	1/12/11	579963	6684689									341.9	63	278.893		21,072		39,907	5.30
NNA5582	1/12/11	579963	6684689									341.9	63	278.893		20,272		38,507	6.32
NNA5584	1/12/11	580030	6684657									341.9	57	284.946		20,772		39,207	6.51
NNA5599	1/01/2012	578560	6684084									340.3				19,260		36,689	4.78
NNA5599	1/01/2012	578560	6684084									340.3				18,960		36,089	4.62
NNA5609	Jan-12	578619	6684166									340.8	54	286.8		18,960		35,989	3.95
NNA5609	Jan-12	578619	6684166									340.8	54	286.8		19,360		36,689	3.89
NNA5649	Jan-12	578708	6683654									341.2	51	290.2		15,150		28,981	4.89
NNA5649	Jan-12	578708	6683654									341.2	51	290.2		15,830		30,001	4.89

APPENDIX II-b
Ambassador and Princess Raw Water Chemistry Data

Hole ID	Date Sampled	GDA East	GDA North	Ca	Mg	Na	K	Cl	HCO3	SO4	NO3	RL	Sample DEPTH	Sample RL	T.F.R.	TDS	TSS	Co	pH	ORP	PO4	Fe	Al	F	Si	Br	I	U	Th	Au	As_Sol	B_Sol	Ba_Sol	Be_Sol	Cd_Sol	Cr_Sol	Cs	Cu_Sol	Co_Sol	Pb_Sol	Mo_Sol	Mn_Sol	Ni_Sol	Sb_Sol	Sn_Sol	Se_Sol	Sr	Ti	Y	Zn	Zr_Sol	V_Sol	W	Hg_Sol
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	m AHD	m	m AHD	mg/L	mg/L	mg/L	µS/cm		mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ug/l	ug/l	ug/L	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
NNA5602	Jan-12	578724	6683756									342.3	54	288.3		10,460		20,289	5.83																																			
NNA5644	Jan-12	578770	6683872									343.3	54	289.3		19,572		37,207	5.39																																			
NNA5644	Jan-12	578770	6683872									343.3	54	289.3		20,272		38,507	6.50																																			
NNA5623	Jan-12	578774	6684324									340.6				64,572		117,007	2.97																																			
NNA5623	Jan-12	578774	6684324									340.6	48	292.6		16,960		32,289	5.08																																			
NNA5623	Jan-12	578774	6684324									340.6	48	292.6		17,360		32,889	5.12																																			
NNA5622	Jan-12	578834	6684277									343.7	54	289.7		20,160		38,089	3.64																																			
NNA5645	Jan-12	578912	6683522									339.2	54	285.2		22,715		42,666	5.53																																			
NNA5645	1/01/2012	578912	6683522									339.2	54	285.2		20,172		38,107	5.83																																			
NNA5605	Jan-12	578913	6683653									340.1	54	286.1		16,360		31,389	6.02																																			
NNA5605	Jan-12	578913	6683653									340.1	54	286.1		16,360		31,289	6.02																																			
NNA5614	Jan-12	578964	6683963									339.8	55	284.8		19,760		37,689	5.03																																			
NNA5614	Jan-12	578964	6683963									339.8	55	284.8		19,760		37,789	4.63																																			
NNA5606	Jan-12	578980	6683585									338.0	54	284.0		20,660		39,089	3.91																																			
NNA5646	Jan-12	578983	6683486									340.1	57	283.1		22,970		42,751	3.98																																			
NNA5646	Jan-12	578983	6683486									340.1	66	274.1		21,140		40,051	4.59																																			
NNA5646	Jan-12	578983	6683486									340.1	66	274.1		20,340		38,651	4.25																																			
NNA5641	Jan-12	579005	6683723									342.5	57	285.5		21,865		41,051	5.83																																			
NNA5641	Jan-12	579005	6683723									342.5	57	285.5		11,750		22,691	5.64																																			
NNA5642	Jan-12	579062	6683671									339.2	51	288.2		21,695		40,626	5.72																																			
NNA5642	Jan-12	579062	6683671									339.2	51	288.2		20,772		39,207	5.50																																			
NNA5642	Jan-12	579062	6683671									339.2	63	276.2		22,040		41,351	5.56																																			
NNA5642	Jan-12	579062	6683671									339.2	63	276.2		21,572		40,807	5.17																																			
NNA5616	Jan-12	579105	6683886									335.6	48	287.6		20,860		39,589	5.75																																			
NNA5616	1/01/12	579105	6683886									335.6	48	287.567		20,660		39,089	5.75																																			
NNA5634	1/01/12	579135	6684302									342.1	51	291.105		8,775		16,996	6.29																																			
NNA5634	1/01/12	579135	6684302									342.1	51	291.105		8,740		17,051	6.29																																			
NNA5617	1/01/12	579177	6683836									333.6	51	282.591		20,960		39,589	5.88																																			
NNA5617	1/01/12	579177	6683836									333.6				20,760		39,289	5.94																																			
NNA5625	1/01/12	579251	6684020									340.2	54	286.231		20,260		38,389	5.66																																			
NNA5625	1/01/12	579251	6684020									340.2	54	286.231		20,660		39,089	5.79																																			
NNA5632	1/01/12	579278	6684251									339.7	57	282.686		19,400		36,631	6.21																																			
NNA5632	1/01/12	579278	6684251									339.7	57	282.686		20,845		39,096	6.17																																			
NNA5626	1/01/12	579317	6683995									338.1	54	284.069		19,360		36,589	5.10																																			
NNA5627	1/01/12	579383	6683961									335.3	48	287.291		20,160		38,089	6.44																																			
NNA5627	1/01/12	579383	6683961									335.3	48	287.291		20,160		38,489	6.20																																			
NNA5630	1/01/12	579451	6684166									342.7	57	285.675		20,060		38,089	5.79																																			
NNA5630	1/01/12	579451	6684166									342.7	63	279.675		21,360		40,389	5.64																																			
NNA5636	1/01/12	579487	6684253									345.5	57	288.531		21,340		40,351	5.83																																			
NNA5636	1/01/12	579487	6684253									345.5	72	273.531		19,400		36,461	6.22																																			
NNA5661	1/01/12	579491	6684365									346.6	78	268.647		22,545		42,241	6.93																																			
NNA5661	1/01/12	579491	6684365									346.6	78	268.647		21,040		40,051	6.65																																			
NNA5591	1/01/12	579874	6684520									339.0	54	284.996		21,060		39,889	6.49																																			
NNA5591	1/01/12	579874	6684520									339.0	54	284.996		19,760		37,789	6.48																																			
NNA5592	1/01/12	579930	6684477									339.3	48	291.305		19,553		37,171	6.97																																			
NNA5592	1/01/12	579930	6684477									339.3	48	291.305		19,660		37,289	7.14																																			
NNA5589	1/01/12	580088	6684614									341.3	60	281.321		20,860		39,589	6.40																																			
NNA5589	1/01/12	580088	6684614									341.3	66	275.321		20,760		39,089	6.37																																			
NNA5589	1/01/12	580088	6684614									341.3	66	275.321		20,860		39,589	6.44																																			
NNA5587	1/01/12	580379	6684654									338.0	48	290.001		19,360		36,889	4.01																																			
NNA5678	1/02/12	570296	6683748									329.3	48	281.3		58,172		105,907	3.12																																			
NNA5678	1/02/2012	570296	6683748									329.3	84	245.3		72,372		130,607	3.34																																			
NNA5677	1/02/2012	570367	6683889									334.9	71	263.9		61,972		112,307	3.31																																			
NNA5677	1/02/2012	570367	6683889									334.9	89	245.9		73,982		129,159	3.25																																			
NNA5676	Feb-12	570458	6684009									329.3				80,102		139,444	3.03																																			
NNA5676	1/02/2012	570458	6684009									329.3	87	242.3		67,692		118,279	3.49																																			
NNA5679	1/02/2012	570969	6683341									325.5	61	264.5		54,372		99,107	3.01																																			
NNA5679	1/02/2012	570969	6683341									325.5	61	264.5		55,872		101,707	3.06																																			
NNA5680	1/02/2012	571080	6683498									325.8	64	261.8		58,660		106,589	3.25																																			
NNA5680	1/02/2012	571080	6683498									325.8	64	261.8		57,660		105,189	3.19																																			
NNA5681	1/02/2012	571201	6683712									329.0	51	278.0		19,760		37,789	4.54																																			
NNA5681	1/02/2012	571201	6683712									329.0	69	260.0		57,460		104,489	4.36																																			
NNA5737	1/02/2012	578015	6682529									339.0	57	282.0		23,872		45,107	5.97																																			
NNA5737	Feb-12	578015	6682529									339.0	81	258.0		31,072		57,907	5.94																																			
NNA5738	Feb-12	578209	6682413									345.1	60	285.1		23,272		43,907	5.16																																			
NNA5755	Feb-12	578625	6683929									342.4	48	294.4		19,772		37,207	4.21																																			
NNA5734	Feb-12	579089	6683078									350.1	69	281.1		20,072		37,907	4.97																																			
NNA5733	1/02/12	579141	6683046									350.1	90	260.07		24,872		46,707	7.10																																			
NNA5733	1/02/12	579141	6683046									350.1	90	260.07		23,872		45,007	6.97																																			
NNA5748	1/02/12	579160	6683733									340.4	57	283.358		21,372		40,107	6.08																																			
NNA5748	1/02/12	579160	6683733									340.4	75	265.358		22,072		42,007	6.95																																			
NNA5749	1/02/12	579238	6683679									334.4	42	292.387		18,472		35,207	6.22																																			
NNA5746	1/02/12	579252	6683890									333.5	51	282.457		19,672		37,307	5.90																																			
NNA5740	1/02/12	579643	6684560									340.5	51	289.453		21,072		39,907	5.67																																			
NNA5757	Mar-12	578852	6682852									337.5	42	295.5		19,472		36,907	6.28																																			
NNA5757	Mar-12	578852	6682852									337.5	78	259.5		21,472		40,407	5.69																																			
NNA5762	1/03/12	579245	6683797									332.8	45	287.837		19,372		36,707	7.11																																			
NNA5760	1/03/12	579311	6683763									333.9	48	285.943		18,972		36,107	4.68																																			
NNA5769	1/03/12	581592	6683730									334.3	60	274.257		13,372		25,707	6.65																																			
NNA5768	1/03/12	581660	6683676									334.8	39	295.821		14,372		27,507	4.02																																			
NNA5767	1/03/12	581782	6683605									337.2	66	271.23		14,572		27,907	5.88																																			
RC1279	26/02/2013	575498	6679995									322.3	35	287.3		33,400		62,100	6.30	46																																		
RC1279	26/02/2013	575498	6679995	610	1,000	9,400	250	16,000	21	3,300		322.3				31,000		43,000	6.40	46											<0.1				<0.005	<0.025		<0.025		<0.1			0.07											
N5030	26/02/2013	575544	6681137									326.2				11,600		20,600	5.62	-135																																		
N5030	Feb-13	575544	6681137	220	320	4,500	190	6,600	8	1,300		326.2				12,100		20,000	5.90	-135											<0.02				0.00	<0.005		<0.005		<0.02			0.01											
N5034	26/02/2013	576399	6681300									332.3				14,550		25,400	6.04	-205																																		
N5034	26/02/2013	576399	6681300	300	480	4,900	230	8,200	60	1,800		332.3				15,400		24,000	6.60	-205											<0.02				<0.001	<0.005		<0.005		<0.02			0.03											
N5036	27/02/2013	576591	6682391	170	230	3,300	130	5,000	83	900		332.9				9,660		16,000	6.80	-207											<0.02				<0.001	<0.005		<0.005		<0.02			0.01											
N5032	Feb-13	578632	6682382	260	450	3,700	240	6,300	150	1,600		337.6				12,700		20,000	6.90	-248											<0.02				<0.001	0.01		<0.005		<0.02			0.06											
N5038	27/02/13	579231	6682522	250	390	3,400	200	5,700	2,100	8		338.3				10,500		17,000	8.00	-364											0.03				0.00	0.01		<0.005		<0.02			0.05											
N5040	27/02/13	580034	6682734	15	19	190	8	330	5	74		332.1				723		1,300	6.00	-119											<0.02				<0.001	<0.005		0.01		<0.02			0.01											
NNA5508	Feb-13	575239	6680797	260	310	4,500	180	7,100	340	1,200		324.3				13,700		21,000	7.60	44											<0.02				<0.001	0.01		<0.005		<0.02			0.02											
RC0065	Feb-13	577282	6676116	400	2,400	24,000	740	38,000	<5	5,600		322.8				75,200		91,000	4.10	251											<0.1				<0.005	<0.025		<0.025		0.65			0.07											
RC1279	Late 1990-Mid 1991	575498	6679995	554	1,007	9,422	213	16,900	149	3,310		322.3				31,510			6.30	125		12.00	<0.1		12.50	18.00	0.36	<2		0.01			0.02			<0.002		<0.004	<0.005	0.00		1.20	0.01	<0.005			8.70			0.01		<0.002	<0.0015	
RC1279	Late 1990-Mid 1991	575498	6679995	704	1,248	11,202	231	20,800	71	3,880		322.3				38,144			6.22	125		23.00	<0.1		7.90	20.00	0.52	<2		<0.001			0.03			0.00		0.01	<0.005	0.00		1.36	0.01	0.01			11.80			0.01		<0.002	<0.0015	
RC1213	Late 1990-Mid 1991	575684	6681498	246	350	3,769	138	6,730	24	1,250		328.9				12,506			5.46	148		0.46	<0.1		21.00	10.60	0.32	<2		0.01			0.03			0.00		0.03	<0.005	0.01		0.22	0.01	<0.005			3.30			0.06		<0.002	<0.0015	
RC1148	Late 1990-Mid 1991	576004	6680326	532	742	6,800	248	11,800	86	2,490		325.3				22,678			5.98	129		0.40	<0.1		21.00	23.10	0.64	<2		<0.001			0.03			<0.002		0.00	<0.005	0.00		0.20	0.01	<0.005			6.90			0.01		<0.002	<0.0015	
RC1152	Late 1990-Mid 1991	576022	6681299	450	700	5,645	231	10,400	30	2,060		328.2				19,522			5.91	143		0.15	<0.1		22.00	20.70	0.01	<2	0.40	<0.001			0.03			<0.002	0.01	0.00	0.01	0.05		0.13	0.02	<0.005			6.30	0.00	0.00	0.03		0.00	<0.0015	
RC1151	Late 1990-Mid 1991	576375	6681103	319	467	4,392	169	7,810	104	1,560		326.0				14,784			6.36	144		0.88	<0.1		15.40	15.00	0.36	<2		<0.001			0.02			<0.002			0.01	0.00		0.24	0.02	0.01			4.00			0.01		0.00	<0.0015	
RC0065	Late 1990-Mid 1991	577282	6676116	316	850	7,938	177	13,800	89	2,180		322.8				25,324			7.71	78		0.00	<0.1		0.30	16.30	0.53	<2		<0.001			0.02			0.00		0.00	<0.005	0.01		3.10	<0.01	<0.005			5.80			<0.005		<0.002	<0.0015	
CD1366	Late 1990-Mid 1991	577430	6682621	461	290	2,271	84	4,210		1,140		338.3				8,461			6.46	80		0.34	<0.1		4.60	4.90	0.15						0.16			<0.002		<0.001	0.01	0.01		0.32	0.02				2.20			0.05				
RC1177	Late 1990-Mid 1991	578272	6682855	683	754	8,236	263	14,200	191	3,090		333.8				27,343			6.58	171	0.00	7.80	<0.1		3.20	15.10	0.19	2.00		0.01			0.05			0.00		0.38	0.05	0.02		0.28	0.04	0.01			5.90			<0.01		<0.002	<0.0011	
RC1216	Late 1990-Mid 1991	578630	6683116	515	681	7,717	249	13,400	339	2,630		339.3				25,376			6.45	9	0.19	5.10	<0.1		1.60	13.00	0.77	<2		<0.001			0.02			0.00		<0.001	<0.005	0.01		0.17	<0.01	<0.005			4.10			<0.005		<0.002	<0.0011	
CD1409	Late 1990-Mid 1991	578711	6682585	174	262	2,285	66	4,070	1,231	56		334.6				7,519			6.58	-167	4.89	0.22	<0.1		2.90	3.30	0.32	<2	<0.1	<0.001			0.14			0.00	0.00	<0.001	0.01	0.01		0.60	0.01	0.02			1.70	<0.000	0.00	<0.005		<0.002	0.01	
CD1515	Late 1990-Mid 1991	579398	6682663	708	1,212	11,278	250	19,000	0	3,520		333.7				35,984			4.27	147	0.49	0.18	<0.1		2.80	14.70	0.45						0.05			0.00		<0.001	<0.005	0.01		1.34	0.04				7.90			0.28				
CD1247	Late 1990-Mid 1991	579947	6682973	626	856	7,939	308	14,000	382	2,950		329.8				26,887			7.01	213	0.00	0.19	<0.1		4.60	20.40	0.04	26.00	0.40	<0.001			0.03			0.00	0.02	0.01	0.01	0.06		0.05	0.02	0.01			5.10	0.00	0.00	0.08		<0.002	0.00	
CD1498	Late 1990-Mid 1991	580035	6683211	858	1,176	9,646	383	16,600	303	4,040		330.5				32,875			6.58	335	0.01	0.00	<0.1		7.60	23.30	0.03	38.00		0.02			0.05			<0.002		<0.001	0.02	0.01		0.06	0.04	0.02			11.60			0.06		<0.002	0.00	
CD1500	Late 1990-Mid 1991	583088	6684326	415	651	5,276	207	9,820	107	2,020		328.0				18,459			6.01	293	0.02	1.02	<0.1		4.00	16.60	0.32	<2	0.20	0.01			0.02			<0.002	0.01	0.01	0.02	0.02		0.27	0.08	0.01			4.10	0.00	0.01	0.19		<0.002	0.00	
RC1419	Late 1990-Mid 1991	585752	6686416	300	522	4,185	204	7,430	283	1,730		332.6				14,535			6.85	173	0.10	6.30	<0.1		6.30	20.30	0.35	<2	0.80	0.01			0.04			<0.002	0.01	0.01	0.01	0.02		0.05	0.02	0.02			3.40	0.00	0.00	0.09		<0.002	0.00	
NNA5027		570336	6688064	197	301	3,038	101	5,311	<5	1,355	0.4	336.5	82	254.5		10,668		17,780	4.10			0.84						<5			<0.005	1.25	0.04	<0.005	<0.0005	<0.005		0.03	0.08	0.02	<0.005	3.21	0.06	<0.005	<0.005	<0.005				0.08	0.08	<0.005		<0.0001
RC0471B		575160	6680830									324.3	65	259.3	20,420	20,420			7.13									9.00	<5																									
RC0324		575161	6680831									324.3			13,260	18,900																																						
AC1226		575344	6681710									327.8	64	263.8	19,780	19,780			6.03									<5	<5																									
NNA5140		575384	6680444	357	422	4,898	171	8,689	9	1,751	<0.2	324.3	51	273.3		16,452		27,420	6.40			<0.2						<5			<0.005	1.21	0.07	<0.005	0.00	<0.005		0.02	0.15	0.01	0.04	0.53	0.18	<0.005	<0.005	<0.005				0.16	0.16	0.01		<0.0001
RC1279		575498	6679995	651	1,171	10,813	250	21,676	9	4,106	<0.2	322.3				34,620		57,700	6.40			<0.2						<10			<0.01	0.85	0.03	<0.01	<0.001	<0.01		0.02	<0.01	<0.01	<0.01	1.57	0.03	<0.01	<0.01	<0.01				0.09	0.09	<0.01		<0.0001
NNA5393		575508	6681421	416	548	5,748	185	11,235	<5	2,237	<0.2	327.8	73	254.8		18,720		31,200	4.20			6.53						28.00			<0.005	1.61	0.04	0.01	0.00	<0.005		0.02	1.05	<0.005	<0.005	1.02	1.89	<0.005	<0.005	<0.005				3.25	3.25	<0.005		<0.0001
NNA5127		575521	6681140	463	531	5,710	187	10,922	49	2,227	<0.2	326.0	65	261.0		18,840		31,400	5.50			0.20						32.00			<0.005	1.41	0.06	<0.005	0.02	<0.005		0.01	0.63	<0.005	0.01	1.25	0.63	<0.005	<0.005	0.01				0.27	0.27	<0.005		<0.0001
NNA5198		575539	6682048	274	336	4,116	128	7,558	<5	1,633	<0.2	329.0	64	265.0		13,836		23,060	3.50			50.81						<5			<0.005	1.01	0.05	0.02	0.00	<0.005		0.02	0.72	0.04	<0.005	1.37	1.15	<0.005	<0.005	0.01				6.65	6.65	<0.005		<0.0001
NNA5155		575805	6680453	362	488	5,087	180	9,677	31	1,827	<0.2	325.5	51	274.5		17,034		28,390	6.70			<0.2						<5			<0.005	1.35	0.05	<0.005	<0.0005	<0.005		0.01	0.03	<0.005	0.01	0.56	0.02	<0.005	<0.005	<0.005				0.07	0.07	<0.005		<0.0001
NNA5107		575856	6681410	620	834	8,130	292	15,717	<5	3,553	<0.2	328.8	69	259.8		26,820		44,700	4.80			<0.2						68.00			<0.01	1.69	0.07	<0.01	0.32	<0.01		1.90	2.29	3.08	<0.01	2.35	2.91	<0.01	<0.01	<0.01				12.89	12.89	<0.01		<0.0001
NNA5103		576153	6681450	580	772	7,602	257	13,693	<5	2,875	<0.2	328.9	66	262.9		25,020		41,700	4.30			0.76						19.00			<0.01	1.72	0.07	<0.01	0.01	0.01		0.63	3.96	0.35	<0.01	1.61	3.83	<0.01	<0.01	0.10				5.26	5.26	<0.01		<0.0001
NNA5199		578636	6682399	614	833	8,197	316	16,462	<5	3,273	<0.2	336.1	55	281.1		27,000		45,000	4.20			5.89						<10			<0.01	2.13	0.09	<0.01	<0.001	<0.01		0.02	0.65	<0.01	<0.01	1.30	1.72	<0.01	<0.01	<0.01				7.78	7.78	<0.01		<0.0001
NNA5086		579150	6682822	604	900	8,651	349	17,219	32	3,317	<0.2	339.8	75	264.793		28,680		47,800	6.80			<0.2						<10			<0.01	2.71	0.05	<0.01	0.01	<0.01		0.02	0.20	<0.01	<0.01	1.96	0.38	<0.01	<0.01	<0.01				0.92	0.92	<0.01		<0.0001
AC1232		579769	6683072									329.0	53	276.001	30,210	30,210			7.54									20.00	<5																									
AC1232		579769	6683072									329.0	70	259.001	30,400	30,400			8.05									<5	<5																									

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APPENDIX II-bi

Ambassador and Princess Raw Water Chemistry Data Rare Earths

Hole ID	Date Sampled	GDA East	GDA North	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	REE (Total)	δ18O	δ2H
				mg/l	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*mg/l*	*(SMOW)*	*(SMOW)*
RC1213	Late 1990-Mid 1991	575684	6681498	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-3.18	-26.4
RC1148	Late 1990-Mid 1991	576004	6680326	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
RC1152	Late 1990-Mid 1991	576022	6681299	0.0022	0.0038	0.0006	0.0029	0.0008	0.0002	0.0008	0.0001	0.0005	0.0003	0.0005	0.0001	0.0005	0.0001	0.0134	nd	nd
CD1366	Late 1990-Mid 1991	577430	6682621	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-2.08	-14
RC1177	Late 1990-Mid 1991	578272	6682855	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-3.47	-32.6
RC1216	Late 1990-Mid 1991	578630	6683116	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-3.59	-32.2
CD1409	Late 1990-Mid 1991	578711	6682585	0.0011	0.0009	0.0002	0.0008	0.0008	0.0003	0.0007	0.0001	0.0004	0.0001	0.0004	0.0001	0.0006	0.0001	0.0066	-3.5	-24

APPENDIX II-c
Injection Area Data

Year	Bore/Hole	mE	mN	RLGL	Sampled	pH	TDS	Cl	Na	K	Ca	Mg	Fe	CO3	HCO3	SO4	NO3	As	Au	B	Ba	Be	Br	C	Cd	Cr	Cu	Co	F	Hg	I	Pb	Mo	Mn	Ni	S	Sb	Si	Sn	Se	Sr	Th	U	Zn	Zr
Sampled				(m AHD)	(m)		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
2014	NGW27	574421	6671852	335.96	72	4.7	42000	24000	14000	410	470	1500		0	0	4700																													
2014	NGW27	574421	6671852	335.96	75	4.6	49000	27000	16000	450	360	1700		0	0	4900																													
2014	NGW27	574421	6671852	335.96	78	4.9	43000	23000	14000	400	460	1500		0	0	4400																													
2014	NGW27	574421	6671852	335.96	88	4.6	62000	33000	20000	560	470	2200		0	0	6500																													
2014	NGW28	575534	6671172	328.41	51	4.9	33000	18000	11000	350	510	1200		0	0	3500																													
2014	NGW28	575534	6671172	328.41	69	4.5	44000	24000	15000	410	450	1600		0	0	4900																													
2014	NGW28	575534	6671172	328.41	90	4.7	70000	41000	24000	610	460	2400		0	0	7200																													
2014	NGW29	574546	6670455	326.59	58	4.7	34000	21000	12000	380	470	1300		0	0	3900																													
2014	NGW29	574546	6670455	326.59	71	4.8	52000	32000	18000	520	430	1900		0	0	6000																													
2014	NGW29	574546	6670455	326.59	84	4.7	66000	37000	23000	610	440	2400		0	0	6900																													
2014	NGW30	575351	6670159	346.15	75	5.2	30000	18000	10000	330	460	1100		0	0	3700																													
2014	NGW30	575351	6670159	346.15	87	5.0	49000	31000	18000	430	440	1800		0	0	6000																													
2014	NGW30	575351	6670159	346.15	98	4.8	64000	36000	22000	510	430	2200		0	0	7100																													
2014	NGW30	575351	6670159	346.15	111	4.5	71000	36000	23000	510	450	2400		0	0	7200																													
2014	NGW31	575010	6668792	339.73	66	4.7	37000	21000	13000	360	470	1300		0	0	4100																													
2014	NGW31	575010	6668792	339.73	81	4.8	49000	28000	18000	470	450	1800		0	0	5700																													
2014	NGW31	575010	6668792	339.73	96	5.1	64000	38000	22000	600	470	2400		0	0	7100																													
2014	NGW32	574523	6668776	332.87		5.6	39000	22000	13000	370	520	1200	0		6	3900	0			4.2	0.029					0.025	0.025			0.00013		0		0.93	0.11		0		0	0		0	0	0.24	
2014	NGW33	576626	6670522	332.87		6.5	29000	17000	9300	230	480	890	0		35	3400	0			5.1	0.051					0.025	0.041					0		1	0.18		0		0	0		0	0	2.4	
2014	NGW34	576791	6671217	334.47		6.9	29000	17000	9000	230	460	840	0		99	3300	0			4.9	0.05					0.027						0		1.6	0.069		0		0	0		0	0	0.26	
2014	NGW35	573179	6666413	335.34		5.5	31000	18000	9600	250	420	890	0		0	3400	0	0.026		4.8	0.03					0	0.052			0.00093		0		0.31	0.075		0		0	0		0	0	0.48	
2014	NGW36	571529	6667012	343.13		4.9	38000	24000	13000	400	470	1200	0		0	4000	0			4.3	0.026					0						0		0.61	0.038		0		0	0		0	0	0.16	
2014	NGW37	575553	6671112	330.21	64	5.5	48000	26000	15000	420	500	1600	0		0	5700	0				0.065																								
2014	NGW37	575553	6671112	330.21	73	4.8	57000	30000	17000	480	540	1800	0		0	6300	0				0																								
2014	NGW37	575553	6671112	330.21	93	4.6	70000	37000	23000	570	460	2300	0		0	8000	0				0																								
2014	NGW54	575554	6671245	327.20	80	5.3	52000	29000	16000	450	380	1700			0	6000																													
2014	NGW54	575554	6671245	327.20	110	4.5	70000	37000	21000	550	470	2200			0	7900																													
2014	NGW54B	575555	6671244	327.20	54	4.1	62000	34000	20000	540	450	2100	0		0	7500	0				0																								
2014	NGW54B	575555	6671244	327.20	84	4.2	36000	20000	11000	340	500	1100	0		0	4400	0				0																								
2014	NGW54C	575552	6671246	327.23	63	5.0	49000	26000	15000	400	490	1600	0		0	4800	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NGW54C	575552	6671246	327.23	78	4.7	68000	34000	22000	560	470	2200	0		0	6000	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NGW54C	575552	6671246	327.23	93	4.7	73000	39000	23000	610	470	2400	0		0	6700	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NGW55	575360	6670233	345.80	78	4.8	20000	10000	5800	210	260	590	0		0	2100	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NGW55	575360	6670233	345.80	100	4.5	64000	35000	21000	540	430	2000	0		0	6000	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2014	NGW55	575360	6670233	345.80	114	4.6	68000	36000	21000	570	460	2200	0		0	6300	0		0	0	0		0	0		0					0	0		0	0	0	0	0			0	0	0	0	0
2015	NWB01	575552	6671190	327.96		4.5	59000	29000	18000	470	470	1800	8.7	0	0	5700	0	0		6.6	0.026	0			0	0	0.32	0	0.4	0		0.11	0	1	0.079		0	15	0	0		0	0	0.45	
2015	NWB01	575552	6671190	327.96		4.4	58000	30000	18000	460	450	1800	7.5	0	0	5700	0	0		6.6	0.02	0			0	0	0	0	0.5	0		0	0	0.96	0.023		0	15	0	0		0	0	0	
2015	NWB02	575363	6670210	345.80		4.0	66000	35000	20000	490	440	2000	10	0	0	6500	0	0		7.2	0.032	0			0	0	0	0.024	0.4	0		0.089	0	1.1	0		0	15	0	0		0	0	0.35	
2015	NWB02	575363	6670210	345.80		4.1	65000	34000	20000	490	440	2000	9.4	0	0	6300	0	0		6.9	0.023	0			0	0	0	0	0.5	0		0	0	1.1	0		0	12	0	0		0	0	0.34	

0 = Below limit of reporting

APPENDIX III
CONSTRUCTION DETAILS AND PUMPING TEST PLOTS FOR PRODUCTION BORES NWB1 AND NWB2

Government of **Western Australia**
Department of **Water**

OFFICE USE ONLY	**Form 2**

Information to be provided on completion of a non-artesian well

Information to be provided to the Department of Water under the *Water Agencies (Powers) Act 1984* and Section 26E of the *Rights in Water and Irrigation Act 1914* and Regulation 39 of the *Rights in Water and Irrigation Regulations 2000*

Please note:

- All information is to be written clearly and in block letters.
- If insufficient room please use a separate piece of paper.
- It is the responsibility of the person carrying out the works to fill out this form.

Part 1: Details of any licence granted for the work under the *Rights in Water And Irrigation Act 1914* section 26D

Licence number CAW N/A

☐ Individual ☒ Company

Licensee's full name Vimy Resources Pty Ltd

Part 2: Details of person carrying out the works

Company	Blue Spec drilling
Driller	Trevor Taylor
Driller licence number (non-mandatory)	no 33
Driller classification (non-mandatory)	Jules Weber class 3
Postal address	Lot 28 Great Eastern Hwy Kalgoorlie, WA 6430
Telephone	08 9021 3033
Facsimile	08 9021 6995
Email	accounts@bluespec.net.au

Part 3: Location of well

A 26D licence will list the premises on which well construction is to occur.

If the physical address of the well is different from the property address listed on the licence, contact the Department of Water prior to the commencement of construction.

Property address of well or other tenure details

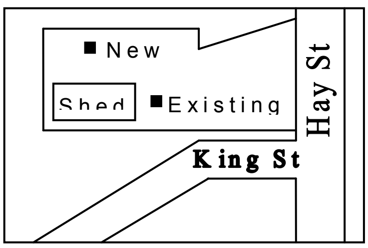
E39/1148

Well coordinates ☒ GPS reading ☐ Estimate

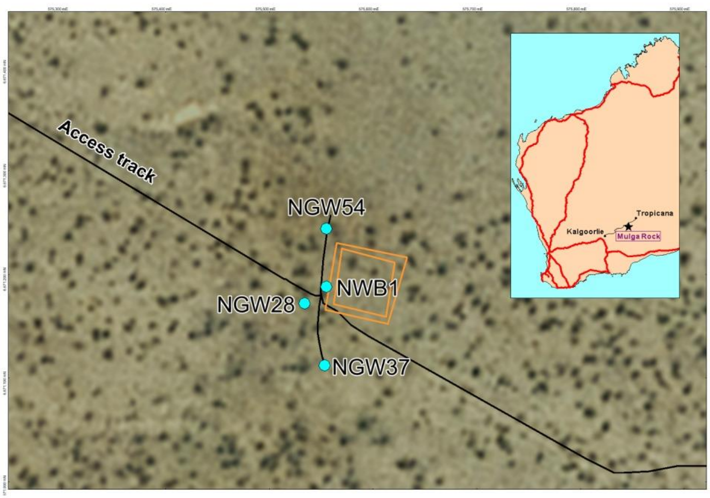
Zone	51
Easting/ latitude	575552
Northing/ longitude	6671190
Datum (e.g. GDA94/WGS84)	GDA94
GPS reliability	3-10m

Location plan – in the box below please sketch a plan showing position of well in relation to building, boundaries, road, nearest cross road and any additional information to assist in locating the well.

SAMPLE



In the box to the right, please sketch a plan showing:
- location of all wetlands / watercourses / wells / soaks (existing and proposed).
- major improvements (house, large sheds etc).
- shaded sections to indicate areas under development.



Part 4: Construction details (All measurements are to be taken from ground level)

Please complete well construction diagram in box provided below. If insufficient room please attach on separate piece of paper.

Production casing detail					
Material	Nominal bore	Diameter O.D (mm)	Wall thickness (mm)	Depth	
				From (m)	To (m)
PVC	155mm	175	10	+0.5	36
PVC	155mm	175	10	42	66
PVC	155mm	175	10	102	108

Screens/slots				
Screens/slot (type)	Diameter O.D (mm)	Aperture (mm)	Top of screen (m)	Bottom of screen (m)
PVC	175	1	36	42
PVC	175	1	66	84
stainless screen	170	1	84	102

Gravel pack details		
Gravel size (mm) 1.6-3.2	From (m)	To (m)
	33	108

Annular fill		
Material type	From (m)	To (m)
Gravek pack	33	108
Bentonite pellets	32	33
cement	+0.3	32

Cementing detail		
☐ Pressure cement grouted ☒ Tremmie		
Casing diameter (mm O.D)	Depth	
	From (m)	To (m)
n/a	+0.3	32

Total depth drilled (from ground level): 108

Geophysical log required as condition of licence? ☐ Yes ☐ No

Geophysical log taken? (attach log and contractor details) ☐ Yes ☐ No

From (m)	To (m)	Strata description (If insufficient room attach on separate page)
0	12	Red + yellow sand (dune)
12	26	White coarse sand
26	42	Red gravel + sand
42	60	White clay
60	98	White coarse sand
98	104	Sandstone
104	108	Sandstone with some clay
104	114	Coarse sand

Part 5: Particulars of well

Drilling start date refers to the date drilling begins. Do not include set up date.

Drilling completion date includes well development and testing.

Well name / number NWB1

Drilling start 06/02/2015 **Drilling completion** 10/02/2015

Drilling method used
- ☐ Rotary air ☐ Cable tool ☐ Auger ☒ Rotary mud
- ☐ Sludge ☐ Other (specify) ____

Final status of well
- ☐ Ready to operate ☐ Decommissioned
- ☒ Other (specify) Water injection well

Purpose (use) of well
- ☐ Production ☒ Investigation ☐ Monitoring
- ☐ Other (specify) Injection wells

Part 6: Well development

Date (dd/mm/yy) 09/02/2015 **Duration of development** 10 **hours**

Method ☐ Airlift ☐ Pump ☒ Jetting ☐ Surging

Development pump rate (e.g. L/s, m^3/day) 5000 gallons/hour

Part 7: Pump testing (If applicable)

Date start (dd/mm/yy) n/a **Date end (dd/mm/yy)** **Duration of test** **hours**

☐ Step test ☐ Constant rate ☐ Other

Constant rate - pump rate (e.g. m^3/day) **Pump type (e.g submersible)**

Water rest level prior to test (m)

Measurements taken from ☐ top of casing (TOC) ☐ ground level (GL)
☐ other (specify) ____

Final drawdown is the distance between the static water level measured prior to the test and the water level measured at the end of the pumping test.

Elevation of measurement reference point if known (metres AHD) ☐ GPS ☐ Estimate
☐ other (specify) ____

Final drawdown **m** **Recommended supply (e.g. m^3/day)**

Comments no test to date

Part 8: Field samples

Specify unit measurements.

Collection method (e.g. pump test, airlift) AIRLIFT

Conductivity (e.g. mS/m) X ☐ Temperature compensated ☒ Temperature uncompensated **pH** X

Water temperature at test x°C

Comments……………………………………………………………………………………

Part 9: Lab samples

Lab samples taken (Please attach) ☐ Yes ☐ No

TDS (e.g. mg/l) n/a

Please submit samples separately to form if not received before the 1 month submission deadline.

Part 10: Water levels

SWL (Static water level) 58.29 **m** **Water cut at** 58,20 **m**

Measurements taken from ☒ top of casing (TOC) ☐ ground level (GL) ☐ other (specify) ____________________

Date of reading (dd/mm/yy) 10/02/2015

Comments……

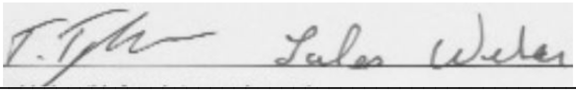
Part 11: Declaration and signature

Capacity of person making declaration:

☒ **An individual who carried out the work**

☐ **An officer who is a director or secretary of a corporation that carried out the work.**

☐ **Other (describe)**……………………………………………………………………………………



I, ____________________(name of person making declaration) declare that the information provided on this form is true and correct.

Important information

- All information must be completed on the form unless otherwise indicated as optional for example; provision of the drillers licence number and classification fields are not mandatory and can be filled in at the drillers discretion. Provision of non-mandatory details would greatly assist the department in completion of its data set.
- Failure to complete all mandatory details and to submit the form to the department is an offence under the *Rights in Water and Irrigation Act 1914.*
- Under section 26E and regulation 39 within 1 month of completion of the construction of or deepening of the well, the person carrying out the work for a 26D licence must submit this form.
- Non-artesian wells in proclaimed areas require a licence unless exempted under the *Rights in Water and Irrigation Exemption (S26C) Order 2007.*

Where and how to submit this form

This form can be submitted by fax, post or in person to the appropriate Department of Water regional office. For assistance in completing this form contact your regional office.

Kimberley Region
Kununurra Regional Office
27 Victoria Hwy
Kununurra WA 6743
Tel: 08 9166 4100
Fax: 08 9168 3174
PO Box 625
Kununurra WA 6743

Kwinana Peel Region
Mandurah Regional Office
107 Breakwater Parade
Mandurah WA 6210
Tel: 08 9550 4222
Fax: 08 9581 4560
PO Box 332
Mandurah WA 6210

South Coast Region
Albany Regional Office
5 Bevan Street
Albany WA 6330
Tel: 08 9842 5760
Fax: 08 9842 1204
PO Box 525
Albany WA 6331

Warren Blackwood District
Manjimup Regional Office
52 Bath Street
Manjimup WA 6528
Tel: 08 9771 1878
Fax: 08 9771 4335

Midwest Gascoyne Region
Geraldton Regional Office
94 Sandford Street
Geraldton WA 6531
Tel: 08 9965 7400
Fax: 08 9964 5983
Po Box 81
Geraldton WA 6531

South West Region
Bunbury Regional Office
35-39 McCombe Road
Bunbury WA 6230
Tel: 08 9726 4111
Fax: 08 9726 4100
PO Box 261
Bunbury WA 6231

Pilbara Region
Karratha Regional Office
Lot 4608 Cherratta Road
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Fax: 08 9144 2610
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Karratha WA 6714

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Tel: 08 9781 0188
Fax: 08 9754 4335
PO Box 269
Busselton WA 6280

Swan Avon Region
Victoria Park Regional Office
7 Ellam Street
Victoria Park WA 6100
Tel: 08 6250 8000
Fax: 08 6250 8050

Please retain a copy of this form for your records

Government of **Western Australia**
Department of **Water**

OFFICE USE ONLY

Form 2

Information to be provided on completion of a non-artesian well

Information to be provided to the Department of Water under the *Water Agencies (Powers) Act 1984* and Section 26E of the *Rights in Water and Irrigation Act 1914* and Regulation 39 of the *Rights in Water and Irrigation Regulations 2000*

Please note:

- All information is to be written clearly and in block letters.
- If insufficient room please use a separate piece of paper.
- It is the responsibility of the person carrying out the works to fill out this form.

Part 1: Details of any licence granted for the work under the *Rights in Water And Irrigation Act 1914* section 26D

Licence number CAW N/A

☐ Individual ☒ Company

Licensee's full name Vimy Resources Pty Ltd

Part 2: Details of person carrying out the works

Company	Blue Spec drilling
Driller	Trevor Taylor
Driller licence number (non-mandatory)	no 33
Driller classification (non-mandatory)	Jules Weber class 3
Postal address	Lot 28 Great Eastern Hwy Kalgoorlie, WA 6430
Telephone	08 9021 3033
Facsimile	08 9021 6995
Email	accounts@bluespec.net.au

Part 3: Location of well

A 26D licence will list the premises on which well construction is to occur.

If the physical address of the well is different from the property address listed on the licence, contact the Department of Water prior to the commencement of construction.

Property address of well or other tenure details

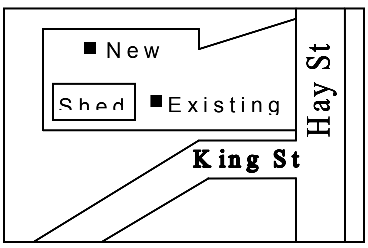
E39/1148

Well coordinates ☒ GPS reading ☐ Estimate

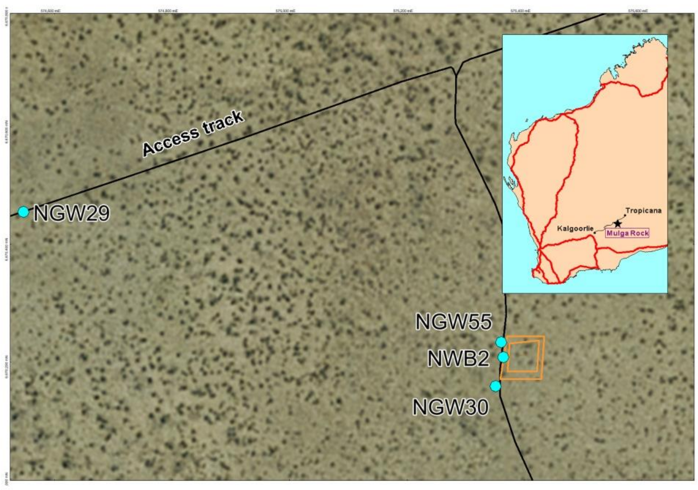
Zone	51
Easting/ latitude	575552
Northing/ longitude	6671190
Datum (e.g. GDA94/WGS84)	GDA94
GPS reliability	3-10m

Location plan – in the box below please sketch a plan showing position of well in relation to building, boundaries, road, nearest cross road and any additional information to assist in locating the well.

SAMPLE



In the box to the right, please sketch a plan showing:
- location of all wetlands / watercourses / wells / soaks (existing and proposed).
- major improvements (house, large sheds etc).
- shaded sections to indicate areas under development.



Part 4: Construction details (All measurements are to be taken from ground level)

Please complete well construction diagram in box provided below. If insufficient room please attach on separate piece of paper.

Production casing detail					
Material	Nominal bore	Diameter O.D (mm)	Wall thickness (mm)	Depth	
				From (m)	To (m)
PVC	155mm	175	10	+0.5	36
PVC	155mm	175	10	42	66
PVC	155mm	175	10	102	108

Screens/slots				
Screens/slot (type)	Diameter O.D (mm)	Aperture (mm)	Top of screen (m)	Bottom of screen (m)
PVC	175	1	36	42
PVC	175	1	66	84
stainless screen	170	1	84	102

Gravel pack details		
Gravel size (mm) 1.6-3.2	From (m)	To (m)
	33	108

Annular fill		
Material type	From (m)	To (m)
Gravek pack	33	108
Bentonite pellets	32	33
cement	+0.3	32

Cementing detail		
☐ Pressure cement grouted ☒ Tremmie		
Casing diameter (mm O.D)	Depth	
	From (m)	To (m)
n/a	+0.3	32

Total depth drilled (from ground level) 108

Geophysical log required as condition of licence? ☐ Yes ☐ No

Geophysical log taken? (attach log and contractor details) ☐ Yes ☐ No

From (m)	To (m)	Strata description (If insufficient room attach on separate page)
0	12	Red + yellow sand (dune)
12	26	White coarse sand
26	42	Red gravel + sand
42	60	White clay
60	98	White coarse sand
98	104	Sandstone
104	108	Sandstone with some clay
104	114	Coarse sand

Part 5: Particulars of well

Drilling start date refers to the date drilling begins. Do not include set up date.

Drilling completion date includes well development and testing.

Well name / number NWB1

Drilling start 06/02/2015 **Drilling completion** 10/02/2015

Drilling method used
☐ Rotary air ☐ Cable tool ☐ Auger ☒ Rotary mud
☐ Sludge ☐ Other (specify) ____

Final status of well
☐ Ready to operate ☐ Decommissioned
☒ Other (specify) Water injection well

Purpose (use) of well
☐ Production ☒ Investigation ☐ Monitoring
☐ Other (specify) Injection wells

Part 6: Well development

Date (dd/mm/yy) 09/02/2015 **Duration of development** 10 **hours**

Method ☐ Airlift ☐ Pump ☒ Jetting ☐ Surging

Development pump rate (e.g. L/s, m^3/day) 5000 gallons/hour

Part 7: Pump testing (If applicable)

Date start (dd/mm/yy) n/a **Date end (dd/mm/yy)** **Duration of test** **hours**

☐ Step test ☐ Constant rate ☐ Other

Constant rate - pump rate (e.g. m^3/day) **Pump type (e.g submersible)**

Water rest level prior to test (m)

Measurements taken from ☐ top of casing (TOC) ☐ ground level (GL)
☐ other (specify) ____

Final drawdown is the distance between the static water level measured prior to the test and the water level measured at the end of the pumping test.

Elevation of measurement reference point if known (metres AHD)
☐ GPS ☐ Estimate
☐ other (specify) ____

Final drawdown **m** **Recommended supply (e.g. m^3/day)**

Comments no test to date ....

Part 8: Field samples

Specify unit measurements.

Collection method (e.g. pump test, airlift) AIRLIFT

Conductivity (e.g. mS/m) X ☐ Temperature compensated ☒ Temperature uncompensated **pH** X

Water temperature at test x°C

Comments ....

....

Part 9: Lab samples

Lab samples taken (Please attach) ☐ Yes ☐ No

TDS (e.g. mg/l) n/a

Please submit samples separately to form if not received before the 1 month submission deadline.

Part 10: Water levels

SWL (Static water level) 58.29 **m** **Water cut at** 58,20 **m**

Measurements taken from ☒ top of casing (TOC) ☐ ground level (GL) ☐ other (specify) ____________________

Date of reading (dd/mm/yy) 10/02/2015

Comments……

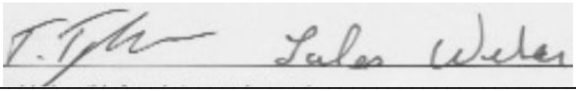
Part 11: Declaration and signature

Capacity of person making declaration:

☒ **An individual who carried out the work**

☐ **An officer who is a director or secretary of a corporation that carried out the work.**

☐ **Other (describe)**……………………………………………………………………………………



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Important information

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Swan Avon Region
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7 Ellam Street
Victoria Park WA 6100
Tel: 08 6250 8000
Fax: 08 6250 8050

Please retain a copy of this form for your records

Client: Vimy Resources
Project: Mulga Rock
Date: March 2015
Dwg. No: 345-0/15/1-AIII-0

NWB1 PRODUCTION BORE
STEP-RATE PUMPING TEST
at 432 kL/d, 618 kL/d, 789 kL/d, 918 kL/d

Rockwater Pty Ltd

NWB1 step test.grf

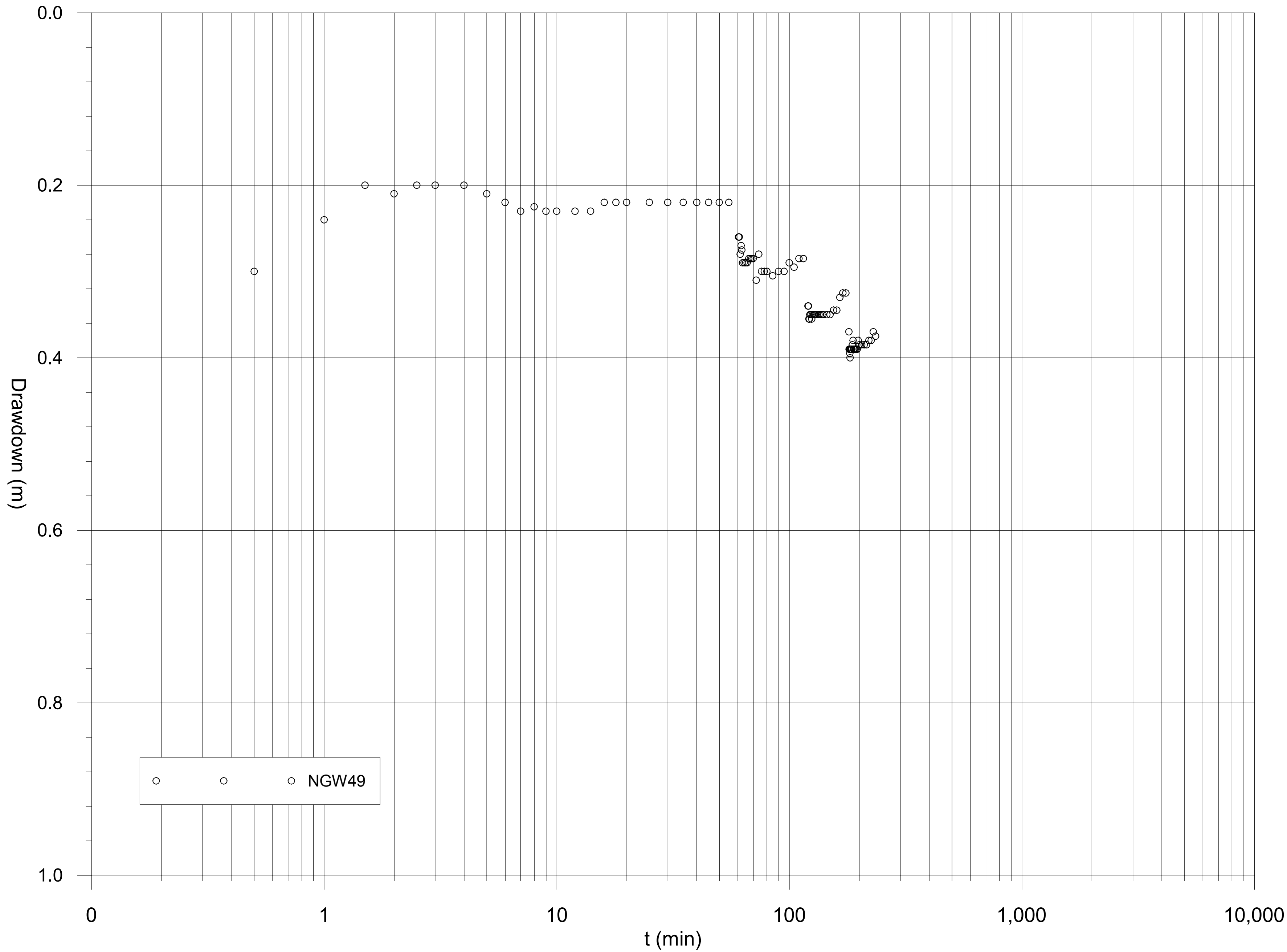
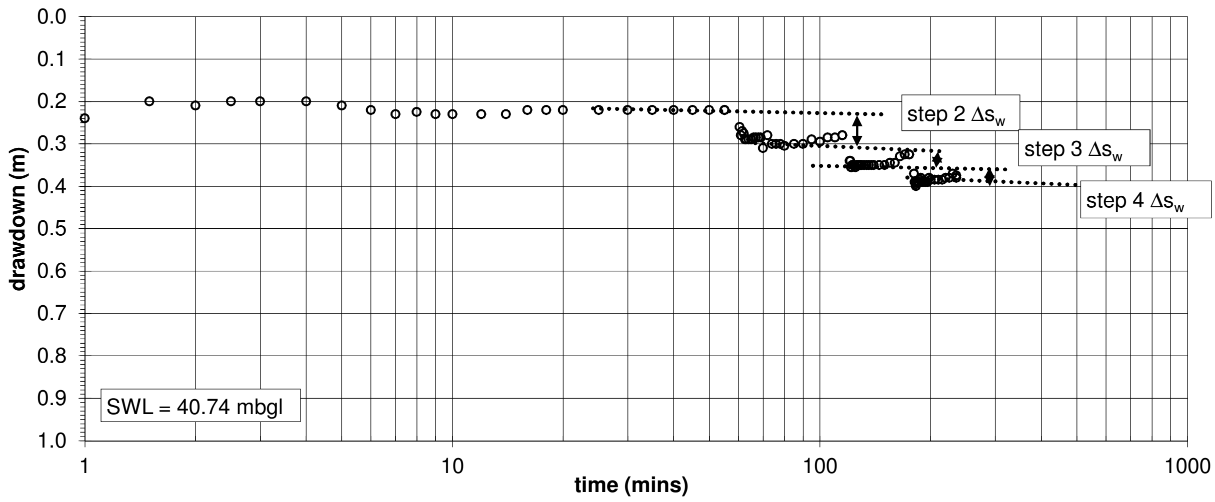


Figure AIII-0



$s=BQ+CQ^2$, where:

BQ is drawdown due to laminar flow

CQ^2 is drawdown due to turbulent flow

s/Q=B+CQ, so in plot of s/Q v. Q, B is the intercept & C is the slope

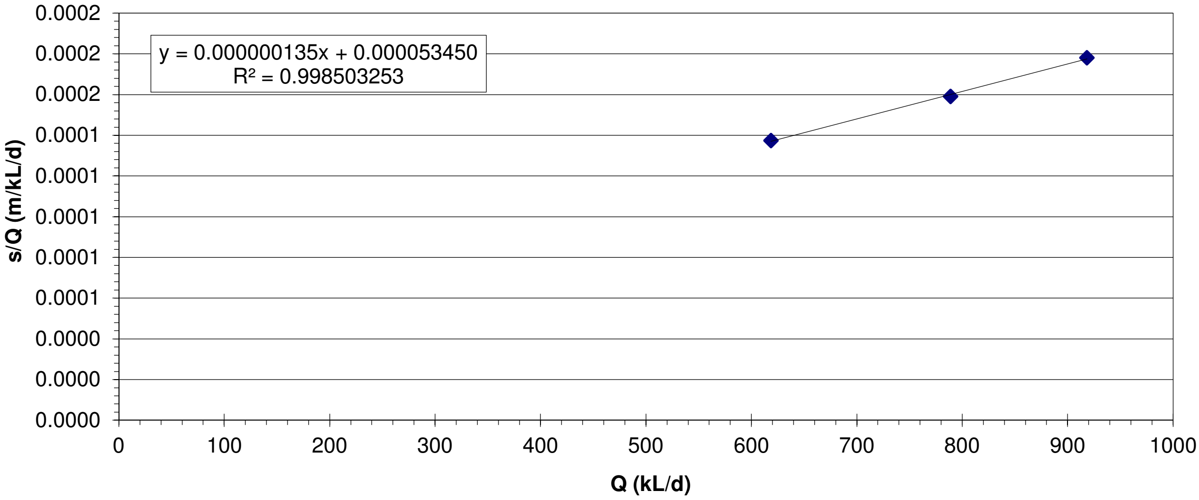
B = 5.3E-05 intercept

C = 1.4E-07 slope

Step	Q		stabilised drawdown (s)		s/Q
	L/s	kL/d	Δs_w (m)	total (m)	m/kL/d
1					
2	7.16	618.62	0.085	0.085	0.00014
3	9.13	788.83	0.041	0.126	0.00016
4	10.63	918.43	0.038	0.164	0.00018

predicted drawdown using B & C @ Q=14 L/s, = 0.26 m

actual drawdown from CRT @ t=1320 mins & Q=14 L/s, = 0.49 m



Drawdown due to turbulent flow in aquifer and bore (Lt)

$Lt=(CQ^2/(BQ+CQ^2))100$

Lt =	52.2	% at Q =5 L/s
Lt =	61.0	% at Q = 7 L/s
Lt =	66.6	% at Q = 9 L/s
Lt =	69.9	% at Q = 11 L/s

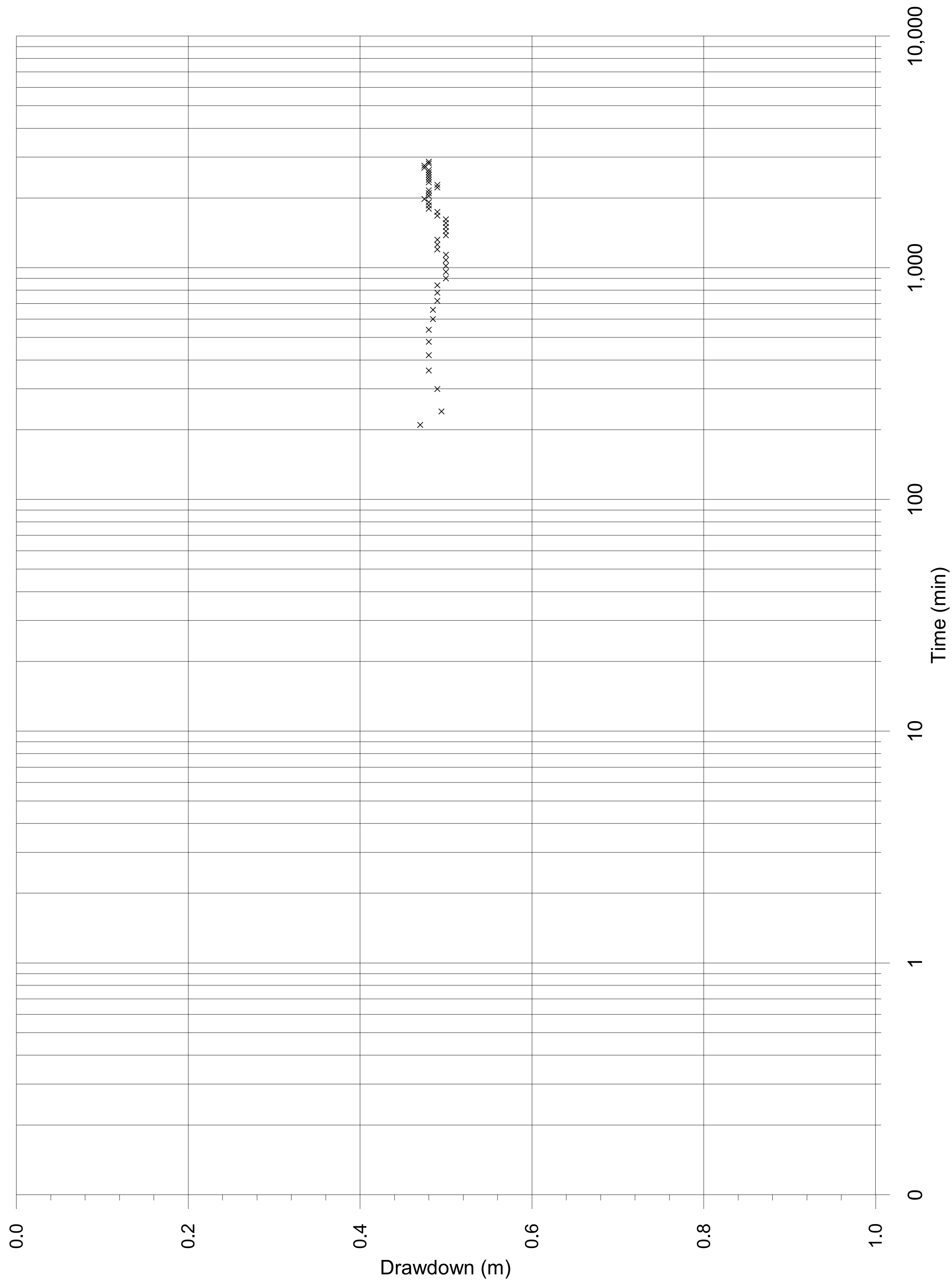
345.0\Data\Pumping Tests\step test - NWB3 Analysis.xls

Client:	Vimy Resources
Project:	345-0
Date	March 2015
Dwg No.	345-0/15/1-AIII-0A

Bore NWB1 Step-rate Test Data with Analysis of Turbulent Flow

Rockwater Pty Ltd

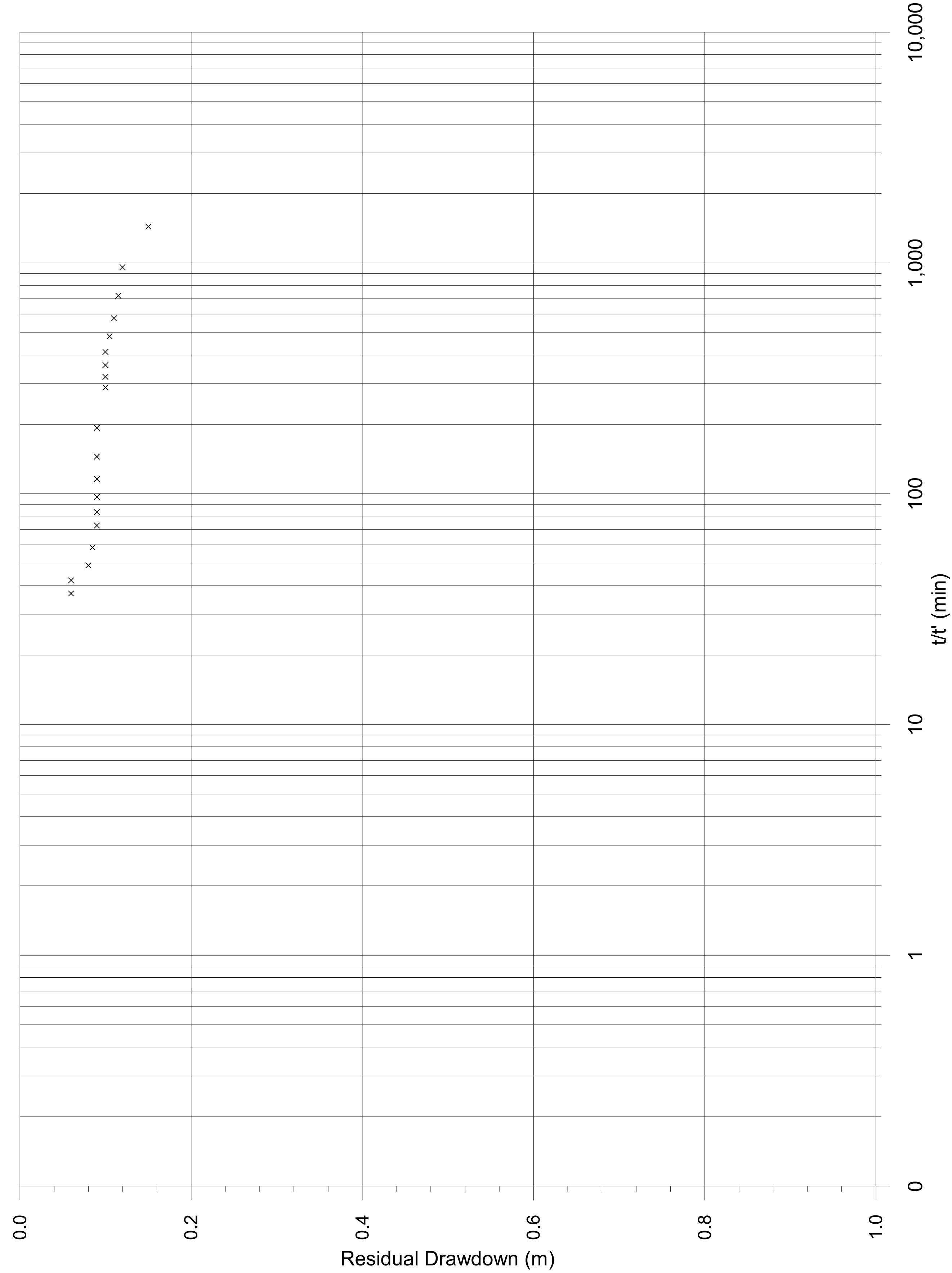
Figure AIII-1



nbw1 prod.grf

Client: Vimy Resources	BORE NBW1 PUMPING TEST
Project: Mulga Rock	AT 1,210 KL/d, 16/3/15
Date: March 2015	DRAWDOWNS IN NBW1
Dwg. No: 345-0/15/1-AIII-1	Rockwater Pty Ltd

Figure AIII-2



nwb1 recovery.grf

Client: Vimy Resources Project: Mulga Rock Date: March 2015 Dwg. No: 345-0/15/1-AIII-2	BORE NWB1 PUMPING TEST AT 1,210 KL/d, 16/3/15 RECOVERY IN NWB1 Rockwater Pty Ltd

Client: Vimy Resources
Project: Mulga Rock
Date: March 2015
Dwg. No: 345-0/15/2-AIII-3

BORE NBW1 PUMPING TEST
AT 1,210 KL/d, 16/3/15
DRAWDOWNS IN NGW37

Rockwater Pty Ltd

nbw1 ngw37.grf

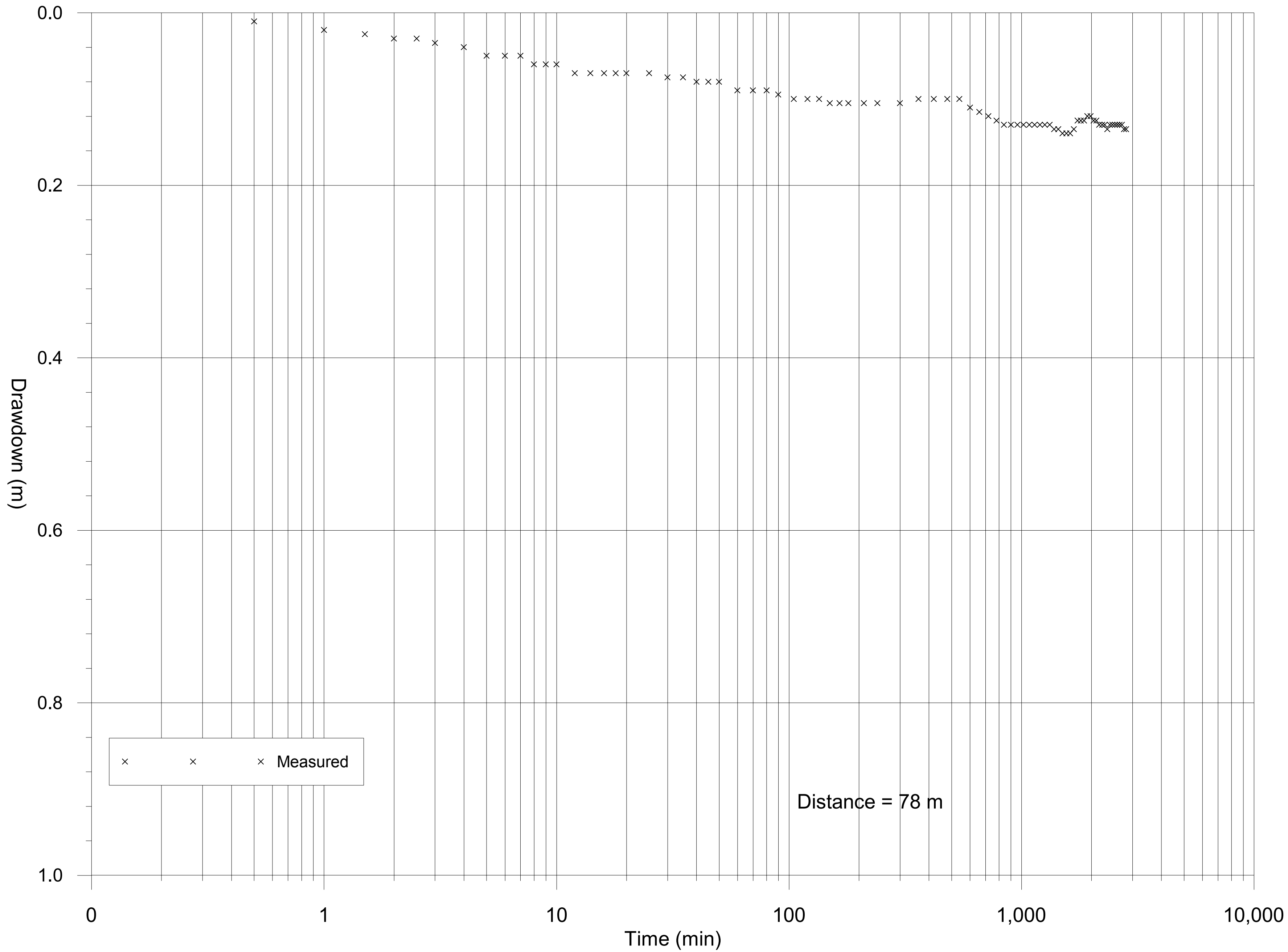


Figure AIII-3

Client: Vimy Resources
Project: Mulga Rock
Date: March 2015
Dwg. No: 345-0/15/2-AIII-4

BORE NBW1 PUMPING TEST
AT 1,210 KL/d, 16/3/15
DRAWDOWNS IN NGW54C

Rockwater Pty Ltd

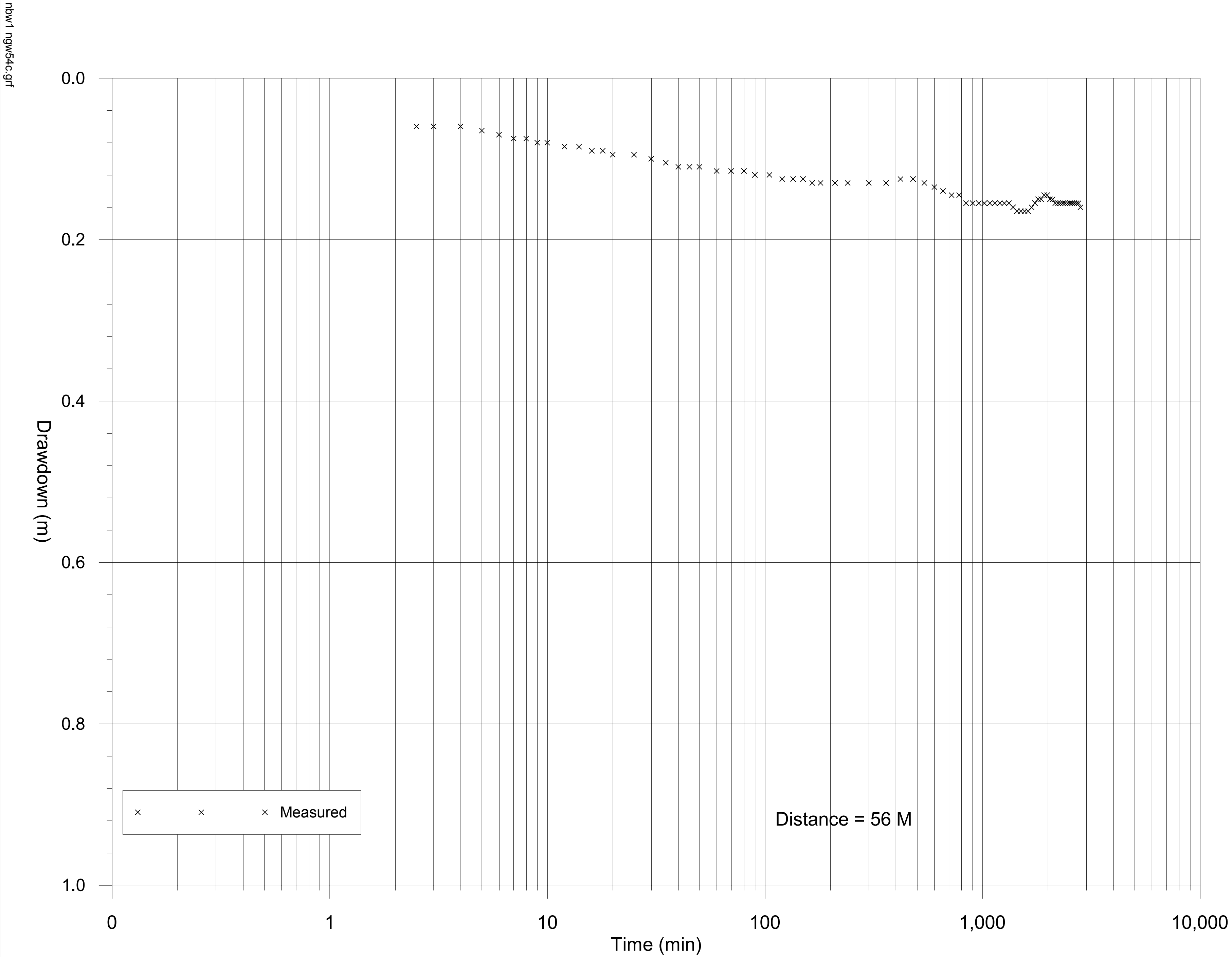
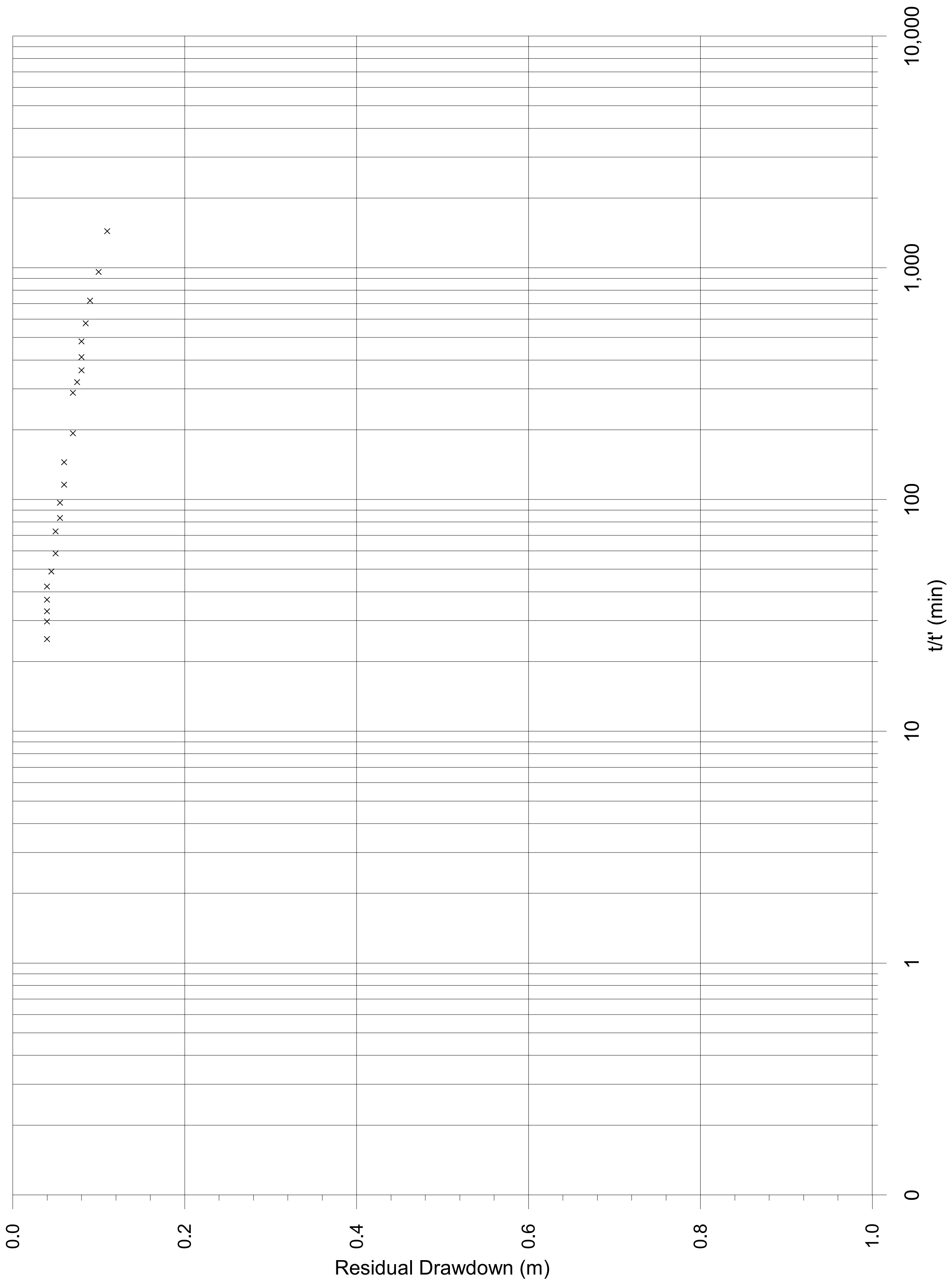


Figure AIII-4

Figure AIII-5



ngw37 recovery.grf

Client: Vimy Resources

Project: Mulga Rock

Date: March 2015

Dwg. No: 345-0/15/2-AIII-5

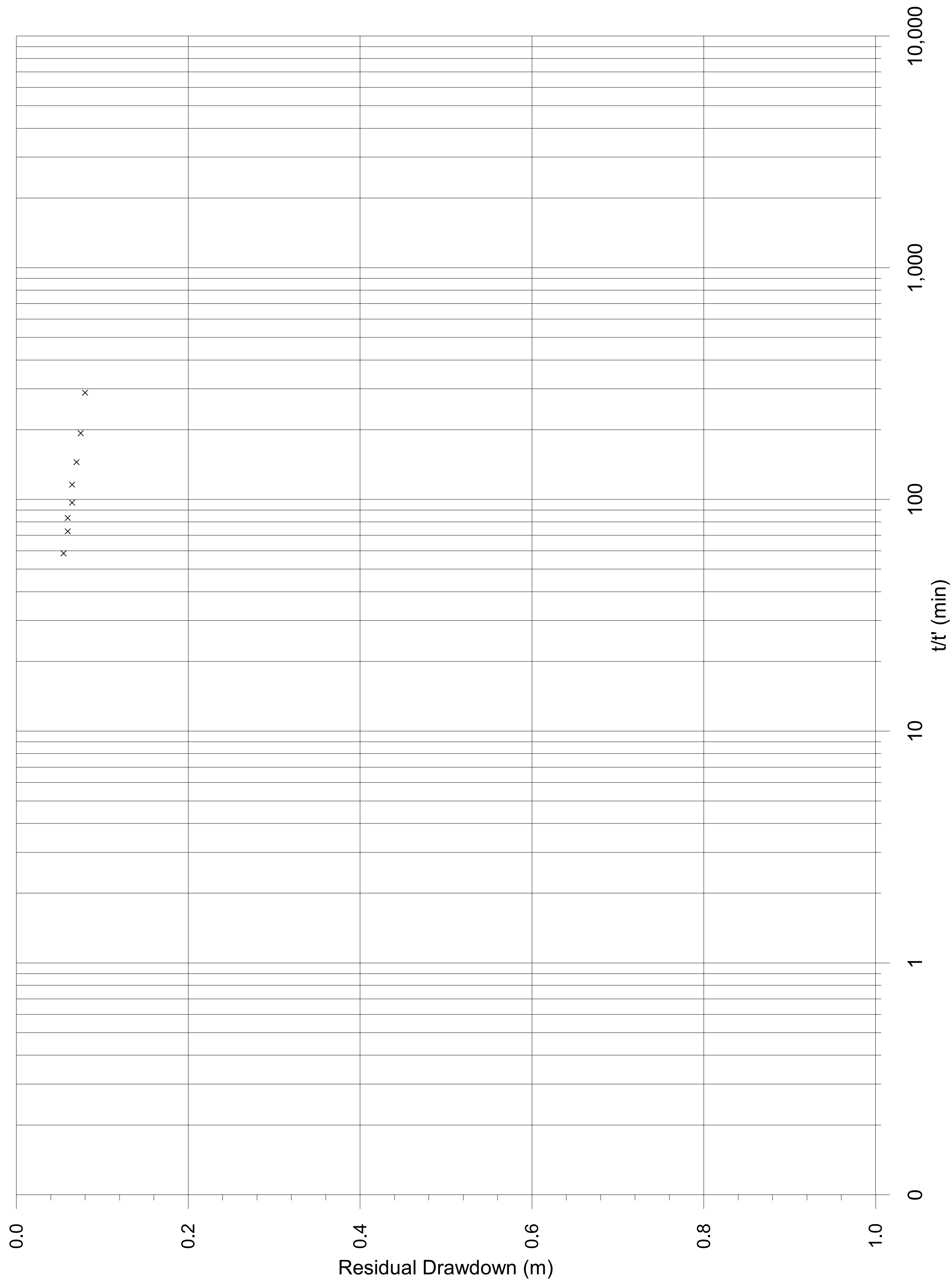
BORE NWB1 PUMPING TEST

AT 1,210 KL/d, 16/3/15

RECOVERY IN NGW37

Rockwater Pty Ltd

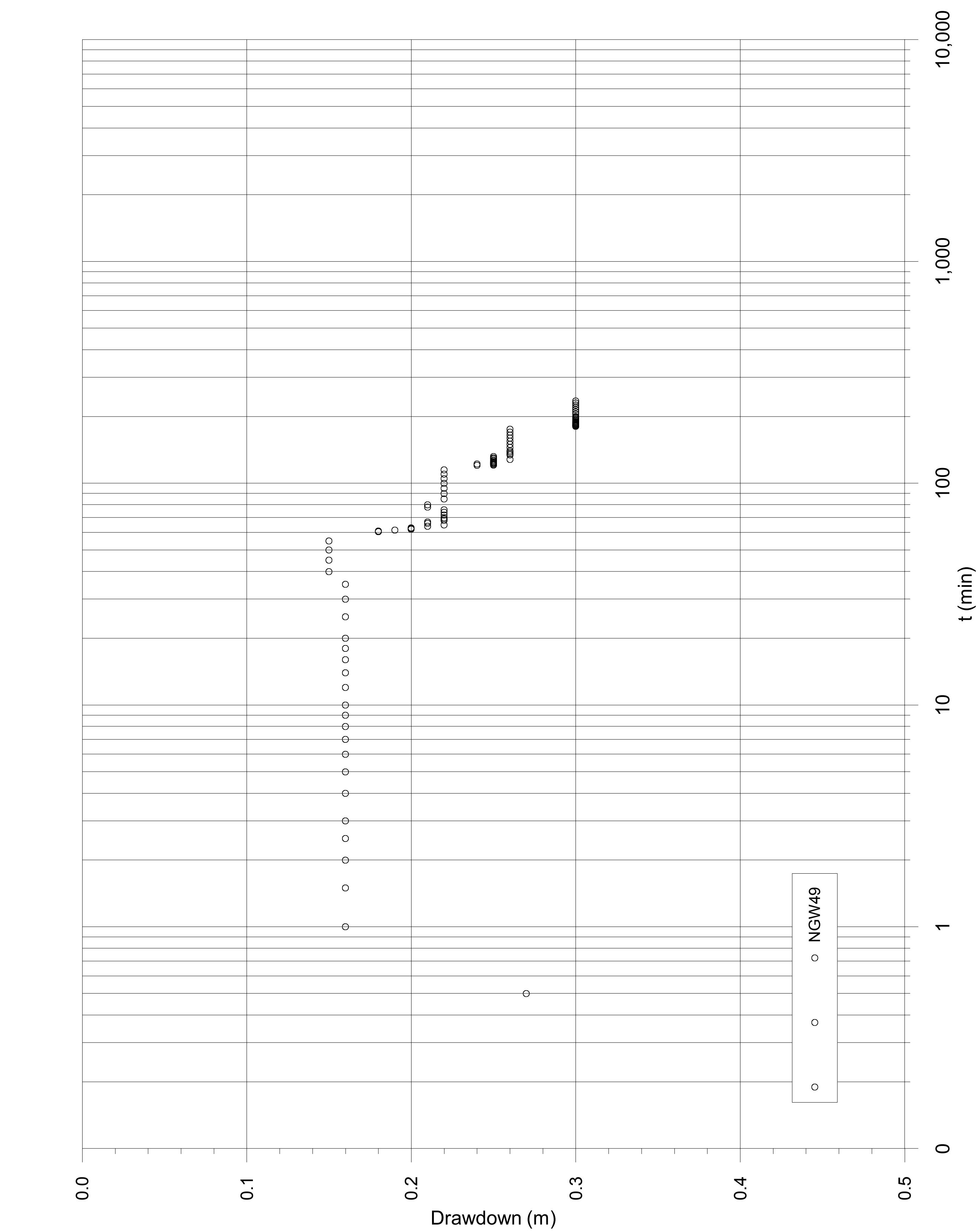
Figure AIII-6



ngw54c recovery.grf

Client: Vimy Resources	BORE NWB1 PUMPING TEST
Project: Mulga Rock	AT 1,210 KL/d, 16/3/15
Date: March 2015	RECOVERY IN NGW54C
Dwg. No: 345-0/15/2-AIII-6	Rockwater Pty Ltd

Figure AIII-7



NWB2 step test.grf

Client: Vimy Resources

Project: Mulga Rock

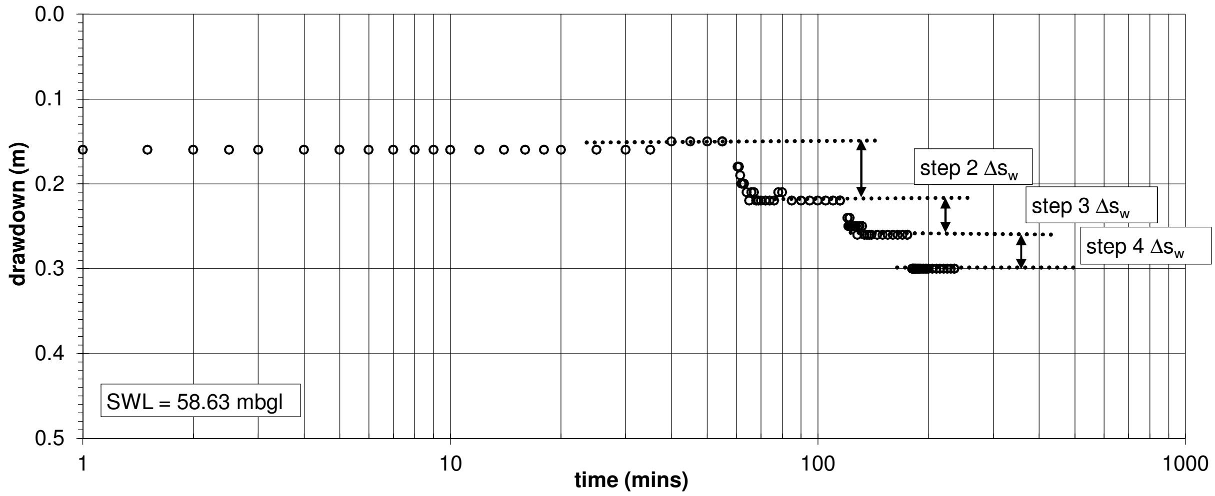
Date: March 2015

Dwg. No: 345-0/15/2-AIII-7

NWB2 PRODUCTION BORE

STEP-RATE PUMPING TEST
at 415 KL/d, 600 kL/d, 767 kL/d, 943 kL/d

Rockwater Pty Ltd

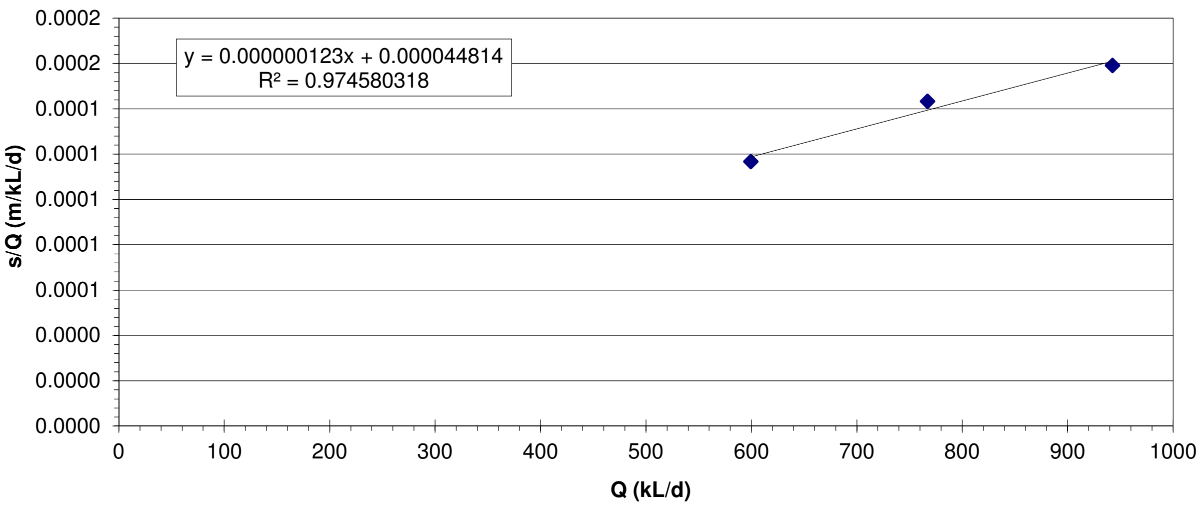


$s=BQ+CQ^2$, where:
BQ is drawdown due to laminar flow
CQ^2 is drawdown due to turbulent flow
$s/Q=B+CQ$, so in plot of s/Q v. Q, B is the intercept
& C is the slope

B = 4.5E-05 intercept
C = 1.2E-07 slope

Step	Q (L/s)	Q (kL/d)	stabilised drawdown (s) Δs_w (m)	stabilised drawdown (s) total (m)	s/Q m/kL/d
1					
2	6.94	599.62	0.070	0.070	0.00012
3	8.88	767.23	0.040	0.110	0.00014
4	10.91	942.62	0.040	0.150	0.00016

predicted drawdown using B & C @ Q=11 L/s, = 0.15 m
actual drawdown from CRT @ t=2873 mins & Q=11 L/s, = 0.32 m



Drawdown due to turbulent flow in aquifer and bore (Lt)
$Lt=(CQ^2/(BQ+CQ^2))100$

Lt = 49.2 % at Q =4 L/s
Lt = 62.3 % at Q = 7 L/s
Lt = 67.9 % at Q = 9 L/s
Lt = 72.2 % at Q = 11 L/s

345.0\Data\Pumping Tests\step test - NWB2 Analysis.xls

Client: Vimy Resources
Project: 345-0
Date March 2015
Dwg No. 345-0/15/1-AIII-7A

Bore NWB2 Step-rate Test Data with Analysis of Turbulent Flow

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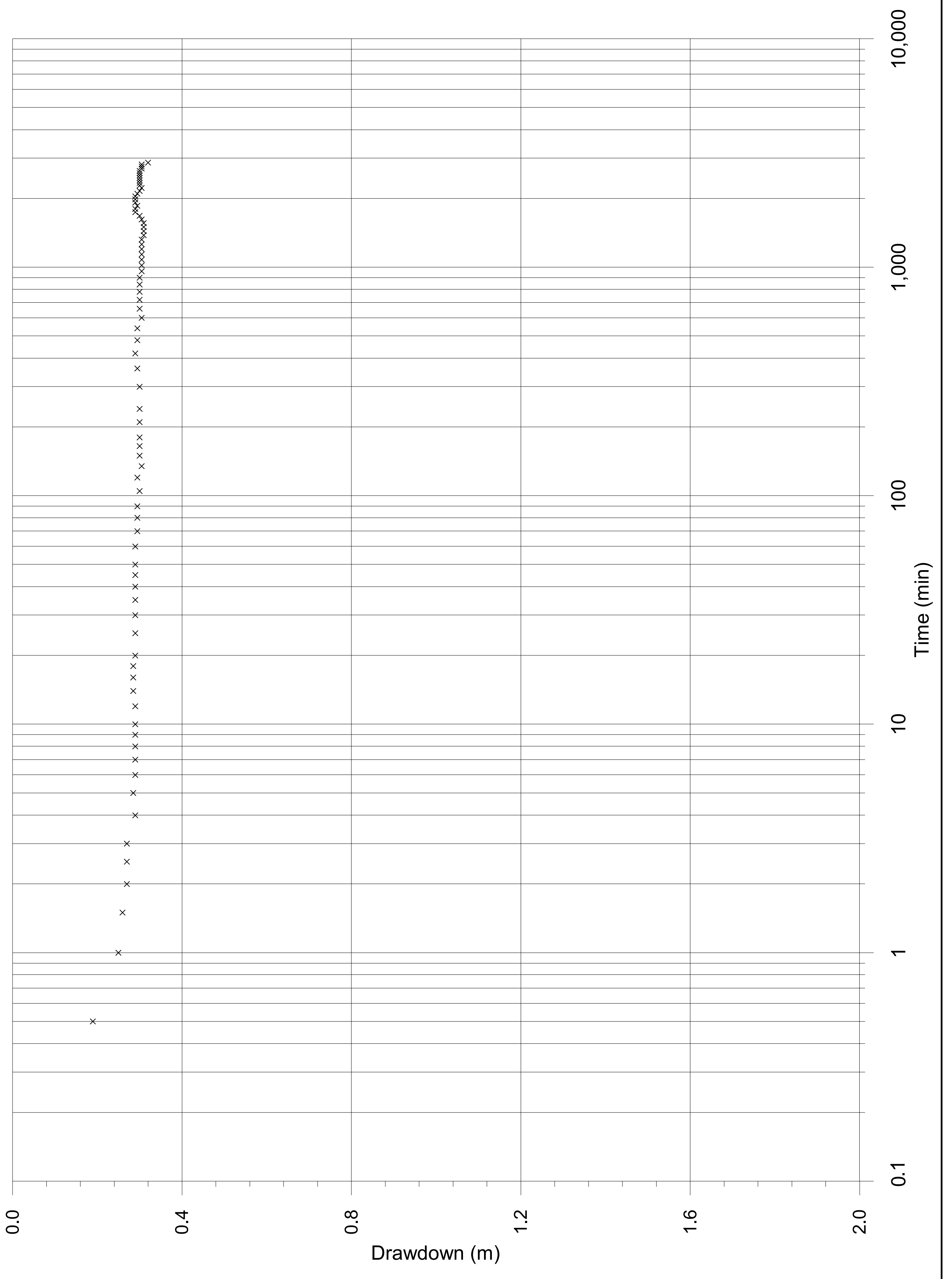
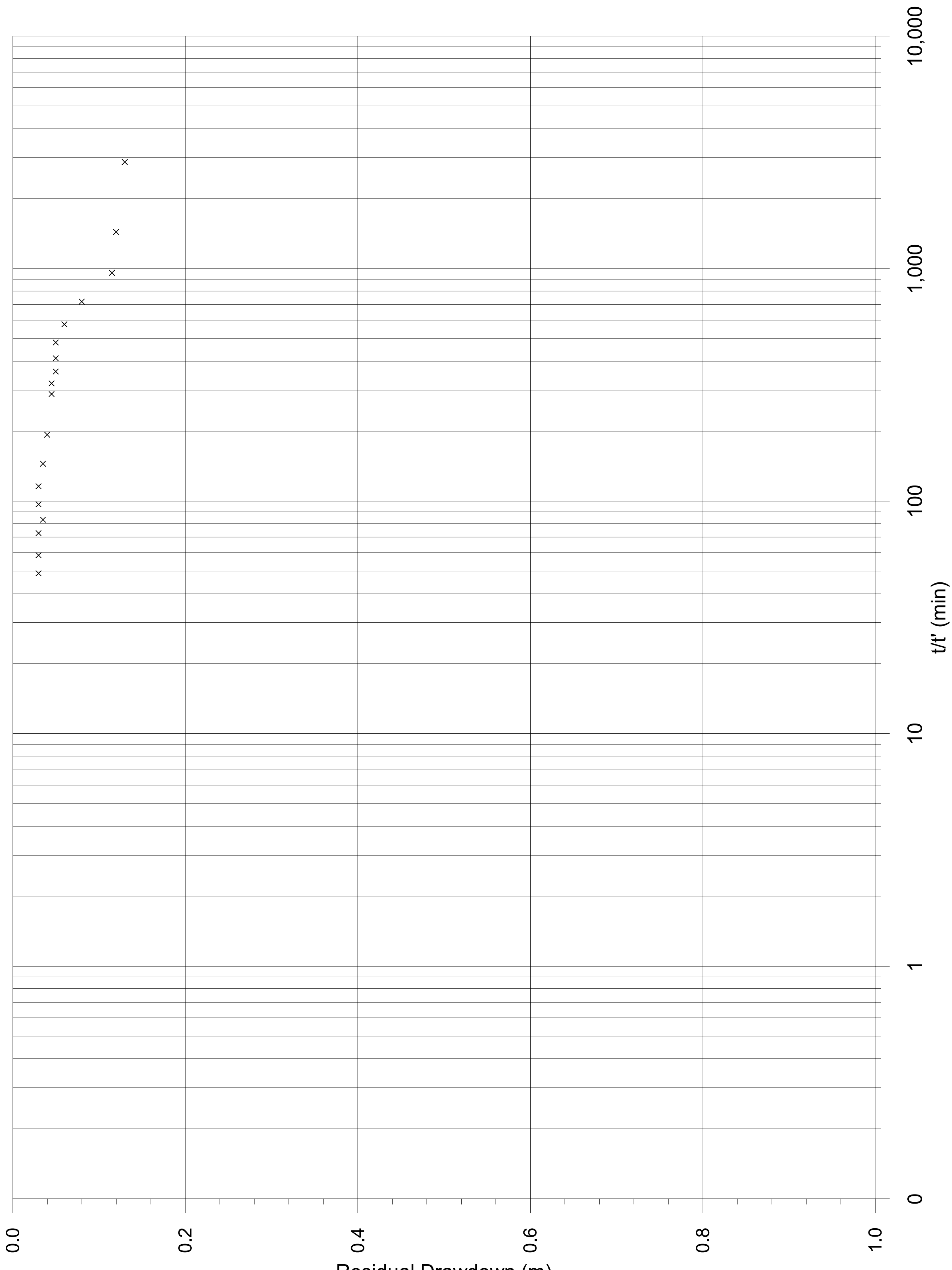
Figure AIII-8



ngw2 prod.grf

Client: Vimy Resources Project: Mulga Rock Date: March 2015 Dwg. No: 345-0/15/2-AIII-8	PRODUCTION BORE NGW2 PUMPING RATE 950 KL/d, Start 13/3/15 DRAWDOWN IN PUMPED BORE Rockwater Pty Ltd

Figure AIII-9



nwb2 recovery.grf

Client: Vimy Resources
Project: Mulga Rock
Date: March 2015
Dwg. No: 345-0/15/2-AIII-9

BORE NWB2 PUMPING TEST
AT 950 KL/d, 7/3/15
RECOVERY IN NWB2

Rockwater Pty Ltd

Client: Vimy Resources
Project: Mulga Rock
Date: March 2015
Dwg. No: 345-0/15/2-AIII-10

BORE NBW2 PUMPING TEST
AT 950 KL/d, 13/3/15
DRAWDOWNS IN NGW30

Rockwater Pty Ltd

nbw2 ngw30.grf

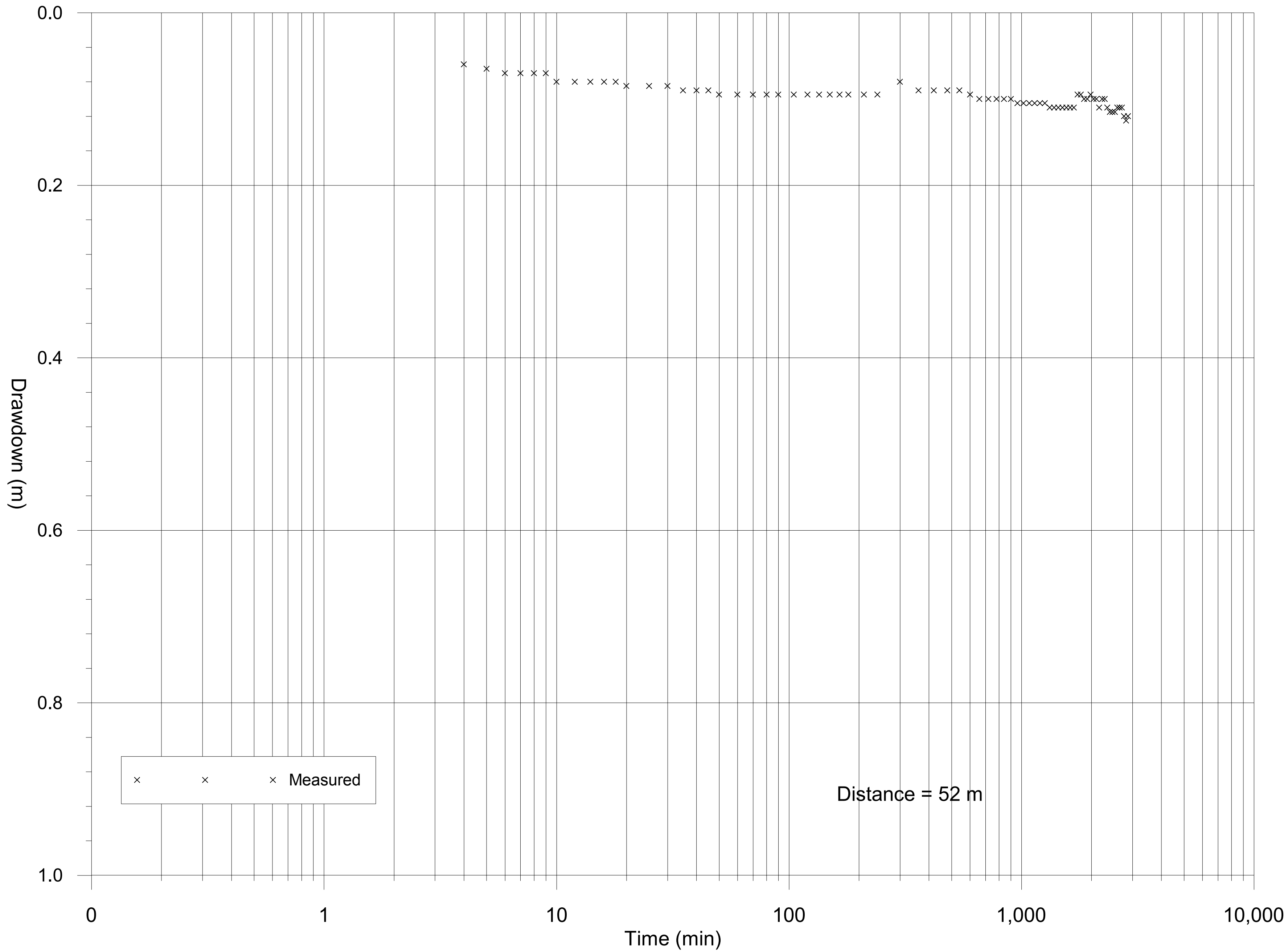


Figure AIII-10

Client: Vimy Resources
Project: Mulga Rock
Date: March 2015
Dwg. No: 345-0/15/2-AIII-11

BORE NBW2 PUMPING TEST
AT 950 KL/d, 13/3/15
DRAWDOWNS IN NGW55

Rockwater Pty Ltd

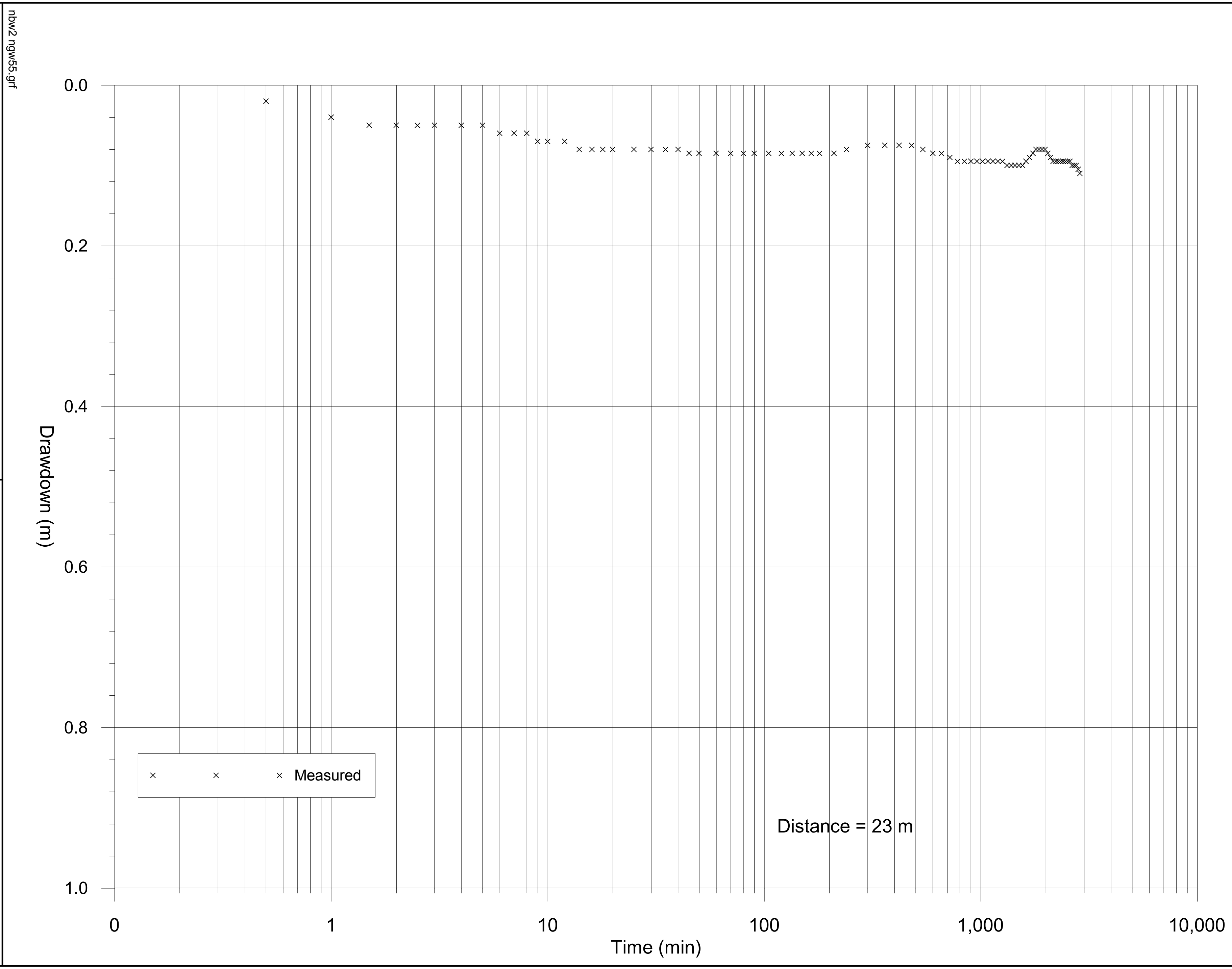
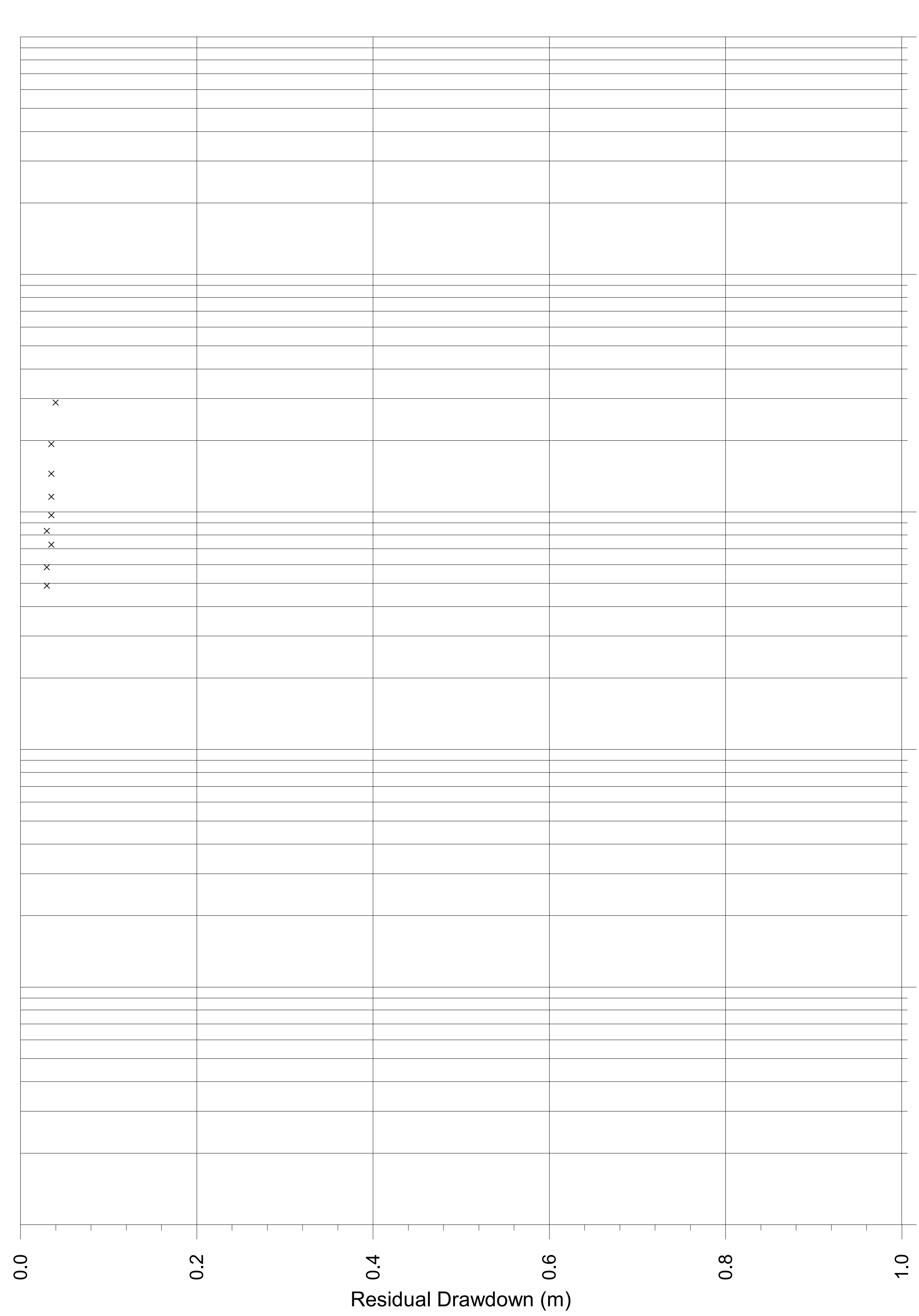


Figure AIII-11

Figure AIII-12



ngw30 recovery.grf

Client: Vimy Resources

Project: Mulga Rock

Date: March 2015

Dwg. No: 345-0/15/2-AIII-12

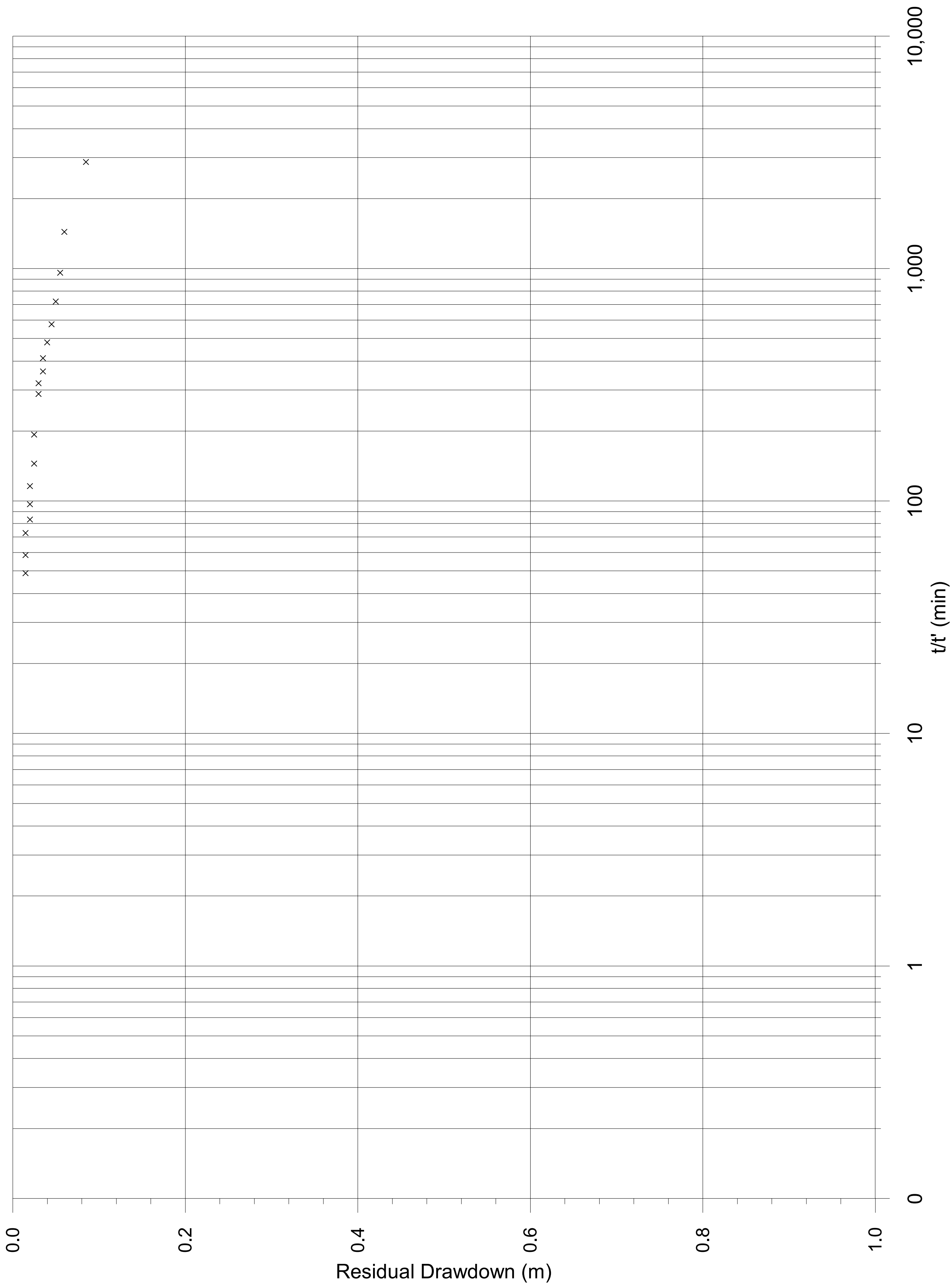
BORE NWB2 PUMPING TEST

AT 950 KL/d, 7/3/15

RECOVERY IN NGW30

Rockwater Pty Ltd

Figure AIII-13



ngw55 recovery.grf

Client: Vimy Resources

Project: Mulga Rock

Date: March 2015

Dwg. No: 345-0/15/2-AIII-13

BORE NWB2 PUMPING TEST

AT 950 KL/d, 7/3/15

RECOVERY IN NGW55

Rockwater Pty Ltd