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2016 Dalyellup Annual Environmental Report

Cristal Pigment Australia Ltd
ABN 50 008 683 627
Locked Bag 245, Bunbury WA 6230
Lot 350 Old Coast road, Australind WA 6233

T +61 8 9780 8333 F +61 8 9780 8500
www.cristal.com

Brilliance inspired by titanium

A TASNEE COMPANY

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SUMMARY

This report documents the environmental review of the Dalyellup treated solid residue disposal facility operated by Cristal. The report is submitted to satisfy the following requirements for the period January – December 2016 for the:

- Closure Notice for Licence 6130/1989/12 (Appendix A) issued by the Department of Environment Regulation under Part V of the Environmental Protection Act 1986, which commenced 14 May 2013; and
- Ministerial Conditions (Appendix B) imposed under Part IV of the Environmental Protection Act 1986.

The key findings of this review are:

- Assessment of monitoring data indicates that the operation of the solid residue facility results in minimal environmental impacts;
- Radiation levels measured at the site boundaries and in groundwater are consistent with previous years and remain at background levels;
- No significant levels of dioxins and furans were found in any of the ground water samples;
- The main drinking supply, the Yarragadee aquifer, remains unaffected by the site;
- The site ceased operation on 1 March 2013, and rehabilitation plans have commenced with ponds capped with at least 2 metres of clean fill. An end land use has been selected, and rehabilitation planning progressed;
- Ministerial conditions related to the closure have been met to the satisfaction of the Office of Environmental Protection Authority.

1.0 INTRODUCTION

1.1 Background of Operations and Purpose

Cristal Pigment Australia Ltd, is a Cristal company that produces titanium dioxide pigment for use in the manufacture of paint, paper, plastic, cosmetics and many other products. Cristal has two manufacturing facilities in the south west region near Bunbury (see Figure 1). They are the Kemerton processing plant and the Australind finishing plant. Combined, the two plants produced 94,951 tonnes of finished pigment in 2016. Cristal also operated a solid residue disposal facility at Dalyellup, 8 kilometres south of Bunbury until March 1 2013. Since 2013, the treated solid residue has been sent to Cleanaway's Banksia Road Facility at Dardanup.

A Closure Notice was issued in May 2013 by DER and amended in August 2013. This report documents the ongoing monitoring of the Dalyellup Treated Solid Residue (TSR) Disposal Facility as required by the Notice.

Figure 1 – Site Location

1.2 Source of Treated Solid residue (TSR)

The vast majority of TSR sent to Dalyellup was from the Kemerton Processing plant (~95%). The plant utilises the chloride process to produce TiO_2. The chloride process is based on the production of titanium tetrachloride ($TiCl_4$) from the chlorination of titanium bearing ore. The purified $TiCl_4$ is subsequently oxidised, yielding titanium dioxide and allowing recycling of chlorine (Cl_2).

Titanium-rich ore, together with a supply of carbon (petroleum coke), is fed into a chlorinating vessel, which operates at approximately 900-1100^{o}C. Chlorine entering the vessel reacts with the TiO_2 and some of the ore impurities to form $TiCl_4$, metal chlorides as well as carbon monoxide (CO) and carbon dioxide (CO_2). The reaction is as follows:

$$3\,TiO_2 + \mathit{M}O_x + 4\,C + 6\,Cl_2 \longrightarrow 3\,TiCl_4 + 2\,CO + 2\,CO_2 + \mathit{M}Cl_x$$

In the purification process, solid and liquid impurities are separated from the hot gas. The gas is condensed and then distilled to produce pure titanium tetrachloride as an intermediate product.

The solid residue separated from the gas stream typically consists of metal chlorides, oxides, various silicates, unreacted ore and coke. Most of the ore and coke is recovered and separated prior to being reused in the production process. A neutralisation process is used to treat the remaining solid residue from the chlorinated gas stream. Lime is added to each of a series of tanks to raise the pH and precipitate the contaminants as hydroxides.

$$MCl_x + Ca(OH)_2 \longrightarrow CaCl_2 + M(OH)_x$$

$$\text{Metal chlorides + lime} \longrightarrow \text{calcium chloride + metal hydroxides}$$

The slurry is then sent to a clarifier where the solids settle and are separated. The solids are filtered by a vacuum filter, washed to remove a large proportion of the soluble salts. Before March 2013 the waste was transferred as a ~20% solid slurry by tankers to the disposal site at Dalyellup.

The Australind residue contributed approximately 2-6% of the total residue sent to Dalyellup. The Australind finishing plant receives TiO_2 slurry from Kemerton via road tanker where it then undergoes surface treatment, washing, filtering, drying, final milling and packaging. Any process wastewater is captured in the drain system which is transferred to the neutralisation plant. The neutralisation process is the same as Kemerton and slurry was transported to Dalyellup in the same manner. The dried residue is an inert, insoluble, non-toxic, clay-like material.

2.0 SITE INFORMATION

2.1 Site History and Location

The disposal site is adjacent to and set within the buffer zone of the No.2 Bunbury Sewage Treatment Works and is approximately 200 metres from the ocean. The disposal site is situated in the swale between the vegetated linear primary dunes and the parabolic secondary dunes, which have a maximum elevation in the area of 45 metres Australian Height Datum (AHD).

Disposal at the site commenced in March 1989 under a five year agreement with the Shire of Capel. DEC, however, agreed to the use of the site for three years, conditional upon satisfactory environmental performance. In June 1991, the company submitted a proposal to the DEC for a two-year extension of its disposal facilities. This was consistent with the original agreement made with the Shire of Capel. In response, the DEC called for a Consultative Environmental Review.

The CER was released in September 1991 and, following the normal public review and assessment period, approval for the project to proceed was received from the Minister for the Environment on 23 January 1992. The extension, approved under Ministerial Statement No. 213 expired on 4 March 1994.

In August 1993 Cristal submitted a proposal to the DEC for continued use of the disposal site. Pursuant to section 46(1) of the Environmental Protection Act (1986), the Minister for the Environment requested the DEC to inquire into and report on the proposed change to Environmental Condition M1.

The section 46 amendment was approved in Ministerial Statement No. 332, published on 9 December 1993. Further Ministerial Conditions were set on the project (see Section 5). The extension, for the “Life of the Site”, is subject to the licensing requirements of the Environmental Protection Act (1986). Cristal was granted approval to operate this site until March 2010.

The site was registered in May 2007 as a Contaminated Site, as required under the Contaminated Sites Act 2003. The registration was accompanied by copies of the licence, the annual reports from previous years, and other studies and reports. The site has been classified by the DEC Contaminated Sites Branch as ‘Possibly Contaminated’ and is suitable for its current use.

In 2008 Cristal commenced community consultation for the issue of a new licence to operate the site from 2010 to 2013. The extension was requested as the facility would not be fully utilised until 2013. This was due to Cristal implementing waste reduction and recycling programs at the Kemerton facility.

During 2009, the Shire of Capel, WA Planning Commission, Radiological Council and Environmental Protection Authority approved continued use of the site. An assessment by the DEC followed and a licence was issued on the 25th January 2010 to operate the site until March 2013, at which time the site ceased to operate.

In 2009-2010, studies on the impact of leachate to the near shore, concluded that there was no evidence of metal, chromium VI, dioxin or furan contamination found in the sediment, sediment elutriates or marine water adjacent to the Dalyellup waste disposal site, and on the basis of the results, ground water discharge adjacent to the site posed negligible risk to the marine environment and had a negligible impact on recreational uses on the beach and waters adjacent to the site.

Disposal ceased on March 1st 2013 and the Final Closure Notice, issued in May 2013 by DER, details the ongoing monitoring requirements. The remaining treated solid residue ponds were covered with 3-4 metres of clean fill in September 2013.

Two rehabilitation options have been considered in detail: redevelopment to sporting fields; and rehabilitation back to native vegetation. In May 2017, The Shire of Capel formally communicated that they were not committing to the sporting field option, and so plans have commenced to extend previous successful revegetation efforts at the south of the site to the rest of the facility.

Refer to appendix H. In 2015, the OEPA was satisfied that ministerial conditions related to the closure had been met. The Mandatory Auditor’s Report was sent to the DER’s Contaminated Sites Branch in July 2015.

Cristal is waiting for DER review of the Closure Notice, as there may be changes in licence conditions which will impact on the EMP.

2.2 Site Hydrogeology

1.1.1 Superficial Formations

The sediments below the disposal area are calcareous, fine to medium grained sands. They range in depth from 10 to 20 metres. Limestone, sand and sandy clays occur in the area at depths between 10 to 30 metres. Below these sediments are dark grey, silty, micaceous clays. Some heavy minerals and silty organic matter occur throughout the profile. The secondary dunes are overlain by about 0.5 to 1.0 metres of topsoil.

The area is underlain by superficial formations, which range in depth from sea level to about 10 metres AHD above sea level. The superficial formations form an anisotropic unconfined aquifer, comprising sand and limestone, with a basal section of less permeable silty sand and sandy clay. The depth to the water table is about 10 metres beneath the base of the tailings storage lagoons and varies with topographic elevation and mounding effects. Seasonal fluctuation is estimated to be 1 to 1.5 metres.

The superficial aquifer has a saturated thickness at about 10 metres beneath the disposal site. Groundwater flow through the superficial formation is towards the ocean where discharge occurs across a seawater interface. The hydraulic gradient is about 1:100. Baseline studies, prior to commissioning the site, recorded electrical conductivities in the order of 1,350 µS/cm, equivalent to about 800 mg/L TDS. Figure 2 shows a hydrogeological conceptual model of the disposal site.

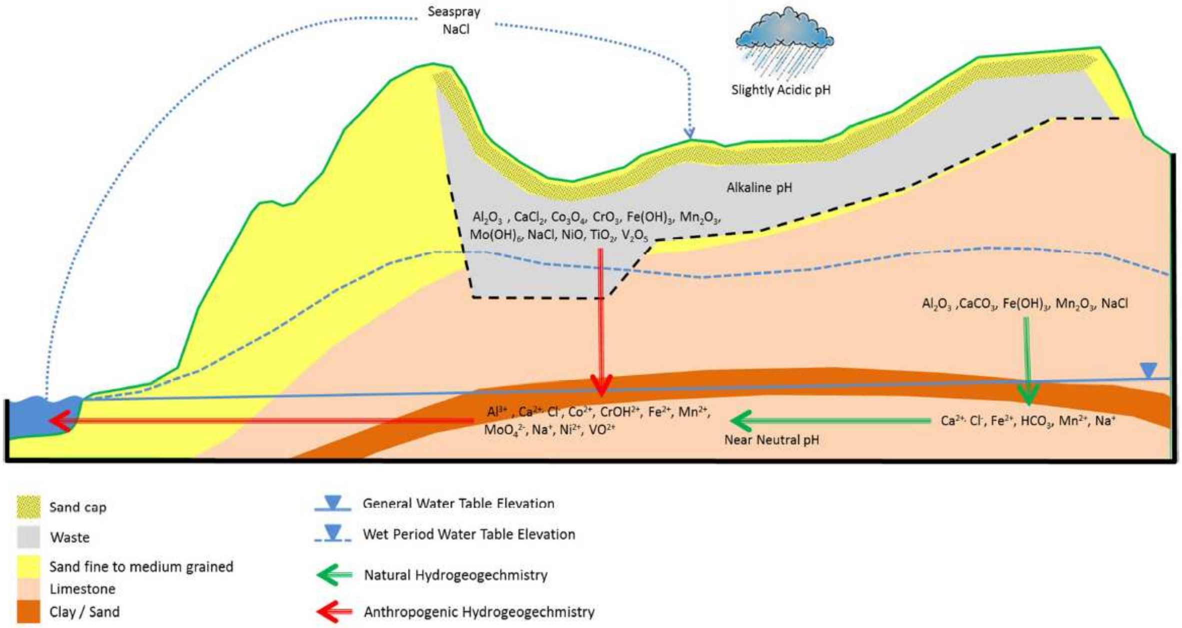

Figure 2 – Conceptual model of the Site[1]

1.1.2 Yarragadee Formation

The Yarragadee formation directly underlies the superficial formation in this area and forms a confined multi layered aquifer, comprising interbedded sandstone, siltstone and shale. In 1996 it was determined that the potentiometric head in the confined aquifer was about 1m higher than in the superficial formations. Consequently, there is upward recharge into the superficial formations. This upward head prevents leachate entering the Yarragadee Aquifer. Regional groundwater flow in the Yarragadee formation is in a North West direction and discharge is via the superficial formation into the ocean. Beneath the disposal site, the groundwater salinity in the Yarragadee formation ranges between 600 and 1,000 mg/L TDS.

3.0 GROUNDWATER MONITORING

3.1 Monitoring Well Network

The monitoring wells on the site are cased with Class 9 PVC, ranging in size from 50 to 100mm. Construction details of the monitoring wells are given in Appendix C. The wells can be divided into two main groups, background monitoring wells and site monitoring wells. The background monitoring wells are constructed of 100mm PVC and are slotted against the entire aquifer thickness. These are designated by the MB (monitoring bore) prefix.

The site monitoring wells are located in pairs, one deep (A) and one shallow (C); these are designated by the DM (Dalyellup monitoring) prefix e.g. DM2A and DM2C. Monitoring at two

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[1] Dalyellup Waste Residue Facility – Hydrogeological Assessment, GHD, April 2015

depths in the aquifer is conducted to identify any stratification that may be occurring in the plume.

Fifteen monitoring wells have been installed around the Dalyellup disposal facility (see Figure 3) including a well to monitor the Yarragadee (YB).

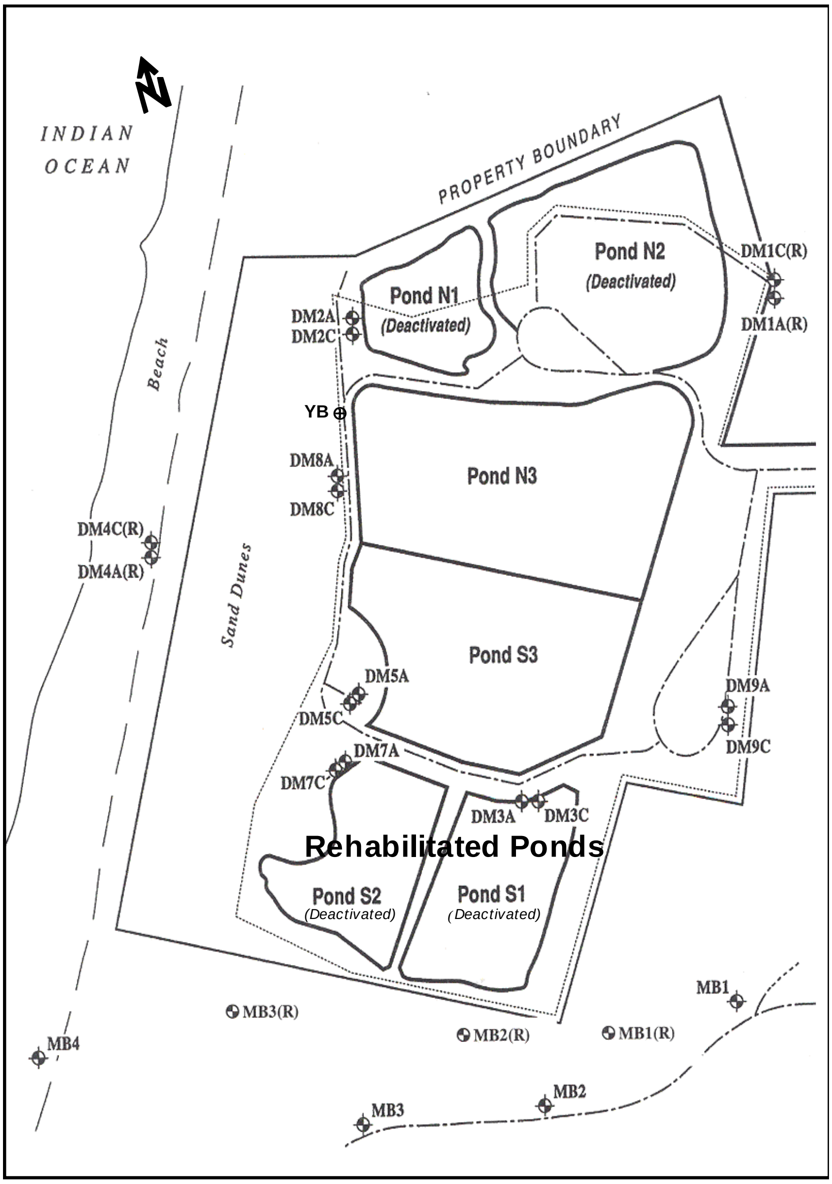


Figure 3 - Monitoring Bore Locations

Wells range in depth from around 15 to 50 metres below ground level and monitor groundwater in the Superficial Formations (quaternary aged shallow aquifer system). Since the monitoring bore network was constructed in 1989, several bores have been replaced. Bores DM1(R) and DM4(R) were replaced in 1992 and 1996 respectively as part of earth works on the site. MB1, MB2 and MB3 were replaced in February 2001 due to earthworks associated with the Dalyellup residential sub-division, which borders the southern boundary of the disposal area. In May 2004 MB1 and MB2 were decommissioned due to further earthworks. This was discussed with the DEC at the time and the licence was amended to reflect the changes in July 2005.

The southern ponds were rehabilitated in 2002. DM3A and DM3C were located in the southern ponds and have now been decommissioned. Some sand was also removed from the southwest part of the central pond to help build a separating wall in the pond. This unintentionally created some erosion around bores DM5A and DM5C and made sampling of these bores unsafe. They are now decommissioned.

3.2 Superficial Aquifer Monitoring Bores

As required by Section 1.3 of the Closure Notice, a report was prepared on the groundwater beneath the site, for the period 4 March 2013 to 4 March 2015. The full report is provided in Appendix G. Groundwater discharges directly into the nearby Indian Ocean. As such, ANZECC 2000 Marine Water, 95% species protection criteria (Marine Criteria) was adopted for the assessment. In summary the report concluded:

a) Geology underlying the Site comprised calcareous, fine to medium grained sands, ranging in depth from 10 to 20 metres. Limestone, sand and sandy clays occur in the area at depths between 10 to 50 metres. Below these sediments are dark grey, silty, micaceous clays. The clays appear from 20 to 40 metres, and occasionally occur above or within the sandy limestone layers;

b) Groundwater standing water level resides in the superficial formation between 0.8 – 2.5 m AHD. Yarragadee aquifer standing water level resides between 1.5 – 2.5 m AHD;

c) The monitoring network incorporating 15 bores was sufficient to complete the hydrogeological review;

d) Groundwater quality investigations reported exceedances of select trace metals. Of these, it was concluded that lead, cobalt, copper and zinc are likely to be due to natural background conditions;

e) Chromium and vanadium were the only two detected trace metals that appear to be linked to the TSR as their concentration shows an increase between the up and down-gradient wells;

f) Mobility of hexavalent chromium and vanadium is dependent on anionic sorption processes with the main anion attracting sites being ferric hydroxide minerals. Therefore dissolution of these metals is dependent on pH. The pulsed nature of mobility would likely result in very slow transport velocities with these metals only migrating during periods when the pH is in a narrow window where sorption and precipitation are not occurring;

g) The TSR is generating saline leachate that is increasing the TDS of the superficial groundwater along the flow path;

h) The most likely mineral responsible for the majority of the observed effect on the major ion composition of the groundwater is calcium chloride. The source of this mineral is considered to be anthropogenic and probably associated with the TSR; and

i) The hydrogeochemical character at the down-gradient well (DM4(4R)) is influenced by mixing of fresh groundwater discharge, impacted by leachate from the TSR and seawater interface, which would be anticipated given the position of the well near the beach.

The report recommended that Cristal:

a) Maintain the monitoring program as currently described in the Closure Notice;

b) Periodically re-evaluate the hydrogeochemical data to establish that conditions remain stable and provide a series of actions and measures to be adopted should any future monitoring identify potential changes in hydrogeochemical conditions and / or risk profile of the TSR to the environment; and

c) Store and manage in a program which can be updated and analysed easily.

Cristal has resolved to continue the monitoring program in its current format, and formally review the data annually. An informal review is to occur after every monitoring campaign (3 monthly for YB and 6 monthly for the rest). Historical groundwater monitoring data was transferred in to an environmental database (ESDAT), which will be the tool for storing and managing the data from this point forward. These actions have been reflected in Cristal's Environmental Monitoring Schedule.

Data including that from samples collected and analysed since the aforementioned report is provided in Appendices D and E. Points of note from the 2016 dataset for the superficial aquifer are:

- There were no notable short-term trends in standing water levels;
- Longer term trends for standing water levels indicate an overall decrease in height in response to decrease in annual average rainfall (Figure 4) and cessation of deposition of slurry;
- There has been a noticeable decrease in salinity at controls site MB4 and MB3 in recent years, potentially attributable to changes to runoff and drainage dynamics from residential development;
- Long term trends in salinity, Na/Cl mole ratio and pH correlate to the introduction and cessation of deposition of slurry with elevated pH, salinity and chloride levels in different cells at different times;
- Copper and cobalt remains elevated above ANZECC 2000 Marine Water, 95% species protection criteria (Marine Criteria) in some bores, which is likely to be due to natural background conditions as noted in the Hydrological Report;
- Hexavalent Chromium remained elevated above the criteria of 0.02mg/L DM2A (0.039 mg/L and <0.001mg/L) and DM2C (0.05mg/L and 0.09mg/L). Levels at 9A reduced from 0.05mg/L and 0.57mg/L in 2015, to <0.001mg/L for both sampling events, while levels at 9C increased from <0.001mg/L in 2015 to 0.2mg/L and 0.22mg/L in 2016. Hexavalent chromium generally dominates in groundwater systems under alkaline conditions with moderate to high oxidation potentials. Marginally elevated pH was detected in both sampling events in at both monitoring sites;
- No other exceedances of the criteria were detected;
- There was no indication of metal contamination from the TSR at downstream bores adjacent to the point of discharge to ocean (DM4A and DM4C); and
- The low radiological concentrations, the number of samples taken over the preceding years, a significant number of samples returning activities of below the detection limits and those readings are lower for the 'deep' wells indicate that there appears to be no leaching of radionuclides into the surrounding groundwater. However, samples taken at DM1C, DM9C and YB indicate that the Ra-226 and/or Ra-228 levels currently exceed the recommended 0.5Bq/L screening level and focus should be given to sampling at these locations.

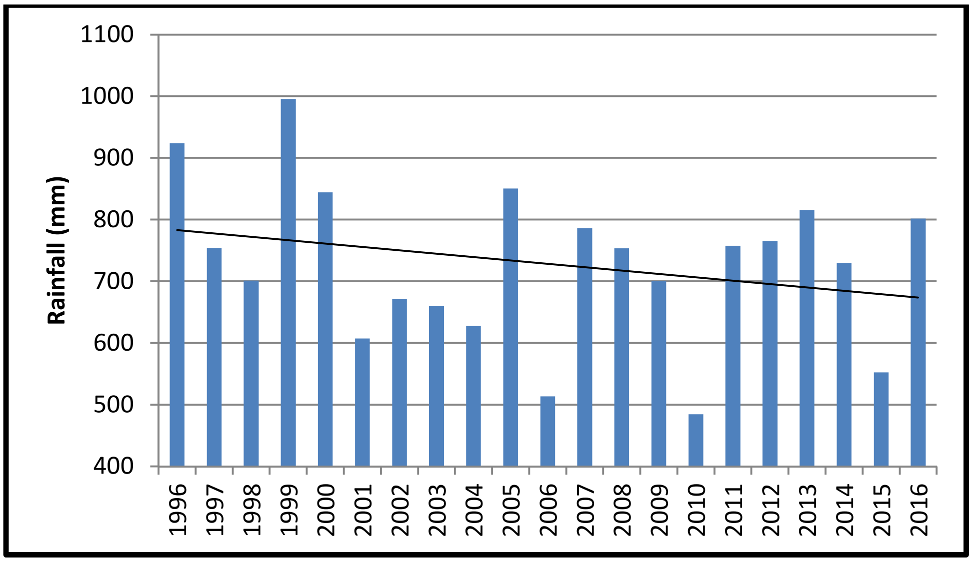


Figure 4 - Total annual rainfall at Bunbury (data from BOM (2016))

3.3 Yarragadee Bore (YB)

YB was sampled quarterly for standing water level, pH, electrical conductivity, chloride, sodium, redox potential and radionuclides, and annually for dioxins and furans (see Section 3.4). This data is provided in Appendices D and E. Results from 2016 monitoring indicate:

- The Yarragadee aquifer standing level continues to reside between 1.5-2m;
- Salinity has decreased slightly since 2013, and remains within the ‘marginal’ salinity threshold category of 500-1000mg/L; and,
- Sodium to chloride ratio values in the Yarragadee monitoring bore continue to be aligned with historical values of around 0.7 indicating that connectivity with the shallow contaminated aquifer is minimal or absent.

3.4 Dioxins and Furans

A requirement of the Closure Notice is to monitor dioxins and furans annually in bores YB, MB3 and DM8. Refer to Appendix I.

There were no measureable dioxins or furans in the groundwater samples from wells MB3, DM8A, and DM8C. In 2016 all reported values for all congeners were reported as less than the level of detection or limit of reporting. The tables (1-4) report the lower, middle and upper boundaries of the data on toxicity equivalent (TEQ) basis. Variability can be expected at these very low levels and boundaries provide a potential range within each sample.

Table 1 - Yarragadee Bore

Sampled YB	Lower Bound pg TEQ/L	Middle Bound pg TEQ/L	Upper bound pg TEQ/L	OCDD pg/L
Aug 2010	0.00	3.08	6.16	<9.29
Feb 2011	0.00	3.94	7.89	<9.29
Aug 2011	0.00	3.00	6.00	<7.20
Feb 2012	0.00	2.72	5.44	<4.37

Sept 2012	0.00	2.13	4.26	<7.34
Feb 2013	0.00	1.95	3.90	<1.69
Apr 2014	0.0	1.50	3.10	<9
Apr 2015	0.00	2.70	5.30	<2
Apr 2016	0.01	0.77	1.5	<1

Table 2 - Superficial Groundwater Background Bore

Sampled MB3	Lower Bound pg TEQ/L	Middle Bound pg TEQ/L	Upper bound pg TEQ/L	1,2,3,7,8 PeCDD pg/L
Aug 2010	0.0	2.54	5.08	<1.63
Feb 2011	0.0	2.55	5.09	<1.40
Aug 2011	0.0	2.95	5.90	<1.82
Feb 2012	0.0	2.19	4.38	<3.95
Sept 2012	0.0	1.99	3.98	<1.90
Feb 2013	0.0	2.59	5.19	<4.51
Apr 2014	0.0	1.2	1.4	<0.9
Apr 2015	0.0	1.5	3.1	<1
Apr 2016	0.0	0.72	1.4	<0.4

Table 3 - Downstream Superficial Groundwater Bore (Deep) of the Ponds

Sampled DM8A	Lower Bound pg TEQ/L	Middle Bound pg TEQ/L	Upper bound pg TEQ/L	1,2,3,7,8 PeCDD pg/L
Aug 2010	0.00	1.86	3.71	<1.28
Feb 2011	0.00	3.15	6.29	<1.59
Aug 2011	0.00	2.16	4.33	<1.44
Feb 2012	0.00	2.52	5.03	<1.88
Sept 2012	1.32	3.00	4.68	1.32
Feb 2013	0.00	2.57	5.13	<1.46
Apr 2014	0.0	1.6	3.1	<0.7
Apr 2015	0.0	2.5	5.0	<1
Apr 2016	0.0	0.79	1.6	<0.4

Table 4 - Downstream Superficial Groundwater Bore (Shallow) of the Ponds

Sampled DM8C	Lower Bound pg TEQ/L	Middle Bound pg TEQ/L	Upper bound pg TEQ/L	1,2,3,7,8 PeCDD pg/L
Aug 2010	0.00	2.58	5.15	<1.47
Feb 2011	0.00	3.48	6.96	<1.34
Aug 2011	0.00	2.25	4.50	<1.55
Feb 2012	Not sampled			
Sept 2012	0.0	2.31	4.61	<3.44
Feb 2013	0.0	2.35	4.70	<2.43
Apr 2014	0.0	1.5	2.9	<1
Apr 2015	0.0	2.5	5.0	<2
Apr 2016	0.0	0.74	1.5	<0.5

The data confirms that levels in ground water are not detectable hence further monitoring is not required.

3.5 Radiological Monitoring

Independent consultants, Radiation Professionals, conduct annual survey of the site. A RCWA approved radiation monitoring program has been implemented by Cristal. The annual report (Appendix F) relates to surveys performed in August 2016.

The results of the gamma monitoring show that the rehabilitation of the area has been successful in returning the gamma radiation levels to within the natural background of the area (0.11 ± 0.02 µGy.h^{-1}).

The Radon and Thoron monitors were deployed for a period of approximately 3 months. Radon results range from 14.8 to 18.5 Bq/m^3 and the Thoron results range from 29.6 to 37.0 Bq/m^3). All Radon and Thoron airborne activity concentrations are below the detectable limit, with exception of RM-05 on the western side of the site, for which thoron levels are slightly above the detection limit at 37 Bq/m^3. The number of samples returning activities of below the detection limit indicates that Radon and Thoron activity levels are low and pose no radiological health issues to the public or the environment.

In the groundwater, the low radiological concentrations, the number of samples taken over the preceding years, a significant number of samples returning activities of below the detection limits and that readings are lower for the ‘deep’ wells indicate that there appears to be no leaching of radionuclides into the surrounding groundwater. However, samples taken at DM1C, DM9C and YB indicate that the Ra-226 and/or Ra-228 levels currently exceed the recommended 0.5 Bq/L screening level and focus should be given to sampling at these locations.

4.0 LICENCE COMPLIANCE & INCIDENTS

4.1 Operating Licence

The site operated under Closure Notice of Prescribed Premises Licence 6130/1989/12. The degree of compliance is summarised in Table 5. All results for monitoring required by the Closure Notice were received and recorded in Cristal’s environmental database ESDAT and provided in Appendix D.

4.2 Incidents

There were no environmental incidents or community complaints recorded for the Dalyellup site, however there were several instances of vandalism of Cristal property and dumping of waste by members of the community which were reported to the Shire of Capel and Police.

Table 5 - Compliance with Closure Notice

	Licence Requirement	Comment	Compliance
1.1.1	The Person to Whom this Notice is Given shall undertake the monitoring in Table 1.1.1 according to the specifications of that Table.	Refer to Appendix J.	✓
1.1.2	The Person to Whom this Notice is Given shall ensure that: (a) all samples required by Table 1 are collected and preserved in accordance with AS/NZS 5667.1; (b) all sampling required by Table	As above. See Appendix J Standard operating procedures for groundwater consultant. See Appendix J Standard operating procedures for	✓

	Licence Requirement	Comment	Compliance
	1 is conducted in accordance with AS/NZS 5667.11; (c) all samples are submitted to a laboratory with current NATA accreditation for the parameters to be analysed; (d) the limit of detection of analysis for all samples is: (i) one order of magnitude below the relevant ANZECC guideline; or (ii) where the laboratory cannot routinely achieve a limit of detection one order of magnitude below the relevant ANZECC guideline, the lowest limit of detection; (e) quarterly monitoring is undertaken at least 45 days apart, with the first round of sampling to commence in Q3 2013 (i.e. 1 July to 30 September 2013); (f) six monthly monitoring is undertaken at least 5 months apart, with the first round of sampling to commence between 1 July and 31 December 2013; and (g) annual monitoring is undertaken at least 9 months apart, with the first round of sampling to commence prior to 1 July 2014.	groundwater consultant. All samples sent to National Measurement Institute (NMI) and Western Radiation Services. Analysis is to the lowest detection limits possible. See Appendix D. 1st quarterly sample taken on 11/7/13. 2016 Quarterly Sampling occurred on 20/01/16, 15/04/16, 07/07/15 and 15/09/2016. 1st bi-annual sample taken on 11/7/13. 2016 Biannual Sampling occurred on 20/01/15 and 15/09/16. 1st annual sampling round was 9/4/14, then on the 16/4/15 followed by 21/04/16.	
1.2.1	The Person to Whom this Notice is Given shall prepare a biennial hydrogeological report on groundwater beneath the Premises, covering the period 4 March 2013 to 4 March 2015.	Refer to Appendix G	✓
1.2.2	The Person to Whom this Notice is Given shall ensure the hydrogeological report referred to in paragraph 1.2.1 of this Notice includes: (a) assessment of groundwater quality below and down. gradient from the Premises and compared to background groundwater quality; (b) assessment of any contaminant plume size, movement and distribution of contaminant concentrations from below the disposal ponds to the near shore groundwater discharge zone; and (c) a characterisation of the interaction between the	Refer to Appendix G	✓

	Licence Requirement	Comment	Compliance
	treated solid residue and the groundwater, more specifically being: (i) the geochemical interactions between leachate, underlying soils and groundwater; (ii) contaminant transport rates; and (iii) contaminant migration pathways.		
1.2.3	The Person to Whom this Notice is Given shall submit the hydrogeological report referred to in paragraph 1.2.1 of this Notice to DER at the Contact Address by 5pm on 1 July 2015.	Accompanies the Annual Report that was delivered to the Greater Swan offices In Bunbury before the due date.	✓
2.1.1	The Person to Whom this Notice is Given shall undertake the monitoring in Table 2.1.1 according to the specifications of that Table whilst the ponds remain uncovered.	Dust monitoring not required as the ponds were covered in September 2013.	✓
2.1.2	The Person to Whom this Notice is Given shall ensure dust sampling equipment is co-located and sited in compliance with AS/NZS 3580.1.1 :2007.	Dust monitoring not required as the ponds were covered in September 2013.	✓
3.1.1	3.1.1 The Person to Whom this Notice is Given shall submit to DER at the Contact Address an annual report on the implementation of the requirements of this Notice by 30 June 2014, and by 30 June in each subsequent year.	Compliant with this condition. Annual report issued before 30 June 2016.	✓
3.1.2	The report referred to in paragraph 3.1.1 of this Notice shall include: (a) annual monitoring data and other collected data required by any clause in this Notice; and (b) interpretation and appraisal of the annual monitoring results against: (i) background water quality below and down gradient from the Premises and compared against background groundwater quality found up gradient of the Premises and against relevant ANZECC guidelines for water quality, historical data, the surrounding environment and other beneficial users; and (ii) NEPM standard of 50 µg/m^3 for PM$_{10}$ (24-hour average) and WHO Guideline of 120 µg/m^3 for TSP (24-hour average).The Licensee shall take representative samples of the TSR solid and TSR filtrate prior to the waste being brought to the Premises for disposal at quarterly intervals.	Contained in Appendices D, E and G and I. See Appendix G. Not required. See condition 2.1.1	✓

5.0 MINISTERIAL CONDITIONS & COMPANY COMMITMENTS

Cristal operates its Dalyellup solid waste disposal facility in accordance with Company Commitments and Ministerial Statements 213 and 332. Details are recorded below (Tables 6 & 7).

Table 6 - Compliance with Ministerial Conditions

Commitment		Action Taken	Outcome
332:M1 Commitments	Fulfil the commitments (which are not inconsistent with the conditions or procedures contained in the Minister's statement)	Cristal has undertaken the requirements that currently apply.	Full compliance.
332:M2:1 Implementation	Adhere to the proposal as amended (via Statement 332)in accordance with any designs, specifications, plans or other technical material submitted by the proponent to the DEC.	Cristal has implemented the proposal as submitted.	Site operated effectively.
332:M2:2 Minor amendments	Seek approval for modifications to the proposal by detailing changes to design, specifications, plans or technical material.	Cristal to notify DER of any changes. Closure plans sent to OEPA and other key stakeholders. OPEA satisfied with Closure Plan in February 2015.	Remaining ponds covered with clean fill. Final end use confirmed.
213:M3 Compliance Audit Report	Prepare "Annual Compliance Report"	Contained in this report	Fully compliant. Refer to Table 7.
332:M4:1 Rehabilitation	Prepare a final rehabilitation programme.	Cristal submitted a staged rehabilitation management program in October 2001. The DEC, Radiological Council and Shire of Capel approved the plan. Preliminary plan was submitted in September 2012. A Final Closure Rehabilitation Plan was sent June 2013.	Final Closure Rehabilitation Plan requires the completion of the Contaminated Sites risk assessment which was progressed further in 2015. OPEA approved Final Closure Rehabilitation Plan in February 2015.

Commitment		Action Taken	Outcome
332:M4:2 Rehabilitation	Implement the rehabilitation programme	Cristal has implemented the first stage of the program as specified in the Staged Rehabilitation Management Program. Final Closure Rehabilitation Plan, June 2013, is being implemented.	Vegetation surveys and dune subsidence surveys conducted in 2003 and 2004. 2009 visual inspections revealed continued success in rates of plant growth. The Contaminated Sites risk assessment is well under way. The remaining ponds were covered with clean fill in Sept 2013. The CS Mandatory Audit Report was issued in July 2015. The Environmental Management Plan needs to be updated once the new DER closure notice is issued.
213:M5 Proponent	Seek approval for transfer of proponent	Not applicable.	Cristal will comply, when or if appropriate
332:M6:1 Site management	Operate and maintain the waste disposal site to protect the environment from unacceptable environmental impacts	Cristal complies with this condition through regular groundwater and radiation monitoring, dust, geochemical and geotechnical research and by following operational control procedures documented in the EMS and Radiation Management Plan, DER licence and Closure Notice	Refer to 2016 Annual Environmental Report and future AERs for ongoing monitoring and assessment.
332:M6:2 Site management	Extent of disposal. Ensure that disposal occurs within the existing lease boundary and does not encroach on the primary dunes and is limited to a fill height of no more than RL24.	Design for disposal ponds show only areas to the east of the primary dunes will be utilised. Cristal will comply with fill height of RL24.	Validation report on the rehabilitated site in January 2014 has confirmed, from core logs, that the fill coverage on top of the mud is 3-4 metres and mud level is below the RL24 mark across the site.
332:M6:3 Site management	Only dispose of waste from own operations	Only treated solid residue produced at Cristal was disposed at the site.	Full compliance.

Table 7 - Compliance with Company Commitments

Commitment		Action Taken	Outcome
P1	The groundwater monitoring and reporting program will continue. This will be combined with ongoing investigations, including solute transport modelling to improve the understanding of the disposal technique.	Groundwater monitoring, radiation monitoring was conducted to schedule in 2016. Reporting as required. Biennial Hydrogeological Report submitted to DER in June 2015.	Full compliance.
P2	Existing topsoil removal practices will be continued to ensure that windblown dust remains under control.	Stockpiled topsoil is appropriately located and germinating seed in the soil alleviates dust problems. "Hydromulch" paper mulch and grass seed was sprayed onto the stockpile at various times (last time in November 2013).	Full compliance. No dust issue at the site. No community complaints relating to dust since project inception.
P3	Radiation monitoring and reporting program will continue.	Radiation monitoring program carried out by Radiation Professionals.	Full compliance. Refer 2016 Annual Environmental Report
P4	At the end of the disposal period the proponent will cause the disposal site to be rehabilitated to the satisfaction of the Shire of Capel and the DEC.	Cristal submitted a staged rehabilitation management program in October 2001. The DEC, Radiological Council and Shire of Capel approved the plan. Preliminary plan was submitted in September 2012. A Final Closure Rehabilitation Plan was sent June 2013 and approved by Shire, RCWA, DER, and OEPA. Shire of Capel in May 2017 formally endorsed the rehabilitation back to natural vegetation on the remaining part of the site.	First stage of the programme completed in 2002 with the successful rehabilitation of the southern ponds. The CS Mandatory Audit Report (MAR) was issued in July 2015.
P5	The proponent will continue Research and Development Studies into methods of waste minimisation and modification including further salinity reductions. This will include further studies of the materials properties and possible uses.	A waste minimisation plant was commissioned in December 1992. This has substantially reduced the quantity of residue solids. A system for washing the solids prior to disposal was also developed. New Facility at Cleanaway's Banksia Road site at Dardanup has a leachate recovery circuit with leachate now returned to Cristal's Kemerton plant for further waste treatment.	Cristal has actively pursued co-product developments with external parties, however no economically viable options were found. Ceased operations at the site in 2013. Continue to run the waste minimisation plant at Kemerton.
P6	The proponent will continue actively pursuing alternative methods of waste disposal.	Cristal has found an alternative residue disposal site. The site will be fully lined and have total leachate recovery. This site is now in use.	Full compliance.

Appendix A
Closure Notice

Government of **Western Australia**
Department of **Environment Regulation**

Your ref:	L6130/1989/12
Our ref:	2013/000411
Enquiries:	Daniel Hartnup
Phone:	9724 6124
Fax:	9725 4300
Email:	daniel.hartnup@der.wa.gov.au

The Manager
Cristal Pigment Australia Ltd
Locked Bag 245
BUNBURY WA 6230

ATTN: Mr Peter Allen

Dear Mr Allen

***ENVIRONMENTAL PROTECTION ACT 1986* – CLOSURE NOTICE**

Dalyellup Waste Residue Disposal Facility
Lot 9077 on Plan 60716
DALYELLUP WA 6230
Lic No. 6130/1989/12

The Department of Environment Regulation (DER) hereby serves a Closure Notice on the Dalyellup Waste Residue Disposal Facility on Thursday, 1 August 2013, which supersedes the Notice served on facility on Thursday, 9 May 2013.

A copy of the Closure Notice is attached.

The premises in question is described as:

> Whole of Lot 9077 on Deposited Plan 60716 – Certificate of Title Volume 2717 and Folio 207.

Pursuant to Section 68A(10) of the *Environmental Protection Act 1986*, I have delivered copies of this Notice to the Western Australian Planning Commission and the Western Australian Land Information Authority for registration.

Please be advised this Notice will be reviewed by DER after 1 October 2015.

Yours sincerely

Alan Sands
Director Environmental Regulation Division
Department of Environment Regulation

Thursday, 1 August 2013

Environmental Protection Act 1986

Section 68A

CLOSURE NOTICE

The Authorisation to which this Notice relates:

Licence number 6130/1989/12 issued on 21 January 2010 and which expired on 3 March 2013.

("the Authorisation")

The Person to Whom this Notice is Given:

(Being the person who held the Authorisation in relation to the Premises described below)

Cristal Pigment Australia Ltd
(ACN: 008 683 627)
4 Old Coast Road
AUSTRALIND in the state of Western Australia

("Person to Whom This Notice is Given")

Premises to which this Notice relates:

The Dalyellup waste residue disposal site located on Lot 9077 on Plan 60716, Maidment Parade, Dalyellup in Western Australia and being more particularly described as:

> Lot 9077 on Plan 60716 – Certificate of Title Volume 2717 and Folio 207, being the area defined in the Premises Map in Schedule 1 of this notice."

("the Premises")

Reason for which this Notice is served:

This notice is issued as a result of something that has happened at the Premises before the expiry of the Authorisation, namely, the disposal of treated solid residue from the production of titanium dioxide pigment, before the expiry of the Authorisation. Ongoing monitoring is required at the Premises following the expiry of the Authorisation.

Requirements of this Notice:

1.1 Groundwater monitoring

1.1.1 The Person to Whom this Notice is Given shall undertake the monitoring in Table 1.1.1 according to the specifications of that Table.

Table 1.1.1: Monitoring of groundwater

Monitoring point reference and location on Map of Monitoring Points in Schedule 1	Parameter	Units	Frequency
YB	standing water level	m (AHD)	Quarterly
	pH	pH unit	
	electrical conductivity	µS/cm	
	chloride	mg/L	
	sodium	mg/L	
	redox potential	mV	
	radionuclides	Bq/L	
MB3, MB4, DM1A(R), DM1C(R), DM2A DM2C, DM4A(R), DM4C(R), DM7A(R), DM7C, DM8A, DM8C(R), DM9A, DM9C	standing water level	m (AHD)	Six monthly
	pH	pH unit	
	electrical conductivity	µS/cm	
	total dissolved solids, bicarbonate, boron, calcium, cadmium, carbonate, chromium, chromium (III)[1], chromium (VI), cobalt, copper, chloride, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, nitrate-nitrogen, potassium, sodium, sulphate, vanadium	mg/L	
	radionuclides	Bq/L	
YB, MB3, DM8	dioxins and furans	pg/L	Annually

Note 1: Can be reported as the difference between Cr and Cr(VI)

1.1.2 The Person to Whom this Notice is Given shall ensure that:

(a) all samples required by Table 1 are collected and preserved in accordance with AS/NZS 5667.1;

(b) all sampling required by Table 1 is conducted in accordance with AS/NZS 5667.11;

(c) all samples are submitted to a laboratory with current NATA accreditation for the parameters to be analysed;

(d) the limit of detection of analysis for all samples is:

  (i) one order of magnitude below the relevant ANZECC guideline; or

  (ii) where the laboratory cannot routinely achieve a limit of detection one order of magnitude below the relevant ANZECC guideline, the lowest limit of detection;

(e) quarterly monitoring is undertaken at least 45 days apart, with the first round of sampling to commence in Q3 2013 (i.e. 1 July to 30 September 2013);

(f) six monthly monitoring is undertaken at least 5 months apart, with the first round of sampling to commence between 1 July and 31 December 2013; and

(g) annual monitoring is undertaken at least 9 months apart, with the first round of sampling to commence prior to 1 July 2014.

1.2 Hydrogeological report

1.2.1 The Person to Whom this Notice is Given shall prepare a biennial hydrogeological report on groundwater beneath the Premises, covering the period 4 March 2013 to 4 March 2015.

1.2.2 The Person to Whom this Notice is Given shall ensure the hydrogeological report referred to in paragraph 1.2.1 of this Notice includes:

(a) assessment of groundwater quality below and down gradient from the Premises and compared to background groundwater quality;

(b) assessment of any contaminant plume size, movement and distribution of contaminant concentrations from below the disposal ponds to the near shore groundwater discharge zone; and

(c) a characterisation of the interaction between the treated solid residue and the groundwater, more specifically being:

  (i) the geochemical interactions between leachate, underlying soils and groundwater;

(ii) contaminant transport rates; and
(iii) contaminant migration pathways.

1.2.3 The Person to Whom this Notice is Given shall submit the hydrogeological report referred to in paragraph 1.2.1 of this Notice to DER at the Contact Address by 5pm on **1 July 2015**.

2.1 Dust monitoring

2.1.1 The Person to Whom this Notice is Given shall undertake the monitoring in Table 2.1.1 according to the specifications of that Table whilst the ponds remain uncovered.

Table 2.1.1: Monitoring of dust emissions

Monitoring point reference	Parameter	Standard	Frequency
D1, D2	TSP	AS/NZS 3580.9.3:2003	One 24-hour sample taken every 6 days starting October 2013 and subsequently 1 October to 31 March, inclusive
	PM_{10}	AS/NZS 3580.9.6:2003	

2.1.2 The Person to Whom this Notice is Given shall ensure dust sampling equipment is co-located and sited in compliance with AS/NZS 3580.1.1:2007.

3.1 Reporting

3.1.1 The Person to Whom this Notice is Given shall submit to DER at the Contact Address an annual report on the implementation of the requirements of this Notice by 30 June 2014, and by **30 June** in each subsequent year.

3.1.2 The report referred to in paragraph 3.1.1 of this Notice shall include:
(a) annual monitoring data and other collected data required by any clause in this Notice; and
(b) interpretation and appraisal of the annual monitoring results against:
  (i) background water quality below and down gradient from the Premises and compared against background groundwater quality found up gradient of the Premises and against relevant ANZECC guidelines for water quality, historical data, the surrounding environment and other beneficial users; and
  (ii) NEPM standard of 50 $\mu g/m^3$ for PM_{10} (24-hour average) and WHO guideline of 120 $\mu g/m^3$ for TSP (24-hour average).

4.1 Interpretation

4.1.1 In this Notice, definitions from the *Environmental Protection Act 1986* apply unless the contrary intention appears.

4.1.2 For the purposes of this Notice, unless the contrary intention appears:

"AHD" means the Australian height datum;

"annual" means the inclusive period from 1 April until 31 March in the following year;

"AS 3580.9.3" means the Australian Standard AS 3580.9.3 *Methods for sampling and analysis of ambient air - Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method;*

"AS 3580.9.6" means the Australian Standard AS 3580.9.6 *Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM_{10} high volume sampler with size - selective inlet – Gravimetric method;*

"AS/NZS 5667.1" means the Australian Standard AS/NZS 5667.1 *Water Quality – Sampling – Guidance of the Design of sampling programs, sampling techniques and the preservation and handling of samples;*

"AS/NZS 5667.11" means the Australian Standard AS/NZS 5667.11 *Water Quality – Sampling – Guidance on sampling of groundwaters;*

"ANZECC" means the Australian and New Zealand Environment Conservation Council (ANZECC) which was a Ministerial Council operating between 1991 and 2001 and which provided a forum for member governments to develop coordinated policies about national and international environment and conservation issues; ANZECC issued a series of Guidelines such as the ANZECC Guidelines for Fresh and Marine Water Quality 2000;

"Bq/L" means becquerel per litre;

"Contact Address" for the purpose of correspondence and advice means:
Regional Leader, South West Region
Department of Environment Regulation
PO Box 1693
BUNBURY WA 6231
Telephone: (08) 9725 4300
Facsimile: (08) 9725 4351
Email: southwestregion.industryregulation@der.wa.gov.au;

"NATA" means the National Association of Testing Authorities, Australia;

"NATA accredited" means in relation to the analysis of a sample that the laboratory is NATA accredited for the specified analysis at the time of the analysis;

"pg/L" means picogram per litre;

"PM" means total particulate matter including both solid fragments of material and miniscule droplets of liquid;

"PM_{10}" means particles with an aerodynamic diameter of less or equal to 10 µm;

"quarterly" means the 4 inclusive periods from 1 January to 31 March, 1 April to 30 June, 1 July to 30 September and 1 October to 31 December in the same year;

"six monthly" means the 2 inclusive periods from 1 January to 30 June and 1 July to 31 December in the same year;

"spot sample" means a discrete sample representative at the time and place at which the sample is taken;

"TSP" means total suspended particles each having an equivalent aerodynamic diameter of less than 50 micrometres; and

"µS/cm" means microsiemens per centimetre.

....
Alan Sands
Director Environmental Regulation Division
Department of Environment Regulation

1 August 2013

IMPORTANT NOTE: **A PERSON WHO IS BOUND BY THIS NOTICE AND WHO DOES NOT COMPLY WITH THIS NOTICE COMMITS AN OFFENCE.**

A person who is aggrieved by a requirement contained in this Notice may within 21 days of being given this Notice

lodge with the Minister for Environment an appeal in writing setting out the grounds of that appeal.

Any other person who disagrees with a requirement contained in this Notice may within 21 days of the making of that requirement lodge with the Minister for Environment an appeal in writing setting out the grounds of that appeal.

PENDING THE DETERMINATION OF AN APPEAL REFERRED TO ABOVE THE RELEVANT REQUIREMENTS CONTAINED IN THIS NOTICE CONTINUE TO HAVE EFFECT.

Schedule 1: Maps

Premises Map and Map of Monitoring Locations

The Premises and the locations of the monitoring points defined in Tables 1.1.1 and 2.1.1 is shown in the map below. The red line depicts the Premises Boundary. The green and blue dots depict the groundwater and dust monitoring locations, respectively.

DEPARTMENT OF ENVIRONMENT AND CONSERVATION
FILE No.

TO: REGISTRAR OF TITLES
REGISTRAR OF DEEDS AND TRANSFERS

NOTIFICATION

ENVIRONMENTAL PROTECTION ACT 1986 (EPA)

~~ENVIRONMENTAL PROTECTION NOTICE (EPA Sec 65);~~

CLOSURE NOTICE (EPA Sec 68A); or

~~VEGETATION CONSERVATION NOTICE (EPA Sec 70)~~

(Delete notices that are not applicable by putting a single line through them)

DESCRIPTION OF LAND	EXTENT	VOLUME	FOLIO
Lot 9077 on Deposited Plan 60716	Whole	2717	207

REGISTERED PROPRIETOR OF LAND

Cristal Pigment Australia Ltd (ACN: 008 683 627)

NOTICE GIVEN TO REGISTERED PROPRIETOR

I certify that the notice attached to this Notification is a true copy of:

~~An Environmental Protection Notice given to the Registered Proprietor pursuant to EPA Sec 65;~~

A Closure Notice given to the Registered Proprietor pursuant to EPA Sec 68A;

~~A vegetation Notice given to the Registered Proprietor pursuant to EPA Sec 70.~~

(Delete the sections which are not applicable by putting a single line through them)

DATED THIS FIRST DAY OF AUGUST 20 13

SIGNED BY:

Signature

ALAN DONALD SANDS

Print Full Name:

DELEGATE OF
THE CHIEF EXECUTIVE OFFICER
UNDER SECTION 20 OF THE *ENVIRONMENTAL PROTECTION ACT 1986*

OFFICE USE ONLY

NOTIFICATION

ENVIRONMENTAL PROTECTION ACT 1986

LODGED BY: Alan Sands

ADDRESS:
The Atrium, Level 4
168 St Georges Tce
PERTH WA 6000

PHONE No. 6467 5300

FAX No. 6467 5562

PREPARED BY:
Daniel Hartnup, South West Region

INSTRUCT IF ANY DOCUMENTS ARE TO ISSUE TO OTHER THAN LODGING PARTY

Nil

TITLES, LEASES, DECLARATIONS ETC LODGED HEREWITH

1. ______________ Received Items
2. ______________
3. ______________ Nos.
4. ______________
5. ______________ Receiving Clerk
6. ______________

EXAMINED

Registered/Lodged pursuant to the provisions of the *TRANSFER OF LAND ACT 1893* as amended on the day and time shown above and particulars entered in the Register.

Landgate

THE GOVERNMENT OF WESTERN AUSTRALIA

Appendix B
Ministerial Statements

Ass # 625
Bull # 589
State # 213

WESTERN AUSTRALIA
MINISTER FOR THE ENVIRONMENT

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

CONTINUED USE OF SCM SOLID RESIDUE DISPOSAL SITE AT DALYELLUP, FROM MARCH 1992 TO MARCH 1994 (625)

SCM CHEMICALS LTD

This proposal may be implemented subject to the following conditions:

1. In implementing the proposal, the proponent shall fulfil the commitments (which are not inconsistent with the conditions or procedures contained in this statement) made in the Consultative Environmental Review, September 1991 (A copy of the commitments is attached).

2. Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal. Where, in the course of that detailed implementation, the proponent seeks to change those designs, specifications, plans or other technical material in any way that the Minister for the Environment determines on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

3. Prior to 30 June each year, the proponent shall prepare and submit an audit report which addresses the following:
   1. environmental performance of the existing site;
   2. progress towards finding an alternative; and
   3. compliance with the conditions of this statement,

   to the satisfaction of the Environmental Protection Authority.

4. The proponent shall be responsible for decommissioning and removal of the plant and installations and rehabilitating the site and its environs, to the satisfaction of the Environmental Protection Authority. At least six months prior to decommissioning, the proponent shall prepare and subsequently implement a decommissioning and rehabilitation plan, to the satisfaction of the Environmental Protection Authority.

5. No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that power of the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.

Published on

23 JAN 1992

Procedure

The operation of this site is currently subject to conditions of a licence issued under the provisions of Part V of the Environmental Protection Act. The continued operation of this site will be subject to the licensing requirements of the Environmental Protection Act.

Bob Pearce, MLA
MINISTER FOR THE ENVIRONMENT

22 JAN 1992

COMMITMENTS:

The proponent has made the following commitments in relation to this proposal.

1. The existing groundwater monitoring and reporting programme will continue. This will be combined with ongoing investigations, including solute transport modelling to improve understanding of the disposal technique.
2. Existing topsoil removal practices will be continued to ensure that wind blown dust remains under control.
3. The existing radiation monitoring and reporting programme will continue.
4. At the end of the disposal period the proponent will cause the disposal site to be rehabilitated to the satisfaction of the Shire of Capel and the EPA.
5. The proponent will continue Research and Development studies into methods of waste minimisation and modification including further salinity reductions. This will include further studies of the materials properties and possible uses.
6. The proponent will continue actively pursuing alternative methods of waste disposal.

WESTERN AUSTRALIA

MINISTER FOR THE ENVIRONMENT

STATEMENT TO AMEND CONDITIONS APPLYING TO A PROPOSAL (PURSUANT TO THE PROVISIONS OF SECTION 46 OF THE ENVIRONMENTAL PROTECTION ACT 1986)

PROPOSAL:	CONTINUED USE OF SCM SOLID RESIDUE DISPOSAL SITE AT DALYELLUP, FROM MARCH 1992 TO MARCH 1994 (625/824)
CURRENT PROPONENT:	SCM CHEMICALS LTD
CONDITIONS SET ON:	22 JANUARY 1992

Conditions 1, 2 and 4 are amended to read as follows:

1 Proponent Commitments

In implementing the proposal, including the proposed amendment to continue using the site beyond March 1994 as reported on in Environmental Protection Authority Bulletin 706, the proponent shall fulfil the commitments (which are not inconsistent with the conditions or procedures contained in this statement) made in the Consultative Environmental Review, September 1991. (A copy of the commitments is attached.)

2 Implementation

Subject to the conditions in this amended statement, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal. Where, in the course of that detailed implementation, the proponent seeks to change those designs, specifications, plans or other technical material in any way that the Minister for the Environment determines on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

4 Rehabilitation

The satisfactory rehabilitation of the site is the responsibility of the proponent.

4-1 At least six months prior to any planned decommissioning of the site, the proponent shall prepare a final rehabilitation programme to the requirements of the Radiological Council and the Environmental Protection Authority on advice of the Shire of Capel.

4-2 The proponent shall implement the programme required by condition 4-1.

Published on

-3 DEC 1993

The following condition is inserted following condition 5:

6 Management of the Site

6-1 The proponent shall operate and maintain the waste disposal site to protect the environment from unacceptable environmental impacts.

6-2 The proponent shall ensure that disposal occurs within the existing lease boundary, does not encroach on the primary dune system, and is limited to a fill height of no more than RL 24.

6-3 The proponent shall only dispose of waste from its own operations.

The procedure is amended to read as follows:

Procedure

1 The Environmental Protection Authority is responsible for verifying compliance with the conditions contained in this statement, with the exception of conditions stating that the proponent shall meet the requirements of either the Minister for the Environment or any other government agency.

2 If the Environmental Protection Authority, other government agency or proponent is in dispute concerning compliance with the conditions contained in this statement, that dispute will be determined by the Minister for the Environment.

3 The operation of this site is currently subject to conditions of a licence issued under the provisions of Part V of the Environmental Protection Act. The continued operation of this site will be subject to the licensing requirements of the Environmental Protection Act.

Kevin Minson MLA
MINISTER FOR THE ENVIRONMENT

8 DEC 1993

PROPONENT'S COMMITMENTS

CONTINUED USE OF SCM SOLID RESIDUE DISPOSAL SITE AT DALYELLUP (625/824)

SCM CHEMICALS LTD

COMMITMENTS:

The proponent has made the following commitments in relation to this proposal.

1. The existing groundwater monitoring and reporting programme will continue. This will be combined with ongoing investigations, including solute transport modelling to improve understanding of the disposal technique.

2. Existing topsoil removal practices will be continued to ensure that wind blown dust remains under control.

3. The existing radiation monitoring and reporting programme will continue.

4. At the end of the disposal period the proponent will cause the disposal site to be rehabilitated to the satisfaction of the Shire of Capel and the EPA.

5. The proponent will continue Research and Development studies into methods of waste minimisation and modification including further salinity reductions. This will include further studies of the materials properties and possible uses.

6. The proponent will continue actively pursuing alternative methods of waste disposal.

Appendix C
Monitoring Bore Construction Data

Bore	Date Drilled	ELEVATION		COMPLETION DETAILS					CO-ORDINATES (MGA)	
		Ground Level (m AHD)	Top Casing (m AHD)	Depth Drilled (m bns)	Drilled Diameter (mm)	Casing ID (mm)	Slotted Intervals (m bns)	Decommiss	Eastings	Northings
MB1	03.11.88	28.74	29.57	31	127	50	24.8 – 30.8	Feb-01		
MB2	04.11.88	23.8	24.67	32.5	127	50	20.5 – 32.3	Feb-01		
MB3	06.11.88	14.19	14.99	26	127	50	16.7 – 25.7	Feb-01		
MB4	10.11.88	3.57	**5.13	16.2	127	50	2.2 – 16.2		370245.4	6303905.3
MB1(R)	23.11.00	26.11	24.12	33	155	100	27.0 – 33.0	May-04	370669.9	6303957.3
MB2(R)	23.11.00	25.85	24.06	32	155	100	25.5 – 31.5	May-04	370578.8	6303984.0
MB3(R)	22.11.00	27.23	25.9	34.5	155	100	28.0 – 34.0		370416.8	6304040.3
DM1A(R)	15.12.92	40.05	40.75	50	168	80	45.0 – 48.0		370835.2	6304509.4
DM1C(R)	15.12.92	40.06	40.71	43	168	80	39.0 – 42.0		370835.0	6304508.1
DM2A	27.02.89	24.489	25.217	35.3	168	100	27.0 – 30.0		370522.2	6304510.7
DM2C	27.02.89	24.614	25.305	26.5	168	100	23.5 – 25.5			
DM3A*	03.03.89	22.53	22.83	32.1	168	100	25.0 – 28.0	May-02		
DM3C*	03.03.89	22.685	22.915	25.5	168	100	21.5 – 24.5	May-02		
DM4A(R)	13.02.89	3.643	4.444	12.5	168	100	9.5 – 12.5		370365.0	6304364.7
DM4C®	13.02.89	3.698	4.497	7	168	100	3.0 – 6.0		370365.2	6304365.9
DM5A	14.05.91	20.473	21.123	30.68	168	100	25.0 – 28.0	May-03	370534.6	6304241.2
DM5C	14.05.91	20.321	21.021	21.8	168	100	18.8 – 20.8	May-03	370535.4	6304242.4
DM7A	26.05.92	20.497	21.347	30.8	168	100	26.0 – 29.0		370479.8	6304180.9
DM7C	27.05.92	20.473	21.323	23	168	100	19.0 – 22.0		370479.7	6304182.4
DM8A	23.7.96	25.7	26.19	36		100	32-36		370506.7	6304411.8
DM8C	23.7.96	25.7	26.19	28		100	24-28		370506.9	6304410.2
DM9A	23.7.96	33.8	34.35	46		100	42-46		370766.3	6304210.4
DM9C	23.7.96	33.8	34.28	28		100	24-28		370765.8	6304209.1
PB1+	14.03.89	23.935	24.188	72.1	254	155	63.14 – 72.10			
YB	24.3.05		27.2	72		100	66 - 72		370516	6304473

Note: m bns - metres below natural surface
* - 1m of casing cut off for access January 1994
** - top of casing level, prior to surface casing being re-set
\+ - bore decommissioned and cement grouted to surface

Appendix D

Monitoring Bore Data

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM1A	1/03/1989	-	1680	7.8	-	294	1	-	-	194
DM1A	1/11/1989	-	1460	7.45	-	290	-	-	-	175
DM1A	1/06/1990	-	1450	7.05	-	290	9	-	-	165
DM1A	1/10/1990	-	1600	7	-	240	-	-	-	155
DM1A	1/06/1991	-	1660	7	-	260	1	-	-	190
DM1A	1/09/1991	-	1630	7.5	-	320	-	-	-	185
DM1A	1/07/1992	-	1550	6.85	-	270	-	-	-	180
DM1A	1/10/1992	-	1550	7.1	-	280	2	-	-	190
DM1A	1/01/1993	-	930	7.6	-	140	7	-	-	75
DM1A	1/07/1993	-	1040	6.95	-	145	15	-	-	85
DM1A	1/10/1993	-	1020	6.8	-	130	-	-	-	70
DM1A	1/01/1994	-	920	7.4	-	120	9	-	-	66.5
DM1A	1/07/1994	-	930	8.2	-	142	6	-	-	65
DM1A	1/10/1994	-	885	7.9	-	120	8	-	-	65
DM1A	1/01/1995	-	830	7.55	-	100	11	-	-	57.5
DM1A	1/07/1995	-	970	7.7	-	150	7	-	-	75
DM1A	1/10/1995	-	-	7.7	-	-	7	-	-	100
DM1A	1/01/1996	-	930	8.3	-	110	17	-	-	55
DM1A	10/07/1996	-	1200	7.6	-	160	31	-	-	120
DM1A	22/10/1996	-	1300	7.9	-	240	26	-	-	140
DM1A	15/01/1997	-	1400	7.5	-	230	38	-	-	160
DM1A	10/04/1997	-	1400	7.9	-	150	23	-	-	140
DM1A	3/07/1997	-	1300	7.6	-	160	65	-	-	150
DM1A	8/10/1997	-	1200	7.3	-	180	17	-	-	140
DM1A	1/07/1998	-	1100	7.5	-	190	3.4	-	-	140
DM1A	1/10/1998	-	1220	7.6	-	190	4	-	-	140

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM1A	1/02/1999	-	1100	7.5	-	200	4	-	-	150
DM1A	1/05/1999	-	-	-	-	200	-	-	-	140
DM1A	1/10/1999	-	1200	7.1	-	240	0.01	-	-	140
DM1A	1/02/2000	-	1200	7.1	-	220	0.01	-	-	140
DM1A	1/06/2000	-	1200	7.2	-	220	0.01	-	-	140
DM1A	9/08/2000	-	1200	7	-	170	8.2	-	-	140
DM1A	30/10/2000	-	1300	7	-	190	7.8	-	-	140
DM1A	1/02/2001	-	1300	7.6	-	200	3.1	-	-	140
DM1A	8/05/2001	-	1300	8.2	-	210	5.5	-	-	130
DM1A	26/07/2001	-	1300	7.3	-	200	2.6	-	-	150
DM1A	29/10/2001	-	1200	7.4	-	160	15	-	-	130
DM1A	18/02/2002	-	1300	7.3	-	190	22	-	-	160
DM1A	15/04/2002	-	1200	7.2	-	180	3.5	-	-	150
DM1A	12/08/2002	-	1200	7.6	-	150	11	-	-	140
DM1A	6/11/2002	-	1300	7.2	-	220	3	-	-	150
DM1A	13/02/2003	-	1300	7.4	-	160	14	-	-	150
DM1A	30/04/2003	-	1300	7.4	-	180	12	-	-	150
DM1A	9/08/2003	-	1400	7.4	-	220	10	-	-	140
DM1A	24/11/2003	-	1230	7.4	-	220	17	-	-	140
DM1A	10/02/2004	-	1200	7.6	-	210	18	-	-	150
DM1A	13/05/2004	-	1193	7.3	-	170	19	-	-	140
DM1A	6/08/2004	-	1177	7.5	-	180	26	-	-	130
DM1A	10/11/2004	-	870	8.1	-	150	8	-	-	110
DM1A	16/02/2005	-	900	7.8	-	150	1.4	-	-	110
DM1A	15/04/2005	-	1376	7.1	-	230	-	-	-	170
DM1A	2/08/2005	-	1343	7.2	-	210	0.2	-	-	170
DM1A	14/11/2005	-	1590	7.4	-	270	0.2	-	-	200
DM1A	15/02/2006	-	1530	7	-	300	-	-	-	180

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM1A	18/05/2006	-	1592	7	-	310	-	-	-	170
DM1A	17/08/2006	-	1681	7.2	-	340	-	-	-	200
DM1A	31/10/2006	-	1774	7.1	-	360	-	-	-	210
DM1A	8/03/2007	-	1890	7.1	-	400	-	-	-	250
DM1A	19/06/2007	-	1980	7.3	-	410	0.2	-	-	240
DM1A	30/08/2007	-	2040	6.9	-	460	0.2	-	-	230
DM1A	2/11/2007	-	2270	7	-	440	0.2	-	-	250
DM1A	2/04/2008	-	2458	6.9	-	520	1	-	-	320
DM1A	8/07/2008	-	2340	6.8	-	540	0.2	-	-	340
DM1A	8/09/2008	-	2430	6.9	-	540	0.2	-	-	310
DM1A	1/03/2009	-	2420	7	-	570	0.2	-	-	350
DM1A	1/07/2009	-	2350	6.8	-	560	0.2	-	-	350
DM1A	30/09/2009	-	2328	7	-	550	0.2	-	-	310
DM1A	18/12/2009	-	2487	7.1	-	560	0.2	-	-	350
DM1A	16/02/2010	-	2260	7.3	-	570	0.2	-	-	340
DM1A	6/05/2010	-	2580	6.7	-	540	0.2	-	-	310
DM1A	18/08/2010	-	2530	7	-	490	0.2	-	-	310
DM1A	26/11/2010	-	2570	7.1	-	540	0.2	-	-	300
DM1A	9/02/2011	-	-	7.2	-	240	6.3	-	-	330
DM1A	11/05/2011	-	-	7.1	-	500	0.2	-	-	280
DM1A	9/08/2011	-	-	7	-	480	0.2	-	-	310
DM1A	10/08/2011	-	2384	7	-	-	-	-	-	-
DM1A	10/11/2011	-	-	6.9	-	510	0.2	-	-	290
DM1A	23/01/2012	-	1430	7.02	-	470	0.2	-	-	280
DM1A	24/05/2012	-	2219	7.22	-	430	0.24	-	-	220
DM1A	14/08/2012	-	1818	6.8	-	350	0.2	-	-	190
DM1A	26/10/2012	-	1853	6.87	-	370	0.2	-	-	210
DM1A	16/01/2013	-	1920	7.15	-	360	0.2	-	-77	250

	Field								
	Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
DM1A	9/04/2013	-	2040	6.97	-	410	0.2	-	-132	230
DM1A	10/10/2013	-	1940	7.09	350	390	<0.2	-	-44	240
DM1A	9/04/2014	<1	1936	6.53	290	380	<0.2	-	-179	280
DM1A	16/10/2014	<1	2090	6.31	310	350	-	<0.2	-	240
DM1A	16/04/2015	<1	1743	6.67	340	330	-	0.2	-	230
DM1A	3/09/2015	<1	1857	7.02	320	570	2.5	2.5	263	310
DM1A	4/09/2015	-	-	-	-	-	-	-	-	-
DM1A	15/04/2016	-	1743	6.67	-	-	-	-	-91.7	-
DM1A	21/04/2016	-	-	-	-	320	<0.2	-	-	230
DM1A	15/09/2016	-	1705	8.06	-	330	<0.2	-	162	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM1C	1/03/1989	-	1680	7.7	-	293	1	-	-	194
DM1C	1/11/1989	-	1520	7.1	-	300	-	-	-	185
DM1C	1/06/1990	-	950	7.45	-	140	4	-	-	70
DM1C	1/10/1990	-	1660	7	-	260	-	-	-	165
DM1C	1/06/1991	-	1290	7.2	-	180	1	-	-	125
DM1C	1/09/1991	-	1610	7.6	-	300	-	-	-	170
DM1C	1/12/1991	-	1560	-	-	-	-	-	-	-
DM1C	1/07/1992	-	1520	6.9	-	250	-	-	-	175
DM1C	1/10/1992	-	1510	7.3	-	280	-	-	-	175
DM1C	1/01/1993	-	1570	7.95	-	330	-	-	-	205
DM1C	1/07/1993	-	1690	6.7	-	290	5	-	-	90
DM1C	1/10/1993	-	1650	6.7	-	335	1	-	-	180
DM1C	1/01/1994	-	1590	7.1	-	320	-	-	-	195
DM1C	1/07/1994	-	1690	8.1	-	330	-	-	-	210
DM1C	1/10/1994	-	1650	7.65	-	320	-	-	-	205
DM1C	1/01/1995	-	1600	7.5	-	330	1	-	-	200
DM1C	1/07/1995	-	1600	7.4	-	300	1	-	-	190
DM1C	1/10/1995	-	1700	7.6	-	310	1	-	-	200
DM1C	1/01/1996	-	1800	7.9	-	370	1	-	-	190
DM1C	1/07/1996	-	1600	7.6	-	290	1	-	-	200
DM1C	22/10/1996	-	1500	7.8	-	310	1	-	-	180
DM1C	15/01/1997	-	1500	8	-	300	-	-	-	180
DM1C	10/04/1997	-	1500	7.7	-	220	-	-	-	160
DM1C	3/07/1997	-	1400	7.3	-	240	-	-	-	160
DM1C	8/10/1997	-	1400	7	-	280	1	-	-	150
DM1C	7/01/1998	-	-	6.7	-	210	1	-	-	150
DM1C	1/07/1998	-	1180	7.2	-	240	0.03	-	-	136
DM1C	1/10/1998	-	1270	7.2	-	240	0.2	-	-	140

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM1C	1/02/1999	-	1200	7.3	-	230	0.2	-	-	150
DM1C	1/05/1999	-	-	-	-	230	-	-	-	140
DM1C	1/10/1999	-	1200	7.5	-	220	2.2	-	-	140
DM1C	1/02/2000	-	1100	7.3	-	170	3	-	-	130
DM1C	1/06/2000	-	1200	7.5	-	200	1.2	-	-	140
DM1C	9/08/2000	-	1200	7	-	220	0.33	-	-	150
DM1C	30/10/2000	-	1300	7	-	220	0.24	-	-	150
DM1C	1/02/2001	-	1200	7.2	-	190	0.05	-	-	140
DM1C	8/05/2001	-	1300	7.6	-	240	0.01	-	-	130
DM1C	26/07/2001	-	1300	7	-	230	0.01	-	-	160
DM1C	29/10/2001	-	1300	7.2	-	210	1	-	-	150
DM1C	8/02/2002	-	1300	7.1	-	230	1	-	-	160
DM1C	15/04/2002	-	1300	7	-	230	0.2	-	-	160
DM1C	6/11/2002	-	1200	7.2	-	230	0.2	-	-	160
DM1C	13/02/2003	-	1300	7.2	-	200	1	-	-	150
DM1C	30/04/2003	-	1400	7.3	-	220	1	-	-	160
DM1C	9/08/2003	-	1400	7.2	-	260	0.5	-	-	160
DM1C	24/11/2003	-	1310	7.3	-	270	1	-	-	160
DM1C	10/02/2004	-	1300	7.1	-	250	1	-	-	180
DM1C	14/05/2004	-	1420	7.6	-	220	1	-	-	160
DM1C	6/08/2004	-	1254	7.2	-	220	1	-	-	150
DM1C	10/11/2004	-	1183	7.2	-	220	1	-	-	150
DM1C	16/02/2005	-	1372	7.2	-	230	-	-	-	160
DM1C	15/04/2005	-	917	7.5	-	170	1.4	-	-	120
DM1C	2/08/2005	-	873	7.7	-	150	1.7	-	-	130
DM1C	14/11/2005	-	976	8	-	150	1.1	-	-	120
DM1C	15/02/2006	-	879	7.8	-	160	-	-	-	110
DM1C	18/05/2006	-	876	7.8	-	160	-	-	-	110

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM1C	17/08/2006	-	887	7.8	-	150	-	-	-	110
DM1C	31/10/2006	-	892	7.9	-	150	-	-	-	110
DM1C	8/03/2007	-	940	7.6	-	150	-	-	-	120
DM1C	19/06/2007	-	905	8.2	-	150	3	-	-	110
DM1C	30/08/2007	-	902	7.5	-	150	3	-	-	91
DM1C	2/11/2007	-	957	7.5	-	130	2.9	-	-	94
DM1C	2/04/2008	-	980	7.3	-	150	17	-	-	100
DM1C	8/07/2008	-	910	7.3	-	180	3.8	-	-	110
DM1C	8/09/2008	-	910	7	-	150	2.9	-	-	100
DM1C	1/03/2009	-	930	7.1	-	150	3.6	-	-	100
DM1C	1/07/2009	-	1100	7	-	-	2.8	-	-	170
DM1C	30/09/2009	-	994	7.5	-	-	2.9	-	-	110
DM1C	23/12/2009	-	992	7.8	-	150	5.7	-	-	110
DM1C	16/02/2010	-	1000	7.8	-	140	3.5	-	-	110
DM1C	21/05/2010	-	957.2	7.73	-	150	3.6	-	-	110
DM1C	18/08/2010	-	1045	7.3	-	160	3.4	-	-	120
DM1C	25/11/2010	-	1140	7.35	-	150	3.3	-	-	110
DM1C	9/02/2011	-	1107	7.7	-	160	3.6	-	-	110
DM1C	11/05/2011	-	-	7.4	-	170	4	-	-	100
DM1C	9/08/2011	-	-	7.3	-	210	3.4	-	-	130
DM1C	10/08/2011	-	1235	7.3	-	-	-	-	-	-
DM1C	10/11/2011	-	-	7.3	-	200	3.6	-	-	110
DM1C	23/01/2012	-	760	7.85	-	180	5.5	-	-	100
DM1C	24/05/2012	-	760	7.85	-	170	6.6	-	-	110
DM1C	14/08/2012	-	1215	7.41	-	160	7	-	-	97
DM1C	26/10/2012	-	1246	7.2	-	180	5.4	-	-	110
DM1C	16/01/2013	-	1312	7.22	-	190	3.8	-	-33	120
DM1C	9/04/2013	-	1375	7.3	-	220	4.7	-	-72	120

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM1C	10/10/2013	-	-	7.29	180	5700	<0.2	-	-	140
DM1C	9/04/2014	<1	1581	6.84	320	320	3	-	-16.8	200
DM1C	16/10/2014	<1	1801	6.61	310	360	-	2.4	-	210
DM1C	16/04/2015	<1	2210	6.65	340	460	-	2.4	-	260
DM1C	3/09/2015	<1	2480	6.8	340	350	0.2	0.2	271	220
DM1C	4/09/2015	-	-	-	-	-	-	-	-	-
DM1C	15/04/2016	-	2210	6.65	-	-	-	-	-65.3	-
DM1C	21/04/2016	-	-	-	-	540	3.8	-	-	330
DM1C	15/09/2016	-	2510	8.43	-	610	2.8	-	404	-
DM1C	22/04/2016	-	-	-	-	-	-	-	-	-
DM1C	15/09/2016	-	-	-	-	-	-	-	-	-
DM1C	22/04/2016	-	-	-	-	-	-	-	-	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM2A	1/08/1989	-	1650	7	-	290	-	-	-	220
DM2A	1/11/1989	-	1050	7.6	-	180	5	-	-	85
DM2A	1/06/1990	-	3470	7.25	-	920	5	-	-	225
DM2A	1/10/1990	-	11,160	7	-	3450	6	-	-	700
DM2A	1/12/1990	-	11,710	7	-	4450	-	-	-	850
DM2A	1/01/1991	-	10,400	7.5	-	3860	3	-	-	890
DM2A	1/04/1991	-	6240	7.4	-	1800	9	-	-	430
DM2A	1/06/1991	-	14,750	6.7	-	4200	1	-	-	870
DM2A	1/09/1991	-	11,550	7.4	-	4000	5	-	-	740
DM2A	1/12/1991	-	9500	7.15	-	3300	8	-	-	590
DM2A	1/04/1992	-	7245	7.2	-	2500	12	-	-	245
DM2A	1/07/1992	-	8990	7	-	2760	4	-	-	495
DM2A	1/10/1992	-	8500	7.1	-	2750	1	-	-	540
DM2A	1/01/1993	-	10,290	7.25	-	3400	3	-	-	560
DM2A	1/04/1993	-	10,500	7.1	-	3500	4	-	-	545
DM2A	1/07/1993	-	8640	6.3	-	2700	5	-	-	410
DM2A	1/10/1993	-	10,500	6.4	-	2880	1	-	-	380
DM2A	1/01/1994	-	7280	6.6	-	2390	2	-	-	330
DM2A	1/07/1994	-	5380	7.7	-	1620	-	-	-	280
DM2A	1/10/1994	-	3800	7.55	-	1080	-	-	-	230
DM2A	1/01/1995	-	4200	7.4	-	1300	8	-	-	230
DM2A	1/04/1995	-	3700	7.9	-	1100	-	-	-	220
DM2A	1/07/1995	-	3900	7.1	-	1100	-	-	-	250
DM2A	1/10/1995	-	5400	7.1	-	1600	-	-	-	250
DM2A	1/01/1996	-	8300	7.8	-	2100	1	-	-	250
DM2A	1/07/1996	-	6400	7.5	-	2000	4	-	-	210
DM2A	1/10/1996	-	6800	7.7	-	2100	-	-	-	200
DM2A	1/01/1997	-	3200	7.4	-	930	2	-	-	140

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM2A	1/04/1997	-	1500	7.6	-	190	-	-	-	140
DM2A	1/07/1997	-	1200	7.6	-	180	-	-	-	150
DM2A	1/10/1997	-	1400	7.2	-	220	2	-	-	140
DM2A	1/01/1998	-	1200	6.8	-	180	-	-	-	160
DM2A	1/07/1998	-	1330	7.5	-	280	0.02	-	-	155
DM2A	1/10/1998	-	2040	7.3	-	480	0.2	-	-	160
DM2A	1/02/1999	-	1600	7.5	-	390	0.2	-	-	160
DM2A	1/05/1999	-	-	-	-	550	-	-	-	160
DM2A	1/08/1999	-	2100	7	-	500	0.24	-	-	160
DM2A	1/10/1999	-	2300	7.3	-	590	0.42	-	-	150
DM2A	1/02/2000	-	1900	7.2	-	440	0.22	-	-	150
DM2A	1/06/2000	-	1600	7.4	-	300	0.13	-	-	140
DM2A	9/08/2000	-	2100	7	-	470	0.3	-	-	150
DM2A	30/10/2000	-	1900	7	-	320	0.35	-	-	120
DM2A	1/02/2001	-	1900	7.4	-	380	0.2	-	-	140
DM2A	8/05/2001	-	1700	7.9	-	330	0.01	-	-	110
DM2A	26/07/2001	-	1800	7.1	-	360	0.01	-	-	150
DM2A	29/10/2001	-	2100	7.2	-	510	8	-	-	170
DM2A	8/02/2002	-	1700	7.1	-	300	1	-	-	150
DM2A	15/04/2002	-	1400	7.1	-	230	0.2	-	-	140
DM2A	12/08/2002	-	1200	7.9	-	160	1	-	-	140
DM2A	6/11/2002	-	1300	7.2	-	220	0.3	-	-	160
DM2A	13/02/2003	-	2200	7.2	-	360	4	-	-	150
DM2A	30/04/2003	-	2400	7.2	-	600	2	-	-	140
DM2A	9/08/2003	-	2800	7.1	-	700	1	-	-	160
DM2A	24/11/2003	-	3400	7.2	-	1140	8	-	-	160
DM2A	10/02/2004	-	2570	7.2	-	690	1	-	-	160
DM2A	14/05/2004	-	4180	6.8	-	1500	-	-	-	210

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM2A	6/08/2004	-	4568	7	-	1350	8	-	-	190
DM2A	10/11/2004	-	4800	7.1	-	1600	1	-	-	210
DM2A	16/02/2005	-	5920	7	-	1930	1.8	-	-	220
DM2A	15/04/2005	-	6860	6.9	-	2170	1.7	-	-	240
DM2A	2/08/2005	-	6820	7	-	2300	0.9	-	-	240
DM2A	14/11/2005	-	7670	7.2	-	2300	11.5	-	-	240
DM2A	15/02/2006	-	7553	6.9	-	2570	4.8	-	-	230
DM2A	18/05/2006	-	8017	6.9	-	2890	-	-	-	240
DM2A	17/08/2006	-	6585	7	-	2220	-	-	-	220
DM2A	31/10/2006	-	6712	7	-	2180	-	-	-	230
DM2A	8/03/2007	-	6450	7	-	1980	-	-	-	250
DM2A	19/06/2007	-	5870	7.1	-	1800	2	-	-	200
DM2A	30/08/2007	-	6500	6.9	-	2100	1.4	-	-	210
DM2A	2/11/2007	-	7525	6.9	-	2300	2.5	-	-	260
DM2A	2/04/2008	-	6786	6.7	-	2000	11	-	-	250
DM2A	8/07/2008	-	6410	6.8	-	2100	1.6	-	-	270
DM2A	8/09/2008	-	6770	6.8	-	2470	2.6	-	-	310
DM2A	1/12/2008	-	7377	6.8	-	2400	2.1	-	-	290
DM2A	1/03/2009	-	7130	7	-	2400	2.4	-	-	300
DM2A	1/07/2009	-	6900	6.8	-	-	1.4	-	-	330
DM2A	30/09/2009	-	7692	6.6	-	-	2.5	-	-	290
DM2A	23/12/2009	-	8580	6.5	-	3000	4.8	-	-	330
DM2A	16/02/2010	-	4060	7.3	-	1200	0.2	-	-	230
DM2A	20/05/2010	-	5182	7.4	-	1700	3.7	-	-	220
DM2A	18/08/2010	-	9270	7	-	2900	0.2	-	-	370
DM2A	25/11/2010	-	8410	6.93	-	2800	0.2	-	-	370
DM2A	9/02/2011	-	8532	6.9	-	2700	0.8	-	-	340
DM2A	11/05/2011	-	-	7.1	-	2800	2	-	-	310

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM2A	9/08/2011	-	-	6.9	-	2800	1.5	-	-	340
DM2A	10/08/2011	-	8750	6.9	-	-	-	-	-	-
DM2A	10/11/2011	-	-	6.9	-	3000	1.5	-	-	340
DM2A	23/01/2012	-	7570	6.96	-	2640	11	-	-	300
DM2A	24/05/2012	-	7501	7.17	-	1800	0.7	-	-	190
DM2A	14/08/2012	-	6520	7.08	-	1970	6	-	-	240
DM2A	26/10/2012	-	10,260	6.75	-	3700	0.2	-	-	380
DM2A	16/01/2013	-	10,280	6.73	-	3500	0.2	-	-254	420
DM2A	9/04/2013	-	8290	7.04	-	2700	1.9	-	-173	310
DM2A	10/10/2013	-	7630	7.07	280	2400	1	-	35	240
DM2A	9/04/2014	<1	9340	6.55	300	3000	3	-	59.1	430
DM2A	16/10/2014	<1	8860	6.8	250	2700	-	<0.2	-	390
DM2A	16/04/2015	<1	7340	6.77	250	2100	-	2.5	-	330
DM2A	3/09/2015	<1	7640	6.95	270	2500	0.5	0.5	67.4	320
DM2A	4/09/2015	-	-	-	-	-	-	-	-	-
DM2A	15/04/2016	-	7340	6.77	-	-	-	-	60	-
DM2A	21/04/2016	-	-	-	-	2000	<0.2	-	-	310
DM2A	15/09/2016	-	6160	7.58	-	2100	0.3	-	123	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM2C	1/03/1989	-	1700	8.1	-	344	-	-	-	219
DM2C	1/08/1989	-	1000	7.4	-	140	5	-	-	85
DM2C	1/11/1989	-	3570	6.9	-	910	2	-	-	380
DM2C	1/06/1990	-	2870	6.85	-	670	4	-	-	305
DM2C	1/10/1990	-	3380	7.2	-	760	3	-	-	260
DM2C	1/12/1990	-	4160	7.3	-	1190	3	-	-	375
DM2C	1/01/1991	-	-	-	-	-	-	-	-	-
DM2C	1/04/1991	-	1690	7.7	-	340	7	-	-	155
DM2C	1/06/1991	-	5350	7	-	1500	2	-	-	500
DM2C	1/09/1991	-	5210	7.6	-	1500	4	-	-	455
DM2C	1/12/1991	-	6270	7.4	-	2000	15	-	-	380
DM2C	1/04/1992	-	3440	7.3	-	1000	16	-	-	185
DM2C	1/07/1992	-	6500	7.1	-	2200	7	-	-	175
DM2C	1/10/1992	-	6000	7.2	-	2200	7	-	-	225
DM2C	1/01/1993	-	8910	7.25	-	3300	10	-	-	390
DM2C	1/04/1993	-	11,500	7.2	-	3050	20	-	-	455
DM2C	1/07/1993	-	8840	6.45	-	2600	5	-	-	410
DM2C	1/10/1993	-	9330	6.5	-	2685	1	-	-	325
DM2C	1/01/1994	-	6780	6.8	-	2060	4	-	-	325
DM2C	1/04/1994	-	5040	7.1	-	1590	4	-	-	260
DM2C	1/07/1994	-	5150	7.6	-	1520	1	-	-	270
DM2C	1/10/1994	-	4590	7.55	-	1300	7	-	-	225
DM2C	1/01/1995	-	3100	7.45	-	850	-	-	-	210
DM2C	1/04/1995	-	3900	7.95	-	1200	1	-	-	200
DM2C	1/07/1995	-	4900	7.1	-	1400	4	-	-	210
DM2C	1/10/1995	-	5400	7.2	-	1600	10	-	-	210
DM2C	1/01/1996	-	7300	7.75	-	1900	13	-	-	230
DM2C	1/07/1996	-	4500	7.4	-	1900	9	-	-	120

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM2C	1/10/1996	-	3400	7.8	-	1000	59	-	-	170
DM2C	1/01/1997	-	1500	7.5	-	250	25	-	-	140
DM2C	1/04/1997	-	1800	7.5	-	290	14	-	-	140
DM2C	1/07/1997	-	1400	7.5	-	220	11	-	-	150
DM2C	1/10/1997	-	2100	7.1	-	540	15	-	-	150
DM2C	1/01/1998	-	1700	6.9	-	290	16	-	-	150
DM2C	1/07/1998	-	1590	7.5	-	380	1.7	-	-	155
DM2C	1/10/1998	-	1510	7.4	-	310	0.75	-	-	160
DM2C	1/02/1999	-	1300	7.4	-	290	2	-	-	160
DM2C	1/05/1999	-	-	-	-	480	-	-	-	150
DM2C	1/08/1999	-	2500	7.1	-	630	3.4	-	-	170
DM2C	1/10/1999	-	3500	7.2	-	1200	0.69	-	-	170
DM2C	1/02/2000	-	1900	7.2	-	450	2.3	-	-	140
DM2C	1/06/2000	-	1400	7.3	-	260	5	-	-	120
DM2C	9/08/2000	-	1500	7	-	280	3	-	-	140
DM2C	30/10/2000	-	2700	7	-	700	8.5	-	-	160
DM2C	1/02/2001	-	2000	7.2	-	440	7	-	-	140
DM2C	8/05/2001	-	1300	8.2	-	230	1.2	-	-	120
DM2C	26/07/2001	-	1500	7.3	-	260	0.51	-	-	140
DM2C	29/10/2001	-	1700	7.2	-	310	1	-	-	140
DM2C	8/02/2002	-	1300	7.3	-	210	2	-	-	150
DM2C	15/04/2002	-	1300	7.2	-	210	0.6	-	-	150
DM2C	12/08/2002	-	1500	8	-	280	12	-	-	170
DM2C	6/11/2002	-	1800	7.2	-	450	1.5	-	-	170
DM2C	13/02/2003	-	1700	7.4	-	250	3	-	-	160
DM2C	30/04/2003	-	2700	7.3	-	770	14	-	-	180
DM2C	9/08/2003	-	3400	7.2	-	970	15	-	-	180
DM2C	24/11/2003	-	3200	7.3	-	1040	19	-	-	160

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM2C	10/02/2004	-	3753	7.2	-	1260	19	-	-	190
DM2C	14/05/2004	-	2580	7.1	-	620	6	-	-	150
DM2C	6/08/2004	-	2520	7.2	-	600	1	-	-	150
DM2C	10/11/2004	-	2750	7.3	-	890	4	-	-	170
DM2C	16/02/2005	-	4673	7.1	-	1500	1.8	-	-	210
DM2C	15/04/2005	-	4710	7.1	-	1500	2.4	-	-	200
DM2C	2/08/2005	-	5620	7.2	-	1500	18.5	-	-	200
DM2C	14/11/2005	-	6220	7.4	-	1800	14.8	-	-	190
DM2C	15/02/2006	-	6622	7	-	2300	2	-	-	220
DM2C	18/05/2006	-	6363	7	-	2160	-	-	-	200
DM2C	17/08/2006	-	6074	7.2	-	2060	-	-	-	220
DM2C	31/10/2006	-	5883	7.1	-	1920	-	-	-	210
DM2C	8/03/2007	-	5090	7.1	-	1520	-	-	-	190
DM2C	19/06/2007	-	4560	7	-	1300	27.9	-	-	160
DM2C	30/08/2007	-	4700	7.1	-	1400	34	-	-	130
DM2C	2/11/2007	-	4380	7.2	-	1100	14.1	-	-	150
DM2C	2/04/2008	-	4550	7	-	1250	24	-	-	200
DM2C	8/07/2008	-	4360	7.1	-	1300	13	-	-	250
DM2C	8/09/2008	-	4390	6.9	-	1390	8.9	-	-	220
DM2C	8/12/2008	-	4998	6.8	-	1500	9.8	-	-	230
DM2C	1/03/2009	-	5240	7	-	1800	20.5	-	-	260
DM2C	1/07/2009	-	5230	6.6	-	1590	13.9	-	-	250
DM2C	30/09/2009	-	4493	6.9	-	1500	22	-	-	180
DM2C	23/12/2009	-	4230	7.3	-	1300	5.4	-	-	220
DM2C	16/02/2010	-	9460	7.1	-	3200	0.6	-	-	320
DM2C	20/05/2010	-	6218	7.3	-	1800	0.6	-	-	270
DM2C	18/08/2010	-	4622	7.2	-	1200	5.8	-	-	220
DM2C	25/11/2010	-	4460	7.09	-	1200	2.4	-	-	200

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM2C	9/02/2011	-	4550	7	-	1400	6.3	-	-	210
DM2C	11/05/2011	-	-	7.2	-	1700	9.8	-	-	220
DM2C	9/08/2011	-	-	7	-	1700	11	-	-	220
DM2C	10/08/2011	-	5899	7	-	-	-	-	-	-
DM2C	10/11/2011	-	-	7.2	-	1600	7.5	-	-	200
DM2C	23/01/2012	-	6370	6.83	-	1450	10	-	-	200
DM2C	24/05/2012	-	4690	7.1	-	1400	0.9	-	-	180
DM2C	14/08/2012	-	4850	7.19	-	1300	7	-	-	210
DM2C	26/10/2012	-	4520	7.04	-	1300	1.8	-	-	160
DM2C	16/01/2013	-	4780	7.09	-	1160	0.2	-	-309	180
DM2C	9/04/2013	-	6680	6.96	-	1900	0.3	-	-319	200
DM2C	10/10/2013	-	5230	7.13	240	1400	13	-	-118	150
DM2C	9/04/2014	<1	5800	6.83	250	1800	34	-	46.4	200
DM2C	16/10/2014	<1	8030	6.78	240	2400	-	2.7	-	320
DM2C	16/04/2015	<1	7290	6.75	240	2300	-	3.6	-	260
DM2C	3/09/2015	<1	8070	6.86	240	2800	0.4	0.4	84.9	280
DM2C	4/09/2015	-	-	6.86	-	-	-	-	-	-
DM2C	15/04/2016	-	7290	6.75	-	-	-	-	31.8	-
DM2C	21/04/2016	-	-	-	-	1900	4.8	-	-	250
DM2C	15/09/2016	-	6290	7.61	-	2200	3.1	-	89	-
DM2C	22/04/2016	-	-	-	-	-	-	-	-	-
DM2C	22/04/2016	-	-	-	-	-	-	-	-	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM4A	1/07/1996	-	1400	7.5	-	290	1	-	-	160
DM4A	1/10/1996	-	1500	7.9	-	320	-	-	-	160
DM4A	1/01/1997	-	1600	7.3	-	330	-	-	-	170
DM4A	1/04/1997	-	1700	7.6	-	310	-	-	-	170
DM4A	1/07/1997	-	1600	7.1	-	230	1	-	-	170
DM4A	1/10/1997	-	1700	7	-	300	-	-	-	170
DM4A	1/01/1998	-	1700	6.5	-	290	0.7	-	-	180
DM4A	1/07/1998	-	1870	7.1	-	480	0.19	-	-	201
DM4A	1/10/1998	-	2930	6.9	-	820	0.2	-	-	210
DM4A	1/02/1999	-	3000	6.8	-	990	0.2	-	-	220
DM4A	1/05/1999	-	3200	6.9	-	930	-	-	-	200
DM4A	1/08/1999	-	4100	6.4	-	1400	0.02	-	-	220
DM4A	1/10/1999	-	3960	6.5	-	1400	0.07	-	-	210
DM4A	1/02/2000	-	4100	6.5	-	1400	0.03	-	-	220
DM4A	1/06/2000	-	4100	6.8	-	1400	0.01	-	-	210
DM4A	9/08/2000	-	5800	6	-	2500	0.16	-	-	230
DM4A	1/02/2001	-	5900	6.2	-	1900	0.05	-	-	200
DM4A	8/05/2001	-	6100	6.1	-	2400	0.01	-	-	180
DM4A	26/07/2001	-	6700	6.2	-	2700	0.03	-	-	250
DM4A	29/10/2001	-	7400	6.6	-	2500	1	-	-	200
DM4A	8/02/2002	-	7300	6.3	-	2400	1	-	-	180
DM4A	19/04/2002	-	5160	6.7	-	1600	0.2	-	-	190
DM4A	12/08/2002	-	7400	6.6	-	2700	1	-	-	200
DM4A	6/11/2002	-	7400	6.5	-	2900	0.2	-	-	200
DM4A	13/02/2003	-	8200	6.4	-	2600	1	-	-	190
DM4A	30/04/2003	-	8200	6.4	-	3170	1	-	-	200
DM4A	9/08/2003	-	8600	6.3	-	3120	0.05	-	-	220
DM4A	24/11/2003	-	7720	6.3	-	3200	1	-	-	190

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM4A	10/02/2004	-	7100	6.6	-	2890	1	-	-	210
DM4A	14/05/2004	-	8400	6.6	-	3300	1	-	-	210
DM4A	6/08/2004	-	7870	6.8	-	2650	1	-	-	180
DM4A	10/11/2004	-	7600	6.7	-	3120	2	-	-	210
DM4A	16/02/2005	-	8400	6.6	-	3000	-	-	-	200
DM4A	15/04/2005	-	8490	6.4	-	3100	-	-	-	200
DM4A	2/08/2005	-	8380	6.5	-	3100	0.2	-	-	220
DM4A	14/11/2005	-	9130	6.5	-	3000	0.2	-	-	220
DM4A	15/02/2006	-	7920	6.6	-	2800	0.4	-	-	210
DM4A	18/05/2006	-	7942	6.6	-	2870	-	-	-	150
DM4A	17/08/2006	-	10,310	6.8	-	3860	-	-	-	280
DM4A	31/10/2006	-	8552	6.7	-	3020	-	-	-	250
DM4A	8/03/2007	-	9320	6.5	-	3340	-	-	-	290
DM4A	19/06/2007	-	8740	6.9	-	3100	0.2	-	-	300
DM4A	30/08/2007	-	11,020	6.8	-	4000	0.2	-	-	350
DM4A	2/11/2007	-	9435	6.7	-	3800	0.2	-	-	290
DM4A	2/04/2008	-	9526	6.7	-	3000	1	-	-	300
DM4A	8/07/2008	-	8760	6.7	-	3600	0.2	-	-	340
DM4A	8/09/2008	-	8390	6.7	-	3000	0.2	-	-	280
DM4A	1/12/2008	-	8913	6.7	-	2900	0.2	-	-	280
DM4A	9/03/2009	-	9290	6.6	-	3900	0.2	-	-	380
DM4A	1/07/2009	-	11,360	7	-	-	0.2	-	-	350
DM4A	30/09/2009	-	9860	6.6	-	-	0.2	-	-	280
DM4A	23/12/2009	-	9600	6.9	-	3300	0.2	-	-	330
DM4A	17/02/2010	-	10,840	6.2	-	3100	0.2	-	-	280
DM4A	20/05/2010	-	9628	6.77	-	3400	0.4	-	-	280
DM4A	18/08/2010	-	10,940	6.7	-	3600	0.2	-	-	340
DM4A	24/11/2010	-	10,800	6.2	-	3700	0.2	-	-	300

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM4A	9/02/2011	-	10,880	7	-	3400	0.2	-	-	250
DM4A	11/05/2011	-	-	6.7	-	3600	0.2	-	-	310
DM4A	10/11/2011	-	-	6.6	-	3800	0.2	-	-	320
DM4A	23/01/2012	-	7000	7.12	-	-	-	-	-	-
DM4A	24/01/2012	-	-	-	-	2500	2	-	-	250
DM4A	24/05/2012	-	7110	7.55	-	2400	2	-	-	210
DM4A	14/08/2012	-	7080	7.61	-	3140	2	-	-	280
DM4A	26/10/2012	-	7580	5.88	-	2500	0.2	-	-	250
DM4A	16/01/2013	-	7410	7.15	-	2000	0.3	-	62	260
DM4A	9/04/2013	-	7430	7.15	-	2500	0.7	-	89	230
DM4A	10/10/2013	-	7910	7.31	51	2600	0.8	-	220	220
DM4A	9/04/2014	<1	7580	7.01	59	2600	0.8	-	59.9	340
DM4A	16/10/2014	<1	7360	6.78	55	2400	-	<0.2	-	280
DM4A	16/04/2015	<1	7410	6.64	58	2300	-	0.5	-	280
DM4A	3/09/2015	<1	7430	5.95	58	2600	<0.2	<0.2	115.5	270
DM4A	4/09/2015	-	-	5.95	-	-	-	-	-	-
DM4A	15/04/2016	-	7410	6.64	-	-	-	-	76.8	-
DM4A	21/04/2016	-	-	-	-	2300	0.4	-	-	280
DM4A	15/09/2016	-	6870	7.96	-	2500	0.8	-	112	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM4C	1/07/1996	-	2000	7.5	-	300	2	-	-	210
DM4C	1/10/1996	-	2400	7.9	-	370	-	-	-	260
DM4C	1/01/1997	-	2600	7.4	-	410	-	-	-	280
DM4C	1/04/1997	-	2800	7.3	-	550	-	-	-	270
DM4C	1/07/1997	-	1900	7.7	-	320	-	-	-	200
DM4C	1/10/1997	-	2300	6.9	-	640	-	-	-	170
DM4C	1/01/1998	-	2800	6.6	-	700	1	-	-	220
DM4C	1/07/1998	-	6360	7	-	2500	0.17	-	-	215
DM4C	1/10/1998	-	7740	6.4	-	2900	0.2	-	-	210
DM4C	1/02/1999	-	6600	6.5	-	2600	0.2	-	-	180
DM4C	1/05/1999	-	5900	6.9	-	2000	-	-	-	170
DM4C	1/08/1999	-	4500	6.6	-	1500	0.02	-	-	160
DM4C	1/10/1999	-	6140	6.6	-	2400	0.06	-	-	210
DM4C	1/02/2000	-	5700	6.7	-	2100	0.01	-	-	190
DM4C	1/06/2000	-	6200	6.9	-	2400	0.01	-	-	200
DM4C	9/08/2000	-	7300	7	-	2800	0.24	-	-	220
DM4C	30/10/2000	-	8600	6	-	3600	0.01	-	-	220
DM4C	1/02/2001	-	9200	6.1	-	3900	0.05	-	-	220
DM4C	8/05/2001	-	8000	6.2	-	3400	0.01	-	-	200
DM4C	26/07/2001	-	7900	6.2	-	2700	0.01	-	-	240
DM4C	29/10/2001	-	9000	6.6	-	3100	1	-	-	210
DM4C	8/02/2002	-	7000	6.5	-	2300	1	-	-	180
DM4C	19/04/2002	-	6630	6.5	-	2200	0.2	-	-	200
DM4C	12/08/2002	-	3700	7.1	-	900	1	-	-	170
DM4C	6/11/2002	-	4600	6.8	-	1600	0.2	-	-	200
DM4C	13/02/2003	-	5400	6.8	-	1400	1	-	-	190
DM4C	30/04/2003	-	5400	6.8	-	1520	1	-	-	170
DM4C	9/08/2003	-	5300	6.8	-	1660	0.05	-	-	190

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
<u>ANZECC 2000 FW 90%</u>										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM4C	24/11/2003	-	6930	6.8	-	2710	1	-	-	210
DM4C	10/02/2004	-	7650	6.8	-	2890	1	-	-	220
DM4C	13/05/2004	-	8830	6.8	-	3600	1	-	-	240
DM4C	6/08/2004	-	9600	7	-	3220	1	-	-	270
DM4C	10/11/2004	-	9190	7	-	3700	1	-	-	270
DM4C	16/02/2005	-	9250	7	-	3250	-	-	-	290
DM4C	15/04/2005	-	9730	6.8	-	3900	-	-	-	300
DM4C	2/08/2005	-	9370	6.9	-	4800	0.2	-	-	320
DM4C	14/11/2005	-	9780	7.2	-	3000	0.2	-	-	290
DM4C	15/02/2006	-	10,580	6.9	-	3750	0.2	-	-	320
DM4C	18/05/2006	-	11,680	6.9	-	4460	-	-	-	330
DM4C	17/08/2006	-	12,190	7	-	4620	-	-	-	350
DM4C	31/10/2006	-	11,670	7	-	4150	-	-	-	370
DM4C	8/03/2007	-	11,600	6.9	-	4330	-	-	-	550
DM4C	19/06/2007	-	12,280	7.2	-	4400	0.2	-	-	410
DM4C	30/08/2007	-	11,750	7	-	4000	0.2	-	-	350
DM4C	2/11/2007	-	11,600	7	-	3900	0.2	-	-	380
DM4C	2/04/2008	-	13,000	6.7	-	4100	1	-	-	370
DM4C	8/07/2008	-	11,820	6.8	-	4000	0.2	-	-	410
DM4C	8/09/2008	-	9780	7	-	3750	0.2	-	-	300
DM4C	1/12/2008	-	9521	6.5	-	3500	0.2	-	-	330
DM4C	1/03/2009	-	9400	6.7	-	3200	0.2	-	-	320
DM4C	1/07/2009	-	11,660	6.9	-	-	0.2	-	-	360
DM4C	30/09/2009	-	12,250	6.7	-	-	0.2	-	-	330
DM4C	23/12/2009	-	12,850	7.2	-	4600	0.2	-	-	400
DM4C	17/02/2010	-	9380	7.2	-	4500	0.2	-	-	330
DM4C	20/05/2010	-	12,600	7.03	-	4600	0.2	-	-	330
DM4C	18/08/2010	-	11,980	6.9	-	3900	0.2	-	-	350

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM4C	24/11/2010	-	11,380	6.664	-	3800	0.2	-	-	300
DM4C	9/02/2011	-	10,890	7.1	-	3500	0.2	-	-	250
DM4C	11/05/2011	-	-	7	-	3700	0.2	-	-	280
DM4C	10/11/2011	-	-	6.9	-	4300	0.2	-	-	350
DM4C	23/01/2012	-	10,120	7.21	-	-	-	-	-	-
DM4C	24/01/2012	-	-	-	-	3700	0.2	-	-	310
DM4C	24/05/2012	-	9680	7.46	-	3400	0.2	-	-	230
DM4C	14/08/2012	-	8880	7.41	-	3000	0.7	-	-	290
DM4C	26/10/2012	-	9820	6.22	-	3500	0.2	-	-	290
DM4C	16/01/2013	-	9650	6.78	-	2900	0.2	-	54	300
DM4C	9/04/2013	-	9650	6.73	-	3300	0.8	-	66	260
DM4C	10/10/2013	-	12,510	7.05	150	3900	<0.2	-	7.1	270
DM4C	9/04/2014	<1	11,130	6.97	130	4200	0.2 - 0.	-	57.3	410
DM4C	16/10/2014	<1	11,660	6.8	130	3700	-	<0.2	-	400
DM4C	16/04/2015	<1	11,430	6.49	150	3900	-	<0.2	-	410
DM4C	3/09/2015	<1	9810	5.94	190	3400	<0.2	<0.2	108	350
DM4C	4/09/2015	-	-	-	-	-	-	-	-	-
DM4C	15/04/2016	-	11,430	6.49	-	-	-	-	77	-
DM4C	21/04/2016	-	-	-	-	2400	<0.2	-	-	320
DM4C	15/09/2016	-	6630	8.04	-	2300	<0.2	-	108	-
DM4C	22/04/2016	-	-	-	-	-	-	-	-	-
DM4C	22/04/2016	-	-	-	-	-	-	-	-	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM7A	30/09/2009	-	4166	6.8	-	-	0.2	-	-	170
DM7A	23/12/2009	-	3640	7.3	-	1000	0.2	-	-	190
DM7A	17/02/2010	-	3650	7.5	-	1100	0.2	-	-	160
DM7A	21/05/2010	-	4540	7.32	-	1400	0.2	-	-	170
DM7A	18/08/2010	-	4886	7.1	-	1200	0.2	-	-	180
DM7A	24/11/2010	-	4110	7.07	-	1100	0.43	-	-	160
DM7A	9/02/2011	-	3965	7.1	-	1300	1	-	-	150
DM7A	11/05/2011	-	-	7.2	-	1100	0.2	-	-	160
DM7A	9/08/2011	-	-	7	-	1200	0.2	-	-	180
DM7A	10/08/2011	-	4330	7	-	-	-	-	-	-
DM7A	10/11/2011	-	-	7	-	1300	0.2	-	-	170
DM7A	23/01/2012	-	2240	5.39 - 7	-	1050	0.2	-	-	140
DM7A	24/05/2012	-	3430	7.1	-	920	0.2	-	-	180
DM7A	14/08/2012	-	3690	6.78	-	1240	0.2	-	-	140
DM7A	26/10/2012	-	3580	6.94	-	870	0.2	-	-	210
DM7A	16/01/2013	-	2810	7.06	-	520	0.2	-	-229	140
DM7A	9/04/2013	-	2900	6.96	-	700	0.2	-	-206	150
DM7A	10/10/2013	-	2600	7.09	350	620	0.2	-	-80	130
DM7A	9/04/2014	<1	2490	6.89	390	1100	<0.2	-	-148	160
DM7A	16/10/2014	<1	2580	6.64	380	490	-	<0.2	-	130
DM7A	16/04/2015	<1	2150	6.69	380	440	-	0.2	-	120
DM7A	3/09/2015	<1	1980	6.64	370	400	<0.2	<0.2	22.4	110
DM7A	4/09/2015	-	-	-	-	-	-	-	-	-
DM7A	15/04/2016	-	2150	6.69	-	-	-	-	-83	-
DM7A	21/04/2016	-	-	-	-	240	<0.2	-	-	110
DM7A	15/09/2016	-	1396	7.7	-	240	<0.2	-	-10	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM7C	1/07/1992	-	2580	7	-	550	2	-	-	185
DM7C	1/10/1992	-	3190	7.4	-	820	3	-	-	160
DM7C	1/01/1993	-	2820	7.8	-	760	2	-	-	200
DM7C	1/04/1993	-	2390	7.35	-	550	4	-	-	170
DM7C	1/07/1993	-	2470	7	-	550	10	-	-	165
DM7C	1/10/1993	-	5080	6.8	-	1320	14	-	-	175
DM7C	1/01/1994	-	4720	6.9	-	1420	14	-	-	170
DM7C	1/04/1994	-	2290	7.5	-	560	2	-	-	185
DM7C	1/07/1994	-	2420	7.75	-	625	1	-	-	190
DM7C	1/10/1994	-	4780	7.6	-	1420	13	-	-	175
DM7C	1/01/1995	-	5600	7.8	-	1600	6	-	-	210
DM7C	1/04/1995	-	4500	7.75	-	1300	2	-	-	230
DM7C	1/07/1995	-	5000	7.3	-	1500	2	-	-	230
DM7C	1/10/1995	-	9100	7.1	-	2600	6	-	-	250
DM7C	1/01/1996	-	13,000	7.7	-	3600	6	-	-	250
DM7C	1/07/1996	-	8400	7.5	-	2700	18	-	-	250
DM7C	1/10/1996	-	12,000	7	-	4000	-	-	-	270
DM7C	1/01/1997	-	12,000	6.7	-	3400	2	-	-	250
DM7C	1/04/1997	-	12,000	6.5	-	3500	2	-	-	270
DM7C	1/07/1997	-	9600	6.7	-	2500	-	-	-	240
DM7C	1/10/1997	-	5000	6.8	-	1500	1	-	-	210
DM7C	1/01/1998	-	6400	6.5	-	1900	3	-	-	250
DM7C	1/07/1998	-	3560	7.1	-	1200	0.07	-	-	210
DM7C	1/10/1998	-	3920	7	-	1200	0.2	-	-	210
DM7C	1/02/1999	-	2800	7	-	890	0.2	-	-	210
DM7C	1/05/1999	-	3600	7.3	-	1100	-	-	-	190
DM7C	1/08/1999	-	4000	6.7	-	1200	0.01	-	-	200
DM7C	1/10/1999	-	4900	7.2	-	1700	2.3	-	-	170

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM7C	1/02/2000	-	4800	7.1	-	1600	1	-	-	170
DM7C	1/06/2000	-	3900	7.3	-	1200	2	-	-	140
DM7C	9/08/2000	-	3100	7	-	830	2.7	-	-	150
DM7C	30/10/2000	-	3400	7	-	940	5.4	-	-	160
DM7C	1/02/2001	-	4600	6.9	-	1500	3.5	-	-	190
DM7C	8/05/2001	-	4300	7.6	-	1400	3.9	-	-	150
DM7C	26/07/2001	-	3700	6.9	-	1100	0.61	-	-	160
DM7C	29/10/2001	-	4300	7.1	-	1200	15	-	-	150
DM7C	8/02/2002	-	3400	7	-	940	9	-	-	160
DM7C	15/04/2002	-	3400	7	-	930	2.5	-	-	140
DM7C	12/08/2002	-	3900	7.3	-	1000	15	-	-	140
DM7C	6/11/2002	-	3600	7	-	1300	4	-	-	110
DM7C	13/02/2003	-	4100	7	-	970	6	-	-	150
DM7C	30/04/2003	-	3800	7.1	-	900	6	-	-	140
DM7C	9/08/2003	-	4000	7	-	1170	3	-	-	160
DM7C	24/11/2003	-	3612	7.2	-	-	-	-	-	-
DM7C	25/11/2003	-	3590	7.2	-	1300	2	-	-	160
DM7C	10/02/2004	-	3718	7.1	-	1240	1	-	-	180
DM7C	13/05/2004	-	4214	6.9	-	1400	5	-	-	190
DM7C	6/08/2004	-	5190	7.1	-	1320	8	-	-	180
DM7C	10/11/2004	-	4371	7.2	-	1580	9	-	-	180
DM7C	16/02/2005	-	4821	7.1	-	1560	1.4	-	-	190
DM7C	15/04/2005	-	4800	7.1	-	1480	1.6	-	-	190
DM7C	2/08/2005	-	4570	7.4	-	1400	0.2	-	-	190
DM7C	14/11/2005	-	5810	7.1	-	1600	0.2	-	-	190
DM7C	15/02/2006	-	6230	7	-	2170	0.2	-	-	210
DM7C	18/05/2006	-	5680	7.1	-	1840	-	-	-	190
DM7C	17/08/2006	-	4722	7.1	-	1500	-	-	-	190

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM7C	31/10/2006	-	4370	7.2	-	1300	-	-	-	190
DM7C	8/03/2007	-	5590	7	-	1460	-	-	-	250
DM7C	19/06/2007	-	5190	7.4	-	1700	3.43	-	-	210
DM7C	30/08/2007	-	4950	7	-	1500	4.9	-	-	170
DM7C	2/11/2007	-	4464	7.1	-	1100	0.2	-	-	180
DM7C	2/04/2008	-	4205	6.8	-	1100	17	-	-	180
DM7C	8/07/2008	-	4140	7.1	-	1200	3.1	-	-	200
DM7C	8/09/2008	-	3700	6.6	-	1100	3.4	-	-	160
DM7C	1/12/2008	-	4292	6.9	-	1400	6.2	-	-	180
DM7C	1/03/2009	-	4310	6.8	-	1300	7.5	-	-	190
DM7C	1/07/2009	-	4397	6.5	-	-	5.1	-	-	220
DM7C	30/09/2009	-	3880	6.8	-	-	3	-	-	150
DM7C	23/12/2009	-	4300	7.3	-	1300	4	-	-	160
DM7C	17/02/2010	-	4420	7.7	-	1400	5.1	-	-	160
DM7C	21/05/2010	-	5017	7.15	-	1600	4.7	-	-	170
DM7C	18/08/2010	-	4790	7	-	1400	4.7	-	-	170
DM7C	24/11/2010	-	4580	6.75	-	1300	5.8	-	-	160
DM7C	9/02/2011	-	4602	6.9	-	1200	5	-	-	120
DM7C	11/05/2011	-	-	7	-	1200	3.6	-	-	150
DM7C	9/08/2011	-	-	6.8	-	1300	3.5	-	-	170
DM7C	10/08/2011	-	4530	6.8	-	-	-	-	-	-
DM7C	10/11/2011	-	-	6.9	-	1200	2	-	-	160
DM7C	23/01/2012	-	2220	5.35 - 7.1	-	1000	2.2	-	-	140
DM7C	24/05/2012	-	3810	6.98	-	920	3.6	-	-	180
DM7C	14/08/2012	-	4120	6.66	-	990	4.6	-	-	150
DM7C	26/10/2012	-	3730	6.98	-	850	3.4	-	-	140
DM7C	16/01/2013	-	2650	7.16	-	480	0.7	-	-223	130
DM7C	9/04/2013	-	3450	6.84	-	910	7.2	-	-138	83

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM7C	10/10/2013	-	2640	6.93	390	560	2.3	-	22	120
DM7C	9/04/2014	-	3140	6.9	-	1100	0.2	-	-89	160
DM7C	16/10/2014	-	2960	6.4	-	-	-	-	-	-
DM7C	16/04/2015	<1	2310	6.7	380	580	-	2.6	-	110
DM7C	3/09/2015	<1	2460	6.6	360	590	3.6	3.6	211	94
DM7C	4/09/2015	-	2460	6.6	-	-	-	-	211	-
DM7C	5/09/2015	-	-	6.6	-	-	-	-	-	-
DM7C	15/04/2016	-	2310	6.7	-	-	-	-	63.7	-
DM7C	21/04/2016	-	-	-	-	520	0.8	-	-	92
DM7C	15/09/2016	-	1848	7.65	-	410	3.4	-	175	-
DM7C	22/04/2016	-	-	-	-	-	-	-	-	-
DM7C	15/09/2016	-	-	-	-	-	-	-	-	-
DM7C	22/04/2016	-	-	-	-	-	-	-	-	-

		Field							
	Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
DM8A	30/09/2009	-	11,580	-	-	-	-	-	-	-
DM8A	9/11/2009	-	2802	7	-	880	0.2	-	-	150
DM8A	23/12/2009	-	11,980	7.1	-	4000	0.2	-	-	380
DM8A	16/02/2010	-	12,400	7.3	-	4500	0.2	-	-	330
DM8A	20/05/2010	-	11,970	7.35	-	4300	0.2	-	-	340
DM8A	18/08/2010	-	13,510	7.3	-	4700	0.2	-	-	390
DM8A	24/11/2010	-	13,370	6.97	-	4700	0.2	-	-	360
DM8A	8/02/2011	-	13,560	6.9	-	4400	0.2	-	-	330
DM8A	11/05/2011	-	-	7.1	-	4600	0.2	-	-	370
DM8A	9/08/2011	-	-	7	-	4200	0.2	-	-	390
DM8A	10/08/2011	-	13,530	6.8 - 7	-	-	-	-	-	-
DM8A	1/11/2011	-	-	6.9	-	-	-	-	-	-
DM8A	10/11/2011	-	-	-	-	4600	0.2	-	-	370
DM8A	23/01/2012	-	10,540	6.8 - 6.9	-	4000	0.2	-	-	320
DM8A	24/05/2012	-	11,640	7.03	-	4100	0.2	-	-	320
DM8A	14/08/2012	-	11,760	6.83	-	4500	0.2	-	-	360
DM8A	26/10/2012	-	13,280	6.83	-	5100	0.2	-	-	400
DM8A	16/01/2013	-	12,170	.77 - 6.9	-	3400	0.2	-	-208	360
DM8A	9/04/2013	-	11,990	.85 - 6.8	-	4600	0.2	-	-210	340
DM8A	10/10/2013	-	-	6.95	330	250	4.6	-	-	140
DM8A	9/04/2014	<1	-	6.81	180	4800	0.2 - 0.	-	-	450
DM8A	16/10/2014	<1	,370 - 11,9	.74 - 6.7	240	3100	-	<0.2	-	390
DM8A	16/04/2015	<1	12,610	6.62	240	3300	-	<0.2	-	400
DM8A	3/09/2015	<1	-	-	150	-	<0.2	<0.2	-	420
DM8A	4/09/2015	-	12,580	6.55	-	-	-	-	252	-
DM8A	5/09/2015	-	-	6.55	-	-	-	-	-	-
DM8A	15/04/2016	-	12,610	6.62	-	-	-	-	-79.4	-
DM8A	21/04/2016	-	-	-	-	3700	<0.2	-	-	410

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM8A	15/09/2016	-	9000	7.53	-	3400	<0.2	-	-2	-

		Field							
	Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
DM8C	30/09/2009	-	-	6.4	-	-	0.2	-	-	320
DM8C	23/12/2009	-	13,480	7	-	4400	0.2	-	-	470
DM8C	16/02/2010	-	12,340	6.7	-	5000	0.2	-	-	340
DM8C	13/05/2010	-	13,090	6.98	-	3900	0.2	-	-	350
DM8C	18/08/2010	-	13,000	6.9	-	4500	0.2	-	-	410
DM8C	24/11/2010	-	13,150	6.67	-	4700	0.2	-	-	360
DM8C	8/02/2011	-	14,300	7	-	7700	0.2	-	-	140
DM8C	11/05/2011	-	-	6.8	-	4900	0.2	-	-	370
DM8C	9/08/2011	-	-	6.8	-	4600	0.2	-	-	400
DM8C	10/08/2011	-	12,060	6.8 - 7	-	-	-	-	-	-
DM8C	1/11/2011	-	-	6.7	-	-	-	-	-	-
DM8C	10/11/2011	-	-	-	-	4800	0.2	-	-	410
DM8C	23/01/2012	-	11,440	.61 - 6.	-	2700	2.5	-	-	250
DM8C	24/05/2012	-	9210	6.71	-	3000	3.7	-	-	240
DM8C	14/08/2012	-	11,210	6.78	-	4230	0.2	-	-	360
DM8C	26/10/2012	-	12,400	6.77	-	5100	0.2	-	-	380
DM8C	16/01/2013	-	11,570	.77 - 6.9	-	3500	0.2	-	-208 - -20	370
DM8C	9/04/2013	-	,990 - 12,7	.85 - 6.8	-	3900	0.3	-	-210 - -19	400
DM8C	10/10/2013	-	12,060	7.06	130	4100	0.7	-	-48	290
DM8C	9/04/2014	<1	,460 - 12,6	.74 - 6.8	170	4500	0.2 - 0.	-	-96 - -92.6	420
DM8C	16/10/2014	<1	11,990	6.74	50 - 24	100 - 38	-	<0.2	-	390 - 41
DM8C	16/04/2015	<1	9610	6.75	160	4600	-	<0.2	-	440
DM8C	3/09/2015	-	870 - 12,58	.42 - 6.5	-	3100	<0.2	-	239 - 252	360
DM8C	4/09/2015	-	8870	6.42	-	-	-	-	239	-
DM8C	15/04/2016	-	9610	6.75	-	-	-	-	-81.1	-
DM8C	21/04/2016	-	-	-	-	2700	<0.2	-	-	360
DM8C	15/09/2016	-	7280	7.62	-	2600	<0.2	-	44	-
DM8C	22/04/2016	-	-	-	-	-	-	-	-	-

		Field							
	Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
DM8C	22/04/2016	-	-	-	-	-	-	-	-	-

		Field							
	Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
DM9A	29/10/2001	-	1100	7.2	310	170	1	-	-	100
DM9A	8/02/2002	-	1100	7.3	310	160	11	-	-	100
DM9A	15/04/2002	-	1100	7.4	290	160	3.3	-	-	110
DM9A	12/08/2002	-	1100	7.6	320	150	16	-	-	120
DM9A	6/11/2002	-	1200	7.4	320	200	3.1	-	-	120
DM9A	13/02/2003	-	1300	7.5	300	120	15	-	-	110
DM9A	30/04/2003	-	1300	7.5	300	150	15	-	-	110
DM9A	9/08/2003	-	1300	7.5	300	190	15	-	-	110
DM9A	24/11/2003	-	1220	7.4	260	190	15	-	-32	100
DM9A	10/02/2004	-	1272	7.3	320	190	13	-	-67	110
DM9A	13/05/2004	-	1260	7.3	310	170	12	-	-63	100
DM9A	6/08/2004	-	1248	7.4	300	140	11	-	-65	90
DM9A	10/11/2004	-	1258	7.2	330	190	11	-	-14	97
DM9A	16/02/2005	-	1403	7.4	320	170	2.6	-	-74	100
DM9A	15/04/2005	-	1284	7.6	300	170	2.8	-	-	100
DM9A	2/08/2005	-	1184	7.7	300	150	2.9	-	-53	110
DM9A	14/11/2005	-	1377	7.5	-	170	2	-	-	100
DM9A	15/02/2006	-	1378	7.4	310	170	3.3	-	-54	100
DM9A	18/05/2006	-	1313	7.4	0	160	-	-	-106	80
DM9A	17/08/2006	-	1279	7.6	0	150	0	-	-84	90
DM9A	31/10/2006	-	1310	7.6	0	150	0	-	-30	89
DM9A	8/03/2007	-	1290	7.4	-	150	-	-	-	100
DM9A	19/06/2007	-	1298	7.4	320	140	3.7	-	-64	81
DM9A	30/08/2007	-	1260	7.4	320	140	4.3	-	-50	64
DM9A	2/11/2007	-	1343	7.6	310	130	3.2	-	-74	73
DM9A	2/04/2008	-	1366	7.7	290	150	15	-	-19	74
DM9A	8/07/2008	-	1210	7.7	310	130	4.1	-	-23	79
DM9A	8/09/2008	-	1190	7.1	330	160	2.4	-	-45	80

		Field							
	Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
DM9A	1/12/2008	-	1321	-	-	-	-	-	-	-
DM9A	1/03/2009	-	1280	7.5	310	160	2.2	-	-86	90
DM9A	1/07/2009	-	1160	7	140	-	3	-	72	110
DM9A	30/09/2009	-	1202	7.2	310	-	2.6	-	105	87
DM9A	23/12/2009	-	1324	7.5	300	170	1.3	-	-71	100
DM9A	16/02/2010	-	1690	7.2	260	190	1.1	-	220	90
DM9A	14/05/2010	1	1439	7.5	260	170	2.2	-	-	87
DM9A	18/08/2010	-	1349	-	-	-	-	-	-	-
DM9A	19/08/2010	1	-	7.2	310	140	2.3	-	-	84
DM9A	24/11/2010	1	1380	7.25	310	140	2.7	-	-	81
DM9A	9/02/2011	1	1417	7.3	310	150	2.9	-	-	73
DM9A	11/05/2011	1	-	7.5	320	140	2	-	-	81
DM9A	10/08/2011	1	1096	7.3	310	140	1.7	-	-	75
DM9A	10/11/2011	1	-	7.4	320	130	0.2	-	-	73
DM9A	23/01/2012	1	710	7.33	320	140	1.6	-	-	75
DM9A	24/05/2012	1	1074	7.33	310	120	14.2	-	-	80
DM9A	14/08/2012	1	1133	7.1	220	170	0.5	-	-	89
DM9A	26/10/2012	1	1013	6.98	300	110	1.5	-	-	59
DM9A	16/01/2013	1	1095	7.04	310	120	0.9	-	-210 - -190	72
DM9A	9/04/2013	<1	1051 - 1286	.66 - 6.9	300	130	1.1	-	-214 - -126	87
DM9A	10/10/2013	-	1129	7.05 - 7.4	320	150	2	-	-79 - 88	90
DM9A	9/04/2014	<1	1150	.94 - 7.0	290	170	2	-	-78	93
DM9A	16/10/2014	<1	1156	6.67	120	260	-	<0.2	-	130
DM9A	16/04/2015	<1	1079	7.17	290	150	-	1.2	-	92
DM9A	3/09/2015	<1	1202	6.85	300	170	1	1	119	93
DM9A	4/09/2015	-	1202	6.85	-	-	-	-	119	-
DM9A	5/09/2015	-	-	6.85	-	-	-	-	-	-
DM9A	15/04/2016	-	1141	6.91	-	-	-	-	-97	-

	Field								
	Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
DM9A	21/04/2016	-	-	-	-	270	<0.2	-	-	140
DM9A	15/09/2016	-	1059	7.83	-	240	0.7	-	85	-

		Field								
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM9C	1/10/1996	-	1000	7.7	-	120	2	-	-	77
DM9C	1/01/1997	-	1200	7	-	160	6	-	-	64
DM9C	1/04/1997	-	1200 - 130	6.7	-	160	7	-	-	66
DM9C	1/07/1997	-	1100	6.8	-	150	11	-	-	80
DM9C	1/10/1997	-	1200	6.5	-	200	7	-	-	76
DM9C	1/01/1998	-	1200	6.2	-	170	8	-	-	73
DM9C	1/07/1998	-	1030	6.7	-	200	0.77	-	-	73
DM9C	1/10/1998	-	1000	6.5	-	180	0	-	-	82
DM9C	1/02/1999	-	1000	6.6	-	170	3	-	-	67
DM9C	1/05/1999	-	1100	6.8	-	170	3	-	-	71
DM9C	1/08/1999	-	1000 - 110	6.5	-	150	1	-	-	97
DM9C	1/10/1999	-	1020	6.6	-	160	0.33	-	-	71
DM9C	1/02/2000	-	1000	6.5	-	150	1.5	-	-	92
DM9C	1/06/2000	-	1000	6.7	-	160	1	-	-	90
DM9C	9/08/2000	-	1100	6	-	170	2.9	-	-	110
DM9C	30/10/2000	-	1200	6	-	170	2.5	-	-	120
DM9C	1/02/2001	-	1200	6.3	-	170	0	-	-	110
DM9C	8/05/2001	-	1200	7.3	-	180	2	-	-	96
DM9C	26/07/2001	-	1100	6.5	-	160	0.07	-	-	110
DM9C	29/10/2001	-	1100	6.8	-	170	1	-	-	100
DM9C	8/02/2002	-	1100	6.6	-	160	11	-	-	100
DM9C	15/04/2002	-	1100	6.6	-	160	3.3	-	-	110
DM9C	12/08/2002	-	1100	7	-	150	16	-	-	120
DM9C	6/11/2002	-	1200	6.8	-	200	3.1	-	-	120
DM9C	13/02/2003	-	1200	6.6	-	120	15	-	-	110
DM9C	30/04/2003	-	1200	6.7	-	150	15	-	-	110
DM9C	9/08/2003	-	1200	6.6	-	190	15	-	-	110
DM9C	24/11/2003	-	1130	6.7	-	190	15	-	-	100

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
DM9C	10/02/2004	-	1122	6.7	-	190	13	-	-	110
DM9C	13/05/2004	-	1052	6.7	-	170	12	-	-	100
DM9C	6/08/2004	-	1056	6.9	-	140	11	-	-	90
DM9C	10/11/2004	-	1126	6.6	-	190	11	-	-	97
DM9C	16/02/2005	-	1146	6.9	-	170	2.6	-	-	100
DM9C	15/04/2005	-	1074	6.8	-	170	2.8	-	-	100
DM9C	2/08/2005	-	1072	6.8	-	150	2.9	-	-	110
DM9C	14/11/2005	-	1203	6.7	-	170	2	-	-	100
DM9C	15/02/2006	-	1100	6.8	-	170	3.3	-	-	100
DM9C	18/05/2006	-	1061	6.9	-	160	-	-	-	80
DM9C	17/08/2006	-	1060	6.8	-	150	0	-	-	90
DM9C	31/10/2006	-	1056	6.9	-	150	0	-	-	89
DM9C	8/03/2007	-	1050	6.7	-	150	-	-	-	100
DM9C	19/06/2007	-	1030	7	-	140	3.7	-	-	81
DM9C	30/08/2007	-	1000	6.9	-	140	4.3	-	-	64
DM9C	2/11/2007	-	1068	6.8	-	130	3.2	-	-	73
DM9C	2/04/2008	-	1057	6.6	-	150	15	-	-	74
DM9C	8/07/2008	-	970	6.9	-	130	4.1	-	-	79
DM9C	8/09/2008	-	1010	6.8	-	160	2.4	-	-	80
DM9C	1/12/2008	-	1119	6.9 - 7.4	320	180	1.6	-	-8	100
DM9C	1/03/2009	-	1050	6.9	-	160	2.2	-	-	90
DM9C	1/07/2009	-	972	6.5	-	-	3	-	-	110
DM9C	30/09/2009	-	1053	6.7	-	-	2.6	-	-	87
DM9C	23/12/2009	-	1145	7	-	170	1.3	-	-	100
DM9C	16/02/2010	-	1060	7.2	-	190	1.1	-	-	90
DM9C	14/05/2010	-	1169	6.94	-	170	2.2	-	-	87
DM9C	18/08/2010	-	-	6.6	-	270	0.2	-	-	160
DM9C	19/08/2010	-	1119	-	-	140	2.3	-	-	84

		Field							
	Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
DM9C	24/11/2010	-	1150	6.65	-	140	2.7	-	-	81
DM9C	9/02/2011	-	1117	7	-	150	2.9	-	-	73
DM9C	11/05/2011	-	-	6.9	-	140	2	-	-	81
DM9C	10/08/2011	-	1341	6.7	-	140	1.7	-	-	75
DM9C	10/11/2011	-	-	6.7	-	130	0.2	-	-	73
DM9C	23/01/2012	-	970	6.87	-	140	1.6	-	-	75
DM9C	24/05/2012	-	1372	7	-	120	14.2	-	-	80
DM9C	14/08/2012	-	1177	6.3	-	170	0.5	-	-	89
DM9C	26/10/2012	-	1209	6.61	-	110	1.5	-	-	59
DM9C	16/01/2013	-	1467	6.77	-	120	0.9	-	-210 - -190	72
DM9C	9/04/2013	-	1051 - 1286	.66 - 6.9	-	130	1.1	-	-214 - -126	87
DM9C	10/10/2013	-	1160	7.05 - 7.4	140	250	<0.2	-	-79	130
DM9C	9/04/2014	<1	1076	.94 - 7.0	140	260	<0.2	-	-28	130
DM9C	16/10/2014	<1	1139	6.77	310	160	-	0.7	-	110
DM9C	16/04/2015	<1	1141	6.91	140	270	-	<0.2	-	130
DM9C	3/09/2015	<1	1202	6.85	130	260	<0.2	<0.2	119	130
DM9C	4/09/2015	-	1133	7.09	-	-	-	-	112	-
DM9C	15/04/2016	-	1079	7.17	-	-	-	-	114.9	-
DM9C	21/04/2016	-	-	-	-	190	1.4	-	-	110
DM9C	15/09/2016	-	1048	7.86	-	150	1.7	-	134	-
MB3	1/02/2001	-	6000	7	-	2200	1.1	-	-	240
MB3	8/05/2001	-	6400	7.1	-	2400	10	-	-	180
MB3	26/07/2001	-	7300	6.9	-	2900	15	-	-	250
MB3	29/10/2001	-	7200	7.3	-	2300	89	-	-	190
MB3	8/02/2002	-	6500	6.9	-	2100	52	-	-	190
MB3	19/04/2002	-	5330	6.9	-	1600	5.2	-	-	150
MB3	12/08/2002	-	3400	7.1	-	740	10	-	-	110
MB3	6/11/2002	-	2300	6.8	-	510	3.6	-	-	90

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
MB3	13/02/2003	-	2000	6.9	-	390	36	-	-	90
MB3	30/04/2003	-	1900	7	-	220	44	-	-	100
MB3	9/08/2003	-	2000	7	-	300	46	-	-	170
MB3	24/11/2003	-	1830	7	-	300	49	-	-	130
MB3	10/02/2004	-	1726	6.9	-	230	63	-	-	120
MB3	13/05/2004	-	1767	6.6	-	230	83	-	-	110
MB3	6/08/2004	-	1867	6.8	-	220	83	-	-	120
MB3	10/11/2004	-	1800	7	-	260	82	-	-	120
MB3	16/02/2005	-	1745	6.8	-	210	19.8	-	-	110
MB3	15/04/2005	-	1771	7	-	170	20.4	-	-	100
MB3	2/08/2005	-	1736	6.9	-	210	22.1	-	-	120
MB3	14/11/2005	-	1769	7	-	160	24	-	-	90
MB3	15/02/2006	-	1775	7.2	-	210	22.4	-	-	110
MB3	18/05/2006	-	1746	6.7	-	230	-	-	-	110
MB3	17/08/2006	-	1751	7.1	-	230	-	-	-	120
MB3	31/10/2006	-	1800	6.9	-	240	-	-	-	130
MB3	8/03/2007	-	1680	7	-	240	-	-	-	140
MB3	19/06/2007	-	1770	6.9	-	250	20	-	-	130
MB3	30/08/2007	-	1760	6.9	-	250	17.8	-	-	110
MB3	2/11/2007	-	1354	7	-	100	9.1	-	-	70
MB3	8/07/2008	-	1600	7.1	-	230	18.8	-	-	130
MB3	8/09/2008	-	1580	7.2	-	250	13.8	-	-	120
MB3	1/12/2008	-	1496	6.8	-	170	19	-	-	99
MB3	1/03/2009	-	1400	6.6	-	160	17.9	-	-	87
MB3	25/08/2009	-	1357	7	-	-	15.3	-	-	92
MB3	30/09/2009	-	1361	6.9	-	-	13.8	-	-	89
MB3	23/12/2009	-	1436	7	-	160	15	-	-	96
MB3	17/02/2010	-	1140	7.2	-	160	17	-	-	90

		Field								
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
MB3	20/05/2010	-	1607	7.32	-	170	15.4	-	-	110
MB3	18/08/2010	-	1614	7.11	-	180	14.8	-	-	120
MB3	24/11/2010	-	1610	7.03	-	180	17.9	-	-	98
MB3	9/02/2011	-	-	7	-	160	16.6	-	-	82
MB3	11/05/2011	-	-	7.1	-	220	17.3	-	-	110
MB3	9/08/2011	-	-	-	-	220	17.1	-	-	120
MB3	10/08/2011	-	1708	7	-	-	-	-	-	-
MB3	10/11/2011	-	-	6.9	-	220	15.9	-	-	130

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
MB3	23/01/2012	-	1120	5.59	-	-	-	-	-	-
MB3	24/01/2012	-	-	-	-	230	17.8	-	-	100
MB3	16/02/2012	-	-	7	-	-	-	-	-	-
MB3	24/05/2012	-	1585	7.02	-	-	-	-	-	-
MB3	14/08/2012	-	1500	7.58	-	-	-	-	-	-
MB3	29/10/2012	-	1519	6.82	-	-	-	-	-	-
MB3	16/01/2013	-	1414	6.92	-	110	15.4	-	-28	76
MB3	9/04/2013	-	1424	6.84	-	-	-	-	108	-
MB3	10/10/2013	-	1461	6.3	450	240	18	-	145	90
MB3	9/04/2014	<1	1366	6.95	420	180	16	-	40.8	110
MB3	16/10/2014	<1	1387	6.47	440	140	-	16 - 17	-	85
MB3	16/04/2015	<1	1489	6.79	390	210	-	13	-	130
MB3	3/09/2015	<1	1397	5.96	370	170	1.1	1.1	25.8	100
MB3	4/09/2015	-	1397	5.96	-	-	-	-	25.8	-
MB3	20/01/2016	-	875	6.21	-	-	-	-	257	-
MB3	15/04/2016	-	1489	6.79	-	-	-	-	113.7	-
MB3	21/04/2016	-	-	-	-	150	12	-	-	95
MB3	15/09/2016	-	1246	8.18	-	160	11	-	46	-
MB3	15/09/2016	-	-	-	-	-	-	-	-	-
MB4	1/11/1988	-	1520	7.9	-	327	2	-	-	161
MB4	1/03/1989	-	2010	7.6	-	439	-	-	-	229
MB4	1/08/1989	-	1980	7.2	-	425	-	-	-	280
MB4	1/11/1989	-	1760	7.35	-	410	-	-	-	220
MB4	1/04/1990	-	1700	8	-	350	-	-	-	210
MB4	1/06/1990	-	1710	6.9	-	370	-	-	-	225
MB4	1/10/1990	-	1930	7.1	-	350	3	-	-	195
MB4	1/12/1990	-	1500	7.65	-	340	-	-	-	175
MB4	1/04/1991	-	1870	6.9	-	460	-	-	-	245

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
MB4	1/08/1991	-	1870	7.2	-	370	-	-	-	235
MB4	1/09/1991	-	1880	7.6	-	430	-	-	-	250
MB4	1/12/1991	-	1710	7.1	-	380	-	-	-	195
MB4	1/04/1992	-	1300	6.7	-	285	-	-	-	160
MB4	1/07/1992	-	1610	7.3	-	290	1	-	-	195
MB4	1/10/1992	-	1480	7.4	-	290	-	-	-	180
MB4	1/01/1993	-	1380	7.6	-	320	-	-	-	180
MB4	1/04/1993	-	1540	7.5	-	320	-	-	-	165
MB4	1/07/1993	-	1600	6.9	-	310	4	-	-	180
MB4	1/10/1993	-	1630	6.8	-	340	-	-	-	180
MB4	1/01/1994	-	1480	6.8	-	300	-	-	-	155
MB4	1/07/1995	-	1400	6.3	-	350	-	-	-	170
MB4	1/10/1995	-	1100	6.6	-	260	2	-	-	130
MB4	1/01/1996	-	900	6.9	-	230	-	-	-	100
MB4	1/07/1996	-	920	6.4	-	230	2	-	-	120
MB4	1/01/1998	-	2200	6.6	-	550	-	-	-	290
MB4	1/07/1998	-	1510	7.3	-	330	0.17	-	-	200
MB4	1/10/1998	-	1590	7.2	-	320	0.2	-	-	180
MB4	1/02/1999	-	1400	6.9	-	370	0.2	-	-	200
MB4	1/05/1999	-	-	-	-	290	-	-	-	160
MB4	1/08/1999	-	1700	7	-	290	0.08	-	-	180
MB4	1/10/1999	-	1600	7.1	-	340	0.06	-	-	170
MB4	1/02/2000	-	1300	6.7	-	300	0.04	-	-	170
MB4	1/06/2000	-	1500	7.4	-	250	0.03	-	-	160
MB4	9/08/2000	-	1700	7	-	290	1	-	-	200
MB4	30/10/2000	-	1700	7	-	250	0.33	-	-	170
MB4	1/02/2001	-	1400	6.9	-	250	0.13	-	-	160
MB4	8/05/2001	-	1500	7.6	-	260	0.19	-	-	180

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
MB4	26/07/2001	-	1500	7	-	240	0.01	-	-	150
MB4	29/10/2001	-	1500	7.3	-	220	1	-	-	140
MB4	8/02/2002	-	1400	6.8	-	230	1	-	-	150
MB4	19/04/2002	-	1460	7	-	230	0.2	-	-	160
MB4	12/08/2002	-	1500	7.4	-	180	1	-	-	150
MB4	6/11/2002	-	1500	7	-	250	0.2	-	-	150
MB4	13/02/2003	-	1600	7	-	170	2	-	-	160
MB4	30/04/2003	-	1600	7.1	-	210	44	-	-	160
MB4	9/08/2003	-	1800	7.2	-	290	4	-	-	140
MB4	24/11/2003	-	1540	7.2	-	250	1	-	-	150
MB4	10/02/2004	-	1450	6.9	-	260	1	-	-	180
MB4	13/05/2004	-	1850	6.9	-	300	4	-	-	220
MB4	6/08/2004	-	1657	7.1	-	200	10	-	-	150
MB4	10/11/2004	-	1630	7.3	-	260	2	-	-	170
MB4	16/02/2005	-	1765	6.9	-	250	1	-	-	170
MB4	15/04/2005	-	1739	7	-	220	2.2	-	-	170
MB4	2/08/2005	-	1678	7.1	-	190	4.5	-	-	160
MB4	14/11/2005	-	1935	7.2	-	230	2.4	-	-	200
MB4	15/02/2006	-	1811	7.3	-	240	0.3	-	-	160
MB4	18/05/2006	-	1743	7.3	-	230	-	-	-	140
MB4	17/08/2006	-	1820	7.4	-	250	-	-	-	160
MB4	31/10/2006	-	1838	7.2	-	250	-	-	-	170
MB4	8/03/2007	-	1640	7.1	-	200	-	-	-	190
MB4	19/06/2007	-	1980	7	-	300	5.5	-	-	180
MB4	30/08/2007	-	1870	7.3	-	310	3.3	-	-	160
MB4	2/11/2007	-	1710	7.4	-	180	3.7	-	-	130
MB4	2/04/2008	-	1734	7	-	190	19	-	-	130
MB4	8/07/2008	-	1570	7.1	-	210	3.5	-	-	140

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
MB4	8/09/2008	-	1540	7.1	-	190	1.74	-	-	140
MB4	1/12/2008	-	1480	7.1	-	210	1.4	-	-	140
MB4	1/03/2009	-	1540	7.1	-	230	0.4	-	-	150
MB4	1/07/2009	-	1570	7.1	-	-	3.5	-	-	190
MB4	30/09/2009	-	1627	7.1	-	-	4.9	-	-	140
MB4	23/12/2009	-	1700	7.1	-	240	3	-	-	150
MB4	17/02/2010	-	1560	7.5	-	250	3	-	-	150
MB4	13/05/2010	-	1588	7.29	-	250	0.3	-	-	150
MB4	18/08/2010	-	1760	7.2	-	230	2.4	-	-	150
MB4	24/11/2010	-	1620	6.96	-	210	0.3	-	-	130
MB4	9/02/2011	-	1727	7.1	-	250	7.9	-	-	110
MB4	11/05/2011	-	-	7.1	-	260	0.2	-	-	160
MB4	10/11/2011	-	-	7	-	310	0.2	-	-	170
MB4	23/01/2012	-	940	7.37	-	-	-	-	-	-
MB4	24/01/2012	-	-	-	-	190	1.5	-	-	110
MB4	24/05/2012	-	1599	7.62	-	200	2.5	-	-	140
MB4	14/08/2012	-	1509	7.94	-	180	5	-	-	110
MB4	26/10/2012	-	-	-	-	180	8.1	-	-	110
MB4	29/10/2012	-	1483	7.01	-	-	-	-	-	-
MB4	16/01/2013	-	1431	7.02	-	170	5.9	-	392	110
MB4	10/10/2013	-	903	6.69	430	2700	8	-	48	1500
MB4	9/04/2014	<1	1531	7.56	520	190	6.3	-	33.8	120
MB4	22/05/2014	-	-	-	-	2200	0.2	-	-	1030
MB4	16/10/2014	<1	1890	7.22	290	320	-	0.2	-	200
MB4	16/04/2015	<1	1927	6.78	290	370	-	<0.2	-	200
MB4	3/09/2015	<1	2200	5.89	280	380	0.4	0.4	-51	190
MB4	4/09/2015	-	2200	5.89	-	-	-	-	-51	-
MB4	15/04/2016	-	1927	6.78	-	-	-	-	-38.6	-

			Field							
		Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
MB4	21/04/2016	-	-	-	-	210	3.6	-	-	130
MB4	15/09/2016	-	540	7.86	-	210	3.6	-	101	-
MB4	22/04/2016	-	-	-	-	-	-	-	-	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
YB	15/04/2005	-	-	-	-	200	0.2	-	-	100
YB	1/08/2005	-	875	6.6	-	0	-	-	-	-
YB	2/08/2005	-	797	6.6	-	180	0.2	-	-	100
YB	14/11/2005	-	862	6.4	-	190	0.02	-	-	90
YB	11/01/2006	-	762	6.3	-	210	-	-	-	85
YB	15/02/2006	-	819	6.3	-	210	0.2	-	-	100
YB	11/03/2006	-	818	6.3	-	200	-	-	-	90
YB	13/04/2006	-	814	6.2	-	200	-	-	-	90
YB	10/05/2006	-	819	6.2	-	210	-	-	-	83
YB	16/06/2006	-	826	6.3	-	200	0	-	-	90
YB	13/07/2006	-	824	6.6	-	200	0	-	-	90
YB	9/08/2006	-	826	6.5	-	200	0	-	-	90
YB	13/09/2006	-	792	6.6	-	210	0	-	-	95
YB	13/10/2006	-	802	6.2	-	250	0	-	-	91
YB	13/11/2006	-	792	6.3	-	200	0	-	-	91
YB	13/12/2006	-	831	6.3	-	200	0	-	-	92
YB	23/01/2007	-	814	6.4	-	200	0	-	-	80
YB	16/02/2007	-	827	6.5	-	200	0	-	-	110
YB	15/03/2007	-	-	-	-	200	-	-	-	100
YB	11/04/2007	-	817	6.4	-	190	0	-	-	110
YB	16/05/2007	-	823	6.3	-	200	-	-	-	92
YB	19/06/2007	-	820	6.6	-	190	0.2	-	-	120
YB	13/07/2007	-	818	6.5	-	190	0	-	-	90
YB	15/08/2007	-	810	6.2	-	200	0	-	-	91
YB	17/09/2007	-	877	6.4	-	200	0	-	-	78
YB	16/10/2007	-	785	6.4	-	200	0	-	-	-
YB	19/11/2007	-	868	6.1	-	-	-	-	-	-
YB	13/12/2007	-	870	6.1	-	-	-	-	-	-

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
YB	1/03/2008	-	846	6.6	-	200	1	-	-	91
YB	21/04/2008	-	855	6.1	-	200	-	-	-	99
YB	8/05/2008	-	822	6.2	-	200	-	-	-	96
YB	8/06/2008	-	793	6.3	-	200	-	-	-	93
YB	8/07/2008	-	800	6.3	-	200	-	-	-	94
YB	8/08/2008	-	785	6.4	-	210	0.2	-	-	93
YB	8/09/2008	-	795	6.5	-	200	-	-	-	93
YB	8/10/2008	-	770	6.4	-	200	0.2	-	-	99
YB	8/11/2008	-	791	6.5	-	200	-	-	-	92
YB	8/12/2008	-	817	6.3	-	190	0.2	-	-	93
YB	9/01/2009	-	793	6.3	-	200	-	-	-	93
YB	1/02/2009	-	799	6.4	-	200	-	-	-	94
YB	1/03/2009	-	792	6.6	-	190	0.2	-	-	88
YB	1/04/2009	-	791	6.5	-	200	-	-	-	95
YB	1/05/2009	-	780	6.5	-	200	-	-	-	95
YB	1/06/2009	-	740	6.4	-	200	-	-	-	95
YB	1/07/2009	-	785	6.3	-	200	0.2	-	-	140
YB	1/08/2009	-	782	6	-	205	-	-	-	105
YB	1/09/2009	-	782	6.5	-	205	0.2	-	-	85
YB	1/10/2009	-	783	6.1	-	205	-	-	-	92
YB	1/11/2009	-	790	6.2	-	200	-	-	-	93
YB	1/12/2009	-	816	6.5	-	200	0.2	-	-	93
YB	1/01/2010	-	827	6	-	205	-	-	-	90
YB	8/01/2010	-	-	-	-	180	-	-	-	80
YB	1/02/2010	-	640	6.3	-	200	0.2	-	-	92
YB	1/03/2010	-	867	6.4	-	200	0.2	-	-	84
YB	1/04/2010	-	870	6.3	-	190	0.2	-	-	95
YB	20/05/2010	-	798.9	6.9	-	190	0.2	-	-	94

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
YB	21/06/2010	-	-	6.2	-	205	-	-	-	92
YB	22/07/2010	-	-	6.3	-	203	-	-	-	91
YB	17/08/2010	-	875	6.4	-	190	-	-	-	92
YB	20/08/2010	-	-	-	-	-	-	-	-	-
YB	17/09/2010	-	850	6.3	-	190	-	-	-	90
YB	26/10/2010	-	830	6.2	-	200	-	-	-	90
YB	22/11/2010	-	-	6.3	-	190	-	-	-	90
YB	15/12/2010	-	870	6.3	-	190	-	-	-	90
YB	5/01/2011	-	882	-	-	180	-	-	-	80
YB	9/02/2011	-	880	6.5	-	200	0.2	-	-	94
YB	22/03/2011	-	910	-	-	190	-	-	-	100
YB	14/04/2011	-	875	6.7	-	190	-	-	-	90
YB	11/05/2011	-	-	6.9	-	200	-	-	-	86
YB	21/06/2011	-	-	-	-	210	-	-	-	96
YB	26/07/2011	-	-	-	-	210	-	-	-	89
YB	9/08/2011	-	-	6.5	-	200	-	-	-	98
YB	10/08/2011	-	883	6.5	-	-	-	-	-	-
YB	13/09/2011	-	-	-	-	200	-	-	-	90
YB	14/09/2011	-	-	6.4	-	-	-	-	-	-
YB	6/10/2011	-	-	-	-	200	-	-	-	90
YB	31/10/2011	-	-	6.2	-	200	-	-	-	89
YB	1/11/2011	-	-	-	-	-	-	-	-	90
YB	10/11/2011	-	-	-	-	210	-	-	-	90
YB	11/11/2011	-	-	-	-	200	-	-	-	98
YB	15/12/2011	-	-	6.3	-	200	-	-	-	96
YB	17/01/2012	-	-	6.3	-	200	-	-	-	90
YB	23/01/2012	-	840	6.5	-	-	-	-	-	-
YB	16/02/2012	-	-	6.2	-	210	-	-	-	90

			Field							
		Carbonate as CaCO3	EC (field)	pH (Field)	Bicarbonate as CaCO3	Chloride	Nitrate (as N)	Nitrate as NO3-N	Redox Potential	Sodium
		mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL		1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%										
ANZECC 2000 FW 95%										
ANZECC 2000 MW 90%										
ANZECC 2000 MW 95%										
Field_ID	**Sampled_Date-Time**									
YB	15/03/2012	-	-	-	-	200	-	-	-	90
YB	20/04/2012	-	-	-	-	250	-	-	-	110
YB	24/05/2012	-	990	6.8	-	210	-	-	-	110
YB	26/06/2012	-	-	-	-	200	-	-	-	90
YB	17/07/2012	-	-	-	-	190	-	-	-	80
YB	14/08/2012	-	909	6.76	-	210	-	-	-	93
YB	24/09/2012	-	-	-	-	210	-	-	-	90
YB	26/10/2012	-	872	6.41	-	200	-	-	-	81
YB	13/11/2012	-	-	-	-	200	-	-	-	99
YB	11/12/2012	-	-	-	-	190	-	-	-	90
YB	8/01/2013	-	-	-	-	190	-	-	-	90
YB	16/01/2013	-	880	6.62	-	230	0.2	-	-97	89
YB	16/02/2013	-	880	6.3	-	210	-	-	-	100
YB	20/03/2013	-	-	-	-	210	-	-	-	100
YB	9/04/2013	-	876	6.67	-	260	0.2	-	-112	89
YB	6/05/2013	-	-	-	-	210	-	-	-	90
YB	11/07/2013	-	884	5.92	-	210	0.2	-	-41	90
YB	10/10/2013	-	900	7.4	69	200	<0.2	-	-54	90
YB	29/01/2014	-	883	6.55	-	250	-	-	253	110
YB	9/04/2014	<1	970	7.47	79	220	<0.2	-	-43.3	110
YB	16/07/2014	-	908	6.4	-	-	-	-	164	-
YB	16/10/2014	<1	870	6.77	77	200	-	<0.2	-	91
YB	22/01/2015	-	843	5.78	-	-	-	-	-12.4	-
YB	23/01/2015	-	-	-	-	210	-	-	-	-
YB	16/04/2015	<1	584 - 854	6.68	84	210	-	<0.2	-64.2	92
YB	9/07/2015	-	873	6.55	-	200	-	-	-2.1	-
YB	3/09/2015	<1	897	6.72	75	220	<0.2	<0.2	-15	94
YB	4/09/2015	-	897	6.72	-	-	-	-	-15	-

		Field							
	Carbonate as CaCO3	**EC (field)**	**pH (Field)**	**Bicarbonate as CaCO3**	**Chloride**	**Nitrate (as N)**	**Nitrate as NO3-N**	**Redox Potential**	**Sodium**
	mg/L	µS/cm	pH	mg/L	mg/L	mg/L	mg/L	mV	mg/L
EQL	1			1	0.1	0.2	0.2		0.05
ANZECC 2000 FW 90%									
ANZECC 2000 FW 95%									
ANZECC 2000 MW 90%									
ANZECC 2000 MW 95%									

Field_ID	**Sampled_Date-Time**									
YB	20/01/2016	-	-	-	-	200	-	-	-	-
YB	15/04/2016	-	854	6.68	-	-	-	-	-64.2	-
YB	21/04/2016	-	-	-	-	210	<0.2	-	-	91
YB	7/07/2016	-	854	5.89	-	200	-	-	261	-
YB	15/09/2016	-	867	8.12	-	210	<0.2	-	-4	-
YB	15/09/2016	-	-	-	-	-	-	-	-	-
YB	21/01/2016	-	-	-	-	-	-	-	-	-
YB	22/04/2016	-	-	-	-	-	-	-	-	-
YB	8/07/2016	-	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM1A	1/03/1989	77.8	898	-	-	-	98.9	-	-
DM1A	1/11/1989	80	1020	-	-	-	100	-	-
DM1A	1/06/1990	60	940	-	-	-	110	-	0.05
DM1A	1/10/1990	140	1020	-	-	-	100	-	0.05
DM1A	1/06/1991	70	1050	-	-	-	95	-	0.05
DM1A	1/09/1991	80	1040	-	-	-	95	-	0.05
DM1A	1/07/1992	20	990	-	-	-	105	-	0.05
DM1A	1/10/1992	65	990	-	-	-	110	-	0.05
DM1A	1/01/1993	40	600	-	-	-	85	-	0.05
DM1A	1/07/1993	25	670	-	-	-	80	-	0.05
DM1A	1/10/1993	25	690	-	-	-	70	-	0.05
DM1A	1/01/1994	20	590	-	-	-	80	-	0.05
DM1A	1/07/1994	22	500	-	-	-	80	-	0.05
DM1A	1/10/1994	10	570	-	-	-	75	-	0.05
DM1A	1/01/1995	5	530	-	-	-	75	-	0.05
DM1A	1/07/1995	25	620	-	-	-	75	-	0.05
DM1A	1/10/1995	70	2000	-	-	-	-	-	0.05
DM1A	1/01/1996	17	600	-	-	-	72	-	0.05
DM1A	10/07/1996	26	670	-	-	-	78	-	0.05
DM1A	22/10/1996	50	830	-	-	-	86	-	0.05
DM1A	15/01/1997	67	740	-	-	-	77	-	0.05
DM1A	10/04/1997	91	640	-	-	-	70	-	0.05
DM1A	3/07/1997	96	880	-	-	-	74	-	0.05
DM1A	8/10/1997	79	680	-	-	-	64	-	0.05
DM1A	1/07/1998	82	790	-	-	-	74	-	0.01
DM1A	1/10/1998	41	650	-	-	-	82	-	0.01

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM1A	1/02/1999	92	790	-	-	-	76	-	0.01
DM1A	1/05/1999	75	-	-	-	-	78	-	0.01
DM1A	1/10/1999	42	720	-	-	-	83	-	0.01
DM1A	1/02/2000	59	770	-	-	-	90	-	0.01
DM1A	1/06/2000	65	780	-	-	-	94	-	0.01
DM1A	9/08/2000	58	810	-	-	-	97	-	0.01
DM1A	30/10/2000	51	770	-	-	-	83	-	0.01
DM1A	1/02/2001	65	830	-	-	-	83	-	0.01
DM1A	8/05/2001	62	730	-	-	-	88	-	0.01
DM1A	26/07/2001	70	800	-	-	-	84	-	0.01
DM1A	29/10/2001	70	800	-	-	-	80	-	0.005
DM1A	18/02/2002	70	830	-	-	-	98	-	0.01
DM1A	15/04/2002	77	780	-	-	-	110	-	0.01
DM1A	12/08/2002	62	730	-	-	-	77	-	0.01
DM1A	6/11/2002	70	700	-	-	-	75	-	0.005
DM1A	13/02/2003	60	770	-	-	-	91	-	0.005
DM1A	30/04/2003	80	790	-	-	-	89	-	0.005
DM1A	9/08/2003	70	760	-	-	-	90	-	0.005
DM1A	24/11/2003	60	860	-	-	-	95	-	0.005
DM1A	10/02/2004	60	830	-	-	-	80	-	0.005
DM1A	13/05/2004	67	770	-	-	-	90	-	0.005
DM1A	6/08/2004	60	740	**0.01**	**0.002**	-	91	-	0.005
DM1A	10/11/2004	30	530	-	-	-	55	-	0.005
DM1A	16/02/2005	20	610	-	-	-	63	-	0.005
DM1A	15/04/2005	77	810	-	-	-	99	-	0.001
DM1A	2/08/2005	19	740	-	-	-	100	-	0.001
DM1A	14/11/2005	85	860	-	-	-	110	-	0.001
DM1A	15/02/2006	85	-	0.001	**0.0003**	-	-	-	-

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM1A	18/05/2006	82	-	-	-	-	-	-	-
DM1A	17/08/2006	82	-	-	-	-	-	-	-
DM1A	31/10/2006	82	-	0.001	0.0001	-	130	**0.024**	0.001
DM1A	8/03/2007	86	-	0.001	0.0001	-	110	**0.005**	0.001
DM1A	19/06/2007	95	1290	0.001	0.0001	-	150	-	0.001
DM1A	30/08/2007	98	1230	0.001	0.0001	-	140	-	0.001
DM1A	2/11/2007	120	1320	0.001	0.0001	-	160	-	0.001
DM1A	2/04/2008	120	1450	0.001	0.0001	-	160	-	0.001
DM1A	8/07/2008	140	1480	0.001	0.0001	-	160	-	0.001
DM1A	8/09/2008	150	1520	0.001	0.0001	-	150	-	0.001
DM1A	1/03/2009	150	1550	0.001	0.0001	-	160	-	0.001
DM1A	1/07/2009	140	1490	0.001	0.0001	-	160	**0.005**	0.001
DM1A	30/09/2009	140	1560	0.001	0.0001	-	150	**0.005**	0.001
DM1A	18/12/2009	140	1520	0.001	0.0001	-	160	-	0.001
DM1A	16/02/2010	150	1400	0.001	0.0001	-	160	-	0.001
DM1A	6/05/2010	140	1550	0.002	0.0001	-	140	-	0.008
DM1A	18/08/2010	130	1440	**0.005**	0.0001	-	150	**0.001**	0.001
DM1A	26/11/2010	120	1480	0.001	0.0001	-	150	**0.001**	0.001
DM1A	9/02/2011	150	1400	0.001	0.0001	-	150	**0.001**	0.001
DM1A	11/05/2011	120	1420	0.001	0.0001	-	160	-	0.001
DM1A	9/08/2011	120	1420	0.001	0.0001	-	140	-	0.001
DM1A	10/08/2011	-	-	-	-	-	-	-	-
DM1A	10/11/2011	110	1390	0.001	0.0001	-	140	**0.001**	0.001
DM1A	23/01/2012	104	1340	0.0019	0.0001	-	150	**0.001**	0.005
DM1A	24/05/2012	110	1290	0.0017	0.0001	-	140	**0.001**	0.001
DM1A	14/08/2012	62	1070	**0.019**	**0.0012**	-	100	**0.001**	0.0042
DM1A	26/10/2012	75	1060	0.0024	0.0001	-	130	**0.001**	0.001
DM1A	16/01/2013	82	1160	0.001	0.0001	-	120	**0.001**	0.001

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM1A	9/04/2013	89	1260	0.001	0.0001	-	120	**0.001**	0.001
DM1A	10/10/2013	120	1150	**0.004**	<0.0001	-	120	<0.001	0.003
DM1A	9/04/2014	110	1090	0.002	<0.0001	-	140	<0.001	0.001
DM1A	16/10/2014	75	1210	0.003	<0.0001	-	130	<0.001	0.002
DM1A	16/04/2015	100	1080	<0.001	<0.0001	-	130	<0.001	0.003
DM1A	3/09/2015	90	1450	0.001	<0.0001	-	140	<0.001	0.011
DM1A	4/09/2015	-	-	-	-	-	-	-	-
DM1A	15/04/2016	-	-	-	-	-	-	-	-
DM1A	21/04/2016	120	1040	**0.005**	**0.0002**	-	130	<0.001	0.002
DM1A	15/09/2016	110	852 - 1070	0.003	<0.0001	<0.0001	-	<0.001	<0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM1C	1/03/1989	90	947	-	-	-	99.6	-	-
DM1C	1/11/1989	80	1060	-	-	-	100	-	-
DM1C	1/06/1990	35	620	-	-	-	90	-	0.05
DM1C	1/10/1990	130	1060	-	-	-	100	-	0.05
DM1C	1/06/1991	40	825	-	-	-	73.5	-	0.05
DM1C	1/09/1991	80	1030	-	-	-	100	-	0.05
DM1C	1/12/1991	-	-	-	-	-	-	-	-
DM1C	1/07/1992	30	970	-	-	-	105	-	0.05
DM1C	1/10/1992	50	970	-	-	-	105	-	0.05
DM1C	1/01/1993	145	1000	-	-	-	110	-	0.05
DM1C	1/07/1993	150	1080	-	-	-	105	-	0.05
DM1C	1/10/1993	75	1010	-	-	-	100	-	0.05
DM1C	1/01/1994	95	1000	-	-	-	85	-	0.05
DM1C	1/07/1994	105	1050	-	-	-	93	-	0.05
DM1C	1/10/1994	100	1030	-	-	-	105	-	0.05
DM1C	1/01/1995	90	1000	-	-	-	90	-	0.05
DM1C	1/07/1995	90	1000	-	-	-	100	-	0.05
DM1C	1/10/1995	90	1100	-	-	-	100	-	0.05
DM1C	1/01/1996	93	1200	-	-	-	110	-	0.05
DM1C	1/07/1996	61	900	-	-	-	96	-	0.05
DM1C	22/10/1996	70	960	-	-	-	110	-	0.05
DM1C	15/01/1997	52	800	-	-	-	97	-	0.05
DM1C	10/04/1997	48	750	-	-	-	91	-	0.05
DM1C	3/07/1997	51	950	-	-	-	100	-	0.05
DM1C	8/10/1997	56	710	-	-	-	93	-	0.05
DM1C	7/01/1998	46	900	-	-	-	91	-	0.05
DM1C	1/07/1998	67	880	-	-	-	92	-	0.01
DM1C	1/10/1998	40	690	-	-	-	100	-	0.02

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM1C	1/02/1999	76	720	-	-	-	92	-	0.01
DM1C	1/05/1999	54	-	-	-	-	86	-	0.01
DM1C	1/10/1999	85	810	-	-	-	75	-	0.01
DM1C	1/02/2000	72	730	-	-	-	79	-	0.01
DM1C	1/06/2000	92	830	-	-	-	86	-	0.01
DM1C	9/08/2000	50	790	-	-	-	97	-	0.01
DM1C	30/10/2000	61	740	-	-	-	89	-	0.01
DM1C	1/02/2001	59	800	-	-	-	90	-	0.01
DM1C	8/05/2001	45	740	-	-	-	67	-	0.01
DM1C	26/07/2001	55	790	-	-	-	88	-	0.01
DM1C	29/10/2001	54	840	-	-	-	95	-	0.005
DM1C	8/02/2002	52	820	-	-	-	110	-	0.01
DM1C	15/04/2002	59	800	-	-	-	100	-	-
DM1C	6/11/2002	65	660	-	-	-	78	-	0.005
DM1C	13/02/2003	53	730	-	-	-	85	-	0.005
DM1C	30/04/2003	70	800	-	-	-	100	-	0.005
DM1C	9/08/2003	60	790	-	-	-	95	-	0.005
DM1C	24/11/2003	50	900	-	-	-	100	-	0.005
DM1C	10/02/2004	60	880	-	-	-	87	-	0.005
DM1C	14/05/2004	75	830	-	-	-	93	-	0.005
DM1C	6/08/2004	70	780	**0.01**	**0.002**	-	89	-	0.005
DM1C	10/11/2004	75	770	-	-	-	54	-	0.005
DM1C	16/02/2005	70	960	-	-	-	100	-	0.005
DM1C	15/04/2005	26	520	-	-	-	74	-	0.0025
DM1C	2/08/2005	19	420	-	-	-	52	-	0.004
DM1C	14/11/2005	19	470	-	-	-	45	-	0.003
DM1C	15/02/2006	20	-	0.001	**0.0003**	-	-	-	-
DM1C	18/05/2006	19	-	-	-	-	-	-	-

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM1C	17/08/2006	19	-	-	-	-	-	-	-
DM1C	31/10/2006	19	-	0.001	0.0001	-	52	**0.005**	0.005
DM1C	8/03/2007	19	-	0.001	0.0001	-	38	**0.005**	0.004
DM1C	19/06/2007	20	520	0.001	0.0001	-	63	-	0.007
DM1C	30/08/2007	22	540	0.001	0.0001	-	64	-	0.006
DM1C	2/11/2007	27	530	0.001	0.0001	-	67	-	0.005
DM1C	2/04/2008	24	520	**0.014**	0.0001	-	63	-	0.019
DM1C	8/07/2008	29	530	0.001	0.0001	-	69	-	0.014
DM1C	8/09/2008	25	530	**0.004**	0.0001	-	60	-	0.013
DM1C	1/03/2009	23	540	0.001	0.0001	-	66	-	0.006
DM1C	1/07/2009	38	660	0.001	0.0001	-	78	**0.005**	0.005
DM1C	30/09/2009	32	590	0.001	0.0001	-	69	**0.005**	0.006
DM1C	23/12/2009	25	580	0.001	0.0001	-	70	-	0.005
DM1C	16/02/2010	24	620	0.001	0.0001	-	72	-	0.005
DM1C	21/05/2010	25	570	0.001	0.0001	-	74	-	0.004
DM1C	18/08/2010	30	620	0.001	0.0001	-	76	**0.001**	0.007
DM1C	25/11/2010	28	620	0.001	0.0001	-	70	**0.004**	0.005
DM1C	9/02/2011	23	590	0.001	0.0001	-	72	**0.001**	0.005
DM1C	11/05/2011	30	610	0.001	0.0001	-	85	-	0.0065
DM1C	9/08/2011	40	760	0.001	0.0001	-	89	-	0.005
DM1C	10/08/2011	-	-	-	-	-	-	-	-
DM1C	10/11/2011	33	710	0.001	0.0001	-	85	**0.001**	0.0039
DM1C	23/01/2012	32	700	**0.0076**	0.0001	-	97	**0.001**	0.039
DM1C	24/05/2012	27	630	0.0012	0.0001	-	95	**0.005**	0.015
DM1C	14/08/2012	26	690	**0.03**	0.00014	-	90	**0.001**	0.046
DM1C	26/10/2012	27	690	0.0015	0.0001	-	97	**0.001**	0.001
DM1C	16/01/2013	27	750	0.0023	0.0001	-	96	**0.001**	0.013
DM1C	9/04/2013	48	750	**0.019**	0.0001	-	100	**0.001**	0.086

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM1C	10/10/2013	32	770	**0.045**	<0.0001	-	1100	<0.001	0.073
DM1C	9/04/2014	50	930	**0.004**	<0.0001	-	140	<0.001	0.029
DM1C	16/10/2014	33	1090	<0.001	<0.0001	-	130	<0.001	<0.001
DM1C	16/04/2015	100	1260	**0.022**	<0.0001	-	150	<0.001	0.15
DM1C	3/09/2015	110	1110	<0.001	<0.0001	-	120	<0.001	0.002
DM1C	4/09/2015	-	-	-	-	-	-	-	-
DM1C	15/04/2016	-	-	-	-	-	-	-	-
DM1C	21/04/2016	110	1480	**0.022**	<0.0001	-	170	<0.001	0.12
DM1C	15/09/2016	130	1260 - 1590	**0.006**	<0.0001	<0.0001	-	**0.002**	0.015
DM1C	22/04/2016	-	-	-	-	-	-	-	-
DM1C	15/09/2016	-	-	-	-	-	-	-	-
DM1C	22/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM2A	1/08/1989	90	1050	-	-	-	110	-	-
DM2A	1/11/1989	30	740	-	-	-	110	-	-
DM2A	1/06/1990	100	2220	-	-	-	435	-	0.05
DM2A	1/10/1990	370	7030	-	-	-	1400	-	0.05
DM2A	1/12/1990	200	7400	-	-	-	1700	-	-
DM2A	1/01/1991	220	8900	-	-	-	1540	-	-
DM2A	1/04/1991	160	3930	-	-	-	690	-	0.05
DM2A	1/06/1991	305	8650	-	-	-	1650	-	0.05
DM2A	1/09/1991	270	7280	-	-	-	1550	-	0.05
DM2A	1/12/1991	150	5980	-	-	-	1200	-	0.05
DM2A	1/04/1992	190	4560	-	-	-	1170	-	0.05
DM2A	1/07/1992	200	5660	-	-	-	1340	-	0.05
DM2A	1/10/1992	200	5350	-	-	-	1210	-	0.05
DM2A	1/01/1993	470	6380	-	-	-	1490	-	0.05
DM2A	1/04/1993	300	6600	-	-	-	1440	-	0.05
DM2A	1/07/1993	370	5440	-	-	-	1210	-	0.05
DM2A	1/10/1993	260	5500	-	-	-	1205	-	0.05
DM2A	1/01/1994	230	4580	-	-	-	940	-	0.05
DM2A	1/07/1994	160	3300	-	-	-	575	-	0.05
DM2A	1/10/1994	130	2320	-	-	-	435	-	0.05
DM2A	1/01/1995	80	2600	-	-	-	500	-	0.05
DM2A	1/04/1995	95	2300	-	-	-	400	-	0.05
DM2A	1/07/1995	110	2500	-	-	-	470	-	0.05
DM2A	1/10/1995	130	3400	-	-	-	640	-	0.05
DM2A	1/01/1996	180	5200	-	-	-	820	-	0.05
DM2A	1/07/1996	160	3800	-	-	-	740	-	0.05
DM2A	1/10/1996	210	4300	-	-	-	700	-	0.05
DM2A	1/01/1997	180	1900	-	-	-	280	-	0.05

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM2A	1/04/1997	110	730	-	-	-	91	-	0.05
DM2A	1/07/1997	110	820	-	-	-	62	-	0.05
DM2A	1/10/1997	95	760	-	-	-	78	-	0.05
DM2A	1/01/1998	67	770	-	-	-	66	-	0.05
DM2A	1/07/1998	110	1000	-	-	-	88	-	0.01
DM2A	1/10/1998	74	1400	-	-	-	190	-	0.01
DM2A	1/02/1999	87	960	-	-	-	140	-	0.01
DM2A	1/05/1999	190	-	-	-	-	240	-	0.01
DM2A	1/08/1999	180	1400	-	-	-	170	-	0.01
DM2A	1/10/1999	170	1500	-	-	-	190	-	0.01
DM2A	1/02/2000	160	1400	-	-	-	160	-	0.01
DM2A	1/06/2000	200	1100	-	-	-	120	-	0.01
DM2A	9/08/2000	240	1500	-	-	-	180	-	0.01
DM2A	30/10/2000	250	1300	-	-	-	150	-	0.01
DM2A	1/02/2001	240	1400	-	-	-	150	-	0.01
DM2A	8/05/2001	130	1200	-	-	-	120	-	0.01
DM2A	26/07/2001	170	1300	-	-	-	120	-	0.01
DM2A	29/10/2001	65	1900	-	-	-	190	-	0.005
DM2A	8/02/2002	140	1300	-	-	-	130	-	0.01
DM2A	15/04/2002	110	1100	-	-	-	110	-	0.01
DM2A	12/08/2002	87	760	-	-	-	71	-	0.01
DM2A	6/11/2002	92	670	-	-	-	64	-	0.005
DM2A	13/02/2003	110	1800	-	-	-	158	-	0.005
DM2A	30/04/2003	140	1900	-	-	-	190	-	0.005
DM2A	9/08/2003	180	1950	-	-	-	240	-	0.005
DM2A	24/11/2003	150	2940	-	-	-	410	-	0.005
DM2A	10/02/2004	150	2320	-	-	-	180	-	0.005
DM2A	14/05/2004	-	4240	-	-	-	470	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM2A	6/08/2004	100	3600	**0.01**	**0.002**	-	260	-	0.005
DM2A	10/11/2004	210	4450	-	-	-	520	-	0.005
DM2A	16/02/2005	260	5330	-	-	-	600	-	0.005
DM2A	15/04/2005	390	4590	-	-	-	780	-	0.001
DM2A	2/08/2005	520	5700	-	-	-	660	-	0.001
DM2A	14/11/2005	440	5840	-	-	-	580	-	0.001
DM2A	15/02/2006	320	5780	0.0016	**0.0011**	-	1300	-	0.0026
DM2A	18/05/2006	280	-	-	-	-	-	-	-
DM2A	17/08/2006	280	-	-	-	-	-	-	-
DM2A	31/10/2006	380	-	0.001	0.0001	-	660	**0.005**	0.001
DM2A	8/03/2007	470	-	0.001	0.0001	-	550	**0.005**	0.001
DM2A	19/06/2007	430	6410	0.001	0.0001	-	560	0	0.001
DM2A	30/08/2007	430	4810	0.001	0.0001	-	590	-	0.001
DM2A	2/11/2007	410	4870	0.001	0.0001	-	740	-	0.001
DM2A	2/04/2008	470	5290	0.001	0.0001	-	620	-	0.003
DM2A	8/07/2008	500	6720	0.001	0.0001	-	650	-	0.005
DM2A	8/09/2008	520	7060	0.001	0.0001	-	660	-	0.014
DM2A	1/12/2008	530	6170	0.001	0.0001	-	740	-	0.044
DM2A	1/03/2009	420	7150	0.001	0.0001	-	840	-	0.088
DM2A	1/07/2009	480	5700	0.001	0.0001	-	730	**0.005**	0.05
DM2A	30/09/2009	530	6770	0.001	0.0001	-	660	**0.005**	0.037
DM2A	23/12/2009	620	6560	0.001	0.0001	-	770	-	0.023
DM2A	16/02/2010	420	2520	0.001	0.0001	-	310	-	0.007
DM2A	20/05/2010	420	4790	0.001	0.0001	-	460	-	0.12
DM2A	18/08/2010	600	7370	0.001	0.0001	-	780	**0.001**	0.041
DM2A	25/11/2010	580	7300	0.001	0.0001	-	670	**0.001**	0.051
DM2A	9/02/2011	570	7160	0.001	0.0001	-	720	**0.001**	0.054
DM2A	11/05/2011	510	6820	0.001	0.0001	-	840	-	0.0043

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM2A	9/08/2011	600	9710	0.001	0.0001	-	820	-	0.036
DM2A	10/08/2011	-	-	-	-	-	-	-	-
DM2A	10/11/2011	640	6450	0.001	0.0001	-	770	**0.001**	0.041
DM2A	23/01/2012	588	7210	0.001	0.0001	-	760	**0.1**	0.1
DM2A	24/05/2012	390	4860	0.001	0.0001	-	530	**0.001**	0.007
DM2A	14/08/2012	430	4590	**0.0075**	**0.00028**	-	480	**0.32**	0.32
DM2A	26/10/2012	710	8860	0.0019	0.0001	-	970	**0.001**	0.001
DM2A	16/01/2013	610	8380	0.001	0.0001	-	860	**0.001**	0.008
DM2A	9/04/2013	470	7190	0.001	0.0001	-	640	**0.01**	0.087
DM2A	10/10/2013	530	5440	**0.007**	<0.0001	-	640	**0.1**	0.13
DM2A	9/04/2014	740	8030	**0.03**	0.0001	-	1070	**0.78**	1.2
DM2A	16/10/2014	580	7400	0.001	<0.0001	-	730	**0.39**	0.67
DM2A	16/04/2015	730	7170	<0.001	<0.0001	-	630	**0.11**	0.13
DM2A	3/09/2015	550	6670	0.003	<0.0001	-	680	**0.047**	0.073
DM2A	4/09/2015	-	-	-	-	-	-	-	-
DM2A	15/04/2016	-	-	-	-	-	-	-	-
DM2A	21/04/2016	250	5170	**0.012**	**0.0002**	-	610	**0.039**	0.26
DM2A	15/09/2016	480	3080 - 7240	**0.005**	<0.0001	<0.0001	-	<0.001	0.4

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM2C	1/03/1989	55	959	-	-	-	79	-	-
DM2C	1/08/1989	30	640	-	-	-	100	-	-
DM2C	1/11/1989	300	2280	-	-	-	275	-	-
DM2C	1/06/1990	130	1840	-	-	-	195	-	0.05
DM2C	1/10/1990	160	2160	-	-	-	270	-	0.05
DM2C	1/12/1990	100	2660	-	-	-	350	-	-
DM2C	1/01/1991	-	-	-	-	-	-	-	-
DM2C	1/04/1991	100	1080	-	-	-	150	-	0.05
DM2C	1/06/1991	90	3300	-	-	-	465	-	0.05
DM2C	1/09/1991	170	3280	-	-	-	485	-	0.05
DM2C	1/12/1991	130	3950	-	-	-	780	-	0.05
DM2C	1/04/1992	75	2200	-	-	-	385	-	0.05
DM2C	1/07/1992	15	4095	-	-	-	920	-	0.05
DM2C	1/10/1992	55	3780	-	-	-	900	-	0.05
DM2C	1/01/1993	10	5600	-	-	-	1290	-	0.05
DM2C	1/04/1993	160	7130	-	-	-	1815	-	0.05
DM2C	1/07/1993	350	5570	-	-	-	1260	-	0.05
DM2C	1/10/1993	210	5080	-	-	-	1255	-	0.05
DM2C	1/01/1994	230	4270	-	-	-	900	-	0.05
DM2C	1/04/1994	130	3180	-	-	-	660	-	0.05
DM2C	1/07/1994	155	3200	-	-	-	625	-	0.05
DM2C	1/10/1994	125	2650	-	-	-	555	-	0.05
DM2C	1/01/1995	80	2000	-	-	-	330	-	0.05
DM2C	1/04/1995	85	2400	-	-	-	440	-	0.05
DM2C	1/07/1995	150	3100	-	-	-	600	-	0.05
DM2C	1/10/1995	110	3400	-	-	-	700	-	0.05
DM2C	1/01/1996	100	4600	-	-	-	820	-	0.05
DM2C	1/07/1996	92	2900	-	-	-	600	-	0.05

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM2C	1/10/1996	73	2200	-	-	-	360	-	0.05
DM2C	1/01/1997	83	770	-	-	-	110	-	0.05
DM2C	1/04/1997	100	830	-	-	-	140	-	0.05
DM2C	1/07/1997	88	950	-	-	-	100	-	0.05
DM2C	1/10/1997	62	1300	-	-	-	200	-	0.05
DM2C	1/01/1998	65	1100	-	-	-	140	-	0.05
DM2C	1/07/1998	78	1300	-	-	-	149	-	0.01
DM2C	1/10/1998	33	790	-	-	-	120	-	0.01
DM2C	1/02/1999	77	790	-	-	-	96	-	0.01
DM2C	1/05/1999	77	-	-	-	-	140	-	0.01
DM2C	1/08/1999	110	1900	-	-	-	240	-	0.02
DM2C	1/10/1999	76	2700	-	-	-	330	-	0.01
DM2C	1/02/2000	120	1400	-	-	-	210	-	0.01
DM2C	1/06/2000	100	950	-	-	-	130	-	0.03
DM2C	9/08/2000	77	990	-	-	-	140	-	0.01
DM2C	30/10/2000	71	1800	-	-	-	300	-	0.01
DM2C	1/02/2001	120	1400	-	-	-	220	-	0.01
DM2C	8/05/2001	62	720	-	-	-	92	-	0.01
DM2C	26/07/2001	76	990	-	-	-	120	-	0.01
DM2C	29/10/2001	160	1300	-	-	-	120	-	0.005
DM2C	8/02/2002	61	840	-	-	-	110	-	0.01
DM2C	15/04/2002	76	880	-	-	-	110	-	0.01
DM2C	12/08/2002	58	890	-	-	-	114	-	0.01
DM2C	6/11/2002	55	1200	-	-	-	127	-	0.005
DM2C	13/02/2003	45	980	-	-	-	107	-	0.005
DM2C	30/04/2003	60	2260	-	-	-	230	-	0.005
DM2C	9/08/2003	130	2610	-	-	-	370	-	0.005
DM2C	24/11/2003	110	2880	-	-	-	360	-	0.005

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM2C	10/02/2004	80	3380	-	-	-	380	-	0.005
DM2C	14/05/2004	120	2210	-	-	-	270	-	0.005
DM2C	6/08/2004	140	2100	**0.01**	**0.002**	-	250	-	0.005
DM2C	10/11/2004	130	2560	-	-	-	230	-	0.005
DM2C	16/02/2005	90	3610	-	-	-	530	-	0.005
DM2C	15/04/2005	140	3590	-	-	-	630	-	0.0049
DM2C	2/08/2005	190	5200	-	-	-	790	-	0.002
DM2C	14/11/2005	250	5130	-	-	-	700	-	0.002
DM2C	15/02/2006	300	4290	0.001	**0.0002**	-	750	-	0.011
DM2C	18/05/2006	330	-	-	-	-	-	-	-
DM2C	17/08/2006	250	-	-	-	-	-	-	-
DM2C	31/10/2006	230	-	0.001	**0.0003**	-	660	**0.005**	0.003
DM2C	8/03/2007	-	-	0.001	0.0001	-	550	**0.005**	0.009
DM2C	19/06/2007	230	4790	0.001	0.0001	-	610	-	0.015
DM2C	30/08/2007	200	4280	0.001	0.0001	-	590	-	0.021
DM2C	2/11/2007	230	2910	0.001	0.0001	-	510	-	0.031
DM2C	2/04/2008	270	3950	0.001	0.0001	-	490	-	0.1
DM2C	8/07/2008	260	4270	0.001	0.0001	-	410	-	0.11
DM2C	8/09/2008	250	4320	0.001	0.0001	-	460	-	0.074
DM2C	8/12/2008	280	4260	0.001	0.0001	-	500	-	0.025
DM2C	1/03/2009	300	630	0.001	0.0001	-	550	-	0.012
DM2C	1/07/2009	310	4420	0.001	0.0001	-	610	**0.011**	0.015
DM2C	30/09/2009	320	3680	0.001	0.0001	-	460	**0.005**	0.006
DM2C	23/12/2009	300	3150	0.001	0.0001	-	400	-	0.007
DM2C	16/02/2010	710	5870	0.001	0.0001	-	690	-	0.007
DM2C	20/05/2010	490	5380	0.001	0.0001	-	460	-	0.03
DM2C	18/08/2010	300	3210	0.001	0.0001	-	350	**0.001**	0.007
DM2C	25/11/2010	330	3530	0.001	0.0001	-	340	**0.011**	0.01

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM2C	9/02/2011	290	3800	0.001	0.0001	-	450	**0.001**	0.011
DM2C	11/05/2011	280	4540	0.001	0.0001	-	600	-	0.0064
DM2C	9/08/2011	270	4930	0.001	0.0001	-	580	-	0.003
DM2C	10/08/2011	-	-	-	-	-	-	-	-
DM2C	10/11/2011	330	3820	0.001	0.0001	-	510	**0.001**	0.0019
DM2C	23/01/2012	334	4110	0.0015	0.0001	-	480	**0.001**	0.008
DM2C	24/05/2012	320	3430	0.001	0.0001	-	410	**0.033**	0.038
DM2C	14/08/2012	275	3700	**0.014**	0.00018	-	480	**0.001**	0.051
DM2C	26/10/2012	230	3560	**0.0098**	0.0001	-	400	**0.001**	0.007
DM2C	16/01/2013	210	3230	0.0024	0.0001	-	400	**0.001**	0.01
DM2C	9/04/2013	360	5140	0.001	0.0001	-	450	**0.001**	0.002
DM2C	10/10/2013	250	3550	**0.007**	<0.0001	-	470	<0.001	0.042
DM2C	9/04/2014	250	4590	0.003	<0.0001	-	620	**0.068**	0.082
DM2C	16/10/2014	440	6990	<0.001	<0.0001	-	750	**0.32**	0.32
DM2C	16/04/2015	540	9080	<0.001	<0.0001	-	930	**0.055**	0.073
DM2C	3/09/2015	380	8190	<0.001	<0.0001	-	1040	**0.031**	0.04
DM2C	4/09/2015	-	-	-	-	-	-	-	-
DM2C	15/04/2016	-	-	-	-	-	-	-	-
DM2C	21/04/2016	380	5020	**0.006**	<0.0001	-	760	**0.05**	0.097
DM2C	15/09/2016	280	3140 - 7450	**0.004**	<0.0001	<0.0001	-	**0.09**	0.087
DM2C	22/04/2016	-	-	-	-	-	-	-	-
DM2C	22/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM4A	1/07/1996	72	800	-	-	-	98	-	0.05
DM4A	1/10/1996	80	960	-	-	-	110	-	0.05
DM4A	1/01/1997	120	880	-	-	-	110	-	0.05
DM4A	1/04/1997	160	910	-	-	-	120	-	0.05
DM4A	1/07/1997	200	1100	-	-	-	130	-	0.05
DM4A	1/10/1997	120	990	-	-	-	110	-	0.05
DM4A	1/01/1998	170	1100	-	-	-	130	-	0.05
DM4A	1/07/1998	200	1700	-	-	-	160	-	0.03
DM4A	1/10/1998	120	1840	-	-	-	310	-	0.01
DM4A	1/02/1999	160	2400	-	-	-	360	-	0.02
DM4A	1/05/1999	150	2400	-	-	-	320	-	0.01
DM4A	1/08/1999	170	2900	-	-	-	400	-	0.02
DM4A	1/10/1999	100	2900	-	-	-	320	-	0.01
DM4A	1/02/2000	160	3100	-	-	-	440	-	0.01
DM4A	1/06/2000	160	3100	-	-	-	450	-	0.01
DM4A	9/08/2000	240	5400	-	-	-	740	-	0.01
DM4A	1/02/2001	200	4800	-	-	-	650	-	0.01
DM4A	8/05/2001	210	5700	-	-	-	600	-	0.01
DM4A	26/07/2001	220	5500	-	-	-	770	-	0.01
DM4A	29/10/2001	230	6700	-	-	-	850	-	0.005
DM4A	8/02/2002	220	6900	-	-	-	840	-	0.01
DM4A	19/04/2002	180	5000	-	-	-	460	-	0.01
DM4A	12/08/2002	220	7000	-	-	-	567	-	0.01
DM4A	6/11/2002	230	5700	-	-	-	634	-	0.005
DM4A	13/02/2003	220	6900	-	-	-	719	-	0.005
DM4A	30/04/2003	280	8780	-	-	-	850	-	0.005
DM4A	9/08/2003	260	6650	-	-	-	900	-	0.005
DM4A	24/11/2003	200	6900	-	-	-	890	-	0.005

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM4A	10/02/2004	200	7120	-	-	-	680	-	0.005
DM4A	14/05/2004	290	8800	-	-	-	780	-	0.005
DM4A	6/08/2004	270	6650	**0.01**	**0.002**	-	810	-	0.005
DM4A	10/11/2004	300	7310	-	-	-	820	-	0.005
DM4A	16/02/2005	280	7830	-	-	-	800	-	0.005
DM4A	15/04/2005	270	6060	-	-	-	810	-	0.001
DM4A	2/08/2005	460	7450	-	-	-	930	-	0.001
DM4A	14/11/2005	400	8490	-	-	-	760	-	0.001
DM4A	15/02/2006	350	6630	0.001	**0.0004**	-	860	-	0.001
DM4A	18/05/2006	360	-	-	-	-	-	-	-
DM4A	17/08/2006	590	-	-	-	-	-	-	-
DM4A	31/10/2006	410	-	0.001	0.0001	-	750	**0.005**	0.001
DM4A	8/03/2007	490	-	0.001	0.0001	-	670	**0.005**	0.001
DM4A	19/06/2007	450	11,100	0.001	0.0001	-	860	-	0.001
DM4A	30/08/2007	730	9190	0.001	0.0001	-	1180	-	0.001
DM4A	2/11/2007	670	6400	0.001	0.0001	-	890	-	0.001
DM4A	2/04/2008	520	8360	0.001	0.0001	-	860	-	0.002
DM4A	8/07/2008	590	8980	0.001	0.0001	-	810	-	0.001
DM4A	8/09/2008	510	9700	0.001	0.0001	-	750	-	0.001
DM4A	1/12/2008	730	8090	0.001	0.0001	-	800	-	0.001
DM4A	9/03/2009	700	7570	0.001	0.0001	-	860	-	0.001
DM4A	1/07/2009	820	10,400	0.001	0.0001	-	1030	**0.005**	0.001
DM4A	30/09/2009	650	8640	0.001	0.0001	-	800	**0.005**	0.001
DM4A	23/12/2009	560	7390	0.001	0.0001	-	830	-	0.001
DM4A	17/02/2010	590	5820	0.001	0.0001	-	710	-	0.001
DM4A	20/05/2010	590	8840	0.001	0.0001	-	810	-	0.001
DM4A	18/08/2010	600	9260	0.001	0.0001	-	900	**0.001**	0.001
DM4A	24/11/2010	690	7430	0.001	0.0001	-	820	**0.001**	0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM4A	9/02/2011	590	9060	0.001	0.0001	-	750	**0.001**	0.001
DM4A	11/05/2011	660	9060	0.001	0.0001	-	1000	-	0.017
DM4A	10/11/2011	770	9060	0.001	0.0001	-	880	**0.001**	0.001
DM4A	23/01/2012	-	-	-	-	-	-	-	-
DM4A	24/01/2012	381	6540	0.0032	0.00017	-	670	**0.001**	0.0027
DM4A	24/05/2012	400	5520	0.001	0.00013	-	650	**0.001**	0.0014
DM4A	14/08/2012	520	5680	0.0028	0.00015	-	610	**0.001**	0.001
DM4A	26/10/2012	410	5860	0.001	0.00016	-	660	**0.001**	0.001
DM4A	16/01/2013	390	5900	0.0023	0.00013	-	630	**0.001**	0.001
DM4A	9/04/2013	220	6770	0.001	0.0001	-	560	**0.001**	0.001
DM4A	10/10/2013	460	5700	<0.001	<0.0001	-	570	<0.001	0.002
DM4A	9/04/2014	440	6360	0.001 - 0.00	0.0001	-	800	**.001 - 0.**	0.001
DM4A	16/10/2014	400	6460	<0.001	<0.0001	-	660	<0.001	<0.001
DM4A	16/04/2015	670	8910	<0.001	**0.0002**	-	640	<0.001	<0.001
DM4A	3/09/2015	440	6600	<0.001	0.0001	-	600	<0.001	<0.001
DM4A	4/09/2015	-	-	-	-	-	-	-	-
DM4A	15/04/2016	-	-	-	-	-	-	-	-
DM4A	21/04/2016	450	6170	<0.001	<0.0001	-	670	<0.001	0.004
DM4A	15/09/2016	450	3440 - 8210	<0.001	<0.0001	<0.0001	-	<0.001	<0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM4C	1/07/1996	200	1300	-	-	-	68	-	0.05
DM4C	1/10/1996	490	1500	-	-	-	240	-	0.05
DM4C	1/01/1997	550	1700	-	-	-	250	-	0.05
DM4C	1/04/1997	320	1500	-	-	-	210	-	0.05
DM4C	1/07/1997	160	1300	-	-	-	150	-	0.05
DM4C	1/10/1997	67	1400	-	-	-	190	-	0.05
DM4C	1/01/1998	70	1800	-	-	-	240	-	0.05
DM4C	1/07/1998	160	5700	-	-	-	850	-	0.01
DM4C	1/10/1998	130	6200	-	-	-	780	-	0.02
DM4C	1/02/1999	180	5900	-	-	-	720	-	0.02
DM4C	1/05/1999	200	4600	-	-	-	490	-	0.01
DM4C	1/08/1999	170	2600	-	-	-	320	-	0.01
DM4C	1/10/1999	150	4800	-	-	-	490	-	0.02
DM4C	1/02/2000	270	2800	-	-	-	540	-	0.01
DM4C	1/06/2000	150	5300	-	-	-	690	-	0.01
DM4C	9/08/2000	360	6600	-	-	-	690	-	0.01
DM4C	30/10/2000	360	8000	-	-	-	880	-	0.01
DM4C	1/02/2001	390	8700	-	-	-	980	-	0.01
DM4C	8/05/2001	340	9100	-	-	-	870	-	0.01
DM4C	26/07/2001	330	7400	-	-	-	740	-	0.01
DM4C	29/10/2001	320	8800	-	-	-	950	-	0.005
DM4C	8/02/2002	250	6500	-	-	-	690	-	0.01
DM4C	19/04/2002	190	6200	-	-	-	810	-	0.01
DM4C	12/08/2002	150	3600	-	-	-	184	-	0.01
DM4C	6/11/2002	200	3700	-	-	-	259	-	0.005
DM4C	13/02/2003	220	4400	-	-	-	435	-	0.005
DM4C	30/04/2003	280	5700	-	-	-	500	-	0.005
DM4C	9/08/2003	250	4350	-	-	-	430	-	0.005

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM4C	24/11/2003	340	6630	-	-	-	590	-	0.005
DM4C	10/02/2004	340	7800	-	-	-	610	-	0.005
DM4C	13/05/2004	570	8770	-	-	-	720	-	0.005
DM4C	6/08/2004	400	8550	**0.01**	**0.002**	-	780	-	0.005
DM4C	10/11/2004	600	9190	-	-	-	730	-	0.005
DM4C	16/02/2005	480	8940	-	-	-	670	-	0.005
DM4C	15/04/2005	550	6240	-	-	-	800	-	0.0012
DM4C	2/08/2005	620	8240	-	-	-	800	-	0.001
DM4C	14/11/2005	620	8050	-	-	-	740	-	0.001
DM4C	15/02/2006	670	8660	0.001	**0.0016**	-	1100	-	0.001
DM4C	18/05/2006	770	-	-	-	-	-	-	-
DM4C	17/08/2006	870	-	-	-	-	-	-	-
DM4C	31/10/2006	850	-	0.001	0.0001	-	1000	**0.005**	0.001
DM4C	8/03/2007	860	-	0.001	**0.016**	-	820	**0.005**	0.001
DM4C	19/06/2007	960	14,500	0.001	0.0001	-	1200	0	0.001
DM4C	30/08/2007	900	9240	0.001	0.0001	-	1130	-	0.001
DM4C	2/11/2007	920	7180	0.001	0.0001	-	1150	-	0.001
DM4C	2/04/2008	860	12,700	0.001	0.0001	-	1150	-	0.001
DM4C	8/07/2008	930	11,900	0.001	0.0001	-	1170	-	0.001
DM4C	8/09/2008	940	9980	0.001	0.0001	-	900	-	0.001
DM4C	1/12/2008	650	8900	0.001	0.0001	-	900	-	0.002
DM4C	1/03/2009	740	8470	0.001	0.0001	-	860	-	0.001
DM4C	1/07/2009	890	10,900	0.001	0.0001	-	1060	**0.005**	0.001
DM4C	30/09/2009	930	11,100	0.001	0.0001	-	1030	**0.005**	0.001
DM4C	23/12/2009	890	11,100	0.001	0.0001	-	1160	-	0.001
DM4C	17/02/2010	970	7630	0.001	0.0001	-	1020	-	0.001
DM4C	20/05/2010	970	12,400	0.001	0.0001	-	1110	-	0.001
DM4C	18/08/2010	860	10,100	0.001	0.0001	-	1040	**0.001**	0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM4C	24/11/2010	780	7770	0.001	0.0001	-	890	**0.001**	0.001
DM4C	9/02/2011	690	9420	0.001	0.0001	-	770	**0.001**	0.001
DM4C	11/05/2011	780	9100	0.001	0.0001	-	970	-	0.001
DM4C	10/11/2011	900	9880	0.001	0.0001	-	1020	**0.001**	0.001
DM4C	23/01/2012	-	-	-	-	-	-	-	-
DM4C	24/01/2012	750	9520	0.0013	0.0001	-	900	**0.001**	0.0035
DM4C	24/05/2012	780	8340	0.0012	0.0001	-	870	**0.001**	0.0072
DM4C	14/08/2012	640	6980	0.0013	0.0001	-	720	**0.001**	0.013
DM4C	26/10/2012	740	7730	0.0014	0.0001	-	860	**0.001**	0.001
DM4C	16/01/2013	650	8140	0.0011	0.0001	-	850	**0.001**	0.001
DM4C	9/04/2013	520	9040	0.001	0.0001	-	710	**0.001**	0.001
DM4C	10/10/2013	730	8820	<0.001	<0.0001	-	880	<0.001	0.003
DM4C	9/04/2014	760	9760	<0.001 - 0.00	.0001 - 0.00	-	1010	**.001 - 0.0**	0.001
DM4C	16/10/2014	770	10,300	<0.001	<0.0001	-	990	<0.001	<0.001
DM4C	16/04/2015	1100	13,300	<0.001	<0.0001	-	920	<0.001	<0.001
DM4C	3/09/2015	780	8200	<0.001	<0.0001	-	720	<0.001	<0.001
DM4C	4/09/2015	-	-	-	-	-	-	-	-
DM4C	15/04/2016	-	-	-	-	-	-	-	-
DM4C	21/04/2016	590	5980	<0.001	<0.0001	-	560	<0.001	0.002
DM4C	15/09/2016	510	3310 - 6640	<0.001	<0.0001	<0.0001	-	<0.001	<0.001
DM4C	22/04/2016	-	-	-	-	-	-	-	-
DM4C	22/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM7A	30/09/2009	170	3530	0.001	0.0001	-	480	**0.005**	0.001
DM7A	23/12/2009	170	2680	0.001	0.0001	-	470	-	0.001
DM7A	17/02/2010	170	2260	0.001	0.0001	-	410	-	0.001
DM7A	21/05/2010	140	4100	0.001	0.0001	-	570	-	0.001
DM7A	18/08/2010	160	3820	0.001	0.0001	-	560	**0.001**	0.001
DM7A	24/11/2010	150	3640	0.001	0.0001	-	460	**0.001**	0.001
DM7A	9/02/2011	180	3200	0.001	0.0001	-	460	**0.001**	0.001
DM7A	11/05/2011	180	1560	0.001	0.0001	-	540	-	0.001
DM7A	9/08/2011	140	3450	0.001	0.0001	-	510	-	0.001
DM7A	10/08/2011	-	-	-	-	-	-	-	-
DM7A	10/11/2011	150	3600	0.001	0.0001	-	520	**0.001**	0.001
DM7A	23/01/2012	121	3010	0.001	0.0001	-	460	**0.001**	0.001
DM7A	24/05/2012	130	2440	0.0016	0.0001	-	410	**0.001**	0.002
DM7A	14/08/2012	110	2810	0.001	0.0001	-	400	**0.001**	0.001
DM7A	26/10/2012	120	2470	0.0013	0.0001	-	660	**0.001**	0.001
DM7A	16/01/2013	110	1950	0.001	0.0001	-	320	**0.001**	0.001
DM7A	9/04/2013	88	2290	0.001	0.0001	-	280	**0.001**	0.002
DM7A	10/10/2013	100	1560	0.002	<0.0001	-	240	<0.001	0.001
DM7A	9/04/2014	90	2710	<0.001	<0.0001	-	460	<0.001	0.002
DM7A	16/10/2014	97	1980	<0.001	<0.0001	-	270	<0.001	<0.001
DM7A	16/04/2015	190	1770	<0.001	<0.0001	-	240	<0.001	<0.001
DM7A	3/09/2015	120	1260	<0.001	<0.0001	-	190	<0.001	<0.001
DM7A	4/09/2015	-	-	-	-	-	-	-	-
DM7A	15/04/2016	-	-	-	-	-	-	-	-
DM7A	21/04/2016	80	910	<0.001	<0.0001	-	170	<0.001	<0.001
DM7A	15/09/2016	86	698 - 910	<0.001	<0.0001	<0.0001	-	<0.001	<0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM7C	1/07/1992	200	1650	-	-	-	205	-	0.05
DM7C	1/10/1992	210	2040	-	-	-	265	-	0.05
DM7C	1/01/1993	115	1800	-	-	-	265	-	0.05
DM7C	1/04/1993	140	1530	-	-	-	185	-	0.05
DM7C	1/07/1993	150	1580	-	-	-	175	-	0.05
DM7C	1/10/1993	95	2980	-	-	-	365	-	0.05
DM7C	1/01/1994	225	3020	-	-	-	500	-	0.05
DM7C	1/04/1994	80	1460	-	-	-	165	-	0.05
DM7C	1/07/1994	110	1550	-	-	-	215	-	0.05
DM7C	1/10/1994	180	2540	-	-	-	470	-	0.05
DM7C	1/01/1995	180	3500	-	-	-	440	-	0.05
DM7C	1/04/1995	120	2500	-	-	-	340	-	0.05
DM7C	1/07/1995	170	3200	-	-	-	530	-	0.05
DM7C	1/10/1995	300	5700	-	-	-	650	-	0.05
DM7C	1/01/1996	360	8100	-	-	-	880	-	0.1
DM7C	1/07/1996	200	5000	-	-	-	800	-	0.05
DM7C	1/10/1996	420	7400	-	-	-	1100	-	0.05
DM7C	1/01/1997	390	7000	-	-	-	910	-	0.05
DM7C	1/04/1997	380	7000	-	-	-	910	-	0.05
DM7C	1/07/1997	380	5800	-	-	-	740	-	0.05
DM7C	1/10/1997	220	3100	-	-	-	380	-	0.05
DM7C	1/01/1998	210	4100	-	-	-	570	-	0.05
DM7C	1/07/1998	170	3200	-	-	-	333	-	0.01
DM7C	1/10/1998	80	2670	-	-	-	350	-	0.01
DM7C	1/02/1999	150	2500	-	-	-	370	-	0.01
DM7C	1/05/1999	150	2700	-	-	-	350	-	0.01
DM7C	1/08/1999	180	2500	-	-	-	360	-	0.01
DM7C	1/10/1999	300	3400	-	-	-	340	-	0.03

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM7C	1/02/2000	260	3900	-	-	-	440	-	0.01
DM7C	1/06/2000	200	3200	-	-	-	360	-	0.04
DM7C	9/08/2000	190	2600	-	-	-	300	-	0.01
DM7C	30/10/2000	180	2500	-	-	-	300	-	0.01
DM7C	1/02/2001	240	3500	-	-	-	440	-	0.04
DM7C	8/05/2001	270	3500	-	-	-	450	-	0.02
DM7C	26/07/2001	240	3000	-	-	-	320	-	0.02
DM7C	29/10/2001	220	3200	-	-	-	420	-	0.04
DM7C	8/02/2002	190	3100	-	-	-	360	-	0.023
DM7C	15/04/2002	200	3500	-	-	-	370	-	0.02
DM7C	12/08/2002	240	3900	-	-	-	241	-	0.037
DM7C	6/11/2002	230	3200	-	-	-	233	-	0.05
DM7C	13/02/2003	240	3500	-	-	-	355	-	0.054
DM7C	30/04/2003	270	3790	-	-	-	320	-	0.005
DM7C	9/08/2003	240	3190	-	-	-	380	-	0.006
DM7C	24/11/2003	-	2913	-	-	-	-	-	-
DM7C	25/11/2003	140	3520	-	-	-	450	-	0.015
DM7C	10/02/2004	100	3540	-	-	-	420	-	0.012
DM7C	13/05/2004	150	4410	-	-	-	390	-	0.005
DM7C	6/08/2004	130	3700	**0.01**	**0.002**	-	440	-	0.007
DM7C	10/11/2004	230	3840	-	-	-	450	-	0.005
DM7C	16/02/2005	170	4380	-	-	-	490	-	0.005
DM7C	15/04/2005	200	3050	-	-	-	580	-	0.0064
DM7C	2/08/2005	250	4210	-	-	-	550	-	0.002
DM7C	14/11/2005	230	4540	-	-	-	640	-	0.002
DM7C	15/02/2006	280	5230	0.001	**0.0024**	-	1200	-	0.0072
DM7C	18/05/2006	270	-	-	-	-	-	-	-
DM7C	17/08/2006	270	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM7C	31/10/2006	250	-	0.001	0.0001	-	480	**0.005**	0.014
DM7C	8/03/2007	280	-	0.001	0.0001	-	400	**0.005**	0.037
DM7C	19/06/2007	290	6180	0.001	0.0001	-	670	-	0.043
DM7C	30/08/2007	300	3830	0.001	0.0001	-	610	-	0.053
DM7C	2/11/2007	260	3070	0.001	0.0001	-	560	-	0.052
DM7C	2/04/2008	220	3860	0.001	0.0001	-	430	-	0.031
DM7C	8/07/2008	210	3580	0.003	0.0001	-	500	-	0.032
DM7C	8/09/2008	220	3390	0.001	0.0001	-	390	-	0.028
DM7C	1/12/2008	220	6060	0.001	0.0001	-	500	-	0.021
DM7C	1/03/2009	210	4520	0.001	0.0001	-	530	-	0.022
DM7C	1/07/2009	190	3510	0.001	0.0001	-	560	**0.019**	0.018
DM7C	30/09/2009	190	3170	0.001	0.0001	-	420	**0.005**	0.009
DM7C	23/12/2009	200	2970	0.001	0.0001	-	480	-	0.009
DM7C	17/02/2010	190	2740	0.001	0.0001	-	490	-	0.014
DM7C	21/05/2010	180	4560	0.001	0.0001	-	610	-	0.018
DM7C	18/08/2010	200	3850	0.001	0.0001	-	520	**0.008**	0.017
DM7C	24/11/2010	180	3930	0.001	0.0001	-	480	**0.016**	0.016
DM7C	9/02/2011	160	3920	0.001	0.0001	-	410	**0.01**	0.014
DM7C	11/05/2011	180	3400	0.001	0.0001	-	510	-	0.014
DM7C	9/08/2011	150	3700	0.001	0.0001	-	480	-	0.014
DM7C	10/08/2011	-	-	-	-	-	-	-	-
DM7C	10/11/2011	170	3300	0.001	0.0001	-	460	**0.003**	0.0066
DM7C	23/01/2012	180	2790	0.0014	0.0001	-	450	**0.002**	0.0058
DM7C	24/05/2012	170	2630	**0.015**	0.0001	-	450	**0.015**	0.029
DM7C	14/08/2012	140	3110	0.0012	0.00016	-	460	**0.012**	0.02
DM7C	26/10/2012	140	2780	0.0013	0.0001	-	480	**0.001**	0.0077
DM7C	16/01/2013	110	1760	0.001	0.0001	-	300	**0.001**	0.002
DM7C	9/04/2013	88	3010	0.001	0.0001	-	83	**0.004**	0.15

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM7C	10/10/2013	100	1650	**0.057**	<0.0001	-	260	<0.001	0.028
DM7C	9/04/2014	90	2710	0.001	0.0001	-	460	**0.001**	0.002
DM7C	16/10/2014	-	-	-	-	-	-	-	-
DM7C	16/04/2015	100	2420	<0.001	<0.0001	-	320	**0.003**	0.005
DM7C	3/09/2015	98	1840	<0.001	<0.0001	-	260	<0.001	0.002
DM7C	4/09/2015	-	-	-	-	-	-	-	-
DM7C	5/09/2015	-	-	-	-	-	-	-	-
DM7C	15/04/2016	-	-	-	-	-	-	-	-
DM7C	21/04/2016	84	1610	**0.006**	<0.0001	-	290	**0.002**	0.01
DM7C	15/09/2016	80	923 - 1470	**0.007**	<0.0001	<0.0001	-	**0.002**	0.005
DM7C	22/04/2016	-	-	-	-	-	-	-	-
DM7C	15/09/2016	-	-	-	-	-	-	-	-
DM7C	22/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM8A	30/09/2009	-	-	-	-	-	-	-	-
DM8A	9/11/2009	180	2060	**0.004**	0.0001	-	180	-	0.005
DM8A	23/12/2009	790	7740	0.001	0.0001	-	990	-	0.001
DM8A	16/02/2010	910	7690	0.001	0.0001	-	890	-	0.001
DM8A	20/05/2010	900	11,700	0.001	0.0001	-	1000	-	0.001
DM8A	18/08/2010	850	11,400	0.001	0.0001	-	1020	**0.001**	0.016
DM8A	24/11/2010	900	12,000	0.002	0.0001	-	1010	**0.001**	0.003
DM8A	8/02/2011	850	12,100	0.001	0.0001	-	960	**0.001**	0.001
DM8A	11/05/2011	890	9360	0.001	0.0001	-	1200	-	0.005
DM8A	9/08/2011	920	10,400	0.001	0.0001	-	950	-	0.001
DM8A	10/08/2011	-	-	-	-	-	-	-	-
DM8A	1/11/2011	-	-	-	-	-	-	-	-
DM8A	10/11/2011	910	10,600	0.001	0.0001	-	970	**0.001**	0.001
DM8A	23/01/2012	907	10,400	0.0012	0.0001	-	960	**0.001**	0.001
DM8A	24/05/2012	860	10,100	0.0026	0.0001	-	1070	**0.001**	0.0034
DM8A	14/08/2012	840	9800	0.0027	0.0001	-	930	**0.001**	0.001
DM8A	26/10/2012	1020	10,700	0.0021	0.0001	-	1130	**0.001**	0.0011
DM8A	16/01/2013	730	9540	0.0025	0.0001	-	960	**0.001**	0.002
DM8A	9/04/2013	610	12,400	0.001	0.0001	-	1000	**0.001**	0.003
DM8A	10/10/2013	32	770	<0.001	0.0001	-	86	<0.001	0.001
DM8A	9/04/2014	860	10,900	0.001 - 0.00	.0001 - 0.00	-	1090	**.001 - 0.0**	0.001
DM8A	16/10/2014	700	-	<0.001	<0.0001	-	800	<0.001	<0.001
DM8A	16/04/2015	1100	11,500	<0.001	<0.0001	-	750	<0.001	0.002
DM8A	3/09/2015	830	11,600	<0.001	<0.0001	-	1120	<0.001	0.002
DM8A	4/09/2015	-	-	-	-	-	-	-	-
DM8A	5/09/2015	-	-	-	-	-	-	-	-
DM8A	15/04/2016	-	-	-	-	-	-	-	-
DM8A	21/04/2016	720	9000	0.001	<0.0001	-	820	<0.001	0.001

			Lead					
	Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL	5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%			0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%			**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%			0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%			0.0044	0.0055	0.0055		0.0044	

Field_ID	**Sampled_Date-Ti**								
DM8A	15/09/2016	640	4500 - 10,700	<0.001	<0.0001	<0.0001	-	<0.001	<0.001

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM8C	30/09/2009	930	10,500	0.001	0.0001	-	950	**0.005**	0.002
DM8C	23/12/2009	940	11,500	0.001	0.0001	-	1310	-	0.001
DM8C	16/02/2010	1000	7650	0.001	0.0001	-	1020	-	0.001
DM8C	13/05/2010	820	11,800	0.001	0.0001	-	870	-	0.004
DM8C	18/08/2010	830	11,000	0.001	0.0001	-	1140	**0.001**	0.001
DM8C	24/11/2010	970	11,900	0.001	0.0001	-	1060	**0.001**	0.001
DM8C	8/02/2011	1500	14,600	0.001	0.0001	-	630	**0.001**	0.001
DM8C	11/05/2011	1000	11,200	0.001	0.0001	-	1310	-	0.001
DM8C	9/08/2011	920	12,300	0.001	0.0001	-	1130	-	0.002
DM8C	10/08/2011	-	-	-	-	-	-	-	-
DM8C	1/11/2011	-	-	-	-	-	-	-	-
DM8C	10/11/2011	930	11,000	0.001	0.0001	-	1120	**0.001**	0.001
DM8C	23/01/2012	525	7030	0.0018	0.0001	-	720	**0.001**	0.001
DM8C	24/05/2012	610	7940	0.0018	0.0001	-	860	**0.001**	0.001
DM8C	14/08/2012	780	9600	0.001	0.0001	-	1000	**0.001**	0.001
DM8C	26/10/2012	870	1160	0.0019	0.0001	-	1230	**0.001**	0.0022
DM8C	16/01/2013	730	10,500	0.001	0.0001	-	1060	**0.001**	0.001
DM8C	9/04/2013	480	11,200	0.001	0.0001	-	900	**0.001**	0.002
DM8C	10/10/2013	630	9500	0.002	0.0001	-	1100	<0.001	0.001
DM8C	9/04/2014	740	10,600	<0.001 - 0.00	.0001 - 0.00	-	1110	**.001 - 0.0**	0.001
DM8C	16/10/2014	90 - 70	8640 - 10,700	<0.001	<0.0001	-	0 - 10	<0.001	<0.001
DM8C	16/04/2015	1100	16,600	<0.001	<0.0001	-	1140	<0.001	0.001
DM8C	3/09/2015	670	8560	<0.001	<0.0001	-	620	<0.001	0.002
DM8C	4/09/2015	-	-	-	-	-	-	-	-
DM8C	15/04/2016	-	-	-	-	-	-	-	-
DM8C	21/04/2016	670	6860	**0.004**	<0.0001	-	680	<0.001	0.005
DM8C	15/09/2016	570	3640 - 7520	0.003	<0.0001	<0.0001	-	<0.001	0.008
DM8C	22/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM8C	22/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM9A	29/10/2001	46	450	-	-	-	89	-	0.022
DM9A	8/02/2002	46	590	-	-	-	92	-	0.01
DM9A	15/04/2002	54	810	-	-	-	91	-	0.01
DM9A	12/08/2002	60	720	-	-	-	87	-	0.01
DM9A	6/11/2002	51	650	-	-	-	78	-	0.02
DM9A	13/02/2003	48	790	-	-	-	107	-	0.018
DM9A	30/04/2003	60	730	-	-	-	98	-	0.005
DM9A	9/08/2003	50	740	-	-	-	100	-	0.016
DM9A	24/11/2003	40	850	-	-	-	100	-	0.036
DM9A	10/02/2004	40	840	-	-	-	110	-	0.028
DM9A	13/05/2004	8	630	-	-	-	100	-	0.037
DM9A	6/08/2004	30	700	**0.01**	**0.002**	-	96	-	0.057
DM9A	10/11/2004	50	750	-	-	-	62	-	0.005
DM9A	16/02/2005	40	760	0	-	-	91	-	0.033
DM9A	15/04/2005	48	600	-	-	-	100	-	0.022
DM9A	2/08/2005	50	610	-	-	-	100	-	0.051
DM9A	14/11/2005	45	650	-	-	-	95	-	0.048
DM9A	15/02/2006	44	680	0.001	**0.0002**	-	100	-	0.043
DM9A	18/05/2006	36	0	-	-	-	0	-	0
DM9A	17/08/2006	35	0	0	0	-	0	-	0
DM9A	31/10/2006	36	0	0.001	0.0001	-	95	**0.005**	0.042
DM9A	8/03/2007	36	-	0.001	0.0001	-	76	**0.008**	0.038
DM9A	19/06/2007	70	620	0.001	0.0001	-	110	-	0.043
DM9A	30/08/2007	35	610	0.001	0.0001	-	110	-	0.054
DM9A	2/11/2007	33	610	0.001	0.0001	-	110	-	0.072
DM9A	2/04/2008	39	650	0.001	0.0001	-	92	-	0.04
DM9A	8/07/2008	33	580	0.001	0.0001	-	98	-	0.055
DM9A	8/09/2008	35	620	0.001	0.0001	-	89	-	0.029

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM9A	1/12/2008	-	-	-	-	-	-	-	-
DM9A	1/03/2009	37	660	0.001	0.0001	-	95	-	0.057
DM9A	1/07/2009	39	610	0.001	0.0001	-	95	**0.062**	0.061
DM9A	30/09/2009	41	650	0.001	0.0001	-	93	**0.005**	0.11
DM9A	23/12/2009	41	690	0.001	0.0001	-	100	-	0.036
DM9A	16/02/2010	43	660	0.001	0.0001	-	93	-	0.053
DM9A	14/05/2010	43	670	0.002	0.0001	-	87	-	0.087
DM9A	18/08/2010	-	-	-	-	-	-	-	-
DM9A	19/08/2010	40	610	0.001	0.0001	-	95	**0.15**	0.15
DM9A	24/11/2010	46	620	0.001	0.0001	-	89	**0.2**	0.19
DM9A	9/02/2011	44	620	0.001	0.0001	-	85	**0.17**	0.17
DM9A	11/05/2011	55	620	0.001	0.0001	-	100	-	0.25
DM9A	10/08/2011	47	650	0.001	0.0001	-	98	-	0.22
DM9A	10/11/2011	50	640	0.001	0.0001	-	98	**0.3**	0.24
DM9A	23/01/2012	51	640	0.001	0.0001	-	100	**0.22**	0.23
DM9A	24/05/2012	40	570	0.0033	0.0001	-	100	**0.32**	0.35
DM9A	14/08/2012	37	640	0.001	0.0001	-	86	**0.001**	0.23
DM9A	26/10/2012	41	560	0.0013	0.0001	-	97	**0.21**	0.44
DM9A	16/01/2013	40	600	0.0028	0.0001	-	96	**0.001**	0.32
DM9A	9/04/2013	31	600	<0.001	<0.0001	-	84	<0.001	0.13
DM9A	10/10/2013	46	610	<0.001	<0.0001	-	98	**0.047**	0.092
DM9A	9/04/2014	40	620	<0.001	<0.0001	-	110	**0.1**	0.13
DM9A	16/10/2014	38	710	<0.001	<0.0001	-	73	<0.001	<0.001
DM9A	16/04/2015	70	680	0.002	<0.0001	-	100	**0.051**	0.071
DM9A	3/09/2015	65	620	<0.001	<0.0001	-	93	**0.057**	0.077
DM9A	4/09/2015	-	-	-	-	-	-	-	-
DM9A	5/09/2015	-	-	-	-	-	-	-	-
DM9A	15/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM9A	21/04/2016	44	690	0.003	<0.0001	-	77	<0.001	0.001
DM9A	15/09/2016	40	530 - 630	0.002	-	<0.0001	-	<0.001	<0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM9C	1/10/1996	20	640	-	-	-	92	-	0.05
DM9C	1/01/1997	22	540	-	-	-	100	-	0.05
DM9C	1/04/1997	20	560	-	-	-	110	-	0.05
DM9C	1/07/1997	12	750	-	-	-	110	-	0.05
DM9C	1/10/1997	22	600	-	-	-	120	-	0.05
DM9C	1/01/1998	22	770	-	-	-	110	-	0.05
DM9C	1/07/1998	27	910	-	-	-	102	-	0.04
DM9C	1/10/1998	22	550	-	-	-	93	-	0.01
DM9C	1/02/1999	41	470	-	-	-	110	-	0.07
DM9C	1/05/1999	38	720	-	-	-	95	-	0.04
DM9C	1/08/1999	50	590	-	-	-	83	-	0.06
DM9C	1/10/1999	41	720	-	-	-	99	-	0.13
DM9C	1/02/2000	47	750	-	-	-	93	-	0.03
DM9C	1/06/2000	41	730	-	-	-	95	-	0.01
DM9C	9/08/2000	26	710	-	-	-	92	-	0.02
DM9C	30/10/2000	38	710	-	-	-	87	-	0.01
DM9C	1/02/2001	54	710	-	-	-	85	-	0.01
DM9C	8/05/2001	28	660	-	-	-	64	-	0.01
DM9C	26/07/2001	31	690	-	-	-	88	-	0.01
DM9C	29/10/2001	46	450	-	-	-	89	-	0.022
DM9C	8/02/2002	46	590	-	-	-	92	-	0.01
DM9C	15/04/2002	54	810	-	-	-	91	-	0.01
DM9C	12/08/2002	60	720	-	-	-	87	-	0.01
DM9C	6/11/2002	51	650	-	-	-	78	-	0.02
DM9C	13/02/2003	48	790	-	-	-	107	-	0.018
DM9C	30/04/2003	60	730	-	-	-	98	-	0.005
DM9C	9/08/2003	50	740	-	-	-	100	-	0.016
DM9C	24/11/2003	40	850	-	-	-	100	-	0.036

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM9C	10/02/2004	40	840	-	-	-	110	-	0.028
DM9C	13/05/2004	8	630	-	-	-	100	-	0.037
DM9C	6/08/2004	30	700	**0.01**	**0.002**	-	96	-	0.057
DM9C	10/11/2004	50	750	-	-	-	62	-	0.005
DM9C	16/02/2005	40	760	0	-	-	91	-	0.033
DM9C	15/04/2005	48	600	-	-	-	100	-	0.022
DM9C	2/08/2005	50	610	-	-	-	100	-	0.051
DM9C	14/11/2005	45	650	-	-	-	95	-	0.048
DM9C	15/02/2006	44	680	0.001	**0.0002**	-	100	-	0.043
DM9C	18/05/2006	36	0	-	-	-	0	-	0
DM9C	17/08/2006	35	0	0	0	-	0	-	0
DM9C	31/10/2006	36	0	0.001	0.0001	-	95	**0.005**	0.042
DM9C	8/03/2007	36	-	0.001	0.0001	-	76	**0.008**	0.038
DM9C	19/06/2007	70	620	0.001	0.0001	-	110	-	0.043
DM9C	30/08/2007	35	610	0.001	0.0001	-	110	-	0.054
DM9C	2/11/2007	33	610	0.001	0.0001	-	110	-	0.072
DM9C	2/04/2008	39	650	0.001	0.0001	-	92	-	0.04
DM9C	8/07/2008	33	580	0.001	0.0001	-	98	-	0.055
DM9C	8/09/2008	35	620	0.001	0.0001	-	89	-	0.029
DM9C	1/12/2008	43	610	0.001	0.0001	-	100	-	0.03
DM9C	1/03/2009	37	660	0.001	0.0001	-	95	-	0.057
DM9C	1/07/2009	39	610	0.001	0.0001	-	95	**0.062**	0.061
DM9C	30/09/2009	41	650	0.001	0.0001	-	93	**0.005**	0.11
DM9C	23/12/2009	41	690	0.001	0.0001	-	100	-	0.036
DM9C	16/02/2010	43	660	0.001	0.0001	-	93	-	0.053
DM9C	14/05/2010	43	670	0.002	0.0001	-	87	-	0.087
DM9C	18/08/2010	59	740	0.001	0.0001	-	73	**0.001**	0.001
DM9C	19/08/2010	40	610	0.001	0.0001	-	95	**0.15**	0.15

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
DM9C	24/11/2010	46	620	0.001	0.0001	-	89	**0.2**	0.19
DM9C	9/02/2011	44	620	0.001	0.0001	-	85	**0.17**	0.17
DM9C	11/05/2011	55	620	0.001	0.0001	-	100	-	0.25
DM9C	10/08/2011	47	650	0.001	0.0001	-	98	-	0.22
DM9C	10/11/2011	50	640	0.001	0.0001	-	98	**0.3**	0.24
DM9C	23/01/2012	51	640	0.001	0.0001	-	100	**0.22**	0.23
DM9C	24/05/2012	40	570	0.0033	0.0001	-	100	**0.32**	0.35
DM9C	14/08/2012	37	640	0.001	0.0001	-	86	**0.001**	0.23
DM9C	26/10/2012	41	560	0.0013	0.0001	-	97	**0.21**	0.44
DM9C	16/01/2013	40	600	0.0028	0.0001	-	96	**0.001**	0.32
DM9C	9/04/2013	31	600	0.001	0.0001	-	84	**0.001**	0.13
DM9C	10/10/2013	20	610	0.002	<0.0001	-	70	<0.001	0.005
DM9C	9/04/2014	30	630	0.001	<0.0001	-	79	<0.001	0.001
DM9C	16/10/2014	53	700	<0.001	<0.0001	-	98	**0.037**	0.037
DM9C	16/04/2015	49	690	<0.001	<0.0001	-	76	<0.001	0.001
DM9C	3/09/2015	46	690	<0.001	<0.0001	-	67	<0.001	0.004
DM9C	4/09/2015	-	-	-	-	-	-	-	-
DM9C	15/04/2016	-	-	-	-	-	-	-	-
DM9C	21/04/2016	92	740	0.002	<0.0001	-	110	**0.2**	0.2
DM9C	15/09/2016	68	523 - 650	0.001	-	<0.0001	91	**0.22**	0.23
MB3	1/02/2001	160	4800	-	-	-	820	-	0.01
MB3	8/05/2001	160	5300	-	-	-	950	-	0.02
MB3	26/07/2001	210	6000	-	-	-	1100	-	0.07
MB3	29/10/2001	180	5500	-	-	-	950	-	0.059
MB3	8/02/2002	160	6200	-	-	-	900	-	0.03
MB3	19/04/2002	180	5000	-	-	-	770	-	0.01
MB3	12/08/2002	160	3300	-	-	-	267	-	0.01
MB3	6/11/2002	110	1500	-	-	-	236	-	0.005

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
MB3	13/02/2003	53	1700	-	-	-	251	-	0.005
MB3	30/04/2003	120	1450	-	-	-	200	-	0.005
MB3	9/08/2003	30	1330	-	-	-	210	-	0.005
MB3	24/11/2003	20	1430	-	-	-	200	-	0.005
MB3	10/02/2004	30	1400	-	-	-	200	-	0.005
MB3	13/05/2004	43	1250	-	-	-	220	-	0.005
MB3	6/08/2004	70	1410	**0.01**	**0.002**	-	220	-	0.005
MB3	10/11/2004	100	1240	-	-	-	98	-	0.005
MB3	16/02/2005	80	1200	-	-	-	190	-	0.005
MB3	15/04/2005	47	1100	-	-	-	240	-	0.0025
MB3	2/08/2005	55	1320	-	-	-	220	-	0.004
MB3	14/11/2005	47	900	-	-	-	220	-	0.004
MB3	15/02/2006	76	-	0.001	**0.0007**	-	250	-	0.002
MB3	18/05/2006	50	-	-	-	-	-	-	-
MB3	17/08/2006	54	-	-	-	-	-	-	-
MB3	31/10/2006	58	-	0.001	0.0001	-	220	**0.005**	0.004
MB3	8/03/2007	54	-	0.001	0.0001	-	150	**0.005**	0.002
MB3	19/06/2007	60	1170	0.001	0.0001	-	230	-	0.003
MB3	30/08/2007	61	1110	0.001	0.0001	-	220	-	0.002
MB3	2/11/2007	64	830	0.001	0.0001	-	190	-	0.002
MB3	8/07/2008	66	1030	0.001	0.0001	-	190	-	0.014
MB3	8/09/2008	65	1410	0.001	0.0001	-	170	-	0.003
MB3	1/12/2008	60	900	0.001	0.0001	-	200	-	0.003
MB3	1/03/2009	60	880	0.001	0.0001	-	180	-	0.004
MB3	25/08/2009	61	880	0.001	0.0001	-	170	**0.005**	0.001
MB3	30/09/2009	59	850	0.001	0.0001	-	160	**0.005**	0.003
MB3	23/12/2009	54	870	0.001	0.0001	-	170	-	0.002
MB3	17/02/2010	59	710	0.001	0.0001	-	160	-	0.004

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
MB3	20/05/2010	52	900	0.001	0.0001	-	160	-	0.002
MB3	18/08/2010	58	940	0.001	0.0001	-	170	**0.001**	0.004
MB3	24/11/2010	60	860	0.001	0.0001	-	160	**0.001**	0.001
MB3	9/02/2011	57	930	0.001	0.0001	-	99	**0.001**	0.001
MB3	11/05/2011	59	1000	0.001	0.0001	-	200	-	0.001
MB3	9/08/2011	64	1010	0.001	0.0001	-	180	-	0.002
MB3	10/08/2011	-	-	-	-	-	-	-	-
MB3	10/11/2011	61	1010	0.001	0.0001	-	170	**0.001**	0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
MB3	23/01/2012	-	-	-	-	-	-	-	-
MB3	24/01/2012	75	1040	0.001	0.0001	-	180	**0.001**	0.0018
MB3	16/02/2012	-	-	-	-	-	-	-	-
MB3	24/05/2012	-	-	-	-	-	-	-	-
MB3	14/08/2012	-	-	-	-	-	-	-	-
MB3	29/10/2012	-	-	-	-	-	-	-	-
MB3	16/01/2013	56	860	-	-	-	170	-	0.001
MB3	9/04/2013	-	-	-	-	-	-	-	-
MB3	10/10/2013	26	820	<0.001	<0.0001	-	180	<0.001	0.002
MB3	9/04/2014	60	900	<0.001	<0.0001	-	210	<0.001	0.001
MB3	16/10/2014	49 - 51	880 - 890	<0.001	<0.0001	-	80 - 19	**001 - 0.0**	0.001
MB3	16/04/2015	120	890	<0.001	<0.0001	-	160	<0.001	0.001
MB3	3/09/2015	76	820	<0.001	<0.0001	-	150	<0.001	<0.001
MB3	4/09/2015	-	-	-	-	-	-	-	-
MB3	20/01/2016	-	-	-	-	-	-	-	-
MB3	15/04/2016	-	-	-	-	-	-	-	-
MB3	21/04/2016	65	770	<0.001	<0.0001	-	160	**0.001**	0.003
MB3	15/09/2016	67	623 - 790	<0.001	-	<0.0001	140	**0.001**	0.002
MB3	15/09/2016	-	-	-	-	-	-	-	-
MB4	1/11/1988	33	759	-	-	-	76	-	-
MB4	1/03/1989	45	1015	-	-	-	126	-	-
MB4	1/08/1989	45	1250	-	-	-	120	-	-
MB4	1/11/1989	30	1160	-	-	-	110	-	-
MB4	1/04/1990	35	1090	-	-	-	95	-	-
MB4	1/06/1990	40	1090	-	-	-	105	-	-
MB4	1/10/1990	70	1230	-	-	-	100	-	-
MB4	1/12/1990	40	960	-	-	-	95	-	-
MB4	1/04/1991	90	1200	-	-	-	125	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
MB4	1/08/1991	45	1200	-	-	-	100	-	-
MB4	1/09/1991	60	1200	-	-	-	105	-	-
MB4	1/12/1991	35	1090	-	-	-	95	-	-
MB4	1/04/1992	30	830	-	-	-	85	-	-
MB4	1/07/1992	40	1030	-	-	-	95	-	-
MB4	1/10/1992	40	950	-	-	-	100	-	-
MB4	1/01/1993	65	880	-	-	-	95	-	-
MB4	1/04/1993	45	980	-	-	-	105	-	-
MB4	1/07/1993	50	1020	-	-	-	100	-	-
MB4	1/10/1993	55	980	-	-	-	100	-	-
MB4	1/01/1994	80	920	-	-	-	85.5	-	-
MB4	1/07/1995	50	900	-	-	-	60	-	-
MB4	1/10/1995	30	700	-	-	-	48.5	-	-
MB4	1/01/1996	18	580	-	-	-	42	-	-
MB4	1/07/1996	31	520	-	-	-	48	-	0.05
MB4	1/01/1998	88	1400	-	-	-	120	-	0.05
MB4	1/07/1998	140	1100	-	-	-	97	-	0.01
MB4	1/10/1998	71	1220	-	-	-	140	-	0.01
MB4	1/02/1999	86	960	-	-	-	90	-	0.01
MB4	1/05/1999	110	-	-	-	-	121	-	0.01
MB4	1/08/1999	220	930	-	-	-	130	-	0.01
MB4	1/10/1999	150	1000	-	-	-	140	-	0.01
MB4	1/02/2000	80	860	-	-	-	91	-	0.01
MB4	1/06/2000	280	1100	-	-	-	140	-	0.01
MB4	9/08/2000	270	1200	-	-	-	150	-	0.01
MB4	30/10/2000	230	1100	-	-	-	140	-	0.01
MB4	1/02/2001	190	1000	-	-	-	120	-	0.01
MB4	8/05/2001	190	910	-	-	-	150	-	0.01

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
MB4	26/07/2001	290	930	-	-	-	140	-	0.01
MB4	29/10/2001	230	1200	-	-	-	140	-	0.005
MB4	8/02/2002	160	940	-	-	-	130	-	0.01
MB4	19/04/2002	200	1200	-	-	-	150	-	0.01
MB4	12/08/2002	270	1200	-	-	-	150	-	0.01
MB4	6/11/2002	300	940	-	-	-	134	-	0.005
MB4	13/02/2003	230	1100	-	-	-	141	-	0.005
MB4	30/04/2003	270	1150	-	-	-	150	-	0.005
MB4	9/08/2003	270	1180	-	-	-	160	-	0.005
MB4	24/11/2003	260	1240	-	-	-	160	-	0.005
MB4	10/02/2004	190	1200	-	-	-	150	-	0.005
MB4	13/05/2004	300	1480	-	-	-	170	-	0.005
MB4	6/08/2004	250	1340	**0.01**	**0.002**	-	160	-	0.005
MB4	10/11/2004	370	1260	-	-	-	160	-	0.005
MB4	16/02/2005	280	1240	-	-	-	200	-	0.005
MB4	15/04/2005	330	1200	-	-	-	200	-	0.001
MB4	2/08/2005	250	1160	-	-	-	190	-	0.001
MB4	14/11/2005	310	1200	-	-	-	200	-	0.001
MB4	15/02/2006	380	1330	0.001	**0.0008**	-	250	-	0.0019
MB4	18/05/2006	380	-	-	-	-	-	-	-
MB4	17/08/2006	310	-	-	-	-	-	-	-
MB4	31/10/2006	350	-	0.001	0.0001	-	210	**0.005**	0.001
MB4	8/03/2007	380	-	0.001	0.0001	-	150	**0.005**	0.001
MB4	19/06/2007	270	1390	0.002	0.0001	-	220	-	0.001
MB4	30/08/2007	230	1290	0.002	0.0001	-	180	-	0.001
MB4	2/11/2007	270	1160	0.001	0.0001	-	210	-	0.001
MB4	2/04/2008	260	1150	0.001	0.0001	-	200	-	0.001
MB4	8/07/2008	180	1130	0.002	0.0001	-	190	-	0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
MB4	8/09/2008	210	1090	0.001	0.0001	-	200	-	0.001
MB4	1/12/2008	180	940	0.003	0.0001	-	170	-	0.003
MB4	1/03/2009	200	1100	0.002	0.0001	-	170	-	0.002
MB4	1/07/2009	120	1030	0.001	0.0001	-	170	**0.005**	0.001
MB4	30/09/2009	160	1120	0.001	0.0001	-	170	**0.005**	0.002
MB4	23/12/2009	200	1140	0.002	0.0001	-	180	-	0.001
MB4	17/02/2010	170	970	**0.005**	0.0001	-	160	-	0.002
MB4	13/05/2010	160	1090	**0.007**	0.0001	-	160	-	0.003
MB4	18/08/2010	150	1060	0.002	0.0001	-	160	**0.001**	0.001
MB4	24/11/2010	140	1010	0.001	0.0001	-	140	**0.001**	0.001
MB4	9/02/2011	42	1020	0.001	0.0001	-	170	**0.001**	0.001
MB4	11/05/2011	150	1050	0.001	0.0001	-	170	-	0.001
MB4	10/11/2011	150	1130	0.001	0.0001	-	140	**0.001**	0.001
MB4	23/01/2012	-	-	-	-	-	-	-	-
MB4	24/01/2012	116	1160	**0.4**	**0.0013**	-	220	**0.001**	0.019
MB4	24/05/2012	130	910	**0.071**	0.00019	-	160	**0.001**	0.0044
MB4	14/08/2012	92	920	**0.036**	0.0001	-	150	**0.001**	0.0023
MB4	26/10/2012	94	850	**0.077**	**0.00039**	-	180	**0.001**	0.001
MB4	29/10/2012	-	-	-	-	-	-	-	-
MB4	16/01/2013	110	910	0.0031	-	-	160	-	0.001
MB4	10/10/2013	450	5220	**0.41**	**0.001**	-	150	<0.001	0.013
MB4	9/04/2014	110	930	**0.72**	**0.002**	-	300	<0.001	0.026
MB4	22/05/2014	370	4680	0.001	0.0001	-	260	**0.001**	0.006
MB4	16/10/2014	210	1300	<0.001	<0.0001	-	180	<0.001	<0.001
MB4	16/04/2015	220	1310	<0.001	<0.0001	-	190	<0.001	0.002
MB4	3/09/2015	260	1480	<0.001	<0.0001	-	160	<0.001	<0.001
MB4	4/09/2015	-	-	-	-	-	-	-	-
MB4	15/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
MB4	21/04/2016	120	910	**0.18**	**0.001**	-	170	<0.001	0.011
MB4	15/09/2016	110	920 - 2690	**0.11**	-	<0.0001	150	<0.001	0.000
MB4	22/04/2016	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
<u>ANZECC 2000 FW 90%</u>				<u>0.0056</u>	<u>0.0004</u>	<u>0.0004</u>		<u>0.006</u>	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
YB	15/04/2005	18	450	-	-	-	45	-	0.001
YB	1/08/2005	-	-	-	-	-	0	-	-
YB	2/08/2005	7	500	-	-	-	50	-	0.001
YB	14/11/2005	12	470	-	-	-	40	-	0.001
YB	11/01/2006	0	0	-	-	-	0	-	0
YB	15/02/2006	14	540	0.001	0.0001	-	40	-	0.001
YB	11/03/2006	15	0	-	-	-	0	-	0
YB	13/04/2006	14	0	-	-	-	0	-	0
YB	10/05/2006	15	0	-	-	-	0	-	0
YB	16/06/2006	12	0	0	0	-	0	-	0
YB	13/07/2006	12	0	0	0	-	0	-	0
YB	9/08/2006	12	0	0	0	-	0	-	0
YB	13/09/2006	14	0	0	0	-	0	-	0
YB	13/10/2006	19	0	0	0	-	0	-	0
YB	13/11/2006	16	0	0.001	0.0001	-	34	**<u>0.02</u>**	0.001
YB	13/12/2006	14	0	0.001	0.0001	-	33	**0.005**	0.001
YB	23/01/2007	16	0	0	0	-	0	0	0
YB	16/02/2007	16	0	0	0	-	0	0	0
YB	15/03/2007	15	-	-	-	-	-	-	-
YB	11/04/2007	15	0	0	0	-	0	0	0
YB	16/05/2007	14	-	-	-	-	-	-	-
YB	19/06/2007	21	480	0.001	**0.0017**	-	37	0	0.001
YB	13/07/2007	14	0	0	0	-	0	0	0
YB	15/08/2007	15	0	0	0	-	0	0	0
YB	17/09/2007	18	0	0	0	-	0	0	0
YB	16/10/2007	18	0	0	0	-	0	0	0
YB	19/11/2007	-	-	-	-	-	-	-	-
YB	13/12/2007	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
YB	1/03/2008	15	450	0.001	0.0001	-	35	-	0.001
YB	21/04/2008	-	-	-	-	-	-	-	-
YB	8/05/2008	-	-	-	-	-	-	-	-
YB	8/06/2008	-	-	-	-	-	-	-	-
YB	8/07/2008	-	-	-	-	-	-	-	-
YB	8/08/2008	15	480	0.001	0.0001	-	35	-	0.001
YB	8/09/2008	-	-	-	-	-	-	-	-
YB	8/10/2008	17	420	0.001	0.0001	-	36	-	0.001
YB	8/11/2008	-	-	-	-	-	-	-	-
YB	8/12/2008	20	430	0.001	0.0001	-	35	-	0.001
YB	9/01/2009	-	-	-	-	-	-	-	-
YB	1/02/2009	21	-	-	-	-	-	-	-
YB	1/03/2009	15	470	0.001	0.0001	-	34	-	0.001
YB	1/04/2009	16	-	-	-	-	-	-	-
YB	1/05/2009	16	-	-	-	-	-	-	-
YB	1/06/2009	16	-	-	-	-	-	-	-
YB	1/07/2009	17	780	0.001	0.0001	-	37	**0.005**	0.001
YB	1/08/2009	20	-	-	-	-	-	-	-
YB	1/09/2009	16	460	0.001	0.0001	-	34	**0.005**	0.001
YB	1/10/2009	24	-	-	-	-	-	-	-
YB	1/11/2009	19	-	-	-	-	-	-	-
YB	1/12/2009	13	460	0.001	0.0001	-	34	-	0.001
YB	1/01/2010	-	-	-	-	-	-	-	-
YB	8/01/2010	-	-	-	-	-	-	-	-
YB	1/02/2010	16	400	0.001	0.0001	-	38	-	0.001
YB	1/03/2010	17	460	0.001	0.0001	-	-	-	0.001
YB	1/04/2010	17	510	-	-	-	35	-	0.001
YB	20/05/2010	18	490	0.001	0.0001	-	35	-	0.001

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
YB	21/06/2010	22	-	0.001	0.0001	-	35	-	0.001
YB	22/07/2010	17	-	-	-	-	-	-	-
YB	17/08/2010	-	-	-	-	-	-	-	-
YB	20/08/2010	-	-	-	-	-	-	-	-
YB	17/09/2010	-	-	-	-	-	-	-	-
YB	26/10/2010	-	-	-	-	-	-	-	-
YB	22/11/2010	-	-	-	-	-	-	-	-
YB	15/12/2010	-	-	-	-	-	-	-	-
YB	5/01/2011	-	-	-	-	-	-	-	-
YB	9/02/2011	17	570	0.001	0.0001	-	34	**0.001**	0.001
YB	22/03/2011	-	-	-	-	-	-	-	-
YB	14/04/2011	-	-	-	-	-	-	-	-
YB	11/05/2011	-	-	-	-	-	-	-	-
YB	21/06/2011	-	-	-	-	-	-	-	-
YB	26/07/2011	-	-	-	-	-	-	-	-
YB	9/08/2011	-	-	-	-	-	-	-	-
YB	10/08/2011	-	-	-	-	-	-	-	-
YB	13/09/2011	-	-	-	-	-	-	-	-
YB	14/09/2011	-	-	-	-	-	-	-	-
YB	6/10/2011	-	-	-	-	-	-	-	-
YB	31/10/2011	-	-	-	-	-	-	-	-
YB	1/11/2011	-	-	-	-	-	-	-	-
YB	10/11/2011	-	-	-	-	-	-	-	-
YB	11/11/2011	-	-	-	-	-	-	-	-
YB	15/12/2011	-	-	-	-	-	-	-	-
YB	17/01/2012	-	-	-	-	-	-	-	-
YB	23/01/2012	-	-	-	-	-	-	-	-
YB	16/02/2012	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	TDS (evap)	Lead Total	Cadmium	Cadmium (Filtered)	Calcium	Chromium (hexavalent)	Chromium Total
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
YB	15/03/2012	-	-	-	-	-	-	-	-
YB	20/04/2012	-	-	-	-	-	-	-	-
YB	24/05/2012	19	520	-	-	-	50	-	0.001
YB	26/06/2012	-	-	-	-	-	-	-	-
YB	17/07/2012	-	-	-	-	-	-	-	-
YB	14/08/2012	19	500	-	-	-	35	-	-
YB	24/09/2012	-	-	-	-	-	-	-	-
YB	26/10/2012	16	510	-	-	-	35	-	0.0017
YB	13/11/2012	-	-	-	-	-	-	-	-
YB	11/12/2012	-	-	-	-	-	-	-	-
YB	8/01/2013	-	-	-	-	-	-	-	-
YB	16/01/2013	23	570	0.001	0.0001	-	41	**0.001**	0.001
YB	16/02/2013	-	-	-	-	-	-	-	-
YB	20/03/2013	-	-	-	-	-	-	-	-
YB	9/04/2013	12	610	0.001	0.0001	-	42	**0.001**	0.001
YB	6/05/2013	-	-	-	-	-	-	-	-
YB	11/07/2013	15	480	0.001	0.0001	-	33	**0.001**	0.001
YB	10/10/2013	22	450	<0.001	<0.0001	-	33	<0.001	0.003
YB	29/01/2014	-	-	-	-	-	-	-	-
YB	9/04/2014	17	500	**0.005**	<0.0001	-	53	**0.002**	0.005
YB	16/07/2014	-	-	-	-	-	-	-	-
YB	16/10/2014	16	820	<0.001	<0.0001	-	38	<0.001	<0.001
YB	22/01/2015	-	-	-	-	-	-	-	-
YB	23/01/2015	-	480	-	-	-	-	-	-
YB	16/04/2015	22	600	<0.001	<0.0001	-	40	<0.001	<0.001
YB	9/07/2015	-	-	-	-	-	-	-	-
YB	3/09/2015	19	480	<0.001	<0.0001	-	37	<0.001	<0.001
YB	4/09/2015	-	-	-	-	-	-	-	-

				Lead					
		Sulphate	**TDS (evap)**	**Lead Total**	**Cadmium**	**Cadmium (Filtered)**	**Calcium**	**Chromium (hexavalent)**	**Chromium Total**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		5	10	0.001	0.0001	0.0001	0.01	0.001	0.001
ANZECC 2000 FW 90%				0.0056	0.0004	0.0004		0.006	
ANZECC 2000 FW 95%				**0.0034**	**0.0002**	**0.0002**		**0.001**	
ANZECC 2000 MW 90%				0.0066	0.014	0.014		0.02	
ANZECC 2000 MW 95%				0.0044	0.0055	0.0055		0.0044	
Field_ID	**Sampled_Date-Ti**								
YB	20/01/2016	-	-	-	-	-	-	-	-
YB	15/04/2016	-	-	-	-	-	-	-	-
YB	21/04/2016	16	480	0.002	<0.0001	-	41	-	0.007
YB	7/07/2016	-	427	-	-	-	-	-	-
YB	15/09/2016	19	433 - 510	0.001	-	<0.0001	38	-	0.002
YB	15/09/2016	-	-	-	-	-	-	-	-
YB	21/01/2016	-	-	-	-	-	-	-	-
YB	22/04/2016	-	-	-	-	-	-	-	-
YB	8/07/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM1A	1/03/1989	-	-	-	-	-	26.1	-	-
DM1A	1/11/1989	-	-	-	-	0.05	28.5	-	-
DM1A	1/06/1990	-	-	-	-	0.05	23.5	0.05	-
DM1A	1/10/1990	-	-	-	-	0.05	29	0.05	-
DM1A	1/06/1991	-	-	-	-	1.7	30	0.15	-
DM1A	1/09/1991	-	-	-	-	0.05	25.5	0.2	-
DM1A	1/07/1992	-	-	-	-	0.05	25.5	0.05	-
DM1A	1/10/1992	-	-	-	-	0.05	25.5	0.2	-
DM1A	1/01/1993	-	-	-	-	0.05	30.5	0.05	-
DM1A	1/07/1993	-	-	-	-	0.2	31	0.1	-
DM1A	1/10/1993	-	-	-	-	0.05	28	0.05	-
DM1A	1/01/1994	-	-	-	-	0.05	29.5	0.05	-
DM1A	1/07/1994	-	-	-	-	0.05	30.5	0.05	-
DM1A	1/10/1994	-	-	-	-	1.5	30	0.05	-
DM1A	1/01/1995	-	-	-	-	0.6	28	0.1	-
DM1A	1/07/1995	-	-	-	-	0.4	32.5	0.05	-
DM1A	1/10/1995	-	-	-	-	0.05	14	0.05	-
DM1A	1/01/1996	-	-	-	-	0.1	31	0.05	-
DM1A	10/07/1996	-	-	-	-	0.05	29	0.05	-
DM1A	22/10/1996	-	-	-	-	0.3	27	0.05	-
DM1A	15/01/1997	-	-	-	-	0.05	30	0.05	-
DM1A	10/04/1997	-	-	-	-	0.05	31	0.2	-
DM1A	3/07/1997	-	-	-	-	0.05	26	0.05	-
DM1A	8/10/1997	-	-	-	-	0.15	25	0.1	-
DM1A	1/07/1998	-	-	-	-	0.4	24	0.05	-
DM1A	1/10/1998	-	-	-	-	0.03	21	0.05	-

Field_ID	Sampled_Date-Ti	Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
DM1A	1/02/1999	-	-	-	-	0.03	22	0.05	-
DM1A	1/05/1999	-	-	-	-	0.01	20	0.01	-
DM1A	1/10/1999	-	-	-	-	0.01	24	0.18	-
DM1A	1/02/2000	-	-	-	-	3.4	26	0.16	-
DM1A	1/06/2000	-	-	-	-	0.31	24	0.16	-
DM1A	9/08/2000	-	-	-	-	-	27	0.01	-
DM1A	30/10/2000	-	-	-	-	-	23	0.01	-
DM1A	1/02/2001	-	-	-	-	0.41	20	0.02	-
DM1A	8/05/2001	-	-	-	-	0.21	20	0.01	-
DM1A	26/07/2001	-	-	-	-	0.07	23	0.01	-
DM1A	29/10/2001	-	-	-	-	0.1	22	0.0072	-
DM1A	18/02/2002	-	-	-	-	0.1	24	0.0072	-
DM1A	15/04/2002	-	-	-	-	0.1	22	0.006	-
DM1A	12/08/2002	-	-	-	-	0.1	21	0.011	-
DM1A	6/11/2002	-	-	-	-	0.1	24	0.019	-
DM1A	13/02/2003	-	-	-	-	0.1	24	0.028	-
DM1A	30/04/2003	-	-	-	-	0.1	24	0.026	-
DM1A	9/08/2003	-	-	-	-	0.1	25	0.033	-
DM1A	24/11/2003	-	-	-	-	0.1	29	0.014	-
DM1A	10/02/2004	-	-	-	-	0.1	25	0.009	-
DM1A	13/05/2004	-	-	-	-	0.1	25	0.007	-
DM1A	6/08/2004	-	-	-	**0.005**	0.1	26	0.006	0.0001
DM1A	10/11/2004	-	-	-	-	0.009	17	0.006	-
DM1A	16/02/2005	-	-	-	-	0.008	14	0.008	-
DM1A	15/04/2005	-	-	-	-	5.6	25	0.16	-
DM1A	2/08/2005	-	-	-	-	0.66	33	0.13	-
DM1A	14/11/2005	-	-	-	-	5.3	29	0.14	-
DM1A	15/02/2006	-	-	-	**0.02**	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM1A	18/05/2006	-	-	-	-	-	-	-	-
DM1A	17/08/2006	-	-	-	-	-	-	-	-
DM1A	31/10/2006	-	-	0.001	0.001	6.7	32	-	0.0001
DM1A	8/03/2007	-	-	0.001	0.001	7	35	-	0.0001
DM1A	19/06/2007	-	-	0.001	0.001	7.7	42	0.18	0.0001
DM1A	30/08/2007	-	-	0.001	0.001	9.3	45	0.23	0.0001
DM1A	2/11/2007	-	-	0.001	0.001	8.5	43	0.24	0.0001
DM1A	2/04/2008	-	-	0.001	0.001	10	43	0.26	0.0001
DM1A	8/07/2008	-	-	0.001	0.001	9.9	45	0.29	0.0001
DM1A	8/09/2008	-	-	0.001	0.001	9.8	45	0.26	0.0001
DM1A	1/03/2009	-	-	0.001	0.001	10	44	0.34	0.0001
DM1A	1/07/2009	-	-	0.001	0.001	11	47	0.26	0.0001
DM1A	30/09/2009	-	-	0.001	0.001	8.7	48	0.22	0.0001
DM1A	18/12/2009	-	-	0.001	0.001	9.6	48	0.27	0.0001
DM1A	16/02/2010	-	-	0.001	0.001	9.1	56	0.21	0.0001
DM1A	6/05/2010	-	-	0.001	0.001	9.5	42	0.27	0.0001
DM1A	18/08/2010	-	-	0.001	0.001	4.1	42	0.26	0.0001
DM1A	26/11/2010	-	-	0.001	0.001	8.8	45	0.3	0.0001
DM1A	9/02/2011	-	-	0.001	0.001	9.5	42	0.28	0.0001
DM1A	11/05/2011	-	-	0.001	0.001	9.5	45	0.27	0.0001
DM1A	9/08/2011	-	-	0.001	0.001	8.8	44	0.29	0.0001
DM1A	10/08/2011	-	-	-	-	-	-	-	-
DM1A	10/11/2011	-	-	0.001	0.001	8.5	37	0.26	0.0001
DM1A	23/01/2012	-	-	0.001	0.0011	8.3	39	0.26	0.0001
DM1A	24/05/2012	-	-	0.001	**0.008**	2.1	39	0.17	0.0001
DM1A	14/08/2012	-	-	0.001	**0.0092**	8.9	26	0.52	0.0001
DM1A	26/10/2012	-	-	0.001	**0.007**	9.8	29	0.41	0.0001
DM1A	16/01/2013	-	-	0.001	**0.0025**	8.2	34	0.4	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM1A	9/04/2013	-	-	0.001	0.001	7.7	34	0.23	0.0001
DM1A	10/10/2013	-	-	<0.001	**0.019**	4.2	33	0.21	<0.0001
DM1A	9/04/2014	0.001	-	<0.001	**0.007**	5.6	36	0.24	<0.0001
DM1A	16/10/2014	<0.001	<0.001	0.002	**0.007**	7.5	36	0.33	<0.0001
DM1A	16/04/2015	-	0.003	<0.001	**0.002**	7	32	0.25	<0.0001
DM1A	3/09/2015	-	0.011	<0.001	**0.003**	2.3	49	0.19	<0.0001
DM1A	4/09/2015	-	-	-	-	-	-	-	-
DM1A	15/04/2016	-	-	-	-	-	-	-	-
DM1A	21/04/2016	-	<0.001	<0.001	**0.007**	3	33	0.24	<0.0001
DM1A	15/09/2016	-	<0.001	<0.001	**0.004**	1.1	31	0.23	<0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM1C	1/03/1989	-	-	-	-	-	30.4	-	-
DM1C	1/11/1989	-	-	-	-	0.05	26	-	-
DM1C	1/06/1990	-	-	-	-	0.05	29	0.05	-
DM1C	1/10/1990	-	-	-	-	0.05	28	0.05	-
DM1C	1/06/1991	-	-	-	-	0.15	32.5	0.1	-
DM1C	1/09/1991	-	-	-	-	0.05	25.5	0.1	-
DM1C	1/12/1991	-	-	-	-	-	-	-	-
DM1C	1/07/1992	-	-	-	-	0.05	26.5	0.05	-
DM1C	1/10/1992	-	-	-	-	0.05	25	0.1	-
DM1C	1/01/1993	-	-	-	-	0.9	28	0.05	-
DM1C	1/07/1993	-	-	-	-	4.65	29	0.1	-
DM1C	1/10/1993	-	-	-	-	6.5	26.5	0.25	-
DM1C	1/01/1994	-	-	-	-	5.15	25	0.15	-
DM1C	1/07/1994	-	-	-	-	4.9	28	0.1	-
DM1C	1/10/1994	-	-	-	-	5.35	28	0.2	-
DM1C	1/01/1995	-	-	-	-	10	24.5	0.15	-
DM1C	1/07/1995	-	-	-	-	6.35	31	0.1	-
DM1C	1/10/1995	-	-	-	-	4.35	28.5	0.1	-
DM1C	1/01/1996	-	-	-	-	6.1	36	0.15	-
DM1C	1/07/1996	-	-	-	-	0.05	26	0.2	-
DM1C	22/10/1996	-	-	-	-	5.8	27	0.1	-
DM1C	15/01/1997	-	-	-	-	0.25	28	0.15	-
DM1C	10/04/1997	-	-	-	-	3.4	26	0.15	-
DM1C	3/07/1997	-	-	-	-	4.7	17	0.2	-
DM1C	8/10/1997	-	-	-	-	6.8	28	0.15	-
DM1C	7/01/1998	-	-	-	-	4.5	27	0.15	-
DM1C	1/07/1998	-	-	-	-	6.5	26	0.17	-
DM1C	1/10/1998	-	-	-	-	5.1	24	0.18	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM1C	1/02/1999	-	-	-	-	5.1	27	0.16	-
DM1C	1/05/1999	-	-	-	-	3.9	23	0.17	-
DM1C	1/10/1999	-	-	-	-	0.01	24	0.01	-
DM1C	1/02/2000	-	-	-	-	0.03	24	0.01	-
DM1C	1/06/2000	-	-	-	-	0.18	21	0.02	-
DM1C	9/08/2000	-	-	-	-	4	26	0.11	-
DM1C	30/10/2000	-	-	-	-	-	24	0.09	-
DM1C	1/02/2001	-	-	-	-	5.2	24	0.14	-
DM1C	8/05/2001	-	-	-	-	4.8	23	0.13	-
DM1C	26/07/2001	-	-	-	-	4.7	25	0.13	-
DM1C	29/10/2001	-	-	-	-	4.2	24	0.17	-
DM1C	8/02/2002	-	-	-	-	4.7	26	0.16	-
DM1C	15/04/2002	-	-	-	-	2.7	26	-	-
DM1C	6/11/2002	-	-	-	-	0.1	25	0.17	-
DM1C	13/02/2003	-	-	-	-	4.7	25	0.16	-
DM1C	30/04/2003	-	-	-	-	0.1	26	0.14	-
DM1C	9/08/2003	-	-	-	-	0.1	26	0.14	-
DM1C	24/11/2003	-	-	-	-	5.2	24	0.14	-
DM1C	10/02/2004	-	-	-	-	5.4	25	0.15	-
DM1C	14/05/2004	-	-	-	-	0.1	25	0.12	-
DM1C	6/08/2004	-	-	-	**0.005**	4.8	25	0.14	0.0001
DM1C	10/11/2004	-	-	-	-	0.007	26	0.17	-
DM1C	16/02/2005	-	-	-	-	0.27	26	0.15	-
DM1C	15/04/2005	-	-	-	-	0.68	27	0.056	-
DM1C	2/08/2005	-	-	-	-	0.058	12	0.007	-
DM1C	14/11/2005	-	-	-	-	0.077	14	0.009	-
DM1C	15/02/2006	-	-	-	**0.0089**	-	-	-	-
DM1C	18/05/2006	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM1C	17/08/2006	-	-	-	-	-	-	-	-
DM1C	31/10/2006	-	-	0.001	0.001	0.18	14	-	0.0001
DM1C	8/03/2007	-	-	0.001	0.001	0.13	15	-	0.0001
DM1C	19/06/2007	-	-	0.001	0.001	0.37	17	0.025	0.0001
DM1C	30/08/2007	-	-	0.001	0.001	0.2	21	0.021	0.0001
DM1C	2/11/2007	-	-	0.001	0.001	0.15	20	0.016	0.0001
DM1C	2/04/2008	-	-	0.001	**0.01**	1.2	20	0.1	0.0001
DM1C	8/07/2008	-	-	0.001	0.001	1.4	21	0.14	0.0001
DM1C	8/09/2008	-	-	0.001	0.001	1.3	19	0.089	0.0001
DM1C	1/03/2009	-	-	0.001	0.001	0.28	20	0.028	0.0001
DM1C	1/07/2009	-	-	0.001	0.001	0.42	25	0.037	0.0001
DM1C	30/09/2009	-	-	0.001	0.001	0.24	23	0.038	0.0001
DM1C	23/12/2009	-	-	0.001	0.001	0.39	22	0.046	0.0001
DM1C	16/02/2010	-	-	0.001	0.001	0.19	26	0.032	0.0001
DM1C	21/05/2010	-	-	0.001	0.001	0.11	22	0.028	0.0001
DM1C	18/08/2010	-	-	0.001	0.001	0.33	22	0.048	0.0001
DM1C	25/11/2010	-	-	0.001	0.001	0.13	23	0.023	0.0001
DM1C	9/02/2011	-	-	0.001	0.001	0.12	22	0.01	0.0001
DM1C	11/05/2011	-	-	0.001	0.001	0.62	26	0.043	0.0001
DM1C	9/08/2011	-	-	0.001	0.001	0.32	30	0.06	0.0001
DM1C	10/08/2011	-	-	-	-	-	-	-	-
DM1C	10/11/2011	-	-	0.001	0.001	0.27	25	0.031	0.0001
DM1C	23/01/2012	-	-	0.0013	**0.0018**	8.7	29	0.79	0.0001
DM1C	24/05/2012	-	-	0.001	0.001	2.1	29	0.21	0.0001
DM1C	14/08/2012	-	-	0.0015	**0.003**	8.1	27	0.7	0.0001
DM1C	26/10/2012	-	-	0.001	0.001	1.3	29	0.089	0.0001
DM1C	16/01/2013	-	-	0.001	0.001	2	33	0.17	0.0001
DM1C	9/04/2013	-	-	0.002	**0.003**	13	31	0.68	0.0001

		Chromium (Trivalent)	**Chromium (Trivalent) (Filtered)**	**Cobalt**	**Copper Total**	**Iron**	**Magnesium**	**Manganese**	**Mercury**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM1C	10/10/2013	-	-	0.001	**0.022**	14	33	0.88	0.0001
DM1C	9/04/2014	0.029	-	0.001	**0.002**	9.1	43	0.6	<0.0001
DM1C	16/10/2014	<0.001	<0.001	<0.001	<0.001	0.27	42	0.11	<0.0001
DM1C	16/04/2015	-	0.15	0.003	**0.007**	31	45	1.5	<0.0001
DM1C	3/09/2015	-	0.002	<0.001	**0.006**	4	33	0.28	<0.0001
DM1C	4/09/2015	-	-	-	-	-	-	-	-
DM1C	15/04/2016	-	-	-	-	-	-	-	-
DM1C	21/04/2016	-	<0.001	0.005	**0.005**	32	53	**2.4**	<0.0001
DM1C	15/09/2016	-	0.013	0.001	**0.003**	4.4	52	0.38	<0.0001
DM1C	22/04/2016	-	-	-	-	-	-	-	-
DM1C	15/09/2016	-	-	-	-	-	-	-	-
DM1C	22/04/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM2A	1/08/1989	-	-	-	-	0.05	28	-	-
DM2A	1/11/1989	-	-	-	-	0.05	25	-	-
DM2A	1/06/1990	-	-	-	-	0.05	38	0.05	-
DM2A	1/10/1990	-	-	-	-	0.05	120	0.05	-
DM2A	1/12/1990	-	-	-	-	0.05	130	-	-
DM2A	1/01/1991	-	-	-	-	1	120	-	-
DM2A	1/04/1991	-	-	-	-	0.05	75	0.05	-
DM2A	1/06/1991	-	-	-	-	0.05	135	0.05	-
DM2A	1/09/1991	-	-	-	-	0.05	105	0.05	-
DM2A	1/12/1991	-	-	-	-	0.05	95	0.05	-
DM2A	1/04/1992	-	-	-	-	0.05	125	0.05	-
DM2A	1/07/1992	-	-	-	-	0.05	65	0.05	-
DM2A	1/10/1992	-	-	-	-	0.05	100	0.05	-
DM2A	1/01/1993	-	-	-	-	0.85	140	0.25	-
DM2A	1/04/1993	-	-	-	-	0.75	150	0.05	-
DM2A	1/07/1993	-	-	-	-	1.1	150	0.05	-
DM2A	1/10/1993	-	-	-	-	1.1	125	0.1	-
DM2A	1/01/1994	-	-	-	-	1.3	150	0.05	-
DM2A	1/07/1994	-	-	-	-	0.6	140	0.05	-
DM2A	1/10/1994	-	-	-	-	1.75	80	0.05	-
DM2A	1/01/1995	-	-	-	-	0.35	80	0.05	-
DM2A	1/04/1995	-	-	-	-	1.4	65	0.05	-
DM2A	1/07/1995	-	-	-	-	2	75	0.1	-
DM2A	1/10/1995	-	-	-	-	5.55	120	0.15	-
DM2A	1/01/1996	-	-	-	-	4	190	0.3	-
DM2A	1/07/1996	-	-	-	-	5.7	250	0.3	-
DM2A	1/10/1996	-	-	-	-	3.6	280	0.1	-
DM2A	1/01/1997	-	-	-	-	0.4	130	0.05	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM2A	1/04/1997	-	-	-	-	0.2	41	0.05	-
DM2A	1/07/1997	-	-	-	-	0.3	33	0.05	-
DM2A	1/10/1997	-	-	-	-	0.7	40	0.05	-
DM2A	1/01/1998	-	-	-	-	0.2	29	0.05	-
DM2A	1/07/1998	-	-	-	-	0.3	35	0.05	-
DM2A	1/10/1998	-	-	-	-	1.1	48	0.05	-
DM2A	1/02/1999	-	-	-	-	0.8	42	0.05	-
DM2A	1/05/1999	-	-	-	-	1.8	72	0.08	-
DM2A	1/08/1999	-	-	-	-	1.6	81	0.05	-
DM2A	1/10/1999	-	-	-	-	0.06	78	0.06	-
DM2A	1/02/2000	-	-	-	-	0.64	70	0.04	-
DM2A	1/06/2000	-	-	-	-	0.21	62	0.05	-
DM2A	9/08/2000	-	-	-	-	2	100	0.05	-
DM2A	30/10/2000	-	-	-	-	-	68	0.03	-
DM2A	1/02/2001	-	-	-	-	1.4	94	0.05	-
DM2A	8/05/2001	-	-	-	-	1.2	62	0.03	-
DM2A	26/07/2001	-	-	-	-	1.4	71	0.03	-
DM2A	29/10/2001	-	-	-	-	0.4	43	0.005	-
DM2A	8/02/2002	-	-	-	-	0.9	80	0.038	-
DM2A	15/04/2002	-	-	-	-	0.4	50	0.031	-
DM2A	12/08/2002	-	-	-	-	0.5	39	0.022	-
DM2A	6/11/2002	-	-	-	-	0.1	35	0.0017	-
DM2A	13/02/2003	-	-	-	-	1.6	86	0.026	-
DM2A	30/04/2003	-	-	-	-	0.1	80	0.031	-
DM2A	9/08/2003	-	-	-	-	0.1	110	0.034	-
DM2A	24/11/2003	-	-	-	-	1.5	96	0.065	-
DM2A	10/02/2004	-	-	-	-	1.8	98	0.044	-
DM2A	14/05/2004	-	-	-	-	-	150	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM2A	6/08/2004	-	-	-	**0.005**	1.6	170	0.087	0.0001
DM2A	10/11/2004	-	-	-	-	1.3	170	0.11	-
DM2A	16/02/2005	-	-	-	-	1.6	260	0.16	-
DM2A	15/04/2005	-	-	-	-	4	340	0.21	-
DM2A	2/08/2005	-	-	-	-	2.2	530	0.34	-
DM2A	14/11/2005	-	-	-	-	3.5	500	0.33	-
DM2A	15/02/2006	-	-	-	**0.14**	1.1	385	0.14	-
DM2A	18/05/2006	-	-	-	-	-	-	-	-
DM2A	17/08/2006	-	-	-	-	-	-	-	-
DM2A	31/10/2006	-	-	0.001	0.001	2.1	380	-	0.0001
DM2A	8/03/2007	-	-	0.002	0.001	1.8	390	-	0.0001
DM2A	19/06/2007	-	-	0.002	0.001	1.8	400	0.14	0.0001
DM2A	30/08/2007	-	-	0.002	0.001	2.5	520	0.2	0.0001
DM2A	2/11/2007	-	-	0.001	0.001	1.5	490	0.15	0.0001
DM2A	2/04/2008	-	-	0.001	**0.002**	1.9	410	0.14	0.0001
DM2A	8/07/2008	-	-	0.001	0.001	1.8	460	0.15	0.0001
DM2A	8/09/2008	-	-	0.001	0.001	1.8	560	0.11	0.0001
DM2A	1/12/2008	-	-	0.001	0.001	1.4	450	0.093	0.0001
DM2A	1/03/2009	-	-	0.003	0.001	0.87	370	0.046	0.0001
DM2A	1/07/2009	-	-	0.002	0.001	1.4	430	0.055	0.0001
DM2A	30/09/2009	-	-	0.002	0.001	1.2	520	0.059	0.0001
DM2A	23/12/2009	-	-	0.002	**0.002**	1.6	620	0.041	0.0001
DM2A	16/02/2010	-	-	0.001	0.001	0.13	210	0.007	0.0001
DM2A	20/05/2010	-	-	0.001	**0.002**	0.02	310	0.002	0.0001
DM2A	18/08/2010	-	-	0.001	0.001	1.1	590	0.033	0.0001
DM2A	25/11/2010	-	-	0.001	0.001	1.1	560	0.033	0.0001
DM2A	9/02/2011	-	-	0.001	0.001	0.91	520	0.031	0.0001
DM2A	11/05/2011	-	-	0.001	0.001	1.2	530	0.003	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM2A	9/08/2011	-	-	0.001	0.001	1.2	570	0.026	0.0001
DM2A	10/08/2011	-	-	-	-	-	-	-	-
DM2A	10/11/2011	-	-	0.001	0.001	1	570	0.029	0.0001
DM2A	23/01/2012	-	-	0.0014	0.001	0.42	570	0.044	0.0001
DM2A	24/05/2012	-	-	0.001	**0.0083**	0.14	360	0.016	0.0001
DM2A	14/08/2012	-	-	0.001	**0.0034**	0.16	410	0.0097	0.0001
DM2A	26/10/2012	-	-	0.001	**0.0024**	2.1	740	0.045	0.0001
DM2A	16/01/2013	-	-	0.001	**0.0026**	1.8	740	0.036	0.0001
DM2A	9/04/2013	-	-	0.002	0.001	0.33	520	0.041	0.0001
DM2A	10/10/2013	-	-	0.001	**0.002**	0.61	360	0.19	<0.0001
DM2A	9/04/2014	0.4	-	0.014	**0.014**	24	750	**4.9**	<0.0001
DM2A	16/10/2014	0.28	0.28	0.001	**0.002**	0.67	670	0.08	<0.0001
DM2A	16/04/2015	-	0.02	<0.001	0.001	0.57	470	0.071	<0.0001
DM2A	3/09/2015	-	0.026	0.002	**0.003**	1.5	420	0.31	<0.0001
DM2A	4/09/2015	-	-	-	-	-	-	-	-
DM2A	15/04/2016	-	-	-	-	-	-	-	-
DM2A	21/04/2016	-	<0.001	0.005	**0.015**	8	460	1.7	<0.0001
DM2A	15/09/2016	-	0.4	0.002	**0.004**	1.7	350	0.63	<0.0001

Field_ID	Sampled_Date-Ti	Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
DM2C	1/03/1989	-	-	-	-	-	28.6	-	-
DM2C	1/08/1989	-	-	-	-	0.05	20	-	-
DM2C	1/11/1989	-	-	-	-	0.05	80	-	-
DM2C	1/06/1990	-	-	-	-	0.05	36.5	0.05	-
DM2C	1/10/1990	-	-	-	-	0.05	52	0.05	-
DM2C	1/12/1990	-	-	-	-	0.05	70	-	-
DM2C	1/01/1991	-	-	-	-	-	-	0.05	-
DM2C	1/04/1991	-	-	-	-	0.05	29.5	0.05	-
DM2C	1/06/1991	-	-	-	-	0.05	87	0.05	-
DM2C	1/09/1991	-	-	-	-	0.05	60	0.05	-
DM2C	1/12/1991	-	-	-	-	0.05	80	0.05	-
DM2C	1/04/1992	-	-	-	-	0.05	60	0.05	-
DM2C	1/07/1992	-	-	-	-	0.05	170	0.05	-
DM2C	1/10/1992	-	-	-	-	0.05	130	0.05	-
DM2C	1/01/1993	-	-	-	-	0.05	225	0.05	-
DM2C	1/04/1993	-	-	-	-	0.05	195	0.05	-
DM2C	1/07/1993	-	-	-	-	0.2	125	0.05	-
DM2C	1/10/1993	-	-	-	-	0.05	90	0.05	-
DM2C	1/01/1994	-	-	-	-	0.05	110	0.05	-
DM2C	1/04/1994	-	-	-	-	0.05	70	0.05	-
DM2C	1/07/1994	-	-	-	-	0.05	97	0.05	-
DM2C	1/10/1994	-	-	-	-	0.1	85	0.05	-
DM2C	1/01/1995	-	-	-	-	0.4	60	0.05	-
DM2C	1/04/1995	-	-	-	-	0.15	75	0.05	-
DM2C	1/07/1995	-	-	-	-	0.1	110	0.05	-
DM2C	1/10/1995	-	-	-	-	0.1	95	0.05	-
DM2C	1/01/1996	-	-	-	-	0.25	130	0.05	-
DM2C	1/07/1996	-	-	-	-	-	150	0.05	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM2C	1/10/1996	-	-	-	-	0.2	100	0.05	-
DM2C	1/01/1997	-	-	-	-	0.05	22	0.05	-
DM2C	1/04/1997	-	-	-	-	0.05	31	0.05	-
DM2C	1/07/1997	-	-	-	-	0.05	27	0.05	-
DM2C	1/10/1997	-	-	-	-	0.6	42	0.05	-
DM2C	1/01/1998	-	-	-	-	0.05	25	0.05	-
DM2C	1/07/1998	-	-	-	-	0.1	28	0.05	-
DM2C	1/10/1998	-	-	-	-	0.12	27	0.05	-
DM2C	1/02/1999	-	-	-	-	0.05	30	0.02	-
DM2C	1/05/1999	-	-	-	-	0.01	35	0.05	-
DM2C	1/08/1999	-	-	-	-	0.18	39	0.05	-
DM2C	1/10/1999	-	-	-	-	0.01	98	0.01	-
DM2C	1/02/2000	-	-	-	-	0.12	42	0.01	-
DM2C	1/06/2000	-	-	-	-	0.3	26	0.01	-
DM2C	9/08/2000	-	-	-	-	-	28	0.01	-
DM2C	30/10/2000	-	-	-	-	-	55	0.01	-
DM2C	1/02/2001	-	-	-	-	0.1	37	0.01	-
DM2C	8/05/2001	-	-	-	-	0.12	17	0.01	-
DM2C	26/07/2001	-	-	-	-	0.14	23	0.01	-
DM2C	29/10/2001	-	-	-	-	0.8	71	0.03	-
DM2C	8/02/2002	-	-	-	-	0.2	25	0.012	-
DM2C	15/04/2002	-	-	-	-	0.1	23	0.005	-
DM2C	12/08/2002	-	-	-	-	0.1	26	0.005	-
DM2C	6/11/2002	-	-	-	-	0.1	36	0.007	-
DM2C	13/02/2003	-	-	-	-	0.1	29	0.0035	-
DM2C	30/04/2003	-	-	-	-	0.1	42	0.003	-
DM2C	9/08/2003	-	-	-	-	0.05	63	0.004	-
DM2C	24/11/2003	-	-	-	-	0.17	76	0.008	-

		Chromium (Trivalent)	**Chromium (Trivalent) (Filtered)**	**Cobalt**	**Copper Total**	**Iron**	**Magnesium**	**Manganese**	**Mercury**
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM2C	10/02/2004	-	-	-	-	0.1	100	0.009	-
DM2C	14/05/2004	-	-	-	-	0.1	82	0.005	-
DM2C	6/08/2004	-	-	-	**0.005**	0.1	93	0.004	0.0001
DM2C	10/11/2004	-	-	-	-	0.032	66	0.005	-
DM2C	16/02/2005	-	-	-	-	0.011	110	0.001	-
DM2C	15/04/2005	-	-	-	-	0.088	110	0.0047	-
DM2C	2/08/2005	-	-	-	-	0.029	190	0.001	-
DM2C	14/11/2005	-	-	-	-	0.035	210	0.001	-
DM2C	15/02/2006	-	-	-	**0.043**	0.1	162	0.0039	-
DM2C	18/05/2006	-	-	-	-	-	-	-	-
DM2C	17/08/2006	-	-	-	-	-	-	-	-
DM2C	31/10/2006	-	-	0.001	0.001	0.031	270	-	0.0001
DM2C	8/03/2007	-	-	0.001	0.001	0.03	170	-	0.0001
DM2C	19/06/2007	-	-	0.001	0.001	0.089	190	0.004	0.0001
DM2C	30/08/2007	-	-	0.001	0.001	0.025	240	0.001	0.0001
DM2C	2/11/2007	-	-	0.001	0.001	0.012	190	0.001	0.0001
DM2C	2/04/2008	-	-	0.001	0.001	0.11	210	0.005	0.0001
DM2C	8/07/2008	-	-	0.001	0.001	0.054	250	0.006	0.0001
DM2C	8/09/2008	-	-	0.001	0.001	0.051	260	0.005	0.0001
DM2C	8/12/2008	-	-	0.001	0.001	0.061	250	0.006	0.0001
DM2C	1/03/2009	-	-	0.002	0.001	0.081	280	0.007	0.0001
DM2C	1/07/2009	-	-	0.001	0.001	0.11	240	0.006	0.0001
DM2C	30/09/2009	-	-	0.001	0.001	0.19	220	0.004	0.0001
DM2C	23/12/2009	-	-	0.001	0.001	0.095	200	0.004	0.0001
DM2C	16/02/2010	-	-	0.001	0.001	1.8	610	0.056	0.0001
DM2C	20/05/2010	-	-	0.001	**0.002**	0.14	400	0.008	0.0001
DM2C	18/08/2010	-	-	0.001	0.001	0.038	230	0.007	0.0001
DM2C	25/11/2010	-	-	0.001	0.001	0.026	230	0.007	0.0001

Field_ID	Sampled_Date-Ti	Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
DM2C	9/02/2011	-	-	0.001	0.001	0.061	240	0.008	0.0001
DM2C	11/05/2011	-	-	0.001	0.001	0.1	280	0.0083	0.0001
DM2C	9/08/2011	-	-	0.001	0.001	0.15	280	0.008	0.0001
DM2C	10/08/2011	-	-	-	-	-	-	-	-
DM2C	10/11/2011	-	-	0.001	0.001	0.22	220	0.0084	0.0001
DM2C	23/01/2012	-	-	0.001	0.001	0.32	260	0.014	0.0001
DM2C	24/05/2012	-	-	0.001	**0.0036**	0.086	260	0.011	0.0001
DM2C	14/08/2012	-	-	0.001	**0.0028**	0.96	210	0.025	0.0001
DM2C	26/10/2012	-	-	0.001	0.001	2.4	240	0.058	0.0001
DM2C	16/01/2013	-	-	0.001	0.001	0.6	280	0.034	0.0001
DM2C	9/04/2013	-	-	0.001	0.001	0.12	360	0.08	0.0001
DM2C	10/10/2013	-	-	0.001	**0.003**	2.6	200	0.33	<0.0001
DM2C	9/04/2014	0.014	-	<0.001	**0.002**	1	310	0.16	<0.0001
DM2C	16/10/2014	<0.001	<0.001	0.002	**0.002**	0.1	480	0.028	<0.0001
DM2C	16/04/2015	-	0.018	<0.001	<0.001	0.25	290	0.055	<0.0001
DM2C	3/09/2015	-	0.008	<0.001	**0.002**	0.16	260	0.027	<0.0001
DM2C	4/09/2015	-	-	-	-	-	-	-	-
DM2C	15/04/2016	-	-	-	-	-	-	-	-
DM2C	21/04/2016	-	<0.001	<0.001	0.001	1.4	270	0.15	<0.0001
DM2C	15/09/2016	-	<0.001	<0.001	0.001	0.16	210	0.037	<0.0001
DM2C	22/04/2016	-	-	-	-	-	-	-	-
DM2C	22/04/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM4A	1/07/1996	-	-	-	-	7.2	22	0.2	-
DM4A	1/10/1996	-	-	-	-	7.9	23	0.1	-
DM4A	1/01/1997	-	-	-	-	0.6	28	0.15	-
DM4A	1/04/1997	-	-	-	-	5.9	27	0.2	-
DM4A	1/07/1997	-	-	-	-	7	26	0.2	-
DM4A	1/10/1997	-	-	-	-	8.5	30	0.2	-
DM4A	1/01/1998	-	-	-	-	8.6	27	0.2	-
DM4A	1/07/1998	-	-	-	-	11	38	0.27	-
DM4A	1/10/1998	-	-	-	-	15	52	0.47	-
DM4A	1/02/1999	-	-	-	-	17	92	0.51	-
DM4A	1/05/1999	-	-	-	-	12	72	0.49	-
DM4A	1/08/1999	-	-	-	-	0.2	130	0.65	-
DM4A	1/10/1999	-	-	-	-	0.01	130	0.76	-
DM4A	1/02/2000	-	-	-	-	19	130	0.63	-
DM4A	1/06/2000	-	-	-	-	0.22	140	0.67	-
DM4A	9/08/2000	-	-	-	-	4	310	1	-
DM4A	1/02/2001	-	-	-	-	33	270	1.2	-
DM4A	8/05/2001	-	-	-	-	33	260	1	-
DM4A	26/07/2001	-	-	-	-	43	410	1.4	-
DM4A	29/10/2001	-	-	-	-	58.8	380	1.5	-
DM4A	8/02/2002	-	-	-	-	36	410	1.5	-
DM4A	19/04/2002	-	-	-	-	-	317	0.65	-
DM4A	12/08/2002	-	-	-	-	37.7	405	1.6	-
DM4A	6/11/2002	-	-	-	-	22.9	369	1.78	-
DM4A	13/02/2003	-	-	-	-	52.8	389	1.7	-
DM4A	30/04/2003	-	-	-	-	23	420	1.8	-
DM4A	9/08/2003	-	-	-	-	24	450	1.75	-
DM4A	24/11/2003	-	-	-	-	59	410	1.7	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM4A	10/02/2004	-	-	-	-	57	430	1.7	-
DM4A	14/05/2004	-	-	-	-	0.1	480	1.7	-
DM4A	6/08/2004	-	-	-	**0.005**	55	470	1.6	0.0001
DM4A	10/11/2004	-	-	-	-	51	460	1.6	-
DM4A	16/02/2005	-	-	-	-	51	490	1.7	-
DM4A	15/04/2005	-	-	-	-	49	520	1.5	-
DM4A	2/08/2005	-	-	-	-	41	510	1.4	-
DM4A	14/11/2005	-	-	-	-	42	610	1.5	-
DM4A	15/02/2006	-	-	-	**0.0097**	37	705	1.6	-
DM4A	18/05/2006	-	-	-	-	-	-	-	-
DM4A	17/08/2006	-	-	-	-	-	-	-	-
DM4A	31/10/2006	-	-	0.002	0.001	44	570	-	0.0001
DM4A	8/03/2007	-	-	0.003	0.001	41	660	-	0.0001
DM4A	19/06/2007	-	-	0.003	0.001	42	660	1.4	0.0001
DM4A	30/08/2007	-	-	0.002	0.001	41	1060	1.3	0.0001
DM4A	2/11/2007	-	-	0.002	0.001	35	680	1.4	0.0001
DM4A	2/04/2008	-	-	0.002	**0.002**	40	660	1.6	0.0001
DM4A	8/07/2008	-	-	0.002	0.001	47	640	**1.9**	0.0001
DM4A	8/09/2008	-	-	0.002	0.001	39	600	1.3	0.0001
DM4A	1/12/2008	-	-	0.001	0.001	15	660	0.55	0.0001
DM4A	9/03/2009	-	-	0.005	0.001	44	690	**1.9**	0.0001
DM4A	1/07/2009	-	-	0.003	0.001	27	920	0.8	0.0001
DM4A	30/09/2009	-	-	0.004	0.001	36	710	1.3	0.0001
DM4A	23/12/2009	-	-	0.004	0.001	42	670	1.4	0.0001
DM4A	17/02/2010	-	-	0.004	0.001	37	590	1.3	0.0001
DM4A	20/05/2010	-	-	0.002	**0.004**	41	640	1.4	0.0001
DM4A	18/08/2010	-	-	0.002	0.001	41	730	1.4	0.0001
DM4A	24/11/2010	-	-	0.002	0.001	42	730	1.4	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM4A	9/02/2011	-	-	0.002	**0.002**	41	620	1.3	0.0001
DM4A	11/05/2011	-	-	0.002	0.001	47	820	1.6	0.0001
DM4A	10/11/2011	-	-	0.0017	0.001	36	720	1.2	0.0001
DM4A	23/01/2012	-	-	-	-	-	-	-	-
DM4A	24/01/2012	-	-	0.001	**0.003**	1.3	460	0.066	0.0001
DM4A	24/05/2012	-	-	0.001	**0.002**	0.32	450	0.0077	0.0001
DM4A	14/08/2012	-	-	0.001	**0.0051**	0.14	430	0.014	0.0001
DM4A	26/10/2012	-	-	0.001	**0.0033**	1.8	460	0.08	0.0001
DM4A	16/01/2013	-	-	0.001	0.0012	0.039	490	0.0082	0.0001
DM4A	9/04/2013	-	-	0.001	0.001	0.074	430	0.006	0.0001
DM4A	10/10/2013	-	-	<0.001	0.001	1.6	440	0.071	<0.0001
DM4A	9/04/2014	0.001	-	001 - 0.	0.001	0.69	560	0.021	<0.0001 - 0.0001
DM4A	16/10/2014	<0.001	<0.001	0.003	<0.001	1.3	480	0.3	<0.0001
DM4A	16/04/2015	-	<0.001	<0.001	0.001	0.16	460	0.012	<0.0001
DM4A	3/09/2015	-	<0.001	0.001	0.001	1.7	450	0.46	<0.0001
DM4A	4/09/2015	-	-	-	-	-	-	-	-
DM4A	15/04/2016	-	-	-	-	-	-	-	-
DM4A	21/04/2016	-	<0.001	<0.001	<0.001	0.74	480	0.017	<0.0001
DM4A	15/09/2016	-	<0.001	<0.001	<0.001	0.11	450	0.014	<0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM4C	1/07/1996	-	-	-	-	7.8	45	0.25	-
DM4C	1/10/1996	-	-	-	-	11	60	0.2	-
DM4C	1/01/1997	-	-	-	-	0.35	60	0.2	-
DM4C	1/04/1997	-	-	-	-	6.4	68	0.2	-
DM4C	1/07/1997	-	-	-	-	4.1	38	0.2	-
DM4C	1/10/1997	-	-	-	-	13	63	0.3	-
DM4C	1/01/1998	-	-	-	-	10	71	0.4	-
DM4C	1/07/1998	-	-	-	-	52	281	1.13	-
DM4C	1/10/1998	-	-	-	-	40	360	1.4	-
DM4C	1/02/1999	-	-	-	-	36	470	1	-
DM4C	1/05/1999	-	-	-	-	18	330	0.77	-
DM4C	1/08/1999	-	-	-	-	0.2	270	0.52	-
DM4C	1/10/1999	-	-	-	-	0.04	350	0.56	-
DM4C	1/02/2000	-	-	-	-	17	320	0.34	-
DM4C	1/06/2000	-	-	-	-	0.26	380	0.45	-
DM4C	9/08/2000	-	-	-	-	47	610	1.1	-
DM4C	30/10/2000	-	-	-	-	0.3	580	1	-
DM4C	1/02/2001	-	-	-	-	43	650	1.6	-
DM4C	8/05/2001	-	-	-	-	40	590	1.4	-
DM4C	26/07/2001	-	-	-	-	40	680	1.3	-
DM4C	29/10/2001	-	-	-	-	46.8	660	1.2	-
DM4C	8/02/2002	-	-	-	-	25	580	0.77	-
DM4C	19/04/2002	-	-	-	-	38.7	378	1.5	-
DM4C	12/08/2002	-	-	-	-	12.1	190	0.4	-
DM4C	6/11/2002	-	-	-	-	0.1	262	0.42	-
DM4C	13/02/2003	-	-	-	-	16.4	282	0.4	-
DM4C	30/04/2003	-	-	-	-	0.1	280	0.44	-
DM4C	9/08/2003	-	-	-	-	0.05	300	0.41	-

Field_ID	Sampled_Date-Ti	Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
DM4C	24/11/2003	-	-	-	-	23	490	0.57	-
DM4C	10/02/2004	-	-	-	-	24	570	0.53	-
DM4C	13/05/2004	-	-	-	**0.005**	0.1	750	0.43	-
DM4C	6/08/2004	-	-	-	**0.005**	17	850	0.35	0.0001
DM4C	10/11/2004	-	-	-	-	18	720	0.32	-
DM4C	16/02/2005	-	-	-	-	7.8	650	0.16	-
DM4C	15/04/2005	-	-	-	-	14	720	0.21	-
DM4C	2/08/2005	-	-	-	-	11	860	0.15	-
DM4C	14/11/2005	-	-	-	-	11	720	0.11	-
DM4C	15/02/2006	-	-	-	**0.024**	7.9	980	0.13	-
DM4C	18/05/2006	-	-	-	-	-	-	-	-
DM4C	17/08/2006	-	-	-	-	-	-	-	-
DM4C	31/10/2006	-	-	0.001	0.001	12	890	-	0.0001
DM4C	8/03/2007	-	-	0.002	0.001	12	950	-	0.0001
DM4C	19/06/2007	-	-	0.002	0.001	15	1010	0.24	0.0001
DM4C	30/08/2007	-	-	0.002	0.001	15	1050	0.22	0.0001
DM4C	2/11/2007	-	-	0.001	0.001	8.1	930	0.14	0.0001
DM4C	2/04/2008	-	-	0.001	0.001	17	1020	0.6	0.0001
DM4C	8/07/2008	-	-	0.001	0.001	20	1050	0.72	0.0001
DM4C	8/09/2008	-	-	0.001	0.001	16	740	0.44	0.0001
DM4C	1/12/2008	-	-	0.002	0.001	40	700	1.8	0.0001
DM4C	1/03/2009	-	-	0.003	0.001	16	740	0.64	0.0001
DM4C	1/07/2009	-	-	0.002	0.001	17	980	0.54	0.0001
DM4C	30/09/2009	-	-	0.003	0.001	18	980	0.44	0.0001
DM4C	23/12/2009	-	-	0.002	0.001	18	1000	0.34	0.0001
DM4C	17/02/2010	-	-	0.001	0.001	16	880	0.28	0.0001
DM4C	20/05/2010	-	-	0.001	**0.003**	16	940	0.22	0.0001
DM4C	18/08/2010	-	-	0.001	0.001	13	850	0.2	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM4C	24/11/2010	-	-	0.001	0.001	13	840	0.17	0.0001
DM4C	9/02/2011	-	-	0.001	0.001	13	710	0.16	0.0001
DM4C	11/05/2011	-	-	0.001	0.001	13	870	0.16	0.0001
DM4C	10/11/2011	-	-	0.001	0.001	9.1	930	0.086	0.0001
DM4C	23/01/2012	-	-	-	-	-	-	-	-
DM4C	24/01/2012	-	-	0.001	**0.006**	1.4	890	0.024	0.0001
DM4C	24/05/2012	-	-	0.001	**0.016**	1.7	820	0.08	0.0001
DM4C	14/08/2012	-	-	0.001	**0.0018**	1.8	680	0.056	0.0001
DM4C	26/10/2012	-	-	0.001	**0.033**	7.4	720	0.35	0.0001
DM4C	16/01/2013	-	-	0.001	0.001	0.3	790	0.22	0.0001
DM4C	9/04/2013	-	-	0.001	0.001	0.069	650	0.003	0.0001
DM4C	10/10/2013	-	-	<0.001	0.001	2.4	850	0.05	<0.0001
DM4C	9/04/2014	0.001	-	001 - 0.	0.001	0.21	900	0.012	<0.0001 - 0.0001
DM4C	16/10/2014	<0.001	<0.001	0.002	0.001	0.057	900	0.003	<0.0001
DM4C	16/04/2015	-	<0.001	<0.001	<0.001	1	860	0.069	<0.0001
DM4C	3/09/2015	-	<0.001	<0.001	<0.001	5	730	0.073	<0.0001
DM4C	4/09/2015	-	-	-	-	-	-	-	-
DM4C	15/04/2016	-	-	-	-	-	-	-	-
DM4C	21/04/2016	-	<0.001	<0.001	<0.001	8.8	590	0.18	<0.0001
DM4C	15/09/2016	-	<0.001	<0.001	<0.001	5.1	490	0.046	<0.0001
DM4C	22/04/2016	-	-	-	-	-	-	-	-
DM4C	22/04/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM7A	30/09/2009	-	-	0.001	0.001	5	140	0.37	0.0001
DM7A	23/12/2009	-	-	0.001	0.001	3	120	0.2	0.0001
DM7A	17/02/2010	-	-	0.001	0.001	2.6	100	0.16	0.0001
DM7A	21/05/2010	-	-	0.001	**0.002**	1	140	0.15	0.0001
DM7A	18/08/2010	-	-	0.001	0.001	1.1	150	0.17	0.0001
DM7A	24/11/2010	-	-	0.001	0.001	1.9	140	0.15	0.0001
DM7A	9/02/2011	-	-	0.001	0.001	1.6	130	0.12	0.0001
DM7A	11/05/2011	-	-	0.001	0.001	2.4	130	0.12	0.0001
DM7A	9/08/2011	-	-	0.001	0.001	3.2	130	0.13	0.0001
DM7A	10/08/2011	-	-	-	-	-	-	-	-
DM7A	10/11/2011	-	-	0.001	0.001	2.5	120	0.12	0.0001
DM7A	23/01/2012	-	-	0.001	0.001	2.5	110	0.11	0.0001
DM7A	24/05/2012	-	-	0.001	**0.002**	1.3	110	0.11	0.0001
DM7A	14/08/2012	-	-	0.001	**0.0028**	1.5	110	0.12	**0.00086**
DM7A	26/10/2012	-	-	0.001	**0.004**	3	170	0.12	0.0001
DM7A	16/01/2013	-	-	0.001	0.001	1.4	87	0.094	0.0001
DM7A	9/04/2013	-	-	0.001	0.001	1.3	73	0.081	0.0001
DM7A	10/10/2013	-	-	<0.001	**0.002**	0.82	62	0.094	<0.0001
DM7A	9/04/2014	0.002	-	<0.001	0.001	2.2	91	0.66	<0.0001
DM7A	16/10/2014	<0.001	<0.001	<0.001	<0.001	1.5	86	0.11	<0.0001
DM7A	16/04/2015	-	<0.001	<0.001	<0.001	0.97	73	0.098	<0.0001
DM7A	3/09/2015	-	<0.001	<0.001	<0.001	0.83	66	0.078	<0.0001
DM7A	4/09/2015	-	-	-	-	-	-	-	-
DM7A	15/04/2016	-	-	-	-	-	-	-	-
DM7A	21/04/2016	-	<0.001	<0.001	<0.001	0.33	54	0.054	<0.0001
DM7A	15/09/2016	-	<0.001	<0.001	<0.001	0.29	46	0.061	<0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM7C	1/07/1992	-	-	-	-	0.05	110	-	-
DM7C	1/10/1992	-	-	-	-	0.05	125	-	-
DM7C	1/01/1993	-	-	-	-	0.05	105	-	-
DM7C	1/04/1993	-	-	-	-	0.05	75	-	-
DM7C	1/07/1993	-	-	-	-	0.3	85	-	-
DM7C	1/10/1993	-	-	-	-	0.05	200	-	-
DM7C	1/01/1994	-	-	-	-	0.05	195	-	-
DM7C	1/04/1994	-	-	-	-	0.05	60	-	-
DM7C	1/07/1994	-	-	-	-	0.1	65	-	-
DM7C	1/10/1994	-	-	-	-	0.6	210	-	-
DM7C	1/01/1995	-	-	-	-	0.15	260	-	-
DM7C	1/04/1995	-	-	-	-	0.3	200	-	-
DM7C	1/07/1995	-	-	-	-	0.2	190	-	-
DM7C	1/10/1995	-	-	-	-	0.35	420	-	-
DM7C	1/01/1996	-	-	-	-	0.15	720	-	-
DM7C	1/07/1996	-	-	-	-	0.05	360	**2**	-
DM7C	1/10/1996	-	-	-	-	41	710	1.2	-
DM7C	1/01/1997	-	-	-	-	9.9	630	0.8	-
DM7C	1/04/1997	-	-	-	-	29	640	0.8	-
DM7C	1/07/1997	-	-	-	-	25	440	0.6	-
DM7C	1/10/1997	-	-	-	-	20	260	0.45	-
DM7C	1/01/1998	-	-	-	-	7.9	340	0.35	-
DM7C	1/07/1998	-	-	-	-	14	158	0.24	-
DM7C	1/10/1998	-	-	-	-	8.7	120	0.2	-
DM7C	1/02/1999	-	-	-	-	8.2	110	0.19	-
DM7C	1/05/1999	-	-	-	-	8.7	110	0.3	-
DM7C	1/08/1999	-	-	-	-	8.8	170	0.2	-
DM7C	1/10/1999	-	-	-	-	0.01	290	0.01	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM7C	1/02/2000	-	-	-	-	0.04	310	0.01	-
DM7C	1/06/2000	-	-	-	-	0.18	260	0.01	-
DM7C	9/08/2000	-	-	-	-	-	180	0.01	-
DM7C	30/10/2000	-	-	-	-	0.08	150	0.01	-
DM7C	1/02/2001	-	-	-	-	0.23	210	0.01	-
DM7C	8/05/2001	-	-	-	-	0.13	230	0.01	-
DM7C	26/07/2001	-	-	-	-	0.09	210	0.01	-
DM7C	29/10/2001	-	-	-	-	0.6	260	0.005	-
DM7C	8/02/2002	-	-	-	-	0.1	210	0.0047	-
DM7C	15/04/2002	-	-	-	-	0.1	160	0.005	-
DM7C	12/08/2002	-	-	-	-	0.1	197	0.0065	-
DM7C	6/11/2002	-	-	-	-	0.1	238	0.013	-
DM7C	13/02/2003	-	-	-	-	0.1	231	0.03	-
DM7C	30/04/2003	-	-	-	-	0.1	200	0.036	-
DM7C	9/08/2003	-	-	-	-	0.05	160	0.03	-
DM7C	24/11/2003	-	-	-	-	-	-	-	-
DM7C	25/11/2003	-	-	-	-	0.1	120	0.02	-
DM7C	10/02/2004	-	-	-	-	0.1	130	0.028	-
DM7C	13/05/2004	-	-	-	-	0.1	190	0.038	-
DM7C	6/08/2004	-	-	-	**0.005**	0.1	180	0.036	0.0001
DM7C	10/11/2004	-	-	-	-	0.11	210	0.046	-
DM7C	16/02/2005	-	-	-	-	0.024	190	0.069	-
DM7C	15/04/2005	-	-	-	-	0.3	170	0.11	-
DM7C	2/08/2005	-	-	-	-	0.042	140	0.083	-
DM7C	14/11/2005	-	-	-	-	0.045	200	0.057	-
DM7C	15/02/2006	-	-	-	**0.014**	0.05	370	0.14	-
DM7C	18/05/2006	-	-	-	-	-	-	-	-
DM7C	17/08/2006	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM7C	31/10/2006	-	-	0.001	0.001	0.06	180	-	0.0001
DM7C	8/03/2007	-	-	0.001	0.001	0.04	280	-	0.0001
DM7C	19/06/2007	-	-	0.001	0.001	0.19	250	0.093	0.0001
DM7C	30/08/2007	-	-	0.001	0.001	0.074	260	0.12	0.0001
DM7C	2/11/2007	-	-	0.001	0.001	0.032	170	0.1	0.0001
DM7C	2/04/2008	-	-	0.001	0.001	0.11	160	0.069	0.0001
DM7C	8/07/2008	-	-	0.001	0.001	0.57	160	0.086	0.0001
DM7C	8/09/2008	-	-	0.001	0.001	0.049	150	0.064	0.0001
DM7C	1/12/2008	-	-	0.001	0.001	0.26	180	0.067	0.0001
DM7C	1/03/2009	-	-	0.002	0.001	0.036	180	0.07	0.0001
DM7C	1/07/2009	-	-	0.001	0.001	0.081	180	0.05	0.0001
DM7C	30/09/2009	-	-	0.001	0.001	0.033	160	0.047	0.0001
DM7C	23/12/2009	-	-	0.001	0.001	0.21	170	0.043	0.0001
DM7C	17/02/2010	-	-	0.001	0.001	0.072	160	0.047	0.0001
DM7C	21/05/2010	-	-	0.001	**0.002**	0.24	210	0.084	0.0001
DM7C	18/08/2010	-	-	0.001	0.001	0.064	190	0.048	0.0001
DM7C	24/11/2010	-	-	0.001	0.001	0.008	190	0.015	0.0001
DM7C	9/02/2011	-	-	0.001	0.001	0.023	140	0.005	0.0001
DM7C	11/05/2011	-	-	0.001	0.001	0.18	180	0.0087	0.0001
DM7C	9/08/2011	-	-	0.001	0.001	0.1	180	0.005	0.0001
DM7C	10/08/2011	-	-	-	-	-	-	-	-
DM7C	10/11/2011	-	-	0.001	0.001	0.04	130	0.0072	0.0001
DM7C	23/01/2012	-	-	0.001	0.001	0.6	120	0.071	0.0001
DM7C	24/05/2012	-	-	0.0013	**0.0016**	1.1	140	0.17	0.0001
DM7C	14/08/2012	-	-	0.001	**0.036**	0.14	140	0.027	0.0001
DM7C	26/10/2012	-	-	0.001	0.001	1.3	130	0.056	0.0001
DM7C	16/01/2013	-	-	0.001	0.001	0.32	77	0.027	0.0001
DM7C	9/04/2013	-	-	0.001	0.001	3	28	0.12	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM7C	10/10/2013	-	-	0.002	**0.003**	1 - 2.2	81	0.52	<0.0001
DM7C	9/04/2014	-	-	0.001	0.001	2.2	130	0.66	0.0001
DM7C	16/10/2014	-	-	-	-	-	-	-	-
DM7C	16/04/2015	-	0.002	<0.001	0.001	0.24	87	0.096	<0.0001
DM7C	3/09/2015	-	0.002	<0.001	0.001	0.26	80	0.049	<0.0001
DM7C	4/09/2015	-	-	-	-	-	-	-	-
DM7C	5/09/2015	-	-	-	-	-	-	-	-
DM7C	15/04/2016	-	-	-	-	-	-	-	-
DM7C	21/04/2016	-	<0.001	0.001	<0.001	0.86	84	0.27	<0.0001
DM7C	15/09/2016	-	0.003	<0.001	<0.001	0.28	70	0.099	<0.0001
DM7C	22/04/2016	-	-	-	-	-	-	-	-
DM7C	15/09/2016	-	-	-	-	-	-	-	-
DM7C	22/04/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM8A	30/09/2009	-	-	-	-	-	-	-	-
DM8A	9/11/2009	-	-	0.002	**0.004**	0.49	160	0.055	0.0001
DM8A	23/12/2009	-	-	0.002	0.001	6.5	910	1.1	0.0001
DM8A	16/02/2010	-	-	0.001	0.001	5.8	890	0.31	0.0001
DM8A	20/05/2010	-	-	0.001	0.001	2.6	930	0.22	0.0001
DM8A	18/08/2010	-	-	0.001	0.001	4.4	1010	0.15	0.0001
DM8A	24/11/2010	-	-	0.001	0.001	3.9	1050	0.13	0.0001
DM8A	8/02/2011	-	-	0.001	0.001	2.9	950	0.17	0.0001
DM8A	11/05/2011	-	-	0.001	0.001	3.1	1110	0.095	0.0001
DM8A	9/08/2011	-	-	0.001	0.001	3.1	1000	0.11	0.0001
DM8A	10/08/2011	-	-	-	-	-	-	-	-
DM8A	1/11/2011	-	-	-	-	-	-	-	-
DM8A	10/11/2011	-	-	0.001	0.001	3	940	0.066	0.0001
DM8A	23/01/2012	-	-	0.001	0.001	4	900	0.023	0.0001
DM8A	24/05/2012	-	-	0.0012	0.001	2.7	1020	0.053	0.0001
DM8A	14/08/2012	-	-	0.001	**0.0029**	3.4	910	0.047	0.0001
DM8A	26/10/2012	-	-	0.001	0.001	4.1	1090	0.083	0.0001
DM8A	16/01/2013	-	-	0.001	**0.004**	5.3	930	0.24	0.0001
DM8A	9/04/2013	-	-	0.001	**0.003**	4.1	930	0.11	0.0001
DM8A	10/10/2013	-	-	<0.001	0.001	2.9	34	0.077	<0.0001
DM8A	9/04/2014	0.001	-	001 - 0.(	0.001	7.3	1060	0.5	<0.0001 - 0.0001
DM8A	16/10/2014	<0.001	-	<0.001	0.001	2.7	740	0.046	<0.0001
DM8A	16/04/2015	-	0.002	<0.001	0.001	3.5	740	0.064	<0.0001
DM8A	3/09/2015	-	0.002	0.002	**0.005**	15	890	**3.9**	<0.0001
DM8A	4/09/2015	-	-	-	-	-	-	-	-
DM8A	5/09/2015	-	-	-	-	-	-	-	-
DM8A	15/04/2016	-	-	-	-	-	-	-	-
DM8A	21/04/2016	-	<0.001	<0.001	<0.001	16	800	1.5	<0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM8A	15/09/2016	-	<0.001	<0.001	**0.002**	13	700	1.3	<0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM8C	30/09/2009	-	-	0.004	0.001	20	840	**2**	0.0001
DM8C	23/12/2009	-	-	0.003	0.001	24	1110	**2.1**	0.0001
DM8C	16/02/2010	-	-	0.001	0.001	20	850	1.3	0.0001
DM8C	13/05/2010	-	-	0.003	**0.004**	18	790	**2.3**	0.0001
DM8C	18/08/2010	-	-	0.001	0.001	22	950	**2.2**	0.0001
DM8C	24/11/2010	-	-	0.001	0.001	21	980	**2**	0.0001
DM8C	8/02/2011	-	-	0.001	0.001	8.6	410	0.65	0.0001
DM8C	11/05/2011	-	-	0.001	0.001	23	1090	**2**	0.0001
DM8C	9/08/2011	-	-	0.002	0.001	21	1100	**2**	0.0001
DM8C	10/08/2011	-	-	-	-	-	-	-	-
DM8C	1/11/2011	-	-	-	-	-	-	-	-
DM8C	10/11/2011	-	-	0.001	0.001	18	990	1.5	0.0001
DM8C	23/01/2012	-	-	0.001	**0.0038**	0.97	610	0.13	0.0001
DM8C	24/05/2012	-	-	0.001	**0.0039**	0.36	740	0.15	0.0001
DM8C	14/08/2012	-	-	0.001	0.001	18	880	**1.9**	0.0001
DM8C	26/10/2012	-	-	0.001	**0.0031**	21	1020	**1.9**	0.0001
DM8C	16/01/2013	-	-	0.001	0.001	18	980	**2.3**	0.0001
DM8C	9/04/2013	-	-	0.001	0.001	5.3	820	1.7	0.0001
DM8C	10/10/2013	-	-	<0.001	**0.005**	6.6	960	1.3	<0.0001
DM8C	9/04/2014	0.001	-	001 - 0.(	0.001	17	900	**3.1**	<0.0001 - 0.0001
DM8C	16/10/2014	<0.001	<0.001	<0.001	**)01 - 0.0**	2.7 - 15	740 - 860	**.046 - 3.**	<0.0001
DM8C	16/04/2015	-	0.001	<0.001	**0.002**	15	910	**3.3**	<0.0001
DM8C	3/09/2015	-	0.002	<0.001	**0.002**	2.4	650	0.21	<0.0001
DM8C	4/09/2015	-	-	-	-	-	-	-	-
DM8C	15/04/2016	-	-	-	-	-	-	-	-
DM8C	21/04/2016	-	<0.001	<0.001	0.001	4.4	660	0.039	<0.0001
DM8C	15/09/2016	-	0.008	<0.001	<0.001	2.1	550	0.048	<0.0001
DM8C	22/04/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM8C	22/04/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM9A	29/10/2001	-	-	-	-	0.4	-	0.019	-
DM9A	8/02/2002	-	-	-	-	0.3	-	0.019	-
DM9A	15/04/2002	-	-	-	-	0.2	-	0.019	-
DM9A	12/08/2002	-	-	-	-	0.5	-	0.039	-
DM9A	6/11/2002	-	-	-	-	0.1	-	0.003	-
DM9A	13/02/2003	-	-	-	-	0.1	-	0.005	-
DM9A	30/04/2003	-	-	-	-	0.1	-	0.013	-
DM9A	9/08/2003	-	-	-	-	0.05	-	0.004	-
DM9A	24/11/2003	-	-	-	-	0.12	-	0.016	-
DM9A	10/02/2004	-	-	-	-	0.2	-	0.016	-
DM9A	13/05/2004	-	-	-	-	0.1	-	0.001	-
DM9A	6/08/2004	-	-	-	**0.005**	0.2	-	0.022	0.0001
DM9A	10/11/2004	-	-	-	-	0.18	-	0.007	-
DM9A	16/02/2005	-	-	-	0	0.008	-	0.004	0
DM9A	15/04/2005	-	-	-	-	0.027	-	0.0043	-
DM9A	2/08/2005	-	-	-	-	0.009	-	0.001	-
DM9A	14/11/2005	-	-	-	-	0.057	-	0.003	-
DM9A	15/02/2006	-	-	-	**0.013**	0.05	-	0.0025	-
DM9A	18/05/2006	-	-	-	-	0	-	-	-
DM9A	17/08/2006	-	-	-	0	0	-	0	0
DM9A	31/10/2006	-	-	0.001	0.001	0.07	-	0	0.0001
DM9A	8/03/2007	-	-	0.001	0.001	0.06	-	-	0.0001
DM9A	19/06/2007	-	-	0.001	0.001	0.18	-	0.006	0.0001
DM9A	30/08/2007	-	-	0.001	0.001	0.093	-	0.006	0.0001
DM9A	2/11/2007	-	-	0.001	0.001	0.035	-	0.001	0.0001
DM9A	2/04/2008	-	-	0.001	0.001	0.11	-	0.009	0.0001
DM9A	8/07/2008	-	-	0.001	0.001	0.14	-	0.008	0.0001
DM9A	8/09/2008	-	-	0.001	0.001	0.18	-	0.013	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM9A	1/12/2008	-	-	-	-	-	-	-	-
DM9A	1/03/2009	-	-	0.001	0.001	0.054	-	0.003	0.0001
DM9A	1/07/2009	-	-	0.001	0.001	0.18	-	0.003	0.0001
DM9A	30/09/2009	-	-	0.001	0.001	0.12	-	0.016	0.0001
DM9A	23/12/2009	-	-	0.001	0.001	0.26	-	0.034	0.0001
DM9A	16/02/2010	-	-	0.001	0.001	0.3	-	0.061	0.0001
DM9A	14/05/2010	-	-	0.004	**0.002**	0.94	-	0.22	0.0001
DM9A	18/08/2010	-	-	-	-	-	-	-	-
DM9A	19/08/2010	-	-	0.001	0.001	0.099	-	0.01	0.0001
DM9A	24/11/2010	-	-	0.001	0.001	0.019	-	0.004	0.0001
DM9A	9/02/2011	-	-	0.001	0.001	0.016	-	0.005	0.0001
DM9A	11/05/2011	-	-	0.001	0.001	0.52	-	0.031	0.0001
DM9A	10/08/2011	-	-	0.001	0.001	0.25	-	0.007	0.0001
DM9A	10/11/2011	-	-	0.001	0.001	0.019	-	0.0014	0.0001
DM9A	23/01/2012	-	-	0.001	0.001	0.22	-	0.014	0.0001
DM9A	24/05/2012	-	-	0.001	**0.0044**	0.82	-	0.085	0.0001
DM9A	14/08/2012	-	-	0.001	**0.0018**	6.2	-	0.21	0.0001
DM9A	26/10/2012	-	-	0.001	0.001	0.7	-	0.026	0.0001
DM9A	16/01/2013	-	-	0.001	**0.0026**	2.9	-	0.25	0.0001
DM9A	9/04/2013	-	-	<0.001	0.001	3.1	-	0.12	<0.0001
DM9A	10/10/2013	-	-	<0.001	**0.003**	0.78	-	0.069	<0.0001
DM9A	9/04/2014	0.003	-	<0.001	<0.001	0.49	-	0.023	<0.0001
DM9A	16/10/2014	-	<0.001	<0.001	**0.002**	18	16	0.13	<0.0001
DM9A	16/04/2015	-	0.02	<0.001	0.001	1.1	32	0.1	<0.0001
DM9A	3/09/2015	-	0.02	<0.001	0.001	0.68	32	0.09	<0.0001
DM9A	4/09/2015	-	-	-	-	-	-	-	-
DM9A	5/09/2015	-	-	-	-	-	-	-	-
DM9A	15/04/2016	-	-	-	-	-	-	-	-

Field_ID	Sampled_Date-Ti	Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
DM9A	21/04/2016	-	<0.001	<0.001	0.001	14	17	0.13	<0.0001
DM9A	15/09/2016	-	<0.001	<0.001	**0.003**	3.7	14	0.11	<0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM9C	1/10/1996	-	-	-	-	0.65	27	0.05	-
DM9C	1/01/1997	-	-	-	-	0.05	37	0.05	-
DM9C	1/04/1997	-	-	-	-	0.05	35	0.05	-
DM9C	1/07/1997	-	-	-	-	0.05	32	0.05	-
DM9C	1/10/1997	-	-	-	-	0.15	38	0.05	-
DM9C	1/01/1998	-	-	-	-	0.35	40	0.05	-
DM9C	1/07/1998	-	-	-	-	0.6	36	0.05	-
DM9C	1/10/1998	-	-	-	-	0.2	31	0.05	-
DM9C	1/02/1999	-	-	-	-	0.1	42	0.05	-
DM9C	1/05/1999	-	-	-	-	0.2	32	0.01	-
DM9C	1/08/1999	-	-	-	-	0.35	28	0.05	-
DM9C	1/10/1999	-	-	-	-	0.01	34	0.01	-
DM9C	1/02/2000	-	-	-	-	0.18	30	0.01	-
DM9C	1/06/2000	-	-	-	-	0.16	31	0.01	-
DM9C	9/08/2000	-	-	-	-	1	30	0.03	-
DM9C	30/10/2000	-	-	-	-	0.03	27	0.01	-
DM9C	1/02/2001	-	-	-	-	0.5	26	0.01	-
DM9C	8/05/2001	-	-	-	-	0.21	28	0.01	-
DM9C	26/07/2001	-	-	-	-	0.15	31	0.01	-
DM9C	29/10/2001	-	-	-	-	0.4	29	0.019	-
DM9C	8/02/2002	-	-	-	-	0.3	29	0.019	-
DM9C	15/04/2002	-	-	-	-	0.2	27	0.019	-
DM9C	12/08/2002	-	-	-	-	0.5	28	0.039	-
DM9C	6/11/2002	-	-	-	-	0.1	32	0.003	-
DM9C	13/02/2003	-	-	-	-	0.1	31	0.005	-
DM9C	30/04/2003	-	-	-	-	0.1	31	0.013	-
DM9C	9/08/2003	-	-	-	-	0.05	30	0.004	-
DM9C	24/11/2003	-	-	-	-	0.12	34	0.016	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM9C	10/02/2004	-	-	-	-	0.2	33	0.016	-
DM9C	13/05/2004	-	-	-	-	0.1	30	0.001	-
DM9C	6/08/2004	-	-	-	**0.005**	0.2	33	0.022	0.0001
DM9C	10/11/2004	-	-	-	-	0.18	32	0.007	-
DM9C	16/02/2005	-	-	-	0	0.008	31	0.004	0
DM9C	15/04/2005	-	-	-	-	0.027	30	0.0043	-
DM9C	2/08/2005	-	-	-	-	0.009	32	0.001	-
DM9C	14/11/2005	-	-	-	-	0.057	30	0.003	-
DM9C	15/02/2006	-	-	-	**0.013**	0.05	30	0.0025	-
DM9C	18/05/2006	-	-	-	-	0	0	-	-
DM9C	17/08/2006	-	-	-	0	0	0	0	0
DM9C	31/10/2006	-	-	0.001	0.001	0.07	33	0	0.0001
DM9C	8/03/2007	-	-	0.001	0.001	0.06	31	-	0.0001
DM9C	19/06/2007	-	-	0.001	0.001	0.18	31	0.006	0.0001
DM9C	30/08/2007	-	-	0.001	0.001	0.093	35	0.006	0.0001
DM9C	2/11/2007	-	-	0.001	0.001	0.035	36	0.001	0.0001
DM9C	2/04/2008	-	-	0.001	0.001	0.11	31	0.009	0.0001
DM9C	8/07/2008	-	-	0.001	0.001	0.14	33	0.008	0.0001
DM9C	8/09/2008	-	-	0.001	0.001	0.18	32	0.013	0.0001
DM9C	1/12/2008	-	-	0.001	0.001	0.12	35	0.007	0.0001
DM9C	1/03/2009	-	-	0.001	0.001	0.054	32	0.003	0.0001
DM9C	1/07/2009	-	-	0.001	0.001	0.18	36	0.003	0.0001
DM9C	30/09/2009	-	-	0.001	0.001	0.12	36	0.016	0.0001
DM9C	23/12/2009	-	-	0.001	0.001	0.26	39	0.034	0.0001
DM9C	16/02/2010	-	-	0.001	0.001	0.3	36	0.061	0.0001
DM9C	14/05/2010	-	-	0.004	**0.002**	0.94	33	0.22	0.0001
DM9C	18/08/2010	-	-	0.001	0.001	17	17	0.15	0.0001
DM9C	19/08/2010	-	-	0.001	0.001	0.099	33	0.01	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
DM9C	24/11/2010	-	-	0.001	0.001	0.019	35	0.004	0.0001
DM9C	9/02/2011	-	-	0.001	0.001	0.016	32	0.005	0.0001
DM9C	11/05/2011	-	-	0.001	0.001	0.52	36	0.031	0.0001
DM9C	10/08/2011	-	-	0.001	0.001	0.25	39	0.007	0.0001
DM9C	10/11/2011	-	-	0.001	0.001	0.019	36	0.0014	0.0001
DM9C	23/01/2012	-	-	0.001	0.001	0.22	35	0.014	0.0001
DM9C	24/05/2012	-	-	0.001	**0.0044**	0.82	36	0.085	0.0001
DM9C	14/08/2012	-	-	0.001	**0.0018**	6.2	27	0.21	0.0001
DM9C	26/10/2012	-	-	0.001	0.001	0.7	32	0.026	0.0001
DM9C	16/01/2013	-	-	0.001	**0.0026**	2.9	35	0.25	0.0001
DM9C	9/04/2013	-	-	0.001	0.001	3.1	28	0.12	0.0001
DM9C	10/10/2013	-	-	<0.001	**0.011**	8.7	16	0.13	<0.0001
DM9C	9/04/2014	0.001	-	<0.001	**0.004**	8.4	37	0.13	<0.0001
DM9C	16/10/2014	<0.001	<0.001	<0.001	<0.001	0.1	33	0.009	<0.0001
DM9C	16/04/2015	-	0.001	<0.001	<0.001	9	17	0.14	<0.0001
DM9C	3/09/2015	-	0.004	<0.001	**0.004**	13	17	0.14	<0.0001
DM9C	4/09/2015	-	-	-	-	-	-	-	-
DM9C	15/04/2016	-	-	-	-	-	-	-	-
DM9C	21/04/2016	-	<0.001	<0.001	<0.001	1.9	40	0.14	<0.0001
DM9C	15/09/2016	-	0.01	<0.001	**0.002**	0.41	31	0.022	<0.0001
MB3	1/02/2001	-	-	-	-	0.26	190	0.14	-
MB3	8/05/2001	-	-	-	-	0.38	200	0.05	-
MB3	26/07/2001	-	-	-	-	0.18	300	0.04	-
MB3	29/10/2001	-	-	-	-	0.7	300	0.036	-
MB3	8/02/2002	-	-	-	-	0.2	320	0.038	-
MB3	19/04/2002	-	-	-	-	0.2	250	0.038	-
MB3	12/08/2002	-	-	-	-	0.2	151	0.036	-
MB3	6/11/2002	-	-	-	-	0.1	71	0.025	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
MB3	13/02/2003	-	-	-	-	0.1	69	0.001	-
MB3	30/04/2003	-	-	-	-	0.1	70	0.004	-
MB3	9/08/2003	-	-	-	-	0.05	64	0.011	-
MB3	24/11/2003	-	-	-	-	1.6	55	0.029	-
MB3	10/02/2004	-	-	-	-	0.1	63	0.021	-
MB3	13/05/2004	-	-	-	-	0.1	65	0.013	-
MB3	6/08/2004	-	-	-	**0.005**	0.1	70	0.015	0.0001
MB3	10/11/2004	-	-	-	-	0.005	53	0.012	-
MB3	16/02/2005	-	-	-	-	0.011	61	0.015	-
MB3	15/04/2005	-	-	-	-	0.018	58	0.014	-
MB3	2/08/2005	-	-	-	-	0.13	70	0.023	-
MB3	14/11/2005	-	-	-	-	0.28	52	0.048	-
MB3	15/02/2006	-	-	-	**0.021**	0.18	51	0.031	-
MB3	18/05/2006	-	-	-	-	-	-	-	-
MB3	17/08/2006	-	-	-	-	-	-	-	-
MB3	31/10/2006	-	-	0.001	0.001	0.17	51	-	0.0001
MB3	8/03/2007	-	-	0.001	0.001	0.11	45	-	0.0001
MB3	19/06/2007	-	-	0.001	0.001	0.24	54	0.048	0.0001
MB3	30/08/2007	-	-	0.001	0.001	0.057	58	0.029	0.0001
MB3	2/11/2007	-	-	0.001	0.001	0.085	42	0.031	0.0001
MB3	8/07/2008	-	-	0.001	0.001	0.039	41	0.034	0.0001
MB3	8/09/2008	-	-	0.001	0.001	0.33	38	0.13	0.0001
MB3	1/12/2008	-	-	0.001	0.001	0.29	40	0.26	0.0001
MB3	1/03/2009	-	-	0.001	0.001	0.18	35	0.089	0.0001
MB3	25/08/2009	-	-	0.001	0.001	0.022	39	0.003	0.0001
MB3	30/09/2009	-	-	0.001	0.001	0.067	37	0.027	0.0001
MB3	23/12/2009	-	-	0.001	0.001	0.12	37	0.038	0.0001
MB3	17/02/2010	-	-	0.001	0.001	0.33	35	0.22	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
MB3	20/05/2010	-	-	0.001	**0.003**	0.081	33	0.017	0.0001
MB3	18/08/2010	-	-	0.001	0.001	0.28	35	0.14	0.0001
MB3	24/11/2010	-	-	0.001	0.001	0.015	40	0.012	0.0001
MB3	9/02/2011	-	-	0.001	0.001	1.7	20	0.066	0.0001
MB3	11/05/2011	-	-	0.001	0.001	0.15	44	0.016	0.0001
MB3	9/08/2011	-	-	0.001	0.001	0.11	44	0.028	0.0001
MB3	10/08/2011	-	-	-	-	-	-	-	-
MB3	10/11/2011	-	-	0.001	0.001	0.077	41	0.0037	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
MB3	23/01/2012	-	-	-	-	-	-	-	-
MB3	24/01/2012	-	-	0.001	0.001	0.17	46	0.057	0.0001
MB3	16/02/2012	-	-	-	-	-	-	-	-
MB3	24/05/2012	-	-	-	-	-	-	-	-
MB3	14/08/2012	-	-	-	-	-	-	-	-
MB3	29/10/2012	-	-	-	-	-	-	-	-
MB3	16/01/2013	-	-	-	-	0.24	41	0.075	-
MB3	9/04/2013	-	-	-	-	-	-	-	-
MB3	10/10/2013	-	-	<0.001	**0.003**	0.3	45	0.13	0.0001
MB3	9/04/2014	0.001	-	<0.001	<0.001	0.16	49	0.033	<0.0001
MB3	16/10/2014	<0.001	<0.001	001 - 0.(	<0.001	).06 - 0.2	37	)02 - 0.0	<0.0001
MB3	16/04/2015	-	0.001	<0.001	0.001	0.098	31	0.028	<0.0001
MB3	3/09/2015	-	<0.001	<0.001	0.001	0.22	31	0.041	<0.0001
MB3	4/09/2015	-	-	-	-	-	-	-	-
MB3	20/01/2016	-	-	-	-	-	-	-	-
MB3	15/04/2016	-	-	-	-	-	-	-	-
MB3	21/04/2016	-	<0.001	<0.001	<0.001	0.39	31	0.084	<0.0001
MB3	15/09/2016	-	0.001	<0.001	0.001	0.15	28	0.009	<0.0001
MB3	15/09/2016	-	-	-	-	-	-	-	-
MB4	1/11/1988	-	-	-	-	-	13	-	-
MB4	1/03/1989	-	-	-	-	-	20.8	-	-
MB4	1/08/1989	-	-	-	-	-	24	-	-
MB4	1/11/1989	-	-	-	-	-	23	-	-
MB4	1/04/1990	-	-	-	-	-	20	-	-
MB4	1/06/1990	-	-	-	-	-	19	-	-
MB4	1/10/1990	-	-	-	-	-	27	-	-
MB4	1/12/1990	-	-	-	-	-	14	-	-
MB4	1/04/1991	-	-	-	-	-	19.5	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
MB4	1/08/1991	-	-	-	-	-	27.5	-	-
MB4	1/09/1991	-	-	-	-	-	27.5	-	-
MB4	1/12/1991	-	-	-	-	-	17	-	-
MB4	1/04/1992	-	-	-	-	-	12	-	-
MB4	1/07/1992	-	-	-	-	-	22.5	-	-
MB4	1/10/1992	-	-	-	-	-	19.5	-	-
MB4	1/01/1993	-	-	-	-	5.6	17.5	-	-
MB4	1/04/1993	-	-	-	-	8.95	18.5	-	-
MB4	1/07/1993	-	-	-	-	5.1	22	-	-
MB4	1/10/1993	-	-	-	-	5.8	22.5	-	-
MB4	1/01/1994	-	-	-	-	12.5	17	-	-
MB4	1/07/1995	-	-	-	-	36	14	-	-
MB4	1/10/1995	-	-	-	-	33.1	8.5	-	-
MB4	1/01/1996	-	-	-	-	24	6.3	-	-
MB4	1/07/1996	-	-	-	-	36	7.5	0.65	-
MB4	1/01/1998	-	-	-	-	12	44	0.4	-
MB4	1/07/1998	-	-	-	-	10.5	25	0.21	-
MB4	1/10/1998	-	-	-	-	8.2	25	0.18	-
MB4	1/02/1999	-	-	-	-	19	19	0.15	-
MB4	1/05/1999	-	-	-	-	18	20	0.2	-
MB4	1/08/1999	-	-	-	-	0.25	28	0.07	-
MB4	1/10/1999	-	-	-	-	0.1	30	0.12	-
MB4	1/02/2000	-	-	-	-	18	19	0.36	-
MB4	1/06/2000	-	-	-	-	0.83	27	0.13	-
MB4	9/08/2000	-	-	-	-	13	37	0.09	-
MB4	30/10/2000	-	-	-	-	1	26	0.09	-
MB4	1/02/2001	-	-	-	-	25	21	0.27	-
MB4	8/05/2001	-	-	-	-	22	27	0.16	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
MB4	26/07/2001	-	-	-	-	8.7	30	0.13	-
MB4	29/10/2001	-	-	-	-	24.8	30	0.21	-
MB4	8/02/2002	-	-	-	-	77	25	0.47	-
MB4	19/04/2002	-	-	-	-	28	30	0.26	-
MB4	12/08/2002	-	-	-	-	8.2	34	0.17	-
MB4	6/11/2002	-	-	-	-	0.1	33	0.18	-
MB4	13/02/2003	-	-	-	-	21.9	33	0.27	-
MB4	30/04/2003	-	-	-	-	0.1	36	0.15	-
MB4	9/08/2003	-	-	-	-	0.1	42	0.11	-
MB4	24/11/2003	-	-	-	-	4.9	38	0.17	-
MB4	10/02/2004	-	-	-	-	11	31	0.37	-
MB4	13/05/2004	-	-	-	-	0.1	55	0.11	-
MB4	6/08/2004	-	-	-	**0.005**	1	45	0.13	0.0001
MB4	10/11/2004	-	-	-	-	0.73	37	0.15	-
MB4	16/02/2005	-	-	-	-	0.51	42	0.22	-
MB4	15/04/2005	-	-	-	-	3.2	42	0.22	-
MB4	2/08/2005	-	-	-	-	0.27	48	0.1	-
MB4	14/11/2005	-	-	-	-	1.5	46	0.14	-
MB4	15/02/2006	-	-	-	**0.024**	0.94	43	0.17	-
MB4	18/05/2006	-	-	-	-	-	-	-	-
MB4	17/08/2006	-	-	-	-	-	-	-	-
MB4	31/10/2006	-	-	0.001	0.001	1.6	48	-	0.0001
MB4	8/03/2007	-	-	0.001	0.001	5	46	-	0.0001
MB4	19/06/2007	-	-	0.001	0.001	3.2	54	0.11	0.0001
MB4	30/08/2007	-	-	0.001	0.001	3.9	61	0.055	0.0001
MB4	2/11/2007	-	-	0.001	0.001	0.39	47	0.079	0.0001
MB4	2/04/2008	-	-	0.001	**0.003**	2.4	45	0.15	0.0001
MB4	8/07/2008	-	-	0.001	0.001	0.85	47	0.12	0.0001

	Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL	0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%				0.0018			2.5	0.0019
ANZECC 2000 FW 95%				**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%	0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%	0.0274	0.0274	0.001	0.0013				0.0004

Field_ID	**Sampled_Date-Ti**								
MB4	8/09/2008	-	-	0.001	0.001	2.1	46	0.15	0.0001
MB4	1/12/2008	-	-	0.001	0.001	13	39	0.14	0.0001
MB4	1/03/2009	-	-	0.001	0.001	11	38	0.17	0.0001
MB4	1/07/2009	-	-	0.001	0.001	0.59	41	0.066	0.0001
MB4	30/09/2009	-	-	0.001	0.001	5.3	41	0.049	0.0001
MB4	23/12/2009	-	-	0.001	0.001	9	44	0.12	0.0001
MB4	17/02/2010	-	-	0.001	0.001	14	42	0.15	0.0001
MB4	13/05/2010	-	-	0.001	**0.002**	36	37	0.21	0.0001
MB4	18/08/2010	-	-	0.001	**0.002**	1.8	37	0.1	0.0001
MB4	24/11/2010	-	-	0.001	0.001	2.7	36	0.13	0.0001
MB4	9/02/2011	-	-	0.001	0.001	0.027	37	0.007	0.0001
MB4	11/05/2011	-	-	0.001	0.001	3.9	38	0.17	0.0001
MB4	10/11/2011	-	-	0.001	0.001	2.3	40	0.027	0.0001
MB4	23/01/2012	-	-	-	-	-	-	-	-
MB4	24/01/2012	-	-	0.0018	**0.014**	61	38	0.67	0.0001
MB4	24/05/2012	-	-	0.001	**0.005**	7.4	43	0.097	0.0001
MB4	14/08/2012	-	-	0.001	**0.0037**	5.8	35	0.049	0.0001
MB4	26/10/2012	-	-	0.001	**0.012**	30	33	0.27	0.0001
MB4	29/10/2012	-	-	-	-	-	-	-	-
MB4	16/01/2013	-	-	-	-	1.2	37	0.037	-
MB4	10/10/2013	-	-	0.002	**0.028**	33	180	0.42	<0.0001
MB4	9/04/2014	0.026	-	0.004	**0.028**	77	48	0.76	<0.0001
MB4	22/05/2014	-	-	0.001	0.001	31	140	0.53	0.0001
MB4	16/10/2014	<0.001	<0.001	<0.001	<0.001	17	46	0.27	<0.0001
MB4	16/04/2015	-	0.002	<0.001	<0.001	32	49	0.26	<0.0001
MB4	3/09/2015	-	<0.001	<0.001	**0.006**	19	46	0.33	<0.0001
MB4	4/09/2015	-	-	-	-	-	-	-	-
MB4	15/04/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
MB4	21/04/2016	-	<0.001	<0.001	**0.005**	43	35	0.12	<0.0001
MB4	15/09/2016	-	0.001	<0.001	**0.005**	6	32	0.11	<0.0001
MB4	22/04/2016	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
YB	15/04/2005	-	-	-	-	25	11	0.1	-
YB	1/08/2005	-	-	-	-	0	0	-	-
YB	2/08/2005	-	-	-	-	19	13	0.23	-
YB	14/11/2005	-	-	-	-	18	11	0.17	-
YB	11/01/2006	-	-	-	-	0	0	-	-
YB	15/02/2006	-	-	-	0.001	24	11	0.15	-
YB	11/03/2006	-	-	-	-	0	0	-	-
YB	13/04/2006	-	-	-	-	0	0	-	-
YB	10/05/2006	-	-	-	-	0	0	-	-
YB	16/06/2006	-	-	-	0	0	0	0	0
YB	13/07/2006	-	-	-	0	0	0	0	0
YB	9/08/2006	-	-	-	0	0	0	0	0
YB	13/09/2006	-	-	-	0	0	0	0	0
YB	13/10/2006	-	-	-	0	0	0	0	0
YB	13/11/2006	-	-	0.001	0.001	25	0	0	0.0001
YB	13/12/2006	-	-	0.001	0.001	24	9.9	0	0.0001
YB	23/01/2007	-	-	0	0	0	0	0	0
YB	16/02/2007	-	-	0	0	0	0	0	0
YB	15/03/2007	-	-	-	-	-	-	-	-
YB	11/04/2007	-	-	0	0	0	0	0	0
YB	16/05/2007	-	-	-	-	-	-	-	-
YB	19/06/2007	-	-	0.001	0.001	0	12	0	0.0001
YB	13/07/2007	-	-	0	0	0	0	0	0
YB	15/08/2007	-	-	0	0	0	0	0	0
YB	17/09/2007	-	-	0	0	0	0	0	0
YB	16/10/2007	-	-	0	0	0	0	0	0
YB	19/11/2007	-	-	-	-	-	-	-	-
YB	13/12/2007	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
YB	1/03/2008	-	-	0.001	0.001	27	11	0.1	0.0001
YB	21/04/2008	-	-	-	-	-	-	-	-
YB	8/05/2008	-	-	-	-	-	-	-	-
YB	8/06/2008	-	-	-	-	-	-	-	-
YB	8/07/2008	-	-	-	-	-	-	-	-
YB	8/08/2008	-	-	0.001	0.001	28	11	0.12	0.0001
YB	8/09/2008	-	-	-	-	-	-	-	-
YB	8/10/2008	-	-	0.001	0.001	24	12	0.098	0.0001
YB	8/11/2008	-	-	-	-	-	-	-	-
YB	8/12/2008	-	-	0.001	0.001	24	11	0.11	0.0001
YB	9/01/2009	-	-	-	-	-	-	-	-
YB	1/02/2009	-	-	-	-	-	-	-	-
YB	1/03/2009	-	-	0.001	0.001	26	11	0.11	0.0001
YB	1/04/2009	-	-	-	-	-	-	-	-
YB	1/05/2009	-	-	-	-	-	-	-	-
YB	1/06/2009	-	-	-	-	-	-	-	-
YB	1/07/2009	-	-	0.001	0.001	24	9.9	0.088	0.0001
YB	1/08/2009	-	-	-	-	-	-	-	-
YB	1/09/2009	-	-	0.001	0.001	21	11	0.085	0.0001
YB	1/10/2009	-	-	-	-	-	-	-	-
YB	1/11/2009	-	-	-	-	-	-	-	-
YB	1/12/2009	-	-	0.001	0.001	26	11	0.096	0.0001
YB	1/01/2010	-	-	-	-	-	-	-	-
YB	8/01/2010	-	-	-	-	-	-	-	-
YB	1/02/2010	-	-	0.001	0.001	22	15	0.086	0.0001
YB	1/03/2010	-	-	0.001	0.001	22	9.8	0.083	0.0001
YB	1/04/2010	-	-	0.001	0.001	26	11	0.097	0.0001
YB	20/05/2010	-	-	0.001	0.001	24	11	0.08	0.0001

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
YB	21/06/2010	-	-	-	0.001	25	11	0.097	-
YB	22/07/2010	-	-	-	-	-	-	-	-
YB	17/08/2010	-	-	-	-	-	-	-	-
YB	20/08/2010	-	-	-	-	-	-	-	-
YB	17/09/2010	-	-	-	-	-	-	-	-
YB	26/10/2010	-	-	-	-	-	-	-	-
YB	22/11/2010	-	-	-	-	-	-	-	-
YB	15/12/2010	-	-	-	**4**	-	-	-	-
YB	5/01/2011	-	-	-	-	-	-	-	-
YB	9/02/2011	-	-	0.001	0.001	25	11	0.094	0.0001
YB	22/03/2011	-	-	-	-	-	-	-	-
YB	14/04/2011	-	-	-	-	-	-	-	-
YB	11/05/2011	-	-	-	-	-	-	-	-
YB	21/06/2011	-	-	-	-	-	-	-	-
YB	26/07/2011	-	-	-	-	-	-	-	-
YB	9/08/2011	-	-	-	-	-	-	-	-
YB	10/08/2011	-	-	-	-	-	-	-	-
YB	13/09/2011	-	-	-	-	-	-	-	-
YB	14/09/2011	-	-	-	-	-	-	-	-
YB	6/10/2011	-	-	-	-	-	-	-	-
YB	31/10/2011	-	-	-	-	-	-	-	-
YB	1/11/2011	-	-	-	-	-	-	-	-
YB	10/11/2011	-	-	-	-	-	-	-	-
YB	11/11/2011	-	-	-	-	-	-	-	-
YB	15/12/2011	-	-	-	-	-	-	-	-
YB	17/01/2012	-	-	-	-	-	-	-	-
YB	23/01/2012	-	-	-	-	-	-	-	-
YB	16/02/2012	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
YB	15/03/2012	-	-	-	-	-	-	-	-
YB	20/04/2012	-	-	-	-	-	-	-	-
YB	24/05/2012	-	-	-	**0.024**	26	17	0.096	-
YB	26/06/2012	-	-	-	-	-	-	-	-
YB	17/07/2012	-	-	-	-	-	-	-	-
YB	14/08/2012	-	-	-	-	25	11	0.09	-
YB	24/09/2012	-	-	-	-	-	-	-	-
YB	26/10/2012	-	-	-	-	24	11	0.089	-
YB	13/11/2012	-	-	-	-	-	-	-	-
YB	11/12/2012	-	-	-	-	-	-	-	-
YB	8/01/2013	-	-	-	-	-	-	-	-
YB	16/01/2013	-	-	0.001	0.001	24	19	0.09	0.0001
YB	16/02/2013	-	-	-	-	-	-	-	-
YB	20/03/2013	-	-	-	-	-	-	-	-
YB	9/04/2013	-	-	0.001	0.001	12	18	0.11	0.0001
YB	6/05/2013	-	-	-	-	-	-	-	-
YB	11/07/2013	-	-	0.001	**0.002**	24	-	0.099	0.0001
YB	10/10/2013	-	-	<0.001	0.001	24	12	0.1	<0.0001
YB	29/01/2014	-	-	-	-	-	-	-	-
YB	9/04/2014	0.003	-	0.001	**0.003**	29	13	0.17	<0.0001
YB	16/07/2014	-	-	-	-	-	-	-	-
YB	16/10/2014	<0.001	<0.001	0.001	<0.001	24	12	0.1	<0.0001
YB	22/01/2015	-	-	-	-	-	-	-	-
YB	23/01/2015	-	-	-	-	-	-	-	-
YB	16/04/2015	-	<0.001	<0.001	<0.001	23	13	0.1	<0.0001
YB	9/07/2015	-	-	-	-	-	-	-	-
YB	3/09/2015	-	<0.001	<0.001	<0.001	15	12	0.12	<0.0001
YB	4/09/2015	-	-	-	-	-	-	-	-

		Chromium (Trivalent)	Chromium (Trivalent) (Filtered)	Cobalt	Copper Total	Iron	Magnesium	Manganese	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.005	0.005	0.001	0.0001
ANZECC 2000 FW 90%					0.0018			2.5	0.0019
ANZECC 2000 FW 95%					**0.0014**			**1.9**	**0.00006|0.0006**
ANZECC 2000 MW 90%		0.0486	0.0486	0.014	0.003				0.0007
ANZECC 2000 MW 95%		0.0274	0.0274	0.001	0.0013				0.0004
Field_ID	**Sampled_Date-Ti**								
YB	20/01/2016	-	-	-	-	-	-	-	-
YB	15/04/2016	-	-	-	-	-	-	-	-
YB	21/04/2016	-	<0.001	<0.001	**0.005**	26	12	0.2	<0.0001
YB	7/07/2016	-	-	-	-	-	-	-	-
YB	15/09/2016	-	0.002	<0.001	<0.001	23	12	0.13	<0.0001
YB	15/09/2016	-	-	-	-	-	-	-	-
YB	21/01/2016	-	-	-	-	-	-	-	-
YB	22/04/2016	-	-	-	-	-	-	-	-
YB	8/07/2016	-	-	-	-	-	-	-	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM1A	1/03/1989	-	-	6.2	-	-	-
DM1A	1/11/1989	-	-	5	-	37	-
DM1A	1/06/1990	-	-	6	0.02	15.2	-
DM1A	1/10/1990	-	-	6.5	0.02	94	-
DM1A	1/06/1991	-	-	7	0.02	15	-
DM1A	1/09/1991	-	-	5.8	0.02	12.7	-
DM1A	1/07/1992	-	-	6	0.2	37	-
DM1A	1/10/1992	-	-	6.3	0.02	47	-
DM1A	1/01/1993	-	-	2.5	0.02	37	-
DM1A	1/07/1993	-	-	3.3	0.05	37	-
DM1A	1/10/1993	-	-	2.7	0.1	1	-
DM1A	1/01/1994	-	-	2	0.05	37	-
DM1A	1/07/1994	-	-	2	0.1	37	-
DM1A	1/10/1994	-	-	2.5	0.1	41	-
DM1A	1/01/1995	-	-	2.5	0.1	37	-
DM1A	1/07/1995	-	-	2.2	0.5	37	-
DM1A	1/10/1995	-	-	3.7	0.5	37	-
DM1A	1/01/1996	-	-	1.7	0.5	37	-
DM1A	10/07/1996	-	-	15	0.5	7	-
DM1A	22/10/1996	-	-	24	0.5	38	-
DM1A	15/01/1997	-	-	20	0.5	27	-
DM1A	10/04/1997	-	-	21	0.5	26	-
DM1A	3/07/1997	-	-	29	0.5	20	-
DM1A	8/10/1997	-	-	28	0.5	10	-
DM1A	1/07/1998	-	-	23	0.5	-	-
DM1A	1/10/1998	-	-	28	0.2	66	-

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM1A	1/02/1999	-	-	31	0.2	-	-
DM1A	1/05/1999	-	-	23	0.2	-	-
DM1A	1/10/1999	-	-	5.7	0.1	-	-
DM1A	1/02/2000	-	-	5.7	0.1	35	308
DM1A	1/06/2000	-	-	5.7	0.01	36	703
DM1A	9/08/2000	-	-	30	0.1	215	-
DM1A	30/10/2000	-	-	61	0.1	10	-
DM1A	1/02/2001	-	-	31	0.1	17	-
DM1A	8/05/2001	-	-	33	0.1	22	670
DM1A	26/07/2001	-	-	22	0.1	5	1130
DM1A	29/10/2001	-	-	31	0.005	40	70
DM1A	18/02/2002	-	-	32	0.05	150	240
DM1A	15/04/2002	-	-	28	0.05	120	110
DM1A	12/08/2002	-	-	26	0.05	140	130
DM1A	6/11/2002	-	-	24	0.005	15	226
DM1A	13/02/2003	-	-	20	0.005	7	-
DM1A	30/04/2003	-	-	22	0.005	17	-
DM1A	9/08/2003	-	-	22	0.005	9	-
DM1A	24/11/2003	-	-	25	0.005	11	100
DM1A	10/02/2004	-	-	29	0.005	10	213
DM1A	13/05/2004	-	-	25	0.005	15	100
DM1A	6/08/2004	-	0.005	25	0.005	3	100
DM1A	10/11/2004	-	0.005	10.4	-	3	100
DM1A	16/02/2005	-	-	14	-	3	100
DM1A	15/04/2005	-	-	6	0.0019	37	296
DM1A	2/08/2005	-	-	6	0.001	38	459
DM1A	14/11/2005	-	-	6	0.001	40	100
DM1A	15/02/2006	-	0.007	-	-	37	100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM1A	18/05/2006	-	-	-	-	94	100
DM1A	17/08/2006	-	-	-	-	74	337
DM1A	31/10/2006	-	0.003	6.5	0.001	47	306
DM1A	8/03/2007	-	0.002	8.3	0.001	3	639
DM1A	19/06/2007	-	0.003	7.8	0.001	41	477
DM1A	30/08/2007	-	0.002	6.6	0.001	-	-
DM1A	2/11/2007	-	0.002	6.4	0.001	48	611
DM1A	2/04/2008	-	0.002	6.4	0.001	25	654
DM1A	8/07/2008	-	0.001	7.5	0.001	100	278
DM1A	8/09/2008	-	0.001	6.9	0.001	100	100
DM1A	1/03/2009	-	0.003	8.1	0.002	47	173
DM1A	1/07/2009	-	0.001	7	0.001	216	294
DM1A	30/09/2009	-	0.002	7.7	0.001	133	572
DM1A	18/12/2009	-	0.001	11	0.001	53	535
DM1A	16/02/2010	-	0.001	9.6	0.001	346	258
DM1A	6/05/2010	-	**0.019**	8.7	0.001	74	155
DM1A	18/08/2010	-	0.001	7.9	0.001	62	168
DM1A	26/11/2010	-	0.001	8.9	0.001	43	100
DM1A	9/02/2011	-	0.001	11	0.001	70	100
DM1A	11/05/2011	-	0.001	9.6	0.001	106	100
DM1A	9/08/2011	-	0.001	9.5	0.001	381	160
DM1A	10/08/2011	-	-	-	-	-	-
DM1A	10/11/2011	-	0.001	9.6	0.001	67	112
DM1A	23/01/2012	<0.001	0.001	10	0.001	54	613
DM1A	24/05/2012	0.0012	0.001	11	0.001	46	100
DM1A	14/08/2012	-	0.0061	8.5	0.0017	33	100
DM1A	26/10/2012	-	0.0015	10	0.001	79	100
DM1A	16/01/2013	-	0.001	10	0.001	29	100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM1A	9/04/2013	-	0.001	8	0.001	68	100
DM1A	10/10/2013	0.001	0.001	10	0.003	138	121
DM1A	9/04/2014	<0.001	0.001	9.7	0.001	217	334
DM1A	16/10/2014	<0.001	0.003	16	<0.001	182	100
DM1A	16/04/2015	<0.001	<0.001	11	0.001	135	100
DM1A	3/09/2015	0.002	0.004	16	0.004	-	-
DM1A	4/09/2015	-	-	-	-	399	<100
DM1A	15/04/2016	-	-	-	-	-	-
DM1A	21/04/2016	<0.001	0.001	15	0.002	-	-
DM1A	15/09/2016	<0.001	0.001	7.9	<0.001	<100	<100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM1C	1/03/1989	-	-	6.2	-	23	50
DM1C	1/11/1989	-	-	6	-	37	-
DM1C	1/06/1990	-	-	3	0.02	9.2	-
DM1C	1/10/1990	-	-	6	0.01	37	-
DM1C	1/06/1991	-	-	4.3	0.02	7	-
DM1C	1/09/1991	-	-	4.5	0.02	17	-
DM1C	1/12/1991	-	-	-	-	-	-
DM1C	1/07/1992	-	-	4.8	0.2	37	-
DM1C	1/10/1992	-	-	5.3	0.02	37	-
DM1C	1/01/1993	-	-	6.9	0.02	37	-
DM1C	1/07/1993	-	-	7	0.05	37	-
DM1C	1/10/1993	-	-	6.9	0.1	22	-
DM1C	1/01/1994	-	-	6.5	0.05	37	-
DM1C	1/07/1994	-	-	7	0.1	37	-
DM1C	1/10/1994	-	-	7	0.1	45	-
DM1C	1/01/1995	-	-	9.5	0.1	37	-
DM1C	1/07/1995	-	-	8	0.5	44	-
DM1C	1/10/1995	-	-	8.5	0.5	38	-
DM1C	1/01/1996	-	-	7.1	0.5	83	-
DM1C	1/07/1996	-	-	7	0.5	30	-
DM1C	22/10/1996	-	-	7	0.5	50	-
DM1C	15/01/1997	-	-	5.8	0.5	49	-
DM1C	10/04/1997	-	-	5.9	0.2	35	-
DM1C	3/07/1997	-	-	7	0.5	40	-
DM1C	8/10/1997	-	-	4.7	0.1	30	-
DM1C	7/01/1998	-	-	6.8	0.5	40	-
DM1C	1/07/1998	-	-	5	0.5	-	-
DM1C	1/10/1998	-	-	5.7	0.2	26	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM1C	1/02/1999	-	-	5.9	0.2	-	-
DM1C	1/05/1999	-	-	5.6	0.2	-	-
DM1C	1/10/1999	-	-	30	0.1	-	-
DM1C	1/02/2000	-	-	26	0.1	19	656
DM1C	1/06/2000	-	-	80	0.1	15	1045
DM1C	9/08/2000	-	-	6	0.1	29	551
DM1C	30/10/2000	-	-	6	0.1	27	-
DM1C	1/02/2001	-	-	5.9	0.1	16	-
DM1C	8/05/2001	-	-	8.4	0.1	29	-
DM1C	26/07/2001	-	-	6.3	0.1	25	-
DM1C	29/10/2001	-	-	7	0.005	70	120
DM1C	8/02/2002	-	-	6	0.05	170	250
DM1C	15/04/2002	-	-	5	-	120	120
DM1C	6/11/2002	-	-	6	0.005	43	-
DM1C	13/02/2003	-	-	6	0.005	42	-
DM1C	30/04/2003	-	-	6	0.16	25	-
DM1C	9/08/2003	-	-	5	0.005	79	-
DM1C	24/11/2003	-	-	6	0.005	75	100
DM1C	10/02/2004	-	-	6	0.005	24	-
DM1C	14/05/2004	-	-	5	0.005	66	100
DM1C	6/08/2004	-	0.005	6	0.005	-	-
DM1C	10/11/2004	-	0.005	7.9	-	9	373
DM1C	16/02/2005	-	-	6	-	16	100
DM1C	15/04/2005	-	-	15	0.0015	4	610
DM1C	2/08/2005	-	-	17	0.002	17	503
DM1C	14/11/2005	-	-	15	0.001	19	614
DM1C	15/02/2006	-	0.001	-	-	14	776
DM1C	18/05/2006	-	-	-	-	14	352

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM1C	17/08/2006	-	-	-	-	5	100
DM1C	31/10/2006	-	0.001	15	0.002	11	100
DM1C	8/03/2007	-	0.001	16	0.001	23	422
DM1C	19/06/2007	-	0.001	15	0.002	14	324
DM1C	30/08/2007	-	0.001	11	0.002	-	-
DM1C	2/11/2007	-	0.001	13	0.002	88	100
DM1C	2/04/2008	-	0.003	10	0.004	16	258
DM1C	8/07/2008	-	0.001	12	0.004	440	420
DM1C	8/09/2008	-	0.001	8.9	0.004	100	240
DM1C	1/03/2009	-	0.001	12	0.002	7	199
DM1C	1/07/2009	-	0.001	10	0.002	48	100
DM1C	30/09/2009	-	0.001	11	0.002	74	100
DM1C	23/12/2009	-	0.001	14	0.001	1102	451
DM1C	16/02/2010	-	0.001	12	0.001	83	188
DM1C	21/05/2010	-	**0.018**	14	0.002	62	143
DM1C	18/08/2010	-	0.001	11	0.002	20	202
DM1C	25/11/2010	-	0.001	12	0.001	10	256
DM1C	9/02/2011	-	0.001	13	0.001	34	100
DM1C	11/05/2011	-	0.001	13	0.0014	12	162
DM1C	9/08/2011	-	0.001	12	0.001	196	250
DM1C	10/08/2011	-	-	-	-	-	-
DM1C	10/11/2011	-	0.001	11	0.0012	6	206
DM1C	23/01/2012	0.001	0.0023	11	0.014	31	10
DM1C	24/05/2012	<0.001	0.0016	11	0.0028	20	100
DM1C	14/08/2012	-	0.0031	10	0.016	37	100
DM1C	26/10/2012	-	0.0014	11	0.0028	20	100
DM1C	16/01/2013	-	0.0014	11	0.001	20	100
DM1C	9/04/2013	-	0.004	8.7	0.026	58	100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM1C	10/10/2013	0.001	0.005	14	0.028	132	<100
DM1C	9/04/2014	0.001	0.003	13	0.012	103	100
DM1C	16/10/2014	0.001	0.003	23	0.001	60	100
DM1C	16/04/2015	0.001	0.006	18	0.054	57	100
DM1C	3/09/2015	<0.001	<0.001	9.5	<0.001	-	-
DM1C	4/09/2015	-	-	-	-	240	<100
DM1C	15/04/2016	-	-	-	-	-	-
DM1C	21/04/2016	0.002	0.006	28	0.05	-	-
DM1C	15/09/2016	<0.001	0.004	14	0.005	547	757
DM1C	22/04/2016	-	-	-	-	<100 - 21	<100
DM1C	15/09/2016	-	-	-	-	<100	<100
DM1C	22/04/2016	-	-	-	-	274	<100

Field_ID	Sampled_Date-Ti	Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
						Radionuclides	
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
DM2A	1/08/1989	-	-	6.5	-	-	-
DM2A	1/11/1989	-	-	3	-	46	-
DM2A	1/06/1990	-	-	8	0.02	25.2	-
DM2A	1/10/1990	-	-	15	0.02	89	150
DM2A	1/12/1990	-	-	20	-	129.1	239.3
DM2A	1/01/1991	-	-	15	-	-	-
DM2A	1/04/1991	-	-	11.5	0.05	56	-
DM2A	1/06/1991	-	-	16	0.02	93	-
DM2A	1/09/1991	-	-	13.5	0.02	98.8	-
DM2A	1/12/1991	-	-	20	0.05	-	-
DM2A	1/04/1992	-	-	10	0.02	50	-
DM2A	1/07/1992	-	-	14	0.2	85	-
DM2A	1/10/1992	-	-	12	0.02	83	-
DM2A	1/01/1993	-	-	12.5	0.05	100	-
DM2A	1/04/1993	-	-	11.5	0.1	53	-
DM2A	1/07/1993	-	-	12.5	0.05	63	-
DM2A	1/10/1993	-	-	9	0.1	49	-
DM2A	1/01/1994	-	-	9	0.05	47	-
DM2A	1/07/1994	-	-	9	0.1	55	-
DM2A	1/10/1994	-	-	8.5	0.1	37	-
DM2A	1/01/1995	-	-	6.5	0.1	59	-
DM2A	1/04/1995	-	-	8.5	0.05	37	-
DM2A	1/07/1995	-	-	8	0.5	53	-
DM2A	1/10/1995	-	-	9	0.5	37	-
DM2A	1/01/1996	-	-	10	0.5	67	-
DM2A	1/07/1996	-	-	13	0.5	40	-
DM2A	1/10/1996	-	-	8	0.5	48	-
DM2A	1/01/1997	-	-	5.2	0.5	28	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM2A	1/04/1997	-	-	3.8	0.2	19	-
DM2A	1/07/1997	-	-	4	0.5	10	-
DM2A	1/10/1997	-	-	3.1	0.1	10	-
DM2A	1/01/1998	-	-	5	0.5	10	-
DM2A	1/07/1998	-	-	10	0.5	-	-
DM2A	1/10/1998	-	-	20	0.2	29	-
DM2A	1/02/1999	-	-	30	0.2	-	-
DM2A	1/05/1999	-	-	34	0.2	-	-
DM2A	1/08/1999	-	-	30	0.5	56	-
DM2A	1/10/1999	-	-	31	0.1	-	-
DM2A	1/02/2000	-	-	30	0.1	65	300
DM2A	1/06/2000	-	-	29	0.1	32	594
DM2A	9/08/2000	-	-	27	0.1	39	772
DM2A	30/10/2000	-	-	21	0.1	19	-
DM2A	1/02/2001	-	-	28	0.1	27	-
DM2A	8/05/2001	-	-	36	0.1	26	-
DM2A	26/07/2001	-	-	24	0.1	26	-
DM2A	29/10/2001	-	-	34	0.005	40	70
DM2A	8/02/2002	-	-	24	0.05	170	250
DM2A	15/04/2002	-	-	25	0.05	120	110
DM2A	12/08/2002	-	-	23	0.05	140	130
DM2A	6/11/2002	-	-	23	0.005	22	180
DM2A	13/02/2003	-	-	24	0.005	55	-
DM2A	30/04/2003	-	-	38	0.005	37	-
DM2A	9/08/2003	-	-	41	0.005	27	-
DM2A	24/11/2003	-	-	43	0.005	32	170
DM2A	10/02/2004	-	-	31	0.005	39	-
DM2A	14/05/2004	-	-	30	-	48	130

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM2A	6/08/2004	-	0.005	24	0.005	59	915
DM2A	10/11/2004	-	0.005	34	-	43	627
DM2A	16/02/2005	-	-	32	-	32	425
DM2A	15/04/2005	-	-	38	0.0083	55	508
DM2A	2/08/2005	-	-	37	0.067	42	100
DM2A	14/11/2005	-	-	35	0.001	69	548
DM2A	15/02/2006	-	**0.011**	-	0.001	61	490
DM2A	18/05/2006	-	-	-	-	56	100
DM2A	17/08/2006	-	-	-	-	39	100
DM2A	31/10/2006	-	0.003	27	0.002	54	408
DM2A	8/03/2007	-	0.002	25	0.001	3	100
DM2A	19/06/2007	-	0.003	23	0.001	42	471
DM2A	30/08/2007	-	0.001	19	0.001	-	-
DM2A	2/11/2007	-	0.002	21	0.001	51	100
DM2A	2/04/2008	-	0.002	16	0.001	35	100
DM2A	8/07/2008	-	0.001	17	0.001	345	463
DM2A	8/09/2008	-	0.002	19	0.001	100	100
DM2A	1/12/2008	-	0.001	14	0.001	3	100
DM2A	1/03/2009	-	0.001	17	0.002	19	324
DM2A	1/07/2009	-	0.001	14	0.001	90	270
DM2A	30/09/2009	-	0.002	15	0.002	41	187
DM2A	23/12/2009	-	0.001	23	0.001	74	271
DM2A	16/02/2010	-	0.001	15	0.002	88	416
DM2A	20/05/2010	-	0.003	19	0.003	3	120
DM2A	18/08/2010	-	0.002	18	0.001	76	100
DM2A	25/11/2010	-	0.001	20	0.001	80	100
DM2A	9/02/2011	-	0.002	20	0.001	36	100
DM2A	11/05/2011	-	0.001	19	0.001	82	100

Field_ID	Sampled_Date-Ti					Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
DM2A	9/08/2011	-	0.001	19	0.001	34	211
DM2A	10/08/2011	-	-	-	-	-	-
DM2A	10/11/2011	-	0.0011	20	0.001	136	380
DM2A	23/01/2012	0.0017	0.0014	20	0.002	79	100
DM2A	24/05/2012	0.0011	0.0032	21	0.0011	94	249
DM2A	14/08/2012	-	0.0015	18	0.0031	55	100
DM2A	26/10/2012	-	0.001	28	0.0017	101	278
DM2A	16/01/2013	-	0.005	26	0.001	40	100
DM2A	9/04/2013	-	0.001	16	0.001	42	100
DM2A	10/10/2013	0.001	0.004	18	0.026	52	<100
DM2A	9/04/2014	0.008	**0.067**	17	1.1	51	100
DM2A	16/10/2014	0.002	0.002	36	0.018	142	112
DM2A	16/04/2015	0.002	0.002	20	0.02	61	100
DM2A	3/09/2015	0.003	0.004	16	0.055	-	-
DM2A	4/09/2015	-	-	-	-	81	<100
DM2A	15/04/2016	-	-	-	-	-	-
DM2A	21/04/2016	0.004	**0.023**	35	0.29	-	-
DM2A	15/09/2016	<0.001	0.01	12	0.11	<100	<100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM2C	1/03/1989	-	-	6	-	20	-
DM2C	1/08/1989	-	-	2.2	-	37	-
DM2C	1/11/1989	-	-	11	-	66	-
DM2C	1/06/1990	-	-	6	0.02	8.8	-
DM2C	1/10/1990	-	-	6	0.02	37	65
DM2C	1/12/1990	-	-	10	-	18.2	117.2
DM2C	1/01/1991	-	-	-	-	-	-
DM2C	1/04/1991	-	-	5.1	0.04	7.8	-
DM2C	1/06/1991	-	-	9	0.02	18	-
DM2C	1/09/1991	-	-	7.3	0.02	19.8	-
DM2C	1/12/1991	-	-	8	0.05	-	-
DM2C	1/04/1992	-	-	7.5	0.02	19.6	-
DM2C	1/07/1992	-	-	7.1	0.2	47	-
DM2C	1/10/1992	-	-	7.6	0.02	37	-
DM2C	1/01/1993	-	-	12.5	0.02	37	-
DM2C	1/04/1993	-	-	11.5	0.1	37	-
DM2C	1/07/1993	-	-	11.5	0.05	57	-
DM2C	1/10/1993	-	-	8.5	0.1	27	-
DM2C	1/01/1994	-	-	7.5	0.05	43	-
DM2C	1/04/1994	-	-	7	0.1	10.6	-
DM2C	1/07/1994	-	-	7	0.1	46	-
DM2C	1/10/1994	-	-	7	0.1	51	-
DM2C	1/01/1995	-	-	7.5	0.1	37	-
DM2C	1/04/1995	-	-	6.5	0.05	37	-
DM2C	1/07/1995	-	-	6.5	0.5	37	-
DM2C	1/10/1995	-	-	8.5	0.5	44	-
DM2C	1/01/1996	-	-	11	0.5	37	-
DM2C	1/07/1996	-	-	14	0.5	15	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM2C	1/10/1996	-	-	14	0.5	34	-
DM2C	1/01/1997	-	-	10	0.5	4	-
DM2C	1/04/1997	-	-	20	0.2	17	-
DM2C	1/07/1997	-	-	20	0.5	30	-
DM2C	1/10/1997	-	-	30	0.1	20	-
DM2C	1/01/1998	-	-	34	0.5	20	-
DM2C	1/07/1998	-	-	26	0.5	-	-
DM2C	1/10/1998	-	-	28	0.2	98	-
DM2C	1/02/1999	-	-	27	0.2	-	-
DM2C	1/05/1999	-	-	22	0.2	-	-
DM2C	1/08/1999	-	-	28	0.5	32	-
DM2C	1/10/1999	-	-	28	0.1	-	-
DM2C	1/02/2000	-	-	31	0.1	22	-
DM2C	1/06/2000	-	-	33	0.1	25	-
DM2C	9/08/2000	-	-	27	0.1	20	-
DM2C	30/10/2000	-	-	21	0.1	34	55
DM2C	1/02/2001	-	-	27	0.1	12	-
DM2C	8/05/2001	-	-	30	0.1	14	-
DM2C	26/07/2001	-	-	27	0.1	21	-
DM2C	29/10/2001	-	-	26	0.005	70	80
DM2C	8/02/2002	-	-	37	0.05	120	110
DM2C	15/04/2002	-	-	25	0.05	130	110
DM2C	12/08/2002	-	-	36	0.05	140	130
DM2C	6/11/2002	-	-	35	0.005	20	273
DM2C	13/02/2003	-	-	31	0.005	35	-
DM2C	30/04/2003	-	-	45	0.005	33	-
DM2C	9/08/2003	-	-	38	0.005	23	-
DM2C	24/11/2003	-	-	42	0.005	-	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM2C	10/02/2004	-	-	37	0.005	16	522
DM2C	14/05/2004	-	-	24	0.005	17	530
DM2C	6/08/2004	-	0.005	25	0.005	8	333
DM2C	10/11/2004	-	0.005	22	-	25	237
DM2C	16/02/2005	-	-	27	-	15	100
DM2C	15/04/2005	-	-	28	0.0066	40	213
DM2C	2/08/2005	-	-	26	0.001	54	100
DM2C	14/11/2005	-	-	24	0.001	24	387
DM2C	15/02/2006	-	0.004	-	0.0012	48	100
DM2C	18/05/2006	-	-	-	-	73	305
DM2C	17/08/2006	-	-	-	-	36	100
DM2C	31/10/2006	-	0.003	23	0.002	34	100
DM2C	8/03/2007	-	0.001	23	0.001	17	208
DM2C	19/06/2007	-	0.001	20	0.001	21	582
DM2C	30/08/2007	-	0.001	14	0.001	-	-
DM2C	2/11/2007	-	0.002	15	0.002	14	242
DM2C	2/04/2008	-	0.001	14	0.002	36	446
DM2C	8/07/2008	-	0.002	16	0.001	-	-
DM2C	8/09/2008	-	0.002	15	0.001	100	283
DM2C	8/12/2008	-	0.001	14	0.001	3	487
DM2C	1/03/2009	-	0.001	15	0.002	11	100
DM2C	1/07/2009	-	0.001	12	0.002	19	285
DM2C	30/09/2009	-	0.002	14	0.002	28	239
DM2C	23/12/2009	-	0.001	18	0.001	21	747
DM2C	16/02/2010	-	0.002	19	0.002	54	464
DM2C	20/05/2010	-	**0.028**	15	0.001	470	361
DM2C	18/08/2010	-	0.001	15	0.002	65	100
DM2C	25/11/2010	-	0.002	15	0.002	137	190

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM2C	9/02/2011	-	0.005	16	0.001	454	100
DM2C	11/05/2011	-	0.0017	16	0.001	53	100
DM2C	9/08/2011	-	0.001	15	0.001	20	100
DM2C	10/08/2011	-	-	-	-	-	-
DM2C	10/11/2011	-	0.001	15	0.001	7	113
DM2C	23/01/2012	0.0036	0.0017	15	0.002	11	139
DM2C	24/05/2012	0.0043	0.0015	16	0.0011	31	100
DM2C	14/08/2012	-	0.0021	17	0.0062	81	635
DM2C	26/10/2012	-	0.0027	15	0.02	30	209
DM2C	16/01/2013	-	0.001	17	0.001	13	100
DM2C	9/04/2013	-	0.001	13	0.002	32	100
DM2C	10/10/2013	0.004	0.005	15	0.056	47	<100
DM2C	9/04/2014	0.004	0.003	18	0.035	50	100
DM2C	16/10/2014	0.003	<0.001	40	0.002	83	100
DM2C	16/04/2015	0.003	<0.001	22	0.002	122	100
DM2C	3/09/2015	0.003	<0.001	17	0.006	-	-
DM2C	4/09/2015	-	-	-	-	98	<100
DM2C	15/04/2016	-	-	-	-	-	-
DM2C	21/04/2016	0.004	0.002	31	0.018	-	-
DM2C	15/09/2016	0.002	0.001	15	0.004	<100	<100
DM2C	22/04/2016	-	-	-	-	<100	<100
DM2C	22/04/2016	-	-	-	-	<100	102

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM4A	1/07/1996	-	-	6	0.5	63	-
DM4A	1/10/1996	-	-	6	0.5	85	-
DM4A	1/01/1997	-	-	6.2	0.5	111	-
DM4A	1/04/1997	-	-	6.2	0.5	120	-
DM4A	1/07/1997	-	-	7	-	60	-
DM4A	1/10/1997	-	-	7.1	-	50	-
DM4A	1/01/1998	-	-	7.3	0.5	70	-
DM4A	1/07/1998	-	-	6	0.5	187.2	-
DM4A	1/10/1998	-	-	8.3	0.2	243	-
DM4A	1/02/1999	-	-	9.3	0.2	-	-
DM4A	1/05/1999	-	-	7.3	0.2	-	-
DM4A	1/08/1999	-	-	11	0.5	40	-
DM4A	1/10/1999	-	-	9.7	0.1	-	-
DM4A	1/02/2000	-	-	9.7	0.1	141	-
DM4A	1/06/2000	-	-	11	0.1	86	640
DM4A	9/08/2000	-	-	11	0.1	18	-
DM4A	1/02/2001	-	-	10	0.1	-	-
DM4A	8/05/2001	-	-	12	0.1	75	-
DM4A	26/07/2001	-	-	11	0.1	156	-
DM4A	29/10/2001	-	-	11	0.05	80	70
DM4A	8/02/2002	-	-	10	0.05	180	250
DM4A	19/04/2002	-	-	10	0.05	130	110
DM4A	12/08/2002	-	-	13	0.05	220	140
DM4A	6/11/2002	-	-	10	0.005	46	-
DM4A	13/02/2003	-	-	10	0.005	84	208
DM4A	30/04/2003	-	-	12	0.005	34	-
DM4A	9/08/2003	-	-	13	0.005	53	-
DM4A	24/11/2003	-	-	12	0.005	193	100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM4A	10/02/2004	-	-	11	0.005	66	665
DM4A	14/05/2004	-	-	12	0.005	70	685
DM4A	6/08/2004	-	0.005	12	0.005	35	630
DM4A	10/11/2004	-	0.005	12	-	49	241
DM4A	16/02/2005	-	-	11	-	40	100
DM4A	15/04/2005	-	-	12	0.0062	73	100
DM4A	2/08/2005	-	-	13	0.089	89	690
DM4A	14/11/2005	-	-	11	0.001	69	138
DM4A	15/02/2006	-	0.002	-	0.001	107	735
DM4A	18/05/2006	-	-	-	-	169	394
DM4A	17/08/2006	-	-	-	-	61	479
DM4A	31/10/2006	-	0.002	13	0.001	127	100
DM4A	8/03/2007	-	0.001	17	0.001	76	100
DM4A	19/06/2007	-	0.002	15	0.001	40	415
DM4A	30/08/2007	-	0.001	13	0.001	-	-
DM4A	2/11/2007	-	0.002	12	0.001	44	431
DM4A	2/04/2008	-	0.003	11	0.001	15	100
DM4A	8/07/2008	-	0.001	11	0.001	170	100
DM4A	8/09/2008	-	0.002	12	0.001	100	350
DM4A	1/12/2008	-	0.001	9.4	0.001	39	100
DM4A	9/03/2009	-	0.003	13	0.001	46	361
DM4A	1/07/2009	-	0.002	11	0.001	107	198
DM4A	30/09/2009	-	0.003	12	0.001	21	294
DM4A	23/12/2009	-	0.003	15	0.001	22	379
DM4A	17/02/2010	-	0.008	12	0.003	48	743
DM4A	20/05/2010	-	**0.015**	13	0.001	44	100
DM4A	18/08/2010	-	0.002	13	0.001	49	100
DM4A	24/11/2010	-	0.003	13	0.001	42	100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM4A	9/02/2011	-	0.002	11	0.001	48	100
DM4A	11/05/2011	-	**0.011**	15	0.001	94	146
DM4A	10/11/2011	-	0.0019	14	0.0038	303	100
DM4A	23/01/2012	-	-	-	-	-	-
DM4A	24/01/2012	0.0013	0.006	15	0.001	17	153
DM4A	24/05/2012	0.0015	0.0083	16	0.001	90	100
DM4A	14/08/2012	-	0.0039	17	0.001	46	100
DM4A	26/10/2012	-	0.0041	17	0.001	564	361
DM4A	16/01/2013	-	0.003	15	0.001	14	100
DM4A	9/04/2013	-	0.004	11	0.001	25	100
DM4A	10/10/2013	<0.001	0.003	12	<0.001	61	<100
DM4A	9/04/2014	<0.001	0.004	12	0.001	37	100
DM4A	16/10/2014	<0.001	0.008	25	<0.001	53	100
DM4A	16/04/2015	<0.001	0.007	15	<0.001	36	100
DM4A	3/09/2015	<0.001	0.006	13	<0.001	-	-
DM4A	4/09/2015	-	-	-	-	179	<100
DM4A	15/04/2016	-	-	-	-	-	-
DM4A	21/04/2016	<0.001	0.006	25	<0.001	-	-
DM4A	15/09/2016	<0.001	0.003	11	<0.001	<100	<100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM4C	1/07/1996	-	-	7	0.5	23	-
DM4C	1/10/1996	-	-	7	0.5	32	-
DM4C	1/01/1997	-	-	8	0.5	38	-
DM4C	1/04/1997	-	-	8.7	0.2	32	-
DM4C	1/07/1997	-	-	7	0.5	0.02	-
DM4C	1/10/1997	-	-	7	0.1	0.02	-
DM4C	1/01/1998	-	-	8.1	0.5	30	-
DM4C	1/07/1998	-	-	9	0.5	-	-
DM4C	1/10/1998	-	-	11	0.2	139	-
DM4C	1/02/1999	-	-	9.9	0.2	-	-
DM4C	1/05/1999	-	-	9	0.2	-	-
DM4C	1/08/1999	-	-	9.2	0.5	24	-
DM4C	1/10/1999	-	-	10	0.1	-	-
DM4C	1/02/2000	-	-	9	0.1	74	426
DM4C	1/06/2000	-	-	12	0.1	44	-
DM4C	9/08/2000	-	-	12	0.2	95	862
DM4C	30/10/2000	-	-	12	0.1	57	-
DM4C	1/02/2001	-	-	11	0.1	113	-
DM4C	8/05/2001	-	-	17	0.1	64	-
DM4C	26/07/2001	-	-	12	0.1	67	313
DM4C	29/10/2001	-	-	13	0.05	70	60
DM4C	8/02/2002	-	-	11	0.05	180	240
DM4C	19/04/2002	-	-	11	0.05	120	110
DM4C	12/08/2002	-	-	9	0.05	180	130
DM4C	6/11/2002	-	-	9	0.005	37	-
DM4C	13/02/2003	-	-	9	0.005	72	353
DM4C	30/04/2003	-	-	9	0.005	40	-
DM4C	9/08/2003	-	-	10	0.005	38	-

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM4C	24/11/2003	-	-	11	0.005	117	100
DM4C	10/02/2004	-	-	11	0.005	42	-
DM4C	13/05/2004	-	-	11	0.005	43	100
DM4C	6/08/2004	-	0.005	12	0.005	21	100
DM4C	10/11/2004	-	0.005	11	-	26	100
DM4C	16/02/2005	-	-	11	-	21	342
DM4C	15/04/2005	-	-	12	0.0054	54	411
DM4C	2/08/2005	-	-	13	0.001	79	100
DM4C	14/11/2005	-	-	11	0.001	25	412
DM4C	15/02/2006	-	0.002	-	0.001	58	306
DM4C	18/05/2006	-	-	-	-	70	100
DM4C	17/08/2006	-	-	-	-	39	207
DM4C	31/10/2006	-	0.002	15	0.001	60	100
DM4C	8/03/2007	-	0.001	-	0.001	57	591
DM4C	19/06/2007	-	0.002	15	0.001	22	975
DM4C	30/08/2007	-	0.001	11	0.001	-	-
DM4C	2/11/2007	-	0.002	13	0.001	48	554
DM4C	2/04/2008	-	0.001	12	0.001	49	100
DM4C	8/07/2008	-	0.001	14	0.001	223	282
DM4C	8/09/2008	-	0.001	13	0.001	100	319
DM4C	1/12/2008	-	0.003	11	0.001	53	317
DM4C	1/03/2009	-	0.001	12	0.001	41	100
DM4C	1/07/2009	-	0.001	11	0.001	42	290
DM4C	30/09/2009	-	0.003	13	0.001	255	372
DM4C	23/12/2009	-	0.003	17	0.001	1052	732
DM4C	17/02/2010	-	0.001	13	0.001	56	351
DM4C	20/05/2010	-	0.007	13	0.001	70	449
DM4C	18/08/2010	-	0.001	12	0.001	58	100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM4C	24/11/2010	-	0.001	12	0.001	588	100
DM4C	9/02/2011	-	0.002	11	0.001	43	100
DM4C	11/05/2011	-	0.001	13	0.001	72	100
DM4C	10/11/2011	-	0.001	15	0.001	25	100
DM4C	23/01/2012	-	-	-	-	-	-
DM4C	24/01/2012	0.0041	0.004	15	0.001	3	100
DM4C	24/05/2012	0.0036	0.0083	15	0.001	41	100
DM4C	14/08/2012	-	0.006	15	0.001	30	100
DM4C	26/10/2012	-	0.0027	17	0.001	28	11
DM4C	16/01/2013	-	0.001	17	0.001	8	100
DM4C	9/04/2013	-	0.002	12	0.001	3	100
DM4C	10/10/2013	0.003	0.002	12	<0.001	40	<100
DM4C	9/04/2014	0.003	0.002	13	.001 - 0.0	17	100
DM4C	16/10/2014	0.004	<0.001	32	<0.001	74	100
DM4C	16/04/2015	0.002	0.001	18	<0.001	96	100
DM4C	3/09/2015	0.003	0.001	14	<0.001	-	-
DM4C	4/09/2015	-	-	-	-	23	<100
DM4C	15/04/2016	-	-	-	-	-	-
DM4C	21/04/2016	0.003	0.002	22	<0.001	-	-
DM4C	15/09/2016	0.002	0.002	9.3	<0.001	<100	<100
DM4C	22/04/2016	-	-	-	-	192	<100
DM4C	22/04/2016	-	-	-	-	<100	<100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM7A	30/09/2009	-	0.001	7.9	0.001	49	262
DM7A	23/12/2009	-	0.001	11	0.001	15	186
DM7A	17/02/2010	-	0.001	7.8	0.001	45	320
DM7A	21/05/2010	-	0.01	11	0.001	42	100
DM7A	18/08/2010	-	0.001	8.6	0.001	108	203
DM7A	24/11/2010	-	0.001	9.2	0.001	37	100
DM7A	9/02/2011	-	0.001	9.2	0.001	37	100
DM7A	11/05/2011	-	0.001	9.9	0.001	29	100
DM7A	9/08/2011	-	0.001	10	0.001	17	100
DM7A	10/08/2011	-	-	-	-	-	-
DM7A	10/11/2011	-	0.001	10	0.001	142	325
DM7A	23/01/2012	0.0015	0.001	11	0.001	17	100
DM7A	24/05/2012	0.0011	0.0042	11	0.001	44	482
DM7A	14/08/2012	-	0.001	11	0.001	59	161
DM7A	26/10/2012	-	0.001	19	0.003	57	100
DM7A	16/01/2013	-	0.001	9.5	0.001	23	100
DM7A	9/04/2013	-	0.001	6.4	0.001	75	100
DM7A	10/10/2013	0.002	0.001	8	0.001	62	<100
DM7A	9/04/2014	<0.004	<0.001	9.3	0.002	72	100
DM7A	16/10/2014	0.001	<0.001	11	<0.001	86	181
DM7A	16/04/2015	0.002	<0.001	7.3	<0.001	98	100
DM7A	3/09/2015	0.002	<0.001	8.7	<0.001	-	-
DM7A	4/09/2015	-	-	-	-	14	<100
DM7A	15/04/2016	-	-	-	-	-	-
DM7A	21/04/2016	0.002	<0.001	7.5	<0.001	-	-
DM7A	15/09/2016	0.001	<0.001	3.9	<0.001	<100	<100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM7C	1/07/1992	-	-	6.1	-	37	-
DM7C	1/10/1992	-	-	7.2	-	37	-
DM7C	1/01/1993	-	-	5.8	-	37	-
DM7C	1/04/1993	-	-	4.4	-	37	-
DM7C	1/07/1993	-	-	5.1	-	37	-
DM7C	1/10/1993	-	-	5.4	-	3	-
DM7C	1/01/1994	-	-	5.5	-	37	-
DM7C	1/04/1994	-	-	5.5	-	5	-
DM7C	1/07/1994	-	-	5.5	-	37	-
DM7C	1/10/1994	-	-	6.5	-	59	-
DM7C	1/01/1995	-	-	8	-	38	-
DM7C	1/04/1995	-	-	8	-	44	-
DM7C	1/07/1995	-	-	8.5	-	37	-
DM7C	1/10/1995	-	-	11.5	-	37	-
DM7C	1/01/1996	-	-	12	-	69	-
DM7C	1/07/1996	-	-	11	0.5	42	-
DM7C	1/10/1996	-	-	12	0.5	72	-
DM7C	1/01/1997	-	-	13	0.5	73	-
DM7C	1/04/1997	-	-	12	0.2	84	-
DM7C	1/07/1997	-	-	11	0.5	80	-
DM7C	1/10/1997	-	-	8.8	0.1	90	-
DM7C	1/01/1998	-	-	10	0.5	90	-
DM7C	1/07/1998	-	-	7	0.5	-	-
DM7C	1/10/1998	-	-	8.1	0.2	146	-
DM7C	1/02/1999	-	-	7.8	0.2	-	-
DM7C	1/05/1999	-	-	7.6	0.2	-	-
DM7C	1/08/1999	-	-	8.5	0.5	77	-
DM7C	1/10/1999	-	-	8.9	0.1	-	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM7C	1/02/2000	-	-	8.3	0.1	29	-
DM7C	1/06/2000	-	-	8.9	0.1	22	128
DM7C	9/08/2000	-	-	7	0.1	18	596
DM7C	30/10/2000	-	-	8	0.1	30	214
DM7C	1/02/2001	-	-	9.8	0.1	21	-
DM7C	8/05/2001	-	-	14	0.1	-	640
DM7C	26/07/2001	-	-	9.6	0.1	11	-
DM7C	29/10/2001	-	-	12	0.05	70	90
DM7C	8/02/2002	-	-	8	0.005	170	240
DM7C	15/04/2002	-	-	8	0.05	120	110
DM7C	12/08/2002	-	-	8	0.05	140	310
DM7C	6/11/2002	-	-	7	0.005	14	218
DM7C	13/02/2003	-	-	7	0.005	37	135
DM7C	30/04/2003	-	-	8	0.005	11	-
DM7C	9/08/2003	-	-	6	0.005	28	113
DM7C	24/11/2003	-	-	-	-	-	-
DM7C	25/11/2003	-	-	8	0.005	9	100
DM7C	10/02/2004	-	-	10	0.005	18	307
DM7C	13/05/2004	-	-	11	0.005	25	252
DM7C	6/08/2004	-	0.005	10	0.005	12	189
DM7C	10/11/2004	-	0.005	9.4	-	14	381
DM7C	16/02/2005	-	-	10	-	9	117
DM7C	15/04/2005	-	-	10	0.0064	3	100
DM7C	2/08/2005	-	-	11	0.002	37	424
DM7C	14/11/2005	-	-	9	0.001	22	441
DM7C	15/02/2006	-	0.003	-	0.002	21	405
DM7C	18/05/2006	-	-	-	-	70	397
DM7C	17/08/2006	-	-	-	-	36	399

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM7C	31/10/2006	-	0.001	12	0.002	31	100
DM7C	8/03/2007	-	0.001	15	0.002	34	530
DM7C	19/06/2007	-	0.001	13	0.002	49	446
DM7C	30/08/2007	-	0.001	9.2	0.002	-	-
DM7C	2/11/2007	-	0.001	10	0.002	25	100
DM7C	2/04/2008	-	0.001	9.1	0.002	17	350
DM7C	8/07/2008	-	0.001	11	0.002	100	100
DM7C	8/09/2008	-	0.001	8.1	0.002	100	287
DM7C	1/12/2008	-	0.001	8.2	0.002	35	216
DM7C	1/03/2009	-	0.001	9.3	0.002	3	100
DM7C	1/07/2009	-	0.001	8.4	0.002	33	449
DM7C	30/09/2009	-	0.001	8	0.002	42	100
DM7C	23/12/2009	-	0.001	11	0.001	24	322
DM7C	17/02/2010	-	0.001	10	0.002	64	522
DM7C	21/05/2010	-	0.006	12	0.003	9	100
DM7C	18/08/2010	-	0.001	9.8	0.002	21	207
DM7C	24/11/2010	-	0.001	11	0.002	49	195
DM7C	9/02/2011	-	0.001	8.5	0.001	27	216
DM7C	11/05/2011	-	0.001	11	0.001	46	100
DM7C	9/08/2011	-	0.001	11	0.001	45	100
DM7C	10/08/2011	-	-	-	-	-	-
DM7C	10/11/2011	-	0.001	11	0.0011	55	100
DM7C	23/01/2012	0.0097	0.001	11	0.0027	14	156
DM7C	24/05/2012	0.012	0.0014	11	0.0044	61	116
DM7C	14/08/2012	-	0.001	12	0.0028	31	214
DM7C	26/10/2012	-	0.001	12	0.0045	22	100
DM7C	16/01/2013	-	0.001	9.7	0.001	15	100
DM7C	9/04/2013	-	0.001	3.7	0.002	26	100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM7C	10/10/2013	0.01	0.003	9	0.02	80	<100
DM7C	9/04/2014	0.004	0.001	9.3	0.002	101	100
DM7C	16/10/2014	-	-	-	-	60	150
DM7C	16/04/2015	0.008	<0.001	8	0.003	91	100
DM7C	3/09/2015	0.009	<0.001	6.4	0.001	-	-
DM7C	4/09/2015	-	-	-	-	166	<100
DM7C	5/09/2015	-	-	-	-	227	<100
DM7C	15/04/2016	-	-	-	-	-	-
DM7C	21/04/2016	0.01	<0.001	11	0.006	-	-
DM7C	15/09/2016	0.005	<0.001	4.8	0.004	<100	<100
DM7C	22/04/2016	-	-	-	-	<100	<100
DM7C	15/09/2016	-	-	-	-	<100	<100
DM7C	22/04/2016	-	-	-	-	126 - 136	<100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM8A	30/09/2009	-	-	-	-	-	-
DM8A	9/11/2009	-	0.004	17	0.021	-	-
DM8A	23/12/2009	-	0.001	20	0.002	49	297
DM8A	16/02/2010	-	0.001	14	0.001	375	123
DM8A	20/05/2010	-	0.003	15	0.001	39	282
DM8A	18/08/2010	-	**0.011**	14	0.001	104	421
DM8A	24/11/2010	-	0.002	15	0.002	60	524
DM8A	8/02/2011	-	0.002	14	0.001	84	100
DM8A	11/05/2011	-	0.008	17	0.001	2451	304
DM8A	9/08/2011	-	**0.017**	15	0.001	37	457
DM8A	10/08/2011	-	-	-	-	-	-
DM8A	1/11/2011	-	-	-	-	-	-
DM8A	10/11/2011	-	0.0012	16	0.001	28	100
DM8A	23/01/2012	0.0079	0.0016	15	0.001	42	100
DM8A	24/05/2012	0.0097	0.0035	20	0.001	39	321
DM8A	14/08/2012	-	0.0011	19	0.001	47	223
DM8A	26/10/2012	-	0.001	22	0.001	124	100
DM8A	16/01/2013	-	0.003	19	0.001	29	100
DM8A	9/04/2013	-	0.004	14	0.001	79	197
DM8A	10/10/2013	0.055	0.001	13	0.001	77	<100
DM8A	9/04/2014	0.009	0.001	14	0.001	79	100
DM8A	16/10/2014	0.019	<0.001	30	<0.001	110	104
DM8A	16/04/2015	0.021	<0.001	17	<0.001	117	272
DM8A	3/09/2015	0.001	<0.001	17	<0.001	-	-
DM8A	4/09/2015	-	-	-	-	102	176
DM8A	5/09/2015	-	-	-	-	-	-
DM8A	15/04/2016	-	-	-	-	-	-
DM8A	21/04/2016	0.003	<0.001	29	<0.001	-	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM8A	15/09/2016	0.002	<0.001	12	<0.001	<100	<100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM8C	30/09/2009	-	0.003	13	0.001	27	465
DM8C	23/12/2009	-	0.001	21	0.001	15	204
DM8C	16/02/2010	-	0.002	13	0.001	138	283
DM8C	13/05/2010	-	0.003	14	0.001	21	254
DM8C	18/08/2010	-	0.001	15	0.001	44	259
DM8C	24/11/2010	-	0.001	15	0.001	49	110
DM8C	8/02/2011	-	0.001	6.3	0.001	26	100
DM8C	11/05/2011	-	0.001	17	0.001	41	100
DM8C	9/08/2011	-	0.002	16	0.001	74	100
DM8C	10/08/2011	-	-	-	-	-	-
DM8C	1/11/2011	-	-	-	-	-	-
DM8C	10/11/2011	-	0.001	17	0.001	17	100
DM8C	23/01/2012	0.0015	0.002	20	0.001	12	100
DM8C	24/05/2012	0.0013	0.0037	20	0.001	67	100
DM8C	14/08/2012	-	0.001	18	0.001	46	181
DM8C	26/10/2012	-	0.001	21	0.0011	54	154
DM8C	16/01/2013	-	0.001	19	0.001	47	100
DM8C	9/04/2013	-	0.003	15	0.001	38	100
DM8C	10/10/2013	0.001	0.002	15	0.001	123	<100
DM8C	9/04/2014	0.001	0.001	13	0.001	64	100
DM8C	16/10/2014	001 - 0.(	<0.001	30 - 35	<0.001	70	100
DM8C	16/04/2015	<0.001	0.001	21	<0.001	93	141
DM8C	3/09/2015	0.03	<0.001	13	<0.001	-	-
DM8C	4/09/2015	-	-	-	-	93	<100
DM8C	15/04/2016	-	-	-	-	-	-
DM8C	21/04/2016	0.023	0.001	25	0.001	-	-
DM8C	15/09/2016	0.037	<0.001	9.6	0.002	<100	<100
DM8C	22/04/2016	-	-	-	-	<100	<100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM8C	22/04/2016	-	-	-	-	122	<100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM9A	29/10/2001	-	-	11	0.005	70	60
DM9A	8/02/2002	-	-	11	0.05	120	110
DM9A	15/04/2002	-	-	10	0.05	120	110
DM9A	12/08/2002	-	-	15	0.05	180	370
DM9A	6/11/2002	-	-	12	0.005	21	-
DM9A	13/02/2003	-	-	12	0.005	-	250
DM9A	30/04/2003	-	-	12	0.005	6	498
DM9A	9/08/2003	-	-	10	0.005	30	349
DM9A	24/11/2003	-	-	11	0.005	8	100
DM9A	10/02/2004	-	-	12	0.005	12	387
DM9A	13/05/2004	-	-	13	0.005	9	100
DM9A	6/08/2004	-	0.005	12	0.005	20	100
DM9A	10/11/2004	-	0.005	11	-	19	100
DM9A	16/02/2005	-	0	12	-	10	384
DM9A	15/04/2005	-	-	13	-	14	100
DM9A	2/08/2005	-	-	14	0.001	17	438
DM9A	14/11/2005	-	-	10	0.001	20	274
DM9A	15/02/2006	-	0.003	0	0.0011	3	429
DM9A	18/05/2006	-	-	0	-	17	100
DM9A	17/08/2006	-	0	0	0	28	345
DM9A	31/10/2006	-	0.001	6.5	0.001	40	100
DM9A	8/03/2007	-	0.001	6.5	0.001	23	473
DM9A	19/06/2007	-	0.001	6.5	0.001	-	-
DM9A	30/08/2007	-	0.001	4.9	0.001	-	-
DM9A	2/11/2007	-	0.001	4.5	0.001	17	100
DM9A	2/04/2008	-	0.004	3.3	0.001	7	100
DM9A	8/07/2008	-	0.001	4.1	0.002	293	100
DM9A	8/09/2008	-	0.001	2.4	0.001	100	100

					Radionuclides	
	Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
	mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL	0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%		0.013				
ANZECC 2000 FW 95%		**0.011**				
ANZECC 2000 MW 90%		0.2		0.16		
ANZECC 2000 MW 95%		0.07		0.1		

Field_ID	Sampled_Date-Ti						
DM9A	1/12/2008	-	-	-	-	-	-
DM9A	1/03/2009	-	0.001	2.9	0.001	19	148
DM9A	1/07/2009	-	0.001	2.8	0.001	40	198
DM9A	30/09/2009	-	0.001	2.7	0.002	36	304
DM9A	23/12/2009	-	0.001	3.3	0.002	52	236
DM9A	16/02/2010	-	0.001	2.3	0.001	14	384
DM9A	14/05/2010	-	0.001	2.4	0.003	253	160
DM9A	18/08/2010	-	-	-	-	-	-
DM9A	19/08/2010	-	0.002	2.6	0.001	13	100
DM9A	24/11/2010	-	0.001	2.5	0.001	12	100
DM9A	9/02/2011	-	0.001	2.8	0.001	602	100
DM9A	11/05/2011	-	0.001	4.9	0.0012	25	349
DM9A	10/08/2011	-	0.001	4.2	0.001	69	130
DM9A	10/11/2011	0.001	0.001	3.8	0.001	66	100
DM9A	23/01/2012	0.001	0.001	4.2	0.001	25	100
DM9A	24/05/2012	0.001	0.0017	5.1	0.002	314	202
DM9A	14/08/2012	0.001	0.001	5.6	0.0025	72	497
DM9A	26/10/2012	0.001	0.001	4.8	0.0025	20	100
DM9A	16/01/2013	0.001	0.001	4.8	0.001	24	100
DM9A	9/04/2013	0.002	0.001	3.8	<0.001	111	200
DM9A	10/10/2013	<0.001	0.001	5.7	0.003	51	<100
DM9A	9/04/2014	<0.001	<0.001	2.5	0.001	3	100
DM9A	16/10/2014	<0.001	<0.001	10	<0.001	-	-
DM9A	16/04/2015	<0.001	<0.001	3.7	0.003	37	100
DM9A	3/09/2015	<0.001	<0.001	4.6	0.002	-	-
DM9A	4/09/2015	-	-	-	-	260	<100
DM9A	5/09/2015	-	-	-	-	-	-
DM9A	15/04/2016	-	-	-	-	-	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM9A	21/04/2016	<0.001	0.001	10	<0.001	-	-
DM9A	15/09/2016	0.002	0.004	11	<0.001	-	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM9C	1/10/1996	-	-	2	0.5	89	-
DM9C	1/01/1997	-	-	1.8	0.5	18	-
DM9C	1/04/1997	-	-	1.7	0.2	17	-
DM9C	1/07/1997	-	-	1.5	0.5	30	-
DM9C	1/10/1997	-	-	2.3	0.1	10	-
DM9C	1/01/1998	-	-	2.6	0.5	10	-
DM9C	1/07/1998	-	-	2	0.5	-	-
DM9C	1/10/1998	-	-	2.3	0.2	14	-
DM9C	1/02/1999	-	-	2	0.2	72	-
DM9C	1/05/1999	-	-	2	0.2	-	-
DM9C	1/08/1999	-	-	3.8	0.5	11	282
DM9C	1/10/1999	-	-	2.3	0.1	-	-
DM9C	1/02/2000	-	-	5.3	0.1	15	-
DM9C	1/06/2000	-	-	6.4	0.1	6	436
DM9C	9/08/2000	-	-	7	0.1	27	-
DM9C	30/10/2000	-	-	9	0.1	24	634
DM9C	1/02/2001	-	-	9.4	0.1	19	-
DM9C	8/05/2001	-	-	13	0.1	9	410
DM9C	26/07/2001	-	-	12	0.1	26	-
DM9C	29/10/2001	-	-	11	0.005	70	60
DM9C	8/02/2002	-	-	11	0.05	120	110
DM9C	15/04/2002	-	-	10	0.05	120	110
DM9C	12/08/2002	-	-	15	0.05	180	370
DM9C	6/11/2002	-	-	12	0.005	21	-
DM9C	13/02/2003	-	-	12	0.005	122	250
DM9C	30/04/2003	-	-	12	0.005	6	498
DM9C	9/08/2003	-	-	10	0.005	30	349
DM9C	24/11/2003	-	-	11	0.005	8	100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM9C	10/02/2004	-	-	12	0.005	12	387
DM9C	13/05/2004	-	-	13	0.005	9	100
DM9C	6/08/2004	-	0.005	12	0.005	20	100
DM9C	10/11/2004	-	0.005	11	-	19	100
DM9C	16/02/2005	-	0	12	-	10	384
DM9C	15/04/2005	-	-	13	0.002	14	100
DM9C	2/08/2005	-	-	14	0.001	17	438
DM9C	14/11/2005	-	-	10	0.001	20	274
DM9C	15/02/2006	-	0.003	0	0.0011	3	429
DM9C	18/05/2006	-	-	0	-	17	100
DM9C	17/08/2006	-	0	0	0	28	345
DM9C	31/10/2006	-	0.001	6.5	0.001	40	100
DM9C	8/03/2007	-	0.001	6.5	0.001	23	473
DM9C	19/06/2007	-	0.001	6.5	0.001	13	445
DM9C	30/08/2007	-	0.001	4.9	0.001	-	-
DM9C	2/11/2007	-	0.001	4.5	0.001	17	100
DM9C	2/04/2008	-	0.004	3.3	0.001	7	100
DM9C	8/07/2008	-	0.001	4.1	0.002	293	100
DM9C	8/09/2008	-	0.001	2.4	0.001	100	100
DM9C	1/12/2008	-	0.001	2.6	0.001	14	100
DM9C	1/03/2009	-	0.001	2.9	0.001	19	148
DM9C	1/07/2009	-	0.001	2.8	0.001	40	198
DM9C	30/09/2009	-	0.001	2.7	0.002	36	304
DM9C	23/12/2009	-	0.001	3.3	0.002	52	236
DM9C	16/02/2010	-	0.001	2.3	0.001	14	384
DM9C	14/05/2010	-	0.001	2.4	0.003	253	160
DM9C	18/08/2010	-	0.001	6.8	0.001	154	195
DM9C	19/08/2010	-	0.002	2.6	0.001	13	100

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
DM9C	24/11/2010	-	0.001	2.5	0.001	12	100
DM9C	9/02/2011	-	0.001	2.8	0.001	602	100
DM9C	11/05/2011	-	0.001	4.9	0.0012	25	349
DM9C	10/08/2011	-	0.001	4.2	0.001	69	130
DM9C	10/11/2011	-	0.001	3.8	0.001	66	100
DM9C	23/01/2012	<0.001	0.001	4.2	0.001	25	100
DM9C	24/05/2012	<0.001	0.0017	5.1	0.002	314	202
DM9C	14/08/2012	-	0.001	5.6	0.0025	72	497
DM9C	26/10/2012	-	0.001	4.8	0.0025	20	100
DM9C	16/01/2013	-	0.001	4.8	0.001	24	100
DM9C	9/04/2013	-	0.001	3.8	0.001	111	200
DM9C	10/10/2013	0.001	0.001	7	0.002	505	197
DM9C	9/04/2014	<0.001	0.002	7	0.001	3	100
DM9C	16/10/2014	<0.001	<0.001	4.1	0.001	3	142
DM9C	16/04/2015	<0.001	<0.001	8.1	<0.001	132	233
DM9C	3/09/2015	<0.001	<0.001	9.9	<0.001	-	-
DM9C	4/09/2015	-	-	-	-	49	<100
DM9C	15/04/2016	-	-	-	-	-	-
DM9C	21/04/2016	<0.001	<0.001	5.5	0.004	-	-
DM9C	15/09/2016	<0.001	<0.001	5.4	0.002	-	-
MB3	1/02/2001	-	-	18	0.1	51	-
MB3	8/05/2001	-	-	26	0.1	46	800
MB3	26/07/2001	-	-	18	0.1	51	-
MB3	29/10/2001	-	-	19	0.05	70	60
MB3	8/02/2002	-	-	16	0.05	170	250
MB3	19/04/2002	-	-	10	0.05	120	110
MB3	12/08/2002	-	-	6	0.05	140	130
MB3	6/11/2002	-	-	4	0.005	15	296

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
MB3	13/02/2003	-	-	3	0.005	17	-
MB3	30/04/2003	-	-	3	0.005	20	-
MB3	9/08/2003	-	-	4	0.005	19	-
MB3	24/11/2003	-	-	4	0.005	20	270
MB3	10/02/2004	-	-	5	0.005	9	-
MB3	13/05/2004	-	-	5	0.005	18	131
MB3	6/08/2004	-	0.005	5	0.005	9	350
MB3	10/11/2004	-	0.005	4.5	-	4	100
MB3	16/02/2005	-	-	5	-	5	321
MB3	15/04/2005	-	-	4	0.0029	18	100
MB3	2/08/2005	-	-	6	0.002	27	100
MB3	14/11/2005	-	-	6	0.002	18	372
MB3	15/02/2006	-	0.003	6	0.0017	29	658
MB3	18/05/2006	-	-	-	-	52	100
MB3	17/08/2006	-	-	-	-	13	215
MB3	31/10/2006	-	0.001	6.6	0.002	77	291
MB3	8/03/2007	-	0.001	7.5	0.001	3	261
MB3	19/06/2007	-	0.001	6.9	0.002	35	-
MB3	30/08/2007	-	0.001	5.7	0.001	-	-
MB3	2/11/2007	-	0.001	6	0.002	23	129
MB3	8/07/2008	-	0.001	7.2	0.002	238	185
MB3	8/09/2008	-	0.001	6.6	0.002	100	127
MB3	1/12/2008	-	0.001	6.2	0.001	58	296
MB3	1/03/2009	-	0.001	7.1	0.002	15	100
MB3	25/08/2009	-	0.001	6.6	0.002	58	490
MB3	30/09/2009	-	0.001	6.9	0.002	24	100
MB3	23/12/2009	-	0.001	8.4	0.001	12	211
MB3	17/02/2010	-	0.001	6.6	0.001	11	400

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
MB3	20/05/2010	-	0.001	6.7	0.001	114	269
MB3	18/08/2010	-	0.002	7.3	0.002	25	267
MB3	24/11/2010	-	0.001	7.7	0.001	17	260
MB3	9/02/2011	-	0.001	5.4	0.001	64	132
MB3	11/05/2011	-	0.001	8.3	0.001	129	123
MB3	9/08/2011	-	0.001	8.1	0.001	57	100
MB3	10/08/2011	-	-	-	-	-	-
MB3	10/11/2011	-	0.001	8.5	0.001	4	100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
MB3	23/01/2012	-	-	-	-	-	-
MB3	24/01/2012	0.0017	0.001	8.7	0.0014	14	100
MB3	16/02/2012	-	-	-	-	-	-
MB3	24/05/2012	0.0023	-	-	-	-	-
MB3	14/08/2012	-	-	-	-	-	-
MB3	29/10/2012	-	-	-	-	12	100
MB3	16/01/2013	-	-	12	-	8	100
MB3	9/04/2013	-	-	-	-	12	100
MB3	10/10/2013	0.002	0.001	7	0.002	54	<100
MB3	9/04/2014	0.002	<0.001	6.7	0.002	37	100
MB3	16/10/2014	0.002	<0.001	10	0.001	37	150
MB3	16/04/2015	0.001	<0.001	7.7	<0.001	150	146
MB3	3/09/2015	0.002	<0.001	7	<0.001	-	-
MB3	4/09/2015	-	-	-	-	69	<100
MB3	20/01/2016	-	-	-	-	-	-
MB3	15/04/2016	-	-	-	-	-	-
MB3	21/04/2016	0.001	<0.001	9.6	0.002	-	-
MB3	15/09/2016	<0.001	<0.001	5.7	0.002	-	-
MB3	15/09/2016	-	-	-	-	<100	<100
MB4	1/11/1988	-	-	12.6	-	57	70
MB4	1/03/1989	-	-	11.5	-	-	-
MB4	1/08/1989	-	-	8.5	-	72	-
MB4	1/11/1989	-	-	8.5	-	179	-
MB4	1/04/1990	-	-	8.5	-	62	-
MB4	1/06/1990	-	-	8.5	-	40.9	-
MB4	1/10/1990	-	-	8	-	37	-
MB4	1/12/1990	-	-	14	-	72.4	-
MB4	1/04/1991	-	-	12	-	98	-

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
MB4	1/08/1991	-	-	8.5	-	48.2	-
MB4	1/09/1991	-	-	7.9	-	32.3	-
MB4	1/12/1991	-	-	10.5	-	-	-
MB4	1/04/1992	-	-	12	-	113	-
MB4	1/07/1992	-	-	8.5	-	37	-
MB4	1/10/1992	-	-	7.6	-	69	-
MB4	1/01/1993	-	-	9.5	-	75	-
MB4	1/04/1993	-	-	9.5	-	71	-
MB4	1/07/1993	-	-	8	-	37	-
MB4	1/10/1993	-	-	6.8	-	22	-
MB4	1/01/1994	-	-	8	-	79	-
MB4	1/07/1995	-	-	17	-	169	-
MB4	1/10/1995	-	-	15.5	-	102	-
MB4	1/01/1996	-	-	16	-	72	-
MB4	1/07/1996	-	-	16	0.5	102	-
MB4	1/01/1998	-	-	13	0.5	0.08	-
MB4	1/07/1998	-	-	8	0.5	-	-
MB4	1/10/1998	-	-	7.7	0.2	29	-
MB4	1/02/1999	-	-	11.9	0.2	-	-
MB4	1/05/1999	-	-	8.9	0.2	-	-
MB4	1/08/1999	-	-	7.9	0.5	-	-
MB4	1/10/1999	-	-	7.2	0.1	-	-
MB4	1/02/2000	-	-	9.7	0.1	170	-
MB4	1/06/2000	-	-	7.3	0.1	68	282
MB4	9/08/2000	-	**0.65**	8	0.1	132	468
MB4	30/10/2000	-	-	6.8	0.1	52	-
MB4	1/02/2001	-	-	7.8	0.1	78	-
MB4	8/05/2001	-	-	8.7	0.1	80	-

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
MB4	26/07/2001	-	-	6.5	0.1	77	-
MB4	29/10/2001	-	-	7	0.005	70	60
MB4	8/02/2002	-	-	8	0.05	250	250
MB4	19/04/2002	-	-	6	0.05	120	110
MB4	12/08/2002	-	-	6	0.05	140	130
MB4	6/11/2002	-	-	7	0.005	43	210
MB4	13/02/2003	-	-	7	0.005	78	142
MB4	30/04/2003	-	-	7	0.005	47	-
MB4	9/08/2003	-	-	8	0.005	59	-
MB4	24/11/2003	-	-	8	0.005	59	463
MB4	10/02/2004	-	-	8	0.005	39	561
MB4	13/05/2004	-	-	9	0.005	51	277
MB4	6/08/2004	-	0.005	8	0.005	17	416
MB4	10/11/2004	-	0.005	8.7	-	19	507
MB4	16/02/2005	-	-	9	-	20	552
MB4	15/04/2005	-	-	8	0.002	67	-
MB4	2/08/2005	-	-	9	0.001	82	-
MB4	14/11/2005	-	-	9	0.001	24	242
MB4	15/02/2006	-	0.003	8	0.001	75	328
MB4	18/05/2006	-	-	-	-	104	448
MB4	17/08/2006	-	-	-	-	29	-
MB4	31/10/2006	-	0.001	9.4	0.001	8	365
MB4	8/03/2007	-	0.001	8.8	0.001	42	473
MB4	19/06/2007	-	0.001	6.9	0.001	41	373
MB4	30/08/2007	-	0.001	9	0.001	-	-
MB4	2/11/2007	-	0.001	6.7	0.001	21	639
MB4	2/04/2008	-	0.002	6.9	0.001	34	163
MB4	8/07/2008	-	0.001	6.8	0.001	286	472

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
MB4	8/09/2008	-	0.001	7.1	0.001	100	100
MB4	1/12/2008	-	0.001	6	0.002	7	180
MB4	1/03/2009	-	0.001	7.5	0.003	39	165
MB4	1/07/2009	-	0.001	6.7	0.001	34	583
MB4	30/09/2009	-	0.001	7.9	0.003	7	100
MB4	23/12/2009	-	0.001	8.9	0.003	3	100
MB4	17/02/2010	-	0.001	7.6	0.004	44	571
MB4	13/05/2010	-	**0.019**	7.7	0.009	4	276
MB4	18/08/2010	-	0.001	7	0.001	65	100
MB4	24/11/2010	-	0.001	7.3	0.001	35	145
MB4	9/02/2011	-	0.001	7.9	0.001	18	100
MB4	11/05/2011	-	0.001	8.4	0.001	89	100
MB4	10/11/2011	-	0.001	9.2	0.001	11	100
MB4	23/01/2012	-	-	-	-	-	-
MB4	24/01/2012	0.0027	0.005	8.7	0.038	9	146
MB4	24/05/2012	0.0011	0.005	8.2	0.0034	48	100
MB4	14/08/2012	-	0.0018	7.4	0.0059	44	100
MB4	26/10/2012	-	0.006	8.3	0.023	90	134
MB4	29/10/2012	-	-	-	-	-	-
MB4	16/01/2013	-	-	7.8	-	3	100
MB4	10/10/2013	0.005	0.004	54	0.034	67	<100
MB4	9/04/2014	0.003	0.008	10	0.074	66	100
MB4	22/05/2014	-	0.001	25	-	-	-
MB4	16/10/2014	<0.001	<0.001	13	0.001	3	100
MB4	16/04/2015	<0.001	<0.001	9.5	0.003	40	100
MB4	3/09/2015	<0.001	<0.001	6.8	0.003	-	-
MB4	4/09/2015	-	-	-	-	180	<100
MB4	15/04/2016	-	-	-	-	-	-

					Radionuclides	
	Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
	mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL	0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%		0.013				
ANZECC 2000 FW 95%		**0.011**				
ANZECC 2000 MW 90%		0.2		0.16		
ANZECC 2000 MW 95%		0.07		0.1		

Field_ID	**Sampled_Date-Ti**						
MB4	21/04/2016	0.003	0.001	14	0.02	-	-
MB4	15/09/2016	0.001	<0.001	6.7	0.002	<100	<100
MB4	22/04/2016	-	-	-	-	158	<100

						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
YB	15/04/2005	-	-	9	0.0015	32	100
YB	1/08/2005	-	-	-	-	-	-
YB	2/08/2005	-	-	9	0.001	41	315
YB	14/11/2005	-	-	7	0.001	30	567
YB	11/01/2006	-	-	0	-	-	-
YB	15/02/2006	-	0.001	0	0.001	35	432
YB	11/03/2006	-	-	0	-	-	-
YB	13/04/2006	-	-	0	-	-	-
YB	10/05/2006	-	-	0	-	-	-
YB	16/06/2006	-	0	0	0	-	-
YB	13/07/2006	-	0	0	0	-	-
YB	9/08/2006	-	0	0	0	-	-
YB	13/09/2006	-	0	0	0	-	-
YB	13/10/2006	-	0	0	0	-	-
YB	13/11/2006	-	0.001	9.1	0.001	-	-
YB	13/12/2006	-	0.001	7.7	0.001	-	-
YB	23/01/2007	-	0	0	0	-	-
YB	16/02/2007	-	0	0	0	-	-
YB	15/03/2007	-	-	-	-	-	-
YB	11/04/2007	-	0	0	0	-	-
YB	16/05/2007	-	-	-	-	-	-
YB	19/06/2007	-	0.001	9.3	0.001	-	-
YB	13/07/2007	-	0	0	0	-	-
YB	15/08/2007	-	0	0	0	-	-
YB	17/09/2007	-	0	0	0	-	-
YB	16/10/2007	-	0	0	0	-	-
YB	19/11/2007	-	-	-	-	-	-
YB	13/12/2007	-	-	-	-	-	-

						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
YB	1/03/2008	-	0.001	5.8	0.001	33	100
YB	21/04/2008	-	-	-	-	-	-
YB	8/05/2008	-	-	-	-	-	-
YB	8/06/2008	-	-	-	-	-	-
YB	8/07/2008	-	-	-	-	480	100
YB	8/08/2008	-	0.001	7.4	0.001	-	-
YB	8/09/2008	-	-	-	-	-	-
YB	8/10/2008	-	0.001	6.4	0.001	100	100
YB	8/11/2008	-	-	-	-	-	-
YB	8/12/2008	-	0.001	6.3	0.001	-	-
YB	9/01/2009	-	-	-	-	75	100
YB	1/02/2009	-	-	-	-	-	-
YB	1/03/2009	-	0.001	7.5	0.001	40	100
YB	1/04/2009	-	-	-	-	-	-
YB	1/05/2009	-	-	-	-	-	-
YB	1/06/2009	-	-	-	-	-	-
YB	1/07/2009	-	0.001	-	0.001	71	327
YB	1/08/2009	-	-	-	-	-	-
YB	1/09/2009	-	0.001	6.6	0.001	-	-
YB	1/10/2009	-	-	-	-	-	-
YB	1/11/2009	-	-	-	-	-	-
YB	1/12/2009	-	0.001	8.4	0.001	79	102
YB	1/01/2010	-	-	-	-	-	-
YB	8/01/2010	-	-	-	-	-	-
YB	1/02/2010	-	0.001	7.4	0.001	32	200
YB	1/03/2010	-	0.001	7	0.001	-	-
YB	1/04/2010	-	0.001	7.2	0.001	-	-
YB	20/05/2010	-	0.009	7.9	0.002	642	523

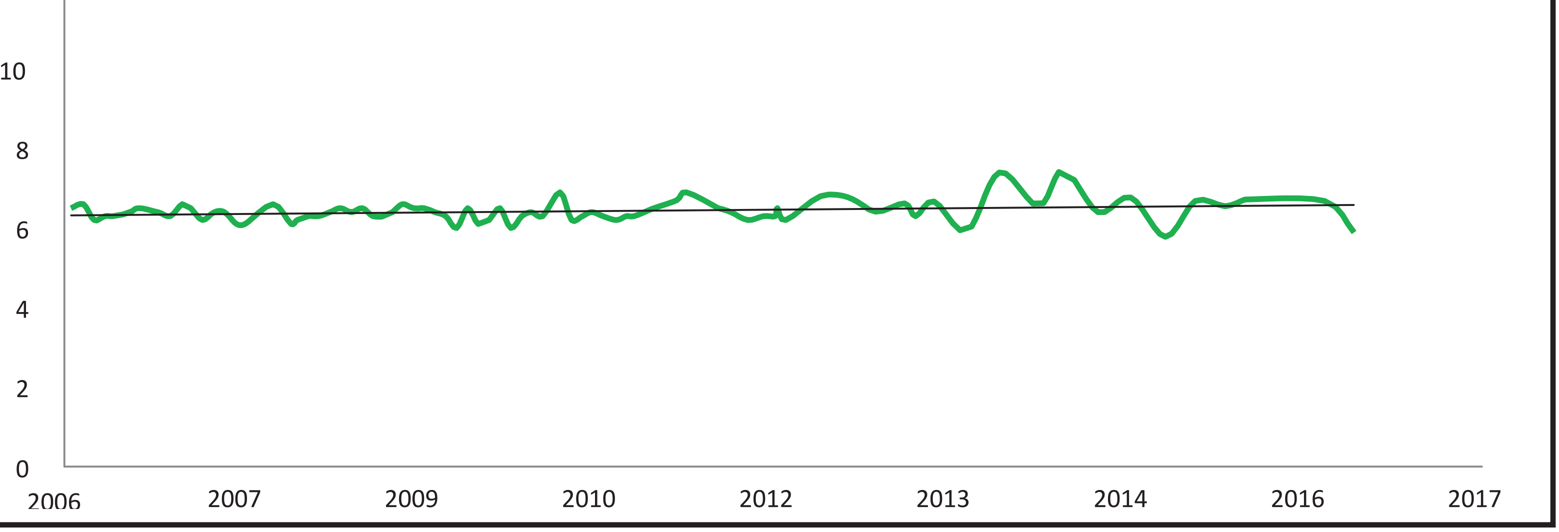
						Radionuclides	
		Molybdenum	**Nickel**	**Potassium**	**Vanadium Total**	**Radium-226**	**Radium-228**
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
YB	21/06/2010	-	0.001	8.2	0.001	-	-
YB	22/07/2010	-	-	-	-	-	-
YB	17/08/2010	-	-	-	-	-	-
YB	20/08/2010	-	-	-	-	60	304
YB	17/09/2010	-	-	-	-	-	-
YB	26/10/2010	-	-	-	-	-	-
YB	22/11/2010	-	-	-	-	-	-
YB	15/12/2010	-	-	-	-	-	-
YB	5/01/2011	-	-	-	-	-	-
YB	9/02/2011	-	0.001	8.3	0.001	76	100
YB	22/03/2011	-	-	-	-	-	-
YB	14/04/2011	-	-	-	-	-	-
YB	11/05/2011	-	-	-	-	463	100
YB	21/06/2011	-	-	-	-	-	-
YB	26/07/2011	-	-	-	-	-	-
YB	9/08/2011	-	-	-	-	104	158
YB	10/08/2011	-	-	-	-	-	-
YB	13/09/2011	-	-	-	-	-	-
YB	14/09/2011	-	-	-	-	-	-
YB	6/10/2011	-	-	-	-	40	100
YB	31/10/2011	-	-	-	-	-	-
YB	1/11/2011	-	-	22	-	-	-
YB	10/11/2011	-	-	-	-	-	-
YB	11/11/2011	-	-	-	-	63	100
YB	15/12/2011	-	-	-	-	-	-
YB	17/01/2012	-	-	-	-	43	121
YB	23/01/2012	-	-	-	-	-	-
YB	16/02/2012	-	-	-	-	-	-

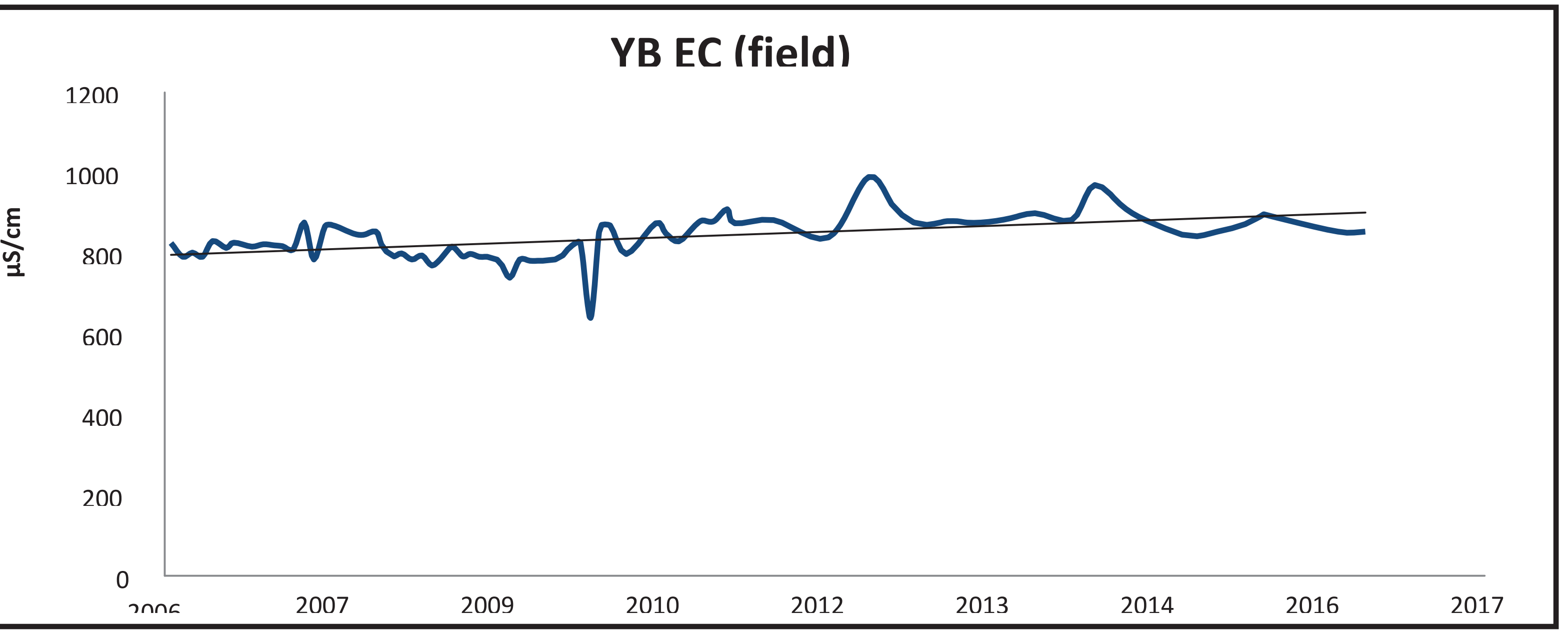
						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
YB	15/03/2012	-	-	-	-	-	-
YB	20/04/2012	-	-	-	-	-	-
YB	24/05/2012	0.0013	-	7.9	0.0012	38	100
YB	26/06/2012	-	-	-	-	-	-
YB	17/07/2012	-	-	-	-	-	-
YB	14/08/2012	-	-	8.1	-	39	114
YB	24/09/2012	-	-	-	-	-	-
YB	26/10/2012	-	-	8.2	-	40	100
YB	13/11/2012	-	-	-	-	-	-
YB	11/12/2012	-	-	-	-	-	-
YB	8/01/2013	-	-	-	-	-	-
YB	16/01/2013	-	0.001	8.1	0.001	36	100
YB	16/02/2013	-	-	-	-	-	-
YB	20/03/2013	-	-	-	-	-	-
YB	9/04/2013	-	0.001	5.8	0.001	56	100
YB	6/05/2013	-	-	-	-	-	-
YB	11/07/2013	-	0.001	8	0.001	56	100
YB	10/10/2013	<0.001	<0.001	8	0.002	64	<100
YB	29/01/2014	-	-	-	-	29	100
YB	9/04/2014	<0.001	0.001	8.3	0.008	74	100
YB	16/07/2014	-	-	-	-	-	-
YB	16/10/2014	<0.001	<0.001	10	<0.001	66	100
YB	22/01/2015	-	-	-	-	177	<100
YB	23/01/2015	-	-	-	-	-	-
YB	16/04/2015	<0.001	<0.001	8.7	<0.001	61	100
YB	9/07/2015	-	-	-	-	26	<100
YB	3/09/2015	<0.001	<0.001	10	<0.001	-	-
YB	4/09/2015	-	-	-	-	26	<100

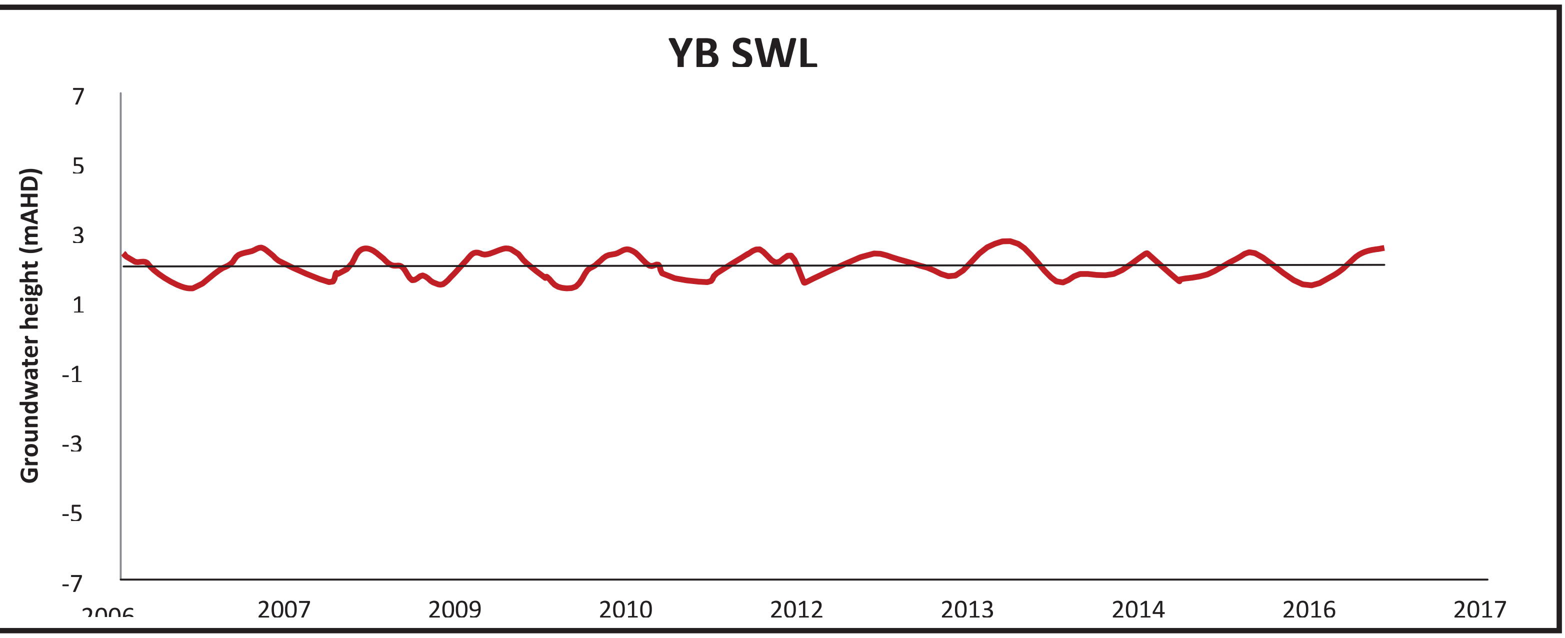
						Radionuclides	
		Molybdenum	Nickel	Potassium	Vanadium Total	Radium-226	Radium-228
		mg/L	mg/L	mg/L	mg/L	mBq/L	mBq/L
EQL		0.001	0.001	0.05	0.001		
ANZECC 2000 FW 90%			0.013				
ANZECC 2000 FW 95%			**0.011**				
ANZECC 2000 MW 90%			0.2		0.16		
ANZECC 2000 MW 95%			0.07		0.1		
Field_ID	**Sampled_Date-Ti**						
YB	20/01/2016	-	-	-	-	-	-
YB	15/04/2016	-	-	-	-	-	-
YB	21/04/2016	<0.001	0.002	10	0.017	-	-
YB	7/07/2016	-	-	-	-	-	-
YB	15/09/2016	<0.001	<0.001	8.4	0.007	-	-
YB	15/09/2016	-	-	-	-	<100	<100
YB	21/01/2016	-	-	-	-	<100	<100
YB	22/04/2016	-	-	-	-	533	192
YB	8/07/2016	-	-	-	-	232	<100

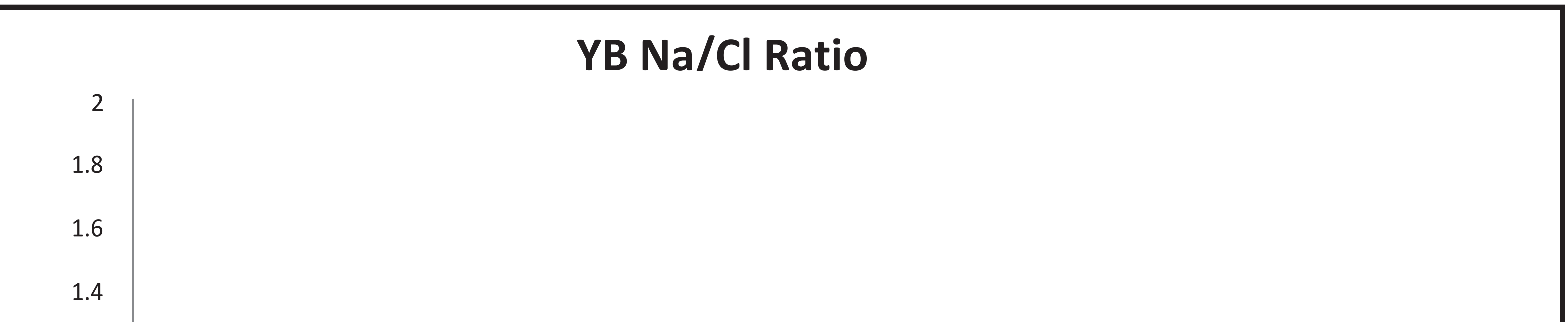
Appendix E

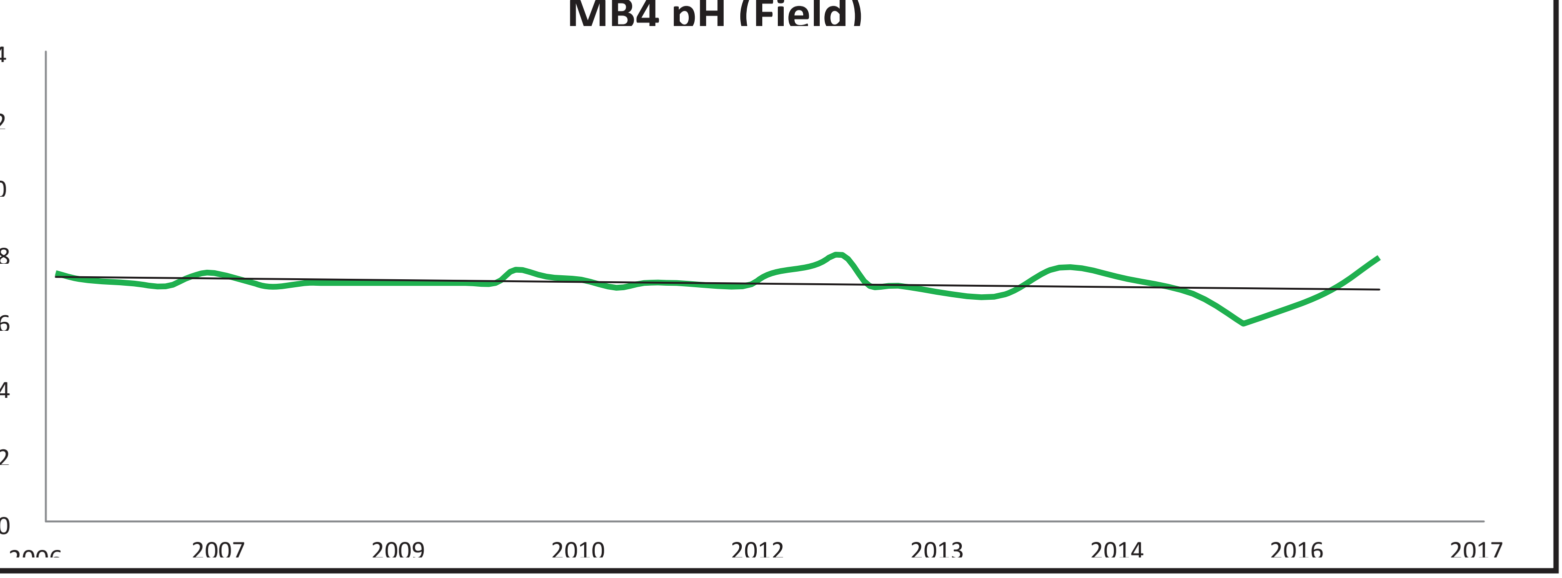
Monitoring Bore Water Chemistry and Standing Wat
Level

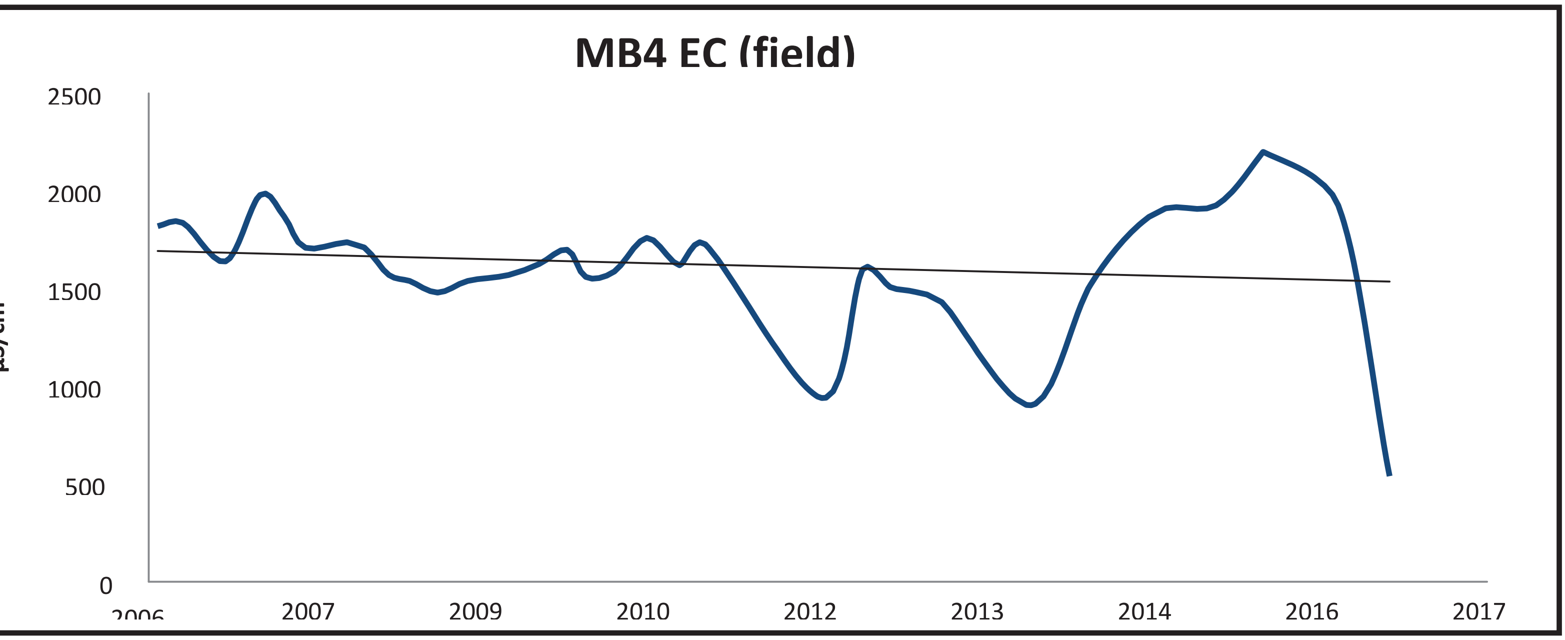



YB EC (field)


YB SWL


YB Na/Cl Ratio


MB4 pH (Field)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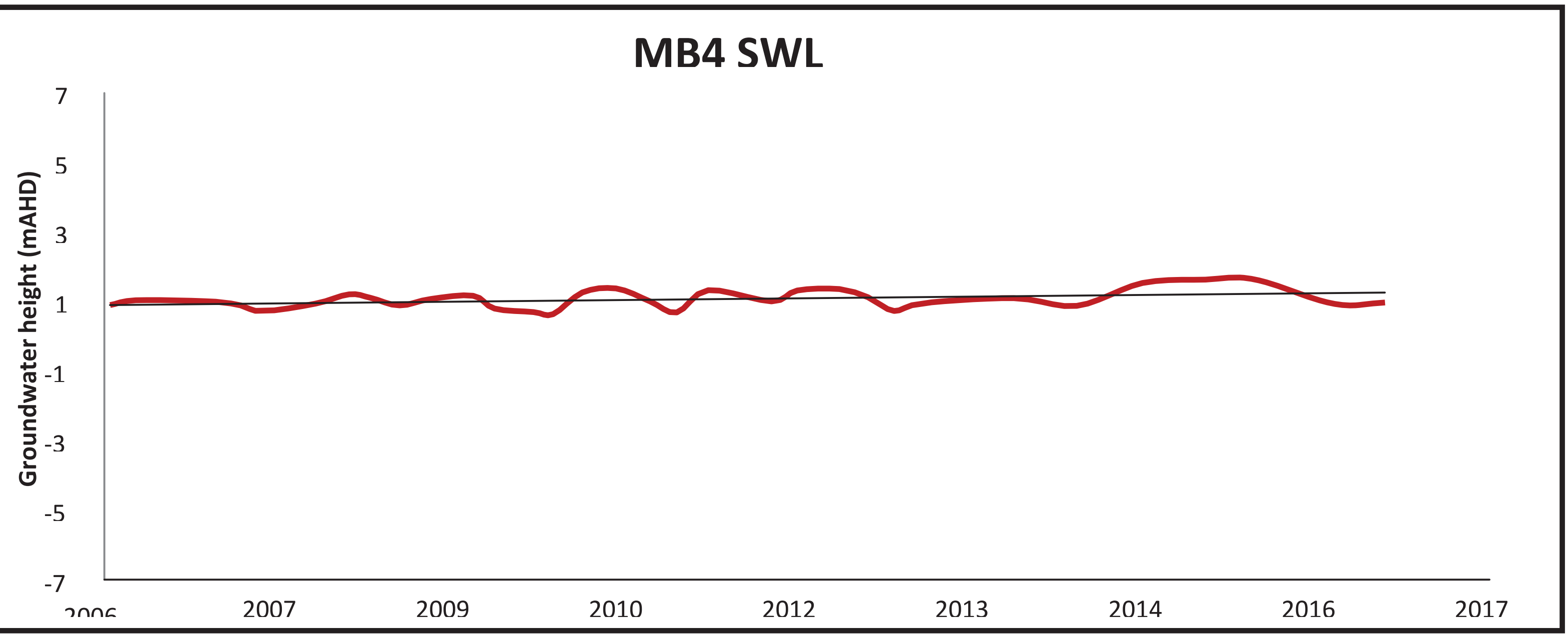
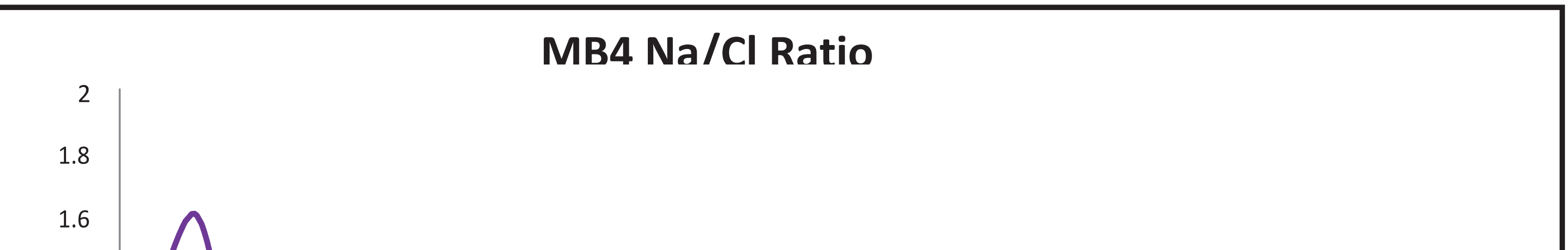

MB4 SWL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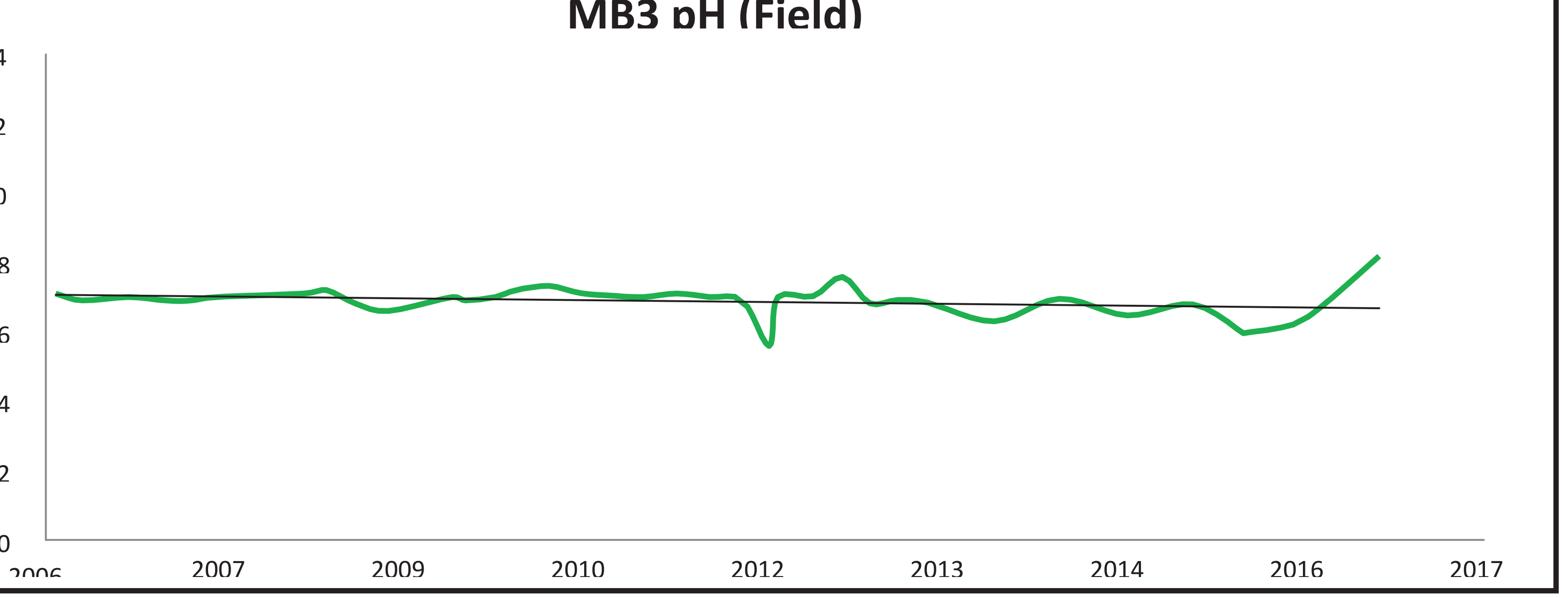
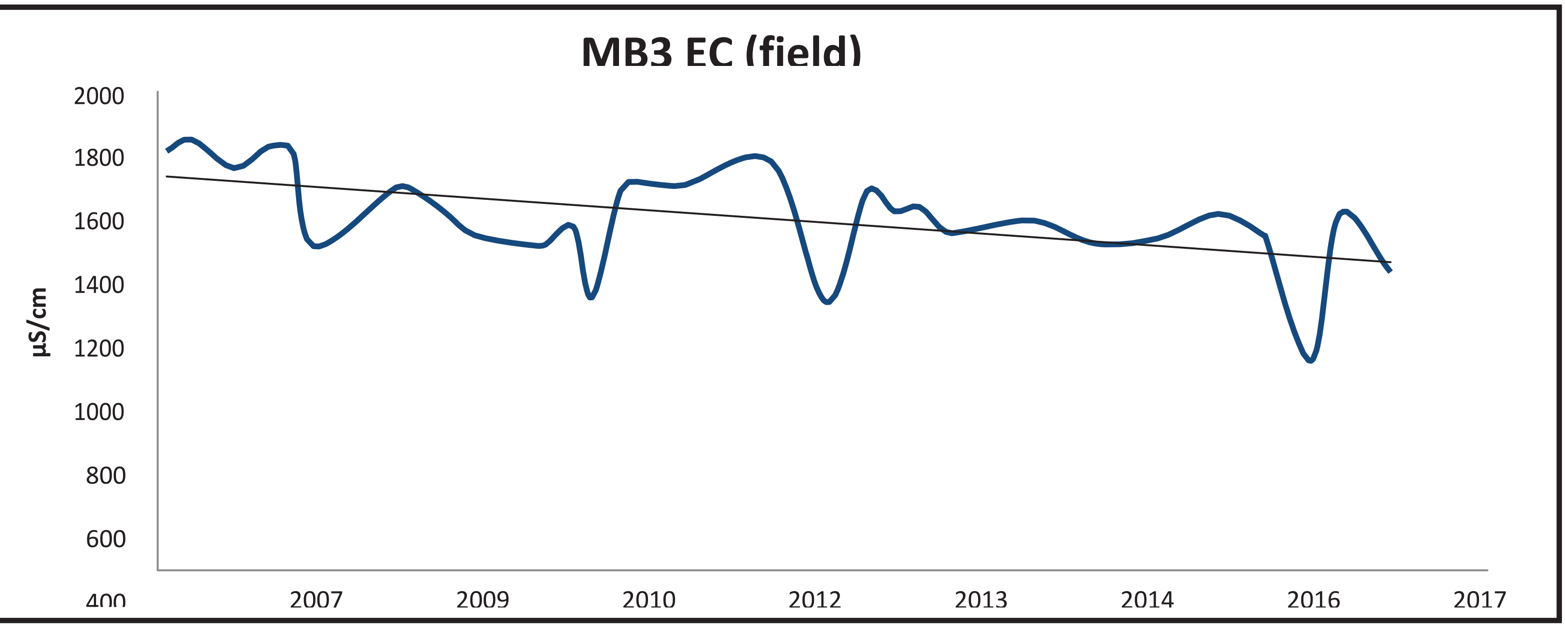
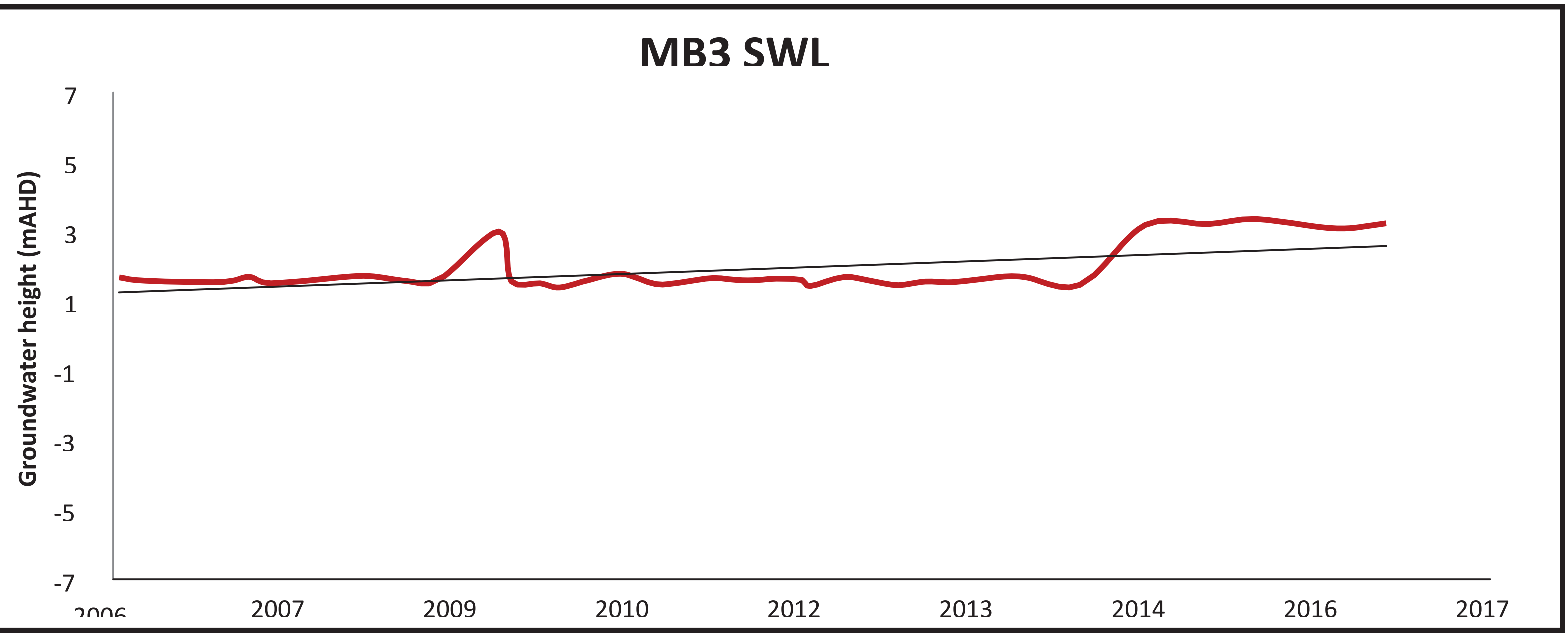
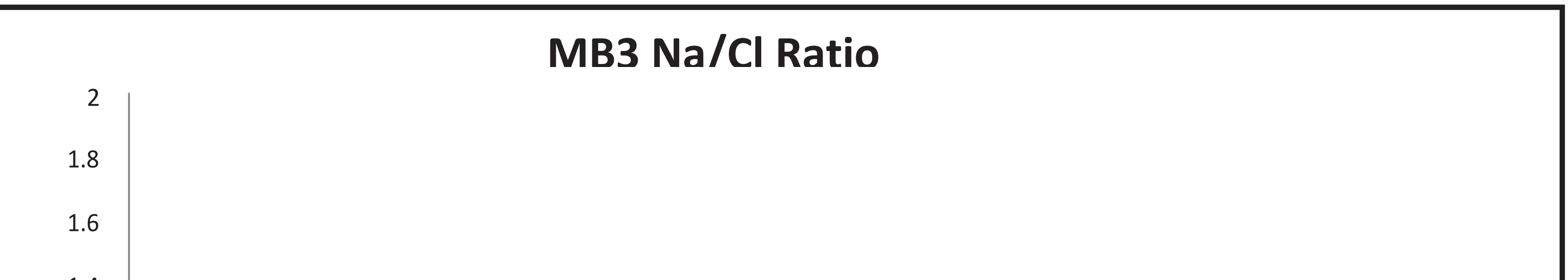
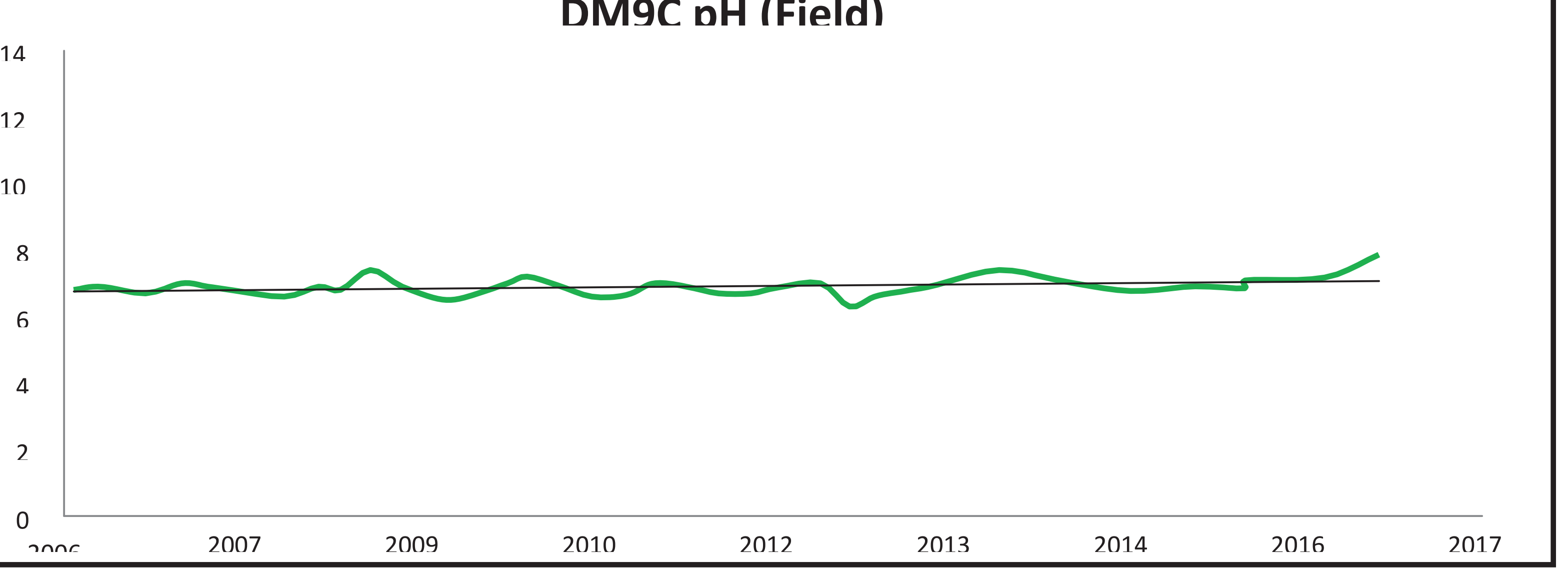
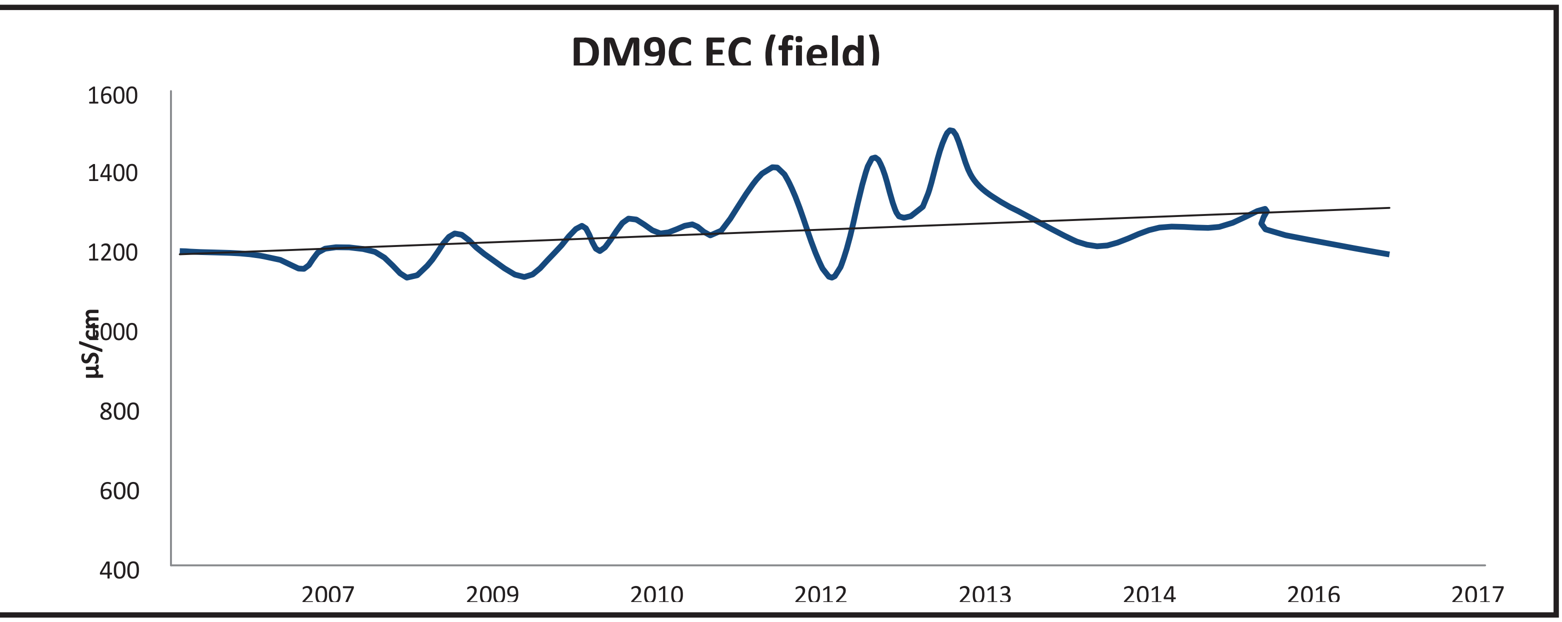

MB3 pH (Field)

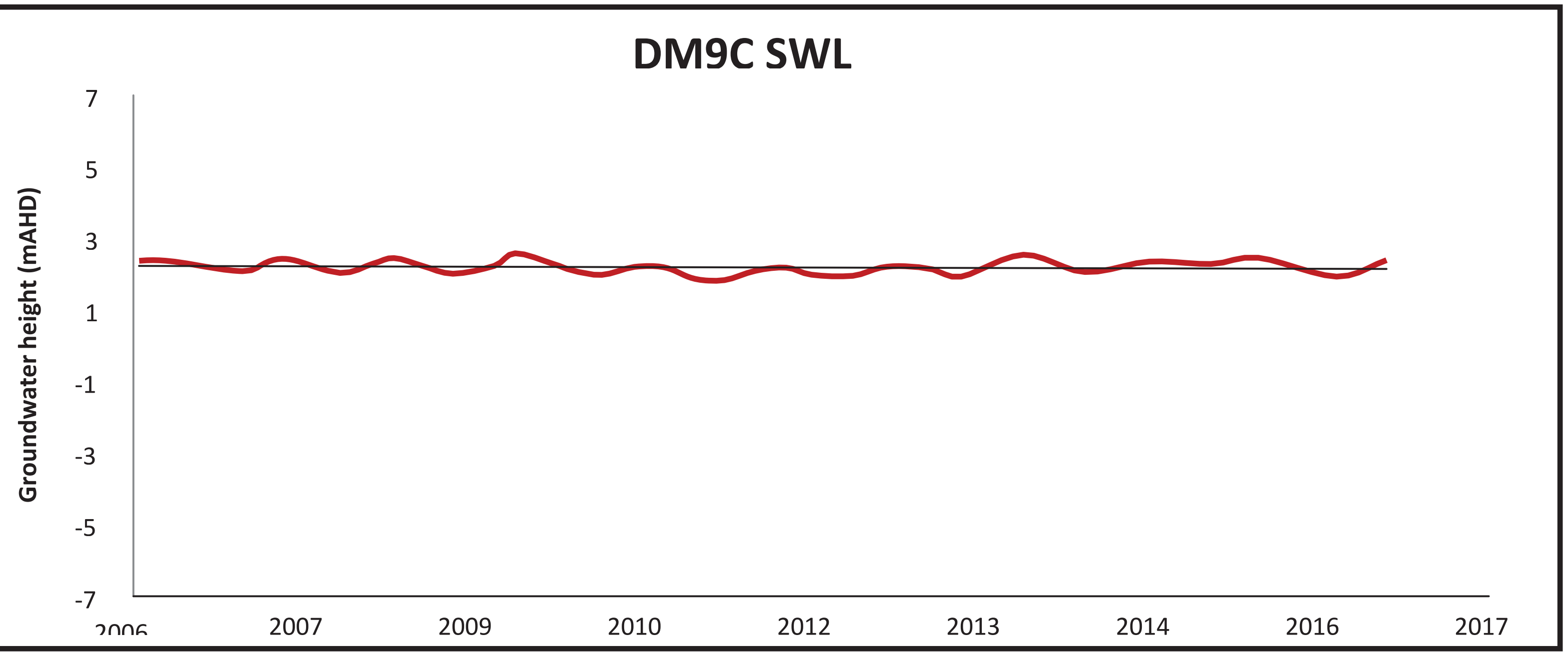

MB3 EC (field)


MB3 SWL


MB3 Na/Cl Ratio


DM9C pH (Field)


DM9C EC (field)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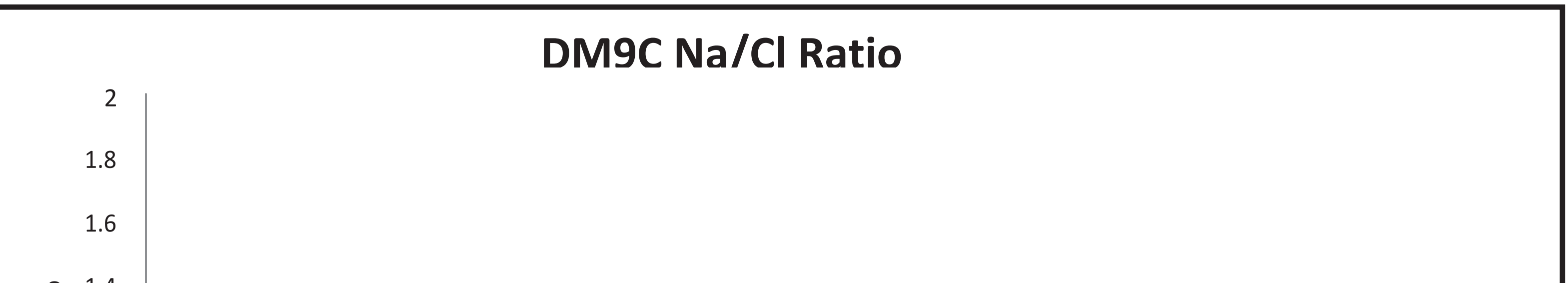
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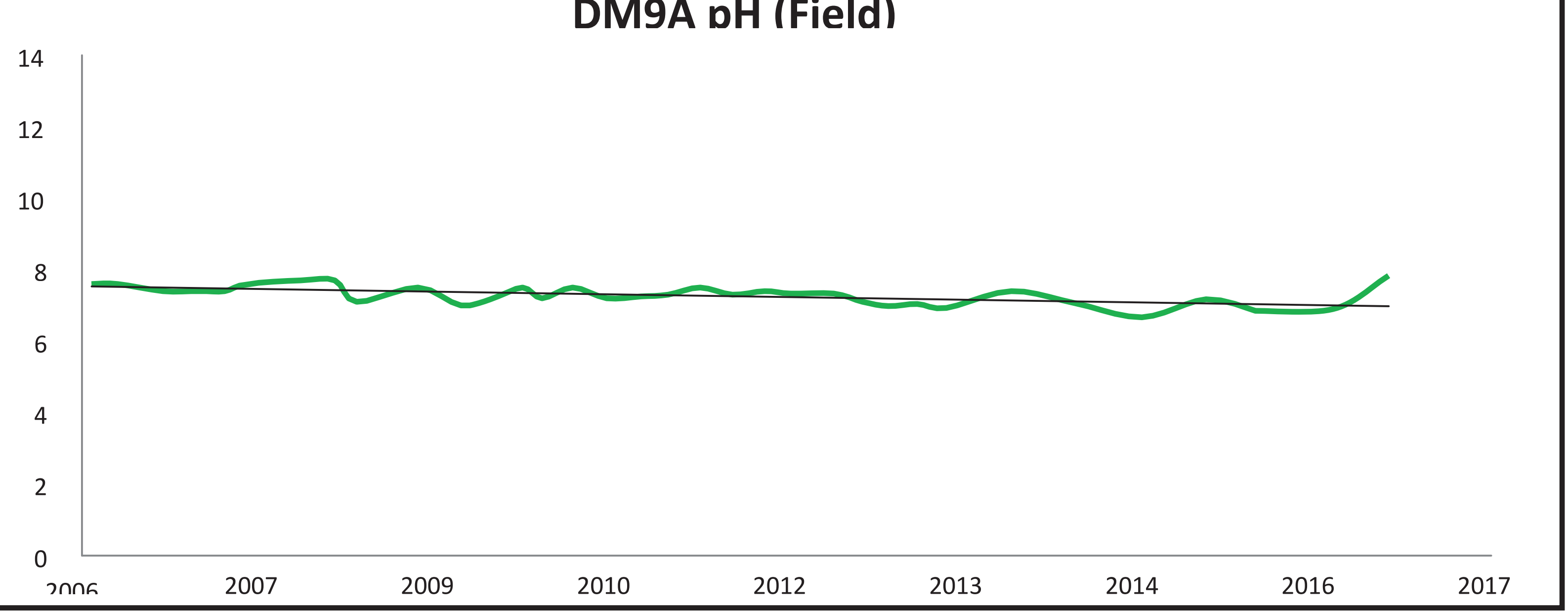
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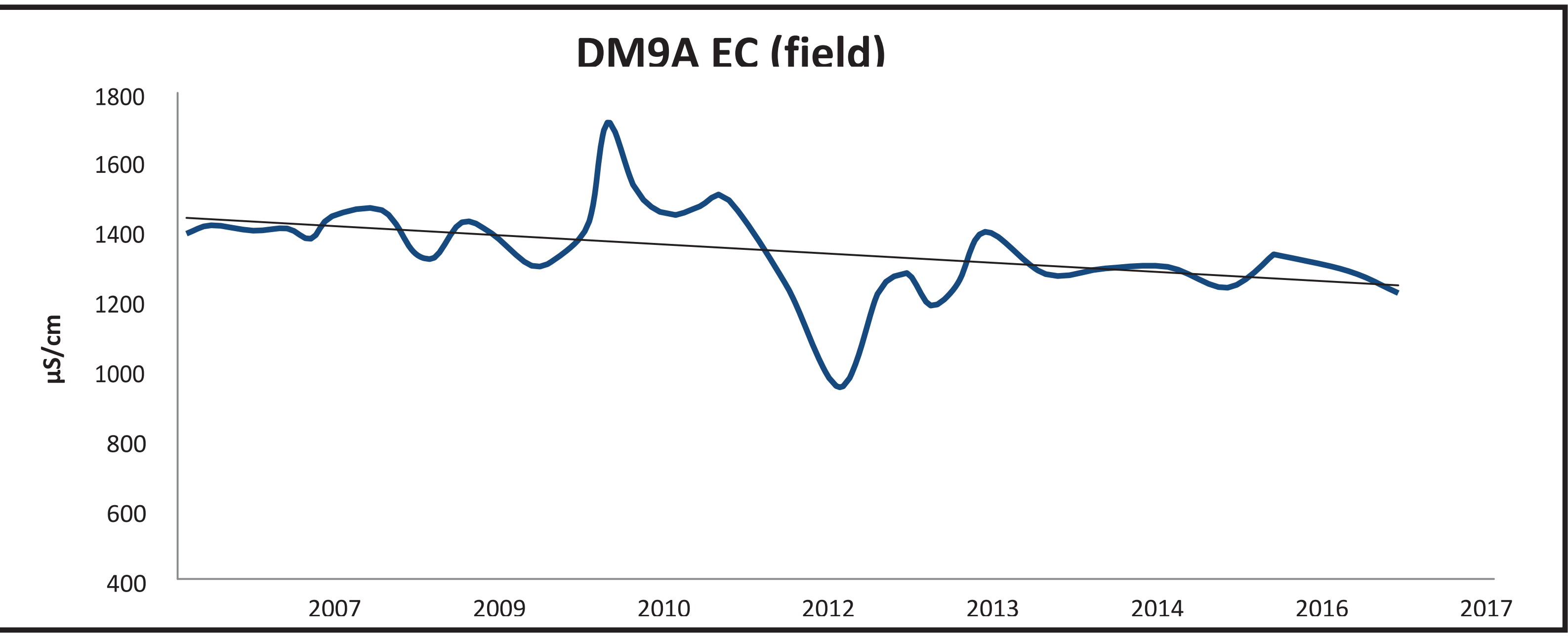
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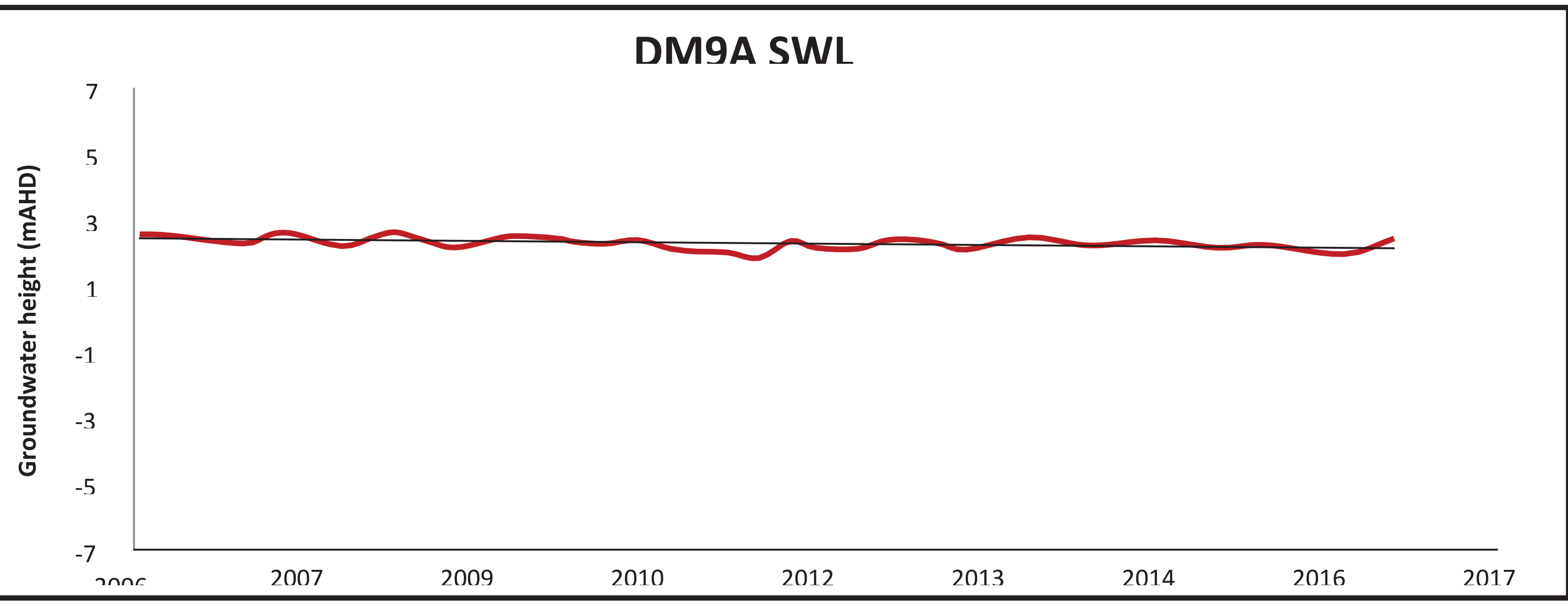
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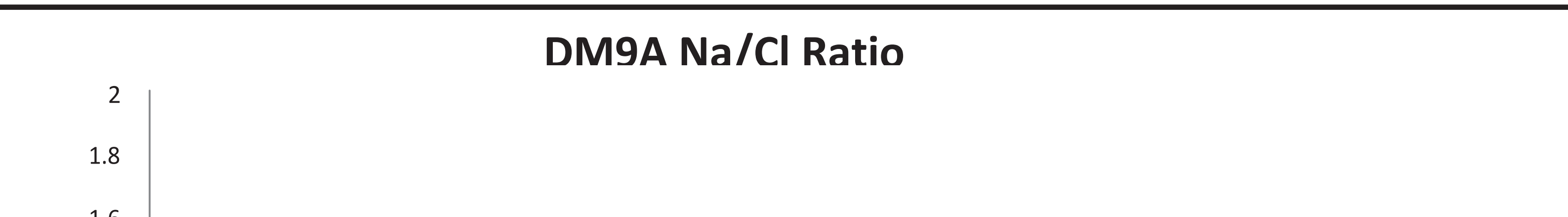
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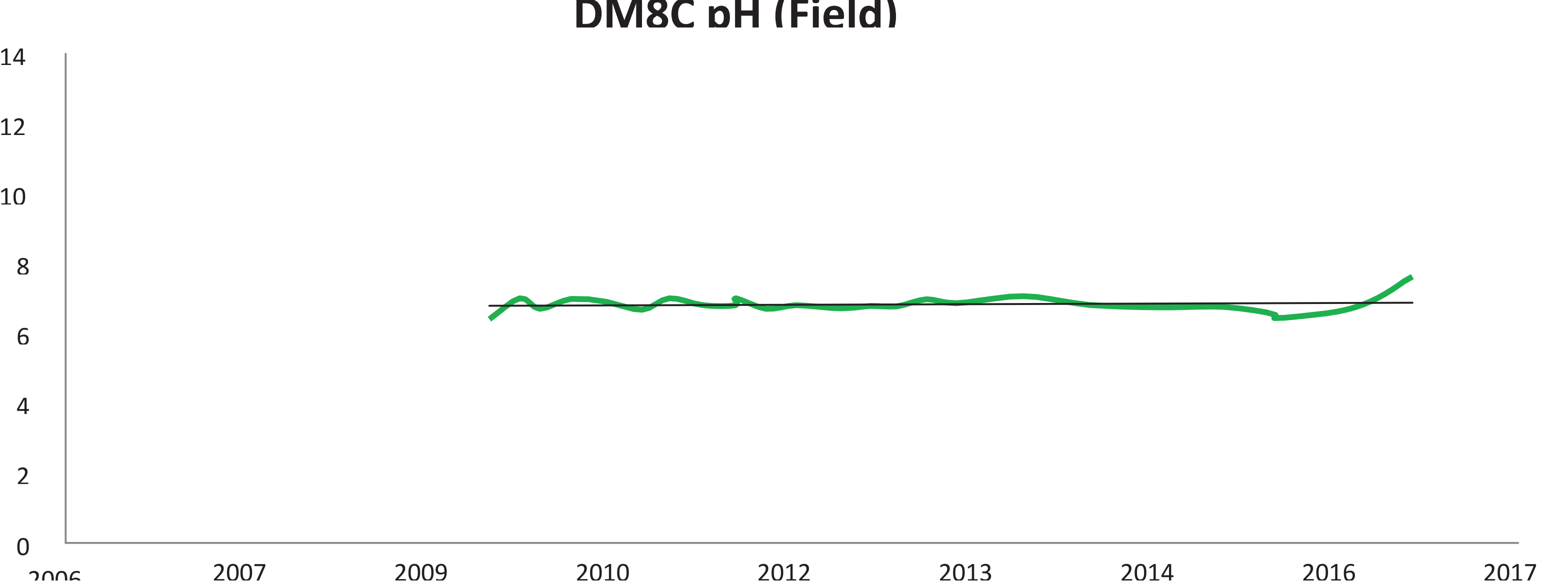
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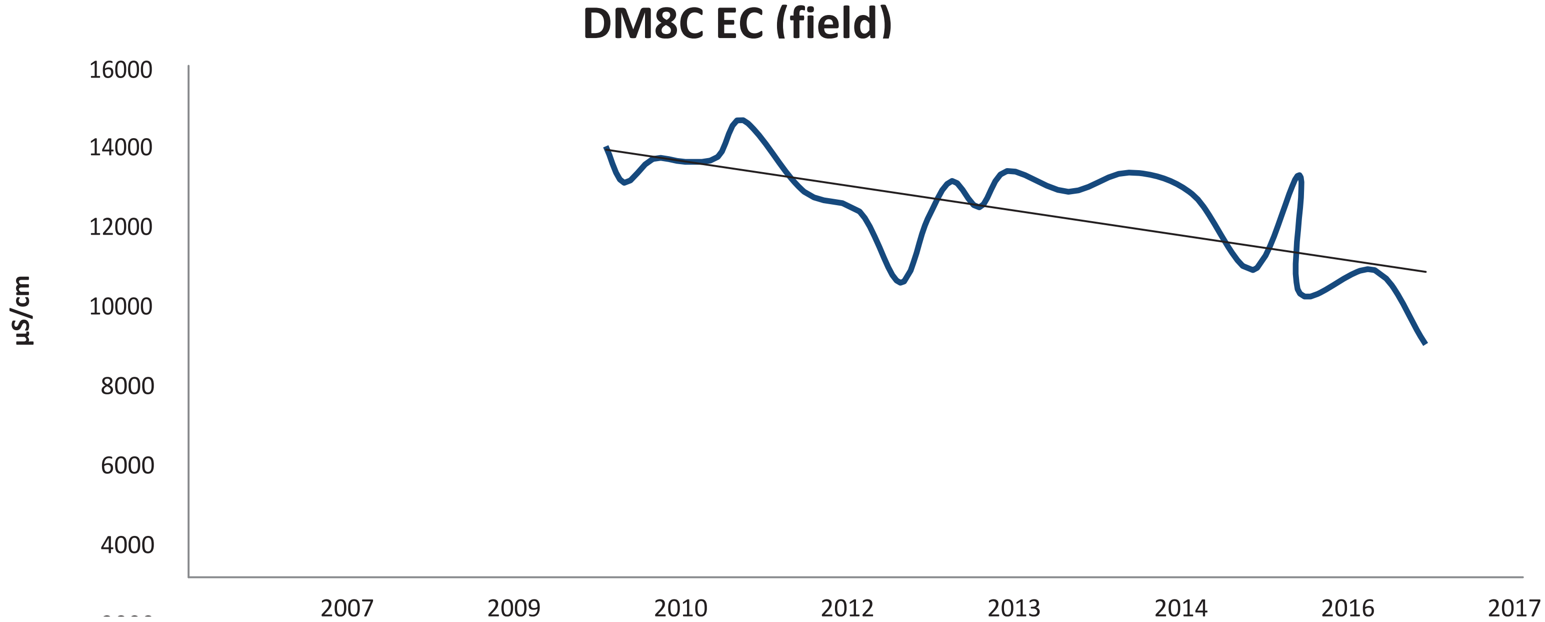
12
10
8
6
4
2
0
2007
2009
2010
2012
2013
2014
2016
2017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µS/cm
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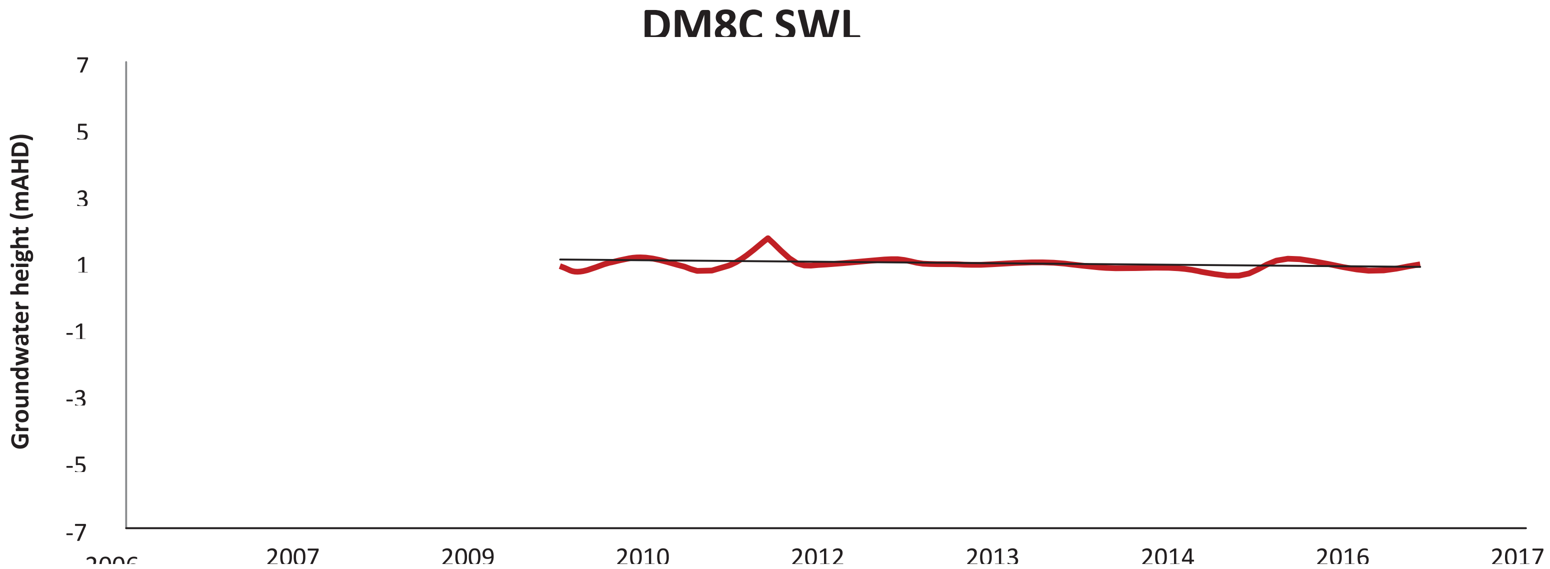
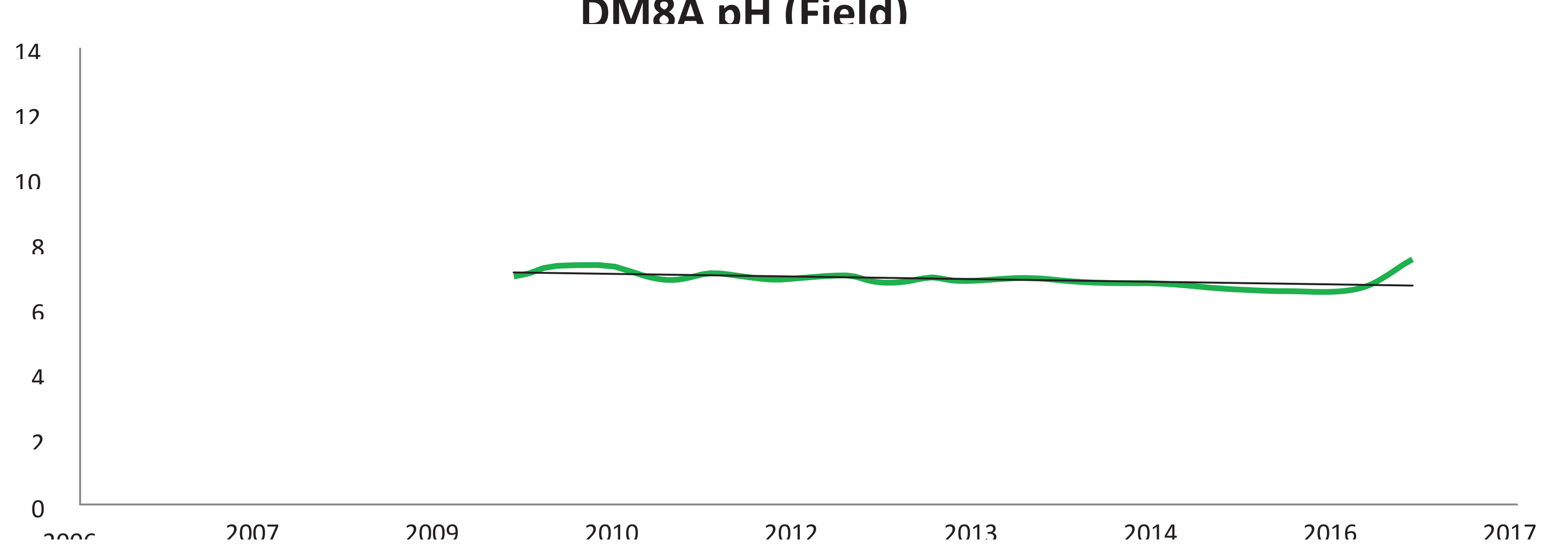
14000
12000
10000
8000
6000
4000
2007
2009
2010
2012
2013
2014
2016
2017


DM8C SWL
Groundwater height (mAHD)
7
5
3
1
-1
-3
-5
-7
2007
2009
2010
2012
2013
2014
2016
2017


DM8C Na/Cl Ratio
2
1.8
1.6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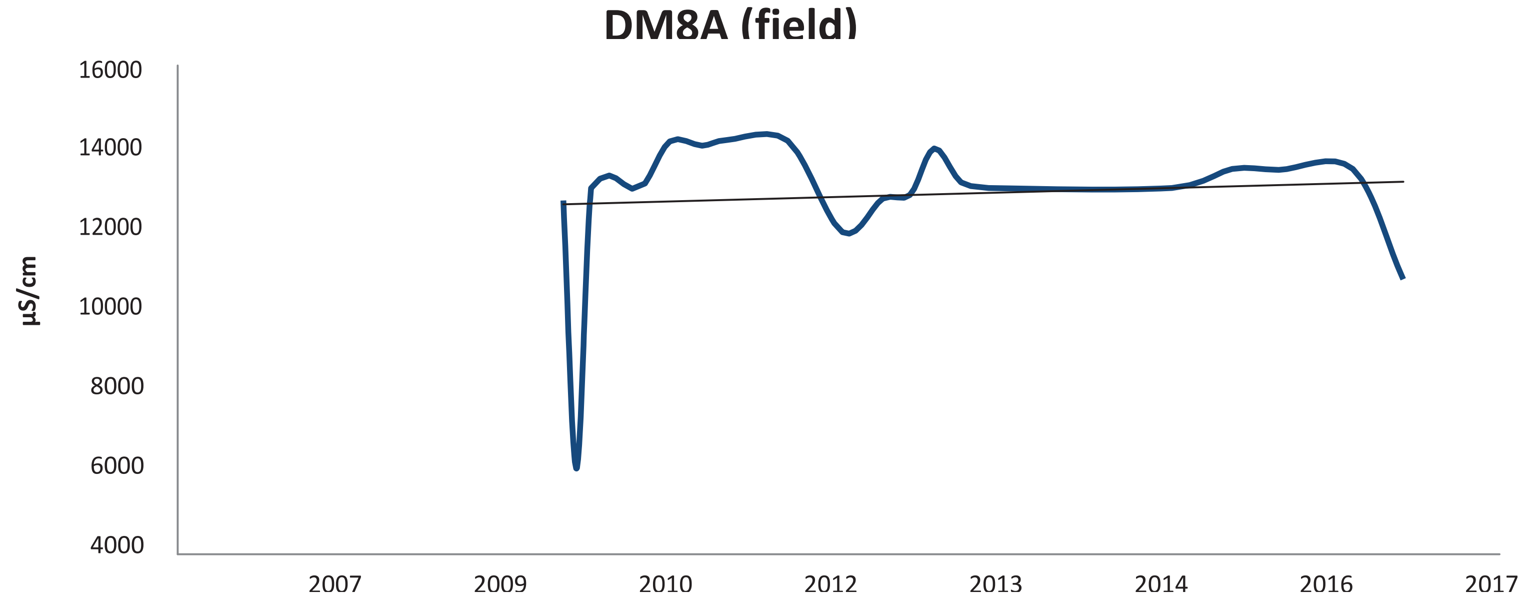
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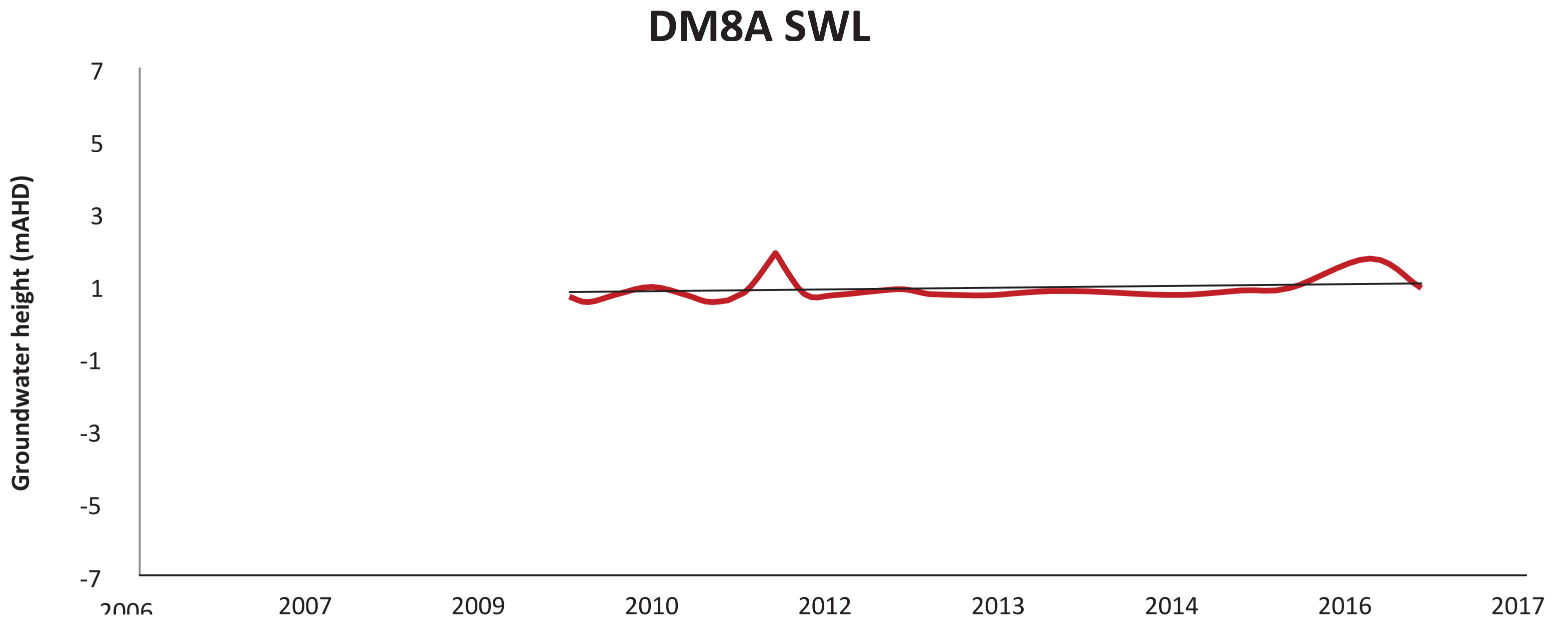
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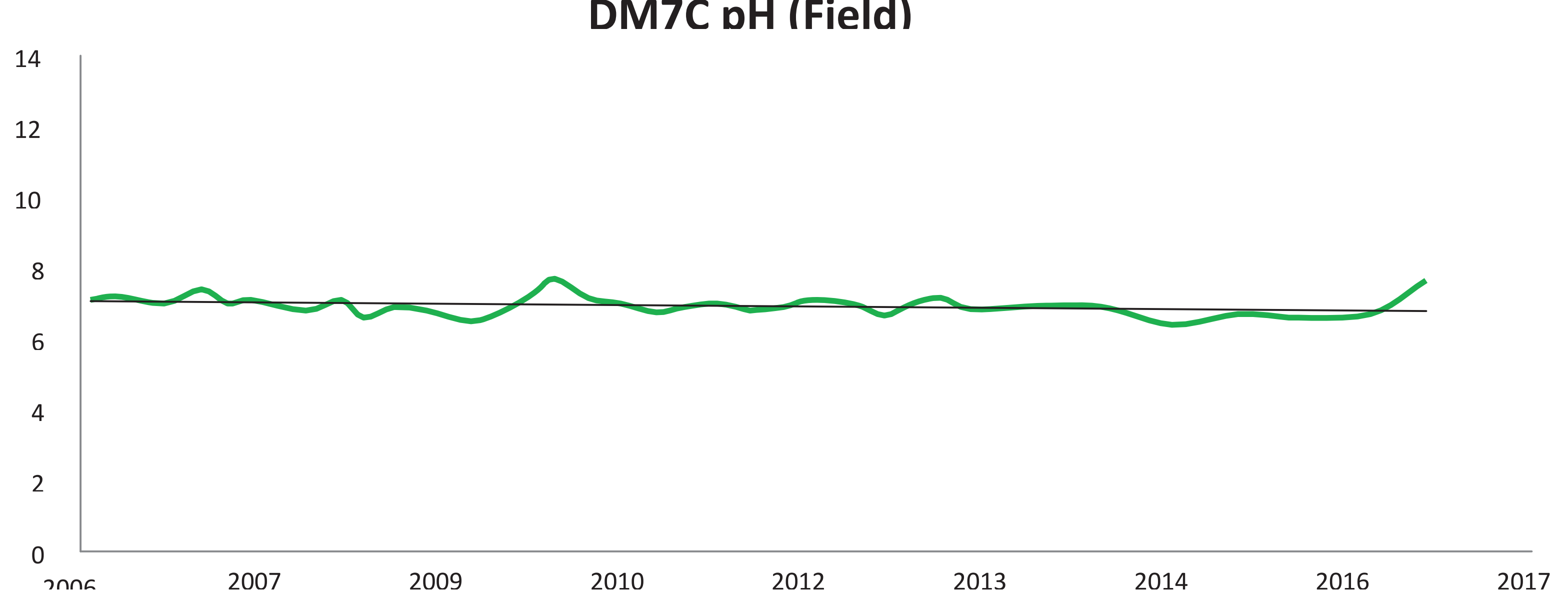
DM8A Na/Cl Ratio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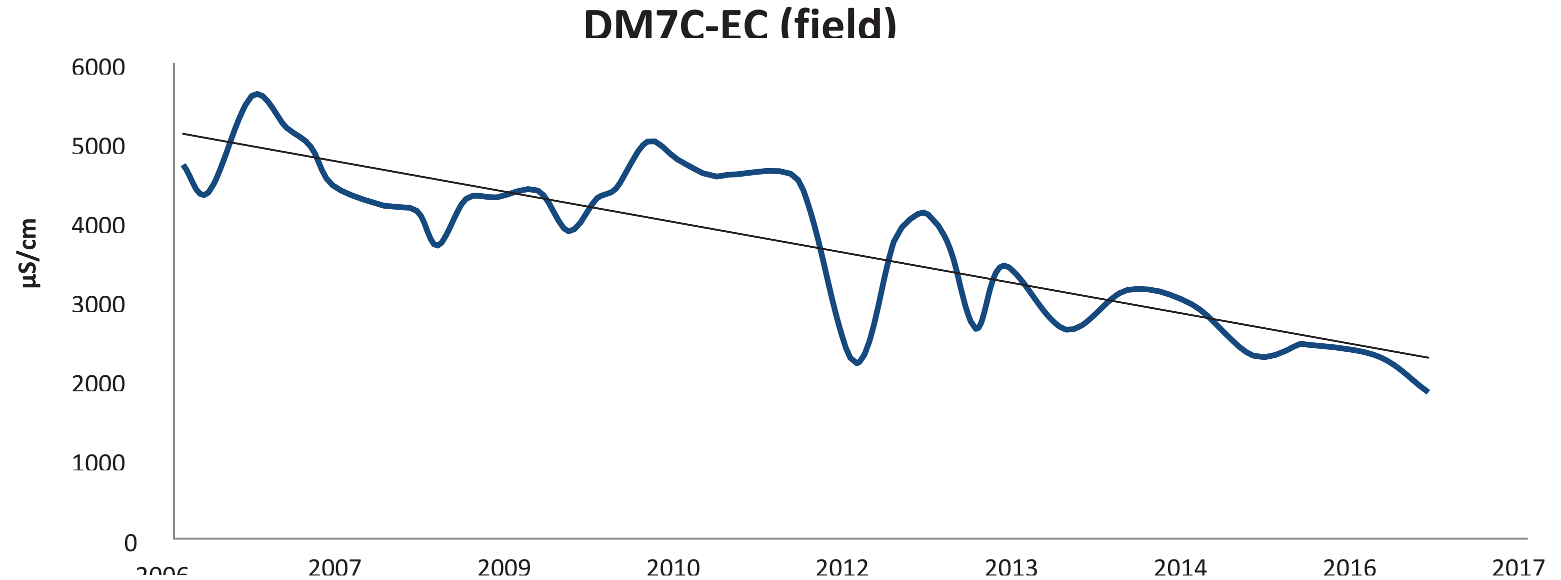
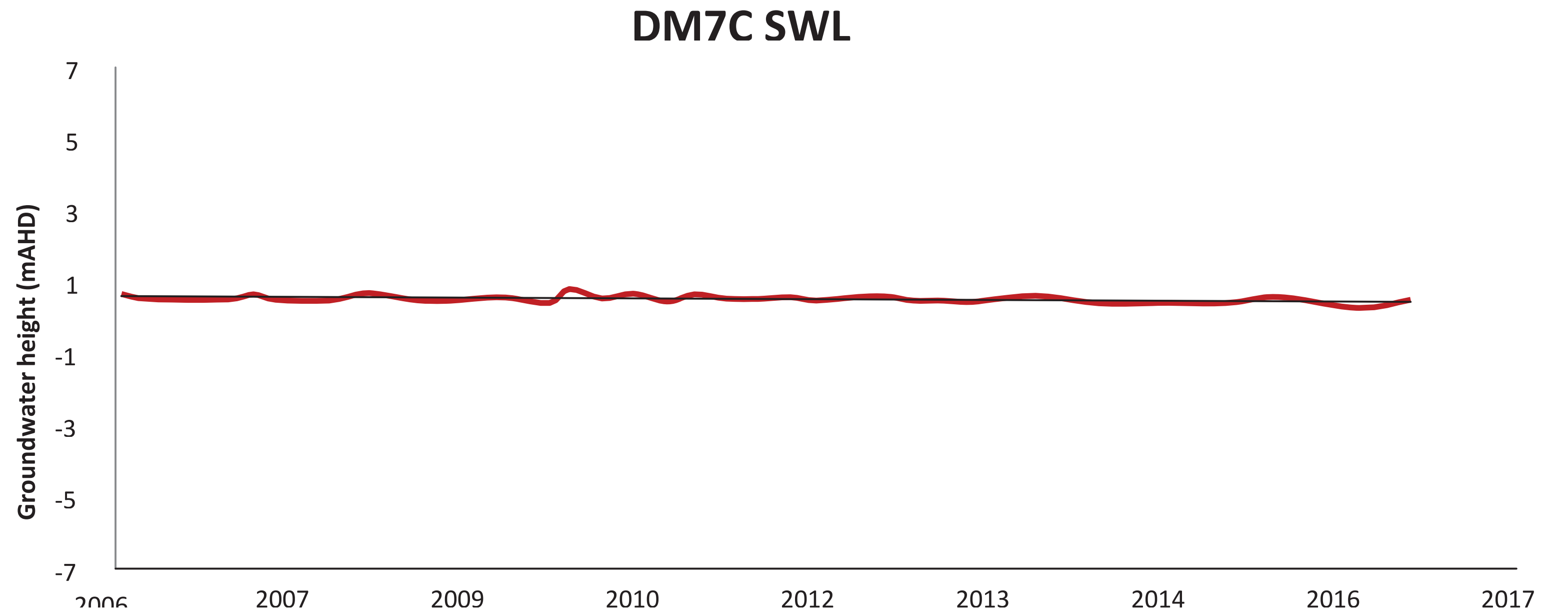
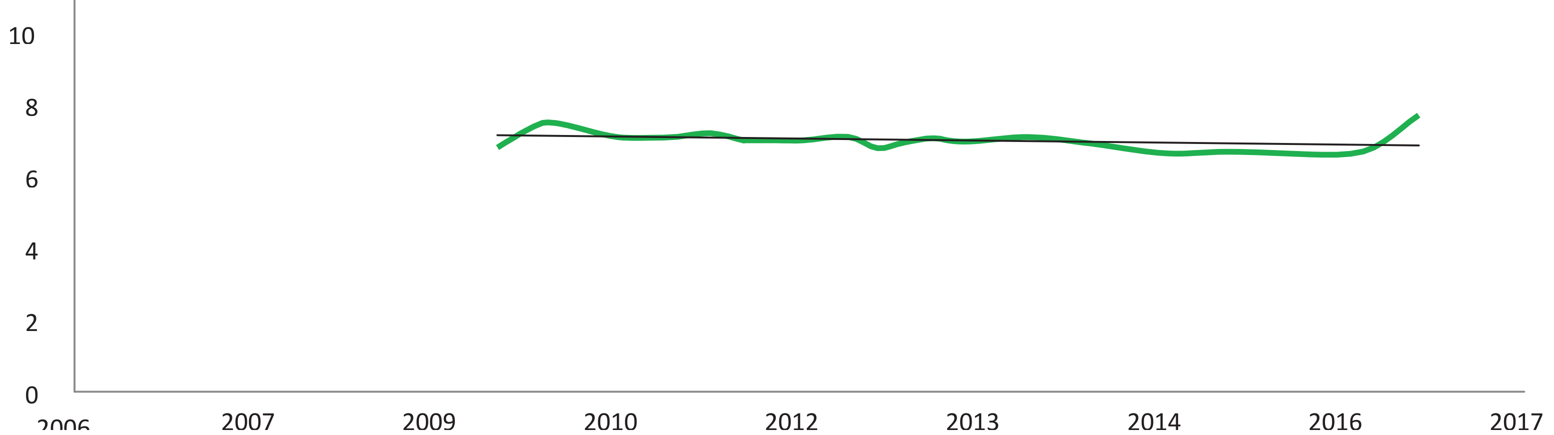
14
12
10
8
6
4
2
0
2006
2007
2009
2010
2012
2013
2014
2016
2017


DM7C-EC (field)
µS/cm
6000
5000
4000
3000
2000
1000
0
2006
2007
2009
2010
2012
2013
2014
2016
2017


DM7C SWL
Groundwater height (mAHD)
7
5
3
1
-1
-3
-5
-7
2006
2007
2009
2010
2012
2013
2014
2016
2017


DM7C Na/Cl Ratio
2
1.8
1.6



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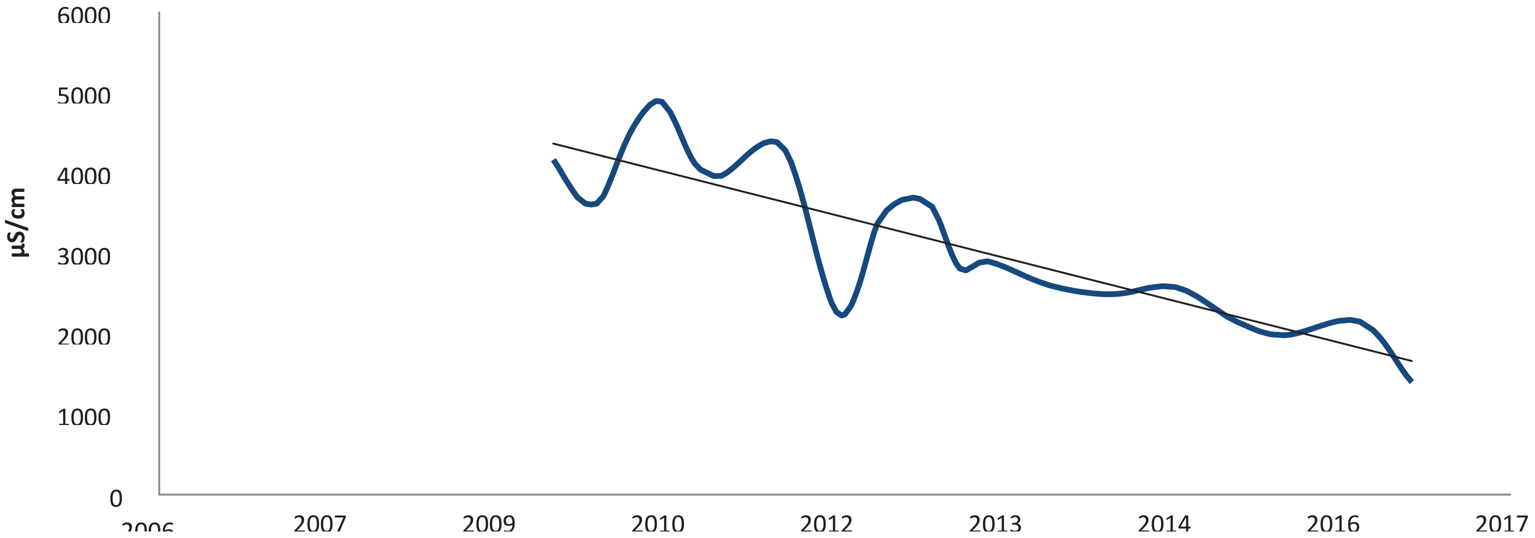

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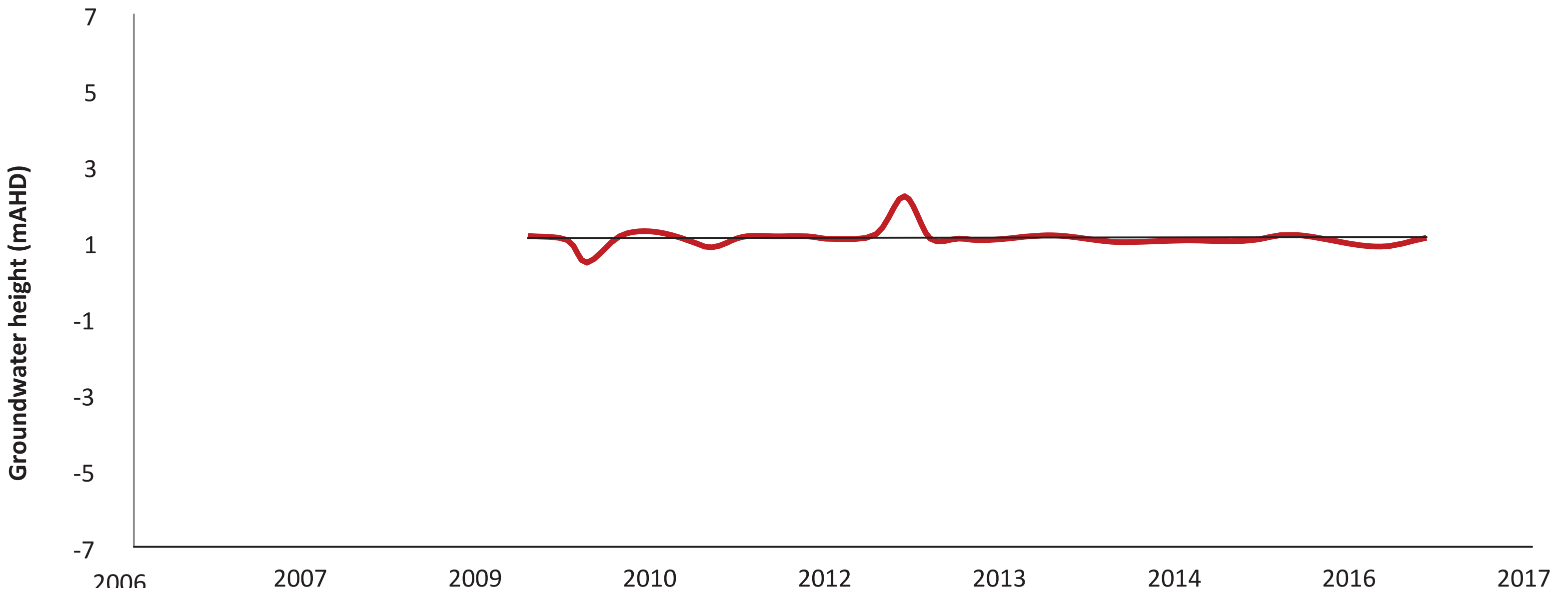

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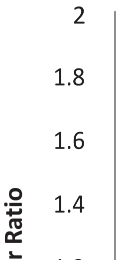

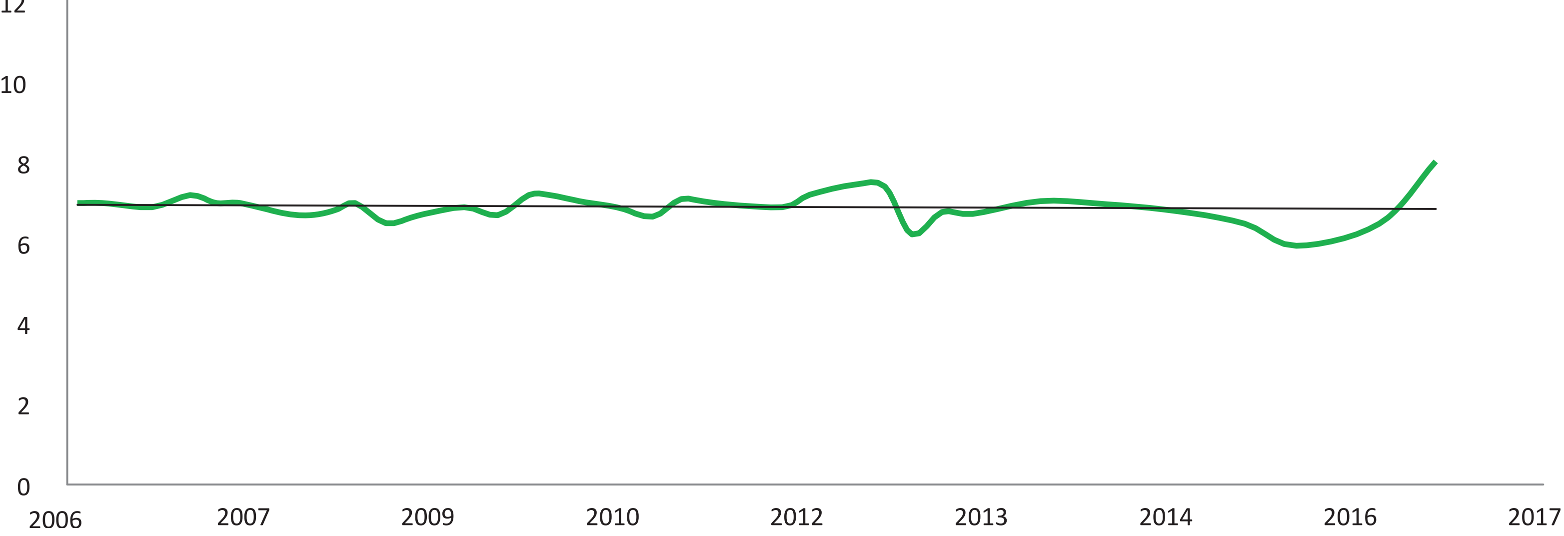

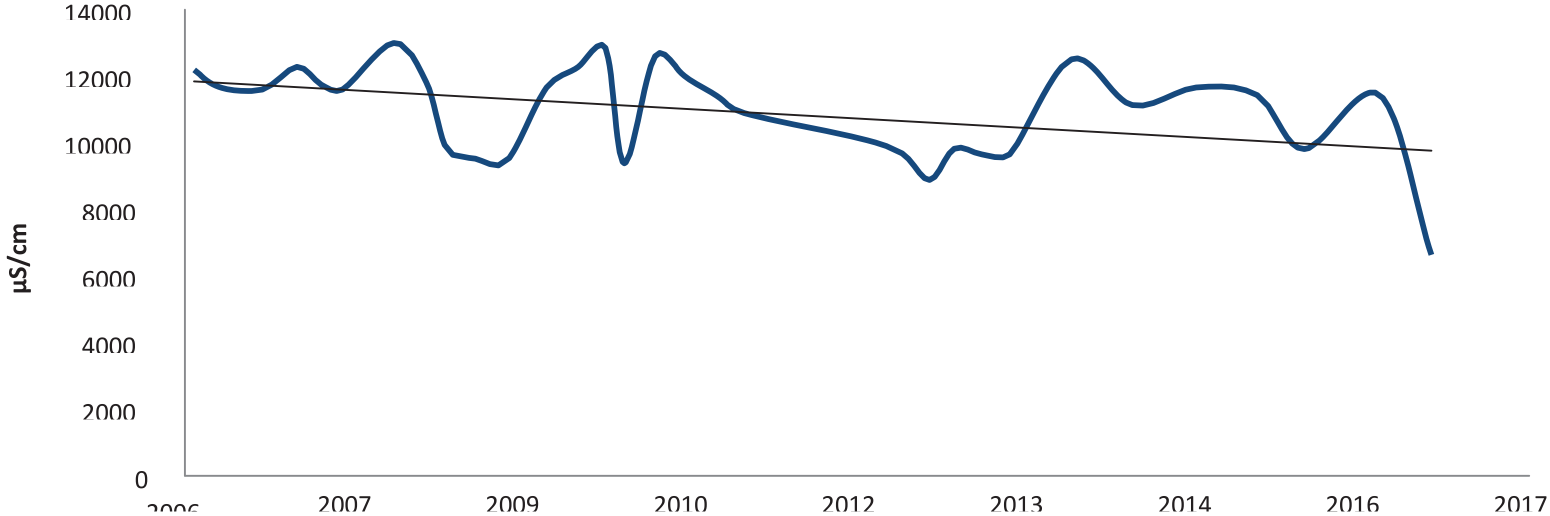
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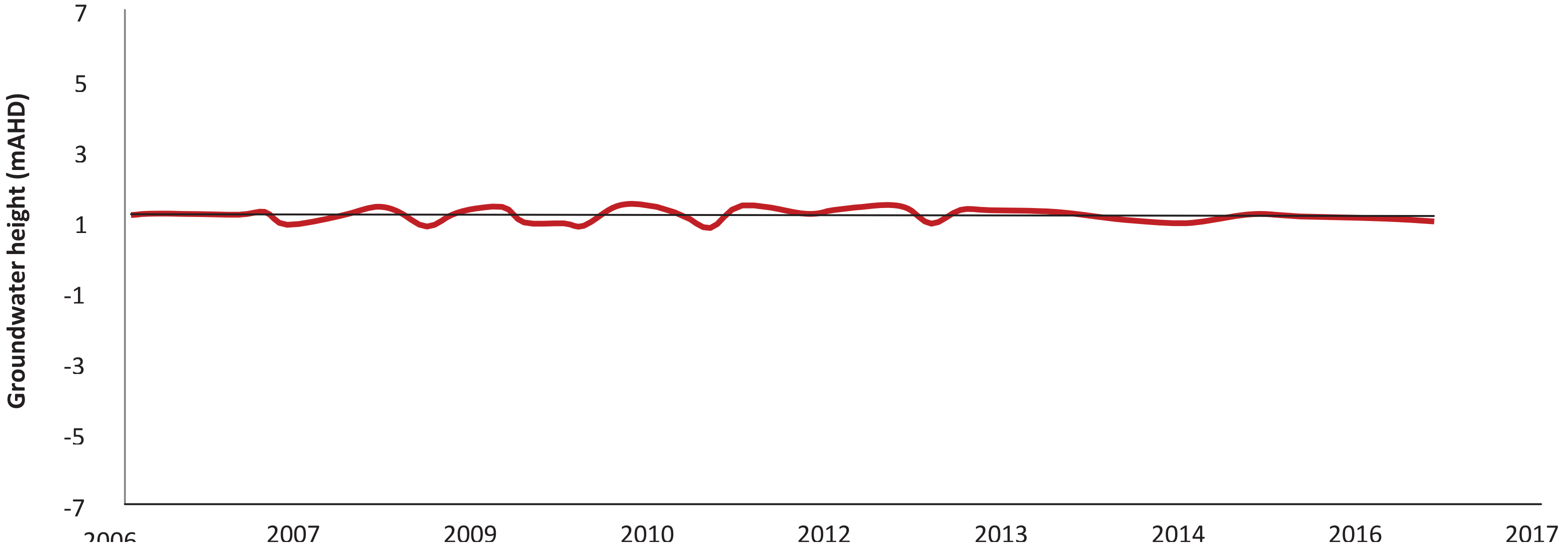
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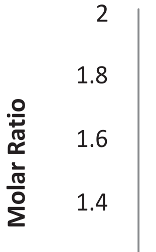
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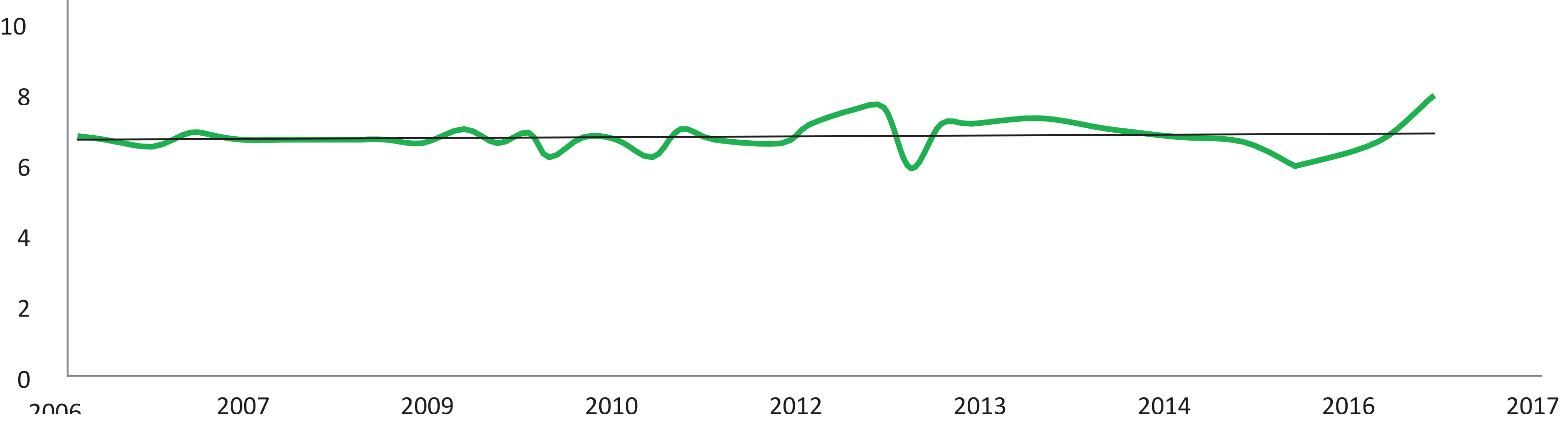

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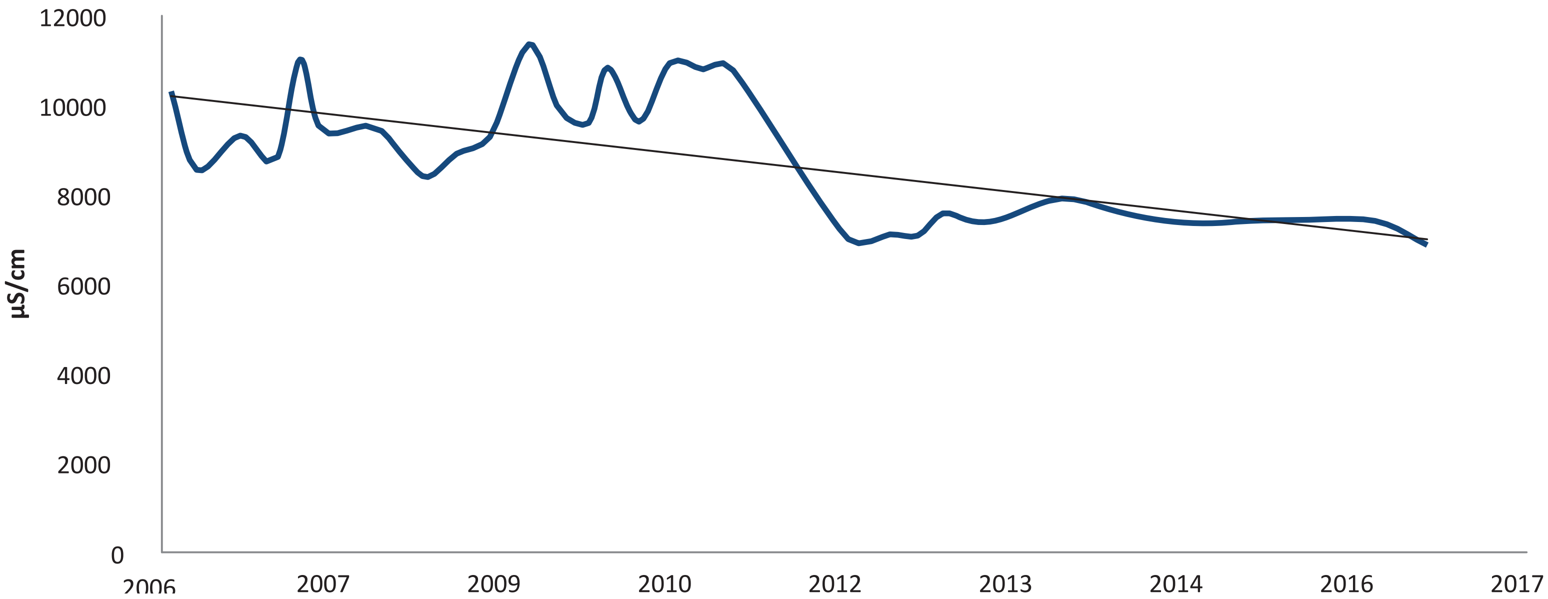

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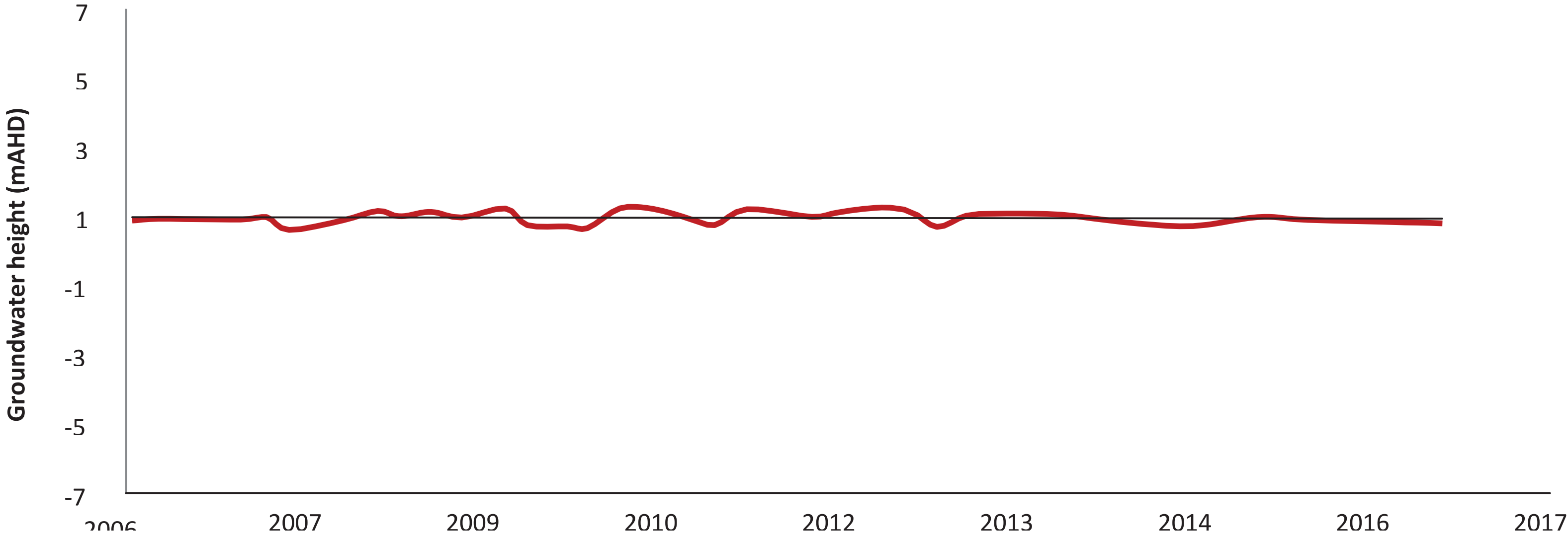

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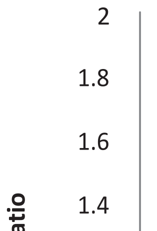

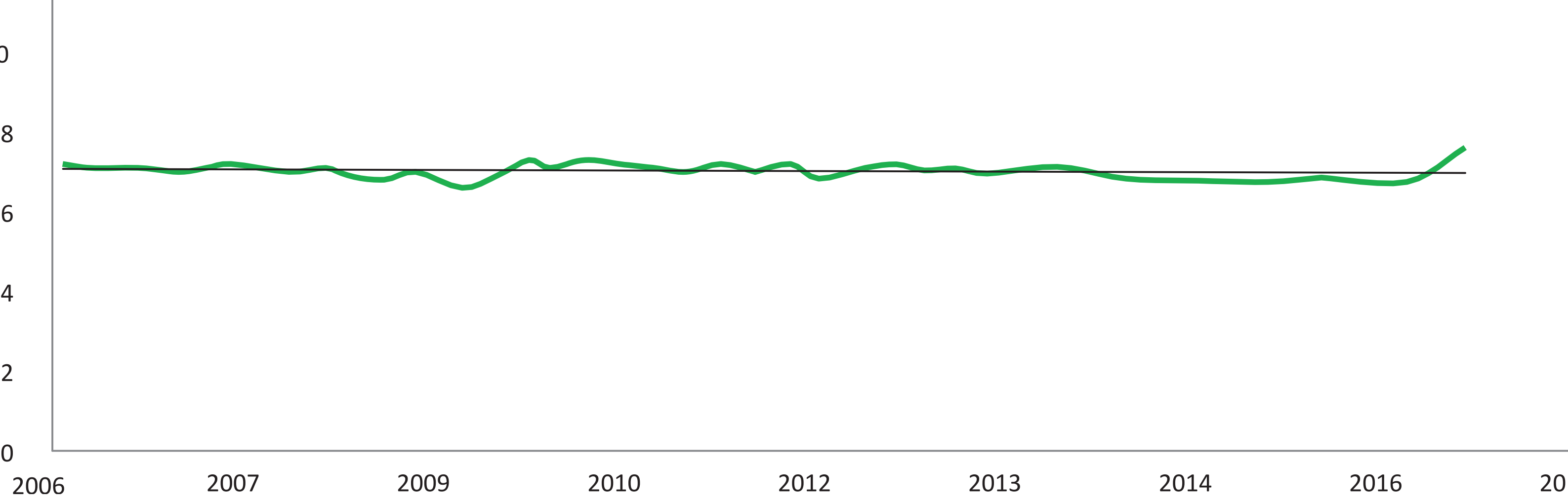

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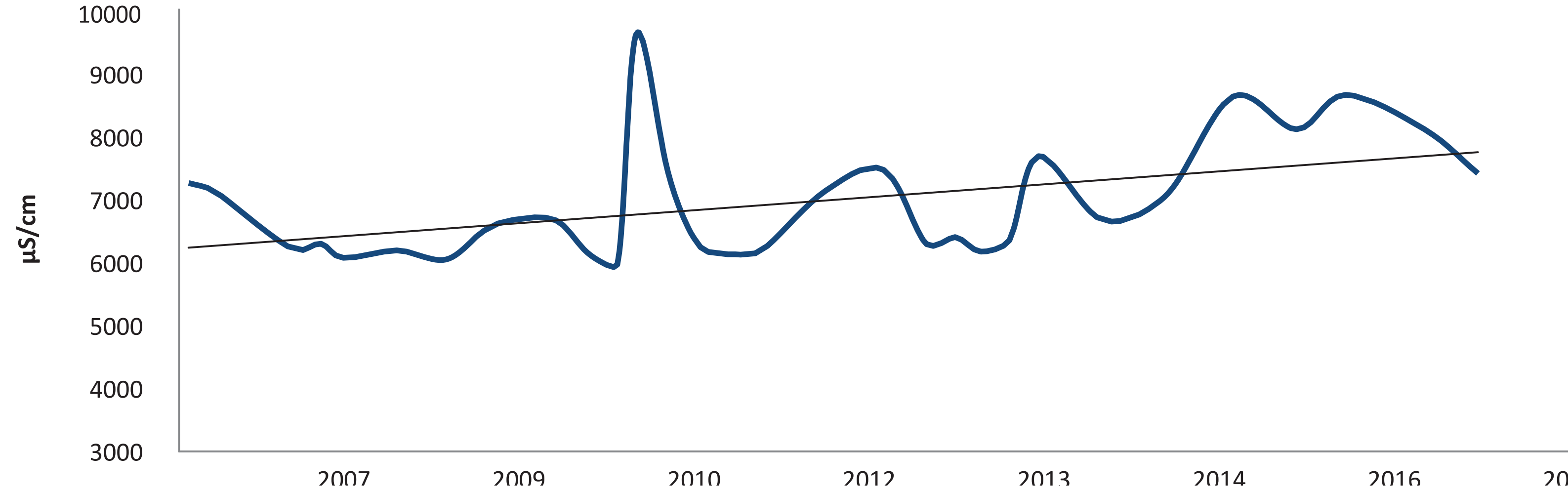

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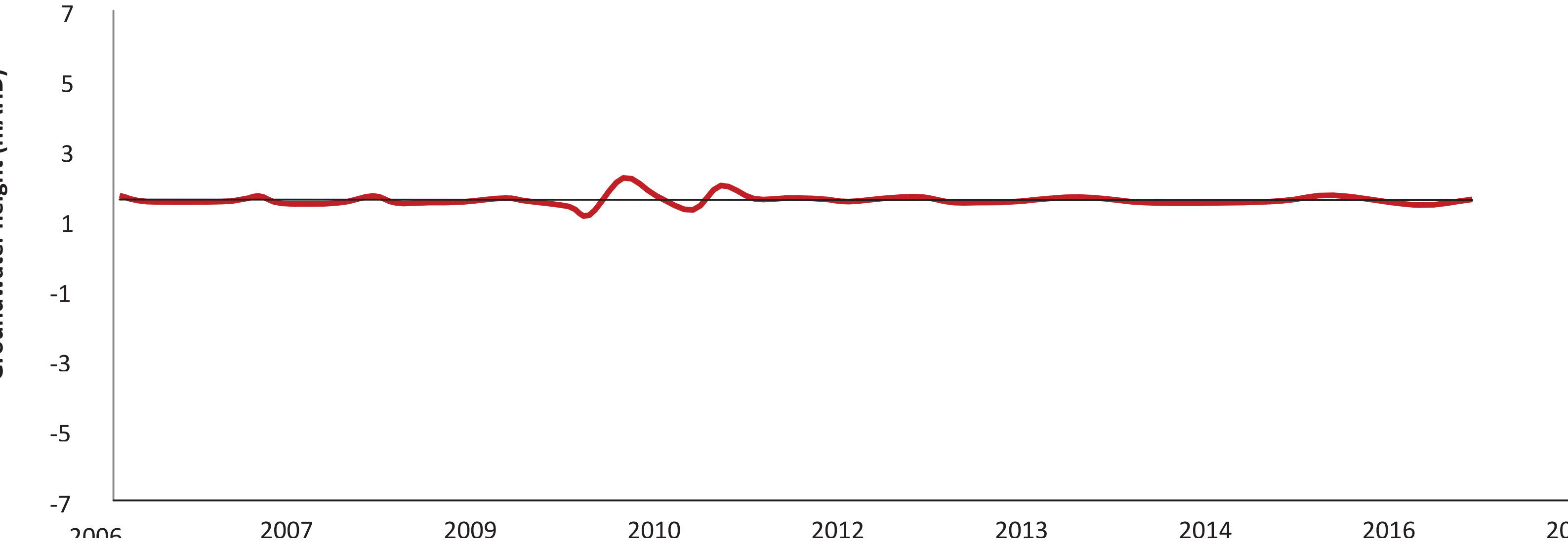

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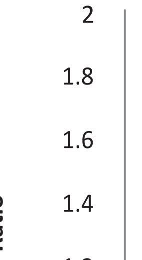

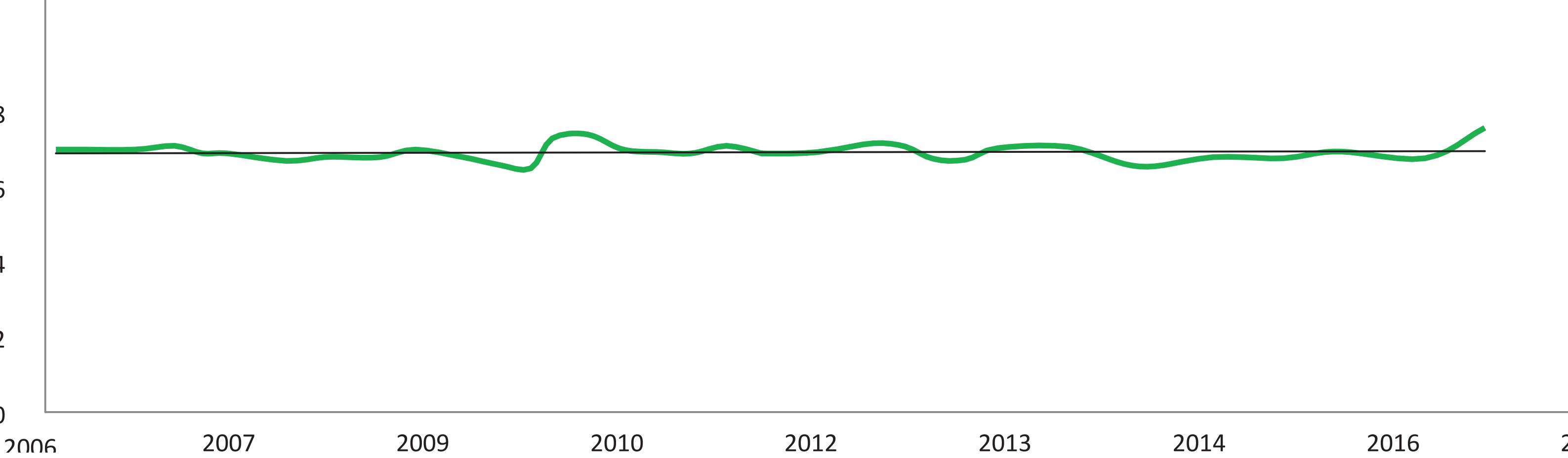

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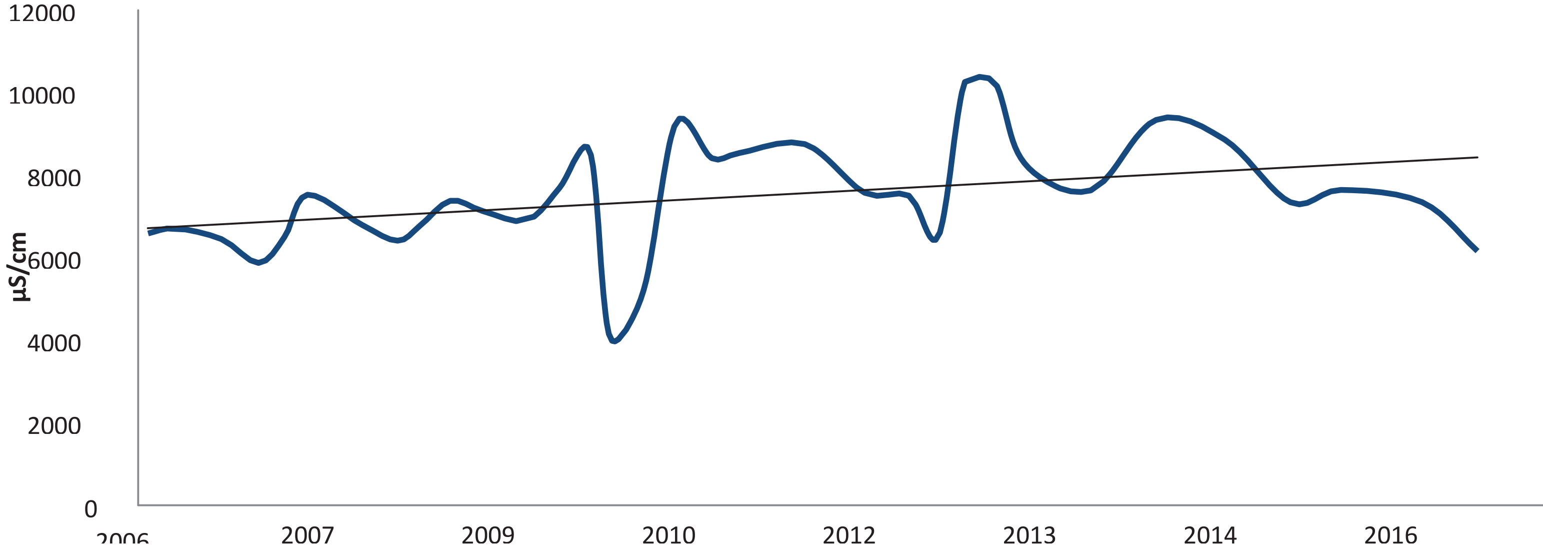

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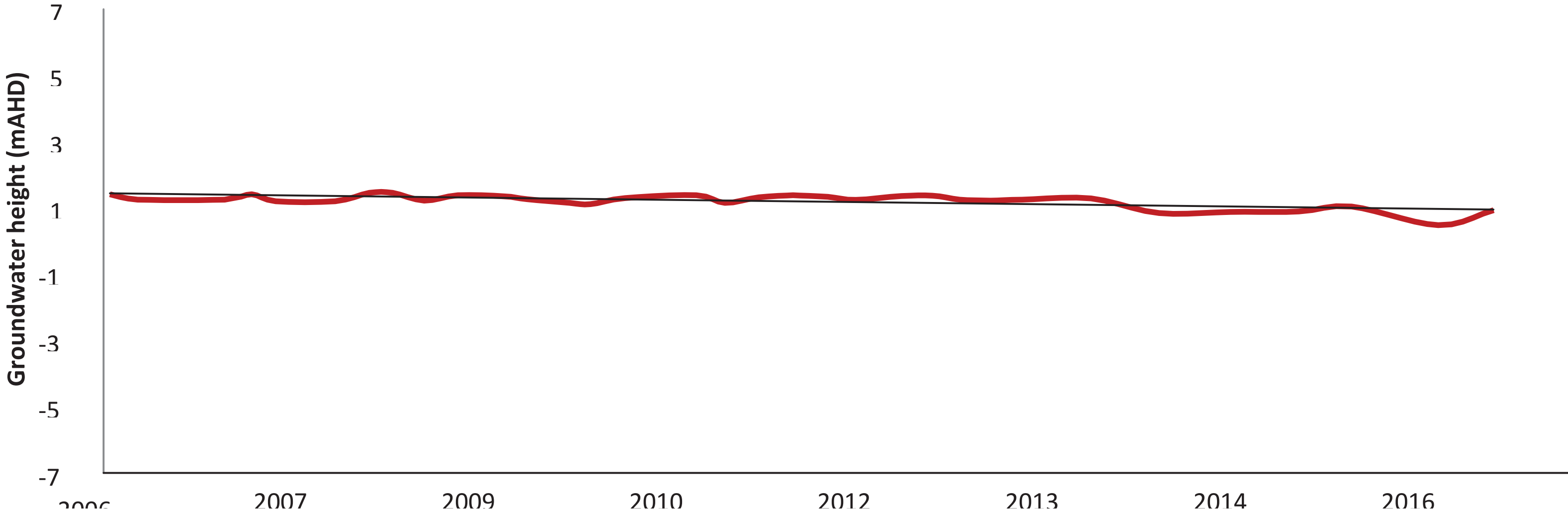

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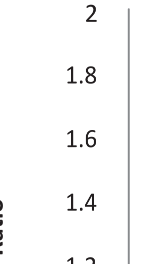

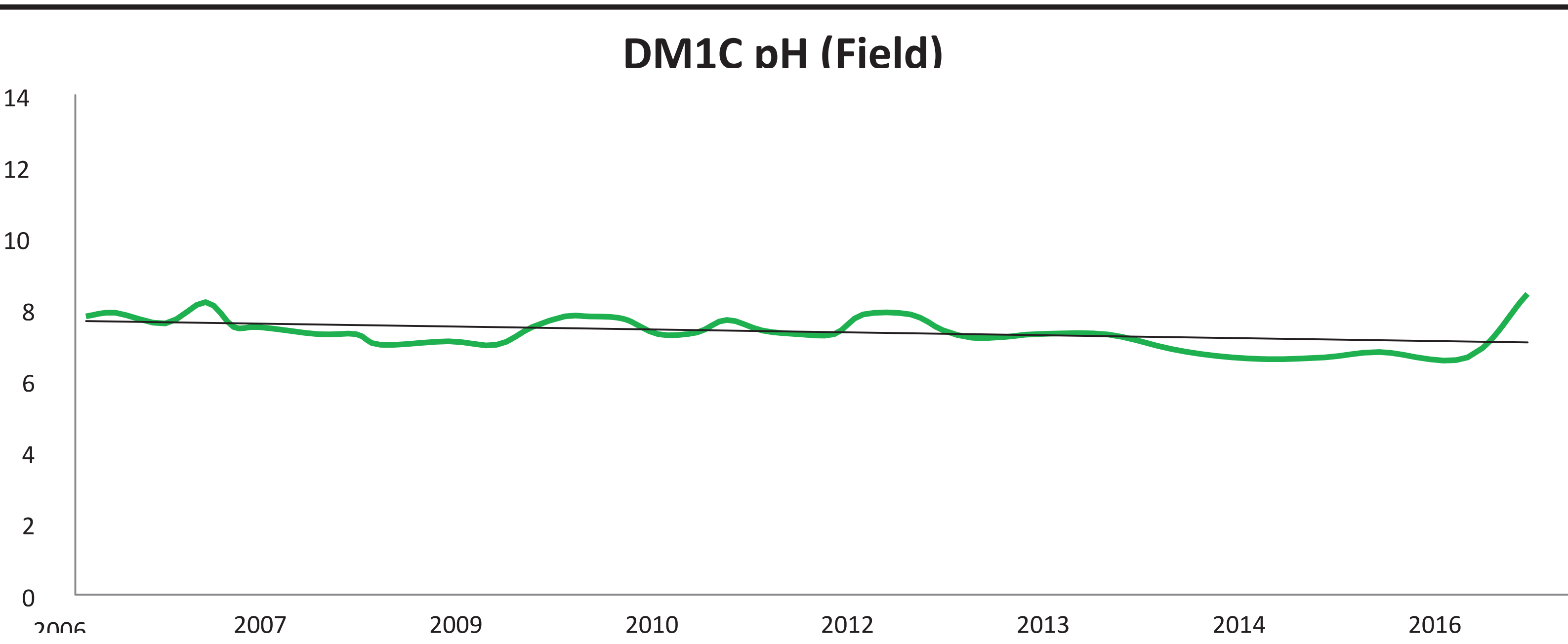

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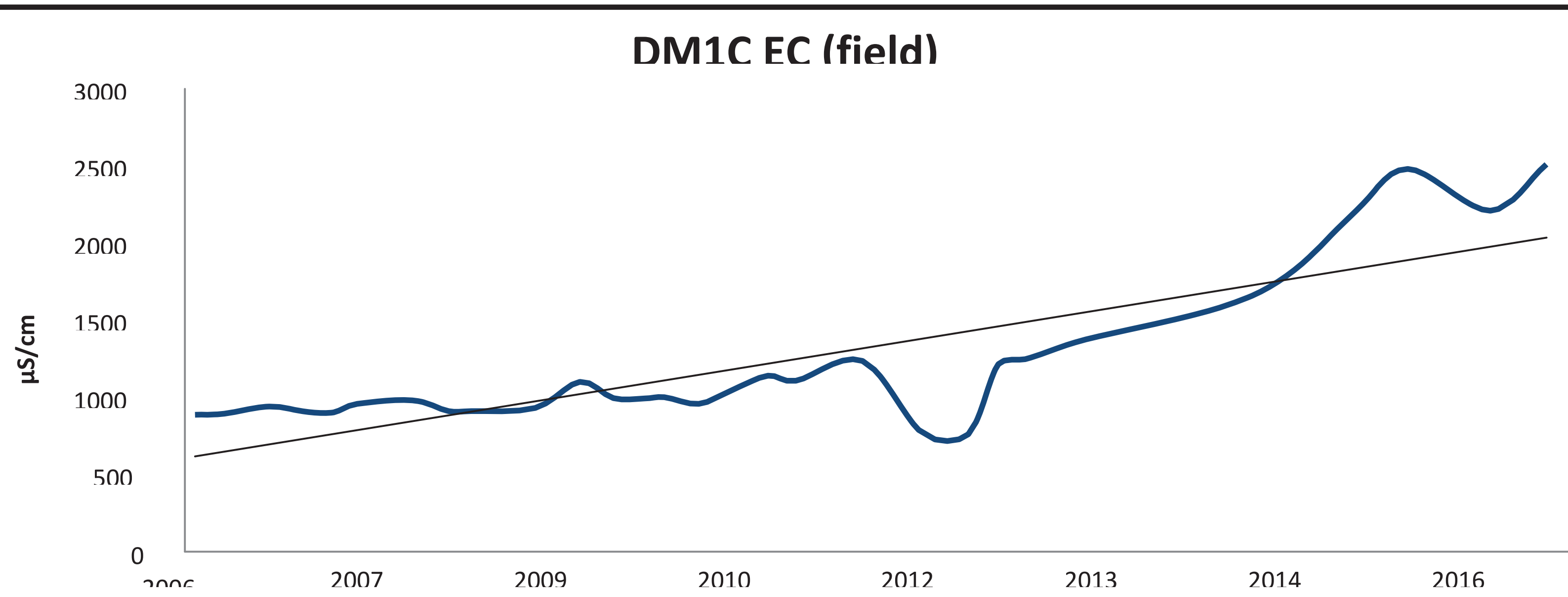

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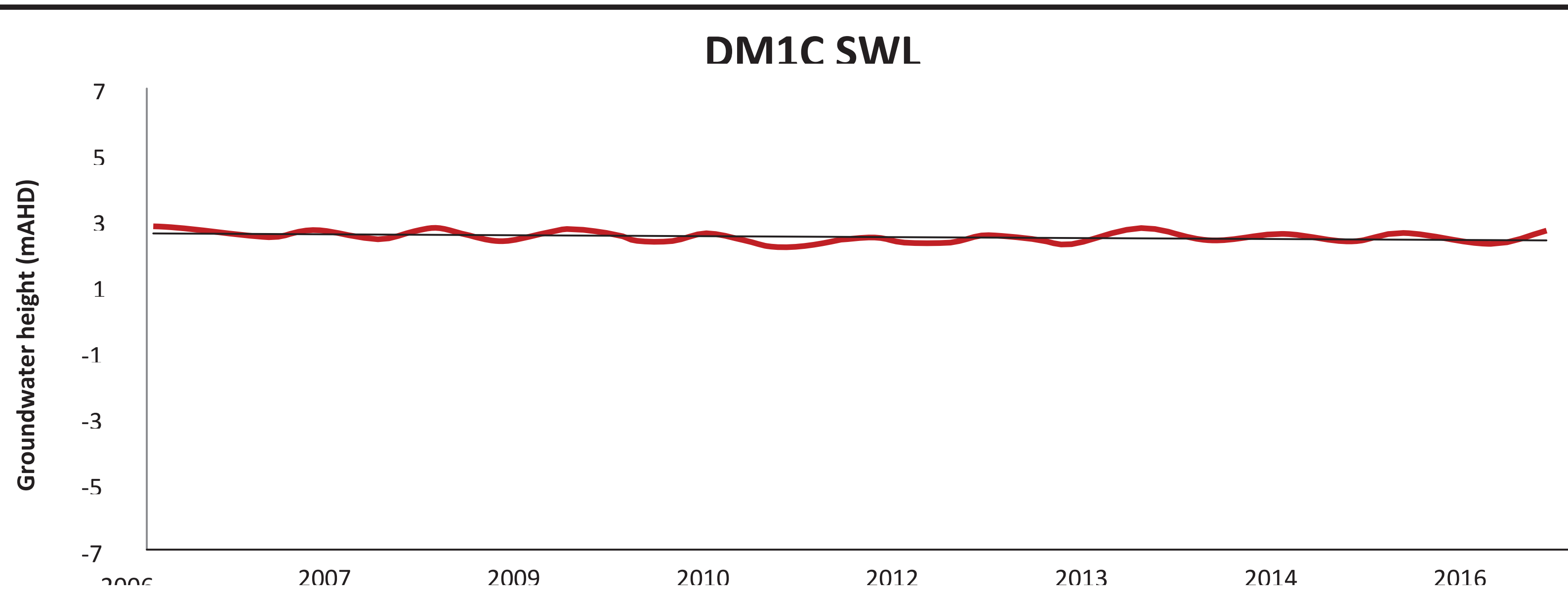

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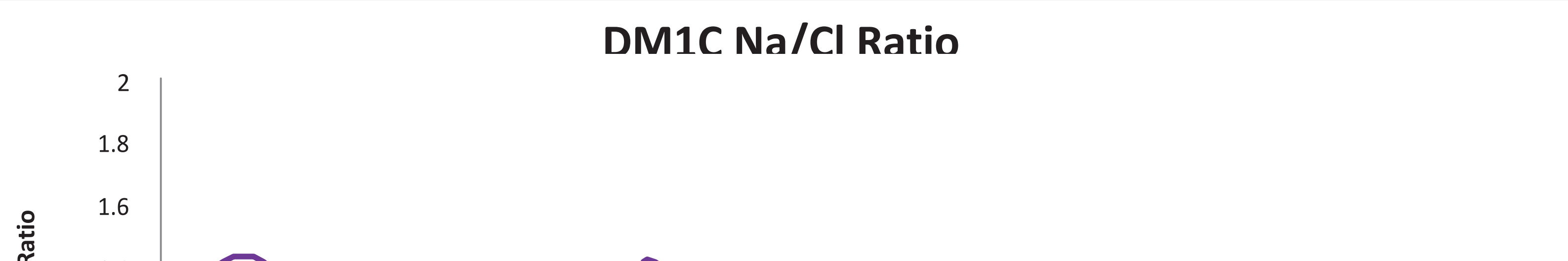

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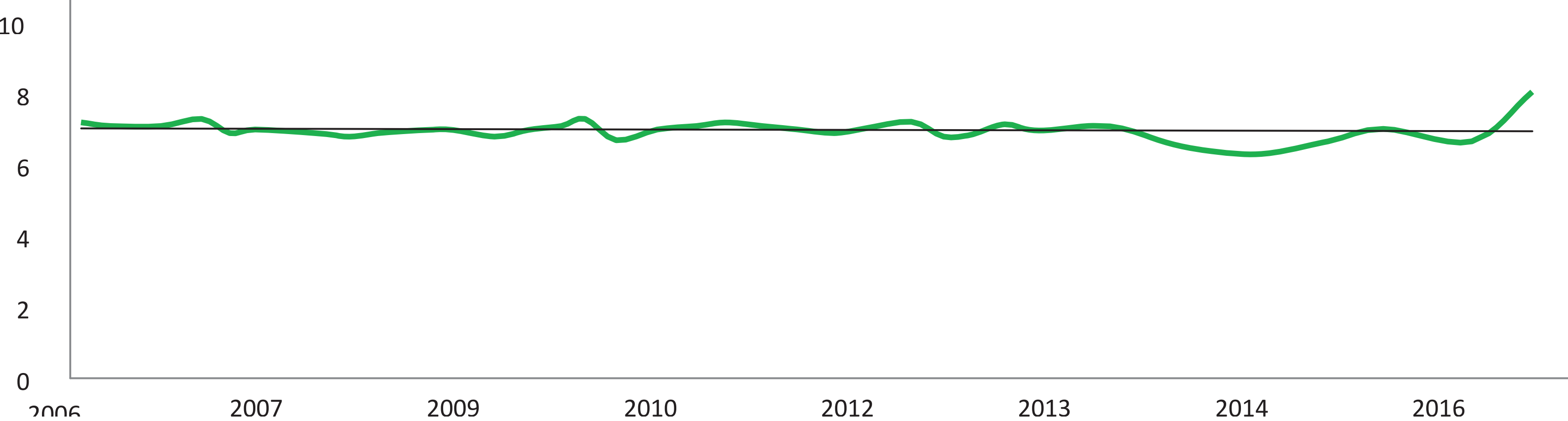

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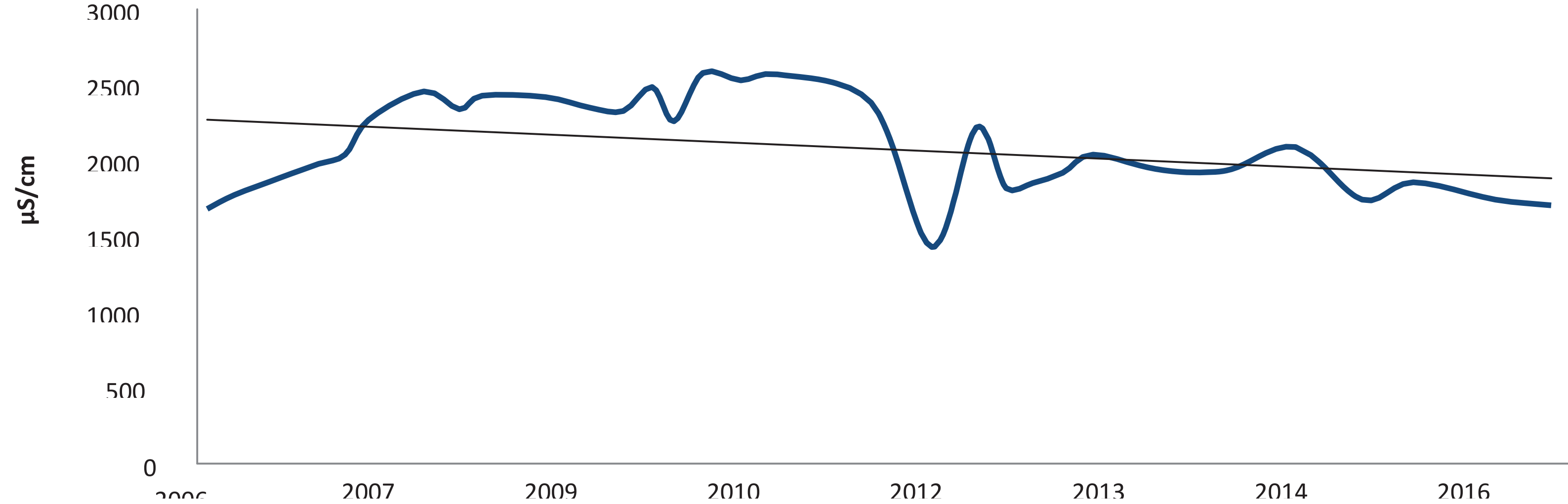

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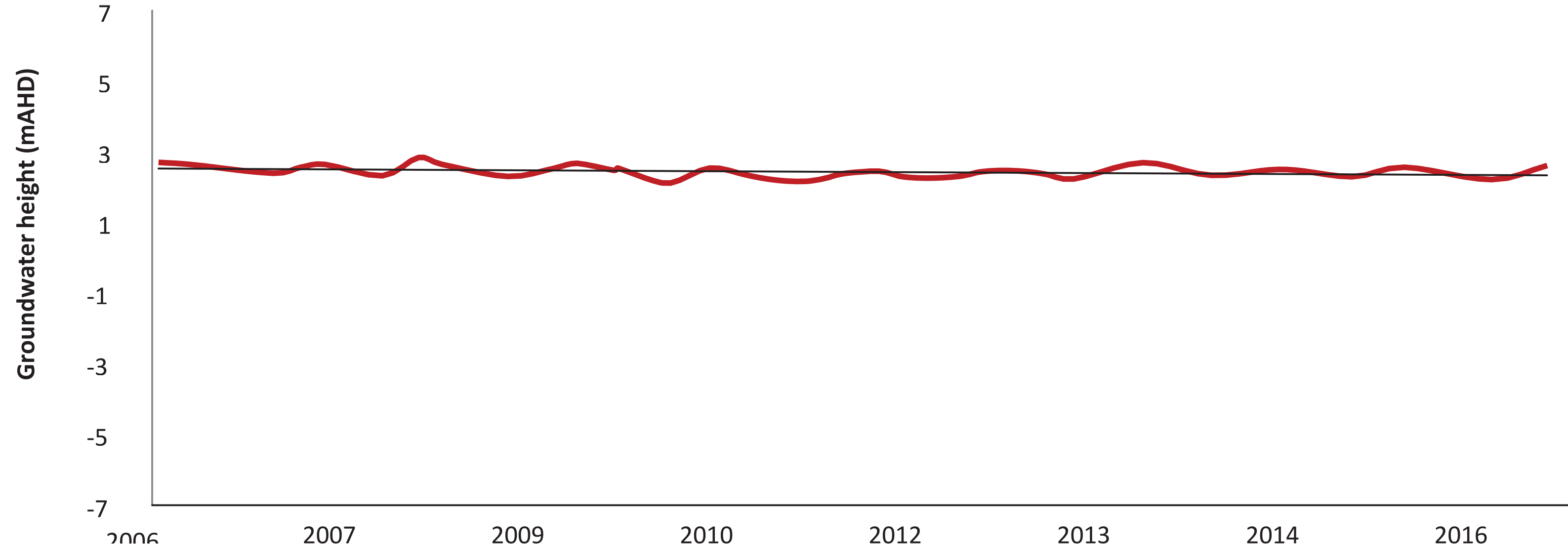

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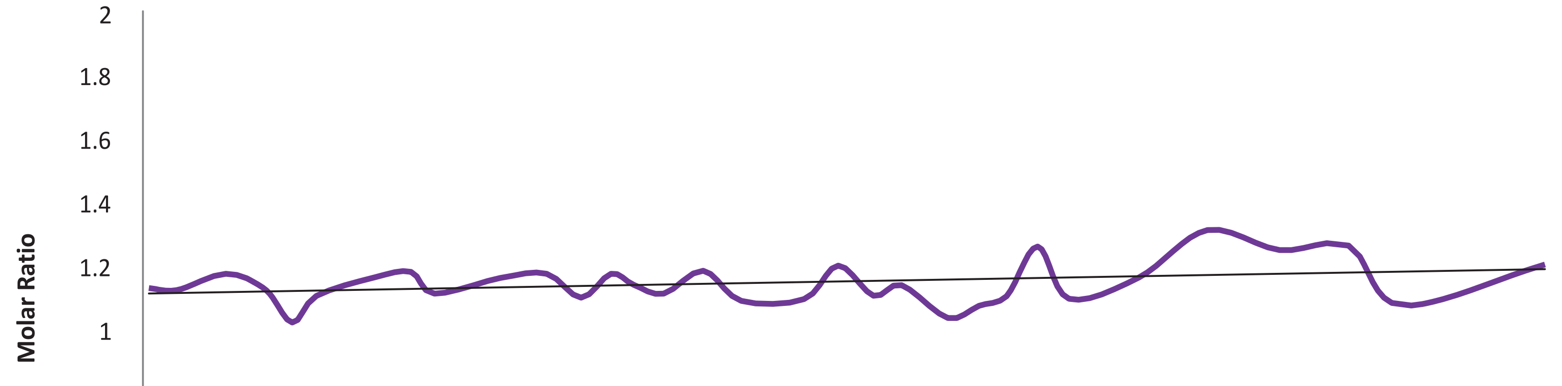

APPENDIX F

ANNUAL RADIOLOGICAL REPORT

Radiation
Professionals
Promoting Informed Decisions

CRISTAL PIGMENT AUSTRALIA LIMITED

ANNUAL REPORT

for

DALYELLUP, POST CAPPING LAYER

20 January 2017

Record of Distribution

No. of copies	File Name	Status	Issue Date	Submission Date	Initials
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Radiation
Professionals
Promoting Informed Decisions

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Document Section	Name	Description

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Role	Name	Signature	Date
Prepared by	Stuart Parr	Stuart Parr	15/12/16
Reviewed by	Alice Jagger	AJagger.	13/01/17
Endorsed by	Anthony O'Brien		20/01/17

Contents

1 EXECUTIVE SUMMARY

Cristal Pigment Australia Ltd (Cristal Pigment), previously known as Millennium Inorganic Chemicals Ltd, operated a disposal facility for the disposal of solid residue from their Kemerton and Australind pigment plants. The facility is located near Dalyellup, 8 km south of Bunbury town center. Disposed residues contained Technically Enhanced Naturally Occurring Radioactive Material (TENORM), in the form of traces of uranium and thorium. The residue was delivered to the disposal facility by tanker trucks as a slurry and then gravity fed into disposal cells.

As part of the decommissioning and rehabilitation of the Dalyellup site, the residue ponds have been capped with a minimum of 2 metres of local sand (shown in Figure 1 below). Post-capping, a rehabilitation program was initiated which includes periodic radiation surveys to ensure that the site is returned to natural background radiation levels for the area.

Figure 1: Aerial View of the Dalyellup Site

Based on the most recent gamma dose rate-in-air, the results clearly show that the gamma radiation levels are consistent with the natural background gamma radiation levels expected in the area and pose no radiological health issues to the public or the environment.

All radon and thoron airborne activity concentrations are below the MDL, with exception of monitor RM-05 for which thoron levels are slightly above the MDL at 37 Bq/m^3. The number of samples returning activities of below the MDL indicate that radon and thoron activity levels are low and pose no radiological health issues to the public or the environment.

The historical values (see Table 6 to Table 20 and accompanying graphs) show a clear downward trend in activity concentrations and show that results returned by monitoring in 2016 are fluctuating within the historical ranges. The low activity concentrations, the number of samples taken over the preceding years, a significant number of samples returning activities of below the MDL, and that readings are lower for the 'deep' samples; indicate that there is no leaching of radionuclides into the surrounding groundwater. However, samples taken at DM1C, DM9C and YB indicate that the Ra-226 and/or Ra-228 levels currently exceed the recommended 0.5Bq/L screening level and focus should be given to sampling at these locations.

2 INTRODUCTION

Radiation Professionals Pty Ltd (RadPro) have been commissioned for the past 3 years to undertake periodic radiation surveys of the Dalyellup site, with the first site visit taking place in October 2013.

The purpose of the periodic site visits is to undertake radiation monitoring on behalf of Cristal Pigment, in support of the site compliance with:

- legal reporting requirements to the Radiological Council Western Australia (RCWA), References [1] and [2];
- the approved Radiation Management Plan (RMP), References [3] and [4]; and
- the ongoing rehabilitation program for the site.

The last visit was undertaken on 29th August 2016, which included gamma-in-air monitoring over 20 historical locations around the site perimeter as well as a grid survey over a previously rehabilitated area and the capped pond using a nominal grid size of 100m by 100m (see Figure 2).

In addition, radon/thoron-in-air monitors were deployed to record airborne concentrations of these gases over a 3-month period (see Figure 3). Cristal Pigment have also undertaken radium 226/228 sampling of the water bore holes on the 22nd April and the 15th September 2016 (also shown in Figure 3).

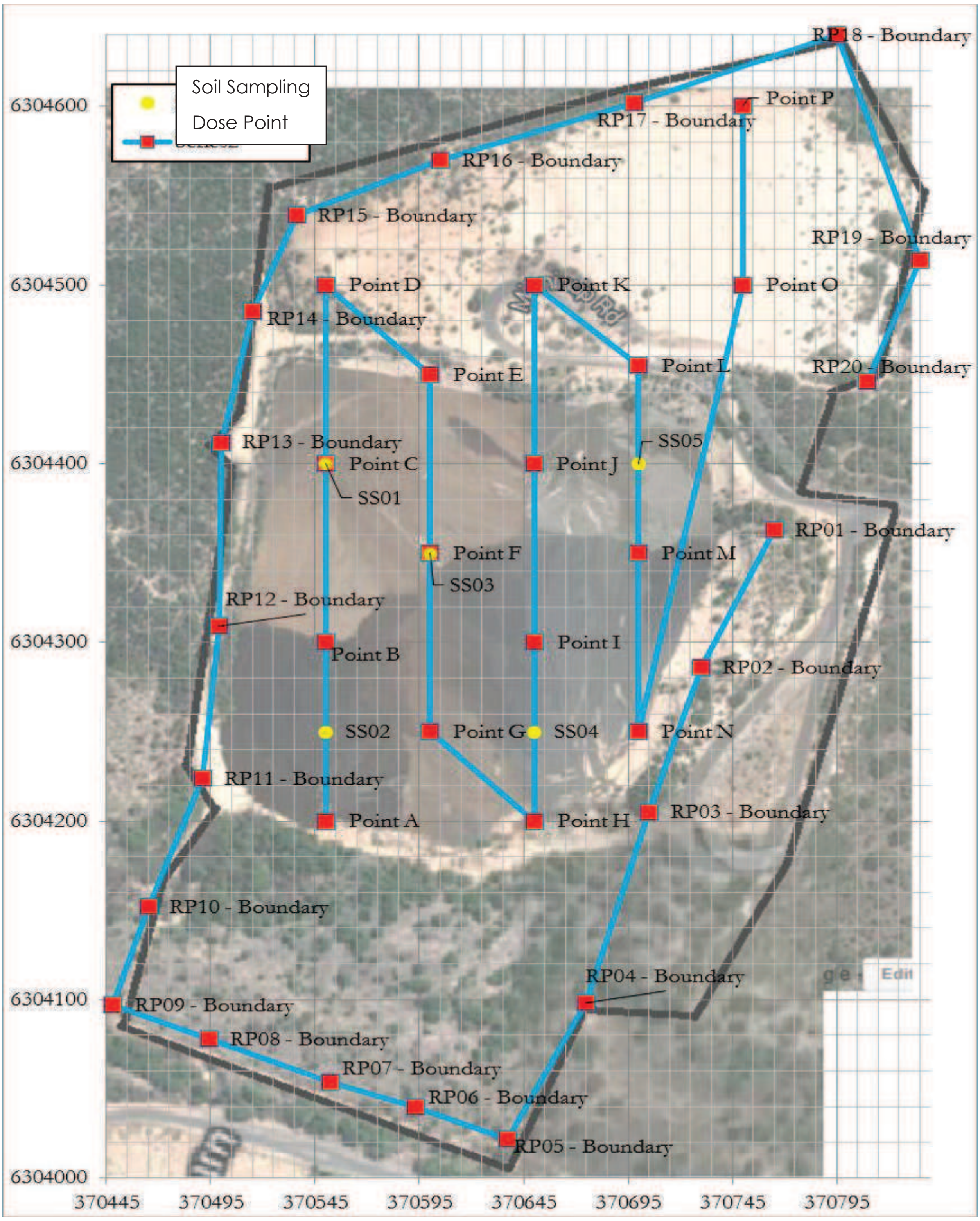


Figure 2: Gamma Monitoring Locations for 29th August 2016

Figure 3: Radon/Thoron Monitoring Locations for 29th August 2016 and Water Bore Hole Locations for 22nd April and 15th September 2016

3 SCOPE

Personnel from RadPro traveled to the Dalyellup site to undertake radiation monitoring in accordance with the requirements of the approved RMP (see Table 1) as follows:

- Conduct annual gamma survey at locations along the perimeter of the site (Figure 2);
- Conduct annual gamma survey at 100m by 100m intervals over the rehabilitated areas and over the capped pond (Figure 2);
- Replace the radon/thoron monitors for a 3-month (quarterly) period (Figure 3).

All gamma survey points were completed to provide continuity against survey points used in the previous site visits during 2014.

The post-capping radiation monitoring described under the rehabilitation program consists of:

(i) absorbed gamma dose rates-in-air measurements;
(ii) recorded radon/thoron levels for a 3-month period;
(iii) radium-226 and radium-228 recorded levels in the bore water;
(iv) and radionuclides in soil residue (not required under the current RMP);

This report includes data for items (i) to (iii).

Water bore sampling was conducted during site visits on 22/04/16 and 15/09/16, gamma survey was completed on 29/08/16, and the 3-month exposure period for the radon/thoron monitors ran from 29/08/16 to 10/11/16.

Table 1: Ongoing Monitoring Program at the Dalyellup Site in Accordance with RMP

Parameter	Site/Locations	Frequency	Technique
Gamma	A 100 x 100m grid over the site Refer to Figure 2	Annually after rehabilitation for a period of 5 years (2013-2018)	On foot, using rate-meter (Radeye or Mini 6-80) with large volume, energy compensated environmental GM, (MC-71 probe), and WGPS for locations 3 x Integrated 60sec measurements @ 1m above ground
Radon Thoron-in-air	Sampling locations 1,3,5,7,9,13,16, and 20. Refer to Figure 3	3 monthly (quarterly) change outs for a period of 5 years (2013 - 2018)	Track etch (RadTrak)
Water Quality	Water bores around site: DM1, DM2, DM4, DM7, DM8, DM9. MB3, MB4 and YB. Refer to Figure 3	Annually for a period of 2013 to 2018	Water sampling as per AS/NZ 5667.11:1998 then elemental U and Th analysis plus radionuclide analysis for Ra226/228

4 METHODOLOGY

4.1 Gamma Survey

A RadEye (model GX) ratemeter coupled to an energy compensated GM detector (type MC-71) was used to conduct the gamma-in-air measurements. The instrument was last calibrated by SGS (formerly Australian Radiation Services) on the 4th February 2015 using a Caesium-137 (Cs-137) gamma source in accordance with the Australian gamma standard. The instrument is calibrated annually. The calibration certificate is attached in Appendix A.

The gamma survey was conducted with the detector one metre above the ground. At each survey location three (3), one (1) minute integrated measurements were collected and recorded on a field sheet along with the GPS co-ordinates for that location. A total of 20 perimeter locations were monitored in addition to 16 locations over the previously rehabilitated areas and capped pond area.

Section 5 gives statistical results of the gamma-in-air surveys. The expressed uncertainty of the results is taken from the 95% confidence level for a normal distribution (1.96x√count) for counting events.

All gamma survey points were located with a Garmin Map GPS 12 using the WGS 84 (GDA94) datum projected in the UTM format, referenced to map zone 50H.

Table 2: Summary of Gamma Measurements

Area	Type of measurement/sampling	No of Samples	Duration (minutes)
Perimeter of site (locations RP01-RP20)	Gamma-in-air monitoring	20	93
Rehabilitated Area & Capped Pond (Locations A-P)	Gamma-in-air monitoring	16	60

4.2 Radon and Thoron

The radon measurement was performed using closed alpha-track detectors as supplied by Landauer following the United States (US) quality guidance in EPA 402-R-95-012. Detectors are deployed in pairs, with a radon only monitor and a radon and thoron monitor placed together at each monitoring location for an exposure period of approximately 90 days.

The detector container is manufactured from electrically conducting plastic. Through a small slit (filter) in the radon only detector, radon gas enters the detector chamber but the diffusion time is long enough to prevent thoron gas from entering.

The thoron detector is constructed differently with holes covered by paper filters in through which both thoron and radon gas enter the chamber. The thoron concentration is calculated by subtracting the radon only measurement from the total exposure value of the combined radon and thoron detector. The film inside the detectors records a 'track' when exposed to alpha particles, which are generated by radon and thoron entering the detectors and by their respective decay products. Analysis of monitors is conducted by the supplier Landauer in an accredited laboratory to determine the radon and thoron exposures.

The radon detector is marked with (R) after the detector number in the results table (see Appendix B) and the combined radon and thoron detector with (T). For each result an uncertainty associated with the measurement to a 95% confidence level is also given. Measurements are given in pCi/L, and the radon and thoron concentrations are calculated based on the period of exposure to give a total exposure in pCi-days/L.

Radon and thoron monitoring was conducted at locations along the perimeter fence of the site over a period of approximately 3 months. At the end of the exposure period, the detectors were collected and sent to Landauer for analysis. A total of 8 locations were monitored (Figure 3) and results are shown in Table 21.

4.3 Equipment

Equipment used during the radiometric survey is described in Section 4.1. Instrument details are given in Table 3.

Table 3: Survey Instrument information

Survey	Gamma-in-Air Survey	
Surveyors:	Stuart Parr/Danielle Stephen	
Survey Date:	29 August 2016	
Instrument Type	**Serial Number**	**Calibration Date**
Radeye model GX	513	11/2/2016
MC-71 probe	19020	11/2/2016

5 MONITORING RESULTS

5.1 Absorbed Gamma Dose Rates-in-Air

The mean values of the absorbed gamma dose rates-in-air over three minutes at each monitoring location are shown in Table 4 for the site visit on the 29th August 2016.

Within the uncertainty of the measurements, the readings for the current survey range between 0.09 ± 0.02 µGy/h and 0.11 ± 0.02 µGy/h, with an average dose rate of 0.10 ± 0.02 µGy/h. This is typical of the background gamma dose rates in the area (measured as 0.09 ± 0.02 µGy/h) and is consistent with measurements made in previous years.

Based on the most recent gamma radiation survey, the results clearly show that the rehabilitation of the site has returned the gamma radiation to levels consistent with the natural background gamma radiation levels expected in the area and pose no radiological health issues to the public or the environment.

5.2 Radon and Thoron

The Radon and Thoron monitors were deployed for a period of approximately 3 months. Radon results range from 14.8 to 18.5 Bq/m^3 (see Table 5) and the thoron results range from 29.6 to 37.0 Bq/m^3 (also see Table 5). All radon and thoron airborne activity concentrations are below the MDL, with exception of monitor RM-05 for which thoron levels are slightly above the MDL at 37 Bq/m^3. The number of samples returning activities of below the MDL indicate that radon and thoron activity levels are low and pose no radiological health issues to the public or the environment.

5.3 Bore Water Levels

The Minimum Detectable Limit (MDL) of the analysis method for Radium-226 and Radium-228 is 100 mBq/L for both isotopes. Locations identified as "A" are for 'deep' bore hole samples and those indicated as "C" are for 'shallow' bore hole samples.

Summarised data (see Table 22) shows that samples taken from bore holes DM2A, DM2C, DM4C, DM7A, DM8A, and DM9A (see Figure 3) contain concentrations of Ra-226 and Ra-228 that are below the MDL for both sampling periods. Concentrations of Ra-228 are also below the MDL for bore holes DM1A, DM2A, DM2C, DM4A, DM4C, DM7A, DM7C, DM8A, DM8C, DM9A, MB3 and MB4 (see Figure 3) for both sampling periods. There are general fluctuations in the levels of Ra-226 and Ra-228 that cannot be related to depth, location or seasonal changes. The highest Ra-226 and Ra-228 concentrations were recorded at water bore DM9C (0.91 Bq/L Ra-226 and 0.57 Bq/L Ra-228 on the 16/09/16), followed by water bores DM1C (0.55 Bq/L Ra-226 and 0.76 Bq/L Ra-228 on the 16/09/16) and YB (0.53 Bq/L Ra-226 and 0.19 Bq/L Ra-228 on the 22/04/16).

The screening levels for drinking water as set by Reference [5], state that compliance with the guideline for radiological quality of drinking water should be assessed, initially, by screening for gross alpha and gross beta activity concentrations. The recommended screening level for gross alpha activity is 0.5 Bq/L. The concentrations of both radium-226 and radium-228 should always be determined, as these are the most significant naturally occurring radionuclides in Australian water supplies.

The historical values (see Table 6 to Table 20 and accompanying graphs) show a clear downward trend in activity concentrations and show that results returned by monitoring in 2016 are fluctuating within the historical ranges. The low activity concentrations, the number of samples taken over the preceding years, a significant number of samples returning activities of below the MDL, and that readings are lower for the 'deep' samples; indicate that there appears to be no leaching of radionuclides into the surrounding groundwater. However, samples taken at DM1C, DM9C and YB indicate that the Ra-226 and/or Ra-228 levels currently exceed the recommended 0.5Bq/L screening level and focus should be given to sampling at these locations.

6 QUALITY MANAGEMENT

The results of this survey were managed in accordance with the requirements of the Radiation Professionals Quality Assurance program. The aim of this program is to provide continued improvement of the radiation monitoring and assessment methods. The quality of the results obtained was evaluated by using standardised documented procedures, using calibrated and well-maintained equipment with radiation sources traceable to the national standard, undertaken by qualified individuals and the monitored data was analysed by accredited laboratories (as far as practicable).

6.1 Sampling Equipment, Procedures and Methods Used

All sampling equipment and procedures used in this report are as described in the DMP NORM guidelines or Radiation Professionals sampling procedures.

6.2 Calibration Records

All equipment used is calibrated and calibration records and certificates are kept by Radiation Professionals.

All equipment is calibrated at least on an annual basis, or more often as required. Calibration certificates are attached in Appendix A.

6.3 Training and Experience of Personnel

Appropriately trained and experienced personnel are employed to undertake the measurements and surveys required, described in this document.

The Radiation Safety Officer responsible for and overseeing the implementation of this radiological survey is certified as competent and holds a current license from the Radiological Council of WA.

7 ABBREVIATIONS

µGy	Unit used to describe absorbed dose is the Gray (Gy). Frequently used SI multiples are the milli-Grays (1 mGy = 10^{-3} Gy = 0.001 Gy) and micro-Grays (1 µGy = 10^{-6} Gy = 0.000001 Gy)
mSv	Unit used to describe effective dose is the Sievert (Sv). Frequently used SI multiples are the milli-Sievert (1 mSv = 10^{-3} Sv = 0.001 Sv) and micro-Sievert (1 µSv = 10^{-6} Sv = 0.000001 Sv)
Bq	A Becquerel is approximately one disintegration per second of radioactive material
Ci	A unit of radioactivity, equal to the amount of radioactive decay of an isotope; equal to 3.7×10^{10} disintegrations per second, or 3.7×10^{10} Becquerels. In 1975, the Curie was replaced by the Becquerel as the standard SI unit of radioactivity
m	A metre is the SI unit of measurement. It can be used as a unit of area (m^2).
s	Second in a unit of time. Multiples of seconds can be used such an hour or a day.
RMP	Radiation Management Plan

8 REFERENCES

[1] Government of Western Australia, " Radiation Safety Act," 1975.

[2] Government of Western Australia, " Radiation Safety (General) Regulations," 1983.

[3] Cristal Pigment, "Radiation Management Plan For Cristal Pigment Australia Limited, Dalyellup Waste Residue Disposal Facility, Post-Decommissioning and Rehabilitation, CRIS150130-RMP-V1.0," January 2016.

[4] Government of Western Australia, "Letter from Radiological Council to Peter Allen, Radiation Safety Act, Radiation Management Plan, 05390_160714ds1," 2nd August 2016.

[5] National Health and Medical Research Council, "National Water Quality Management Strategy, Australian Drinking Water Guidelines 6 2011, Version 3.3," Updated November 2016.

9 TABLES

9.1 Gamma Dose Rates-in-Air Measurements

Table 4: Gamma Data Statistical Results for 29th August 2016 Site Visit

Point #	Time	GPS E	GPS N	Location	Count 1	Count 2	Count 3	Average cpm	Average cps	Conversion (cps/uGy/h)	Dose Rate (uGy/h) ± 0.02	Comment
BG	10:02 AM	370734	6304389	Approx. 50m NE of RP01	79	89	87	**85**	1.42	15.00	0.09	Background Readings
21	11:41 AM	370787	6304375	RP01 - Boundary	104	100	85	**96**	1.61	15.00	0.11	Radon Monitor #8
20	11:36 AM	370730	6304286	RP02 - Boundary	74	92	77	81	1.35	15.00	0.09	
19	11:31 AM	370705	6304205	RP03 - Boundary	97	98	72	**89**	1.48	15.00	0.10	Radon Monitor #7
18	11:26 AM	370675	6304098	RP04 - Boundary	85	88	76	**83**	1.38	15.00	0.09	
17	11:20 AM	370635	6304034	RP05 - Boundary	75	108	77	**87**	1.44	15.00	0.10	Radon Monitor #6
16	11:16 AM	370593	6304040	RP06 - Boundary	96	100	79	**92**	1.53	15.00	0.10	
15	11:12 AM	370552	6304054	RP07 - Boundary	76	93	73	**81**	1.34	15.00	0.09	Radon Monitor #5
14	11:08 AM	370494	6304078	RP08 - Boundary	83	75	93	**84**	1.39	15.00	0.09	
13	11:04 AM	370448	6304097	RP09 - Boundary	89	72	104	**88**	1.47	15.00	0.10	Radon Monitor #4
12	10:58 AM	370465	6304152	RP10 - Boundary	85	98	89	**91**	1.51	15.00	0.10	
11	10:53 AM	370491	6304224	RP11 - Boundary	90	93	104	**96**	1.59	15.00	0.11	
10	10:49 AM	370499	6304309	RP12 - Boundary	102	104	88	**98**	1.63	15.00	0.11	
9	10:45 AM	370502	6304413	RP13 - Boundary	85	93	83	**87**	1.45	15.00	0.10	Radon Monitor #3
8	10:40 AM	370515	6304485	RP14 - Boundary	73	85	93	**84**	1.39	15.00	0.09	
7	10:36 AM	370536	6304539	RP15 - Boundary	106	75	88	**90**	1.49	15.00	0.10	
6	10:32 AM	370600	6304579	RP16 - Boundary	87	96	90	**91**	1.52	15.00	0.10	Radon Monitor #2

Point #	Time	GPS E	GPS N	Location	Count 1	Count 2	Count 3	Average cpm	Average cps	Conversion (cps/uGy/h)	Dose Rate (uGy/h) ± 0.02	Comment
5	10:28 AM	370698	6304602	RP17 - Boundary	99	93	85	**92**	1.54	15.00	0.10	
3	10:20 AM	370795	6304640	RP18 - Boundary	91	91	75	**86**	1.43	15.00	0.10	
2	10:13 AM	370835	6304514	RP19 - Boundary	87	89	93	**90**	1.49	15.00	0.10	
1	10:08 AM	370810	6304446	RP20 - Boundary	86	79	75	**80**	1.33	15.00	0.09	Radon Monitor #1
4	10:24 AM	370750	6304600	Point A	92	87	91	**90**	1.50	15.00	0.10	
22	11:51 AM	370750	6304500	Point B	97	93	4	**65**	1.08	15.00	0.07	
23	11:55 AM	370650	6304500	Point C	105	97	101	**101**	1.68	15.00	0.11	
24	11:59 AM	370550	6304500	Point D	78	92	89	**86**	1.44	15.00	0.10	
25	12:04 PM	370550	6304400	Point E	105	115	71	**97**	1.62	15.00	0.11	
26	12:08 PM	370550	6304300	Point F	95	66	75	**79**	1.31	15.00	0.09	
27	12:13 PM	370550	6304200	Point G	69	92	95	**85**	1.42	15.00	0.09	
28	12:17 PM	370600	6304250	Point H	80	95	107	**94**	1.57	15.00	0.10	
29	12:22 PM	370600	6304350	Point I	68	91	93	**84**	1.40	15.00	0.09	
30	12:26 PM	370600	6304450	Point J	103	106	85	**98**	1.63	15.00	0.11	
31	12:30 PM	370650	6304400	Point K	84	101	87	**91**	1.51	15.00	0.10	
32	12:34 PM	370650	6304300	Point L	89	100	85	**91**	1.52	15.00	0.10	
33	12:38 PM	370650	6304200	Point M	105	103	90	**99**	1.66	15.00	0.11	
34	12:42 PM	370700	6304250	Point N	108	116	106	**110**	1.83	15.00	0.12	
35	12:47 PM	370700	6304350	Point O	89	89	92	**90**	1.50	15.00	0.10	
36	12:51 PM	370700	6304455	Point P	86	97	103	**95**	1.59	15.00	0.11	

9.2 Radon and Thoron-in-Air Measurements

Table 5: Quarterly Results for Period 29th August to 11th November 2016

Location	Detector	pCi/l	Bq/l	pCi-days/l	Bq-days/l	Bq/m³	Bq-days/m³	Radiation Type
Point 20	RM-01	<0.4	<0.01	<29	<1.07	<14.80	<1073.00	Radon
	RM-01	<0.8	<0.03	<59	<2.18	<29.60	<2183.00	Thoron
Point 16	RM-02	<0.5	<0.02	<39	<1.44	<18.50	<1443.00	Radon
	RM-02	<0.8	<0.03	<59	<2.18	<29.60	<2183.00	Thoron
Point 13	RM-03	<0.4	<0.01	<29	<1.07	<14.80	<1073.00	Radon
	RM-03	<0.8	<0.03	<59	<2.18	<29.60	<2183.00	Thoron
Point 9	RM-04	<0.4	<0.01	<29	<1.07	<14.80	<1073.00	Radon
	RM-04	<0.8	<0.03	<59	<2.18	<29.60	<2183.00	Thoron
Point 7	RM-05	<0.4	<0.01	<29	<1.07	<14.80	<1073.00	Radon
	RM-05	1.0 ± 0.6	0.04	74 ± 41	2.74	37.00	2738.00	Thoron
Point 5	RM-06	<0.4	<0.01	<29	<1.07	<14.80	<1073.00	Radon
	RM-06	<0.8	<0.03	<59	<2.18	<29.60	<2183.00	Thoron
Point 3	RM-07	<0.5	<0.02	<39	<1.44	<18.50	<1443.00	Radon
	RM-07	<0.8	<0.03	<59	<2.18	<29.60	<2183.00	Thoron
Point 1	RM-08	<0.5	<0.02	<39	<1.44	<18.50	<1443.00	Radon
	RM-08	<0.8	<0.03	<59	<2.18	<29.60	<2183.00	Thoron

9.3 Water Bore Radiation Activity Levels

Table 6: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM1A

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM1A	1/11/1989	37	
DM1A	1/06/1990	15	
DM1A	1/10/1990	94	
DM1A	1/12/1990	20	
DM1A	1/04/1991	21	
DM1A	1/06/1991	15	
DM1A	1/09/1991	13	
DM1A	1/04/1992	31	
DM1A	1/07/1992	37	
DM1A	1/10/1992	47	
DM1A	1/01/1993	37	
DM1A	1/04/1993	37	
DM1A	1/07/1993	37	
DM1A	1/10/1993	1	
DM1A	1/01/1994	37	
DM1A	1/04/1994	2	
DM1A	1/07/1994	37	
DM1A	1/10/1994	41	
DM1A	1/01/1995	37	
DM1A	1/04/1995	39	
DM1A	1/07/1995	37	
DM1A	1/10/1995	37	
DM1A	1/01/1996	37	
DM1A	10/07/1996	7	
DM1A	22/10/1996	38	
DM1A	15/01/1997	27	
DM1A	10/04/1997	26	
DM1A	3/07/1997	20	
DM1A	8/10/1997	10	
DM1A	1/10/1998	66	
DM1A	1/08/1999	25	
DM1A	1/02/2000	35	308
DM1A	1/06/2000	36	703
DM1A	9/08/2000	215	
DM1A	30/10/2000	10	
DM1A	1/02/2001	17	
DM1A	8/05/2001	22	670

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM1A	26/07/2001	5	1130
DM1A	29/10/2001	40	70
DM1A	18/02/2002	150	240
DM1A	15/04/2002	120	110
DM1A	12/08/2002	140	130
DM1A	6/11/2002	15	226
DM1A	13/02/2003	7	
DM1A	30/04/2003	17	
DM1A	9/08/2003	9	
DM1A	24/11/2003	11	100
DM1A	10/02/2004	10	213
DM1A	13/05/2004	15	100
DM1A	6/08/2004	3	100
DM1A	10/11/2004	3	100
DM1A	16/02/2005	3	100
DM1A	15/04/2005	37	296
DM1A	2/08/2005	38	459
DM1A	14/11/2005	40	100
DM1A	15/02/2006	37	100
DM1A	18/05/2006	94	100
DM1A	17/08/2006	74	337
DM1A	31/10/2006	47	306
DM1A	8/03/2007	3	639
DM1A	19/06/2007	41	477
DM1A	2/11/2007	48	611
DM1A	2/04/2008	25	654
DM1A	8/07/2008	100	278
DM1A	8/09/2008	100	100
DM1A	1/12/2008	58	100
DM1A	1/03/2009	47	173
DM1A	1/07/2009	216	294
DM1A	30/09/2009	133	572
DM1A	18/12/2009	53	535
DM1A	16/02/2010	346	258
DM1A	6/05/2010	74	155
DM1A	18/08/2010	62	168
DM1A	26/11/2010	43	100
DM1A	9/02/2011	70	100
DM1A	11/05/2011	106	100
DM1A	9/08/2011	381	160
DM1A	10/11/2011	67	112

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM1A	23/01/2012	54	613
DM1A	24/05/2012	46	100
DM1A	14/08/2012	33	100
DM1A	26/10/2012	79	100
DM1A	16/01/2013	29	100
DM1A	9/04/2013	68	100
DM1A	10/10/2013	138	121
DM1A	9/04/2014	217	334
DM1A	16/10/2014	182	100
DM1A	16/04/2015	135	100
DM1A	4/09/2015	399	100
DM1A	**22/04/2016**	**210**	**<100**
DM1A	**16/09/2016**	**<100**	**<100**

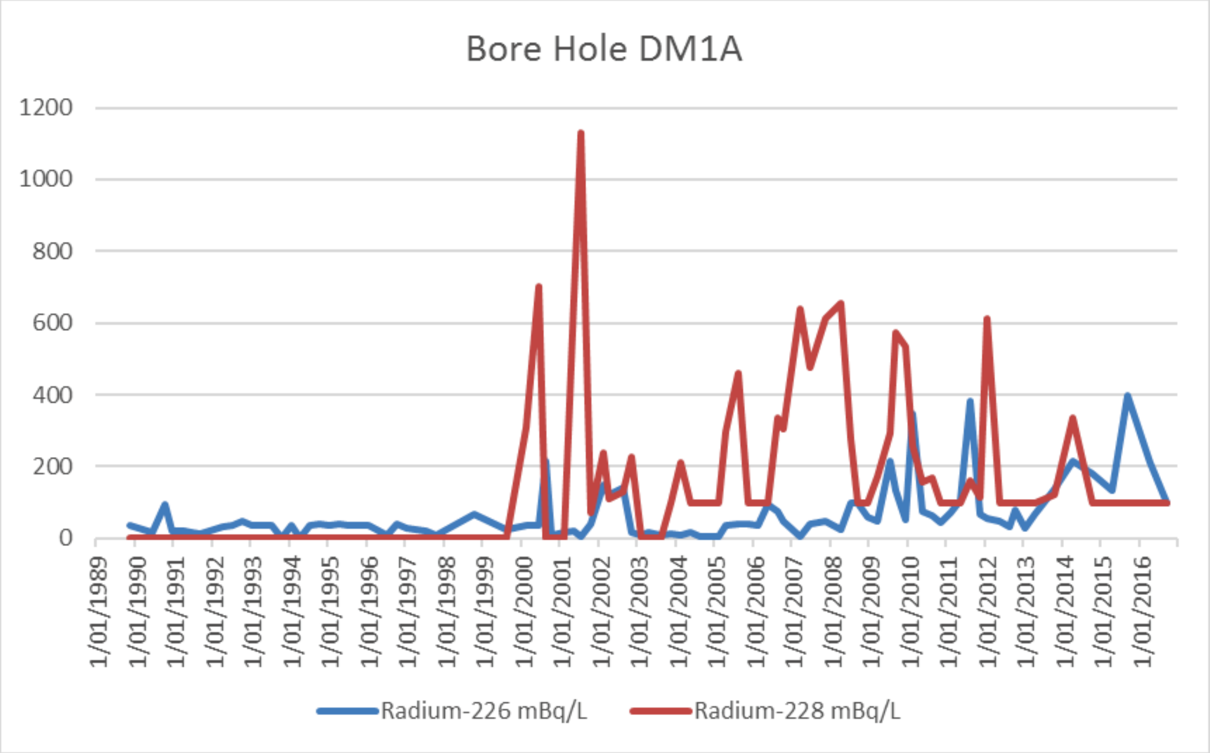


Table 7: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM1C

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM1C	1/03/1989	23	50
DM1C	1/08/1989	38	
DM1C	1/11/1989	37	
DM1C	1/06/1990	9	
DM1C	1/10/1990	37	
DM1C	1/12/1990	14	
DM1C	1/04/1991	10	
DM1C	1/06/1991	7	
DM1C	1/09/1991	17	
DM1C	1/04/1992	24	
DM1C	1/07/1992	37	
DM1C	1/10/1992	37	
DM1C	1/01/1993	37	
DM1C	1/04/1993	37	
DM1C	1/07/1993	37	
DM1C	1/10/1993	22	
DM1C	1/01/1994	37	
DM1C	1/04/1994	20	
DM1C	1/07/1994	37	
DM1C	1/10/1994	45	
DM1C	1/01/1995	37	
DM1C	1/04/1995	39	
DM1C	1/07/1995	44	
DM1C	1/10/1995	38	
DM1C	1/01/1996	83	
DM1C	1/07/1996	30	
DM1C	22/10/1996	50	
DM1C	15/01/1997	49	
DM1C	10/04/1997	35	
DM1C	3/07/1997	40	
DM1C	8/10/1997	30	
DM1C	7/01/1998	40	
DM1C	1/10/1998	26	
DM1C	1/08/1999	38	
DM1C	1/02/2000	19	656
DM1C	1/06/2000	15	1045
DM1C	9/08/2000	29	551
DM1C	30/10/2000	27	
DM1C	1/02/2001	16	
DM1C	8/05/2001	29	

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM1C	26/07/2001	25	
DM1C	29/10/2001	70	120
DM1C	8/02/2002	170	250
DM1C	15/04/2002	120	120
DM1C	6/11/2002	43	
DM1C	13/02/2003	42	
DM1C	30/04/2003	25	
DM1C	9/08/2003	79	
DM1C	24/11/2003	75	100
DM1C	10/02/2004	24	
DM1C	14/05/2004	66	100
DM1C	10/11/2004	9	373
DM1C	16/02/2005	16	100
DM1C	15/04/2005	4	610
DM1C	2/08/2005	17	503
DM1C	14/11/2005	19	614
DM1C	15/02/2006	14	776
DM1C	18/05/2006	14	352
DM1C	17/08/2006	5	100
DM1C	31/10/2006	11	100
DM1C	8/03/2007	23	422
DM1C	19/06/2007	14	324
DM1C	2/11/2007	88	100
DM1C	2/04/2008	16	258
DM1C	8/07/2008	440	420
DM1C	8/09/2008	100	240
DM1C	1/12/2008	11	290
DM1C	1/03/2009	7	199
DM1C	1/07/2009	48	100
DM1C	30/09/2009	74	100
DM1C	23/12/2009	1102	451
DM1C	16/02/2010	83	188
DM1C	21/05/2010	62	143
DM1C	18/08/2010	20	202
DM1C	25/11/2010	10	256
DM1C	9/02/2011	34	100
DM1C	11/05/2011	12	162
DM1C	9/08/2011	196	250
DM1C	10/11/2011	6	206
DM1C	23/01/2012	31	10
DM1C	24/05/2012	20	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM1C	14/08/2012	37	100
DM1C	26/10/2012	20	100
DM1C	16/01/2013	20	100
DM1C	9/04/2013	58	100
DM1C	10/10/2013	132	100
DM1C	9/04/2014	103	100
DM1C	16/10/2014	60	100
DM1C	16/04/2015	57	100
DM1C	4/09/2015	240	100
DM1C	**22/04/2016**	**274**	**<100**
DM1C	**16/09/2016**	**547**	**757**

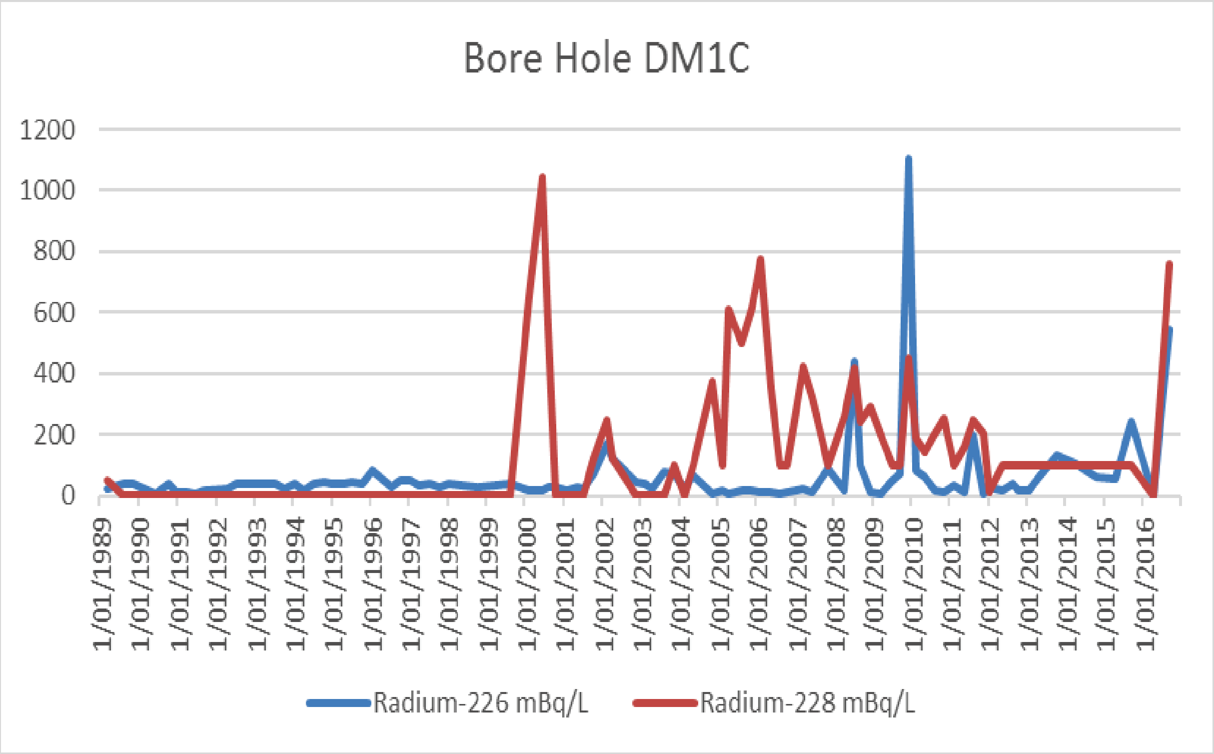


Table 8: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM2A

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM2A	1/11/1989	46	
DM2A	1/06/1990	25	
DM2A	1/10/1990	89	150
DM2A	1/12/1990	129	239
DM2A	1/04/1991	56	
DM2A	1/06/1991	93	
DM2A	1/09/1991	99	
DM2A	1/04/1992	50	
DM2A	1/07/1992	85	
DM2A	1/10/1992	83	
DM2A	1/01/1993	100	
DM2A	1/04/1993	53	
DM2A	1/07/1993	63	
DM2A	1/10/1993	49	
DM2A	1/01/1994	47	
DM2A	1/07/1994	55	
DM2A	1/10/1994	37	
DM2A	1/01/1995	59	
DM2A	1/04/1995	37	
DM2A	1/07/1995	53	
DM2A	1/10/1995	37	
DM2A	1/01/1996	67	
DM2A	1/07/1996	40	
DM2A	1/10/1996	48	
DM2A	1/01/1997	28	
DM2A	1/04/1997	19	
DM2A	1/07/1997	10	
DM2A	1/10/1997	10	
DM2A	1/01/1998	10	
DM2A	1/10/1998	29	
DM2A	1/08/1999	56	
DM2A	1/02/2000	65	300
DM2A	1/06/2000	32	594
DM2A	9/08/2000	39	772
DM2A	30/10/2000	19	
DM2A	1/02/2001	27	
DM2A	8/05/2001	26	
DM2A	26/07/2001	26	
DM2A	29/10/2001	40	70
DM2A	8/02/2002	170	250

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM2A	15/04/2002	120	110
DM2A	12/08/2002	140	130
DM2A	6/11/2002	22	180
DM2A	13/02/2003	55	
DM2A	30/04/2003	37	
DM2A	9/08/2003	27	
DM2A	24/11/2003	32	170
DM2A	10/02/2004	39	
DM2A	14/05/2004	48	130
DM2A	6/08/2004	59	915
DM2A	10/11/2004	43	627
DM2A	16/02/2005	32	425
DM2A	15/04/2005	55	508
DM2A	2/08/2005	42	100
DM2A	14/11/2005	69	548
DM2A	15/02/2006	61	490
DM2A	18/05/2006	56	100
DM2A	17/08/2006	39	100
DM2A	31/10/2006	54	408
DM2A	8/03/2007	3	100
DM2A	19/06/2007	42	471
DM2A	2/11/2007	51	100
DM2A	2/04/2008	35	100
DM2A	8/07/2008	345	463
DM2A	8/09/2008	100	100
DM2A	1/12/2008	3	100
DM2A	1/03/2009	19	324
DM2A	1/07/2009	90	270
DM2A	30/09/2009	41	187
DM2A	23/12/2009	74	271
DM2A	16/02/2010	88	416
DM2A	20/05/2010	3	120
DM2A	18/08/2010	76	100
DM2A	25/11/2010	80	100
DM2A	9/02/2011	36	100
DM2A	11/05/2011	82	100
DM2A	9/08/2011	34	211
DM2A	10/11/2011	136	380
DM2A	23/01/2012	79	100
DM2A	24/05/2012	94	249
DM2A	14/08/2012	55	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM2A	26/10/2012	101	278
DM2A	16/01/2013	40	100
DM2A	9/04/2013	42	100
DM2A	10/10/2013	52	100
DM2A	9/04/2014	51	100
DM2A	16/10/2014	142	112
DM2A	16/04/2015	61	100
DM2A	4/09/2015	81	100
DM2A	**22/04/2016**	**<100**	**<100**
DM2A	**16/09/2016**	**<100**	**<100**

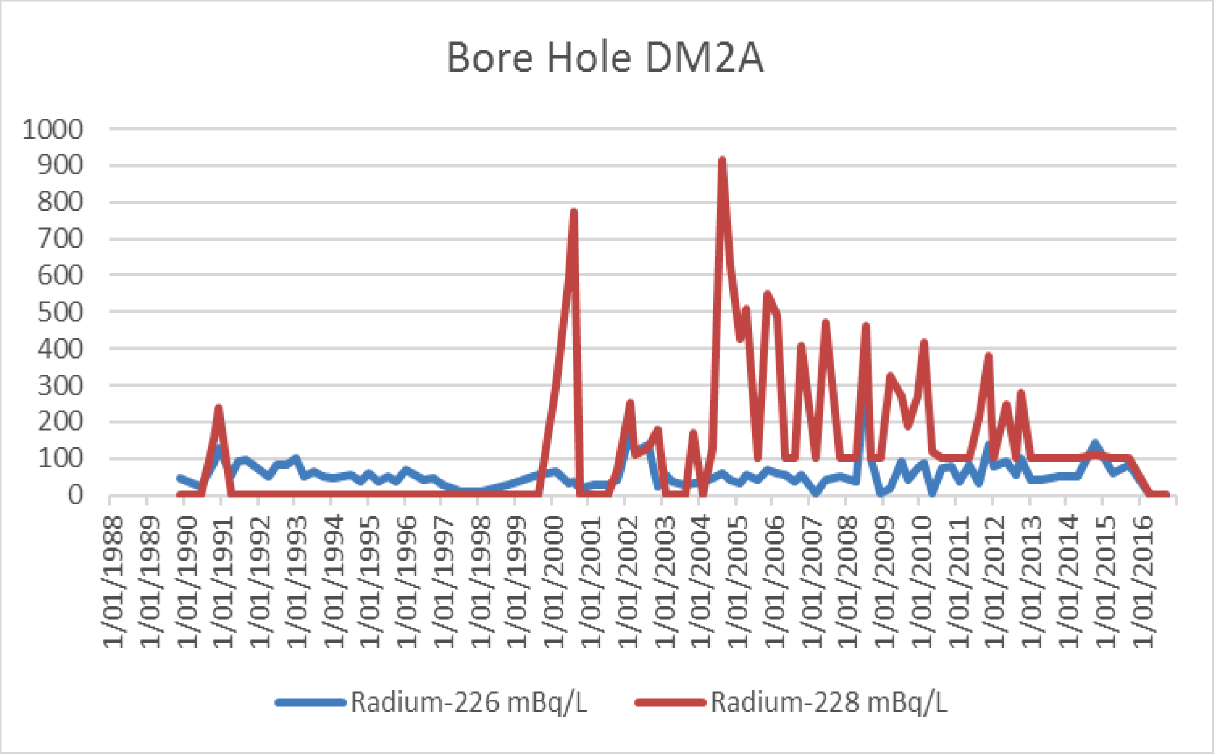


Table 9: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM2C

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM2C	1/03/1989	20	
DM2C	1/08/1989	37	
DM2C	1/11/1989	66	
DM2C	1/06/1990	9	
DM2C	1/10/1990	37	65
DM2C	1/12/1990	18	117
DM2C	1/04/1991	8	
DM2C	1/06/1991	18	
DM2C	1/09/1991	20	
DM2C	1/04/1992	20	
DM2C	1/07/1992	47	
DM2C	1/10/1992	37	
DM2C	1/01/1993	37	
DM2C	1/04/1993	37	
DM2C	1/07/1993	57	
DM2C	1/10/1993	27	
DM2C	1/01/1994	43	
DM2C	1/04/1994	11	
DM2C	1/07/1994	46	
DM2C	1/10/1994	51	
DM2C	1/01/1995	37	
DM2C	1/04/1995	37	
DM2C	1/07/1995	37	
DM2C	1/10/1995	44	
DM2C	1/01/1996	37	
DM2C	1/07/1996	15	
DM2C	1/10/1996	34	
DM2C	1/01/1997	4	
DM2C	1/04/1997	17	
DM2C	1/07/1997	30	
DM2C	1/10/1997	20	
DM2C	1/01/1998	20	
DM2C	1/10/1998	98	
DM2C	1/08/1999	32	
DM2C	1/02/2000	22	
DM2C	1/06/2000	25	
DM2C	9/08/2000	20	
DM2C	30/10/2000	34	55
DM2C	1/02/2001	12	
DM2C	8/05/2001	14	

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM2C	26/07/2001	21	
DM2C	29/10/2001	70	80
DM2C	8/02/2002	120	110
DM2C	15/04/2002	130	110
DM2C	12/08/2002	140	130
DM2C	6/11/2002	20	273
DM2C	13/02/2003	35	
DM2C	30/04/2003	33	
DM2C	9/08/2003	23	
DM2C	10/02/2004	16	522
DM2C	14/05/2004	17	530
DM2C	6/08/2004	8	333
DM2C	10/11/2004	25	237
DM2C	16/02/2005	15	100
DM2C	15/04/2005	40	213
DM2C	2/08/2005	54	100
DM2C	14/11/2005	24	387
DM2C	15/02/2006	48	100
DM2C	18/05/2006	73	305
DM2C	17/08/2006	36	100
DM2C	31/10/2006	34	100
DM2C	8/03/2007	17	208
DM2C	19/06/2007	21	582
DM2C	2/11/2007	14	242
DM2C	2/04/2008	36	446
DM2C	8/09/2008	100	283
DM2C	8/12/2008	3	487
DM2C	1/03/2009	11	100
DM2C	1/07/2009	19	285
DM2C	30/09/2009	28	239
DM2C	23/12/2009	21	747
DM2C	16/02/2010	54	464
DM2C	20/05/2010	470	361
DM2C	18/08/2010	65	100
DM2C	25/11/2010	137	190
DM2C	9/02/2011	454	100
DM2C	11/05/2011	53	100
DM2C	9/08/2011	20	100
DM2C	10/11/2011	7	113
DM2C	23/01/2012	11	139
DM2C	24/05/2012	31	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM2C	14/08/2012	81	635
DM2C	26/10/2012	30	209
DM2C	16/01/2013	13	100
DM2C	9/04/2013	32	100
DM2C	10/10/2013	47	100
DM2C	9/04/2014	50	100
DM2C	16/10/2014	83	100
DM2C	16/04/2015	122	100
DM2C	4/09/2015	98	100
DM2C	**22/04/2016**	**<100**	**102**
DM2C	**16/09/2016**	**<100**	**<100**

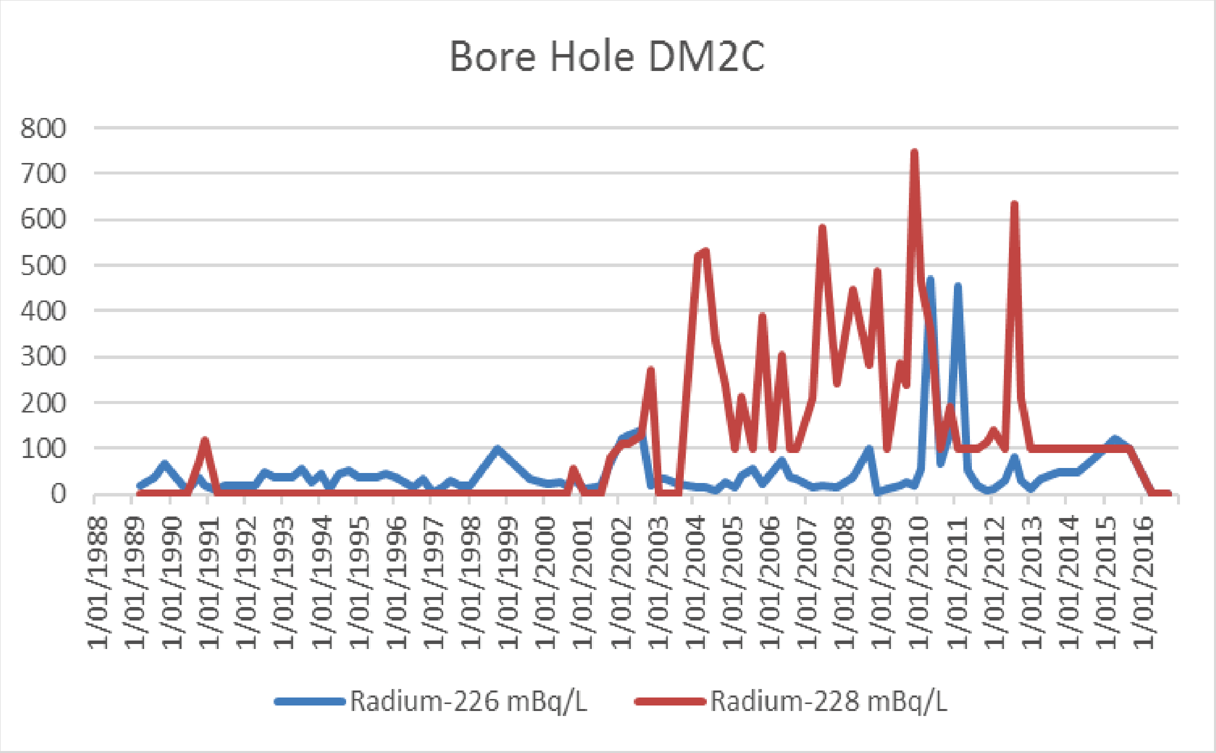


Table 10: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM2C

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM4A	1/08/1989	55	
DM4A	1/11/1989	37	
DM4A	1/04/1990	36	
DM4A	1/06/1990	31	
DM4A	1/10/1990	37	
DM4A	1/12/1990	31	
DM4A	1/04/1991	34	
DM4A	1/08/1991	30	
DM4A	1/09/1991	26	
DM4A	1/04/1992	55	
DM4A	1/07/1992	38	
DM4A	1/10/1992	39	
DM4A	1/01/1993	37	
DM4A	1/04/1993	37	
DM4A	1/07/1993	37	
DM4A	1/10/1993	49	
DM4A	1/01/1994	37	
DM4A	1/04/1994	13	
DM4A	1/07/1994	81	
DM4A	1/10/1994	41	
DM4A	1/01/1995	37	
DM4A	1/04/1995	37	
DM4A	1/07/1995	37	
DM4A	1/10/1995	37	
DM4A	1/01/1996	37	
DM4A	1/07/1996	63	
DM4A	1/10/1996	85	
DM4A	1/01/1997	111	
DM4A	1/04/1997	120	
DM4A	1/07/1997	60	
DM4A	1/10/1997	50	
DM4A	1/01/1998	70	
DM4A	1/07/1998	187	
DM4A	1/10/1998	243	
DM4A	1/08/1999	40	
DM4A	1/02/2000	141	
DM4A	1/06/2000	86	640
DM4A	9/08/2000	18	
DM4A	8/05/2001	75	
DM4A	26/07/2001	156	

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM4A	29/10/2001	80	70
DM4A	8/02/2002	180	250
DM4A	19/04/2002	130	110
DM4A	12/08/2002	220	140
DM4A	6/11/2002	46	
DM4A	13/02/2003	84	208
DM4A	30/04/2003	34	
DM4A	9/08/2003	53	
DM4A	24/11/2003	193	100
DM4A	10/02/2004	66	665
DM4A	14/05/2004	70	685
DM4A	6/08/2004	35	630
DM4A	10/11/2004	49	241
DM4A	16/02/2005	40	100
DM4A	15/04/2005	73	100
DM4A	2/08/2005	89	690
DM4A	14/11/2005	69	138
DM4A	15/02/2006	107	735
DM4A	18/05/2006	169	394
DM4A	17/08/2006	61	479
DM4A	31/10/2006	127	100
DM4A	8/03/2007	76	100
DM4A	19/06/2007	40	415
DM4A	2/11/2007	44	431
DM4A	2/04/2008	15	100
DM4A	8/07/2008	170	100
DM4A	8/09/2008	100	350
DM4A	1/12/2008	39	100
DM4A	9/03/2009	46	361
DM4A	1/07/2009	107	198
DM4A	30/09/2009	21	294
DM4A	23/12/2009	22	379
DM4A	17/02/2010	48	743
DM4A	20/05/2010	44	100
DM4A	18/08/2010	49	100
DM4A	24/11/2010	42	100
DM4A	9/02/2011	48	100
DM4A	11/05/2011	94	146
DM4A	10/11/2011	303	100
DM4A	24/01/2012	17	153
DM4A	24/05/2012	90	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM4A	14/08/2012	46	100
DM4A	26/10/2012	564	361
DM4A	16/01/2013	14	100
DM4A	9/04/2013	25	100
DM4A	10/10/2013	61	100
DM4A	9/04/2014	37	100
DM4A	16/10/2014	53	100
DM4A	16/04/2015	36	100
DM4A	4/09/2015	179	100
DM4A	**22/04/2016**	**192**	**<100**
DM4A	**16/09/2016**	**<100**	**<100**

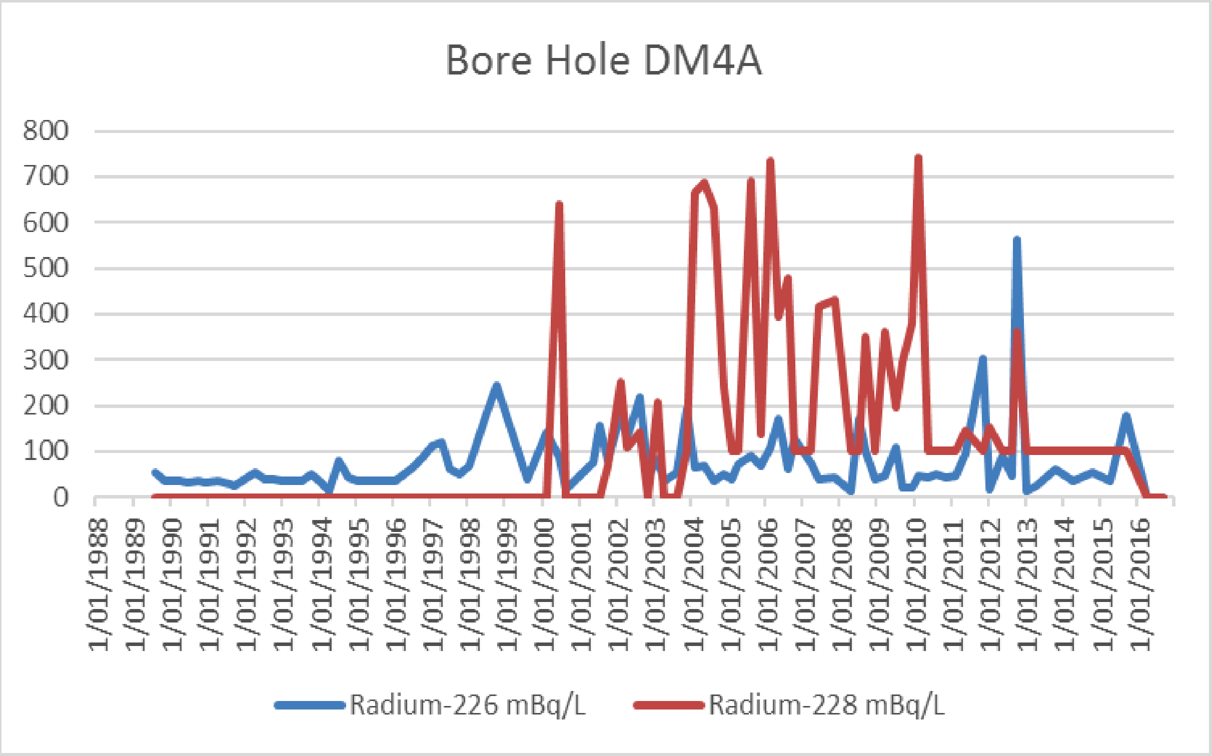


Table 11: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM4C

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM4C	1/08/1989	43	
DM4C	1/11/1989	37	
DM4C	1/04/1990	11	
DM4C	1/06/1990	16	
DM4C	1/10/1990	37	
DM4C	1/12/1990	13	
DM4C	1/04/1991	23	
DM4C	1/08/1991	26	
DM4C	1/09/1991	29	
DM4C	1/04/1992	61	
DM4C	1/07/1992	50	
DM4C	1/10/1992	77	
DM4C	1/01/1993	37	
DM4C	1/04/1993	37	
DM4C	1/07/1993	37	
DM4C	1/10/1993	20	
DM4C	1/01/1994	37	
DM4C	1/07/1994	37	
DM4C	1/10/1994	37	
DM4C	1/01/1995	81	
DM4C	1/04/1995	37	
DM4C	1/07/1995	37	
DM4C	1/10/1995	37	
DM4C	1/01/1996	37	
DM4C	1/07/1996	23	
DM4C	1/10/1996	32	
DM4C	1/01/1997	38	
DM4C	1/04/1997	32	
DM4C	1/07/1997	0	
DM4C	1/10/1997	0	
DM4C	1/01/1998	30	
DM4C	1/10/1998	139	
DM4C	1/08/1999	24	
DM4C	1/02/2000	74	426
DM4C	1/06/2000	44	
DM4C	9/08/2000	95	862
DM4C	30/10/2000	57	
DM4C	1/02/2001	113	
DM4C	8/05/2001	64	
DM4C	26/07/2001	67	313

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM4C	29/10/2001	70	60
DM4C	8/02/2002	180	240
DM4C	19/04/2002	120	110
DM4C	12/08/2002	180	130
DM4C	6/11/2002	37	
DM4C	13/02/2003	72	353
DM4C	30/04/2003	40	
DM4C	9/08/2003	38	
DM4C	24/11/2003	117	100
DM4C	10/02/2004	42	
DM4C	13/05/2004	43	100
DM4C	6/08/2004	21	100
DM4C	10/11/2004	26	100
DM4C	16/02/2005	21	342
DM4C	15/04/2005	54	411
DM4C	2/08/2005	79	100
DM4C	14/11/2005	25	412
DM4C	15/02/2006	58	306
DM4C	18/05/2006	70	100
DM4C	17/08/2006	39	207
DM4C	31/10/2006	60	100
DM4C	8/03/2007	57	591
DM4C	19/06/2007	22	975
DM4C	2/11/2007	48	554
DM4C	2/04/2008	49	100
DM4C	8/07/2008	223	282
DM4C	8/09/2008	100	319
DM4C	1/12/2008	53	317
DM4C	1/03/2009	41	100
DM4C	1/07/2009	42	290
DM4C	30/09/2009	255	372
DM4C	23/12/2009	1052	732
DM4C	17/02/2010	56	351
DM4C	20/05/2010	70	449
DM4C	18/08/2010	58	100
DM4C	24/11/2010	588	100
DM4C	9/02/2011	43	100
DM4C	11/05/2011	72	100
DM4C	10/11/2011	25	100
DM4C	24/01/2012	3	100
DM4C	24/05/2012	41	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM4C	14/08/2012	30	100
DM4C	26/10/2012	28	11
DM4C	16/01/2013	8	100
DM4C	9/04/2013	3	100
DM4C	10/10/2013	40	100
DM4C	9/04/2014	17	100
DM4C	16/10/2014	74	100
DM4C	16/04/2015	96	100
DM4C	4/09/2015	23	100
DM4C	**22/04/2016**	**<100**	**<100**
DM4C	**16/09/2016**	**<100**	**<100**

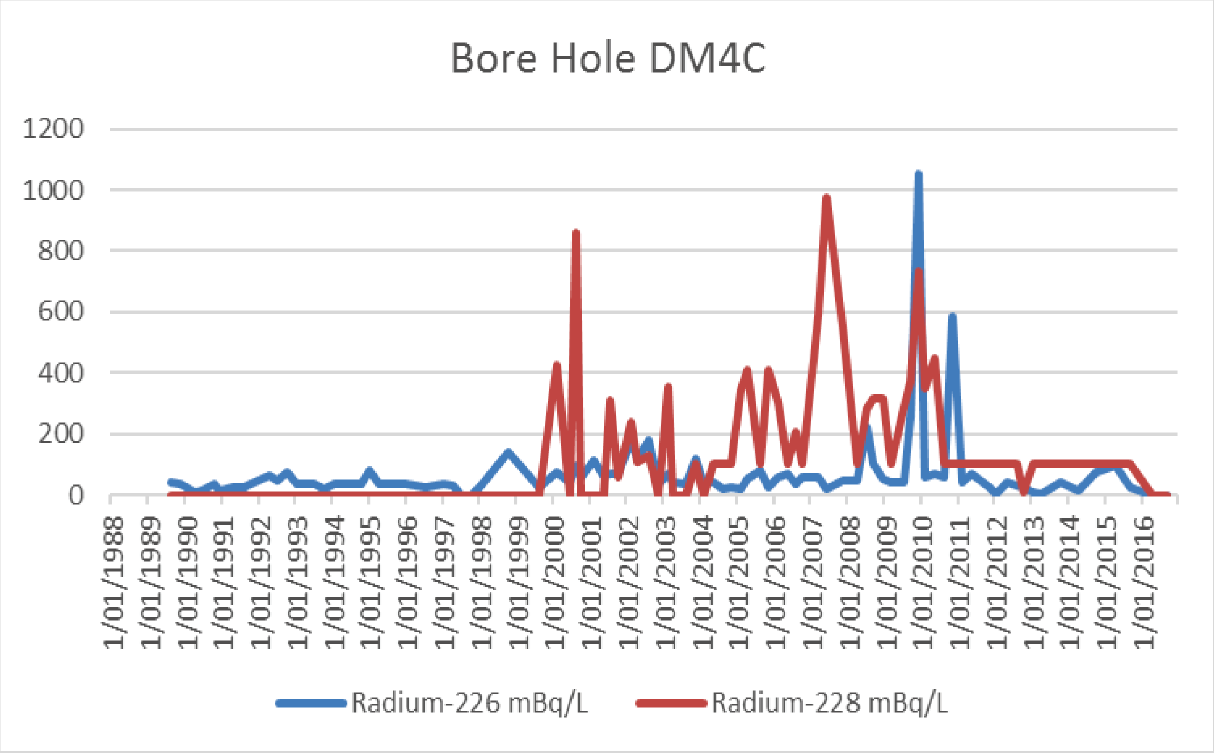


Table 12: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM7A

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM7A	24/07/2009	31	464
DM7A	30/09/2009	49	262
DM7A	23/12/2009	15	186
DM7A	17/02/2010	45	320
DM7A	21/05/2010	42	100
DM7A	18/08/2010	108	203
DM7A	24/11/2010	37	100
DM7A	9/02/2011	37	100
DM7A	11/05/2011	29	100
DM7A	9/08/2011	17	100
DM7A	10/11/2011	142	325
DM7A	23/01/2012	17	100
DM7A	24/05/2012	44	482
DM7A	14/08/2012	59	161
DM7A	26/10/2012	57	100
DM7A	16/01/2013	23	100
DM7A	9/04/2013	75	100
DM7A	10/10/2013	62	100
DM7A	9/04/2014	72	100
DM7A	16/10/2014	86	181
DM7A	16/04/2015	98	100
DM7A	4/09/2015	14	100
DM7A	**22/04/2016**	**<100**	**<100**
DM7A	**16/09/2016**	**<100**	**<100**

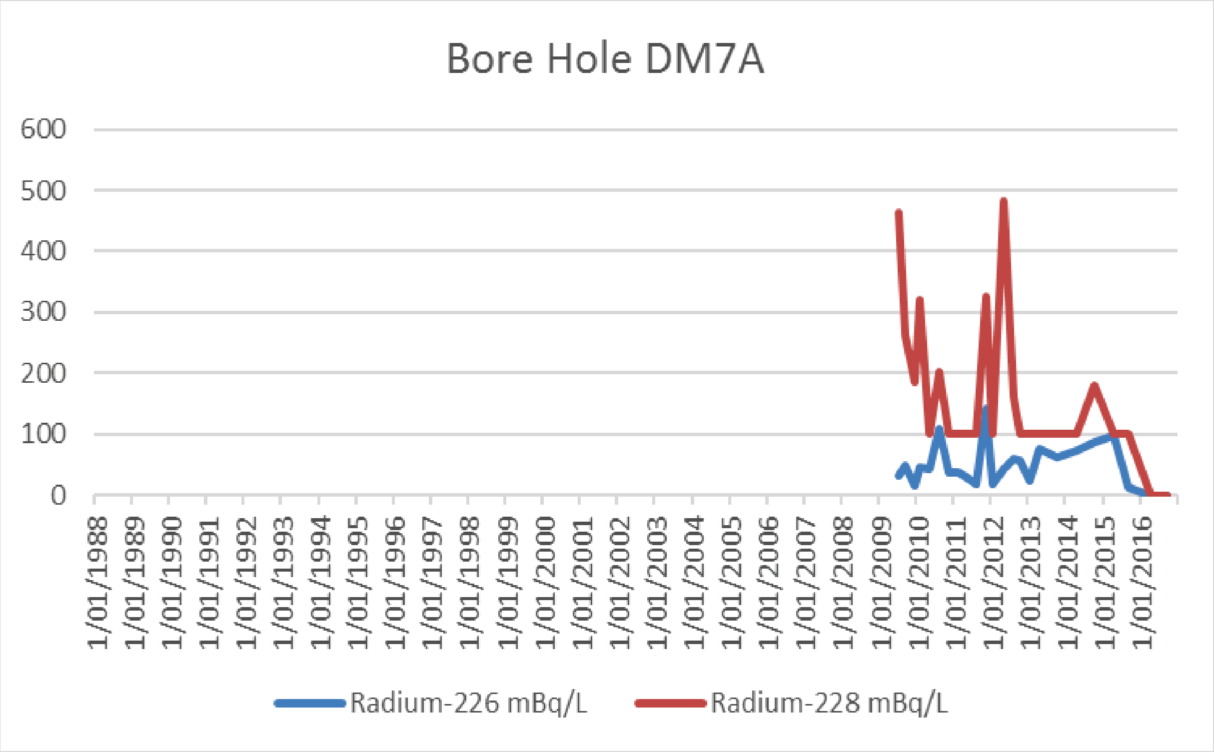

Bore Hole DM7A
600
500
400
300
200
100
0
1/01/1988
1/01/1989
1/01/1990
1/01/1991
1/01/1992
1/01/1993
1/01/1994
1/01/1995
1/01/1996
1/01/1997
1/01/1998
1/01/1999
1/01/2000
1/01/2001
1/01/2002
1/01/2003
1/01/2004
1/01/2005
1/01/2006
1/01/2007
1/01/2008
1/01/2009
1/01/2010
1/01/2011
1/01/2012
1/01/2013
1/01/2014
1/01/2015
1/01/2016
Radium-226 mBq/L
Radium-228 mBq/L

Table 13: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM7C

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM7C	1/07/1992	37	
DM7C	1/10/1992	37	
DM7C	1/01/1993	37	
DM7C	1/04/1993	37	
DM7C	1/07/1993	37	
DM7C	1/10/1993	3	
DM7C	1/01/1994	37	
DM7C	1/04/1994	5	
DM7C	1/07/1994	37	
DM7C	1/10/1994	59	
DM7C	1/01/1995	38	
DM7C	1/04/1995	44	
DM7C	1/07/1995	37	
DM7C	1/10/1995	37	
DM7C	1/01/1996	69	
DM7C	1/07/1996	42	
DM7C	1/10/1996	72	
DM7C	1/01/1997	73	
DM7C	1/04/1997	84	
DM7C	1/07/1997	80	
DM7C	1/10/1997	90	
DM7C	1/01/1998	90	
DM7C	1/10/1998	146	
DM7C	1/08/1999	77	
DM7C	1/02/2000	29	
DM7C	1/06/2000	22	128
DM7C	9/08/2000	18	596
DM7C	30/10/2000	30	214
DM7C	1/02/2001	21	
DM7C	8/05/2001		640
DM7C	26/07/2001	11	
DM7C	29/10/2001	70	90
DM7C	8/02/2002	170	240
DM7C	15/04/2002	120	110
DM7C	12/08/2002	140	310
DM7C	6/11/2002	14	218
DM7C	13/02/2003	37	135
DM7C	30/04/2003	11	
DM7C	9/08/2003	28	113
DM7C	25/11/2003	9	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM7C	10/02/2004	18	307
DM7C	13/05/2004	25	252
DM7C	6/08/2004	12	189
DM7C	10/11/2004	14	381
DM7C	16/02/2005	9	117
DM7C	15/04/2005	3	100
DM7C	2/08/2005	37	424
DM7C	14/11/2005	22	441
DM7C	15/02/2006	21	405
DM7C	18/05/2006	70	397
DM7C	17/08/2006	36	399
DM7C	31/10/2006	31	100
DM7C	8/03/2007	34	530
DM7C	19/06/2007	49	446
DM7C	2/11/2007	25	100
DM7C	2/04/2008	17	350
DM7C	8/07/2008	100	100
DM7C	8/09/2008	100	287
DM7C	1/12/2008	35	216
DM7C	1/03/2009	3	100
DM7C	1/07/2009	33	449
DM7C	30/09/2009	42	100
DM7C	23/12/2009	24	322
DM7C	17/02/2010	64	522
DM7C	21/05/2010	9	100
DM7C	18/08/2010	21	207
DM7C	24/11/2010	49	195
DM7C	9/02/2011	27	216
DM7C	11/05/2011	46	100
DM7C	9/08/2011	45	100
DM7C	10/11/2011	55	100
DM7C	23/01/2012	14	156
DM7C	24/05/2012	61	116
DM7C	14/08/2012	31	214
DM7C	26/10/2012	22	100
DM7C	16/01/2013	15	100
DM7C	9/04/2013	26	100
DM7C	10/10/2013	80	100
DM7C	9/04/2014	101	100
DM7C	16/10/2014	60	150
DM7C	16/04/2015	91	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM7C	4/09/2015	166	100
DM7C	5/09/2015	227	100
DM7C	**22/04/2016**	**<100**	**<100**
DM7C	**16/09/2016**	**<100**	**<100**

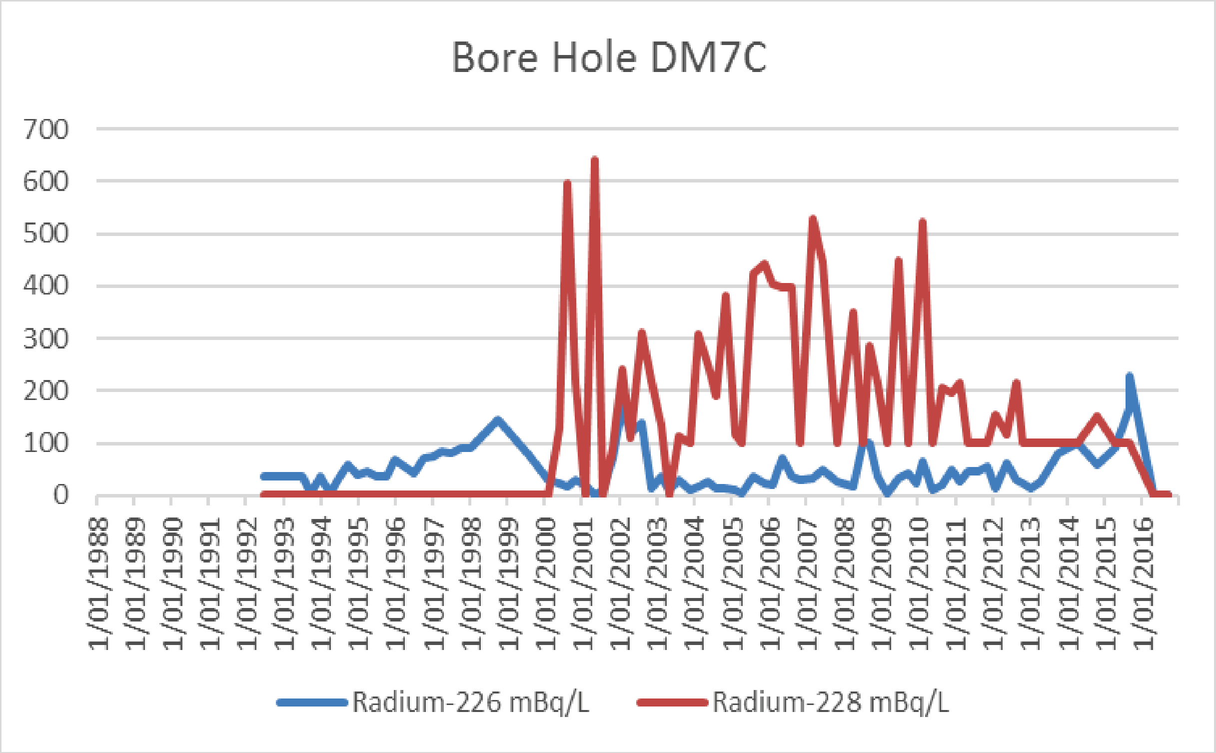


Table 14: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM8A

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM8A	23/12/2009	49	297
DM8A	16/02/2010	375	123
DM8A	20/05/2010	39	282
DM8A	18/08/2010	104	421
DM8A	24/11/2010	60	524
DM8A	8/02/2011	84	100
DM8A	11/05/2011	2451	304
DM8A	9/08/2011	37	457
DM8A	10/11/2011	28	100
DM8A	23/01/2012	42	100
DM8A	24/05/2012	39	321
DM8A	14/08/2012	47	223
DM8A	26/10/2012	124	100
DM8A	16/01/2013	29	100
DM8A	9/04/2013	79	197
DM8A	10/10/2013	77	100
DM8A	9/04/2014	79	100
DM8A	16/10/2014	110	104
DM8A	16/04/2015	117	272
DM8A	4/09/2015	102	176
DM8A	**22/04/2016**	**<100**	**<100**
DM8A	**16/09/2016**	**<100**	**<100**

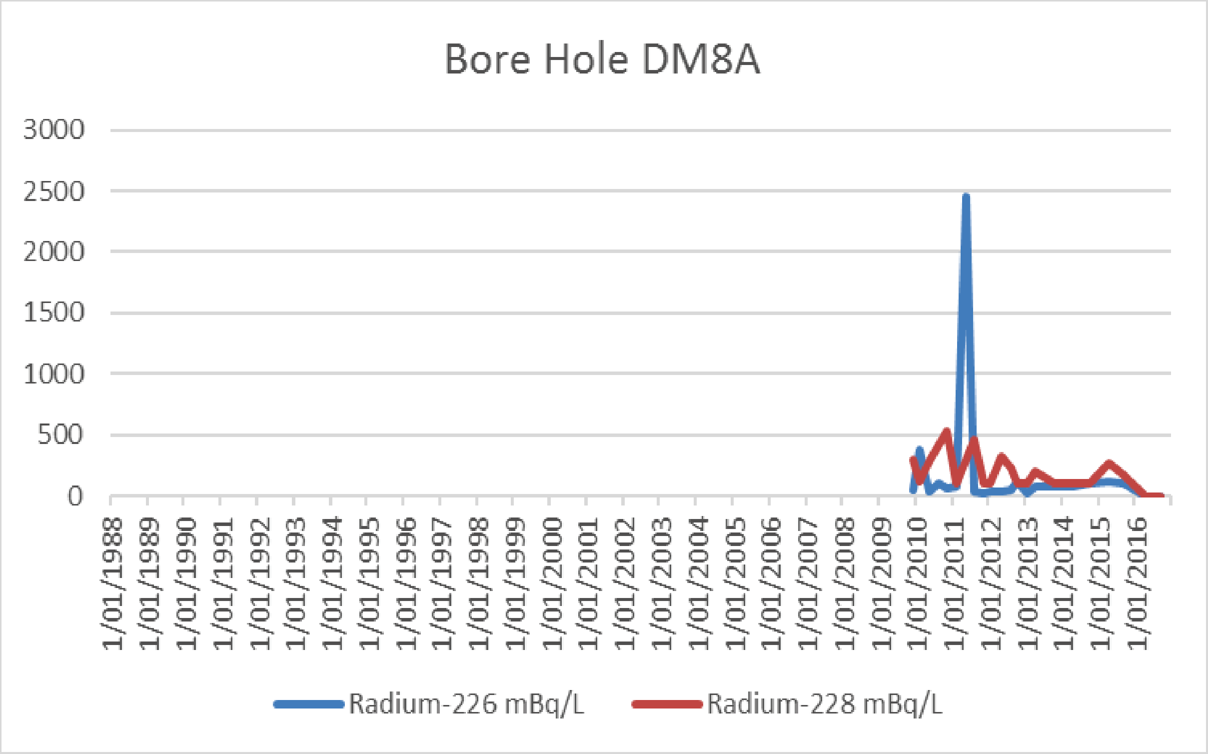

Bore Hole DM8A
3000
2500
2000
1500
1000
500
0
1/01/1988
1/01/1989
1/01/1990
1/01/1991
1/01/1992
1/01/1993
1/01/1994
1/01/1995
1/01/1996
1/01/1997
1/01/1998
1/01/1999
1/01/2000
1/01/2001
1/01/2002
1/01/2003
1/01/2004
1/01/2005
1/01/2006
1/01/2007
1/01/2008
1/01/2009
1/01/2010
1/01/2011
1/01/2012
1/01/2013
1/01/2014
1/01/2015
1/01/2016
Radium-226 mBq/L
Radium-228 mBq/L

Table 15: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM8C

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM8C	1/10/1996	49	
DM8C	1/04/1997	58	
DM8C	1/07/1997	110	
DM8C	1/10/1997	80	
DM8C	1/01/1998	100	
DM8C	1/10/1998	88	
DM8C	1/08/1999	96	140
DM8C	1/02/2000	196	
DM8C	1/06/2000	90	428
DM8C	9/08/2000	119	
DM8C	30/10/2000	61	
DM8C	1/02/2001	63	281
DM8C	8/05/2001	117	
DM8C	26/07/2001	109	
DM8C	29/10/2001	90	150
DM8C	18/02/2002	170	250
DM8C	15/04/2002	120	110
DM8C	12/08/2002	150	310
DM8C	6/11/2002	27	190
DM8C	13/02/2003	131	374
DM8C	30/04/2003	71	551
DM8C	9/08/2003	55	289
DM8C	24/11/2003	97	402
DM8C	10/02/2004	32	
DM8C	13/05/2004	85	453
DM8C	6/08/2004	49	366
DM8C	10/11/2004	21	243
DM8C	16/02/2005	58	214
DM8C	15/04/2005	39	273
DM8C	2/08/2005	41	100
DM8C	14/11/2005	49	167
DM8C	15/02/2006	71	739
DM8C	18/05/2006	83	439
DM8C	17/08/2006	53	463
DM8C	31/10/2006	35	100
DM8C	8/03/2007	71	574
DM8C	19/06/2007	43	711
DM8C	2/11/2007	59	100
DM8C	2/04/2008	66	595
DM8C	8/07/2008	289	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM8C	8/09/2008	100	425
DM8C	1/12/2008	47	417
DM8C	1/03/2009	29	159
DM8C	1/07/2009	71	375
DM8C	30/09/2009	27	465
DM8C	23/12/2009	15	204
DM8C	16/02/2010	138	283
DM8C	13/05/2010	21	254
DM8C	18/08/2010	44	259
DM8C	24/11/2010	49	110
DM8C	8/02/2011	26	100
DM8C	11/05/2011	41	100
DM8C	9/08/2011	74	100
DM8C	10/11/2011	17	100
DM8C	23/01/2012	12	100
DM8C	24/05/2012	67	100
DM8C	14/08/2012	46	181
DM8C	26/10/2012	54	154
DM8C	16/01/2013	47	100
DM8C	9/04/2013	38	100
DM8C	10/10/2013	123	100
DM8C	9/04/2014	64	100
DM8C	16/10/2014	70	100
DM8C	16/04/2015	93	141
DM8C	4/09/2015	93	100
DM8C	**22/04/2016**	**122**	**<100**
DM8C	**16/09/2016**	**<100**	**<100**

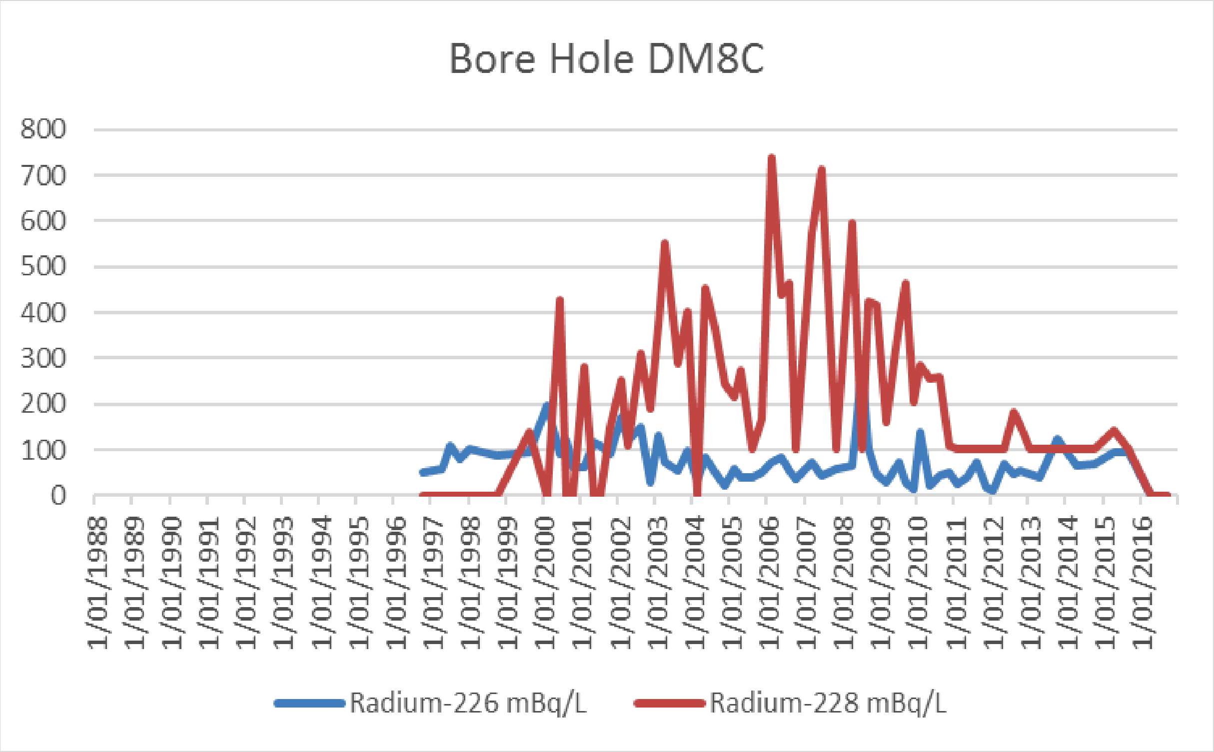

Bore Hole DM8C
800
700
600
500
400
300
200
100
0
1/01/1988
1/01/1989
1/01/1990
1/01/1991
1/01/1992
1/01/1993
1/01/1994
1/01/1995
1/01/1996
1/01/1997
1/01/1998
1/01/1999
1/01/2000
1/01/2001
1/01/2002
1/01/2003
1/01/2004
1/01/2005
1/01/2006
1/01/2007
1/01/2008
1/01/2009
1/01/2010
1/01/2011
1/01/2012
1/01/2013
1/01/2014
1/01/2015
1/01/2016
Radium-226 mBq/L
Radium-228 mBq/L

Table 16: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM9A

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM9A	29/10/2001	70	60
DM9A	8/02/2002	120	110
DM9A	15/04/2002	120	110
DM9A	12/08/2002	180	370
DM9A	6/11/2002	21	
DM9A	13/02/2003		250
DM9A	30/04/2003	6	498
DM9A	9/08/2003	30	349
DM9A	24/11/2003	8	100
DM9A	10/02/2004	12	387
DM9A	13/05/2004	9	100
DM9A	6/08/2004	20	100
DM9A	10/11/2004	19	100
DM9A	16/02/2005	10	384
DM9A	15/04/2005	14	100
DM9A	2/08/2005	17	438
DM9A	14/11/2005	20	274
DM9A	15/02/2006	3	429
DM9A	18/05/2006	17	100
DM9A	17/08/2006	28	345
DM9A	31/10/2006	40	100
DM9A	8/03/2007	23	473
DM9A	2/11/2007	17	100
DM9A	2/04/2008	7	100
DM9A	8/07/2008	293	100
DM9A	8/09/2008	100	100
DM9A	1/03/2009	19	148
DM9A	1/07/2009	40	198
DM9A	30/09/2009	36	304
DM9A	23/12/2009	52	236
DM9A	16/02/2010	14	384
DM9A	14/05/2010	253	160
DM9A	19/08/2010	13	100
DM9A	24/11/2010	12	100
DM9A	9/02/2011	602	100
DM9A	11/05/2011	25	349
DM9A	10/08/2011	69	130
DM9A	10/11/2011	66	100
DM9A	23/01/2012	25	100
DM9A	24/05/2012	314	202

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM9A	14/08/2012	72	497
DM9A	26/10/2012	20	100
DM9A	16/01/2013	24	100
DM9A	9/04/2013	111	200
DM9A	10/10/2013	51	100
DM9A	9/04/2014	3	100
DM9A	16/04/2015	37	100
DM9A	4/09/2015	260	100
DM9A	**22/04/2016**	**<100**	**<100**
DM9A	**16/09/2016**	**<100**	**<100**

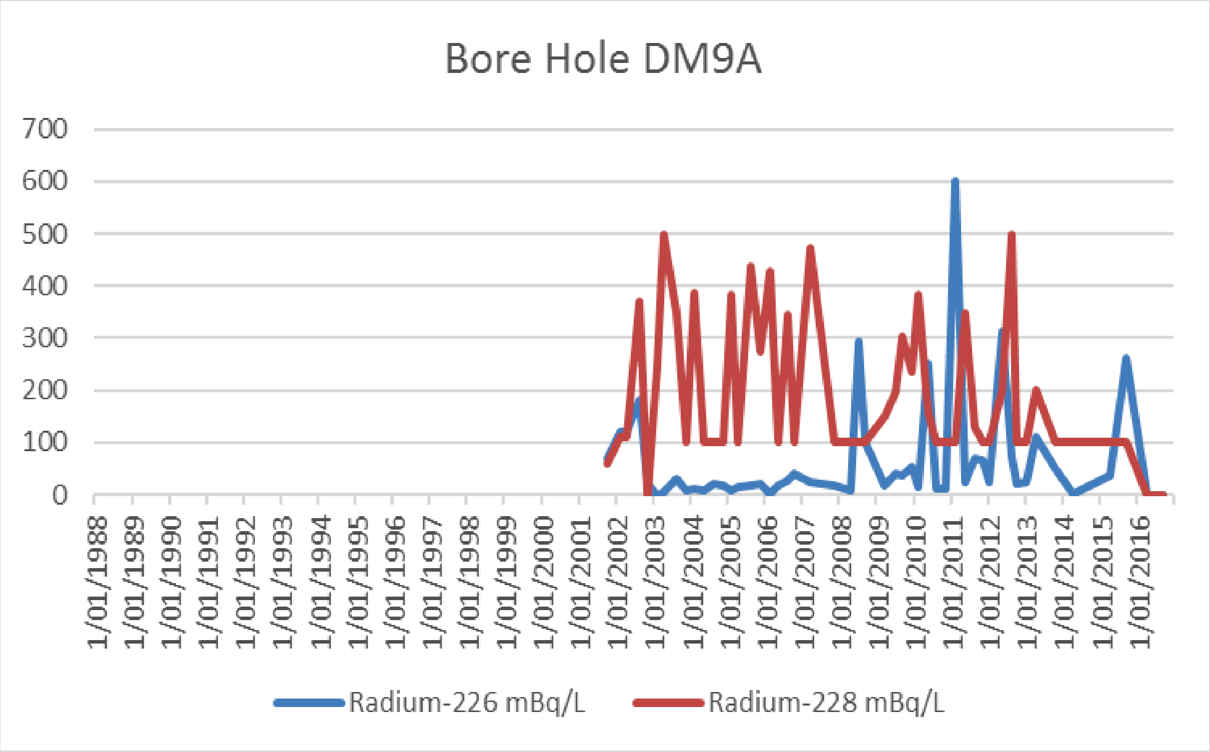


Table 17: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at DM9C

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM9C	1/10/1996	89	
DM9C	1/01/1997	18	
DM9C	1/04/1997	17	
DM9C	1/07/1997	30	
DM9C	1/10/1997	10	
DM9C	1/01/1998	10	
DM9C	1/10/1998	14	
DM9C	1/02/1999	72	
DM9C	1/08/1999	11	282
DM9C	1/02/2000	15	
DM9C	1/06/2000	6	436
DM9C	9/08/2000	27	
DM9C	30/10/2000	24	634
DM9C	1/02/2001	19	
DM9C	8/05/2001	9	410
DM9C	26/07/2001	26	
DM9C	29/10/2001	70	60
DM9C	8/02/2002	120	110
DM9C	15/04/2002	120	110
DM9C	12/08/2002	180	370
DM9C	6/11/2002	21	
DM9C	13/02/2003	122	250
DM9C	30/04/2003	6	498
DM9C	9/08/2003	30	349
DM9C	24/11/2003	8	100
DM9C	10/02/2004	12	387
DM9C	13/05/2004	9	100
DM9C	6/08/2004	20	100
DM9C	10/11/2004	19	100
DM9C	16/02/2005	10	384
DM9C	15/04/2005	14	100
DM9C	2/08/2005	17	438
DM9C	14/11/2005	20	274
DM9C	15/02/2006	3	429
DM9C	18/05/2006	17	100
DM9C	17/08/2006	28	345
DM9C	31/10/2006	40	100
DM9C	8/03/2007	23	473
DM9C	19/06/2007	13	445
DM9C	2/11/2007	17	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
DM9C	2/04/2008	7	100
DM9C	8/07/2008	293	100
DM9C	8/09/2008	100	100
DM9C	1/12/2008	14	100
DM9C	1/03/2009	19	148
DM9C	1/07/2009	40	198
DM9C	30/09/2009	36	304
DM9C	23/12/2009	52	236
DM9C	16/02/2010	14	384
DM9C	14/05/2010	253	160
DM9C	18/08/2010	154	195
DM9C	19/08/2010	13	100
DM9C	24/11/2010	12	100
DM9C	9/02/2011	602	100
DM9C	11/05/2011	25	349
DM9C	10/08/2011	69	130
DM9C	10/11/2011	66	100
DM9C	23/01/2012	25	100
DM9C	24/05/2012	314	202
DM9C	14/08/2012	72	497
DM9C	26/10/2012	20	100
DM9C	16/01/2013	24	100
DM9C	9/04/2013	111	200
DM9C	10/10/2013	505	197
DM9C	9/04/2014	3	100
DM9C	16/10/2014	3	142
DM9C	16/04/2015	132	233
DM9C	4/09/2015	49	100
DM9C	**22/04/2016**	**<100**	**<100**
DM9C	**16/09/2016**	**909**	**574**

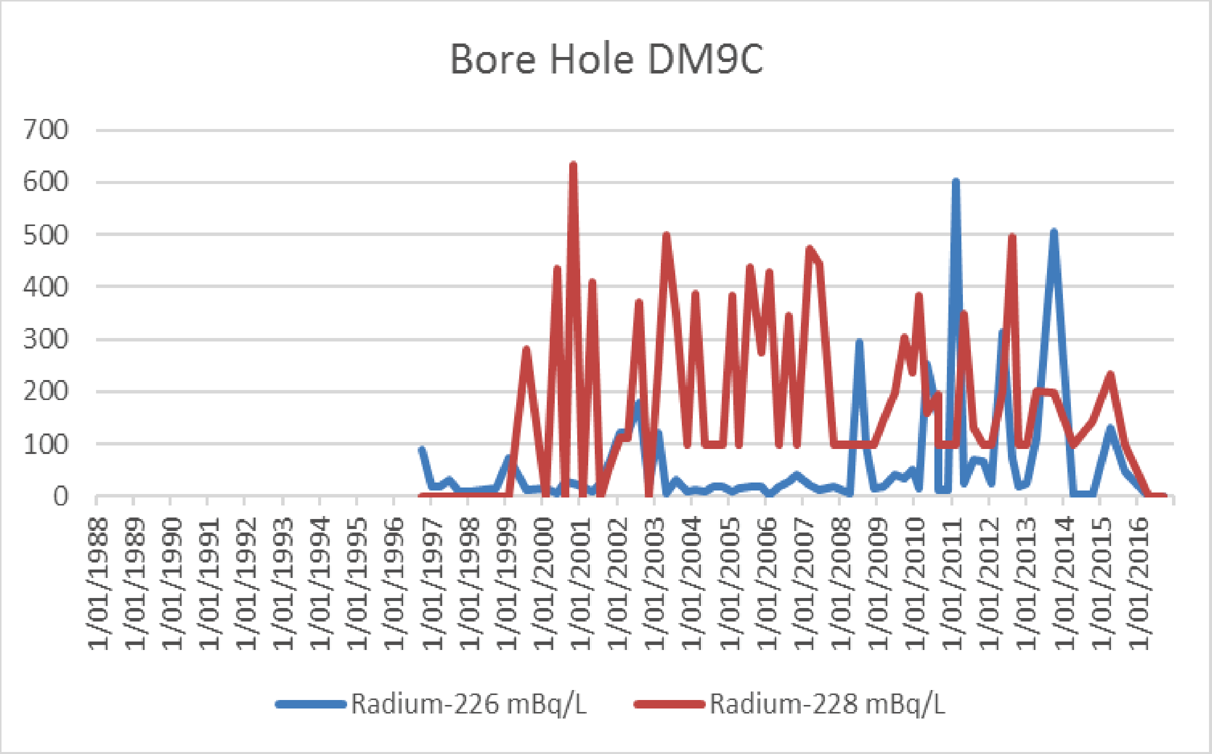

Bore Hole DM9C
700
600
500
400
300
200
100
0
1/01/1988
1/01/1989
1/01/1990
1/01/1991
1/01/1992
1/01/1993
1/01/1994
1/01/1995
1/01/1996
1/01/1997
1/01/1998
1/01/1999
1/01/2000
1/01/2001
1/01/2002
1/01/2003
1/01/2004
1/01/2005
1/01/2006
1/01/2007
1/01/2008
1/01/2009
1/01/2010
1/01/2011
1/01/2012
1/01/2013
1/01/2014
1/01/2015
1/01/2016
Radium-226 mBq/L
Radium-228 mBq/L

Table 18: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at MB3

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
MB3	1/11/1988	45	70
MB3	1/08/1989	67	
MB3	1/11/1989	59	
MB3	1/04/1990	64	
MB3	1/06/1990	47	
MB3	1/10/1990	37	
MB3	1/12/1990	78	
MB3	1/04/1991	74	
MB3	1/06/1991	55	
MB3	1/09/1991	55	
MB3	1/04/1992	84	
MB3	1/07/1992	62	
MB3	1/10/1992	59	
MB3	1/01/1993	72	
MB3	1/04/1993	74	
MB3	1/07/1993	41	
MB3	1/10/1993	61	
MB3	1/01/1994	76	
MB3	1/04/1994	104	
MB3	1/07/1994	66	
MB3	1/10/1994	91	
MB3	1/01/1995	135	
MB3	1/04/1995	42	
MB3	1/07/1995	90	
MB3	1/10/1995	93	
MB3	1/01/1996	65	
MB3	1/07/1996	70	
MB3	1/10/1996	91	
MB3	1/01/1997	105	
MB3	1/04/1997	52	
MB3	1/07/1997	70	
MB3	1/10/1997	70	
MB3	1/01/1998	40	
MB3	1/10/1998	69	
MB3	1/02/2000	97	168
MB3	1/06/2000	59	1106
MB3	9/08/2000	56	
MB3	1/02/2001	51	
MB3	8/05/2001	46	800
MB3	26/07/2001	51	

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
MB3	29/10/2001	70	60
MB3	8/02/2002	170	250
MB3	19/04/2002	120	110
MB3	12/08/2002	140	130
MB3	6/11/2002	15	296
MB3	13/02/2003	17	
MB3	30/04/2003	20	
MB3	9/08/2003	19	
MB3	24/11/2003	20	270
MB3	10/02/2004	9	
MB3	13/05/2004	18	131
MB3	6/08/2004	9	350
MB3	10/11/2004	4	100
MB3	16/02/2005	5	321
MB3	15/04/2005	18	100
MB3	2/08/2005	27	100
MB3	14/11/2005	18	372
MB3	15/02/2006	29	658
MB3	18/05/2006	52	100
MB3	17/08/2006	13	215
MB3	31/10/2006	77	291
MB3	8/03/2007	3	261
MB3	19/06/2007	35	
MB3	2/11/2007	23	129
MB3	8/07/2008	238	185
MB3	8/09/2008	100	127
MB3	1/12/2008	58	296
MB3	1/03/2009	15	100
MB3	25/08/2009	58	490
MB3	30/09/2009	24	100
MB3	23/12/2009	12	211
MB3	17/02/2010	11	400
MB3	20/05/2010	114	269
MB3	18/08/2010	25	267
MB3	24/11/2010	17	260
MB3	9/02/2011	64	132
MB3	11/05/2011	129	123
MB3	9/08/2011	57	100
MB3	10/11/2011	4	100
MB3	24/01/2012	14	100
MB3	29/10/2012	12	100

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
MB3	16/01/2013	8	100
MB3	9/04/2013	12	100
MB3	10/10/2013	54	100
MB3	9/04/2014	37	100
MB3	16/10/2014	37	150
MB3	16/04/2015	150	146
MB3	4/09/2015	69	100
MB3	**22/04/2016**	**151**	**<100**
MB3	**16/09/2016**	**<100**	**<100**

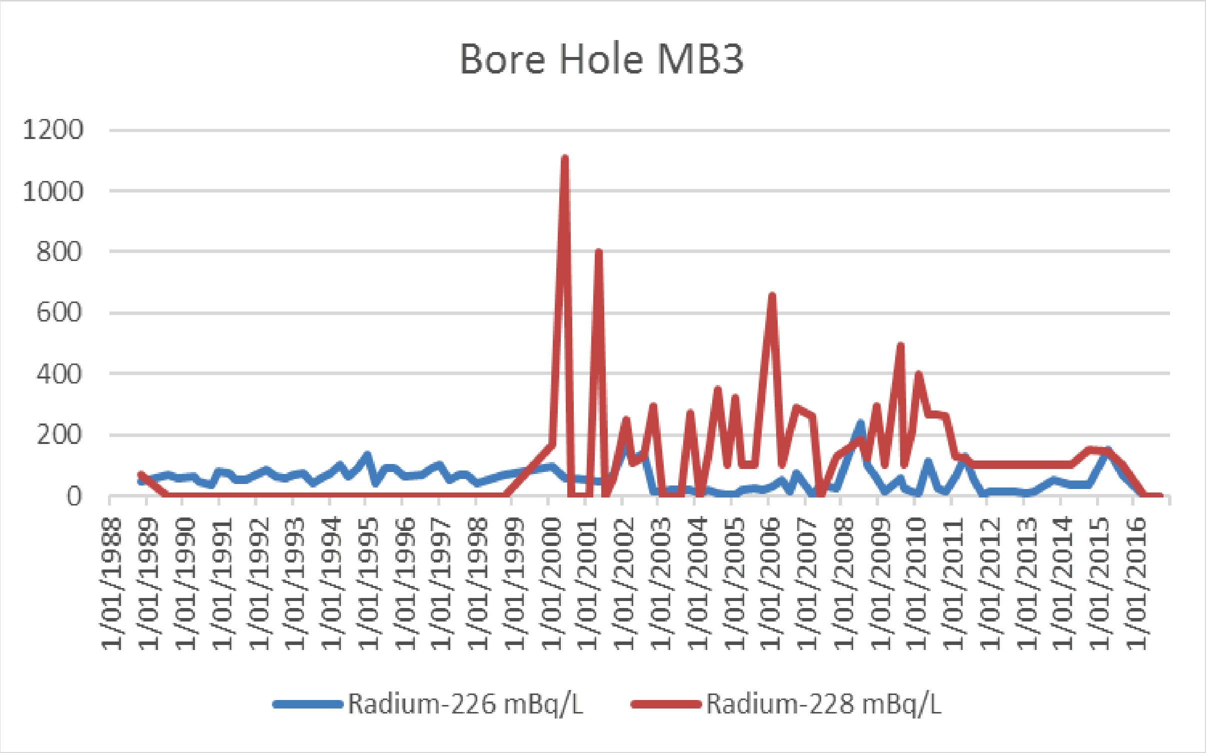


Table 19: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at MB4

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
MB4	1/11/1988	57	70
MB4	1/08/1989	72	
MB4	1/11/1989	179	
MB4	1/04/1990	62	
MB4	1/06/1990	41	
MB4	1/10/1990	37	
MB4	1/12/1990	72	
MB4	1/04/1991	98	
MB4	1/08/1991	48	
MB4	1/09/1991	32	
MB4	1/04/1992	113	
MB4	1/07/1992	37	
MB4	1/10/1992	69	
MB4	1/01/1993	75	
MB4	1/04/1993	71	
MB4	1/07/1993	37	
MB4	1/10/1993	22	
MB4	1/01/1994	79	
MB4	1/07/1995	169	
MB4	1/10/1995	102	
MB4	1/01/1996	72	
MB4	1/07/1996	102	
MB4	1/01/1998	0	
MB4	1/10/1998	29	
MB4	1/02/2000	170	
MB4	1/06/2000	68	282
MB4	9/08/2000	132	468
MB4	30/10/2000	52	
MB4	1/02/2001	78	
MB4	8/05/2001	80	
MB4	26/07/2001	77	
MB4	29/10/2001	70	60
MB4	8/02/2002	250	250
MB4	19/04/2002	120	110
MB4	12/08/2002	140	130
MB4	6/11/2002	43	210
MB4	13/02/2003	78	142
MB4	30/04/2003	47	
MB4	9/08/2003	59	
MB4	24/11/2003	59	463

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
MB4	10/02/2004	39	561
MB4	13/05/2004	51	277
MB4	6/08/2004	17	416
MB4	10/11/2004	19	507
MB4	16/02/2005	20	552
MB4	15/04/2005	67	
MB4	2/08/2005	82	
MB4	14/11/2005	24	242
MB4	15/02/2006	75	328
MB4	18/05/2006	104	448
MB4	17/08/2006	29	
MB4	31/10/2006	8	365
MB4	8/03/2007	42	473
MB4	19/06/2007	41	373
MB4	2/11/2007	21	639
MB4	2/04/2008	34	163
MB4	8/07/2008	286	472
MB4	8/09/2008	100	100
MB4	1/12/2008	7	180
MB4	1/03/2009	39	165
MB4	1/07/2009	34	583
MB4	30/09/2009	7	100
MB4	23/12/2009	3	100
MB4	17/02/2010	44	571
MB4	13/05/2010	4	276
MB4	18/08/2010	65	100
MB4	24/11/2010	35	145
MB4	9/02/2011	18	100
MB4	11/05/2011	89	100
MB4	10/11/2011	11	100
MB4	24/01/2012	9	146
MB4	24/05/2012	48	100
MB4	14/08/2012	44	100
MB4	26/10/2012	90	134
MB4	16/01/2013	3	100
MB4	10/10/2013	67	100
MB4	9/04/2014	66	100
MB4	16/10/2014	3	100
MB4	16/04/2015	40	100
MB4	4/09/2015	180	100
MB4	**22/04/2016**	**158**	**<100**

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
MB4	15/09/2016	<100	<100

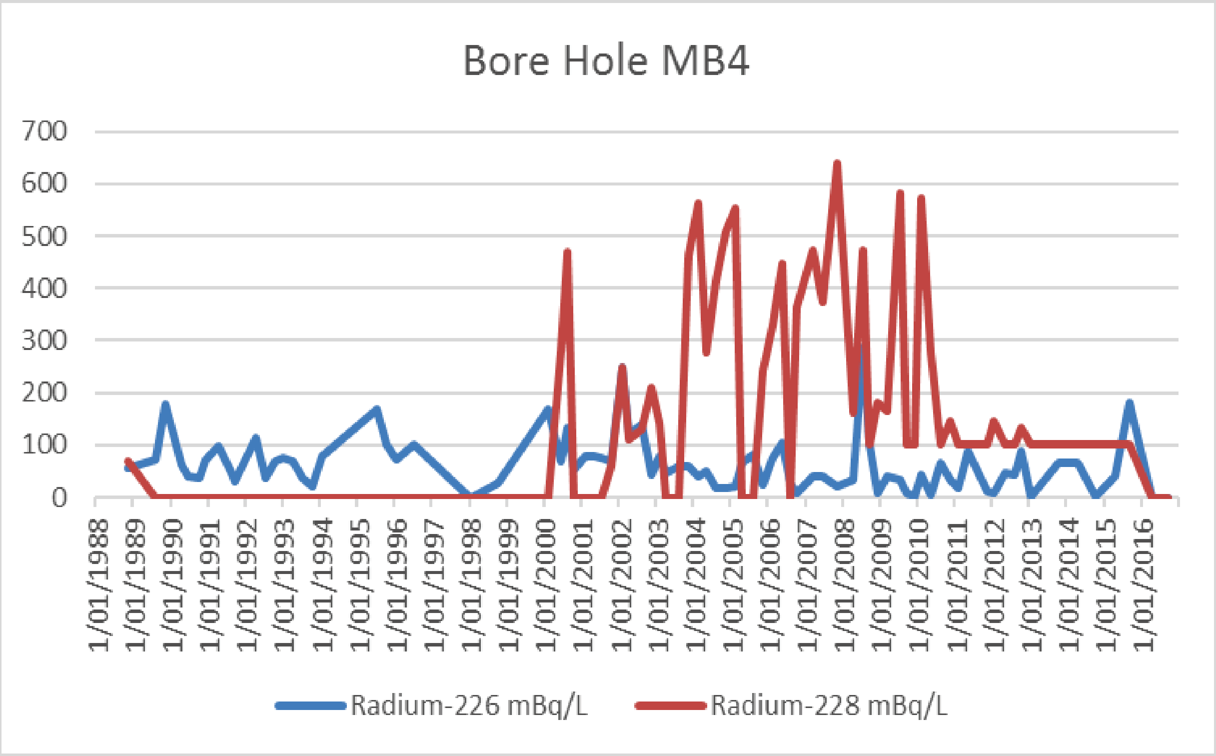
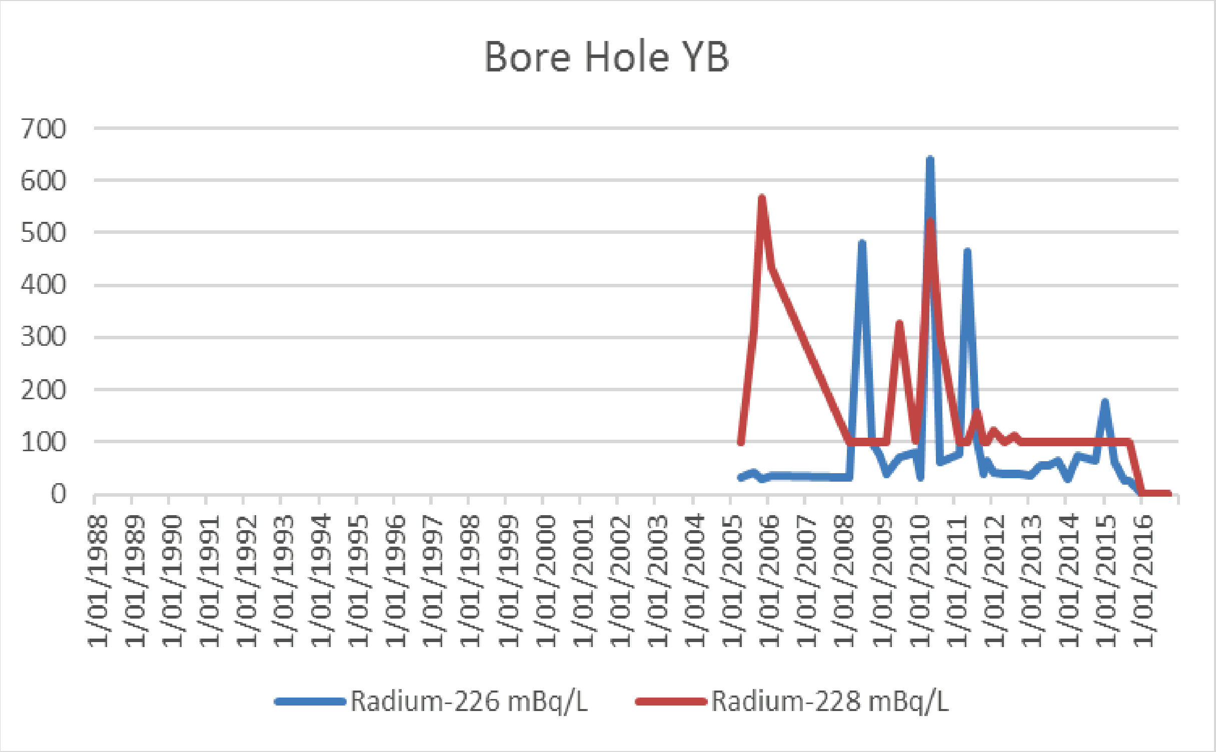


Table 20: Historical Water Bore Hole Levels for Radium-226/228 (mBq/L) at YB

Bore ID	Survey Date	Radium-226 mBq/L	Radium-228 mBq/L
YB	15/04/2005	32	100
YB	2/08/2005	41	315
YB	14/11/2005	30	567
YB	15/02/2006	35	432
YB	1/03/2008	33	100
YB	8/07/2008	480	100
YB	8/10/2008	100	100
YB	9/01/2009	75	100
YB	1/03/2009	40	100
YB	1/07/2009	71	327
YB	1/12/2009	79	102
YB	1/02/2010	32	200
YB	20/05/2010	642	523
YB	20/08/2010	60	304
YB	9/02/2011	76	100
YB	11/05/2011	463	100
YB	9/08/2011	104	158
YB	6/10/2011	40	100
YB	11/11/2011	63	100
YB	17/01/2012	43	121
YB	24/05/2012	38	100
YB	14/08/2012	39	114
YB	26/10/2012	40	100
YB	16/01/2013	36	100
YB	9/04/2013	56	100
YB	11/07/2013	56	100
YB	10/10/2013	64	100
YB	29/01/2014	29	100
YB	9/04/2014	74	100
YB	16/10/2014	66	100
YB	22/01/2015	177	100
YB	16/04/2015	61	100
YB	9/07/2015	26	100
YB	4/09/2015	26	100
YB	**21/01/2016**	**<100**	**<100**
YB	**22/04/2016**	**533**	**192**
YB	**8/07/2016**	**232**	**<100**
YB	**16/09/2016**	**<100**	**<100**


Bore Hole YB
700
600
500
400
300
200
100
0
1/01/1988
1/01/1989
1/01/1990
1/01/1991
1/01/1992
1/01/1993
1/01/1994
1/01/1995
1/01/1996
1/01/1997
1/01/1998
1/01/1999
1/01/2000
1/01/2001
1/01/2002
1/01/2003
1/01/2004
1/01/2005
1/01/2006
1/01/2007
1/01/2008
1/01/2009
1/01/2010
1/01/2011
1/01/2012
1/01/2013
1/01/2014
1/01/2015
1/01/2016
Radium-226 mBq/L
Radium-228 mBq/L

Appendix A: Calibration Reports

RadEye GX with MC-71-MHV Certificate of Calibration

ARS-CCT-CL36 Rev.3

Page 1 of 3

SGS AUSTRALIAN RADIATION SERVICES

NATA WORLD RECOGNISED ACCREDITATION
Accreditation No. 16987
Accredited for compliance with ISO/IEC 17025

Certificate of Calibration

Certificate No.: CAL-16-10339

A. Issued to

Company name: Radiation Professionals Pty. Ltd.
Address: Level 1, 46 Hill Street
East Perth 6004

B. Instrument and use

Manufacturer: Thermo Fisher Scientific GmbH
Model No.: RADEYE GX / MC71-MHV
Serial No.: 00513 / 19020
Intended use: Environmental gamma ray survey

C. Details of calibration

Previous calibration: 4th February 2015

Date calibrated: 11th February 2016
Type of test: Annual calibration.
Test conditions: The response of the instrument to a beam of collimated gamma rays from one or more ^{137}Cs sources was also evaluated (test method: ARS-SOP-CL2).
Test reference point: 16 mm behind wall of probe, 155 mm from top of probe.
Orientation: Vertical in radiation beam.
Uncertainties: The uncertainties stated on this certificate are expressed with a coverage factor of 2 corresponding to a 95% confidence level.
Traceability: The outputs of all ^{137}Cs sources used to calibrate this instrument are traceable to the Australian Primary Standard of Exposure maintained by ARPANSA.

D. Calibration results

The instrument is suitable for the use described in Section B.

Refer to the results on page 2 of this certificate for the response of the instrument at specified test points.

Notes:
1. Before using this instrument the user should be familiar with its characteristics (energy dependence, directional dependence, etc.).
2. Any alteration to the electronic settings or damage to the instrument will render the calibration void.
3. This is an instrument that is used to quantify surface contamination levels and should not be used to measure external dose rates.

Calibrated by: Mr. Roland Sargent
Position: Senior Technical Officer
Signature: R Sargent.
Date: 11th February 2016

Reviewed by: Mr. Glenn Riley
Position: Senior Health Physicist
Signature:
Date: 11th February 2016

SGS Australian Radiation Services | PO Box 3103, Nunawading VIC 3131 7/25–37 Chapman Street Blackburn North VIC 3130
t +61 (0)3 9210 2000 f +61 (0)3 9899 6155 www.radiation.net.au www.sgs.com

Member of the SGS Group (SGS SA)

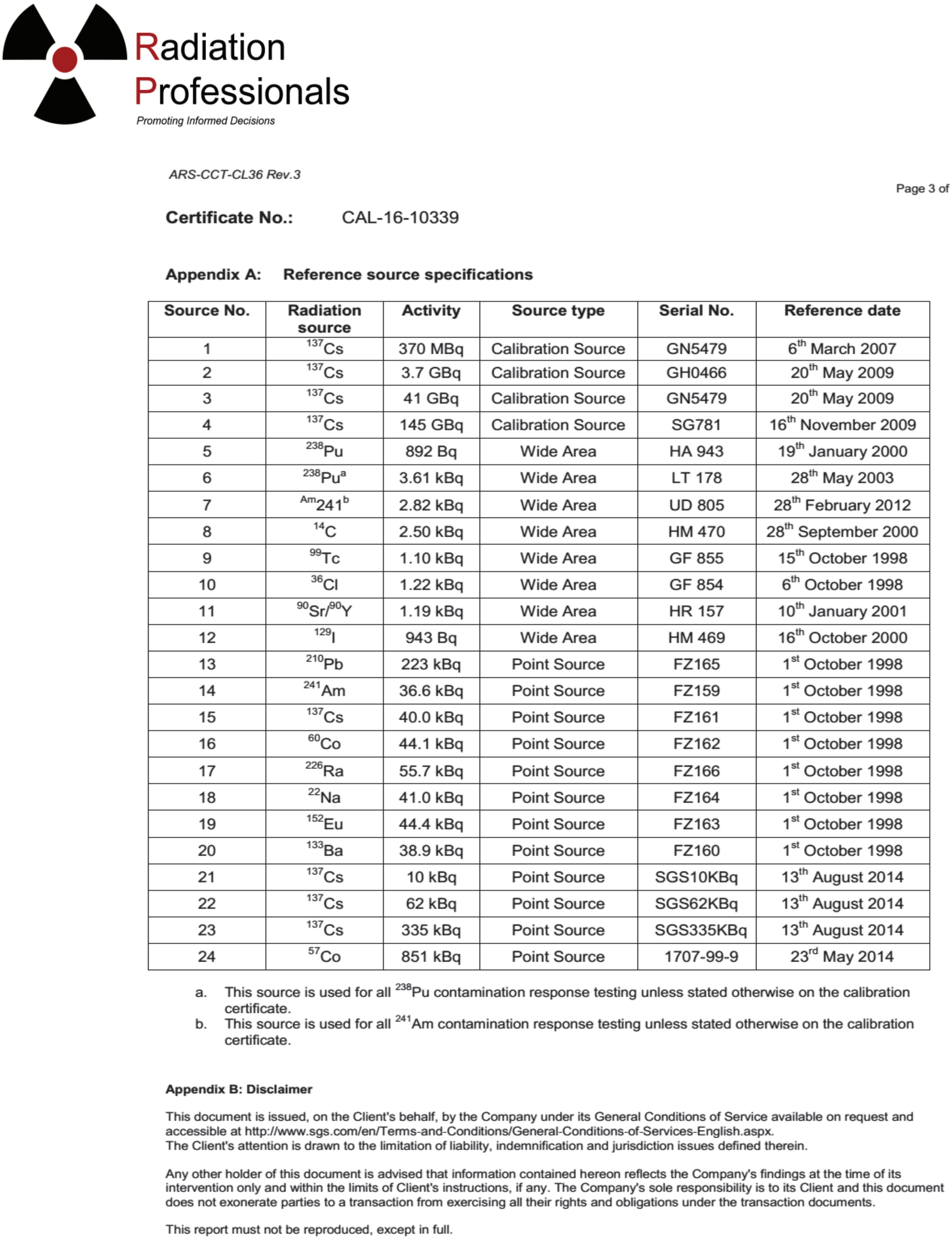
ABN 44 000 964 278

Certificate No.: CAL-16-10339

E. Linearity (^{137}Cs – 662 keV)

Radiation source	Instrument range	Measured count rate[a] (cps)	Actual air kerma rate (μGy·h^{-1})	Instrument linearity (cps/μGy·h^{-1})	Estimated uncertainty
Background	Auto	1.63[b]	0.08[c]	N/A	N/A
^{137}Cs (3.7 GBq)	Auto	3.68	0.25	15.0	±10%
^{137}Cs (3.7 GBq)	Auto	16.2	0.95	17.1	±8%
^{137}Cs (3.7 GBq)	Auto	29.4	1.79	16.4	±9%
^{137}Cs (3.7 GBq)	Auto	151	9.62	15.7	±8%
^{137}Cs (3.7 GBq)	Auto	585	37.1	15.7	±6%
^{137}Cs (41 GBq)	Auto	4700	148	31.8	±7%

a. Background correction has been applied.
b. No background correction applies.
c. The actual background has been measured in units of air kerma (μGy·h^{-1}) using a Health Physics Instruments Model 1010 (SN:419).



Certificate No.: CAL-16-10339

Appendix A: Reference source specifications

Source No.	Radiation source	Activity	Source type	Serial No.	Reference date
1	^{137}Cs	370 MBq	Calibration Source	GN5479	6th March 2007
2	^{137}Cs	3.7 GBq	Calibration Source	GH0466	20th May 2009
3	^{137}Cs	41 GBq	Calibration Source	GN5479	20th May 2009
4	^{137}Cs	145 GBq	Calibration Source	SG781	16th November 2009
5	^{238}Pu	892 Bq	Wide Area	HA 943	19th January 2000
6	$^{238}Pu^{a}$	3.61 kBq	Wide Area	LT 178	28th May 2003
7	$^{Am}241^{b}$	2.82 kBq	Wide Area	UD 805	28th February 2012
8	^{14}C	2.50 kBq	Wide Area	HM 470	28th September 2000
9	^{99}Tc	1.10 kBq	Wide Area	GF 855	15th October 1998
10	^{36}Cl	1.22 kBq	Wide Area	GF 854	6th October 1998
11	$^{90}Sr/^{90}Y$	1.19 kBq	Wide Area	HR 157	10th January 2001
12	^{129}I	943 Bq	Wide Area	HM 469	16th October 2000
13	^{210}Pb	223 kBq	Point Source	FZ165	1st October 1998
14	^{241}Am	36.6 kBq	Point Source	FZ159	1st October 1998
15	^{137}Cs	40.0 kBq	Point Source	FZ161	1st October 1998
16	^{60}Co	44.1 kBq	Point Source	FZ162	1st October 1998
17	^{226}Ra	55.7 kBq	Point Source	FZ166	1st October 1998
18	^{22}Na	41.0 kBq	Point Source	FZ164	1st October 1998
19	^{152}Eu	44.4 kBq	Point Source	FZ163	1st October 1998
20	^{133}Ba	38.9 kBq	Point Source	FZ160	1st October 1998
21	^{137}Cs	10 kBq	Point Source	SGS10KBq	13th August 2014
22	^{137}Cs	62 kBq	Point Source	SGS62KBq	13th August 2014
23	^{137}Cs	335 kBq	Point Source	SGS335KBq	13th August 2014
24	^{57}Co	851 kBq	Point Source	1707-99-9	23rd May 2014

a. This source is used for all ^{238}Pu contamination response testing unless stated otherwise on the calibration certificate.
b. This source is used for all ^{241}Am contamination response testing unless stated otherwise on the calibration certificate.

Appendix B: Disclaimer

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/Terms-and-Conditions/General-Conditions-of-Services-English.aspx.
The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

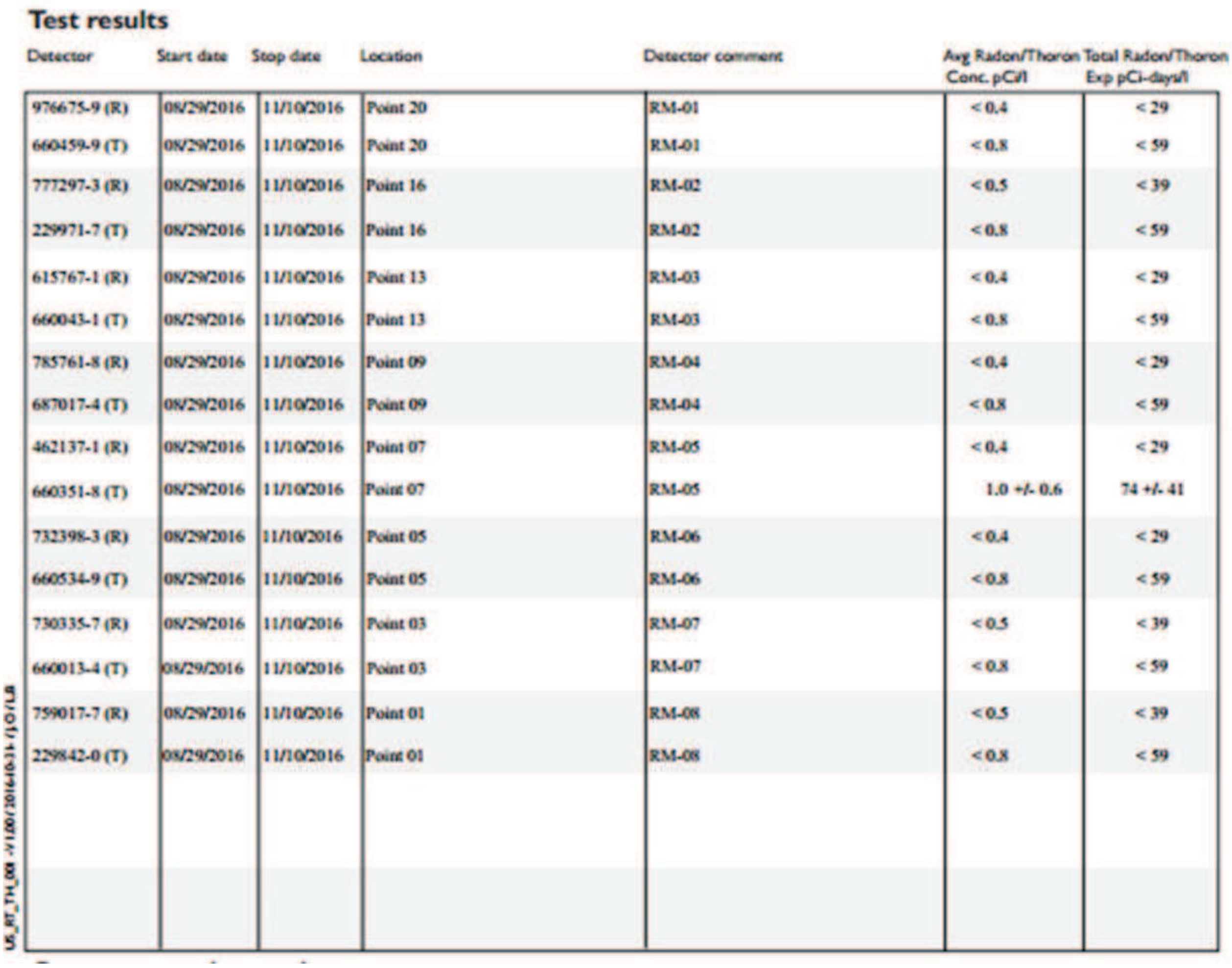
Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full.

Appendix B: Laboratory Reports

9.4 Radon/Thoron-in-Air

Table 21: Test Results for 29th August to 11th November 2016 (Landauer Australasia Pty. Ltd)



Test results

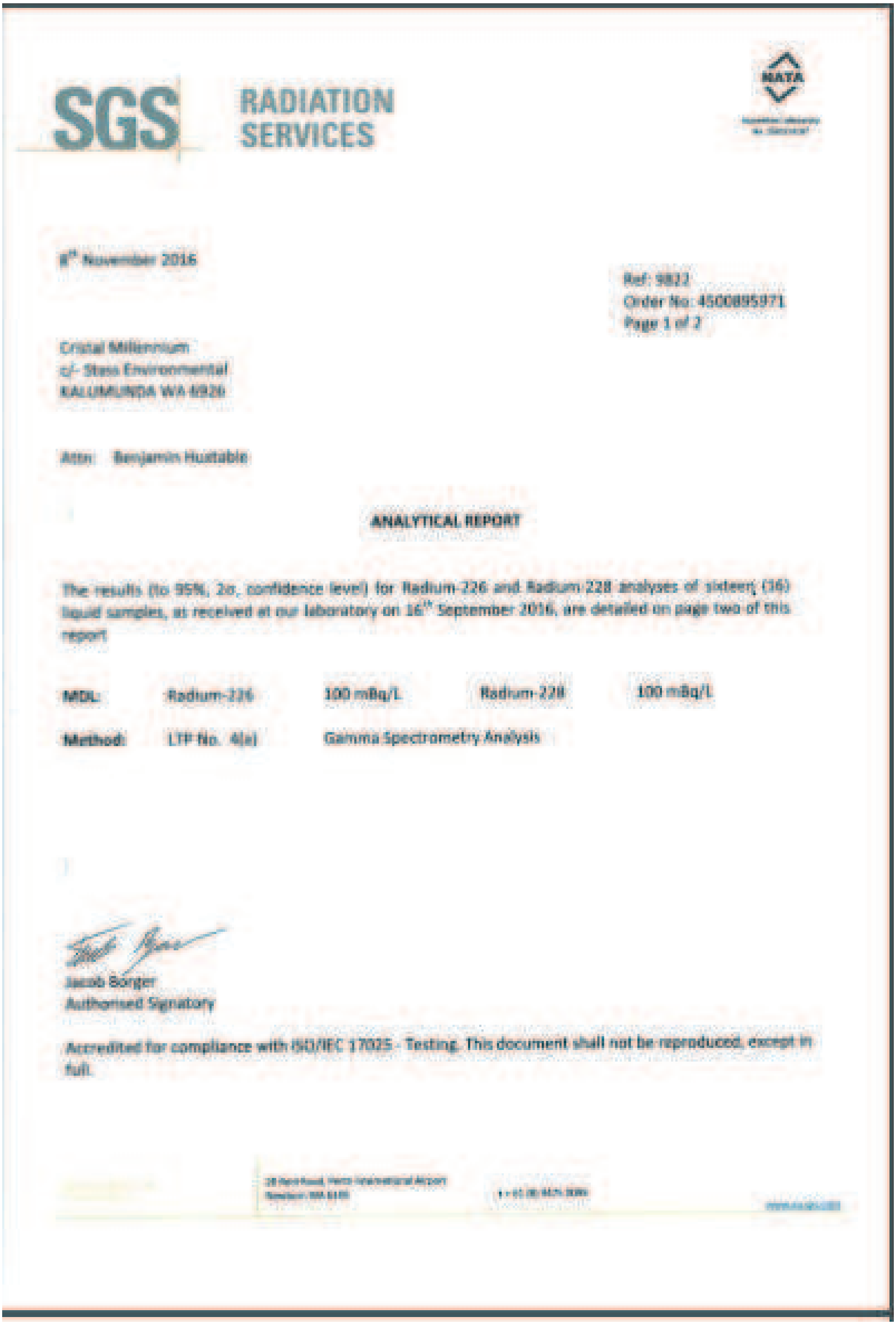
Detector	Start date	Stop date	Location	Detector comment	Avg Radon/Thoron Conc. pCi/l	Total Radon/Thoron Exp pCi-days/l
976675-9 (R)	08/29/2016	11/10/2016	Point 20	RM-01	< 0.4	< 29
660459-9 (T)	08/29/2016	11/10/2016	Point 20	RM-01	< 0.8	< 59
777297-3 (R)	08/29/2016	11/10/2016	Point 16	RM-02	< 0.5	< 39
229971-7 (T)	08/29/2016	11/10/2016	Point 16	RM-02	< 0.8	< 59
615767-1 (R)	08/29/2016	11/10/2016	Point 13	RM-03	< 0.4	< 29
660043-1 (T)	08/29/2016	11/10/2016	Point 13	RM-03	< 0.8	< 59
785761-8 (R)	08/29/2016	11/10/2016	Point 09	RM-04	< 0.4	< 29
687017-4 (T)	08/29/2016	11/10/2016	Point 09	RM-04	< 0.8	< 59
462137-1 (R)	08/29/2016	11/10/2016	Point 07	RM-05	< 0.4	< 29
660351-8 (T)	08/29/2016	11/10/2016	Point 07	RM-05	1.0 +/- 0.6	74 +/- 41
732398-3 (R)	08/29/2016	11/10/2016	Point 05	RM-06	< 0.4	< 29
660534-9 (T)	08/29/2016	11/10/2016	Point 05	RM-06	< 0.8	< 59
730335-7 (R)	08/29/2016	11/10/2016	Point 03	RM-07	< 0.5	< 39
660013-4 (T)	08/29/2016	11/10/2016	Point 03	RM-07	< 0.8	< 59
759017-7 (R)	08/29/2016	11/10/2016	Point 01	RM-08	< 0.5	< 39
229842-0 (T)	08/29/2016	11/10/2016	Point 01	RM-08	< 0.8	< 59

US_RT_TH_004 -V1.00/2016-10-31-/JO/LB

9.5 Radionuclides in Water

Table 22: Borehole Monitoring Results for the Year Ending December 2016 (SGS Radiation Services)

		Radium-226	**Radium-228**
Bore	**Date**	mBq/L	mBq/L
DM1A	22/04/2016	210 ± 33	<100
DM1C	22/04/2016	274 ± 34	<100
DM1A	16/09/2016	<100	<100
DM1C	16/09/2016	547 ± 91	757 ± 157
DM2A	22/04/2016	<100	<100
DM2C	22/04/2016	<100	102 ± 39
DM2A	16/09/2016	<100	<100
DM2C	16/09/2016	<100	<100
DM4A	22/04/2016	192 ± 23	<100
DM4C	22/04/2016	<100	<100
DM4A	16/09/2016	<100	<100
DM4C	16/09/2016	<100	<100
DM7A	22/04/2016	<100	<100
DM7C	22/04/2016	136 ± 24	<100
DM7A	16/09/2016	<100	<100
DM7C	16/09/2016	<100	<100
DM8A	22/04/2016	<100	<100
DM8C	22/04/2016	122 ± 19	<100
DM8A	16/09/2016	<100	<100
DM8C	16/09/2016	<100	<100
DM9A	22/04/2016	<100	<100
DM9C	22/04/2016	<100	<100
DM9A	16/09/2016	<100	<100
DM9C	16/09/2016	909 ± 114	574 ± 114
MB3	22/04/2016	151 ± 19	<100
MB3	16/09/2016	<100	<100
MB4	22/04/2016	158 ± 27	<100
MB4	16/09/2016	<100	<100
YB	21/01/2016	<100	<100
YB	22/04/2016	533 ± 84	192 ± 51
YB	8/07/2016	232 ± 35	<100
YB	16/09/2016	<100	<100



SGS RADIATION SERVICES

8th November 2016

Ref: 9822
Order No: 4500895971
Page 1 of 2

Cristal Millennium
c/- Stass Environmental
KALUMUNDA WA 6926

Attn: Benjamin Huxtable

ANALYTICAL REPORT

The results (to 95%, 2σ, confidence level) for Radium-226 and Radium-228 analyses of sixteen (16) liquid samples, as received at our laboratory on 16th September 2016, are detailed on page two of this report.

MDL:	Radium-226	100 mBq/L	Radium-228	100 mBq/L
Method:	LTP No. 4(a)	Gamma Spectrometry Analysis		

Jacob Borger
Authorised Signatory

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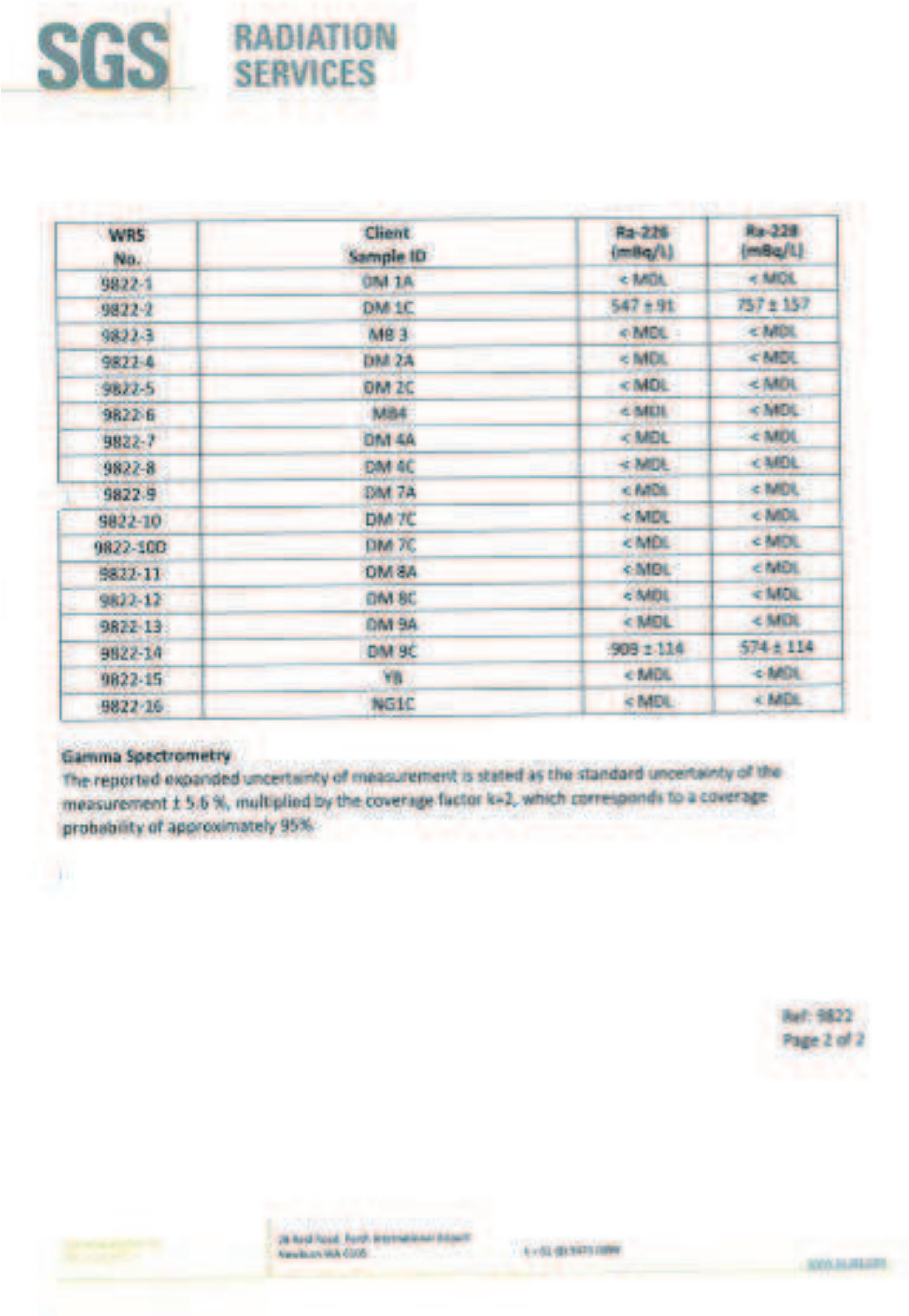

SGS RADIATION SERVICES

WRS No.	Client Sample ID	Ra-226 (mBq/L)	Ra-228 (mBq/L)
9822-1	DM 1A	< MDL	< MDL
9822-2	DM 1C	547 ± 91	757 ± 157
9822-3	MB 3	< MDL	< MDL
9822-4	DM 2A	< MDL	< MDL
9822-5	DM 2C	< MDL	< MDL
9822-6	MB4	< MDL	< MDL
9822-7	DM 4A	< MDL	< MDL
9822-8	DM 4C	< MDL	< MDL
9822-9	DM 7A	< MDL	< MDL
9822-10	DM 7C	< MDL	< MDL
9822-10D	DM 7C	< MDL	< MDL
9822-11	DM 8A	< MDL	< MDL
9822-12	DM 8C	< MDL	< MDL
9822-13	DM 9A	< MDL	< MDL
9822-14	DM 9C	909 ± 114	574 ± 114
9822-15	YB	< MDL	< MDL
9822-16	NG1C	< MDL	< MDL

Gamma Spectrometry
The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

Ref: 9822
Page 2 of 2

SGS

Western Radiation Services

25 August 2016

Ref: 9728
Order No: Andre
Page 1 of 1

Stass Environmental
PO Box 11
KALAMUNDA WA 6926

Attn: Mr. Andre Stass

ANALYTICAL REPORT

The result (to 95%, 2σ confidence level) for Radium-226, Radium-228 analyses of one (1) liquid sample as received at our laboratory on 8th July 2016 is detailed below.

WRS No.	Client Sample ID	Ra-226 (mBq/l)	Ra-228 (mBq/l)
9728-1	YB	232 ± 35	<MDL

Gamma Spectrometry Analysis

The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

MDL:	Radium-226	100 mBq/l	Radium-228	100 mBq/l
Method:	LTP No. 4(a)	Gamma Spectrometry Analysis		

Madassar A. Qureshi
Authorised Signatory

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SGS
Western Radiation Services
analytical laboratory & consulting

25 May 2015

Ref: 9657
Order No: Andre
Page 1 of 2

Stass Environmental
PO Box 11
KALAMUNDA WA 6926

Attn: Mr. Andre Stass

ANALYTICAL REPORT

The result (to 95%, 2σ confidence level) for Radium-226, Radium-228 analyses of sixteen (16) liquid samples as received at our laboratory on 22nd April 2016 are detailed on page two of this report.

MDL:	Radium-226	100 mBq/l	Radium-228	100 mBq/l

Method:	LTP No. 4(a)	Gamma Spectrometry Analysis

Madassar A. Qureshi
Authorised Signatory

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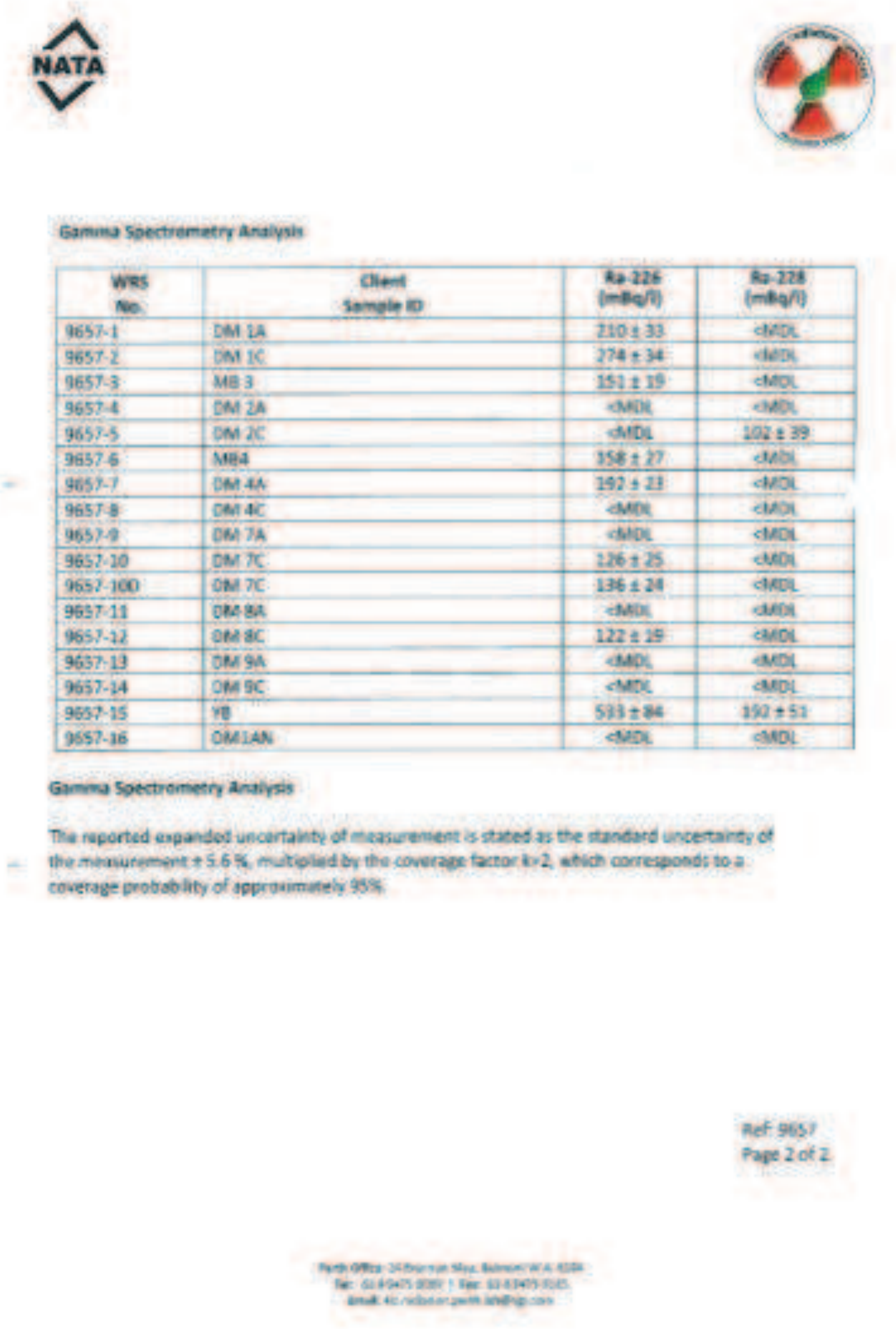

NATA

Gamma Spectrometry Analysis

WRS No.	Client Sample ID	Ra-226 (mBq/l)	Ra-228 (mBq/l)
9657-1	DM 1A	210 ± 33	<MDL
9657-2	DM 1C	274 ± 34	<MDL
9657-3	MB 3	151 ± 19	<MDL
9657-4	DM 2A	<MDL	<MDL
9657-5	DM 2C	<MDL	102 ± 39
9657-6	MB4	158 ± 27	<MDL
9657-7	DM 4A	192 ± 23	<MDL
9657-8	DM 4C	<MDL	<MDL
9657-9	DM 7A	<MDL	<MDL
9657-10	DM 7C	126 ± 25	<MDL
9657-10D	DM 7C	136 ± 24	<MDL
9657-11	DM 8A	<MDL	<MDL
9657-12	DM 8C	122 ± 19	<MDL
9657-13	DM 9A	<MDL	<MDL
9657-14	DM 9C	<MDL	<MDL
9657-15	YB	533 ± 84	192 ± 51
9657-16	DM1AN	<MDL	<MDL

Gamma Spectrometry Analysis

The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

Ref: 9657
Page 2 of 2

SGS NATA

Western Radiation Services

9th December 2016

Ref: 9548
Order No: 4500874061
Page 1 of 1

Cristal Pigments
PO Box 245
Bunbury WA 6230
Australia

Attn: Mr. Allan Lee

RE-ISSUED ANALYTICAL REPORT

This is a re-issue of report 9548, originally issued 19th February 2016.

The result (to 95%, 2σ confidence level) for Radium-226, Radium-228 analyses of one (1) liquid samples as received at our laboratory on 21st January 2016 are detailed below.

Gamma Spectrometry Analysis

WRS No.	Client Sample ID	Ra-226 (mBq/l)	Ra-228 (mBq/l)
9548-1	YB	<MDL	<MDL

The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

MDL: Radium-226 100 mBq/l Radium-228 100 mBq/l

Method: LTP No. 4(a) Gamma Spectrometry Analysis

Jacob Berger
Authorised Signatory

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Appendix G

Biennial Hydrogeological Report

Cristal Pigments Australia Ltd

Dalyellup Waste Residue Facility - Minninup Road, Dalyellup, Western Australia

Hydrogeological Assessment

April 2015

Executive summary

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.5 and the assumptions and qualifications contained throughout the Report.

GHD Pty Ltd (GHD) was commissioned by Cristal Pigment Australia Ltd (Cristal) to complete a Hydrogeological Assessment of the Dalyellup Waste Residue Disposal Facility (DWRF) located on Minninup Road, Dalyellup, Western Australia (the Site). The Hydrogeological Assessment is required as per the DER's closure notice[1], specifically Condition 1.2, focusing on groundwater quality, leachate and groundwater interaction, contamination plume size and migration.

This report details the results of groundwater quality monitoring undertaken at the Site between November 1988 and October 2014. The report addresses the requirements outlined in RFQ20141119. March 2015 data was unavailable at the time of reporting.

GHD completed a hydrogeological review of the Site including review of eight environmental investigation documents and groundwater analytical data collected over the 25 years of facility operation.

The findings of the hydrogeological review are summarised below:

- Geology underlying the Site comprised calcareous, fine to medium grained sands, ranging in depth from 10 to 20 metres. Limestone, sand and sandy clays occur in the area at depths between 10 to 50 metres (deepest at DM9). Below these sediments are dark grey, silty, micaceous clays. The clays appear from 20 to 40 metres, and occasionally occur above or within the sandy limestone layers.
- Groundwater standing water level resides in the superficial formation between 0.8 – 2.5 m AHD. Yarragadee aquifer standing water level resides between 1.5 – 2.5 m AHD.
- Groundwater monitoring network incorporating 15 bores was sufficient to complete the hydrogeological review.
- Groundwater quality investigations reported exceedances of select metals. Of these trace metals, it was concluded that lead, cobalt, copper and zinc are likely to be due to natural background conditions encountered at the time of sampling.
- Chromium and vanadium were the only two trace metals that appear to be linked to the TSR as their concentration shows an increase between the up and down-gradient wells.
- Mobility of hexavalent chromium and vanadium is dependent on anionic sorption processes with the main anion attracting sites being ferric hydroxide minerals. Therefore dissolution of these metals is dependent on pH. The pulsed nature of mobility would likely result in very slow transport velocities with these metals only migrating during periods when the pH is in a narrow window where sorption and precipitation are not occurring. Therefore the potential for sustained discharge of chromium at concentrations above the adopted water quality ecosystem criteria was considered very low.
- TSR is generating saline leachate that is increasing the TDS of the groundwater along flow path. ERM (2012) estimated a travel time of 5 years for water between the TSR and the ocean and this assessment found this value to be realistic for the groundwater system.
- TSR material may be a source of the excess calcium in groundwater samples.

---

[1] DER (2013) Environmental Protection Act 1986, Section 68A, Closure Notice (Licence number 6130/1989/12.

- The most likely mineral responsible for the majority of the observed effect on the major ion composition of the groundwater is Calcium Chloride ($CaCl_2$). The source of this mineral is considered to be anthropogenic and probably associated with the TSR.
- The hydrogeochemical character at the down-gradient well (DM4(4R)) is influenced by mixing of fresh groundwater discharge, impacted by leachate from the TSR and seawater interface, which would be anticipated given the position of the well near the beach.

Recommendations

An ongoing monitoring program is already a requirement of the Closure Notice, which can continue in its current form.

GHD recommends that an action plan be developed that periodically re-evaluates the hydrogeochemical data to establish that conditions remain stable and provides a series of actions and measures to be adopted should any future monitoring identify potential changes in hydrogeochemical conditions and / or risk profile of the TSR to the environment.

Hydrogeochemical data should be stored and managed in a program which can be updated and analysed easily.

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Figure index

Appendices

1. Introduction

GHD Pty Ltd (GHD) was commissioned by Cristal Pigment Australia Ltd (Cristal) to complete a Hydrogeological Assessment of the Dalyellup Waste Residue Disposal Facility (DWRF) located on Minninup Road, Dalyellup, Western Australia (the Site). The Site location is presented as Figure 26 (Appendix A). The Hydrogeological Assessment is required as per the DER's closure notice[2], specifically Condition 1.2, focusing on groundwater quality, leachate and groundwater interaction, contamination plume size and migration.

1.1 Background

The Site is part of a three stage process including a chloride process titanium dioxide facility at Kemerton, a finishing plant at Australind and the Site where a by-product known as Total Solid Residue (TSR) is disposed. The *Environmental Protection Act 1986* Licence (L6130/1989/12) expired on 3 March 2013, ending the 25 year operation. The Site's operating licence (L6130/1989/12) describes the dried TSR composition as an *inert, mostly insoluble, non-toxic, clay-like material*. With regard to the chemical composition of TSR, the Human Health Risk Assessment[3] describes TSR as '*a mixture containing aluminium, calcium, chloride, chromium, iron, manganese, sulphur, titanium and vanadium and other trace constituents at high pH to precipitate metals as hydroxides'*.

The Site was issued a Closure Notice from the Department of Environment Regulation (DER) on 9 May 2013 and a revised closure notice superseding the previous on 1 August 2013. A final closure plan[4] has been approved by stakeholders including DER, Office of the Environmental Protection Authority (OEPA), the Site Auditor, Jason Clay, Radiological Council and Shire of Capel.

The Shire of Capel proposes the final end use of the Site to be recreational playing fields and sporting facilities.

During the DWRF's operational phase, TSR was disposed in a series of ponds. The Site also comprises two bitumen sealed turning circles used by incoming trucks to dispose the TSR (i.e. Eastern turning circle (ETC) and Northern turning circle (NTC)). A Residue Pond Layout plan is presented as Figure 27 (Appendix A).

It is noted the rehabilitation plan for the Southern Ponds portion of the DWRF was accepted by the EPA in 2001 and this area is now covered by native vegetation. The Eastern Turning Circle has been approved by the DER to be returned to bushland and the Northern Turning Circle has been included in Area 4, Area 5 and Central Tailings Pond (CTP) footprint.

1.2 Purpose of this report

This report details the results of groundwater quality monitoring undertaken at the Site between November 1988 and October 2014 as required in RFQ20141119. To meet the 1 July 2015 deadline of issuing this report to the DER, as imposed by the Closure Notice, the March 2015 data were not included.

---

[2] DER (2013) *Environmental Protection Act 1986*, Section 68A, Closure Notice (Licence number 6130/1989/12.

[3] ERM (2012) *MIC Dalyellup Solid Residue Disposal Facility, Health Risk Assessment*, Ref: 0124484RP1.

[4] Cristal Global (June 2013) *Dalyellup Facility, Final Closure Plan, Remediation-Validation-Ongoing Management FCPRVOM Closure Report.*

1.3 Objectives

The objectives of the Project are to:

- Address DER's requirements associated with development of a Hydrogeological Report as per Section 1.2 of DER's closure notice for the site.
- Address recommendations outlined in DoW correspondence dated 13 August 2014.
- Provide information and conclusions regarding the chemical status of groundwater at the Site.
- Provide conclusions regarding the risks posed to relevant groundwater sensitive receptors by the groundwater quality.

1.4 Scope of work

The objectives outlined in Section 1.3 have been met by completing the following scope of work which was provided in the RFQ20141119 Schedule 1.

- Preparation of a report detailing the objectives, scope of work and data that has been reviewed.
- Interpretation of chemical data including temporal and spatial trends.
- Exceedances of adopted groundwater criteria and risks associated with these exceedances in relation to groundwater beneficial uses.
- Tier 1 Risk Assessment discussing the risks associated with the chemical status of monitored groundwater.
- Assessment of groundwater quality below and down gradient from the Site and compared to background groundwater quality.
- Assessment of any contaminant plume size, movement and distribution of contaminant concentrations from below the disposal ponds to the near shore groundwater discharge zone.
- Characterisation of the interaction between the TSR and the groundwater, more specifically being:
  - The geochemical interactions between leachate, underlying soils and groundwater;
  - Contaminant transport rates; and
  - Contaminant migration pathways.
- Conclusions regarding the interpreted data and suitability of future land use.
- Recommendations for further work (if required).

A Contaminated Sites Auditor, accredited by DER under the *Contaminated Sites Act 2003* has been engaged to review this investigation.

1.5 Limitations and assumptions

This report: *Dalyellup Waste Residue Facility – Minninup Road, Dalyellup, Western Australia, Hydrogeological Assessment* has been prepared by GHD for Cristal Pigment Australia Ltd and AECOM and may only be used and relied on by Cristal Pigment Australia Ltd and AECOM for the purpose agreed between GHD and the Cristal Pigment Australia Ltd as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Cristal Pigment Australia Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Cristal Pigment Australia Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

This report is subject to review by a DER contaminated sites Auditor.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

GHD has not been involved in the preparation of the following reports:

- Oceanica Consulting Pty Ltd (February 2011) *Dalyellup Waste Residue Disposal Facility – Marine Environmental Risk Assessment Field Study*.
- ERM (June 2012) *Millenium Inorganic Chemicals Ltd, Dalyellup Treated Solid Residue Disposal Facility – Hydrogeological Assessment*, Ref: 0166052_MIC_Dalyellup rpt_FINAL
- Radiation Professionals Pty Ltd (November 2012) *Operational Radiation Monitoring Program at Solid Residue Disposal Site, Dalyellup – Annual Report: Year Ending 30 September 2012*.
- Cristal Global (June 2013) *Dalyellup Facility, Final Closure Plan, Remediation-Validation-Ongoing Management FCPRVOM Closure Report*.
- Cristal (June 2013) 2012 *Dalyellup Annual Environmental Report (Licence L6130/1989/12)*.
- Cristal (June 2014) 2013 *Dalyellup Annual Environmental Report*.

2. Previous investigations

Environmental investigations have previously been completed for the Site. A summary of applicable investigations is outlined below.

Oceanica Consulting Pty Ltd (February 2011) Dalyellup Waste Residue Disposal Facility – Marine Environmental Risk Assessment Field Study.

Desktop risk assessment

A Marine Environmental Risk Assessment (MERA) and subsequent field study was complete to examine the potential impacts the Dalyellup WRF posed to the marine environment. The MERA addressed the potential impact of the waste disposal ponds to the marine environment The MERA also investigated a set of possible scenarios for transport of the TSR leachate to the Geographe Bay, via the superficial aquifer.

The MERA was based on the most conservative guidelines available, ANZECC/ARMCANZ (2000) 99% species protection. An assumption of no attenuation of contaminants as the leachate drained into the groundwater and mixing with nearshore marine waters under conditions of atypical low currents.

The MERA reported that dioxins are formed in low concentrations during the processing cycle. Dioxins are relatively insoluble, binding strongly to sediments, so that while they will be present in trace amounts in the TSR at Dalyellup, there was a minimal risk of material entering the superficial aquifer and the marine environment.

Field study

To confirm the findings of the MERA, a field study was undertaken including:

- A baseline study of the sediments and pore water in the nearshore zone, west of the Central Ponds.
- Dioxin analysis of naturally occurring shellfish adjacent to the Dalyellup site.

Results of the field study indicated that:

- No sediments at any of the sites associated with TSR disposal show any sign of accumulation of the contaminants typically associated with TSR.
- TSR filtrate is similar in composition to the process waste water discharged at the Kemerton ocean outfall (Oceanica 2009) and it is noted that discharge of process waste water for over 20 years has not resulted in any adverse effects due to accumulation of contaminants in marine sediments or deployed mussels (Oceanica 2009).
- TSR solids reported low levels of dioxins, which were below adopted guidelines for residential soils.
- Brackish salinities reported in the sediment samples indicate these samples were exposed to groundwater flow. It is likely this groundwater flow may have been exposed to WRF leachate, however analytes associated with WRF leachate were not reported to exceed guideline values.
- Marine water samples reported metal concentrations below the adopted guidelines. Dioxins and furans were not detected in any marine water samples near the WRF.

The field study concluded that “groundwater discharge adjacent to the WRDF poses negligible risk to the marine environment and has a negligible impact on recreational use of the beach and water adjacent to the WRDF.”

ERM (June 2012) Millenium Inorganic Chemicals Ltd, Dalyellup Treated Solid Residue Disposal Facility – Hydrogeological Assessment, Ref: 0166052_MIC_Dalyellup rpt_FINAL

A hydrogeological assessment was completed for the Site in 2012. Findings of the assessment are summarised below:

- There were only minor anthropogenic activities present on the Site prior to 1989 when Cristal started operating.
- The primary beneficial use of groundwater is eventual discharge into the Indian Ocean.
- No freshwater bodies have been identified in the vicinity of the Site.
- The Superficial Formation comprising predominantly sands, has a groundwater flow direction to the north-north-west, towards the Indian Ocean. The water table is at approximately 5 m AHD, seasonally fluctuating by 1 – 1.5 m.
- The Yarragadee Formation underlies the Superficial Formation and consists of a confined multi-layered aquifer, comprising interbedded sandstone, siltstone and shale. The potentiometric head of the Yarragadee aquifer is approximately 1 m higher than in the Superficial Formation.
- Total dissolved solids, electrical conductivity and salinity has changed over the monitoring period. This may be due to natural processes and/or impact from TSR leachate.
- DM1 and DM9, located on the eastern Site boundary and inferred up-hydraulic gradient of the Site, indicate fresh groundwater quality.
- Remaining bores indicate brackish to saline groundwater quality.
- Based on historical monitoring data, the following contaminants of potential concern (COPC) include:
    - Metals: chromium, hexavalent chromium, cobalt, nickel, manganese, molybdenum.
    - Cations: magnesium, calcium.
    - Anions: chloride.
- A risk assessment completed for the Site indicated changes in the groundwater quality are potentially a function of natural changes and/or leachate generation from the TSR.
- Chromium, chloride, cobalt and manganese concentrations were reported above the adopted guidelines in groundwater sampled from the Superficial Formation.
- The Yarragadee Formation is not impacted by the COPC.

Radiation Professionals Pty Ltd (November 2012) Operational Radiation Monitoring Program at Solid Residue Disposal Site, Dalyellup – Annual Report: Year Ending 30 September 2012.

The TSR residues contain technically enhanced, naturally occurring radioactive material (TENORM) comprising traces of uranium and thorium. A radiation monitoring program was established for the facility. Results obtained from the 2012 monitoring program are summarised below:

- The radiation monitoring program included measurements of:
    - Absorbed dose rates in air;
    - Radionuclides in water;

    - Radionuclides in the residue;
    - Radon and thoron concentrations in air; and
    - Alpha activity in airborne dust.
- The mean absorbed dose rate in air at the Site boundaries is constant at 0.12 ± 0.02 µGy h^{-1}, concluding:
    - The operations at the WRF are not causing any detrimental effects on the gamma radiation levels at the Site boundaries; and
    - The gamma radiation levels over the uncovered disposal ponds are similar to those predicted from the radionuclide content of the solid residues, assuming water content of 60%.
- Radon/thoron levels surrounding the WRF are proportionate to background levels in the area.
- There are no obvious increases of radium-226 content in the shallow bores to indicate any leaching of this radionuclide from the residue.

Cristal (June 2013) 2012 Dalyellup Annual Environmental Report (Licence L6130/1989/12).

Cristal summarised activities completed at the Site during 2012:

- TSR results – the majority of metals analysed in TSR solid and filtrates were reported in concentrations below the adopted criteria. All leachate samples were below the adopted criteria except for molybdenum. Molybdenum occurs naturally in the ore bodies.
- Dioxin and furans results – Cristal commissioned a review of dioxin and furans results by Scherger and Associates. Findings of this review were presented in Scherger D. A. (2012) *Peer review of sampling procedures and analytical data for the February 2012 sampling of groundwater and TSR solids/filtrate per Dalyellup facility license requirements for Millenium Inorganic Chemicals, A Cristal Company*. A summary of the Scherger (2012) review is outlined below:
    - One groundwater sample taken from monitoring bore DM8A during the August 2012 sampling round, reported a “trace level of one congener 1,2,3,7,8 pentachlorodibenzo-p-dioxin (PeCDD) at 1.32 pg/L. This was just above the detection limit of approximately 1 pg/L.” Dioxin and furans results from all bores collected during the subsequent February 2013 monitoring round were reported below the LOR. The detected PeCDD result from DM8A is considered to be an anomaly.
    - TSR solids contain detectable levels of dioxins and furans. The 2012 TSR solids results remain in similar concentrations over time. The 2013 TSR solids results indicate that the concentrations have returned to the levels measured in 2011. “The 2013 concentrations are similar to the levels in the waste material that was characterized and approved for disposal at the Dalyellup site as part of the Licensing process and License Renewal.”
    - “The filtrate results…show that the dioxins and furans present in the filtrate are very low or not detected as would be expected. All of the filtrate results were reported as not detected for all the congeners. Dioxins and furans tend to adsorb onto solids and are generally not leachable to any appreciable amount. The low filtrate concentrations not detected show that the dioxins and furans are bound with the solids and are expected to remain with the solids in the landfill. This indicates that the potential for dioxins and furans to enter the liquid phase and migrate towards the groundwater is small.”

- Groundwater results – the on-Site monitoring well network comprises 15 wells. Groundwater analysis reported leachate impact in the Superficial Formation. The Yarragadee Formation did not report any leachate impact.

Cristal Global (June 2013) Dalyellup Facility, Final Closure Plan, Remediation-Validation-Ongoing Management FCPRVOM Closure Report.

Cristal ceased operations at the WRF in March 2013. A human health and ecological risk assessment was commissioned by the land owner, the Shire of Capel, to determine if the facility can be redeveloped into sporting fields. The objective of the Final Closure Plan is to ensure the Site is suitable for this future use. Other aims include:

- No evidence of contamination into the Yarragadee Formation;
- No evidence of inverse impact on the marine environment from the chloride plume exiting the Site.
- COPCs are stable in the TSR, with the exception of molybdenum.
- The TSR ponds have reached equilibrium in the Superficial Formation.

The adopted remediation method is passive with continued monitoring of the Site until equilibrium occurs.

Monitoring was completed on parameters including radiological, marine, flora, fauna, soil, dust and groundwater.

The process of remediation will be achieved when all finishing criteria are closed to the satisfaction of stakeholders including DER Contaminated Site Branch, Radiological Council of Western Australia and the Shire of Capel. Based on the time taken to remediate the southern ponds, it is anticipated the remediation of the remaining portions of the WRF will be achieved within five years of closure (i.e. March 2018).

GHD (February 2014) Dalyellup Waste Residue Disposal Facility – Eastern Turning Circle Validation.

As part of the Site closure, GHD completed soil validation sampling of the portion known as the Eastern Turning Circle (ETC). The validation sampling was completed in September 2013 which involved grid sampling to a maximum depth of 0.5 m bgl.

ETC lithology comprised slightly moist, light brown sands, with medium sized grains. No odours or staining was noted in any samples. No asphalt or TSR was observed in any samples.

Laboratory results confirmed that no analyte concentrations exceeded the adopted criteria for ecological receptors and human health in a recreational open space setting.

No further investigations or management requirements were recommended.

Cristal (June 2014) 2013 Dalyellup Annual Environmental Report.

Groundwater samples analysed from the Superficial Formation reported the following:

- Background bores – cobalt, copper, lead and zinc exceeded the adopted marine ecosystem criteria.
- Down hydraulic gradient bores – chromium III, chromium VI, cobalt, copper and zinc exceeded the adopted marine ecosystem criteria.
- No analyte concentrations exceeded the Drinking Water guidelines at any down hydraulic gradient bores.

The Yarragadee bore water results reported analyte concentrations less than the Drinking Water guidelines.

GHD (2015) Dalyellup Facility – Rehabilitation Sand Stockpile Characterisation Program, Validation – Central Tailings Pond, Area 4, Area 5_Rev2, February 2015.

As part of the Site closure, GHD completed a soil validation program in November 2013 for Cristal on Area 4, Area 5 and the CTP. The validation program was required to confirm that a minimum two metre thick cap comprising clean sand had been applied to portions of the Site that have previously been used as TSR disposal ponds.

A total of 132 soil bores were advanced across Area 4, Area 5 and the CTP. Analysis was completed on collected soil samples at varying depths (nominally 0 – 0.1 m bgl and 1.8 – 2 m bgl).

The assessment of the capping material concluded the following:

- The capping material was observed to be greater than two metres thick above the TSR pond at Area 4 and Area 5 and at all locations but one at the CTP where it is potentially 1.7 m. All other boreholes surrounding CTP01 indicate at least 2 m of capping material.
- The capping material comprised mainly sand with instances of trace clay with a textural and chemical composition resembling the TSR. Borehole logs indicate that at only two locations, the clay material is found at the surface (0.0 m to 0.1 m bgl).
- Concentrations of chromium (total), chromium (VI), cobalt, manganese, molybdenum, nickel, tin and vanadium were detected in some samples exceeding ecological investigation levels (EIL). None exceeded health investigation levels for recreational use (HIL-C).
- The qualitative risk assessment indicated that:
  - Concentrations of metals exceeding EIL are unlikely to have an adverse effect on introduced ecological receptors;
  - Given the magnitude of the exceedences and because they occurred in a small number of samples, typically at depth, it is considered the capping material presents no unacceptable risk to ecological receptors;
  - The leachate results indicated the cap, which contains only traces of TSR, is unlikely to leach chromium and vanadium at concentrations exceeding the marine waters criteria.
  - Due to the infrequency of occurrence of suspect TSR in the cap, and in particular at the surface (top 10 cm), the likelihood of human exposure to the suspect TSR is low and therefore unlikely to present a significant risk to human health.
  - The results of the post remediation gamma monitoring (Cristal Pigment, 2014) showed that gamma radiation levels were within the natural background radiation of the area, further supporting that TSR exposure is unlikely to pose a significant risk to human health receptors.

In summary, based on the results and within the limitations of the investigation it is concluded that the capping material applied at this Site is at least two metres thick and presents no unacceptable risk to human health and/or the environment and that the Site is suitable for the proposed recreational playing field land use.

3. Site characterisation

3.1 Site location

The Site is located on Minninup Road, Dalyellup, Western Australia, as depicted and outlined in Figure 26 (Appendix A). The Site comprises two land titles, noted in Table 1.

Table 1 Land titles

Land Title	Approx. Area (ha)
Lot 9077 on Deposited Plan 60716. Volume 2717/Folio 207	13.0824
Lot 9090 on Deposited Plan 69838. Volume 2790/Folio 895	1.1444
Total Site area	**14.2268**

3.2 Site description and layout

The majority of the Site comprises TSR ponds, which have now been closed and capped with sand and mulch. The remaining southern portion of the Site is a rehabilitated TSR pond, which has established native vegetation. A figure showing the locations of the closed residue ponds is presented in Figure 27 (Appendix A). Details of the ponds are provided in Section 3.7.

An area adjacent to the east of the waste residue ponds, known as the Eastern Turning Circle, was also used to store TSR and has since been capped with sand and mulch.

There is no infrastructure on the Site.

3.3 Topography

As part of the Site closure, the ground surface was levelled to between 26 – 27 m AHD. The eastern turning circle is levelled to between 22 – 34.5 m AHD, sloping downwards from south to north. A topographic plan is presented in Figure 28 (Appendix A).

Geographe Bay is located 200 west of the Site. The coastal dunes drop steeply from the western Site boundary to sea level.

3.4 Regional geology and hydrogeology

Geological formations underlying the Site and also in the broader area, along with associated hydrogeology are as summarised in Table 2 and discussed below.

Table 2 Geology and hydrogeology of the Bunbury region

Age	Formation	Thickness (m)	Hydrogeology	On-Site
Quaternary	Safety Bay Sand	40	Superficial	Present
	Tamala Limestone	40	Superficial	Present
	Bassendean Sand	15	Superficial	Not present
	Guildford Formation	20	Superficial	Not present
	Yoganup Formation	15	Superficial	Not present
Cretaceous	Leederville Formation	300	Regionally confined	Not present
	Bunbury Basalt	70	Aquiclude	Not present

Age	Formation	Thickness (m)	Hydrogeology	On-Site
Jurassic	Yarragadee Formation	200 – 500	Confined basement	Present
	Cockleshell Gully Formation	400	Confined basement – hydraulically connected to Yarragadee	

3.4.1 Quaternary Age Formations

Safety Bay Sands – Generally up to 40 m thick consisting of calcareous quartz sands (Bunbury-Burekup Urban Geology 2031 III to 2031II, 1981). The formation contains groundwater which recharges directly from:

- rainfall and urban run-off;
- upward leakage from the Yarragadee Formation near the coast where there is no Bunbury Basalt present; and
- where the potentiometric head of the Yarragadee Formation is higher than the water table (Commander, 1981).

Conductivity ranges between 500 – 10,000 mg/L and is used for non-potable garden irrigation.

Tamala Limestone – The Tamala Limestone comprises aolian and marine calcarenite dunes, with minor amounts of coarse quartz. The formation forms an elongated dune approximately 2 – 3 km wide and has a thickness of between 15 – 40 m.

3.4.2 Cretaceous Age Formations

Leederville Formation – The Leederville Formation extends eastwards, comprising sand, shale and siltstone with minor carbonaceous material (Geological Survey of WA, 1981).

Groundwater is recharged from the Blackwood Plateau, where the Leederville Formation surfaces. Groundwater tends to flow upwards into the Superficial Formation and downwards into the Yarragadee Formation causing variations in vertical head (Commander, 1981).

Bunbury Basalt – The Bunbury Basalt surfaces along the northwest sea shore of the Bunbury city centre. It comprises fresh, porphyritic tholeiitic basalt which forms an aquiclude between the underlying Yarragadee Formation and overlying Leederville Formation or Superficial Formations (Commander, 1981).

3.4.3 Jurassic Age Formations

Yarragadee Formation – The Yarragadee Formation comprises very coarse quartz sand, with minor interbeds of grey shale which are commonly weathered to a yellow-brown colour (Commander, 1981).

Groundwater within the Yarragadee is fresh with a salinity of less than 1,000 mg/L and is confined below the Leederville aquifer. The top of the formation has been intersected between 49 – 272 m AHD and is up to 1,700 m thick (Water Corporation, 2005).

The Yarragadee supplies the Bunbury area with groundwater used for multiple purposes including irrigation and drinking water.

Groundwater flows north-north west from recharge areas on the Blackwood Plateau. Groundwater discharges into Superficial Formations where the water table is lower than the potentiometric head in the Yarragadee Formation. Groundwater then discharges to the sea either directly from the Yarragadee Formation or through the Superficial Formation (Commander, 1981).

Iron and manganese concentrations are naturally elevated in the Bunbury area.

Cockleshell Gully Formation – The Cockleshell Gully Formation comprises coarse quartz sand and interbedded shale. The formation is a continuous sequence of terrestrial sediments and is hydraulically connected to the Yarragadee Formation (Commander, 1981).

3.5 Local/Site geology and lithology

Site lithology is presented on Figure 29 and Figure 30 (Appendix A) and is discussed below.

3.5.1 Local/Site

The sediments below the disposal area are calcareous, fine to medium grained sands. They range in depth from 10 to 20 metres. Limestone, sand and sandy clays occur in the area at depths between 10 to 50 metres (deepest at DM9). Below these sediments are dark grey, silty, micaceous clays. The clays appear from 20 to 40 metres, and occasionally occur above or within the sandy limestone layers.

Some heavy minerals and silty organic matter occur throughout the profile. The secondary dunes are overlain by approximately 0.5 to 1.0 m of topsoil. The area is underlain by superficial formations, which extend from the ground surface to about 10 m AHD. The Superficial formations form an anisotropic unconfined aquifer comprising sand and limestone with a basal section of less permeable silty sand and sandy clay (MIC, 2011).

Geological borelogs prepared during the monitoring well installations are presented in Appendix B.

3.5.2 Disposed material

TSR was deposited at the Site between 1989 and 2013. The Site was licensed to dispose 200,000 tonnes of TSR per year. The TSR is an inert, mostly insoluble, non-toxic, clay-like material and has a chemical composition described as a mixture containing aluminium, calcium, chloride, chromium, iron, manganese, sulphur, titanium and vanadium and other trace constituents at high pH to precipitate metals as hydroxides.

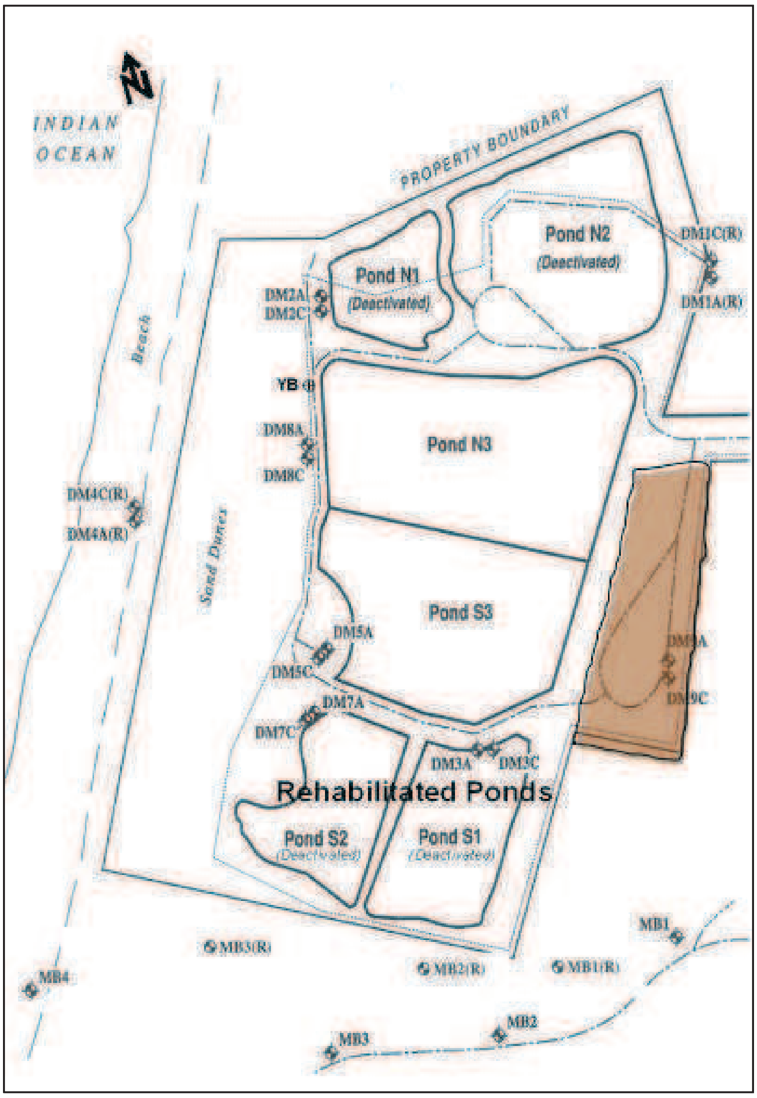
3.6 Surface water receptors

The Indian Ocean located 200 m west of the Site is the primary surface water receptor. There are no other natural surface water receptors in the vicinity of the Site. However, there are three man-made lakes along Maidment Parade, approximately 400 m south east of the Site. These lakes may receive surface water run-off from the Site and may be exposed to groundwater interaction.

3.7 Waste residue facility construction and closure

In March 1989, Cristal began disposing TSR at the Site which was sourced from their titanium dioxide processing plants, located in Kemerton and Australind. The Site was comprised of six TSR ponds as depicted on Figure A below, which were filled in stages over 24 years (1989 – 2013).

Figure A Layout of Site



Sourced from Figure 3 – Final Closure Plan (Cristal, 2013).

Rehabilitation of the Site was completed in the following stages:

- April 2002 – covering and seeding of the Southern Ponds (S1 and S2).
- Mid-1996 – covering of the Northern Ponds (N1 and N2) with sand excavated from the Central Ponds (N3 and S3).
- August 2013 – covering of the Central Ponds (N3 and S3) with 2 metres thick of clean sand.
- September 2013 – contouring of the final surface level, ensuring 2 metres thick of clean sand covered the TSR ponds.
- January 2014 – mulching of entire Site.

3.8 Groundwater monitoring program

The groundwater monitoring program implemented at the Site is based on DER Licence (6130/1989/12) requirements. Continued monitoring is required as per the Site Closure Notice.

Groundwater monitoring has been completed at the Site on a quarterly basis since 1989. A total of 162 groundwater monitoring events have been completed at the Site.

4. Hydrogeological data review

4.1 Groundwater monitoring network

There are 15 groundwater monitoring wells that are monitored as part of the Licence requirements. The network details are listed in Table 3 and presented in Figure 31 (Appendix A). Table 4 presents historical information of the monitoring well network including current operational status of each well.

Table 3 Current groundwater monitoring network

Well Id	Targeted aquifer	Date drilled	Depth of well (m bgl)	Screened interval (m bgl)	Elevation (m AHD)	Top of Casing (m AHD)	Easting	Northing
Up-gradient wells								
DM1RS	Superficial	15.12.92	43	39 – 42	40.05	39.56	370837	6304504
DM1RD	Superficial	15.12.92	50	45 – 48	40.05	39.54	370837	6304504
DM9S	Superficial	23.7.96	36	32 – 35	33.8	34.35	370765.78	6304209.08
DM9D	Superficial	23.7.96	46	42 – 46	33.8	34.28	370765.78	6304209.08
Down-gradient wells								
DM2RS	Superficial	27.02.89	26.5	23.5 – 25.5	24.489	26.4	370525	6304503
DM2RD	Superficial	27.02.89	35.3	27 – 30	24.489	26.25	370525	6304503
DM4RS	Superficial	4.04.96	7.8	4.8 – 7.8	3.643	4.78	370364.96	6304368.66
DM4RD	Superficial	13.02.89	12.5	9.5 – 12.5	4.444	4.77	370364.96	6304368.66
DM7RS	Superficial	27.5.92	23	19 – 22	20.497	24.52	370479.84	6304180.9
DM7RD	Superficial	29.5.09	30.8	26 – 29	20.497	24.66	370479.84	6304180.9
DM8RS	Superficial	23.7.96	28	24 – 28	26.19	26.47	370506.9	6304410.2
DM8RD	Superficial	23.7.96	36	32 – 36	26.19	26.39	370506.9	6304410.2
Background wells								
MBR3D	Superficial	22.11.00	34.5	28 – 34	25.9	27.93	370416.8	6304040.34
MB4D	Superficial	10.11.88	16.2	2.2 – 16.2	5.13	3.35	370245	6303905
Yarragadee well								
YBd	Yarragadee	24.03.05	72	66 – 72	26	27.2	370516	6304473

Table 4 Monitoring well network historical information

Well Id	Previous Ids	Date of initial installation	Dates of re-installment	Current status
DM1RS	DM1C, DM1S, DM1RC	15/12/1992		Operational
DM1RD	DM1A, DM1D, DM1RA	15/12/1992		Operational
DM9RS	DM9C, DM9S, DM9RS	23/07/1996	NA	Operational
DM9RD	DM9A, DM9	23/07/1996	NA	Operational
DM2RS	DM2C, DM2S, DM2RC	27/02/1989		Operational
DM2RD	DM2A, DM2D, DM2RA	27/02/1989		Operational
DM3S	DM3C	3/03/1989	NA	Decommissioned
DM3D	DM3A	3/03/1989	NA	Decommissioned
DM4RS	DM4C, DM4S, DM4RS	13/02/1989	4/04/1996	Operational
DM4RD	DM4A, DM4D, DM4RA	13/02/1989	4/04/1996	Operational
DM5S	DM5C	14/05/1991	NA	Decommissioned
DM5D	DM5A	14/05/1991	NA	Decommissioned

Well Id	Previous Ids	Date of initial installation	Dates of re-installment	Current status
DM7RS	DM7C, DM7S, DM7RC	27/05/1992		Operational
DM7RD	DM7A, DM7D, DM7RA		29/05/2009	Operational
DM8RS	DM8C, DM8S, DM8RS	23/07/1996	09/2009	Operational
DM8RD	DM8A, DM8D, DM8RD	23/07/1996		Operational
MB1RD	MB1	3/11/1988	23/11/2000	Decommissioned
MB2RD	MB2	4/11/1988	23/11/2000	Decommissioned
MB3RD	MB3RA, MB3D	6/11/1988	22/11/2000	Operational
MB4D	MB4A	10/11/1988	2014	Operational
YB	none	24/03/2005	NA	Operational

4.2 Groundwater quality

4.2.1 Assessment criteria

Groundwater discharges directly into the nearby Indian Ocean. As such, ANZECC 2000 Marine Water, 95% species protection criteria (Marine Criteria) have been adopted for the assessment.

4.2.2 Marine Water species protection criteria exceedances (2013-2014)

Groundwater data collected during the closure period (i.e. 2013 – 2014) has been compared to the Marine Criteria and are presented in Table C1 (Appendix C). Exceedances of the Marine Criteria are shown on Figure 32 (Appendix A).

Table 5 presents a summary of groundwater analytical results from 2013 and 2014. These results are discussed in the below section.

Table 5 Groundwater analytical results from 2013 – 2014, exceeding Marine Water species protection criteria

Analyte	Maximum reported concentration	Minimum reported concentration	ANZECC 2000 Marine Water (95%) criteria	Wells exceeding criteria
Lead	0.72 mg/L (MB4D – 9.04.14)	<0.001 mg/L (multiple)	0.0044 mg/L	Up-gradient: DM1S, DM1D Down-gradient: DM2S, DM7S, MB4 Yarragradee: YB
Chromium VI	0.78 mg/L (DM2D – 9.04.14)	<0.001 mg/L (multiple)	0.0044 mg/L	Up-gradient: DM9D, DM9S Down-gradient: DM2D, DM2S,
Chromium III	0.28 mg/L (DM2D – 16.10.14)	<0.001 mg/L (multiple)	0.0274 mg/L	Down-gradient: DM2D

Analyte	Maximum reported concentration	Minimum reported concentration	ANZECC 2000 Marine Water (95%) criteria	Wells exceeding criteria
Cobalt	0.014 mg/L (DM2D – 9.04.14)	<0.001 mg/L (multiple)	0.001 mg/L	Up-gradient: DM1D, DM1S, DM9D Down-gradient: DM2D, DM2S, DM4D, DM4S, DM7S, DM8D, DM8S, Background: MB3, MB4 Yarragadee: YB
Copper	0.028 mg/L (MB4 – 10.10.13 & 9.04.14)	<0.001 mg/L (multiple)	0.0013 mg/L	Up-gradient: DM1D, DM1S, DM9D, DM9S Down-gradient: DM2D, DM2S, DM7D, DM7S, DM8D, DM8S Background: MB3, MB4 Yarragadee: YB
Vanadium	1.1 mg/L (DM2D – 9.04.14)	<0.001 mg/L (multiple)	0.1 mg/L	Down-gradient: DM2D
Zinc	4.5 mg/L (MB4 – 10.10.13)	0.002 mg/L (DM4S – 10.10.13)	0.015 mg/L	Up-gradient: DM9D Down-gradient: DM2D, DM2S, DM4D, DM7S, DM8D Background: MB4

Copper is naturally occurring in elevated concentrations (Geoprocc Pty, 2009), which is confirmed in the dataset. Cobalt was also reported in background bores and the bores monitoring the Superficial and Yarragadee aquifers. Zinc was reported in one background bore and all Superficial aquifer bores, both up-gradient and down-gradient of the Site.

Copper, cobalt and zinc are likely to be naturally occurring in elevated concentrations within the area and therefore exceedances of the adopted Marine Water Criteria do not trigger the need for further investigation.

Lead and chromium VI concentrations were reported in bores both up- and down-hydraulic gradient of the Site. Highest lead concentrations were reported at MB4, located on shore, slightly south of the Site. There is no obvious source of lead contamination in this area and continued monitoring at this location is required. In April 2014, lead was also reported (0.005 mg/L) slightly above the Marine Water criteria (0.0044 mg/L) at monitoring bore YB, which monitors the Yarragadee Aquifer. Lead has fluctuated below LOR (<0.001 mg/L) to slightly above LOR (0.001 mg/L). Continued monitoring of lead in YB will determine if this lead concentration is continually present or an anomaly.

Chromium VI concentrations were highest at DM2, located in the north western portion of the Site, on the edge of the TSR pond. Chromium VI is a COPC associated with Site activities and therefore the reported chromium VI is likely to be sourced from this.

An increase in chromium VI concentrations was observed in background well DM9S. This has been linked to a trial of road base at the surface of DM9S. The tailings material was trialled as a road base to determine if it was suitable, both from a construction and contamination perspective. The trial was short term and has since ceased.

Chromium III and vanadium concentrations were reported to exceed the Marine Water Criteria in down-hydraulic gradient bore, DM2. Chromium III and vanadium are COPC associated with Site activities and therefore reported chromium III and vanadium are likely to be sourced from the Site activities.

4.2.3 Seasonal trends

Bicarbonate, chloride, sodium/chloride ratio and pH results for 2013 and 2014 monitoring were used to determine trends of increasing or decreasing value.

Spring monitoring round data reported the following increasing trends:

- Bicarbonate has increased at DM1 and YB.
- Chloride has increased at DM2 and DM8.
- Sodium/chloride ratio has increased at DM4.
- pH has increased at DM8 and YB.

Autumn monitoring round data reported the following increasing trends:

- Bicarbonate has increased at DM7.
- Chloride has increased at YB.
- Sodium/chloride ratio has increased at DM4 and DM7.
- pH has increased at DM2, DM4, DM8, DM9, MB4 and YB.

Alkalinity has decreased during the Spring monitoring rounds at the following bores:

- DM1, DM2, DM4, DM7, DM8, DM9, MB3, MB4.

Alkalinity has decreased during the Autumn monitoring rounds at the following bores:

- DM1, DM2, DM8, DM9.

Decreases in alkalinity are indicators of TSR leachate. Hydrogeochemical processes associated with these trends are discussed in Section 4.3.

Risks posed to the receiving marine environment by the quality of groundwater and more specifically, these exceedances and increasing trends in analytes, is discussed in Section 5.

4.2.4 Marine Water species protection criteria – Historical exceedances (1989-2014)

Table 6 summarises the adopted Marine Water species protection criteria exceedances for groundwater collected and analysed over the monitoring period (i.e. 1989 – 2014).

Table 6 Groundwater analytical results from 1989 – 2014, exceeding the Marine Water species protection criteria

Analyte	Maximum reported concentration	Minimum reported concentration	ANZECC 2000 Marine Water (95%) criteria	Wells exceeding criteria
Carbon	23 mg/L (DM1Rd 31/10/2006)	0 mg/L (YBd multiple)	NA	NA
Carbonate as $CaCO_3$	<1 mg/L (all results)	<1 mg/L (all results)	NA	NA
Na/Cl Ratio	1.375 (DM1Rd 9/2/2011)	0.01818 (DM8d 8/2/2011)	NA	NA
EC (field)	14,750 µS/cm (DM2Rd 1/6/1991)	640 µS/cm (YBd 1/2/2010)	NA	NA
pH (Field)	8.3 (DM1Rd 1/1/1996)	5.59 (MB3Rd 23/1/2012)	NA	NA
Temp (field)	23.1 ^{o}C DM4s 24/5/2012 DM8s 8/2/2011	17.4 ^{o}C (DM4s 26/10/2012)	NA	NA
Ammonia as N	9,000 µg/L DM2Rd 10/10/2013	<1000 µg/L (multiple)	NA	NA
Bicarbonate	640 mg/L MB3R, 4 samples during 2004	0 mg/L YBd, various dates	NA	NA
Bicarbonate as $CaCO_3$	450 MB3Rd 10/10/2013	51 DM4d 10/10/2013	NA	NA
Chloride	7,700 mg/L DM8d 8/2/2011	0 mg/L YBd 1/8/2005	NA	NA
Nitrate (as N)	89 mg/L MB3Rd 29/10/2001	0 YBd, various dates	NA	NA
Redox Potential	253 mV YBd 29/01/2014	-319 mV DM2Rs 9/4/2013	NA	NA
Sodium	1,500 mg/L MB4d 10/10/2013	55 mg/L DM1Rd 1/1/1996	NA	NA
Sulphate	1,500 mg/L DM8d 8/2/2011	0 mg/L YBd 11/1/2006	NA	NA

Analyte	Maximum reported concentration	Minimum reported concentration	ANZECC 2000 Marine Water (95%) criteria	Wells exceeding criteria
TDS (evap)	14,600 mg/L DM8d 8/2/2011	0 mg/L DM9d and YBd, various dates	NA	NA
Lead	0.72 mg/L MB4d 9/4/2014	0 mg/L YBd, various dates	0.0044 mg/L	YBd, MB4d, MB3Rd, DM9d, DM8d, DM7Rs, DM4s, DM4d, DM2Rs, DM2Rd, DM1Rs, DM1Rd
Aluminium	0.15 mg/L YBd 21/6/2015	0 mg/L YBd, various	NA	NA
Arsenic	0.045 mg/L DM1Rs, 10/10/2013	0 mg/L YBd, various	NA	NA
Boron	1.2 mg/L DM9d 9/8/2000	0 DM9d, YB, various dates	NA	NA
Cadmium	0.016 mg/L DM4s 8/3/2007	<0.0001 mg/L (multiple)	0.0055 mg/L	DM4s
Calcium	2,000 mg/L DM8d 15/2/2006	0 mg/L DM9d, YBd, various dates	NA	NA
Chromium (hexavalent)	0.78 mg/L DM2Rd, 9/4/2014	<0.001 mg/L (multiple)	0.0044 mg/L	YBd, MB4d, MB3Rd, DM9s, DM9d, DM8d, DM7Rs, DM7d, DM4s, DM4d, DM2Rs, DM2Rd, DM1Rs, DM1Rd
Chromium Total	1.2 mg/L DM2Rd 9/4/2014	<0.001 mg/L (multiple)	NA	
Chromium (Trivalent)	0.28 mg/L DM2Rd 16/10/2014	<0.001 mg/L (multiple)	0.0274 mg/L	DM2Rd
Cobalt	0.014 mg/L DM2Rd 9/4/2014	<0.001 mg/L (multiple)	0.001 mg/L	YBd, MB4d, MB3Rd, DM9s, DM9d, DM8s, DM8d, DM7Rs, DM7d, DM4Rs, DM4Rd, DM4s, DM4d, DM3d, DM2Rs, DM2Rd, DM1Rs, DM1Rd
Copper	4 mg/L YBd 15/12/2010	<0.001 mg/L (multiple)	0.0013 mg/L	YBd, MB4d, MB3Rd, DM9Rs, DM9s, DM9d, DM8Rd, DM8s, DM8d, DM7Rs, DM7d, DM4s, DM4d, DM2Rs, DM2Rd, DM1Rs, DM1Rd
Iron	77 mg/L MB4d 8/2/2002	0 mg/L YBd, various	NA	NA

Analyte	Maximum reported concentration	Minimum reported concentration	ANZECC 2000 Marine Water (95%) criteria	Wells exceeding criteria
Magnesium	1,150 mg/L DM8d 15/2/2006	0 mg/L DM9d, YBd, various dates	NA	NA
Manganese	4.9 mg/L DM2Rd 9/4/2014	0 mg/L DM9d, YBd, various dates	NA	NA
Mercury	0.00086 mg/L DM7Rd 14/08/2012	<0.0001 mg/L (multiple)	0.0004 mg/L	DM7Rd
Molybdenum	0.055 mg/L DM8Rs 10/10/2013	<0.001 mg/L (multiple)	NA	NA
Nickel	0.65 mg/L MB4d 9/8/2000	<0.001 mg/L (multiple)	0.07 mg/L	MB4d
Potassium	150 mg/L MB4d, 10/10/2013	0 mg/L DM9d, YBd, various	NA	NA
Selenium	0.009 mg/L DM8Rs 10/10/2013	<0.001 mg/L (multiple)	NA	NA
Vanadium	1.1 mg/L DM2Rd 9/4/2014	<0.001 mg/L (multiple)	0.1 mg/L	MB4d, MB3Rd, MB3d, DM9d, DM8d, DM7Rs, DM4s, DM4d, DM2Rs, DM2Rd, DM1Rs, DM1Rd
Zinc	4.5 mg/L MB4d 10/10/2013	0.002 mg/L DM4s 10/10/2013	0.015 mg/L	MB4d, DM9d, DM8Rd, DM7Rs, DM4d, DM2Rs, DM2Rd
Acidity (as $CaCO_3$)	10 Various	0 (multiple)	NA	NA
Radium-226	2,451 mBq/L DM8s 11/05/2011	0.02 mBq/L DM4s, various	NA	NA
Radium-228	1,130 mBq/L DM1Rd 26/07/2001	10 mBq/L DM1Rs 23/01/2012	NA	NA

4.3 Hydrogeochemical process evaluation

This section presents the result of an assessment of the key hydrogeochemcial processes that appear to occur on the Site to inform the conceptual site model that was utilised to inform the qualitative risk assessment.

To assist in understanding the hydrogeochemical process the available monitoring data were divided into background wells, source zone wells and down-gradient wells as follows:

- Up-gradient Well: DM9;
- Source Zone Wells: DM7(7R) and DM8(8R);
- Down-gradient Well: DM4(4R)

4.3.1 Charge balance error evaluation

The Charge Balance Error is a simple and effective means of assessing the reliability of groundwater data for use in hydrogeochemical process evaluation. The CBE evaluation indicated the following:

- A total of 996 sample analyses included analytes required to allow for CBE calculation;
- A total of 884 analyses had a CBE of less than 10%. This represented 92% of the total data set.
- A total of 82 analyses had a CBE of more than 10%. This represented 8% of the total data set.
- A total of 673 analyses had a CBE of less than 5%. This represented 70% of the total data set.
- A total of 293 analyses had a CBE of more than 5%. This represented 30% of the total data set.

The results of the CBE evaluation suggested that the majority of the data available is suitable for quantitative assessment of the hydrogeochemical process occurring in the project area.

4.3.2 Rainfall trend evaluation

Climate, particularly rainfall recharge, can have significant effects on the hydrogeochemistry of unconfined groundwater systems within permeable soil settings. Calculating the Residual Rainfall Mass (RRM) and Cumulative Rainfall Mass (CRM) for the nearest weather station that offers a log record provides an indication of the potential effects rainfall may have on the hydrogeological and hydrogeochemical dynamics of the groundwater system. For this assessment the rainfall data for Donnybrook weather station (9534) was utilised. The station had monthly rainfall data for the period between June 1900 and January 2015. The CRM results are presented in Figure 1.

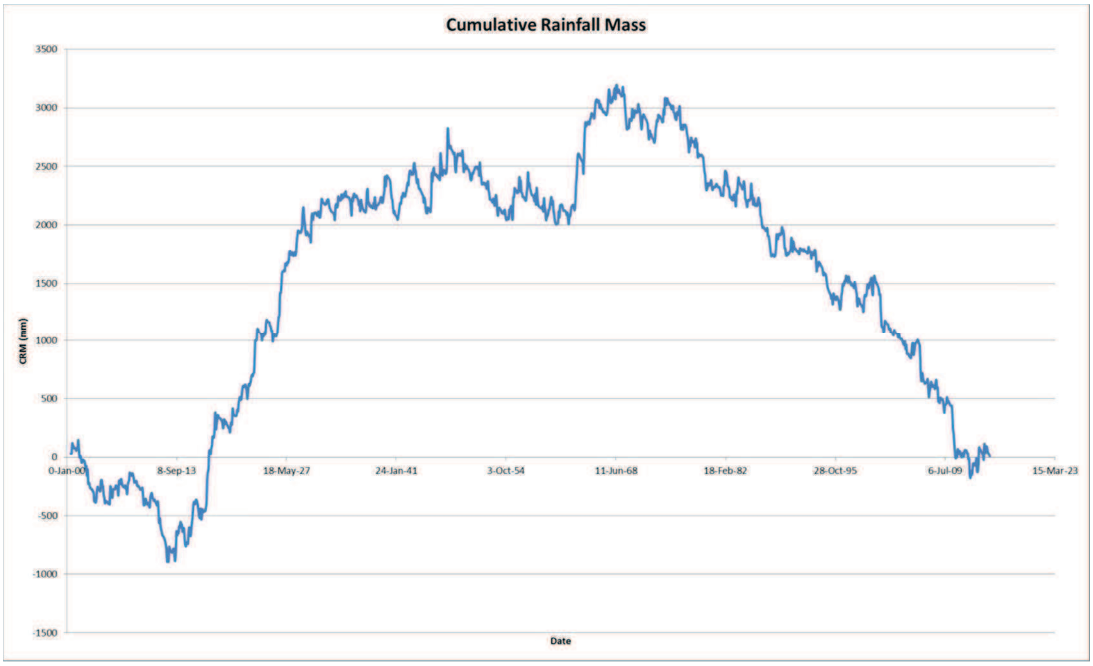


Figure 1: Cumulative Rainfall Mass for Donnybrook Monthly Rainfall Data

The CRM shows a relatively drier period between 1900 and 1914. After 1914 a prolonged wet period occurred, lasting until around 1968. After 1968 a long term dry period followed lasting until the present. When assessing CRM (Figure 2) over the period of groundwater monitoring (1988 to present) the declining trend is also apparent over this period. Unfortunately groundwater level monitoring data was limited to the period of 2010 to 2015.

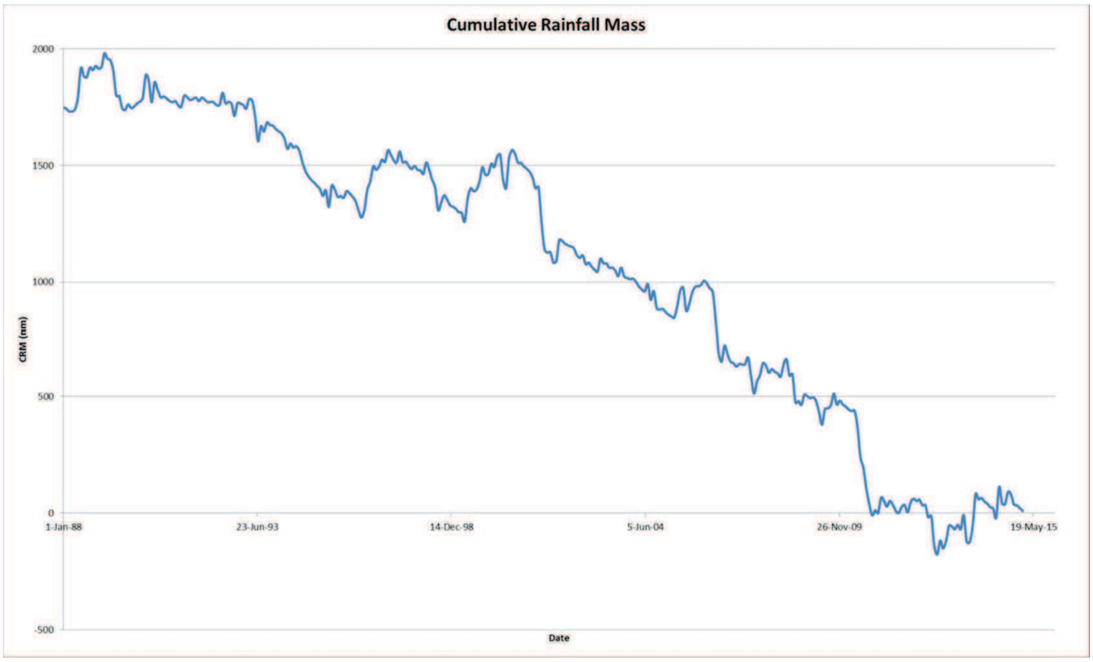


Figure 2: Cumulative Rainfall Mass for Groundwater Level Monitoring Period

Figure 3 shows the relationship between CRM and hydraulic head. Both CRM and hydraulic head appear relatively stable over this period. However, the hydraulic head monitoring frequency is not sufficient to capture any potential short term response to individual rainfall events.

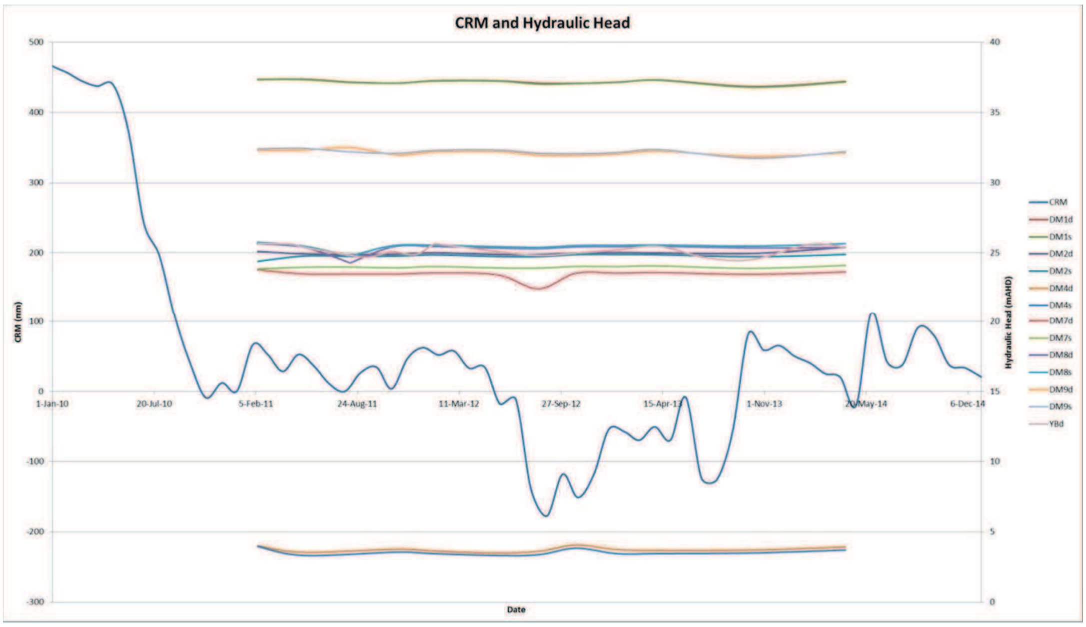


Figure 3: Cumulative Rainfall Mass and Hydraulic Head Response

4.3.3 Major dissolved ion relationships

An assessment of the major cation and anion relationship provides useful information of main geochemical processes that are likely to be active in the groundwater system, due to both natural and anthropogenic influences. To assist in this assessment a series of scatter plots (Figure 4 to Figure 11) was developed.

Sodium and Chloride Relationship

Halite (NaCl) is the most common naturally occurring sodium chloride mineral in coastal sand and limestone groundwater systems. In natural systems where halite is the major source of sodium and chloride mequ/L concentration in solution, the ratio of the two ions is generally near 1:1. Where this ratio is not near 1:1 the cause can be due to:

- Weathering of natural minerals that release additional sodium causing an excess in sodium over chloride; or
- Naturally occurring evaporative systems where other naturally occurring chloride minerals are present, causing an excess of chloride over sodium, although these systems are rare in coastal fringe groundwater systems; or
- Anthropogenic sources of minerals and salts that increase either sodium or chloride preferentially when these enter solution.

Figure 4 shows there is a significant excess of chloride over sodium in the more saline groundwater samples collected on the Site. These samples generally relate to the source zone wells suggesting that the TSR material may be a source of the excess chloride in these samples. These source zone samples have sodium to chloride ratios of almost up to 1:20. Samples from the up-gradient wells and deeper Yarragadee Formation display sodium to chloride ratios close to 1:1, which is more in line with what would be expected under natural flow conditions in the groundwater systems present at the Site.

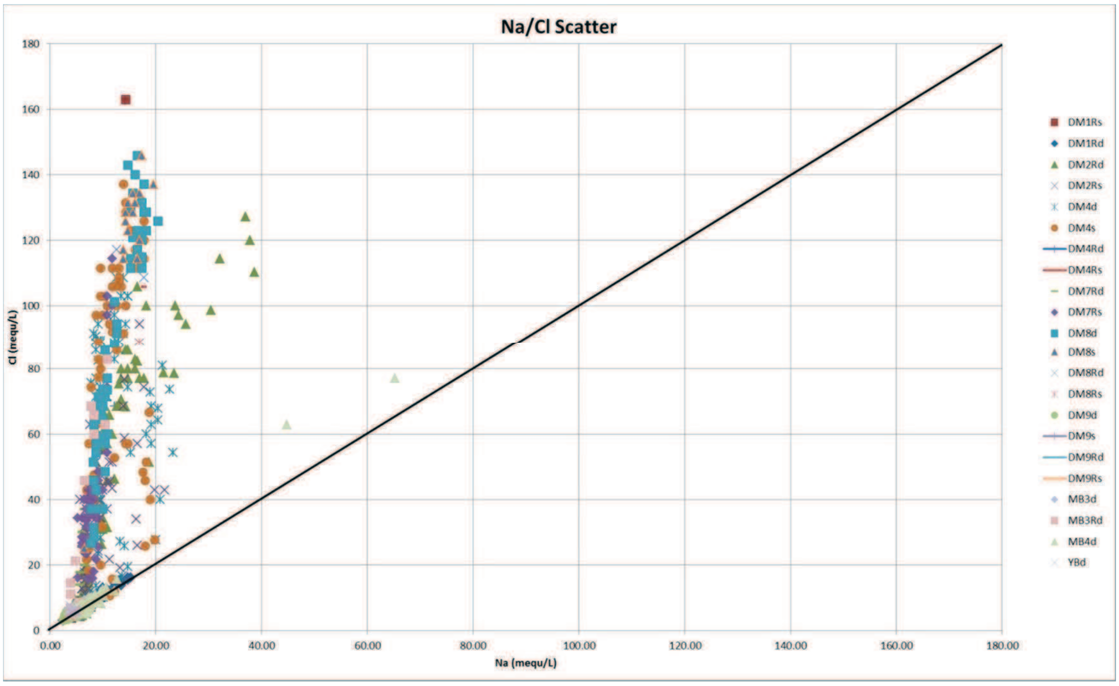


Figure 4: Sodium (Na) vs Chloride (Cl) Scatter Plot (all data) in mequ/L.

Figure 5 shows the changes in sodium to chloride relationship along the flow path from up-gradient (DM9) beneath the source zone (DM7(7R), DM8(8R)) to the down-gradient monitoring location (DM4(4R)). The figure clearly shows the near 1:1 ratio of sodium to chloride in the up-gradient well (DM9). The source zone wells (DM7(7R) and DM8(8R)) clearly show the enrichment in chloride over sodium that occurs over this section of the flow path and is also evident in the down-gradient monitoring location (DM4(4R)). This would suggest that leaching of minerals other than halite from the TSR could be responsible for the observed chloride enrichment.

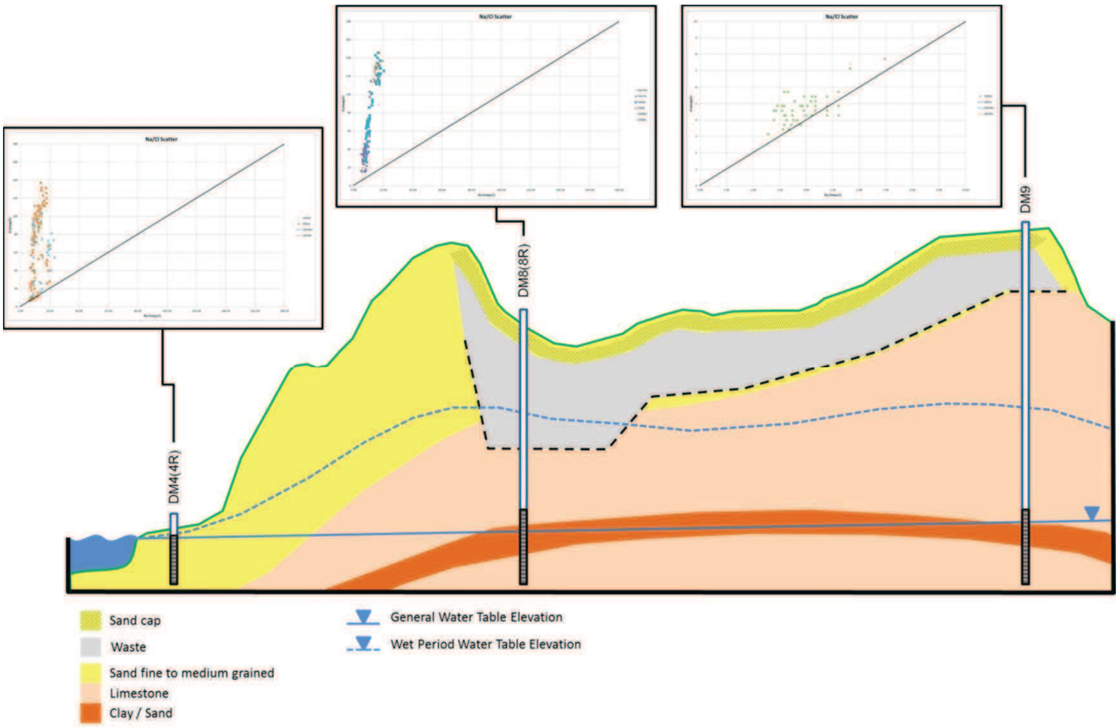


Figure 5: Na vs Cl Scatter Plots (mequ/L) along flow path.

Calcium and Carbonate Relationship

Calcium Carbonate ($CaCO_3$) is the most common naturally occurring mineral in coastal sand and limestone groundwater systems. In natural systems where calcium carbonate is the major source of calcium and bicarbonate mequ/L concentration in solution, the ratio of the two ions is generally near 1:1. Where this ratio is not near 1:1 the cause can be due to:

- Active recharge of CO_2 that can lead to enrichment of bicarbonate over calcium; or
- Naturally occurring evaporative systems where other naturally occurring calcium rich minerals (e.g. Gypsum) are present, causing an excess of calcium over bicarbonate, although these systems are rare in coastal fringe groundwater systems; or
- Anthropogenic sources of minerals and salts that increase either calcium or bicarbonate preferentially when these enter solution.

Figure 6 shows there is a significant excess of calcium over bicarbonate in the more saline groundwater samples collected on the Site. These samples generally relate to the source zone wells suggesting that the TSR material may be a source of the excess calcium in these samples. These source zone samples have calcium to bicarbonate ratios of almost up to 20:1. The TSR is known to contain calcium chloride ($CaCl_2$). Samples from the up-gradient wells and deeper Yarragadee Formation display calcium to bicarbonate ratios close to 1:1, which is more in line with what would be expected under natural flow conditions in the groundwater systems present at the Site.

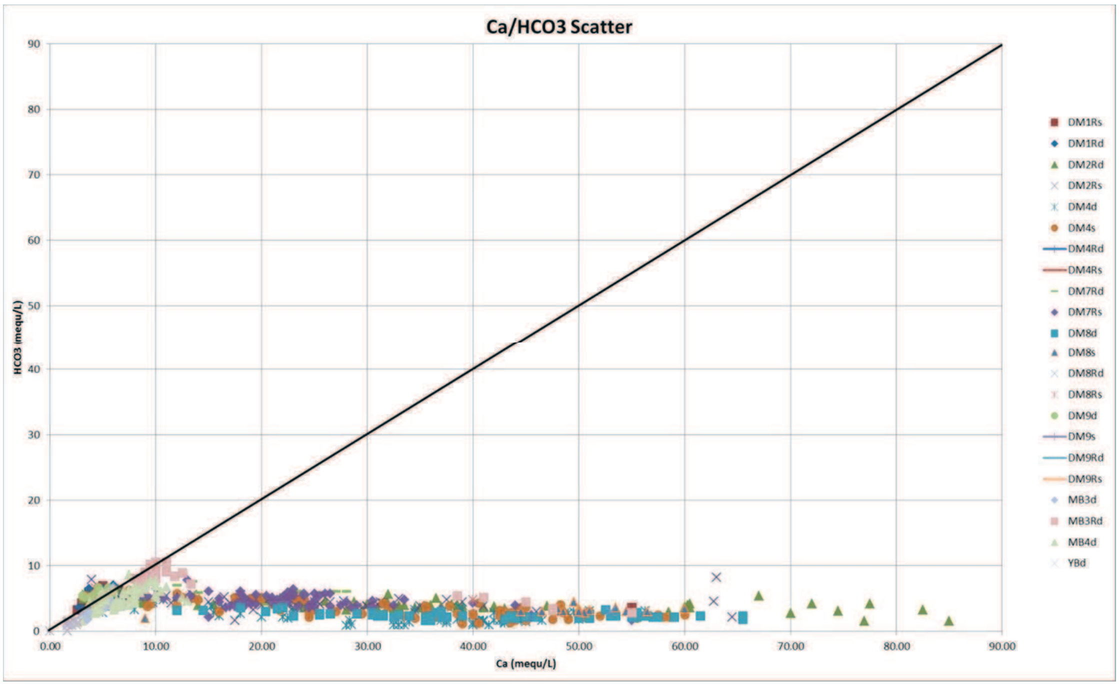


Figure 6: Calcium (Ca) vs Bicarbonate (HCO_3) Scatter Plot (all data) in mequ/L.

Figure 7 shows the changes in calcium to bicarbonate relationship along flow path from up-gradient (DM9) beneath the source zone (DM7(7R), DM8(8R)) to the down-gradient monitoring location (DM4(4R)). The figure clearly shows the near 1:1 ratio of calcium to bicarbonate in the up-gradient well (DM9). The source zone wells (DM7(7R) and DM8(8R)) clearly show the enrichment in calcium over bicarbonate that occurs over this section of the flow path and is also evident in the down-gradient monitoring location (DM4(4R)). This would suggest that natural weathering of calcium carbonate in the limestone is not the dominant source of calcium and that this solute enrichment is more likely to be associated with leaching of a mineral such as Calcium Chloride from the TSR as hydrate lime is the neutralizing agent used to produce TSR.

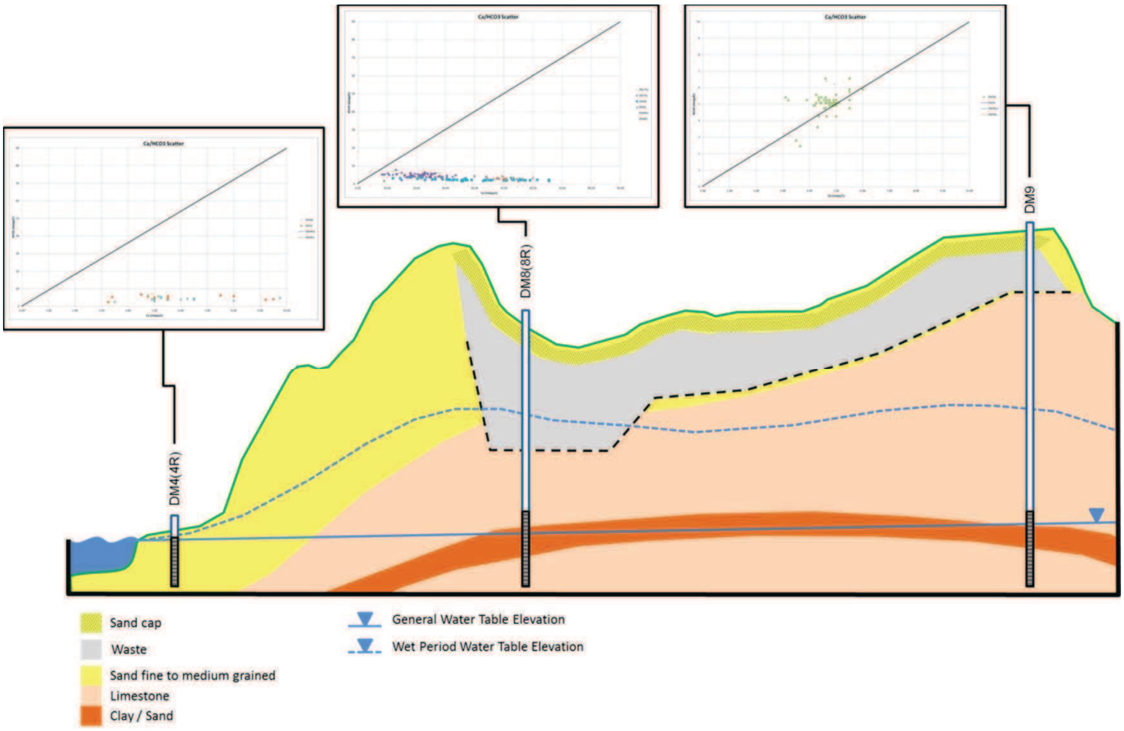


Figure 7: Ca vs HCO_3 Scatter Plots (mequ/L) along flow path.

Sodium and Calcium Relationship

In most coastal sand and limestone groundwater systems there is generally a similar concentration of sodium and calcium in solution, or a slight excess of sodium over calcium. In natural systems where halite and calcium carbonate are the major source of sodium and calcium mequ/L concentration in solution, the ratio of the two ions is generally near 1:1 or in some instances up to 2:1. Where this ratio is not near 1:1 the cause is most likely due to anthropogenic effects associated with leaching of waste materials.

Figure 8 shows there is a significant excess of calcium over sodium in the more saline groundwater samples collected on the Site. These samples generally relate to the source zone wells suggesting that the TSR material may be a source of the excess calcium in these samples. These source zone samples have sodium to calcium ratios of around 1:3. The TSR is known to contain calcium chloride ($CaCl_2$). Samples from the up-gradient wells and deeper Yarragadee Formation display calcium to bicarbonate ratios close to 1:1, which is more in line with what would be expected under natural flow conditions in the groundwater systems present at the Site.

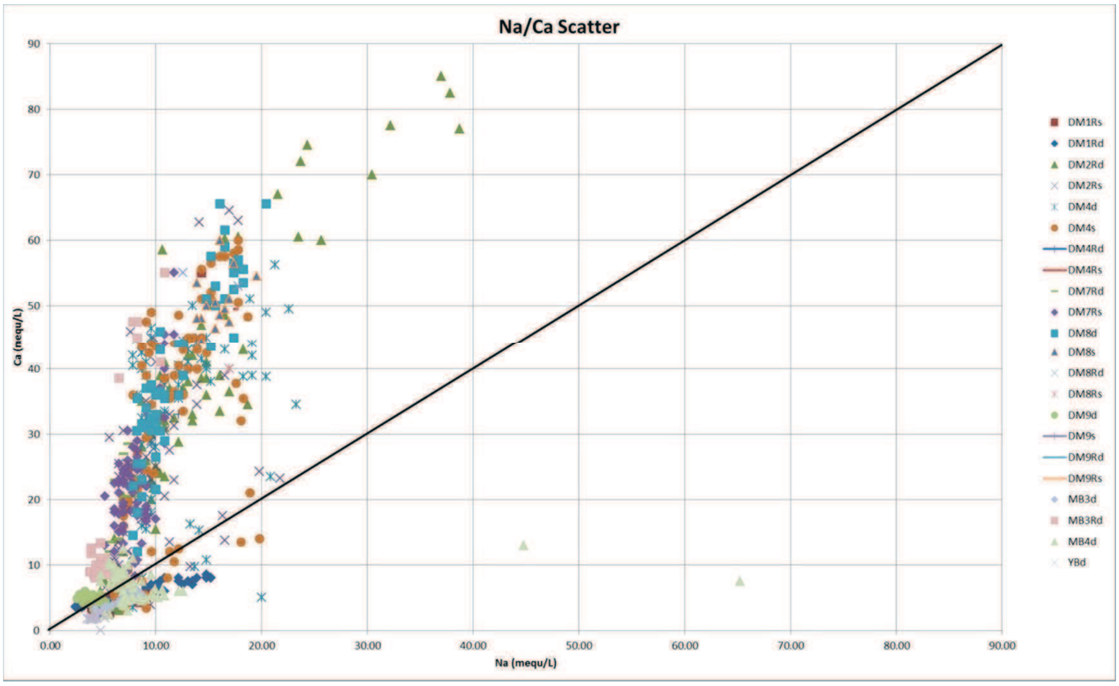


Figure 8: Sodium (Na) vs Calcium (Ca) Scatter Plot (all data) in mequ/L.

Figure 9 shows the changes in sodium to calcium relationship along flow path from up-gradient (DM9) beneath the source zone (DM7(7R), DM8(8R)) to the down-gradient monitoring location (DM4(4R)). The figure clearly shows the near 1:1 ratio of sodium to calcium in the up-gradient well (DM9).

The source zone wells (DM7(7R) and DM8(8R)) clearly show the enrichment in calcium over sodium that occurs over this section of the flow path and is also evident in the down-gradient monitoring location (DM4(4R)). This would suggest that natural weathering of calcium carbonate in the limestone is not the dominant source of calcium and that this solute enrichment is more likely to be associated with leaching of a mineral such as Calcium Chloride from the TSR.

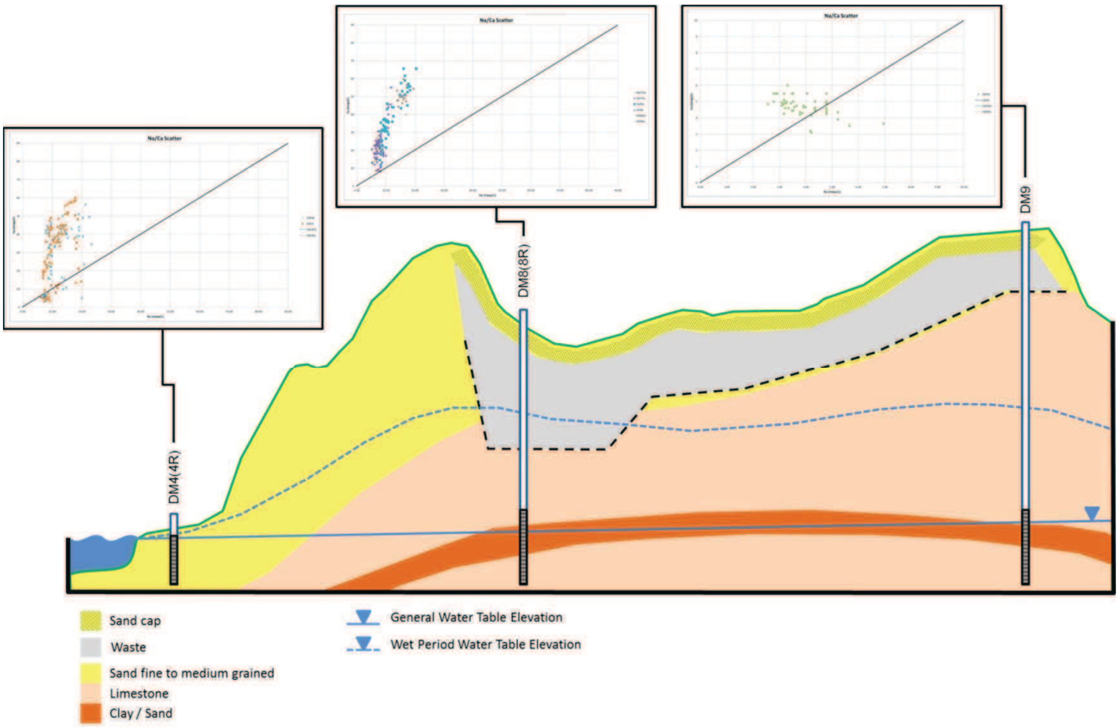


Figure 9: Na vs Ca Scatter Plots (mequ/L) along flow path.

Calcium and Chloride Relationship

Calcium Chloride ($CaCl_2$) is a rare naturally occurring calcium chloride mineral in coastal sand and limestone groundwater systems. In natural systems where halite is present the major source of sodium and chloride mequ/L concentration in solution, the ratio of the two ions is generally near 1:1. Where this ratio is not near 1:1 the cause can be due to:

- Weathering of natural minerals that release additional sodium causing an excess in sodium over chloride; or
- Naturally occurring evaporative systems where other naturally occurring chloride minerals are present, causing an excess of chloride over sodium, although these systems are rare in coastal fringe groundwater systems; or
- Anthropogenic sources of minerals and salts that increase either sodium or chloride preferentially when these enter solution.

Figure 10 shows there is a significant excess of chloride over sodium in the more saline groundwater samples collected on the Site. These samples generally relate to the source zone wells suggesting that the TSR material may be a source of the excess chloride in these samples, with calcium chloride considered the most likely mineral responsible. These source zone samples have sodium to chloride ratios of almost up to 1:20.

Samples from the up-gradient wells and deeper Yarragadee Formation display sodium to chloride ratios close to 1:1, which is more in line with what would be expected under natural flow conditions in the groundwater systems present at the Site.

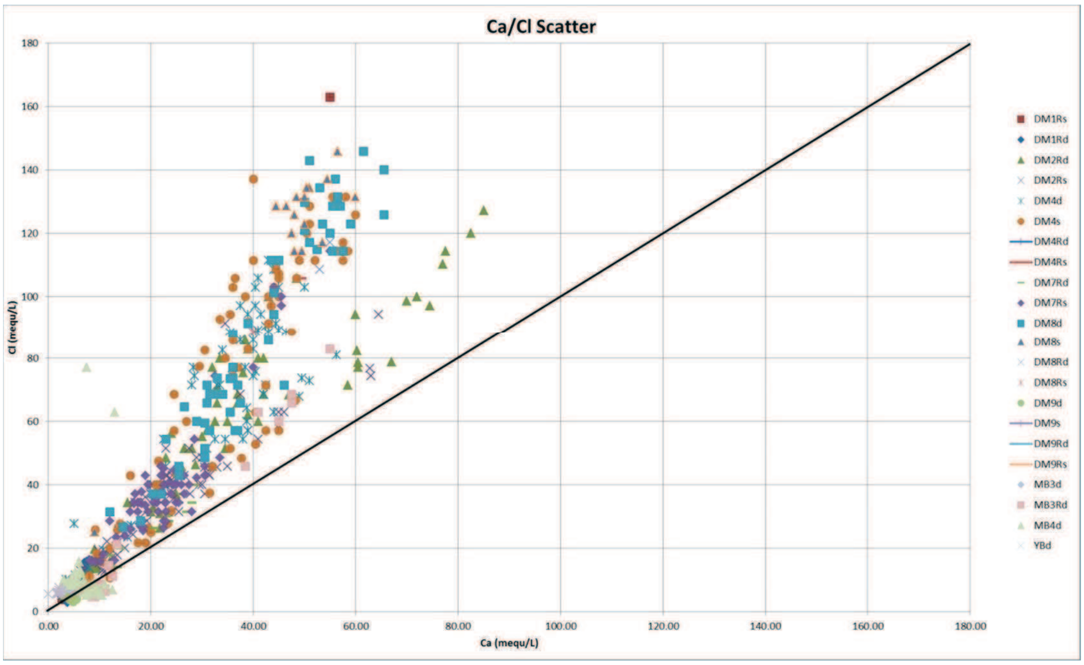


Figure 10: Calcium (Ca) vs Chloride (Cl) Scatter Plot (all data) in mequ/L.

Figure 11 shows the changes in sodium to chloride relationship along flow path from up-gradient (DM9) beneath the source zone (DM7(7R), DM8(8R)) to the down-gradient monitoring location (DM4(4R)). The figure clearly shows the near 1:1 ratio of sodium to chloride in the up-gradient well (DM9). The source zone wells (DM7(7R) and DM8(8R)) clearly show the enrichment in chloride over sodium that occurs over this section of the flow path and is also evident in the down-gradient monitoring location (DM4(4R)). This would suggest that leaching of minerals other than halite from the TSR could be responsible for the observed chloride enrichment.

The major dissolved ion analysis shows that leaching from the TSR appears to influence groundwater hydrogeochemistry and that leaching of minerals contained in the TSR cause a noticeable alteration in the hydrogeochemcial character of the groundwater system as it passes beneath the Site. The most likely mineral responsible for the majority of the observed effect on the major ion composition of the groundwater is Calcium Chloride ($CaCl_2$). The source of this mineral is considered to be anthropogenic and probably associated with the TSR. Calcium chloride can occur in natural evaporative environments as the rare evaporite minerals sinjarite ($CaCl_2$•2(H_2O)) and antarcticite ($CaCl_2$•6(H_2O)). However, these minerals are not considered to be present naturally within the environmental setting of the Site.

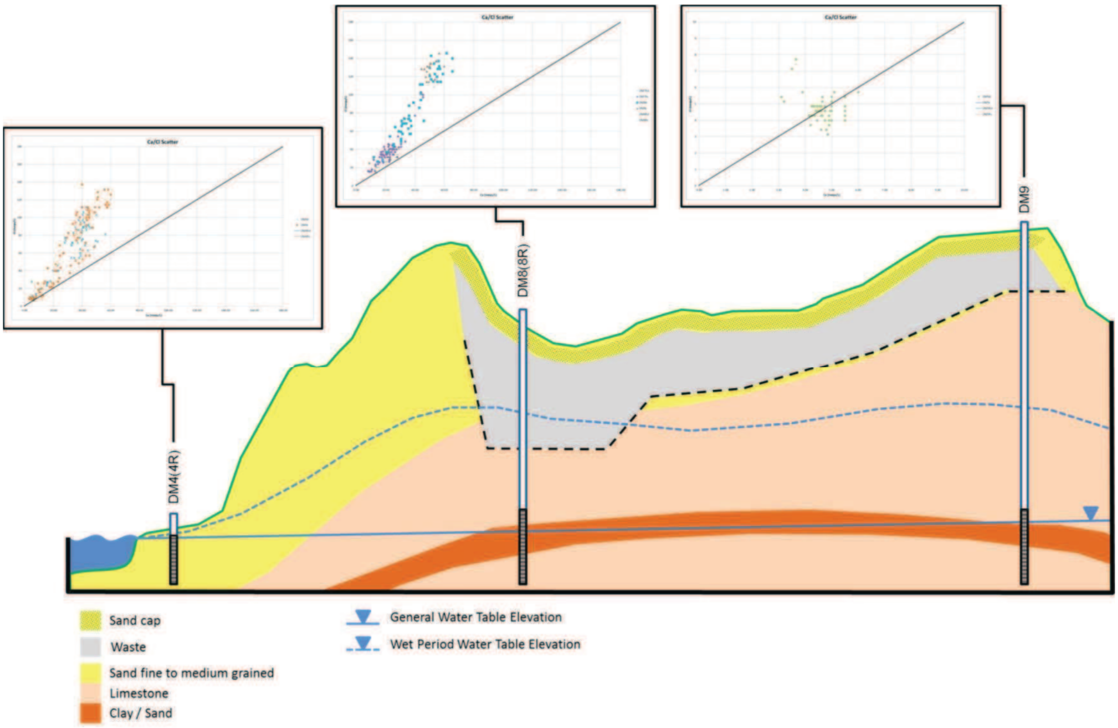


Figure 11: Ca vs Cl Scatter Plots (mequ/L) along flow path.

4.3.4 Major ion hydrogeochemical dynamics

Assessment of the variation in hydrogeochemical conditions over time is another aspect that requires assessment to understand the hydrogeochemcial dynamics of the groundwater system. For this investigation the assessment of hydrogeochemical dynamics focused on salinity and major ion ratio variation, with the results presented in Figure 12: to Figure 21.

Variation in Total Dissolved Solids

The Total Dissolved Solids (TDS) concentration is variable over the monitoring period as shown in Figure 12. The figure also shows an increasing trend in TDS from the early 2000’s to the present in DM2(2R) and DM8(8R). Both of these monitoring wells are located in or very near the source zone.

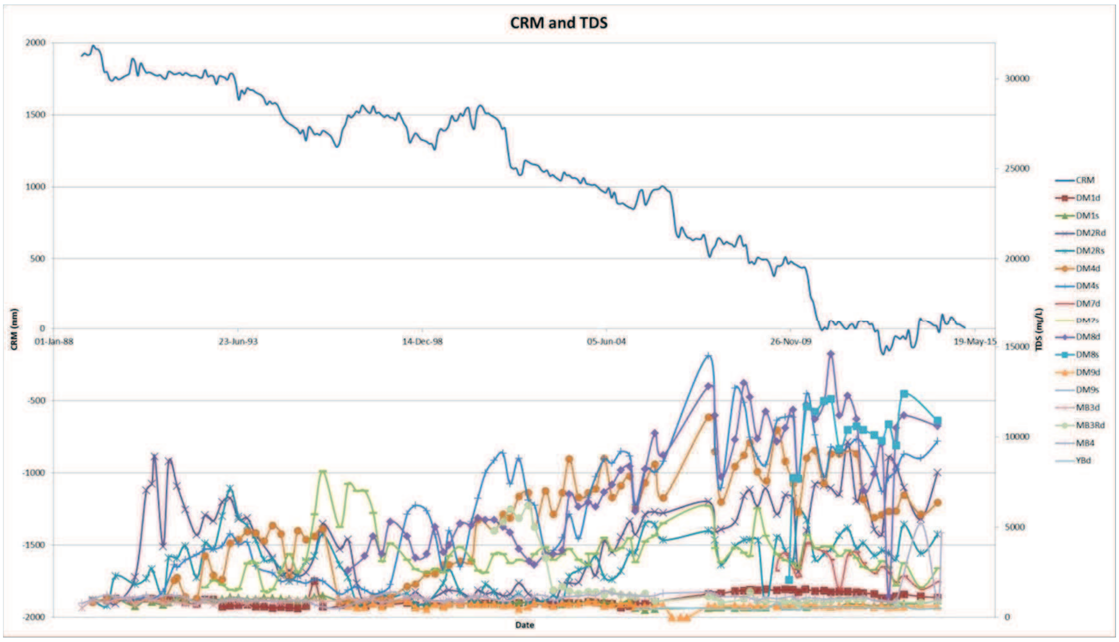


Figure 12: Variation in Total Dissolved Solids (TDS) over monitoring period.

Assessment of TDS trends along flow path as shown in Figure 13 shows relatively stable TDS in the up-gradient location (DM9) while the source zone (DM8(8R)) and down-gradient well (DM4(4R)) show an increasing trend since the early 2000’s. This suggests the TSR is generating saline leachate that is increasing the TDS of the groundwater along the flow path.

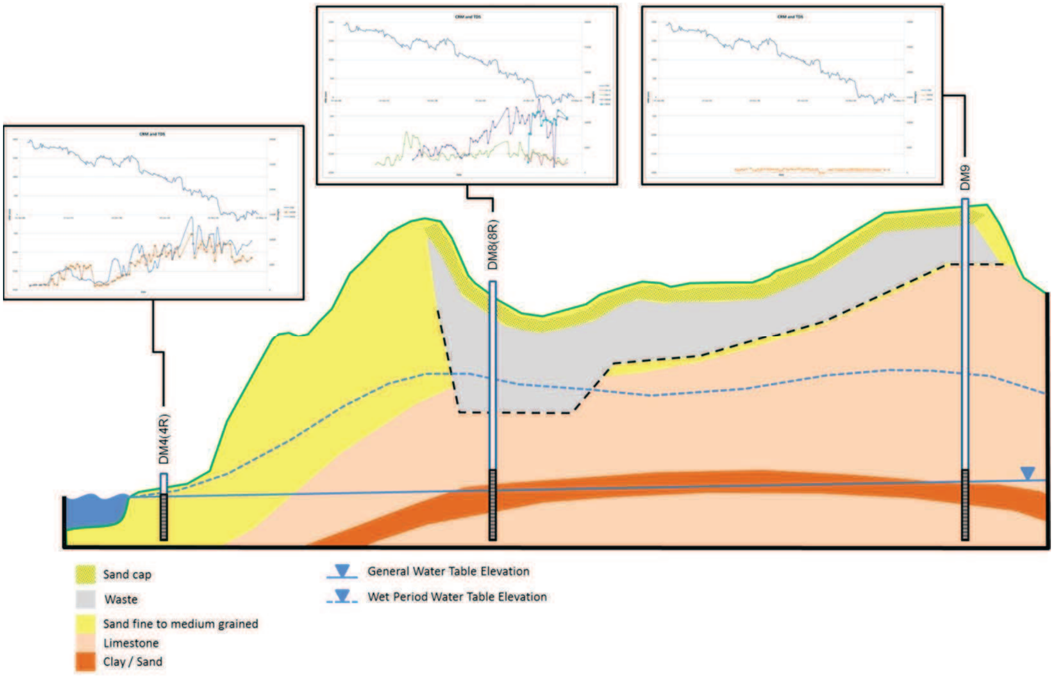


Figure 13: Variation in TDS along flowpath over monitoring period.

Variation in Na/Cl Ratio

The Na/Cl Ratio is variable over the monitoring period as shown in Figure 14. The figure also shows a distinct fluctuation for DM2(2R) and DM8(8R) in Na/Cl Ratio during the late 1980's and early 1990's and again between the mid 1990's and early 2000's. During both periods the Na/Cl Ratio is near 1:1, while over the remainder of the period there is a noticeable excess of Chloride in the samples. Both of these monitoring wells are located in or very near the source zone.

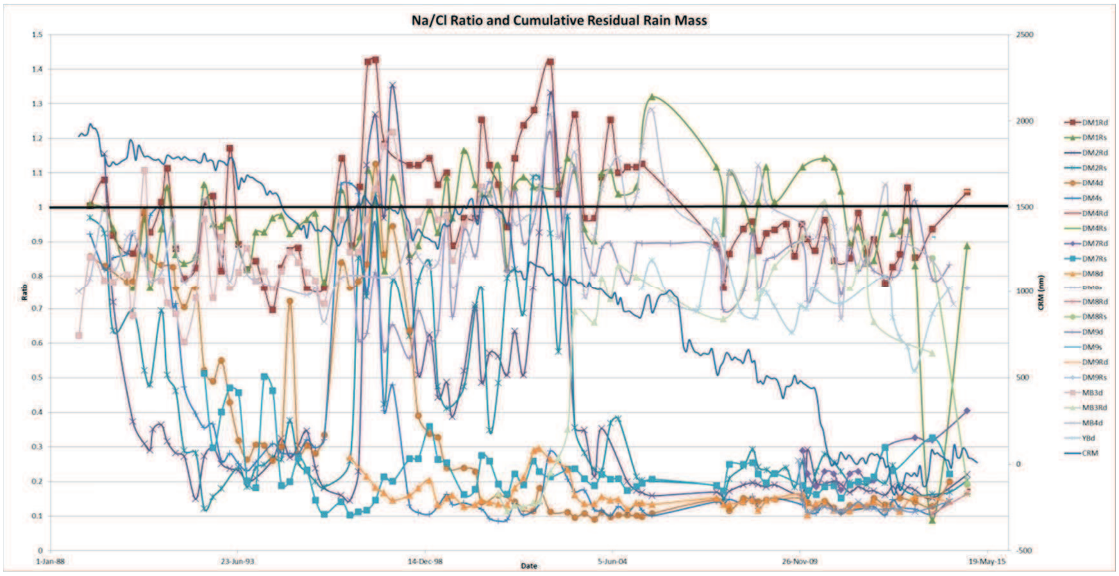


Figure 14: Variation in Na/Cl ratio over monitoring period.

Assessment of Na/Cl Ratio trends along the flow path as shown in Figure 15 shows a Na/Cl Ratio near 1:1 in the up-gradient location (DM9) while the source zone (DM8(8R)) show a Na/Cl Ratio well below 1:1 suggesting enrichment in chloride. The down-gradient well (DM4(4R) has an Na/Cl Ratio of near 1:1 early in the monitoring period and then shows a declining trend suggesting enrichment in chloride during the early 1990's. The Na/Cl Ratio then increases again in the mid 1990's reaching a ratio of near 1:1 in the late 1990's.

In the early 2000's the Na/Cl Ratio declines to well below 1:1 and remains there for the duration of the monitoring period, suggesting noticeable and permanent enrichment in chloride.

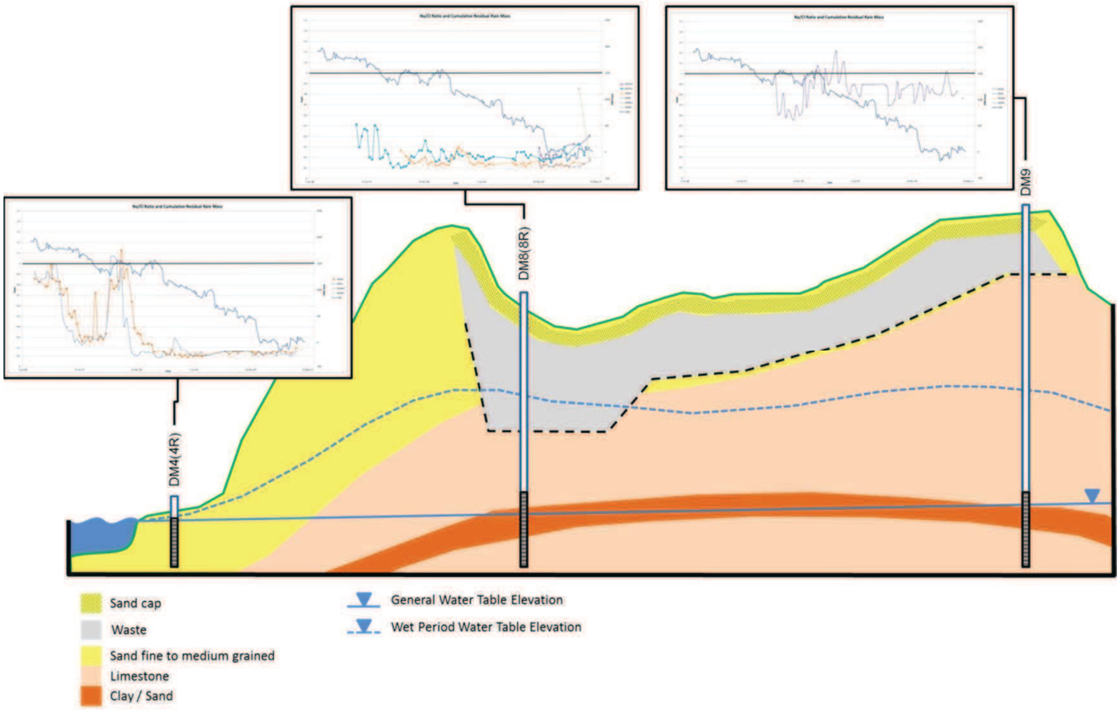


Figure 15: Variation in Na/Cl ratio along flowpath over monitoring period.

Variation in Na/Ca Ratio

The Na/Ca Ratio is variable over the monitoring period as shown in Figure 16. The figure also shows that samples from several monitoring bores, including up-gradient bore (DM9) show Na/Ca ratios of near 1:1 (DM9, MB4d) or enrichment of sodium over calcium (DM1(1R), MB3d and YBd). Monitoring bore MB4d showed an initial Na/Ca ratio of near 2:1 between the late 1980's and late 1990's, after which there appeared to be a steady decline in Na/Ca ratio until the mid-2000's when the ratio stabilised at a ratio of just below 1:1. This suggests gradual enrichment in calcium and a new equilibrium in hydrogeochemcial conditions.

Also apparent on Figure 16 is that the Na/Ca ratio in the source zone wells (DM2(2R) and DM8(8R)) is well below 1:1, suggesting enrichment in calcium over the majority of the monitoring period.

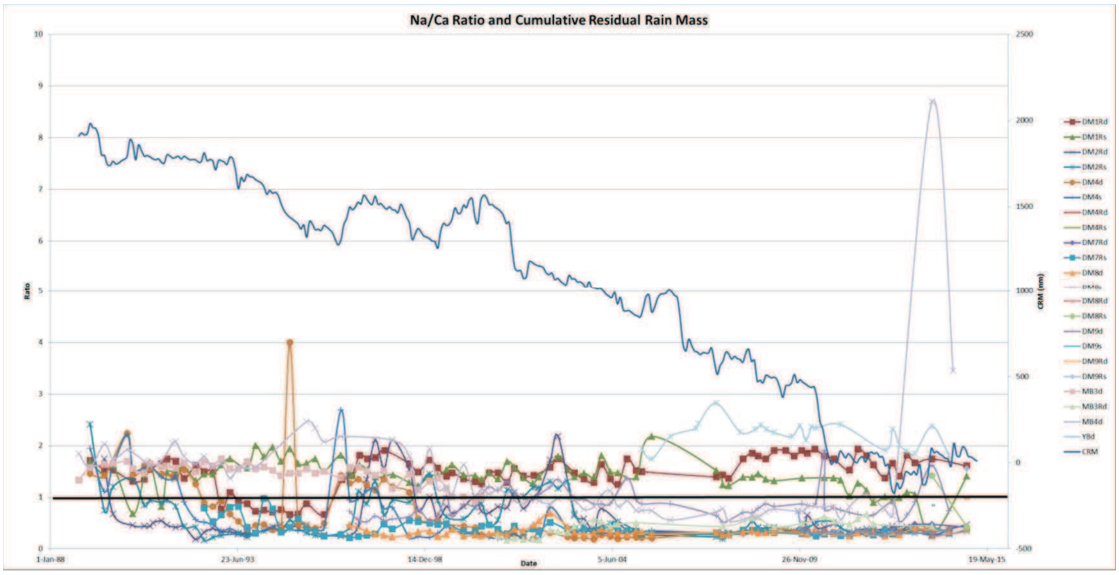


Figure 16: Variation in Na/Ca ratio over monitoring period.

Assessment of Na/Ca Ratio trends along flow path as shown in Figure 17 shows a Na/Ca Ratio near 1:1 in the up-gradient location (DM9) while the source zone (DM8(8R)) show a Na/Cl Ratio well below 1:1suggesting enrichment in calcium. The down-gradient well (DM4(4R) has a Na/Ca Ratio of near or above 1:1 early in the monitoring period and then shows a declining trend suggesting enrichment in calcium in the early 1990,s. The Na/Ca Ratio the increase again in the mid 1990’s reaching a ratio of near 1:1 in the late 1990’s. After this time the Na/Ca Ratio declines to well below 1:1 and remains there for the duration of the monitoring period, suggesting noticeable and permanent enrichment in calcium.

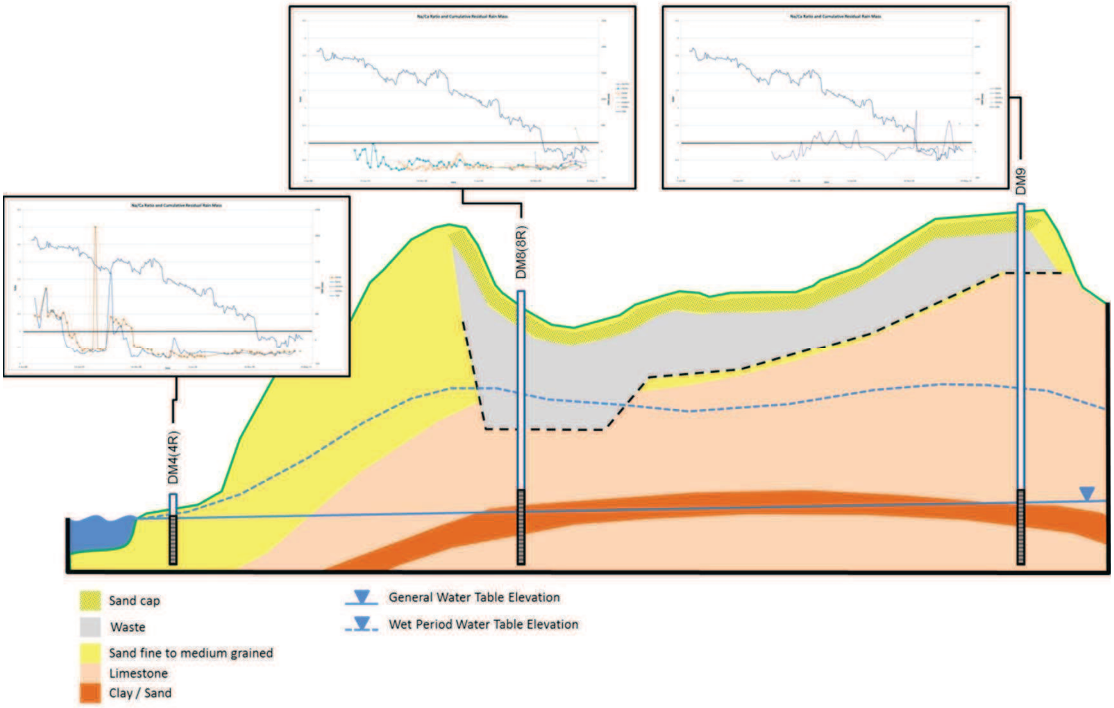


Figure 17: Variation in Na/Ca ratio along flowpath over monitoring period.

Variation in Ca/Cl Ratio

The Ca/Cl Ratio is variable over the monitoring period as shown in Figure 18. The figure also shows a general excess of chloride over calcium in samples collected in the late 1980's and throughout the 1990's. However in the early 2000's some wells show an increasing enrichment in calcium (MB3 and MB4). Monitoring well DM9 indicates fluctuating Ca/Cl ratios over the monitoring period with fluctuation generally around the 1:1 ratio. Monitoring well YBd has the lowest Ca/Cl ratio, suggesting significant enrichment of chloride over calcium.

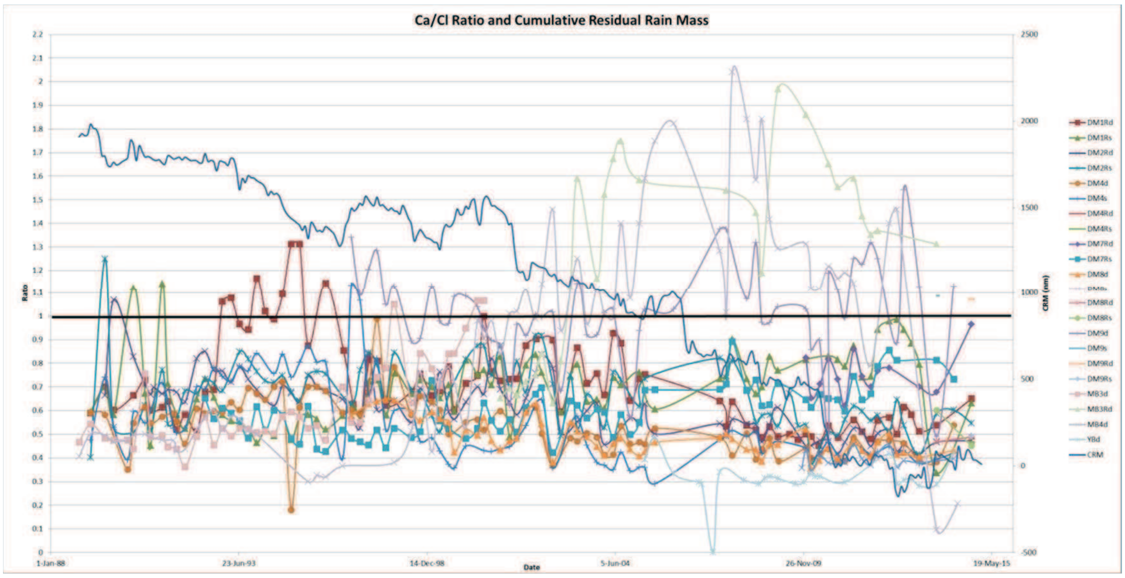


Figure 18: Variation in Ca/Cl ratio over monitoring period.

Assessment of Ca/Cl Ratio trends along the flow path as shown in Figure 19 shows a Ca/Cl Ratio fluctuating around the 1:1 ratio in the up-gradient location (DM9) while the source zone (DM8(8R)) show a Ca/Cl Ratio well below 1:1 suggesting enrichment in chloride. The down-gradient well (DM4(4R) shows an initial increase in Ca/Cl Ratio to near 1:1 early in the monitoring period and then shows a declining trend suggesting enrichment in chloride after the late 1990's.

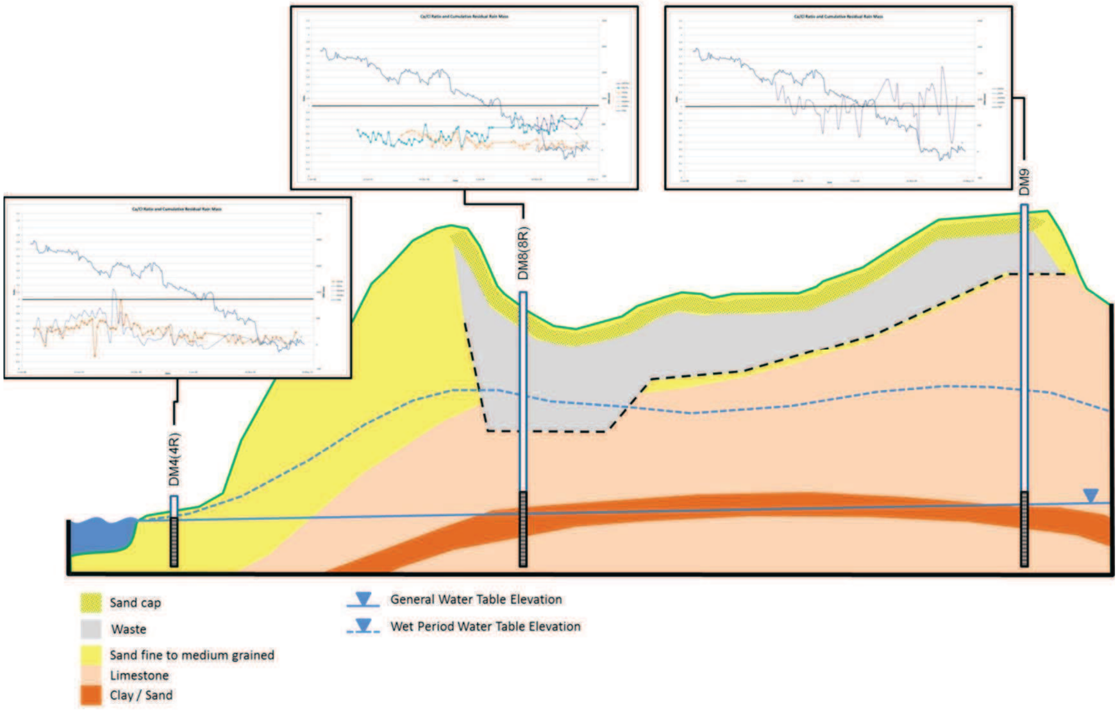


Figure 19: Variation in Ca/Cl ratio along flowpath over monitoring period.

Variation in Hydrogeochemical Character

To assess the overall variability in hydrogeochemical character along the flow path, piper plots were prepared and are shown in Figure 20. The up-gradient groundwater hydrogeochemical character (DM9) shows limited variability and is generally consistent with fresh water characteristics with a Calcium and Bicarbonate signature. The source zone well (DM8(8R)) also shows a relatively consistent character dominated by Calcium and Chloride signature. The down-gradient well (DM4(4R)) shows a more variable character that appears to vary between the calcium and chloride signature of the source and a mixing between the up-gradient calcium bicarbonate and seawater sodium chloride signatures. This suggests that the hydrogeochemical character at the down-gradient well (DM4(4R)) is influenced by mixing of fresh groundwater discharge, impacted by leachate from the TSR and seawater interface, which would be anticipated given the position of the well near the beach.

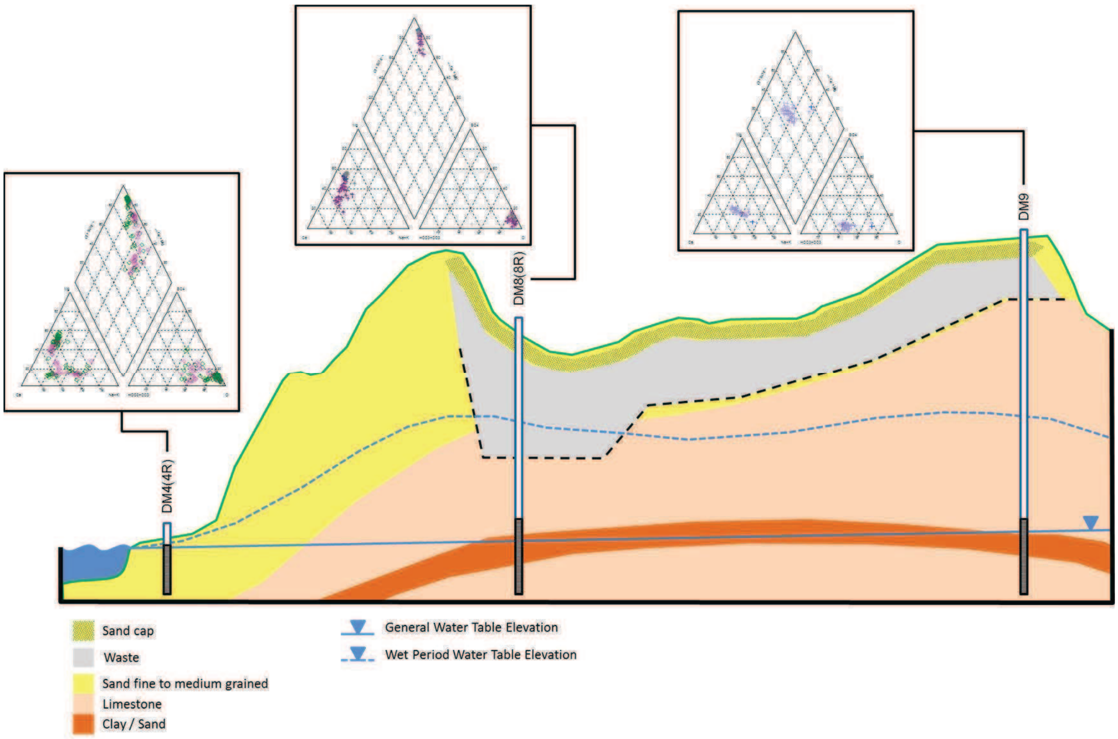


Figure 20: Piper Plots along flow path showing variability in geochemical character.

Figure 21 shows the piper plots for each well in the monitoring network. The wells located away from (MB3, MB4 YBd) or up-gradient (DM1(1R) and DM9(9R)) of the TSR show relatively stable hydrogeochemical character, that is consistent with freshwater or seawater and freshwater mixing. The wells located down-gradient (DM2(2R), DM4(4R) and DM8(8R)) of the TSR show a different character and for DM2(2R) and DM4(4R) a variable character that suggests mixing between fresher up-gradient water, leachate (DM2(2R)) and possibly mixed leachate, fresher up-gradient water and seawater (DM4(4R)).

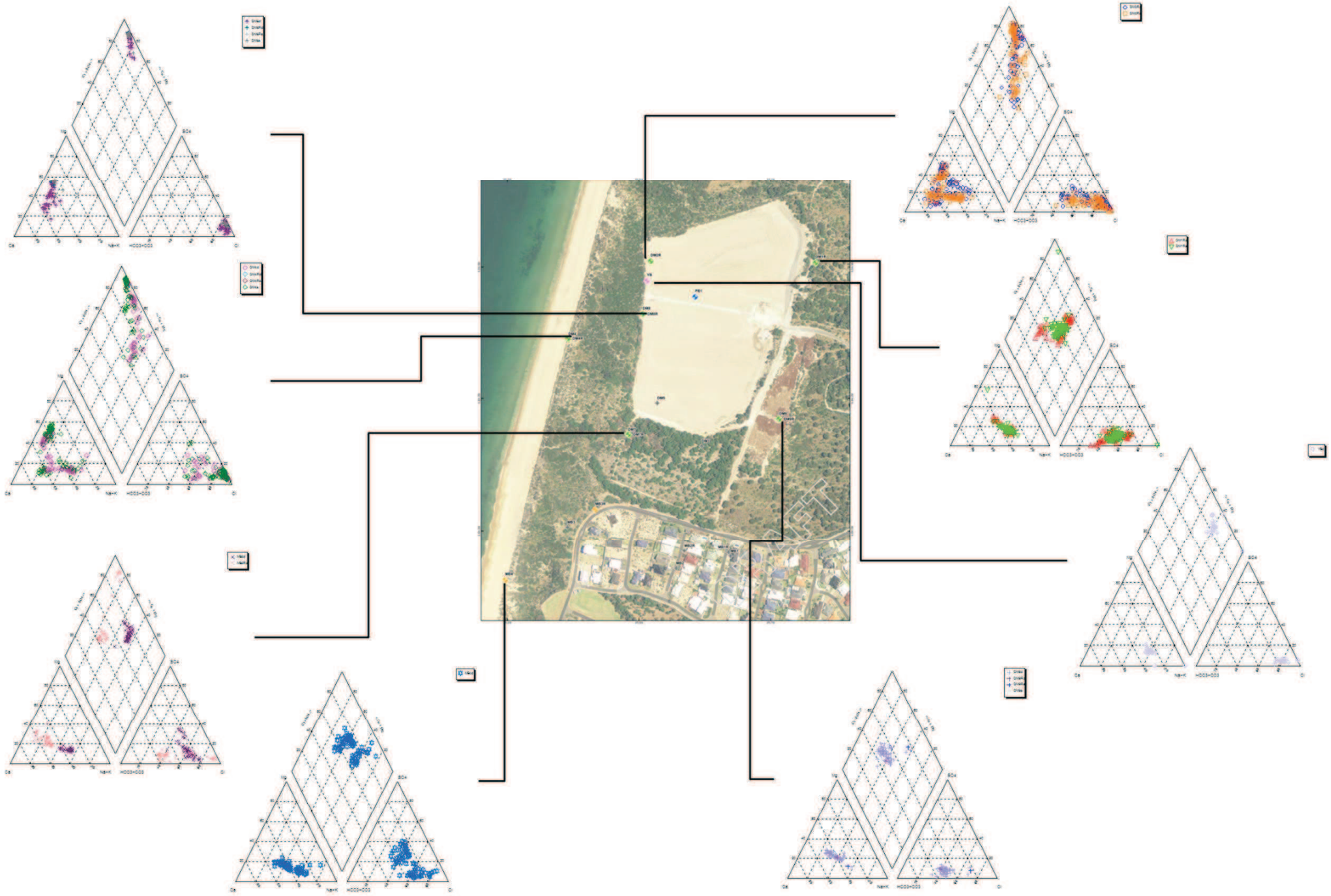


Figure 21: Piper plots for monitoring well network

4.3.5 Trace metal hydrogeochemistry

The monitoring program identified a number of trace metal concentrations in samples from across the monitoring network as outlined in Table 5. Of these trace metals, previous investigations concluded that due to their occurrence in up-gradient wells and wells away from the TSR the following trace metals are likely to be due to natural background conditions encountered at the time of sampling:

- Lead was measured above the adopted criteria in up-gradient, cross gradient and deeper aquifer;
- Cobalt was measured above the adopted criteria in up-gradient, cross gradient and deeper aquifer;
- Copper was measured above the adopted criteria in up-gradient, cross gradient and deeper aquifer;
- Zinc was measured above the adopted criteria in up-gradient, cross gradient and deeper aquifer.

Chromium and Vanadium were the only two trace metals that appear to be linked to the TSR as their concentration shows an increase between the up and down-gradient wells. Chromium occurs in two common oxidation states in groundwater systems.

Trivalent chromium generally dominates under acidic conditions unless highly oxidising conditions prevail. This redox species of chromium generally has low toxicity and low mobility under more neutral pH and oxidation potentials of most groundwater systems. Hexavalent chromium generally dominates in groundwater systems under alkaline conditions under moderate to high oxidation potentials. This redox species of chromium is toxic and highly mobile as an anion under alkaline pH and moderate oxidation potential.

Vanadium can occur in three oxidation states in groundwater systems (V3+, V4+ and V5+). In the presence of ferrous iron, vanadium is generally removed from solution as ferrous vanadate. In solution, vanadium can form numerous oxides and hydroxides, with majority in anion form.

Therefore mobility of hexavalent chromium and vanadium is dependent on anionic sorption processes and hence would preferentially portion onto sorption sites with preference for anion species. At the prevailing groundwater pH (~6 to ~8) the main anion attracting sites would be ferric hydroxide minerals. Therefore the mobility of chromium and vanadium would be dependent on the behaviour of iron on the groundwater system. Iron sorption and solubility are dependent on redox conditions and pH. The reduced species of iron (ferrous) has a significantly higher solubility than the oxidised ferric form and most iron oxide an hydroxide species have a preference for anion attracting at acidic to neutral pH. To assess the potential relationship between pH, Eh, and iron to the measured concentrations of chromium and vanadium a brief assessment of iron mobility was undertaken.

Figure 22 shows that iron concentration is dependent on Eh with the highest concentrations occurring under slightly reducing conditions between about -250mV and 100mV. Iron is present in the ferrous form in the range and not removed from solution as a sulphide mineral which would occur under more reducing conditions. At Eh above 100mV ferrous iron is generally oxidised to the ferric state and removed from solution as oxide and hydroxide precipitates.

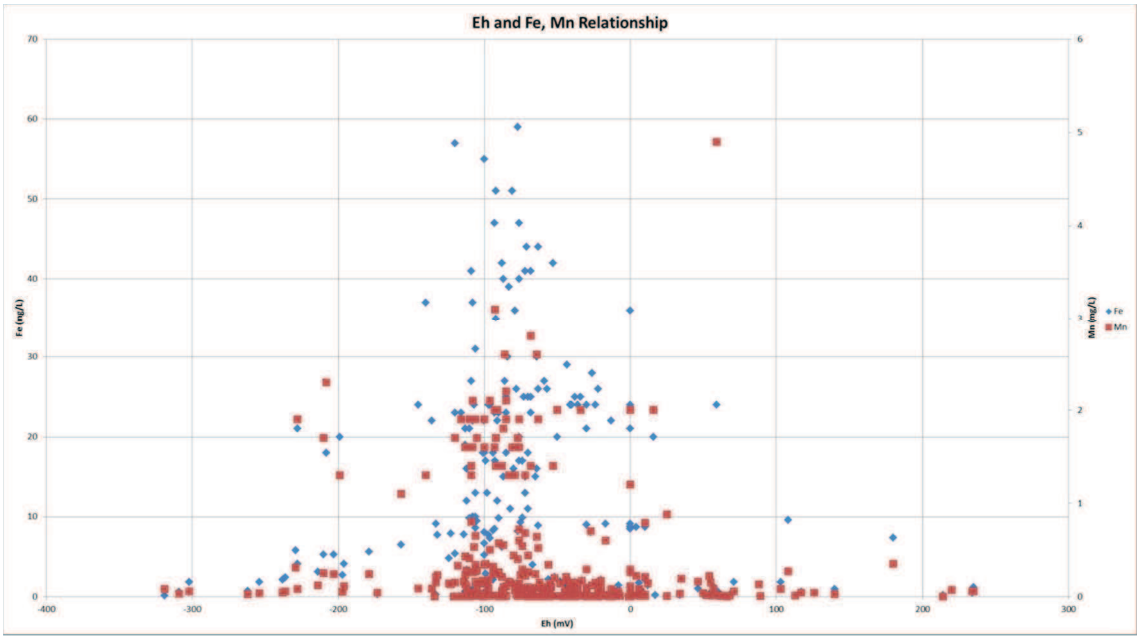


Figure 22: Relationship between Eh and iron and manganese concentration.

Figure 23 and Figure 24 show the concentrations of chromium and vanadium under the measured Eh and pH conditions. As shown on the figures, chromium and vanadium concentrations appear higher at Eh around 50mV and under slightly acidic to neutral pH.

These observations suggest that dissolution of iron species is not a likely release mechanism for the observed chromium and vanadium concentrations. It appears that pH is the main driver for chromium and vanadium mobility with acidic pH causing reduction of the two metals and attenuation as oxide and hydroxide precipitates and sorption and attenuation on aluminium and iron oxide and hydroxide surfaces at neutral pH. This would suggest that mobility of the two metals is limited to a relatively narrow pH range. Given the observed fluctuation in pH over the monitoring period and the observed continual leaching from the TSR, it would be anticipated that chromium and vanadium have limited mobility and are generally attenuated at more acidic pH as oxide and hydroxide precipitates or sorbed at neutral pH. The transport velocity of these metals is therefore likely to be very slow and pulsed in nature with mobility limited to a narrow window of pH.

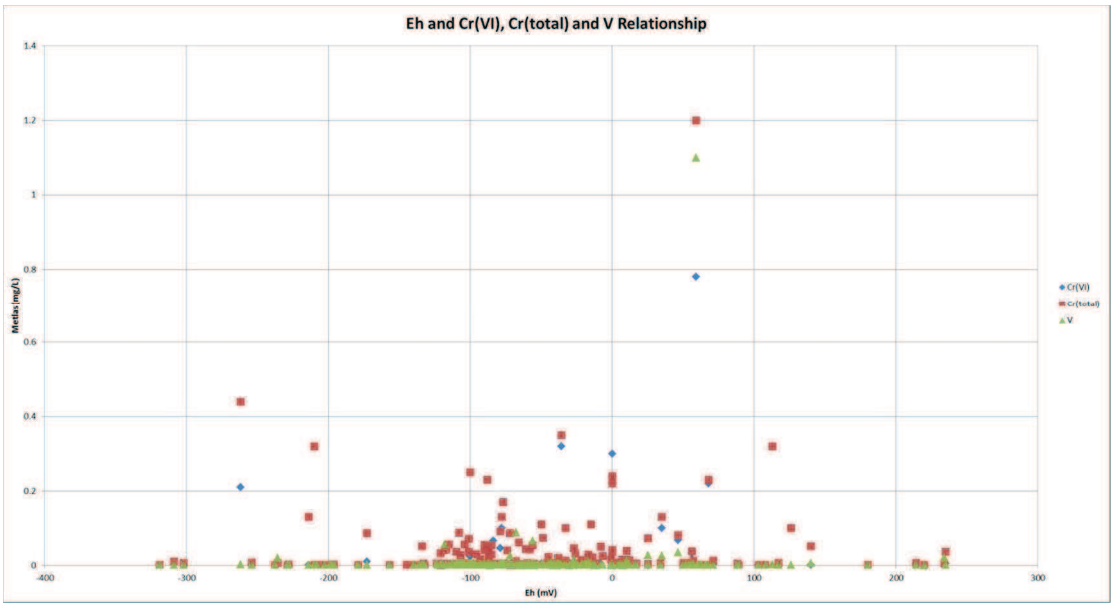


Figure 23: Relationship between Eh and chromium and vanadium.

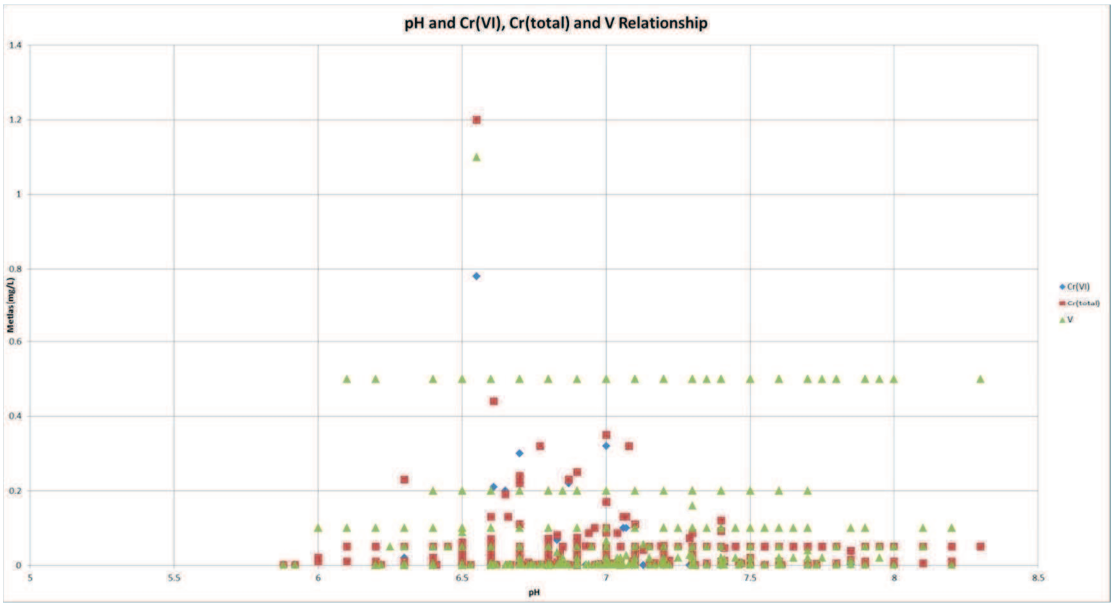


Figure 24: Relationship between pH and chromium and vanadium

5. Groundwater flow

Groundwater flow direction was calculated for the Superficial Aquifer using groundwater level data obtained during Autumn (April and May) and Spring (October) monitoring rounds between 2012 and 2014. Data from eight monitoring bores was used to calculate groundwater flow.

Figure 33 (Appendix A) presents groundwater contours across the Site for Autumn. Groundwater flows in a westerly direction towards the Indian Ocean. The most eastern monitoring bore (DM1R) reported a groundwater level of approx. 2.5 m AHD. A downward gradient was observed across the Site to 0.8 m AHD at the most western on-Site monitoring bore (DM8R).

Figure 34 (Appendix A) presents groundwater contours across the Site for Spring. Groundwater flows in a westerly direction towards the Indian Ocean, from 2.3 m AHD on the eastern site boundary to 1 m AHD on the western site boundary. Mounding is present around monitoring bore DM8R which may be due to more rapid surface water infiltration into virgin dune sands, rather than through the capped TSR, which is more ‘clay like’ and therefore less permeable than sand.

ERM (2012) estimate an average linear groundwater flow velocity that would allow water from the TSR to reach the ocean and commence discharge within about 5 years of mass loading to the groundwater commencing. This assessment and additional data analysis considers that this estimate appears reasonable. Given the age of the TSR water impacted by saline mass loading since operations commenced would have reached the ocean already and been discharging for some time.

6. Conceptual site model

6.1 Contamination nature and extent

The following section presents an assessment of the nature and extent of contamination at the Site including off-Site effects, assessment of the chemical degradation, possible exposure routes and exposed populations and the sensitivity of the receiving environment.

Soil impact occurs across the majority of the Site, particularly where TSR was buried over the last 28 years. The route of exposure to the TSR no longer exists due to Site remediation including capping the TSR with at least 2 metres of clean sand.

However, the TSR is impacting the underlying groundwater by way of leachate. Leachate has been reported in a number of groundwater monitoring wells located down-gradient of the TSR zone as well as in on-shore bores.

6.2 Possible exposure routes and exposed populations

Populations at greatest risk to exposure of TSR leachate contamination is the near-shore marine environment. However, the Oceanica (2011) study concluded that groundwater discharge adjacent to the Site poses negligible risk to the marine environment and has a negligible impact on recreational use of the beach and water adjacent to the Site.

The receiving environment’s sensitivity to TSR leachate is considered negligible.

6.3 Hydrogeochemical conceptualisation

Based on the hydrogeochemical analysis undertaken and documented in Section 4.3 a conceptual model for the key groundwater hydrogeochemical characteristics was developed and is documented in Figure 25. The model clearly notes the presence of a range of potential minerals in the TSR and the natural soils that could act as a source of the dissolved ion measured in the groundwater samples collected over the monitoring period. The assessment found that the minerals present in the TSR are generating leachate (red arrows) that affects the natural groundwater chemistry (green arrows) and the effects are identified in the down-gradient wells near the groundwater discharge point into the Indian Ocean.

While the saline leachate can be clearly identified, the mobility of the key trace metals of concern (chromium and vanadium) is more complex with their mobility dependent mainly on pH. The fluctuating pH in the groundwater system would limit mobility of these metals and thus any discharge to the Indian Ocean would be occasional with average discharge concentrations likely to be well below the adopted criteria.

Based on the available information, particularly the major ion data the TSR is clearly generating saline leachate with a distinct calcium chloride signature, creating a plume that migrates to the Indian Ocean. The evidence suggest that the plume reached the Indian Ocean in the early 1990’s and has been discharging since on a more or less continuous basis. It is considered likely that the plume is a similar width to the TSR facility and may extent from just up-gradient of the TSR to the Indian Ocean. While the data suggests that the saline plume (comprised of major cations and anions with calcium chloride dominance) has reached the Indian Ocean and is discharging to the Indian Ocean, there is limited evidence that suggests the plume is causing continual discharge of chromium and vanadium. It appears these heavy metals have limited mobility and are attenuated in the groundwater system, primarily by sorption and precipitation. There is no clear trend in discharge concentrations of chromium and vanadium, with concentrations showing a spiked pattern that suggests desorption and resorption.

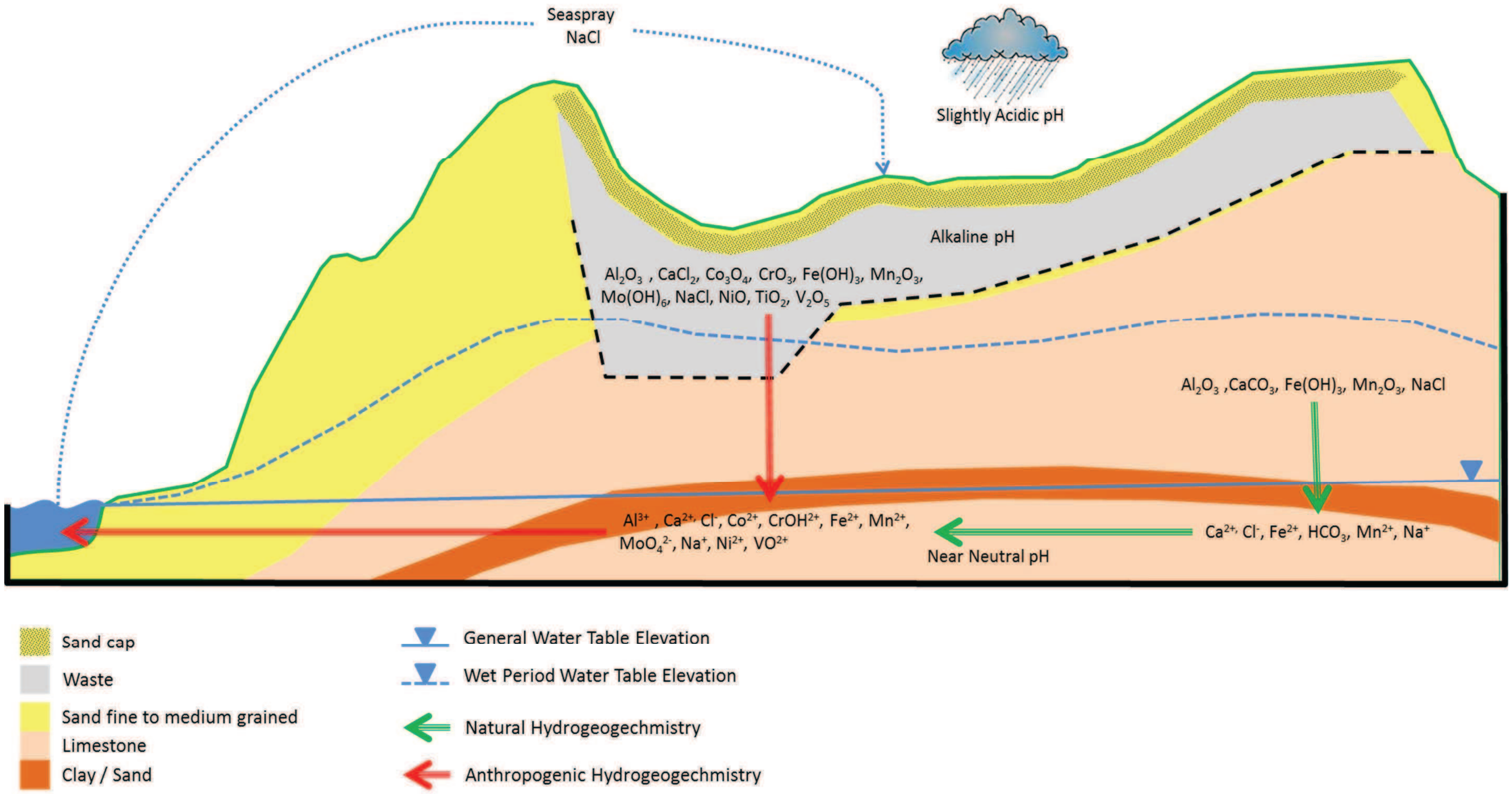


Figure 25: Graphical representation of hydrogeochemical conceptualisation.

7. Tier 1 risk assessment

This section considers the significance of analytes reported in excess of the adopted screening criteria outlined in Section 4.2.1, representing a potential risk to receptors. It takes into consideration the CSM presented in Section 5, which identifies the source-pathway-receptor linkages that potentially exist at the Site.

Source	Pathways	Receptors	Hazard	Likelihood	Risk
TSR	Vertical migration through strata	Marine environment.	Uptake of contaminants by marine biota.	Low	Low
		Groundwater users.	Damage to production bore infrastructure by calcium deposits.	High	High
			Reducing quality of deep aquifer water for domestic non-potable purposes.	Low	Low

The monitoring program identified a number of trace metal concentrations in samples from across the monitoring network exceeding the adopted Marine Water Criteria. Of these trace metals, previous investigations concluded that due to their occurrence in up-gradient wells and wells away from the TSR the following trace metals are likely to be due to natural background conditions encountered at the time of sampling:

- Lead was measured above the adopted criteria in up-gradient, cross gradient and deeper aquifer;
- Cobalt was measured above the adopted criteria in up-gradient, cross gradient and deeper aquifer;
- Copper was measured above the adopted criteria in up-gradient, cross gradient and deeper aquifer;
- Zinc was measured above the adopted criteria in up-gradient, cross gradient and deeper aquifer.

Chromium and Vanadium were the only two trace metals that appear to be linked to the TSR as their concentration shows an increase between the up and down-gradient wells.

Therefore mobility of hexavalent chromium and vanadium is dependent on anionic sorption processes and hence would preferentially portion onto sorption sites with preference for anion species. At the prevailing groundwater pH (~6 to ~8) the main anion attracting sites would be ferric hydroxide minerals. Therefore the mobility of chromium and vanadium would be dependent on the behaviour of iron on the groundwater system. Iron sorption and solubility are dependent on redox conditions and pH. The reduced species of iron (ferrous) has a significantly higher solubility than the oxidised ferric form and most iron oxide and hydroxide species have a preference for anion attracting at acidic to neutral pH. To assess the potential relationship between pH, Eh, and iron to the measured concentrations of chromium and vanadium a brief assessment of iron mobility was undertaken outlined in Section 4.3.5.

These observations suggest that dissolution of iron species is not a likely release mechanism for the observed chromium and vanadium concentrations. It appears that pH is the main driver for chromium and vanadium mobility with acidic pH causing reduction of the two metals and attenuation as oxide and hydroxide precipitates and sorption and attenuation on aluminium and iron oxide and hydroxide surfaces at neutral pH. This implies that mobility of the two metals is limited to a relatively narrow pH range. Given the observed fluctuation in pH over the monitoring period and the observed continual leaching from the TSR, it would be anticipated that chromium and vanadium have limited mobility and are generally attenuated at more acidic pH as oxide and hydroxide precipitates or sorbed at neutral pH.

Therefore the key study questions were addressed by a more in depth hydrogeochemical assessment without the need for the proposed modelling, particularly as there was clear evidence that the plume had already reached the ocean and was discharging. The hydrogeochemical assessment also identified very limited potential mobility of the chromium and vanadium. The assessment clearly identified that Cr and V anion species would be attenuated by sorption and precipitation over most of the measured pH range at the Site. Only when pH was neutral to slightly alkaline, which occurred periodically, were Cr and V found at the more elevated concentrations measured. Under these circumstances Cr and V anion’s were released from sorption and temporarily mobilised before being attenuated by reportion and / or precipitation of oxide and hydroxide minerals. Under the conditions identified modelling would offer very limited to no value in predicting future mobility unless very costly and intensive further assessment was conducted to understand the sorption kinetics and surface area available to allow for the development of representative models. This was not warranted in the context of the relatively low risk and the ability to monitor and if necessary manage any potentially unacceptable risks to receptors should these arise in the future.

8. Conclusions

GHD completed a hydrogeological review of the Site including review of eight environmental investigation documents and groundwater analytical data collected over the 25 years of facility operation.

The findings of the hydrogeological review are summarised below:

- Geology underlying the Site comprised calcareous, fine to medium grained sands, ranging in depth from 10 to 20 metres. Limestone, sand and sandy clays occur in the area at depths between 10 to 50 metres (deepest at DM9). Below these sediments are dark grey, silty, micaceous clays. The clays appear from 20 to 40 metres, and occasionally occur above or within the sandy limestone layers.
- Groundwater standing water level resides in the superficial formation between 0.8 – 2.5 m AHD. Yarragadee aquifer standing water level resides between 1.5 – 2.5 m AHD.
- Groundwater monitoring network incorporating 15 bores was sufficient to complete the hydrogeological review.
- Groundwater quality investigations reported exceedances of select metals. Of these trace metals, it was concluded that lead, cobalt, copper and zinc are likely to be due to natural background conditions encountered at the time of sampling.
- Chromium and vanadium were the only two trace metals that appear to be linked to the TSR as their concentration shows an increase between the up and down-gradient wells.
- Mobility of hexavalent chromium and vanadium is dependent on anionic sorption processes with the main anion attracting sites being ferric hydroxide minerals. Therefore dissolution of these metals is dependent on pH. The pulsed nature of mobility would likely result in very slow transport velocities with these metals only migrating during periods when the pH is in a narrow window where sorption and precipitation are not occurring. Therefore the potential for sustained discharge of chromium at concentrations above the adopted water quality ecosystem criteria was considered very low.
- TSR is generating saline leachate that is increasing the TDS of the groundwater along flow path. ERM (2012) estimated a travel time of 5 years for water between the TSR and the ocean and this assessment found this value to be realistic for the groundwater system.
- TSR material may be a source of the excess calcium in groundwater samples.
- The most likely mineral responsible for the majority of the observed effect on the major ion composition of the groundwater is Calcium Chloride ($CaCl_2$). The source of this mineral is considered to be anthropogenic and probably associated with the TSR.
- The hydrogeochemical character at the down-gradient well (DM4(4R)) is influenced by mixing of fresh groundwater discharge, impacted by leachate from the TSR and seawater interface, which would be anticipated given the position of the well near the beach.

9. Recommendations

An ongoing monitoring program is already a requirement of the Closure Notice, which can continue in its current form.

GHD recommends that an action plan be developed that periodically re-evaluates the hydrogeochemical data to establish that conditions remain stable and provides a series of actions and measures to be adopted should any future monitoring identify potential changes in hydrogeochemical conditions and / or risk profile of the TSR to the environment.

Hydrogeochemical data should be stored and managed in a program which can be updated and analysed easily.

10. References

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Appendices

Appendix A – Figures

LEGEND

Study Area

🟥 AREA 4

🟪 AREA 5

🟨 Deactivated central tailings pond

🟩 Eastern turning circle

1:10,000 (at A3)

0 50 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

Job Number	61-31852
Revision	0
Date	30 Mar 2015

Locality plan

Figure 26

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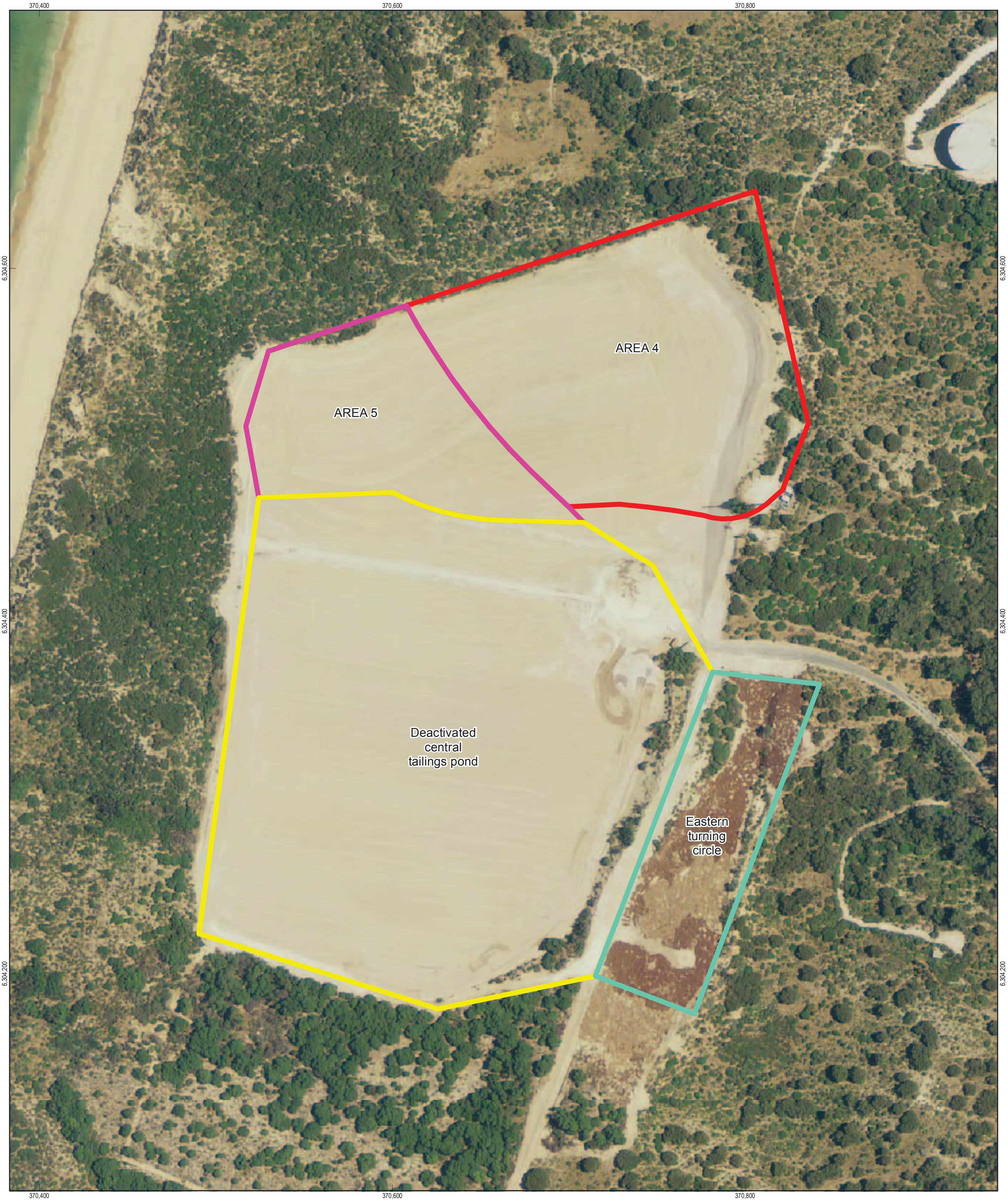
1st Floor, 10 Victoria Street Bunbury WA 6230 Australia **T** 61 8 9721 0700 **F** 61 8 9721 0777 **E** bunmail@ghd.com **W** www.ghd.com

Data source: GHD: Study Area - 20130805; Landgate: Imagery - 2013, Road - 20150327. Created by: afeeney



LEGEND

Study Area

🟥 AREA 4

🟪 AREA 5

🟨 Deactivated central tailings pond

🟩 Eastern turning circle

1:2,000 (at A3)

0 10 20 40 60 80 100

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

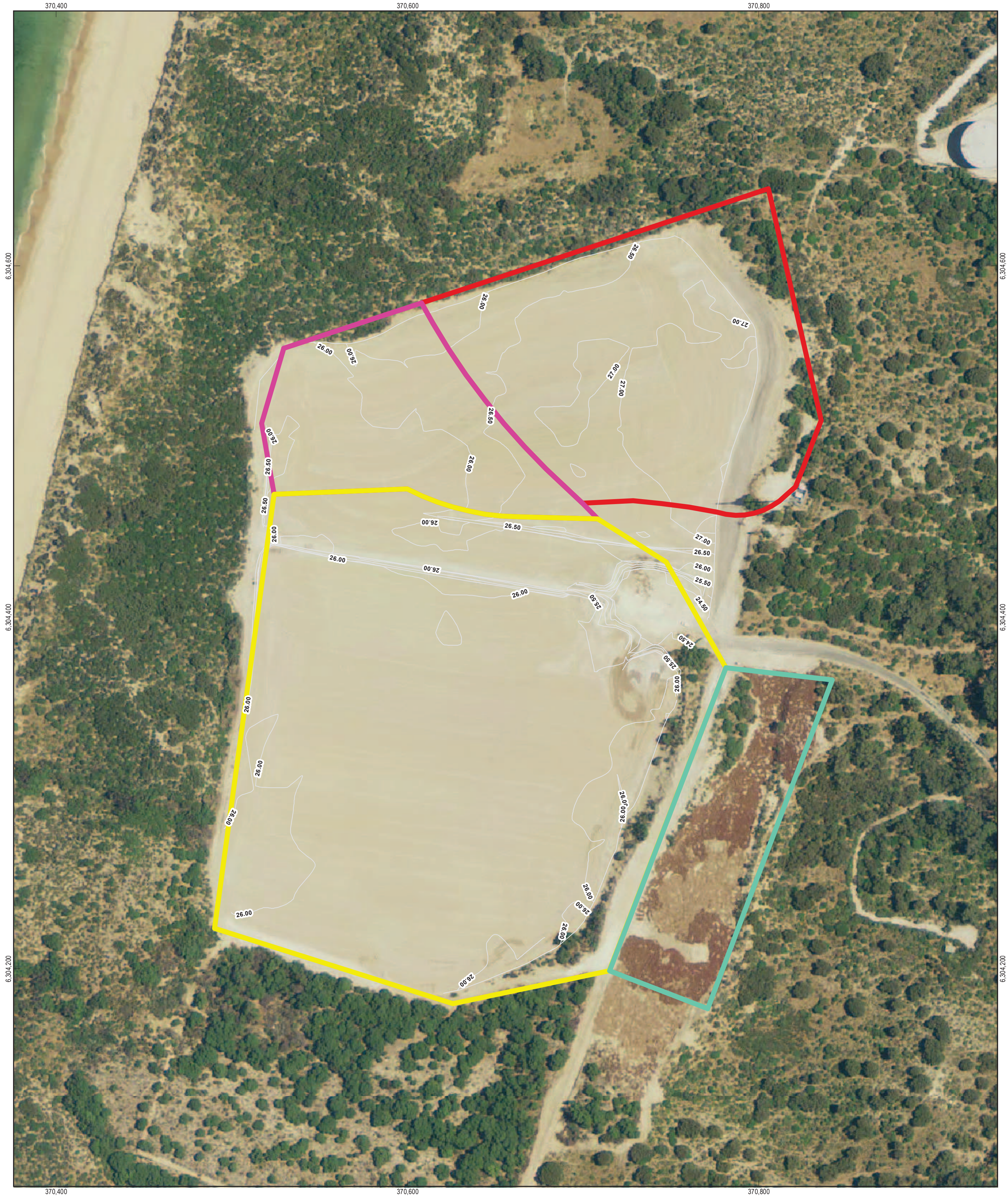
Job Number	61-31852
Revision	0
Date	30 Mar 2015

Residue pond layout

Figure 27

G:\61\31852\GIS\Maps\MXD\20150330\6131852_G002_Rev0_Fig27.mxd

Data source: GHD: Study Area - 20130805; Landgate: Bunbury 2012 Townsite - 20131119. Created by: afeeney



LEGEND

— Survey Contours	🟪 Area 5
Study Area	🟨 Deactivated central tailings pond
🟥 Area 4	🟩 Eastern turning circle

1:2,000 at A3

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

Job Number	61-31852
Revision	0
Date	30 Mar 2015

Topography

Figure 28

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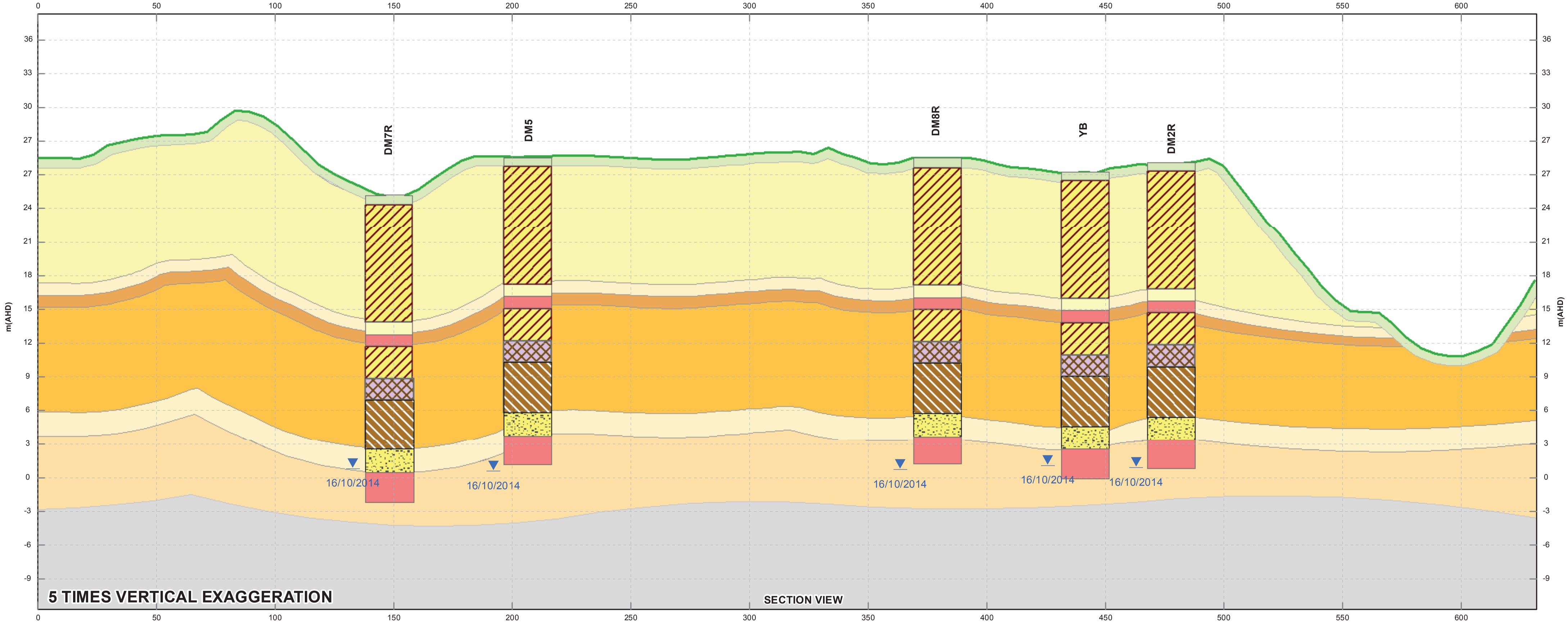
1st Floor, 10 Victoria Street Bunbury WA 6230 Australia **T** 61 8 9721 0700 **F** 61 8 9721 0777 **E** bunmail@ghd.com **W** www.ghd.com

Data source: Landgate: Landgate: Bunbury 2012 Townsite - 20131119; Cristal: Survey Contours - 20150205; GHD: Study Area - 20130805. Created by: afeeney



HorizonTal Scale of Plan View 1:1,600 @A3 Paper
0 5 10 20 30 40
Metres

Section View @ A3 Paper
Vertical Scale 1:350 (5 Times Vertical Exaggeration)
0 5 10 20 30 40
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994, Grid: GDA 1994 Perth Coastal Grid 1994

Legend for Plan View

- ● Bore
- ═ Section line
- ━ Surface topography
- ▼ Water level

Legend for Section View

Geology

- 🟩 Topsoil
- 🟨 Sand, fine to medium
- ▢ Limestone
- 🟧 Clay
- 🟧 Sand / Clay
- ▢ Clay / Sand /Silt
- ▢ Unknown

Lithology

- 🟥 Clay
- ▢ Limestone
- ▨ Limestone and sand
- ▨ Sand
- ▨ Sand and clay
- ▨ Sand with limestone
- 🟩 Topsoil

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Date	30 Mar 2015

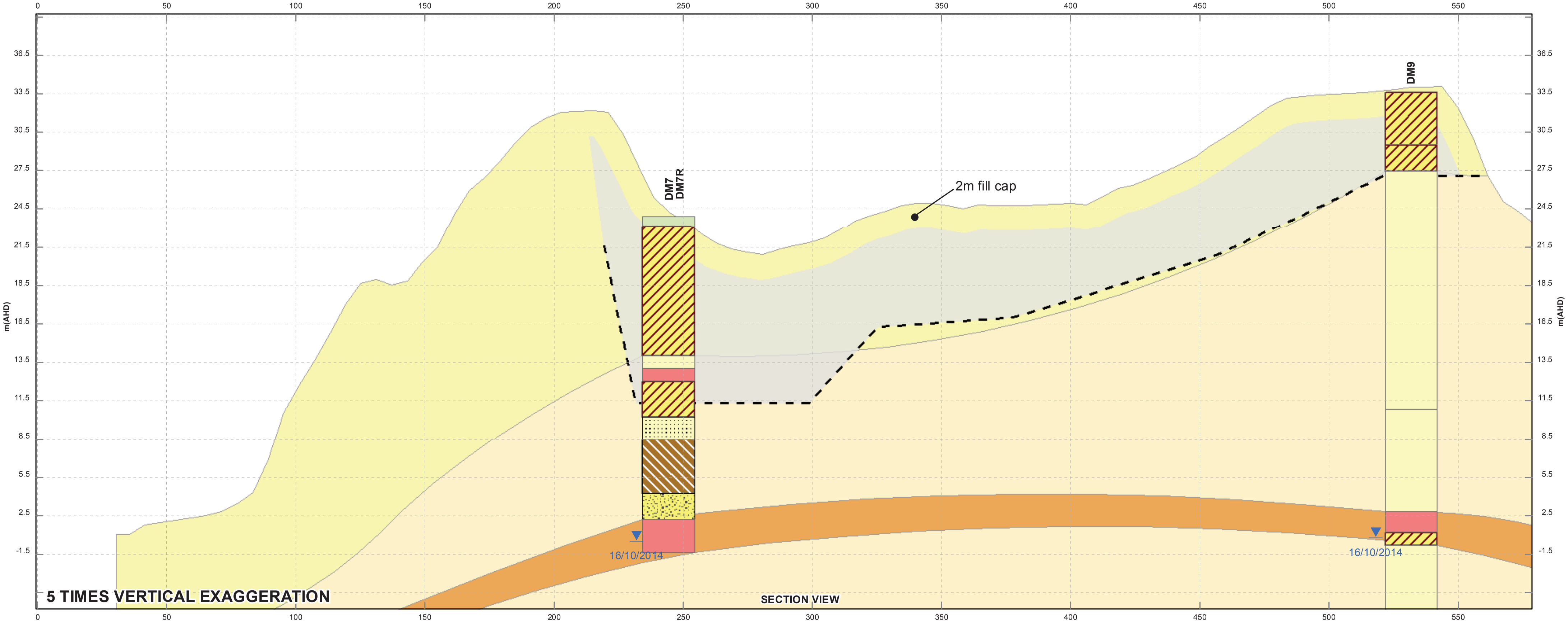
Cross Section : South to North

Figure 29

1st Floor, 10 Victoria Street Bunbury WA 6230 Australia **T** 61 8 9721 0700 **F** 61 8 9721 0777 **E** bunmail@ghd.com **W** www.ghd.com

G:\61\31852\GIS\Maps\MXD\20150330\6131852_G004_Rev0_Fig29.mxd

Data source: Landgate: Bunbury Imagery - December 2013; GHD: Section line, Bore, Surface topography, Water level, Geology, Lithology - 20150304. Created by: vdinh, afeeney



Horizontal Scale of Plan View 1:1,650 @ A3 Paper

0 5 10 20 30 40
Metres

Section View @ A3 Paper
Vertical Scale 1:350 (5 Times Vertical Exaggeration)

0 5 10 20 30 40
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994, Grid: GDA 1994 Perth Coastal Grid 1994

Legend for Plan View
- ● Bore
- ═ Section line

Legend for Section View

Lithology
- Topsoil
- Clay
- Limestone and sand
- Limestone
- Sand and clay
- Sand with limestone
- Sand

Geology
- Clay / sand
- Sand, fine to medium
- Limestone
- Tailings
- Indicative initial pond depth level

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

Job Number	61-31852
Revision	0
Date	30 Mar 2015

Cross Section : West to East

Figure 30

1st Floor, 10 Victoria Street Bunbury WA 6230 Australia T 61 8 9721 0700 F 61 8 9721 0777 E bunmail@ghd.com W www.ghd.com

G:\61\31852\GIS\Maps\MXD\20150330\6131852_G005_Rev0_Fig30.mxd

Data source: Landgate: Bunbury Imagery - December 2013; GHD: Section line, Bore, Surface topography, Indicative initial pond depth, Tailings, Water level, Geology, Lithology - 20150304. Created by: vdinh, afeeney

LEGEND

Well location

⌖ Decommissioned

⌖ Off site Monitoring Well

⌖ Superficial Aquifer Monitoring Well

⌖ Yarragadee Aquifer Monitoring Well

1:2,500 at A3

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

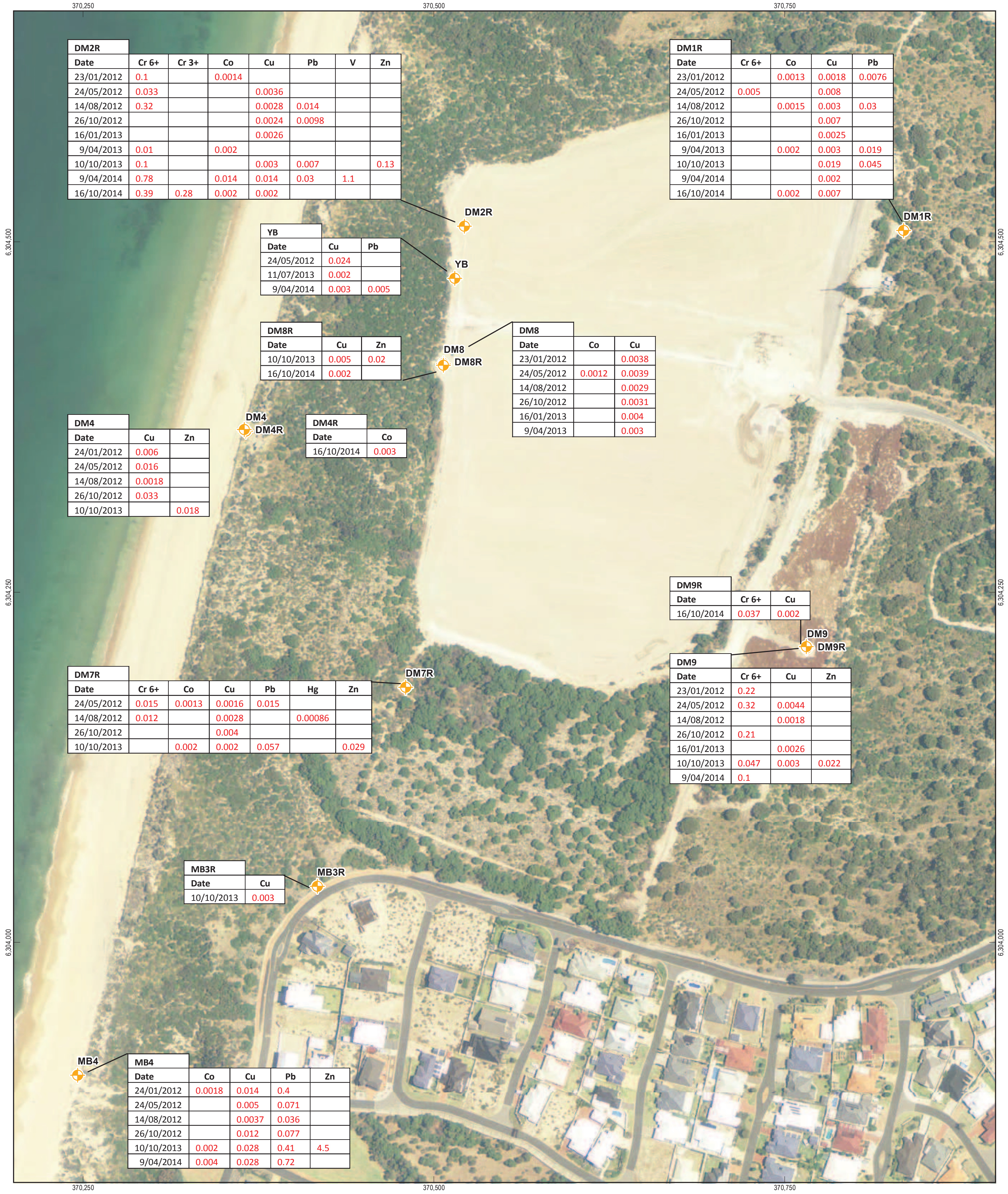
Groundwater well locations

Job Number	61-31852
Revision	0
Date	30 Mar 2015

Figure 31

G:\61\31852\GIS\Maps\MXD\20150330\6131852_G006_Rev0_Fig31.mxd

Data source: GHD: Groundwater well location - 20150312; Landgate: Bunbury 2013. Created by: vdinh



DM2R

Date	Cr 6+	Cr 3+	Co	Cu	Pb	V	Zn
23/01/2012	0.1		0.0014				
24/05/2012	0.033			0.0036			
14/08/2012	0.32			0.0028	0.014		
26/10/2012				0.0024	0.0098		
16/01/2013				0.0026			
9/04/2013	0.01		0.002				
10/10/2013	0.1			0.003	0.007		0.13
9/04/2014	0.78		0.014	0.014	0.03	1.1	
16/10/2014	0.39	0.28	0.002	0.002			

DM1R

Date	Cr 6+	Co	Cu	Pb
23/01/2012		0.0013	0.0018	0.0076
24/05/2012	0.005		0.008	
14/08/2012		0.0015	0.003	0.03
26/10/2012			0.007	
16/01/2013			0.0025	
9/04/2013		0.002	0.003	0.019
10/10/2013			0.019	0.045
9/04/2014			0.002	
16/10/2014		0.002	0.007	

YB

Date	Cu	Pb
24/05/2012	0.024	
11/07/2013	0.002	
9/04/2014	0.003	0.005

DM8R

Date	Cu	Zn
10/10/2013	0.005	0.02
16/10/2014	0.002	

DM8

Date	Co	Cu
23/01/2012		0.0038
24/05/2012	0.0012	0.0039
14/08/2012		0.0029
26/10/2012		0.0031
16/01/2013		0.004
9/04/2013		0.003

DM4

Date	Cu	Zn
24/01/2012	0.006	
24/05/2012	0.016	
14/08/2012	0.0018	
26/10/2012	0.033	
10/10/2013		0.018

DM4R

Date	Co
16/10/2014	0.003

DM9R

Date	Cr 6+	Cu
16/10/2014	0.037	0.002

DM7R

Date	Cr 6+	Co	Cu	Pb	Hg	Zn
24/05/2012	0.015	0.0013	0.0016	0.015		
14/08/2012	0.012		0.0028		0.00086	
26/10/2012			0.004			
10/10/2013		0.002	0.002	0.057		0.029

DM9

Date	Cr 6+	Cu	Zn
23/01/2012	0.22		
24/05/2012	0.32	0.0044	
14/08/2012		0.0018	
26/10/2012	0.21		
16/01/2013		0.0026	
10/10/2013	0.047	0.003	0.022
9/04/2014	0.1		

MB3R

Date	Cu
10/10/2013	0.003

MB4

Date	Co	Cu	Pb	Zn
24/01/2012	0.0018	0.014	0.4	
24/05/2012		0.005	0.071	
14/08/2012		0.0037	0.036	
26/10/2012		0.012	0.077	
10/10/2013	0.002	0.028	0.41	4.5
9/04/2014	0.004	0.028	0.72	

LEGEND

⊕ Well Location

1:2,500 at A3

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

Exceedances of 95% Marine Waters Criteria

Job Number	61-31852
Revision	0
Date	30 Mar 2015

Figure 32

G:\61\31852\GIS\Maps\MXD\20150330\6131852_G007_Rev0_Fig32.mxd

1st Floor, 10 Victoria Street Bunbury WA 6230 Australia **T** 61 8 9721 0700 **F** 61 8 9721 0777 **E** bunmail@ghd.com **W** www.ghd.com

Data source: GHD: Well location - 20150312; Landgate: Bunbury 2013. Created by: vdinh

LEGEND

Well location

Groundwater contour Autumn (May and April 2012 - 2014)

1:2,500 at A3

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

Job Number	61-31852
Revision	0
Date	30 Mar 2015

Groundwater contours
Autumn - May and April 2012 - 2014

Figure 33

G:\61\31852\GIS\Maps\MXD\20150330\6131852_G008_Rev0_Fig33.mxd

239 Adelaide Terrace Perth WA 6004 Australia **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: GHD: Well location - 20150312; Landgate: Bunbury 2013.GHD: Groundwater contours - 20150313. Created by: vdinh

LEGEND

⌖ Well location

— Groundwater contours Spring (October 2012-2014)

1:2,500 at A3

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

CRISTAL

powered by SLIP ENABLER

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

Job Number	61-31852
Revision	0
Date	30 Mar 2015

Groundwater contours
Spring - October 2012-2014

Figure 34

G:\61\31852\GIS\Maps\MXD\20150330\6131852_G009_Rev0_Fig34.mxd

1st Floor, 10 Victoria Street Bunbury WA 6230 Australia **T** 61 8 9721 0700 **F** 61 8 9721 0777 **E** bunmail@ghd.com **W** www.ghd.com

Data source: GHD: Well location - 20150312, Groundwater contours - 20150313; Landgate: Bunbury 2013. Created by: vdinh

Appendix B – Borelogs

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM4R

Page: 1 of 2

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 4/04/1996 to: 4/04/1996

Drill Co: Bunb Boring
Driller:
Rig Type:
Total Depth (m): 15
Diameter (mm): 168

Easting: 370365
Northing: 6304366
Grid Ref: GDA94_MGA_zone_50
Collar RL: 4.78 **Elevation:** 4
Logged by: Bunb Boring **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
							Ground Surface				4.00
0.0							SAND Fine				0.00
1.0											
2.0											
3.0											
4.0				▽	Backfill						
							SAND Orange medium/Coarse				-0.80 4.80
5.0											
6.0											
							SAND Medium Pebbles				-2.10 6.10
7.0											
8.0					Cement						
9.0											
							SAND Brown Fine/Medium				-5.80 9.80
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

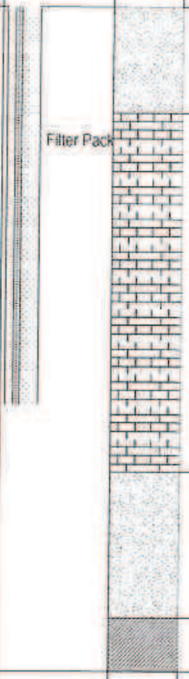
Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM4R

Page: 2 of 2

Client: Cristal	Drill Co: Bunb Boring	Easting: 370365
Project: Dalyellup Monitoring	Driller:	Northing: 6304366
Project No.: Dalyellup Monitoring	Rig Type:	Grid Ref: GDA94_MGA_zone_50
Location: Dalyellup	Total Depth (m): 15	Collar RL: 4.78 Elevation: 4
Date Drilled: 4/04/1996 to: 4/04/1996	Diameter (mm): 168	Logged by: Bunb Boring Checked by: Georgia
B.C.L. No.: Casing: PVC	Screen:	Surface Completion:



DRILLING					Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water							
11.0					Filter Pack		LIMESTONE Hard				-6.80 10.80
12.0											
13.0							SAND Green Fine/Medium Minor Clay				-9.50 13.50
14.0							CLAY Green Firm				-10.60 14.60
15.0							End of Log				-11.00 15.00
16.0											
17.0											
18.0											
19.0											
20.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM8

Page: 1 of 4

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 23/07/1996 **to:** 23/07/1996

Drill Co: Bunb Boring
Driller:
Rig Type:
Total Depth (m): 36.4
Diameter (mm): 171

Easting: 370507
Northing: 6304413
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.19 **Elevation:** 26.6
Logged by: Bunb Boring **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
							Ground Surface				26.60
0.0							SAND Yellow Shell				0.00
1.0											
2.0											
3.0											
4.0											
5.0											
6.0											
7.0											
8.0											
9.0							SAND Yellow Limestone present				17.60 9.00
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM8

Page: 2 of 4

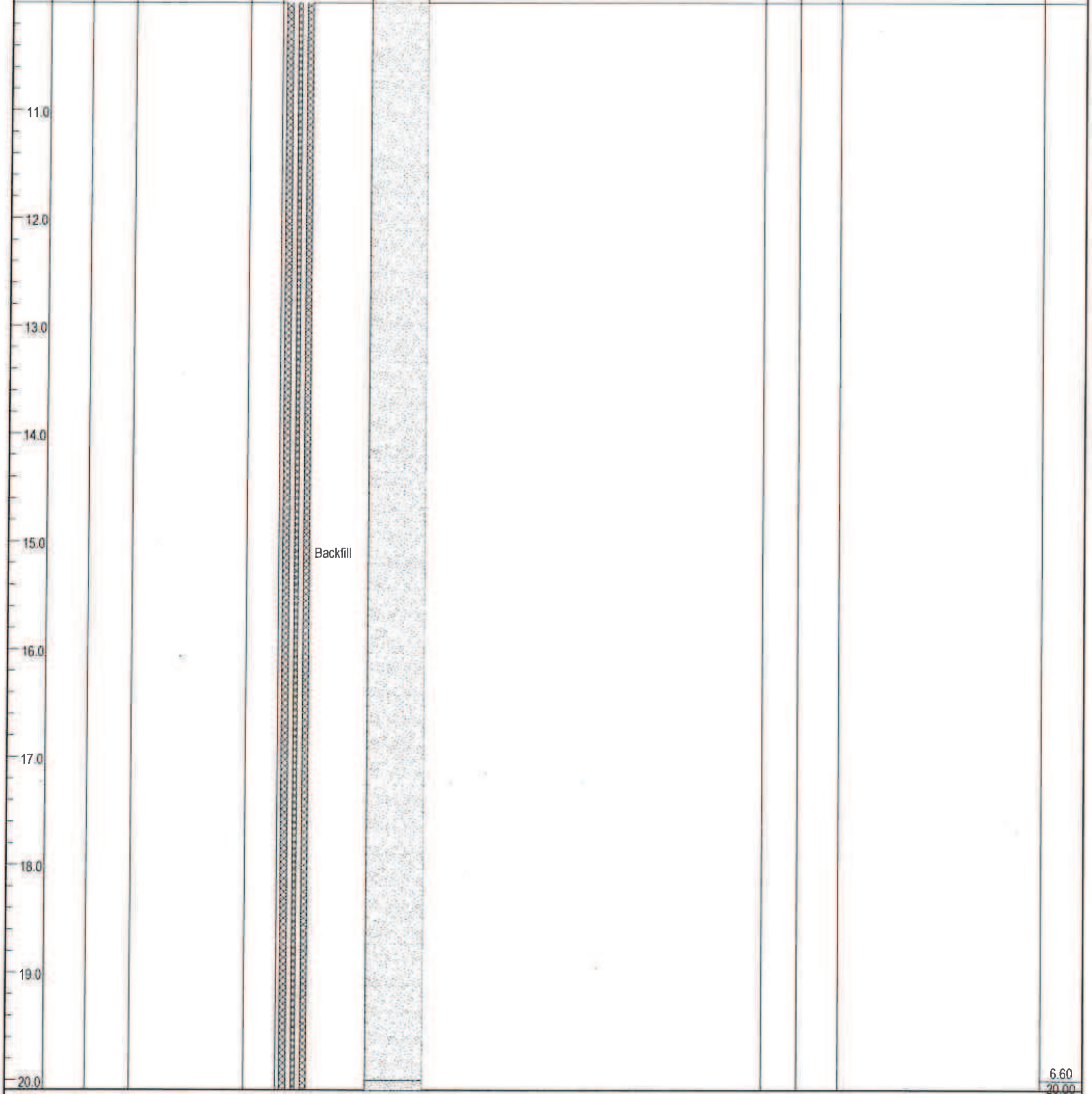
Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 23/07/1996 to: 23/07/1996

Drill Co: Bunb Boring
Driller:
Rig Type:
Total Depth (m): 36.4
Diameter (mm): 171

Easting: 370507
Northing: 6304413
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.19 **Elevation:** 26.6
Logged by: Bunb Boring **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

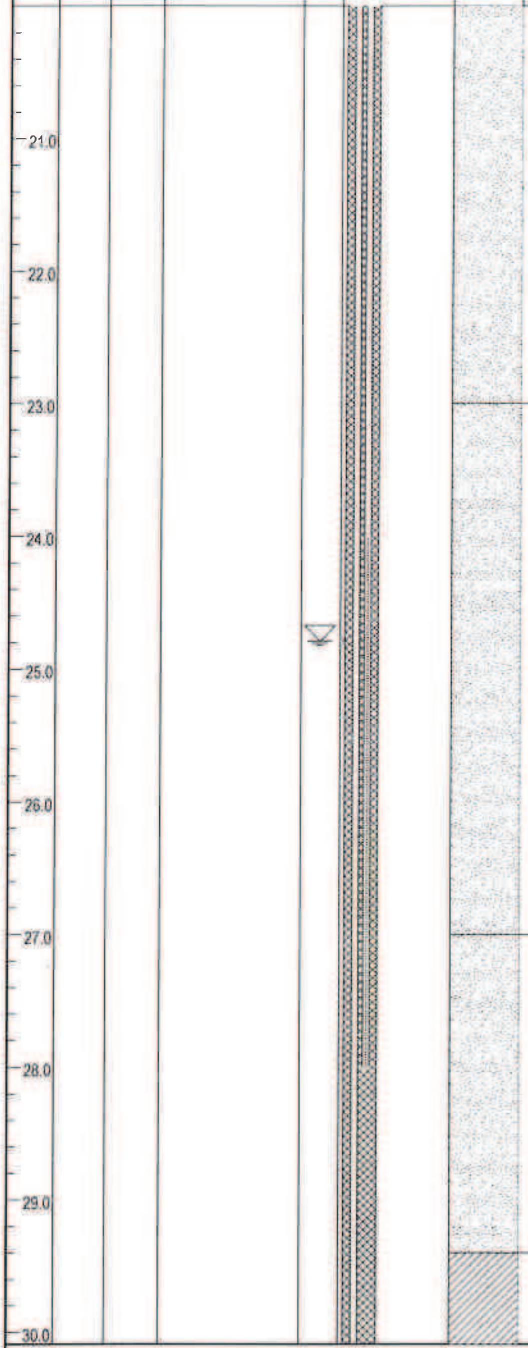
Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM8

Page: 3 of 4

Client: Cristal	**Drill Co:** Bunb Boring	**Easting:** 370507
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304413
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 36.4	**Collar RL:** 26.19 **Elevation:** 26.6
Date Drilled: 23/07/1996 to: 23/07/1996	**Diameter (mm):** 171	**Logged by:** Bunb Boring **Checked by:** Georgia
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**



DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
							SAND Brown Yellow Limestone present				3.60 23.00
				▽			SAND Brown Fine/Medium				-0.40 27.00
							SAND Green Brown				-2.80 29.40
							SANDY CLAY Brown Grey				

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM8
Page: 4 of 4

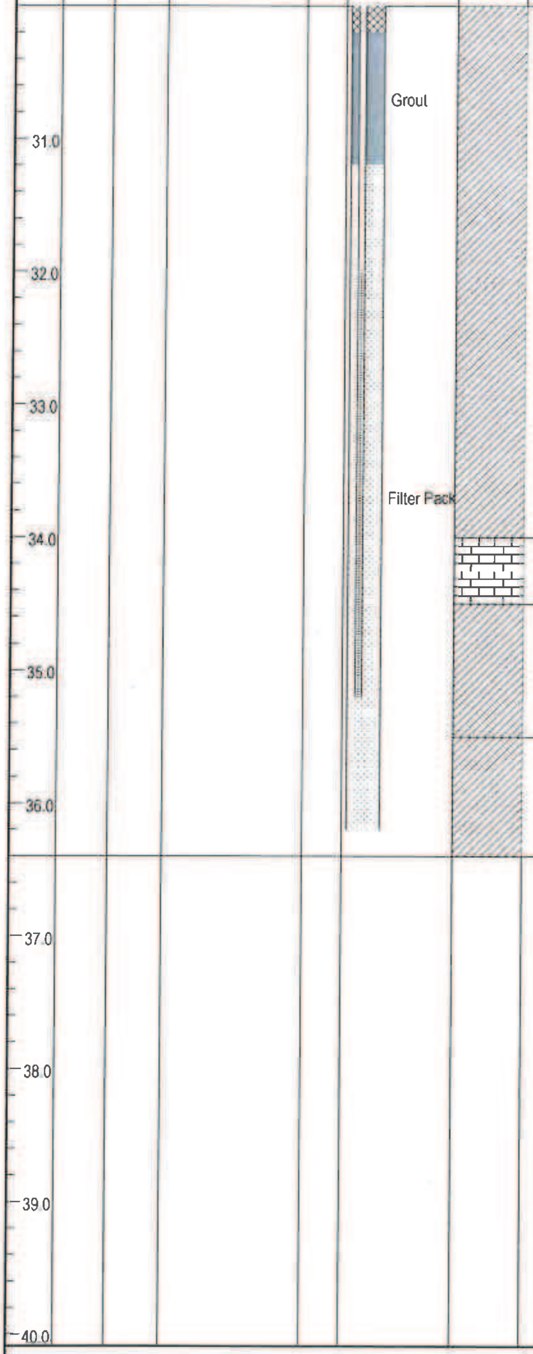
Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 23/07/1996 to: 23/07/1996

Drill Co: Bunb Boring
Driller:
Rig Type:
Total Depth (m): 36.4
Diameter (mm): 171

Easting: 370507
Northing: 6304413
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.19 **Elevation:** 26.6
Logged by: Bunb Boring **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING: Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
							LIMESTONE				-7.40 34.00
							SANDY CLAY Brown green Limestone present				-7.90 34.50
							SANDY CLAY Grey Medium/Coarse Sand				-8.90 35.50
							End of Log				-9.80 36.40



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM8R

Page: 1 of 3

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 9/10/2009 to: 9/10/2009

Drill Co:
Driller:
Rig Type:
Total Depth (m): 28
Diameter (mm): 200

Easting: 370506.9
Northing: 6304412
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.47 **Elevation:** 26.6
Logged by: Aust Water Bor **Checked by:** Georgia

B.C.L. No.:
Casing: PVC
Screen:
Surface Completion:

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
							Ground Surface				26.60
0.0							SAND Pale Yellow Medium/Fine				0.00
1.0											
2.0											
3.0											
4.0											
5.0											
6.0											
7.0											
8.0											
9.0											
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM8R

Page: 2 of 3

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 9/10/2009 to: 9/10/2009

Drill Co:
Driller:
Rig Type:
Total Depth (m): 28
Diameter (mm): 200

Easting: 370506.9
Northing: 6304412
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.47 **Elevation:** 26.6
Logged by: Aust Water Bor **Checked by:** Georgia

B.C.L. No.:
Casing: PVC
Screen:
Surface Completion:

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
11.0											
12.0					Sand						
13.0											
14.0											
15.0											
16.0											
17.0											
18.0											
19.0											
							SAND Tan Yellow Medium/Fine				7.10 19.50
20.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM8R
Page: 3 of 3

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 9/10/2009 **to:** 9/10/2009

Drill Co:
Driller:
Rig Type:
Total Depth (m): 28
Diameter (mm): 200

Easting: 370506.9
Northing: 6304412
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.47 **Elevation:** 26.6
Logged by: Aust Water Bor **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
21.0							SAND Yellow Medium				5.60 21.00
22.0											
23.0											
24.0											
				▽							
25.0											
							SAND Tan Grey Medium				1.10 25.50
26.0					Filler Pack						
27.0											
							CLAYEY SAND Tan Grey Medium/Fine				-0.90 27.50
28.0							End of Log				-1.40 28.00
29.0											
30.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	Cohesive Soils
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

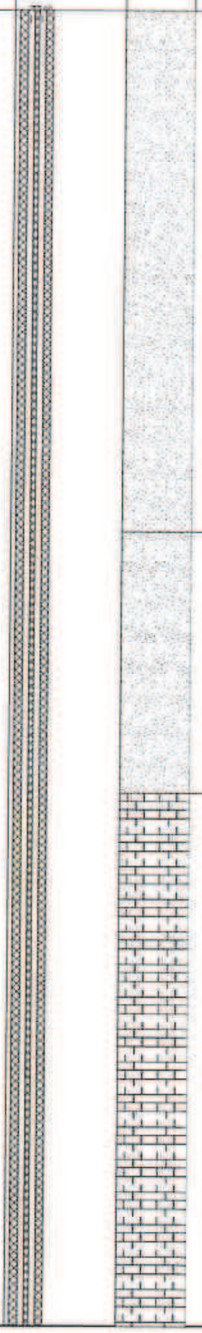
Bore ID.: DM9

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 27/07/1996 to: 27/07/1996

Drill Co: Bunb Boring
Driller:
Rig Type:
Total Depth (m): 48.2
Diameter (mm): 171

Easting: 370766
Northing: 6304210
Grid Ref: GDA94_MGA_zone_50
Collar RL: 34.35 **Elevation:** 34
Logged by: Bunb Boring **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**



DRILLING					Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water							
							Ground Surface				34.00
0.0							SAND Yellow Shell Fine				0.00
4.0							SAND Yellow Shell & Limestone Fine				30.00 4.00
6.0							LIMESTONE Brown Shells				28.00 6.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	Cohesive Soils
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

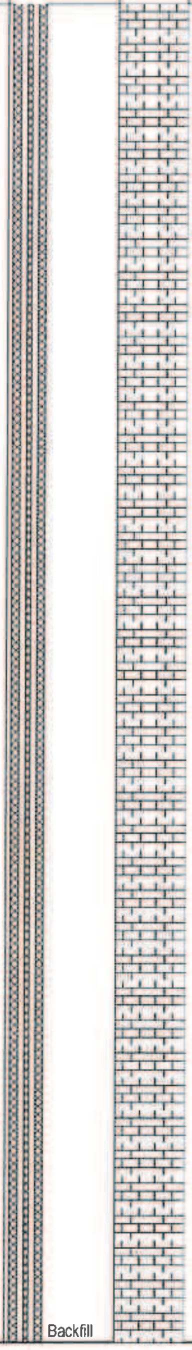
BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM9

Page: 2 of 5

Client: Cristal	**Drill Co:** Bunb Boring	**Easting:** 370766	
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304210	
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50	
Location: Dalyellup	**Total Depth (m):** 48.2	**Collar RL:** 34.35	**Elevation:** 34
Date Drilled: 27/07/1996 to: 27/07/1996	**Diameter (mm):** 171	**Logged by:** Bunb Boring	**Checked by:** Georgia
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**	

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
11.0											
12.0											
13.0											
14.0											
15.0											
16.0											
17.0											
18.0											
19.0											
20.0					Backfill						



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM9

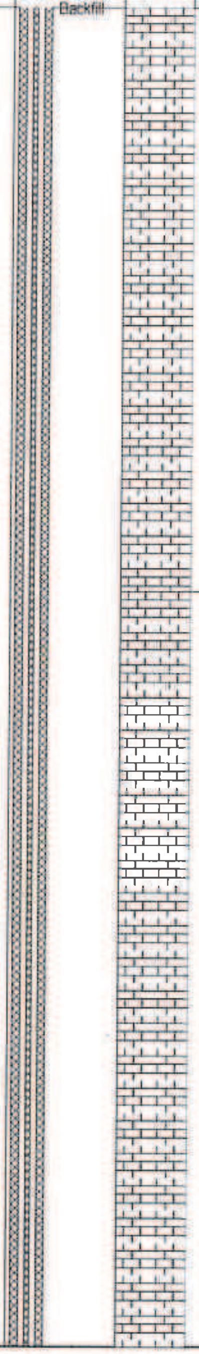
Page: 3 of 5

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 27/07/1996 to: 27/07/1996

Drill Co: Bunb Boring
Driller:
Rig Type:
Total Depth (m): 48.2
Diameter (mm): 171

Easting: 370766
Northing: 6304210
Grid Ref: GDA94_MGA_zone_50
Collar RL: 34.35 **Elevation:** 34
Logged by: Bunb Boring **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**



DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
					Backfill						
21.0											
22.0											
23.0											
24.0											
							LIMESTONE Brown Sand & broken Limestone				9.60 24.40
25.0											
26.0											
27.0											
28.0											
29.0											
30.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	Cohesive Soils
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM9

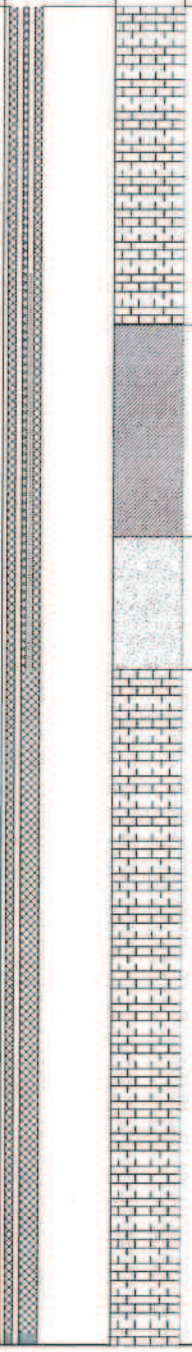
Page: 4 of 5

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 27/07/1996 to: 27/07/1996

Drill Co: Bunb Boring
Driller:
Rig Type:
Total Depth (m): 48.2
Diameter (mm): 171

Easting: 370766
Northing: 6304210
Grid Ref: GDA94_MGA_zone_50
Collar RL: 34.35 **Elevation:** 34
Logged by: Bunb Boring **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**



DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
31.0											
				▽							
32.0											
							CLAY Grey Sand				1.60 32.40
33.0											
34.0											
							SAND Brown Orange Fine/Medium Limestone				0.00 34.00
35.0											
							LIMESTONE				-1.00 35.00
36.0											
37.0											
38.0											
39.0											
40.0											

NOTES:

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Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: DM9

Page: 5 of 5

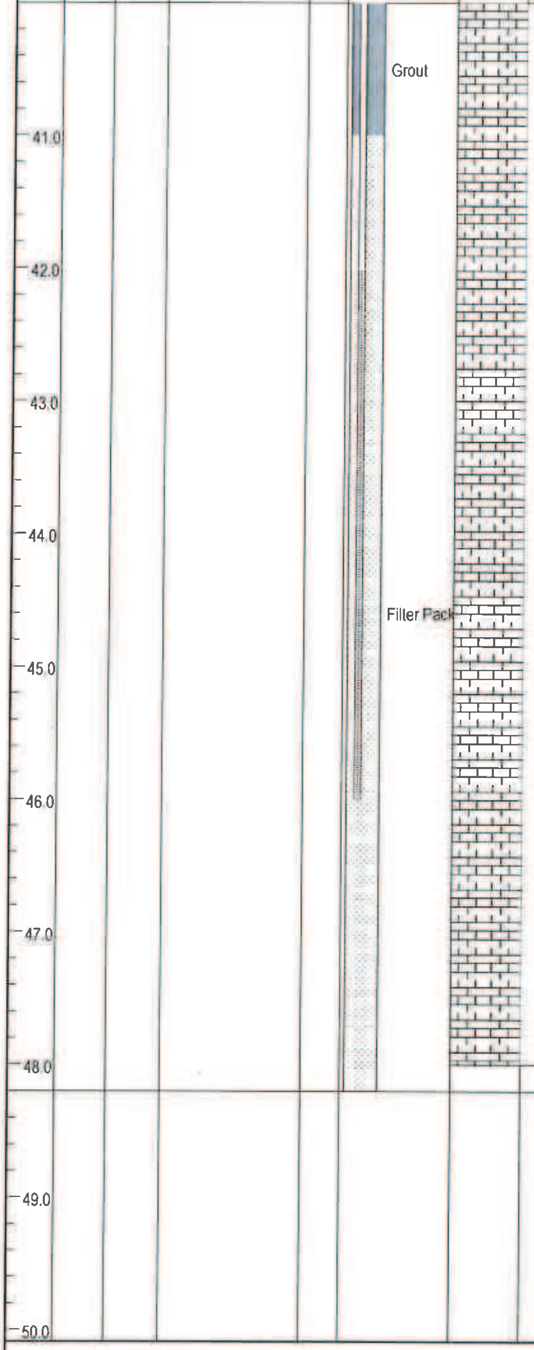
Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 27/07/1996 to: 27/07/1996

Drill Co: Bunb Boring
Driller:
Rig Type:
Total Depth (m): 48.2
Diameter (mm): 171

Easting: 370766
Northing: 6304210
Grid Ref: GDA94_MGA_zone_50
Collar RL: 34.35 **Elevation:** 34
Logged by: Bunb Boring **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
							End of Log				-14.20 48.20



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	Cohesive Soils
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB1

Page: 1 of 4

Client: Cristal	**Drill Co:**	**Easting:** 370674
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303950
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 31	**Collar RL:** 29.57 **Elevation:** 28.74
Date Drilled: 3/10/1988 **to:** 3/10/1988	**Diameter (mm):** 127	**Logged by:** SCM Chemicals**Checked by:**

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
							Ground Surface				28.74
0.0					Grout		SAND White, cream, fine to medium grained, well sorted, subangular to well rounded, mainly quartz, a few shell fragments, trace of dark fines. From 0 to 2.7m: Silty with common organic material				0.00
1.0											
2.0											
3.0											
4.0											
5.0											
6.0											
7.0											
8.0											
9.0											
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

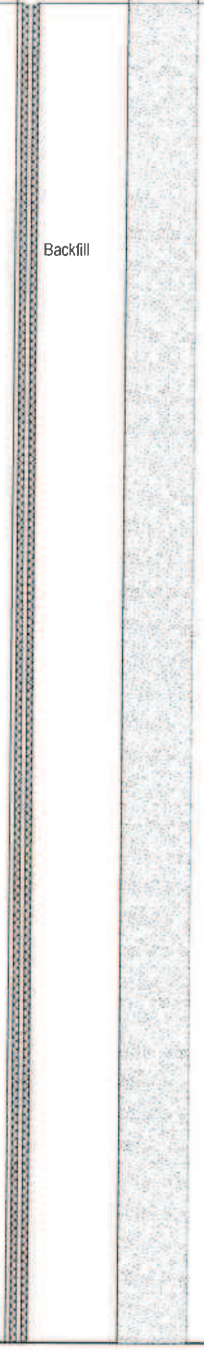
Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB1
Page: 2 of 4

Client: Cristal	**Drill Co:**	**Easting:** 370674
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303950
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 31	**Collar RL:** 29.57 **Elevation:** 28.74
Date Drilled: 3/10/1988 **to:** 3/10/1988	**Diameter (mm):** 127	**Logged by:** SCM Chemicals **Checked by:**
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING					Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water							
11.0											
12.0											
13.0											
14.0											
15.0											
16.0											
17.0											
18.0											
19.0											
20.0											



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB1

Page: 3 of 4

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 3/10/1988 **to:** 3/10/1988

Drill Co:
Driller:
Rig Type:
Total Depth (m): 31
Diameter (mm): 127

Easting: 370674
Northing: 6303950
Grid Ref: GDA94_MGA_zone_50
Collar RL: 29.57 **Elevation:** 28.74
Logged by: SCM Chemicals **Checked by:**

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
21.0											
22.0 23.0 24.0							SAND WITH LIMESTONE Cream to grey sand and limestone. Sand is similar to the sand above. Limestone is sandy and slightly silty.				7.24 21.50
25.0 26.0 27.0 28.0 29.0 30.0				▽	Filter Pack		SAND WITH LIMESTONE Sand, limestone and sandy clay. Sand is brown, similar to the sand above, with rare to common wood fragments. Limestone is sandy and slightly silty. Sandy clay is grey-green.				4.24 24.50

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	Cohesive Soils
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB1

Page: 4 of 4

Client: Cristal	**Drill Co:**	**Easting:** 370674
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303950
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 31	**Collar RL:** 29.57 **Elevation:** 28.74
Date Drilled: 3/10/1988 to: 3/10/1988	**Diameter (mm):** 127	**Logged by:** SCM Chemicals**Checked by:**
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
							LIMESTONE Limestone, sand and sandy clay. Limestone is green sandy, well cemented with common shell fragments. Sand is similar to above. Sandy clay is grey-green. Clay content increases with depth.				-1.56 30.30
31.0							End of Log				-2.26 31.00
32.0											
33.0											
34.0											
35.0											
36.0											
37.0											
38.0											
39.0											
40.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	Cohesive Soils
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB1R
Page: 1 of 4

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 23/01/2001 **to:** 23/01/2001

Drill Co: Thorpe
Driller:
Rig Type:
Total Depth (m): 33
Diameter (mm): 155

Easting: 370669.87
Northing: 6303957.34
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.91 **Elevation:** 26.11
Logged by: Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING					Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water							
							Ground Surface				26.11
0.0							SAND Pale Brown Medium/Coarse				0.00
1.0											
2.0											
3.0											
4.0											
5.0											
6.0											
7.0											
8.0											
9.0											
10.0											

NOTES: Surface elevation reduced by 1870mm 12/11/01

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	**Cohesive Soils**
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB1R

Page: 2 of 4

Client: Cristal	**Drill Co:** Thorpe	**Easting:** 370669.87
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303957.34
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 33	**Collar RL:** 26.91 **Elevation:** 26.11
Date Drilled: 23/01/2001 to: 23/01/2001	**Diameter (mm):** 155	**Logged by:** Thorpe **Checked by:** Georgia
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
11.0											
12.0					Grout						
13.0											
14.0											
15.0											
16.0											
17.0											
18.0											
19.0											
20.0											

NOTES: Surface elevation reduced by 1870mm 12/11/01

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
		Granular Soils	**Cohesive Soils**
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

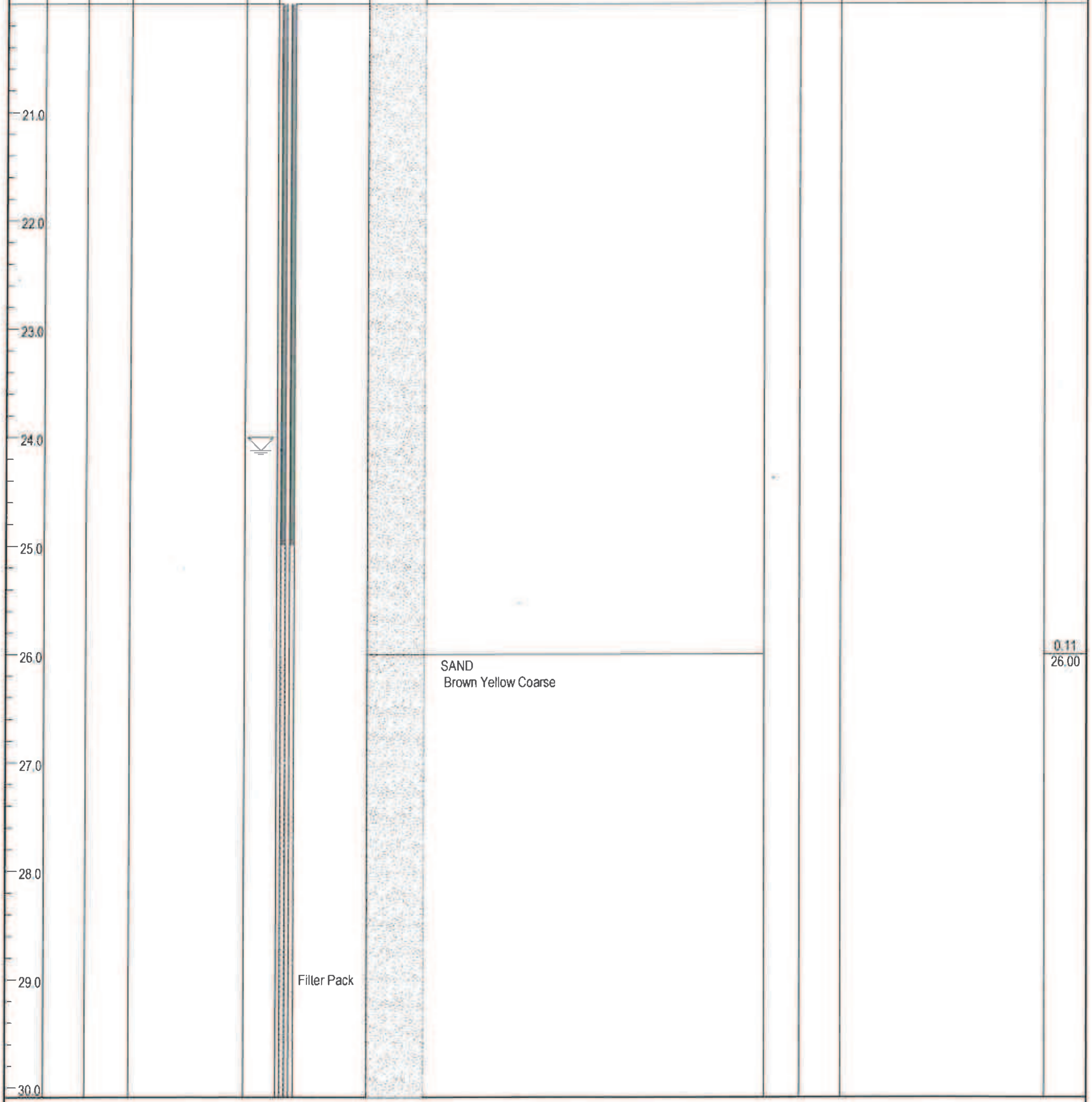
BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB1R

Page: 3 of 4

Client: Cristal	**Drill Co:** Thorpe	**Easting:** 370669.87
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303957.34
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 33	**Collar RL:** 26.91 **Elevation:** 26.11
Date Drilled: 23/01/2001 **to:** 23/01/2001	**Diameter (mm):** 155	**Logged by:** Thorpe **Checked by:** Georgia
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
26.0							SAND Brown Yellow Coarse				0.11 26.00
29.0					Filter Pack						



NOTES: Surface elevation reduced by 1870mm 12/11/01

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	Cohesive Soils
AH - Air Hammer, AR - Air Rotary, BE - Bucket Excavation, DC - Diamond Core, FH - Foam Hammer, HA - Hand Auger, HE - Hand Excavation (shovel), HFA - Hollow Flight Auger, NDD - Non Destructive Drilling, PT - Pushtube, SD - Sonic Drilling, SFA - Solid Flight Auger, SS - Split Spoon, WB - Wash Bore, WS - Window Sampler	D - Dry, SM - Slightly Moist, M - Moist, VM - Very Moist, W - Wet, S - Saturated	VL - Very Loose, L - Loose, MD - Medium Dense, D - Dense, VD - Very Dense	VS - Very Soft, S - Soft, F - Firm, ST - Stiff, VST - Very Stiff, H - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB1R

Page: 4 of 4

Client: Cristal	**Drill Co:** Thorpe	**Easting:** 370669.87
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303957.34
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 33	**Collar RL:** 26.91 **Elevation:** 26.11
Date Drilled: 23/01/2001 to: 23/01/2001	**Diameter (mm):** 155	**Logged by:** Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
31.0											
32.0											
33.0							End of Log				-6.89 33.00
34.0											
35.0											
36.0											
37.0											
38.0											
39.0											
40.0											

NOTES: Surface elevation reduced by 1870mm 12/11/01

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler

Moisture Abbreviations:
D - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated

Consistency Abbreviations:

Granular Soils
VL - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense

Cohesive Soils
VS - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB2
Page: 1 of 4

Client: Cristal	**Drill Co:**	**Easting:** 370570.52
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303927.21
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 32.5	**Collar RL:** 24.67 **Elevation:** 23.8
Date Drilled: 4/10/1988 to: 4/10/1988	**Diameter (mm):** 127	**Logged by:** SCM Chemicals **Checked by:**
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
							Ground Surface				23.80
0.0					Grout		TOPSOIL Topsoil				0.00
1.0							SAND White, cream, fine to medium grained, well sorted, subangular to rounded, mainly quartz, a few shell fragments, trace of heavy minerals becoming silty towards 9.5m.				22.80 1.00
2.0											
3.0											
4.0											
5.0											
6.0											
7.0											
8.0											
9.0											
					Backfill		SAND WITH LIMESTONE Sand similar to above. Bands of sandy limestone, well cemented in places.				14.30 9.50
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB2

Page: 2 of 4

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 4/10/1988 to: 4/10/1988

Drill Co:
Driller:
Rig Type:
Total Depth (m): 32.5
Diameter (mm): 127

Easting: 370570.52
Northing: 6303927.21
Grid Ref: GDA94_MGA_zone_50
Collar RL: 24.67 **Elevation:** 23.8
Logged by: SCM Chemicals **Checked by:**

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
11.0											
12.0											
13.0											
14.0											
15.0											
16.0											
17.0											
18.0											
							SAND AND CLAY Sand, brown to grey, silty, siimlar to above interval with grey clay bands.				5.00 18.80
19.0											
20.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB2

Page: 3 of 4

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 4/10/1988 to: 4/10/1988

Drill Co:
Driller:
Rig Type:
Total Depth (m): 32.5
Diameter (mm): 127

Easting: 370570.52
Northing: 6303927.21
Grid Ref: GDA94_MGA_zone_50
Collar RL: 24.67 **Elevation:** 23.8
Logged by: SCM Chemicals**Checked by:**

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
21.0											
22.0				▽			LIMESTONE Limestone is grey to yellow, sandy with sand of brown to grey, silty, rare shell fragments similar to above material.				1.30 22.50
23.0											
24.0											
25.0					Filter Pack						
26.0							LIMESTONE Cream, sandy, well cemented, becoming light green, silty and less well cemented with depth.				-2.70 26.50
27.0											
28.0											
29.0											
30.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB2

Page: 4 of 4

Client: Cristal	**Drill Co:**	**Easting:** 370570.52
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303927.21
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 32.5	**Collar RL:** 24.67 **Elevation:** 23.8
Date Drilled: 4/10/1988 **to:** 4/10/1988	**Diameter (mm):** 127	**Logged by:** SCM Chemicals **Checked by:**
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
31.0											
32.0							CLAY Dark grey, silty, slightly sandy, micaceous.				-8.20 32.00
							End of Log				-8.70 32.50
33.0											
34.0											
35.0											
36.0											
37.0											
38.0											
39.0											
40.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler

Moisture Abbreviations:
D - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated

Consistency Abbreviations:

Granular Soils
VL - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense

Cohesive Soils
VS - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB2R

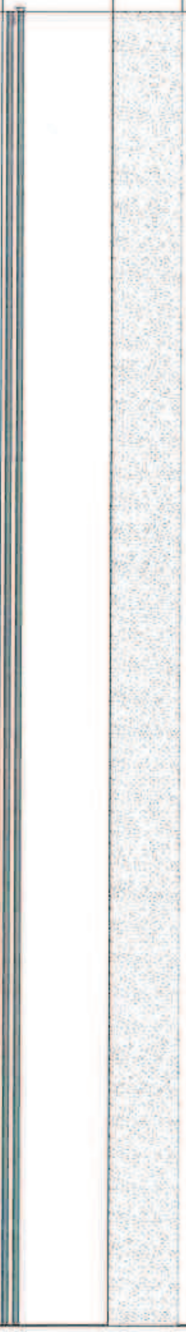
Page: 1 of 4

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 23/01/2001 to: 23/01/2001

Drill Co: Thorpe
Driller:
Rig Type:
Total Depth (m): 32
Diameter (mm): 155

Easting: 370586
Northing: 6303960
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.6 **Elevation:** 25.85
Logged by: Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**



DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
							Ground Surface				25.85
0.0							SAND Pale Brown Medium				0.00
1.0											
2.0											
3.0											
4.0											
5.0											
6.0											
7.0											
8.0											
9.0											
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

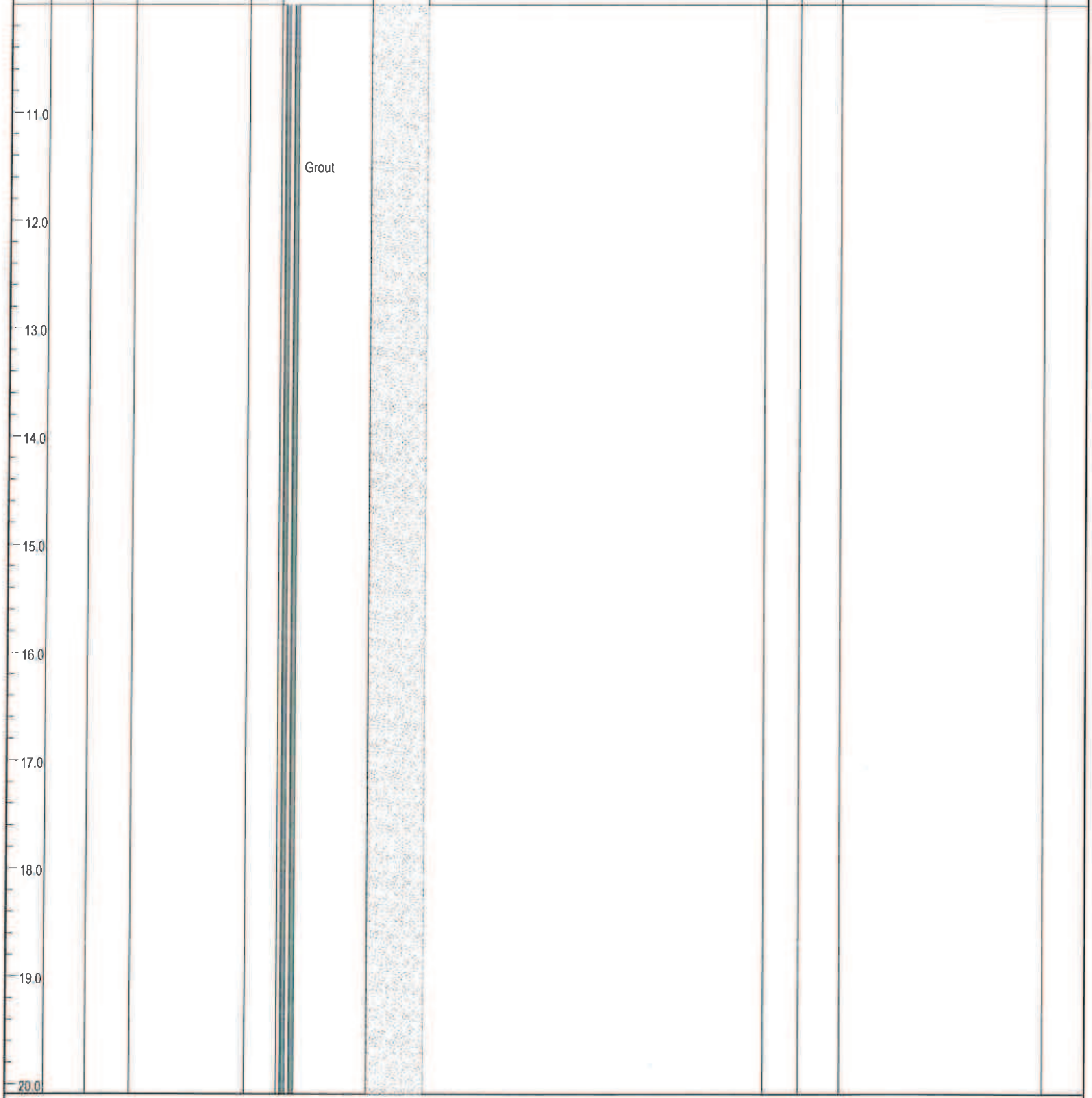
Bore ID.: MB2R

Page: 2 of 4

Client: Cristal	**Drill Co:** Thorpe	**Easting:** 370586
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303960
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 32	**Collar RL:** 26.6 **Elevation:** 25.85
Date Drilled: 23/01/2001 to: 23/01/2001	**Diameter (mm):** 155	**Logged by:** Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)



NOTES:

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Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
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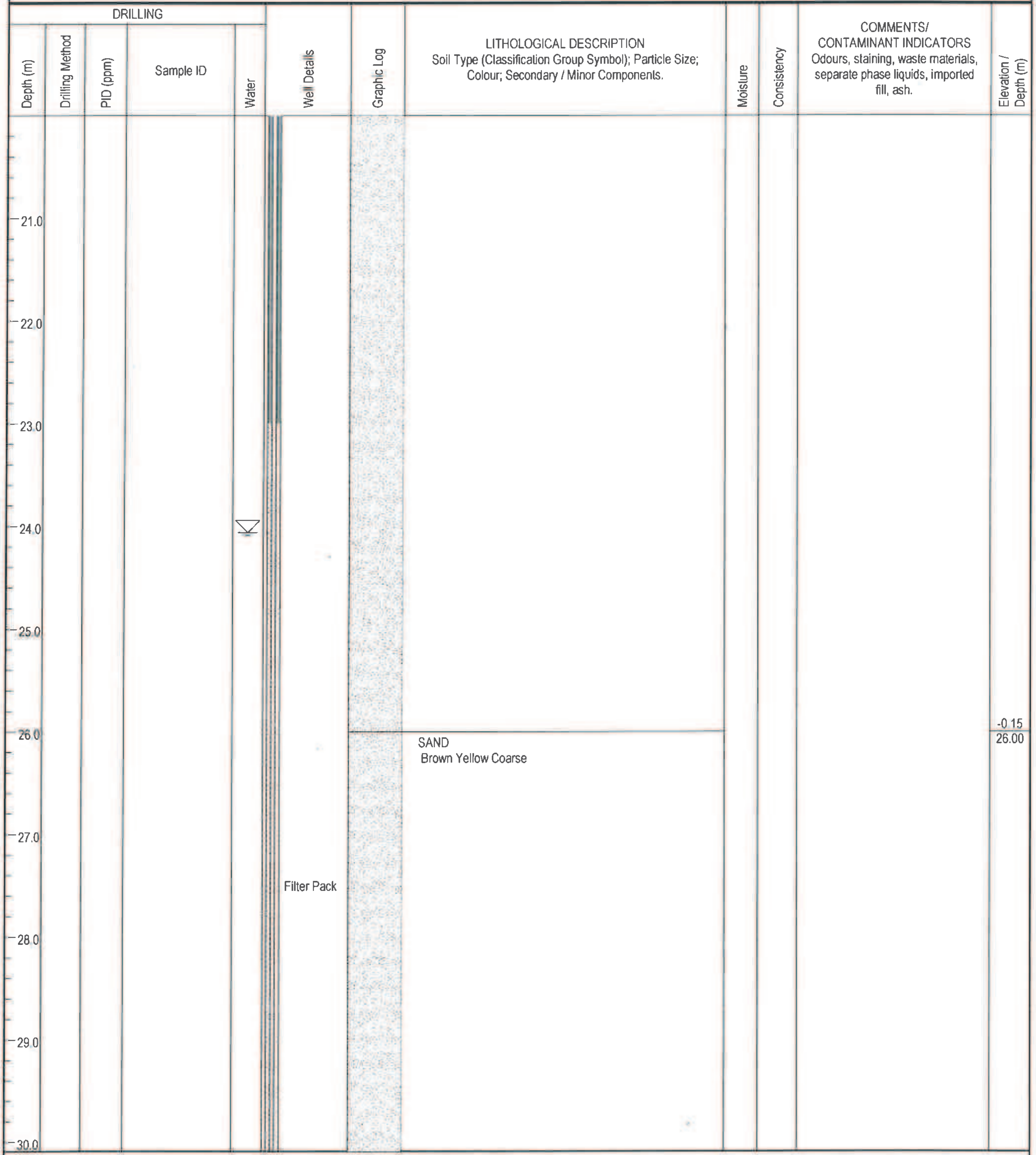
BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB2R

Page: 3 of 4

Client: Cristal	**Drill Co:** Thorpe	**Easting:** 370586
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6303960
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 32	**Collar RL:** 26.6 **Elevation:** 25.85
Date Drilled: 23/01/2001 to: 23/01/2001	**Diameter (mm):** 155	**Logged by:** Thorpe **Checked by:** Georgia
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**



DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
21.0											
22.0											
23.0											
24.0				▽							
25.0											
26.0							SAND Brown Yellow Coarse				-0.15 26.00
27.0					Filter Pack						
28.0											
29.0											
30.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB2R

Page: 4 of 4

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 23/01/2001 to: 23/01/2001

Drill Co: Thorpe
Driller:
Rig Type:
Total Depth (m): 32
Diameter (mm): 155

Easting: 370586
Northing: 6303960
Grid Ref: GDA94_MGA_zone_50
Collar RL: 26.6 **Elevation:** 25.85
Logged by: Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
31.0											
32.0							End of Log				-6.15 32.00
33.0											
34.0											
35.0											
36.0											
37.0											
38.0											
39.0											
40.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB3

Page: 1 of 3

Client: Cristal	**Drill Co:**	**Easting:** 370364.1
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304007.2
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 26	**Collar RL:** 26.21 **Elevation:** 14.19
Date Drilled: 6/10/1988 to: 6/10/1988	**Diameter (mm):** 127	**Logged by:** SCM Chemicals**Checked by:**

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
							Ground Surface				14.19
0.0							TOPSOIL Topsoil.				0.00
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0							SAND Cream to white, slightly silty, fine to medium grained, well sorted, sub-angular to rounded, well sorted, mainly quartz, a few shell fragments, trace of dark fines.				13.39 0.80

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB3

Page: 2 of 3

Client: Cristal	**Drill Co:**	**Easting:** 370364.1
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304007.2
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 26	**Collar RL:** 26.21 **Elevation:** 14.19
Date Drilled: 6/10/1988 to: 6/10/1988	**Diameter (mm):** 127	**Logged by:** SCM Chemicals**Checked by:**
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
											3.39 10.80
11.0							LIMESTONE Sandy, few shell fragments.				2.39 11.80
12.0							CLAY Black, silty.				1.39 12.80
13.0 14.0 15.0				▽			SAND Grey to brown, silty, fine to medium grained, well sorted, subrounded, mainly quartz.				-1.31 15.50
16.0 17.0							SAND WITH LIMESTONE Sand similar to above. Grey green, sandy limestone and dark green and sandy clay.				-3.11 17.30
18.0 19.0 20.0							SAND AND CLAY Sand, olive green, grey similar to above interval with olive-green sandy clay.				

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
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BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB3
Page: 3 of 3

Client: Cristal	**Drill Co:**	**Easting:** 370364.1
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304007.2
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 26	**Collar RL:** 26.21 **Elevation:** 14.19
Date Drilled: 6/10/1988 to: 6/10/1988	**Diameter (mm):** 127	**Logged by:** SCM Chemicals**Checked by:**

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
21.0					Filter Pack						
22.0 23.0							LIMESTONE AND SAND Grey to yellow, well cemented, sandy limestone with sand, fine to coarse grained, poorly sorted, subrounded, mainly quartz, few shell fragments.				-7.31 21.50
24.0 25.0						▨	CLAY Dark grey, silty, slightly sandy, micaceous.				-9.31 23.50
26.0 27.0 28.0 29.0 30.0							End of Log				-11.81 26.00

NOTES:

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Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
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BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB3R

Page: 1 of 4

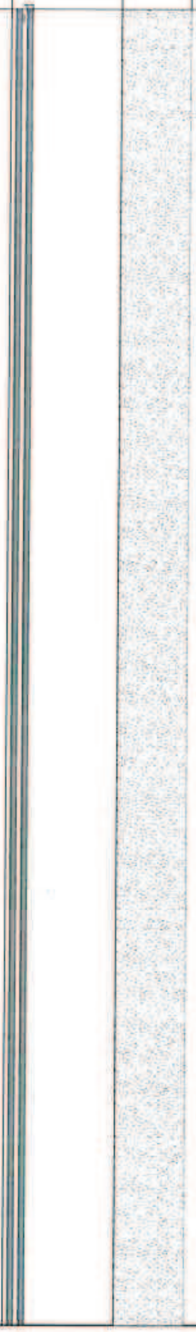
Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 22/01/2001 to: 23/01/2001

Drill Co: Thorpe
Driller:
Rig Type:
Total Depth (m): 34.5
Diameter (mm): 155

Easting: 370417
Northing: 6304040
Grid Ref: GDA94_MGA_zone_50
Collar RL: 27.93 **Elevation:** 25.5
Logged by: Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
							Ground Surface				25.50
0.0							SAND Pale Brown Medium				0.00
1.0											
2.0											
3.0											
4.0											
5.0											
6.0											
7.0											
8.0											
9.0											
10.0											



NOTES: Surf elevation reduced by 1817mm 12/11/01

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Drilling Abbreviations:
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Moisture Abbreviations:
D - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated

Consistency Abbreviations:
Granular Soils
VL - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense

Cohesive Soils
VS - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB3R

Page: 2 of 4

Client: Cristal	**Drill Co:** Thorpe	**Easting:** 370417
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304040
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 34.5	**Collar RL:** 27.93 **Elevation:** 25.5
Date Drilled: 22/01/2001 to: 23/01/2001	**Diameter (mm):** 155	**Logged by:** Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
11.0											
12.0											
13.0					Grout						
14.0											
15.0											
16.0											
17.0											
18.0											
19.0											
20.0											

NOTES: Surf elevation reduced by 1817mm 12/11/01

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

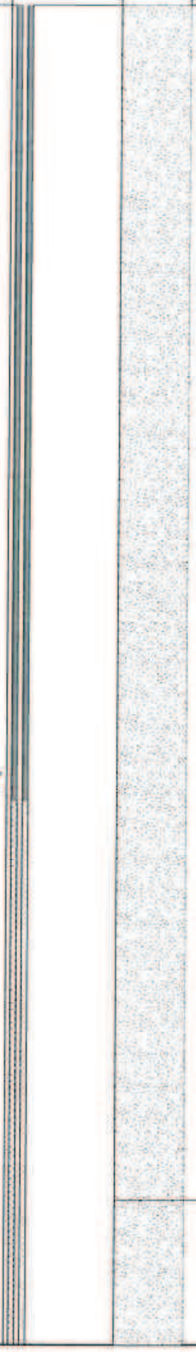
Bore ID.: MB3R
Page: 3 of 4

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 22/01/2001 to: 23/01/2001

Drill Co: Thorpe
Driller:
Rig Type:
Total Depth (m): 34.5
Diameter (mm): 155

Easting: 370417
Northing: 6304040
Grid Ref: GDA94_MGA_zone_50
Collar RL: 27.93 **Elevation:** 25.5
Logged by: Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**



DRILLING					Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water							
21.0											
22.0											
23.0											
24.0											
25.0											
				▽							
26.0											
27.0											
28.0											
29.0							SAND Brown/Yellow Coarse				-3.50 29.00
30.0											

NOTES: Surf elevation reduced by 1817mm 12/11/01

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BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB3R
Page: 4 of 4

Client: Cristal	**Drill Co:** Thorpe	**Easting:** 370417
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304040
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 34.5	**Collar RL:** 27.93 **Elevation:** 25.5
Date Drilled: 22/01/2001 **to:** 23/01/2001	**Diameter (mm):** 155	**Logged by:** Thorpe **Checked by:** Georgia

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
31.0 32.0 33.0 34.0					Filter Pack						-9.00
35.0 36.0 37.0 38.0 39.0 40.0							End of Log				34.50

NOTES: Surf elevation reduced by 1817mm 12/11/01

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB4
Page: 1 of 2

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 10/10/1988 to: 10/10/1988

Drill Co:
Driller:
Rig Type:
Total Depth (m): 16.2
Diameter (mm): 127

Easting: 370246
Northing: 6303905
Grid Ref: GDA94_MGA_zone_50
Collar RL: 3.35 Elevation: 2
Logged by: SCM Chemicals Checked by:

B.C.L. No.: Casing: PVC Screen: PVC Surface Completion:

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
							Ground Surface				2.00
0.0					Grout		**SAND** White to cream, orange to brown, fine to medium grained subangular to rounded, well sorted mainly quartz, few shell fragments. From 3 to 3.2m: Abundant heavy minerals.				0.00
1.0											
2.0											
3.0											
4.0				▽							
5.0											
6.0											-4.70
							LIMESTONE AND SAND Grey to orange, sandy, well cemented limestone, with sand similar to above				6.70
7.0											
8.0					Filter Pack						
9.0											
10.0											

NOTES:

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Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
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BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: MB4

Page: 2 of 2

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 10/10/1988 to: 10/10/1988

Drill Co:
Driller:
Rig Type:
Total Depth (m): 16.2
Diameter (mm): 127

Easting: 370246
Northing: 6303905
Grid Ref: GDA94_MGA_zone_50
Collar RL: 3.35 **Elevation:** 2
Logged by: SCM Chemicals **Checked by:**

B.C.L. No.: **Casing:** PVC **Screen:** PVC **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
11.0							SILT Dark brown, sandy, clayey in parts, calcareous?, partially cemented.				-8.30 10.30
12.0 13.0 14.0							CLAY Brown silty clay and sandy clay.				-10.00 12.00
15.0 16.0							CLAY Grey, silty, sandy, micaceous.				-12.70 14.70
17.0 18.0 19.0 20.0							End of Log				-14.20 16.20

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler

Moisture Abbreviations:
D - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated

Consistency Abbreviations:

Granular Soils
VL - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense

Cohesive Soils
VS - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: YB

Page: 1 of 8

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 24/03/2005 to: 24/03/2005

Drill Co: Aquatech
Driller:
Rig Type:
Total Depth (m): 72
Diameter (mm): 100

Easting: 370515
Northing: 6304474
Grid Ref: GDA94_MGA_zone_50
Collar RL: 27.2
Elevation: 26.5
Logged by: Aquatech
Checked by: Georgia

B.C.L. No.:
Casing: PVC
Screen: PVC
Surface Completion:

DRILLING					Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water							
							Ground Surface				26.50
0.0							SANDS Shell & Sand				0.00
1.0											
2.0											
3.0											
4.0											
5.0											
6.0											
7.0											
8.0											
9.0											
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler

Moisture Abbreviations:
D - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated

Consistency Abbreviations:

Granular Soils
VL - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense

Cohesive Soils
VS - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Client: Cristal	Drill Co: Aquatech	Easting: 370515
Project: Dalyellup Monitoring	Driller:	Northing: 6304474
Project No.: Dalyellup Monitoring	Rig Type:	Grid Ref: GDA94_MGA_zone_50
Location: Dalyellup	Total Depth (m): 72	Collar RL: 27.2 Elevation: 26.5
Date Drilled: 24/03/2005 to: 24/03/2005	Diameter (mm): 100	Logged by: Aquatech Checked by: Georgia
B.C.L. No.: Casing: PVC	Screen: PVC	Surface Completion:

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
11.0											
12.0											
13.0											
14.0											
15.0											
16.0											
17.0											
18.0											
19.0											
20.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
		Granular Soils	Cohesive Soils
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BORHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore ID.: YB

Page: 3 of 8

Client: Cristal		**Drill Co:** Aquatech	**Easting:** 370515
Project: Dalyellup Monitoring		**Driller:**	**Northing:** 6304474
Project No.: Dalyellup Monitoring		**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup		**Total Depth (m):** 72	**Collar RL:** 27.2 **Elevation:** 26.5
Date Drilled: 24/03/2005	**to:** 24/03/2005	**Diameter (mm):** 100	**Logged by:** Aquatech **Checked by:** Georgia
B.C.L. No.:	**Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
21.0											
22.0											
23.0											
24.0											
25.0				▽							
26.0							SANDS Brown Sand				0.50 26.00
27.0											
28.0											
29.0											
30.0											-3.50 30.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: YB

Page: 4 of 8

Client: Cristal	**Drill Co:** Aquatech	**Easting:** 370515
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304474
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 72	**Collar RL:** 27.2 **Elevation:** 26.5
Date Drilled: 24/03/2005 to: 24/03/2005	**Diameter (mm):** 100	**Logged by:** Aquatech **Checked by:** Georgia
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
31.0							CLAYEY SAND Green Shell & Sand				
32.0 33.0 34.0 35.0					Grout		SHALE Black				-5.50 32.00
36.0 37.0 38.0 39.0 40.0											

NOTES:

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Drilling Abbreviations:
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler

Moisture Abbreviations:
D - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated

Consistency Abbreviations:
Granular Soils
VL - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense
Cohesive Soils
VS - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: YB

Page: 5 of 8

Client: Cristal	**Drill Co:** Aquatech	**Easting:** 370515
Project: Dalyellup Monitoring	**Driller:**	**Northing:** 6304474
Project No.: Dalyellup Monitoring	**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup	**Total Depth (m):** 72	**Collar RL:** 27.2 **Elevation:** 26.5
Date Drilled: 24/03/2005 **to:** 24/03/2005	**Diameter (mm):** 100	**Logged by:** Aquatech **Checked by:** Georgia
B.C.L. No.: **Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash	Elevation / Depth (m)
41.0											
42.0							SANDY CLAY White				-15.50 42.00
43.0											
44.0											
45.0											
46.0											
47.0											
48.0											
49.0											
50.0											

NOTES:

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Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: YB

Page: 6 of 8

Client: Cristal		**Drill Co:** Aquatech	**Easting:** 370515
Project: Dalyellup Monitoring		**Driller:**	**Northing:** 6304474
Project No.: Dalyellup Monitoring		**Rig Type:**	**Grid Ref:** GDA94_MGA_zone_50
Location: Dalyellup		**Total Depth (m):** 72	**Collar RL:** 27.2 **Elevation:** 26.5
Date Drilled: 24/03/2005	to: 24/03/2005	**Diameter (mm):** 100	**Logged by:** Aquatech **Checked by:** Georgia
B.C.L. No.:	**Casing:** PVC	**Screen:** PVC	**Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
51.0											
52.0											
53.0											
54.0											
55.0											
56.0											
57.0											
58.0											
59.0											
60.0											

NOTES:

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Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
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BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: YB

Page: 7 of 8

Client: Cristal
Project: Dalyellup Monitoring
Project No.: Dalyellup Monitoring
Location: Dalyellup
Date Drilled: 24/03/2005 to: 24/03/2005

Drill Co: Aquatech
Driller:
Rig Type:
Total Depth (m): 72
Diameter (mm): 100

Easting: 370515
Northing: 6304474
Grid Ref: GDA94_MGA_zone_50
Collar RL: 27.2
Elevation: 26.5
Logged by: Aquatech
Checked by: Georgia

B.C.L. No.:
Casing: PVC
Screen: PVC
Surface Completion:

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
61.0											
62.0											
63.0											
64.0							SAND Brown Medium/Coarse				-37.50 64.00
65.0											
66.0											
67.0											
68.0					Filter Pack						
69.0											
70.0											

NOTES:

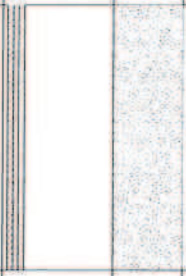
GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG
ENVIRONMENTAL - GROUNDWATER

Bore ID.: YB
Page: 8 of 8

Client: Cristal	Drill Co: Aquatech	Easting: 370515	
Project: Dalyellup Monitoring	Driller:	Northing: 6304474	
Project No.: Dalyellup Monitoring	Rig Type:	Grid Ref: GDA94_MGA_zone_50	
Location: Dalyellup	Total Depth (m): 72	Collar RL: 27.2	Elevation: 26.5
Date Drilled: 24/03/2005 to: 24/03/2005	Diameter (mm): 100	Logged by: Aquatech	Checked by: Georgia
B.C.L. No.:	Casing: PVC	Screen: PVC	Surface Completion:



DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
71.0											
72.0							End of Log				-45.50 72.00
73.0											
74.0											
75.0											
76.0											
77.0											
78.0											
79.0											
80.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	Moisture Abbreviations:	Consistency Abbreviations:	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

Appendix C – Groundwater Chemistry Tables

Table C1 – Groundwater analytical results (2013-2014)

Table C1
Groundwater analytical data (2013-2014)

				LocCode	DM1R	DM1R	DM1R	DM1R	DM1R	DM1R	DM1R	DM1R	DM1R	DM1R	DM2R	DM2R	DM2R	DM2R	DM2R	DM2R	DM2R	DM2R	DM2R	DM2R	DM3
				WellCode	d	d	d	d	d	s	s	s	s	s	d	d	d	d	d	s	s	s	s	s	d
				Sampled_Date-Time	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/10/2014
Chem_Group	ChemName	Units	EQL	ANZECC 2000 MW 95%																					
	Carbonate as CaCO3	mg/L	1		-	-	-	-	<1	-	-	-	-	<1	-	-	-	-	<1	-	-	-	-	<1	<1
	Na/Cl Ratio	ratio			0.6944	0.561	-	0.7368	-	0.6316	0.5455	-	0.625	-	0.12	0.1148	-	0.1433	-	0.1552	0.1053	-	0.1111	-	-
Field	EC (field)	µS/cm			-	-	-	-	2090	-	-	-	-	1801	-	-	-	-	8860	-	-	-	-	8030	-
	pH (Field)	pH			7.15	6.97	7.09	6.53	6.31	7.22	7.3	7.29	6.84	6.61	6.73	7.04	7.07	6.55	6.8	7.09	6.96	7.13	6.83	6.78	-
	Temp (field)	oC			-	-	-	-	19	-	-	-	-	19.3	-	-	-	-	20.8	-	-	-	-	20.7	-
Inorganics	Ammonia as N	µg/L			-	-	<1000	-	-	-	-	<1000	-	-	-	-	9000	-	-	-	-	<1000	-	-	-
	Bicarbonate	mg/L			310	300	-	290	-	300	320	-	320	-	210	240	-	300	-	250	260	-	250	-	-
	Bicarbonate as CaCO3	mg/L	1		-	-	350	-	310	-	-	180	-	310	-	-	280	-	250	-	-	240	-	240	440
	Chloride	mg/L			360	410	390	380	350	190	220	5700	320	360	3500	2700	2400	3000	2700	1160	1900	1400	1800	2400	140
	Nitrate (as N)	mg/L			0.2	0.2	<0.2	0.2	-	3.8	4.7	<0.2	3	-	0.2	1.9	1	3	-	0.2	0.3	13	34	-	-
	Redox Potential	mV			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sodium	mg/L	0.05		250	230	240	280	240	120	120	330	200	210	420	310	240	430	390	180	200	150	200	320	85
	Sulphate	mg/L	5		82	89	120	110	75	27	48	32	50	33	610	470	530	740	580	210	360	250	250	440	51
	TDS (evap)	mg/L	10		1160	1260	1150	1090	1210	750	750	770	930	1090	8380	7190	5440	8030	7400	3230	5140	3550	4590	6990	890
Lead	Lead Total	mg/L	0.001	0.0044	0.001	0.001	0.004	0.002	0.003	0.0023	0.019	0.045	0.004	<0.001	0.001	0.001	0.007	0.03	0.001	0.0024	0.001	0.007	0.003	<0.001	<0.001
Metals	Arsenic	mg/L			-	-	0.015	-	-	-	-	0.045	-	-	-	-	0.002	-	-	-	-	0.002	-	-	-
	Boron	mg/L	0.005		0.076	0.079	0.097	0.074	0.076	0.081	0.08	0.1	0.082	0.091	0.24	0.21	0.33	0.28	0.29	0.16	0.2	0.21	0.19	0.3	0.15
	Cadmium	mg/L	0.0001	0.0055	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001
	Calcium	mg/L	0.005		120	120	120	140	130	96	100	1100	140	130	860	640	640	1070	730	400	450	470	620	750	190
	Chromium (hexavalent)	mg/L	0.001	0.0044	0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	<0.001	0.001	<0.001	0.001	0.01	0.1	0.78	0.39	0.001	0.001	<0.001	0.068	0.32	0.001
	Chromium Total	mg/L	0.001		0.001	0.001	0.003	0.001	0.002	0.013	0.086	0.073	0.029	<0.001	0.008	0.087	0.13	1.2	0.67	0.01	0.002	0.042	0.082	0.32	0.001
	Chromium (Trivalent)	mg/L	0.001	0.0274	-	-	-	-	<0.001	-	-	-	-	<0.001	-	-	-	-	0.28	-	-	-	-	<0.001	<0.001
	Cobalt	mg/L	0.001	0.001	0.001	0.001	<0.001	0.001	0.002	0.001	0.002	0.001	0.001	<0.001	0.001	0.002	0.001	0.014	0.001	0.001	0.001	0.001	0.001	0.002	0.001
	Copper Total	mg/L	0.001	0.0013	0.0025	0.001	0.019	0.007	0.007	0.001	0.003	0.022	0.002	<0.001	0.0026	0.001	0.002	0.014	0.002	0.001	0.001	0.003	0.002	0.002	<0.001
	Iron	mg/L	0.005		8.2	7.7	-	5.6	7.5	2	13	-	9.1	0.27	1.8	0.33	-	24	0.67	0.6	0.12	-	1	0.1	0.06
	Magnesium	mg/L	0.005		34	34	33	36	36	33	31	1100	43	42	740	520	360	750	670	280	360	200	310	480	37
	Manganese	mg/L	0.001		0.4	0.23	0.21	0.24	0.33	0.17	0.68	0.88	0.6	0.11	0.036	0.041	0.19	4.9	0.08	0.034	0.08	0.33	0.16	0.028	0.003
	Mercury	mg/L	0.0001	0.0004	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001
	Molybdenum	mg/L	0.001		-	-	0.001	<0.001	<0.001	-	-	0.001	0.001	0.001	-	-	0.001	0.008	0.002	-	-	0.004	0.004	0.003	0.002
	Nickel	mg/L	0.001	0.07	0.001	0.001	0.001	0.001	0.003	0.0014	0.004	0.005	0.003	0.003	0.005	0.001	0.004	0.067	0.002	0.001	0.001	0.005	0.003	<0.001	<0.001
	Potassium	mg/L	0.05		10	8	10	9.7	16	11	8.7	14	13	23	26	16	18	17	36	17	13	15	18	40	10
	Selenium	mg/L			-	-	<0.001	-	-	-	-	0.001	-	-	-	-	0.003	-	-	-	-	0.003	-	-	-
	Vanadium Total	mg/L	0.001	0.1	0.001	0.001	0.003	0.001	<0.001	0.001	0.026	0.028	0.012	0.001	0.001	0.001	0.026	1.1	0.018	0.001	0.002	0.056	0.035	0.002	0.001
	Zinc	mg/L		0.015	-	-	0.011	-	-	-	-	0.012	-	-	-	-	0.034	-	-	-	-	0.13	-	-	-
Radionuclides	Radium-226	mBq/L			29	68	-	217	182	20	58	-	103	60	40	42	-	51	142	13	32	-	50	83	-
	Radium-228	mBq/L			100	100	-	334	100	100	100	-	100	100	100	100	-	100	112	100	100	-	100	100	-

[Sampled_Date-Time] > #01 Jan 2013#
G:\61\31852\Technical\Lab data\Report2015Outputs\ChemTable_2013-2014Results

Table C1
Groundwater analytical data (2013-2014)

				LocCode	DM4	DM4	DM4	DM4	DM4	DM4R	DM4R	DM4	DM4	DM4	DM4	DM4	DM7R	DM7R	DM7R	DM7R	DM7R	DM7R	DM7R	DM7R	DM7R	DM7R
				WellCode	d	d	d	d	d	d	s	s	s	s	s	s	d	d	d	d	d	s	s	s	s	s
				Sampled Date-Time	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/10/2014	16/10/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014
Chem Group	ChemName	Units	EQL	ANZECC 2000 MW 95%																						
	Carbonate as CaCO3	mg/L	1		-	-	-	-	-	<1	<1	-	-	-	-	-	-	-	-	-	<1	-	-	-	-	-
	Na/Cl Ratio	ratio			0.13	0.092	-	0.1308	-	-	-	0.1034	0.07879	-	0.09762	-	0.2692	0.2143	-	0.2857	-	0.2708	0.09121	-	0.1455	-
Field	EC (field)	µS/cm			-	-	-	-	7360	-	-	-	-	-	-	11,660	-	-	-	-	2580	-	-	-	-	2960
	pH (Field)	pH			7.15	7.15	7.31	7.01	6.78	-	-	6.78	6.73	7.05	6.97	6.8	7.06	6.96	7.09	6.89	6.64	7.16	6.84	6.93	6.9	6.4
	Temp (field)	oC			-	-	-	-	20.1	-	-	-	-	-	-	21	-	-	-	-	20.7	-	-	-	-	20.8
Inorganics	Ammonia as N	µg/L			-	-	<1000	-	-	-	-	-	-	<1000	-	-	-	-	<1000	-	-	-	-	<1000	-	-
	Bicarbonate	mg/L			52	51	-	59	-	-	-	170	160	-	130	-	370	360	-	370	-	370	340	-	390	-
	Bicarbonate as CaCO3	mg/L	1		-	-	51	-	-	55	130	-	-	150	-	-	-	-	350	-	380	-	-	390	-	-
	Chloride	mg/L			2000	2500	2600	2600	-	2400	3700	2900	3300	3900	4200	-	520	700	620	630	490	480	910	560	1100	-
	Nitrate (as N)	mg/L			0.3	0.7	0.8	0.8	-	-	-	0.2	0.8	<0.2	0.2	-	0.2	0.2	0.2	0.2	-	0.7	7.2	2.3	0.2	-
	Redox Potential	mV			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sodium	mg/L	0.05		260	230	220	340	-	280	400	300	260	270	410	-	140	150	130	180	130	130	83	120	160	-
	Sulphate	mg/L	5		390	220	460	440	-	400	770	650	520	730	760	-	110	88	100	100	97	110	88	100	90	-
	TDS (evap)	mg/L	10		5900	6770	5700	6360	-	6460	10,300	8140	9040	8820	9760	-	1950	2290	1560	1970	1980	1760	3010	1650	2710	-
Lead	Lead Total	mg/L	0.001	0.0044	0.0023	0.001	<0.001	0.001	-	<0.001	<0.001	0.0011	0.001	<0.001	0.001	-	0.001	0.001	0.002	0.001	<0.001	0.001	0.001	0.057	0.001	-
Metals	Arsenic	mg/L			-	-	0.001	-	-	-	-	-	-	0.009	-	-	-	-	0.002	-	-	-	-	0.009	-	-
	Boron	mg/L	0.005		0.12	0.11	0.13	0.1	-	0.13	0.29	0.25	0.23	0.28	0.2	-	0.17	0.17	0.19	0.14	0.17	0.17	0.065	0.18	0.15	-
	Cadmium	mg/L	0.0001	0.0055	0.00013	0.0001	<0.0001	0.0001	-	<0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	-	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	-
	Calcium	mg/L	0.005		630	560	570	800	-	660	990	850	710	880	1010	-	320	280	240	360	270	300	83	260	460	-
	Chromium (hexavalent)	mg/L	0.001	0.0044	0.001	0.001	<0.001	0.001	-	<0.001	<0.001	0.001	0.001	<0.001	0.001	-	0.001	0.001	<0.001	0.001	<0.001	0.001	0.004	<0.001	0.001	-
	Chromium Total	mg/L	0.001		0.001	0.001	0.002	0.001	-	<0.001	<0.001	0.001	0.001	0.003	0.001	-	0.001	0.002	0.001	0.002	<0.001	0.002	0.15	0.028	0.002	-
	Chromium (Trivalent)	mg/L	0.001	0.0274	-	-	-	-	-	<0.001	<0.001	-	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Cobalt	mg/L	0.001	0.001	0.001	0.001	<0.001	0.001	-	0.003	0.002	0.001	0.001	<0.001	0.001	-	0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	0.002	0.001	-
	Copper Total	mg/L	0.001	0.0013	0.0012	0.001	0.001	0.001	-	<0.001	0.001	0.001	0.001	0.001	0.001	-	0.001	0.001	0.002	0.001	<0.001	0.001	0.001	0.003	0.001	-
	Iron	mg/L	0.005		0.039	0.074	-	0.69	-	1.3	0.057	0.3	0.069	-	0.21	-	1.4	1.3	-	0.94	1.5	0.32	3	-	2.2	-
	Magnesium	mg/L	0.005		490	430	440	560	-	480	900	790	650	850	900	-	87	73	62	91	86	77	28	81	130	-
	Manganese	mg/L	0.001		0.0082	0.006	0.071	0.021	-	0.3	0.003	0.22	0.003	0.05	0.012	-	0.094	0.081	0.094	0.13	0.11	0.027	0.12	0.52	0.66	-
	Mercury	mg/L	0.0001	0.0004	0.0001	0.0001	<0.0001	0.0001	-	<0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	-	0.0001	0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	0.0001	-
	Molybdenum	mg/L	0.001		-	-	<0.001	<0.001	-	<0.001	0.004	-	-	0.003	0.003	-	-	-	0.002	<0.001	0.001	-	-	0.01	0.004	-
	Nickel	mg/L	0.001	0.07	0.003	0.004	0.003	0.004	-	0.008	<0.001	0.001	0.002	0.002	0.002	-	0.001	0.001	0.001	0.001	<0.001	0.001	0.001	0.003	0.001	-
	Potassium	mg/L	0.05		15	11	12	12	-	25	32	17	12	12	13	-	9.5	6.4	8	8.6	11	9.7	3.7	9	9.3	-
	Selenium	mg/L			-	-	0.006	-	-	-	-	-	-	0.006	-	-	-	-	<0.001	-	-	-	-	0.001	-	-
	Vanadium Total	mg/L	0.001	0.1	0.001	0.001	<0.001	0.001	-	<0.001	<0.001	0.001	0.001	<0.001	0.001	-	0.001	0.001	0.001	0.001	<0.001	0.001	0.002	0.02	0.002	-
	Zinc	mg/L		0.015	-	-	0.018	-	-	-	-	-	-	0.002	-	-	-	-	0.006	-	-	-	-	0.029	-	-
Radionuclides	Radium-226	mBq/L			14	25	-	37	53	-	-	8	3	-	17	74	23	75	-	72	86	15	26	-	101	60
	Radium-228	mBq/L			100	100	-	100	100	-	-	100	100	-	100	100	100	100	-	100	181	100	100	-	100	150

Table C1
Groundwater analytical data (2013-2014)

				LocCode	DM8	DM8	DM8	DM8	DM8R	DM8R	DM8R	DM8R	DM8R	DM8R	DM8	DM8	DM8	DM8	DM9	DM9	DM9	DM9	DM9	DM9R	DM9R	DM9	DM9	DM9	DM9	DM9
				WellCode	d	d	d	d	d	d	d	s	s	s	s	s	s	s	d	d	d	d	d	d	s	s	s	s	s	s
				Sampled_Date-Time	16/01/2013	9/04/2013	10/10/2013	9/04/2014	10/10/2013	9/04/2014	16/10/2014	10/10/2013	9/04/2014	16/10/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/10/2014	16/10/2014	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014
Chem_Group	**ChemName**	**Units**	**EQL**	ANZECC 2000 MW 95%																										
	Carbonate as CaCO3	mg/L	1		-	-	-	-	-	-	<1	-	-	<1	-	-	-	-	-	-	-	-	-	<1	<1	-	-	-	-	-
	Na/Cl Ratio	ratio			0.1057	0.1026	-	0.09333	-	-	-	-	-	-	0.1059	0.07391	-	0.09375	0.6	0.6692	-	0.5471	-	-	-	-	-	-	-	-
Field	EC (field)	µS/cm			-	-	-	-	-	-	11,990	-	-	10,370	-	-	-	-	-	-	-	-	1139	-	-	-	-	-	-	1156
	pH (Field)	pH			6.77	6.85	7.06	6.74	-	-	6.74	-	-	6.78	6.97	6.86	6.95	6.81	6.77	6.66	7.05	7.06	6.77	-	-	7.04	6.93	7.4	6.94	6.67
	Temp (field)	oC			-	-	-	-	-	-	20.3	-	-	20.2	-	-	-	-	-	-	-	-	20.3	-	-	-	-	-	-	20.2
Inorganics	Ammonia as N	µg/L			-	-	-	-	<1000	-	-	1000	-	-	-	-	-	-	-	-	<1000	-	-	-	-	-	-	<1000	-	-
	Bicarbonate	mg/L			150	130	-	170	-	-	-	-	-	-	190	180	-	180	310	300	-	290	-	-	-	-	-	-	-	-
	Bicarbonate as CaCO3	mg/L	1		-	-	-	-	130	-	150	330	-	240	-	-	-	-	-	-	140	-	-	310	120	-	-	320	-	-
	Chloride	mg/L			3500	3900	-	4500	4100	-	3800	250	-	3100	3400	4600	-	4800	120	130	250	170	-	160	260	-	-	150	-	-
	Nitrate (as N)	mg/L			0.2	0.3	-	0.2	0.7	-	-	4.6	-	-	0.2	0.2	-	0.2	0.9	1.1	<0.2	2	-	-	-	-	-	2	-	-
	Redox Potential	mV			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sodium	mg/L	0.05		370	400	-	420	290	-	410	140	-	390	360	340	-	450	72	87	130	93	-	110	130	-	-	90	-	-
	Sulphate	mg/L	5		730	480	-	740	630	-	690	32	-	700	730	610	-	860	40	31	20	40	-	53	38	-	-	46	-	-
	TDS (evap)	mg/L	10		10,500	11,200	-	10,600	9500	-	10,700	770	-	8640	9540	12,400	-	10,900	600	600	610	620	-	700	710	-	-	610	-	-
Lead	Lead Total	mg/L	0.001	0.0044	0.001	0.001	-	0.001	0.002	-	<0.001	<0.001	-	<0.001	0.0025	0.001	-	0.001	0.0028	0.001	0.002	0.001	-	<0.001	<0.001	-	-	<0.001	-	-
Metals	Arsenic	mg/L			-	-	-	-	0.003	-	-	0.004	-	-	-	-	-	-	-	-	0.001	-	-	-	-	-	-	0.004	-	-
	Boron	mg/L	0.005		0.23	0.2	-	0.16	0.27	-	0.24	0.52	-	0.4	0.37	0.26	-	0.26	0.075	0.064	0.098	0.061	-	0.11	0.061	-	-	0.085	-	-
	Cadmium	mg/L	0.0001	0.0055	0.0001	0.0001	-	0.0001	0.0001	-	<0.0001	0.0001	-	<0.0001	0.0001	0.0001	-	0.0001	0.0001	0.0001	<0.0001	0.0001	-	<0.0001	<0.0001	-	-	<0.0001	-	-
	Calcium	mg/L	0.005		1060	900	-	1110	1100	-	1060	86	-	800	960	1000	-	1090	96	84	70	110	-	98	73	-	-	93	-	-
	Chromium (hexavalent)	mg/L	0.001	0.0044	0.001	0.001	-	0.001	<0.001	-	<0.001	<0.001	-	<0.001	0.001	0.001	-	0.001	0.001	0.001	<0.001	0.1	-	0.037	<0.001	-	-	0.047	-	-
	Chromium Total	mg/L	0.001		0.001	0.002	-	0.001	0.001	-	<0.001	0.001	-	<0.001	0.002	0.003	-	0.001	0.32	0.13	0.005	0.13	-	0.037	<0.001	-	-	0.092	-	-
	Chromium (Trivalent)	mg/L	0.001	0.0274	-	-	-	-	-	-	<0.001	-	-	<0.001	-	-	-	-	-	-	-	-	-	<0.001	<0.001	-	-	-	-	-
	Cobalt	mg/L	0.001	0.001	0.001	0.001	-	0.001	<0.001	-	<0.001	<0.001	-	<0.001	0.001	0.001	-	0.001	0.001	0.001	<0.001	0.001	-	<0.001	<0.001	-	-	<0.001	-	-
	Copper Total	mg/L	0.001	0.0013	0.001	0.001	-	0.001	0.005	-	0.002	0.001	-	0.001	0.004	0.003	-	0.001	0.0026	0.001	0.011	0.001	-	<0.001	0.002	-	-	0.003	-	-
	Iron	mg/L	0.005		18	5.3	-	17	-	-	15	-	-	2.7	5.3	4.1	-	7.3	2.9	3.1	-	0.49	-	0.1	18	-	-	-	-	-
	Magnesium	mg/L	0.005		980	820	-	900	960	-	860	34	-	740	930	930	-	1060	35	28	16	37	-	33	16	-	-	36	-	-
	Manganese	mg/L	0.001		2.3	1.7	-	3.1	1.3	-	3.6	0.077	-	0.046	0.24	0.11	-	0.5	0.25	0.12	0.13	0.023	-	0.009	0.13	-	-	0.069	-	-
	Mercury	mg/L	0.0001	0.0004	0.0001	0.0001	-	0.0001	<0.0001	-	<0.0001	<0.0001	-	<0.0001	0.0001	0.0001	-	0.0001	0.0001	0.0001	<0.0001	0.0001	-	<0.0001	<0.0001	-	-	<0.0001	-	-
	Molybdenum	mg/L	0.001		-	-	-	-	0.001	0.001	<0.001	0.055	0.009	0.019	-	-	-	-	-	-	0.001	<0.001	-	<0.001	<0.001	-	-	<0.001	<0.001	-
	Nickel	mg/L	0.001	0.07	0.001	0.003	-	0.001	0.002	-	<0.001	0.001	-	<0.001	0.003	0.004	-	0.001	0.001	0.001	0.001	0.001	-	<0.001	<0.001	-	-	0.001	-	-
	Potassium	mg/L	0.05		19	15	-	13	15	-	35	13	-	30	19	14	-	14	4.8	3.8	7	2.5	-	4.1	10	-	-	4	-	-
	Selenium	mg/L			-	-	-	-	0.008	-	-	0.009	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-	<0.001	-	-
	Vanadium Total	mg/L	0.001	0.1	0.001	0.001	-	0.001	0.001	-	<0.001	0.001	-	<0.001	0.001	0.001	-	0.001	0.001	0.001	0.002	0.001	-	0.001	<0.001	-	-	0.003	-	-
	Zinc	mg/L		0.015	-	-	-	-	0.02	-	-	0.004	-	-	-	-	-	-	-	-	0.022	-	-	-	-	-	-	0.011	-	-
Radionuclides	Radium-226	mBq/L			47	38	-	64	-	-	70	-	-	110	29	79	-	79	24	111	-	3	3	-	-	-	-	-	-	184
	Radium-228	mBq/L			100	100	-	100	-	-	100	-	-	104	100	197	-	100	100	200	-	100	142	-	-	-	-	-	-	603

Table C1
Groundwater analytical data (2013-2014)

				LocCode	MB3R	MB3R	MB3R	MB3R	MB3R	MB4	MB4	MB4	MB4	MB4	MB4	YB	YB	YB	YB	YB	YB	YB	YB	YB	YB	YB	YB	YB	YB
				WellCode	d	d	d	d	d	d	d	d	d	d	s		d	d	d	d	d	d	d	d	d	d	d	d	d
				Sampled_Date-Time	16/01/2013	9/04/2013	10/10/2013	9/04/2014	16/10/2014	16/01/2013	10/10/2013	9/04/2014	22/05/2014	16/10/2014	16/10/2014	16/10/2014	8/01/2013	16/01/2013	16/02/2013	20/03/2013	9/04/2013	6/05/2013	11/07/2013	10/10/2013	29/01/2014	9/04/2014	16/07/2014	16/10/2014	22/01/2015
Chem_Group	ChemName	Units	EQL	ANZECC 2000 MW 95%																									
	Carbonate as CaCO3	mg/L	1		-	-	-	-	<1	-	-	-	-	<1	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-
	Na/Cl Ratio	ratio			0.6909	-	0.375	0.6111	-	0.6471	0.5556	0.6316	-	-	-	-	0.47	0.387	-	-	0.3423	-	0.4286	0.45	0.44	0.5	-	-	-
Field	EC (field)	µS/cm			-	-	-	-	1387	-	-	-	-	-	1890	-	-	-	-	-	-	-	-	-	-	-	908	870	843
	pH (Field)	pH			6.92	6.84	6.3	6.95	6.47	7.02	6.69	7.56	-	-	7.22	-	-	6.62	-	-	6.67	-	5.92	7.4	6.55	7.47	6.4	6.77	5.78
	Temp (field)	oC			-	-	-	-	20.9	-	-	-	-	-	21.3	-	-	-	-	-	-	-	-	-	-	-	19	20.4	21.8
Inorganics	Ammonia as N	µg/L			-	-	<1000	-	-	-	<1000	-	-	-	-	-	-	-	-	-	-	-	-	<1000	-	-	-	-	-
	Bicarbonate	mg/L			470	-	450	420	-	360	430	520	280	-	-	-	-	52	-	-	52	-	88	69	-	79	-	-	-
	Bicarbonate as CaCO3	mg/L	1		-	-	450	-	440	-	430	-	-	290	-	77	-	-	-	-	-	-	-	69	-	-	-	-	-
	Chloride	mg/L			110	-	240	180	140	170	2700	190	2200	320	-	200	190	230	210	210	260	210	210	200	250	220	-	-	-
	Nitrate (as N)	mg/L			15.4	-	18	16	-	5.9	8	6.3	0.2	-	-	-	-	0.2	-	-	0.2	-	0.2	<0.2	-	0.2	-	-	-
	Redox Potential	mV			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	164	-	-
	Sodium	mg/L	0.05		76	-	90	110	85	110	1500	120	1030	200	-	91	90	89	100	100	89	90	90	90	110	110	-	-	-
	Sulphate	mg/L	5		56	-	26	60	49	110	450	110	370	210	-	16	-	23	-	-	12	-	15	22	-	17	-	-	-
	TDS (evap)	mg/L	10		860	-	820	900	880	910	5220	930	4680	1300	-	820	-	570	-	-	610	-	480	450	-	500	-	-	-
Lead	Lead Total	mg/L	0.001	0.0044	-	-	<0.001	0.001	<0.001	0.0031	0.41	0.72	0.001	<0.001	-	<0.001	-	0.001	-	-	0.001	-	0.001	<0.001	-	0.005	-	-	-
Metals	Arsenic	mg/L			-	-	0.002	-	-	-	0.029	-	-	-	-	-	-	-	-	-	-	-	-	0.001	-	-	-	-	-
	Boron	mg/L	0.005		0.12	-	0.12	0.1	0.16	0.11	0.84	0.14	0.34	0.15	-	0.026	-	0.039	-	-	0.029	-	0.019	0.026	-	0.025	-	-	-
	Cadmium	mg/L	0.0001	0.0055	-	-	<0.0001	0.0001	<0.0001	-	0.001	0.002	0.0001	<0.0001	-	<0.0001	-	0.0001	-	-	0.0001	-	0.0001	<0.0001	-	0.0001	-	-	-
	Calcium	mg/L	0.005		170	-	180	210	180	160	150	300	260	180	-	38	-	41	-	-	42	-	33	33	-	53	-	-	-
	Chromium (hexavalent)	mg/L	0.001	0.0044	-	-	<0.001	0.001	<0.001	-	<0.001	0.001	0.001	<0.001	-	<0.001	-	0.001	-	-	0.001	-	0.001	<0.001	-	0.002	-	-	-
	Chromium Total	mg/L	0.001		0.001	-	0.002	0.001	0.001	0.001	0.013	0.026	0.006	<0.001	-	<0.001	-	0.001	-	-	0.001	-	0.001	0.003	-	0.005	-	-	-
	Chromium (Trivalent)	mg/L	0.001	0.0274	-	-	-	-	<0.001	-	-	-	-	<0.001	-	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cobalt	mg/L	0.001	0.001	-	-	<0.001	0.001	<0.001	-	0.002	0.004	0.001	<0.001	-	0.001	-	0.001	-	-	0.001	-	0.001	<0.001	-	0.001	-	-	-
	Copper Total	mg/L	0.001	0.0013	-	-	0.003	0.001	<0.001	-	0.028	0.028	0.001	<0.001	-	<0.001	-	0.001	-	-	0.001	-	0.002	0.001	-	0.003	-	-	-
	Iron	mg/L	0.005		0.24	-	-	0.16	0.27	1.2	-	77	31	17	-	24	-	24	-	-	12	-	24	-	-	29	-	-	-
	Magnesium	mg/L	0.005		41	-	45	49	37	37	180	48	140	46	-	12	-	19	-	-	18	-	-	12	-	13	-	-	-
	Manganese	mg/L	0.001		0.075	-	0.13	0.033	0.002	0.037	0.42	0.76	0.53	0.27	-	0.1	-	0.09	-	-	0.11	-	0.099	0.1	-	0.17	-	-	-
	Mercury	mg/L	0.0001	0.0004	-	-	0.0001	0.0001	<0.0001	-	<0.0001	0.0001	0.0001	<0.0001	-	<0.0001	-	0.0001	-	-	0.0001	-	0.0001	<0.0001	-	0.0001	-	-	-
	Molybdenum	mg/L	0.001		-	-	0.002	0.002	0.002	-	0.005	0.003	-	<0.001	-	<0.001	-	-	-	-	-	-	-	<0.001	-	<0.001	-	-	-
	Nickel	mg/L	0.001	0.07	-	-	0.001	0.001	<0.001	-	0.004	0.008	0.001	<0.001	-	<0.001	-	0.001	-	-	0.001	-	0.001	<0.001	-	0.001	-	-	-
	Potassium	mg/L	0.05		12	-	7	6.7	10	7.8	150	10	25	13	-	10	-	8.1	-	-	5.8	-	8	8	-	8.3	-	-	-
	Selenium	mg/L			-	-	<0.001	-	-	-	0.003	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Vanadium Total	mg/L	0.001	0.1	-	-	0.002	0.002	0.001	-	0.034	0.074	-	0.001	-	<0.001	-	0.001	-	-	0.001	-	0.001	0.002	-	0.008	-	-	-
	Zinc	mg/L		0.015	-	-	0.008	-	-	-	4.5	-	-	-	-	-	-	-	-	-	-	-	-	0.003	-	-	-	-	-
Radionuclides	Radium-226	mBq/L			8	12	-	37	37	3	-	66	-	3	-	-	-	36	-	-	56	-	56	-	29	74	-	66	-
	Radium-228	mBq/L			100	100	-	100	150	100	-	100	-	100	-	-	-	100	-	-	100	-	100	-	100	100	-	100	-

GHD

1st Floor 10 Victoria Street
Bunbury WA 6230
T: 08 9721 0700   F: 08 9721 0777   E: bunmail@ghd.com.au

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	Alice Rentsch Dr Peter Beck	Dr Peter Beck Barry Mann		Ben Anderson		24/03/15
0	Alice Rentsch Dr Peter Beck	Dr Peter Beck		Fionnuala Hannon	Fionnuala Hannon	30/03/15
1	Alice Rentsch Dr Peter Beck	Dr Peter Beck		Fionnuala Hannon	Fionnuala Hannon	22/04/15

www.ghd.com

Appendix H

Key Correspondence on Future End Use

AECOM Australia Pty Ltd
Level 21, 420 George Street
Sydney NSW 2000
PO Box Q410
QVB Post Office NSW 1230
Australia
www.aecom.com

+61 2 8934 0000 tel
+61 2 8934 0001 fax
ABN 20 093 846 925

23 March 2015

Paul Sheedy
Shire of Capel
31 Forrest Road
Capel WA 6271

Dear Paul

Contaminated Sites Auditor Review of Cristal Solid Residue Disposal Facility - Health Risk Assessment, Revised Draft - Rev 3

1.0 Introduction

Jason Clay of AECOM Australia Pty Ltd (AECOM) has been engaged by the Shire of Capel (the Shire) as a Western Australia Department of Environment Regulation (DER)-accredited Contaminated Sites Auditor, under the *Contaminated Sites Act 2003*, for the Dalyellup Waste Residue Disposal Facility, located on Minninup Road, Dalyellup, Western Australia (the Site).

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned to prepare a Health Risk Assessment (HRA).

This letter presents the Auditor's review of the *Cristal Solid Residue Disposal Facility, Health Risk Assessment FINAL Draft – Rev 3*, February 2015 (ERM 2015).

2.0 Document Review

The Auditor is satisfied that across the various documents potential health risks have been shown to be not unacceptable under the proposed sports field use. As such the above document can be considered final.

3.0 Closure

Should you have any queries in relation to this review please do not hesitate to contact Jason Clay.

Yours sincerely
On behalf of **AECOM Australia Pty Ltd**

Jason Clay

Jason Clay
WA DER Accredited Contaminated Sites Auditor
jason.clay@aecom.com

This interim audit advice is not a Mandatory Auditor's Report, but forms part of the site audit process. It is intended that a Mandatory Auditor's Report will be issued at the completion of the site audit.

Consistent with WA DER requirements for staged "sign-off" of sites that are the subject of progressive assessment, remediation and validation, the Auditor is required to advise that:
- This interim audit advice does not constitute a Mandatory Auditor's Report.
- This interim audit advice is considered by the Auditor to be consistent with WA DER guidelines and policies.
- This interim audit advice will be included in the final Mandatory Auditor's Report and associated documentation.

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Mr Viv Laurie
Safety, Health and Environmental Manager
Cristal Pigment Australia Ltd
Locked Bag 245
BUNBURY WA 6230

Our Ref: *2013:0000262828:ST01-2013-0008*
Enquiries: *Annarie Boer, 6145 0840*
Email: *annarie.boer@epa.wa.gov.au*

Dear Mr Laurie

DALYELLUP FINAL REHABILITATION PROGRAMME – CONDITION 4 OF MINISTERIAL STATEMENT 213; AND CONDITIONS 4-1 AND 4-2 OF MINISTERIAL STATEMENT 332

Thank you for the submission of the revised 'Dalyellup Facility Final Closure Plan – Remediation-Validation-Ongoing Closure Report – June 2013' on 18 March 2015 and the 'Response to Radiological Council of WA letter, dated 31/01/2014' submitted on 20 August 2014.

These documents have been prepared to meet condition 4 of Ministerial Statement 213 and condition 4-1 of Ministerial Statement 332.

Condition 4 of Ministerial Statement 213 states:
4 *At least six months prior to decommissioning, the proponent shall prepare and subsequently implement a decommissioning and rehabilitation plan, to the satisfaction of the Environmental Protection Authority.*

Condition 4-1 of Ministerial Statement 332 states:
4-1 *At least six months prior to any planned decommissioning of the site, the proponent shall prepare a final rehabilitation programme to the requirements of the Radiological Council and the Environmental Protection Authority on the advice of the Shire of Capel.*

The 'Dalyellup Facility Final Closure Plan' and supporting information were reviewed and are considered to satisfy the requirements of these conditions. During the review of the documentation, the Department of Environment Regulation, the Radiological Council and the Shire of Capel were consulted. Advice for implementation of the Closure Plan is included in Attachment 1.

If there are any changes to the Closure Plan that would substantially affect the management actions or targets, the amended Plan would require submittal to the Office of Environmental Protection Authority.

You are reminded that this approval does not replace any responsibilities you may have for seeking approvals from other government agencies to implement the Closure Plan.

If you have any questions on the content of this letter, please contact Annarie Boer on (08) 6145 0840, or email <annarie.boer@epa.wa.gov.au>.

Yours sincerely

Kim Taylor
GENERAL MANAGER

8 April 2015

Encl.: Attachment 1: Advice for implementation of the Dalyellup Facility Final Closure Plan – Remediation-Validation-Ongoing Closure Report – June 2013

cc:
DER; Attn: Advice Coordinator
DER, Contaminated Sites Branch; Attn: Mr Andrew Miller
Shire of Capel; Attn: Mr Paul Sheedy
Radiological Council; Attn: Mr Duncan Surin

Attachment 1

Advice for implementation of the Dalyellup Facility Final Closure Plan – Remediation-Validation-Ongoing Closure Report – June 2013

Advice provided by the Radiological Council

Radiation monitoring

The Radiological Council supports the proponent's commitment for continued ongoing monitoring of the site upon closure and supports potential relaxation of aspects of monitoring. The detailed post-remediation monitoring program may be submitted for review to assess monitoring relaxation options on completion of remediation. Note that monitoring after reclassification of the site by the Contaminated Sites Branch of the DER will be regulated under the *Contaminated Sites Act 2003.*

Rehabilitation and management

The Radiological Council endorses the proposal to cover the disposal ponds with at least 2 metres of neutral fill, which should ensure that the gamma radiation levels are essentially the same as the surrounding area and that emanation of radon and thoron are unlikely to be significant.

The Radiological Council reiterates that the most significant radiological aspect to be flagged is ensuring that there will be no future intrusion of the final landform after rehabilitation. The proposed end use of the site and 2 metres of capping over the disposal ponds should minimise the possibility of intrusion.

The conceptual plan incorporating sport fields and ovals over the facility is congruent with the approved Radiation Management Plan of June 1988 as revised September 1993 and the Staged Rehabilitation Program of August 1993.

Further assessment conducted

The proponent submitted documentation prepared by radiation professionals indicating the concentration of stable lead generated from the decay of radon, thorium and uranium (in tailings) is calculated as 1.9 ppb to 70 ppb, which is significantly less than the concentration of lead in soil in the area (50 ppm).

Clarifications requested on the 'Final Closure Plan' submitted in June 2013, have been addressed in the amended 'Final Closure Plan' submitted on 18 March 2015 and 'Response to RCWA letter, dated 31/01/2014' submitted to the OEPA on 20 August 2014.

Advice provided by the DER

The Dalyellup Facility Final Closure Plan – Remediation-Validation-Ongoing Closure Report – June 2013 is appropriate for implementation with regard to the following:

- the requirements of the *Contaminated Sites Act 2003* and the *Contaminated Sites Management Series Guidelines*, including reporting standards;
- the requirements of the *Closure Notice* relating to Licence number 6130/1989/12 issued under Section 68A of the *Environmental Protection Act 1986*; and
- scope and monitoring to collect information for site reclassification, with specific reference to the Site Management Plan (section 16) and Ongoing Monitoring (section 17).

On completion of rehabilitation, the site will be validated as suitable for the proposed end use, reclassified by the Contaminated Sites Branch of the DER and future management and monitoring requirements will be regulated under the *Contaminated Sites Act 2003* through an agreed ongoing site management plan.

Advice provided by the Shire of Capel

Implementation of rehabilitation specified in the Plan requires ongoing liaison between the Shire and Cristal Global until a decision on the two potential land use options is agreed.

Radiation Professionals

Telephone: +61 8 9325 9948
info@radsafe.com.au

ABN: 60 126 395 739

Peter Allen
Environmental Superintendent,
Cristal Pigment Australia Ltd
Locked Bag 245,
Bunbury W A 6230

Dear Peter

It is the opinion of Radiation Professionals that, based on the post capping radon, gamma, water and soil sampling data, plus the 20+ years of operational monitoring data prior to rehabilitation, the rehabilitation of the Dalyellup residue ponds has been successful in returning the radiological exposure levels to the public to a level commensurate with the local background.

Radiation Professionals believe there is no reason for further monitoring if the site remains undisturbed. Should any future development of the area be planned though, it should be kept in mind the history of the site.

Yours sincerely

Anthony O'Brien

Managing Director

11th June 2015

Government of **Western Australia**
Department of **Environment Regulation**

Your ref
Our ref DER2013/181 DMO1323
Enquiries Melanie Nunn
Phone 9333 7467
Fax 9333 7575
Email melanie.nunn@der.wa.gov.au

Jason Clay
Senior Principal
Senversa Pty Ltd
Level 14, 309 Kent Street,
Sydney NSW 2000

Dear Jason

MANDATORY AUDITORS REPORT, DALYELLUP TAILINGS FACILITY

Thank you for submitting the report "Mandatory Auditor's Report – Dalyellup Tailings Facility (AECOM 20 July 2015) (the MAR) and supporting consultants' reports to the Department of Environment Regulation (DER). The reports were received on 21 July 2015.

The former Dallyellup Tailings Facility (the site) operated under Part IV of the *Environmental Protection Act 1986* (licence L6130/1989/12). The site operated as a licenced facility for the disposal of Treated Solid Residue (TSR) from the production of titanium dioxide pigment between March 1989 and March 2013. The site comprised waste disposal ponds (two northern ponds, one central pond and two southern ponds), with the remainder of this lot being access roads and coastal dunes. The site was issued a Closure Notice by DER on 14 May 2013. This Closure Notice was revised on 1 August 2013.

DER notes that an interim MAR was submitted to DER in October 2013 in relation to the 'Dalyellup Facility Final Closure Plan-Remediation-Validation-Ongoing Closure Report-June 2013' (the Closure Plan). The Closure Plan was prepared in order to satisfy the conditions of Ministerial Statements (Condition 4 of Ministerial Statement 213; and Condition 4-1 of Ministerial Statement 332).

These conditions read as follows:

Ministerial Statement 213, Condition 4 reads "the proponent shall be responsible for decommissioning and removal of the plant and installations and rehabilitating the site and its environs, to the satisfaction of the Environmental Protection Authority. At least six months prior to decommissioning, the proponent shall prepare and subsequently implement a decommissioning and rehabilitation plan, to the satisfaction of the Environmental Protection Authority.'"

Ministerial Statement 332 Condition 4-1 reads "At least six months prior to any planned decommissioning of the site, the proponent shall prepare a final rehabilitation programme to the requirements of the Radiological Council and the Environmental Protection Authority on advice of the Shire of Capel."

These conditions were cleared by the Environmental Protection Authority in a letter dated 8 April 2015.

As stated in the MAR, this audit falls under the requirements of Regulation 31(1)(c) of the Contaminated Sites Regulations 2006 and relates to Condition 4-2 of Ministerial Statement 332, published 6 December 1993 which reads as follows:

Ministerial Statement 332 Condition 4-2 reads "The proponent shall implement the programme required by condition 4-1."

DER, the Department of Health (DoH) and the Radiological Council (RC) have reviewed the MAR and supporting documentation. Further information is required prior to the reclassification of the site. Specific information required by DoH and RC is provided in technical advice letters included as Attachment 1 and Attachment 2. DER concurs with DoH and RC advice and has included the following DER comments which should be read in conjunction with DoH and RC technical advice letters.

Potential Leachate and Ecological Risks:

With regards to travel time of leachate from the pond area to the water table, asserting that it will take 30 years for water to travel from the residue storage area to the water table is not correct. Dating of water at the water table in coastal areas suggests that water is only a few years old even when the water table is 20 to 30m deep.

With regard to the leaching tests that were undertaken at the site, the ASLP leaching procedure is unlikely to give a good indication of the leachability of the residues under chemical conditions present in soils. In particular, there is likely to be an elevated partial pressure of carbon dioxide in soil pore water. This chemical factor, together with the presence of nitrate leached from the application of fertiliser on turf overlying the residue containment area, is likely to exacerbate the mobilisation of uranium and some other chemical constituents from the residues. The ongoing irrigation of turf is also likely to produce sufficient infiltration of water through the residues to transport soluble chemical constituents away from the residue storage area.

Additionally, DER considers that there has been an inadequate assessment of radionuclides in groundwater and in the groundwater discharge zone. The proponent has assumed that radiological constituents in the wastes will have a limited leachability and will not infiltrate to the water table. This assumption is unlikely to be the case for radium in particular which has similar behaviours to calcium. It is noted from the reports provided that large amounts of calcium appeared to be leaching from the waste material in the pond, which suggests that radium will be leaching as well.

DER agrees that local hydrogeological conditions will make it unlikely that contamination from the residues will infiltrate into the Yarragadee aquifer.

Given the above, further information is requested regarding the potential leachability of chemicals of concern with regards to ongoing irrigation, including increased nutrient input through fertiliser use and the proposed reuse of waste water.

Environmental Management Plan

DER understands that the Environmental Management Plan (EMP) for the site has been prepared in order to detail the ongoing monitoring and management in accordance with proposed closure and rehabilitation measures. Revision of the proposed EMP is required to ensure that the appropriate monitoring and management strategies are in place, and that the implementation of these strategies aligns with current guidance.

The duration of the monitoring program needs to be reviewed and DER considers it is likely that groundwater monitoring will be required for a period greater than 5 years. There is some uncertainty in the travel time of groundwater and the potential leachability of chemicals of potential concern as a consequence of the proposed irrigation regime and intense fertiliser use. There is also some uncertainty relating to risks to the marine environment.

DER would like to reiterate RC advice that no disturbance of tailings material is permitted and that a minimum of 2m of clean fill should be maintained at all times across the site. The EMP should be updated to ensure that this criterion is met. There is insufficient information around how excavations will be managed, particularly at depths greater than 1m. While a radiation management plan is proposed, further detail is required as to what standards/guidelines will be adopted and how this aligns with RC advice.

DER notes that the EMP proposes the potential for the construction of an abstraction bore down gradient of the recharge area. DER would like to reiterate, and based on Auditor recommendations for restriction on land use, that groundwater abstraction, including dewatering, is not permitted at the site.

As the Closure Notice (6130/1989/12) is due for review (October 2015), consideration should also be given to any amendments included as a consequence of this review. Any relevant changes should be included, or referenced for inclusion, in the amended EMP.

Please note that other issues may need to be considered in addition to the comments above to ensure this EMP meets the standards required. When further information is submitted, DER will assess and consider the reclassification of the site.

If you have any further queries, please contact Contaminated Sites Officer, Melanie Nunn, on 9333 7467.

Yours sincerely

Paul Newell
A/SENIOR MANAGER
CONTAMINATED SITES

3 November 2015

c.c.
Cristal Pigment Australia, Peter Allen
Office of Environmental Protection Authority, General Manager
Department of Health, Martin Matisons
Radiological Council, Duncan Surin

Attachment 1: Department of Health-Environmental Health Directorate advice letter dated 19 August 2015
Attachment 2: Radiological Council advice letter dated 29 September 2015

DEC 1637
A980113

Government of **Western Australia**
RADIOLOGICAL COUNCIL

Address all correspondence to
The Secretary

Your ref DMO1323
Our ref CS412_150918ds1
Enquiries Mr D Surin 08 9388 4999

REPORT [illegible]
1323
Re: PC-IR
Mel
Mel

Mr Andrew Miller
A/Manager, Contaminated Sites Branch
Department of Environment Regulation
Locked Bag 33
CLOISTERS SQUARE WA 6850

Attn: Ms Melanie Nunn

DEPARTMENT OF ENVIRONMENT
REGULATION
29 SEP 2015
Corporate Information Section

Dear Ms Nunn

RADIATION SAFETY ACT
Mandatory Audit Report for the former Dalyellup Tailings Facility

Thank you for your letter of 29 July 2015 regarding the request for technical advice on radiological contamination for the above site. As you are aware, further clarification and information was sought from Iluka Resources and was received in May 2014.

The Council has also provided advice on this site when it was operational to the Contaminated Sites Branch on 29 September 2009 (your reference DEC1637, our reference CS412_090925ds1).

***Radiation*[i]**

The documentation provided with the request for technical advice has been reviewed by officers of the Radiological Council. The overall conclusion in the report to classify the site as ***remediated for restricted use*** is supported, with the proposed site use being for public open space and recreating grounds.

In the assessment of the proponent's *Final Closure Plan*, the Council stated that it had no objections to the plan with respect to those aspects covering radiation safety and management, with the exception of the timing of the cessation of radiation monitoring. The Council supported the proponent's commitment for continued ongoing monitoring of the site upon closure, but stated that it would be prudent that amendments in monitoring from the operational stage (as set

out in the Operational Radiation Monitoring Program) to the post-rehabilitation stage be clearly identified in a separate protocol or plan as provided for in the *Radiation Management Plan – Decommissioning and Rehabilitation*. This would also include the potential for the relaxation of any monitoring requirements during the specified control period, only where the remediation validation has been verified and approved by the relevant authorities including the Radiological Council and, where appropriate, the Department of Environment Regulation and Environmental Protection Authority.

The Council reiterates that the most significant radiological aspect to be flagged is in ensuring that there will be no future intrusion of the site after rehabilitation. The proposed end use of the site and 2 metres of capping over the disposal ponds should minimise the possibility of intrusion. A memorial placed on the land title will be required under the Contaminated Sites legislation, to ensure that the site is marked into perpetuity and that the future land use is restricted to approved activities.

The following comments are provided on the Mandatory Auditor's Report –

Section 3.1, page 13	The *Central Tailings Pond, Area 4 and Area 5 Validation* section states that the thickness of the capping was 1.7 m at sampling location CTP01. A capping layer at a thickness of 2 m was stipulated and approved in the Final Closure Plan. This is the minimum level of cover required under the *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)* published by the National Health and Medical Research Council. It is not clear whether any further work was undertaken near this area.
Section 4.2.2, page 17	The section discusses that the site of the facility is located within the buffer zone for the Bunbury Sewerage Treatment Works. Section 2.0 / table 2 (page 5) further lists the site owner for Lot 9077 as Cristal Pigment Australia Ltd and for Lot 9102, which constitutes the land for the previous 'Eastern Turning Circle', as the Department of Housing (see also section 4.1, page 17). It would be prudent to discuss whether buffer zones have been established for the tailings facility. This would be particularly beneficial due to the encroaching Dalyellup Residential Estate.

Section 4.7.2, page 20	The auditor reports that the "radiation data obtained as part of the investigations provided a suitable basis for characterisation of radiation at the Site". Although this conclusion may be correct, the section only quotes gamma radiation levels and not any other radiation exposure pathways.

Should you have any further queries on this matter, please contact Mr Duncan Surin at this office.

Yours faithfully

Ha. upton

Ms Hazel Upton
Secretary, Radiological Council

24 SEP 2015

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[i] ***Disclaimers***

- This advice is on radiation only and has been prepared on the request for advice submitted by the DER on 29 July 2015, and further information provided which includes –
  - Mandatory Auditor's Report, Dalyellup Tailings Facility (Jason Clay, 20 July 2015) and associated appendices.

  Any subsequent changes to the land use and resulting occupancy may render one or more of the recommendations invalid and Council should be contacted for further advice.
- The dose limits used in preparing the report are based on guidelines accepted by the Radiological Council. These conservative guidelines acknowledge that the dose limits have been consistently reduced over time and apply the ALARA principle recommended by the International Commission on Radiological Protection.

Government of **Western Australia**
Department of **Health**
Environmental Health Directorate

Our ref: EHB1887
Your ref: DMO1323
Enquiries: Lindy Nield
Phone: 9388 4977
Email: Linda.Nield@health.wa.gov.au

DEPARTMENT OF ENVIRONMENT
REGULATION
19 AUG 2015
Corporate Information Section

SCANNED

RECORD ALLOCATION DER2013/001181
A954345
DMO: 1323
Classification: Re: PC-IR
Officer: Mel
New Officer: mel

Mr Andrew Miller – Senior Manager
Contaminated Sites
Department of Environment Regulation
Locked Bag 33
Cloisters Square
PERTH WA 6850

Dear Andrew,

MANDATORY AUDIT REPORT FOR THE FORMER DALLYELLUP TAILINGS FACILITY

Thank you for your correspondence dated 29 July 2015 requesting advice under s.13(5)(a) of the *Contaminated Sites Act 2003* (the Act), in relation to Mandatory Audit Report (MAR) for this site. This letter provides comment on the adequacy of the remediation works with consideration of auditor assumptions and the health risk assessment. Issues related to radiation arising from traces of uranium and thorium in the residue material will be addressed by the Radiological Council who will provide separate correspondence.

Relevant officers of the Environmental Health Hazards Unit of Department of Health (DOH) have reviewed the following reports:

- Dalyellup Facility, Preliminary Closure Plan (Cristal, August, 2012)
- Dalyellup Facility, Final Closure Plan: Remediation-Validation-Ongoing Closure Report (Cristal, June 2013)
- Dalyellup Facility, Interim Site Management Plan: Site Consolidation - Earthmoving Works (Cristal, August 2013)
- Dalyellup Waste Residue Disposal Facility, Eastern Turning Circle Validation (GHD, December 2013)
- 2013 Dalyellup Annual Environmental Report (Cristal, June 2014)
- Dalyellup Facility - Rehabilitation Sand Stockpile Characterisation Program: Validation – Central Tailings Pond, Area 4 Area 5 (GHD, February 2015)
- Cristal Solid Residue Disposal Facility, Health Risk Assessment FINAL Draft – Rev 3 (ERM, February 2015)
- Environmental Management Plan – Lot 9077 on Deposited Plan 60716, Dalyellup (GHD, June 2015)
- Email from Steve Appleyard (Principal Hydrogeologist, Contaminated Sites, Department of Environment) dated 13 August 2015.

The following comments are provided:

- The site is known as the Dalyellup Waste Residue Disposal Facility and is located on Minninup Road, Dalyellup, adjacent Geographe Bay.
- Lot 9077 on DP60716 is owned by Cristal Pigment Australia Ltd. It stored Treated Solid Residue (TSR) from production of titanium dioxide pigment until March 2013 after 24 years of operation and was classified as *Possibly contaminated – investigation required* since 2009.
- Lot 9102 on DP401230 contains the Eastern Turning Circle (ETC) for trucks carrying the TSR to the storage ponds. It is not classified under the Act however it was audited due to potential contamination from haul truck movement. It is currently owned by the Housing Authority.
- Remediation involved capping the TSR ponds with approximately two metres of clean fill, after surface material from areas at higher elevations of TSR and surface layers of the ETC were collected and deposited on lower lying areas of the central tailings pond (CTP).
- The Shire of Capel's preferred land use option is to develop the remediated TSR ponds into sporting field facilities, with the second option of rehabilitating to a coastal dune environment for public open space.
- The Shire of Capel commissioned an HRA that has been submitted for review retaining the DRAFT watermark. It focussed on potential impacts at the site and did not assess the potential for future off-site health or amenity risks related to movement of leachate metals into the superficial aquifer to the public beach.
    - Management of on-site radiation from residual trace concentrations of uranium, thorium, heavy metals, dioxins and furans were considered to be the main chemicals of concern. The authors recommended the following management measures to ensure there were no risks to human health and the environment:
        - The quality and the thickness of the fill cover should be maintained (i.e. clean fill of at least 2 m).

- Shallow rooted species should be selected for revegetation.
- The quality and volume of water used for irrigation should be compliant with adopted standards.
- No onsite groundwater abstraction should be undertaken, other than for monitoring purposes as part of the rehabilitation monitoring program.

The DOH believes further detail on what constitutes "adopted standards" and improved characterisation of the leachability of metals present in the TSR are necessary to understand the potential for off-site impacts, particularly along the adjacent beach area. Without such evidence it is not possible to support the development of irrigated playing fields.

The Environmental Management Plan (EMP) (GHD, June 2015) outlines guidance on requirements for managing the following parameters:

- ongoing monitoring of radiation and groundwater to ensure ongoing stability and protection of the Yaragadee drinking water aquifer with the aim of reaching equilibrium within five years of decommissioning the facility;
- any disturbance to one metre below ground level, stating that disturbance at greater depths will require a task specific management plan;
- dust, weed and site access management;
- soil capping integrity and soil slumpage/subsidence management;
- infrastructure construction management;
- irrigation management and reporting.

The DOH supports most of actions outlined in the "EMP actions summary" in section 12 of the EMP (GHD, June 2015) however, as mentioned above, requires further detail in relation to leachability under proposed irrigation conditions for long-term management of potential release of heavy metals into the superficial aquifer that may lead to future contamination of the adjacent public beach-front.

The auditor concluded that "the Site is considered to be contaminated as defined in the Contaminated Sites Act 2003; however with appropriate manage (sic) under the current land use and proposed recreational sporting ground land use the Site is not considered to pose a risk to the identified receptors".

The auditor recommended a classification of *Remediated – Restricted Use*, with the following restrictions:

- The Environmental Management Plan (GHD 2015b) should be listed on the titles and the site owner(s) and occupier(s) should ensure it is executed appropriately.
- The Final Closure Plan Remediation Validation Ongoing Management Report (Cristal, 2013) should be followed.
- Land use should be restricted to public open space / recreational sporting grounds. Further assessments would be required for any change in land use requiring a development application or subdivision approval.
- Groundwater abstraction should be prevented at the Site to ensure that the identified receptors do not come into contact with the identified groundwater contamination.

The DOH is generally in agreement with the auditor however the investigations and EMP focus on receptors located at the site. The DOH believe that potential for future, off-site contamination is also important to manage public health issues associated with this site and that this issue has not yet been adequately addressed.

Based on this information and the auditor review, the DOH supports a classification of *Remediated – Restricted Use*, for rehabilitation of the storage ponds to a coastal dune environment land-use only. We will refrain from commenting on the suitability for this site to be used as playing fields until further and sufficient detail has been provided on the leachability of residual metals in the TSR (refer to advice from Steve Appleyard). With further scientific confidence, appropriate contingent strategies to manage potential impacts to public health or their perception can be developed. For example, tolerance to low levels of radiation or heavy metal contamination, such as chromium, onto the public beachfront is likely to present a highly contentious issue regardless of confirmation that of health risks to beachfront users, especially if such an issue could have been forecasted, monitored and prevented.

The DOH supports the restrictions recommended by the auditor with the following comments and qualifications:

- The proposed groundwater monitoring protocols are satisfactory however, it is noted that the EMP will need to be updated to accommodate further detail associated with final decisions on land-use, adopted irrigation plans, location and extent of hard-stand or synthetic fields that may reduce water volume, fertiliser requirements and their potential impacts on leachate conditions within the TSR.
- The EMP will be reviewed and updated on an annual basis, requiring review and comment by the auditor. The DOH recommends that the annual auditor review and updates should be automatically forwarded to the DER

to be appended to the site entry in the Contaminated Sites database to ensure the most current information is available and to verify compliance with this requirement.

- The EMP (GHD, June 2015, p9) states that "should three exceedances of the guidelines and a rising trend in an analyte be observed, a groundwater investigation to delineate the contamination may be required". The DOH suggests that changes to any conditions (e.g., pH or redox potential) that lead to mobilisation of toxic or radioactive heavy metals, will require an appropriate investigation that includes adequate stakeholder communication, in accordance with best practice risk management protocols that take public health and amenity into consideration.

If you have any concerns or queries, please do not hesitate to contact Lindy Nield by phone 9388 4977 or email Linda.Nield@health.wa.gov.au.

Yours sincerely,

Martin Matisons
PRINCIPAL TOXICOLOGIST
ENVIRONMENTAL HEALTH HAZARDS UNIT

17 August 2015

1508010nl Dalleyup_TSR Disposal Area_MAR_Radn_Metal

30 March 2015

Peter Allen
Cristal Pigments Australia Ltd
Locked Bag 245
Bunbury WA 6230

Our ref: 61/31852
14877
Your ref:

Dear Peter

Dalyellup Waste Residue Facility
Response to Department of Water

The Department of Water (DoW) provided a letter to Cristal Pigments Australia Ltd (Cristal) dated 13 August 2014 that outlined a regulatory perspective and comment on the 2013 Annual Environmental Report (2013 AER). The 2013 AER is associated with Cristal's Waste Residue Facility, located on Minninup Road, Dalyellup (Site).

In this letter the DoW provided a number of comments and raised some issues for further clarification. Please find a response to these comments and issues raised in the attached table. Also included with this letter is a Hydrogeological Assessment Report that provides further data and evaluation in relation to the TSR's interaction with the groundwater system at and around the site.

Please do not hesitate to contact us should you any further questions.

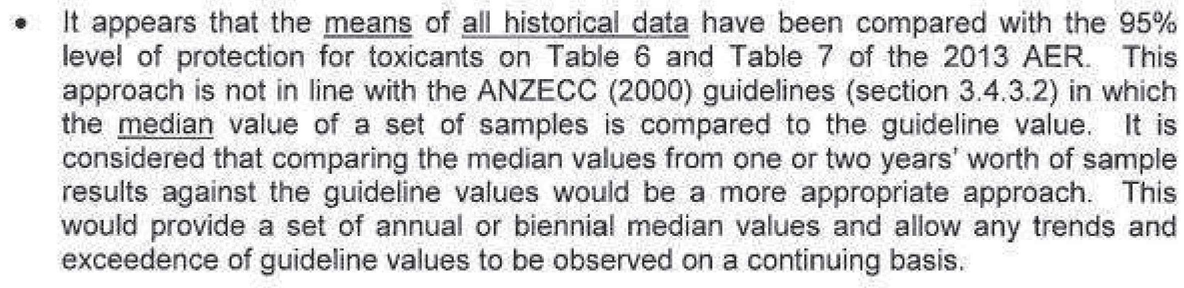
Sincerely
GHD Pty Ltd

Alice E. Rentsch.

Alice Rentsch
Environmental Scientist
61 8 9721 0722

Dr Peter Beck
Principal Environmental Engineer &
Accredited Contaminated Sites Auditor (WA, VIC, NSW)

1. *DoW Comment*

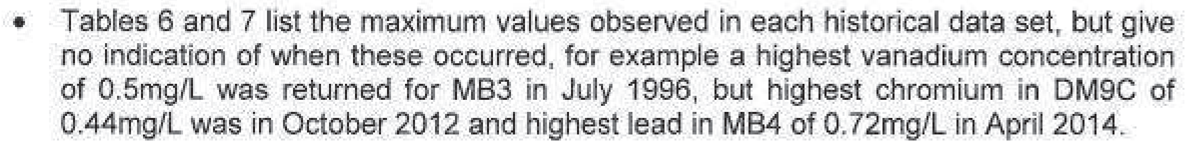


- It appears that the means of all historical data have been compared with the 95% level of protection for toxicants on Table 6 and Table 7 of the 2013 AER. This approach is not in line with the ANZECC (2000) guidelines (section 3.4.3.2) in which the median value of a set of samples is compared to the guideline value. It is considered that comparing the median values from one or two years' worth of sample results against the guideline values would be a more appropriate approach. This would provide a set of annual or biennial median values and allow any trends and exceedence of guideline values to be observed on a continuing basis.

1. *GHD Response*

The updated report includes a table that shows the minimum, maximum and median of each contaminant of concern measured in the groundwater and compares these to the ANZECC 2000 95% protection criteria. (Refer to Table 6 in revised report).

2. DoW Comment



- Tables 6 and 7 list the maximum values observed in each historical data set, but give no indication of when these occurred, for example a highest vanadium concentration of 0.5mg/L was returned for MB3 in July 1996, but highest chromium in DM9C of 0.44mg/L was in October 2012 and highest lead in MB4 of 0.72mg/L in April 2014.

2. GHD Response

Refer to revised report Table 6, which now includes this information.

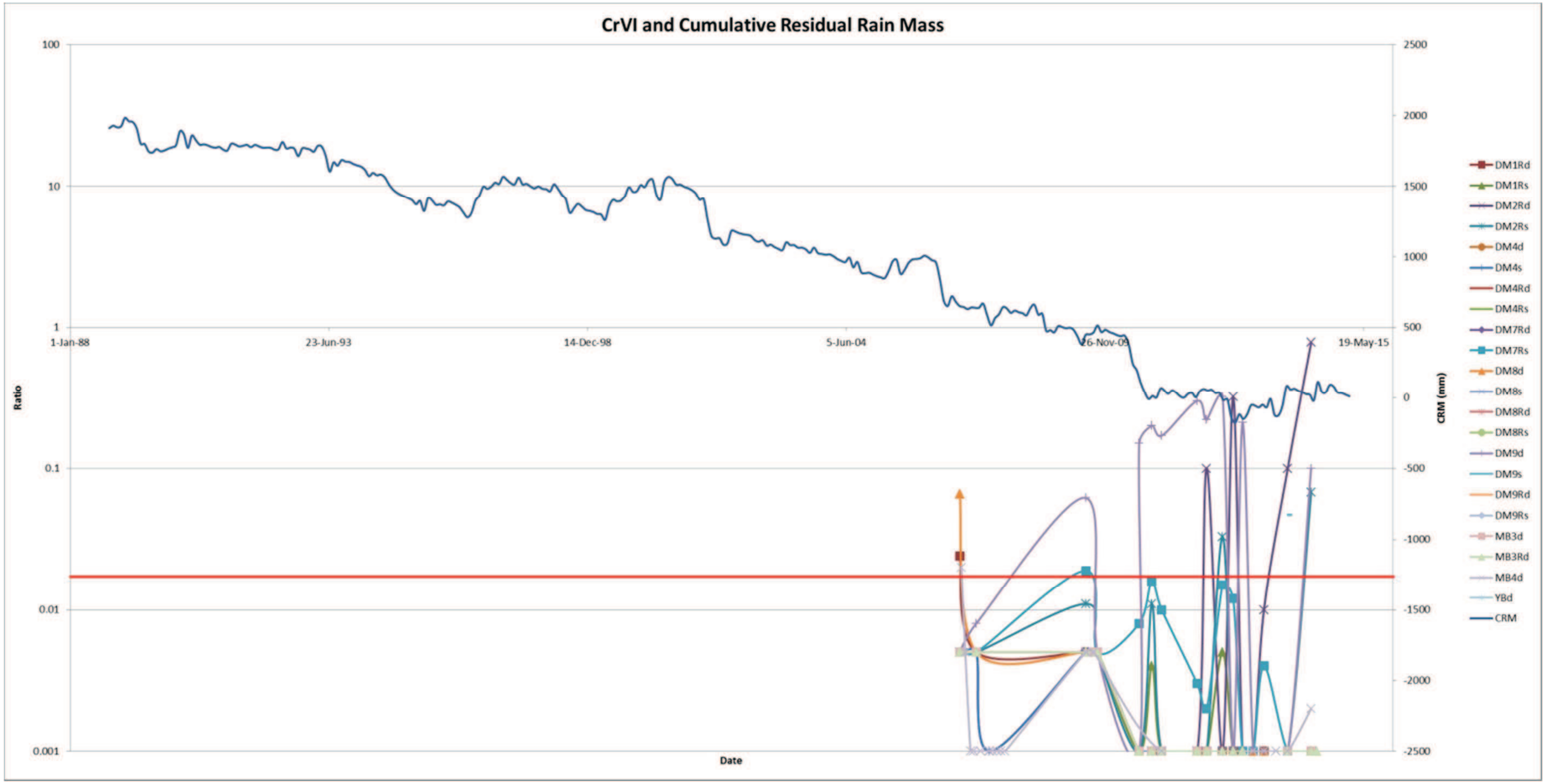
3. DoW Comment

- Historical data graphs in Appendix E are restricted to pH, electrical conductivity, water level and Na/Cl ratio. Concentrations of toxicants have not been illustrated in the same way making it difficult to observe any improving or deteriorating trends in the data. For example, vanadium rose in bore DM1A/C from 0.02 mg/L in June 1990 to 0.5mg/L in July 1995, before falling steadily to 0.001mg/L by August 2005.

3. GHD Response

Trend graphs were developed for Chromium and Vanadium and are presented below.

Chromium (VI) trend

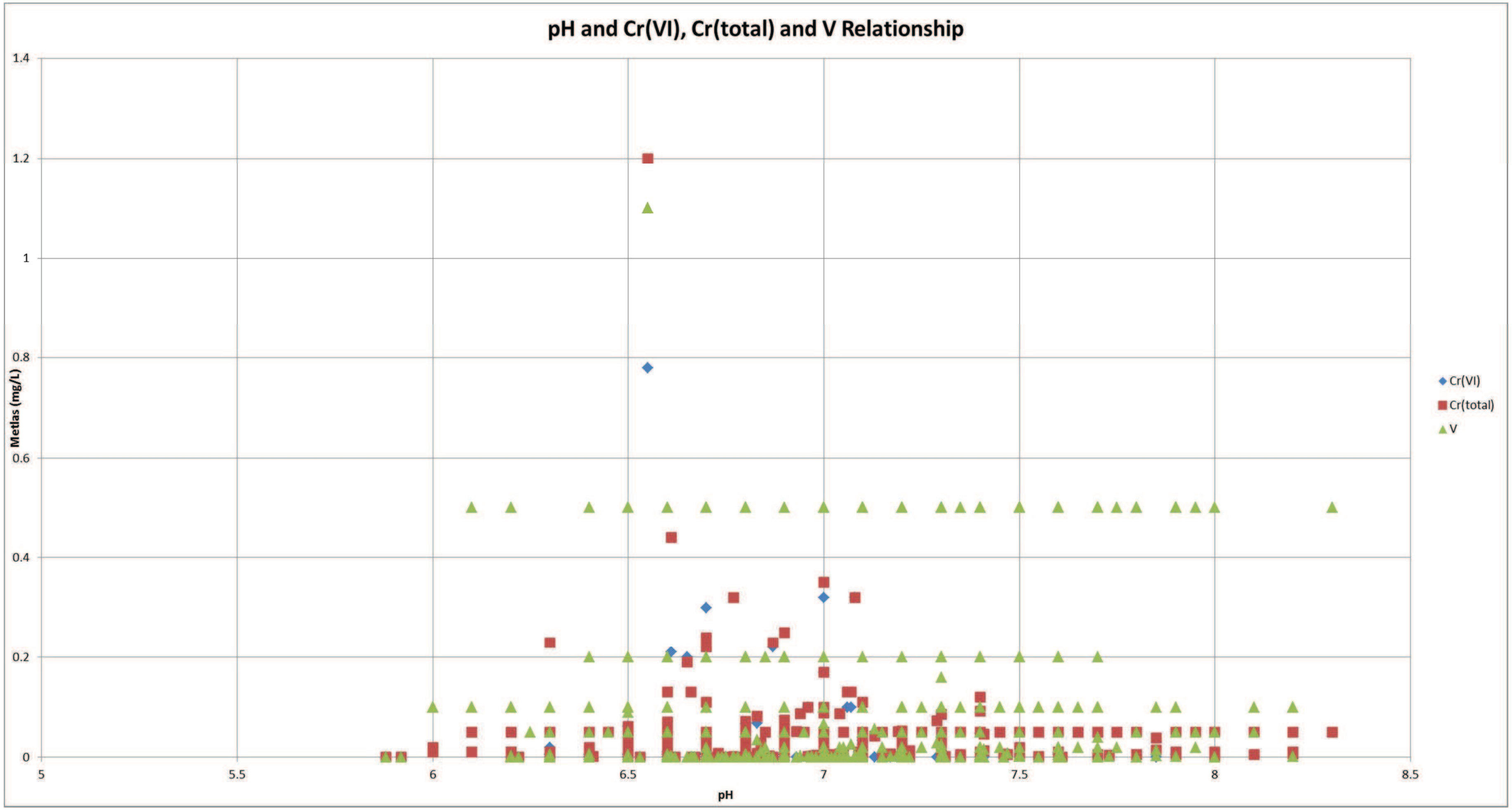


Chromium and Vanadium show a “spiked” concentration pattern, which occurs in several wells including:

- DM1 up-gradient
- DM4 down-gradient
- MB4 cross-gradient

Both chromium (VI) and vanadium generally occur as anions in solution. These dissolved species generally sorb onto aluminium and iron oxide and hydroxide surfaces on mineral grains under slightly acidic conditions. When pH in the groundwater system becomes neutral then the sorbed anions are released and occur in solution. The concentration occurrence coincides with neutral pH. Concentrations decrease when pH conditions become slightly acidic and sorption occurs.

pH and Chromium and Vanadium relationship



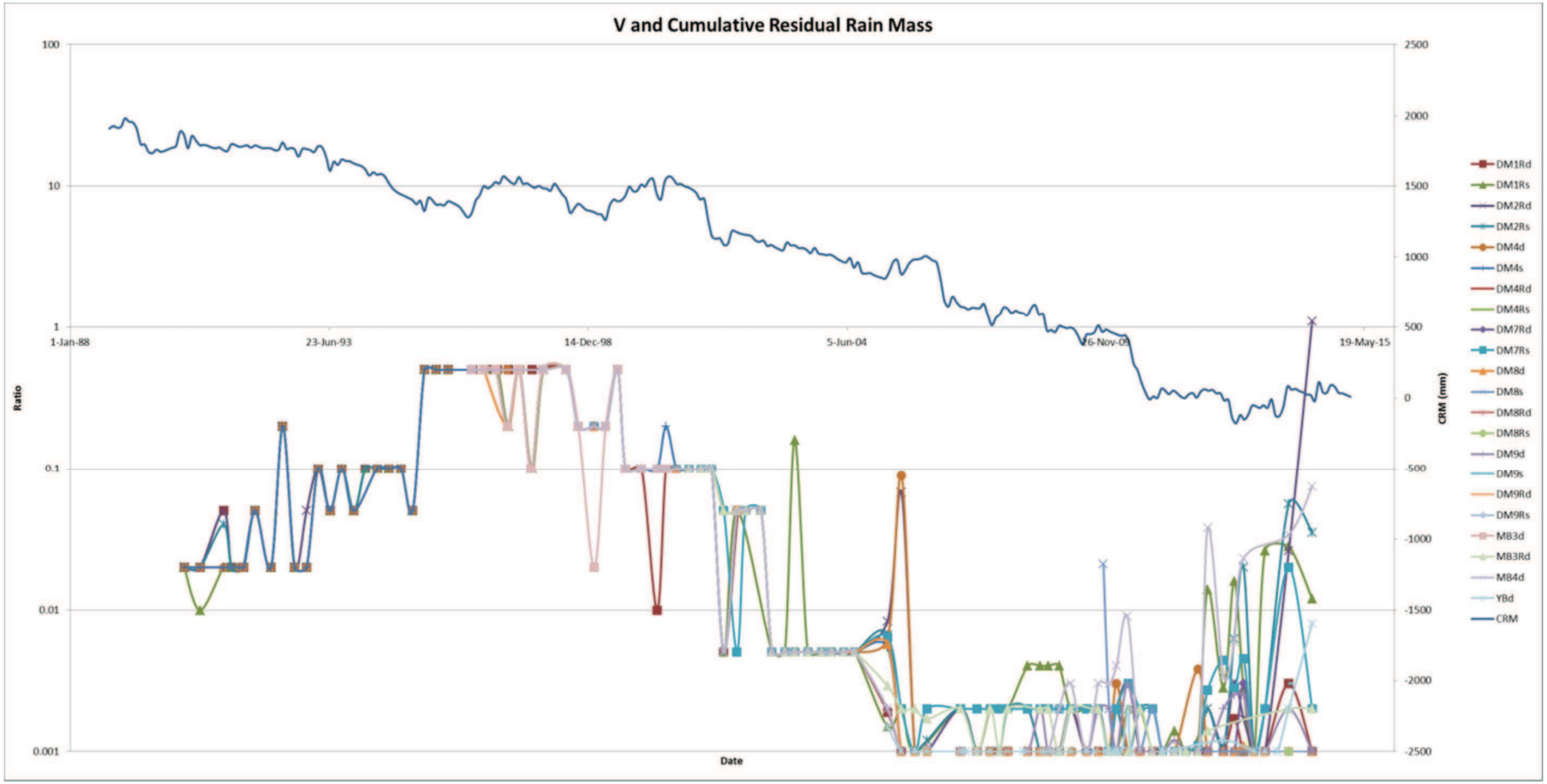
4. DoW Comment

- This variation in vanadium concentration was observed in both *Background* and *Downstream* bores and, considering that vanadium is listed as one of the toxicants contained in the Treated Solid Residue (TSR), deserves some comment as to its significance. Vanadium was not included in the list of Contaminants of Potential Concern (COPC) listed in ERM (2012) due to levels having returned below the screening criteria at the time of assessment.

4. GHD Response

As noted above, there appears to be a correlation between pH and vanadium concentration. This relationship appears to relate to sorption processes active in the groundwater system. Heavy metals including vanadium can naturally occur in groundwater systems as well as occur due to anthropogenic inputs.

Vanadium trends



As noted above vanadium concentration appears to be related to pH driven sorption behaviour and this process would apply to both naturally occurring and anthropogenically introduced vanadium. The concentration behaviour suggests that the primary mechanism for mobilisation is temporary desorption and resorption of vanadium anions and the behaviour is not consistent with a continuous mass loading source. The major ion analysis as outlined in the report suggests the TSR is leaching on a continual basis. It the TSR was a sole source of vanadium and the groundwater conditions were conducive to vanadium transport then the continual presence of vanadium concentrations should occur in the source zone wells. This is not the case in the observed concentration pattern in the source wells

Based on the data available information it appears that vanadium is mobilised periodically but there is no evidence to suggest that there are distinct trends in concentration and therefore application of median concentrations would be appropriate when assessing risk to the environment.

5. DoW Comment

- Chromium concentrations (an element also present in the TSR) have been rising in bore DM9C since 2009, peaking at 0.44mg/L in October 2012 (Table 6 misleadingly gives a maximum for DM1A/C & DM9A/C of only 0.029mg/L). Concentrations are still above guideline values even though this is deemed to be a *Background* bore. The rise in chromium has been accompanied by increases in the concentrations of iron and manganese, and a reduction in pH. The ERM (2012) report noted that *'High concentration of Cr in the well DM9C, located adjacent but upgradient of the activated central pond, infers the potential for a preferential pathway between the pond and this groundwater bore'*.

  Monitoring bore DM9C, is presented on the Conceptual Site Model at Figure 2 as being shallower than bore DM9A, but there is a discrepancy with the construction data in Appendix C of the 2013 AER which shows DM9C as being screened at a deeper level than DM9A. This discrepancy needs to be resolved as it has implications for the representation of the contamination plume shown on Figure 2.

  Figure 2 should be revised to show correct bore depths, screen depths and the base of the Superficial formations (around -10 to -15mAHD) against a true vertical scale in order to allow a proper appreciation of the relationships. For example, DM9A and DM9C are shown as having overlapping screened sections, but in reality there is a 14m separation of the screens. This means that the extent of the contaminant plume to the east is misrepresented and remains undefined.

  It is recommended that further investigations be conducted into identifying the spread of the contamination plume around DM9C (both laterally and vertically), and in assessing the potential risk to other users. This may require the reactivation or reconstruction of previously used monitoring bores.

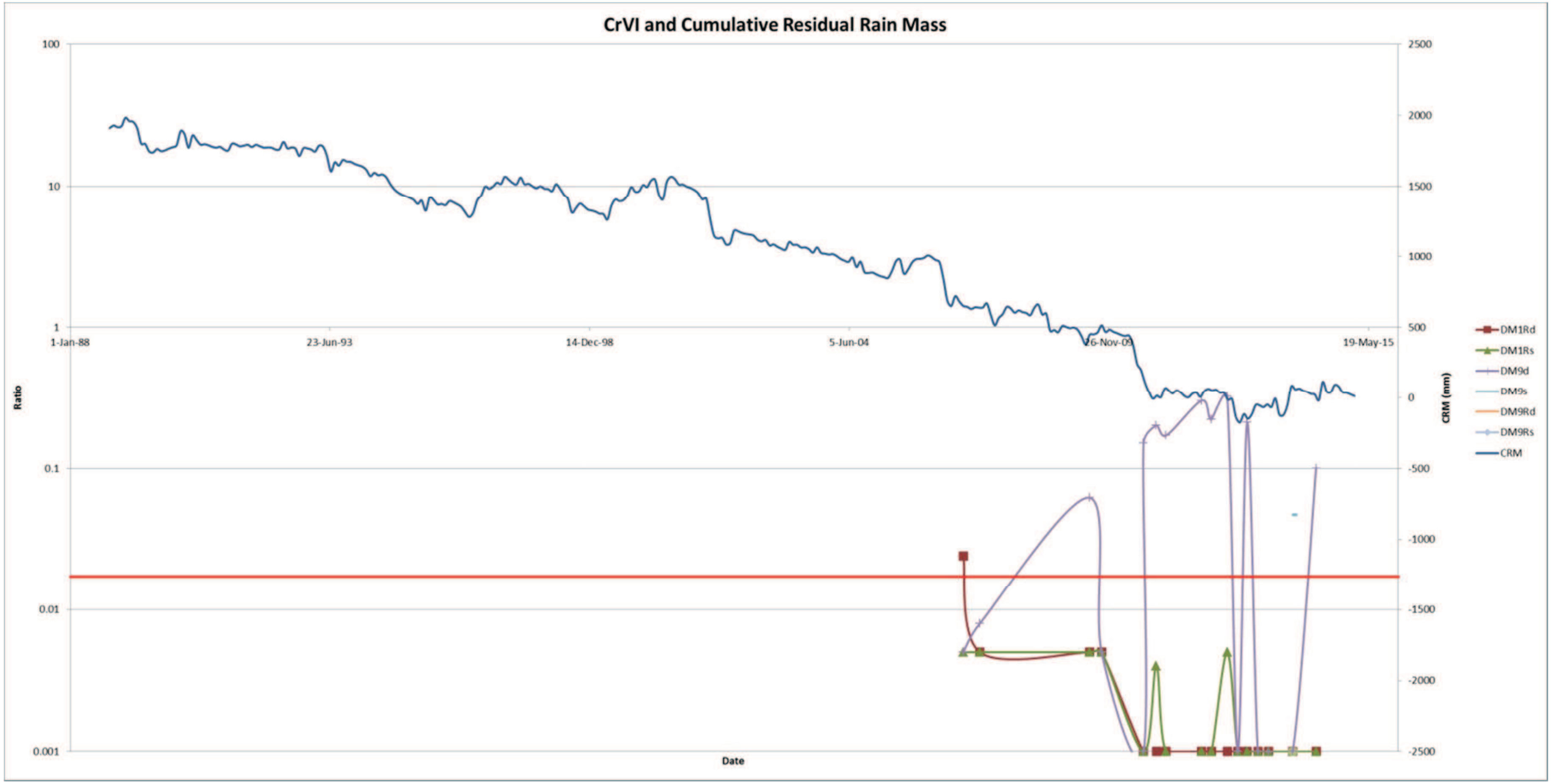
5. GHD Response

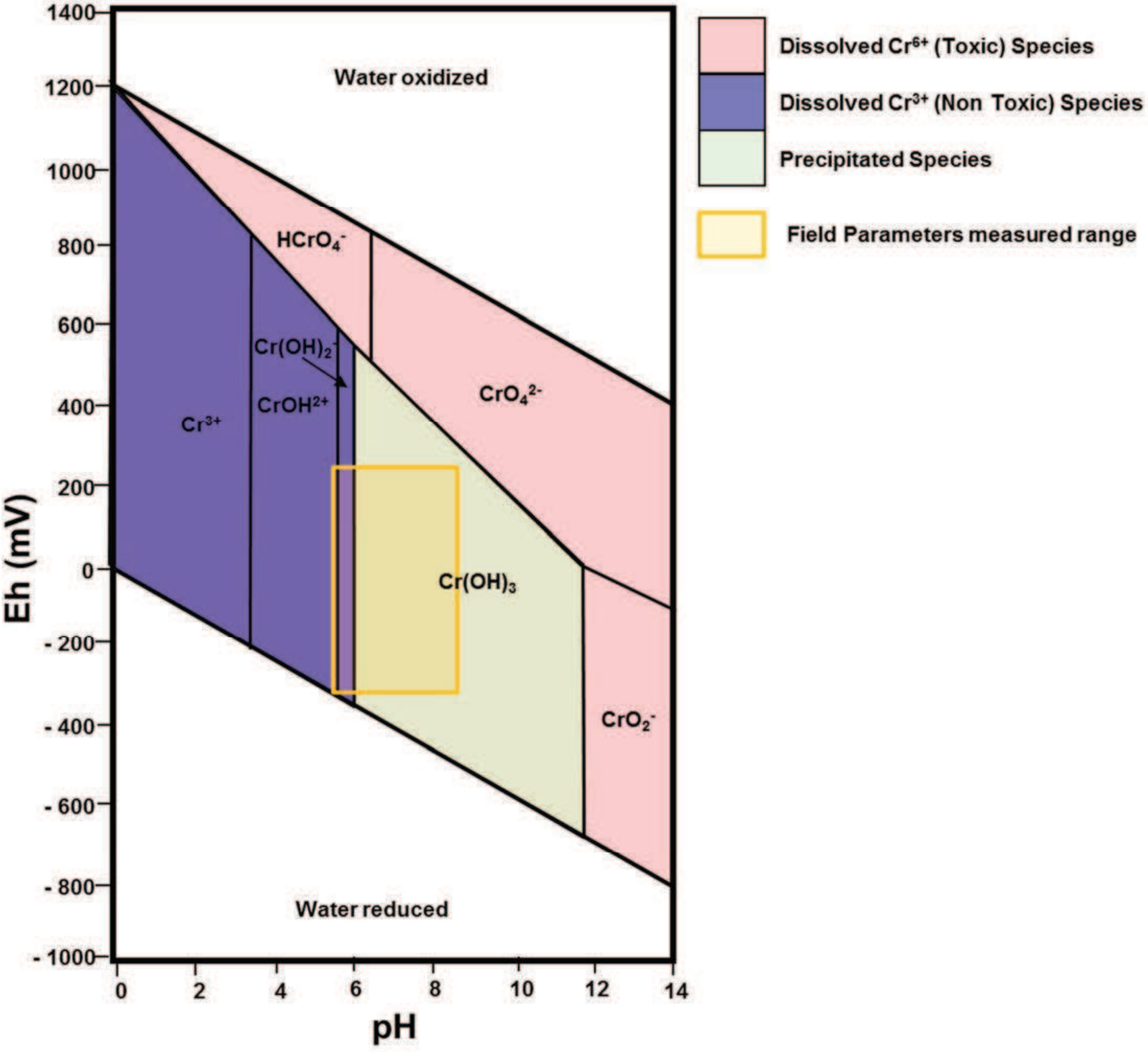
Chromium concentrations in the two up-gradient wells show a spiked pattern in both up-gradient monitoring wells as shown in the figure below. The comments notes that the chromium concentration appear associated with higher iron and manganese concentrations and decrease in pH. As shown on the chromium stability diagram below, hexavalent chromium is less stable under acidic than alkaline conditions. The presence of iron also suggests that the observed chromium concentration is more than likely in the trivalent redox state and is therefore in the low toxicity state.

Also the occurrence of iron in solution and the more acidic condition are likely to result in potential false positives in hexavalent chromium detection due to the limitations of the colorimetric analysis method commonly used for hexavalent chromium measurement in groundwater samples.

During development of the eastern turning circle, TSR was used as a road base material. The presence of chromium in DM9C is most likely to be associated with the deposited road base TSR. The TSR was removed in 2013 as part of the validation program, and the remaining surface was validated to 0.5 m below ground level. A reduction in chromium concentrations in groundwater sampled from DM9C should be reported in subsequent monitoring rounds. Ongoing monitoring will be undertaken.

Chromium in up-gradient wells

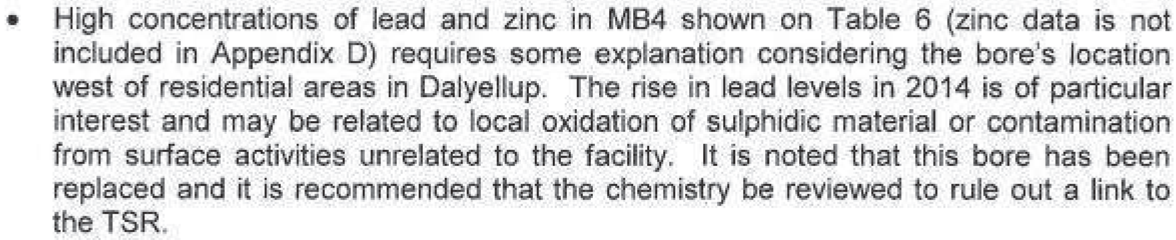




1400
1200
1000
800
600
400
200
0
- 200
- 400
- 600
- 800
- 1000
Eh (mV)
0
2
4
6
8
10
12
14
pH
Water oxidized
Water reduced
Cr^{3+}
$HCrO_4^-$
$Cr(OH)_2^+$
$CrOH^{2+}$
CrO_4^{2-}
$Cr(OH)_3$
CrO_2^-
Dissolved Cr^{6+} (Toxic) Species
Dissolved Cr^{3+} (Non Toxic) Species
Precipitated Species
Field Parameters measured range

Assessment of the potential driver for chromium migration up-gradient is mounding under the TSR following rainfall, which would cause temporary flow towards the west. This could lead to migration and accumulation of chromium up-gradient of the TSR and migration preferentially along more permeable zones is a possibility. However, in terms of risk the key observation that the more elevated chromium concentrations are associated with decreased pH and increased iron concentrations, coupled with the observed range of pH and Eh as shown on the stability diagram suggests that chromium occurs in the trivalent low toxicity form that would only have low mobility in the groundwater systems beneath the TSR.

6. DoW Comment



- High concentrations of lead and zinc in MB4 shown on Table 6 (zinc data is not included in Appendix D) requires some explanation considering the bore's location west of residential areas in Dalyellup. The rise in lead levels in 2014 is of particular interest and may be related to local oxidation of sulphidic material or contamination from surface activities unrelated to the facility. It is noted that this bore has been replaced and it is recommended that the chemistry be reviewed to rule out a link to the TSR.

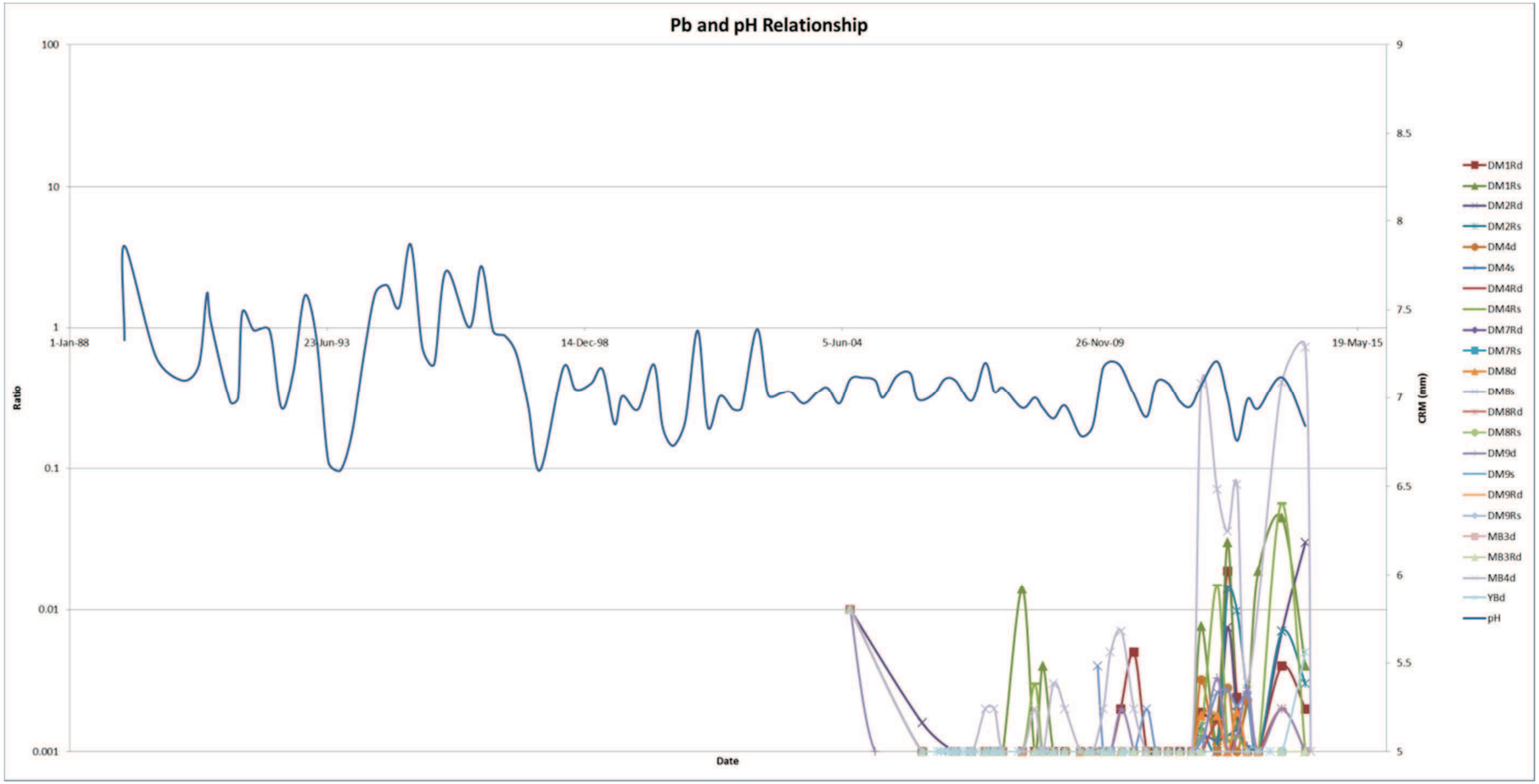
6. GHD Response

Lead and zinc show a similar spiked concentration patterns to chromium and vanadium and their mobility appears related to variation in pH, with decreasing pH correlating to higher zinc and lead concentrations as shown below.

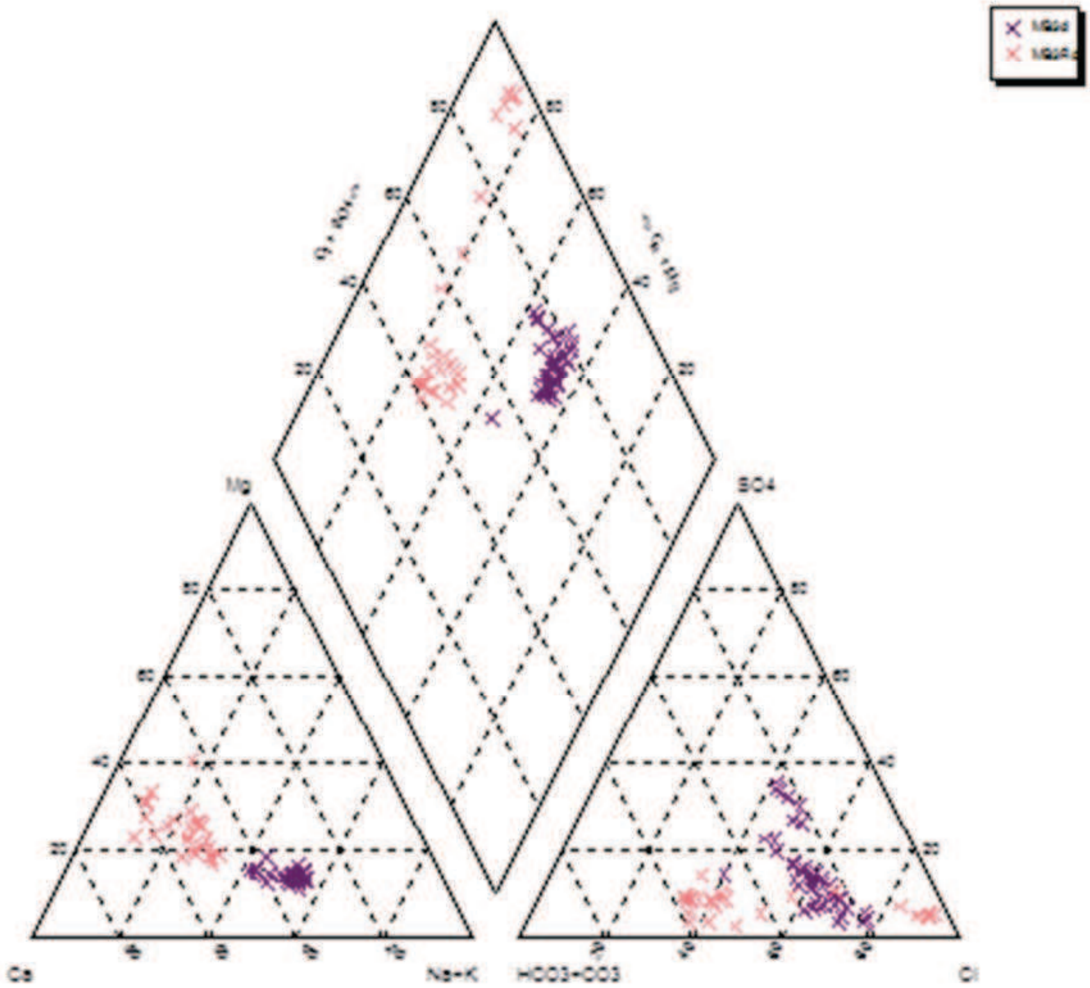
Residential areas are a common source of zinc and lead in the environment due to the use of these metals in roofing materials that leads to leaching and transport in stormwater that then recharges groundwater. Given location of MB4 and relatively lower lead and zinc concentrations in the bores near the TSR, it appears that the residential area is the more likely source of the observed lead and zinc concentrations in the samples from MB4.

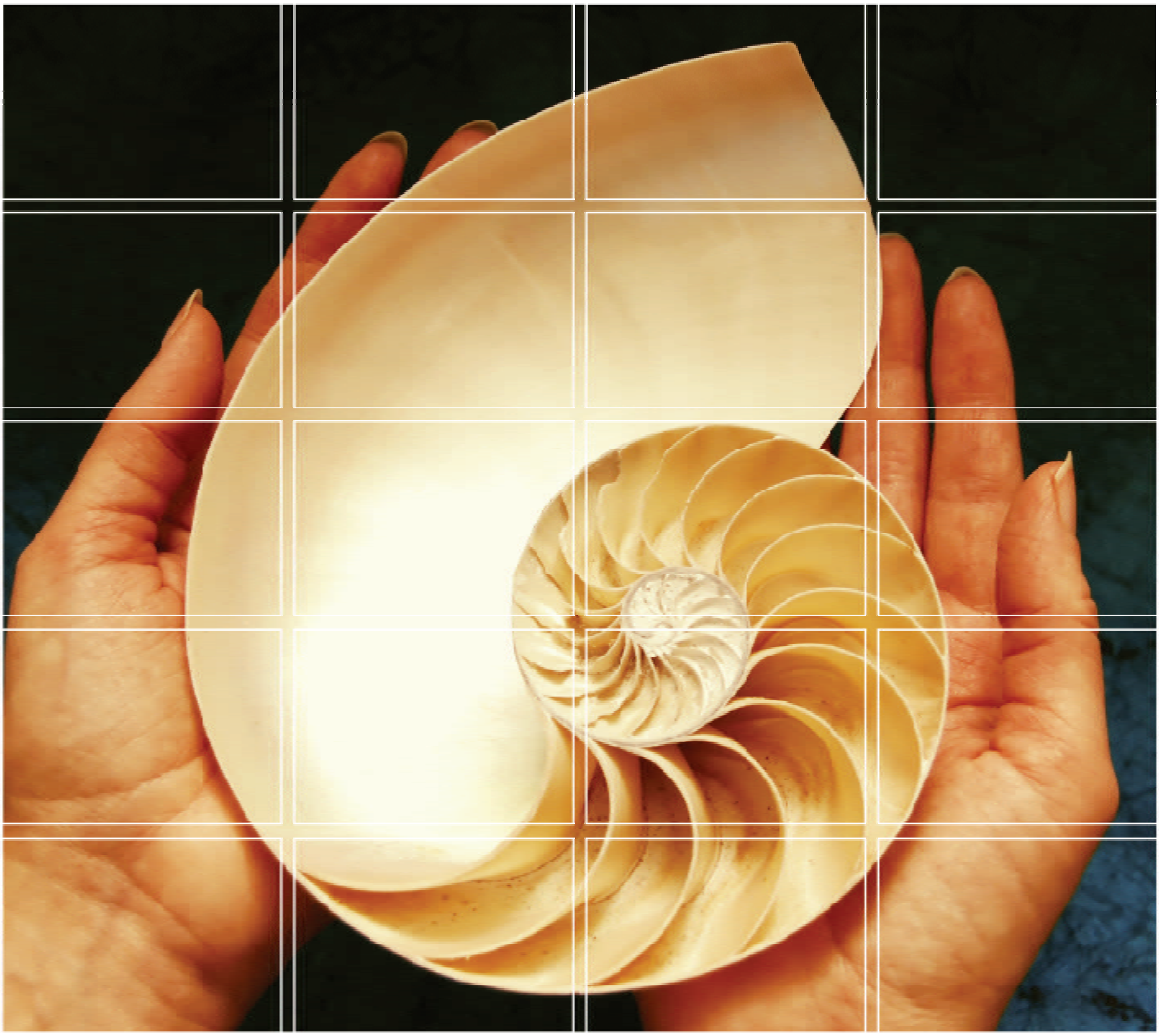
To assess the impacts of replacing MB4 on the water sample results a piper plot of the major cation and anion data for MB4 was prepared and presented below. The piper plot shows two distinct groupings for the data from MB4 and MB4R which suggests that the sample analysis results between the two is not directly compatible. This difference is likely due to a slight shift in location and depth between MB4 and MB4R. The data for MB4 suggests the well was screened in a slightly fresher section of the groundwater system than MB4R, which plots along the fresh, saltwater mixing line a little closer to the saltwater field.

Lead concentration relationship with pH



Piper Plot showing difference between original MB4 and replacement bore MB4R





Cristal Solid Residue Disposal Facility

Health Risk Assessment
FINAL Draft - Rev 3

For Shire of Capel

February 2015

0124484

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FINAL DRAFT REPORT

Shire of Capel

Cristal Dalyellup Treated Solid Residue Disposal Facility

Health Risk Assessment

February 2015

Reference: 0124484RP1_rev3

Environmental Resources Management Australia
6th Floor, 172 St Georges Terrace
Perth WA 6000
Telephone +61 8 9321 5200
Facsimile +61 8 9321 5262
www.erm.com

Cristal Solid Residue Disposal Facility

Health Risk Assessment

Shire of Capel

February 2015

FINAL Draft 0124484_Rev3

0124484

Approved by:	*Monica Pandele*
Position:	Project Manager
Signed:	
Date:	*25 February 2015*
Approved by:	*Paul Myers-Allen*
Position:	Partner
Signed:	
Date:	*25 February 2015*

Environmental Resources Management Australia Pty Ltd Quality System

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EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by the Shire of Capel (the Shire) to prepare a Health Risk Assessment (HRA) at the Dalyellup treated solid residue disposal facility located at Lot 9077 on Plan 60716 and Lot 9090 on Plan 69838 (the Site) operated and owned by Cristal Pigment Australia Ltd Company (Cristal).

Cristal has operated the Site between 1989 and 2013 as a Department of Environment Regulation (DER, formerly DEC) licensed facility for the disposal of treated solid residue resulted from the production of titanium dioxide pigment. Cristal has ceased disposal operations in 2013 and since then rehabilitation works were undertaken at the Site in line with an approved Site closure plan. It is understood that the Shire and Cristal have agreed to a conceptual plan to redevelop the Site into recreational grounds (sporting fields), for which the Shire has identified a need of the surrounding Dalyellup community.

The Site has been classified under the Contaminated Sites Act (2003) (the Act) by the DEC as "Possibly Contaminated - Investigation Required" in 2009. Further assessment consistent with DER guidance is required before the Site can be reclassified and considered suitable for the proposed redevelopment as a public open space.

The main objectives of the HRA were to:

1) *assess whether solid residue disposed at the Site represents a significant risk to human health at the Site following site closure (assuming its redevelopment for recreational land use scenario);*

2) *support an assessment of the Site's suitability for future use in terms of potential health and environmental risks; and*

3) *assist with satisfying requirements of the Shire and the DER (including relevant consideration under the Act).*

The risk assessment approach recommended by the NEPM (1999 updated in 2013) built on the enHealth 2012 guideline was used as a general framework for this HRA, however modifications to the standard approach were adopted to account for sources and extent of the data sets while ensuring all critical risk assessment tasks were addressed. For the development of the initial Conceptual Site Model (CSM) a comprehensive review of existing data related to the Site was undertaken. The data reviewed included publicly available information on the history of the Site as well as various internal Cristal reports and assessments undertaken by third parties either to comply with the operational licence requirements or to inform the overall Site closure strategy.

For the instances where the review of the source-pathway-receptor linkages established as part of the initial CSM were considered to be potentially complete (leading to potential unacceptable risks to the identified sensitive receptors), further *assessment in the form of a tier 1 qualitative screening was undertaken against adopted guidelines (NEPM).*

Given the fact that the residue disposed at the Site contains traces of uranium and thorium it was deemed necessary to consider the radiological issues in relation with the redevelopment scenario as a sporting field. For this task a specialised contractor (Radiation Professionals) has undertaken a radiological risk assessment tailored for the desired land-use. Collected field data corroborated with Site and residue material specific characteristics have determined calculations for the quantification of gamma, radon and thoron (and their progeny) doses into environment through specific pathways. Based on several scenarios if was determined the minimum capping layer thickness required to be applied on top of the residue to minimise radiological risks.

The Closure Management Plan prepared and implemented by Cristal at the end of disposal operations in 2013 took into account the assumptions of the Conceptual Site Model developed by ERM in the draft HRA (ERM, 2012) (application of a minimum 2 m thick clean fill layer). The soil validation investigation results indicated that generally the minimal fill layer thickness requirement has been met. While the cover was intended to be free of contaminants, the low level of metals identified by the investigation undertaken by GHD (mostly chromium VI) ERM concurs with the conclusions of the GHD report that the fill material is unlikely to present unacceptable risks to human health and the environment and that the Site is generally suitable for the intended recreational sports fields land use.

Subject to the implementation of appropriate risk management measures outlined in this risk assessment and the closure plan (ongoing monitoring and completion of set performance criteria), the Site is considered suitable for the development of playing fields. Care should be given to the irrigation aspects of the fields and the type of vegetation (especially trees) contemplated to be used for landscaping.

1 INTRODUCTION

1.1 COMMISSION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by the Shire of Capel (the Shire) to prepare a Health Risk Assessment (HRA) at the Dalyellup treated solid residue disposal facility located at Lot 9077 on Plan 60716 and Lot 9090 on Plan 69838 (the Site) operated and owned by Cristal Pigment Australia Ltd Company (referenced as CPA). The company has held different names in the past including Millennium Inorganic Chemicals (referenced as MIC), Cristal Global (referenced as CG) and currently Cristal Pigment Australia Pty Ltd (referenced as CGA). Here after in this report the company is referred to as "Cristal".

1.2 PROJECT APPRECIATION

Cristal has operated the Site between 1989 and 2013 as a Department of Environment Regulation (DER, formerly DEC) licensed facility, and has undertaken various forms of environmental assessment and monitoring to meet conditions of the licence.

It is understood that the Shire and Cristal have agreed to a conceptual plan to redevelop the Site (after its closure in 2013) into recreational grounds (sporting fields), for which the Shire has identified a need of the surrounding Dalyellup community. The Site has been classified under the *Contaminated Sites Act* (2003) (the Act) by the DEC as "*Possibly Contaminated - Investigation Required*". Further assessment consistent with DER guidance is required before the Site can be reclassified and considered suitable for the proposed redevelopment. This report has been prepared to provide information to support reclassification of the Site.

Jason Clay of AECOM has been appointed as the WA DER accredited Contaminated Sites Auditor for this project. In 2012 the Auditor reviewed the first draft of the interim HRA report and provided comments to the Shire of Capel in in a letter issued on 07 Sep 2012 (AECOM, 2012). These comments have been incorporated into the current version of the HRA report. To assist in the reclassification of the Site the findings of the updated HRA will require to be considered by the Auditor.

The Site will require reclassification under the CS Act (2003) into "Remediated – restricted use", after rehabilitation and validation works will be finalised and the Site is considered suitable for the proposed redevelopment as a public open space.

1.3 OBJECTIVES

The objectives of the HRA were to:

4) assess whether solid residue disposed at the Site represents a significant risk to human health at the Site following site closure (assuming its redevelopment for recreational land use scenario);

5) support an assessment of the Site's suitability for future use in terms of potential health and environmental risks; and

6) assist with satisfying requirements of the Shire and the DER (including relevant consideration under the Act).

1.4 SCOPE OF WORK

The scope of work undertaken to achieve the project objectives followed in general the recommended risk assessment process structure in Australia (NEPM 1999 updated 2013), which is based on the enHealth (2012) guidelines. Key tasks are outlined below:

1) Background information relating to the history and physical nature of the Site and the surrounding area which was publically available (e.g. land ownership, historical photographs, acid sulphate soils, cultural and aboriginal heritage searches, dangerous goods search), was collated and reviewed.

2) Various existing environmental assessments (studies, monitoring programs, investigations) related to the use of the Site as a disposal facility for over 24 years have been reviewed.

3) Based on the review, an initial Conceptual Site Model (CSM) was prepared to describe the possible sources of contamination, the receptors that may be exposed and adversely affected, and the pathways by which exposure may occur.

4) Qualitative (Tier 1) risk assessment following the guidance provided by the NEPM was undertaken on the pathways that indicated potential complete source-pathway-receptor linkages.

5) Radiation data collection and modelling of gamma radiation, radon and thoron gases was undertaken by a specialised contractor (Radiation Professionals) to assess the control measures potentially required to be applied at the Site to ensure no unacceptable risks from these sources will be posed to future users based on the proposed future recreational redevelopment scenario.

6) This report was prepared to document the objectives, methodology, information review, risk assessment process and results, conclusions and recommendations on the Site's suitability for recreational land use.

Note: The scope of works also includes the preparation of a community consultation plan. This will be prepared to identify key stakeholders and support decisions to manage community consultation as required by DER reporting guidelines. The community consultation plan will be provided after the client and the auditor approve the content of the HRA report.

1.5 *ADOPTED RISK ASSESSMENT APPROACH AND REPORT STRUCTURE*

Guidance provided in the Schedule B4 of the NEPM (1999 updated 2013) and enHealth 2012 approach was used as a base for this assessment. However, given the reliance on information and existing studies provided by others the structure of the HRA is not strictly compliant with this guideline. However, the approach followed is considered fit for purpose.

The updated risk assessment model recommended by Department of Health (enHealth, 2012) proposes a staged process that is aligned generally with the previous structure (enHealth 2004), with the amendment that the 2012 model is considered more holistic and provides a more structured and informative framework:

Phase I Problem formulation and scoping – refers to the identification of the key issues amenable to risk assessment. In this HRA the key issues are related to potential health risks from the historical land use of the Site as a solid residue disposal facility in relation to the proposed future land-use as an open sports field. Where potential risks are identified, can the sources generating the risk (i.e. TSR) be modified, managed, remediated in order to ensure the Site is suitable for use as an open sports field.

Phase II: Planning and conduct of risk assessment - which is divided in three stages:

Stage 1. Planning – when a decision is made around the question of what assessments are needed to characterize the potential health risks.

Stage 2. Risk assessment - which includes hazard identification, dose response assessment, exposure assessment and risk characterisation. The Conceptual Site Model (CSM) is developed at this stage. The CSM is a qualitative site specific description of the mechanisms by which receptors may plausibly be exposed to site contamination for exposure to be considered possible, some mechanism ('pathway') must exist by which contamination from a given source can reach a given receptor. A 'source-pathway-receptor' exposure mechanism is referred to as a 'SPR linkage' throughout this report. Exposure via the 'SPR linkages' is quantified and evaluated at later stages in the assessment. At this stage a tiered risk assessment approach applies with the basic tier 1 screening using conservative default exposure parameter estimates and comparison with existing published health-based guidelines conservative guideline values. In case of exceedances of Tier 1 generic guidelines a more detailed site specific tier Tier 2 level risk assessment is conducted.

Stage 3. Confirmation of assessment utility to evaluate whether the risk assessment outcomes met the objectives and the reliability of data used has been appropriately assessed (e.g. through peer-reviews).

Phase III: Risk Management – is primarily designed to frame the actions required to be taken during the implementation of the risk management strategy. Another important aspect to be dealt with during this stage is the need to correlate the risk assessment outcomes to social and economic aspects such as costs, technological feasibility, sustainability and adequate stakeholder engagement in the assessment of various risk reduction options. Finally, suitable ways to evaluate the effectiveness of the proposed management options should be identified as part of this phase.

Given the plethora of data from former studies/monitoring programs, and an approved site closure plan, the current risk assessment process relies considerably on Site relevant information gathered by third parties. This is a primary reason why the process as described in this report has deviated from the standard approach presented above. *Table 1.1* summarises how the standard approach has been implemented in the current health risk assessment (HRA) and how it relates to the report structure. Figure 1.1 provides a summary of the logic process (i.e. a sequence of eight steps) undertaken in the HRA and in which sections of the report are then presented and discussed.

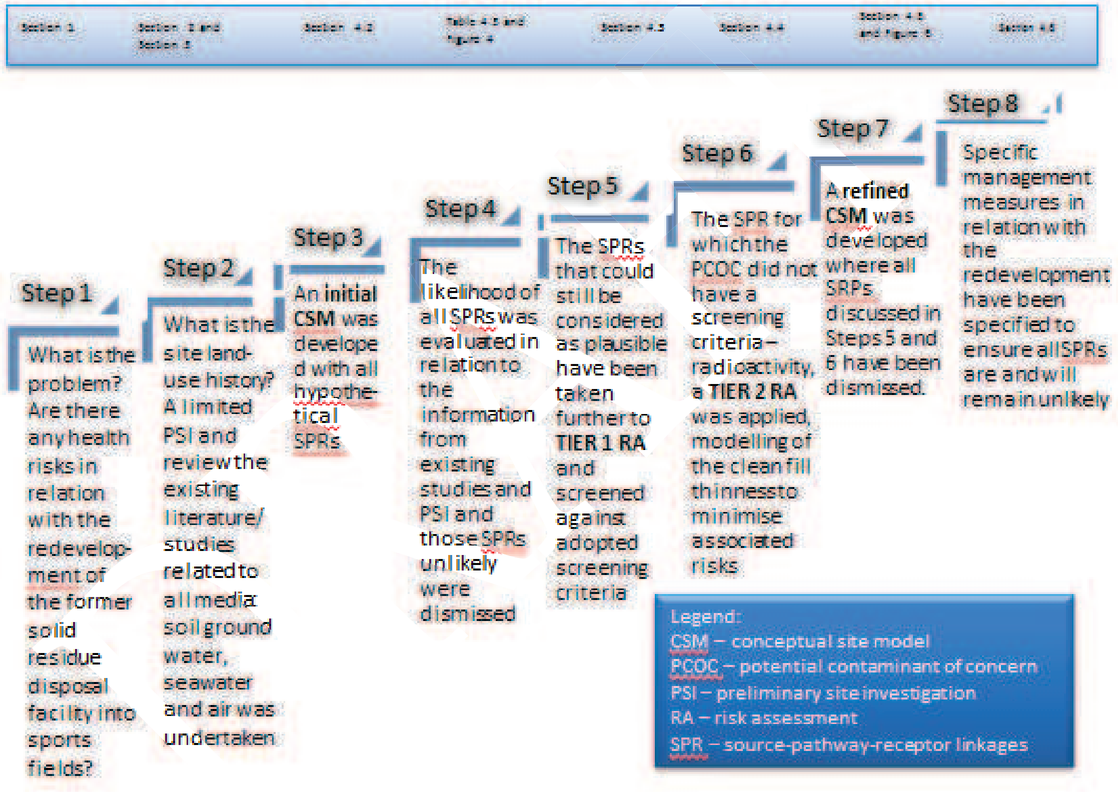

Figure 1.1 Summary the adopted HRA process steps

Table 1.1 Summary of risk assessment adopted approach

Stage	**Phase**	**Description of action taken as part of HRA**	**Location in the report**
I- Problem formulation and scoping		In this stage the objectives of the HRA were established, to identify the potential risks that will the Site may pose in case of a recreational sporting field (also known as Public Open Space - POS),	Section 1.3
II- Planning and conduct or risk assessment	Planning	This stage describes the steps undertaken to achieve the objectives, identification of what information may be required, what assessments would be needed.	Section 1.4
	Risk Assessment	*Hazard identification* Potential Contaminants of Concern (PCOCs) have been identified based on the review of site history, operations, composition of disposed materials, etc.	Section 1-2,
		Dose-response assessment Where it was appropriate, specific assessments undertaken by third parties for marine assessment, radiological assessments have used for specific toxicity data.	Section 3
		Exposure Assessment A preliminary CSM was developed using the understanding of the Site conditions gained from the review of data presented in Chapters 2 and 3. A summary table presenting the theoretical complete linkages between sources-pathways-receptors is presented in *Table 4.3*. The table also discusses the potential for the complete SPR linkages to occur based on data collected in over 24 years of monitoring and the current understanding of the hydrogeological conditions at the Site. Potential SPR linkages have been categorised as: none, unlikely, possible and likely. 'None' or 'Unlikely' SPR linkages were considered to require no further action.	Section 4.2
		Risk Characterization For the SPR linkages that required further assessment (i.e. 'Possible' and 'Likely') the existing site specific data has been used in a Tier 1 assessment (specifically the groundwater and solids composition) against relevant guidelines (DEC, 2010 and NEPM, 2013).	Section 4.3
		In the case of the particular risk related to radionuclides released to the ambient air, where SPR linkages were considered to be potentially complete and resulting in significant risks, a Tier 2 risk assessment was undertaken by modeling expected radiation levels at different thickness of a physical barrier – fill layer. Site specific data (e.g. air monitoring, physical properties of the materials stored on site, regional meteorological data) and conservative assumptions were used to determine the safe thickness of fill layer to be applied on top of the residue material to create no unacceptable risks to human health.	Section 4.4 Section 4.5
		A refined CSM prepared based on the Tier 1 and tier 2 assessments, and the summary is presented in *Table 4.4.*	
	Confirmation of utility	Evidence of the robustness and utility of the HRA results will be provided by the independent review of the report by the CS Auditor who will prepare an Audit report for submission to the DER.	

Stage	Phase	Description of action taken as part of HRA	Location in the report
III – Risk management		The risk management results flagged some mandatory measures (e.g. thickness of fill layer), or some recommended measures such as the design of a " smart water use" irrigation management plan that reduces water infiltration, use of recycled waste water of specific quality standards for recommended type of vegetation to avoid deep penetration of fill layer. An important aspect of the risk management stage is represented by the stakeholder engagement which will take place after the outcomes of this HRA report are endorsed by the Auditor. A community consultation plan will be developed in line with existing NEPM guidance Schedule B8.	Section 4.6

2 *SITE DESCRIPTION, HISTORY AND ENVIRONMENTAL SETTINGS*

As part of the data collection focused on identifying potential risks a series of documents (licences and assessments) associated with The Dalyellup Treated Solid Residue Disposal Facility (DTSRF) provided by Cristal were reviewed (e.g. annual reports, periodical monitoring reports, special studies, etc) and a Site visit was conducted in 2010.

In addition, several searches of publicly available information were conducted to collect information on historical potential contaminating activities at and around the Site or special environmental or heritage sites that may affect the future development including:

1) Historical aerial photographs search;

2) Historical certificates of title search;

3) Department of Mines and Petroleum FOI request;

4) DEC online data base search; and

5) Aboriginal heritage search.

2.1 *SITE LOCATION*

The Site is located at Lot 9077 on Deposited Plan 60716 and part Lot 9090 on Plan 69838 (formally Lot 1 on Plan 17972), Maidment Parade, Dalyellup WA 6230. The Site covers approximately 21 ha and is located 8 km south of Bunbury as shown in *Annex A, Figure 1*, within the buffer zone of Bunbury Sewage Treatment Works (BSTW).

The Site is situated in an interdunal area 200m from the coastline. The surrounding area is a coastal dune system with housing development south and east of the facility.

The DTSRF surrounding areas were identified as:

1) To west: sand dunes and Indian Ocean beach;

2) To east: undeveloped sand dune covered in vegetation, followed by a swamp area and residential neighbourhood approximately 50 m;

3) To south: residential neighbourhood across the road along the south boundary; and

4) To north: undeveloped sand dunes partly covered with native vegetation and BSTW located 750 m to the north.

2.2 SITE HISTORY AND OPERATIONS

To capture essential details on the history of the Site for the purpose of identifying potentially impacting activities that would be relevant to this risk assessment, ERM has consulted various sources including operational licences, results of searches of publicly available information in relation to historical aerial photography, historical land-ownership, high risk activities such as storage and handling of dangerous good (FOI search), etc.

2.2.1 *Current Site Condition*

The Site used to operate as a licenced disposal facility for treated residue as described in *Section 2.2.2.* The Site ceased its disposal operations on 27 February 2013 (CG, 2013). Since then, the Site has been inactive and after allowing the ponds to dry over a period of six months, rehabilitation works commenced on the central and northern ponds (i.e. covering of the deposited treated solids with fill) in line with the earthworks strategy developed by *Worley Parsons* in 2013 and attached to the Site Closure Plan (CG, 2013). This represents Stage II of the overall Site Rehabilitation plan that commenced in 1996. Details on activities undertaken as part of the rehabilitation plan are described in *Section 3.7*.

2.2.2 *Historical Residue Waste Materials Disposal Related Activities*

The Site is also known as the DTSRF and operated from 1989 until February 2013 as a "solid waste facility premises (other than premises within category 67A) on which solid waste produced on other premises is stored, reprocessed, treated, or discharged onto land" (MIC, 2010). It is not classified as a landfill.

The Site has been used for 24 years by the company Cristal for the disposal of neutralised treated residue resulted from the titanium dioxide pigment manufacturing process. The titanium dioxide pigment (TiO_2) is used in the manufacture of paint, paper, plastic, cosmetics and many other products. Cristal has two manufacturing facilities in the south west region near Bunbury.

The DTSRF accepted solid residue (called Treated Solid Residue - TSR) resulted from the processing of ore into titanium tetrachloride and further on to titanium dioxide in the Kemerton processing plant and the Australind finishing plant. The TSR is described as a solid residue typically consisting of metal chlorides, oxides and hydroxides, various silicates, unreacted ore and coke. Most of the disposed material was generated by the Kemerton facility (96%) and 4 % from the Australind facility (MIC, 2011).

The residue was treated prior to being sent off to DTSRF for disposal from the processing and finishing plants. The treatment consisted of several steps. Firstly, the residue was neutralised (the pH was raised by adding lime to precipitate the metal chlorides as hydroxides), the resulting intermediate slurry was sent to a clarifier and allowed to settle and then filtered by vacuum filter and washed again to remove a large proportion of the soluble salts. The wash water (process wastewater) from the solid residue was discharged into the lower reaches of the Collie River.

At the waste terminal filter press of the treatment plants, the material was solid but was subsequently re-wetted into slurry (12-20% solids) to allow for transfer into disposal trucks. This resultant slurry (treated solid residue) was then disposed by a simple gravity feed system at Dalyellup site. When in situ on Site, the slurry dried and the resultant residue formed a solid. Disposal via this method was based on the understanding that the dried solid residue was inert, mostly insoluble, non-toxic, clay like material.

The treated solid residue (TSR) material is a clayey silty like mud containing unreacted sand ore and coke. The TSR is a mixture of iron, titanium, aluminium, calcium, chromium, manganese, titanium and vanadium, chloride, sulphur and other trace constituents at neutral to slightly alkaline pH to precipitate metals as hydroxides. The concentration of main and trace elements varies depending on the feedstock. The composition of TSR is presented in detail in Section 4.2.1 and *Tables 2.1 and 2.2*.

Site layout

The DTSRF has been separated into a series of ponds which have been used at different times throughout the operation of the Site as illustrated in the aerial photograph summary (*Annex B*). The ponds are grouped into Northern, Central and Southern ponds. The 'Central Ponds' (40,000m^2) which consist of the amalgamation of previous N3 and S3 ponds, have been in use between 1996 and 2013, and are the only ponds that have been utilised since 2001. The two southern ponds, (total of 25,000m^2), were deactivated in 2000 and were rehabilitated in 2002 as part of the stage I rehabilitation plan. After a period of one year, the southern ponds dried out and were covered with a minimum of 2 metres of inert material (calacareus dune sand). Subsequently the surface was reshaped and covered with brush, fascine and seed of indigenous species. The two northern ponds of the facility, N1 and N2 (150,000m^2), were deactivated in 1993 and 1995, respectively using stockpiled soil excavated from the construction activities at the central ponds (CG, 2013).

Disposal activities period

Disposal of treated solid residue –TSR at the DTSRF commenced in March 1989. Cristal originally had approval from the DEC to operate this Site until January 2010, under Licence No. 6130/11. The disposal facility was licensed to receive 200,000 tonnes of slurry per year, but the actual disposed quantities were lower than the stipulated limit. As a result of Cristal implementing waste reduction and recycling programs, the disposal ponds were not fully utilised by 2010 and consequently Cristal sought – and were granted – an extension to the Licence until March 2013 (Licence No. 6130/1989/12). From February 2013 when the Site ceased its disposal activities, the TSR is now disposed-of at Transpacific's Banksia Road facility in Dardanup.

2.3 *AERIAL PHOTOGRAPHY*

An aerial photograph review was conducted to provide insight into any potentially contaminating activities which may have occurred historically at the Site. The review included examination of selected aerial photographs from the earliest available recorded runs to the most recent. For each reviewed photograph, the conditions at the Site and in surrounding areas were observed and documented. The historical aerial photographs are presented in *Annex B*. The review of historic aerial photographs is summarised below in *Table 2.1*.

Table 2.1 Historical Aerial Photograph Review

Year	Description
February 1958	*Photograph number 5157, Run 7 (5155-5182), Scale not identified* The Site and surrounds appear undeveloped. Some clearing and Bussell Highway are present to the south of the Site.
December 1980	*Photograph number 5052, Run (5046-5082), Scale 1:15,000* Site and surrounds predominantly unchanged, with the exception of some visible tracks leading to the beach through vegetation. The future waste water treatment plant to the north of the Site has begun development.
November 1990	*Photograph number 5197, Run 5N(5196-5201), Scale 1:250,000* The waste water treatment plant to the north of the Site appears to be fully developed and operational. Minninup Rd is visible, and there also appears to be two ponds associated with the Site. The eastern portion of the Site remains predominantly uncleared.
1996	*Source: Landgate Online Database* The southern pond has been partially restructured with the remaining pond area being divided into two areas and there appears to be earth movements within the central site area. Site surrounds remain unchanged.
November 1998	*Photograph number 5093, Run 11 (5076-5096), Scale 1:100,000* The northern pond at the Site appears to have been filled. Site surrounds are predominantly unchanged.
2001	*Source: Landgate Online Database* The site appears predominantly unchanged. The land adjacent to the southern boundary has been cleared for residential lots and the bush vegetation to the east and southeast has become established.
January 2003	*Photograph number 5002, Run 20 (5001-5007), Scale 1:7000* The southern pond seems to appear as two distinct structures as opposed to the one noted previously. Extensive clearing and development has occurred to the Site's south and east. A structure is present on the eastern portion of the Site, associated with the side road leading from Minninup Rd.

Year	Description
2004	*Source: Landgate Online Database* The central ponds appear to have merged into one central pond. The bush vegetation to the east and southeast, particularly along the Minninup Rd is more developed.
March 2006	*Photograph number 5131, Run 11 (5128-5147), Scale 1:100,000* Site and immediate surrounds appear predominantly unchanged other than an increase in development density in the surrounding areas.
2009	*Source: Landgate Online Database* Bush vegetation on the southern rehabilitated ponds area and new developed residential lots along the southern boundary.
2011	*Source: Landgate Online Database* Bush vegetation on the southern rehabilitated ponds area is now established. The remaining site surrounds remain unchanged.
2014	*Source: Landgate Online Database* The central ponds appear to be levels and covered with cream-yellow sand.

The aerial photograph review indicated that only minor anthropogenic influences have been present on the Site before 1989 when Cristal started its operations. The photographs confirm the staged operation of the ponds over time, with:

1) the northern ponds filled up at first, and being closed before 1998;
2) the southern ponds utilised until 2001, followed by a comprehensive rehabilitation program which included successful revegetation of the area; and
3) central ponds which appeared to be in operation since 1996 with two cells (east and west) separated by a vertical wall, still active in 2011.

2.3.1 *Historical Certificates of Title*

A historical Certificate of Title review was conducted to document all of the previous owners of the Site and where possible provide insight into the historical uses of the land (i.e. to identify any potentially contaminating activities which may have occurred at the Site). Historic Certificate of Title documentation is presented in *Annex C*, and a summary presented in *Table 2.2.*

It is noted that on 15 March 2014 the ownership of the land was transferred from the Western Australian Land Authority (LandCorp) over to Cristal Pigment Australia Ltd as a result of the clause 15.3 of the Lease based on which Landcorp held the right to transfer the Land from the date of termination. The new owner (Cristal) acknowledged that the certificate of title was encumbered by and the land was subject to following registered encumbrances:

- Easement Benefit T2716/1912 (registered in 1912)

- Easement Benefit H598229
- Caveat K923638
- Caveat K923639, and
- Memorial L709156

The historical certificate of title review over the period of time 1886-2014 does not give any indication that there may be a history of contaminating activities at the Site other than those undertaken as part of the DTSRF.

Table 2.2 Historical Land Ownership Summary

Year	Lot/ Location Number	Registered Proprietor	C.L./ Volume/ Folio
24/09/1886	'a parcel of land situated in the Wellington district'	William Cunningham (occupation unknown)	XX/70
04/12/1928	Wellington Location 497	Uranie Ramsay (widow)	1006/22
27/03/1991	Wellington Locations 41 and 497	The State Housing Commission	1894/495
27/03/1991	A portion of Wellington Location 497	The State Housing Commission	1894/496
05/03/1996	A portion of Wellington Location 497	The State Housing Commission	2096/42
12/01/2001	Portion of Wellington Location 497 depicted on Crown Pan Wellington 50	The State Housing Commission	2208/287
09/11/2001	Lot 9008 on Deposited Plan 29067	The State Housing Commission	2217/567
29/04/2009	Lot 1 on Plan 17972	Industrial Lands Development Authority	1894/495
03/07/2002	Lot 9017 on Deposited Plan 32010	The State Housing Commission	2519/793
30/08/2002	Lot 9010 on Deposited Plan 32947	The State Housing Commission	2523/421
30/08/2002	Lot 9020 on Deposited Plan 33032	The State Housing Commission	2523/449
20/08/2003	Lot 9029 on Deposited Plan 37798	The State Housing Commission	2543/856
23/01/2004	Lot 9031 on Deposited Plan 38801	The State Housing Commission	2555/933
09/11/2004	Lot 9038 on Deposited Plan 42107	The State Housing Commission	2578/355
17/02/2005	Lot 9041 on Deposited Plan 42954	The State Housing Commission	2585/57

Year	Lot/ Location Number	Registered Proprietor	C.L./ Volume/ Folio
20/12/2005	Lot 9056 on Deposited Plan 47649	The State Housing Commission	2610/573
31/03/2006	Lot 9063 on Deposited Plan 48769	The State Housing Commission	2616/666
15/08/2006	Lot 9070 on Deposited Plan 50648	Housing Authority	2631/363
22/09/2006	Lot 9071 on Deposited Plan 50649	Housing Authority	2635/666
29/04/2009	Lot 9077 on Deposited Plan 60716	Western Australian Land Authority	2717/207
7/05/2009	Lot 9077 on Deposited Plan 60716	Western Australian Land Authority	2717/207
11/06/2010	Lot 9084 on Deposited Plan 66982 – easement	Housing Authority - Department of Housing	2746/287
16/08/2011	Lot 9077 on Deposited Plan 60716. Amendment referring to a new Memorial Contaminated Sites Act 20013 – L709156	Western Australian Land Authority	2717/207
04/05/2012	Lot 9090 on Deposited Plan 69838 -easement	Housing Authority – Department of Housing	2790/895
12/06/2014	Lot 9077 on Deposited Plan 60716	Cristal Pigment Australia	2717/207

2.4 *DANGEROUS GOODS LICENSE SEARCH*

A Freedom of Information (FOI) Dangerous Goods Licence search was lodged with the Department of Mines and Petroleum (DMP), in order to access any information held by the department relating to storage of dangerous goods at the Site. The results of this search received on 14 January 2011 show no such records exist. A copy of the correspondence from the DMP is attached in *Annex D*.

Taking into account that the type of activities undertaken at the Site since ERM received the FOI request results were consistent with those before 2011, it is considered that the FOI information conclusions remain relevant until the Site operations ceased in March 2013.

2.5 *DER CONTAMINATED SITES SEARCH*

There was no information held on the Online DER Contaminated Sites Database regarding classification of the Site under the *Contaminated Sites Act 2003*.

A basic search request of the DER's records of the Site provided the current Site classification under the *CS Act 2003, as Potentially Contaminated – Investigation*

Required, issued by the Contaminated Sites Branch of the DEC in 2009. The basis for this classification was the presence in the solid residue of certain metals (cadmium, chromium III, copper, nickel and vanadium) exceeding ecological investigation levels (EILs). It was noted that the residue disposed at the Site contained rare metals such as thorium and uranium, for which no Australian soil guidelines were available at the date of Site classification. Chromium III was detected in shallow monitoring bores in the superficial aquifer, both up and down-gradient of the ponds at concentrations exceeding trigger values for slightly-moderately disturbed marine aquatic ecosystems. A screening risk assessment was therefore indicated as required to determine the risk to the environment and environmental values.

A copy of the DEC classification letter is attached in *Annex E*.

In February 2013 in a response letter referring to the review of the preliminary closure plan drafted by Cristal, the DER – Contaminated Sites Branch (CSB) (DEC, 2013- DEC4412) indicated that once rehabilitation is complete and the Site is validated as suitable for the proposed end use, the Site will be reclassified by the CSB.

No other known or suspected contaminated sites have been identified within a radius of 1 km from the DTSRF boundaries.

2.6 *ACID SULPHATE SOILS*

A search on online information on the areas that may present acid sulphate risks indicated that the risks for the acid sulphate soils to occur is low as indicated by the map attached in *Annex F*. The closest area that could be subject to acid sulphate soils are the swamps located approximately 500 m to the east.

2.7 *ABORIGINAL HERITAGE*

A search of the Aboriginal Sites Register on the Department of Indigenous Affairs (DIA) website was undertaken but did not identify any areas of Aboriginal significance within or in close proximity to the Site. Copies of the online search results are attached in *Annex G*.

2.8 *ERM SITE INSPECTION*

ERM personnel visited the Site on 17 September 2010 when the Site was operational in the company of the Shire and Cristal representatives and conducted a Site inspection. ERM observed and noted:

1) that the Site was fenced and access was limited through a single gate located on Maidment Parade;

2) that the surface of the former disposal pond/s in the southern portion of the Site was vegetated;

3) that TSR was disposed of into the ponds through poly-vinyl chloride (PVC) pipework at several locations around the central pond directly from trucks;

4) that the surface of TSR in the central pond was approximately 3-4 m lower than the road surface on the northern edge;

5) that the surface of the TSR in the central pond was dry and characterised by large cracks (tens of centimetres wide);

6) the presence of some of the groundwater monitoring wells located west of the central pond;

7) sand said to be excavated from the central pond during its construction was located on the former northern pond/s;

8) a loop road to the east of central pond used for trucks to turn around; and

9) immature vegetation growing in the middle of the loop in the road where a small scale trial of growing vegetation on native soil mixed with TSR was undertaken by Cristal.

2.9 ENVIRONMENTAL SETTING

2.9.1 Topography

The Site is located approximately 200 m from the coastline, within sand dunes which are 20-45m (above sea level) in height. The base of the ponds is at approximately 8 m Australian Height Datum (AHD) and the maximum point to which the various ponds have been filled with TSR varies between 22-23.2m AHD.

2.9.2 Hydrology

The Site is located adjacent to the coast within sand dunes. Due to the propensity of sandy surfaces for absorption, there is unlikely to be any significant surface runoff from the Site. No freshwater bodies have been identified in the vicinity of the DTSRF.

2.9.3 Geology

The Site is located in a swale between the vegetated linear primary dunes and the parabolic secondary dunes that are described by *Bunbury-Burekup Urban Geology 2031 III to 2031II* (1981) as:

Q_{hs}-calcareous quartz sand dunes, generally 20-40m in height.

Q_{hsm}-mobile calcareous quartz sand dunes, generally about 20m in height.

The referenced map also depicts a number of peaty swamp deposits in the vicinity of the Site.

Site specific investigations (1998) indicate surficial materials are mainly comprised of fine to medium grained sands present between 10-20 m depth and between 10-30 m depth limestone, sands and sandy clays occur. Underlying these sediments are dark grey, silty clays.

2.9.4 Hydrogeology

The Site is located on the Swan Coastal Plain and is underlain by the 'Superficial Swan' and 'Yaragadee South' aquifers.

Shallow aquifer (Superficial Swan) characteristics:

- Water table at approximately 5 m AHD with seasonal fluctuations in the order of 1.0 to 1.5m;
- Groundwater flow direction to the north-north-west, towards the Indian Ocean (Bunbury-Burekup Urban Geology 2031 III to 2031II, 1981) which is confirmed by the monitoring network at the Site where it discharges above the seawater interface (saline wedge);
- Hydraulic gradient ranges from 1:100 to 1:200;
- Consists of superficial formations of sand and limestone with a basal section of less permeable silty sand and sandy clay;
- Is an anisotropic, unconfined aquifer, approximately 10 m thick in the area of the DTSRF; and
- Variable groundwater quality from saline to the east at the discharge to the ocean, brackish south and north of the ponds and fresh up hydraulic gradient from the ponds.

Deeper Aquifer (Yaragadee) characteristics:

- Directly underlies the superficial formation;

  Consists of a confined multi layered aquifer, compromising of interbedded sandstone, siltstone and shale;
- The potentiometric head of the confined aquifer is approximately 1 m higher than in superficial formations. The significance of this characteristic is that there is an upward recharge into superficial formations which significantly reduces the downward potential migration of leachate from the superficial into the Yarragadee Aquifer (Geoprocc, 2009); and

- The groundwater salinity in the Yaragadee ranges between 600 and 1,000 mg/l TDS.

There are a total of 15 groundwater monitoring wells located throughout the residue disposal facility including a well to monitor the Yarragadee aquifer as illustrated in *Figure 2, Annex A*. Fourteen of the wells are installed in pairs to intersect different depths within the superficial aquifer at the same location. The wells range in depth from 15 to 50 metres below ground level and are used to monitor groundwater in the superficial aquifer.

3 PREVIOUS ENVIRONMENTAL SITE ASSESSMENTS AND MONITORING REPORTS

The Site has been subject to numerous environmental and some geochemical and geotechnical assessments given the nature of the deposited material and the disposal facility sensitive surroundings. Some of these are related to the operation licence requirements (e.g. groundwater, radiation, dust, residue material composition) and others have been requested by Cristal to improve the understanding of the Site conditions and to inform decisions related to the site closure plans.

Cristal prepared Annual Environmental Performance reports as per operational requirements and these were provided on a yearly basis to the relevant state authorities. The reports included compliance information on all monitored media as well as additional environmental studies undertaken by Cristal on a voluntary basis.

A selection of the main environmental monitoring programs or specific studies prepared by or for Cristal are summarised below. It should be noted that the level of description of the listed programs/studies varies from report to report depending on the relative significance of the contents to the overall scope of the current HRA.

3.1 TREATED SOLID RESIDUE COMPOSITION ASSESSMENT PROGRAM

The TSR originated from two processing plants (Kemerton and Australind) have been analysed on a quarterly basis since 1989 for a wide range of metals as per operating licence requirements. The analyses included: arsenic (As), beryllium (Be), calcium (Ca), chromium (Cr), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), aluminium (Al), barium (Ba), boron (B), cobalt (Co), copper (Cu), magnesium (Mg), vanadium (V) and zinc (Zi) and these elements were analysed on subsamples of composite samples collected by the operator from each residue load prior to being discharged into the ponds.

Over time, the suite of analysed analytes has changed as a function of new licence conditions. In addition to the analysis of TSR solids, TSR filtrate (liquid portion of the slurry prior to disposal) has subsequently been analysed for the same set of parameters to assess for leachability potential of the TSR.

Since 2010, the analysis of the TSR leachate was an additional requirement of the operating licence which stipulated that if the concentration of one parameter exceeded the regulated trigger value in the TSR solid, a leachate test was required to check potential risk of that contaminant to become mobile within the leachate and migrate towards the water table.

The solid TSR and its "secondary compounds" that can be formed/generated from its interaction with the surrounding media, i.e. leachates of metals and salts in water, radioactivity in soil, air, water, dioxins and furans in water, air, represent the main sources considered in this HRA. A detailed review of the TSR composition data and further definitions on the sources are provided in *Section 4.1.2* as part of the characterisation of the risk assessment sources.

3.2 RADIATION MONITORING PROGRAM

The residue products of the Kemerton and Australind pigment plants are known to contain traces of uranium and thorium so it was deemed necessary to consider the radiological issues of the management of the facility. Based on the information provided by the Cristal environmental reports register (MIC, 2008), there have been a total of some 45 radiation monitoring programmes between the years of 1989 and 2009 at the DTSRF. Seventeen of these were conducted biannually between 1989 and 1997; a further 27 were conducted between 1997 and 2007, 2008, 2009 and 2010. Some additional 10 reports were related to testing overburden including the site's radon and thoron flux or gamma radiation which were either requested by the Radiological Council or commissioned by Cristal for their own purposes.

Katee Enterprises conducted the first 13 monitoring programmes between 1989 and 1995 to help the operator adhere to DEC monitoring requirements set in 1989 which included the monitoring of radiation. The Katee Enterprises radiation monitoring programmes consisted of measurements of at least three of the following:

1) absorbed dose rates in air;
2) radionuclides in water;
3) radionuclides in the residue;
4) radon concentrations; and
5) radionuclides in the air.

Over the six year monitoring period between 1989 and 1995, it was found by Katee Enterprises that radionuclides in air, water and residue were generally stable over the period. This was also reflected in the absorbed dose rates in air. It is however noted that the March 1994 report indicated a noticeably higher than usual peak of radionuclides in water, and in subsequent years the levels dropped.

As a result of the extensive re-structuring of the disposal facility undertaken during 1996 a revised operational radiation monitoring program was submitted to the Radiological Council on October 1996. Additional measurements of radon and thoron concentrations in air and alpha activity in airborne dust were added to monitoring. The 17 year period between 1996 and 2013 consisted of a very similar scope of work to the Katee Enterprises reports.

Additional radiation monitoring was requested by the Radiological Council of Western Australia (RCWA) in July 2009 for the one time analysis of additional radiological parameters. This included sampling of radionuclides in air by means of high volume sampling and monitoring for 16 radon and thoron daughter concentrations.

This monitoring scope was undertaken bi-annually and the results have been reported in the annual environmental performance reports (MIC, 2010, MIC, 2011, MIC, 2012, CG 2013 and CPA, 2014).

The last operational radiological monitoring events were undertaken in November 2012 and May 2013 (CPA, 2014). The results of these sampling events are discussed in more detail below in the context of historical trends.

The review of the past five years of radiological monitoring results (2009-2013), indicated consistent stable gamma radiation levels at the Site boundaries and the gamma radiation levels over the uncovered disposal ponds were similar to those predicted from the radionuclide content of the solid residues, assuming a water content of 60% and the operations of the solid residues disposal facility were not causing any detrimental effects on the gamma radiation levels. In 2013 there has been an increase in the uranium levels over historical levels, though levels are reasonably consistent with levels since 2009, when a change in feedstock occurred. The radionuclide contents of the solid residues can be expected to be dependent upon the radionuclide content of the feed stock to the pigment plant, thus changes of the order seen could be attributed to the changes in the feedstock ratios of natural to artificial rutile. A post remediation (earthworks related to the capping of the ponds) gamma radiation status monitoring was also undertaken after the ponds were covered with a fill layer, and the results of this assessment indicate that the gamma radiation levels to within the natural background of the area. Further details are presented in *Section 3.9.4* as part of the closure and rehabilitation plan works.

The radionuclides in the TSR are monitored biannually. The identified uranium contents have been varying over time with the latest monitoring data showing mean thorium contents of 197 ppm and 173 ppm and the mean uranium contents were 245 ppm and 134 ppm for the two monitoring periods. During the period Cristal trialled different ore blends including periods of using titanium slags which have lower uranium (10 -20 ppm) and thorium (40 -180) contents. This is the reason why the thorium contents of the solid residues are showing significant variation, with average levels dropping lower than historical variations.

Operational monitoring of radon, thoron, inside the facility and its boundaries has been undertaken for over 20 years. The latest monitoring report (CPA, 2014) indicated that the thoron and radon concentration in the air over the last 4 years have been fairly consistent with radon values below 20 Bg/m^3 except some measurements in 2011. The highest radon readings from 2011 would equate to an annual dose of 0.7 mSv/year (assuming an equilibrium factor of 0.4). The thoron data over the period 2009-2013 calculated from the combined radon and thoron measurements are in most cases also below 20 Bq/m^3. The few exceptions to this trend showed thoron values between 554 and 896 B1/m^3 which would equate to an annual dose of 2-3 mSv. In conclusion, radon and thoron in air monitoring results indicated that the readings are commensurate with normal background levels in the area, with some elevations on the western side of the TSR ponds which could partly be attributed to effects of wind direction influences (CPA, 2014). Based on the long term monitoring results there is sufficient evidence that alpha activities of airborne dusts at the boundary of the facility over the operational lifetime of the DTSRF are within the normal environmental range.

Monitoring data of radium-226 concentrations in the shallow groundwater over time indicated that higher radium-226 values are recorded in the deeper bores compared to the shallower bores, indicating a potential natural radium-226 source rather than from the solid residue. This conclusion was also supported by the fact that some of the highest radium-226 concentrations occurred in bore DM9A, despite being up-gradient of the disposal facility, while some of the lowest concentrations were in the deep and shallow down-gradient bores (DM7 and DM8).

In 2013 there were no discernible increases of radium-226 content in the shallow bores to indicate any leaching of this radionuclide from the residue. The series of off-site bores, MB1-4, to the south of the disposal site, showed fluctuations in the relative radium-226 levels however these fluctuations were well within (and on the lower end of) the historical levels of these bores. The bores MB3 and MB4 located downstream of the facility consistently showed low radionuclide levels over time.

As stated in the annual monitoring report (CPA, 2014) the radium-228 content in the shallow groundwater did not indicate large fluctuations at each location as seen historically, indicating likely improved laboratory reliability. Most of the data in the 2013 year was below or near the laboratory detection limit, highlighting the limitations of the analytical technique. However, within the limitations of the technique. the radiation survey report states that there were no indications of ongoing variability trends in the data (CPA, 2014).

Long term groundwater monitoring undertaken on the deep bore installed in the Yarragadee aquifer indicated that radium-226 and radium-228 are not present above detection limits, and in conclusion the deeper aquifer is considered to not be affected by radionuclides migrating from the TSR through the shallow aquifer.

3.3 *GROUNDWATER ASSESSMENTS*

3.3.1 *Groundwater Study (Geoprocc)*

A report on the groundwater quality was undertaken in 2009 by Geoprocc Pty Ltd (Geoprocc, 2009), on monitoring data collected at the Site between 2003 and 2009 with the view to improve the understanding of the groundwater and hydrogeological movement of leachate into the subsurface environment at DTSRF. The scope of the report included:

1) quantifying the Site's natural (background) quality of groundwater;
2) the evaluation of impacts of TSR disposal on groundwater in the period of 2003 to 2009 and comparing results with previous reviews of groundwater quality between 1989 and 2003;
3) comparing groundwater quality with environmental guidelines;
4) assessing plume movement in groundwater below the disposal ponds and possible effects of reduced groundwater flow from increased abstraction and declining rainfall; and,
5) investigating a source of elevated groundwater concentrations of chromium in bores, up hydraulic gradient of the DTSRF (background bores).

Most relevant conclusions of the study are summarised as follows:

1) Effects of TSR leachate from the disposal ponds were expressed in increasing salinity and decreasing alkalinity, pH and sodium/chloride (Na/Cl) ratio. Impacts were identified in some of the wells located down hydraulic gradient (well pairs DM4 and DM8).
2) It was concluded that arsenic, iron and copper concentrations were naturally elevated in a number of bores both up and down hydraulic gradient from the ponds. Copper concentrations were marginally above relevant criteria could be related to leaching of the ponds.
3) The high concentrations of chromium VI incidentally monitored in some for the bores were considered to be anomalous as they exceeded the total chromium amounts.
4) Overall, groundwater in bores up hydraulic gradient of the disposal ponds was considered to not be affected by TSR disposal and that the Yarragadee aquifer was also not affected by TSR disposal up hydraulic gradient of the disposal ponds;
5) Leachate travel time from the ponds to the groundwater table (vertical migration) was approximated at 30 years. Groundwater

travel time in the saturated zone from the ponds to the ocean discharge point was approximately 3 years. Note: This assumption may be overly conservative as indicated in a hydrogeological report (ERM, 2012) and discussed further in *Section 4.2.1 CSM assumptions*.

6) There was some uncertainty regarding the exact groundwater flow pattern at and around the DTSRF.

The study concluded that the quality of groundwater discharging into the ocean near the beach at the DTSRF disposal site was not adversely affecting ocean water and did not exceed environmental guidelines.

The 1988-2003 groundwater monitoring reports provided overall, similar conclusions to the Geoprocc 2009 report. The pH has remained constant with iron levels decreasing on average. The salinity and Na/Cl ratios in groundwater in one of the monitoring bores (MB3), which indicated contamination by TSR leachate in the period before 2003, have returned to background levels. Magnesium/calcium ratios however, have increased since the period before 2003 in groundwater from bores DM2C&A and particularly from bores DM4C&A and DM8A&C.

3.3.2 Groundwater Monitoring Program

There have been a total of some 95 groundwater monitoring events conducted during period 1989 and 2013 (mostly undertaken quarterly) at the DTSRF as part of the operational licence requirements from the well network installed at the Site (up to 15 wells, some of them replaced over time). The standard suite of analysed parameters, as per the latest operational licence, included: electric conductivity, TDS, bicarbonate, boron, calcium, cadmium, carbonate, copper, chloride, iron, lead, chromium, magnesium, manganese, mercury, nickel, nitrogen, potassium, sodium, sulphate and vanadium. Over the years the suite of analytes has been modified with some of the initial parameters no longer being considered of potential concern and new ones added to the monitoring program, function of licence requirements.

Monitoring of the Yarragadee formation ceased in 1996 as authorities were satisfied that the disposal ponds were not affecting this confined aquifer. A basic monitoring program comprising depth to water, EC, pH, redox potential, Na and Cl and Radionuclides was, however, considered to be prudent and monitoring was resumed with a new bore in 2005.

The review of the 2013 data confirms that in some of the down-gradient bores (DM4A and DM4C, DM7A and DM7C, DM8A and DM8C) the salts leachate assessed through the Na/Cl ratios is still present in groundwater in the superficial aquifer. However, the concentrations are steady when compared to the previous years (CPA, 2014).

The comparison of the average 2013 metal concentrations in groundwater reported by Cristal in the latest annual environmental report (CCPA, 2014) against the marine waters guideline indicated that cobalt, copper, lead and zinc exceeded the 95% trigger level in background wells. Metals exceeding the 95% trigger level in downstream bores were chromium III and VI, cobalt, copper and zinc.

3.4 *DUST MONITORING PROGRAM*

Dust monitoring was undertaken internally by Cristal over time using a TSP and PM10 high volume sampler for 24 hours within a fourteen day interval from the 1 October to 31 March each year at the north-eastern end of the central ponds (CG, 2013). As presented in recent yearly annual environmental assessments (MIC, 2009, 2010, 2011, 2012 and CG, 2013) the dust monitoring data indicates no incidents of dust reported. Due to the clay-like nature of the TSR, no dust is liberated from the site. Dust monitoring indicates particulate levels are below air quality standards/guidelines. In previous studies of the dust deposition carried out as part of the radiological studies at Dallyellup on the analysis of the insoluble portion of the dust there was found to be no evidence of the footprint of elements derived from the TSR residue (CG, 2013).

"These results indicate that very little to none of the material deposited comes from the tailings itself. From this data there is no indication that the residue is becoming airborne and presenting an inhalation issue as it dries."

As part of the Ministerial conditions the ponds surface was hydro-mulched in late 2013 to reduce the potential for dust mobilisation.

3.5 *DIOXINS AND FURANS MONITORING PROGRAM*

Testing for dioxins in TSR solids was undertaken by MIC voluntarily in 2002, 2007 and 2010 (Oceanica, 2009). The TSR solids indicated detectable levels of dioxins but concentrations were below available international guidelines for residential soils (Germany 1,000 TEQ; and New Zealand 1,500 TEQ). Testing in 2007 and 2010 also showed that 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) was not detected in the TSR at Dalyellup (MIC 2009b, MIC 2011).

As per the latest operation licence requirements (L6130/1989/12; DEC, 2010) the solid samples were collected and analysed by an accredited organisation and the results were be peer reviewed by an independent consultant with recognised standing in the field (Scherger). The presence of these chemicals was monitored in the TSR solids and groundwater samples (YB, MB3 and MB8). The groundwater monitoring results are discussed in section 3.3.2.

The monitoring undertaken by 2010, 2011 and 2012, 2013 (MIC, 2011, MIC 2012, CG 2013, CPA, 2014) have established that the low levels of Dioxins (D) and Furans (F) in the residue are well below the Low Persistent Organic Pollutant (POP) standard and were typical for the tested waste materials and the concentrations have been consistent over time. Based on the pond soil samples, the levels of D&F in the residue are less than 1/30th of the Basel Convention definition of 'Low POP level' (15 mg TEQ/kg) of polychlorinated dibenzo dioxins (PCDDs) and Polychlorinated dibenzofurans (PCDFs). The low levels of D&F in the waste stream implied that treating the entire waste stream (~130,000 tonnes per annum) via a high temperature pyrolysis process to destroy these contaminants (potentially releasing other contaminants into the atmosphere) was not warranted.

Through commissioning independent sampling and testing, MIC has been measuring and minimising unintentional D&F prior to the ratification of POPs under the Stockholm Convention. Together with the physical properties of D&F and the corresponding very low sample levels of D&F in the TSR and surrounding disposal facility environment, D&F are not considered emissions of significance (MIC, 2010).

In 2013 no dioxins or furans were detected in the groundwater samples from wells MB3, DM8A, and DM8C. The Yarragadee well sample indicated the presence of a dioxin and furan isomer octachlorodibenzodioxin (OCDD) at a concentration (9.6pg/L) marginal to the laboratory detection limit (7pg/L). OCDD was also found in the method blank (2.2 pg/L). The reported value in Yarragadee well for OCDD is marginally above the LOR, using the laboratory convention of setting the LOR at 3X the concentration measured in the blank. Looking at the past five years of results no dioxin and furans congeners were detected in samples from the Yarragadee well. Cristal interprets the marginal hit of OCDD in 2013 as an anomaly due either to external contamination or laboratory analysis variability. OCDD is the least toxic of the dioxin and furan isomers (TEF = 0.0003). A similar "positive" result for another congener 1,2,3,7,8 pentachlorodibenzo-p-dioxin (PeCDD) occurred in August 2012 in well DM8A. This congener has subsequently not been detected in the past two sampling events suggesting the low level measurement was likely an anomalous result.

3.6 *MARINE ENVIRONMENTAL RISK ASSESSMENT*

Oceanica Consulting Pty Ltd (Oceanica) has undertaken a marine environmental risk assessment for Cristal as a means to understand the potential influence of the leachate from the ponds to the nearby marine environment. The study was prepared in two stages: a desktop based risk assessment in 2009 (Oceanica, 2009) followed by additional field data collection and risk assessment refinement in 2010 (Oceanica, 2011).

The desktop study used available information as supplied by Cristal and *Geoprocc,* and estimates of groundwater and near shore ocean flux to present a risk assessment to address these potential concerns on impacts on the marine environment. The PCOCs considered by *Oceanica* are based on the data made available by CP on the composition of the TSR solids major elements average concentration data (Al, Ca, Cl, Fe, K, Mg, Mn, Na, S – total, S as SO4 and Ti) and minor elements (As, B, Ba, Cd, Co, Cr, Cr VI, Cu, Hg, Nb, Ni, P, Pb, Se, Sn, Th, U, V, Zn and Zr) as listed in the Geoprocc study (2009). as well as TSR filtrate average concentration data of major elements (Al, Ca, Cl, Fe, K, Mg, Mn, Na, S as SO4, P as PO4 and Ti) and minor elements (As, Cd, Co, Cr total, Cr VI, Cu, Hg, Nb, Ni, Pb, Se, Sn, Th, U, V, Zn and Zr)

Four scenarios were considered as part of the risk assessment:

1) Based on a 'constant' flow (without attenuation) where the entire volume of estimated leachate and associated contaminants would travel through the aquifer into the ocean;
2) A constant but 'reduced' flow where only a proportion of the contaminants (10%), but the full contaminant load (all PCOCs), reaches the aquifer and ocean;
3) Variable flow with a lesser volume but with no attenuation would reach the superficial aquifer and discharge into the ocean; and
4) Variable flow with a lesser volume, with 90% attenuation during flow within the aquifer before reaching the marine environment.

These last two scenarios were considered far more representative of actual conditions, but the first two conservative scenarios (without attenuation) covered the possibility of the capacity of the aquifer to attenuate contaminants being exhausted.

The 90% attenuation factor used by *Oceanica* was based on existing groundwater study (*Geoprocc* 2009), and this represents a conservative position as the quoted attenuation range is 90% (e.g. for metals like cadmium, cobalt and zinc) to 99.99 % (e.g. for metals like mercury and tin).

Oceanica found that there appeared to be minimal risk to the marine environment from the operation of the Dalyellup disposal facility. Even under the worst case scenario, where the entire load of contaminant and leachate volume enter the superficial aquifer and then discharge into the near shore zone, *Oceanica* estimated that the concentrations in the ocean would be below the National Water Quality Guidelines for the highest level of ecosystem protection.

The study also compared the characteristics of the TSR filtrate disposed at DTSRF to the wastewater released at Kemerton via Cristal's ocean outfall. It was noted that seven elements (i.e. iron, magnesium, manganese, titanium, chromium, copper and nickel)—had higher concentrations in the TSR filtrate than in the Kemerton wastewater, but in all cases were below guideline threshold values (ANZECC/ARMCANZ (2000) 99% species protection level).

The comparison to the Kemerton wastewater was relevant in the context of over 20 years of waste water being discharged directly into the ocean without showing any significant impact on the marine environment in the Kemerton area. The Kemerton outfall is frequently monitored, including three-yearly sediment and sentinel mussels surveys. If any of the contaminants discharged from the outfall were impacting on the marine environment there would be evidence of elevated levels in the mussels and sediments, but no such evidence has been found in studies undertaken in 2009, 2007 and 2004 (Oceanica, 2009). Monitoring results from the Kemerton ocean outfall suggest that there is minimal risk to the marine environment due to the discharge of process wastewater into the ocean. This provides considerable confidence as a line of evidence taken with the other evidence presented that the leachate from Dalyellup facility does not represent a risk to the marine environment.

The final conclusion of the desktop risk assessment was that the continued use of the DTSRF for a further three years was not increasing the risk of any impacts to the marine environment.

The 2nd stage of the marine risk assessment consisted of field data collection at five representative sampling locations on the beach adjacent to the DWSRF and at a reference location, 7 km to the south, of sediment, sediment elutriate, marine water and biota. The sampling design was focused on the intertidal zone, in the main area of groundwater discharge, and further inland (berm crest), to capture sediment and groundwater characteristics less affected by dilution with marine waters. The results were compared to the relevant ecological guidelines for sediment and marine water (ANZECC/ARMCANZ 2000), and human health guidelines (DEC, 2010).

The field study confirmed the outcomes of the desk based risk assessment, showing that based on 2010 field data there is no evidence of impacts to marine ecology from DTSRF which possess negligible risk to the marine environment and has a negligible impact on recreational uses of the beach and marine waters in the DTSRF area.

3.7 *PONDS REHABILITATION MONITORING PROGRAM*

A staged Rehabilitation Management Plan was developed in 2001 based on several research studies undertaken previously at the Site. The two southern ponds, S1 and S2 deactivated in 2001 were rehabilitated in 2002 as part of stage I rehabilitation plan following the specifications of a Tailings

Rehabilitation Plan developed by Worley Parsons in 2001. The ponds were covered with a 2 m thick layer of stockpiled sand from within the Site and brush matting was constructed and native plants were seeded to resemble a typical coastal sand dune environment (CG, 2013). The Rehabilitation Plan included monitoring long term the radiological parameters, groundwater conditions, soil cover and ecological performance. The ecological performance of the plan monitored rehabilitation progress, vegetation recovery, vegetation succession and diversity and required weed control measures.

Based on the last rehabilitation plan update (CPA, 2013) the southern pond rehabilitation remains stable after over 10 years. The native vegetation and brushing is reported to provide adequate protection against wind and water erosion. Acacia varieties have thrived in the coastal dune system, and are now providing shelter for other small trees and shrubs. It is stated that the radiation levels in this area are at background levels and fauna (e.g. birds and kangaroos) have been seen frequenting the rehabilitated area. Cristal indicated that over time, the drying process which determined a loss resulted in deep desiccation cracking and delamination of the dried material in the rehabilitated ponds. Dune subsidence surveys on the rehabilitated southern ponds, show, since the initial subsidence, the rate of subsidence has slowed to less than 3 centimetres/year by 2012.

3.8 FLORA AND FAUNA STUDIES

To support the rehabilitation efforts at the Site, several research studies (plant physiology and ecology) were undertaken by Cristal in collaboration with universities between 1996 and 2001, to establish whether the presence of the treated residue could have a heath impact on some targeted plant species. Some fauna studies targeting a specific insect group (ants) were also conducted on the revegetated residue ponds. In general the studies concluded that the presence of the treated residue was not visibly affecting the researched plants and that applied rehabilitation measures were successful with considerable revegetation and repopulation of the sand dunes. Copies of the various flora and fauna studies are provided as annexes to the final Site Closure Plan (CG, 2013).

3.9 SITE CLOSURE AND REHABILITATION PLAN

Because the TSR is considered in a conservative approach as a Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) (O'Brien, 2010), there are some considerations that have to be followed during the closure of such disposal facility. According to Radiation Health Series – Code of practice for near-surface disposal of radioactive waste in Australia (RHS35) (ARPANSA, 1992) a minimum of 2 m thick layer of soil or clean fill should be placed on top of the waste.

As per ministerial conditions at the end of treated solid disposal activities, the operator of the DTSRF was requested to develop a final rehabilitation program (referred to hereafter as the Closure Plan) to the requirements of the Radiological Council and the DER. The Plan was prepared in June 2013 and updated in August 2013 based on comments received from various stakeholders including the CS auditor, licencing and contaminated sites DER branches, Radiological Council, Shire of Capel and Environmental protection Agency. The Closure Plan was endorsed by the CS Auditor subject to the implementation of some specific comments raised in a letter issued in Oct 2013 (AECOM, 2013).

Cristal has received a Closure Notice from the DER in June 2013 and this was amended in August 2013 (CCPA, 2014).

As part of the closure requirements several studies/assessments have been prepared by Cristal or contracted to specialised firms. In this section is presented a brief summary of the assessments considered to provide relevant information for the current HRA.

3.9.1 Rehabilitation Plan

As already mentioned in *Section 2.2.1*, Cristal has developed a staged Rehabilitation Plan in 2001 for the various disposal ponds. The southern ponds were the subject of the stage I of rehabilitation. After the disposal operations ceased in March 2013, the stage II of the rehabilitation plan commenced on the central and northern ponds (i.e. covering of the deposited treated solids with fill) in line with the earthworks strategy developed by Worley in 2013 (CG, 2013). The fill stockpile was generated during the excavation of the central ponds constructed in 1996 and was stored on Site since then. The thickness of the fill layer applied on top of the TSR varied between 5 m in the north western pond, 4 m in the north eastern pond and 3.3 m in the central ponds area. The relative elevation of the finished fill cover surface is between 26-28 m AHD. The conclusion of the rehabilitation works undertaken to date is that stockpiled topsoil was appropriately located and applied germinating seed will decrease potential dust generation issues. "Hydromulch" paper mulch and grass seed was sprayed onto the stockpile at various times (most recently in November 2013) (CPA, 2014).

Apart from resurfacing works the rehabilitation plan refers to a series of ongoing monitoring programs (i.e. groundwater, dust, radiological, vegetation). The level to which the rehabilitation plan will be implemented will depend on whether the future land-use scenario of sporting fields will be considered feasible and when set finishing criteria (ecological, radiological, groundwater) will be considered to be met. Groundwater quality, radiological monitoring and revegetation progress monitoring are expected to continue at the Site at least until 2018 as per the Closure notice issued by DER in August 2013, when a Final Rehabilitation Report will be submitted to the DER (CPA, 2014). A verification marine assessment is planned to be undertaken at that stage to confirm the outcomes of the similar marine assessment undertaken in 2011 (Oceanica, 2011).

3.9.2 Hydrogeological Assessment

In 2012 independent of the HRA project, ERM was commissioned to prepare a hydrogeological report (ERM, 2012) as per closure Ministerial conditions requirements. The assessment involved the review of existing groundwater monitoring data provided by Cristal.

With the exception of well pairs DM1 and DM9, which indicate fresh groundwater quality conditions, the rest of the wells installed in the superficial aquifer indicate brackish to saline quality. Based on data compiled for this report, the physical and chemical parameters in groundwater downgradient of the ponds were reported to have changed over time. The main changes were related to an increase of total dissolved solids, electrical conductivity and salinity. The changes in groundwater quality are potentially a function of natural changes (i.e. through oxidation of sulphidic minerals and dissolution of metals in the subsurface) and / or leachate generation from the TSR. Groundwater quality changes do however suggest that leachate has potentially reached the groundwater. This might suggest that the prediction of 30 year travel time of leachate to groundwater was over-estimated.

Based on the groundwater monitoring data, the PCOCs identified in the assessment included:

- Trace metals: Chromium (Cr), chromium VI (Cr VI), cobalt (Co), Nickel (Ni), Manganese (Mn), Molybdenum (Mo);
- Cations: Magnesium (Mg) and Calcium (Ca);
- Anions: Chloride (Cl).

Concentrations of PCOCs in the surficial aquifer monitoring wells up-gradient and down-gradient of the TSR ponds have been more variable over time but are generally either stable or increasing (ERM, 2012).

The Yarragadee aquifer was not impacted by the identified PCOCs.

Generally, concentrations of PCOCs in the surficial aquifer background wells were either stable or decreasing. As part of this assessment a long term monitoring program post closure consistent with the license 6130/12 conditions (Requirement 4 (iii)) to monitor any migration of PCOCs from the ponds was developed. According to this program all surficial aquifer monitoring wells should be sampled biannually while the Yarragadee aquifer monitoring well should be sampled annually for a wide range of physical and chemical parameters including pH, EC, TDS, selected metals, chloride and sulphate, dioxins, furans, radionuclides, etc. The monitoring program was amended later on by Cristal based on recommendations received from the CS Auditor (AECOM, 2013).

3.9.3 *Soil Validation Report*

The earthworks scheduled as part of the rehabilitation plan Stage II (see *Section 3.9.1*) included covering of the deposited TSR ponds with a clean fill layer at least 2 m thick, as per closure plan requirements. *GHD* was commissioned in 2013 to undertake a soil validation investigation on the fill layer placed over the central and northern TSR ponds to confirm the quality and thickness of the fill layer (GHD, 2014).

The soil investigation was undertaken in November 2013 as proposed in the Sampling and Analysis Plans (SAPs) approved by the CS Auditor. The adopted sampling strategy included 132 bores drilled following a grid based pattern and collection of over 327 soil samples (including 40 field duplicates and triplicates).

The bore information indicated that at 33 of the 132 locations traces of brown sandy clay/clayey sands or clay 'pebbles' were observed. These observations of clay material may represent TSR or naturally occurring clay within the stockpiled fill material. The clayey material was predominantly identified in the deeper section of the investigated fill profile with 13 instances in top metre. It was estimated that approximately 6% of the fill layer contains some clayey materials (17 of 286 m of drillings).

The chemical analysis of the fill material indicated exceedances of ecological and human health guidelines for several metals in soil (chromium (VI), cobalt, manganese, molybdenum, nickel, tin and vanadium). In the absence of a guideline value in the new NEPM for chromium IV the DEC guideline for recreation land-use was used and the screening indicated 173 cases of concentrations above the 1 mg/kg screening level. Other metals that showed exceedances of ecological guidelines included vanadium and cobalt in 8 samples, molybdenum and manganese in 6 samples, nickel in 2 samples, and tin and chromium total in 1 sample. The majority of the exceedances occurred in the deeper layer of the investigated fill material (between 1.5-2 m below ground surface).

There appears to be a correlation between the high concentration of the metals in soils and the occurrence of the clayey materials at different depths in the bores. Further composition analysis and statistical tests undertaken by GHD to identify the possible origin of the clayey material indicated that the clayey materials are likely to be generated by the TSR becoming incorporated into the fill layer. The naturally occurring nature of the clayey materials was discounted.

The report argues that the majority of the EIL exceedances for metals are considered to be isolated and infrequent. In the case of chromium VI most of exceedances are less than 20 mg/kg, value below which adverse impacts to flora species are unlikely to occur based on evidence from literature.

Leachate analysis was undertaken on nine soil samples collected from the clayey materials showing exceedances of EILs in the soil samples. The concentration of leached chromium VI at neutral pH exceeded the marine and fresh water guidelines in five samples and leached vanadium indicated exceedance of marine water guideline in five samples. The maximum concentrations exceeded the ANZECC 2000 marine waters criteria by a factor of 80 for chromium VI and 2 for vanadium. Based on the estimated proportion of clay containing material in the fill layer (6%) GHD has estimated that the fill layer as a whole would generate leachate concentrations marginal to the marine waters criteria. GHD considers that given the conservative conditions in which leachate is analysed in the laboratory the actual concentration of chromium and vanadium leachate would be lower and natural processes such adsorption and dilution would contribute to the attenuation of the leachate concentrations.

Given the magnitude of the exceedances and because they occurred typically at depth, the report considers the capping material presents no unacceptable risk to ecological receptors.

No exceedance of human health criteria for recreational land use have been reported, hence no unacceptable risks are likely to occur to human from the composition of the fill material. The report also states that the potential to human health related to radiological exposure via direct contact/ingestion/dust inhalation of radionuclides in the TSR materials or from exposure to unacceptable levels of radiation is considered to be low and reducing to very low following establishment of vegetation cover. The results of the radiological monitoring report undertaken by the Radiation Professionals at the Site in February 2014 (see section 3.9.4) showing gamma radiation levels within background levels was used by GHD as further evidence to support the unlikely significant risk to human posed by the presence of TSR materials in the fill layer.

It is noted that from a QA/QC perspective the analysis of the 40 QA/QC samples (inter- and intra-laboratory duplicates) indicated a significant number of relative percent difference (RPD) calculations above 50% (with 48 cases above 100%). In most cases the difference in results was attributed to concentrations close to the detection limit and the slightly different analytical methods employed by the two laboratories. Conservatively the higher concentrations have been taken into consideration in the risk assessment.

The borelogs illustrating the type of materials encountered during the validation works indicate that in few cases the minimum thickness of 2m of fill layer (considered to be sand) was not achieved, especially at the locations where access ways or pond walls were constructed in the past (e.g. CTP12, CTP46, CTP53, A524, CTP30). At these locations a clayey sand material was described to be present within the first two metres bgl.

The final conclusion of the soil validation report is that the capping material applied to the Site is at generally least two metres thick and presents no unacceptable risks to human health or the environment.

These findings are based on the assumptions that the future land use will be recreational playing fields with no future disturbance to the cap besides installation of services including irrigation, power, water, etc. It is further assumed these would be installed in the top 700 mm and no disturbance to the underlying TSR material would occur during installation.

3.9.4 Radiation monitoring post remediation

In February 2014, Radiation Professionals undertook gamma radiation monitoring and radon flux sampling using a nominal grid size of 50m by 50m over previously rehabilitated areas with a section of 25m x 25m grid spacing over the newly capped pond, with the intent of determining the success (or lack of) for the rehabilitation of the area.

The results of the gamma monitoring show that the rehabilitation of the area has been successful in returning the gamma radiation levels to within the natural background of the area (0.10 μGy h-1) (CPA, 2014).

4 *RISK ASSESSMENT*

This section describes Stage 2 of the overall risk assessment approach, as described in *Section 1.5, Figure 1.1* and *Table 1.1*. The review of the data summarised in *Section 3* has enabled the development of a site specific Conceptual Site Model (CSM). The CSM includes a qualitative description of all plausible mechanisms ('pathways') by which receptors may be exposed to sources of chemicals on the Site and it is developed to provide an overall understanding of the Site. For exposure to be considered possible a pathway must exist by which impacts from a given source can reach a given receptor. A complete 'source-pathway-receptor' exposure mechanism is referred to as an 'SPR linkage'. There may be many 'sources' at the Site, and they are defined three dimensionally using site characterisation data (*Section 4.2.2*). Sources, or more specifically Potential Chemicals or Contaminants of Concern (PCOCs) identified in the sources are then evaluated for potential connection to identified receptors (*Section 4.2.3*) via a pathway (*Section 4.2.4*).

The standard tiered approach recommends that SPR linkages that are likely to be complete and which fail the Tier 1 assessment (screening against generic criteria) are progressed to Tier 2 for further assessment. The approach taken by ERM to the assessment of risk at this Site involves a tiered assessment but the methodology has varied slightly from the theoretical model since a number of the assessments that already existed had undertaken risk assessment at a range of levels of sophistication. For this reason, the first tier of assessment sought to develop an initial conceptual site model using existing third party data information (summarised to the extent possible in *Section 3*) and which contemplated all theoretical SPR linkages. Where preliminary assessment of existing information meant that a possible risk existed, it was subject to further assessment/discussion. Likewise, where existing information provided sufficient evidence that a SPR is unlikely to be complete, such linkages have been discounted without further discussion. The degree of further assessment on potential complete SPRs was tailored to suit the specific issue where in some cases the low probability of risk and high quality of existing data meant the further assessment was limited to a verification exercise (e.g. groundwater and TSR solids composition) and in some cases specialised tier 2 risk assessment techniques were necessary (e.g. gamma radiological assessment).

4.1 *DATA COLLECTION AND QUALITY EVALUATION*

The goal of data collection is to adequately characterise the nature and extent of human and ecological risks arising from the current and historical use of the Site. Data collection is an important component of issue identification and the quality of a risk assessment as mentioned in *Section 1.5*, and is dependent on the quality of input data on which it is based. A brief assessment of the quality of the data used in this risk assessment is included below.

4.1.1 *Data Quality Objectives*

The amount, nature and quality of the data used in this risk assessment have been determined by the data quality objectives (DQOs). Consideration of the DQOs has been given to demonstrate that the reported data are sufficient to characterise the potential risks that may exist in a sports field scenario in relation with the current and historical land use, especially the operational period of the disposal facility.

In establishing DQOs for the HRA, the following general processes have been applied:

- issue identification – consideration of the site setting and data required to assess plausible exposure pathways and receptors;
- identification of information needed to adequately characterise the hazard and quantify exposures (including previous assessments, investigations, interviews, historical information, government/agency records);
- definition of the spatial/temporal adequacy of the data; and
- setting of acceptable limits for decision and data quality errors relative to consequences.

4.1.2 *Data Used in the Risk Assessment*

The HRA was based on the review of extensive information provided by third parties. ERM was not involved in any physical data collection (i.e. field sampling).

The PSI related data was collected mainly from publicly available information provided by authorities (aerial photography, land ownership history, heritage aspects, geology and hydrogeology details, and contaminated sites information).

Most of the quantitative data (field and laboratory analytical results) was taken/adopted from information collected and interpreted in various environmental assessments prepared by other parties either to comply with Cristal's operational licence requirements (including monitoring of various environmental aspects), or requested by Cristal to improve the understanding of the Site conditions and to inform future decisions related to the site closure plans (e.g. hydrogeological and geotechnical studies).

Information pertinent to the Site (e.g. site history, site settings, geology, and hydrogeology) groundwater quality data, air quality data, seawater/sediment quality, dust, radiation measurements, composition of total solid residue (TSR) data, TSR leachate and TSR filtrate data collected by others have been used in this risk assessment.

4.1.3 *Data Quality Assessment Criteria*

The quality of analytical data was considered based on the metrics listed below. Where the specific data quality metrics were not met or were not possible to be assessed, data were considered for potential use in the HRA on a case-by-case basis (as discussed in *Section 4.1.5*).

1. Field Quality

In an ideal case, the quality of field data should be proven through the implementation of a series of tools and measures as detailed below.

- Collection and analysis of field duplicate samples is required at a rate greater than 1 in 20 primary samples. Relative percent differences (RPDs) of the primary and duplicate samples are required to be within the acceptable range of 30%.

- Trip blanks and trip spikes are required to be included in field sample storage and transportation. Trip blank analytical results are required to be less than the laboratory LOR and trip spike recoveries are required to be within acceptable recovery criteria.

- Preparation of field rinsate blanks is required and subsequent analytical results are required to be below the laboratory LOR.

2. Laboratory Quality

The laboratory implemented quality measures of play an important role for the quantification of accuracy, representativeness, comparability completeness and reliability of the data included in the HRA. The assessment criteria considered for laboratory quality are listed below.

- Preparation of laboratory method blank samples is required at a frequency of one per process batch. Subsequent analysis is required to be below the laboratory LOR.

- Preparation of laboratory matrix spike samples, surrogates and laboratory control samples is required at a frequency of 1 in 20 samples. Subsequent analysis is required to have a percent recovery within the established limits.

- Preparation of laboratory duplicate samples is required at a frequency of 1 in 20 samples. Subsequent analysis is required to be within the acceptable RPD range of 70% to 130%.

- Samples are required to be collected in approved containers and analysed within established holding times.

3. Adequacy of Investigation

Sufficient samples are required to be collected to adequately characterise the spatial and temporal heterogeneity in the distribution and level of impact of the PCOCs in the various assessed media (solids, subsurface (unsaturated zone), groundwater, seawater and air).

4.1.4 Data Quality Assessment Summary

In general the ability to assess the applicability, precision, accuracy, reliability, comparability and completeness of the data sets used on the various reports was constrained because of the limited or lack of information on such aspects as well as minimal transparency on methodologies and standards applied. Therefore some uncertainty may exist associated with the representativeness and accuracy of the data

1. Field Quality

From the review of the quality of analytical data used for the characterisation of the TSR solids and TSR filtrate it can be concluded that the data appears representative of the typical chemical composition and leaching properties based on 15 years of data and consequently, can be considered fit for purpose. Consistency in the trends over time was used as line of evidence By ERM to infer that the data can be deemed fit for use for the purpose of this assessment.

Groundwater monitoring data sets collected as part of more than 90 monitoring events, were analysed by NATA accredited laboratories and each monitoring event included collection of QC samples (as per information from Cristal). The sample collection followed the relevant existing standards (i.e. Australian Standard 5667.11.1998) based on written correspondence with the Cristal environmental department representative (Allan Lee, Feb. 2012). The previous study focused on assessing the quality of groundwater at the site (Geoprocc, 2009) concluded that the majority of the data included in the assessment (2003-2009) was of acceptable quality. The study also refers to the fact that results of duplicate analyses and percentage recoveries of spiked elements were routinely reported.

The field methodologies applied for data collection data provided by other technical studies prepared by external experts such as the periodical radiation monitoring (O'Brien, 2009, 2011), the peer review Dalyellup Dioxins and Furans (Scherger, 2010, 2012) and the marine risk assessments (Oceanica, 2009 and 2011) are considered to be robust, and representative based on the detailed description of the methodology followed and the QA/QC procedures applied to the results interpretation.

The QA/QC information provided in the soil validation investigation (GHD, 2014) appears to be sufficient and representative of the condition of the placed fill layer overlying the TSR ponds.

2. ***Laboratory Quality***

Based on the above DQOs for laboratory quality, it is considered that environmental data from the reports reviewed (those which had this type of information made available) are of acceptable laboratory quality for the purposes of this HRA. A number of non-compliances with laboratory quality parameters were identified during the data quality assessment, but these were assessed and justified within the individual reports and were not considered to significantly impact the fitness for use of the data.

3. ***Adequacy of Investigation***

It is considered that there are sufficient data contained in the reports listed above to adequately characterise temporal and spatial variation of the PCOCs concentrations in particular the TSR solids, dioxins and furans, radioactivity in soils and air, dust and groundwater impacts at the Site. Uncertainties in the spatial extent of groundwater impacts are discussed in *Section 4.1.5.* These uncertainties are not considered to significantly impact the assessment of risks herein.

Overall, it is concluded that despite limited information on the QA/QC aspects and in some cases use of data collection methodologies that are not in line with best practice, the data referred to in this assessment, it was considered generally suitable for use in this assessment.

4.1.5 Summary of Data Gaps, Uncertainties and their implications

Several data gaps/uncertainties have been identified during the initial stages of the HRA development (issue identification and development of the initial CSM). The initial CSM is discussed in detail in *Section 4.2* and below are listed and discussed key identified uncertainties and their potential implications in the overall HRA data interpretation.

1. **Composition of the total solid residue (TSR), definition of PCOCs.** The information available on the TSR composition is provided by elemental composition (see *Table 4.1* and *Table 4.2)* rather than the chemical compounds these elements may make up (e.g. hydroxides, carbonates, acids, etc.). The concentration of these individual elements (atomic forms) has been used for the screening for solids and groundwater as information on the actual form in which these elements exist at the Site is limited. However, the review of the MSDS details of the TSR material transported to the disposal facility from the processing plants (MIC, 2007) has indicated that the composition of the TSR at disposal time is mainly water 20-50%, iron hydroxide 7-32%, silica (named also "tripoli") 0.5-10% and minor quantities of

aluminium hydroxide 4-11%, manganese dioxide 2-8%, calcium chloride 0.7-4%, magnesium carbonate 0.7-3.7% and coke 0.3-1.6%. The review of the low toxicity of these compounds to human and environmental heath as provided in the MSDS (MIC, 2007) provides confidence in the definition of the TSR which is considered to be inert in its solid form by the manufacturer (Cristal). Consequently, the screening process applied for the assessment of the TSR solids using elements which are considered to form the TSR solids PCOCs is considered to be sufficient, especially given the potential secondary TSR sources such as dioxins, furans, radionuclides in various forms (radium 226/228, thorium and uranium, gamma radiation) are evaluated individually in groundwater and air.

2. **QA/QC methodologies applied in some of the groundwater monitoring reports are unknown or are not necessarily in line with best practice available at the time of sampling.** Although the data quality issues identified above may introduce some uncertainty into the data set, the risk assessment takes this into consideration by evaluating groundwater data over multiple sampling events and conservatively applying consideration of the maximum concentrations over time.

3. **Data gaps caused by changes in the groundwater parameters suite analysed as part of the operational licencing requirements overtime.** The HRA is utilising in the screening task groundwater quality data gathered by Cristal for the purpose of meeting compliance with licence requirements. As the operational licence has been renewed several times during the operation of the DTSRF, changes in the list of parameters occurred as a consequence. In some cases the regulatory agency (WA EPA) has considered specific compounds to no longer be of concern based on an improved understanding of the site conditions and instead new compounds /elements have been included as required to be analysed in the subsequent monitoring programs. While the changes in the analysed parameters suites could lead to gaps in the data sets (see *Tables H.3-H.8* in *Annex H*) the uncertainty associated with these gaps is considered to be low given these changes were requested by the EPA and the available data indicated no significant variability of the discontinued parameters over the monitoring period.

4. **Actual nature and extent of TSR impact in shallow groundwater.** There is an apparent uncertainty related to the level of knowledge of the specific types and concentrations of the TSR salts and dissolved metals that generate the impact in the shallow aquifer, especially that the available groundwater quality data may have not covered all compounds that could be formed as a consequence of TSR leaching. The confirmed presence of salts in groundwater can be partly attributed to natural processes (seawater intrusion) and can also be a result of TSR leaching processes (as already stated in the

hydrogeological study ERM, 2102). The information provided by the groundwater well network present at the Site is considered to provide a sufficient spatial coverage for the characterisation of the identified salts and dissolved metals plume, even if some of the details of the actual plume stability may not be fully understood. The marine risk assessment findings (i.e. no significant impacts on marine ecology after 20 years of disposal operations) based on targeted sediment sampling locations immediately down gradient from the wells on Site (see *Figure 3, Annex A*) provided confidence that even if some of the groundwater plume details may remain unknown, the uncertainties related to these are low for the purposes of the HRA. Ongoing monitoring of the existing well network should provide continued confidence with this regard in the future.

5. **Behaviour of the TSR overtime in case of the future scenario which involves additional water volumes applied on its surface, beyond the natural water balance**

Numerous TSR solids samples have been collected and analysed over time, and while the behaviour of the TSR solids is sufficiently understood, there is some uncertainty around its behaviour in case of excessive watering of the resultant end use sports field ground surface. As discussed in Section *4.6.2.* Potentially an increase of water infiltration into the subsurface could theoretically mobilise more metals into solution and create additional leachate. However an increase in infiltration can also potentially create increased recharge to the shallow groundwater and actually reduce PCOCs concentrations in the groundwater due to dilution. The TSR material is shown to be predominantly composed of clayey materials (MIC, 2012). Therefore, in case of an increased infiltration, the TSR would adsorb excess water due to high clay material content and as a result of swelling, cracking may close up reducing the overall hydraulic conductivity. Site specific research (CPA, 2014) has shown that following drying out of the residue material, the mobilisation potential of the metals from the residue matrix is reduced due to the formation of poorly soluble metal oxides through the oxidation of ferrous iron and divalent-manganese. Given the moderate to high acid neutralisation capacity (about 15% as calcium carbonate) of the dry TSR any leachate seeping to the underlying soil profile would remain alkaline. Both of these properties play an important role in management of the ponds and leachate quality. The stability of elements within the solid phase (i.e. residue bed and underlying soil) is pH dependent. As the pH of the TSR layer is 8-9 and the underlying soil is 7-8, a favourable alkaline buffering capacity exists in case an acid leachate would be formed. There is sufficient information to indicate that a long-term addition of water to the dried TSR will not cause significant adverse conditions in the unsaturated and saturated zones beneath the disposal ponds. Additionally, the watering management measures described in *Section 4.6.2* will provide additional confidence that the behaviour and characteristics of the TSR residue will not significantly change to create variable storage and release of the PCOCS. On-going monitoring of groundwater as per closure requirements will provide additional confirmation of stable conditions.

4.2 *INITIAL CONCEPTUAL SITE MODEL*

The initial CSM was based on the current understanding of the potential risks that theoretically may exist at and in the vicinity of the Site based on existing information. The initial CSM has considered in the first instance all potential SPRs.

During this stage potential risks that could be adequately assessed using the information relied upon have been eliminated (e.g. dioxin and furans in groundwater, radionuclides in Yaragadee aquifer, risks from TSR leachate to marine environment, etc.). At the same time other potential risks that highlighted the need for further scrutiny were assessed further typically by comparing these to adopted guideline criteria (if applicable). Highlighted potential risks were then subject to further risk assessment, the results of which are summarised in a refined CSM (*Section 4.5*).

The CSM has been developed using Site specific information on the physical, geological and hydrogeological settings as well as future land-use scenario characteristics. The environmental Site settings adopted in the CSM are provided in *Section 2.9* of this report and a schematic representation is illustrated in *Figure 4, Annex A*.

It should be noted that the initial CSM did not take into account the works undertaken in 2013-2014 as part of site closure and rehabilitation works. These activities and their outcomes were interpreted as part of the refined CSM.

4.2.1 *CSM assumptions*

The CSM is a model of a real situation which implies the necessity of defining several assumptions in which the risk assessment process is applicable. Most of the assumptions are adopted from results/outcomes from Site specific assessments.

1) The hydraulic head in the deep bore installed in the Yarragadee aquifer is significantly above the hydraulic head in neighbouring bores DM2A&C and DM8A&C installed in the superficial aquifer, indicating a confining layer between the underlying Yarragadee and the superficial aquifer above below the Site. This aquitard will inhibit migration of TSR leachate from the superficial aquifer to the Yarragadee aquifer;

2) Based on the groundwater level in the Yarragadee aquifer (the lower aquifer) being above the groundwater level in the shallower

aquifer, this indicates an upward hydraulic gradient between the aquifers that will limit downward movement of TSR leachate into the underlying Yarragadee;

3) Mobilities of trace metals from TSR leachate in soils to the superficial groundwater and subsequently to the ocean are inhibited through a retention factor. This retention factor can vary between about 90% (e.g. for metals like Co, Zn and Cd) and 99.99% (e.g. for metals like Sn and Hg) which translates into mobilities (relative to water) of 10% and 0.01, respectively (Geoprocc, 2009);
4) Leachate travel time from the ponds to the groundwater table has been initially estimated to be approximately 30 years (Geoprocc, 2009) but subsequent later studies indicate that the leachate has already reached the monitoring wells located downgradient in a shorter time, in the vicinity of the coastline (ERM, 2012Groundwater travel time from the ponds to the ocean discharge point is approximately 3 years (Geoprocc, 2009);
5) Seasonal groundwater fluctuation does not affect directly the behaviour of the PCOCs during the time, and
6) The hydraulic transmissivity can vary between 20 and 200 m/year corresponding to a sand and limestone aquifer characteristics (Oceanica, 2011).

The CSM is built on the assumption that the future land at the Site refers to a recreational redevelopment associated with the construction of open air sport fields, with no buildings constructed on top of the TSR facility and minor ancillary buildings on the sides of the fields. The sport fields are expected to cover the majority of the surface formerly occupied by the TSR ponds and the fields will serve different type of sports (e.g. AFL, tennis, soccer, etc), most of the areas would be covered with grass, served by several paved access roads. A 2m clean sand layer will cap the TSR across the entirety of the Site. An artistic representation of the proposed future development design is presented in *Figure 4, Annex A*.

4.2.2 *Sources*

The main source of PCOCs identified in the HRA is the treated solid residue (TSR) disposed in the ponds over a period of 24 years. The composition of this material was briefly described in *Section 3.1* and is further discussed in the section below. Through several release mechanisms listed in *Table 4.3* (including dissolution of metals and salts into leachate, emission of dioxins and furans, emission of radionuclides, etc), from the TSR solids by-products chemicals/compounds are released in different media (unsaturated zone, saturated zone and air). These by-products act as sources with specific PCOCs, therefore they are considered in this HRA as secondary sources. Consequently, the HRA distinguishes between primary (TSR solids) and secondary sources (TSR leachate – metals and salts, radionuclides, dioxins and furans).

Total Solid Residue solids

A brief description of the process generating the TSR was included in *Section 2.2.2*. The TSR material is a silty clayey like mud containing unreacted sand ore and coke. The TSR is a mixture of iron, titanium, aluminium, calcium, chromium, manganese, titanium and vanadium, chloride, sulphur and other trace constituents at neutral to slightly alkaline pH to precipitate metals as hydroxides.

The Kemerton and Australind treatment plants neutralised and filtered the solids before shipment to Dalyellup. The residue resulting from the treatment plants was a solid but was subsequently re-wetted into slurry (12-20% solids) to allow for transfer into disposal trucks and for ease of transport. The liquid waste was neutral to slightly alkaline with elevated total dissolved solids derived from bicarbonate, calcium, chloride, sodium and sulphate. When in situ on site, the slurry dried and the resultant residue becomes a solid. Disposal via this method is based on the understanding that the dried solid residue is inert, mostly insoluble, non-toxic, clay like material.

Typically, the compounds that are in feedstock, rutile and synthetic rutile determine the residue that is generated. The composition is dependent on the premises that the residue is derived from.

The review of the MSDS details of the TSR material transported to the disposal facility from the processing plants (MIC, 2007) has indicated that the composition of the TSR at disposal time is mainly comprised of:

- water 20-50%,
- iron hydroxide 7-32%
- aluminium hydroxide 4-11%
- silica (tripoli) 0.5-10%

and minor quantities of manganese dioxide 2-8%, calcium chloride 0.7-4%, magnesium carbonate 0.7-3.7% and coke 0.3-1.6%. Toxicity details of each of these compounds are presented in *Annex J.*

Modelling of the average filtrate composition of TSR from Kemerton using 'PHREEQC modelling software' (suggests presence of calcite ($CaCO_3$), dolomite ($CaMg(CO_3)_2$), Mg and Ca ferrite (XFe_2O_4), siderite ($FeCO_3$) and rhodosochrite ($MnCO_3$). Modelling of the Australind filtrate suggests presence of calcite, dolomite, Mg and Ca ferrite (XFe_2O_4) and siderite (Geoprocc, 2009).

Filtrate compositions of TSR from Kemerton and Australind also suggest possible presence of alunite ($KA_{l3}(SO_4)_7(OH)_6$), basaluminate ($A_{l4}OH(SO_4)_{10}$) and (Australind TSR only) jarosite ($KFe_3(SO_4)_2(OH)_6$). On dissolution these compounds release sulphuric acid (Geoprocc, 2009).

The material contains traces of naturally occurring radioactive materials (uranium and thorium) which are technically (or technologically) enhanced and therefore, the material is conservatively considered to be a TENORM. (MIC, 2011).

Details on the average elemental composition of the TSR from the Kemerton and Australind plants are provided in *Table 4.1*, and *Table 4.2*.

Table 4.1 Average Composition of TSR solids from the Kemerton Plant 2008-2013

	2008	2009	2010	2011	2012	2013
Major Elements %						
Al	3.6	2.2	2.1	1.8	1.43	1.71
Ca	1.6	2.6	NA	NA	NA	NA
Cl	NA	2.8	NA	NA	NA	NA
Fe	13.2	8.7	NA	NA	NA	NA
K	0.009	<0.01	NA	NA	NA	NA
Mg	2.3	1.85	NA	NA	NA	NA
Mn	NA	0.86	1.52	0.86	1.85	2.29
Na	0.2	0.21	NA	NA	NA	NA
Total S	1	0.87	NA	NA	NA	NA
S SO4	NA	NA	NA	NA	NA	NA
Si	NA	NA	NA	NA	NA	NA
Ti	1.8	1.6	NA	NA	NA	NA
Minor Elements mg/kg						
As	1.8	1.5	1.5	2.3	2.7	0.97
B	NA	47	55.2	111.7	92	28
Ba	NA	NA	757.5	967.5	870	420
Cd	0.5	0.5	0.5	0.5	1.9	<0.5
Co	133.7	106	71.75	33.75	43	15
Cr III	4840	2033	NA	NA	NA	NA
Cr (VI)	6.54	2.125	0.74	5.475	2.3	<0.5
Cu	82.5	85.75	71.5	33.5	40	27
Hg	4.528	19.8	0.2	0.2	8.7	<0.2
Nb	NA	NA	NA	NA	NA	NA
Ni	622.5	547.5	622.5	637.5	690	490
P	NA	NA	NA	NA	NA	NA
Pb	27.9	86	177.5	182.5	330	77
Se	1.6	0.67	0.62	0.71	0.77	<0.5
Sn	193.2	613.3	NA	NA	NA	NA
Th	905	606.6	NA	NA	3.52	2.78
U	125.7	99.2	NA	NA	2.9*	2.29*
V	11507	13250	17150	18500	21000	13900
Zn	62.2	106	215	242.5	220	64

- NA - Not Available , element not reported, not part of required suite of parameters to be analysed as per operating licence requirements
- * Average concentrations from the TSR materials already disposed of at the Site

	2008	2009	2010	2011	2012	2013

- The highest concentration values have been chosen where more than one data pointswere available for a calendar year.

Table 4.2 *Average Composition of TSR solids from the Australind Plant 2008-2013*

	2008	2009	2010	2011	2012	2013
Major Elements %						
Al	2.6	2.6	2.87	2.09	2.43	2.7
Ca	17.5	8.8	NA	NA	NA	NA
Cl	NA	NA	NA	NA	NA	NA
Fe	2.4	2.4	NA	NA	NA	NA
K	0.04	0.04	NA	NA	NA	NA
Mg	4.4	4.4	NA	NA	NA	NA
Mn	NA	0.079	0.087	0.075	0.078	0.075
Na	0.5	0.48	NA	NA	NA	NA
Total S	0.44	0.34	NA	NA	NA	NA
S SO4	NA	NA	NA	NA	NA	NA
Si	NA	NA	NA	NA	NA	NA
Ti	2.1	2.1	NA	NA	NA	NA
Minor Elements mg/kg						
As	2.2	1.2	2.4	3.55	5	5.2
B	NA	46	47.25	37	84	84
Ba	NA	250	287.5	295	340	390
Cd	0.5	0.5	<0.5	<0.5	1.3	<0.5
Co	11.3	6.3	8.67	6.7	10	11
Cr III	55.3	30	NA	NA	NA	NA
Cr (VI)	4.4	2.1	3.6	2.8	7.7	4.6
Cu	46.3	26.1	20.7	21.2	26	10
Hg	0.2	0.2	<0.2	0.9	0.21	<0.2
Nb	NA	NA	NA	NA	NA	NA
Ni	76.3	23.5	28.2	20.5	40	32
P	NA	NA	NA	NA	NA	NA
Pb	8.3	4.875	5.6	4.1	7.6	6.5
Se	0.5	0.53	<0.5	<0.5	<0.5	<0.5
Sn	1483	773	NA	NA	NA	NA
Th	4.5	2.2	NA	NA	2.9	2.29
U	4.4	2.133	NA	NA	3.52	2.78
V	39.3	17.1	33.7	17.7	33	31
Zn	NA	NA	437	290	240	470

- NA - Not Available , element not reported, not part of required suite of parameters to be analysed as per operating licence requirements
- * Average concentrations from the TSR materials already disposed of at the Site
- The highest concentration values have been chosen where more than one data points were available for a calendar year.

Leachate (dissolved salts and metals)

The TSR in the slurry form (80% solid) has the potential to generate leachate of salts and trace metals which become mobile. It has been noted

(Geoprocc, 2009) that there is a tendency for evaporative concentration of leachate from the ponds. Cations in groundwater down hydraulic gradient of the TSR ponds indicate that salt leachate has affected shallow groundwater at some of the bores located down hydraulic gradient from the ponds these showing higher Mg/Cl ratios and lower Na/Cl ration compared to background wells.

It has been indicated that metals can become more mobile in a high salinity environment such as the salts leachate of a briny nature (Geoprocc, 2009). Metals that have been noted to be present above LOR in the TSR leachate (based on specific analysis undertake by Cristal) include Al, B, Ba, Be, Cr, Mn, Mo, Zn and V as shown in Tables H.5 and H.6, Annex H.

Salts are another class of compounds that results from dissolution processes of the TSR and these include: iron hydroxide, aluminium hydroxide, calcium chloride and magnesium carbonate. There may be other salts that present in the TSR leachate which have not been analysed for yet therefore the general term of TSR salts will be used in the HRA.

Information available on toxicity of the major salts comprised in the TSR is listed in *Annex J*.

Dioxins and furans

Dioxins and furans are not commercial chemical products but are trace level unintentional by-products of most forms of combustion and several industrial chemical processes and are formed in very small quantities during the chlorination process used during TiO_2 processing. Because dioxins are widely distributed throughout the environment in low concentrations, are persistent and bioaccumulate, most people have detectable levels of dioxins in their tissues. These levels, in the low parts per trillion, have accumulated over a lifetime and will persist for years, even if no additional exposure were to occur. This background exposure is likely to result in an increased risk of cancer and is uncomfortably close to levels that can cause subtle adverse non-cancer effects in animals and humans. As different types of dioxins have different degrees of toxicity, their toxicity is measured in terms of a Toxic EQuivalency (TEQ). TEQ is a summary measure of all dioxins in a sample, giving them different weightings depending on how toxic they are. The most toxic dioxin is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which is given a TEQ factor of 1. Less toxic dioxins are expressed relative to this.

Dioxins are relatively insoluble in water (ANZECC/ARMCANZ [2000] reports a solubility of 0.2 µg/L for TCDD), and they preferentially bind strongly to sediments, given the local geology (high content of sediments).

Although dioxins and furans have been shown to not exceed background levels at the Site during the extensive monitoring program applied by

Cristal in line with operational licence requirements (see *Section 3.5*) these TSR secondary sources are considered in the initial CSM as a precautionary measure rather than actual PCOCs.

Radionuclides

As already mentioned, the TSR contains traces of uranium and thorium, so it is necessary to consider the radiological issues of the management of the facility.

Over the 24 years of Site operations Cristal trialled different ore blends including periods of using titanium slags which have lower uranium (10 -20 ppm) and thorium (40 -180) contents and some with higher concentrations uranium (352 ppm) and thorium (290 ppm).

In summary the PCOCs considered in the initial CSM are categorised based on the type of contaminant release mechanisms:

- TSR solids: metals (as per those listed in *Tables 4.1 and 4.2*), dioxins and furans;
- TSR leachate: dissolved metals (chromium, cobalt, nickel, manganese, molybdenum, vanadium), salts (magnesium, calcium and chloride) and dioxins and furan; and
- TSR natural radioactivity: thorium and uranium (and progeny) (in air, ground and groundwater).

4.2.3 *Receptors*

Based on the proposed future development and the current understanding of the on-Site and off-Site land uses as described in *Section 2.1.1* following receptors have been considered relevant in the CSM:

Human health receptors

1) On-Site recreational users – including children and adults who will use the sports facilities to be developed on Site;
2) Off-Site recreational users – using the beach along the west Site boundary where the groundwater is expected to discharge; and
3) Off-Site residential users – who live in the residencies built along the southern DTSRF site boundary across a main road, as well as residents located elsewhere who consume drinking water from the source located 900 m north of the Site.

Environmental receptors

1) On-Site vegetation – grass layer, bushes and trees that may extend their roots in deeper layers of the ground

2) Underlying superficial aquifer; and

3) Marine biota in the sector where shallow groundwater is discharging into the ocean.

It is noted that two of the former ponds have been rehabilitated and the ecological performance of the rehabilitation has been considered successful in relation to the recovery of both flora and fauna. On-site or off-site terrestrial fauna have not been considered as potential sensitive ecological receptors based on the future land use as a sports field. The site will likely be fenced off, and the TSR covered in a 2 m clean sand fill layer covered in a layer of turf which will minimise either vegetation growth or burrowing animals encountering the TSR.

4.2.4 *Exposure pathways*

A total of eight theoretical exposure pathways have been identified to be applicable between some of the resources and the receptors listed above:

- Indoor inhalation;
- Outdoor inhalation;
- External exposure to gamma radiation;
- Outdoor direct contact with TSR, groundwater or seawater impacted by PCOCs – which refers to both dermal contact and ingestion;
- Biological uptake by terrestrial vegetation of various PCOCs as illustrated in Table 4.3; and
- Uptake by marine ecology of various PCOCs as illustrated in Table 4.3.

  It is noted that current knowledge indicates that the hypothetical scenario of bioaccumulation of PCOCs (trace metals) in the human food chain from seafood consumption is unlikely. However, should trace metals in ground/seawater occur at concentrations that could bio accumulate in marine ecological receptors further assessment on implications on seafood consumption may be warranted.

- Drinking water consumption of water from the deeper aquifer – a very conservative assumption knowing that groundwater from this aquifer is abstracted from a depth of 300 m at a distance of 900 m north of DTSRF site.

A summary table presenting the theoretical complete linkages between sources-pathways-receptors is presented in *Table 4.3*. The table also discusses the potential for the complete SPR linkages to occur based on data collected in over 24 years of monitoring and the current understanding of the hydrogeological conditions at the Site.

Using the existing information summarised in *Section 3*, potential theoretical SPR linkages have been categorised using the four alternatives listed below:

1) None;
2) Unlikely;
3) Possible and
4) Likely.

'None' or 'Unlikely' SPR linkages are considered to require no further action and 'Possible' and 'Likely' SPR linkages require further assessment (and potentially management).

The identification of SPR linkages assumes that the likelihood is not materially influenced by the predicted duration, timing and frequency of exposure as the assessment is based on both existing measured and future long term predicted impacts and future uses of the Site and environs.

Table 4.3 Initial CSM Summary Table

Sources			Exposure Route							Receptor						Potential for SPR linkage	Comments
Primary Source	**Release Mechanism**	**Secondary Source**	Indoor inhalation	Outdoor inhalation	External exposure to gamma radiation	Outdoor direct contact[1]	Uptake by aquifer/marine ecology	Uptake by terrestrial vegetation	Drinking water consumption	On-Site recreational users	Offsite recreational users (beach)	Offsite Residential users	Onsite terrestrial plants	Marine ecology	Superficial Aquifer beneath the Site		
Treated Solid residue material	Total Solid residue material					✓				✓		✓				Unlikely	The TSR contains heavy metals that could potentially pose an unacceptable risk to human health via direct contact. However given the scenario of Site redevelopment with a minimum of 2 m of clean fill placed above the TSR, the potential for exposure is unlikely. *Note: the potential risks related to construction works is out with the scope of this risk assessment and should be addressed via the appropriate workplace health and safety guidance.*
	Dissolution of salts and trace metals combined with vertical migration via unsaturated zone	Salts and trace metals in TSR leachate and TSR filtrate in unsaturated zone				✓				✓						Unlikely	The TSR filtrate and leachate may contain dissolved salts and trace metals but given the basic scenario of the redevelopment of the Site involving a minimum of 2 m of clean fill placed above the TSR, the potential for exposure is unlikely.
								✓					✓			**Possible**	The TSR filtrate and leachate contain dissolved salts and trace metals but given the basic scenario of the redevelopment of the site involving a minimum of 2 m of clean fill placed above the TSR, and the fact that plants associated with the redevelopment would not be expected to have roots that would extend beneath the fill layer, the potential for linkage is low. *Note: Suitable type of trees may be chosen for this reason.* Whilst elimination of an exposure pathway would be the primary means of addressing this potential risk, further assessment of historical data of TSR solid composition, TSR filtrate and TSR leachate to the most relevant soil and groundwater guideline values has been undertaken to better inform potential risk of complete linkage in this case. Irrigation using external water sources would minimise the risks to the sporting fields from dissolved salts and trace metals generated from the TSR.
	Dissolution of salts and trace metals combined with vertical migration via unsaturated zone to saturated zone	Dissolved Salts and trace metals and Ground water (shallow aquifer)					✓							✓		**Possible**	The risk of the TSR leachate salts and trace metals reaching the marine environment via shallow groundwater is considered to be low (Oceanica, 2011). Estimated travel time between the Site and marine environment was anticipated to be approximately 30 years based on modelling undertaken by Geoprocc, 2009. Oceanica (2011) using the hydrogeological characteristics estimated by Geoprocc (retention factors, travel times, aquifer hydraulic conductivity, etc.) applied on monitoring data from 2003-2009, concluded that there was minimal risk to the marine environment due to the operation of the Dalyellup Treated Solid Residue Disposal Facility (DTSRF). To support this conclusion, further assessment of new monitoring data (2010-2013) has been undertaken to check if the trends identified in the recent years are still applicable and to confirm the validity of the previous studies.
							✓								✓	Unlikely	The shallow aquifer could be considered as a sensitive receptor in an ideal case, and it is known that the TSR leachate in the form of dissolved salts (chlorides) and metals have already reached this aquifer from the hydrogeological study (ERM, 2012). However, the beneficial use of this aquifer on its own is limited given its brackish quality, low connectivity with the deeper aquifer and low likelihood of stygofauna presence. The shallow aquifer would be relevant in the current setting only as an intermediate between the TSR sources and the marine receptors, SPRs which are assessed separately in this HRA. Therefore, for the purpose of this assessment the shallow aquifer is no longer considered to be a relevant receptor and the SPR as unlikely. Similar unlikely SPRs are considered for other TSR secondary sources that could theoretically interact with this receptor (dioxins and furans and radioactivity in groundwater), and these are not discussed individually in this table.
							✓				✓					Unlikely	The hypothetical scenario of trace metals entering the human food chain through seafood which accumulated and concentrated the COPC originating from the Site is very unlikely (as demonstrated by Oceanica 2009 and 2011). Note: See section 3.6.
								✓					✓			**Possible**	The hydrogeological assessment (ERM, 2012) indicated that in some areas of the site the groundwater has been affected by the leachate generated from the ponds. As such, further assessment has been undertaken to assess the existing data including more recent data sets (2010-2013) in the view of the potential future use of groundwater from shallow aquifer for irrigation (e.g. verge watering) and the potential influence on on-Site vegetation.
						✓				✓						**Possible**	The summary report on the quality of groundwater based on data from period 2003-2009 indicate that in some areas of the Site the groundwater has been affected by the leachate generated from the ponds. As such, further assessment has been undertaken to assess the existing data in the view of the potential future use of groundwater from shallow aquifer for domestic non-potable purposes (e.g. verge watering) in case the groundwater could come in direct contact with recreational users.
						✓					✓					**Possible**	Based on existing studies Oceanica (2009 and 2011) the risk from trace metals and salts to marine biota is low and consequently the recreational users coming in contact with the marine environment are not expected to be exposed to unacceptable risks. To support this conclusion, further assessment of new monitoring data (2010 and 2011) from TSR leachate, filtrate and groundwater has been undertaken to confirm the estimated low risks for the recreational users of the beach section where groundwater passing underneath the DTSRF is expected to discharge.
		Dissolved Salts and trace metals and Ground water (deeper aquifer)							✓			✓				Unlikely	The Yarragadee aquifer (deeper aquifer) is accessed for drinking purposes at a distance some 900 m north east of the DTSRF at depths greater than 300 metres. The Water Corporation and Department of Water (DoW) have modelled the potential impacts upon the Public Drinking Water Supply well field in Dalyellup including potential impacts from the DTSRF facility. Water Corporation has indicated no impacts to the Corporations infrastructure or water supply back in 2009 when MIC was reapplying for the operational licence (MIC, 2010). Monitoring data over the last 20 years shows no impacts from the shallow aquifer. The upward movement from the deeper to the shallow aquifer (Geoprocc, 2009) and the presence of a confining layer between the two aquifers provide enough weight of evidence to consider very low risk for the deeper aquifer to be affected by the DTSRF activities.
	Mobilisation of Dioxins and Furans in unsaturated zone	Dioxins and Furans in TSR solids		✓		✓				✓						Unlikely	Dioxins and Furans (D&F) are present in the waste residue at residual concentrations and based on data from 2002, 2007 and 2009 these are in the same range as or lower than the standards set by some countries for residential soils (EU and Canada) (MIC, EP Act Operating Licence 2010-2013). No Australian guidelines have been published to date therefore no direct comparison can be made to National standards. Since early 2000 MIC has been minimising the production of D&F in the chlorination plant, which is reflected in the TSR data after this date. The low actual concentrations of D&F identified in the in the TSR coupled with the basic scenario of the redevelopment of the Site involving a minimum of 2 m of clean fill placed above the TSR, the potential for linkage is unlikely.
		Dioxins and Furans in leachate in unsaturated zone		✓				✓		✓		✓	✓			Unlikely	The low D&F concentrations identified in the TSR solids, the physical characteristics of D&F (very low solubility and mobility), the presence of TOC in the sediments underlying the ponds (which have a high affinity to bind the D&F), and a very low vapour pressure of D&F (no tendency to migrate into atmosphere from soil media) indicate the low risks to both the local environment and health of residents from the D&F that may be present in the soils.

Table 4.3 Initial CSM Summary Table

Sources			Exposure Route							Receptor						Potential for SPR linkage	
Primary Source	**Release Mechanism**	**Secondary Source**	Indoor inhalation	Outdoor inhalation	External exposure to gamma radiation	Outdoor direct contact[1]	Uptake by aquifer/marine ecology	Uptake by terrestrial vegetation	Drinking water consumption	On-Site recreational users	Offsite recreational users (beach)	Offsite Residential users	Onsite terrestrial plants	Marine ecology	Superficial Aquifer beneath the Site		**Comments**
	Presence of Dioxins and Furans in unsaturated zone and migration to saturated zone	Dioxins and Furans in ground water (shallow aquifer)				✓	✓			✓	✓		✓	✓		Unlikely	The risk of D&F present in the unsaturated zone to come in contact with various receptors is unlikely. The monitoring data collected from the shallow aquifer show some D&F concentrations above detection limits but below international drinking water standards (US-EPA). On this basis is considered unlikely that the minimal quantities of D&F present within the disposed materials in the ponds will enter the superficial aquifer at potentially unacceptable concentrations. Should groundwater from this aquifer be used for non-potable uses (e.g. verge watering) the risk for the on-Site recreational users to be exposed to unacceptable D&F impacts is considered low. Recent groundwater D&F monitoring peer-reviewed results by Scherger Associates for period 2010-2013 has not identified D&F in groundwater with the exception of one OCDD congener at concentrations marginal to LOR, and which was considered anomalous (see Section 3.3.2). The results of the marine environment investigation (Oceanica, 2011) down hydraulic gradient from the ponds showed no D&F was present in the sediment or sediment elutriate. These facts provide sufficient evidence to not consider D&F as a contaminant of concern for groundwater and marine environment at DTSRF.
		Dioxins and Furans in ground water (deeper aquifer)				✓	✓		✓		✓	✓		✓		Unlikely	Very low concentrations of D&F in TSR solids and the low likelihood of impact upon the shallow aquifer from D&F generated from the site, and the additional "barriers" represented by the confining layer between the two aquifers and upward groundwater flow between the two water bodies– indicate the low probability for dioxins from the TSR to enter the deeper aquifer and become accessible to humans and environment via this path way.
	Presence of uranium and thorium radionuclides	Thorium and uranium (and their progeny) in solids and unsaturated zone			✓	✓		✓		✓			✓			**Possible**	The radionuclides in the TSR are monitored biannually. The identified uranium contents have been varying over time with the latest monitoring data showing mean thorium contents of 197 ppm and 173 ppm and The mean uranium contents were 245 ppm and 134 ppm for the two monitoring periods. During the period the DTSRF operator (CG) trialled different ore blends including periods of using titanium slags which have lower uranium (10 -20 ppm) and thorium (40 -180) contents. This is the reason why the thorium contents of the solid residues are showing significant variation, with average levels dropping lower than historical variations. Operational and additional monitoring of radon, thoron, alpha and gamma radiations has been undertaken inside the facility and its boundaries for over 20 years and the number of monitoring points on and around the Site has increased from 4 to 20 in 2009. The overall monitoring results concluded that: the operations of the solid residues disposal facility are not causing any detrimental effects on the gamma radiation levels at the site boundaries and that gamma radiation levels over the uncovered disposal ponds are similar to those predicted from the radionuclide content of the solid residues, assuming water content of 70%. In the context of the new redevelopment it is necessary to assess the need for specific design requirements to be implemented as control measures to ensure no unacceptable risks to on- and off-Site users will occur (see Section 4.4).
		Thorium and uranium and (and their progeny) in air born dusts	✓	✓		✓				✓			✓			Unlikely	Based on the long term monitoring results there is sufficient evidence that alpha activities of airborne dusts at the boundary of the facility over the operational lifetime of the DTSRF are within the normal environmental range and this SPR is unlikely to be complete in the scenario of the proposed development if the tailings are not going to be disturbed by construction activities.
		Radon and Thoron in air	✓	✓						✓		✓				**Possible**	Operational and additional monitoring of radon, thoron, inside the DTSRF and its boundaries has been undertaken for over 20 years. The latest monitoring report (PGA. 2014) indicated that the thoron and radon concentration in the air over the last 4 years have been fairly consistent with radon values below 20 Bg/m3 except some measurements in 2011, The highest radon readings from 2011 would equate to an annual dose of 0.7 mSv/year (assuming an equilibrium factor of 0.4). The thoron data over the period 2009-2013 calculated form the combined radon and thoron measurements are in most cases also below 20 Bq/m3. The few exceptions to this trend showed thoron values between 554 and 896 B1/m3 which would equate to annual dose of 2-3 mSv In conclusion, radon and thoron in air monitoring results indicated that the readings are commensurate with normal background levels in the area, with some elevations on the western side of the TSR ponds which could partly be attributed to effects of wind direction influences. However, further assessment of the significance of measured radon and thoron levels in the context of potential risks to sensitive human (onsite recreational and offsite residential) and ecological receptors of the new development is considered necessary. The fill capping of 2 m is expected to reduce potential risks and calculations to be undertaken as part of the additional radiological assessment will provide further evidence in this sense.
				✓						✓						Unlikely	Theoretically radon and thoron present in air could potentially interact with the off-site recreational users of the nearby beach. However, radon and thoron in air monitoring results over 20 years undertaken inside and around the DTSRF boundaries have indicated that the readings are commensurate with normal background levels in the area and therefore the SPR in discussion is considered unlikely.
		Radium 226/228 radionuclides in shallow groundwater				✓	✓						✓	✓		Unlikely	Shallow groundwater is not intended for drinking purposes therefore this theoretically feasible beneficial use is not considered in this HRA. Groundwater monitoring of radium 226 and 228 commenced in 1989 and over time it has been noted that the radium 226 concentrations are higher in the deeper layers of shallow aquifer, indicating that the source of Ra226 is from an off-Site source rather than the TSR ponds. It is noted that here are no applicable federal guidelines for radionuclides in groundwater. Overall it was considered that there are no obvious increases in Ra-226 content in shallow bores surrounding the DTSRF relative to background, to indicate any leaching of this radionuclide from the residue. Identified concentrations show apparently natural levels of Ra-226 and Ra-228 with variation commonly seen in the groundwater in WA (O'Brien, 2010).
						✓					✓					Unlikely	
		Radium 226/228 radionuclides in deep groundwater							✓			✓				Unlikely	Long term groundwater studies undertaken on the deep bore installed in the Yarragadee aquifer demonstrated that deeper aquifer is not affected by radium-226 and radium-228 migrating from the TSR through the shallow aquifer.

As mentioned in *Table 4.3* even if theoretically many potential SPR linkages between the identified sources and receptors could exist, the review of the data provided in previous studies undertaken at the Site in the form of monitoring reports and expert studies (described in *Section 3*) provided sufficient evidence to rule out many of the SPR linkages. The leading facts that determined ruling out some the SPR linkages are described in detail in *Table 4.3* and summarised below:

The retention factor of metals by the subsurface as calculated based on Site specific data (Geoprocc, 2009) showed that even if present dissolved trace metals are retained at a rate between 90% (for metals like Co, Zn and Cd) and 99% for metals like Sn and Hg) which make the metals 10 to 100% less mobile than groundwater and unlikely to reach the groundwater in high quantities.

The results of the marine risk assessment based on very conservative worst case scenarios indicate minimal risks to the marine environment caused by the activities undertaken at the DTSRF and implicitly the salt and trace metal leachates.

Testing for dioxins in TSR solids indicated low levels of dioxins at concentrations below available international guidelines for residential soils (Germany 1,000 TEQ; and New Zealand 1,500 TEQ). Testing in 2007 and 2010-2013 also showed that 2,3,7,8-TCDD was not detected in the TSR at Dalyellup (MIC 2009b, MIC 2011, CG, 2013). The physical properties of the dioxins (as presented in *Section 3.1*) in relation with the unsaturated layer of the subsurface determine the low identified concentrations in the TSR to not become available for uptake by human and environmental receptors fact demonstrated by the low levels in the monitoring bores (at concentrations below the US EPA drinking water guideline of 0.030 I-TEQ ng/L) support the expectation that dioxins present in the TSR are unlikely to enter the superficial aquifer.

Overall most of the theoretical SPR linkages have been considered as being “unlikely” based on the judgements provided in the comments section of *Table 3.1*, and in few cases the SPR linkages remains possible. In each of these cases further risk assessment has been undertaken to better understand the potential risks:

1. Uptake of dissolved salts and trace metals present in TSR leachate in the unsaturated zone by terrestrial vegetation;

2. Direct contact of on-Site recreational users with groundwater from shallow aquifer potentially affected by leachate, in case this is used for domestic – non potable uses such as watering the vegetation;

3. Uptake by on-Site terrestrial vegetation of groundwater from the shallow aquifer potentially impacted by leachate in case this source is used for watering purposes;

4. Direct contact of off-Site recreational users with marine waters potentially affected by leachate discharging into the ocean – non potential linkage based on existing studies;

5. Uptake by marine ecology of contaminants from shallow aquifer potentially affected by leachate discharging into the ocean -– unlikely linkage based on existing studies, but screening of recent data (2010-2013) is desired to confirm this;

6. External exposure of on-Site human receptors to gamma radiation, radon and thoron inhalation and uptake by terrestrial vegetation from the TSR solids (thorium and uranium and their progeny) in unsaturated zone; and

7. External exposure of on-Site human receptors and terrestrial vegetation to gamma radiation, radon and thoron in air.

4.3 TIER 1 RISK ASSESSMENT

Further assessment was undertaken on the instances where potential complete SPR linkages were identified (listed in *Section 4.1.4*). This involved a combination of tier 1 screening techniques and qualitative assessment of the potential pollutant linkages. In some cases, this resulted in specific management measures being recommended to address possible risks.

In the case of the sixth and seventh potential complete SPR linkage related to radiological risks, a Tier 2 risk assessment type exercise was adopted, in which collected field data were modelled to calculate suitable management measures to minimise potential risks (as detailed in *Section 4.3*).

4.3.1 Assessment criteria

Taking into account the current and future land use of the Site for recreational purposes, the adopted human health criteria for the assessment of soils was the NEPM (1999 updated 2013) "Health Investigation Levels (HIL) for recreational open space and playing fields" (HIL-C) and for environmental health the "Environmental Investigation Levels (EIL)" outlined for public open spaces. The *Assessment Levels for Soil, Sediment and Water – Contaminated Sites Management Series* (published as DEC, 2010*)* (HIL-E and EILs) were used in case the primary adopted guideline did not provide specific criteria for certain PCOCs.

The assessment criteria used to assess potential groundwater contamination are based on the highest likely beneficial use of groundwater. Due to the location of the Site in the close proximity to the ocean, no surface water bodies in its vicinity, the highest beneficial use of shallow groundwater is eventual discharge into the ocean. On this basis, the adopted assessment criteria for groundwater are adopted from the NEPM (1999 updated 2013). The NEPM adopted existing guidelines and these have been adopted as follows:

1) For human health: assessment levels for domestic non-potable groundwater use - Department of Health (2006); and

2) For off-Site environmental receptors: marine water assessment levels - ANZECC & ARMCANZ (2000); and

3) For on-Site environmental receptors: long term irrigation water criteria (ANZECC, 2000) in case in case the shallow aquifer is used for landscape/sports watering.

The DER issued a new series of guidelines in December 2014 which contain updated values for some of the screening parameters for groundwater non-potable use (adopted from DoH, 2014), these criteria were included in the Tier 1 screening tables included in Annex H. It is noted however, that these are included for comparison purposes and were not used in the actual screening of the data.

Additional information on adopted screening criteria for each SPR is discussed in *Section 4.3.2*

It is noted that the adopted screening criteria may not include screening values for all of the PCOCs. Where the concentrations of these PCOCs would indicate concerns (i.e. significant concentrations compared to the rest for the PCOCs), further screening guidelines may need to be included consistent with the DER hierarchical screening approach (DER, 2014).

4.3.2 *Screening of potential complete SPRs*

The linkages that were characterised as “possible” in the initial CSM summary *Table 4.3* have been carried to the next level of assessment, which has included screening of relevant data using the most appropriate published guideline criteria.

> *Possible SPR Linkage 1*: Uptake of dissolved salts and trace metals present in TSR leachate in the unsaturated zone by terrestrial vegetation.

To assess the potential risks posed by the TSR primary source and secondary sources (leachate salts and trace metals) ERM has screened the TSR solids data collected by Cristal since the monitoring of TSR composition started in 1994 (and 1997) until 2013. The data was screened against EIL criteria (DEC, 2010) in a recreational landuse scenario, to identify which of the TSR components would indicate concentrations that may pose a risk over time, followed by the assessment of the leachability of those components in the TSR filtrate and TSR leachate data.

The TSR solids composition data review from both Kemerton (1994-2013) and Australind (1997-2013) plants is presented as a summary in *Table H.1* and *Table H.2* in *Annex H*. To calculate the actual EIL criteria numbers as per the updated NEPM guideline, site specific background data (i.e. Ambient Background Concentration - ABC) values are required. As ERM has not undertaken any sampling at this Site, to overcome this gap, the EIL values calculated by GHD in the soil validation report (GHD, 2014) have been adopted, as these are considered relevant as they are based on background metals concentrations from samples collected in the vicinity of the Site in 2013.

The screening against the adopted guideline undertaken by ERM showed that for the six metals (arsenic, chromium (III+VI), copper, lead, nickel and zinc) for which there are currently screening criteria in the updated NEPM, Cu, Ni and Zn have exceeded in some instances the adopted criteria. The comparison of the metal concentrations against the alternative adopted guideline, DEC 2010 EILs (for the recreational landuse) indicated as well several exceedances for a number of metals (Ni, V, Cr, Cu, Co, Mn) over the years especially in the TSR from Kemerton and in fewer cases in the TSR from Australind. However, further assessment of those specific compounds in the TSR filtrate data (1994-2001) (presented in *Table H.3* and *Table H.4, Annex H*) and the available leachate data for years 2010-2013 (presented in *Table H.5* and *Table H.6, Annex H*) indicated that the TSR solid exceedances are in general not reflected in the liquid forms.

It is recognised that there are some exceedances of EIL screening criteria and that assessment of filtrate/leachate is not a definitive measure of bioavailability. However, the screening process has provided a degree of confidence that the potential risk being assessed is low. Should plants be selected whose roots would not penetrate beyond the cap layer, this low risk would be likely eliminated.

Consequently it can be considered that the amount of dissolved salts and metals available for uptake by on-Site vegetation will be low and the risk of impact to environmental receptor on-Site is low.

> *Possible SPR Linkage 2*: Direct contact of on-Site recreational users with groundwater from shallow aquifer potentially affected by leachate, in case this is used for domestic – non potable uses such as landscape/sports fields watering.

To assess this potential linkage the groundwater data from the 15 on-Site wells over during period 1989-2013 was reviewed. The comparison against human health -domestic non-potable groundwater criteria) indicated that groundwater on-Site exceed the trigger values for iron and chloride in most of the wells over time, and in a few cases exceedances of trace metals including Cr VI, Ni, Mn, V and Pb were noted.. *Table H.7* in *Annex H* summarises the exceedances identified in each well during the monitoring period 1997-2011 and *Table H-8* in *Annex H* presents individual excedances identified in each well for period 2010-2013. Iron exceedances are not considered to be a result of the residue ponds because high iron concentrations have been identified in well pairs up hydraulic gradient (DM1 and DM9) and down hydraulic gradient from the ponds (DM4, DM2). The presence of iron could be related with the local geology but no clear evidence has been gathered to identify the source. It is known that iron is a very sensitive parameter for sampling and this could be one reason for the wide variation of identified iron concentrations over time.

It should be noted that domestic non-potable groundwater criteria are derived from drinking water standard criteria (ARMCANZ, 1996) by applying a general factor of 10 to the drinking water screening levels. In the drinking water criteria iron trigger values are published based on aesthetic concerns rather than health risk. On this basis even at concentrations exceeding the non-potable groundwater criteria, is not expected that this compound will affect human health on Site. Aesthetic effects (red staining) of Fe depositions on constructed surfaces may appear over long term of groundwater use for sprinklers, (a phenomenon common in the Perth area).

Another compound identified above trigger values in groundwater, Chloride (Cl), is important and is expected to limit the potential beneficial use of this aquifer. The wells affected by Cl exccedances are, as expected, located closer to the ocean (well pairs DM2, DM4, DM7 and DM8) and can be partly associated with the progressive saline wedge. The previous groundwater quality study (Geoprocc, 2009) indicated that some of the Cl concentrations in wells located down hydraulic gradient are related to the salt leachate from the ponds. The presence of Cl in exceedance is not expected to adversely affect human receptors on-Site based on similar considerations as those highlighted in the case of iron exceedances, where the guideline for Chloride is based on aesthetic consideration rather than human health. However, high concentrations of chloride would have an impact on the sport facilities if water was to be abstracted from the impacted wells, (see further details in the discussion of *Possible SPR Linkage 3).*

Other metals such as Ni, Mn, V, PB and CrVI indicated isolated exceedances of either the non-potable or long term irrigation screening criteria as highlighted in Tables H.7 and H.8. Given the long term average concentrations of these dissolved metals are significantly below the adopted criteria, isolated exceedance are not of concern. Furthermore, it should be noted that the long term irrigation criteria as adopted as an overly conservative screening as no consumption of crops/vegetables are envisaged in the preferred future land use.

> *Possible SPR Linkage 3*: Uptake by on-Site terrestrial vegetation of groundwater from the shallow aquifer potentially impacted by leachate in case this water resource would be used for watering of the sport fields and other decorative bushes or trees.

As presented above, in some cases the concentrations of Fe, Cl as well as in isolated cases Cr VI, Ni, Mn, V and Pb have been identified above adopted trigger values for domestic no-potable use in groundwater beneath the Site.

A detailed analysis of the Electrical conductivity (EC) and Total Dissolved Solids (TDS) as measured on a quarterly basis during 1989-2013 has been undertaken to characterise potential trends in different parts of the aquifer under DTSRF. *Table H.9* in *Annex H* presents the main outcomes and the categorisation of the groundwater into fresh, brackish or saline depending on the predominant behaviour noticed over time and especially over the last 10 years. It can be concluded that with the exception of well pairs DM1 and DM9 which clearly indicate fresh groundwater quality conditions, and MB3, MB4 with brackish water conditions, the rest of the wells are either brackish to saline (DM2C and DM4A) or saline (DM2A, DM4C, DM7A, DM7C, DM8A and DM8C). Consequently, only the groundwater from up hydraulic gradient of the ponds is suitable for watering..

The identified increased salinity in groundwater beneath the Site could be attributed to natural conditions (sea water intrusion or background aquifer concentrations)and/ or as a result of TSR chloride salts leaching into the shallow aquifer. Regardless of the source of salinity, relevant for the assessed potential receptor (i.e. onsite vegetation), shallow groundwater would not be suitable for watering without pre-treatment.

In 2013 it was discussed by the Shire of Capel and the WaterCorp the possibility to use recycled wastewater generated by WaterCorp at their wastewater treatment plant located in close vicinity to the Site. The use of this alternate irrigation water source would completely eliminate this SPR linkage. Implications on the use of the recycled wastewater are discussed in *Section 4.6*.

> *Possible SPR Linkage 4*: Direct contact of off-Site recreational users with marine waters where groundwater from shallow aquifer potentially affected by leachate is discharging into the ocean – considered at the very lower end of "possible" based on existing information but screening of recent data (2010-2013) was undertaken to confirm this.

As already stated by Oceanica (2009 and 2011) the risk to a marine environment and human health using the beach is low. The review of the concentration trends in the recent groundwater data (2010-2013), especially exceedances of human and environmental criteria, is presented in *Table H.8, Annex H*. The comparison of 2011-2013 exceedances against previous data (groundwater, TSR filtrate and TSR leachate, *Tables H.3, H.4, H.5, H6 and H.7, Annex H*) indicated no changes in the overall trends for the contaminants of potential concern compared to previous years. The review supports the outcomes of the marine risk assessment (Oceanica, 2009 and 2011) which continues to be applicable with no unacceptable risks to human or marine environment health.

> *Possible SPR Linkage 5:* Uptake by marine ecology of contaminants from shallow aquifer potentially affected by leachate discharging into the ocean - considered at the very lower end of "possible" based on existing information but screening of recent data (2010-2013) is required to confirm the unlikelihood.

The assessment of this linkage is closely related with the SPR linkage No. 4 and the results are transferable. The review of 2010-2013 data has confirmed that the outcomes of the risk assessment (Oceanica, 2009 and 2011) with low risk to the marine environment even in conservative scenario conditions.

> *Possible SPR Linkage 6*: External exposure of on-Site human receptors to thorium and uranium by terrestrial vegetation from the TSR solids in the unsaturated zone, and
>
> *Possible SPR Linkage 7*: External exposure of on-Site human receptors and onsite vegetation to gamma radiation, radon and thoron in air.

Further analysis of the two principal exposure pathways (radon and thoron inhalation and external gamma radiation) as well as appropriate treatment of secondary pathways (uptake by vegetation, disturbance of tailings) is required in order to assess the magnitude of risks and associated necessary control measures. To address this, a tier 2 type risk assessment exercise was undertaken by a specialised radiation consultancy firm (*Radiation Professionals*) and the summary of this assessment is presented in *Section 4.4.*

4.4 TIER 2RISK ASSESSMENT - RADIOLOGICAL RISK ASSESSMENT

For the purpose of addressing the risks that may potentially be caused by air radionuclides in the context of the future site redevelopment, ERM has engaged *Radiation Professionals Pty Ltd* to undertake a study that assessed the minimum thickness of the capping layer (soil or clean fill) required to reduce the potential exposures from radiation to the public post DTSRF rehabilitation. This report was reviewed separately by the Auditor and revised as per comments highlighted by the Auditors radiological experts. The revised report was considered to satisfy Auditor's expectations. A copy of the report is attached in *Annex I* and a summary of the objective, scope and results is provided below.

The study assessed the radiological aspects of gamma and radon exposures and has been prepared against the requirements from Western Australian Guidelines, Australian Codes and international guidelines. The scope included:

1) Modelling the radon flux from tailings surface;
2) Confirming these theoretical radon flux levels through monitoring of the tailings facility;
3) Deriving relationships between the radon flux, diffusion through the capping layer and total dose;
4) Modelling of gamma dose rates from tailings and confirming by comparison with historical monitoring;
5) Combining the radon and gamma dose rates to provide a relationship between capping layer thickness and total dose rate at the surface of the facility; and
6) Comparison of these relationships with use criteria.

The modelling was based on both historical data provided by the bi-annual radiation monitoring program implemented at the Site as a per operational licence requirements and also based on further sampling specifically undertaken for the purpose of this assessment (i.e. monitoring of radon flux levels).

For the concentration of Radon due to surface flux, two airborne concentration scenarios have been considered. The first scenario is for an open air situation and the second is for the most severe case scenario assuming an enclosed building and assuming worst case of flooring completely transparent to radon diffusion. This all disregards advection caused by wind and barometric changes, as the molecular diffusion process dominates for transport of Radon. The modelling is based upon Standard Temperature and Pressure.

The risk assessment has been performed using three end user scenarios:

1. Light industrial/Heavy recreational (offices, sporting complex) – 2000 h/year inside and 0 h/year outside;
2. Moderate Recreational (Family/children's Park) – 0 h/year inside and 1000 h/year outside; and
3. Light Recreational (Sporting fields) –0 h/year inside and 500 h/year outside.

Table 4.4 presents a summary of the calculated total doses as a function of end user scenario and capping layer based on the modelled dose rates.

Table 4.4 Annual Doses vs Capping Layer Thickness for different Use Scenarios

Capping Layer thickness	**Annual Dose (mSv above background)**		
	Light Industrial/ Heavy Recreational	**Moderate recreational**	**Light Recreational**
0.00	5.65	0.79	0.40
0.25	3.87	0.32	0.16
0.50	2.91	0.17	0.09
0.75	2.29	0.12	0.06
1.00	1.82	0.10	0.05
1.25	1.44	0.08	0.04
1.50	1.15	0.06	0.03
1.75	0.91	0.05	0.02
2.00	0.73	0.04	0.02
2.25	0.58	0.03	0.02
2.50	0.46	0.02	0.01
2.75	0.37	0.02	0.01
3.00	0.29	0.02	0.01
3.25	0.23	0.01	0.01
3.50	0.18	0.01	0.00
3.75	0.15	0.01	0.00
4.00	0.12	0.01	0.00
Maximum capping layer thickness required to meet dose constraint of 0.3 mSv	**3.00m**	**0.5m**	**0.25m**

Note: The dose constraints were adopted from this table.

The calculated layer thicknesses have then been mapped against four contaminated site categories as listed in *Table 4.5*.

Table 4.5 *Site Categories vs Capping Layer Thickness for Different Use Scenarios*

Capping Thickness (m)	Use Scenario		
	Light Industrial	Moderate Rec.	Light Rec.
0.0	4	2	2
0.25	4	2	1
0.50	3	1	1
0.75	3	1	1
1.00	3	1	1
1.25	3	1	1
1.50	3	1	1
1.75	2	1	1
2.00	2	1	1
2.25	2	1	1
2.50	2	1	1
2.75	2	1	1
3.00	1	1	1
3.25	1	1	1
3.50	1	1	1
3.75	1	1	1
4.00	1	1	1

- 1 – Unrestricted Use - 0.0 mSv/y < DOSE < 0.3 mSv/year
- 2 – Restricted Use - 0.3 mSv/y < DOSE < 1.0 mSv/year
- 3 – Remediation Necessary in Most Cases - 1.0 mSv/y < DOSE < 3.0 mSv/year
- 4 – Remediation Necessary in All Cases - DOSE > 3.0 mSv/y

The Site is likely to be designated for sporting fields. *Table .4.5* indicates that that for the preferred recreational use scenario (in this case the sport fields could be considered in the category of 'moderate recreational"), a capping layer of anything more than 0.5m will place the Site into the Unrestricted Use category for radiological purposes.

This is a preliminary radiological risk assessment that included a one off data collection at the time it was prepared. As such to finalise the setting of risk categories, ongoing monitoring is recommended to be undertaken at the end of life of the facility to confirm all parameters used and source terms for the modelling. Also ongoing monitoring of radon flux, external gamma radiation levels, radionuclides in water and radionuclides in flora will need to be undertaken after the capping layer has been installed.

The assumptions and approximations of the properties of the treated residue and capping materials were conservative but approximate given the definitive capping details are still to be decided upon at the time when this modelling exercise was undertaken. In any case, a capping (as set out in

RHS35) of 2 m thickness was considered by O'Brien to engineer in a significant margin of error to fulfil the requirements of achieving the unrestricted status for the proposed use scenarios. Even if the capping material was 10 times more porous (and 10 times less dense) than normal sand (approximately the density of balsa wood) and completely dry, the proposed use scenarios would still be below the 0.3mSv per year above background.

4.5 REFINED CONCEPTUAL SITE MODEL

The risk assessment steps conducted in *Section 4.2* and *Section 4.3*, have allowed for the potential complete SPR linkages to be reassessed and the initial CSM presented in *Section 4.1* to be refined. All SPR linkages considered "possible" in the initial CSM have been re-characterised as being "unlikely' as summarised in *Table 4.6* in the scenario of a light recreational scenario (i.e. sporting fields).

A graphical representation of the main elements of the refined CSM is presented on *Figure 4, Annex* A.

The conclusions that none of the SPR linkages considered in this HRA are likely to be complete are based on certain redevelopment scenario assumptions as well as on specific risk management measures as discussed further in *Section 4.6.*

Table 4.6 Refined CSM Summary

Sources			Exposure Route						Receptor					Potential for linkage	
Primary Source	Release Mechanism	Secondary Source	Indoor inhalation	Outdoor inhalation	External exposure to gamma radiation	Outdoor direct contact[1]	Uptake by marine ecology	Uptake by terrestrial vegetation	On-Site recreational users	Offsite recreational users (beach)	Offsite Residential users	Onsite terrestrial plants	Marine ecology		Comments
Total Solid residue material	Dissolution of salts and trace metals combined							✓				✓		**Unlikely**	The TSR filtrate and leachate contain dissolved salts and trace metals but given the basic scenario of the redevelopment of the Site involving a minimum of 2 m of clean fill, the potential for linkage is low particularly if shallow rooted plants will be planted on-Site. This is partially supported by further assessment of historical data of TSR solid composition, TSR filtrate and TSR leachate.
	Dissolution of salts and trace metals combined with vertical migration via unsaturated zone to saturated zone	Dissolved Salts and trace metals and Ground water (shallow aquifer)					✓						✓	**Unlikely**	The risk of the leachate salts and trace metals reaching the marine environment via shallow groundwater is considered to be low (Oceanica 2009, 2011). Further assessment of recent monitoring data (2010-2013) confirms the trends identified in the recent years are still applicable and reinforces the validity of the previous studies.
								✓				✓		**None**	The summary report on the quality of groundwater based on data from period 2003-2009 indicate that in some areas of the Site the groundwater has been affected by the leachate generated from the ponds fact confirmed by the hydrogeological assessment that included monitoring data up to 2012 (ERM, 2012). Further assessment undertaken as part of this HRA of existing data indicated that some of the shallow aquifer areas are not suitable for the potential future use of groundwater (e.g. plant watering because of the high concentration of chloride and corresponding high salinity that has the potential to affect on-Site ecological receptors). Regardless of the potential cause for high salinity (natural – sea intrusion or anthropogenic –TSR leachate) the risk for this TSR is considered inexistent based on the assumption that recycled wastewater from WaterCorp will be used as the source for the irrigation of the sporting fields and the groundwater on-Site will not be abstracted apart from monitoring purposes.
						✓			✓					**Unlikely**	The summary report on the quality of groundwater based on data from period 2003-2009 indicate that in some areas of the site the groundwater has been affected by the leachate generated from the ponds. Further assessment indicates that the risk posed to on site human health in case the groundwater is used for domestic non-potable uses is considered to be low. The low probability of this risk is supported by the fact that the human receptors will not be exposed to groundwater as an alternative irrigation water source is considered (i.e. recycled waste water from WaterCorp).
						✓				✓				**Unlikely**	Based on existing studies Oceanica (2009 and 2011) the risk from trace metals and salts to marine biota is very low and consequently the recreational users coming in contact with the marine environment are not expected to be exposed to unacceptable risks. Further assessment of new monitoring data (2010 and 2013) from TSR leachate, filtrate and groundwater confirm the estimated low risks for the recreational users.

Sources			Exposure Route						Receptor					Potential for linkage	
Primary Source	**Release Mechanism**	**Secondary Source**	Indoor inhalation	Outdoor inhalation	External exposure to gamma radiation	Outdoor direct contact[1]	Uptake by marine ecology	Uptake by terrestrial vegetation	On-Site recreational users	Offsite recreational users (beach)	Offsite Residential users	Onsite terrestrial plants	Marine ecology		**Comments**
	Presence of uranium and thorium radionuclides	Thorium and uranium (and their progeny) in solids and unsaturated zone			✓	✓		✓	✓			✓		**Unlikely**	The radiological risk assessment has indicated that a 0.25 m capping of clean fill on top of the TSR material would bring the annual doses to lower than background levels (<0.3 mSv/year) for a light recreational redevelopment scenario (i.e. sporting fields). In conclusion the radiological assessment states that Cristal's closure plans involving a minimum cap of 2 m of capping (as set out in RHS35) will engineer in a significant margin of error to fulfil the requirements of achieving the unrestricted status for the proposed use scenario of sporting field. Even if the capping material was 10 times more porous (and 10 times less dense) than normal sand (approximately the density of balsa wood) and completely dry, the proposed use scenarios would still be below the 0.3mSv per year above background.
		Gama radiation ,Radon and Thoron in air	✓	✓					✓		✓			**Unlikely**	

4.6 *RISK MANAGEMENT RELATED TO THE USE OF THE FUTURE RECREATIONAL LAND-USE*

This section is intended to discuss several design particularities associated with the proposed use of the Site as sporting field and highlights specific requirements and management measures to be considered as part of the proposed redevelopment plan to ensure minimal risks for human health and the environment.

While the previous parts of *Section 4* of this report presented and discussed the evidence based on which no unacceptable risks are expected to be posed by the former disposal ponds, specific conditions such as the quality and thickness of the fill cover, the quality and volumes of irrigation water, and the type of vegetation to be used in landscaping of the sport fields, etc. have to be considered to complement the overall closure plan conditions (e.g. the performance criteria and monitoring programs described in *Section 3.9*).

4.6.1 *Source of Irrigation Water*

Based on the long term monitoring results of the shallow groundwater at the Site, with few exceptions, the water is brackish to saline and therefore its beneficial use for watering the sporting fields without pre-treatment is limited. The source of water currently considered by the Shire is the recycled wastewater provided by WaterCorp from the treatment plant located 0.5 km north of the Site. While the use of a non-drinking water system (e.g. recycled water) is encouraged by the relevant WA authorities as it can be considered a fit-for purpose water source in the cases where a lower quality is sufficient for the intended use (e.g. irrigation of open public spaces) there are several requirements to be considered.

The decision to use recycled waste water at the Site will have to take into account the compliance requirements set by the WA guideline for the non-potable uses of recycled water (DoH, 2011) which stipulates specific water end-uses based on different exposure risk assessments. Specific water quality compliance standards will be required to be met (e.g. physical and chemical parameters quality criteria, setting up suitable irrigating schedule to minimise exposure, etc.). Further details on the approval process of non-drinking water systems in WA have been recently published by the (DoW, 2013).

To minimise potential incidental direct contact with the groundwater at the Site, groundwater should not be abstracted for any other purposes other than for testing as part of the rehabilitation monitoring program.

Examples of POS of former landfills redevelopments using recycled water in Perth metropolitan area

The Christ Church Grammar School sporting fields (CCGS PF) project is one example of a successful land redevelopment of a former landfill into a POS which uses recycled waste water for irrigation (D.Doy. (2014). CCGS PF purchased a land area over 8.6 hectare from LandCorp with the aim of developing the site for playing fields site forming part of the former Brockway Road landfill site. Of the total site area of 8.6 hectares, approximately 7.6 hectares (88% of site) contains rubbish placed at depths up to 17 metres deep, topped off with a minimum of 1 metre of sand cover. As per information provided by the wastewater department of the WaterCorp, these sporting fields are irrigated with recycled waste water provided by WaterCorp.

Examples of POSs using recycled water in the South West region of WA

The use of recycled waste water for various forms of public open spaces is already well established in South West. Some examples provided by the representatives of the Wastewater division of WaterCorp in a meeting and a follow-up email communication include:

- Halls Head WWTP supplying infiltrated water to local parks in the Seascapes housing development,
- Margaret River WWTP supplying recycled water to many local ovals, including the Gloucester Park complex, Reuther Park, Riverslea, Margaret River high school & primary school ovals and golf course,
- Subiaco WWTP supplying recycled water to McGillivray Oval (large sporting and recreational facility) in Shenton Park, and
- Busselton WWTP supplying recycled water to a private garden user and the golf course.

4.6.2 *Irrigation Volumes Implications*

In the review letter of the Site Closure Plan draft (AECOM, 2013) the CS Auditor raised a concern associated with the increase of water volumes in the unsaturated layer that may be generated by the irrigation of the sporting fields and potential effects on the chemistry of the deposited residue material and ultimately the release of increased leachate concentrations into groundwater.

Ideally the Shire should ensure a "smart water use" through an Irrigation Management Plan that will take into account the existing water balance applicable for Dalyellup area (precipitation regime) to ensure the applied water irrigation volumes will minimise the infiltration of excess water and will be designed taking into consideration specific site conditions (based on trial tests). A water shedding rather than water capture capping design would be recommended.

Potentially an increase of water infiltration into the subsurface could mobilise more metals into solution and create additional leachate. However an increase in infiltration can also potentially create increased recharge to the shallow groundwater and actually reduce PCOCs concentrations in the groundwater due to dilution. The TSR material is shown to be predominantly composed of clayey materials (MIC, 2012). Therefore, in case of an increased infiltration, the TSR would swell and adsorb excess water due to high clay material content up to a saturation point and consequently cracking may decline reducing the overall infiltration rate at depth. In times of dryness this water would be released again.

As per the 2013 Cristal Pigment Annual Environmental Report (CPA, 2014), research has shown that following drying out of the residue material, the mobilisation potential of the metals from the residue matrix is reduced. In case of iron and manganese, the stronger metal retention is primarily due to the formation of poorly soluble metal oxides through the oxidation of ferrous iron and divalent-manganese. Poorly reversible metal sorption reactions would generally be expected to become more important as the residue dries out. Air-dried residue also has a moderate to high acid neutralisation capacity (about 15% as calcium carbonate). Because of this, any leachate seeping to the underlying soil profile would remain alkaline. Both of these properties play an important role in management of the ponds and leachate quality. The stability of elements within the solid phase (i.e. residue bed and underlying soil) is pH dependent. As the residue bed pH is 8-9 and the underlying soil is 7-8, a favourable alkaline buffering capacity exists.

The same source (CPA, 2014) mentions that at moderate pH (5) moisture content of the residue material is important and moisture content near 20 percent (w/w) is associated with all element forms, except manganese, that are stable under moderate leaching conditions. However, due to the residue's high buffering capacity in the pH range 7-8, the disposed residue should remain neutral to alkaline in the long term. Test work results indicate that the solubility of all elements (except Mn) in the material is very low at pH 7-8 irrespective of moisture content.

4.6.3 *Fill cap thickness and quality*

Conservative radiological modelling results (see *Section 4.3*) indicated that a "clean" fill cap of 2 m would provide high level of confidence around the unlikely risks to be posed by radiation generated by the residue to future users of the sporting fields. As described in the final closure plan (CG, 2013) it was agreed that a minimum 2 metres of sand will be placed on top of the residue ponds.

The soil validation report (GHD, 2014) indicated that the fill layer applied in November 2013 is generally at least 2 m thick in most areas of the Site, but it contains materials with metal concentrations above screening criteria for ecological receptors. However, based on a series of considerations, GHD concludes that the material presents no unacceptable risks to human health and the environment and that the Site is suitable for the intended recreational sports fields land use.

There is indication that the TSR is mixed in with the sand and the capping may not be completely clean in some areas. ERM generally concurs with the conclusions of the soil validation report, despite these uncertainties.

While the cover was intended to be free of contaminants, the low level of metals identified in the GHD report, (mostly chromium VI with concentrations ranging between 2-10 mg/kg close to the LOR of 0.5mg/kg) and the potential of these to affect the close by marine environment and through wind transport would be reduced through a maintained grass cover.

While the grass cover will unlikely be affected by the presence of metals at levels exceeding adopted screening criteria, should trees be planted, their roots may penetrate deeper in the capping and reach areas with trace TSR. While GHD state that concentrations below 20 mg/kg are unlikely to affect plants, based on a research, the potential long terms impacts on the health of plants with deep roots remain unknown. As a precautionary measure only plants with shallow – flat roots should be considered.

5 *CONCLUSIONS AND RECOMMENDATIONS*

The former Dalyellup disposal facility (DTSRF) operated for 24 years for the disposal of treated solid residue generated from the production of titanium dioxide. The operations ceased in 2013 after the facility has reached approved disposal capacity. The Shire of Capel is considering redeveloping the site as an open sport field for the use by the local community. Given that the site has been previously classified as potentially contaminated- investigation required" under the CS Act (2003) by the DER, it will require reclassification into "Remediated – restricted use", after rehabilitation and validation works, in order to be considered suitable for the proposed redevelopment as a public open space.

HRA objectives and scope

The main objective of the health risk assessment (HRA) was to assess whether the former disposal facility would be suitable for redevelopment into sport fields after remediation and rehabilitation works. Specific HRA objectives included:

- assessing whether solid residue disposed at the Site represents a significant risk to human health at the Site following site closure (assuming its redevelopment for recreational land use scenario);
- supporting an assessment of the Site's suitability for future use in terms of potential health and environmental risks; and
- to assist with satisfying requirements of the Shire and the DER (including relevant consideration under the Act).

In order to achieve these objectives the assessment process involved:

- a comprehensive review of historical data including elements of a preliminary site investigation (PSI) to characterise the historical and current site conditions. Given the site was subject to operational monitoring requirements for several environmental media (soil, groundwater, air, radiation, etc) over two decades a wide range of environmental data was collected over time. The review of existing data fed into the development of the risk assessment approach adopted for this assessment.
- a tiered risk assessment process was implemented including an initial conceptual site model (CSM), a qualitative Tier 1 screening against adopted criteria for soil and groundwater, followed by quantitative risk assessment (Tier 2) for the radiation risks was undertaken. The outcomes of the risk assessment were summarised in an updated CSM and specific management measures were stipulated, and
- Preparation of this report to document the HRA process, outcomes and conclusions.

Risk assessment approach

It was noted from the start of this assessment that its structure would not be completely consistent with the recommended tiered risk assessment approach stipulated in relevant Australian guidelines (enHealth2012). The reasons for this deviation include the complexity of the site, the nature of assessed material but also the myriad of human and environmental existing risks assessment information that was already prepared by third parties in relation with the site from which the data was derived.

The review of existing environmental relevant data allowed for the identification of potential HRA sources and associated potential chemicals of concern (PCOCs) which were related to the TSR and by-products as a reaction with the environment (dissolved salts and metals, dioxins, furans and radionuclides in soil water, air, dusts , etc). An initial (CSM) was developed with hypothetical source-pathways-receptors linkages (SPRs) assessed in the context of the desired future land-use. At this stage, based on the exiting reviewed data (mainly prepared by third parties) most of the SPRs have been considered unlikely to occur, with only few SPR requiring further assessment. The initial CSM was prepared in 2011 when the facility was still operational, therefore even though the environmental data suggested some of the SPRs were unlikely, additional screening of data to be gathered for the reminder of the operational period was considered necessary to increase the confidence on the likely incomplete SPRs.

Tier 1 risk assessment

A total of seven possible SPRs identified in the initial CSM have been subject to a tier 1 risk assessment scrutiny. The composition of the solids and groundwater quality data provided by Cristal has been screened against adopted criteria. Based on the tier 1 screening assessment outcomes, in the refined CSM, five of the seven SPRs have been considered to be unlikely as summarised below:

1. Uptake of dissolved salts and trace metals present in TSR leachate in the unsaturated zone by terrestrial vegetation; The comparison of the available composition data on the TSR solids, TSR leachate and TSR filtrate against the relevant ecological screening criteria (Environmental Investigation Levels- EILs for solids and long term irrigation criteria for water) indicated some exceedances for metals and salts with potential risks for onsite vegetation. However, given the management measures considered as part of the Site rehabilitation and redevelopment (2 m think layer of clean fill and use of plants with shallow roots) this potential SPR will be maintained at a very low likelihood.

2. Direct contact of on-Site recreational users with groundwater from shallow aquifer potentially affected by leachate, in case this is used for

domestic – non potable uses such as irrigation of the vegetation; The presence of dissolved metals and chloride salts in the shallow groundwater in some cases above adopted human health criteria and at concentrations that would classify it as brackish or saline indicate its unsuitability for irrigation without pre-treatment. However, given the Shire are anticipating use of recycled wastewater from a nearby wastewater treatment facility, this SPR is unlikely.

3. Uptake by on-Site terrestrial vegetation of groundwater from the shallow aquifer potentially impacted by leachate in case this source is used for watering purposes; This SPR could have indicated unacceptable risks if shallow groundwater containing dissolved metals and salts was to be used, but given the scenario described at SPR2, the recycled wastewater was identified as a feasible alternative for fields irrigation, and therefore this SPR is unlikely. To prevent plant roots from interacting with the impacted groundwater, only certain plants should be considered to be used in the redevelopment (i.e. with shallow roots). The majority of the Site will be developed into a sports field where grass roots will have limited depth penetration.

4. Direct contact of off-Site recreational users with marine waters potentially affected by leachate discharging into the ocean was already considered unlikely based on historical data up until 2011.; The additional groundwater monitoring data collected for period 2011-2013, since the initial CSM was developed, indicate that this SPR remain unlikely, with dissolved salts and metals present in groundwater at concentrations similar to those assessed in the initial CSM, with no signs of increasing trends that could indicate that the dissolved plume identified in the shallow groundwater has significantly changes. This SPR is therefore considered unlikely, but continuous groundwater monitoring should be undertaken to confirm expected conditions.

5. Uptake by marine ecology of contaminants from the shallow aquifer potentially affected by leachate discharging into the ocean -– unlikely complete linkage based on existing studies (including Oceanica 1999 and 2011) but additional evidence indicating a stable groundwater dissolved plume conditions was required for the reminder period the DTSRF was operational (2011-2013); Subsequent groundwater monitoring data provided further confirmation that the dissolved salts and metals remain at similar concentrations to pre-2011and therefore this SPR remains unlikely.

6. External exposure of on-Site human receptors to radiation, and uptake by terrestrial vegetation from the TSR solids (thorium and uranium and their progeny) in the unsaturated zone; given the TSR deposited at the Site was clarified an technologically enhanced NORM, and with no set screening criteria available for the assessment of this linkage,

additional assessment involving site specific inputs was required. This was achieved by undertaking a tier 2 type exercise described further below.

7. External exposure of on-Site human receptors and terrestrial vegetation to gamma radiation, radon and thoron in air. Similar to SPR 6, given the TSR deposited at the Site was clarified an technologically enhanced NORM, and with no set screening criteria available for the assessment of this linkage, additional assessment involving site specific inputs was required. This was achieved by undertaking a tier 2 type exercise described below.

Tier 2 risk assessment

The objective of the quantitative radiological risk assessment was to inform the calculation of an adequate barrier thickness which would be required to be applied on top of the TSR to ensure no unacceptable risks to human health from gamma radiation. The field data collection and subsequent modelling were undertaken by the Radiation Professionals Pty Ltd. Based on a conservative adopted approach it was concluded that any barrier of a thickness greater than 0.5m would achieve the desired level of protection. Therefore, the 2 m thick capping layer planned by the operator as part of the rehabilitation works is regarded as very conservative minimising any risks that could be posed by gamma radiation generated from the treated residue disposed of Site. This study was reviewed by the Auditor's radiation experts and its current version was found to be prepared and presented at a satisfactory level by the Auditor. It is noted that since 2011 when the study was made, more recent monitoring of groundwater and radiation levels after the operations ceased indicate no significant changes in the historical trends.

Management measures

In order to ensure all risks for human health and the environment through SPR remain unlikely specific management measures should be considered as part of the proposed redevelopment plan. Specific conditions refer to:

I. the quality and thickness of the fill cover: i.e. clean fill of at least 2 m. The soil validation results (GHD, 2014) indicated that generally the minimal fill layer thickness requirement has been met. While the cover was intended to be free of contaminants, the low level of metals identified by the investigation undertaken by GHD (mostly chromium VI) ERM concurs with the conclusions of the GHD report that the fill material is unlikely to present unacceptable risks to human health and the environment and that the Site is generally suitable for the intended recreational sports fields land use.

II. the type of vegetation used for the redevelopment, i.e. care should be given to the type of vegetation (especially trees) contemplated to be used for landscaping using predominantly plants with shallow root;

III. the quality and volumes of the water intended to be used for irrigation, with specific water quality compliance standards to be met (e.g. physical and chemical parameters quality and suitable irrigation schedule to minimise exposure criteria designed for the intended use); A water shedding rather than water capture capping design would be recommended.

IV. no onsite groundwater abstraction should be undertaken other than for testing as part of the rehabilitation monitoring program, in order to minimise potential incidental direct contact with the impacted groundwater at the Site;

Subject to the implementation of appropriate risk management measures outlined in this risk assessment (*Section 4.6*) and the closure plan (ongoing monitoring and completion of set performance criteria), the SPRs identified and assessed as part of the initial and refined CSM will be maintained as unlikely.

In conclusion, it is considered that the overall objectives of the HRA have been met and the potential risks to human health and environment in relation with the proposed land-use have been adequately identified and characterised and are manageable. Based on the outcomes of the HRA this Site is considered to be suitable for the proposed land-use as a sports field subject to the implementation of the management measures described above.

6 LIMITATIONS

The findings of this report are based on the Scope of Work described. ERM performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental assessment profession. No warranties, expressed or implied, are made.

Subject to the Scope of Work, ERM's work was limited strictly to assessing potential risk to human health and the environment associated with identified and specified contamination sources, pathways and receptors. Although normal standards of professional practice have been applied, the absence of any identified hazardous or toxic materials on the subject property, migration of exposure pathways or sensitive receptors should not be interpreted as a guarantee that such aspects do not exist associated with the Site.

This report's findings are based on previously established environmental information and adopting methods consistent with current industry practice associated with undertaking risk assessments. All conclusions and recommendations made in the report are the professional opinions of the ERM personnel involved with the project and, while normal checking of the accuracy of data has been conducted, ERM assumes no responsibility or liability for errors in data obtained from regulatory agencies or any other external sources, nor from occurrences outside the scope of this project.

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Annex A

Figures

Client:	Shire of Capel		**Figure 1 - Site Location**
Drawing No:	0124484p_G001_R0.mxd		MIC Dalyellup DF - PSI
Date:	11/02/2015	Drawing Size: A4	
Drawn By:	DN / GC	Reviewed By: MP	

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Notes:
MB#(R) reinstalled in 2000 as original well locations were destroyed.

Source:
bing imagery date Nov 2011

Client:	Shire of Capel		**Figure 2 - Site Layout and Bore Locations**
Drawing No:	0124484p_G002_R0.mxd		MIC Dalyellup DF - PSI
Date:	13/02/2015	Drawing Size: A4	
Drawn By:	DN / GC	Reviewed By: MP	

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Notes:
Information on sediment sampling adopted from Oceanica, 2011 Marine Environmental Risk Assessment Field Study, Feb, 2011 (ref 429_004).

Legend

- ▭ Site Boundary
- ⊕ Groundwater Monitoring Well
- ⊕ Groundwater Monitoring Well (pair of shallow and deep)
- 🟨 Sediment Sample

T#-BC Berm Crest Zone
T#-US Upper Swash Zone
T#-LS Lower Swash Zone
Locations T4, T5 and T6 are reference sampling sites located 7km south of the Site.

Source:
bing imagery date Nov 2011

Client:	Shire of Capel		
Drawing No:	0124484s_G006_R0.mxd		
Date:	13/02/2015	Drawing Size:	A4
Drawn By:	GC	Reviewed By:	MP

Figure 3 - Marine Risk Assessment Sampling Locations

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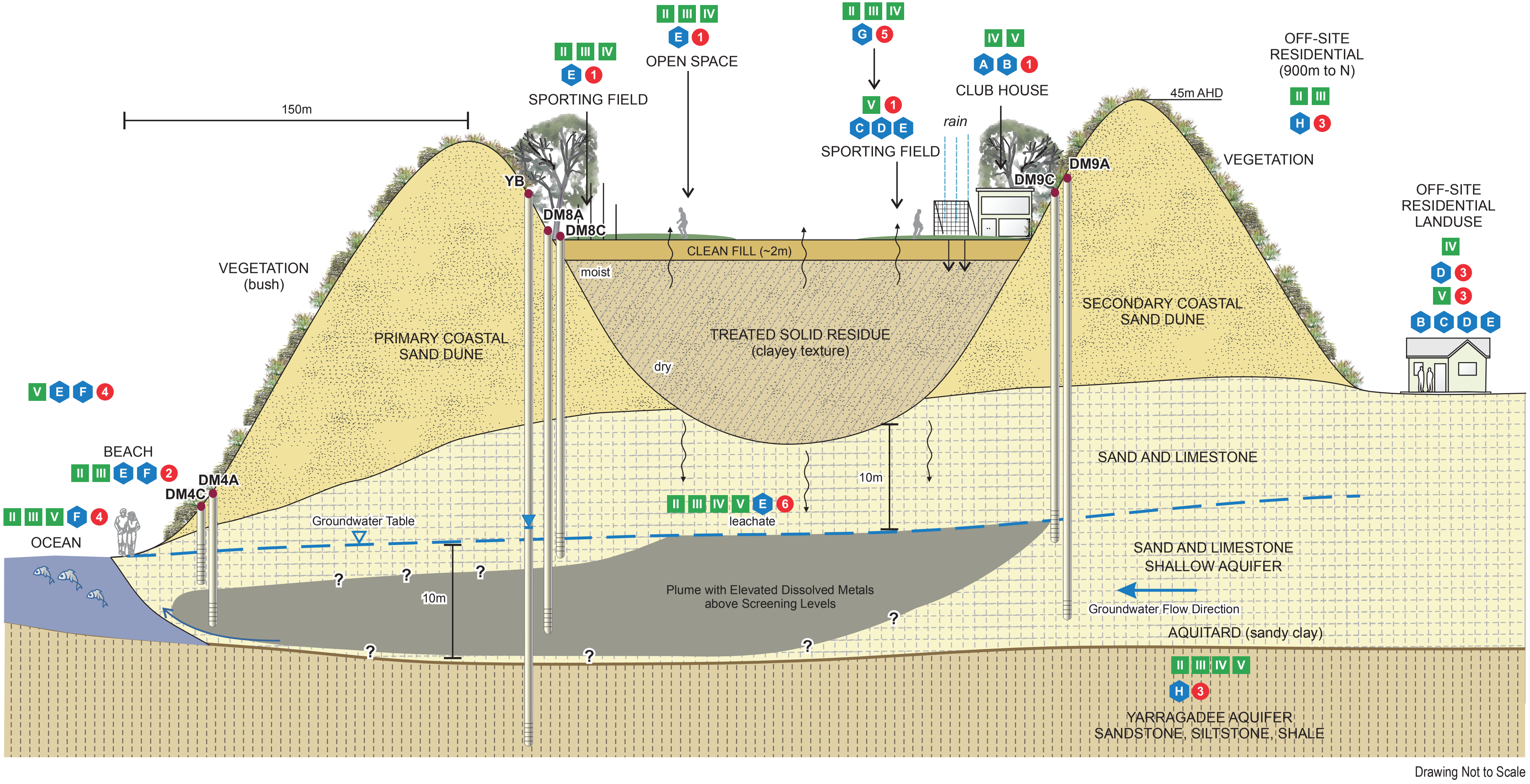

Drawing Not to Scale

SOURCES	PATHWAYS	RECEPTORS
I TSR (primary source)	A Indoor inhalation	1 Onsite recreational users
II Heavy metals from TRS (secondary source)	B Indoor absorption (only for radionuclides)	2 Offsite recreational users
III Salts from TRS (secondary source)	C Outdoor absorption (only for radionuclides)	3 Offsite residential users
IV Dioxines and furans (secondary source)	D Outdoor inhalation	4 Marine ecology
V Radionuclides (secondary source)	E Outdoor direct contact	5 Onsite terrestrial vegetation
	F Uptake by marine ecology	6 Shallow Aquifer
	G Uptake by terrestrial vegetation	
	H Drinking water consumption	

Note:

- All theoretical SPR linkages are illustrated, despite their likelihood to be complete
- ? extent unknown
- Surface elevations and well construction details are for illustration purposes only and are not attempting to replicate actual measurements

Client:	Shire of Capel		
Drawing No:	0124484p_C002_R2.cdr		
Date:	11/02/2015	Drawing size:	A4
Drawn by:	DN / GC	Reviewed by:	MP

Figure 4 - Conceptual Site Model (Initial)

MIC Dalyellup DF - PSI

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Legend

🟥 Site Boundary

Source:
bing imagery date Nov 2011

N

0 25 50 75m

Client: Shire of Capel
Drawing No: 0124484p_G003_R0.mxd
Date: 11/02/2015 Drawing Size: A4
Drawn By: DN / GC Reviewed By: MP

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Figure 5 - Proposed Future Land use

MIC Dalyellup DF - PSI

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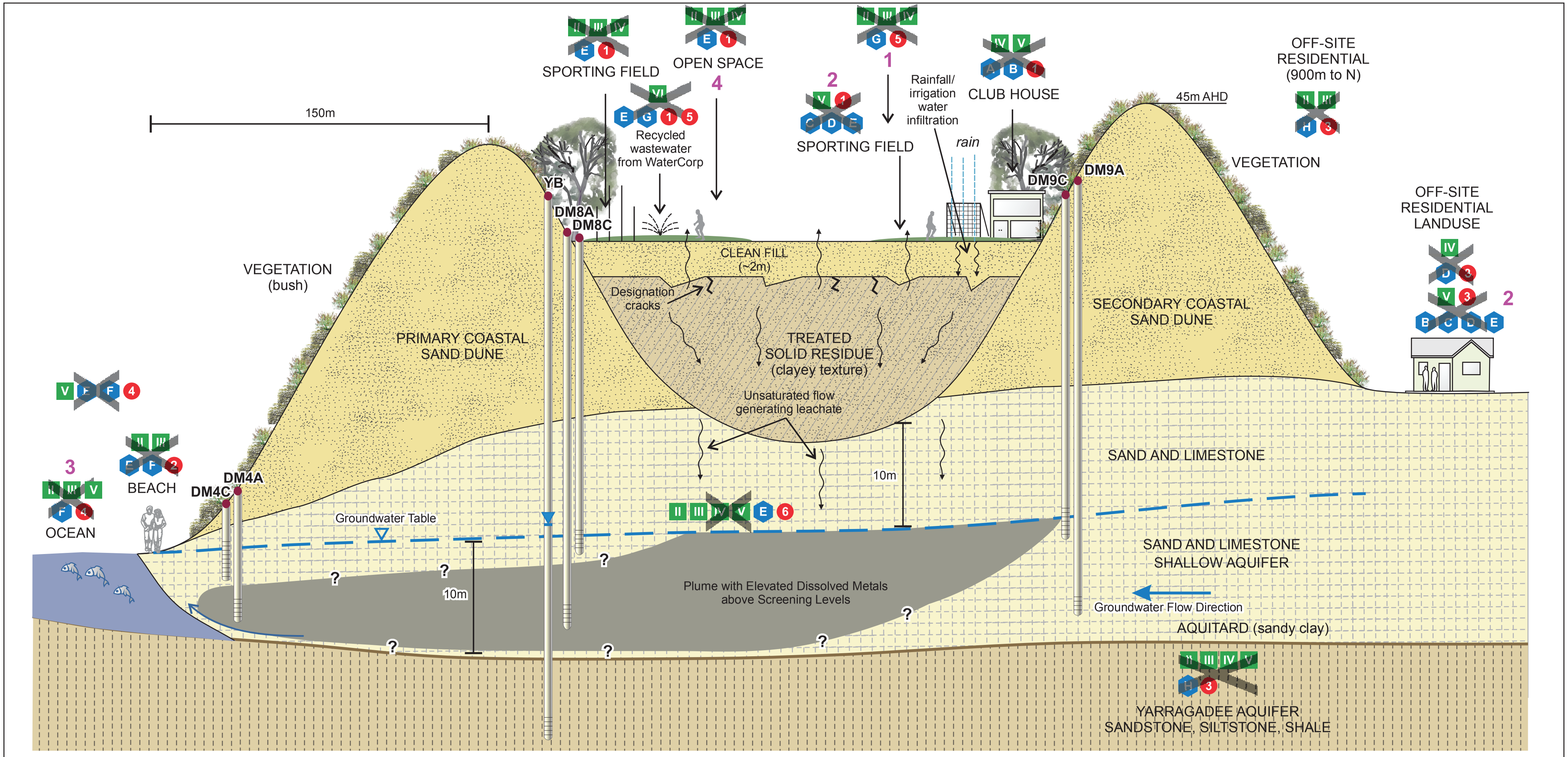

Drawing Not to Scale

SOURCES

- I TSR (primary source)
- II Heavy metals from TRS (secondary source)
- III Salts from TRS (secondary source)
- IV Dioxines and furans (secondary source)
- V Radionuclides (secondary source)
- VI Treated wastewater from WaterCorp

PATHWAYS

- A Indoor inhalation
- B Indoor absorption (only for radionuclides)
- C Outdoor absorption (only for radionuclides)
- D Outdoor inhalation
- E Outdoor direct contact
- F Uptake by marine ecology
- G Uptake by terrestrial vegetation
- H Drinking water consumption

RECEPTORS

- ① Onsite recreational users
- ② Offsite recreational users
- ③ Offsite residential users
- ④ Marine ecology
- ⑤ Onsite terrestrial vegetation
- ⑥ Shallow Aquifer

✕ indicates no unacceptable risks associated with the specific SPR based on HRA outcomes

1 if adequate vegetation (with flat, superficial roots) and external irrigation sources will be considered (no shallow groundwater use)
2 on going monitoring required to confirm no unacceptable risks
3 additional risk assessment in 5-10 years time to confirm no unacceptable risks
4 if the fill layer will be covered with a continuous layer of grass

Note:

- ? extent unknown
- Surface elevations and well construction details are for illustration purposes only and are not attempting to replicate actual measurements

Client: Shire of Capel
Drawing No: 0124484p_C003_R1.cdr
Date: 11/02/2015 Drawing size: A4
Drawn by: DN / GC Reviewed by: MP

Figure 6 - Conceptual Site Model (Refined)

MIC Dalyellup DF - PSI

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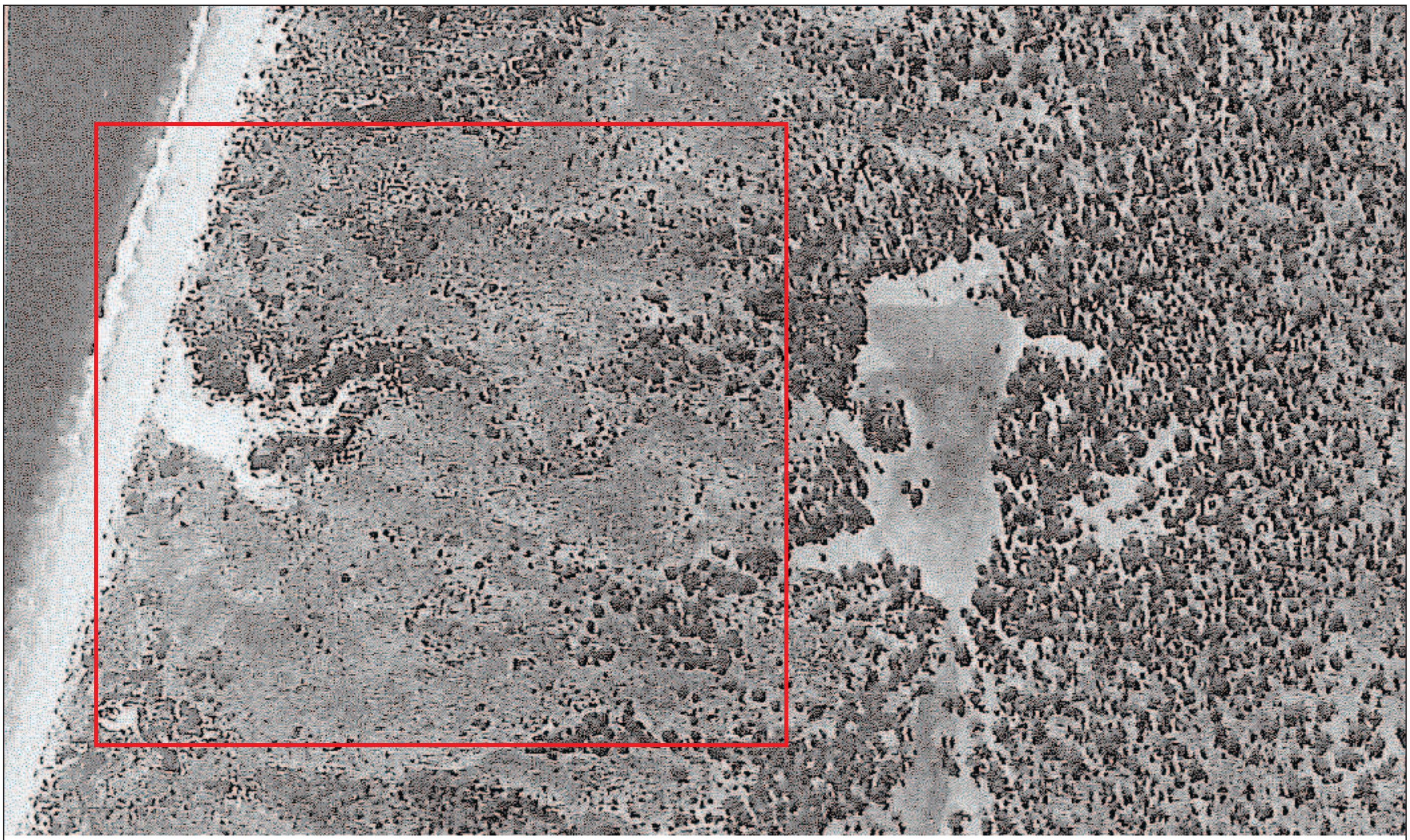
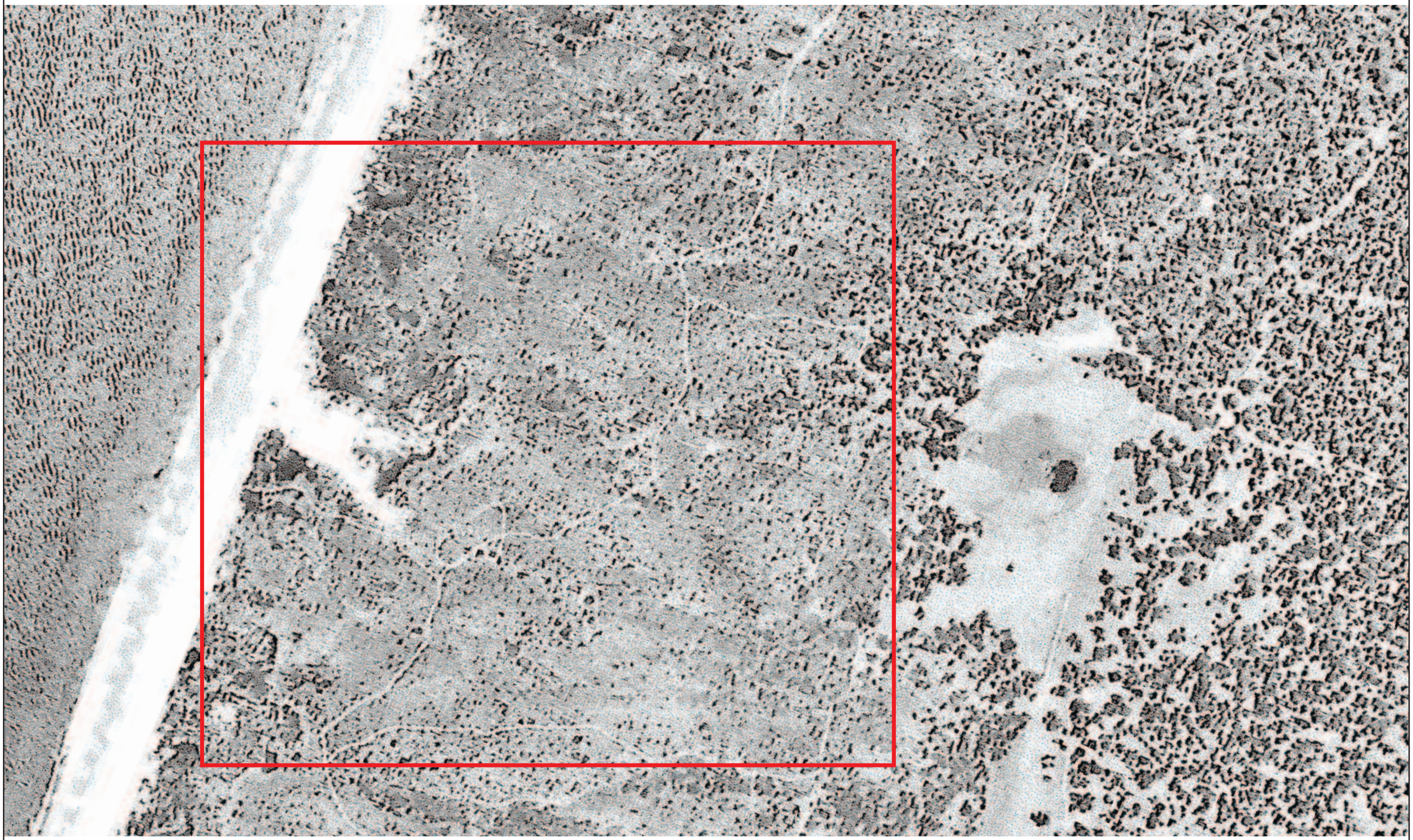
Annex B

Historical Aerial Photographs



AERIAL PHOTOGRAPH 1958



AERIAL PHOTOGRAPH 1980

Legend

▭ Area of Interest

Client:	Shire of Capel		**Aerial Photographs Summary**
Drawing No:	0124484p_PHOTOLOG_C001.cdr		
Date:	29/02/2012	Drawing size: A4	Greenstone Project
Drawn by:	DN	Reviewed by: MP	

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AERIAL PHOTOGRAPH 1990

AERIAL PHOTOGRAPH 1996

Legend

🟥 Area of Interest

Client: Shire of Capel
Drawing No: 0124484p_PHOTOLOG_C001.cdr
Date: 29/02/2012 Drawing size: A4
Drawn by: DN Reviewed by: MP

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Aerial Photographs Summary

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AERIAL PHOTOGRAPH 1998

AERIAL PHOTOGRAPH 2001

Legend

▭ Area of Interest

Client: Shire of Capel
Drawing No: 0124484p_PHOTOLOG_C001.cdr
Date: 29/02/2012 Drawing size: A4
Drawn by: DN Reviewed by: MP

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Aerial Photographs Summary

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AERIAL PHOTOGRAPH 2003

AERIAL PHOTOGRAPH 2004

Legend

🟥 Area of Interest

Client:	Shire of Capel		**Aerial Photographs Summary**
Drawing No:	0124484p_PHOTOLOG_C001.cdr		
Date:	29/02/2012	Drawing size: A4	Greenstone Project
Drawn by:	DN	Reviewed by: MP	

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AERIAL PHOTOGRAPH 2006

AERIAL PHOTOGRAPH 2009

Legend

▭ Area of Interest

Client: Shire of Capel

Drawing No: 0124484p_PHOTOLOG_C001.cdr

Date: 29/02/2012 Drawing size: A4

Drawn by: DN Reviewed by: MP

Aerial Photographs Summary

Greenstone Project

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AERIAL PHOTOGRAPH 2011

Source: Cristal Pigment Australia

AERIAL PHOTOGRAPH 2014

Legend

🟥 Area of Interest

Client: Shire of Capel

Drawing No: 0124484p_PHOTOLOG_C001.cdr

Date: 12/11/2014 Drawing size: A4

Drawn by: DN Reviewed by: MP

Aerial Photographs Summary

MIC Dalyellup Treated Solid Residue Disposal Facility - Hydrogeological Assessment

Environmental Resources Management Australia Pty Ltd

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Annex C

Historical Certificates of Title

TRANSFER 13375 VOL. 20. , FOL. 70.
1928.

28364'6 38411 37901/29 15067/36. 10952/23.

CT 1006 0022 F

INDEXED.

Vol. 1006 Fol. 22.
P. 17934.
P. 17972

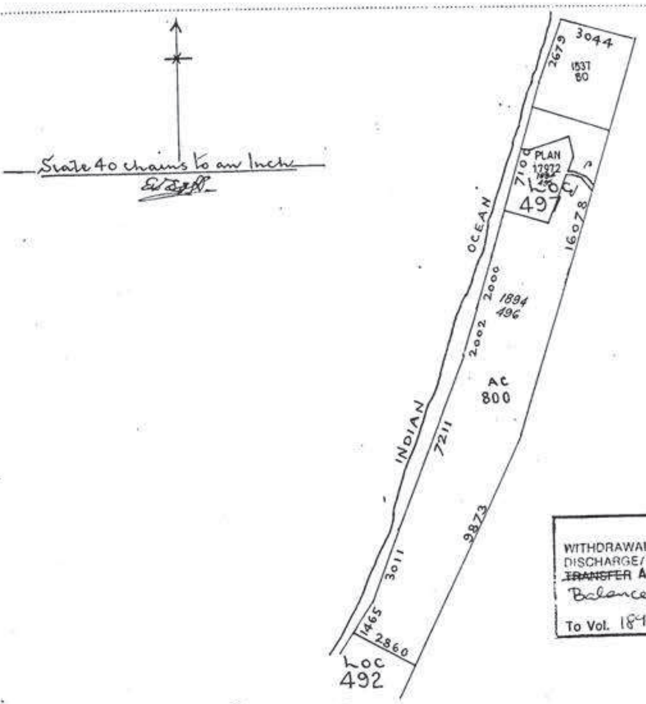
WESTERN AUSTRALIA.

Certificate of Title CANCELLED

under "The Transfer of Land Act, 1893" (Sch. 5, 56 Vict., 14.)

Uranie Ramsay of Minninup near Capel Widow

is now the sole proprietor of an estate in fee simple in possession subject to the easements and encumbrances notified hereunder in ALL that piece of land delineated and coloured green on the map hereon, containing eight hundred acres or thereabouts, being Wellington Location 497.



CANCELLED

TOTALLY CANCELLED
WITHDRAWAL/S
DISCHARGE/S
~~TRANSFER~~ APPLICATION E575460
Balance
To Vol. 1894 Fol. 496
LODGED/REGISTERED
27.03.91 at
15 11 hrs.

Dated the fourth day of December One thousand nine hundred and twenty-eight.

Application 2801/1929 Geo. Barrett
10 December 1929 ASSISTANT. REGISTRAR OF TITLES.

Assistant Registrar of Titles.

Transfer 13376/1928 Transferred to Michael Murnane Adrian Roy Murnane Farmers Beulah Emily Murnane and Pearl Gladys Murnane married women all of Minninup near Capel as tenants in common in equal shares Registered 4th December 1928 at 3 o'clock.

Transfer 5762/1943. Transferred to Frederick Vivian Harewood of Boyanup. Farmer. Registered 12th November 1943 at 2 o'c.

~~ASSISTANT~~ REGISTRAR OF TITLES

Transfer 32018/66 to The State Housing Commission of Perth. Registered 16th May 1966 at 10.00 o'c.

L. F. Symes
asst. REGISTRAR OF TITLES

CANCELLED

u10803/28*

For encumbrances and other matters affecting the land see back.

EASEMENTS AND ENCUMBRANCES REFERRED TO.

As to the Interests of Michael Valmont Murnane and Beulah Emily Murnane only
Instrument stamped £2.0.0
Mortgage 13183/1929 Michael Valmont Murnane and Beulah Emily Murnane to Bank of New South Wales. Registered 10th December 1929 at 3 o'c

Geo Barrett
ASSISTANT REGISTRAR OF TITLES

Discharge 3242/1936 of Mortgage 13183/1929 Registered 1st September 1936 at 12.10 o'c

A Dachall
ASSISTANT REGISTRAR OF TITLES.

As to the undivided fourth share of Michael Valmont Murnane only.
Warrant 46/1940 Lodged 16.10.1940 at 11 o'c
Not to be executed except by leave
of the Supreme Court.

ASSISTANT REGISTRAR OF TITLES.

Collateral to mortgage stamped to secure £5000
Mortgage 9155/1961 Frederick Vivian Harwood to
THE COMMISSIONERS OF THE RURAL AND INDUSTRIES BANK OF WESTERN AUSTRALIA
Registered 17th August 1961 at 9.18 o'c

DISCHARGED

ASSISTANT REGISTRAR OF TITLES

Discharge 32015/66 of Mortgage 9155/1961. Registered 16th May 1966 at 10.01 o'c.

L J Symes
a/ REGISTRAR OF TITLES

TRANSFER B745522.
Registered 10th July 1979 at 12.16 o'c
Portion
To Vol 1537 Fol 80.

WITHDRAWAL/S DISCHARGE/S APPLICATION E575459 The portion of Plan 17942 herein included in To Vol. 1844 Fol. 495	LODGED/REGISTERED 27.03.91 at 15.11 hrs.

CT 1006 0022 B

CERTIFICATE OF TITLE.

Registered Vol.................Fol.................

ORIGINAL—NOT TO BE REMOVED FROM OFFICE OF T

LT. 37

CT 1894 0495 F

Page 1 (of 2 pages) 1894 VOL. 495 FOL.

Application E575459

Volume	Folio
449	14
1006	22
1311	726

WESTERN AUSTRALIA

1894 495

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

Dated 27th March, 1991

D J Mulcahy
REGISTRAR OF TITLES

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of each of Wellington Locations 41 and 497 and being Lot 1 the subject of Plan 17972, delineated on the map in the Third Schedule hereto. As to the said portion of Wellington Location 41 only: together with a right of carriageway over the portions coloured brown on Plan 3097 as set out in Transfer 2756/1912.

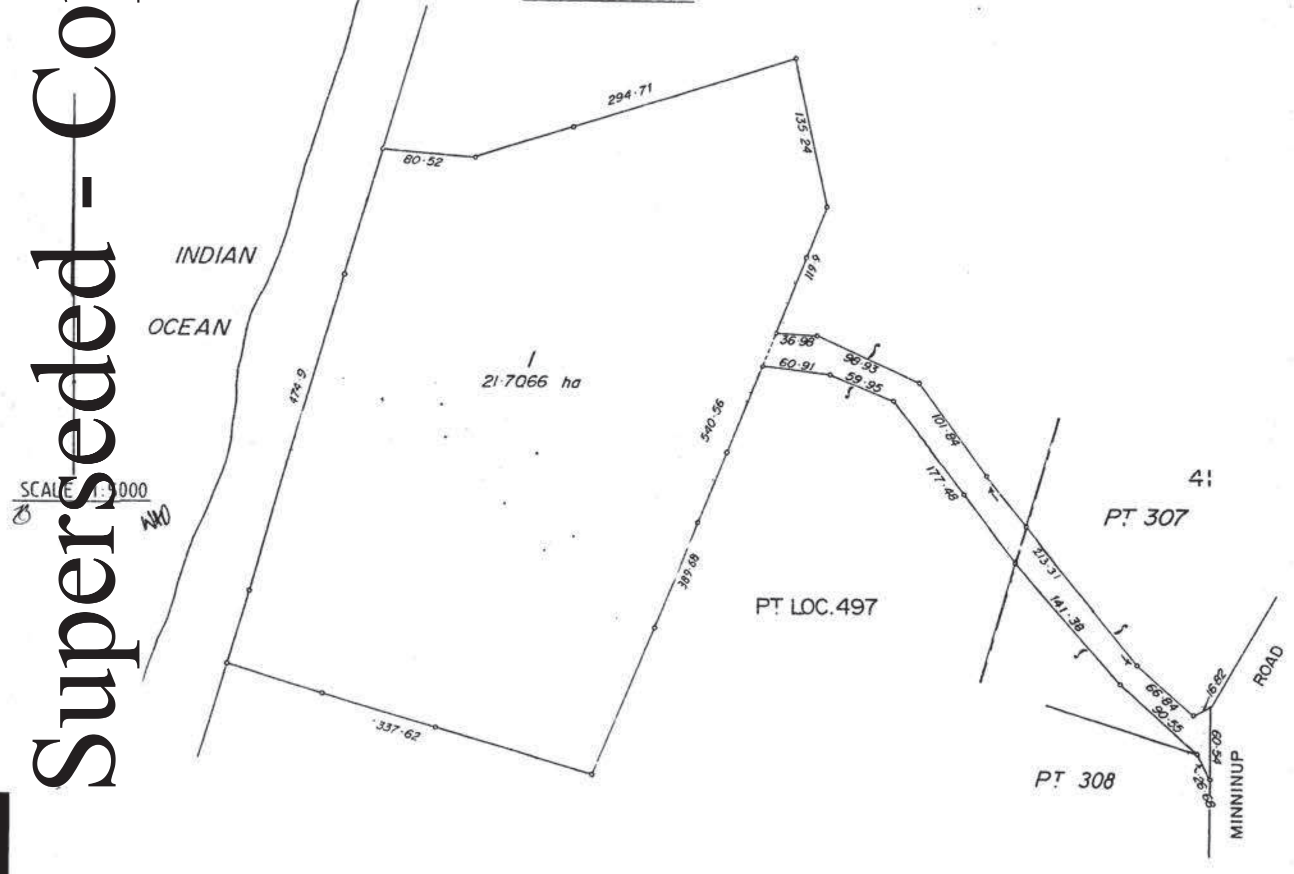
FIRST SCHEDULE (continued overleaf)

~~The State Housing Commission of 99 Plain Street, East Perth.~~

SECOND SCHEDULE (continued overleaf)

NIL

THIRD SCHEDULE



NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

E67590/3/89-20M-L/4664

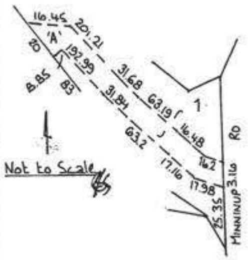
FIRST SCHEDULE (continued)

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT		REGISTERED	TIME	SEAL	CERT. OFFICER
	NATURE	NUMBER				
Industrial Lands Development Authority of 26 Saint Georges Terrace, Perth.	Transfer	E575461	27.3.91	15.11		

SECOND SCHEDULE (continued)

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT		PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER
NATURE	NUMBER										
EASEMENT	H598929	 The right to enter in upon under over and across the portion of the within land marked 'A' on the map in the margin for the purpose of exercising certain television cabling rights as set out in the said Easement is granted to the proprietor or proprietors for the time being of the portion of Wellington Location 497 comprised in Vol 2208 Fol 287 and the part of Lot 307 on Plan 3097 (Sheet 2) comprised in Vol 2208 Fol 288.	16.11.00	11.05							

CERTIFICATE OF TITLE VOL. 1894 FOL. 495

REGISTER NUMBER	
1/P17972	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 1894 FOLIO 495

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

Cancelled

LAND DESCRIPTION:

LOT 1 ON PLAN 17972

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

INDUSTRIAL LANDS DEVELOPMENT AUTHORITY OF 26 SAINT GEORGES TERRACE, PERTH
(T K923632) REGISTERED 29 APRIL 2009

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. T2756/1912 EASEMENT BENEFIT AS TO THE PORTION OF WELLINGTON LOCATION 41 ONLY. SEE TRANSFER 2756/1912. REGISTERED 10.1.1912.
2. *H598929 EASEMENT BURDEN SEE SKETCH ON VOLUME 1894 FOLIO 495. REGISTERED 16.11.2000.
   *J066925 EASEMENT H598929 PARTIALLY SURRENDERED. AS TO THE LAND IN VOLUME 2210 FOLIO 558 ONLY. REGISTERED 28.10.2004.
3. *K923632 THE PORTION OF LOT 2969 ON DEPOSITED PLAN 60716 HEREIN INCLUDED IN VOLUME 2717 FOLIO 205 REGISTERED 29.4.2009.
4. *K923636 RESTRICTIVE COVENANT TO SHIRE OF CAPEL AS TO LOTS 922 - 924 AND 2968 - 2970 ON DEPOSITED PLAN 60716. REGISTERED 29.4.2009.
5. *K923637 NOTIFICATION SECTION 165 PLANNING & DEVELOPMENT ACT 2005 AS TO LOTS 922 - 924 AND 2968 - 2970 ON DEPOSITED PLAN 60716. LODGED 29.4.2009.
6. *K923634 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP60716 TO VOLUME 2717 FOLIOS 201-207 INCLUSIVE. REGISTERED 29.4.2009.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

--END OF CERTIFICATE OF TITLE--

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1894-495 (1/P17972).
PREVIOUS TITLE:	1311-726, 1006-22, 449-14.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.

END OF PAGE 1 - CONTINUED OVER

RECORD OF CERTIFICATE OF TITLE

REGISTER NUMBER: 1/P17972 VOLUME/FOLIO: 1894-495

RESPONSIBLE AGENCY: WESTERN AUSTRALIAN LAND AUTHORITY.

NOTE 1:	J066925	DUPLICATE CERTIFICATE OF TITLE NOT PRODUCED FOR J66925.
NOTE 2:	K638368	DEPOSITED PLAN 60716 LODGED

LT. 37

ORIGINAL—NOT TO BE REMOVED FROM OFFICE OF TITLES

Application E575460
Volume 1006 Folio 22

WESTERN AUSTRALIA

REGISTER BOOK
VOL. 1894 FOL. 496
D89772

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

PLAN 17934

Page 1 (of 2 pages) VOL. 1894 FOL. 496

Cancelled

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

Dated 27th March, 1991

CANCELLED

D J Mulcahy
REGISTRAR OF TITLES

OFFICE OF TITLES WESTERN AUSTRALIA

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Wellington Location 497, delineated on the map in the Third Schedule hereto.

CT 1894 0496 F

FIRST SCHEDULE (continued overleaf)

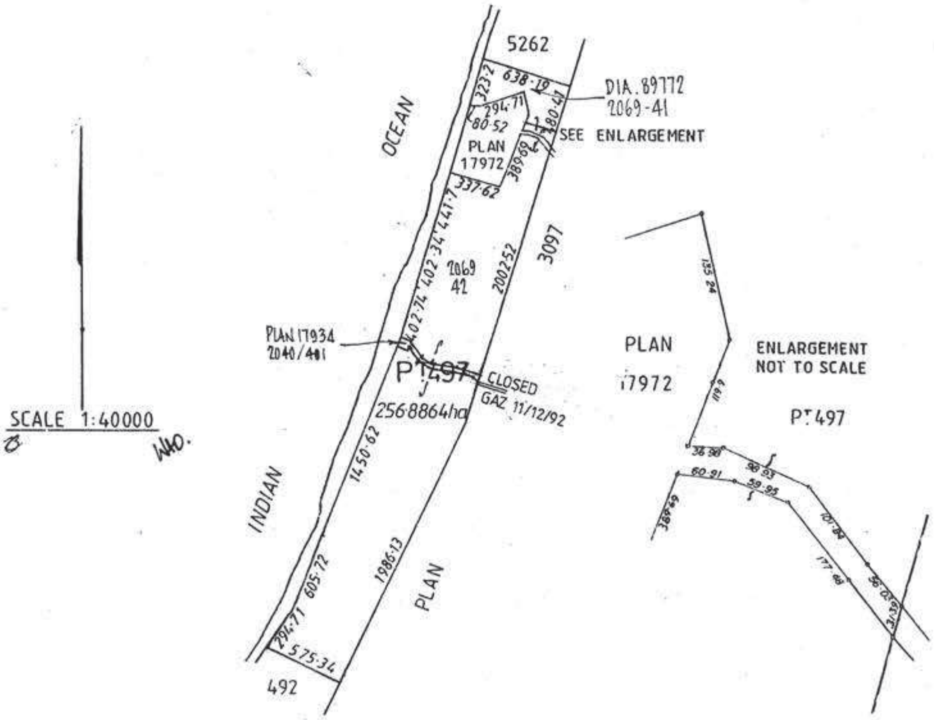
The State Housing Commission of 99 Plain Street, East Perth.

SECOND SCHEDULE (continued overleaf)

NIL

THIRD SCHEDULE

CANCELLED



CANCELLED

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

E67590/3/89-20M-L/4664

Page 2 (of 2 pages) LT. 37

FIRST SCHEDULE (continued)

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT		REGISTERED	TIME	SEAL	CERT. OFFICER
	NATURE	NUMBER				
The portion of Plan 17934 herein included in Vol 2040 Fol 401.	Application	F851962	10.4.95	15.38		
The portion of Diagram 89772 herein included in to Vol 2069 Fol 41.	Transfer	G117257	5.3.96	14.32		
Cancelled: Balance to Vol 2069 Fol 42.	Application	G117258	5.3.96	14.32		

SECOND SCHEDULE (continued)

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT		PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER
NATURE	NUMBER										
Caveat	E760986	Lodged 5.12.91 at 14.51 hrs.					Withdrawn	F851961	10.4.95		
Caveat	F851963	Lodged 10.4.1995 at 15.39 hrs.					Withdrawn	G117255	5.3.96		

CERTIFICATE OF TITLE VOL. 1894 FOL. 496

Cancelled Page 1 (of 2 pages) 2069 VOL. 42 FOL.

LT. 37

ORIGINAL—NOT TO BE REMOVED FROM OFFICE OF TITLES

Application G117258
Volume 1894 Folio 496

WESTERN AUSTRALIA

REGISTER BOOK
VOL. FOL.
CT 2069 42

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

Dated 5th March, 1996

G Sach
REGISTRAR OF TITLES

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Wellington Location 497, delineated on the map in the Third Schedule hereto.

FIRST SCHEDULE (continued overleaf)

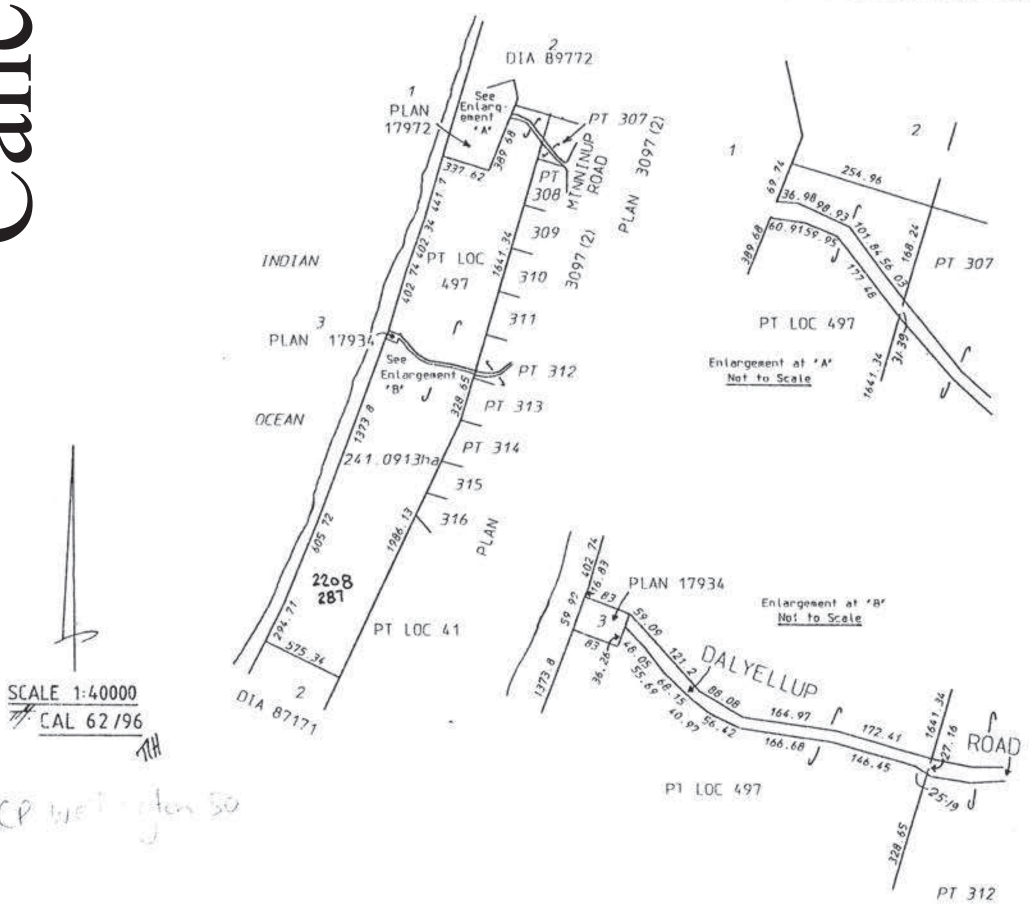
The State Housing Commission of 99 Plain Street, East Perth.

SECOND SCHEDULE (continued overleaf)

NIL

THIRD SCHEDULE

CANCELLED



CP Wellington 50

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

FIRST SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT		REGISTERED	TIME	SEAL	CERT. OFFICER
	NATURE	NUMBER				
The right to enter in upon under over and across the portion of Lot 1 on Plan 17972 hachured on the map in Easement H598929 for the purpose of exercising certain television cabling rights as set out in the said Easement is granted to the proprietor or proprietors for the time being of the within land.	Easement	H598929	16.11.00	11.05		✓
Cancelled to Vol 2208 Fol 287.	Application	H642764	12.1.01	9.25		✓

SECOND SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT		PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER
NATURE	NUMBER										

CERTIFICATE OF TITLE VOL. 2069 FOL. 42

S.G. Receipts 1556 K

24881/86.

Sch. 2.
38 V. 13.

CT 0020 0070 F

REGISTER BOOK.
Vol. XX. Fol. 70.

CULLED

Cancelled

WESTERN AUSTRALIA.

Certificate of Title under "The Transfer of Land Act, 1874."

Application 1873/1926 Cunn Lovell ASSISTANT REGISTRAR OF TITLES, 17th October 1926.

William ~~Cunningham~~ Ramsay of Minninup Grazier

is now the Sole proprietor

of an estate in fee simple in possession subject to the encumbrances if any notified on the back of these presents

in ALL THAT parcel of land Situate in the Wellington District

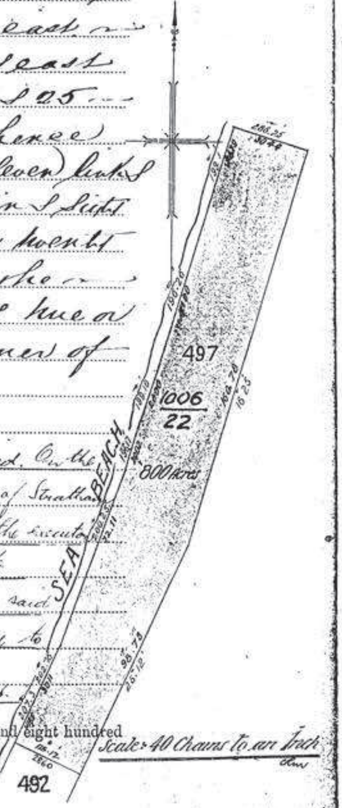
containing Eight hundred acres.

or thereabouts being Wellington location 497 – and bounded by lines Starting from the north east angle of Wellington location 492 and extending North 25 degrees 12 minutes east ninety eight chains seventy three links, thence North sixteen degrees 25 minutes east one hundred and sixty chains seventy eight links thence north 186 degrees 25 minutes east thirty chains forty four links, thence north 199 degrees 1 minute east twenty six chains seventy nine links thence north 196 degrees 26 minutes east seventy one chains thence North 199 degrees ten minutes east twenty chains thence North 196 degrees 17 minutes east twenty chains two links thence North 200 degrees 05 minutes east seventy two chains eleven links thence north 202 degrees 16 minutes east, thirty chains eleven links thence North 207 degrees 3 minutes east fourteen chains sixty five links thence North 115 degrees 12 minutes east twenty eight chains sixty links to the Starting point, the measurements being more or less, the bearings true or thereabouts, and a squared post at each corner of the location.

56 Vic. No. 14 Sec. 187

Application 1894/1926 On the 12th day of October 1925 William Ramsay died. On the 6th day of May 1926 probate of his Will was granted to Vernon Gale Roberts of Stratham Farmer and Michael Murnane of Minninup near Capel Farmer two of the executors named in the said Will leave being reserved of making a like grant to Anthony Glindon Layman of Capel Farmer the other executor named in the said Will and on the 1st day of June 1926 probate of the said Will was granted to the said Anthony Glindon Layman.

Cunn Lovell
ASSISTANT REGISTRAR OF TITLES, 17th October 1926.



Dated the twenty-fourth day of September One thousand eight hundred and Eighty-six.

J. C. N. James

Commissioner of Land Titles.

Transfer 13375/1928. Totally cancelled by Francis Ramsay
Registered 4th December 1928 at 3 o'c
1006-22.
ASSISTANT REGISTRAR OF TITLES.

ENCUMBRANCES REFERRED TO.

LT.175

APPLICATION H642764

VOLUME 2069 FOLIO 42

VOLUME **FOLIO**
2208 **287**
IN THE REGISTER

WESTERN AUSTRALIA

CERTIFICATE OF TITLE

UNDER THE " TRANSFER OF LAND ACT, 1893 " AS AMENDED

DP 25792 H676327
DP 25793 H676328

The person described in the First Schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the Second Schedule.

CANCELLED

DATED 12TH JANUARY, 2001

REGISTRAR OF TITLES

DP 29066 (XE) H900453
DP 29067 (XE) H900454

LAND DESCRIPTION:

PORTION OF WELLINGTON LOCATION 497 ON CROWN PLAN WELLINGTON 50, DELINEATED ON THE MAP IN THE THIRD SCHEDULE HERETO.

REGISTERED PROPRIETOR:

FIRST SCHEDULE (continued overleaf)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH.

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

SECOND SCHEDULE (continued overleaf)

1. EASEMENT H598929. BENEFIT OF THE RIGHT TO ENTER IN, UPON, UNDER, OVER AND ACROSS THE PORTION OF LOT 1 ON PLAN 17972 MARKED 'A' ON THE MAP IN THE THIRD SCHEDULE HERETO FOR THE PURPOSE OF EXERCISING CERTAIN TELEVISION CABLING RIGHTS. REGISTERED 16.11.2000 AT 11.05 HRS.

THIRD SCHEDULE (see overleaf)

CANCELLED

FIRST SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

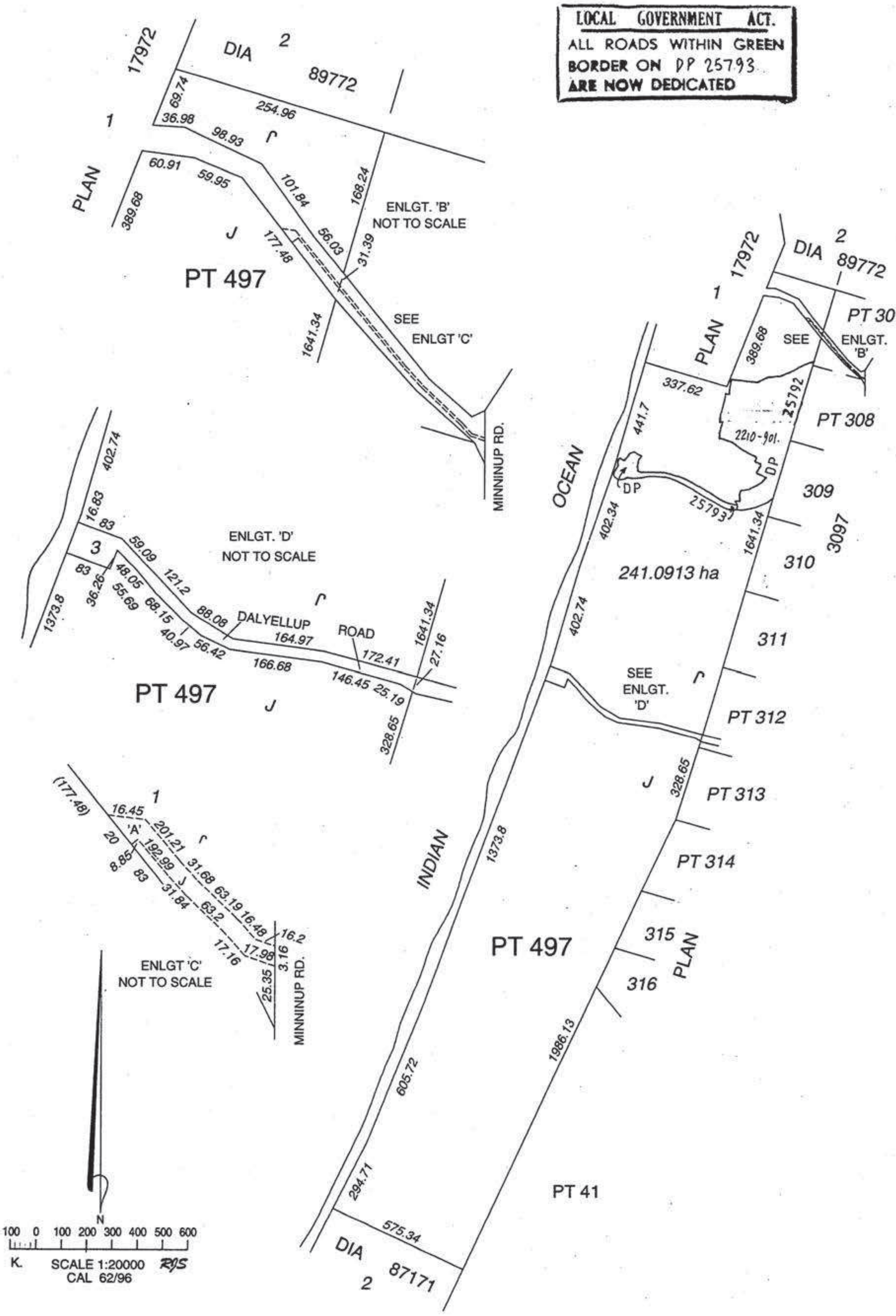
PARTICULARS	INSTRUMENT		REGISTERED	TIME	SEAL & INITIAL
	NATURE	NUMBER			
The portion of Deposited Plan 25792 herein included in to Vol 2210 Fol 901.	Application	H681791	8.3.01	10.11	
Lot 1187 on Deposited Plan 25793 to Vol 2210 Fol 558.	Application	H681792	8.3.01	10.11	
Cancelled: as to Deposited Plan 29066 to Vol. 2217 Folios 501 to 548 (inc)	Application	H922579	9.11.2001	10.59	

SECOND SCHEDULE (continued)	REGISTERED or LODGED	TIME	SEAL & INITIAL	CANCELLATION		REGISTERED or LODGED	SEAL & INITIAL
				NATURE	NUMBER		

VOLUME FOLIO
2208 287
IN THE REGISTER

VOLUME FOLIO
2208 287
IN THE REGISTER

LOCAL GOVERNMENT ACT.
ALL ROADS WITHIN GREEN
BORDER ON DP 25793
ARE NOW DEDICATED



REGISTER NUMBER **9008/DP29067**	
DUPLICATE EDITION **N/A**	DATE DUPLICATE ISSUED **N/A**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2217** FOLIO **567**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9008 ON DEPOSITED PLAN 29067

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH

(A H922581) REGISTERED 9 NOVEMBER 2001

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. H598929 EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2. *I162309 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP32010 TO VOLUME 2519 FOLIOS 773 TO 793 (INCLUSIVE) REGISTERED 3.7.2002.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP29067 [SHEET 1,2,3].
PREVIOUS TITLE:	2208-287.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1: I116467 DEPOSITED PLAN 32010 LODGED.

REGISTER NUMBER	
9017/DP32010	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**8/7/2002**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME	FOLIO
2519	**793**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9017 ON DEPOSITED PLAN 32010

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH

(AF I162309) REGISTERED 3 JULY 2002

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. H598929 EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2. *I220705 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP32947 TO VOLUME 2523 FOLIOS 401 TO 421 (INCLUSIVE) REGISTERED 30.8.2002.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP32010 [SHEET 1,3].
PREVIOUS TITLE:	2217-567.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1:	I191113	DEPOSITED PLAN 32947 LODGED
NOTE 2:	I197581	DEPOSITED PLAN 33032 LODGED

REGISTER NUMBER	
9019/DP32947	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2523** FOLIO **421**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9019 ON DEPOSITED PLAN 32947

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH
(AF I220705) REGISTERED 30 AUGUST 2002

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

[illegible] *H598929 EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2. *I220687 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP33032 TO VOLUME 2523 FOLIOS 422 TO 449 (INCLUSIVE) REGISTERED 30.8.2002.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP32947 [SHEET 1,2,3].
PREVIOUS TITLE: 2519-793.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY: DEPARTMENT OF HOUSING (SSHC).

NOTE 1: I197581 DEPOSITED PLAN 33032 LODGED

REGISTER NUMBER	
9020/DP33032	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	2/9/2002

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2523** FOLIO **449**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9020 ON DEPOSITED PLAN 33032

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH
(AF I220687) REGISTERED 30 AUGUST 2002

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1.	H598929	EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2.	*I597427	FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP37798 TO VOLUME 2543 FOLIOS 839 TO 857. REGISTERED 20.8.2003.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP33032 [SHEET 1,2,3].
PREVIOUS TITLE:	2523-421.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1:	I543791	DEPOSITED PLAN 37798 LODGED
NOTE 2:	I543789	DEPOSITED PLAN 37797 LODGED

REGISTER NUMBER
9029/DP37798

DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	22/8/2003

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2543** FOLIO **856**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

Cancelled

LAND DESCRIPTION:

LOT 9029 ON DEPOSITED PLAN 37798

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH
(AF I597427) REGISTERED 20 AUGUST 2003

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. H598929 EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2. EASEMENT BURDEN CREATED UNDER SECTION 27A OF T. P. & D. ACT - SEE DEPOSITED PLAN 37798
3. *I769504 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DEPOSITED PLAN 38801 TO VOLUME 2555 FOLIOS 901 TO 933 (INCLUSIVE). REGISTERED 23.1.2004.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP37798 [SHEET 1,2,3].
PREVIOUS TITLE:	2523-449.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1:	I707028	DEPOSITED PLAN 38801 LODGED.
NOTE 2:	I731456	DEPOSITED PLAN 39546 LODGED

REGISTER NUMBER	
9031/DP38801	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	28/1/2004

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME	FOLIO
2555	933

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9031 ON DEPOSITED PLAN 38801

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH
(AF I769504) REGISTERED 23 JANUARY 2004

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1.	H598929	EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2.	*J079341	NOTIFICATION CONTAINS FACTORS AFFECTING THE WITHIN LAND. AS TO ALL LOTS ON DP42107 EXCEPT LOTS 8005, 9038 AND 9509 LODGED 9.11.2004.
3.	*J079343	FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP42107. (VOL 2578 FOLS 331 - 356 INC) REGISTERED 9.11.2004.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

--END OF CERTIFICATE OF TITLE--

STATEMENTS:

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SKETCH OF LAND:	DP38801 [SHEET 1,2,3].
PREVIOUS TITLE:	2543-856.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1:	I731456	DEPOSITED PLAN 39546 LODGED
NOTE 2:	J006460	DEPOSITED PLAN 42107 LODGED
NOTE 3:	J025295	DEPOSITED PLAN 42960 LODGED.
NOTE 4:	J023775	DEPOSITED PLAN 42954 LODGED.

REGISTER NUMBER	
9038/DP42107	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	17/11/2004

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 2578 FOLIO 355

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

Cancelled

LAND DESCRIPTION:

LOT 9038 ON DEPOSITED PLAN 42107

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH
(AF J079343) REGISTERED 9 NOVEMBER 2004

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1.	H598929	EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2.	*J185637	FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP42954 TO VOLUME 2585 FOLIOS 33 TO 58 (INCLUSIVE) REGISTERED 17.2.2005.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP42107 [SHEET 1,,2,,3,,4].
PREVIOUS TITLE:	2555-933.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1:	J023775	DEPOSITED PLAN 42954 LODGED.
NOTE 2:	J025295	DEPOSITED PLAN 42960 LODGED.

REGISTER NUMBER	
9041/DP42954	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**17/2/2005**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME	FOLIO
2585	**57**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9041 ON DEPOSITED PLAN 42954

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH

(AF J185637) REGISTERED 17 FEBRUARY 2005

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1.	H598929	EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2.	*J558001	NOTIFICATION. TOWN PLANNING AND DEVELOPMENT ACT 1928 AS TO ALL LOTS ON DEPOSITED PLAN 47649 EXCEPT LOTS 9056-9058 AND 9515. REGISTERED 20.12.2005.
3.	*J558003	FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DEPOSITED PLAN 47649 TO VOLUME 2610 FOLIOS 522 TO 576 (INCLUSIVE). REGISTERED 20.12.2005.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

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SKETCH OF LAND:	DP42954 [SHEET 1,3].
PREVIOUS TITLE:	2578-355.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1:	J465718	DEPOSITED PLAN 47649 LODGED.
NOTE 2:	J483630	DEPOSITED PLAN 48775 LODGED.
NOTE 3:	J483631	DEPOSITED PLAN 48772 LODGED.
NOTE 4:	J483632	DEPOSITED PLAN 48769 LODGED.

REGISTER NUMBER
9056/DP47649
DUPLICATE EDITION **1**
DATE DUPLICATE ISSUED **23/12/2005**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2610**
FOLIO **573**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:
LOT 9056 ON DEPOSITED PLAN 47649

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH
(AF J558003) REGISTERED 20 DECEMBER 2005

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. H598929 EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2. *J682880 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP48769 TO VOLUME 2616 FOLIOS 663 TO 667. REGISTERED 31.3.2006.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:
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SKETCH OF LAND: DP47649 [SHEET 1,2,3,4].
PREVIOUS TITLE: 2585-57.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY: DEPARTMENT OF HOUSING (SSHC).

NOTE 1: J483630 DEPOSITED PLAN 48775 LODGED
NOTE 2: J483631 DEPOSITED PLAN 48772 LODGED.
NOTE 3: J483632 DEPOSITED PLAN 48769 LODGED.

REGISTER NUMBER	
9063/DP48769	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	5/4/2006

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME	FOLIO
2616	666

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9063 ON DEPOSITED PLAN 48769

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH
(AF J682880) REGISTERED 31 MARCH 2006

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1.	H598929	EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2.	*J874253	NOTIFICATION SECTION 165 PLANNING & DEVELOPMENT ACT 2005 ALL LOTS EXCEPT 9070 ON DEPOSITED PLAN 50648. LODGED 15.8.2006.
3.	*J874252	FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP50648. SEE VOL.2631 FOL'S 336-363 REGISTERED 15.8.2006.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

--END OF CERTIFICATE OF TITLE--

STATEMENTS:

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SKETCH OF LAND:	DP48769 [SHEET 1,2,3].
PREVIOUS TITLE:	2610-573.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1:	J483630	DEPOSITED PLAN 48775 LODGED
NOTE 2:	J764597	DEPOSITED PLAN 50648 LODGED

REGISTER NUMBER	
9070/DP50648	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	18/8/2006

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 2631 FOLIO 363

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

B G Roberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9070 ON DEPOSITED PLAN 50648

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

HOUSING AUTHORITY OF 99 PLAIN STREET, EAST PERTH
(AF J874252) REGISTERED 15 AUGUST 2006

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. H598929 EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2. *J925182 NOTIFICATION SECTION 165 PLANNING & DEVELOPMENT ACT 2005 AS TO ALL LOTS ON DP50649 EXCEPT LOT 9071 LODGED 22.9.2006.
3. *J925184 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP50649. (VOL 2635 FOLS 644 - 666) REGISTERED 22.9.2006.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

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SKETCH OF LAND:	DP50648 [SHEET 1,2,3].
PREVIOUS TITLE:	2616-666.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1: J887519 DEPOSITED PLAN 50649 LODGED

REGISTER NUMBER	
9071/DP50649	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**27/9/2006**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2635** FOLIO **666**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9071 ON DEPOSITED PLAN 50649

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

HOUSING AUTHORITY OF 99 PLAIN STREET, EAST PERTH
(AF J925184) REGISTERED 22 SEPTEMBER 2006

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. H598929 EASEMENT BENEFIT SEE SKETCH ON VOL 2208 FOL 287. REGISTERED 16.11.2000.
2. *L332407 FOLIO CANCELLED. NEW FOLIOS HAVE BEEN CREATED FOR LOT(S) ON DP66982 TO VOLUME 2746 FOLIOS 255 TO 296. REGISTERED 11.6.2010.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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---END OF CERTIFICATE OF TITLE---

STATEMENTS:

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SKETCH OF LAND:	DP50649 [SHEET 1,2,3].
PREVIOUS TITLE:	2631-363.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	NO LOCAL GOVERNMENT AUTHORITY INFORMATION AVAILABLE.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1: L327276 DEPOSITED PLAN 66982 LODGED

REGISTER NUMBER
9077/DP60716

DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	7/5/2009

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2717** FOLIO **207**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9077 ON DEPOSITED PLAN 60716

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH
(AF K923634) REGISTERED 29 APRIL 2009

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1.	T2756/1912	EASEMENT BENEFIT REGISTERED 10.1.1912.
2.	H598929	EASEMENT BURDEN SEE SKETCH ON DEPOSITED PLAN 60716. REGISTERED 16.11.2000.
	J066925	EASEMENT H598929 PARTIALLY SURRENDERED. AS TO THE LAND IN VOLUME 2210 FOLIO 558 ONLY. REGISTERED 28.10.2004.
3.	*K923638	CAVEAT BY MILLENNIUM INORGANIC CHEMICALS LTD LODGED 29.4.2009.
4.	*K923639	CAVEAT BY HSBC BANK USA, NATIONAL ASSOCATION LODGED 29.4.2009.

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Lot as described in the land description may be a lot or location.

--END OF CERTIFICATE OF TITLE--

STATEMENTS:

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SKETCH OF LAND:	DP60716 [SHEET 1,2].
PREVIOUS TITLE:	2696-378, 1894-495.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	SHIRE OF CAPEL.
RESPONSIBLE AGENCY:	WESTERN AUSTRALIAN LAND AUTHORITY.

REGISTER NUMBER	
9084/DP66982	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**15/6/2010**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2746** FOLIO **287**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9084 ON DEPOSITED PLAN 66982

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

HOUSING AUTHORITY OF 99 PLAIN STREET, EAST PERTH

(AF L332407) REGISTERED 11 JUNE 2010

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. H598929 EASEMENT BENEFIT SEE SKETCH ON VOLUME 2208 FOLIO 287. REGISTERED 16.11.2000.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP66982 [SHEET 1,3,4,7,8].
PREVIOUS TITLE:	2635-666.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	SHIRE OF CAPEL.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

REGISTER NUMBER	
9077/DP60716	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**7/5/2009**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME	FOLIO
2717	**207**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9077 ON DEPOSITED PLAN 60716

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH
(AF K923634) REGISTERED 29 APRIL 2009

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. T2756/1912 EASEMENT BENEFIT REGISTERED 10.1.1912.
2. H598929 EASEMENT BURDEN SEE SKETCH ON DEPOSITED PLAN 60716. REGISTERED 16.11.2000.
    J066925 EASEMENT H598929 PARTIALLY SURRENDERED. AS TO THE LAND IN VOLUME 2210 FOLIO 558 ONLY. REGISTERED 28.10.2004.
3. *K923638 CAVEAT BY MILLENNIUM INORGANIC CHEMICALS LTD LODGED 29.4.2009.
4. *K923639 CAVEAT BY HSBC BANK USA, NATIONAL ASSOCATION LODGED 29.4.2009.
5. *L709156 MEMORIAL. CONTAMINATED SITES ACT 2003 REGISTERED 16.8.2011.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

--END OF CERTIFICATE OF TITLE--

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP60716.
PREVIOUS TITLE:	2696-378, 1894-495.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	SHIRE OF CAPEL.
RESPONSIBLE AGENCY:	WESTERN AUSTRALIAN LAND AUTHORITY.

AMENDMENTS TABLE

VERSION	AMENDMENT	AUTHORISED BY	DATE
2	Audit requirements	Scott J. ANDERSON	29/08/2008

INTERESTS AND NOTIFICATIONS

SUBJECT	PURPOSE	STATUTORY REFERENCE	ORIGIN	LAND BURDENED	BENEFIT TO	COMMENTS
⊗	EASEMENT		T2756/1912	SEE DOC	ALL LOTS SEE DOCUMENT & LOTS 922Ⓗ & 2970Ⓗ	
Ⓖ.Ⓗ	EASEMENT		DOC H598929	LOT 9077		SEE NOTE 'Z'
Ⓑ	EASEMENT (Underground Electric)	SEC 167, REG 8, P. & D. ACT	THIS PLAN	LOT 923	ELECTRICITY NETWORKS CORPORATION	
	RESTRICTIVE COVENANT	SEC 136D OF THE TLA	THIS PLAN & DOC K923635	LOTS 922-924, 2968-2970	LOTS 922-924, 2968-2970	
Ⓑ▸Ⓒ	RESTRICTIVE COVENANT	SEC 129BA OF THE TLA	DOC K923636	LOT 2968-2970	SHIRE OF CAPEL	ACCESS RESTRICTION
Ⓓ▸Ⓔ	RESTRICTIVE COVENANT	SEC 129BA OF THE TLA	DOC K923636	LOT 922-924	SHIRE OF CAPEL	ACCESS RESTRICTION
	NOTIFICATION	SEC 165 OF THE P & D ACT	DOC K923637	ALL LOTS EXCEPT 9077		(MOSQUITOS)

SURVEY CARRIED OUT UNDER REG 26A
SPECIAL SURVEY AREA GUIDELINES
SEE SHEET 3 FOR SURVEY INFORMATION

ALL BOUNDARY / CORNER SURVEY MARKS SHOWN ON THIS SHEET ARE INDICATIVE ONLY. USE ONLY THE SURVEY SHEET/S WHEN DETERMINING THE TRUE FINAL POSITION AND TYPE OF ALL SURVEY MARKS PLACED PERTAINING TO THIS PLAN.

FORMER TENURE TABLE

LOT	FORMER TENURE	ON PLAN / DIAGRAM	TITLE
2969	PT LOT 9531 PT LOT 1	DP 55511 P17972	2696-378 1894-495
2968, 2970, 922-924	PT LOT 9531	DP 55511	2696-378
9077	PT LOT 1	P17972	1894-495

TYPE FREEHOLD
PURPOSE SUBDIVISION
PLAN OF

LOT 922-924, 2968-2970, 9077, ROAD AND RESTRICTIVE COVENANT

DISTRICT WELLINGTON
TOWNSITE
S.S.A. YES

D.P.I. FILE No.
LOCALITY DALYELLUP
LOCAL AUTHORITY SHIRE OF CAPEL
FORMER TENURE SEE FORMER TENURE TABLE

FIELD BOOK 84894, 80657 86698, 94491
ON INDEX SEE SMARTPLAN

SURVEYOR'S CERTIFICATE - Reg 54

I Scott J. ANDERSON hereby certify that this plan is accurate and is a correct representation of the - (a) *survey, and/or (b) *calculations from measurements, [*delete if inapplicable], undertaken for the purposes of this plan and that it complies with the relevant written law(s) in relation to which it is lodged.

Scott J. ANDERSON
2008.10.14 10:10:01 +08'00'
Licensed Surveyor Date

McMULLEN NOLAN www.mapsurvey.com.au
PO Box 117, South Perth WA 6951
Telephone: (08) 6436 1599
Facsimile: (08) 6436 1500
Email: maps@mapsurvey.com.au

SCALE: 1 : 2500 at A2
ALL DISTANCES ARE IN METRES
MAPS Ref : 91900dp-851f
DP60716#01.CSD

LODGED
DATE 24-Jun-08
FEE PAID $555.00
ASSESS No. 3984844

TYPE OF VALIDATION 27/10/2008
FULL AUDIT
CERTIFIED CORRECT A James
LEGAL COMPONENT A. James
I.S.C.
DOCKET PLAN 1682-2005/09
F.S.C. 434-2008

APPROVED BY WESTERN AUSTRALIAN PLANNING COMMISSION
FILE 130761, 131861
29/10/2008
Delegated under Sec 16 P & D Act 2005 DATE

IN ORDER FOR DEALINGS
SUBJECT TO
Sec^s 129 BA + 136D TLA
Sec^s 165, 167 + 168 (1) (2) P+D Act
3.11.08
For INSPECTOR OF PLANS & SURVEYS / AUTHORIZED LAND OFFICER DATE

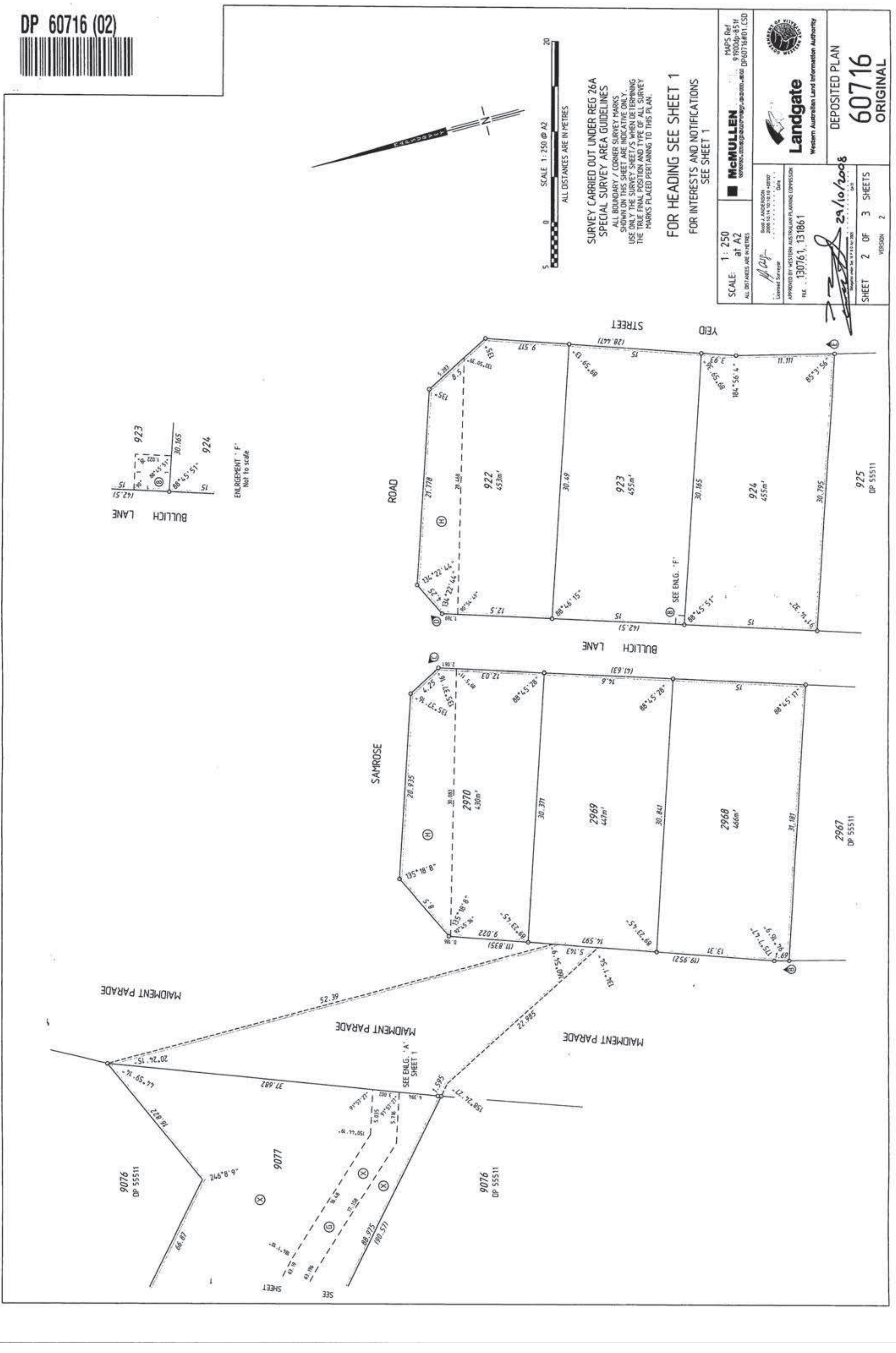
APPROVED REG26A (4)
APPROVED 29-4-09
INSPECTOR OF PLANS & SURVEYS / AUTHORIZED LAND OFFICER DATE

Landgate
Western Australian Land Information Authority

DEPOSITED PLAN
60716
ORIGINAL
SHEET 1 OF 3 SHEETS
VERSION 2

DP 60716 (01)

DP 60716 (02)



SURVEY CARRIED OUT UNDER REG 26A
SPECIAL SURVEY AREA GUIDELINES
ALL BOUNDARY / CORNER SURVEY MARKS
SHOWN ON THIS SHEET ARE INDICATIVE ONLY.
USE ONLY THE SURVEY SHEET/S WHEN DETERMINING
THE TRUE FINAL POSITION AND TYPE OF ALL SURVEY
MARKS PLACED PERTAINING TO THIS PLAN.

FOR HEADING SEE SHEET 1

FOR INTERESTS AND NOTIFICATIONS
SEE SHEET 1

SCALE: 1 : 250 at A2
ALL DISTANCES ARE IN METRES

Licensed Surveyor
Scott J. ANDERSON
2008-10-14 10:10:10 +0800
Date

McMULLEN
MAPS Ref
91900dp-851f
DP60716#01.CSD

APPROVED BY WESTERN AUSTRALIAN PLANNING COMMISSION
FILE 130761, 131861

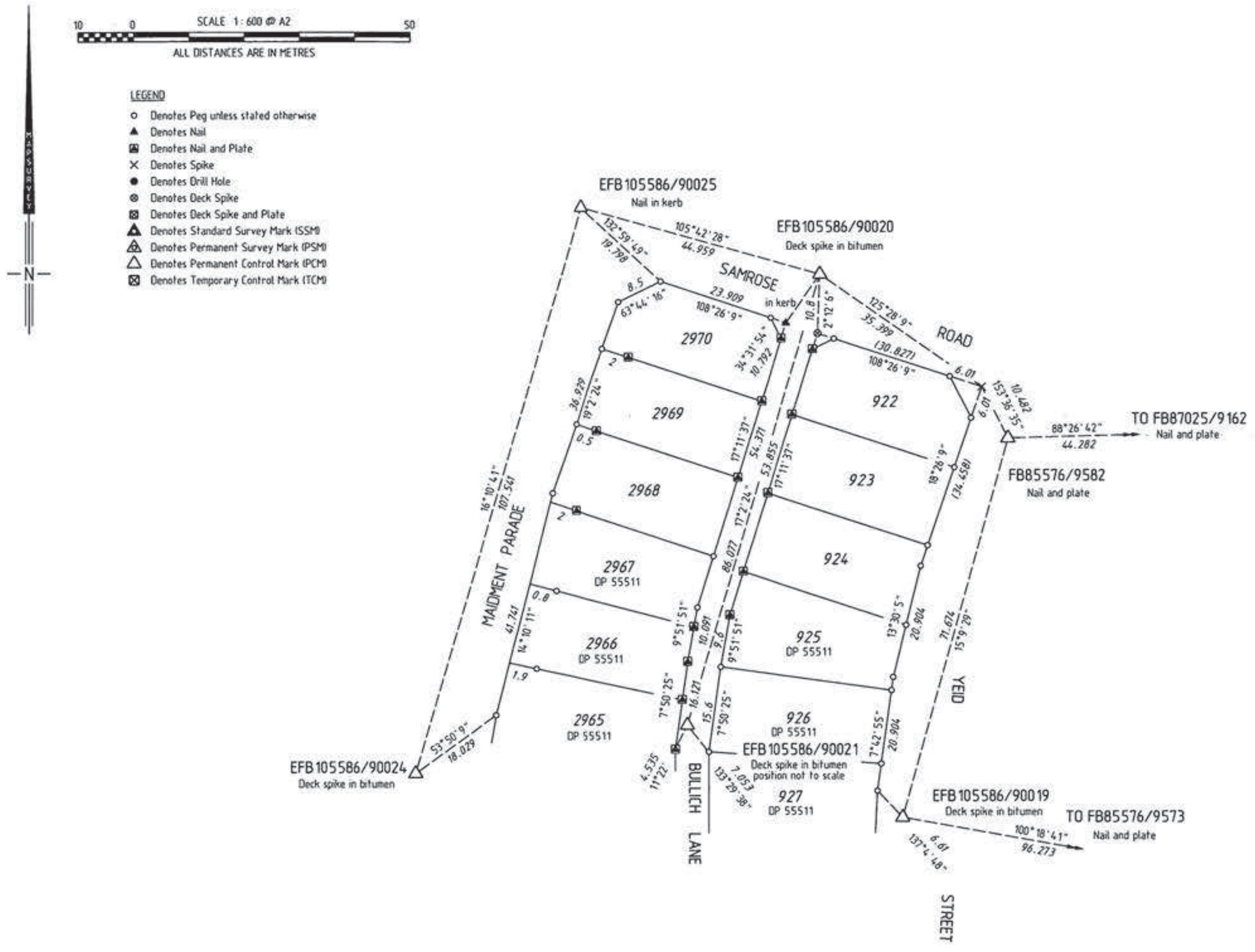
29/10/2008

Landgate
Western Australian Land Information Authority

DEPOSITED PLAN
60716
ORIGINAL

SHEET 2 OF 3 SHEETS
VERSION 2

LANDGATE COPY OF ORIGINAL NOT TO SCALE Wed May 29 09:01:03 2013 JOB 41923026



FOR HEADING SEE SHEET 1
SURVEY INFORMATION ONLY
SURVEY SHEET

SURVEY CARRIED OUT UNDER REG 26A
SPECIAL SURVEY AREA GUIDELINES

ALL BEARINGS AND DISTANCES ON THIS SHEET
ARE THE RESULT OF LEAST SQUARES ADJUSTMENTS
CARRIED OUT ON FIELD OBSERVATIONS

GRID DATUM IS PCG

FOR INTERESTS AND NOTIFICATIONS
SEE SHEET 1

SURVEY SHEET AUDITED
DATE: 4.06.2009 MB
DOCKET: 02787-2008

SCALE: 1 : 600 at A2 ALL DISTANCES ARE IN METRES	McMULLEN NOLAN www.mapsurvey.com.au MAPS Ref 91900dp-851f
Scott J. ANDERSON 2008.10.14 10:10:28 +08'00' Licensed Surveyor .... Date	Landgate Western Australian Land Information Authority
APPROVED BY WESTERN AUSTRALIAN PLANNING COMMISSION FILE 130761, 131861 Delegated under Sec. 16 P & D Act 2005 .... DATE	DEPOSITED PLAN 60716 ORIGINAL
SHEET 3 OF 3 SHEETS VERSION 2	

INSTRUCTIONS

1. If insufficient space in any section, Additional Sheet Form B1, should be used with appropriate headings. The boxed sections should only contain the words "see page....."
2. Additional Sheets shall be numbered consecutively and bound to this document by staples along the left margin prior to execution by the parties.
3. No alteration should be made by erasure. The words rejected should be scored through and those substituted typed or written above them, the alteration being initialled by the persons signing this document and their witnesses.

NOTES

1. **DESCRIPTION OF LAND**
   Lot and Diagram/Plan/Strata/Survey-Strata Plan number or Location name and number to be stated.
   Extent - Whole, part or balance of the land comprised in the Certificate of Title to be stated. If this document relates to only part of the land comprised in the Certificate of Title further narrative or graphic description may be necessary. The volume and folio number to be stated.
2. **REGISTERED PROPRIETOR**
   State full name and address of the Registered Proprietors as shown on the Certificate of Title and the address / addresses to which future notices can be sent.
3. **INFORMATION CONCERNING SITE CLASSIFICATION**
   Include information concerning site classification as either: contaminated – restricted use, contamination – remediation required, remediated for restricted use or possibly contaminated – investigation required.
4. **CHIEF EXECUTIVE OFFICER'S ATTESTATION**
   This document must be signed by or on behalf of the Chief Executive Officer, Department of Environment and Conservation under Section 91 of Contaminated Sites Act 2003. An <u>Adult</u> <u>Person</u> should witness this signature. The address and occupation of the witness <u>must</u> be stated.

EXAMINED

OFFICE USE ONLY

L709156 ML
16 Aug 2011 13:17:39 Perth
REG $ 160.00

MEMORIAL
CONTAMINATED SITES ACT 2003

LODGED BY
Department of Environment and Conservation

ADDRESS
Level 4, 168 St Georges Terrace
Perth, WA 6842

PHONE No. 1300 762 982

FAX No. (08) 9333 7575

REFERENCE No. 26817

ISSUING BOX No. 888V

PREPARED BY
Contaminated Sites Section
Department of Environment and Conservation

ADDRESS
Level 4, 168 St Georges Terrace
Perth, WA 6842

PHONE No. 1300 762 982 FAX No. (08) 9333 7575

INSTRUCT IF ANY DOCUMENTS ARE TO ISSUE TO OTHER THAN LODGING PARTY

TITLES, LEASES, DECLARATIONS ETC LODGED HEREWITH

1. __________
2. __________
3. __________
4. __________
5. __________
6. __________

Received Items

Nos. 0.

Receiving Clerk

Lodged pursuant to the provisions of the TRANSFER OF LAND ACT 1893 as amended on the day and time shown above and particulars entered in the Register.

REGISTRAR OF TITLES WESTERN AUSTRALIA

APPROVAL NUMBER

DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Client ID 1323

WESTERN AUSTRALIA
TRANSFER OF LAND ACT 1893 AS AMENDED

MEMORIAL

CONTAMINATED SITES ACT 2003

SECTION 58(1) (a) (i) (I) (II) (III) (IV)

DESCRIPTION OF LAND (Note 1)	EXTENT	VOLUME	FOLIO
LOT 9077 ON DEPOSITED PLAN 60716	Whole	2717	207

REGISTERED PROPRIETOR (Note 2)

WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH

INFORMATION CONCERNING SITE CLASSIFICATION (Note 3)

Under the 'Contaminated Sites Act 2003', this Site has been classified as "possibly contaminated - investigation required". For further information on the contamination status of this Site, please contact the Contaminated Sites Branch of the Department of Environment & Conservation.

Dated this Eleventh day of August Year 2011

CHIEF EXECUTIVE OFFICER'S ATTESTATION (Note 4)

AMiller

Andrew Miller
SECTION MANAGER
DELEGATE OF THE CHIEF EXECUTIVE OFFICER
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
UNDER SECTION 91 OF THE
CONTAMINATED SITES ACT 2003

OCG

C Chau
SIGNATURE OF WITNESS

FULL NAME: Christopher Chau
ADDRESS: 168 St Georges Tce PERTH WA 6000
OCCUPATION: Data Management Officer

REGISTER NUMBER
9077/DP60716

DUPLICATE EDITION **1**
DATE DUPLICATE ISSUED **7/5/2009**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2717**
FOLIO **207**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9077 ON DEPOSITED PLAN 60716

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

CRISTAL PIGMENT AUSTRALIA LTD OF LOT 4 OLD COAST ROAD, AUSTRALIND
(T M667801) REGISTERED 12 JUNE 2014

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. T2756/1912 EASEMENT BENEFIT REGISTERED 10.1.1912.
2. H598929 EASEMENT BURDEN SEE SKETCH ON DEPOSITED PLAN 60716. REGISTERED 16.11.2000.
   J066925 EASEMENT H598929 PARTIALLY SURRENDERED. AS TO THE LAND IN VOLUME 2210 FOLIO 558 ONLY. REGISTERED 28.10.2004.
3. *L709156 MEMORIAL. CONTAMINATED SITES ACT 2003 REGISTERED 16.8.2011.
4. *M379789 NOTIFICATION. ENVIRONMENTAL PROTECTION ACT 1986. REGISTERED 22.8.2013.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP60716.
PREVIOUS TITLE: 2696-378, 1894-495.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: SHIRE OF CAPEL.

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING M667801

REGISTER NUMBER
9090/DP69838

DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2790** FOLIO **895**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9090 ON DEPOSITED PLAN 69838

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

HOUSING AUTHORITY OF 99 PLAIN STREET, EAST PERTH
(AF L926889) REGISTERED 4 MAY 2012

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. *H598929 EASEMENT BENEFIT - SEE INSTRUMENT H598929. REGISTERED 16.11.2000.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

---END OF CERTIFICATE OF TITLE---

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

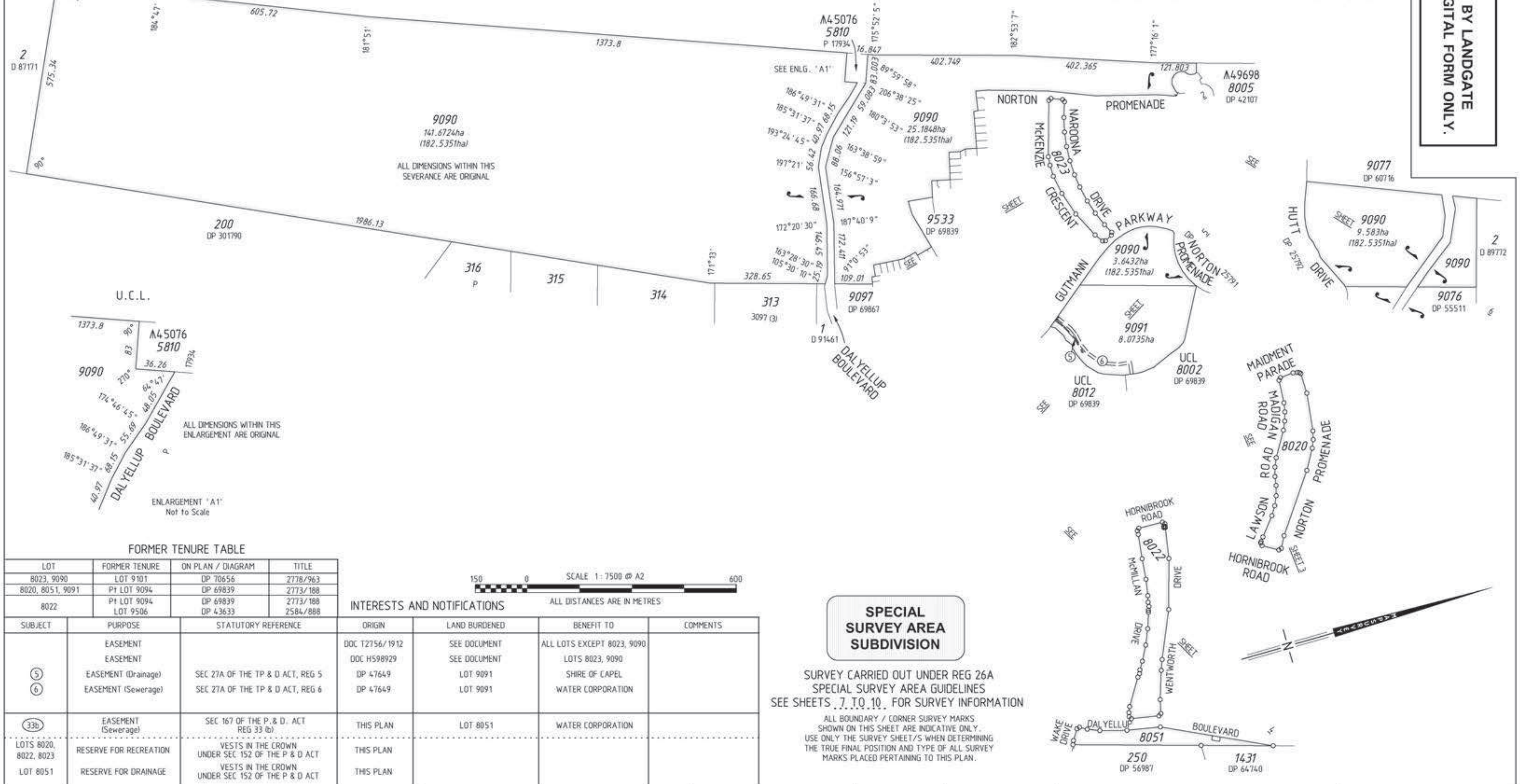
SKETCH OF LAND: DP69838.
PREVIOUS TITLE: 2778-963.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: SHIRE OF CAPEL.
RESPONSIBLE AGENCY: DEPARTMENT OF HOUSING (SSHC).

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING L926889

HELD BY LANDGATE IN DIGITAL FORM ONLY.

AMENDMENTS TABLE

VERSION	AMENDMENT	AUTHORISED BY	DATE
2	Moved and enlarged road widening on Wentworth Drive and added C/T's & UCL on lots 8002. 8012	S. Torode	19/01/2012
3	FSC & SURVEY SHEET ADDED	LANDGATE	2/05/2012
4	SURVEY SHEET AMENDED	LANDGATE.	2/11/2012



SPECIAL SURVEY AREA SUBDIVISION

SURVEY CARRIED OUT UNDER REG 26A
SPECIAL SURVEY AREA GUIDELINES
SEE SHEETS 7 TO 10 FOR SURVEY INFORMATION

ALL BOUNDARY / CORNER SURVEY MARKS SHOWN ON THIS SHEET ARE INDICATIVE ONLY. USE ONLY THE SURVEY SHEET/S WHEN DETERMINING THE TRUE FINAL POSITION AND TYPE OF ALL SURVEY MARKS PLACED PERTAINING TO THIS PLAN.

FORMER TENURE TABLE

LOT	FORMER TENURE	ON PLAN / DIAGRAM	TITLE
8023, 9090	LOT 9101	DP 70656	2778/963
8020, 8051, 9091	Pt LOT 9094	DP 69839	2773/188
8022	Pt LOT 9094 LOT 9506	DP 69839 DP 43633	2773/188 2584/888

INTERESTS AND NOTIFICATIONS

SUBJECT	PURPOSE	STATUTORY REFERENCE	ORIGIN	LAND BURDENED	BENEFIT TO	COMMENTS
	EASEMENT		DOC T2756/1912	SEE DOCUMENT	ALL LOTS EXCEPT 8023, 9090	
	EASEMENT		DOC H598929	SEE DOCUMENT	LOTS 8023, 9090	
⑤	EASEMENT (Drainage)	SEC 27A OF THE TP & D ACT, REG 5	DP 47649	LOT 9091	SHIRE OF CAPEL	
⑥	EASEMENT (Sewerage)	SEC 27A OF THE TP & D ACT, REG 6	DP 47649	LOT 9091	WATER CORPORATION	
(33b)	EASEMENT (Sewerage)	SEC 167 OF THE P.& D. ACT REG 33 (b)	THIS PLAN	LOT 8051	WATER CORPORATION	
LOTS 8020, 8022, 8023	RESERVE FOR RECREATION	VESTS IN THE CROWN UNDER SEC 152 OF THE P & D ACT	THIS PLAN			
LOT 8051	RESERVE FOR DRAINAGE	VESTS IN THE CROWN UNDER SEC 152 OF THE P & D ACT	THIS PLAN			

TYPE FREEHOLD
PURPOSE SUBDIVISION

PLAN OF
LOTS 8020, 8022, 8023, 8051, 9090, 9091,
EASEMENT AND ROAD WIDENING

S.S.A. YES

DISTRICT WELLINGTON
TOWNSITE
D.P.I. FILE No.
LOCALITY DALYELLUP
LOCAL AUTHORITY SHIRE OF CAPEL

ON
INDEX SEE SMARTPLAN

FORMER TENURE
SEE TENURE TABLE

FIELD BOOK
80657
84894
86698
94491

SCALE: 1 : 7500 at A2
ALL DISTANCES ARE IN METRES

McMULLENNOLAN
PO Box 3526, Success, W.A. 6964
Telephone: (08) 6436 1599
Facsimile: (08) 6436 1500
Email: info@mapsurvey.com.au

MAPS Ref : 91900dp-984h
DP69838#02.CSD

SURVEYOR'S CERTIFICATE
Reg 54

I Stuart L.TORODE hereby certify that this plan is accurate and is a correct representation of the -
(a) *survey, and/or
(b) *calculations from measurements,
(*delete if inapplicable)
undertaken for the purposes of this plan and that it complies with the relevant written law(s) in relation to which it is lodged.

Stuart L A Torode
2012.01.20
15:23:17 +08'00'
Licensed Surveyor Date

LODGED
DATE 21-Jul-11
FEE PAID $351.00
ASSESS No. 9114105

TYPE OF VALIDATION
FULL AUDIT
LEGAL COMPONENT JC
DOCKET PLAN 23708-2010
CERTIFIED CORRECT 23/01/12
I.S.C.
F.S.C. 82-2012

APPROVED BY WESTERN AUSTRALIAN PLANNING COMMISSION
FILE 142184
23-Jan-2012
Delegated under Sec 16 P & D Act 2005 DATE

IN ORDER FOR DEALINGS
SUBJECT TO
Sec's 152, 167 & 168(3) of the P & D Act
2-May-2012
For INSPECTOR OF PLANS & SURVEYS / AUTHORIZED LAND OFFICER DATE

APPROVED REG26A (4)
4/5/2012
INSPECTOR OF PLANS & SURVEYS / AUTHORIZED LAND OFFICER DATE

Landgate
Western Australian Land Information Authority

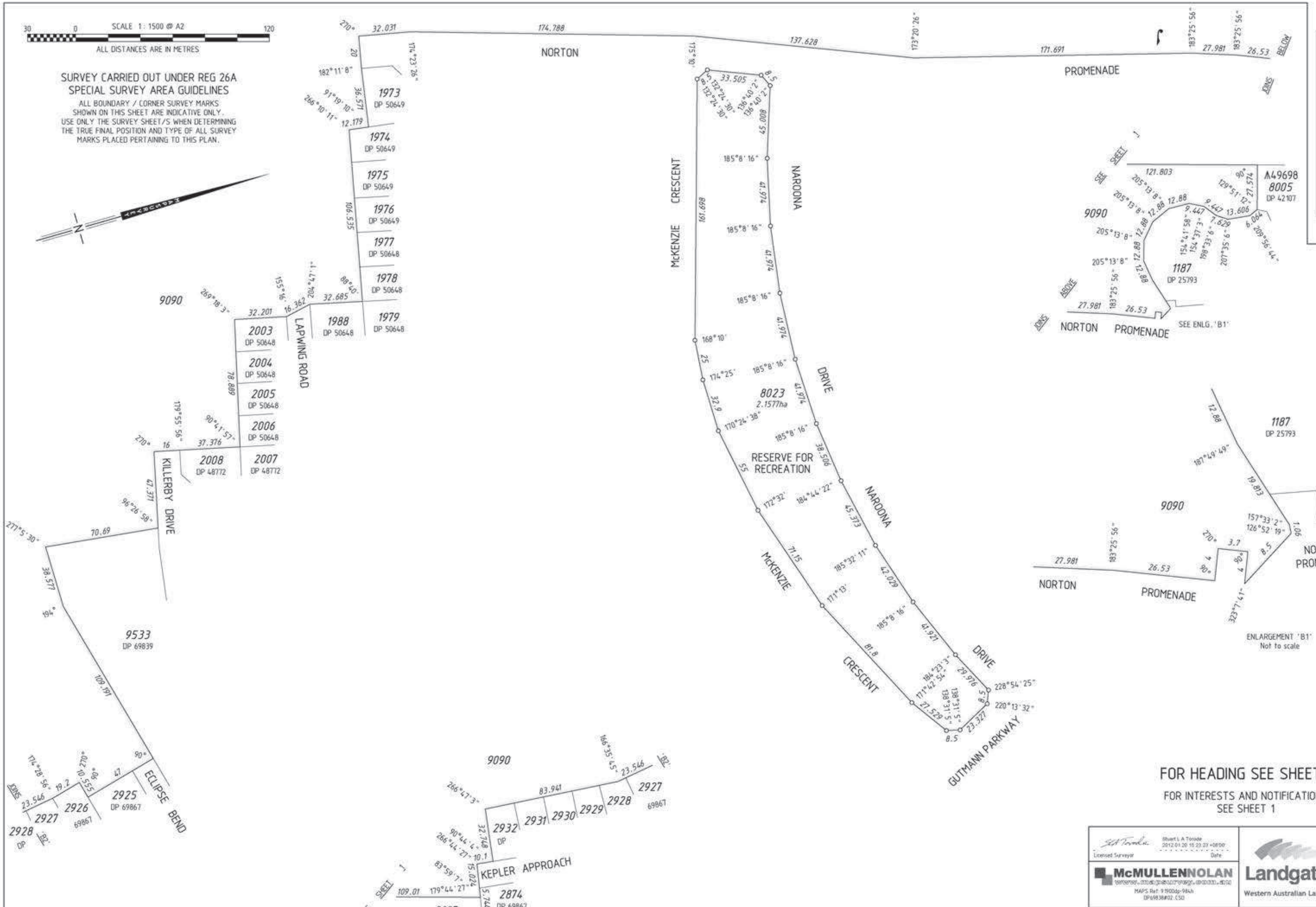
DEPOSITED PLAN
69838

SHEET 1 OF 10 SHEETS
VERSION 4

**HELD BY LANDGATE
IN DIGITAL FORM ONLY.**

SCALE 1 : 1500 @ A2
ALL DISTANCES ARE IN METRES

SURVEY CARRIED OUT UNDER REG 26A
SPECIAL SURVEY AREA GUIDELINES
ALL BOUNDARY / CORNER SURVEY MARKS
SHOWN ON THIS SHEET ARE INDICATIVE ONLY.
USE ONLY THE SURVEY SHEET/S WHEN DETERMINING
THE TRUE FINAL POSITION AND TYPE OF ALL SURVEY
MARKS PLACED PERTAINING TO THIS PLAN.



FOR HEADING SEE SHEET 1

FOR INTERESTS AND NOTIFICATIONS
SEE SHEET 1

Stuart L A Torode
2012.01.20 15:23:23 +08'00'
Licensed Surveyor
Date

McMULLENNOLAN
[illegible]
MAPS Ref: 9 1900dp-984h
DP69838#02.CSD

Landgate
Western Australian Land Information Authority

SCALE 1 : 1500 at A2
ALL DISTANCES ARE IN METRES

SHEET 2 OF 10 SHEETS
VERSION 4

DEPOSITED PLAN
69838

HELD BY LANDGATE
IN DIGITAL FORM ONLY.

30 0 SCALE 1 : 1500 @ A2 120

ALL DISTANCES ARE IN METRES

SURVEY CARRIED OUT UNDER REG 26A
SPECIAL SURVEY AREA GUIDELINES

ALL BOUNDARY / CORNER SURVEY MARKS
SHOWN ON THIS SHEET ARE INDICATIVE ONLY.
USE ONLY THE SURVEY SHEET/S WHEN DETERMINING
THE TRUE FINAL POSITION AND TYPE OF ALL SURVEY
MARKS PLACED PERTAINING TO THIS PLAN.

FOR HEADING SEE SHEET 1

FOR INTERESTS AND NOTIFICATIONS
SEE SHEET 1

Stuart L A Torode 2012.01.20 16:23:29 +08'00' Licensed Surveyor Date	Landgate Western Australian Land Information Authority
McMULLENNOLAN www.mapsurvey.com.au MAPS Ref: 91900dp-984h DP69838#02.CSD	
SCALE 1 : 1500 at A2 ALL DISTANCES ARE IN METRES	DEPOSITED PLAN 69838
SHEET 3 OF 10 SHEETS VERSION 4	

LANDGATE COPY OF ORIGINAL NOT TO SCALE Wed May 29 09:01:19 2013 JOB 41923026

Annex D

Dangerous Goods Search

14 JAN 2011

Government of **Western Australia**
Department of **Mines and Petroleum**
Resources Safety

Your Ref: 0124484
Our Ref: 10/11 - 307 A0025/201101
Enquiries: Liz Haddon-Cave
Email: liz.haddon-cave@dmp.wa.gov.au
Telephone: 9358 8145
Facsimile: 9358 8000

Ms J Sharp
ERM
PO Box 7338
CLOISTERS SQUARE WA 6850

Dear Ms Sharp

NOTICE OF DECISION UNDER S30 *FREEDOM OF INFORMATION ACT 1992* (the Act)

Your application under the Act sought access to Dangerous Goods Storage (DGS) licence documents for Lots 9077 and 9071 Minninup Rd, Dalyellup.

1. On the information you provided, a search of our records has failed to locate any documentation containing the information you seek. Under s26 of the Act, the failure of the Department to locate any documents after a diligent search is deemed as a refusal to grant access.

2. Consequently, it was decided on 13 January 2011 by Liz Haddon-Cave, A/FOI Co-ordinator, Business Development, (delegated decision maker by a general directive provided under s.100 (1) (b) of the Act), that you may not have access to documents as the Department has no record of any such documentation.

3. Location descriptors provided by applicants may not always match site location details in our database and we ask if possible applicants provide the DGS Licence number of the site of interest to them. We recognise this is not always possible and do all we reasonably can to search for the site from the information provided.

4. The lack of information held by the Department in relation to this property does not necessarily mean the property is not or has ever been a dangerous goods storage site. Accordingly, if you have any reason to suspect the property is or may have been the subject of a DGS licence or dangerous goods may have been stored there, you may need to consider carrying out additional site inspection investigations.

5. If you wish to contest the decision to refuse access, you have a right to have the decision reviewed. Details of the review process are set out in the attached notes.

Yours sincerely

Liz Haddon-Cave
A/FOI CO-ORDINATOR
RESOURCES SAFETY

13 January 2011

Enc.: Notes, Receipt for Application Fee

NOTES

REVIEW AND APPEAL PROCESS
(UNDER THE FREEDOM OF INFORMATION ACT 1992)

Internal Review (S.39-40 and 54)
If you are dissatisfied or aggrieved by certain decisions of an agency regarding access to documents or amendment of personal information, you can apply to the agency concerned for an internal review of its decision.

To apply for an internal review, you must write a letter or fill in an internal review application form and send the letter to, or lodge the form with, the agency which made the decision within 30 days after being given notice of the decision.

The application must give details of the decision you wish to have reviewed and give an address in Australia to which notices can be sent.

There is no right to an internal review of a decision made by a Minister or the principal officer of an agency.

There is no charge for an internal review of a decision.

External Review by the Information Commissioner (S. 65-66)
If, after an internal review has been completed, you are still dissatisfied with the agency's decision, you can make a complaint to the Information Commissioner. The Information Commissioner may allow a complaint to be made even though an internal review has not been sought or has not been completed if you can show that there are good reasons why you should not apply for an internal review or why an internal review should not be completed.

A complaint must be made by letter to the Information Commissioner, Office of the Information Commissioner, PO Box Z5386, PERTH WA 6831. The letter must give details of the decision to which the complaint relates and give an address in Australia to which notices can be sent.

If you are seeking access to documents or amendment of personal information, your complaint must be lodged within 60 days after being given written notice of the decision.

If you are a third party to an application for access to personal or commercial or business information concerning yourself, your complaint must be lodged within 30 days after being given written notice of the decision.

As a general rule, each party to a complaint pays his/her own costs. However, the Information Commissioner may order a person to pay the costs of another party to a complaint in certain circumstances.

Appeals to the Supreme Court (S.85)
The Commissioner may refer to the Supreme Court any question of law that arises in the course of dealing with a complaint. This may be done on the Commissioner's initiative or at the request of a party to the complaint. Parties to a complaint are generally responsible for their own costs.

* * *

Annex E

DEC Site Classification CS Act (2003)

Government of **Western Australia**
Department of **Environment and Conservation**

Your ref:
Our ref: DEC4412
Enquiries: Registrar
Phone: 1300 762982
Fax:
Email:

Viv Lawrie
Health, Safety & Environmental Manager
Millennium Inorganic Chemicals Ltd
Locked Bag 245
Bunbury WA 6230

Dear Sir/Madam

New legislation is in place to record and manage contaminated sites in Western Australia, in order to protect people's health and the environment. Please note that contamination does not necessarily mean that an area is unsafe to live or work in – for example, it may be limited to groundwater, and only becomes an issue to be managed if a groundwater bore was being considered.

The *Contaminated Sites Act 2003*, which came into effect on 1 December 2006, requires the Department of Environment and Conservation (DEC) to classify sites reported to it and inform a number of people, including owners and occupiers, so they can make informed decisions about the site.

Set out below in this letter is the formal notice of a classification of a known or suspected contaminated site in which you have an interest. The notice explains why the site received the classification, any restrictions on the use of the site, and how you can appeal the classification if you believe it is incorrect. In some cases, this notice may include a list of lots in addition to the one in which you have an interest.

Also attached is a copy of the brochure *Contaminated sites: New laws for Western Australia*, which has more information about the new Act. If you have any queries, please contact DEC's Contaminated Sites Section on 1300 762 982.

NOTICE OF A CLASSIFICATION OF A KNOWN OR SUSPECTED CONTAMINATED SITE GIVEN UNDER SECTION 15 OF THE *CONTAMINATED SITES ACT 2003*

The site detailed below, consisting of 1 parcel(s) of land, was reported to the CEO of DEC as a known or suspected contaminated site and has been classified under the Act:

- LOT 9077 ON DEPOSITED PLAN 60716 (Formerly Lot 1 on Plan 17972) as shown on certificate of title 2717/207 known as Dalyellup WA 6230 (the Site)

This notification is being sent to you in accordance with section 15(1) of the Act on the grounds that you, as the recipient, are one or more of the following:

(a) owner of the site;
(b) occupier of the site;

DIRECTOR GENERAL AND ENVIRONMENTAL SERVICES DIVISIONS: The Atrium, 168 St Georges Terrace, Perth, Western Australia 6000
Phone: (08) 6467 5000 Fax: (08) 6467 5562 TTY: 1880 555 630
PARKS AND CONSERVATION SERVICES DIVISIONS: Executive: Corner of Australia II Drive and Hackett Drive, Crawley, Western Australia 6009
Phone: (08) 9442 0300 Fax: (08) 9386 1578 Operations: 17 Dick Perry Avenue, Technology Park, Kensington, Western Australia 6151
Phone: (08) 9219 8000 Fax: (08) 9334 0498 TTY: 9334 0546
POSTAL ADDRESS FOR ALL DIVISIONS: Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
www.dec.wa.gov.au
wa.gov.au
XDECL001

(c) relevant public authority;
(d) person in the CEO's opinion there is particular reason to notify;
(e) person who made the report under section 11 or 12; and
(f) person in the CEO's opinion who may be responsible for remediation of the site classified as *contaminated – remediation required.*

Site Classification

The Site is classified as the following category:

Category of Site classification: Possibly contaminated - investigation required

Date of site classification: 09/10/2009

Reasons for classification: This Site was reported to the Department of Environment and Conservation (DEC) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003', which commenced on 1 December 2006. The Site classification is based on information and advice received by DEC by September 2009.

The Site is currently operated as a disposal facility for treated residue from the production of titanium dioxide. The disposal of residue from mining and extractive industries is a land use that has the potential to cause contamination as per the guideline 'Potentially Contaminating Activities, Industries and Land Uses' (Department of Environment, October 2004).

Operations at the Site are regulated under the 'Environmental Protection Act 1986', through Part IV Ministerial Statement 213 (published 23 January 1992) as amended by Ministerial Statement 332 (published 9 December 1993) and Part V Licence L6130/1989/11. The occupier is required to submit annual monitoring reports including the monitoring of groundwater quality and radiation levels.

The Site contains two rehabilitated ponds in the south (which were covered with imported top soils and revegetated prior to 2001), two large operational disposal ponds in the centre and two 'deactivated' ponds in the north.

At the time of classification, DEC's Contaminated Sites Branch had received and reviewed the following documents: Staged Rehabilitation Management Plan (2001), Review of Shallow Groundwater Quality (2003) and Annual Assessment Reports for 2005, 2007 and 2008.

Solid residue within the ponds on the Site has been found to contain cadmium, chromium III, copper, nickel and vanadium exceeding soil Ecological Investigation Levels (EIL), but below available Health-based Investigation Levels for commercial/industrial land use, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment, 2003). The solid residue also contains rare-earth metals including thorium and uranium; there are no Australian soil guidelines currently available for these substances.

The liquid component of the residue slurry (also referred to as filtrate) within the ponds contains various salts. The filtrate has also been found to contain concentrations of cadmium, chromium III, copper and vanadium above trigger values for marine aquatic ecosystems, as published in 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality' (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2000).

Groundwater monitoring of shallow groundwater (also referred to as the superficial aquifer) is undertaken quarterly, in accordance with licence conditions. Monitoring of the deeper Yarragadee aquifer is undertaken monthly. Evidence of impact from leachate from the ponds is present in monitoring bores in the superficial aquifer to the west (down groundwater gradient) of the ponds, based on changes in salinity and salt composition. No evidence of leachate impact has been detected in the Yarragadee monitoring bore.

Chromium III was detected in shallow monitoring bores in the superficial aquifer, both up and down-gradient of the ponds, at concentrations exceeding trigger values for slightly-moderately disturbed marine aquatic ecosystems, as published in 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality' (ANZECC and ARMCANZ, 2000). Further investigation and risk assessment of the chromium III detected in shallow groundwater is required. (DEC notes that chromium III is an essential trace element for humans, and there is no Australian Drinking Water Guideline value set for chromium III).

A radiation monitoring program, approved by the Radiological Council, is conducted at the Site. The Radiological Council has advised that, while levels at the operating ponds are higher, the radiation dose at the Site boundary does not exceed the limit of radiation exposure for the general public, as per 'Industry Guideline - Reporting of Radiologically Contaminated Site Naturally Occurring Radioactive Material (NORM)' (Radiological Council, 2009). Monitoring above the rehabilitated southern pond has also demonstrated that the remedial measures have successfully reduced radiation levels to below the limit of radiation exposure for the general public. The Radiological Council has further advised that the levels identified at the Site boundary are comparable with background levels for the Swan Coastal Plain and Darling Scarp areas.

Based on the available information, and taking into account advice received from the Radiological Council, the Site is considered suitable for its current use as a treated residue disposal facility, provided public access to the site is restricted and groundwater and radiation monitoring continues.

Concentrations of chromium III in shallow groundwater have been found to exceed adopted assessment levels for marine aquatic ecosystems. A Screening Risk Assessment has therefore indicated that further investigation is required to determine the risk to the environment and environmental values.

As there are grounds to indicate possible groundwater contamination of the Site, and since further groundwater investigation and risk assessment are required to determine the risk to the environment, or any environmental value, the Site has been classified "possibly contaminated - investigation required".

When the results of further investigations and/or risk assessment are submitted to DEC, these will be reviewed, and the Site may be re-classified.

DEC, in consultation with the Department of Health and Radiological Council, has classified this Site based on the information available to DEC at the time of classification. It is acknowledged that the contamination status of the Site may have changed since the information was collated and/or submitted to DEC, and as such, the usefulness of this information may be limited.

In accordance with Department of Health advice, if groundwater is being or is proposed to be abstracted, DEC recommends that analytical testing should be carried out to determine whether the groundwater is suitable for its intended use.

The nature and extent of contamination and any restrictions on the use of the land, if applicable, are listed in Attachment A.

Information in relation to the classification of the Site will be available to the public through a request for a summary of records on written application and payment of a prescribed fee from the Reported Sites Register.

In some instances DEC has had to classify sites based on historical information.. It should be noted that a site may be re-classified at any stage to better reflect the current status when additional information becomes available, for example where a new investigation or remediation report completed in accordance with DEC's *Contaminated Sites Management Series* of guidelines, is submitted to DEC. The current site classification is the classification most recently conferred on the Site.

Memorials

In accordance with section 58(1) of the Act, DEC will lodge a memorial against the Certificate(s) of Title 2717/207 relating to the Site, with Landgate, which will record the site classification. The parcel(s) that do not have a registration number or certificate of title will not have a memorial lodged against them until a certificate of title has been created. Confirmation of the lodgement of the memorial(s) will be forwarded to the following people once completed:

(a) each owner,
(b) the Western Australian Planning Commission;
(c) the CEO of the Department of Health;
(d) the Local Government Authority;
(e) the relevant scheme authority.

Given that memorial(s) will be lodged against the Site, the Western Australian Planning Commission (WAPC) may not approve the subdivision of the land under Section 135 of the *Planning and Development Act 2005*, or the amalgamation of that land with any other land without seeking, and taking into account, the advice of DEC as to the suitability of the land for subdivision or amalgamation. Furthermore, a responsible authority (e.g. Local Government Authorities) may not grant approval under a scheme for any proposed development of the land without seeking, and taking into account, advice from DEC as to the suitability of the proposed development.

Appealing the Site classification

All site classifications given by DEC are appealable. However, only certain people can lodge a valid appeal depending on the classification category as detailed in the attached Fact Sheet. Appeals need to be lodged in writing with the Contaminated Sites Committee at Level 22, The Forrest Centre, 221 St Georges Terrace, Perth WA 6000, within 45 days of being given this notification. The appeal should set out the appellant's relationship to the Site, and must include the grounds and facts upon which it is based.

For further information on all aspects of site classification, please refer to the *Site Classifications – What do they Mean?* Fact Sheet and *Site Classification Scheme 2006* (guideline) which are available from DEC's website www.dec.wa.gov.au/contaminatedsites or by contacting the Registrar on 1300 762 982.

Yours sincerely

..............................Sally Dodds, A/SECTION MANAGER

, A/SECTION

CONTAMINATED SITES BRANCH
Delegated Officer under section 91
of the *Contaminated Sites Act 2003*

09/10/2009

Enc. Attachment A – Nature and Extent and Restrictions on Use.

Rights of Appeal under the *Contaminated Sites Act 2003* Fact Sheet
Site Classifications – "What do they mean" Fact Sheet

ATTACHMENT A – Nature and Extent and Restrictions on Use

- LOT 9077 ON DEPOSITED PLAN 60716

Nature and Extent: Chromium III and salinity are present in underlying groundwater.

Restriction on Use: Please refer to Reasons for Classification for further information.

Annex F

Acid Sulphate Soils Search

Legend

▭ Site Boundary

🟥 Acid Sulphate Soil Risk Category - high to moderate risk of ASS occuring within 3m of natural soil surface

Source:
Department of Environment and Conservation (Western Australia)

Client:	Shire of Capel	
Drawing No:	0124484p_G005_R0.mxd	
Date:	02/04/2012	Drawing Size: A4
Drawn By:	DN	Reviewed By: MP

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure F1 - Acid Sulphate Soils

MIC Dalyellup DF - PSI

Environmental Resources Management ANP

Adelaide, Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Annex G

Aboriginal Heritage

Legend

▭ Site Boundary

🟨 Aboriginal Heritage Sites

Notes:
An Aboriginal heritage search was conducted over the site location and no heritage locations were found.

Source:
Department of Indigenous Affairs (Western Australia)

Client: Shire of Capel
Drawing No: 0124484p_G004_R0.mxd
Date: 02/04/2012 Drawing Size: A4
Drawn By: DN Reviewed By: MP

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure G1 - Aboriginal Heritage Search

MIC Dalyellup DF - PSI

Environmental Resources Management ANP

Adelaide, Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Government of **Western Australia**
Department of **Indigenous Affairs**

Aboriginal Heritage Inquiry System

Aboriginal Sites Database

Search Criteria

0 sites in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 50	
Northing	Easting
6304060	370459
6304552	370911

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Copyright in the information contained herein is and shall remain the property of the State of Western Australia. All rights reserved. This includes, but is not limited to, information from the Register of Aboriginal Sites established and maintained under the Aboriginal Heritage Act 1972 (AHA).

Legend

Restriction

N	No restriction
M	Male access only
F	Female access

Access

C	Closed
O	Open
V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L - Lodged		IA - Information Assessed		ACMC Decision Made
Information lodged, awaiting assessment	→	Information Awaiting ACMC Decision Assessment Only	→	R - Registered Site I - Insufficient information S - Stored Data

*Explanation of Assessment

Sites lodged with the Department are assessed under the direction of the Registrar of Aboriginal Sites. These are not the final assessment.

Final assessment and decisions will be determined by the Aboriginal Cultural Material Committee (ACMC).

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Sites Shown on Maps

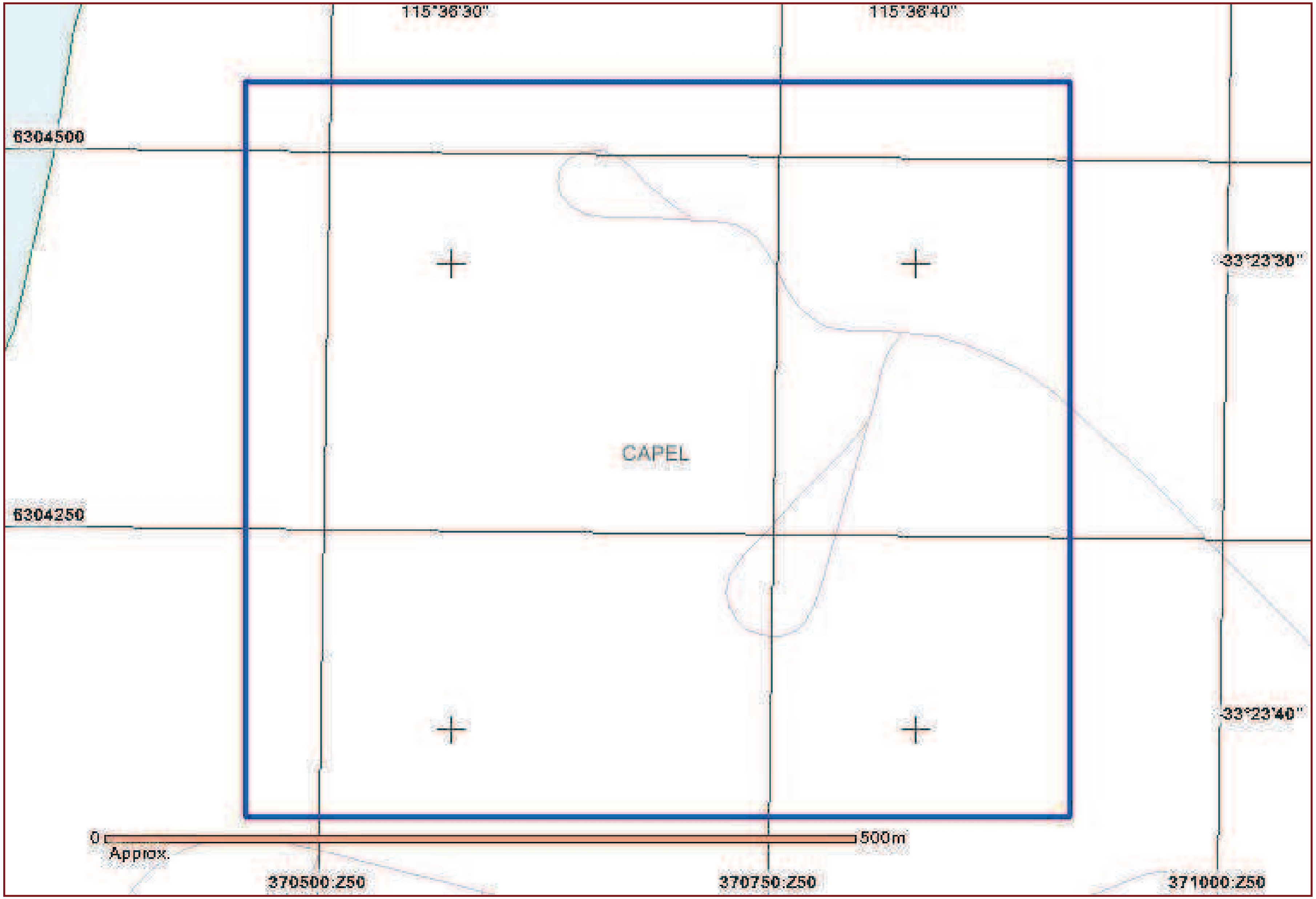
Site boundaries may not appear on maps at low zoom levels

List of Registered Aboriginal Sites with Map

No results

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



Legend

Selected Heritage Sites

- ▨ Registered Sites
- ● Town
- ☐ Map Area
- — Search Area

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Cadastre, Local Government Authority, Native Title boundary data copyright © Western Australian Land Information Authority trading as Landgate (2010).

Geothermal Title, Mining Tenement, Petroleum Title boundary data copyright © the State of Western Australia (DMP) (2010.12).

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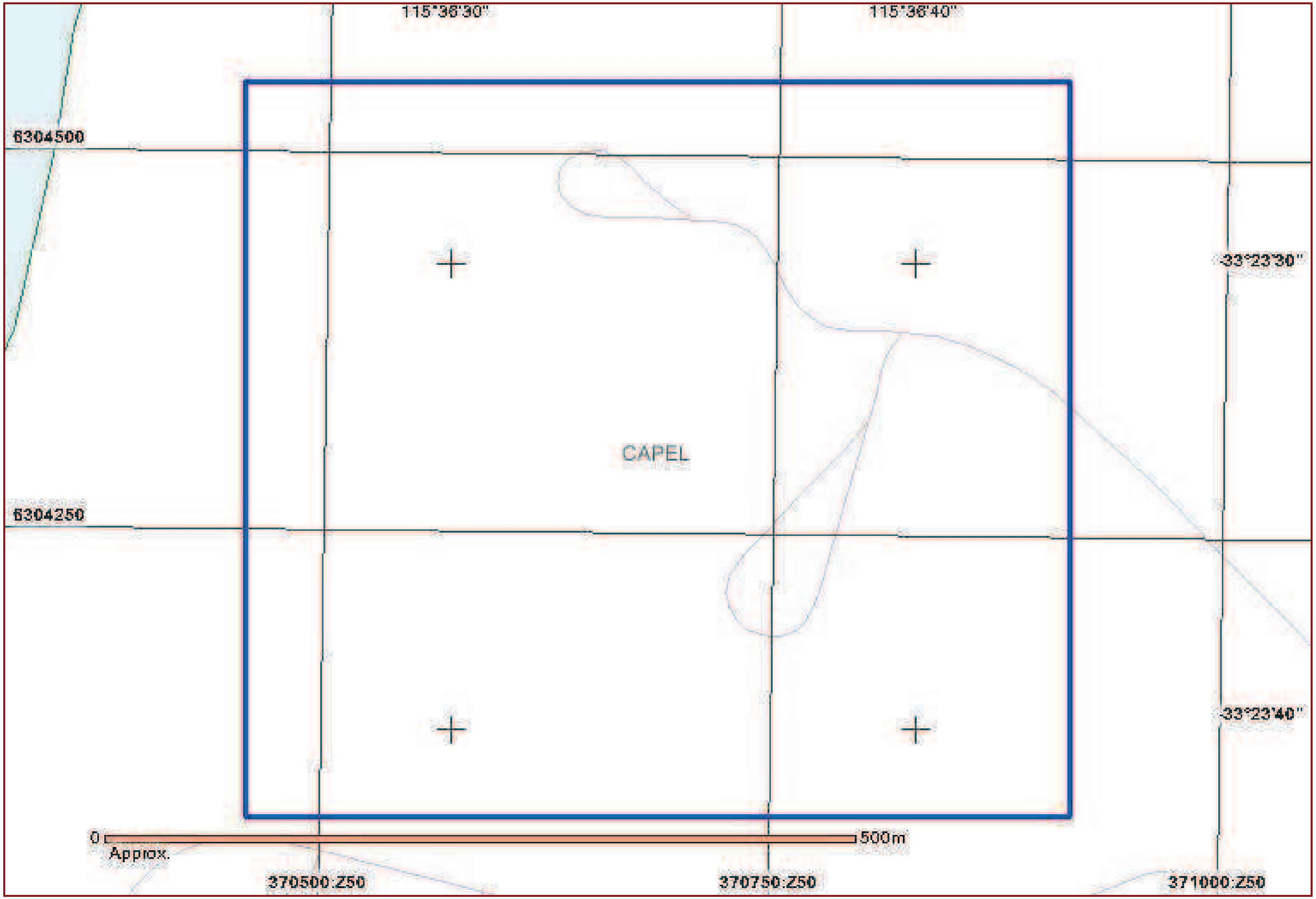
List of Other Heritage Places with Map

No results

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



Legend

Selected Heritage Sites

▨ Other Heritage Places

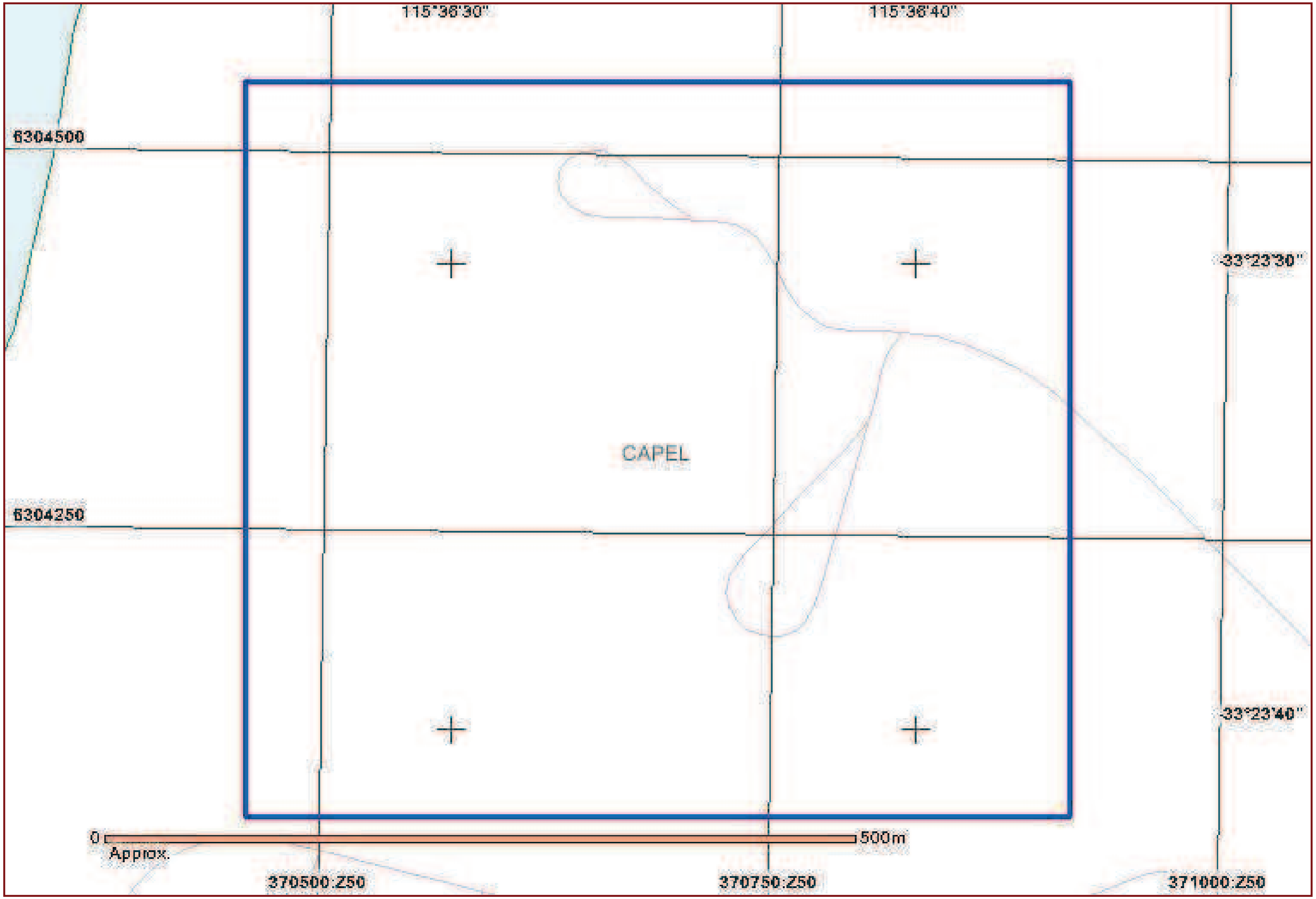
● Town

□ Map Area

— Search Area

For further important information on using this information please see the Department of Indigenous Affairs' Terms of Use statement at http://www.dia.wa.gov.au/Terms-Of-Use/

Map Showing Registered Aboriginal Sites and Other Heritage Places



Legend

Selected Heritage Sites

- ▨ Registered Sites
- ▨ Other Heritage Places
- ● Town
- □ Map Area
- — Search Area

For further important information on using this information please see the Department of Indigenous Affairs' Terms of Use statement at http://www.dia.wa.gov.au/Terms-Of-Use/

Annex H

Data Summary Tables

Table H.1 Summary of Australind TSR solids HIL and EIL exceedances during period 1997-2013

Analyte	Units	Minimum concentration	Maximum concentration	Total Samples analysed	Total number of DEC and NEPM criteria exceedances				DEC and NEPM criteria values			
					DEC EIL	DEC HIL-E	NEPM HIL-C	NEPM EIL-C	DEC EIL criteria	DEC HIL-E criteria	NEPM HIL-C criteria	NEPM EIL-C criteria
Al	mg/kg	19500	41000	8	-	-	-	-	NG	NG	NG	NG
As	mg/kg	0.5	8	32	0	0	0	0	20	200	300	100
B	mg/kg	6.6	100	26	0	0	0	-	NG	6000	20000	NG
Ba	mg/kg	60	450	28	11	0	-	-	300	NG	NG	NG
Be	mg/kg	<0.5	6.3	13	0	0	0	-	NG	40	90	NG
Cd	mg/kg	0.1	4.8	29	1	0	0	-	3	40	90	NG
Co	mg/kg	2.3	60	33	1	0	0		50	200	300	NG
Cu	mg/kg	7.4	455	36	14	0	0	14	100	2000	17000	150
Cr	mg/kg	10	120	26	0	0	-	0	400	240000	NG	400
Cr VI	mg/kg	1.2	9.8	26	26	0	0	-	1	200	300	NG
Fe	mg/kg	0.685	4.5	2	-	-	-	-	NG	NG	-	NG
Hg	mg/kg	<0.05	2.3	39	2	0	0	-	1	30	80	NG
Mg	mg/kg	0.03	6.82	3	-	-	-	-	NG	NG	NG	NG
Mn	mg/kg	560	1000	13	13	0	0	-	500	3000	19000	NG
Pb	mg/kg	0.5	14	40	0	0	0	0	600	600	600	1100
Ni	mg/kg	11	150	40	8	0	0	6	60	600	1200	100
Se	mg/kg	<0.5	<10	40	-	-	0	-	NG	NG	700	NG
V	mg/kg	4.1	58	39	2	0	-	-	50	-	NG	NG
U	mg/kg	0.75	12500	24	-	-	-	-	NG	NG	NG	NG
Th	mg/kg	1.6	83	23	-	-	-	-	NG	NG	NG	NG
Si	mg/kg	0.0014	7.21	2	-	-	-	-	NG	NG	NG	NG
Ti	mg/kg	0.96	14.9	2	-	-	-	-	NG	NG	NG	NG
K	mg/kg	50	5390	19	-	-	-	-	NG	NG	NG	NG
Ca	mg/kg	0.38	19.3	3	-	-	-	-	NG	NG	NG	NG
Cl	mg/kg	0.6	1.7	2	-	-	-	-	NG	NG	NG	NG
Na	mg/kg	450	30780	26	-	-	-	-	NG	NG	NG	NG
P	mg/kg	159	5978	14	2	-	-	-	2000	NG	NG	NG
Nb	mg/kg	0.55	82	11	-	-	-	-	NG	NG	NG	NG
Sn	mg/kg	16	2620	11	7	-	-	-	50	NG	NG	NG
S	mg/kg	0.057	1.1	2	-	-	-	-	NG	NG	NG	NG
K	mg/kg	120	1040	26	-	-	-	-	NG	NG	NG	NG
Mo	mg/kg	1.1	11	13	0	-	-	-	40	NG	NG	NG
Ag	mg/kg	<0.5	3.3	13	-	-	-	-	NG	NG	NG	NG
Zn	mg/kg	79	720	13	10	0	0	5	200	14000	30000	340

EIL	Ecological Investigation Levels - from the Department of Environment and Concervation " Assessment Levels for Soil, Sediment and Water". DEC, 2010
HIL-C	Health Investigation Levels for recreational land use (C) from the National Environemntal Protection Measure, NEPM 1999 amended in 2013
HIL-E	Health Investigation Levels for recreational land use from the Department of Environment and Concervation " Assessment Levels for Soil, Sediment and Water". DEC, 2010
EIL-C	Ecological Investigation Levels for recreational land use (C) from the National Environemntal Protection Measure, NEPM 1999 amended in 2013

Note: For the calculation of NEPM EIL-C criteria values the ambient background concentrations (ABC) and addedd contaminant limit (ACC) values calculated in the GHD soil validation investigation (GHD, 2014) were adopted.

NG - No Guidelines available

\- no screening possible due to lack of guideline values

Values are averaged per year from 4 quarterly data values

Table H.2 Summary of Kemerton TSR solids HIL and EIL exceedances during period 1994-2013

Analyte	Units	Minimum concentration	Maximum concentration	Total Samples analysed	Total number of DEC and NEPM criteria exceedances				DEC and NEPM criteria values			
					DEC EIL	DEC HIL-E	NEP HIL-C	NEP EIL-C	DEC EIL criteria	DEC HIL-E criteria	NEPM HIL-C criteria	NEPM EIL-C criteria
Al	mg/kg	11200	23400	9	-	-	-	-	NG	NG	NG	NG
As	mg/kg	<0.5	28	41	1	0	0	0	20	200	300	100
B	mg/kg	<0.1	3400	35	0	0	0	-	NG	6000	20000	NG
Ba	mg/kg	100	1090	31	12	0	-	-	300	NG	NG	NG
Be	mg/kg	4.4	11	13	-	0	0	-	NG	40	90	NG
Cd	mg/kg	0.05	6.3	50	2	0	0	-	3	40	90	NG
Co	mg/kg	15	180	22	12	0	0		50	200	300	NG
Cu	mg/kg	19	230	46	17	0	0	17	100	2000	17000	150
Cr	mg/kg	910	7850	36	36	0	-	0	400	240000	NG	400
Cr VI	mg/kg	<0.5	32	26	10	0	0	-	1	200	300	NG
Fe	mg/kg	6.3	22.9	2	-	-	-	-	NG	NG	-	NG
Hg	mg/kg	<0.005	11	50	8	0	0	-	1	30	80	NG
Mg	mg/kg	0.02	3.85	3	-	-	-	-	NG	NG	NG	NG
Mn	mg/kg	2300	22900	13	13	8	0	-	500	3000	19000	NG
Pb	mg/kg	0.5	330	50	0	0	0	0	600	600	600	1100
Ni	mg/kg	160	1120	50	50	23	0	37	60	600	1200	100
Se	mg/kg	0.3	19	37	-	-	0	-	NG	NG	700	NG
V	mg/kg	1850	21700	50	49	-	-	-	50	-	NG	NG
U	mg/kg	14	240	36	-	-	-	-	NG	NG	NG	NG
Th	mg/kg	3.4	4700	34	-	-	-	-	NG	NG	NG	NG
Si	mg/kg	0.44	1810	2	-	-	-	-	NG	NG	NG	NG
Ti	mg/kg	0.19	13.2	2	-	-	-	-	NG	NG	NG	NG
K	mg/kg	54	680	12	-	-	-	-	NG	NG	NG	NG
Ca	mg/kg	0.9	3.37	2	-	-	-	-	NG	NG	NG	NG
Cl	mg/kg	0.11	6.08	2	-	-	-	-	NG	NG	NG	NG
Na	mg/kg	230	6460	36	-	-	-	-	NG	NG	NG	NG
P	mg/kg	9.2	1250	22	0	-	-	-	2000	NG	NG	NG
Nb	mg/kg	110	8700	16	-	-	-	-	NG	NG	NG	NG
Sn	mg/kg	54	1250	8	8	-	-	-	50	NG	NG	NG
S	mg/kg	700	67000	32	-	-	-	-	NG	NG	NG	NG
K	mg/kg	54	680	12	-	-	-	-	NG	NG	NG	NG
Mo	mg/kg	75	160	13	13	-	-	-	40	NG	NG	NG
Ag	mg/kg	11	210	13	-	-	-	-	NG	NG	NG	NG
Zn	mg/kg	19	460	45	8	0	0	4	200	14000	30000	340

EIL	Ecological Investigation Levels - from the Department of Environment and Concervation " Assessment Levels for Soil, Sediment and Water". DEC, 2010
HIL-C	Health Investigation Levels for recreational land use (C) from the National Environemntal Protection Measure, NEPM 1999 amended in 2013
HIL-E	Health Investigation Levels for recreational land use from the Department of Environment and Concervation " Assessment Levels for Soil, Sediment and Water". DEC, 2011
EIL-C	Ecological Investigation Levels for recreational land use (C) from the National Environemntal Protection Measure, NEPM 1999 amended in 2013

Note: For the calculation of NEPM EIL-C criteria values the ambient background concentrations (ABC) and addedd contaminant limit (ACC) values claculated in the GHD soil validation investigation (GHD, 2014) wee adopted.

NG - No Guidelines available

Values are averaged per year from 4 quarterly data values

-	no screening possible due to lack of guideline values

Table H.3 Summary of Australind TSR Filtrate results for period 1997-2013 (only exceedances)

	Al	As	Cd	Cu	Cr total	Cr VI	Co	Ba	Bo	Fe	Hg	Mn	Pb	Ni	Se	V	U	Cl	No3	Zn
Domestic non-potable (mg/L) DoH, 2006	2	0.07	0.02	20		0.5	1	7	40	3	0.01	5	0.1	0.2	0.1		0.2	2500	500	30
Domestic non-potable (mg/L) DoH, 2014	**0.2**	**0.1**	0.02	20		0.5		20		**0.3**							**0.17**			**3**
Marine Waters (mg/L)			0.0007	0.0013	-	0.0044	0.001	-	-	1	0.0001	-	4.4	0.007	-	0.1	-	-	0.015	0.015
Long Term Irrigation (mg/L)	5	0.1	0.01	0.2	0.1	-	0.05	-	0.5	0.2	0.002	0.2	2	0.2	0.02	0.1	0.01	-	-	2
Sampled_Date																				
18/04/97	-	-	-	0.02	-	▨	-	-	-	-	-	-	0.05	-	-	-	-	1600	-	0.05
20/02/98	-	▨	▨	▨	-	▨	-	-	-	-	-	-	▨	-	-	-	-	1300	-	0.3
22/07/98	-	-	-	▨	-	▨	-	-	-	-	-	-	-	-	-	-	0.07	1900	-	0.05
12/05/99	-	-	▨	▨	-	▨	0.11	-	-	-	-	-	0.3	-	-	-	▨	1100	-	0.04
13/04/00	▨	-	▨	▨	-	▨	-	-	-	-	-	-	0.01	-	-	-	▨	2000	-	0.03
09/07/01	▨	-	▨	▨	-	▨	-	-	-	-	-	-	-	-	-	0.1	-	1200	-	0.02
16/08/02	-	-	▨	▨	▨	▨	▨	-	-	-	-	-	-	-	-	-	-	1400	-	▨
08/08/03	-	-	-	0.0025	-	▨	▨	▨	-	-	-	-	-	-	-	-	-	1700	-	-
10/11/04	-	-	-	▨	-	▨	▨	▨	-	-	-	-	▨	-	-	-	-	1100	-	-
18/02/05	-	-	-	▨	-	▨	▨	▨	-	-	-	-	▨	-	-	-	▨	1200	-	-
30/04/05	-	-	0.17	▨	-	▨	▨	▨	-	11	-	-	▨	-	-	-	▨	810	-	11
28/11/05	2.4	-	-	0.021	-	▨	▨	▨	-	-	-	-	▨	<0.01	-	-	▨	1700	-	0.038
20/02/06	-	-	-	▨	-	▨	▨	▨	▨	-	-	-	▨	-	-	-	▨	570	-	-
18/05/06	-		-	0.003	-	-	0.0015	▨	▨	-	-	▨	▨	-	-	-	▨	2600	-	-
08/11/06	3.8	-	-	0.025	-	▨	0.004	▨	▨	4.7	-	▨	▨	0.013	-	-	▨	▨	▨	0.046
28/08/06	-	-	-	0.028	-	0.012	0.0034	▨	▨	3.4	-	▨	▨	-	-	-	▨	810	▨	0.071
09/02/07	4.4	-	-	0.024	-	-	0.004	▨	▨	3.6	-	▨	▨	0.01	-	-	▨	1200	▨	0.049
03/09/07	2.8	-	-	2.8	-	-	0.016	▨	▨	-	-	▨	▨	-	-	-	▨	830	▨	0.045
07/11/07	-	-	-	-	-	-	0.004	▨	▨	-	-	▨	▨	-	-	-	-	750	▨	-
08/04/08	6.5	-	-	6.5	-	-	0.011	▨	▨	4	-	▨	-	0.008	-	-	-	750	▨	0.05
01/07/08	-	-	-	-	-	-	-	▨	▨	-	-	▨	-	-	-	-	-	1100	▨	-
01/09/08	-	-	-	-	-	-	0.019	▨	▨	-	-	▨	-	-	-	-	-	▨	▨	-
01/12/08	-	-	-	-	-	-	0.004	▨	▨	-	-	▨	-	-	-	-	-	860	▨	0.036
01/04/09	-	-	-	-	-	▨	-	▨	▨	-	-	▨	-	-	-	-	-	1400	▨	-
14/07/09	-	-	-	-	-	-	0.002	▨	▨	-	-	▨	-	-	-	-	-	1500	▨	-
23/10/09	-	-	-	-	▨	-	-	-	-	▨	-	-	-	-	-	-	▨	▨	▨	-
18/12/09	-	-	-	-	-	-	-	▨	▨	-	-	▨	-	-	-	-	-	3300	▨	-
01/03/10	-	-	-	-	▨	0.002	-	-	-	▨	-	-	-	0.038	-	-	▨	▨	▨	0.18
01/05/10	-	-	-	-	▨	-	-	-	-	▨	-	-	-	-	-	-	▨	▨	▨	0.026
01/08/10	-	-	-	-	▨	-	-	-	-	▨	-	-	-	-	-	-	▨	▨	▨	0.024
01/11/10	-	-	-	-	▨	0.011	-	-	-	▨	-	-	-	-	-	-	▨	▨	▨	-
01/02/11	-	-	-	-	▨	0.005	-	-	-	▨	-	-	-	-	-	-	▨	▨	▨	-
01/05/11	-	-	-	-	▨	0.015	-	-	-	▨	-	-	-	-	-	-	▨	▨	▨	-
01/08/11	-	-	-	-	▨	0.004	-	-	-	▨	-	-	-	-	-	-	▨	▨	▨	-
01/11/11	-	-	-	-	▨	-	-	-	-	▨	-	-	-	-	-	-	▨	▨	▨	-
01/02/12	-	-	-	-	▨	-	-	-	▨	▨	-	-	-	-	-	-	▨	▨	▨	-
01/06/12	-	-	-	-	▨	-	-	-	▨	▨	-	-	-	-	-	-	▨	▨	▨	-
01/08/12	4.1	-	-	0.0019	▨	0.008	0.0013	-	▨	▨	-	-	-	-	-	-	▨	▨	▨	-
01/11/12	-	-	-	-	▨	0.005	-	-	▨	▨	-	-	-	-	-	-	▨	▨	▨	-
01/02/13	-	-	-	-	▨	0.012	-	-	▨	▨	-	-	-	-	-	-	▨	▨	▨	-

🟨	Shaded indicates concentration above the Domestic non-potable groundwater use (DOH, 2006),
🟩	(DOH, 2014), new values for some analytes in bold are included only for comparison reasons to previous guideline values (DoH, 2006) adopted in this HRA.
🟦	Shaded indicates concentration above the Marine Waters guideline (ANZECC ARMCANZ, 2000) for sligtly moderately disturbed ecosystems
🟧	Shaded indicates concentration above the Long Term Irrigation Water guideline (ANZECC ARMCANZ, 2000)
🟥	Element concentration exceeds Long Term Irrigation Guideline and either DEC 2010 Marine Water Guideline or DoH Health Guideline
▨	Not Analysed
-	No exceedances

Note: only values exceeding guidelines shown

Table H.4 Summary of Kemerton TSR Filtrate results for period 1997-2013

	Al	As	Cd	Cu	Cr total	Cr VI	Co	Ba	Bo	Fe	Hg	Mn	Pb	Ni	Se	V	U	Cl	No3	Zn
Domestic non-potable (mg/L) DoH, 2006	2	0.07	0.02	20		0.5	1	7	40	3	0.01	5	0.1	0.2	0.1		0.2	2500	500	30
Domestic non-potable (mg/L) DoH, 2014	**0.2**	**0.1**	0.02	20		0.5		20		**0.3**							**0.17**			**3**
Marine Waters (mg/L)			0.0007	0.0013	-	0.0044	0.001	-	-	1	0.0001	-	4.4	0.007	-	0.1	-	-	0.015	0.015
Long Term Irrigation (mg/L)	5	0.1	0.01	0.2	0.1	-	0.05	-	0.5	0.2	0.002	0.2	2	0.2	0.02	0.1	0.01	-	-	2
Sampled_Date																				
08/02/94	-	-	-	-	-	▨	▨	▨	▨	-	-	-	-	-	-	-	-	-	-	▨
01/03/95	-	-	0.017	-	▨	▨	▨	▨	▨	-	-	-	-	-	-	-	-	-	-	▨
01/06/95	-	-	-	-	▨	▨	▨	▨	24.6	-	-	0.5	-	-	-	-	-	-	-	▨
26/07/95	-	-	-	-	▨	-	▨	▨	-	-	-	-	-	-	-	-	-	-	▨	▨
16/02/96	-	-	-	-	▨	▨	▨	▨	▨	-	-	0.3	-	-	-	-	-	-	-	▨
18/04/97	-	-	0.004	0.02	▨	▨	▨	▨	-	-	-	1.7	-	-	-	-	-	3600	▨	▨
22/07/98	-	-	▨	-	▨	▨	▨	▨	-	-	-	0.55	-	-	-	-	0.05	-	-	▨
12/05/99	-	-	-	▨	-	▨	-	▨	-	-	-	2.6	-	-	-	-	-	-	-	▨
13/04/00	▨	-	-	▨	▨	▨	▨	▨	-	-	-	0.9	-	-	-	-	-	2500	-	▨
26/06/01	-	-	-	-	-	▨	▨	▨	▨	-	-	4.3	-	-	-	-	0.28	2500	-	▨
16/08/02	-	-	-	-	▨	▨	▨	▨	-	-	-	1.7	-	-	-	-	-	3020	▨	▨
08/08/03	-	-	0.001	0.0025	-	▨	▨	▨	-	-	-	1.2	-	-	-	-	-	-		▨
17/02/04	-	-	-	-	▨	▨	▨	▨	-	-	-	2.64	-	-	-	-	-	-	▨	▨
15/05/04	-	-	-	-	▨	▨	▨	▨	-	-	-	0.79	-	-	-	-	-	2600	▨	▨
10/11/04	-	-	-	-	▨	▨	▨	▨	-	-	-	2.6	-	-	-	-	-	-	▨	▨
18/02/05	-	-	-	-	▨	▨	▨	▨	-	-	-	3.4	-	-	-	-	0.59	-	▨	▨
30/04/05	-	-	-	-	▨	▨	▨	▨	-	-	-	5	-	-	-	-	-	-	-	▨
30/07/05	-	-	-	-	▨	▨	▨	▨	-	-	-	-	-	-	-	-	-	-	-	▨
28/11/05	2.5	-	-	-	-	▨	▨	▨	-	8.7	-	5.4	-	-	-	0.49	-	3400	-	▨
24/02/06	-	▨	-	-	▨	▨	▨	▨	-	-	-	2.2	-	-	-	-	-	-	-	▨
30/04/06	-	-	-	-	▨	▨	▨	▨	-	-	-	-	-	-	-	-	-	-	-	▨
15/05/06	-	-	-	0.0022	-	▨	▨	▨	▨	4.4	-	▨	-	-	-	0.13	-	-	▨	▨
18/08/06	-	-	-	0.003	-	▨	▨	▨	▨	4.8	-	▨	-	-	-	0.25	-	-	▨	▨
08/11/06	-	-	-	0.015	0.2	▨	▨	▨	▨	26	-	▨	-	-	-	0.8	-	-	▨	▨
28/02/07	-	-	-	0.002	-	▨	▨	▨	▨	-	-	▨	-	-	-	0.16	-	-	▨	▨
03/09/07	5.1	-	-	0.015	0.43	▨	▨	▨	▨	21	-	▨	-	-	-	1.2	-	2600	▨	▨
08/11/07	-	-	-	-	-	▨	▨	▨	▨	-	-	▨	-	-	-	0.15	-	-	▨	▨
01/04/08	-	-	-	-	0.22	▨	▨	▨	▨	5.2	-	▨	-	-	-	0.65	-	-	▨	▨
01/07/08	-	-	-	-	-	▨	▨	▨	▨	-	-	▨	-	-	-	-	-	3000	▨	▨
12/08/08	-	-	-	-	0.13	▨	▨	▨	▨	3.8	-	▨	-	-	-	0.49	-	-	▨	▨
16/12/08	-	-	-	-	0.13	▨	▨	▨	▨	-	-	▨	-	-	-	0.21	-	-	▨	▨
01/04/09	-	-	-	-	-	▨	▨	▨	▨	-	-	▨	-	-	-	-	-	-	▨	▨
15/07/09	-	-	-	0.002	-	▨	▨	▨	▨	-	-	▨	-	-	-	-	-	-	▨	▨
23/10/09	-	-	-	-	▨	▨	▨	▨	-	▨	-	-	-	-	-	-	▨	▨	▨	▨
02/12/09	-	-	-	0.004	-	▨	▨	▨	▨	3.7	-	▨	-	-	-	0.19	-	-	▨	▨
01/03/10	66	-	-	-	▨	0.047	0.89	-	-	▨	-	5	-	4.2	-	0.37	▨	▨	▨	2.1
01/05/10	-	-	-	-	▨	-	0.002	-	-	▨	-	0.56	-	0.019	-	52	▨	▨	▨	-
01/08/10	-	-	-	-	▨	-	-	-	-	▨	-	2.1	-	0.018	-	-	▨	▨	▨	-
01/11/10	-	-	-	-	▨	-	-	-	-	▨	-	0.56	-	0.009	-	0.24	▨	▨	▨	-
01/02/11	-	-	-	-	▨	-	-	-	-	▨	-	-	-	0.012	-	0.21	▨	▨	▨	-
01/05/11	-	-	0.0026	-	▨	0.006	-	-	0.65	▨	-	-	-	0.014	-	1.7	▨	▨	▨	-
01/08/11	-	-	-	-	▨	-	-	-	-	▨	-	-	-	-	-	0.3	▨	▨	▨	-
01/11/11	-	-	0.0013	-	▨	-	-	-	1.2	▨	-	2.1	-	0.013	-	0.15	▨	▨	▨	-
01/02/12	-	-	0.0013	-	▨	0.006	0.0011	-	▨	▨	-	-	-	0.048	-	2.8	▨	▨	▨	-
01/06/12	-	-	0.008	-	▨	-	0.0017	-	▨	▨	-	-	-	0.027	-	1.3	▨	▨	▨	-
01/08/12	-	-	0.0017	-	▨	-	-	-	▨	▨	-	1	-	0.043	-	0.16	▨	▨	▨	-
01/11/12	-	-	-	-	▨	-	-	-	▨	▨	-	1.4	-	0.025	-	-	▨	▨	▨	-
01/02/13	-	-	0.001	-	▨	-	0.003	-	▨	▨	-	9.6	-	0.023	-	-	▨	▨	▨	-

	Shaded indicates concentration above the Domestic non-potable groundwater use (DOH, 2006),
	(DOH, 2014), new values for some analytes in bold are included only for comparison reasons to previous guideline values (DoH, 2006) adopted in this HRA.
	Shaded indicates concentration above the Marine Waters guideline (ANZECC ARMCANZ, 2000) for sligtly moderately disturbed ecosystems
	Shaded indicates concentration above the Long Term Irrigation Water guideline (ANZECC ARMCANZ, 2000)
	Element concentration exceeds Long Term Irrigation Guideline and either DEC 2010 Marine Water Guideline or DoH Health Guideline
▨	Not Analysed
-	No exceedances

Note: only values exceeding guidelines shown

Table H.5 Australind ASLP leachate results 2010-2013

Element	Al	As	Ba	Be	B	Cd	Cr (VI)	Co	Cu	Pb	Mn	Hg	Mo	Ni	Se	Ag	V	Zn
Domestic non-potable (mg/L) DoH, 2006	2	0.07	7	-	40	0.2	0.5	-	20	0.1	5	0.01	0.5	0.2	0.1	1	-	30
Domestic non-potable (mg/L) DoH, 2014																		
Marine Waters (mg/L)	-	-	-	-	-	0.0007	0.0044	0.001	0.0013	-	-	0.0001	-	0.007	-	0.0014	0.1	0.015
Long Term Irrigation (mg/L)	5	0.1	-	0.1	0.5	0.01	-	0.05	0.2	2	0.2	0.002	0.01	0.2	0.02	-	0.1	2
Sampled date																		
Mar-10	0.47	<0.05	0.08	<0.01	<0.05	<0.01	<0.001	<0.01	<0.01	<0.05	<0.01	<0.01	0.011	<0.01	<0.05	<0.01	<0.01	<0.01
May-10	0.45	<0.05	0.075	<0.01	0.093	<0.01	<0.001	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.015
Aug-10	0.37	<0.05	0.084	<0.01	0.12	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Nov-10	0.94	<0.05	0.07	<0.01	0.08	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.01
Mar-11	0.79	<0.05	0.26	<0.01	0.21	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.052
May-11	0.55	<0.05	0.75	<0.01	0.38	<0.01	0.002	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.043
Aug-11	1.2	<0.05	0.21	<0.01	0.24	<0.01	<0.001	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.083
Nov-11	0.48	<0.05	0.016	<0.01	0.088	<0.01	0.003	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Feb-12	0.9	<0.05	0.12	<0.01	0.1	<0.01	<0.001	NA	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.031
Jun-12	0.89	<0.05	0.87	<0.01	0.6	<0.01	<0.001	<0.01	<0.01	<0.05	<0.01	<0.01	0.072	<0.01	<0.05	<0.01	<0.01	0.53
Aug-12	0.93	<0.05	1.5	<0.01	0.26	<0.01	<0.001	<0.01	<0.01	<0.05	0.0082	<0.01	0.038	<0.01	<0.05	<0.01	<0.01	0.58
Nov-12	1.5	<0.05	0.7	<0.01	0.4	<0.01	<0.001	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.046
Feb-13	1	<0.05	0.47	<0.01	0.25	<0.01	0.001	<0.01	<0.01	<0.05	0.041	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.067

▨	Limit of Reporting below below asessment criteria
🟨	Shaded indicates concentration above the DEC 2010 Doemstic non-potable groundwater use
🟩	(DOH, 2014), new values for some analytes in bold are included only for comparison reasons to previous guideline values (DoH, 2006) adopted in this HRA.
🟦	Shaded indicates concentration above the DEC 2010 Marine Waters guideline
🟧	Shaded indicates concentration above the Long Term Irrigation guideline
NA	Not Analysed

values expressed in mg/L

Table H.6 Kemerton ASLP leachate results 2010-2013

Element	Al	As	Ba	Be	B	Cd	Cr (VI)	Co	Cu	Pb	Mn	Hg	Mo	Ni	Se	Ag	V	Zn
Domestic non-potable (mg/L) DoH, 2006	2	0.07	7	-	40	0.2	0.5	-	20	0.1	5	0.01	0.5	0.2	0.1	1	-	30
Domestic non-potable (mg/L) DoH, 2014																		
Marine Waters (mg/L)	-	-	-	-	-	0.0007	0.0044	0.001	0.0013	0.0044	-	0.0001	-	0.007	-	0.0014	0.1	0.015
Long Term Irrigation (mg/L)	5	0.1	-	0.1	0.5	0.01	-	0.05	0.2	2	0.2	0.002	0.01	0.2	0.02	-	0.1	2
Sampled date																		
Mar-10	0.13	<0.05	0.13	<0.01	0.17	<0.17	<0.001	<0.01	<0.01	<0.05	23	<0.01	0.47	<0.01	<0.05	<0.01	0.033	<0.01
May-10	0.21	<0.05	0.083	<0.01	0.24	<0.01	0.002	<0.01	<0.01	<0.05	0.3	<0.01	0.97	<0.01	<0.05	<0.01	0.21	0.017
Aug-10	0.074	<0.05	0.084	<0.01	0.12	<0.01	<0.001	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01
Nov-10	0.18	<0.05	0.09	<0.01	0.2	<0.01	<0.001	<0.01	<0.01	<0.05	0.29	<0.01	0.81	<0.01	<0.05	<0.01	0.16	0.01
Mar-11	0.15	<0.05	0.38	<0.01	1.5	<0.01	<0.001	<0.01	<0.01	<0.05	0.78	<0.01	0.57	<0.01	<0.05	<0.01	0.062	0.12
May-11	0.28	<0.05	0.57	<0.01	0.91	<0.01	0.01	<0.01	<0.01	<0.05	0.06	<0.01	1.2	<0.01	<0.05	<0.01	1.3	0.16
Aug-11	0.17	<0.05	0.49	<0.01	1.2	<0.01	<0.001	<0.01	<0.01	<0.05	0.78	<0.01	0.44	0.014	<0.05	<0.01	0.043	0.23
Nov-11	0.39	<0.05	0.032	<0.01	0.19	<0.01	<0.02	<0.01	<0.01	<0.05	<0.01	<0.01	0.72	<0.01	<0.05	<0.01	0.82	0.022
Feb-12	0.25	<0.05	0.14	<0.01	0.67	<0.01	<0.001	NA	<0.01	<0.05	0.81	<0.01	0.73	<0.01	<0.05	<0.01	0.083	0.056
Jun-12	0.21	<0.05	0.046	<0.01	0.29	<0.01	0.004	<0.01	<0.01	<0.05	0.027	<0.01	1	<0.01	<0.05	<0.01	0.64	0.049
Aug-12	0.087	<0.05	1.6	<0.01	0.39	<0.01	0.004	<0.01	<0.01	<0.05	0.059	<0.01	1.2	<0.01	<0.05	<0.01	0.65	0.61
Nov-12	0.054	<0.05	0.66	<0.01	0.51	<0.01	<0.001	<0.01	<0.01	<0.05	0.15	<0.01	0.62	<0.01	<0.05	<0.01	0.072	0.18
Feb-13	0.15	<0.05	0.55	<0.01	0.25	<0.01	<0.001	<0.01	<0.01	<0.05	2.3	<0.01	0.08	<0.01	<0.05	<0.01	<0.01	0.19

▨	Limit of Reporting below below asessment criteria
🟨	Shaded indicates concentration above the Domestic non-potable groundwater use (DOH, 2006)
🟩	(DOH, 2014), new values for some analytes in bold are included only for comparison reasons to previous guideline values (DoH, 2006) adopted in this HRA.
🟦	Shaded indicates concentration above the Marine Waters guideline (ANZECC ARMCANZ, 2000) for sligtly moderately disturbed ecosystems
🟧	Shaded indicates concentration above the Long Term Irrigation Water guideline (ANZECC ARMCANZ, 2000)
NA	Not Analysed

Table H.7 Summary of groundwater analytical data for period 1989-2011

					DM1C						DM2A						DM2C					
Analyte	**Domestic non-potable (mg/L) DoH, 2006**	**Marine Waters (mg/L)**	**Long Term Irrigation (mg/L)**	Units	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline
pH	8-8.4	-	-		6.7	8.2	86	79	-	-	6.3	7.9	87	86	-	-	6.45	8.2	87	83	-	-
EC uS/cm	-	-	-	uS/cm	760	1800	85	-	-	-	1050	14750	87	-	-	-	1000	11500	87	-	-	-
ORP	-	-	-		-133	57	21	-	-	-	-108	235	22	-	-	-	-59	214	22	-	-	-
Temp	-	-	-		19	23.8	21	-	-	-	19.6	22.6	22	-	-	-	19.4	22.6	22	-	-	-
Al mg/L	-	2	5	mg/l	0.01	0.013	3	-	-	0	0.006	0.026	3	0	-	0	0.006	0.014	3	-	0	0
As mg/L	-	0.07	0.1	mg/l	0.003	0.004	2	-	-	0	0.01	0.011	2	0	-	0	0.001	0.001	2	-	0	0
B mg/L	-	40	0.5	mg/l	0.029	0.43	59	-	-	0	0.03	0.44	65	0	-	0	0.03	0.38	66	-	0	0
C mg/L	-	-		mg/l	7	7	1	-	-		12	12	5	-	-	-	10	10	5	-	-	-
Ca mg/l	-	-	-	mg/l	38	115	84	-	-		62	1700	90	-	-	-	79	1815	90	-	-	-
Co mg/L	0.001	-	0.05	mg/l	0.001	0.0015	22	0	-		0.001	0.004	28	10	0	0	0.001	0.002	26	1	-	0
Cr mg/L	-	0.1	0.1	mg/l	0.001	0.05	79	-	-		0.001	0.32	84	-	1	0	0.002	0.11	86	-	-	0
Cr6 mg/L	0.0044	0.5	-	mg/l	0.001	0.005	9	5	0		0.001	0.32	14	6	0	-	0.001	0.033	13	5	0	-
Fe mg/L	1	3	0.2	mg/l	0.007	10	82	42	34	55	0.02	42	87	56	6	65	0.01	2.4	86	2	0	11
Mg mg/L	-	-	-	mg/l	12	36	84	-	-	-	25	740	90	-	-		17	610	90	-	-	
Mn mg/L	-	5	0.2	mg/l	0.007	0.79	77	-	0	5	0	0.34	82	-	0	6	0.001	0.06	85	-	0	0
V mg/L	0.1	-	0.1	mg/l	0.001	0.5	77	16	-	16	0.001	0.5	82	15	-	15	0.001	0.5	84	15	-	15
HCO3 mg/L	-	-	-	mg/l	170	423	80	-	-	-	95	408	87	-	-	-	100	500	87	-	-	-
CaCo3 mg/L	-	-	-	mg/l	1	10	30	-	-	-	1	10	36	-	-	-	1	10	36	-	-	-
Cl mg/L	-	2500	refer to guideline	mg/l	130	370	87	-	0	0	160	4700	92	-	19	0	140	3300	92	-	5	0
NO3-N mg/L	-	500	-	mg/l	0.01	17	62	-	0		0.01	12	75	-	0	-	0.2	59	85	-	0	-
K mg/L	-	-	-	mg/l	3	80	84	-	-		3	43	89	-	-	-	2.2	45	89	-	-	-
Na mg/L	-	-	-	mg/l	70	210	87	-	-	-	85	890	92	-	-	-	85	500	92	-	-	-
SO4 mg/L	-	5000	-	mg/l	19	150	87	-	0	-	30	710	71	-	0	-	10	710	91	-	0	-
TDS mg/L			-	mg/l	420	1200	81	-	-	-	670	8900	87	-	-	-	630	7130	87	-	-	-
Cd mg/L	0.0007	0.02	0.01	mg/l	0.0001	0.002	24	1	0	0	0.0001	0.002	28	2	0	0	0.0001	0.002	28	3	0	0
Cu mg/L	0.0013	20	0.2	mg/l	0.001	0.01	24	5	0	0	0.001	0.14	28	8	0	0	0.001	0.043	28	4	0	0
Pb mg/L	0.0044	0.1	2	mg/l	0.001	0.03	24	4	0	0	0.001	0.01	28	2	0	0	0.001	0.014	28	3	1	0
Hg mg/L	0.0001	0.01	0.002	mg/l	0.0001	0.0001	23	0	0	0	0.0001	0.0001	27	0	0	0	0.0001	0.0001	27	0	0	0
Ni mg/L	0.007	0.2	0.2	mg/l	0.001	0.02	25	2	0	0	0.001	0.011	29	1	0	0	0.001	0.03	29	1	0	0
Na/Cl Ratio	-	-	-	mg/l	0.31	0.89	87	-	-	-	0.08	0.89	92	-	-	-	0.06	0.71	90	-	-	-
Ra 226 (mBq/L)	-	-	-	mg/l	4	1102	76	-	-	-	3	345	79	-	-	-	3	140	80	-	-	-
Ra 228 (mBq/L)	-	-	-	mg/l	10	1045	34	-	-	-	70	915	42	-	-	-	55	747	38	-	-	-

Table H.7 Summary of groundwater analytical data for period 1989-2011 (continued)

					DM4A						DM4C						DM7A						DM7C					
Analyte	Domestic non-potable (mg/L) DoH, 2006	Marine Waters (mg/L)	Long Term Irrigation (mg/L)	Units	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline
pH	8-8.4	-	-		5.88	8.1	87	86	-	-	6	8.15	88	84	-	-	6.5	7.95	76	74	-	-	6.5	7.8	78	78	-	-
EC uS/cm	-	-	-	uS/cm	1340	11360	88	-	-	-	1360	13000	88	-	-	-	2100	13000	75	-	-	-	2290	13000	78	-	-	-
ORP	-	-	-		-120	-53	22	-	-	-	-123	-64	22	-	-	-	-140	22	22	-	-	-	-123	87	22	-	-	-
Temp	-	-	-		18.8	22	22	-	-	-	19.2	22.2	22	-	-	-	19.7	23	21	-	-	-	19.8	23.2	22	-	-	-
Al mg/L	-	2	5	mg/l	0.03	0.11	3	-	0	0	0.025	0.038	3	-	0	0	0.008	0.028	3	-	0	0	0.005	0.024	3	-	0	0
As mg/L	-	0.07	0.1	mg/l	0.019	0.022	2	-	0	0	0.016	0.017	2	-	0	0	0.02	0.025	2	-	0	0	0.001	0.002	2	-	0	0
B mg/L	-	40	0.5	mg/l	0.03	0.4	64	-	0	0	0.03	0.49	65	-	0	0	0.03	0.59	60	-	0	1	0.03	0.81	61	-	0	1
C mg/L	-	-		mg/l	10	10	4	-	-	-	12	12	4	-	-	-	12	12	5	-	-	-	8	8	5	-	-	-
Ca mg/l	-	-	-	mg/l	70	1180	89	-	-	-	65	1200	89	-	-	-	140	1000	77	-	-	-	165	1200	74	-	-	-
Co mg/L	0.001	-	0.05	mg/l	0.001	0.005	25	16	-	0	0.001	0.003	25			0	0.001	0.005	25	8	-	0	0.001	0.002	25	2	-	0
Cr mg/L	-	0.1	0.1	mg/l	0.001	0.05	81	-	-	0	0.001	0.05	84	-	-	0	0.001	0.05	62	-	-	0	0.002	0.1	76	-	-	0
Cr6 mg/L	0.0044	0.5	-	mg/l	0.001	0.005	12	4	0	-	0.001	0.005	13	4	0	-	0.001	0.051	18	5	0	-	0.001	0.019	12	6	0	-
Fe mg/L	1	3	0.2	mg/l	0.01	72	87	63	60	70	0.04	52	88	52	48	64	0.02	51	77	54	44	62	0.01	41	77	13	11	26
Mg mg/L	-	-	-	mg/l	19	1060	89	-	-		23.5	1050	89	-	-		55.5	670	77	-	-		60	720	78	-	-	
Mn mg/L	-	5	0.2	mg/l	0.0077	1.9	81	-	0	65	0.024	1.8	83	-	0	47	0.02	1.7	59	-	0	34	0.005	2	61	-	0	9
V mg/L	0.1	-	0.1	mg/l	0.001	0.5	79	14	-	14	0.001	0.5	82	16	0	16	0.001	0.5	53	5	-	5	0.001	0.5	61	11	-	11
HCO3 mg/L	-	-	-	mg/l	35	365	86	-	-	-	65	406	85	-	-	-	110	390	74	-	-	-	100	370	75	-	-	-
CaCo3 mg/L	-	-	-	mg/l	1	10	34	-	-	-	1	10	35	-	-	-	1	10	35	-	-	-	1	10	35	-	-	-
Cl mg/L	-	2500	refer to guideline	mg/l	230	4200	91	-	39	0	260	4800	91	-	42	0	500	4100	78	-	6	0	480	4000	80	-	6	0
NO3-N mg/L	-	500	-	mg/l	0.01	5	67	-	0	-	0.01	9	74	-	0	-	0.01	13	65	-	0	-	0.01	18	73	-	0	-
K mg/L	-	-	-	mg/l	2.2	20	88	-	-	-	3.5	17	87	-	-	-	6	19	76	-	-	-	4.4	15	77	-	-	-
Na mg/L	-	-	-	mg/l	150	535	91	-	-	-	140	550	91	-	-	-	140	290	79	-	-	-	110	270	80	-	-	-
SO4 mg/L	-	5000	-	mg/l	33	820	91	-	0	-	40	970	91	-	0	-	50	450	79	-	0	-	80	420	80	-	0	-
TDS mg/L			-	mg/l	800	11100	87	-	-	-	870	14500	87	-	-	-	140	7590	75	-	-	-	1460	8100	77	-	-	-
Cd mg/L	0.0007	0.02	0.01	mg/l	0.0001	0.002	27	1	0	0	0.0001	0.016	27	3	0	0	0.0001	0.002	27	2	0	0	0.0001	0.0024	27	2	0	0
Cu mg/L	0.0013	20	0.2	mg/l	0.001	0.01	27	7	0	0	0.001	0.033	28	7	0	0	0.001	0.008	27	5	0	0	0.001	0.036	27	4	0	0
Pb mg/L	0.0044	0.1	2	mg/l	0.001	0.01	27	1	0	0	0.001	0.01	27	1	0	0	0.001	0.01	27	1	0	0	0.001	0.015	27	3	0	0
Hg mg/L	0.0001	0.01	0.002	mg/l	0.0001	0.0001	26	0	0	0	0.0001	0.0001	26	0	0	0	0.0001	0.00086	26	1	0	0	0.0001	0.0001	26	0	0	0
Ni mg/L	0.007	0.2	0.2	mg/l	0.001	0.01	28	3	0	0	0.001	0.01	28	2	0	0	0.001	0.01	28	1	0	0	0.001	0.01	28	1	0	0
Na/Cl Ratio	-	-	-	mg/l	0.05	0.74	91	-	-	-	0.06	0.7	86	-	-	-	0.06	0.42	78	-	-	-	0.07	0.34	80	-	-	-
Ra 226 (mBq/L)	-	-	-	mg/l	13	564	81	-	-	-	0.02	1052	80	-	-	-	3	521	69	-	-	-	3	170	70	-	-	-
Ra 228 (mBq/L)	-	-	-	mg/l	70	735	38	-	-	-	11	975	38	-	-	-	70	1358	38	-	-	-	90	640	43	-	-	-

🟨 Shaded indicates concentration above the Domestic non-potable groundwater use (DOH, 2006)
🟦 Shaded indicates concentration above the Marine Waters guideline (ANZECC ARMCANZ, 2000) for sligtly moderately disturbed ecosystems
🟧 Shaded indicates concentration above the Long Term Irrigation Water guideline (ANZECC ARMCANZ, 2000)

Guidelines are derived from the Department of Environment and Concervation " Assessment Levels for Soil, Sediment and Water". DEC, 2010

\- indicates no guideline value available to screen againt

Table H.7 Summary of groundwater analytical data for period 1989-2011 (continued)

					DM8A						DM8C						DM9A						DM9C					
Analyte	**Domestic non-potable (mg/L) DoH, 2006**	**Marine Waters (mg/L)**	**Long Term Irrigation (mg/L)**	Units	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline
pH	8-8.4	-	-		6	7.7	60	60	-	-	6.5	7.6	60	60	-	-	6	7.7	61	61	-	-	6.98	8.2	61	58	-	-
EC uS/cm	-	-	-	uS/cm	3200	13480	60	-	-	-	2000	13540	59	-	-	-	930	1690	61	-	-	-	710	1203	61	-	-	-
ORP	-	-	-		-120	16	23	-	-	-	-229	234	24	-	-	-	-134	-15	22	-	-	-	-106	105	22	-	-	-
Temp	-	-	-		19.8	22.1	22	-	-	-	20	23	23	-	-	-	19.5	22.6	22	-	-	-	19.3	22.6	22	-	-	-
Al mg/L	-	2	5	mg/l	0.005	0.042	3	-	0	0	0.008	0.022	3	-	0	0	0.005	0.025	3	-	0	0	0.009	0.013	3	-	0	0
As mg/L	-	0.07	0.1	mg/l	0.013	0.016	2	-	0	0	0.003	0.003	2	-	0	0	0.008	0.011	2	-	0	0	0.001	0.001	2	-	0	0
B mg/L	-	40	0.5	mg/l	0.05	0.71	60	-	0	3	0.071	3	58	-	0	3	0.005	0.83	60	-	0	1	0.0000	1.2	62	-	0	1
C mg/L	-	-		mg/l	10	10	5	-	-	-	10	10	5	-	-	-	6	6	4	-	-	-	7	7	4	-	-	-
Ca mg/l	-	-	-	mg/l	240	2000	58	-	-	-	150	1340	57	-	-	-	49	140	58	-	-	-	0.0000	120	60	-	-	-
Co mg/L	0.001	-	0.05	mg/l	0.001	0.004	26	8	-	0	0.001	0.005	27	8	-	0	0.001	0.004	25	3	-	0	0.001	0.004	25	1	-	0
Cr mg/L	-	0.1	0.1	mg/l	0.001	0.05	62	-	-	0	0.001	0.07	61	-	-	0	0.001	0.05	62	-	-	0	0.001	0.44	64	-	-	0
Cr6 mg/L	0.0044	0.5	-	mg/l	0.001	0.066	13	4	0	-	0.001	0.005	12	3	0	-	0.001	0.005	12	4	0	-	0.001	0.32	12	7	0	-
Fe mg/L	1	3	0.2	mg/l	0.01	36	62	50	49	60	0.03	23	61	26	12	53	0.1	220	62	54	52	61	0.001	6.2	64	2	1	20
Mg mg/L	-	-	-	mg/l	78	1150	62	-	-		94	1190	61	-	-		12	31	62	-	-		0	42	64	-	-	
Mn mg/L	-	5	0.2	mg/l	0.053	2.8	61	-	0	56	0.005	2.2	59	-	0	7	0.1	0.32	60	-	0	8	0	0.25	62	-	0	3
V mg/L	0.1	-	0.1	mg/l	0.001	0.5	60	9	-	9	0.001	0.5	59	7	-	7	0.001	0.5	60	10	-	10	0.001	0.5	60	10	-	10
HCO3 mg/L	-	-	-	mg/l	100	220	59	-	-	-	100	280	58	-	-	-	90	270	59	-	-	-	0	400	62	-	-	-
CaCo3 mg/L	-	-	-	mg/l	1	10	36	-	-	-	1	10	37	-	-	-	1	10	35	-	-	-	1	10	36	-	-	-
Cl mg/L	-	2500	refer to guideline	mg/l	930	7700	64	-	33	0	450	5100	63	-	32	0	230	320	64	-	0	0	110	200	64	-	0	0
NO3-N mg/L	-	500	-	mg/l	0.01	15	57	-	0	-	0.01	3	55	-	0	-	0.01	1	54	-	0	-	0.2	16	62	-	0	-
K mg/L	-	-	-	mg/l	7.4	21	61	-	-	-	5.7	22	60	-	-	-	5.3	10	61	-	-	-	0	15	64	-	-	-
Na mg/L	-	-	-	mg/l	140	470	64	-	-	-	110	510	63	-	-	-	110	200	64	-	-	-	59	120	64	-	-	-
SO4 mg/L	-	5000	-	mg/l	40	1500	64	-	0	-	100	1040	63	-	0	-	11	180	64	-	0	-	8	70	64	-	0	-
TDS mg/L			-	mg/l	2600	13000	60	-	-	-	1500	15400	59	-	-	-	510	1050	60	-	-	-	0	910	63	-	-	-
Cd mg/L	0.0007	0.02	0.01	mg/l	0.0001	0.002	28	2	0	0	0.0001	0.002	29	2	0	0	0.0001	0.002	27	2	0	0	0.0001	0.002	28	1	0	0
Cu mg/L	0.0013	20	0.2	mg/l	0.001	0.01	28	6	0	0	0.001	0.01	29	5	0	0	0.001	0.023	27	6	0	0	0.001	0.013	29	5	0	0
Pb mg/L	0.0044	0.1	2	mg/l	0.001	0.01	28	1	0	0	0.001	0.01	29	1	0	0	0.001	0.013	27	2	0	0	0.001	0.01	29	1	0	0
Hg mg/L	0.0001	0.01	0.002	mg/l	0.0001	0.0001	27	0	0	0	0.0001	0.0001	28	0	0	0	0.0001	0.0001	26	0	0	0	0.0001	0.0001	28	0	0	0
Ni mg/L	0.007	0.2	0.2	mg/l	0.001	0.005	29	0	0	0	0.001	0.017	30	1	0	0	0.001	0.074	28	1	0	0	0.001	0.005	30	0	0	0
Na/Cl Ratio	-	-	-	mg/l	0.07	0.19	64	-	-	-	0.06	0.29	63	-	-	-	0.41	0.67	64	-	-	-	0.37	0.92	64	-	-	-
Ra 226 (mBq/L)	-	-	-	mg/l	15	289	55	-	-	-	5	352	52	-	-	-	13	318	56	-	-	-	3	314	54	-	-	-
Ra 228 (mBq/L)	-	-	-	mg/l	100	739	43	-	-	-	59	760	39	-	-	-	100	859	40	-	-	-	60	634	42	-	-	-

🟨	Shaded indicates concentration above the Domestic non-potable groundwater use (DOH, 2006)
🟦	Shaded indicates concentration above the Marine Waters guideline (ANZECC ARMCANZ, 2000) for sligtly moderately disturbed ecosystems
🟧	Shaded indicates concentration above the Long Term Irrigation Water guideline (ANZECC ARMCANZ, 2000)

Guidelines are derived from the Department of Environment and Conservation " Assessment Levels for Soil, Sediment and Water". DEC, 2010

-	indicates no guideline value available to screen againt

Table H.7 Summary of groundwater analytical data for period 1989-2011 (continued)

					MB3						MB4						YB					
Analyte	Domestic non-potable (mg/L) DoH, 2006	Marine Waters (mg/L)	Long Term Irrigation (mg/L)	Units	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline	Minimum	Maximum	Total Samples analysed	Total no. Exceedances of non-potable guidleine	Total no. Exceedances of marine guideline	Total no. Exceedances of long term irrigation guideline
pH	8-8.4	-	-		5.59	8.1	87	83	-	-	6.3	8	79	78	-	-	6	6.76	75	75	-	-
EC uS/cm	-	-	-	uS/cm	1090	7300	87	-	-	-	900	2200	79	-	-	-	640	1087	75	-	-	-
ORP	-	-	-		-534	1746	24	-	-	-	-89	194	22	-	-	-	-136	0	69	-	-	-
Temp	-	-	-		19.4	76	22	-	-	-	18.6	22	21	-	-	-	0	23.3	57	-	-	-
Al mg/L	-	2	5	mg/l	0.019	0.038	3	-	0	0	0.007	0.026	3	-	0	0	0	0.03	14	-	0	0
As mg/L	-	0.07	0.1	mg/l	0.003	0.003	2	-	0	0	0.001	0.001	2	-	0	0	0	0.001	10	-	0	0
B mg/L	-	40	0.5	mg/l	0.03	0.77	59	-	0	1	0.03	1	56	-	0	1	0	0.12	39	-	0	0
C mg/L	-	-		mg/l	14	14	5	-	-	-	6	6	4	-	-	-	0	2	12	-	-	-
Ca mg/l	-	-	-	mg/l	60	1100	86	-	-	-	42	250	77	-	-	-	0	50	40	-	-	-
Co mg/L	0.001	-	0.05	mg/l	0.001	0.001	24	0	-	0	0.001	0.0018	24	1	-	0	0.001	0.001	23	0	-	0
Cr mg/L	-	0.1	0.1	mg/l	0.001	0.07	62	-	-	0	0.001	0.05	58	-	-	0	0.001	0.0017	38	-	-	0
Cr6 mg/L	0.0044	0.5	-	mg/l	0.001	0.005	12	4	0	-	0.001	0.005	11	4	0	-	0.001	0.02	17	4	0	-
Fe mg/L	1	3	0.2	mg/l	0.005	24	75	26	25	41	0.1	77	66	47	40	60	0.001	28	40	18	18	19
Mg mg/L	-	-	-	mg/l	15	320	90	-	-		6.3	61	81	-	-		0	19	40	-	-	
Mn mg/L	-	5	0.2	mg/l	0.001	0.26	60	-	0	2	0.007	0.67	56	-	0	15	0	0.23	35	-	0	1
V mg/L	0.1	-	0.1	mg/l	0.001	0.5	59	10	-	10	0.001	0.5	55	7	-	7	0.001	0.0015	33	0	-	0
HCO3 mg/L	-	-	-	mg/l	105	640	87	-	-	-	80	470	78	-	-	-	0	100	39	-	-	-
CaCo3 mg/L	-	-	-	mg/l	1	10	33	-	-	-	1	10	34	-	-	-	1	1	31	-	-	-
Cl mg/L	-	2500	refer to guideline	mg/l	100	2900	92	-	1	0	170	550	83	-	0	0	0	250	65	-	0	0
NO3-N mg/L	-	500	-	mg/l	0.01	89	65	-	0	-	0.01	44	59	-	0		0	1	32	-	0	-
K mg/L	-	-	-	mg/l	3	26	90	-	-	-	6	17	81	-	-		0	9.3	38	-	-	-
Na mg/L	-	-	-	mg/l	70	250	92	-	-	-	100	290	83	-	-	-	78	140	74	-	-	-
SO4 mg/L	-	5000	-	mg/l	15	270	92	-	0	-	18	380	83	-	0	-	0	24	48	-	0	-
TDS mg/L			-	mg/l	522	6200	86	-	-	-	520	1480	78	-	-	-	0	780	39	-	-	-
Cd mg/L	0.0007	0.02	0.01	mg/l	0.0001	0.002	26	1	0	0	0.0001	0.002	26	4	0	0	0.0001	0.0017	29	1	0	0
Cu mg/L	0.0013	20	0.2	mg/l	0.001	0.021	26	4	0	0	0.001	0.024	26	7	0	0	0.001	0.024	30	1	0	0
Pb mg/L	0.0044	0.1	2	mg/l	0.001	0.01	26	1	0	0	0.001	0.4	27	7	1	0	0.001	0.001	29	0	0	0
Hg mg/L	0.0001	0.01	0.002	mg/l	0.0001	0.0001	25	0	0	0	0.0001	0.0001	25	0	0	0	0.0001	0.0001	28	0	0	0
Ni mg/L	0.007	0.2	0.2	mg/l	0.001	0.0053	27		0	0	0.001	0.02	27	1	0	0	0.001	0.001	29	0	0	0
Na/Cl Ratio	-	-	-	mg/l	0.08	0.8	88	-	-	-	0.43	0.95	81	-	-	-	0.36	0.7	59	-	-	-
Ra 226 (mBq/L)	-	-	-	mg/l	3	253	80	-	-	-	0.08	286	71	-	-	-	30	480	20	-	-	-
Ra 228 (mBq/L)	-	-	-	mg/l	60	1106	39	-	-	-	60	639	38	-	-	-	100	567	20	-	-	-

🟨	Shaded indicates concentration above the Domestic non-potable groundwater use (DOH, 2006)
🟦	Shaded indicates concentration above the Marine Waters guideline (ANZECC ARMCANZ, 2000) for sligtly moderately disturbed ecosystems
🟧	Shaded indicates concentration above the Long Term Irrigation Water guideline (ANZECC ARMCANZ, 2000)

Guidelines are derived from the Department of Environment and Concervation " Assessment Levels for Soil, Sediment and Water". DEC, 2010

\- indicates no guideline value available to screen againt

Table H.8 Summary of Groundwater Exceedances for period 2010-2013

Guideline / Element		Cl	Co	Fe	Ni
Domestic non-potable (mg/L) DoH, 2006		2500	-	3	0.200
Domestic non-potable (mg/L) DoH, 2014					
Marine Waters (mg/L)			0.001	1	0.007
Long Term Irrigation (mg/L)		-	0.05	0.2	0.2
Location	Sample Date				
DM1A	16/02/10	-	-	9.1	-
DM1A	06/05/10	-	-	9.5	0.020
DM1A	18/08/10	-	-	4.1	-
DM1A	26/11/10	-	-	8.8	-
DM1C	21/05/10	-	-	-	0.020
DM2A	18/08/10	2900	-	1.1	-
DM2A	25/11/10	2800	-	1.1	-
DM2C	16/02/10	3200	-	1.8	-
DM2C	20/05/10	-	-	-	0.030
DM4A	17/02/10	3100	0.004	37	-
DM4A	20/05/10	3400	0.002	41	-
DM4A	18/08/10	3600	0.002	41	-
DM4A	24/11/10	3700	0.002	42	-
DM4C	17/02/10	4500	-	16	-
DM4C	20/05/10	4600	-	16	-
DM4C	18/08/10	3900	-	13	-
DM4C	24/11/10	3800	-	13	-
DM7A	17/02/10	-	-	2.6	-
DM7A	18/08/10	-	-	1.1	-
DM7A	24/11/10	-	-	1.9	-
DM8A	16/02/10	5000	-	20	-
DM8A	13/05/10	3900	0.003	18	-
DM8A	18/08/10	4500	-	22	-
DM8A	24/11/10	4700	-	21	-
DM8C	16/02/10	4500	-	5.8	-
DM8C	20/05/10	4300	-	2.6	-
DM8C	18/08/10	4700	-	4.4	-
DM8C	24/11/10	4700	-	3.9	-
DM9A	16/02/10	-	-	11	-
DM9A	14/05/10	-	0.004	11	-
DM9A	18/08/10	-	-	17	-
DM9A	24/11/10	-	-	17	-
DM9C	14/05/10		0.004	0.9	-
MB4	17/02/10	-	-	14	-
MB4	13/05/10	-	-	36	0.020
MB4	24/11/10	-	-	2.7	-

Guideline / Element		Cr	Co	Fe	Cl	Cr VI	Ni
Domestic non-potable (mg/L) DoH, 2006		-	-	3	2500	0.5	0.2
Domestic non-potable (mg/L) DoH, 2014							
Marine Waters (mg/L)		0.027	0.001	1		0.0044	0.007
Long Term Irrigation (mg/L)		0.1	0.05	0.2	-	-	0.2
Location	Sample Date						
DM1A	09/02/11	-	-	9.5	-	-	-
DM1A	11/05/11	-	-	9.5	-	-	-
DM1A	09/08/11	-	-	8.8	-	-	-
DM1A	10/11/11	-	-	8.5	-	-	-
DM2A	09/02/11	0.054	-	0.91	2700	-	-
DM2A	11/05/11		-	1.2	2800	-	-
DM2A	09/08/11	0.036	-	1.2	2800	-	-
DM2A	10/11/11	0.041	-	1.0	-	-	-
DM4A	09/02/11	-	-	41	3400	-	-
DM4A	11/05/11	-	0.002	47	3600	-	0.011
DM4A	10/11/11	-	0.0017	36	-	-	-
DM4C	09/02/11	-	-	13	3500	-	-
DM4C	11/05/11	-	-	13	3700	-	-
DM4C	10/11/11	-	-	9.1	-	-	-
DM7A	09/02/11	-	-	1.6	-	-	-
DM7A	11/05/11	-	-	2.4	-	-	-
DM7A	09/08/11	-	-	3.2	-	-	-
DM7A	10/11/11	-	-	2.5	-	-	-
DM7C	09/02/11	0.014	-	-	-	0.01	-
DM7C	10/11/11	-	-	-	-	0.003	-
DM8A	08/02/11	-	-	8.6	7700	-	-
DM8A	11/05/11	-	-	23	4900	-	-
DM8A	09/08/11	-	0.002	21	4600	-	-
DM8A	10/11/11	-	-	18		-	-
DM8C	08/02/11	-	-	2.9	4400	-	-
DM8C	11/05/11	-	-	3.1	4600	-	0.008
DM8C	09/08/11	-	-	3.1	4200	-	0.017
DM8C	10/11/11	-	-	3	-	-	-
DM9A	09/02/11	-	-	14	-	-	-
DM9A	11/05/11	-	-	17	-	-	-
DM9A	10/08/11	-	-	17	-	-	-
DM9A	10/11/11	-	-	16	-	-	-
DM9C	09/02/11	0.17	-	-	-	0.17	-
DM9C	10/08/11	0.22	-		-	-	-
DM9C	10/11/11	0.24	-	-	-	0.3	-
MB3	09/02/11	-	-	1.7	-	-	-
MB4	11/05/11	-	-	3.9	-	-	-
MB4	10/11/11	-	-	2.3	-	-	-

Guideline / Element		Cr	Co	Fe	Cl	Cr VI	Ni
Domestic non-potable (mg/L) DoH, 2006		-	-	3	2500	0.5	0.2
Domestic non-potable (mg/L) DoH, 2014							
Marine Waters (mg/L)		0.027	0.001	1		0.0044	0.007
Long Term Irrigation (mg/L)		0.1	0.05	0.2	-	-	0.2
Location	Sample Date						
DM1A	23/01/12	-	-	8.3			
DM1A	24/05/12	-	-	2.1	-	-	
DM1A	14/08/12	-	-	8.9	-	-	
DM1A	26/10/12	-	-	9.8	-	-	
DM1C	23/01/12	0.039	0.0013	8.7	-	-	
DM1C	24/05/12			2.1		0.005	
DM1C	14/08/12	0.046	0.0015	8.1			
DM1C	26/10/12	0.001	0.001	1.3			
DM2A	23/01/12	0.1	0.0014	0.42	2640	0.1	
DM2A	14/08/12	0.32		0.16	1970	0.32	
DM2A	26/10/12			2.1	3700		
DM2C	23/01/12			0.32			
DM2C	24/05/12	0.038		0.086		0.033	
DM2C	14/08/12	0.051		0.96			
DM2C	26/10/12			2.4			
DM4A	23/01/12			1.3			
DM4A	24/05/12			0.32			0.0083
DM4A	14/08/12			0.14	3140		
DM4A	26/10/12			1.8			
DM4C	23/01/12			1.4	3700		
DM4C	24/05/12			1.7	3400		0.0083
DM4C	14/08/12			1.8	3000		
DM4C	26/10/12			7.4	3500		
DM7A	23/01/12			2.5			
DM7A	24/05/12			1.3			
DM7A	14/08/12			1.5			
DM7A	26/10/12			3			
DM7C	24/05/12	0.029	0.0013	1.1		0.015	
DM7C	14/08/12			0.14		0.012	
DM7C	26/10/12			1.3			
DM8A	23/01/12			1.0	2700		
DM8A	24/05/12			0.4	3000		
DM8A	14/08/12			18	4230		
DM8A	26/10/12			21	5100		
DM8C	23/01/12			4	4000		
DM8C	24/05/12		0.0012	2.7	4100		
DM8C	14/08/12			3.4	4500		
DM8C	26/10/12			4.1	5100		
DM9A	23/01/12		0.0015	12			
DM9A	24/05/12			6.9			
DM9A	14/08/12			19			
DM9A	26/10/12			18			
DM9C	23/01/12	0.23		0.2		0.22	
DM9C	24/05/12	0.35		0.8		0.32	
DM9C	14/08/12	0.23		6.2			
DM9C	26/10/12	0.44		0.7		0.21	
MB3	14/08/12			0.2			
MB3	26/10/12			0.065			
MB4	24/01/12		0.0018	61			
MB4	24/05/12			7.4			
MB4	14/08/12			5.8			
MB4	26/10/12			30			

Guideline / Element		Cr	Co	Fe	Cl	Cr VI	Ni
Domestic non-potable (mg/L) DoH, 2006		-	-	3	2500	0.5	0.2
Domestic non-potable (mg/L) DoH, 2014							
Marine Waters (mg/L)		0.027	0.001	1		0.0044	0.007
Long Term Irrigation (mg/L)		0.1	0.05	0.2	-	-	0.2
Location	Sample Date						
DM1A	16/01/13	-	-	8.2		-	-
DM1C	16/01/13	-	-	2		-	-
DM2A	16/01/13	-	-	1.8	3500	-	-
DM2C	16/01/13	-	-	0.6		-	-
DM4C	16/01/13	-	-	0.3	2900	-	-
DM7A	16/01/13	-	-	1.4		-	-
DM7C	16/01/13	-	-	0.3		-	-
DM8A	16/01/13	-	-	18	3500	-	-
DM8C	16/01/13	-	-	5.3	3400	-	-
DM9A	16/01/13	-	-	13		-	-
DM9C	16/01/13	0.32	-	2.9		-	-
MB3	16/01/13	-	-	0.2		-	-
MB4	16/01/13	-	-	1.2		-	-

🟨	Shaded indicates concentration above the Domestic non-potable groundwater use (DOH, 2006),
🟩	(DOH, 2014), new values for some analytes in bold are included only for comparison reasons to previous guideline values (DoH, 2006) 2006) adopted in this HRA
🟦	Shaded indicates concentration above the Marine Waters guideline (ANZECC ARMCANZ, 2000) for sligtly moderately disturbed ecosystems
🟧	Shaded indicates concentration above the Long Term Irrigation Water guideline (ANZECC ARMCANZ, 2000)
🟫	Shaded indicates concentration above the DEC Long Term Irrigation and either the Domestic non-potable groundwater use
-	No exceedances

H.9 Summary of Groundwater quality review for period 1989-2013 (Shallow Aquifer)

Well ID	Site location of well	No. of Brackish monitoring events	Dates of Brackish monitoring events	No. of Saline monitoring events	Dates of Saline monitoring events	No. of Freshwater monitoring events	Overall groundwater conditions based on EC and TDS results	Predominant water quality
DM1A	Northeast site area, adjacent to Pond N2	28	1990-2013	-	-	**53**	Freshwater tending to Brackish in monitoring events from 1990 onwards, Brackish in 2012-2013	**F-B**
DM1C	Northeast site area, adjacent to Pond N2	13	1989-2013	-	-	**66**	Freshwater to Brackish	**F**
DM2A	Northwest site area, adjacent to Pond N1	25	1989-2010	**48**	1990-2013	7	Saline to Brackish, becoming increasingly Saline from 2012	**S**
DM2C	Northwest site area, adjacent to Pond N1	**27**	1989-2007	**31**	1991-2011 2004 – 2013 more saline conditions	15	Transitional between Brackish and Saline with occasional freshwater ingress, becoming more Saline recently	**B-S**
DM4A	Adjacent to western site boundary, on the beach	**80**	1989-1999	**24**	Upto 1999 groundwater fluctuates between brackish & saline **2000 – 2013 reflects saline conditions**	-	Fluctuating between Brackish and Saline conditions upto 1999, thereafter, Saline conditions	**B-S**
DM4C	Adjacent to western site boundary, on the beach	21	1989-1999	**55**	A few saline conditions up to 1999, 2000-2013 reflect saline conditions	-	Predominantly Brackish until 1999, thereafter Saline conditions	**S**
DM7A	Western site area, adjacent to rehabilitated ponds	25	1993-2013 14 monitoring events within this time show higher TDS values indicative of saline conditions, 2012-2013 indicates brackish conditions	**27**	1993-2011	-	Fluctuating between Brackish and Saline conditions with a freshwater ingress in 2010, predominantly Brackish from 2012	**B-S**
DM7C	Western site area, adjacent to rehabilitated ponds	22	1992-2013	**25**	1995-2011 21 monitoring events between 1995-2010 conditions reflect more saline conditions	-	Fluctuating between Brackish and Saline conditions, predominantly Brackish from 2012	**B-S**
DM8A	Western site area, adjacent to west central ponds	2	1996 and 2002	**50**	1997-2013 8 monitoring events between 1998-2005 show higher TDS values more indicative of saline conditions	-	Saline conditions	**S**
DM8C	Western site area, adjacent to west central ponds	9	1997-2002	**36**	1997-2011 6 monitoring events between 1998-2003 showed higher TDS values indicative of saline conditions	-	Saline conditions	**S**
DM9A	Eastern site area, adjacent to eastern site boundary	-	-	-	-	**63**	Freshwater conditions, some EC values in 2012-2013 tending towards Brackish	**F**
DM9C	Eastern site area, adjacent to eastern site boundary	-	-	-	-	**64**	Freshwater conditions	**F**
MB3	Adjacent to southern site boundary, located off-site	**20**	1990-2013	7	2001-2002 and 2011 in 2002 showed more indicative of saline conditions	15	Fluctuating between Freshwater and Brackish conditions with Saline conditions in 2001-2002, EC values tending towards Brackish in 2012-2013 while TDS values suggest Freshwater conditions	**B**
MB4	Southwest of southern site boundary, located on the beach	**37**	1989-2013	1	2011	23	Fluctuating between Brackish and Freshwater conditions	**B**

Note: the number of monitoring events was different between well function of their installation date
F- Fresh water conditions
B- Brackish water gonditions
S- Saline water conditions
The assessment of the predominant water quality was based on EC and TDS readings

Water Quality Parameters				
	EC		TDS	
Freshwater	0-800	🟩	100-1000	🟩
Brackish Water	1600-4800	🟨	1000-3000	🟨
Saline Water	>4800	🟧	>3000	🟧
Seawater	51500	🟥	35000	🟥

Annex I

Radiological Risk Assessment

ERM

RADIOLOGICAL IMPACTS OF PROPOSED SITE REHABILITATION

FOR

Dalyellup Tailings Facility

DECEMBER 2010

Prepared By:
Anthony O’Brien
Director
Radiation Professionals
Western Australia
28 April 2011

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1 INTRODUCTION AND SUMMARY

The purpose of this report is to provide the context for assessing the thickness of a sand capping layer required to reduce the potential exposures from radiation to the public post-rehabilitation of the Dalyellup tailings facility. The local Capel shire has expressed the preferred intent to utilize the rehabilitated area for open sporting grounds.

The report has been prepared against the requirements from both Western Australian Guidelines, Australian Codes and international guidelines (which are almost entirely adopted into the Western Australian guidelines).

On this basis an analysis of the level of radiological risks to the public posed by the MIC Dalyellup tailings disposal facility after rehabilitation has been conducted. The risk is assessed based upon several end-use scenarios and the criteria assessed against will be that proposed by the Contaminated Sites Act, Department of Environment and Conservation, Western Australian Radiation Safety Act, the Australasian Radiation Protection And Nuclear Safety Act (in adoption of the ICRP guidelines). These criteria (as outlined in the DMP NORM Guidelines 4.2) propose classifications of:

Unrestricted Use - 0.0 mSv/y < DOSE < 0.3 mSv/year
Restricted Use - 0.3 mSv/y < DOSE < 1.0 mSv/year
Remediation Necessary in Most Cases - 1.0 mSv/y < DOSE < 3.0 mSv/year
Remediation Necessary in All Cases - DOSE > 3.0 mSv/y

The assessment is of:

1. The potential gamma radiation dose rate levels from the tailings facility based upon:
    a. Historical measurements over the tailings facility
    b. Theoretical levels calculated from conversion coefficients
2. The potential external gamma radiation dose rates to members of the public
3. Migration of radionuclides into the environment through the pathways of:
    a. Leaching of radionuclides into ground water
    b. Transport of the radionuclides by natural movement of the soil
    c. Emanation of radon/thoron gases from the tailings into the ground
4. Flux rates of radon/thoron gas from the surface of the rehabilitated facility (taking into account emanation fractions and diffusion lengths in the particular soil to be used for rehabilitation)
5. Dispersion of the radon/thoron and progeny into the environment
6. Exposure levels to the environment and potential doses to members of the public for use of the rehabilitated site (based upon a number of different use scenarios)

The tailings have been treated to a pH level of approximately 9 to hold the heavy minerals and the radium into the tailings matrix. Leachability tests carried out by MIC have shown the radionuclides are not mobile in water. Therefore there is not an expectation of the radionuclides becoming mobile due to leaching in the future. Historical monitoring of groundwater around the Dalyellup facility has shown there is no measurable leaching of radionuclides into the environment. However to confirm this ongoing monitoring would need to be carried out.

The nature of the tailings material and the physical structure of the tailings facility effectively eliminate the likelihood of transportation of radionuclides by natural movement of the soil. This is achieved in part by rehabilitation of the tailings ponds that promotes re-growth of natural flora hence stabilizing the coastal dune structures of the area.

An important consideration is that the capping layer is required to be a minimum of 1 metre thick according to the DMP NORM guidelines and 2 meters thick for category A waste according to RHS35 - Code of practice for the near-surface disposal of radioactive waste in Australia (1992) (the Near Surface Disposal Code).

Therefore the risk assessment will not include the scenario of zero capping layer. It will include comments and reference to capping layers of less than 1 metre for clarity however will address the site criteria based on a minimum of 2 metre thick capping. With this stipulation it is not likely that any pathway will eventuate that will see an increase in airborne radionuclide exposure (either dust or radon) from the facility once the capping layer is on. There is the potential in the future that deep-rooted plants (such as banksias) may introduce radionuclides to the ecosystem through bio-accumulation in the plant and then in animals that eat the plants should such plants exist directly above the treated solid residue. . Assessment of this risk is not directly applied in the scope of this assessment however this is a radionuclide transfer pathway that would need to be included in future monitoring and ongoing assessment after rehabilitation and closure of the facility should deep rooted plants be grown above the treated solid residue.

This risk would only be likely to be realized if the deep rooted plants (Banksias) were planted on the capping, allowing their roots to penetrate to the tails. This is not likely however as the proposed usage scenario is for open sporting grounds, therefore no Banksias (or other deep rooted plants) are likely to be planted there. This could be enforced further by adding a stipulation on the classification of the site for post-rehabilitation and subsequent registering of the site under the Contaminated Sites Act of WA, that deep rooted fauna are not planted directly over the rehabilitated ponds.

Possible future disturbance of the tailings may occur from human activities such as construction or landscaping. If the capping layer is at least 2m thick then disturbance of the tails for most activities is unlikely. However if intrusive works were to disturb the tails and bring material to surface, the external dose rates would **not** exceed 0.79 µGy h^{-1} (see section 2.2) or 0.553 µSv h^{-1}. Unless significant quantities were brought to surface, radon/thoron and progeny exposure would not be of significance. Due to the nature of the material (water saturation of more than 50% up to 95%) dust exposure from these activities would be highly unlikely, though it is a possibility. Evaluating the potential risk from this (dust) exposure pathway would require prior knowledge of the activities to be carried out. However if comparison was to be drawn between mining exploration drilling activities, dose rates would not be expected to exceed 0.5 µSv h^{-1} with no likelihood of exceeding 2 µSv h^{-1}. The other potential exposure pathway would be from external contamination and then transfer of the radionuclides to the mouth allowing ingestion. Again this pathway is extremely difficult to assess unless there is prior knowledge of the activities being carried out. However using dose conversion figures from UNSCEAR and an estimated ingestion rate of 0.1g tailings per hour would still only equate to a dose rate of 0.5 µSv h^{-1}.

Therefore adding these dose contributors together, a very conservative estimate of the dose rates to construction workers disturbing the tailings would be <3 µSv h^{-1} (more realistically <1.0 µSv h^{-1}). For a 12 month construction project that continually disturbed the tailings with no controls at all, a very pessimistic estimation of doses would be therefore be 6mSv, with a more realistic estimation for this level of activity being <2mSv. This is above the allowable public dose limit.

As such it is recommended that a stipulation on the classification of the site for post-rehabilitation and subsequent registering of the site under the Contaminated Sites Act of WA, be that earth disturbing activities need to be assessed for the potential to disturb the tailings before being carried out.

Therefore the elements assessed for the radiological aspects were the gamma and radon exposures. This was achieved by:

- Modeling the radon flux from tailings surface
- Confirming these theoretical radon flux levels through monitoring of the tailings facility
- Deriving relationships between the radon flux, diffusion through the capping layer and total dose
- Modeling of gamma dose rates from tailings and confirming by comparison with historical monitoring
- Combining the radon and gamma dose rates to provide a relationship between capping layer thickness and total dose rate at the surface of the facility
- Comparison of these relationships with use criteria

2 METHODOLOGY

2.1 RADON DOSE RATES

The first step in determining Radon dose rates from radon concentration levels is to determine the rate at which Radon is emanating from the ground, the Radon Flux.

For the Dalyellup site the Radon Flux is modelled for differing levels of capping materials placed over the tailings facility. This is done in two parts, with the radon flux from the tailings being determined first and then the diffusion of that flux through a capping layer. The flux can be determined both by direct measurement and confirmation by theoretical methods.

Radon Flux from tailings.
From the UNSCEAR 2000 report, the Radon flux can be determined from the parameters of the tailings material including the Radium concentration as per the following equation

$$J_D = C_{Ra}\,\lambda_{Rn}\,f\,\rho_s\,(1-\varepsilon)\left(\frac{D_e}{\lambda_{Rn}}\right)^{1/2}\,(Bq\,m^{-2}\,s^{-1}) \qquad (1)$$

Where:

- $\boldsymbol{C_{Ra}}$ is the concentration of radium in the soil in Bq kg^{-1}
- $\boldsymbol{J_D}$ is the radon flux from one square meter of surface in Bq m^{-2} s^{-1}
- $\boldsymbol{\lambda_{Rn}}$ is the radon decay constant (2.1 x 10^{-6} s^{-1} for ^{222}Rn and 12.5 x 10^{-3} s^{-1} for ^{220}Rn)
- $\boldsymbol{D_e}$ is the effective diffusion coefficient in m^2 s^{-1}
- $\boldsymbol{\rho_s}$ is the soil grain density in kg m^{-3}
- $\boldsymbol{\varepsilon}$ is the dimensionless soil porosity fraction and
- ***f*** is the dimensionless emanation fraction of Radon in soil (approximately 0.2 for both ^{222}Rn and ^{220}Rn)

For the tailings in the ponds, based on the Coffey 2001 report, section 6.2, the soil grain density is 2900 kg m^{-3} and the dry density to 9 metres is 400 kg m^{-3}, giving a pore fraction of approximately 0.85. The water mass fraction is 0.67 with the water volume fraction being 0.82. This means that the pore fraction of the tailings is 95% saturated.

However over time with hydraulic action, compaction and other mechanisms, the material may dry somewhat and the pore fraction become less, more representative of clays. This is illustrated by the Coffey report, with the material at a depth of 11m having a higher dry density (520 kg m^{-3}) and a lower water mass fraction being 0.61 (however this still means the pore fraction is 97% saturated). Over time, as the material more closely represents a clay (dry density of 1200 kg m^{-3}) the pore fraction may approach 0.6. However as clay has a low hydraulic conductivity, the material would not be expected to release the water volume quickly and with recharge through the overlying capping, would be expected to maintain a relatively high pore saturation level, at least 50%.

Using the values of pore fraction and saturation fraction of 0.6 and 0.5 respectively for the drier, compacter tails in the future, the following equation can be used to derive the effective diffusion coefficient for the tailings [Rogers and Nielson 1991].

$$D_e = D_0\,p_t \times Exp\left((-6p_tR_s) + \left(-6{R_s}^{14p_t}\right)\right)\,(m^2\,s^{-1}) \qquad (2)$$

Where

- $\boldsymbol{D_e}$ is the effective diffusion coefficient for radon in a material
- $\boldsymbol{D_0}$ is the diffusion coefficient for radon in open air – 1.1 x 10^{-5} m^2 s^{-1}

- $\boldsymbol{p_t}$ is the total porosity of a material
- $\boldsymbol{R_s}$ is the water saturation in soil – the fraction of the pore space filled with water

This provides an effective diffusion coefficient for the tailings in the current state of 2.8×10^{-9} m^2 s^{-1} but over time as the tailings may be expected to compact and dry over time the diffusion coefficient could be expected to approach 1.1×10^{-6} m^2 s^{-1}.

Therefore the Radon flux function simplifies to

$$J_D = C_{Ra} \times 3.5 \times 10^{-4} \ (Bq\ m^{-2}\ s^{-1}) \qquad (3)$$

For ^{222}Rn, with C_{Ra} being the concentration of ^{226}Ra and

$$J_D = C_{Ra} \times 2.7 \times 10^{-2} \ (Bq\ m^{-2}\ s^{-1}) \qquad (4)$$

For ^{220}Rn with C_{Ra} being the concentration of ^{224}Ra.

The 3 orders of magnitude difference in the effective diffusion coefficient illustrates just how dependent the radon flux rates are on water content and porosity of the tailings. The heavy dependence on moisture content was also clearly illustrated by Kojima and Nagano (1999) with soils in Japan showing radon flux rates halving with 5% change in water content.

As the top few centimetres of tails may dry out significantly from one day to another, this could be expected to influence the level of agreement between the calculated and the measured radon flux rates.

Diffusion of Radon Flux through capping layer.

The equation for the radon emanation rate at surface after the radon source flux has been diffused through a capping layer (to allow for the decay of the radon as it diffuses through the capping layer) combines the radon flux equation and the radioactive decay equation [Rogers and Nielson, 1984]

$$J_{DC} = J_{DS} \times Exp\left[-\left(\frac{\lambda_{Rn}}{D_e}\right)^{1/2} \times x\right] (Bq\ m^{-2}\ s^{-1}) \qquad (5)$$

Where:

- $\boldsymbol{J_{DC}}$ is the radon flux at the surface of the capping layer in Bq m^{-2} s^{-1}
- $\boldsymbol{J_{DS}}$ is the radon flux from one square meter of the source in Bq m^{-2} s^{-1}
- $\boldsymbol{\lambda_{Rn}}$ is the radon decay constant (2.1×10^{-6} s^{-1} for ^{222}Rn and 12.5×10^{-3} s^{-1} for ^{220}Rn)
- $\boldsymbol{D_e}$ is the effective diffusion coefficient for the capping material in m^2 s^{-1}
- $\boldsymbol{x}$ is the thickness of the capping layer in m

For the sand capping layer to be used, the sand is assumed to have a porosity of 0.25 and a saturation level of 10%. This gives a diffusion coefficient of $D_e = 2.4 \times 10^{-6}$ m^2 s^{-1}. Therefore the capping layer diffusion simplifies to

$$J_{DC} = J_{DS} \times 0.40^{x\,m^{-1}} \ (Bq\ m^{-2}\ s^{-1}) \qquad (6)$$

For ^{222}Rn and

$$J_{DC} = J_{DS} \times (4.5 \times 10^{-32})^{x\,m^{-1}} \ (Bq\ m^{-2}\ s^{-1}) \qquad (7)$$

For ^{220}Rn.

Therefore for the Dalyellup site, the flux at surface of a sand capping layer can be calculated as

$$J_{DC} = C_{Ra} \times 3.5 \times 10^{-4} \times 0.40^{x\,m^{-1}} \ (Bq\ m^{-2}\ s^{-1}) \qquad (8)$$

from equations (3) and (6) for ^{222}Rn and

Equation (7) illustrates clearly that for Thoron (^{220}Rn) the dominant characteristic determining surface flux is the thickness of the capping layer. In fact if the material were pure ^{224}Ra (C_{Ra} = 6 x 10^{18} Bq/kg) the flux through about 65cm of capping would be less than the flux of ^{222}Rn from 1ppm Uranium bearing material (less than the world's crustal average). At 1 metre capping this ratio would be less than 1/1billion. Therefore for the purposes of radon flux through the capping layer, the contribution from Thoron (^{220}Rn) will be disregarded.

Based on historical data [O'Brien 2010] the average ^{226}Ra concentrations in the pond are generally around 1½ times the levels that would be derived from uranium levels. Historically uranium levels averaged around 60ppm with two excursions up to around 200ppm. Therefore ^{226}Ra levels would be expected to be below 4,000 Bq/kg (^{226}Ra analysis shows levels of 2,920 Bq/kg on one occasion with an average of 1,360 Bq/kg) with an average of around 1,500 Bq/kg. Therefore a reasonable upper bound on the radon flux from the surface of the tailings facility uses the average radium concentrations (as the radon flux rates will be dominated by the average radium concentration in the bulk material, not localised elevated levels) and also equation (3) for the future potential clay structure of the tails. This equates to 0.525 Bq m^{-2} s^{-1}. This then provides for an upper bounded radon flux level through the capping layer that can be expressed as

$$J_{DC} = 0.525 \times 0.40^{x\,m^{-1}}\ (Bq\ m^{-2}\ s^{-1}) \qquad (9)$$

For the concentration of Radon due to surface flux, two airborne concentration scenarios have been considered. The first scenario is for an open air situation and the second is for the most severe case scenario assuming an enclosed building (clubhouses?) and assuming worst case of flooring completely transparent to radon diffusion. This all disregards advection caused by wind and barometric changes, as the molecular diffusion process dominates for transport of Radon. The modelling is based upon Standard Temperature and Pressure.

Scenario 1, the open air situation.

A Gaussian area diffusion plume model [Masters, 1998], (treating each square metre as a discreet source and integrating over the total ponds of 400m by 200m, the length and width of the tailings ponds, including the already rehabilitated Southern pond) was used as follows

$$C_{Rn} = \frac{J_D}{\pi \upmu_H \sigma_y \sigma_z} exp\left(\frac{-H^2}{{\sigma_z}^2}\right) exp\left(\frac{-y^2}{{\sigma_y}^2}\right) \qquad (10)$$

Where:

- $\boldsymbol{C_{Rn}}$ is the radon concentration at the point in Bq/m^3
- the vertical dispersion coefficient is $\boldsymbol{\sigma_z}$=0.082$x^{0.736}$ +0.1 for a location $\boldsymbol{x}$ metres from the source (for a conservative situation where atmospheric conditions are stable, atmospheric stability class F)
- the horizontal dispersion coefficient is $\boldsymbol{\sigma_y}$=0.035x + 1.5 for a location $\boldsymbol{x}$ metres from the source (for a conservative situation where atmospheric conditions are stable, atmospheric stability class F)
- the equations used for the dispersion coefficients are geometric power-law relationships derived from the Pasquill Gifford curves. It should be noted that uncertainties for indicator locations closer than 100m to the source, the Pasquill Gifford curves for the diffusion coefficients can display uncertainties of up to 30%
- $\boldsymbol{\mu_H}$ is the average wind speed at the height of the receptor $\boldsymbol{H}$, taken to be 1 metres and
- $\boldsymbol{J_D}$ is the radon flux from one square meter of surface in Bq/m^2/s.

This provides, over the pond, a maximum Radon concentration of

$$C_{Rn} = \frac{J_D}{\upmu_H} \times 88.5 \qquad (11)$$

At the downwind edge of the pond.

A quick check of this value can be done using the Box dispersion model [Schiager 1974]

$$C_{Rn} = \frac{J_D}{\mu_H \sigma_z} \times L \qquad (12)$$

Where ***L*** is the length of the ponds.

In this situation the box model will overestimate concentrations as it does not allow for horizontal dispersion. This is however countered by the fact that there will be some underestimation due to the dispersion of the Radon through the "airshed" not being even in reality. For a conservative situation where atmospheric conditions are stable, atmospheric stability class F, the vertical dispersion coefficient is 6.8 for the pond of length ***L***=400m. This then simplifies equation (12) to

$$C_{Rn} = \frac{J_D}{\mu_H} \times 59 \qquad (13)$$

Which is in order of magnitude agreement with the derived Gaussian model.

From climate data from the Bureau of Meteorology, as the Dalyellup site is located on the coast, wind speeds are generally calm (<0.1m/s) less than 5% of the time and >2m/s more than 75% of the time, with wind speed in excess of 5 m/s more than 40% of the time, therefore the simplified Gaussian model for the Dalyellup tailings pond can be written as

$$C_{Rn} = J_D \times 84.5 \qquad (14)$$

Scenario 2, the enclosed building

A building was considered such that the majority contribution would be from diffusion of the Radon through the floor of the building. The diffusion length of a 20cm thick concrete slab is approximately 20cm therefore less than 65% of radon would be transmitted, however for conservatism the floor is considered completely transparent to Radon. The equation used for radon concentration was derived from UNSCEAR 2000, assuming that no radon is diffused through the walls and where the exchange rate of air in the building was assumed to be once per hour.

$$C_{Rn} = J_D \times 3600/h \qquad (15)$$

Where *h* is the interior height of the ceilings and 3600 is the number of seconds in one hour to account for the air exchange frequency. Assuming a standard ceiling height for clubrooms of 3m, the equation is then

$$C_{Rn} = J_D \times 1200 \qquad (16)$$

This shows that the scenario of considering an enclosed clubroom is the most likely to generate elevated Radon concentrations, at levels approximately 14 times that of outdoors.

Therefore for the two scenarios the resultant equations are respectively (based on equations (9), (14) and (16))

$$C_{Rn} = 44 \times 0.40^{x\,m^{-1}} \quad (Bq\ m^{-3}) \qquad (17)$$
$$C_{Rn} = 630 \times 0.40^{x\,m^{-1}} \quad (Bq\ m^{-3}) \qquad (18)$$

Radon dose levels can then be derived from Radon concentration levels by

$$E = f_e \times T \times C_{Rn} \times DCF \qquad (19)$$

Where:

- ***E*** is the effective dose from exposure to the concentration of radon for the specific time in nSv
- ***fe*** is the equilibrium factor between radon and progeny, currently 0.4 indoors and 0.6 outdoors

- ***T*** is the estimated total exposure time in hours
- ***C_{Rn}*** is the radon concentration in Bq m^{-3}
- ***DCF*** is the dose conversion factor, for radon (^{222}Rn) currently accepted to be 9nSv / (Bq h m^{-3})

Combining (19) with (17) and (18) provides an equation for the doses from radon for the two exposure scenarios of outdoor and indoor respectively

$$E_{od} = T \times 240 \times 0.40^{x\,m^{-1}} \quad (nSv) \qquad (20)$$

$$E_{id} = T \times 2270 \times 0.40^{x\,m^{-1}} \quad (nSv) \qquad (21)$$

These equations can be rearranged to provide hourly dose rates as

$$\Delta E_{od} = 0.24 \times 0.40^{x\,m^{-1}} \quad (\mu Sv\ h^{-1}) \qquad (22)$$

$$\Delta E_{id} = 2270 \times 0.40^{x\,m^{-1}} \quad (nSv\ h^{-1}) \qquad (23)$$

2.2 GAMMA DOSE RATES

For the Dalyellup site the ambient gamma dose rate is modelled for differing levels of capping materials placed over the tailings facility. This is done in two parts, the ambient gamma dose rate from the surface of the tailings being determined first and then the attenuation of that dose rate by a capping layer. The tailings ambient gamma dose rate can be determined both by direct measurement and confirmation by theoretical methods.

Gamma Dose from tailings.

From the UNSCEAR 2000 report, the absorbed gamma dose rate can be determined from the parameters of the tailings material including the Uranium (U) and Thorium (Th) concentrations as per the following equation

$$D = 0.0057 \times ppmU + 0.0025 \times ppmTh \quad (\mu Gy\ h^{-1}) \qquad (24)$$

Where:

- ***D*** is the absorbed gamma dose rate in micro Grays per hour (µGy h^{-1})
- ***ppmU*** is the elemental uranium concentration in parts per million by weight
- ***ppmTh*** is the elemental Thorium concentration in parts per million by weight

For calculating gamma dose from the tailings the water content fraction needs to be taken into account, which was 0.68 based on the Coffey 2001 report. Therefore the previous equation becomes

$$D = 0.32 \times 0.0057 \times ppmU + 0.32 \times 0.0025 \times ppmTh \quad (\mu Gy\ h^{-1}) \qquad (25)$$

where the ppm values are given for the dry material.

Based on historical data [O'Brien 2010] the average U and Th concentrations in the pond for the dry material are 60ppmU with two excursions up to around 200ppmU, and around 850 ppmTh with only two excursions of above 1500ppmTh. Therefore an upper bound on the ambient absorbed gamma dose rate from the surface of the tailings facility using equation (25) is 0.79 µGy h^{-1}. Historical monitoring and calculated dose rates based on average Uranium and Thorium values show results of 0.78 and 0.79 µGy h^{-1}. Therefore a value of **0.79 µGy h^{-1}** will be assumed for the ambient gamma absorbed dose rate from the surface of the tailings.

Reduction of Ambient Gamma dose rate due to attenuation and also distance.

For the tailings facility, the quoted uncapped dose rate of 0.79 µGy h^{-1} is for a height of 1m above the surface of the tailings. However the addition of a capping layer will both raise the measurement point away from the source as well as attenuate the gamma through absorption and scattering.

In terms of the reduction in the gamma levels due to distance, for a point source the relationship between dose rates is

$$I = \frac{I_0}{d^2}\ (\mu Gy\ h^{-1}) \qquad (26)$$

Where:

- ***I*** is the incident gamma level at a point ***d*** metres from the source and
- ***I₀*** is the incident gamma level at a point 1 metre from the source

This equation however does not work for an area source.

For an area electromagnetic radiation source the relationship between intensities is of the form

$$I = I_0 \Bigg/ \left[\frac{ln\left(\frac{R^2+d_0^2}{d_0^2}\right)}{ln\left(\frac{R^2+d^2}{d^2}\right)}\right] \qquad (27)$$

Where:

- ***I*** is the incident radiation level at a point ***d*** metres from the source and
- ***I₀*** is the incident radiation level at a point ***d₀*** metres from the source
- ***d₀*** is 1 meter above the source and
- ***R*** is the radius of the of the area source

This equation is unwieldy to implement for a non-circular source when doing a modelling calculation but can be approximated to within 5% for a source where ***R*** is of the magnitude of 100 to 200 metres by the equation for an area source

$$I = \frac{I_0}{d^u}\ (\mu Gy\ h^{-1}) \qquad (28)$$

Where ***u*** is a function of source geometry and source dimensions in relation to distance from the source. As the distance to the source ***d*** becomes much larger than the dimensions of the source, the value for ***u*** approaches 2 (a point source). However as the source dimensions become much larger than the distance to source, the value for ***u*** approaches 0.2. Therefore an approximation (to within 5%) for the change in the gamma levels for a source the size of the tailings facility is

$$I = \frac{I_0}{d^{0.23}}\ (\mu Gy\ h^{-1}) \qquad (29)$$

The formula for gamma radiation from an area source (approximated by the infinite plane) attenuated due to a shield is

$$I = I_o \times b \times e^{-\mu x}\ (\mu Gy\ h^{-1}) \qquad (30)$$

Where:

- ***I*** is the gamma level after shielding
- ***I₀*** is the incident gamma level from the source before shielding
- ***b*** is the buildup factor, which is dependent on the energy of the incident radiation, the properties of the shielding material and the thickness of the shielding material
- ***x*** is the thickness of the shielding material in m and
- ***μ*** which is the linear attenuation coefficient for the shielding material in m^{-1}

For sand the linear attenuation can be approximated by that of concrete which is 9.9 m^{-1} for natural gamma radiation.

The build up factor is a complex series of relationships generally requiring Monte Carlo modelling for single gamma energies. When multiple energies (as is the case for natural radionuclides) are involved the solution for ***b*** becomes unwieldy. From computer modelling based on data from the American Nuclear Society at the

World Information Services on Energy (WISE) website “External Radiation Dose Calculator” (see http://www.wise-uranium.org/rdcx.html) the following values where obtained for the ratio between attenuation of gamma radiation with (wbu) and without (wobu) build up factors for a set number of shielding thicknesses in concrete.

Shield thickness (m)	**γ +wbu (Uranium)** **γ +wobu**	**γ +wbu (Thorium)** **γ +wobu**
0.25	3.48	2.96
0.5	6.58	5.05
0.75	9.12	7.26
1.0	12.37	9.59
2.5	30.83	25.46

This means that an empirically derived relationship

$b = 10.05x + 0.3$ for dose contribution from thorium
$b = 12.18x + 0.3$ for dose contribution from uranium (31)

can be used which approximates the modelled build up factor values to within 5%. Combing these equations with the values of average uranium and thorium concentrations used for deriving the result of equation (25) gives an equation for the build-up factor of:

$$b = 10.34x + 0.3 \qquad (32)$$

Combining equations (29), (30) and (32) gives the following equation for gamma dose rate through shielding material, noting that *d* in equation (29) is *d = x +1* to account for the 1 metre above ground for ambient.

$$I = \frac{I_0}{(x+1)^{0.23}} \times (10.34x + 0.3) \times e^{-9.9x}\ (\mu Gy\ h^{-1}) \qquad (33)$$

Applying the ambient gamma absorbed dose rate from the surface of the tailings (0.79 μGy h^{-1}) provides an equation for the ambient gamma dose rate above the shielding/capping layer of

$$I = \frac{0.79}{(x+1)^{0.23}} \times (10.34x + 0.3) \times e^{-9.9x}\ (\mu Gy\ h^{-1}) \qquad (34)$$

For effective dose from environmental gamma radiation this equation is multiplied by a factor of 0.7.
Therefore:

$$E = \frac{0.553}{(x+1)^{0.23}} \times (10.34x + 0.3) \times e^{-9.9x}\ (\mu Sv\ h^{-1}) \qquad (35)$$

3 RESULTS AND DISCUSSION

3.1 RADON FLUX – CALCULATED VERSUS MEASURED

The calculated radon flux level for the surface of the tailings, based on equation (3) is 0.525 Bq m^{-2} s^{-1}.

The monitoring of radon flux at site was carried out using E-PERM electrets with a radon drum. The locations are shown in Figure 1. Results are tabled below. The Radon drum measurement returns a radon concentration result in Bq/m^3. This is then converted to a flux value based upon the dimensions of the drum and the duration of the sampling.

Table 1: Radon Flux Measurements at MIC Dalyellup Facility

Location	GPS E (deg)	GPS N (deg)	Duration (min)	C_{Rn} (Bq/m^3)	J_D (Bq/m^2/s)
Background1	33.39130	115.6092	250	<32	0.000
Background2	33.39389	115.6090	235	<32	0.000
NW	*33.39187*	*115.6081*	*112*	*4,562*	*0.035*
MN	*33.39197*	*115.6087*	*117*	*2,405*	*0.017*
NE	**33.39187**	**115.6095**	**105**	**24,301**	**0.196**
ME	*33.39269*	*115.6091*	*114*	*4,722*	*0.035*
SE	*33.39345*	*115.6090*	*96*	*2,477*	*0.022*
SW	**33.39341**	**115.6078**	**118**	**21,817**	**0.157**
MW	*33.39272*	*115.6080*	*119*	*4,715*	*0.034*
M	**33.39288**	**115.6087**	**109**	**21,294**	**0.166**

It should be noted that the Radon concentration readings varied significantly. The lower readings at points NW, MN, ME, SE and MW do not necessarily reflect much lower radon flux rates. The requirement for radon flux measurements is that the base of the radon drum is sealed onto the surface, that way any radon diffusing from the surface collects in the drum. A slight gap will allow radon to diffuse or be vented into the environment, significantly reducing the radon concentration in the drum. This was an issue with the monitoring at the Dalyellup site due to the highly fractured nature of the surface of the tailings. Therefore only the higher readings at NE, SW and M are likely to reflect the true Radon flux rates.

The monitoring data shows values of 30-37% of the modelled values. This may be considered reasonable agreement when considering that the modelling is based upon a situation when the tails is drier than the current state and as was demonstrated in section 2.1 the diffusion coefficients can vary by orders of magnitude depending upon the assumption/measurement of the level of saturation of the material. However it should be pointed out that the modelled values were based on a more conservative approach and a situation likely to more closely reflect the state of the rehabilitated tails, therefor the modelled data shall still be used for risk assessment.

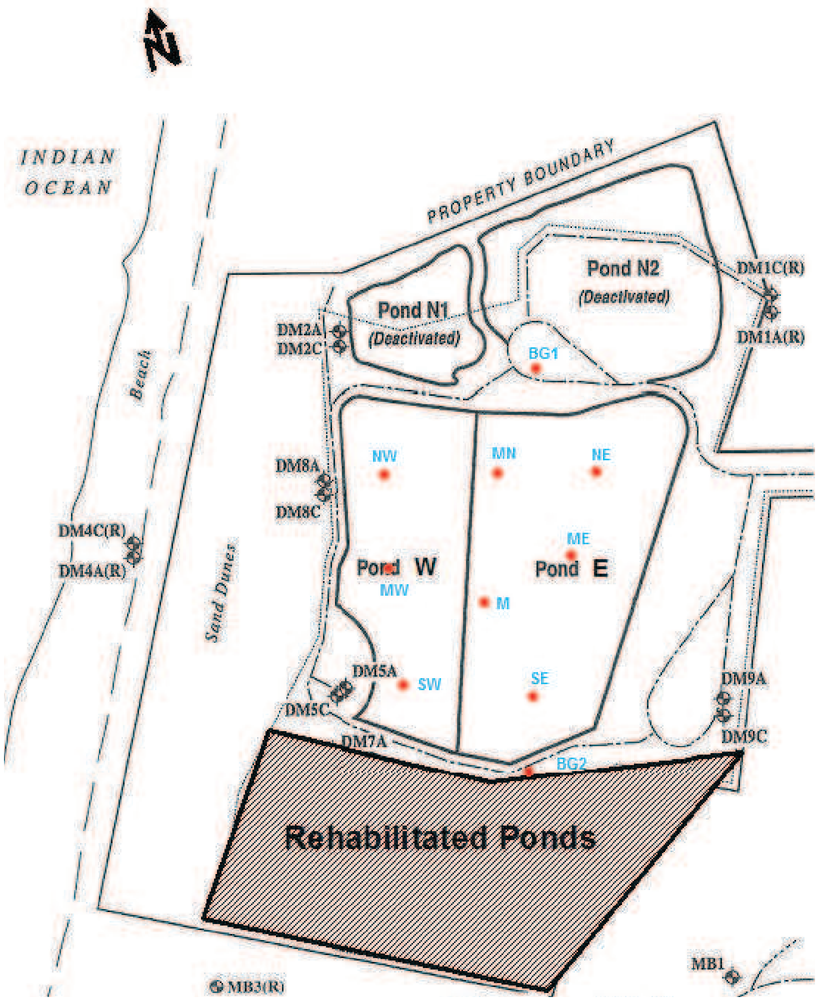

Figure 1: Dalyellup Radon Flux monitoring locations

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3.2 COMBINED MODEL - TOTAL DOSE RATE VS CAPPING LAYER THICKNESS

The dose rate from the radon and from the gamma levels can be combined from equations (22), (23) and (35) into one equation for each of the exposure scenarios.

$$\Delta E_{od} = \frac{0.553}{(x+1)^{0.23}} \times (10.34x + 0.3) \times e^{-9.9x} + 0.24 \times 0.40^{x\, m^{-1}} \; (\mu Sv\; h^{-1}) \qquad (36)$$

$$\Delta E_{id} = \frac{0.553}{(x+1)^{0.23}} \times (10.34x + 0.3) \times e^{-9.9x} + 2.27 \times 0.40^{x\, m^{-1}} \; (\mu Sv\; h^{-1}) \qquad (37)$$

When plotted against capping layer thickness, these two equations provide plots as below

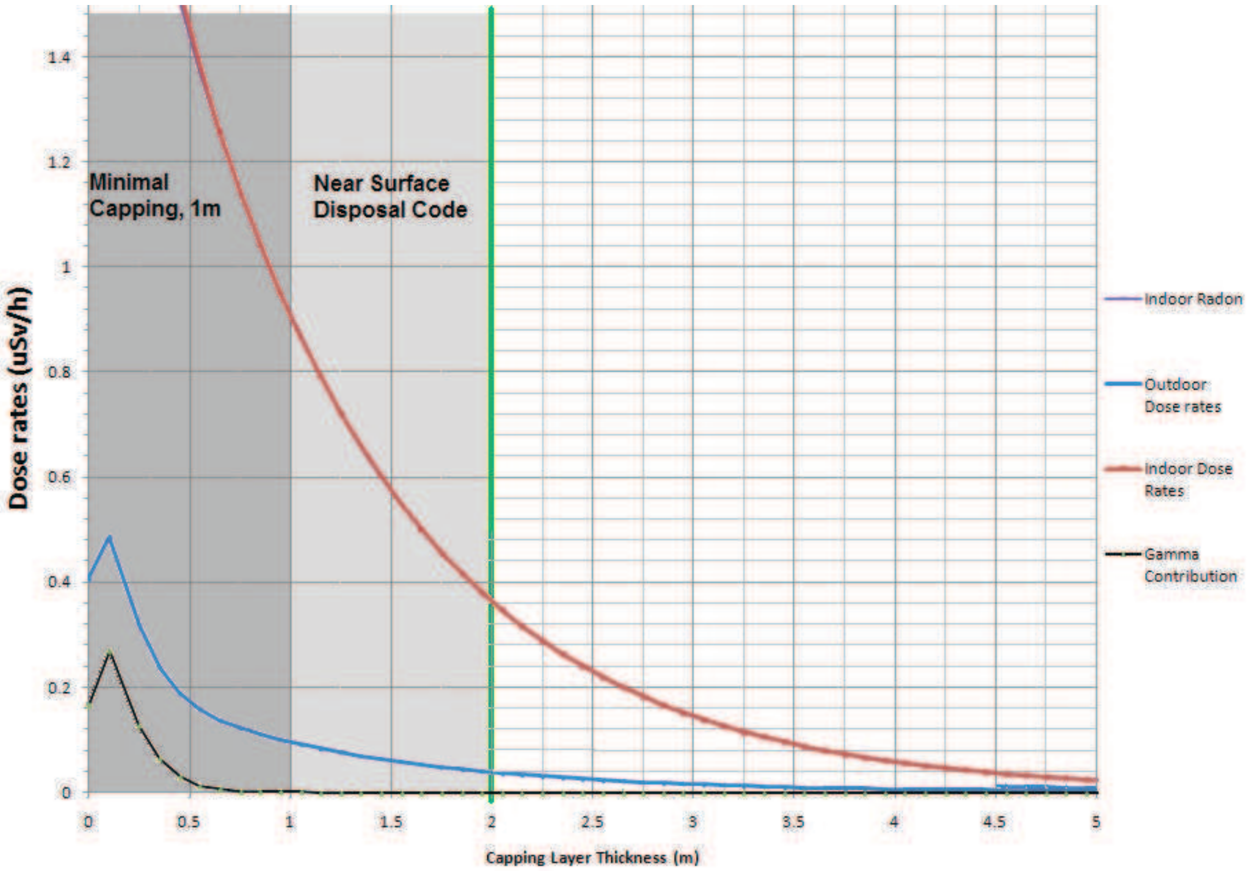

Figure 2: Dose Rate to Capping Layer relationships

It is apparent on this plot that for a capping layer of more than 0.5m thickness there is no appreciable transmission of gamma, so increasing the capping past 2m has no impact on gamma attenuation. The significant contributor to dose for capping thicknesses of greater than 2m will be radon. The minimum capping layer (as per the Near Surface Disposal Code) of two metres show that the dose rates from the gamma and radon combined have dropped below 0.04 μSv h^{-1} for outdoor scenarios, and below 0.4 μSv h^{-1} for indoor scenarios.

4 CONCLUSIONS

The risk assessment has been performed based upon three end user scenarios:

- Light industrial/Heavy recreational (offices, sporting complex) – 2000 h/year inside and 0 h/year outside
- Moderate Recreational (Family/children’s Park) – 0 h/year inside and 1000 h/year outside
- Light Recreational (Sporting fields) –0 h/year inside and 500 h/year outside

Below is a table of calculated total doses as a function of end user scenario and capping layer based on the modelled dose rates

Table 2: Annual Doses vs capping layer thickness for different use scenarios

Capping Layer thickness	Annual Dose (mSv above background)		
	Light Industrial/ Heavy Recreational	Moderate recreational	Light Recreational
1.00	1.82	0.10	0.05
1.25	1.44	0.08	0.04
1.50	1.15	0.06	0.03
1.75	0.91	0.05	0.02
2.00	0.73	0.04	0.02
2.25	0.58	0.03	0.02
2.50	0.46	0.02	0.01
2.75	0.37	0.02	0.01
3.00	0.29	0.02	0.01
3.25	0.23	0.01	0.01
3.50	0.18	0.01	0.00
3.75	0.15	0.01	0.00
4.00	0.12	0.01	0.00

These have then been mapped against four contaminated site categories as listed below:

- 1 – Unrestricted Use - 0.0 mSv/y < DOSE < 0.3 mSv/year
- 2 – Restricted Use - 0.3 mSv/y < DOSE < 1.0 mSv/year
- 3 – Remediation Necessary in Most Cases - 1.0 mSv/y < DOSE < 3.0 mSv/year
- 4 – Remediation Necessary in All Cases - DOSE > 3.0 mSv/y

Table 3: Site categories vs capping layer thickness for different use scenarios

Capping Thickness (m)	Use Scenario		
	Light Industrial	Moderate Rec.	Light Rec.
1.00	3	1	1
1.25	3	1	1
1.50	3	1	1
1.75	2	1	1
2.00	2	1	1
2.25	2	1	1
2.50	2	1	1
2.75	2	1	1
3.00	1	1	1
3.25	1	1	1
3.50	1	1	1
3.75	1	1	1
4.00	1	1	1

The site is likely to be designated for sporting fields or recreational park land. This matrix clearly shows that for the preferred use scenarios, a capping layer of anything more than 1m will place the site into the Unrestricted Use category for radiological purposes.

ONGOING MONITORING:

This is a preliminary desktop risk assessment. As such to finalise the setting of risk categories, monitoring will need to be undertaken at the end of life of the facility to confirm all parameters used and source terms for the modelling. Also ongoing monitoring of radon flux, external gamma radiation levels, radionuclides in water and radionuclides in flora will need to be undertaken after the capping layer has been installed.

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Annex J

Toxicity Profiles

Toxicity Profile Total Solid Residue

Information adopted from MSDS of PRODUCT NAME Millennium Neutralised Waste Solids (MIC, 2007)

SYNONYMS "road base approved landfill"

PRODUCT USE Road base.

1 *HAZARDS IDENTIFICATION*

It is a non-hazardous substance, non-dangerous goods according to NOHSC Criteria, and ADG Code.

COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS 13463-67-7RN	
Chemwatch MSDS (REVIEW)	Revision No: 2.0	Chemwatch 4946-
Issue Date: 6-Dec-2007		CD 2010/1
iron hydroxide	11113-66-9	7-32
aluminium hydroxide	21645-51-2	4-11
tripoli	1317-95-9	0.6-9.9
manganese dioxide	1313-13-9	2-8
calcium chloride	10043-52-4	0.7-4
magnesium carbonate	546-93-0	0.7-3.7
coke		0.3-1.6
water	7732-18-5	20-50

2 *EXPOSURE CONTROLS / PERSONAL PROTECTION EXPOSURE CONTROLS*

Material	Time weighted average (TWA) mg/m^3
Titanium dioxide (Titanium dioxide)	10
tripoli (Silica - Amorphous Fumed silica (respirable dust))	2
manganese dioxide (Silica - Amorphous Fumed silica respirable dust)	2
magnesium carbonate (Magnesite (a))	10

The following materials had no occupational exposure limits (OELs) on our records

- iron hydroxide: CAS:11113-66-9
- calcium chloride: CAS:10043-52-4
- water: CAS:7732-18-5

EMERGENCY EXPOSURE LIMITS

Material	**Revised Immediately dangerous to health and life (IDLH) Value (mg/m3)**
titanium dioxide	5,000
tripoli	50
manganese dioxide	500

2.1 *MATERIAL DATA*

2.1.1 TITANIUM DIOXIDE:

Titanium oxide is classified as part of the sensory irritants which are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the Threshold limit values (TLV) committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.

OSHA (USA) concluded that exposure to sensory irritants can:

- cause inflammation
- cause increased susceptibility to other irritants and infectious agents
- lead to permanent injury or dysfunction
- permit greater absorption of hazardous substances and
- acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

Animal exposed by inhalation to 10 mg/m3 titanium dioxide show no significant fibrosis, possibly reversible tissue reaction. The architecture of lung air spaces remains intact.

2.1.2 IRON HYDROXIDE:

These "dusts" have little adverse effect on the lungs and do not produce toxic effects or organic disease. Although there is no dust which does not evoke some cellular response at sufficiently high concentrations, the cellular response caused by P.N.O.C.s has the following characteristics:

- the architecture of the air spaces remain intact,
- scar tissue (collagen) is not synthesised to any degree,
- tissue reaction is potentially reversible. Extensive concentrations of P.N.O.C.s may:
- seriously reduce visibility,
- cause unpleasant deposits in the eyes, ears and nasal passages,
- contribute to skin or mucous membrane injury by chemical or mechanical action, per se, or by the rigorous skin cleansing procedures necessary for their removal. [ACGIH]

This limit does not apply:

- to brief exposures to higher concentrations
- nor does it apply to those substances that may cause physiological impairment at lower concentrations but for which a TLV has as yet to be determined.

This exposure standard applies to particles which:

- are insoluble or poorly soluble* in water or, preferably, in aqueous lung fluid (if data is available) and
- have a low toxicity (i.e.. are not cytotoxic, genotoxic, or otherwise chemically reactive with lung tissue, and do not emit ionizing radiation, cause immune sensitization, or cause toxic effects other than by inflammation or by a mechanism of lung overload.

2.1.3 ALUMINIUM HYDROXIDE:

The TLV is based on the exposures to aluminium chloride and the amount of hydrolysed acid and the corresponding acid TLV to provide the same degree of freedom from irritation. Workers chronically exposed to aluminium dusts and fumes have developed severe pulmonary reactions including fibrosis, emphysema and pneumothorax. A much rarer encephalopathy has also been described.

2.1.4 TRIPOLI:

The concentration of dust, for application of breathable dust limits, is to be determined from the fraction that penetrates a separator whose size collection efficiency is described by a cumulative log-normal function with a median aerodynamic diameter of 4.0 µm (+-) 0.3 µm and with a geometric standard deviation of 1.5 µm (+-) 0.1 µm, i.e. generally less than 5 µm.

Because the margin of safety of the quartz TLV is not known with certainty and given the associated link between silicosis and lung cancer it is recommended that quartz concentrations be maintained as far below the TLV as prudent practices will allow.

For inhalation exposure ONLY: This substance has been classified by the ACGIH as A2 Suspected Human Carcinogen.

2.1.5 MANGANESE DIOXIDE:

Ceiling values were recommended for manganese and compounds in earlier publications. As manganese is a chronic toxin a TWA is considered more appropriate. Because workers exposed to fume exhibited manganism at air-borne concentrations below those that affect workers exposed to dust a lower value has been proposed to provide an extra margin of safety. This value is still above that experienced by two workers exposed to manganese fume in the course of one study.

A number of studies have shown that susceptibility to the effects of manganese at or about 1 - 5 mg/m3 (TWA) can lead to clinical manifestations of manganism or more commonly to the development of indicators of sub-clinical manganism (e.g. hand tremor, exaggerated reflexes, short-term memory deficits, poor psychomotor performance). Controlling long-term exposure to the recommended ES TWA level or below should provide protection for those individuals susceptible to neurological effects of prolonged exposure.

2.1.6 CALCIUM CHLORIDE:

No TLV has been established until 2007, even though this material may produce adverse health effects (as evidenced in animal experiments or clinical experience).

Airborne concentrations must be maintained as low as is practically possible and occupational exposure must be kept to a minimum.

NOTE: The ACGIH occupational exposure standard for Particles Not otherwise Specified (P.N.O.S) does NOT apply.

Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.

OSHA (USA) concluded that exposure to sensory irritants can:

- cause inflammation
- cause increased susceptibility to other irritants and infectious agents
- lead to permanent injury or dysfunction
- permit greater absorption of hazardous substances and
- acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

2.1.7 *MAGNESIUM CARBONATE:*

At this time no TLV has been established, even though this material may produce adverse health effects (as evidenced in animal experiments or clinical experience). Airborne concentrations must be maintained as low as is practically possible and occupational exposure must be kept to a minimum.

3 *PHYSICAL AND CHEMICAL PROPERTIES APPEARANCE*

Brown solid; does not mix with water. Solid. Does not mix with water. Sinks in water.

CHEMICAL STABILITY: incompatible materials are present, product is considered stable, hazardous polymerisation will not occur.

4 *TOXICOLOGICAL INFORMATION*

4.1 *POTENTIAL HEALTH EFFECTS*

ACUTE HEALTH EFFECTS direct contact - ingestion

Accidental ingestion of the material may be damaging to the health of the individual.

Iron poisoning results in pain in the upper abdomen and vomiting, and is followed hours later by shock, in severe cases coma and death. Iron toxicity increases in proportion to their solubility in the gastrointestinal tract. There is often vomiting of blood due to dilation of capillaries and bleeding from the walls of the gastrointestinal system. A watery diarrhoea can occur, often leading to cardiovascular collapse after fluid and mineral loss and there can be a relapse marked by profound metabolic acidosis after several hours of apparent recovery. There may also be liver damage. Symptoms of poisoning include metallic taste, restlessness, lethargy, loss of muscle tone, coma, pallor or cyanosis (blue-grey skin), fast and weak pulse, low blood pressure, hyperventilation, shock, vasomotor instability and cardiovascular collapse. There may be inflammation, swelling and bleeding from the lungs, convulsions, jaundice, low blood sugar, multiple blood clotting defects, kidney damage with absence of urine, damage to the pancreas, vascular damage, blood loss, shock and vascular collapse. Survivors can display stomach scarring, obstruction or narrowing of digestive tract sphincters, liver hardening or nervous system effects.

Poisonings rarely occur after oral administration of manganese salts because they are poorly absorbed from the gut.

Magnesium salts are generally absorbed so slowly that oral administration causes few toxic effects, as the dose is readily expelled via the bowel. If evacuation fails, mucosal irritation and absorption may result. This can result in nervous system depression, heart effects, loss of reflexes and death due to paralysis of breathing. These usually do not occur unless the bowel or kidneys are damaged.

ACUTE HEALTH EFFECTS EYE

There is some evidence that material may produce eye irritation in some persons and produce eye damage 24 hours or more after instillation. Moderate inflammation may be expected with redness; conjunctivitis may occur with prolonged exposure. The dust may produce eye discomfort and abrasive eye inflammation.

The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

ACUTE HEALTH EFFECTS SKIN

There is some evidence to suggest that the material may cause mild but significant inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterised by redness, swelling and blistering.

Skin contact is not thought to have harmful health effects (as classified under EC Directives); the material may still produce health damage following entry through wounds, lesions or abrasions.

Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.

ACUTE HEALTH EFFECTS INHALATION

The material is not thought to produce either adverse health effects or irritation of the respiratory tract following inhalation (as classified by EC Directives using animal models). Nevertheless, adverse systemic effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting.

CHRONIC HEALTH EFFECTS
Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.
On the basis of limited epidemiological or animal data, it has been concluded that prolonged inhalation of the material, in an occupational setting, may increase the risk of cancer in humans.
Long term exposure to titanium and several of its compounds produces lung scarring and chronic bronchitis. Breathing is impaired and cardiac changes with right heart enlargements occur. There is an increased chance of developing cancers of the respiratory tract.
Chronic excessive intake of iron have been associated with damage to the liver and pancreas. People with a genetic disposition to poor control over iron are at an increased risk. Iron overload in men may lead to diabetes, joint inflammation, liver cancer, heart irregularities and problems with other organs.
Exposure to large doses of aluminium has been connected with the degenerative brain disease Alzheimer's Disease.

4.2 *TOXICITY AND IRRITATION*

None assigned to titanium dioxide. Refer to individual constituents.

TOXICITY and IRRITATION

Oral (Rat) LD50: >20000 mg/kg *

Skin (human): 0.3 mg /3D (int)-Mild * Oral (Mouse) LD50: >10000 mg/kg *
The material may produce moderate eye irritation leading to inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.

For titanium dioxide Human exposure to titanium dioxide can be via inhalation, ingestion or dermal contact. Inhaled titanium dioxide may deposit in lung tissue as well as in lymph nodes causing impaired function of the lungs and its immune system. Absorption by the gastrointestinal tract is particle size-dependent. Skin penetration is only to the outermost layers of the stratum corneum, suggesting that healthy skin may be an effective barrier. There is no substantive data on genetic toxicity, though cases have been reported on some experimental animals. Exposure presents variable cancer causing effect ranging from malignant to benign and to no-cancer effect depending on the animals involved.
* IUCLID

4.2.1 *IRON HYDROXIDE:*

No significant acute toxicological data identified in literature search.

4.2.2 *ALUMINIUM HYDROXIDE:*

Unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY and IRRITATION

Intraperitoneal (Rat) LD: 150 mg/kg

4.2.3 *TRIPOLI:*

Unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.
No significant acute toxicological data identified in literature search.
WARNING: For inhalation exposure ONLY: This substance has been classified by the IARC as Group 1: CARCINOGENIC TO HUMANS
The International Agency for Research on Cancer (IARC) has classified occupational exposures to respirable (<5 um) crystalline silica as being carcinogenic to humans . This classification is based on what IARC considered sufficient evidence from epidemiological studies of humans for the carcinogenicity of inhaled silica in the forms of quartz and cristobalite. Crystalline silica is also known to cause silicosis, a non-cancerous lung disease.

4.2.4 *MANGANESE DIOXIDE:*

Unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

Oral (Rat) LD50: 3478 mg/kg
No significant acute toxicological data identified in literature search.

4.2.5 *CALCIUM CHLORIDE:*

Unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

Oral (rat) LD50: 1000 mg/kg

Skin (unknown): moderate* Eye (unknown): severe* [ICI]
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.

4.2.6 *MAGNESIUM CARBONATE:*

No significant acute toxicological data identified in literature search.

4.2.7 WATER:

No significant acute toxicological data identified in literature search.

CARCINOGEN

- Titanium dioxide - International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs Group 2B
- Silica, amorphous International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs Group 3

5 ECOLOGICAL INFORMATION

5.1 TITANIUM DIOXIDE:

Metal-containing inorganic substances generally have negligible vapour pressure and are not expected to partition to air. Once released to surface waters and moist soils their fate depends on solubility and dissociation in water. Environmental processes (such as oxidation and the presence of acids or bases) may transform insoluble metals to more soluble ionic forms. Microbiological processes may also transform insoluble metals to more soluble forms. Such ionic species may bind to dissolved ligands or sorb to solid particles in aquatic or aqueous media. A significant proportion of dissolved/ sorbed metals will end up in sediments through the settling of suspended particles. The remaining metal ions can then be taken up by aquatic organisms.

When released to dry soil most metals will exhibit limited mobility and remain in the upper layer; some will leach locally into ground water and/ or surface water ecosystems when soaked by rain or melt ice. Environmental processes may also be important in changing solubilities.

Even though many metals show few toxic effects at physiological pHs, transformation may introduce new or magnified effects.

A metal ion is considered infinitely persistent because it cannot degrade further.

The current state of science does not allow for an unambiguous interpretation of various measures of bioaccumulation.

The counter-ion may also create health and environmental concerns once isolated from the metal. Under normal physiological conditions the counter-ion may be essentially insoluble and may not be bioavailable. Environmental processes may enhance bioavailability.

5.2 IRON HYDROXIDE:

Ecotoxicity:

Fish 12 mg/l (245 months) (Growth) Brook trout (Salvelinus fontinalis)

5.3 ALUMINIUM HYDROXIDE:

No discharge into sewer or waterways is permitted.

For aluminium and its compounds and salts:

Environmental fate:

Aluminium occurs in the environment in the form of silicates, oxides and hydroxides, combined with other elements such as sodium, fluorine and arsenic complexes with organic matter.

Acidification of soils releases aluminium as a transportable solution. Mobilisation of aluminium by acid rain results in aluminium becoming available for plant uptake.

As an element, aluminium cannot be degraded in the environment, but may undergo various precipitation or ligand exchange reactions. Aluminium in compounds has only one oxidation state (+3), and would not undergo oxidation-reduction reactions under environmental conditions. Aluminium can be complexed by various ligands present in the environment (e.g., fulvic and humic acids). The solubility of aluminium in the environment will depend on the ligands present and the pH.

The trivalent aluminium ion is surrounded by six water molecules in solution. The hydrated aluminium ion, [Al(H2O)6]3+, undergoes hydrolysis, in which a stepwise deprotonation of the coordinated water ligands forms bound hydroxide ligands (e.g., [Al(H2O)5(OH)] 2+, [Al(H2O)4(OH)2]+). The speciation of aluminium in water is pH dependent. The hydrated trivalent aluminium ion is the predominant form at pH levels below 4. Between pH 5 and 6, the predominant hydrolysis products are Al(OH)2+ and Al(OH)2+, while the solid Al(OH)3 is most prevalent between pH 5.2 and 8.8. The soluble species Al(OH)4- is the predominant species above pH 9, and is the only species present above pH 10. Polymeric aluminium hydroxides appear between pH 4.7 and 10.5, and increase in size until they are transformed into colloidal particles of amorphous Al(OH)3, which crystallise to gibbsite in acid waters.

Polymerisation is affected by the presence of dissolved silica; when enough silica is present, aluminium is precipitated as poorly crystallised clay mineral species.

Hydroxyaluminium compounds are considered amphoteric (e.g., they can act as both acids and bases in solution). Because of this property, aluminium hydroxides can act as buffers and resist pH changes within the narrow pH range of 4-5.

Monomeric aluminium compounds, typified by aluminium fluoride, chloride, and sulfate, are considered reactive or labile compounds, whereas polymeric aluminium species react much more slowly in the environment. Aluminium has a stronger attraction for fluoride in an acidic environment compared to other inorganic ligand.

The adsorption of aluminium onto clay surfaces can be a significant factor in controlling aluminium mobility in the environment, and these adsorption reactions, measured in one study at pH 3.0-4.1, have been observed to be very rapid. However, clays may act either as a sink or a source for soluble aluminium depending on the degree of aluminium saturation on the clay surface.

Within the pH range of 5-6, aluminium complexes with phosphate and is removed from solution. Because phosphate is a necessary nutrient in ecological systems, this immobilization of both aluminium and phosphate may result in depleted nutrient states in surface water.

Plant species and cultivars of the same species differ considerably in their ability to take up and translocate aluminium to above- ground parts. Tea leaves may contain very high concentrations of aluminium, >5,000 mg/kg in old leaves.

Other plants that may contain high levels of aluminium include Lycopodium (Lycopodiaceae), a few ferns, Symplocos (Symplocaceae), and Orites (Proteaceae). Aluminium is often taken up and concentrated in root tissue. In sub-alpine ecosystems, the large root biomass of the Douglas fir, Abies amabilis, takes up aluminium and immobilizes it, preventing large accumulation in above-ground tissue. It is unclear to what extent aluminium is taken up into root food crops and leafy vegetables. An uptake factor (concentration of aluminium in the plant/concentration of aluminium in soil) of 0.004 for leafy vegetables and 0.00065 for fruits and tubers has been reported, but the pH and plant species from which these uptake factors were derived are unclear. Based upon these values, however, it is clear that aluminium is not taken up in plants from soil, but is instead biodiluted.

Aluminium concentrations in rainbow trout from an alum-treated lake, an untreated lake, and a hatchery were highest in gill tissue and lowest in muscle. Aluminium residue analyses in brook trout have shown that whole-body aluminium content decreases as the fish advance from larvae to juveniles. These results imply that the aging larvae begin to decrease their rate of aluminium uptake, to eliminate aluminium at a rate that exceeds uptake, or to maintain approximately the same amount of aluminium while the body mass increases. The decline in whole-body aluminium residues in juvenile brook trout may be related to growth and dilution by edible muscle tissue that accumulated less aluminium than did the other tissues.

The greatest fraction of the gill-associated aluminium was not sorbed to the gill tissue, but to the gill mucus. It is thought that mucus appears to retard aluminium transport from solution to the membrane surface, thus delaying the acute biological response of the fish. It has been reported that concentrations of aluminium in whole-body tissue of the Atlantic salmon exposed to high concentrations of aluminium ranging from 3 ug/g (for fish exposed to 33 ug/L) to 96 ug/g (for fish exposed to 264 ug/L) at pH 5.5.

After 60 days of exposure, BCFs ranged from 76 to 190 and were directly related to the aluminium exposure concentration. In acidic waters (pH 4.6-5.3) with low concentrations of calcium (0.5-1.5 mg Ca/L), labile aluminium between 25 and 75 µg/L is toxic. Because aluminium is toxic to many aquatic species, it is not bioaccumulated to a significant degree (BCF <300) in most fish and shellfish; therefore, consumption of contaminated fish does not appear to be a significant source of aluminium exposure in humans. Bioconcentration of aluminium has also been reported for several aquatic invertebrate species. BCF values ranging from 0.13 to 0.5 in the whole-body were reported for the snail. Bioconcentration of aluminium has also been reported for aquatic insects.

Ecotoxicity

1. **Freshwater species pH >6.5**

Fish: Acute LC50 (48-96 h) 5 spp: 0.6 (Salmo salar) - 106 mg/L; Chronic NOEC (8-28 d): 7 spp,NOEC, 0.034-7.1 mg/L. The lowest measured chronic figure was an 8-d LC50 of 0.17 mg/L for Micropterus sp.

Amphibian: Acute LC50 (4 d): Bufo americanus, 0.86-1.66 mg/L; Chronic LC50 (8-d) 2.28 mg/L Crustaceans LC50 (48 h): 1 sp 2.3-36 9 mg/L; Chronic NOEC (7-28 d) 3 spp, 0.136-1.72 mg/L

Algae EC50 (96 h): population growth, 0.46-0.57 mg/L; 2 spp, chronic NOEC, 0.8-2.0 mg/L

2. **Freshwater species pH <6.5 (all between pH 4.5 and 6.0)**

Fish LC50 (24-96 h): 4 spp, 0.015 (S. trutta) - 4.2 mg/L; chronic data on Salmo trutta, LC50 (21-42 d) 0.015- 0.105 mg/L Amphibians LC50 (4-5 d): 2 spp, 0.540-2.670 m/L (absolute range 0.40-5.2 mg/L)

Alga: 1 sp NOEC growth 2.0 mg/L

Among freshwater aquatic plants, single-celled plants are generally the most sensitive to aluminium. Fish are generally more sensitive to aluminium than aquatic invertebrates. Aluminium is a gill toxicant to fish, causing both ionoregulatory and respiratory effects.

The bioavailability and toxicity of aluminium is generally greatest in acid solutions. Aluminium in acid habitats has been observed to be toxic to fish and phytoplankton. Aluminium is generally more toxic over the pH range 4.4.5.4, with a maximum toxicity occurring around pH 5.0.5.2. The inorganic single unit aluminium species (Al(OH)2 +) is thought to be the most toxic. Under very acid conditions, the toxic effects of the high H+ concentration appear to be more important than the effects of low concentrations of aluminium; at approximately neutral pH values, the toxicity of aluminium is greatly reduced. The solubility of aluminium is also enhanced under alkaline conditions, due to its amphoteric character, and some researchers found that the acute toxicity of aluminium increased from pH 7 to pH 9. However, the opposite relationship was found in other studies. The uptake and toxicity of aluminium in freshwater organisms generally decreases with increasing water hardness under acidic, neutral and alkaline conditions. Complexing agents such as fluoride, citrate and humic substances reduce the availability of aluminium to organisms, resulting in lower toxicity. Silicon can also reduce aluminium toxicity to fish. Drinking Water Standards:

aluminium: 200 ug/l (UK max.) 200 ug/l (WHO guideline)
chloride: 400 mg/l (UK max.)250 mg/l (WHO guideline
fluoride: 1.5 mg/l (UK max.)1.5 mg/l (WHO guideline)
nitrate: 50 mg/l (UK max.) 50 mg/l (WHO guideline)
sulfate: 250 mg/l (UK max.)

5.4 TRIPOLI:

For silica the literature on the fate of silica in the environment concerns dissolved silica in the aquatic environment, irrespective of its origin (man-made or natural), or structure (crystalline or amorphous). Indeed, once released and dissolved into the environment no distinction can be made between the initial forms of silica. At normal environmental pH, dissolved silica exists exclusively as monosilicic acid [Si(OH)4]. At pH 9.4 the solubility of amorphous silica is about 120 mg SiO2/l . Quartz has a solubility of only 6 mg/l, but its rate of dissolution is so slow at ordinary temperature and pressure that the solubility of amorphous silica represents the upper limit of dissolved silica concentration in natural waters. Moreover, silicic acid is the bioavailable form for aquatic organisms and it plays an important role in the biogeochemical cycle of Si, particularly in the oceans.

In the oceans, the transfer of dissolved silica from the marine hydrosphere to the biosphere initiates the global biological silicon cycle. Marine organisms such as diatoms, silicoflagellates and radiolarians build up their skeletons by taking up silicic acid from seawater. After these organisms die, the biogenic silica accumulated in them partly dissolves. The portion of the biogenic silica that does not dissolve settles and ultimately reaches the sediment. The transformation of opal (amorphous biogenic silica) deposits in sediments through diagenetic processes allows silica to re-enter the geological cycle. Silica is labile between the water and sediment interface.

Ecotoxicity

Fish LC50 (96 h): Brachydanio rerio >10000 mg/l;
zebra fish >10000 mg/l
Daphnia magna EC50 (24 h): >1000 mg/l; LC50 924 h): >10000 mg/l.

5.5 MANGANESE DIOXIDE:

The information below is relevant for manganese and its compounds:

Environmental fate

It has been established that while lower organisms (e.g., plankton, aquatic plants, and some fish) can significantly bioconcentrate manganese, higher organisms (including humans) tend to maintain manganese homeostasis. This indicates that the potential for biomagnification of manganese from lower trophic levels to higher ones is low.

There were two mechanisms involved in explaining the retention of manganese and other metals in the environment by soil. First, through cation exchange reactions, manganese ions and the charged surface of soil particles form manganese oxides, hydroxides, and oxyhydroxides which in turn form absorption sites for other metals. Secondly, manganese can be adsorbed to other oxides, hydroxides, and oxyhydroxides through ligand exchange reactions. When the soil solution becomes saturated, these manganese oxides, hydroxides, and oxyhydroxides can precipitate into a new mineral phase and act as a new surface to which other substances can absorb.

The tendency of soluble manganese compounds to adsorb to soils and sediments depends mainly on the cation exchange capacity and the organic composition of the soil. The soil adsorption constants (the ratio of the concentration in soil to the concentration in water) for Mn(II) span five orders of magnitude, ranging from 0.2 to 10,000 mL/g, increasing as a function of the organic content and the ion exchange capacity of the soil; thus, adsorption may be highly variable. In some cases, adsorption of manganese to soils may not be a readily reversible process. At low concentrations, manganese may be "fixed" by clays and will not be released into solution readily. At higher concentrations, manganese may be desorbed by ion exchange mechanisms with other ions in solution. For example, the discharge of waste water effluent into estuarine environments resulted in the mobilization of manganese from the bottom sediments. The metals in the effluent may have been preferentially adsorbed resulting in the release of manganese. The oxidation state of manganese in soil and sediments may be altered by microbial activity; oxidation may lead to the precipitation of manganese. Bacteria and microflora can increase the mobility of manganese.

The transport and partitioning of manganese in water is controlled by the solubility of the specific chemical form present, which in turn is determined by pH, Eh (oxidation-reduction potential), and the characteristics of the available anions. The metal may exist in water in any of four oxidation states.

Manganese(II) predominates in most waters (pH 4-7) but may become oxidized at a pH >8 or 9. The principal anion associated with Mn(II) in water is usually carbonate (CO3.2), and the concentration of manganese is limited by the relatively low solubility (65 mg/L) of MnCO3. In relatively oxidized water, the solubility of Mn(II) may be controlled by manganese oxide equilibria, with manganese being converted to the Mn(II) or Mn(IV) oxidation states. In extremely reduced water, the fate of manganese tends to be controlled by formation of a poorly soluble sulfide. Manganese in water may undergo oxidation at high pH or Eh and is also subject to microbial activity. For example, Mn(II) in a lake was oxidized during the summer months, but this was inhibited by a microbial poison, indicating that the oxidation was mediated by bacteria . The microbial metabolism of manganese is presumed to be a function of pH, temperature, and other factors.

Manganese in water may be significantly bioconcentrated at lower trophic levels. A bioconcentration factor (BCF) relates the concentration of a chemical in plant and animal tissues to the concentration of the chemical in the water in which they live. The BCF of manganese was estimated as 2,500 - 6,300 for phytoplankton, 300 -5,500 for marine algae, 80 - 830 for intertidal mussels, and 35 - 930 for coastal fish. Similarly, the BCF of manganese was estimated to be 10,00 - 20,000 for marine and freshwater plants, 10,000 - 40,000 for invertebrates, and 10 - 600 for fish. In general, these data indicate that lower organisms such as algae have larger BCFs than higher organisms. In order to protect consumers from the risk of manganese bioaccumulation in marine mollusks, the U.S. EPA has set a criterion for manganese at 0.1 mg/L for marine waters.

Elemental manganese and inorganic manganese compounds have negligible vapor pressures but may exist in air as suspended particulate matter derived from industrial emissions or the erosion of soils. Manganese-containing particles are mainly removed from the atmosphere by gravitational settling, with large particles tending to fall out faster than small particles. The half-life of airborne particles is usually on the order of days, depending on the size of the particle and atmospheric conditions. Some removal by washout mechanisms such as rain may also occur, although it is of minor significance in comparison to dry deposition.

Ecotoxicity:
Manganese ion is toxic to aqueous organisms Fish LC50 (28 d): orfe 2490 mg/l, trout 2.91 mg/l Daphnia magna LC50: 50 mg/l
Pseudomonas putida LC50: 10.6 mg/l
Photobacterium phosphoreum LC50: 14.7 mg/l
Turbellarian worms (EC0): Polycelis nigra 660 mg/l
(interference threshold); microregma 31 mg/l.

5.6 CALCIUM CHLORIDE:

Fish LC50 (96hr.) (mg/l): 8.4 (24hr)

Although inorganic chloride ions are not normally considered toxic they can exist in effluents at acutely toxic levels (chloride >3000 mg/l). The resulting salinity can exceed the tolerances of most freshwater organisms.

Inorganic chlorine eventually finds its way into the aqueous compartment and as such is bioavailable. Incidental exposure to inorganic chloride may occur in occupational settings where chemicals management policies are improperly applied. The toxicity of chloride salts depends on the counter-ion (cation) present; that of chloride itself is unknown. Chloride toxicity has not been observed in humans except in the special case of impaired sodium chloride metabolism, e.g. in congestive heart failure. Healthy individuals can tolerate the intake of large quantities of chloride provided that there is a concomitant intake of fresh water.

Although excessive intake of drinking-water containing sodium chloride at concentrations above 2.5 g/litre has been reported to produce hypertension, this effect is believed to be related to the sodium ion concentration.

Chloride concentrations in excess of about 250 mg/litre can give rise to detectable taste in water, but the threshold depends upon the associated cations. Consumers can, however, become accustomed to concentrations in excess of 250 mg/litre. No health- based guideline value is proposed for chloride in drinking-water.

In humans, 88% of chloride is extracellular and contributes to the osmotic activity of body fluids. The electrolyte balance in the body is maintained by adjusting total dietary intake and by excretion via the kidneys and gastrointestinal tract. Chloride is almost completely absorbed in normal individuals, mostly from the proximal half of the small intestine. Normal fluid loss amounts to about 1.5-2 l/day, together with about 4 g of chloride per day. Most (90 - 95%) is excreted in the urine, with minor amounts in faeces (4-8%) and sweat (2%).

Chloride increases the electrical conductivity of water and thus increases its corrosivity. In metal pipes, chloride reacts with metal ions to form soluble salts thus increasing levels of metals in drinking-water. In lead pipes, a protective oxide layer is built up, but chloride enhances galvanic corrosion. It can also increase the rate of pitting corrosion of metal pipes.

5.7 *MAGNESIUM CARBONATE*

No effects known until 2007.

Ecotoxicity

Ingredient	Persistence Water/soil	Persistence air	Bioaccumulation	Mobility
Titanium dioxide	high		Low	High
Tripoli	Low		Low	High
Manganese dioxide	Low		Low	High
Calcium chloride			Low	
Magnesium carbonate	Low		Low	High
Water	low		low	high

AECOM Australia Pty Ltd
Level 21, 420 George Street
Sydney NSW 2000
PO Box Q410
QVB Post Office NSW 1230
Australia
www.aecom.com

+61 2 8934 0000 tel
+61 2 8934 0001 fax
ABN 20 093 846 925

11 December 2014

Peter Allen
Cristal Pigment Australia
Lot 1 Marriott Road
Kemerton Industrial Park
Kemerton WA 6233

Dear Peter

Site Auditor Interim Advice
2013 Dalyellup Annual Environmental Report

1.0 Introduction

Jason Clay of AECOM Australia Pty Ltd (AECOM) has been engaged by Cristal Pigment Australia Ltd (Cristal) (previously known as Millennium Inorganic Chemicals (MIC) and Cristal Global) as a Western Australia Department of Environment Regulation (WA DER) Accredited Contaminated Site Auditor (under the *Contaminated Sites Act 2003*) for the Dalyellup Waste Residue Disposal Facility, located on Minninup Road, Dalyellup, Western Australia (‘the Site’).

Cristal has prepared an Annual Environmental Report, in accordance with the requirements of the Closure Notice issued by WA DER on 1 August 2013. This letter presented the Site Auditor’s review of the Annual Environmental Report.

2.0 Background

The Site operated as a licenced facility for the disposal of treated solid residue from the production of titanium dioxide pigment between March 1989 and March 2013. The Site was issued a Closure Notice from the DER on 14 May 2013. This Closure Notice was revised on 1 August 2013. Pursuant to Section 68A(1) of the *Environmental Protection Act 1986*, DER provided the Closure Notice to the Western Australian Planning Commission and the Western Australian Land Information Authority for registration.

It is understood that the Shire of Capel and Cristal have agreed to a conceptual plan to redevelop the Site into recreational grounds (sporting fields). The Site has been classified under the *Contaminated Sites Act 2003* as ‘*Possibly Contaminated – Investigation Required*’. Accordingly, further environmental assessment in accordance with DER guidance is required prior to the Site being classified as suitable for the proposed redevelopment as a public open space.

3.0 Document Reviewed

The Auditor has undertaken a review of the following document:

- Cristal (2014) *2013 Dalyellup Annual Environmental Report*. 27 June 2014.

4.0 Technical Review

The Auditor has undertaken a review of the Annual Environmental Report to assess whether it meets the requirements of the Closure Notice, dated 1 August 2013.

The Auditor’s review comments are provided in grey shaded boxes throughout this letter for ease of reading.

4.1 Introduction and Site Identification

Sections 1.0 to 3.0 presented the introduction and site information, including the background, source of treated solid residue (TSR), site history, hydrogeology and disposal rates.

The Auditor considers that these sections provide clear background information on the Site.

4.2 Groundwater Monitoring

Section 4.0 presented information on groundwater monitoring at the Site, including a discussion of the groundwater monitoring network and groundwater monitoring programs. Groundwater monitoring has been undertaken at a number of locations across the Site since the commencement of operations in March 1989. Groundwater results were presented in Appendix D.

The Auditor considers that the information presented in this section is generally adequate for the purposes of the

Closure Notice; however the Auditor notes the following:

- It is more appropriate to present individual results from groundwater monitoring events and compare these against the adopted criteria, rather than only presenting statistical data. It may also be useful to present the data graphically to allow trends in contaminant concentrations to be observed.
- Any exceedances of the adopted criteria should be clearly identified within the results tables.
- A number of contaminants which have been stipulated in the Closure Notice have not been presented in Table 6 to Table 8, including boron, iron, manganese, molybdenum, total dissolved solids, calcium, chloride, magnesium nitrate, potassium, sodium, bicarbonate and carbonate. Furthermore it is noted that no molybdenum results have been presented in Appendix D.
- The results from the Yarragadee Bore (YB) should also be compared against the ANZECC (2000) Marine Water Guidelines.
- The discussion of results should be updated based on the changes highlighted by the Auditor.
- A review of the groundwater results presented in Appendix D indicates that biannual groundwater monitoring has not been undertaken in accordance with the Closure Notice.

4.3 Radiation Monitoring Results

Section 5.0 presented a summary of the radiation monitoring results. Detailed radiation monitoring reports were presented in Appendix G.

Based on the results from radiation monitoring it was concluded that, following the rehabilitation of the pond area (comprising capping with 3 – 4 m of fill), radiation levels across the area were reflective of background conditions.

The Auditor is currently getting this section reviewed by his radiological expert support team and will respond under a separate cover.

4.4 Licence Compliance and Incidents

Section 6.0 presented a summary of licence compliance and incident information. The Closure Notice was presented in Appendix A.

The Auditor notes the following in relation to the information presented in this section:

- There was no evidence of molybdenum analysis being undertaken on groundwater samples in the results presented in Appendix D. This non-conformance with the Closure Notice should be discussed in the report.
- Cristal should include evidence within the report that groundwater sampling was undertaken in accordance with AS/NZS 5667.11 and that laboratory analysis of groundwater samples was undertaken by a NATA accredited laboratory.
- The first round of biannual groundwater monitoring should have commenced between 1 July 2013 and 31 December 2013; however the Auditor notes that groundwater monitoring in accordance with the Closure Notice does not appear to have been undertaken during this period.
- The Closure Notice required dust monitoring whilst the ponds remained uncovered. The Auditor notes that there was a period of approximately 1 month (August 2013 to September 2013), when the ponds were uncovered and no dust monitoring was undertaken. Cristal should include a discussion of why no dust monitoring was undertaken during this period.
- As noted previously, the individual groundwater results should be tabulated against the adopted guidelines, rather than comparing statistical results to the guidelines.

4.5 Ministerial Conditions and Company Commitments

Section 7.0 presented a summary of compliance with the Ministerial Conditions. The Ministerial Conditions were presented in Appendix B.

The Auditor considers that the information presented in this section is generally adequate for the purposes of the Closure Notice and Ministerial Conditions.

As a minor note, the incorrect figure references are presented in Section 7.4.

5.0 Closure

Should you have any queries relating to the above review, please do not hesitate to contact Jason Clay.

Yours sincerely
For **AECOM Australia Pty Ltd**

Jason Clay

Jason Clay
WA DER Accredited Contaminated Sites Auditor
jason.clay@aecom.com

Mobile: +61 410 431 674
Direct Dial: +61 2 8934 0164
Direct Fax: +61 2 8934 0001

This interim site audit advice is not a Mandatory Auditor’s Report, but forms part of the Site Audit process. It is intended that a Mandatory Auditor’s Report will be issued at the completion of the site audit.

Consistent with WA DER requirements for staged “sign-off” of sites that are the subject of progressive assessment, remediation and validation, the Auditor is required to advise that:

- This site audit advice does not constitute a Mandatory Auditor’s Report.
- This interim advice is considered by the Auditor to be consistent with WA DER guidelines and policies.
- This interim advice will be included in the final Mandatory Auditor’s Report and associated documentation.

Government of **Western Australia**
Department of **Environment Regulation**

Your ref
Our ref DER2013/181 DMO1323
Enquiries Melanie Nunn
Phone 9333 7467
Fax 9333 7575
Email melanie.nunn@der.wa.gov.au

Jason Clay
Senior Principal
Senversa Pty Ltd
Level 14, 309 Kent Street,
Sydney NSW 2000

Dear Jason

MANDATORY AUDITORS REPORT, DALYELLUP TAILINGS FACILITY

Thank you for submitting the report "Mandatory Auditor's Report – Dalyellup Tailings Facility (AECOM 20 July 2015) (the MAR) and supporting consultants' reports to the Department of Environment Regulation (DER). The reports were received on 21 July 2015.

The former Dallyellup Tailings Facility (the site) operated under Part IV of the *Environmental Protection Act 1986* (licence L6130/1989/12). The site operated as a licenced facility for the disposal of Treated Solid Residue (TSR) from the production of titanium dioxide pigment between March 1989 and March 2013. The site comprised waste disposal ponds (two northern ponds, one central pond and two southern ponds), with the remainder of this lot being access roads and coastal dunes. The site was issued a Closure Notice by DER on 14 May 2013. This Closure Notice was revised on 1 August 2013.

DER notes that an interim MAR was submitted to DER in October 2013 in relation to the 'Dalyellup Facility Final Closure Plan-Remediation-Validation-Ongoing Closure Report-June 2013' (the Closure Plan). The Closure Plan was prepared in order to satisfy the conditions of Ministerial Statements (Condition 4 of Ministerial Statement 213; and Condition 4-1 of Ministerial Statement 332).

These conditions read as follows:

Ministerial Statement 213, Condition 4 reads "the proponent shall be responsible for decommissioning and removal of the plant and installations and rehabilitating the site and its environs, to the satisfaction of the Environmental Protection Authority. At least six months prior to decommissioning, the proponent shall prepare and subsequently implement a decommissioning and rehabilitation plan, to the satisfaction of the Environmental Protection Authority.'"

Ministerial Statement 332 Condition 4-1 reads "At least six months prior to any planned decommissioning of the site, the proponent shall prepare a final rehabilitation programme to the requirements of the Radiological Council and the Environmental Protection Authority on advice of the Shire of Capel."

These conditions were cleared by the Environmental Protection Authority in a letter dated 8 April 2015.

As stated in the MAR, this audit falls under the requirements of Regulation 31(1)(c) of the Contaminated Sites Regulations 2006 and relates to Condition 4-2 of Ministerial Statement 332, published 6 December 1993 which reads as follows:

Ministerial Statement 332 Condition 4-2 reads "The proponent shall implement the programme required by condition 4-1."

DER, the Department of Health (DoH) and the Radiological Council (RC) have reviewed the MAR and supporting documentation. Further information is required prior to the reclassification of the site. Specific information required by DoH and RC is provided in technical advice letters included as Attachment 1 and Attachment 2. DER concurs with DoH and RC advice and has included the following DER comments which should be read in conjunction with DoH and RC technical advice letters.

Potential Leachate and Ecological Risks:

With regards to travel time of leachate from the pond area to the water table, asserting that it will take 30 years for water to travel from the residue storage area to the water table is not correct. Dating of water at the water table in coastal areas suggests that water is only a few years old even when the water table is 20 to 30m deep.

With regard to the leaching tests that were undertaken at the site, the ASLP leaching procedure is unlikely to give a good indication of the leachability of the residues under chemical conditions present in soils. In particular, there is likely to be an elevated partial pressure of carbon dioxide in soil pore water. This chemical factor, together with the presence of nitrate leached from the application of fertiliser on turf overlying the residue containment area, is likely to exacerbate the mobilisation of uranium and some other chemical constituents from the residues. The ongoing irrigation of turf is also likely to produce sufficient infiltration of water through the residues to transport soluble chemical constituents away from the residue storage area.

Additionally, DER considers that there has been an inadequate assessment of radionuclides in groundwater and in the groundwater discharge zone. The proponent has assumed that radiological constituents in the wastes will have a limited leachability and will not infiltrate to the water table. This assumption is unlikely to be the case for radium in particular which has similar behaviours to calcium. It is noted from the reports provided that large amounts of calcium appeared to be leaching from the waste material in the pond, which suggests that radium will be leaching as well.

DER agrees that local hydrogeological conditions will make it unlikely that contamination from the residues will infiltrate into the Yarragadee aquifer.

Given the above, further information is requested regarding the potential leachability of chemicals of concern with regards to ongoing irrigation, including increased nutrient input through fertiliser use and the proposed reuse of waste water.

Environmental Management Plan

DER understands that the Environmental Management Plan (EMP) for the site has been prepared in order to detail the ongoing monitoring and management in accordance with proposed closure and rehabilitation measures. Revision of the proposed EMP is required to ensure that the appropriate monitoring and management strategies are in place, and that the implementation of these strategies aligns with current guidance.

The duration of the monitoring program needs to be reviewed and DER considers it is likely that groundwater monitoring will be required for a period greater than 5 years. There is some uncertainty in the travel time of groundwater and the potential leachability of chemicals of potential concern as a consequence of the proposed irrigation regime and intense fertiliser use. There is also some uncertainty relating to risks to the marine environment.

DER would like to reiterate RC advice that no disturbance of tailings material is permitted and that a minimum of 2m of clean fill should be maintained at all times across the site. The EMP should be updated to ensure that this criterion is met. There is insufficient information around how excavations will be managed, particularly at depths greater than 1m. While a radiation management plan is proposed, further detail is required as to what standards/guidelines will be adopted and how this aligns with RC advice.

DER notes that the EMP proposes the potential for the construction of an abstraction bore down gradient of the recharge area. DER would like to reiterate, and based on Auditor recommendations for restriction on land use, that groundwater abstraction, including dewatering, is not permitted at the site.

As the Closure Notice (6130/1989/12) is due for review (October 2015), consideration should also be given to any amendments included as a consequence of this review. Any relevant changes should be included, or referenced for inclusion, in the amended EMP.

Please note that other issues may need to be considered in addition to the comments above to ensure this EMP meets the standards required. When further information is submitted, DER will assess and consider the reclassification of the site.

If you have any further queries, please contact Contaminated Sites Officer, Melanie Nunn, on 9333 7467.

Yours sincerely

Paul Newell
A/SENIOR MANAGER
CONTAMINATED SITES

3 November 2015

c.c.
Cristal Pigment Australia, Peter Allen
Office of Environmental Protection Authority, General Manager
Department of Health, Martin Matisons
Radiological Council, Duncan Surin

Attachment 1: Department of Health-Environmental Health Directorate advice letter dated 19 August 2015
Attachment 2: Radiological Council advice letter dated 29 September 2015

DEC 1637
A980113

Government of **Western Australia**
RADIOLOGICAL COUNCIL

Address all correspondence to
The Secretary

Your ref DMO1323
Our ref CS412_150918ds1
Enquiries Mr D Surin 08 9388 4999

REPORT
1323
...fication: Re: PC-IR
Mel
...w Offic... Mel

Mr Andrew Miller
A/Manager, Contaminated Sites Branch
Department of Environment Regulation
Locked Bag 33
CLOISTERS SQUARE WA 6850

Attn: Ms Melanie Nunn

DEPARTMENT OF ENVIRONMENT
REGULATION
29 SEP 2015
Corporate Information Section

Dear Ms Nunn

RADIATION SAFETY ACT
Mandatory Audit Report for the former Dalyellup Tailings Facility

Thank you for your letter of 29 July 2015 regarding the request for technical advice on radiological contamination for the above site. As you are aware, further clarification and information was sought from Iluka Resources and was received in May 2014.

The Council has also provided advice on this site when it was operational to the Contaminated Sites Branch on 29 September 2009 (your reference DEC1637, our reference CS412_090925ds1).

Radiation[i]

The documentation provided with the request for technical advice has been reviewed by officers of the Radiological Council. The overall conclusion in the report to classify the site as ***remediated for restricted use*** is supported, with the proposed site use being for public open space and recreating grounds.

In the assessment of the proponent's *Final Closure Plan*, the Council stated that it had no objections to the plan with respect to those aspects covering radiation safety and management, with the exception of the timing of the cessation of radiation monitoring. The Council supported the proponent's commitment for continued ongoing monitoring of the site upon closure, but stated that it would be prudent that amendments in monitoring from the operational stage (as set

Letters: Locked Bag 2006 P O Nedlands WA 6009
Telephone (61 8) 9388 4999 **Facsimile** (61 8) 9382 0701
www.radiologicalcouncil.wa.gov.au
wa.gov.au

out in the Operational Radiation Monitoring Program) to the post-rehabilitation stage be clearly identified in a separate protocol or plan as provided for in the *Radiation Management Plan – Decommissioning and Rehabilitation*. This would also include the potential for the relaxation of any monitoring requirements during the specified control period, only where the remediation validation has been verified and approved by the relevant authorities including the Radiological Council and, where appropriate, the Department of Environment Regulation and Environmental Protection Authority.

The Council reiterates that the most significant radiological aspect to be flagged is in ensuring that there will be no future intrusion of the site after rehabilitation. The proposed end use of the site and 2 metres of capping over the disposal ponds should minimise the possibility of intrusion. A memorial placed on the land title will be required under the Contaminated Sites legislation, to ensure that the site is marked into perpetuity and that the future land use is restricted to approved activities.

The following comments are provided on the Mandatory Auditor's Report –

Section 3.1, page 13	The *Central Tailings Pond, Area 4 and Area 5 Validation* section states that the thickness of the capping was 1.7 m at sampling location CTP01. A capping layer at a thickness of 2 m was stipulated and approved in the Final Closure Plan. This is the minimum level of cover required under the *Code of practice for the near-surface disposal of radioactive waste in Australia (1992)* published by the National Health and Medical Research Council. It is not clear whether any further work was undertaken near this area.
Section 4.2.2, page 17	The section discusses that the site of the facility is located within the buffer zone for the Bunbury Sewerage Treatment Works. Section 2.0 / table 2 (page 5) further lists the site owner for Lot 9077 as Cristal Pigment Australia Ltd and for Lot 9102, which constitutes the land for the previous 'Eastern Turning Circle', as the Department of Housing (see also section 4.1, page 17). It would be prudent to discuss whether buffer zones have been established for the tailings facility. This would be particularly beneficial due to the encroaching Dalyellup Residential Estate.

Section 4.7.2, page 20	The auditor reports that the "radiation data obtained as part of the investigations provided a suitable basis for characterisation of radiation at the Site". Although this conclusion may be correct, the section only quotes gamma radiation levels and not any other radiation exposure pathways.

Should you have any further queries on this matter, please contact Mr Duncan Surin at this office.

Yours faithfully

H. Upton

Ms Hazel Upton
Secretary, Radiological Council

24 SEP 2015

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[i] ***Disclaimers***

- This advice is on radiation only and has been prepared on the request for advice submitted by the DER on 29 July 2015, and further information provided which includes –
  - Mandatory Auditor's Report, Dalyellup Tailings Facility (Jason Clay, 20 July 2015) and associated appendices.

  Any subsequent changes to the land use and resulting occupancy may render one or more of the recommendations invalid and Council should be contacted for further advice.
- The dose limits used in preparing the report are based on guidelines accepted by the Radiological Council. These conservative guidelines acknowledge that the dose limits have been consistently reduced over time and apply the ALARA principle recommended by the International Commission on Radiological Protection.

Government of **Western Australia**
Department of **Health**
Environmental Health Directorate

Our ref: EHB1887
Your ref: DMO1323
Enquiries: Lindy Nield
Phone: 9388 4977
Email: Linda.Nield@health.wa.gov.au

DEPARTMENT OF ENVIRONMENT
REGULATION
19 AUG 2015
Corporate Information Section

SCANNED

RECORD ALLOCATION DER2013/00181
A954345
DMO: 1323
Classification: Re: PC-IR
Officer: Mel
New Officer: mel

Mr Andrew Miller – Senior Manager
Contaminated Sites
Department of Environment Regulation
Locked Bag 33
Cloisters Square
PERTH WA 6850

Dear Andrew,

MANDATORY AUDIT REPORT FOR THE FORMER DALLYELLUP TAILINGS FACILITY

Thank you for your correspondence dated 29 July 2015 requesting advice under s.13(5)(a) of the *Contaminated Sites Act 2003* (the Act), in relation to Mandatory Audit Report (MAR) for this site. This letter provides comment on the adequacy of the remediation works with consideration of auditor assumptions and the health risk assessment. Issues related to radiation arising from traces of uranium and thorium in the residue material will be addressed by the Radiological Council who will provide separate correspondence.

Relevant officers of the Environmental Health Hazards Unit of Department of Health (DOH) have reviewed the following reports:

- Dalyellup Facility, Preliminary Closure Plan (Cristal, August, 2012)
- Dalyellup Facility, Final Closure Plan: Remediation-Validation-Ongoing Closure Report (Cristal, June 2013)
- Dalyellup Facility, Interim Site Management Plan: Site Consolidation - Earthmoving Works (Cristal, August 2013)
- Dalyellup Waste Residue Disposal Facility, Eastern Turning Circle Validation (GHD, December 2013)
- 2013 Dalyellup Annual Environmental Report (Cristal, June 2014)
- Dalyellup Facility - Rehabilitation Sand Stockpile Characterisation Program: Validation – Central Tailings Pond, Area 4 Area 5 (GHD, February 2015)
- Cristal Solid Residue Disposal Facility, Health Risk Assessment FINAL Draft – Rev 3 (ERM, February 2015)
- Environmental Management Plan – Lot 9077 on Deposited Plan 60716, Dalyellup (GHD, June 2015)
- Email from Steve Appleyard (Principal Hydrogeologist, Contaminated Sites, Department of Environment) dated 13 August 2015.

The following comments are provided:

- The site is known as the Dalyellup Waste Residue Disposal Facility and is located on Minninup Road, Dalyellup, adjacent Geographe Bay.
- Lot 9077 on DP60716 is owned by Cristal Pigment Australia Ltd. It stored Treated Solid Residue (TSR) from production of titanium dioxide pigment until March 2013 after 24 years of operation and was classified as *Possibly contaminated – investigation required* since 2009.
- Lot 9102 on DP401230 contains the Eastern Turning Circle (ETC) for trucks carrying the TSR to the storage ponds. It is not classified under the Act however it was audited due to potential contamination from haul truck movement. It is currently owned by the Housing Authority.
- Remediation involved capping the TSR ponds with approximately two metres of clean fill, after surface material from areas at higher elevations of TSR and surface layers of the ETC were collected and deposited on lower lying areas of the central tailings pond (CTP).
- The Shire of Capel's preferred land use option is to develop the remediated TSR ponds into sporting field facilities, with the second option of rehabilitating to a coastal dune environment for public open space.
- The Shire of Capel commissioned an HRA that has been submitted for review retaining the DRAFT watermark. It focussed on potential impacts at the site and did not assess the potential for future off-site health or amenity risks related to movement of leachate metals into the superficial aquifer to the public beach.
    - Management of on-site radiation from residual trace concentrations of uranium, thorium, heavy metals, dioxins and furans were considered to be the main chemicals of concern. The authors recommended the following management measures to ensure there were no risks to human health and the environment:
        - The quality and the thickness of the fill cover should be maintained (i.e. clean fill of at least 2 m).

- Shallow rooted species should be selected for revegetation.
- The quality and volume of water used for irrigation should be compliant with adopted standards.
- No onsite groundwater abstraction should be undertaken, other than for monitoring purposes as part of the rehabilitation monitoring program.

The DOH believes further detail on what constitutes "adopted standards" and improved characterisation of the leachability of metals present in the TSR are necessary to understand the potential for off-site impacts, particularly along the adjacent beach area. Without such evidence it is not possible to support the development of irrigated playing fields.

The Environmental Management Plan (EMP) (GHD, June 2015) outlines guidance on requirements for managing the following parameters:

- ongoing monitoring of radiation and groundwater to ensure ongoing stability and protection of the Yaragadee drinking water aquifer with the aim of reaching equilibrium within five years of decommissioning the facility;
- any disturbance to one metre below ground level, stating that disturbance at greater depths will require a task specific management plan;
- dust, weed and site access management;
- soil capping integrity and soil slumpage/subsidence management;
- infrastructure construction management;
- irrigation management and reporting.

The DOH supports most of actions outlined in the "EMP actions summary" in section 12 of the EMP (GHD, June 2015) however, as mentioned above, requires further detail in relation to leachability under proposed irrigation conditions for long-term management of potential release of heavy metals into the superficial aquifer that may lead to future contamination of the adjacent public beach-front.

The auditor concluded that "the Site is considered to be contaminated as defined in the Contaminated Sites Act 2003; however with appropriate manage (sic) under the current land use and proposed recreational sporting ground land use the Site is not considered to pose a risk to the identified receptors".

The auditor recommended a classification of *Remediated – Restricted Use*, with the following restrictions:

- The Environmental Management Plan (GHD 2015b) should be listed on the titles and the site owner(s) and occupier(s) should ensure it is executed appropriately.
- The Final Closure Plan Remediation Validation Ongoing Management Report (Cristal, 2013) should be followed.
- Land use should be restricted to public open space / recreational sporting grounds. Further assessments would be required for any change in land use requiring a development application or subdivision approval.
- Groundwater abstraction should be prevented at the Site to ensure that the identified receptors do not come into contact with the identified groundwater contamination.

The DOH is generally in agreement with the auditor however the investigations and EMP focus on receptors located at the site. The DOH believe that potential for future, off-site contamination is also important to manage public health issues associated with this site and that this issue has not yet been adequately addressed.

Based on this information and the auditor review, the DOH supports a classification of *Remediated – Restricted Use*, for rehabilitation of the storage ponds to a coastal dune environment land-use only. We will refrain from commenting on the suitability for this site to be used as playing fields until further and sufficient detail has been provided on the leachability of residual metals in the TSR (refer to advice from Steve Appleyard). With further scientific confidence, appropriate contingent strategies to manage potential impacts to public health or their perception can be developed. For example, tolerance to low levels of radiation or heavy metal contamination, such as chromium, onto the public beachfront is likely to present a highly contentious issue regardless of confirmation that of health risks to beachfront users, especially if such an issue could have been forecasted, monitored and prevented.

The DOH supports the restrictions recommended by the auditor with the following comments and qualifications:

- The proposed groundwater monitoring protocols are satisfactory however, it is noted that the EMP will need to be updated to accommodate further detail associated with final decisions on land-use, adopted irrigation plans, location and extent of hard-stand or synthetic fields that may reduce water volume, fertiliser requirements and their potential impacts on leachate conditions within the TSR.
- The EMP will be reviewed and updated on an annual basis, requiring review and comment by the auditor. The DOH recommends that the annual auditor review and updates should be automatically forwarded to the DER

to be appended to the site entry in the Contaminated Sites database to ensure the most current information is available and to verify compliance with this requirement.

- The EMP (GHD, June 2015, p9) states that "should three exceedances of the guidelines and a rising trend in an analyte be observed, a groundwater investigation to delineate the contamination may be required". The DOH suggests that changes to any conditions (e.g., pH or redox potential) that lead to mobilisation of toxic or radioactive heavy metals, will require an appropriate investigation that includes adequate stakeholder communication, in accordance with best practice risk management protocols that take public health and amenity into consideration.

If you have any concerns or queries, please do not hesitate to contact Lindy Nield by phone 9388 4977 or email Linda.Nield@health.wa.gov.au.

Yours sincerely,

Martin Matisons
PRINCIPAL TOXICOLOGIST
ENVIRONMENTAL HEALTH HAZARDS UNIT

17 August 2015

1508010nl Dalleyup_TSR Disposal Area_MAR_Radn_Metal

Senversa Pty Ltd
Level 25, 108 St Georges Terrace, Perth WA 6000
ABN 89 132 231 380
www.senversa.com.au

18 December 2015

Peter Allen
Environmental Superintendent
Cristal Pigment Australia Ltd
Locked Bag 245
Bunbury WA 6230

Dear Peter,

Re: Interim Auditor Advice

Proposed Approach to DER Dalyellup – Approach to DER Letter Response

1. Background

Mr Jason Clay of Senversa Pty Ltd has been commissioned by Cristal Pigment Australia Ltd (Cristal) as the WA Department of Environment Regulation (DER) Accredited Contaminated Sites Auditor (‘Auditor’) for the Dalyellup Tailings Facility (‘the site’).

The site operated as a licenced facility for the disposal of Treated Solid Residue (TSR) from the production of titanium dioxide pigment between March 1989 and March 2013. The site has since been capped and is proposed to be used for sporting ground purposes.

The site has been subject to a number of contaminated site investigations, which culminated in the submission of a Mandatory Auditor’s Report (MAR) on 20 July 2015. The DER has subsequently provided a number of comments on the information provided, which will need to be addressed prior to the reclassification of the site.

This letter outlines the identified issues that require addressing and provides a set of responses / proposed actions to satisfy the requirements of DER and therefore allow reclassification of the site.

2. Issues Identified

The issues identified by the DER, and other relevant authorities including the Department of Health (DOH) and the Radiological Council (RC), which require addressing prior to the reclassification of the site are presented in the table below.

Authority	Issue	Response / Proposed Actions
DER	**Potential Leachate and Ecological Risks** *“Further information is requested regarding the potential leachability of chemicals of concern with regards to ongoing irrigation, including increased nutrient input*	Irrigation and nutrient management plans will be included in the Site Management Plan (SMP) to ensure that all irrigation water is appropriately managed to avoid potential additional leaching of contaminants from the TSF.

	through fertiliser use and the proposed reuse of waste water".	
	Supporting Comments: • With regards to travel time of leachate from the pond area to the water table, asserting that it will take 30 years for water to travel from the residue storage area to the water table is not correct. Dating of water at the water table in coastal areas suggests that water is only a few years old even when the water table is 20 to 30 m deep.	The Auditor understands that an additional hydrogeology report has been prepared by GHD which will be provided to the Auditor for review and inclusion in the MAR. Cristal has advised that GHD has estimated a travel time of 5 years within the hydrogeology report.
	• ASLP is unlikely to give a good indication of the leachability of residues under chemical conditions presented in soils. In particular there is likely an elevated partial pressure of carbon dioxide in soil pore water. This chemical factor, together with the presence of nitrate leached from the application of fertiliser on turf overlying the containment area, is likely to exacerbate the mobilisation of uranium and some other chemical constituents from the residues. The ongoing irrigation of turf is also likely to produce sufficient infiltration of water through residues to transport soluble chemical constituents away from the residue storage area.	Some additional information on the geochemical nature of the TSF will be required to address the DER comments. This will also include an assessment of the hydrogeological properties of the TSF which may also control infiltration of irrigation water. This may include more aggressive leachate testing, if required.
	• DER considers that there has been inadequate assessment of radionuclides in groundwater and in the groundwater discharge zone. The proponent has assumed that radiological constituents in the wastes will have limited leachability and will not infiltrate to the water table. This assumption is unlikely to be the case for radium in particular which has similar behaviours to calcium. It is noted that from the reports provided that large amounts of calcium appeared to be leaching from the waste material in the pond, which suggests that radium will be leaching as well.	The HRA indicates that groundwater monitoring for radionuclides (including radium 226 and 228) has been undertaken in down-gradient wells (DM8 and 4) since 1989. Furthermore the Cristal has advised that the RC has reviewed groundwater data and assessed the risks. The results from groundwater monitoring will be discussed in further detail in the MAR including wider discussion on RC acceptance. No additional groundwater monitoring is considered necessary to address this issue.
	• DER agrees that the local hydrogeological conditions will make it unlikely that contamination from the residues will infiltrate into the Yarragadee aquifer.	Noted.
DER	**Environmental Management Plan** *"Revision of the proposed EMP is required to ensure that appropriate monitoring and management strategies are in place, and that the implementation of these strategies aligns with current guidance".*	The EMP will be revised as per the comments below.
	Supporting Comments: • The duration of the monitoring program needs to be reviewed and DER considers it is likely that groundwater monitoring will be required for a period	The EMP should be revised to include an increased duration for groundwater monitoring. This will include a period of monitoring following completion of construction of sporting fields.

	greater than 5 years. There is some uncertainty in the travel time of groundwater and the potential leachability of chemicals of potential concern as a consequence of the proposed irrigation regime and intense fertiliser use. There is also some uncertainty relating to risks to the marine environment.	The Auditor will review the additional hydrogeological report prepared by GHD and include a discussion of both this report and the Oceanica Report in the revised MAR.
	• No disturbance of tailings material is permitted and that a minimum of 2 m of clean fill should be maintained at all times across the site. The EMP should be updated to ensure that this criterion is met. There is insufficient information around how excavations will be managed, particularly with depths greater than 1 m. While a radiation management plan is proposed, further detail is required as to what standards/guidelines will be adopted and how this aligns with RC advice.	The EMP should be revised to clearly identify that no disturbance of tailings material is permitted and that a minimum of 2 m of clean fill should be maintained at all times. The Auditor also understands that there is an approved Radiation Management Plan that has been prepared for the Site. This will be referenced in the MAR.
	• The EMP proposes the potential for construction of an abstraction bore down gradient of the recharge area. DER would like to reiterate, and based on Auditor recommendations for restriction on land use, that groundwater abstraction, including dewatering, is not permitted at the site.	The EMP should be revised to remove the reference to construction of an abstraction bore down-gradient of the recharge area.
	• As the Closure Notice (6130/1989/12) is due for review (October 2015), consideration should also be given to any amendments included as a consequence of this review. Any relevant changes should be included, or referenced for inclusion, in the amended EMP.	The EMP should be updated to include any relevant changes from revision of the Closure Notice.
RC	**Mandatory Auditor Report - Section 3.1** *"The Central Tailings Pond, Area 4 and Area 5 Validation section states that the thickness of capping was 1.7 m at sampling location CTP01. A capping layer at a thickness of 2 m was stipulated and approved in the Final Closure Plan. This is the minimum level of cover required under the Code of practice for the near-surface disposal of radioactive waste in Australia (1992) published by the National Health and Medical Research Council. It is not clear whether any further work was undertaken near this area."*	There is a limited number of locations where the capping layer is slightly shallower than 2 m; however this is not considered to affect the overall risk profile of the Site. This will be discussed in further detail in the MAR.
RC	**Mandatory Auditor Report - Section 4.2.2** *"It would be prudent to discuss whether buffer zones have been established for the tailings facility. This would be particularly beneficial due to the encroaching Dalyellup Residential Estate."*	Buffer zones will be discussed within the MAR.
RC	**Mandatory Auditor Report - Section 4.7.2** *"The auditor reports that the "radiation data obtained as part of the investigations provided a suitable basis for*	Additional radiation pathways will be discussed within the MAR.

	characterisation of radiation at the Site". Although this conclusion may be correct, the section only quotes gamma radiat6ion levels and not any other radiation exposure pathways."	
DOH	**Health Risk Assessment** The HRA *"focussed on potential impacts at the site and did not assess the potential for future off-site health or amenity risks related to movement of leachate metals into the superficial aquifer to the public health".* *"The DOH believes further detail on what constitutes "adopted standards"* [for irrigation water] *and improved characterisation of the leachability of metals present in the TSR are necessary to understand the potential for off-site impacts, particularly along the adjacent beach area."*	We will add further discussion around existing information to the MAR. This will also include discussion on the hydrogeological properties of the TSF which may also control infiltration of irrigation water. This may require more aggressive leachate testing to be conducted.
DOH	**Environmental Management Plan** The DOH requires *"further detail in relation to leachability under proposed irrigation conditions for long-term management of potential release of heavy metals into the superficial aquifer that may lead to future contamination of the adjacent public beach-front."*	The EMP should be updated to include irrigation details and more aggressive leachate testing or reconsideration/representation of existing data may be required to satisfy this element.
DOH	**Environmental Management Plan** *"The DOH believe that potential for future, off-site contamination is also important to manage public health issues associated with this site and that this issue has not yet been adequately addressed."*	We will add further discussion around existing information to the MAR. This will also include discussion on the hydrogeological properties of the TSF which may also control infiltration of irrigation water.
DOH	**Environmental Management Plan** *"…the EMP will need to be updated to accommodate further detail associated with final decisions on land-use, adopted irrigation plans, location and extent of hard-stand or synthetic playing field that may reduce water volume, fertiliser requirements and their potential impacts on leachate concentrations in the TSR."*	Ongoing discussions with Shire of Capel are occurring. The EMP should be updated to include additional information regarding the final land use (including possible design and construction plans). The EMP will also be revised to include an Irrigation and Nutrient Management Plan.
DOH	**Environmental Management Plan** *"The EMP will be reviewed and updated on an annual basis, requiring review and comment by the auditor. The DOH recommends that the annual auditor review and updates should be automatically forwarded to the DER to be appended to the site entry in the Contaminated Sites database to ensure the most current information is available and to verify compliance with this requirement."*	Noted. The timing for the revision of the EMP and review by the Auditor will be discussed further.
DOH	**Environmental Management Plan**	Noted. Any changes in contaminant concentrations that potentially pose a risk to identified receptors

"The DOH suggests that changes to any conditions (e.g., pH or redox potential) that lead to mobilisation of toxic or radioactive heavy metals, will require an appropriate investigation that includes adequate stakeholder communication, in accordance with best practice risk management protocols that take public health and amenity into consideration."	will be appropriately communicated to relevant stakeholders.

3. Closure

If you have any questions or would like to discuss the comments, please contact me on 0410 431 674 or jason.clay@senversa.com.au.

Yours sincerely,
On behalf of **Senversa Pty Ltd**

Jason Clay

Jason Clay
WA DER Contaminated Sites Auditor

AB/JC

Meeting: Contaminated Sites discussions on CPA’s Dalyellup Re-development

Venue: Contaminated Sites Branch, Department of Environment Regulation, Booragoon

Time: 17 February 2016, 1000 – 1120 am

Present: Melanie Nunn, Contaminated Sites Officer, CS DER; Steve Miller, Manager, CS DER; Steve Appleyard, Principal Hydrogeologist, DER; Jason Gick, Executive Manager Engineering & Development Services, Shire of Capel; Duncan Surin, Authorised Officer, RCWA; Mrs Jubin Koshy, Authorised Officer ,RCWA; Jason Clay, CS DER accredited auditor, Senversa; Ashton Betti, Associate Environmental Scientist, Senversa; Simon French, Principal, GHD; Alice Clark, Environmental Scientist, GHD; Lindy Nield, Senior Scientific Officer, Environmental Health Hazards Unit, Environmental Health Division Department of Health ; Peter Allen, Environmental Superintendent, CPA; Ben Huxtable, Senior Environmental Advisor, CPA

Agenda

1.1. Confirm agreement of stakeholders on Senversa responses (attached) to address issues raised by CS Branch on the risk assessment for the proposed sporting fields re-development at Dalyellup (attached).

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1.2. Obtain specifics on any major issues that shall need to be addressed by CPA to achieve a classification of “restricted use – sporting fields”.

Discussion

2.1. There was no disagreement by attendees on approach outlined in the Senversa response to the letter from the DEC.
2.2. There were no major issues raised by RCWA on the current risk assessment.
2.3. Senversa had obtained a hydrogeological report from GHD post the DER assessment and subsequent letter which addressed most of the concerns raised in the original CS DER which would be incorporated in a revised MAR.
2.4. DoH and CS DER were guided by Steven Appleyard who strongly indicated CPA had taken a low cost option in developing a waste facility with no pond liners and this had created a situation that DER would not provide the classification because:
    a) There had been no technical assessment performed to illustrate the potential impacts that the change of land use could have on receptors. Namely, the change in land use to sporting fields and the associated use of irrigation and fertilizers reacting with the tailings materials TSR, andin turn the leachate impacting on the foreshore that is used by the public;
    b) Irrigation and Nutrient Management Plans, which should provide effective nourishment to plants, are often plagued by poor execution and in themselves do not provide an adequate level of mitigation of risk; and
    c) Leachability studies had been conducted by the Australian Standard Leaching Protocol (ASLP) which he considered unreliable and any further studies should be by the USEPA methodology. [Peter Allen comment – if discrediting the established method why hasn’t DER informed proponents and environmental practitioners].

2.5. Simon French had discussed the matter of Steven Appleyard's position with Peter Beck, GHD's Principal Hydrogeologist, who believed that the change in land use would, at worst, have a gradual impact on the foreshore. Simon recommended that Peter Beck and Steve Appleyard should have technical discussions. Appleyard was non-committal on the invitation but emphasised the need for data that gives him comfort that we understand fully how the material will interact in an irrigation scenario in the long term for any further assessment.

2.6. Lindy Nield stated that DoH would be guided by Steve Appleyard as redevelopment would not only attract more people to the sporting fields but also to the Dalyellup foreshore. Greater numbers would increase the frequency component of any risk assessment. In twenty years' time if any real or perceived impact became a community concern then the State would need to resolve the concern, therefore it is important to assess all possible impacts now.

2.7. It was agreed by department representatives that there were no issues for the site to be classified - "restricted use to dunal vegetation"

Other points of Interest

3.1. Jason Gick stated that the redevelopment option was still a concept with a project schedule subject to funding, including the detailed design in 2019-20 and construction in 2021-22.

3.2. CPA is the owner of the land and will remain so with Shire having a leasing arrangement. Hence legacy liabilities would remain with CPA and public liability for public activities with the Shire.

3.3. RCWA raised concern over lack of consultation by Satterley, the developer of the proposed housing development to the east of the site. Matter will be taken up with the developer.

3.4. RCWA stated that as required by Code of practice for the near-surface disposal of radioactive waste in Australia (1992) that monitoring would be for 100 years but clearly not at the current frequency.

Actions:

4.1. GHD to determine best way to address Steve Appleyard's requirements and provide a scope of work (updating the Environmental Management Plan and Steve Appleyard's concerns) and price to CPA. Completion: April 2016. Alice Clark.

4.2. CPA to request review and guidance from Steve Appleyard on proposed next steps prior to any further test work commencing.

4.3. GHD to update the Environmental Management Plan as agreed by stakeholders. Completion: dependent on action 4.1. Alice Clark

4.4. Senversa to review information obtained from actions 4.1 &4.2 to submit a revised MAR.

Appendix I

Dioxins and Furans Data

2014-2016

May 28, 2014

Scherger Associates
3017 Rumsey Drive
Ann Arbor. MI 48105
USA
1-734-213-8150

Mr. Peter Allen
Environmental Superintendent
Millennium Inorganic Chemicals, A Cristal Company
Locked Bag 245
Bunbury WA 6230
AUSTRALIA

Dear Mr. Allen:

As requested, I have performed a peer review of the sampling and analysis procedures used for the annual dioxins and furans sampling and analysis, performed in April 2014, This annual sampling and analysis is required by the Dalyellup Closure Notice of 1 August 2013. The sampling procedures used are described in the written document - Sampling of Treated Solid Residue and Groundwater for Dioxin and Furan Determination (Cristal Procedure AP/M054-16 version 3). This sampling plan was previously reviewed and found to follow standard industry practice and good laboratory practice for the sampling and analysis of dioxins and furans in solid and liquid (water) samples. I have also reviewed the laboratory reports and quality assurance data summary provided by the laboratory. These laboratory reports indicate that approved analytical procedures were followed and the quality assurance results indicate that the data meet standard industry practice, good laboratory practice and typical requirements of the regulatory agencies. The National Measurement Institute, the laboratory for this work, represents that they are a NATA accredited laboratory (NATA #198) as required by the Closure Notice. Further, I have reviewed the results for the groundwater for the April 2014 samples. The groundwater samples have no measureable concentration of either dioxins or furans, except for a low level of OCDD in well YB. A brief report of my review of these data is attached. As stated in that report, the low level of OCDD is most likely a data anomaly, but results from this well should be tracked carefully in future annual sampling events to look for any changes or trends in the well water quality.

Based upon my review, it is my opinion that the procedures outlined in the sampling plan and used for sample collection, and the data reported by the laboratory meet the requirements as described in the Closure Notice.

Dale A. Scherger

Dale A. Scherger, P.E.
Principal and Owner
Scherger Associates

Dale
Scherg
er

Digitally signed by Dale
Scherger
DN: cn=Dale Scherger
gn=Dale Scherger c=United
States l=US o=Scherger
Associates
e=daleres@aol.com
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Location:
Date: 2014-05-28 10:14-04:00

Scherger Associates
Ann Arbor, MI, USA

May 27, 2014

Peer Review of Sampling Procedures and Analytical Data for the April 2014 Sampling of Groundwater per Dalyellup Facility Closure Notice Requirements for Millennium Inorganic Chemicals, A Cristal Company

by
Dale A. Scherger, P.E.

Background

The Dalyellup Facility is no longer receiving residues from Millennium Inorganic Chemical (MIC), a Cristal Company. The Closure Notice for the Dalyellup Facility, dated 1 August 2013 requires that MIC monitor dioxins and furans in the groundwater on a annual basis. The Closure Notice Item 1.1.2 requires that representative samples be collected and analyzed, and requires that the samples be collected and analyzed by an organization with NATA accreditation.

This report and the accompanying cover letter present the results of the peer review for the collection and analysis of samples in April 2014, as requested by MIC.

In 2010 prior to the start of the sampling and analysis program, MIC developed a written sampling procedure titled: Sampling of Treated Solid Residue and Groundwater for Dioxin and Furan Determination (Cristal Procedure AP/M054-16). The sampling plan was reviewed to ensure that the procedures met standard industry practice and procedures. The plan details the methods to be used for sample collection, sample compositing and handling, storage, and shipment to the laboratory. In July 2011, the sampling and analysis plan was updated to improve the field logs that are used during sampling events and to clarify the instructions to the laboratory to ensure best detection limits are achieved for the samples. This updated plan, Cristal Procedure AP/M054-16 version 3, was reviewed and approved by this reviewer at that time. The procedures were found to meet the industry standard and typical regulatory agency requirements as established throughout the world.

Sample Procedures

The groundwater samples (YB, MB3, DM8A and DM8C) were collected on 9 April 2014 in accordance with the established procedures (MIC AP/M054-16 version 3). The wells were purged prior to the collection of samples. Sixty (60) litres of groundwater were removed from each of the three wells DM8A, DM8C, and MB3 during the purging cycle. Sixty five (65) liters were purged from well YB. The groundwater samples were collected and placed into clean glass bottles provided by the analytical laboratory. Two 1-liter bottles of each groundwater sample were collected so that the laboratory would have sufficient volume available for extraction and concentration to achieve the desired low detection limits. Samples were stored under ice and/or in a refrigerator prior to shipment to the laboratory.

The written procedures that were followed for sample collection, handling, storage and shipment ensured that the samples were collected and handled in accordance with industry standards and good laboratory practice and produced representative samples for analysis.

Laboratory Analysis

All analyses were performed and reported by the National Measurement Institute. The laboratory is a NATA accredited laboratory (NATA Accreditation Number 198), as required by the Closure Notice. The laboratory report provided dioxin and furan results for the target individual congeners, total concentration for each chlorination level, and also provided TEQ results using the World Health Organization Toxicity Equivalent Factors (WHO_{95} TEF) and the calculated WHO_{95} TEQ concentrations.

The laboratory quality assurance data indicated the data were of sound quality with all of the labeled compound recoveries within the established lower and upper control limits (60 out of 60 labeled compound recoveries were within target limits). The method blank associated with the water samples was reported as less than values (< LOD) for all dioxin and furan congeners, except for trace levels of octachlorodibenzofuran (OCDF), octachlorodibenzodioxin (OCDD), and 1,2,3,4,6,7,8 heptachlorodibenzodioxin (HpCDD). There were no data qualifiers on any of these sample results.

Review of the data report indicates that these data are sound and useable data for purposes of representing the concentrations of dioxins and furans in the groundwater.

Groundwater Results

Four (4) groundwater samples were collected on April 9, 2014 and sent to the laboratory for analysis. Samples were collected at locations YB, MB3, DM8A and DM8C. Samples were received by the laboratory cold and in good condition on April 14, 2014, as indicated by the chain of custody sheet.

There were no measureable dioxins or furans in the groundwater samples from wells MB3, DM8A, and DM8C. All reported values for all congeners were reported as less than the level of detection or limit of reporting (LOD or LOR) for these samples. One (1) liter samples sizes were used in the analysis to achieve detection limits for the various congeners ranging from < 0.4 pg/L to < 9 pg/L. Well YB showed all reported dioxin and furan isomers as less than the LOD/LOR also, except there was a reported value of 9.6 pg/L of OCDD. OCDD was also found in the method blank (2.2 pg/L). The reported value in well YB for OCDD is just slightly above the LOR of 7 pg/L for OCDD, using the laboratory convention of setting the LOR at 3X the concentration measured in the blank.

Well YB has been sampled six times over the past five years and has not shown the presence of any dioxin or furan congeners. It is suspected that this trace level of OCDD is a anomaly due either to external contamination or laboratory analysis variability. OCDD is the least toxic of the dioxin and furan isomers (TEF = 0.0003). A similar "positive" result for another congener 1,2,3,7,8 PeCDD occurred in August 2012 in Well DM8A (see discussion below). This congener has not been detected in the past two sampling events suggesting the low level measurement was an anomaly.

Given that a trace level of OCDD was detected in well YB, it is important to carefully track the results for the next two annual sampling periods to see if any detectable levels are found at this location. If future results indicate the current result is not an anomaly, then in this reviewer's opinion additional investigation at this well location will be warranted.

Table 1 shows the historical WHO_{95} TEQ data for Well YB for the period 2010 through 2014. The laboratory reports the lower, middle, and upper bound of the dioxins and furans data on a TEQ basis. These boundaries are reported to present the statistically significant range for the data. Variability can be expected at these low levels and the TEQ boundaries help to show the potential range within a given sample. Table 1 also shows the actual concentration of OCDD (not TEQ based) reported in the 2010 to 2014 well YB samples.

As can be seen, the most recent 2014 data are well within the historical TEQ range for the past 5 years of data. These historical data should be compared to future dioxin and furan measurements in well YB in order to track any changes in the well.

Table 1. Well YB Historical TEQ Results for Dioxins and Furans and Concentration of OCDD

		WHO_{95} TEQ			Reported Concentration
Well YB	Month Sampled	Lower Bound pg TEQ/kg	Middle Bound pg TEQ/kg	Upper Bound pg TEQ/kg	OCDD pg/L
	Apr-14	0.00	1.50	3.10	9.60
	Feb-13	0.00	1.95	3.90	<1.69
	Sep-12	0.00	2.13	4.26	<7.34
	Feb-12	0.00	2.72	5.44	<4.37
	Aug-11	0.00	3.00	6.00	<7.20
	Feb-11	0.00	3.94	7.89	<9.29
	Aug-10	0.00	3.08	6.16	<9.29

Well DM8A Tracking Data

During the sampling event in August 2012, the groundwater sample from DM8A showed a trace level of one congener 1,2,3,7,8 pentachlorodibenzo-p-dioxin (PeCDD) at 1.32 pg/L. This was the first time that any detectable dioxins or furans had been reported in any groundwater sample. The February 2013 and April 2014 sampling events have shown all congeners in well DM8A are below the LOR (all "<" values). Therefore, it does appear that the result of the previous sampling in August 2012 was an anomaly. Results will continue to be carefully reviewed to ensure that the August 2012 result for well DM8A was an anomaly.

Table 2. Well DM8A Historical TEQ Results for Dioxins and Furans and Concentration of PeCDD

		WHO_{95} TEQ			Reported Concentration
Well DM8A	Month Sampled	Lower Bound pg TEQ/kg	Middle Bound pg TEQ/kg	Upper Bound pg TEQ/kg	1,2,3,7,8 PeCDD pg/L
	Apr-14	0.00	1.6	3.1	<0.7
	Feb-13	0.00	2.57	5.13	<1.46
	Sep-12	1.32	3.00	4.68	1.32
	Feb-12	0.00	2.52	5.03	<1.88
	Aug-11	0.00	2.16	4.33	<1.44
	Feb-11	0.00	3.15	6.29	<1.59
	Aug-10	0.00	1.86	3.71	<1.28

REPORT OF ANALYSIS

Page: 1 of 1
Report No. RN1019844

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	Job No.	: CRIS05_W/140410
		Quote No.	: QT-01932
		Order No.	: 4500740712
		Date Sampled	: 9-APR-2014
		Date Received	: 10-APR-2014
Attention	: ALLAN LEE / ANDREW WILLIAMSON	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: DAVID LYNCH	Phone	: (08) 9368 8420

Lab Reg No.	Sample Ref	Sample Description
W14/006082X	YB	Dalyellup-Bi-annually WATER 09/04/14
W14/006087X	MB 3	Dalyellup-Bi-annually WATER 09/04/14
W14/006093X	DM 8A	Dalyellup-Bi-annually WATER 09/04/14
W14/006094X	DM 8C	Dalyellup-Bi-annually WATER 09/04/14

Lab Reg No.		W14/006082X	W14/006087X	W14/006093X	W14/006094X	
Sample Reference	Units	YB	MB 3	DM 8A	DM 8C	Method
Total TEQ						
Total TEQ		DAU14_087	DAU14_087	DAU14_087	DAU14_087	AUTL_01

Alan Yates, Analyst
Dioxin Analysis Unit
Accreditation No. 198

9-MAY-2014

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Australian Government
National Measurement Institute

CERTIFICATE OF ANALYSIS # DAU14_087

Client Cristal Pigment Australia Ltd
Lot 4, Old Coast Road
Australind WA 6233

Contact Allan Lee

Job No. CRIS05_W/140410

Sampled by Client
Date Sampled Not Specified
Date Received 11-Apr-14

The results relate only to the sample(s) tested.

Method AUTL_01

Date Reported 9-May-14

Details

The method is for determination of tetra- through octa-chlorinated dibenzo-p-dioxins (PCDDs) & dibenzofurans (PCDFs) in aqueous samples by high resolution gas chromatography / high resolution mass spectrometry (HRGC/HRMS). This method provides data on all toxic 2,3,7,8-PCDD (seven) and PCDF (ten) isomers. PCDD and PCDF totals for each homologue group (tetra to octa) are also reported. The dioxin toxicity equivalent (WHO_{05}-TEQ_{DF}) in each sample is calculated using World Health Organization toxic equivalency factors (WHO_{05}-TEFs). All results are corrected for labelled surrogate recoveries.

After sampling, the liquid is spiked with a range of isotopically labelled surrogate standards and exhaustively extracted. Clean up is effected by partitioning with sulphuric acid then distilled water. Further purification is performed using column chromatography on acid and base modified silica gels, basic alumina and carbon dispersed on celite.

Immediately prior to injection, internal standards are added to each extract, and an aliquot of the extract is injected into the GC. The analytes are separated by the GC and detected by a high-resolution (>10,000) mass spectrometer.

Authorisation

Nino Piro
Senior Chemist
Dioxin Analysis Unit

Dr Alan Yates
Senior Analyst
Dioxin Analysis Unit

Accreditation

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accreditation Number : 198

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Sample Details : Job No. CRIS05_W/140410

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
W14/006082X	YB	Water	Water
W14/006087X	MB 3	Water	Water
W14/006093X	DM 8A	Water	Water
W14/006094X	DM 8C	Water	Water

Project Details

Project Name	*Not Specified*
Project Number	*Not Specified*

Key

Analytes

TCDD	Tetrachlorodibenzo-p-dioxin	TCDF	Tetrachlorodibenzofuran
PeCDD	Pentachlorodibenzo-p-dioxin	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	HxCDF	Hexachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	HpCDF	Heptachlorodibenzofuran
OCDD	Octachlorodibenzo-p-dioxin	OCDF	Octachlorodibenzofuran

Units & Abbreviations

pg/kg	picograms per kilogram
<	level less than limit of detection (LOD)
WHO_{05}-TEF†	World Health Organization toxic equivalency factor
WHO_{05}-TEQ_{DF}†	World Health Organization toxic equivalents (Dioxins & Furans)

† as defined by Van den Berg et al., *Toxicol. Sci.* ***93** (2), pp. 223–241* (2006)

TEQs are calculated by multiplying the quantified level for each individual dioxin and furan congener reported by the corresponding TEF value and summing the result:

$$WHO_{05}-TEQ_{DF} = \sum_{i=1}^{7}\left[PCDD_i \times TEF_i\right] + \sum_{j=1}^{10}\left[PCDF_j \times TEF_j\right]$$

i = PCDD congener index (1 - 7)
j = PCDF congener index (1 - 10)

Lower Bound TEQ	defines all congener values reported below the LOD as equal to zero.
Middle Bound TEQ	defines all congener values reported below the LOD as equal to half the LOD.
Upper Bound TEQ	defines all congener values reported below the LOD as equal to the LOD.

Surrogate Recovery	percentage recovery for $^{13}C_{12}$ labelled surrogate standard
⚐	Laboratory surrogate recovery outside normal acceptance criteria: Solid and liquid matrices **25 - 125%**

Results : Job No. CRIS05_W/140410

Laboratory Reg. No.	W14/006082X	**Date Extracted**	23-Apr-14
Client Sample Ref.	YB	**DB5 Analysis**	2-May-14
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO$_{05}$-TEF	WHO$_{05}$-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<2	0.1	0.1	59	
2,3,7,8-TCDD	<1	1	0.5	57	
1,2,3,7,8-PeCDF	<1	0.03	0.015	54	
2,3,4,7,8-PeCDF	<0.8	0.3	0.12	61	
1,2,3,7,8-PeCDD	<1	1	0.5	66	
1,2,3,4,7,8-HxCDF	<1	0.1	0.05	61	
1,2,3,6,7,8-HxCDF	<0.8	0.1	0.04	63	
2,3,4,6,7,8-HxCDF	<0.6	0.1	0.03	59	
1,2,3,7,8,9-HxCDF	<0.7	0.1	0.035	70	
1,2,3,4,7,8-HxCDD	<0.9	0.1	0.045	81	
1,2,3,6,7,8-HxCDD	<0.9	0.1	0.045	82	
1,2,3,7,8,9-HxCDD	<0.8	0.1	0.04		
1,2,3,4,6,7,8-HpCDF	<2	0.01	0.01	80	
1,2,3,4,7,8,9-HpCDF	<1	0.01	0.005	78	
1,2,3,4,6,7,8-HpCDD	<2	0.01	0.01	91	
OCDF	9.6	0.0003	0.0029		
OCDD	<9	0.0003	0.0014	78	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<20
Total TCDD isomers	<7
Total PeCDF isomers	<6
Total PeCDD isomers	<6
Total HxCDF isomers	<5
Total HxCDD isomers	<3
Total HpCDF isomers	<3
Total HpCDD isomers	<4

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	9.6	pg/kg
WHO$_{05}$ -TEQ$_{DF}$		
Lower Bound [excluding LOD values]	**0.0029**	pg/kg
Middle Bound [including half LOD values]	**1.5**	pg/kg
Upper Bound [including LOD values]	**3.1**	pg/kg

Results : Job No. CRIS05_W/140410

Laboratory Reg. No.	W14/006087X	**Date Extracted**	23-Apr-14
Client Sample Ref.	MB 3	**DB5 Analysis**	2-May-14
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO_{05}-TEF	WHO_{05}-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<0.7	0.1	0.035	73	
2,3,7,8-TCDD	<0.8	1	0.4	90	
1,2,3,7,8-PeCDF	<0.4	0.03	0.006	75	
2,3,4,7,8-PeCDF	<0.5	0.3	0.075	76	
1,2,3,7,8-PeCDD	<0.9	1	0.45	90	
1,2,3,4,7,8-HxCDF	<0.5	0.1	0.025	77	
1,2,3,6,7,8-HxCDF	<0.5	0.1	0.025	76	
2,3,4,6,7,8-HxCDF	<0.5	0.1	0.025	69	
1,2,3,7,8,9-HxCDF	<0.6	0.1	0.03	72	
1,2,3,4,7,8-HxCDD	<0.8	0.1	0.04	96	
1,2,3,6,7,8-HxCDD	<0.8	0.1	0.04	98	
1,2,3,7,8,9-HxCDD	<0.8	0.1	0.04		
1,2,3,4,6,7,8-HpCDF	<0.9	0.01	0.0045	94	
1,2,3,4,7,8,9-HpCDF	<1	0.01	0.005	91	
1,2,3,4,6,7,8-HpCDD	<0.9	0.01	0.0045	110	
OCDF	<0.7	0.0003	0.00011		
OCDD	<3	0.0003	0.00045	103	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<6
Total TCDD isomers	<5
Total PeCDF isomers	<3
Total PeCDD isomers	<5
Total HxCDF isomers	<3
Total HxCDD isomers	<3
Total HpCDF isomers	<2
Total HpCDD isomers	<0.9

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	0	pg/kg
WHO_{05}-TEQ_{DF}		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**1.2**	pg/kg
Upper Bound [including LOD values]	**2.4**	pg/kg

Results : Job No. CRIS05_W/140410

Laboratory Reg. No. W14/006093X **Date Extracted** 23-Apr-14

Client Sample Ref. DM 8A **DB5 Analysis** 2-May-14
Matrix Water
Description Water

PCDD/F Congeners	Level pg/kg	WHO$_{05}$-TEF	WHO$_{05}$-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<1	0.1	0.05	68	
2,3,7,8-TCDD	<0.9	1	0.45	75	
1,2,3,7,8-PeCDF	<0.9	0.03	0.014	62	
2,3,4,7,8-PeCDF	<3	0.3	0.45	69	
1,2,3,7,8-PeCDD	<0.7	1	0.35	79	
1,2,3,4,7,8-HxCDF	<0.9	0.1	0.045	56	
1,2,3,6,7,8-HxCDF	<0.5	0.1	0.025	62	
2,3,4,6,7,8-HxCDF	<0.6	0.1	0.03	56	
1,2,3,7,8,9-HxCDF	<0.4	0.1	0.02	69	
1,2,3,4,7,8-HxCDD	<0.7	0.1	0.035	75	
1,2,3,6,7,8-HxCDD	<0.6	0.1	0.03	81	
1,2,3,7,8,9-HxCDD	<0.6	0.1	0.03		
1,2,3,4,6,7,8-HpCDF	<2	0.01	0.01	65	
1,2,3,4,7,8,9-HpCDF	<2	0.01	0.01	62	
1,2,3,4,6,7,8-HpCDD	<1	0.01	0.005	84	
OCDF	<1	0.0003	0.00015		
OCDD	<3	0.0003	0.00045	73	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	34
Total TCDD isomers	<6
Total PeCDF isomers	42
Total PeCDD isomers	<4
Total HxCDF isomers	15
Total HxCDD isomers	<2
Total HpCDF isomers	<4
Total HpCDD isomers	<1

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	91	pg/kg
WHO$_{05}$ -TEQ$_{DF}$		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**1.6**	pg/kg
Upper Bound [including LOD values]	**3.1**	pg/kg

Results : Job No. CRIS05_W/140410

Laboratory Reg. No.	W14/006094X	**Date Extracted**	23-Apr-14
Client Sample Ref.	DM 8C	**DB5 Analysis**	8-May-14
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO_{05}-TEF	WHO_{05}-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<1	0.1	0.05	55	
2,3,7,8-TCDD	<1	1	0.5	58	
1,2,3,7,8-PeCDF	<0.9	0.03	0.014	55	
2,3,4,7,8-PeCDF	<0.7	0.3	0.11	61	
1,2,3,7,8-PeCDD	<1	1	0.5	65	
1,2,3,4,7,8-HxCDF	<0.7	0.1	0.035	65	
1,2,3,6,7,8-HxCDF	<0.7	0.1	0.035	60	
2,3,4,6,7,8-HxCDF	<0.6	0.1	0.03	60	
1,2,3,7,8,9-HxCDF	<0.7	0.1	0.035	63	
1,2,3,4,7,8-HxCDD	<0.9	0.1	0.045	75	
1,2,3,6,7,8-HxCDD	<1	0.1	0.05	67	
1,2,3,7,8,9-HxCDD	<1	0.1	0.05		
1,2,3,4,6,7,8-HpCDF	<1	0.01	0.005	65	
1,2,3,4,7,8,9-HpCDF	<1	0.01	0.005	62	
1,2,3,4,6,7,8-HpCDD	<1	0.01	0.005	74	
OCDF	<2	0.0003	0.0003		
OCDD	<6	0.0003	0.0009	68	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<8
Total TCDD isomers	<7
Total PeCDF isomers	<6
Total PeCDD isomers	<6
Total HxCDF isomers	<4
Total HxCDD isomers	<3
Total HpCDF isomers	<2
Total HpCDD isomers	<1

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	0	pg/kg
WHO_{05} -TEQ_{DF}		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**1.5**	pg/kg
Upper Bound [including LOD values]	**2.9**	pg/kg

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REPORT OF ANALYSIS

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Report No. RN1066218

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	Job No.	: CRIS05_W/150417
		Quote No.	: QT-01932
		Order No.	: 4500816979
		Date Sampled	: 16-APR-2015
		Date Received	: 17-APR-2015
Attention	: ALLAN LEE	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: DAVID LYNCH	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W15/007504X	YB	Dalyellip - Bi Annually WATER 16/04/15
W15/007509X	MB 3	Dalyellup - Bi Annually WATER 16/04/15
W15/007515X	DM 8A	Dalyellup - Bi Annually WATER 16/04/15
W15/007516X	DM 8C	Dalyellup - Bi Annually WATER 16/04/15

Lab Reg No.		W15/007504X	W15/007509X	W15/007515X	W15/007516X	
Sample Reference	Units	YB	MB 3	DM 8A	DM 8C	Method
Total TEQ						
Total TEQ		DAU15_065	DAU15_065	DAU15_065	DAU15_065	AUTL_01

Alan Yates, Analyst
Dioxin Analysis Unit
Accreditation No. 198

7-MAY-2015

REPORT OF ANALYSIS

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	Job No.	: CRIS05_W/150417
		Quote No.	: QT-01932
		Order No.	: 4500816979
		Date Sampled	: 16-APR-2015
		Date Received	: 17-APR-2015
Attention	: ALLAN LEE	Sampled By	: CLIENT
Project Name :			
Your Client Services Manager	: DAVID LYNCH	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W15/007519X	NG3	Dalyellup - Bi Annually WATER 16/04/15

Lab Reg No.		W15/007519X				
Sample Reference	Units	NG3				Method
Total TEQ						
Total TEQ		DAU15_065				AUTL_01

Alan Yates, Analyst
Dioxin Analysis Unit
Accreditation No. 198

7-MAY-2015

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CERTIFICATE OF ANALYSIS # DAU15_065

Client	Cristal Pigment Australia Ltd Lot 4, Old Coast Road Australind WA 6233	**Job No.**	CRIS05_W/150417
		Sampled by	Client
		Date Sampled	16-Apr-15
Contact	Allan Lee	**Date Received**	17-Apr-15

The results relate only to the sample(s) tested.

Method AUTL_01 **Date Reported** 7-May-15

Details

The method is for determination of tetra- through octa-chlorinated dibenzo-p-dioxins (PCDDs) & dibenzofurans (PCDFs) in aqueous samples by high resolution gas chromatography / high resolution mass spectrometry (HRGC/HRMS). This method provides data on all toxic 2,3,7,8-PCDD (seven) and PCDF (ten) isomers. PCDD and PCDF totals for each homologue group (tetra to octa) are also reported. The dioxin toxicity equivalent ($\mathrm{WHO_{05}}$-$\mathrm{TEQ_{DF}}$) in each sample is calculated using World Health Organization toxic equivalency factors ($\mathrm{WHO_{05}}$-TEFs). All results are corrected for labelled surrogate recoveries.

After sampling, the liquid is spiked with a range of isotopically labelled surrogate standards and exhaustively extracted. Clean up is effected by partitioning with sulphuric acid then distilled water. Further purification is performed using column chromatography on acid and base modified silica gels, basic alumina and carbon dispersed on celite.

Immediately prior to injection, internal standards are added to each extract, and an aliquot of the extract is injected into the GC. The analytes are separated by the GC and detected by a high-resolution (>10,000) mass spectrometer.

Authorisation

Nino Piro
Senior Chemist
Dioxin Analysis Unit

Dr Alan Yates
Senior Analyst
Dioxin Analysis Unit

Accreditation

NATA Accredited Laboratory Number : 198

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Sample Details : Job No. CRIS05_W/150417

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
W15/007504X	YB	Water	Water
W15/007509X	MB 3	Water	Water
W15/007515X	DM 8A	Water	Water
W15/007516X	DM 8C	Water	Water
W15/007519X	NG3	Water	Water

Project Details

Project Name	*Dalyellup*
Project Number	*Not specified*

Key

Analytes

TCDD	Tetrachlorodibenzo-p-dioxin	TCDF	Tetrachlorodibenzofuran
PeCDD	Pentachlorodibenzo-p-dioxin	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	HxCDF	Hexachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	HpCDF	Heptachlorodibenzofuran
OCDD	Octachlorodibenzo-p-dioxin	OCDF	Octachlorodibenzofuran

Units & Abbreviations

pg/kg	picograms per kilogram
<	level less than limit of detection (LOD)
WHO_{05}-TEF[†]	World Health Organization toxic equivalency factor
WHO_{05}-TEQ_{DF}[†]	World Health Organization toxic equivalents (Dioxins & Furans)

[†] as defined by Van den Berg et al., *Toxicol. Sci.* ***93** (2), pp. 223–241* (2006)

TEQs are calculated by multiplying the quantified level for each individual dioxin and furan congener reported by the corresponding TEF value and summing the result:

$$WHO_{05}-TEQ_{DF} = \sum_{i=1}^{7}\left[PCDD_i \times TEF_i\right] + \sum_{j=1}^{10}\left[PCDF_j \times TEF_j\right]$$

i = PCDD congener index (1 - 7)
j = PCDF congener index (1 - 10)

Lower Bound TEQ	defines all congener values reported below the LOD as equal to zero.
Middle Bound TEQ	defines all congener values reported below the LOD as equal to half the LOD.
Upper Bound TEQ	defines all congener values reported below the LOD as equal to the LOD.

Surrogate Recovery	percentage recovery for $^{13}C_{12}$ labelled surrogate standard
⚐	Laboratory surrogate recovery outside normal acceptance criteria: Solid and liquid matrices **25 - 125%**

Results : Job No. CRIS05_W/150417

Laboratory Reg. No. W15/007504X **Date Extracted** 1-May-15

Client Sample Ref. YB **DB5 Analysis** 6-May-15
Matrix Water
Description Water

PCDD/F Congeners	Level pg/kg	WHO$_{05}$-TEF	WHO$_{05}$-TEQ contribution	Labelled Surrogate recovery
2,3,7,8-TCDF	<2	0.1	0.1	44
2,3,7,8-TCDD	<2	1	1	46
1,2,3,7,8-PeCDF	<2	0.03	0.03	46
2,3,4,7,8-PeCDF	<1	0.3	0.15	57
1,2,3,7,8-PeCDD	<2	1	1	63
1,2,3,4,7,8-HxCDF	<1	0.1	0.05	58
1,2,3,6,7,8-HxCDF	<1	0.1	0.05	60
2,3,4,6,7,8-HxCDF	<1	0.1	0.05	64
1,2,3,7,8,9-HxCDF	<1	0.1	0.05	66
1,2,3,4,7,8-HxCDD	<1	0.1	0.05	74
1,2,3,6,7,8-HxCDD	<1	0.1	0.05	85
1,2,3,7,8,9-HxCDD	<1	0.1	0.05	
1,2,3,4,6,7,8-HpCDF	<1	0.01	0.005	50
1,2,3,4,7,8,9-HpCDF	<2	0.01	0.01	46
1,2,3,4,6,7,8-HpCDD	<2	0.01	0.01	63
OCDF	<2	0.0003	0.0003	
OCDD	<2	0.0003	0.0003	64

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<20
Total TCDD isomers	<10
Total PeCDF isomers	<10
Total PeCDD isomers	<10
Total HxCDF isomers	<6
Total HxCDD isomers	<4
Total HpCDF isomers	<3
Total HpCDD isomers	<4

Summary Results

Sum of PCDD and PCDF congeners

Excluding LOD values 0 pg/kg

WHO$_{05}$ -TEQ$_{DF}$

Lower Bound [excluding LOD values] **0** pg/kg
Middle Bound [including half LOD values] **2.7** pg/kg
Upper Bound [including LOD values] **5.3** pg/kg

Results : Job No. CRIS05_W/150417

Laboratory Reg. No. W15/007509X **Date Extracted** 1-May-15

Client Sample Ref. MB 3 **DB5 Analysis** 6-May-15
Matrix Water
Description Water

PCDD/F Congeners	Level pg/kg	WHO$_{05}$-TEF	WHO$_{05}$-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<1	0.1	0.05	71	
2,3,7,8-TCDD	<1	1	0.5	76	
1,2,3,7,8-PeCDF	<1	0.03	0.015	63	
2,3,4,7,8-PeCDF	<1	0.3	0.15	65	
1,2,3,7,8-PeCDD	<1	1	0.5	75	
1,2,3,4,7,8-HxCDF	<0.8	0.1	0.04	77	
1,2,3,6,7,8-HxCDF	<0.8	0.1	0.04	78	
2,3,4,6,7,8-HxCDF	<0.9	0.1	0.045	71	
1,2,3,7,8,9-HxCDF	<1	0.1	0.05	74	
1,2,3,4,7,8-HxCDD	<0.8	0.1	0.04	85	
1,2,3,6,7,8-HxCDD	<0.8	0.1	0.04	96	
1,2,3,7,8,9-HxCDD	<0.8	0.1	0.04		
1,2,3,4,6,7,8-HpCDF	<0.9	0.01	0.0045	54	
1,2,3,4,7,8,9-HpCDF	<1	0.01	0.005	49	
1,2,3,4,6,7,8-HpCDD	<2	0.01	0.01	65	
OCDF	<3	0.0003	0.00045		
OCDD	<3	0.0003	0.00045	54	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<8
Total TCDD isomers	<7
Total PeCDF isomers	<7
Total PeCDD isomers	<6
Total HxCDF isomers	<5
Total HxCDD isomers	<3
Total HpCDF isomers	<2
Total HpCDD isomers	<4

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	0	pg/kg
WHO$_{05}$ -TEQ$_{DF}$		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**1.5**	pg/kg
Upper Bound [including LOD values]	**3.1**	pg/kg

Results : Job No. CRIS05_W/150417

Laboratory Reg. No.	W15/007515X	**Date Extracted**	1-May-15
Client Sample Ref.	DM 8A	**DB5 Analysis**	6-May-15
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO_{05}-TEF	WHO_{05}-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<1	0.1	0.05	43	
2,3,7,8-TCDD	<2	1	1	44	
1,2,3,7,8-PeCDF	<2	0.03	0.03	50	
2,3,4,7,8-PeCDF	<1	0.3	0.15	64	
1,2,3,7,8-PeCDD	<2	1	1	71	
1,2,3,4,7,8-HxCDF	<0.7	0.1	0.035	65	
1,2,3,6,7,8-HxCDF	<0.7	0.1	0.035	65	
2,3,4,6,7,8-HxCDF	<0.7	0.1	0.035	65	
1,2,3,7,8,9-HxCDF	<0.8	0.1	0.04	69	
1,2,3,4,7,8-HxCDD	<0.8	0.1	0.04	83	
1,2,3,6,7,8-HxCDD	<0.8	0.1	0.04	84	
1,2,3,7,8,9-HxCDD	<0.8	0.1	0.04		
1,2,3,4,6,7,8-HpCDF	<0.8	0.01	0.004	56	
1,2,3,4,7,8,9-HpCDF	<1	0.01	0.005	49	
1,2,3,4,6,7,8-HpCDD	<1	0.01	0.005	71	
OCDF	<1	0.0003	0.00015		
OCDD	<1	0.0003	0.00015	66	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<8
Total TCDD isomers	<10
Total PeCDF isomers	<10
Total PeCDD isomers	<10
Total HxCDF isomers	<4
Total HxCDD isomers	<3
Total HpCDF isomers	<2
Total HpCDD isomers	<2

Summary Results

Sum of PCDD and PCDF congeners

Excluding LOD values	0	pg/kg

WHO_{05} -TEQ_{DF}

Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**2.5**	pg/kg
Upper Bound [including LOD values]	**5.0**	pg/kg

Results : Job No. CRIS05_W/150417

Laboratory Reg. No. W15/007516X **Date Extracted** 1-May-15

Client Sample Ref. DM 8C **DB5 Analysis** 6-May-15
Matrix Water
Description Water

PCDD/F Congeners	Level pg/kg	WHO_{05}-TEF	WHO_{05}-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<2	0.1	0.1	51	
2,3,7,8-TCDD	<2	1	1	52	
1,2,3,7,8-PeCDF	<2	0.03	0.03	54	
2,3,4,7,8-PeCDF	<2	0.3	0.3	65	
1,2,3,7,8-PeCDD	<2	1	1	73	
1,2,3,4,7,8-HxCDF	<0.9	0.1	0.045	68	
1,2,3,6,7,8-HxCDF	<0.9	0.1	0.045	67	
2,3,4,6,7,8-HxCDF	<0.9	0.1	0.045	68	
1,2,3,7,8,9-HxCDF	<1	0.1	0.05	75	
1,2,3,4,7,8-HxCDD	<1	0.1	0.05	84	
1,2,3,6,7,8-HxCDD	<1	0.1	0.05	89	
1,2,3,7,8,9-HxCDD	<1	0.1	0.05		
1,2,3,4,6,7,8-HpCDF	<2	0.01	0.01	58	
1,2,3,4,7,8,9-HpCDF	<2	0.01	0.01	55	
1,2,3,4,6,7,8-HpCDD	<1	0.01	0.005	76	
OCDF	<2	0.0003	0.0003		
OCDD	<2	0.0003	0.0003	73	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<20
Total TCDD isomers	<10
Total PeCDF isomers	<10
Total PeCDD isomers	<10
Total HxCDF isomers	<6
Total HxCDD isomers	<4
Total HpCDF isomers	<4
Total HpCDD isomers	<2

Summary Results

Sum of PCDD and PCDF congeners

Excluding LOD values	0	pg/kg

WHO_{05}-TEQ_{DF}

Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**2.8**	pg/kg
Upper Bound [including LOD values]	**5.6**	pg/kg

Results : Job No. CRIS05_W/150417

Laboratory Reg. No. W15/007519X **Date Extracted** 1-May-15

Client Sample Ref. NG3 **DB5 Analysis** 6-May-15
Matrix Water
Description Water

PCDD/F Congeners	Level pg/kg	WHO_{05}-TEF	WHO_{05}-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<0.8	0.1	0.04	72	
2,3,7,8-TCDD	<1	1	0.5	80	
1,2,3,7,8-PeCDF	<0.7	0.03	0.011	72	
2,3,4,7,8-PeCDF	<0.6	0.3	0.09	78	
1,2,3,7,8-PeCDD	<1	1	0.5	91	
1,2,3,4,7,8-HxCDF	<0.7	0.1	0.035	78	
1,2,3,6,7,8-HxCDF	<0.6	0.1	0.03	85	
2,3,4,6,7,8-HxCDF	<0.7	0.1	0.035	73	
1,2,3,7,8,9-HxCDF	<0.8	0.1	0.04	80	
1,2,3,4,7,8-HxCDD	<0.6	0.1	0.03	90	
1,2,3,6,7,8-HxCDD	<0.6	0.1	0.03	97	
1,2,3,7,8,9-HxCDD	<0.7	0.1	0.035		
1,2,3,4,6,7,8-HpCDF	<0.8	0.01	0.004	59	
1,2,3,4,7,8,9-HpCDF	<1	0.01	0.005	55	
1,2,3,4,6,7,8-HpCDD	<1	0.01	0.005	75	
OCDF	<2	0.0003	0.0003		
OCDD	<2	0.0003	0.0003	64	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<6
Total TCDD isomers	<7
Total PeCDF isomers	<5
Total PeCDD isomers	<6
Total HxCDF isomers	<4
Total HxCDD isomers	<2
Total HpCDF isomers	<2
Total HpCDD isomers	<2

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	0	pg/kg
WHO_{05} -TEQ_{DF}		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**1.4**	pg/kg
Upper Bound [including LOD values]	**2.8**	pg/kg

Australian Government
Department of Industry, Innovation and Science

National Measurement Institute

REPORT OF ANALYSIS

Report No. RN1114761

Client : CRISTAL PIGMENT AUSTRALIA LTD
LOT 4 OLD COAST ROAD
AUSTRALIND WA 6233

Attention : BENJAMIN HUXTABLE
Project Name : CRISTAL DALYELLUP APRIL 2016
Your Client Services Manager : David Lynch

Job No. : CRIS05_W/160422
Quote No. : QT-01932
Order No. : 4500867576
Date Sampled : 21-APR-2016
Date Received : 22-APR-2016
Sampled By : CLIENT
Phone : (08) 9368 8400

Lab Reg No.	**Sample Ref**	**Sample Description**
W16/007603X	YB	DALYELLUP WATER 21/04/16
W16/007608X	MB 3	DALYELLUP WATER 21/04/16
W16/007614X	DM 8A	DALYELLUP WATER 21/04/16
W16/007615X	DM 8C	DALYELLUP WATER 21/04/16

Lab Reg No.		**W16/007603X**	**W16/007608X**	**W16/007614X**	**W16/007615X**	
Sample Reference	Units	**YB**	**MB 3**	**DM 8A**	**DM 8C**	**Method**
Total TEQ						
Total TEQ		DAU16_096	DAU16_096	DAU16_096	DAU16_096	AUTL_01

Alan Yates, Analyst
Dioxin Analysis Unit
Accreditation No. 198

20-MAY-2016

ACCREDITED FOR TECHNICAL COMPETENCE

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Results relate only to the sample(s) tested.

Australian Government
National Measurement Institute

CERTIFICATE OF ANALYSIS # DAU16_096

Client	Cristal Pigment Australia Ltd Locked Bag 245 Bunbury WA 6230	**Job No.**	CRIS05_W/160422
		Sampled by	Client
		Date Sampled	21-Apr-16
Contact	Ben Huxtable	**Date Received**	22-Apr-16

The results relate only to the sample(s) tested.

Method	AUTL_01	**Date Reported**	20-May-16

Details

The method is for determination of tetra- through octa-chlorinated dibenzo-p-dioxins (PCDDs) & dibenzofurans (PCDFs) in aqueous samples by high resolution gas chromatography / high resolution mass spectrometry (HRGC/HRMS).
This method provides data on all toxic 2,3,7,8-PCDD (seven) and PCDF (ten) isomers.
PCDD and PCDF totals for each homologue group (tetra to octa) are also reported.
The dioxin toxicity equivalent (WHO$_{05}$-TEQ$_{DF}$) in each sample is calculated using World Health Organization toxic equivalency factors (WHO$_{05}$-TEFs). All results are corrected for labelled surrogate recoveries.

After sampling, the liquid is spiked with a range of isotopically labelled surrogate standards and exhaustively extracted. Clean up is effected by partitioning with sulphuric acid then distilled water. Further purification is performed using column chromatography on acid and base modified silica gels, basic alumina and carbon dispersed on celite.

Immediately prior to injection, internal standards are added to each extract, and an aliquot of the extract is injected into the GC. The analytes are separated by the GC and detected by a high-resolution (>10,000) mass spectrometer.

Authorisation

Nino Piro Senior Chemist Dioxin Analysis Unit	Dr Alan Yates Senior Analyst Dioxin Analysis Unit

Accreditation

NATA Accredited Laboratory Number : 198

Accredited for compliance with ISO/IEC 17025.

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Sample Details : Job No. CRIS05_W/160422

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
W16/007603X	YB	Water	Water
W16/007608X	MB 3	Water	Water
W16/007614X	DM 8A	Water	Water
W16/007615X	DM 8C	Water	Water

Project Details

Project Name	*Dalyellup*
Project Number	*Not specified*

Key

Analytes

TCDD	Tetrachlorodibenzo-p-dioxin	TCDF	Tetrachlorodibenzofuran
PeCDD	Pentachlorodibenzo-p-dioxin	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	HxCDF	Hexachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	HpCDF	Heptachlorodibenzofuran
OCDD	Octachlorodibenzo-p-dioxin	OCDF	Octachlorodibenzofuran

Units & Abbreviations

pg/kg	picograms per kilogram
<	level less than limit of detection (LOD)
$\text{WHO}_{05}\text{-TEF}^{\dagger}$	World Health Organization toxic equivalency factor
$\text{WHO}_{05}\text{-TEQ}_{\text{DF}}^{\dagger}$	World Health Organization toxic equivalents (Dioxins & Furans)

† as defined by Van den Berg et al., *Toxicol. Sci.* ***93*** *(2), pp. 223–241* (2006)

TEQs are calculated by multiplying the quantified level for each individual dioxin and furan congener reported by the corresponding TEF value and summing the result:

$$\text{WHO}_{05}-\text{TEQ}_{\text{DF}} = \sum_{i=1}^{7}\left[\text{PCDD}_i \times \text{TEF}_i\right] + \sum_{j=1}^{10}\left[\text{PCDF}_j \times \text{TEF}_j\right]$$

i = PCDD congener index (1 - 7)
j = PCDF congener index (1 - 10)

Lower Bound TEQ	defines all congener values reported below the LOD as equal to zero.
Middle Bound TEQ	defines all congener values reported below the LOD as equal to half the LOD.
Upper Bound TEQ	defines all congener values reported below the LOD as equal to the LOD.
Surrogate Recovery	percentage recovery for $^{13}C_{12}$ labelled surrogate standard
⚐	Laboratory surrogate recovery outside normal acceptance criteria: Solid and liquid matrices **25 - 125%**

Results : Job No. CRIS05_W/160422

Laboratory Reg. No.	W16/007603X	**Date Extracted**	11-May-16
Client Sample Ref.	YB	**DB5 Analysis**	19-May-16
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO_{05}-TEF	WHO_{05}-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<0.4	0.1	0.02	75	
2,3,7,8-TCDD	<0.7	1	0.35	69	
1,2,3,7,8-PeCDF	<0.5	0.03	0.0075	90	
2,3,4,7,8-PeCDF	<0.4	0.3	0.06	99	
1,2,3,7,8-PeCDD	<0.4	1	0.2	103	
1,2,3,4,7,8-HxCDF	<0.3	0.1	0.015	77	
1,2,3,6,7,8-HxCDF	<0.3	0.1	0.015	78	
2,3,4,6,7,8-HxCDF	<0.3	0.1	0.015	71	
1,2,3,7,8,9-HxCDF	<0.3	0.1	0.015	77	
1,2,3,4,7,8-HxCDD	<0.4	0.1	0.02	85	
1,2,3,6,7,8-HxCDD	<0.4	0.1	0.02	80	
1,2,3,7,8,9-HxCDD	<0.4	0.1	0.02		
1,2,3,4,6,7,8-HpCDF	0.80	0.01	0.0080	79	
1,2,3,4,7,8,9-HpCDF	<0.3	0.01	0.0015	76	
1,2,3,4,6,7,8-HpCDD	<0.3	0.01	0.0015	77	
OCDF	6.0	0.0003	0.0018		
OCDD	<1	0.0003	0.00015	81	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	3.7
Total TCDD isomers	<5
Total PeCDF isomers	<3
Total PeCDD isomers	<2
Total HxCDF isomers	<2
Total HxCDD isomers	<2
Total HpCDF isomers	0.80
Total HpCDD isomers	<0.3

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	11	pg/kg
WHO_{05} -TEQ_{DF}		
Lower Bound [excluding LOD values]	**0.0098**	pg/kg
Middle Bound [including half LOD values]	**0.77**	pg/kg
Upper Bound [including LOD values]	**1.5**	pg/kg

Results : Job No. CRIS05_W/160422

Laboratory Reg. No.	W16/007608X	**Date Extracted**	11-May-16
Client Sample Ref.	MB 3	**DB5 Analysis**	19-May-16
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO_{05}-TEF	WHO_{05}-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<0.3	0.1	0.015	75	
2,3,7,8-TCDD	<0.7	1	0.35	68	
1,2,3,7,8-PeCDF	<0.4	0.03	0.006	93	
2,3,4,7,8-PeCDF	<0.3	0.3	0.045	100	
1,2,3,7,8-PeCDD	<0.4	1	0.2	101	
1,2,3,4,7,8-HxCDF	<0.3	0.1	0.015	79	
1,2,3,6,7,8-HxCDF	<0.3	0.1	0.015	77	
2,3,4,6,7,8-HxCDF	<0.3	0.1	0.015	71	
1,2,3,7,8,9-HxCDF	<0.3	0.1	0.015	72	
1,2,3,4,7,8-HxCDD	<0.3	0.1	0.015	83	
1,2,3,6,7,8-HxCDD	<0.3	0.1	0.015	82	
1,2,3,7,8,9-HxCDD	<0.3	0.1	0.015		
1,2,3,4,6,7,8-HpCDF	<0.1	0.01	0.0005	74	
1,2,3,4,7,8,9-HpCDF	<0.2	0.01	0.001	60	
1,2,3,4,6,7,8-HpCDD	<0.2	0.01	0.001	72	
OCDF	<0.5	0.0003	0.000075		
OCDD	3.1	0.0003	0.00094	76	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<2
Total TCDD isomers	<5
Total PeCDF isomers	<2
Total PeCDD isomers	<2
Total HxCDF isomers	<2
Total HxCDD isomers	<1
Total HpCDF isomers	<0.3
Total HpCDD isomers	<0.2

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	3.1	pg/kg
WHO_{05} -TEQ_{DF}		
Lower Bound [excluding LOD values]	**0.00094**	pg/kg
Middle Bound [including half LOD values]	**0.72**	pg/kg
Upper Bound [including LOD values]	**1.4**	pg/kg

Results : Job No. CRIS05_W/160422

Laboratory Reg. No.	W16/007614X	**Date Extracted**	11-May-16
Client Sample Ref.	DM 8A	**DB5 Analysis**	19-May-16
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO$_{05}$-TEF	WHO$_{05}$-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<0.4	0.1	0.02	72	
2,3,7,8-TCDD	<0.7	1	0.35	64	
1,2,3,7,8-PeCDF	<0.4	0.03	0.006	87	
2,3,4,7,8-PeCDF	<0.4	0.3	0.06	96	
1,2,3,7,8-PeCDD	<0.5	1	0.25	96	
1,2,3,4,7,8-HxCDF	<0.2	0.1	0.01	74	
1,2,3,6,7,8-HxCDF	<0.2	0.1	0.01	76	
2,3,4,6,7,8-HxCDF	<0.2	0.1	0.01	68	
1,2,3,7,8,9-HxCDF	<0.3	0.1	0.015	70	
1,2,3,4,7,8-HxCDD	<0.4	0.1	0.02	79	
1,2,3,6,7,8-HxCDD	<0.4	0.1	0.02	77	
1,2,3,7,8,9-HxCDD	<0.4	0.1	0.02		
1,2,3,4,6,7,8-HpCDF	<0.1	0.01	0.0005	74	
1,2,3,4,7,8,9-HpCDF	<0.2	0.01	0.001	64	
1,2,3,4,6,7,8-HpCDD	<0.3	0.01	0.0015	71	
OCDF	<0.4	0.0003	0.00006		
OCDD	<0.5	0.0003	0.000075	77	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<3
Total TCDD isomers	<5
Total PeCDF isomers	<3
Total PeCDD isomers	<3
Total HxCDF isomers	<1
Total HxCDD isomers	<2
Total HpCDF isomers	<0.3
Total HpCDD isomers	<0.3

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	0	pg/kg
WHO$_{05}$ -TEQ$_{DF}$		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**0.79**	pg/kg
Upper Bound [including LOD values]	**1.6**	pg/kg

Results : Job No. CRIS05_W/160422

Laboratory Reg. No.	W16/007615X	**Date Extracted**	11-May-16
Client Sample Ref.	DM 8C	**DB5 Analysis**	19-May-16
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO$_{05}$-TEF	WHO$_{05}$-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<0.3	0.1	0.015	79	
2,3,7,8-TCDD	<0.7	1	0.35	71	
1,2,3,7,8-PeCDF	<0.4	0.03	0.006	92	
2,3,4,7,8-PeCDF	<0.4	0.3	0.06	99	
1,2,3,7,8-PeCDD	<0.4	1	0.2	102	
1,2,3,4,7,8-HxCDF	<0.2	0.1	0.01	80	
1,2,3,6,7,8-HxCDF	<0.2	0.1	0.01	78	
2,3,4,6,7,8-HxCDF	<0.3	0.1	0.015	73	
1,2,3,7,8,9-HxCDF	<0.3	0.1	0.015	72	
1,2,3,4,7,8-HxCDD	<0.4	0.1	0.02	85	
1,2,3,6,7,8-HxCDD	<0.4	0.1	0.02	82	
1,2,3,7,8,9-HxCDD	<0.4	0.1	0.02		
1,2,3,4,6,7,8-HpCDF	<0.1	0.01	0.0005	76	
1,2,3,4,7,8,9-HpCDF	<0.3	0.01	0.0015	56	
1,2,3,4,6,7,8-HpCDD	<0.3	0.01	0.0015	76	
OCDF	<0.5	0.0003	0.000075		
OCDD	<2	0.0003	0.0003	78	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<2
Total TCDD isomers	<5
Total PeCDF isomers	<3
Total PeCDD isomers	<2
Total HxCDF isomers	<2
Total HxCDD isomers	<2
Total HpCDF isomers	<0.4
Total HpCDD isomers	<0.3

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	0	pg/kg
WHO$_{05}$ -TEQ$_{DF}$		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**0.74**	pg/kg
Upper Bound [including LOD values]	**1.5**	pg/kg

Appendix J

Sampling Operating Procedures

STANDARD TECHNICAL OPERATING PROCEDURE 29
FIELD SAMPLE QUALITY CONTROL

1. *PURPOSE*

To describe the quality control measures undertaken to ensure the integrity of our field samples.

2. *EQUIPMENT/MATERIALS*

See various field sampling procedures.

3. *PROCEDURE*

When out sampling in the field, there is a risk that our samples can become inadvertently contaminated due to site conditions or sample handling. This field contamination can cause erroneous analytical results. Therefore, there are a number of different quality control samples that can be taken to act as indicators for contamination problems. **The following methods are standard practice at Stass Environmental and are required to be performed for every job.**

3.1. SOILS

3.1.1. Duplicates

Duplicates can be used to determine the overall precision of the sampling methods we use and also the analytical methods used by the laboratory.

- During sampling two or more representative samples are collected from the same sampling point.
- Duplicates are collected for every ten samples taken or for every project if less than ten samples are collected.
- It is not necessary to collect a duplicate for every field trip. One per ten samples is sufficient.
- In the case of soils, a sample with a high PID reading should be taken so that analytical results obtained can be compared. (two sets of non-detection data are of limited use!).

3.1.2. Equipment / Rinsate Blanks

Equipment or rinsate blanks are designed to measure any sample contamination caused by the sampling device and also to document the adequate decontamination of sampling equipment between sampling events.

- Only to be collected when equipment is being decontaminated between samplings. eg: augers and split spoons (it is usually easier to take a rinsate blank of the split spoon). Do not take rinsate blanks from excavator buckets and spades where the samples taken do not connect with the equipment.
- One rinsate blank to be taken per project, or as directed by the Operations Manager, State Manager or Client.
- A rinsate blank is performed by rinsing the equipment in question with distilled water after it has been decontaminated in the usual way and collecting the rinsate in a standard sample bottle. The sample is then treated as per other samples collected on the day.
- If possible, sample a rinsate blank directly after sampling a soil with a high PID reading and decontamination.

3.2. WATERS

This SOP incorporates the requirements of AS/NZS 5667.1 and 5667.11. Details are provided below. In some respects, this SOP exceeds the requirements of Australian Standards for sampling of waters.

3.2.1. Duplicates

- One duplicate to be taken for every ten samples, or one duplicate per project if less than ten samples are taken.
- As for soils, it is not necessary to take a duplicate for every day in the field. One per ten samples is sufficient.

3.2.2. Field / Rinsate Blanks

These blanks are designed to measure sample contamination during the whole sampling process, including any contamination present in our disposable bailers.

- One field blank to be taken per day in the field.
- To be sampled at the beginning of field activities.
- Prepared by taking distilled water into the field and rinsing through a new bailer into a standard sampling bottle.
- To be stored and treated as per the other samples taken on the day.

3.3. NON-ROUTINE QC SAMPLES

The following types of quality control samples are taken only when specified by our clients. They are not routine procedures. The Operations Manager will inform staff if non-standard QC is required.

3.3.1. Laboratory Sample Splits

These samples provide a check on the analytical proficiency of our laboratories.

- One sample per project.
- The splitting of the sample should be performed at the laboratory and not in the field.
- The sample should be sent to our primary laboratory along with two sets of paperwork. One addressed to our primary lab and one addressed to our secondary lab.(ie. chain of custody and purchase order).
- Instruct the primary laboratory to split the sample and to courier the split ASAP to the secondary laboratory along with the relevant documentation.

- Request analysis for the same parameters on both samples.

3.3.2. Trip Blanks

Trip blanks are designed to measure the sample contamination from the storage container, field handling and transportation.

- These blanks apply to water sampling.
- A trip blank consists of collecting a sample container already filled with distilled water from the laboratory, storing this bottle with your other containers at the office, taking the bottle with you to the site and returning it to the laboratory unopened.

3.3.3. Background Samples

These samples are designed to measure the presence in the background of any of the contaminants in question.

- A sample of the same media being examined is collected near to the time and place of the sampling.
- These samples are taken from nearby areas where contamination is not expected.

3.3.4. Field Spikes

Field spikes are utilised to measure the magnitude of interference caused to the analysis by matrix characteristics and also the loss of contaminants from the sample due to sampling procedures.

- The laboratory supplies us with a sample that has been previously spiked with a known concentration of the analyte in question.
- The sample is taken to the site unopened. It should be kept chilled at all times and kept out of direct sunlight.
- At the site and point of sampling, the spike sample is opened and placed into another sampling container similar to the other samples taken.

- The spike sample should be treated exactly as per the other samples taken on the day.

4. *TIPS*

- It is important to remember that all QC samples are to be treated exactly the same as other samples collected on the day. Otherwise they are not a reflection of true conditions.
- Soil QC samples are labelled NGS-# and water QC samples are labelled NGW-# (where # corresponds to a consecutive number identifying the sample).
- An outline of how to interpret the results of QC sample analysis can be found in STOP40.

5. *FORMS*

No specific forms are required for QC samples alone. They are documented along with all other samples collected on site.(See STOP 15 and STOP 20.

STANDARD OPERATING PROCEDURE 30
INTERPRETATION OF ANALYTICAL RESULTS

1. *PURPOSE*

To outline the steps taken to interpret the quality of analytical results received from sub-contractor laboratories, including the interpretation of quality control data.

This SOP incorporates the requirements of AS/NZS 5667.1 and 5667.11. Details are provided below. In some respects, this SOP exceeds the requirements of Australian Standards for sampling of waters.

2. *EQUIPMENT/MATERIALS*

- No equipment or materials are required for the implementation of this procedure.

3. *PROCEDURE*

3.1. COMPARISON OF RESULTS WITH FIELD OBSERVATIONS

- The first step to take when inspecting results received from the laboratory is to compare the general trend of results with observations made in the field. eg: PID readings, visual observations of contamination etc.
- Contamination that is observed by sight or smell in the field will generally show up as high analytical results. If contamination has been visually observed and analytical results are low, the results should be queried. Usually, a high PID reading will correspond with a high analytical result for volatile hydrocarbons (BTEX), although there are exceptions.
- **Care must be exercised when comparing PID readings to analytical results for BTEX.** This is because PIDs are non-specific indicators for volatile organic compounds and are able to pick up many more compounds than just benzene, toluene, ethylbenzene and xylenes. For example, a high PID reading could mean lots of trichloroethylene and no petroleum products.

3.2. ANALYTE RECOVERIES

3.2.1. Laboratory Spike Recoveries

- Analyte recoveries are obtained by spiking a sample with a known concentration of the analyte in question and recording the percentage of that concentration recovered after extraction and analysis.
- Recoveries measure the effect of the sample matrix on the analysis and also loss of the analyte during the analytical procedure.
- The acceptable range for recoveries is between 70-130%.
- If a recovery result falls outside the above limits the laboratory should be consulted regarding possible causes.
- Sometimes more than one spike and recovery is performed and the difference between the two is statistically expressed as a "relative precision difference". See section 3.4.2 (laboratory duplicates) for a discussion of what RPDs are acceptable.

3.2.2. Field Spike Recoveries

- Field spike recoveries are essentially similar to laboratory spike recoveries, except the sample is spiked with a known concentration of the analyte in question before the sample is taken into the field.
- Therefore, in addition to measuring the effect of the matrix and lab procedures on the recovery of the analyte, a field spike recovery also measures the effect of our field sample handling.
- The same acceptance criteria apply to field spike recoveries as to laboratory spike recoveries. (see the last section of this procedure : 3.2.1).

3.3. BLANK RESULTS

3.3.1. Field Blanks / Rinsate Blanks

- These blanks are utilised as an indicator of any contamination that we may be introducing into our samples both during sampling and transportation.
- Henceforth, a high analytical result for a field blank is an indication of contamination problems that should be investigated. These can include contamination of sampling equipment, insufficient cleaning of equipment between samplings, contamination of the sample containers or contamination of the blank during transportation.
- The results of field blank analysis must be observed in the context of the results obtained from accompanying samples. eg: if all benzene results are in the region of 10mg/l and the field blank is showing 0.005mg/l, this level of contamination will have no effect whatsoever on the analytical results of the samples collected. If unsure, consult with the Principal Chemist.

3.3.2. Trip Blanks

- These blanks are designed to measure contamination of a closed water sample from the sample container, field handling and transportation.
- A high analytical result for a trip blank points to contamination problems that should be investigated. These could include contamination of the sampling container, contamination from being stored on site, contamination diffusing from other samples stored with it and contamination resulting from transport procedures.
- As for field blanks (see section 3.3.1 of this procedure), results of trip blank analysis must be interpreted in the context of the analytical results obtained for the accompanying samples.

3.3.3. Laboratory Blanks

- Laboratory blanks are designed to indicate any contamination resulting from the lab's treatment of the samples prior to and during analysis.
- These blanks should be run at a frequency of 5%. That is, there should be one blank per twenty samples.
- Contamination can come from laboratory glassware, reagents added to the samples or contamination of the instrument utilised for the analysis.
- Laboratory blank analysis should give results below the practical quantitation limit (PQL) of the analytical method in question. If not, the laboratory should be consulted regarding possible causes.

3.4. DUPLICATE RESULTS

3.4.1. Field Duplicates

- Field duplicates are utilised to measure the overall precision of our sampling procedures and also the laboratory's analytical methods.
- The results of field duplicate analysis should be within 30% of each other. An investigation is warranted if the difference between the two sets of results is greater than 30%.
- The main reason encountered for large differences in duplicate results is that the samples are not homogeneous. This can be due to the nature of the soil itself, bad sampling technique, the method of sub-sample collection by the laboratory, and the treatment of the duplicate samples during extraction and analysis. All can result in the non-uniform distribution of analytes within the samples in question.

3.4.2. Laboratory Duplicates

- Laboratory duplicates are designed to measure the precision of the lab's internal sub-sampling procedure and of the lab's analytical procedures.

- These duplicates should be performed at the frequency of 5%. That is, one in every 20 samples analysed.
- As for field duplicates, the results for laboratory duplicates should be within 30% of each other. Larger differences in laboratory duplicates can be due to the nature of the sample itself, the method of sub-sample collection and the treatment of the sample during extraction and analysis.
- Some laboratories utilise a calculation called a "relative precision difference" or RPD for short. These figures are used as indicators of the precision of the analysis by comparing the results of duplicate analyses statistically. The following outlines acceptance criteria for lab duplicates when these figures are supplied.

i) <u>For low level waters</u> (results < 10 x Practical Quantitation Limit) ....**%RPD<40%**

ii) <u>For high level waters</u> (results > 10 x Practical Quantitation Limit).......................................**%RPD<20%**

iii) <u>For low level soils</u> (results < 10 x Practical Quantitation Limit)...**%RPD<50 %**

iv) <u>For high level soils</u> (results > 10 x Practical Quantitation Limit)...**%RPD<30 %**

4. *<u>TIPS</u>*

- Check that the project number and sample references indicated on the analytical report correspond to our own records.
- The C_6-C_9 fraction of TPH results includes all the BTEX components. Therefore the sum of the BTEX components should be less than or equal to the C_6-C_9 result for TPH. If not, consult with the laboratory.
- Be aware that laboratories utilise volatile chlorinated hydrocarbons as solvents for sample extraction. (eg:

dichloromethane, chloroform, trichloroethylene, and freon). Hence low levels of these compounds found in samples analysed may in fact be laboratory contaminants.

- Some results stick out like a sore thumb and should be investigated. For example, a high result for ethylbenzene and non-detection results for all other BTEX components. Another example of this is a high result where no contamination was expected.
- Weird looking results are often caused by laboratory error. For example: weighing an incorrect amount of sample for extraction, swapping samples by mistake, and calculation errors. Do not be scared to ring the lab and ask to have your results checked. If checking comes back OK, consider asking the lab to re-analyse your sample (most commercial laboratories will do this for you at no cost).
- Beware of results for those samples immediately following samples with very high levels of contaminants. Contamination of the analytical instrument and carry over of contamination to the next samples can occur if steps aren't taken by the laboratory to rinse out the instrument after a particularly high sample.

5. FORMS

No forms are utilised in this procedure.

Appendix K
Laboratory Records

Australian Government

Department of Industry, Innovation and Science

National Measurement Institute

NATA

REPORT OF ANALYSIS

Report No. RN1102024

Client : CRISTAL PIGMENT AUSTRALIA LTD
LOT 4 OLD COAST ROAD
AUSTRALIND WA 6233

Attention : PETER ALLEN
Project Name :
Your Client Services Manager : David Lynch

Job No. : CRIS05_W/160121
Quote No. : QT-01932
Order No. : 4500867576
Date Sampled : 20-JAN-2016
Date Received : 21-JAN-2016
Sampled By : CLIENT
Phone : (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/001398	GGW12A	GOLDER & AUSTRALIND BORES WATER 20/01/16
W16/001399	GGW12B	GOLDER & AUSTRALIND BORES WATER 20/01/16
W16/001400	GGW12C	GOLDER & AUSTRALIND BORES WATER 20/01/16
W16/001401	YB	DALYELLUP YB-QUARTERLY WATER 20/01/16

Lab Reg No.		W16/001398	W16/001399	W16/001400	W16/001401	
Sample Reference	Units	GGW12A	GGW12B	GGW12C	YB	Method
Filtered Trace Elements by ICP						
Aluminium Filtered	mg/L	0.23	55	26	Not Tested	NT2_47
Arsenic Filtered	mg/L	<0.001	0.029	0.007	Not Tested	NT2_47
Cadmium Filtered	mg/L	<0.0001	0.017	0.001	Not Tested	NT2_47
Chromium Filtered	mg/L	<0.001	0.017	0.003	Not Tested	NT2_47
Copper Filtered	mg/L	0.003	6.6	0.003	Not Tested	NT2_47
Iron Filtered	mg/L	0.98	39	20	Not Tested	NT2_47
Lead Filtered	mg/L	<0.001	0.002	<0.001	Not Tested	NT2_47
Magnesium Filtered	mg/L	11	97	8.6	Not Tested	NT2_47
Manganese Filtered	mg/L	0.099	39	1.5	Not Tested	NT2_47
Mercury Filtered	mg/L	<0.0001	<0.0001	<0.0001	Not Tested	NT247_244
Nickel Filtered	mg/L	0.003	1.6	0.16	Not Tested	NT2_47
Potassium Filtered	mg/L	16	27	5.7	Not Tested	NT2_47
Selenium Filtered	mg/L	<0.001	0.021	0.001	Not Tested	NT2_47
Sodium Filtered	mg/L	79	170	28	Not Tested	NT2_47
Zinc Filtered	mg/L	0.027	11	1.1	Not Tested	NT2_47

W16/001398
- W16/001400
Samples had sediment present.

Ling Shuang Lu, Analyst
Inorganics - NSW
Accreditation No. 198

16-FEB-2016

Accredited for compliance with ISO/IEC 17025

REPORT OF ANALYSIS

Report No. RN1102024

Lab Reg No.		W16/001398	W16/001399	W16/001400	W16/001401	
Sample Reference	Units	GGW12A	GGW12B	GGW12C	YB	Method
Inorganics						
Carbonate as CaCO3	mg/L	<1	<1	<1	Not Tested	WL122
Chloride	mg/L	140	230	42	200	WL119WL293
Conductivity at 25C	uS/cm	590	4200	900	Not Tested	WL121
Nitrate as NO3-N	mg/L	<0.2	<0.2	0.4	Not Tested	WL119
Nitrite as NO2-N	mg/L	<0.2	<0.2	<0.2	Not Tested	WL119
pH		6.5	2.8	3.3	Not Tested	WL120
Sodium - Filterable	mg/L	Not Tested	Not Tested	Not Tested	99	WL272
Sulfate	mg/L	26	2400	360	Not Tested	WL119WL293
Total Dissolved Solids (Evap)	mg/L	350	3160	620	Not Tested	WL123
Total Kjeldahl Nitrogen	mg/L	1	1	2	Not Tested	WL132
Total Nitrogen (Calc)	mg/L	1	1	2	Not Tested	WL132CALC
Total Phosphorus	mg/L	<0.1	<0.1	<0.1	Not Tested	WL195WL272
Turbidity	NTU	150	14	150	Not Tested	WL130

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

16-FEB-2016

Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

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Results relate only to the sample(s) tested.

This Report supersedes reports: RN1100419 RN1100580

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Cristal Pigment Australia LTD

Lot 4 Old Old Coast Road
AUSTRALIND WA 6230

Attention: Peter Allen

NMI Job No: CRIS05_W/160121
Sample Matrix: Water
Sample LRN Range: W16/001398 - 001401

Analyte	LOR	Blank	Units	LRN	Duplicate	Recovery	Acceptability
				W16/001400	D	%	Limits
Carbonate as CaCO3	1	<1	mg/L	<1	<1	101%	80 - 110
Chloride	10	<10	mg/L	42	42	103%	90 - 110
Conductivity at 25'C	10	<10	uS/cm	900	910	-	-
Nitrate as NO3-N	0.2	<0.2	mg/L	0.4	0.4	101%	90 - 110
Nitrite as NO2-N	0.2	<0.2	mg/L	<0.2	<0.2	-	-
pH	-	-	-	3.3	3.3	-	-
Sodium - Filterable	10	<10	mg/L	-	-	96%	85 - 110
Sulfate	5	<5	mg/L	360	360	101%	85 - 115
Total Dissolved Solids (Evap)	10	<10	mg/L	620	620	97%	90 - 110
Total Kjeldahl Nitrogen	1	<1	mg/L	2	2	100%	80 - 110
Total Nitrogen (Calc)	1	<1	mg/L	2	2	-	-
Total Phosphorus	0.1	<0.1	mg/L	<0.1	<0.1	100%	80 - 110
Turbidity	0.1	<0.1	NTU	150	160	90%	-

Signed:

David Lynch
Senior Environmental Chemist
NMI WA, Inorganic Section

Date: **12/02/2016**

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Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: **CRISTAL PIGMENT AUSTRALIA LTD**

NMI QA Report No: **CRIS05_W/160121**

Sample Matrix: Water

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		mg/L	mg/L	mg/L	mg/L	%	%	%
Inorganics Section				**W16/001400**				**W16/001400**
Aluminium Filtered	NT2.47	0.005	<0.005	26	26	0	96	101
Arsenic Filtered	NT2.47	0.001	<0.001	0.007	0.007	0	98	99
Cadmium Filtered	NT2.47	0.0001	<0.0001	0.001	0.001	0	100	99
Chromium Filtered	NT2.47	0.001	<0.001	0.003	0.003	0	101	98
Copper Filtered	NT2.47	0.001	<0.001	NA	0.003	NA	103	86
Iron Filtered	NT2.47	0.005	<0.005	21	20	5	95	88
Lead Filtered	NT2.47	0.001	<0.001	<0.001	<0.001	ND	102	99
Magnesium Filtered	NT2.47	0.005	<0.005	8.6	8.5	1	97	97
Manganese Filtered	NT2.47	0.001	<0.001	1.5	1.4	7	98	97
Mercury Filtered	NT2.47/2.44	0.0001	<0.0001	<0.0001	<0.0001	ND	102	96
Nickel Filtered	NT2.47	0.001	<0.001	0.16	0.16	0	102	99
Potassium Filtered	NT2.47	0.05	<0.05	5.7	5.6	2	97	#
Selenium Filtered	NT2.47	0.001	<0.001	0.001	0.002	67	104	101
Sodium Filtered	NT2.47	0.05	<0.05	28	28	0	99	100
Zinc Filtered	NT2.47	0.001	<0.001	1.1	1.1	0	100	100

Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations >5 times LOR. Greater RPD may be expected at <5 times LOR.
LOR = Limit Of Reporting ND = Not Determined
RPD = Relative Percent Difference NA = Not Applicable
LCS = Laboratory Control Sample.
#: Spike level is less than 50% of the sample's concentration, hence the recovery data is not reliable.

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
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Signed:

Dr Michael Wu
Inorganics , NMI-North Ryde
Date: **5/02/2016**

SGS

NATA
Accredited Laboratory
No. 14174

Western Radiation Services
analytical laboratory & consulting

ABN: 44 000 964 278

9th December 2016

Ref: 9548
Order No: 4500874061
Page 1 of 1

Cristal Pigments
PO Box 245
Bunbury WA 6230
Australia

Attn: Mr. Allan Lee

RE-ISSUED ANALYTICAL REPORT

This is a re-issue of report 9548, originally issued 19th February 2016.

The result (to 95%, 2σ confidence level) for Radium-226, Radium-228 analyses of one (1) liquid samples as received at our laboratory on 21st January 2016 are detailed below.

Gamma Spectrometry Analysis

WRS No.	Client Sample ID	Ra-226 (mBq/l)	Ra-228 (mBq/l)
9548-1	YB	<MDL	<MDL

The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

MDL: Radium-226 100 mBq/l Radium-228 100 mBq/l

Method: LTP No. 4(a) Gamma Spectrometry Analysis

Jacob Borger
Authorised Signatory

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REPORT OF ANALYSIS

Page: 1 of 2

Report No. RN1114761

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	**Job No.**	: CRIS05_W/160422
		Quote No.	: QT-01932
		Order No.	: 4500867576
		Date Sampled	: 21-APR-2016
		Date Received	: 22-APR-2016
Attention	: BENJAMIN HUXTABLE	**Sampled By**	: CLIENT
Project Name	: CRISTAL DALYELLUP APRIL 2016		
Your Client Services Manager	: David Lynch	**Phone**	: (08) 9368 8400

Lab Reg No.	**Sample Ref**	**Sample Description**
W16/007603X	YB	DALYELLUP WATER 21/04/16
W16/007608X	MB 3	DALYELLUP WATER 21/04/16
W16/007614X	DM 8A	DALYELLUP WATER 21/04/16
W16/007615X	DM 8C	DALYELLUP WATER 21/04/16

Lab Reg No.		**W16/007603X**	**W16/007608X**	**W16/007614X**	**W16/007615X**	
Sample Reference	**Units**	**YB**	**MB 3**	**DM 8A**	**DM 8C**	**Method**
Total TEQ						
Total TEQ		DAU16_096	DAU16_096	DAU16_096	DAU16_096	AUTL_01

Alan Yates, Analyst
Dioxin Analysis Unit
Accreditation No. 198

20-MAY-2016

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Australian Government
National Measurement Institute

CERTIFICATE OF ANALYSIS # DAU16_096

Client	Cristal Pigment Australia Ltd Locked Bag 245 Bunbury WA 6230	**Job No.**	CRIS05_W/160422
		Sampled by	Client
		Date Sampled	21-Apr-16
Contact	Ben Huxtable	**Date Received**	22-Apr-16

The results relate only to the sample(s) tested.

Method	AUTL_01	**Date Reported**	20-May-16

Details

The method is for determination of tetra- through octa-chlorinated dibenzo-p-dioxins (PCDDs) & dibenzofurans (PCDFs) in aqueous samples by high resolution gas chromatography / high resolution mass spectrometry (HRGC/HRMS).
This method provides data on all toxic 2,3,7,8-PCDD (seven) and PCDF (ten) isomers. PCDD and PCDF totals for each homologue group (tetra to octa) are also reported.
The dioxin toxicity equivalent (WHO_{05}-TEQ_{DF}) in each sample is calculated using World Health Organization toxic equivalency factors (WHO_{05}-TEFs). All results are corrected for labelled surrogate recoveries.

After sampling, the liquid is spiked with a range of isotopically labelled surrogate standards and exhaustively extracted. Clean up is effected by partitioning with sulphuric acid then distilled water. Further purification is performed using column chromatography on acid and base modified silica gels, basic alumina and carbon dispersed on celite.

Immediately prior to injection, internal standards are added to each extract, and an aliquot of the extract is injected into the GC. The analytes are separated by the GC and detected by a high-resolution (>10,000) mass spectrometer.

Authorisation

Nino Piro Senior Chemist Dioxin Analysis Unit	Dr Alan Yates Senior Analyst Dioxin Analysis Unit

Accreditation

NATA Accredited Laboratory Number : 198

Accredited for compliance with ISO/IEC 17025.

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Sample Details : Job No. CRIS05_W/160422

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
W16/007603X	YB	Water	Water
W16/007608X	MB 3	Water	Water
W16/007614X	DM 8A	Water	Water
W16/007615X	DM 8C	Water	Water

Project Details

Project Name	*Dalyellup*
Project Number	*Not specified*

Key

Analytes

TCDD	Tetrachlorodibenzo-p-dioxin	TCDF	Tetrachlorodibenzofuran
PeCDD	Pentachlorodibenzo-p-dioxin	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	HxCDF	Hexachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	HpCDF	Heptachlorodibenzofuran
OCDD	Octachlorodibenzo-p-dioxin	OCDF	Octachlorodibenzofuran

Units & Abbreviations

pg/kg	picograms per kilogram
<	level less than limit of detection (LOD)
$\mathrm{WHO_{05}\text{-}TEF}^{\dagger}$	World Health Organization toxic equivalency factor
$\mathrm{WHO_{05}\text{-}TEQ_{DF}}^{\dagger}$	World Health Organization toxic equivalents (Dioxins & Furans)

† as defined by Van den Berg et al., *Toxicol. Sci.* ***93*** *(2), pp. 223–241* (2006)

TEQs are calculated by multiplying the quantified level for each individual dioxin and furan congener reported by the corresponding TEF value and summing the result:

$$\mathrm{WHO_{05}-TEQ_{DF}} = \sum_{i=1}^{7}\left[\mathrm{PCDD}_i \times \mathrm{TEF}_i\right] + \sum_{j=1}^{10}\left[\mathrm{PCDF}_j \times \mathrm{TEF}_j\right]$$

i = PCDD congener index (1 - 7)
j = PCDF congener index (1 - 10)

Lower Bound TEQ	defines all congener values reported below the LOD as equal to zero.
Middle Bound TEQ	defines all congener values reported below the LOD as equal to half the LOD.
Upper Bound TEQ	defines all congener values reported below the LOD as equal to the LOD.
Surrogate Recovery	percentage recovery for $^{13}C_{12}$ labelled surrogate standard
⚐	Laboratory surrogate recovery outside normal acceptance criteria: Solid and liquid matrices **25 - 125%**

Results : Job No. CRIS05_W/160422

Laboratory Reg. No.	W16/007603X	**Date Extracted**	11-May-16
Client Sample Ref.	YB	**DB5 Analysis**	19-May-16
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO$_{05}$-TEF	WHO$_{05}$-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<0.4	0.1	0.02	75	
2,3,7,8-TCDD	<0.7	1	0.35	69	
1,2,3,7,8-PeCDF	<0.5	0.03	0.0075	90	
2,3,4,7,8-PeCDF	<0.4	0.3	0.06	99	
1,2,3,7,8-PeCDD	<0.4	1	0.2	103	
1,2,3,4,7,8-HxCDF	<0.3	0.1	0.015	77	
1,2,3,6,7,8-HxCDF	<0.3	0.1	0.015	78	
2,3,4,6,7,8-HxCDF	<0.3	0.1	0.015	71	
1,2,3,7,8,9-HxCDF	<0.3	0.1	0.015	77	
1,2,3,4,7,8-HxCDD	<0.4	0.1	0.02	85	
1,2,3,6,7,8-HxCDD	<0.4	0.1	0.02	80	
1,2,3,7,8,9-HxCDD	<0.4	0.1	0.02		
1,2,3,4,6,7,8-HpCDF	0.80	0.01	0.0080	79	
1,2,3,4,7,8,9-HpCDF	<0.3	0.01	0.0015	76	
1,2,3,4,6,7,8-HpCDD	<0.3	0.01	0.0015	77	
OCDF	6.0	0.0003	0.0018		
OCDD	<1	0.0003	0.00015	81	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	3.7
Total TCDD isomers	<5
Total PeCDF isomers	<3
Total PeCDD isomers	<2
Total HxCDF isomers	<2
Total HxCDD isomers	<2
Total HpCDF isomers	0.80
Total HpCDD isomers	<0.3

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	11	pg/kg
WHO$_{05}$ -TEQ$_{DF}$		
Lower Bound [excluding LOD values]	**0.0098**	pg/kg
Middle Bound [including half LOD values]	**0.77**	pg/kg
Upper Bound [including LOD values]	**1.5**	pg/kg

Results : Job No. CRIS05_W/160422

Laboratory Reg. No.	W16/007608X	**Date Extracted**	11-May-16
Client Sample Ref.	MB 3	**DB5 Analysis**	19-May-16
Matrix	Water		
Description	Water		

PCDD/F Congeners	**Level pg/kg**	**WHO$_{05}$-TEF**	**WHO$_{05}$-TEQ contribution**	**Labelled Surrogate recovery**	
2,3,7,8-TCDF	<0.3	0.1	0.015	75	
2,3,7,8-TCDD	<0.7	1	0.35	68	
1,2,3,7,8-PeCDF	<0.4	0.03	0.006	93	
2,3,4,7,8-PeCDF	<0.3	0.3	0.045	100	
1,2,3,7,8-PeCDD	<0.4	1	0.2	101	
1,2,3,4,7,8-HxCDF	<0.3	0.1	0.015	79	
1,2,3,6,7,8-HxCDF	<0.3	0.1	0.015	77	
2,3,4,6,7,8-HxCDF	<0.3	0.1	0.015	71	
1,2,3,7,8,9-HxCDF	<0.3	0.1	0.015	72	
1,2,3,4,7,8-HxCDD	<0.3	0.1	0.015	83	
1,2,3,6,7,8-HxCDD	<0.3	0.1	0.015	82	
1,2,3,7,8,9-HxCDD	<0.3	0.1	0.015		
1,2,3,4,6,7,8-HpCDF	<0.1	0.01	0.0005	74	
1,2,3,4,7,8,9-HpCDF	<0.2	0.01	0.001	60	
1,2,3,4,6,7,8-HpCDD	<0.2	0.01	0.001	72	
OCDF	<0.5	0.0003	0.000075		
OCDD	3.1	0.0003	0.00094	76	

PCDD/F Homologue Groups	**Level pg/kg**
Total TCDF isomers	<2
Total TCDD isomers	<5
Total PeCDF isomers	<2
Total PeCDD isomers	<2
Total HxCDF isomers	<2
Total HxCDD isomers	<1
Total HpCDF isomers	<0.3
Total HpCDD isomers	<0.2

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	3.1	pg/kg
WHO$_{05}$ -TEQ$_{DF}$		
Lower Bound [excluding LOD values]	**0.00094**	pg/kg
Middle Bound [including half LOD values]	**0.72**	pg/kg
Upper Bound [including LOD values]	**1.4**	pg/kg

Results : Job No. CRIS05_W/160422

Laboratory Reg. No.	W16/007614X	**Date Extracted**	11-May-16
Client Sample Ref.	DM 8A	**DB5 Analysis**	19-May-16
Matrix	Water		
Description	Water		

PCDD/F Congeners	Level pg/kg	WHO_{05}-TEF	WHO_{05}-TEQ contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	<0.4	0.1	0.02	72	
2,3,7,8-TCDD	<0.7	1	0.35	64	
1,2,3,7,8-PeCDF	<0.4	0.03	0.006	87	
2,3,4,7,8-PeCDF	<0.4	0.3	0.06	96	
1,2,3,7,8-PeCDD	<0.5	1	0.25	96	
1,2,3,4,7,8-HxCDF	<0.2	0.1	0.01	74	
1,2,3,6,7,8-HxCDF	<0.2	0.1	0.01	76	
2,3,4,6,7,8-HxCDF	<0.2	0.1	0.01	68	
1,2,3,7,8,9-HxCDF	<0.3	0.1	0.015	70	
1,2,3,4,7,8-HxCDD	<0.4	0.1	0.02	79	
1,2,3,6,7,8-HxCDD	<0.4	0.1	0.02	77	
1,2,3,7,8,9-HxCDD	<0.4	0.1	0.02		
1,2,3,4,6,7,8-HpCDF	<0.1	0.01	0.0005	74	
1,2,3,4,7,8,9-HpCDF	<0.2	0.01	0.001	64	
1,2,3,4,6,7,8-HpCDD	<0.3	0.01	0.0015	71	
OCDF	<0.4	0.0003	0.00006		
OCDD	<0.5	0.0003	0.000075	77	

PCDD/F Homologue Groups	Level pg/kg
Total TCDF isomers	<3
Total TCDD isomers	<5
Total PeCDF isomers	<3
Total PeCDD isomers	<3
Total HxCDF isomers	<1
Total HxCDD isomers	<2
Total HpCDF isomers	<0.3
Total HpCDD isomers	<0.3

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	0	pg/kg
WHO_{05} -TEQ_{DF}		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**0.79**	pg/kg
Upper Bound [including LOD values]	**1.6**	pg/kg

Results : Job No. CRIS05_W/160422

Laboratory Reg. No.	W16/007615X	**Date Extracted**	11-May-16
Client Sample Ref.	DM 8C	**DB5 Analysis**	19-May-16
Matrix	Water		
Description	Water		

PCDD/F Congeners	**Level pg/kg**	**WHO$_{05}$-TEF**	**WHO$_{05}$-TEQ contribution**	**Labelled Surrogate recovery**	
2,3,7,8-TCDF	<0.3	0.1	0.015	79	
2,3,7,8-TCDD	<0.7	1	0.35	71	
1,2,3,7,8-PeCDF	<0.4	0.03	0.006	92	
2,3,4,7,8-PeCDF	<0.4	0.3	0.06	99	
1,2,3,7,8-PeCDD	<0.4	1	0.2	102	
1,2,3,4,7,8-HxCDF	<0.2	0.1	0.01	80	
1,2,3,6,7,8-HxCDF	<0.2	0.1	0.01	78	
2,3,4,6,7,8-HxCDF	<0.3	0.1	0.015	73	
1,2,3,7,8,9-HxCDF	<0.3	0.1	0.015	72	
1,2,3,4,7,8-HxCDD	<0.4	0.1	0.02	85	
1,2,3,6,7,8-HxCDD	<0.4	0.1	0.02	82	
1,2,3,7,8,9-HxCDD	<0.4	0.1	0.02		
1,2,3,4,6,7,8-HpCDF	<0.1	0.01	0.0005	76	
1,2,3,4,7,8,9-HpCDF	<0.3	0.01	0.0015	56	
1,2,3,4,6,7,8-HpCDD	<0.3	0.01	0.0015	76	
OCDF	<0.5	0.0003	0.000075		
OCDD	<2	0.0003	0.0003	78	

PCDD/F Homologue Groups	**Level pg/kg**
Total TCDF isomers	<2
Total TCDD isomers	<5
Total PeCDF isomers	<3
Total PeCDD isomers	<2
Total HxCDF isomers	<2
Total HxCDD isomers	<2
Total HpCDF isomers	<0.4
Total HpCDD isomers	<0.3

Summary Results		
Sum of PCDD and PCDF congeners		
Excluding LOD values	0	pg/kg
WHO$_{05}$ -TEQ$_{DF}$		
Lower Bound [excluding LOD values]	**0**	pg/kg
Middle Bound [including half LOD values]	**0.74**	pg/kg
Upper Bound [including LOD values]	**1.5**	pg/kg

Australian Government
Department of Industry, Innovation and Science
National Measurement Institute

REPORT OF ANALYSIS

Report No. RN1113040

Client : CRISTAL PIGMENT AUSTRALIA LTD
LOT 4 OLD COAST ROAD
AUSTRALIND WA 6233

Attention : BENJAMIN HUXTABLE
Project Name : CRISTAL DALYELLUP APRIL 2016
Your Client Services Manager : David Lynch

Job No. : CRIS05_W/160422
Quote No. : QT-01932
Order No. : 4500867576
Date Sampled : 21-APR-2016
Date Received : 22-APR-2016
Sampled By : CLIENT
Phone : (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/007603	YB	DALYELLUP WATER 21/04/16
W16/007604	DM 1A	DALYELLUP WATER 21/04/16
W16/007605	DM 1C	DALYELLUP WATER 21/04/16
W16/007606	DM 2A	DALYELLUP WATER 21/04/16

Lab Reg No.		W16/007603	W16/007604	W16/007605	W16/007606	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method
Total Recoverable Trace Elements by ICP						
Boron Total	mg/L	0.065	0.11	0.13	0.37	NT2_47
Cadmium Total	mg/L	<0.0001	0.0002	<0.0001	0.0002	NT2_47
Calcium Total	mg/L	41	130	170	610	NT2_47
Chromium Total	mg/L	0.007	0.002	0.12	0.26	NT2_47
Chromium Trivalent	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Cobalt Total	mg/L	<0.001	<0.001	0.005	0.005	NT2_47
Copper Total	mg/L	0.005	0.007	0.005	0.015	NT2_47
Iron Total	mg/L	26	3	32	8	NT2_47
Lead Total	mg/L	0.002	0.005	0.022	0.012	NT2_47
Magnesium Total	mg/L	12	33	53	460	NT2_47
Manganese Total	mg/L	0.2	0.24	2.4	1.7	NT2_47
Mercury Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT247_244
Molybdenum Total	mg/L	<0.001	<0.001	0.002	0.004	NT2_47
Nickel Total	mg/L	0.002	0.001	0.006	0.023	NT2_47
Potassium Total	mg/L	10	15	28	35	NT2_47
Sodium Total	mg/L	91	230	330	310	NT2_47
Vanadium Total	mg/L	0.017	0.002	0.05	0.29	NT2_47

W16/007603
-N16/007619
Chromium Trivalent is calculated from the difference between Chromium Filtered and Chromium Hexavalent.

Lab Reg No.		W16/007603	W16/007604	W16/007605	W16/007606	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

Lab Reg No.		W16/007603	W16/007604	W16/007605	W16/007606	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method
Miscellaneous						
Chloride	mg/L	210	320	540	2000	NW_D3_B14
Chromium - Hexavalent	mg/L	<0.001	<0.001	<0.001	0.039	NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

Lab Reg No.		W16/007603	W16/007604	W16/007605	W16/007606	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method
Inorganics						
Bicarbonate as CaCO3	mg/L	57	340	340	800	WL122
Carbonate as CaCO3	mg/L	<1	<1	<1	<1	WL122
Nitrate as NO3-N	mg/L	<0.2	<0.2	3.8	<0.2	WL119
Sulfate	mg/L	16	120	110	250	WL119WL293
Total Dissolved Solids (Evap)	mg/L	480	1040	1480	5170	WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

10-MAY-2016

REPORT OF ANALYSIS

Client : CRISTAL PIGMENT AUSTRALIA LTD
LOT 4 OLD COAST ROAD
AUSTRALIND WA 6233

Job No. : CRIS05_W/160422
Quote No. : QT-01932
Order No. : 4500867576
Date Sampled : 21-APR-2016
Date Received : 22-APR-2016
Sampled By : CLIENT

Attention : BENJAMIN HUXTABLE
Project Name : CRISTAL DALYELLUP APRIL 2016
Your Client Services Manager : David Lynch
Phone : (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/007607	DM 2C	DALYELLUP WATER 21/04/16
W16/007608	MB 3	DALYELLUP WATER 21/04/16
W16/007609	DM 4A	DALYELLUP WATER 21/04/16
W16/007610	DM 4C	DALYELLUP WATER 21/04/16

Lab Reg No.		W16/007607	W16/007608	W16/007609	W16/007610	
Sample Reference	Units	DM 2C	MB 3	DM 4A	DM 4C	Method
Total Recoverable Trace Elements by ICP						
Boron Total	mg/L	0.29	0.11	0.6	0.31	NT2_47
Cadmium Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT2_47
Calcium Total	mg/L	760	160	670	560	NT2_47
Chromium Total	mg/L	0.097	0.003	0.004	0.002	NT2_47
Chromium Trivalent	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Cobalt Total	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Copper Total	mg/L	0.001	<0.001	<0.001	<0.001	NT2_47
Iron Total	mg/L	1.4	0.39	0.74	8.8	NT2_47
Lead Total	mg/L	0.006	<0.001	<0.001	<0.001	NT2_47
Magnesium Total	mg/L	270	31	480	590	NT2_47
Manganese Total	mg/L	0.15	0.084	0.017	0.18	NT2_47
Mercury Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT247_244
Molybdenum Total	mg/L	0.004	0.001	<0.001	0.003	NT2_47
Nickel Total	mg/L	0.002	<0.001	0.006	0.002	NT2_47
Potassium Total	mg/L	31	9.6	25	22	NT2_47
Sodium Total	mg/L	250	95	280	320	NT2_47
Vanadium Total	mg/L	0.018	0.002	<0.001	<0.001	NT2_47

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

REPORT OF ANALYSIS

Lab Reg No.		W16/007607	W16/007608	W16/007609	W16/007610	
Sample Reference	Units	DM 2C	MB 3	DM 4A	DM 4C	Method
Miscellaneous						
Chloride	mg/L	1900	150	2300	2400	NW_D3_B14
Chromium - Hexavalent	mg/L	0.050	0.001	<0.001	<0.001	NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

Lab Reg No.		W16/007607	W16/007608	W16/007609	W16/007610	
Sample Reference	Units	DM 2C	MB 3	DM 4A	DM 4C	Method
Inorganics						
Bicarbonate as CaCO3	mg/L	270	380	57	240	WL122
Carbonate as CaCO3	mg/L	<1	<1	<1	<1	WL122
Nitrate as NO3-N	mg/L	4.8	12	0.4	<0.2	WL119
Sulfate	mg/L	380	65	450	590	WL119WL293
Total Dissolved Solids (Evap)	mg/L	5020	770	6170	5980	WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

10-MAY-2016

REPORT OF ANALYSIS

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233		Job No.	: CRIS05_W/160422
			Quote No.	: QT-01932
			Order No.	: 4500867576
			Date Sampled	: 21-APR-2016
			Date Received	: 22-APR-2016
Attention	: BENJAMIN HUXTABLE		Sampled By	: CLIENT
Project Name	: CRISTAL DALYELLUP APRIL 2016			
Your Client Services Manager	: David Lynch		Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/007611	MB4	DALYELLUP WATER 21/04/16
W16/007612	DM 7A	DALYELLUP WATER 21/04/16
W16/007613	DM 7C	DALYELLUP WATER 21/04/16
W16/007614	DM 8A	DALYELLUP WATER 21/04/16

Lab Reg No.		W16/007611	W16/007612	W16/007613	W16/007614	
Sample Reference	Units	MB4	DM 7A	DM 7C	DM 8A	Method
Total Recoverable Trace Elements by ICP						
Boron Total	mg/L	0.12	0.14	0.14	0.25	NT2_47
Cadmium Total	mg/L	0.001	<0.0001	<0.0001	<0.0001	NT2_47
Calcium Total	mg/L	170	170	290	820	NT2_47
Chromium Total	mg/L	0.011	<0.001	0.01	0.001	NT2_47
Chromium Trivalent	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Cobalt Total	mg/L	<0.001	<0.001	0.001	<0.001	NT2_47
Copper Total	mg/L	0.005	<0.001	<0.001	<0.001	NT2_47
Iron Total	mg/L	43	0.33	0.86	16	NT2_47
Lead Total	mg/L	0.18	<0.001	0.006	0.001	NT2_47
Magnesium Total	mg/L	35	54	84	800	NT2_47
Manganese Total	mg/L	0.12	0.054	0.27	1.5	NT2_47
Mercury Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT247_244
Molybdenum Total	mg/L	0.003	0.002	0.01	0.003	NT2_47
Nickel Total	mg/L	0.001	<0.001	<0.001	<0.001	NT2_47
Potassium Total	mg/L	14	7.5	11	29	NT2_47
Sodium Total	mg/L	130	110	92	410	NT2_47
Vanadium Total	mg/L	0.02	<0.001	0.006	<0.001	NT2_47

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

REPORT OF ANALYSIS

Lab Reg No.		W16/007611	W16/007612	W16/007613	W16/007614	
Sample Reference	Units	MB4	DM 7A	DM 7C	DM 8A	Method
Miscellaneous						
Chloride	mg/L	210	240	520	3700	NW_D3_B14
Chromium - Hexavalent	mg/L	<0.001	<0.001	0.002	<0.001	NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

Lab Reg No.		W16/007611	W16/007612	W16/007613	W16/007614	
Sample Reference	Units	MB4	DM 7A	DM 7C	DM 8A	Method
Inorganics						
Bicarbonate as CaCO3	mg/L	390	400	370	180	WL122
Carbonate as CaCO3	mg/L	<1	<1	<1	<1	WL122
Nitrate as NO3-N	mg/L	3.6	<0.2	0.8	<0.2	WL119
Sulfate	mg/L	120	80	84	720	WL119WL293
Total Dissolved Solids (Evap)	mg/L	910	910	1610	9000	WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

10-MAY-2016

REPORT OF ANALYSIS

Report No. RN1113040

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	Job No. Quote No. Order No. Date Sampled Date Received	: CRIS05_W/160422 : QT-01932 : 4500867576 : 21-APR-2016 : 22-APR-2016
Attention	: BENJAMIN HUXTABLE	Sampled By	: CLIENT
Project Name	: CRISTAL DALYELLUP APRIL 2016		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/007615	DM 8C	DALYELLUP WATER 21/04/16
W16/007616	DM 9A	DALYELLUP WATER 21/04/16
W16/007617	DM 9C	DALYELLUP WATER 21/04/16
W16/007618	FB	DALYELLUP WATER 21/04/16

Lab Reg No.		W16/007615	W16/007616	W16/007617	W16/007618	
Sample Reference	Units	DM 8C	DM 9A	DM 9C	FB	Method
Total Recoverable Trace Elements by ICP						
Boron Total	mg/L	0.31	0.065	0.084	<0.005	NT2_47
Cadmium Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT2_47
Calcium Total	mg/L	680	77	110	<0.005	NT2_47
Chromium Total	mg/L	0.005	0.001	0.2	<0.001	NT2_47
Chromium Trivalent	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Cobalt Total	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Copper Total	mg/L	0.001	0.001	<0.001	<0.001	NT2_47
Iron Total	mg/L	4.4	14	1.9	<0.005	NT2_47
Lead Total	mg/L	0.004	0.003	0.002	<0.001	NT2_47
Magnesium Total	mg/L	660	17	40	<0.005	NT2_47
Manganese Total	mg/L	0.039	0.13	0.14	<0.001	NT2_47
Mercury Total	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT247_244
Molybdenum Total	mg/L	0.023	<0.001	<0.001	<0.001	NT2_47
Nickel Total	mg/L	0.001	0.001	<0.001	<0.001	NT2_47
Potassium Total	mg/L	25	10	5.5	<0.05	NT2_47
Sodium Total	mg/L	360	140	110	<0.05	NT2_47
Vanadium Total	mg/L	0.001	<0.001	0.004	<0.001	NT2_47

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

REPORT OF ANALYSIS

Lab Reg No.		W16/007615	W16/007616	W16/007617	W16/007618	
Sample Reference	Units	DM 8C	DM 9A	DM 9C	FB	Method
Miscellaneous						
Chloride	mg/L	2700	270	190	<0.1	NW_D3_B14
Chromium - Hexavalent	mg/L	<0.001	<0.001	0.20	<0.001	NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

Lab Reg No.		W16/007615	W16/007616	W16/007617	W16/007618	
Sample Reference	Units	DM 8C	DM 9A	DM 9C	FB	Method
Inorganics						
Bicarbonate as CaCO3	mg/L	280	120	310	3	WL122
Carbonate as CaCO3	mg/L	<1	<1	<1	<1	WL122
Nitrate as NO3-N	mg/L	<0.2	<0.2	1.4	<0.2	WL119
Sulfate	mg/L	670	44	92	<5	WL119WL293
Total Dissolved Solids (Evap)	mg/L	6860	690	740	<10	WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

10-MAY-2016

REPORT OF ANALYSIS

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	Job No.	: CRIS05_W/160422
		Quote No.	: QT-01932
		Order No.	: 4500867576
		Date Sampled	: 21-APR-2016
		Date Received	: 22-APR-2016
Attention	: BENJAMIN HUXTABLE	Sampled By	: CLIENT
Project Name	: CRISTAL DALYELLUP APRIL 2016		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/007619	R	DALYELLUP WATER 21/04/16

Lab Reg No.		W16/007619				
Sample Reference	Units	R				Method
Total Recoverable Trace Elements by ICP						
Boron Total	mg/L	<0.005				NT2_47
Cadmium Total	mg/L	<0.0001				NT2_47
Calcium Total	mg/L	<0.005				NT2_47
Chromium Total	mg/L	<0.001				NT2_47
Chromium Trivalent	mg/L	<0.001				NT2_47
Cobalt Total	mg/L	<0.001				NT2_47
Copper Total	mg/L	<0.001				NT2_47
Iron Total	mg/L	<0.005				NT2_47
Lead Total	mg/L	<0.001				NT2_47
Magnesium Total	mg/L	<0.005				NT2_47
Manganese Total	mg/L	<0.001				NT2_47
Mercury Total	mg/L	<0.0001				NT247_244
Molybdenum Total	mg/L	<0.001				NT2_47
Nickel Total	mg/L	<0.001				NT2_47
Potassium Total	mg/L	<0.05				NT2_47
Sodium Total	mg/L	<0.05				NT2_47
Vanadium Total	mg/L	<0.001				NT2_47

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

REPORT OF ANALYSIS

Lab Reg No.		W16/007619				Method
Sample Reference	Units	R				
Miscellaneous						
Chloride	mg/L	<0.1				NW_D3_B14
Chromium - Hexavalent	mg/L	<0.001				NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

10-MAY-2016

Lab Reg No.		W16/007619				Method
Sample Reference	Units	R				
Inorganics						
Bicarbonate as CaCO3	mg/L	3				WL122
Carbonate as CaCO3	mg/L	<1				WL122
Nitrate as NO3-N	mg/L	<0.2				WL119
Sulfate	mg/L	<5				WL119WL293
Total Dissolved Solids (Evap)	mg/L	<10				WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

10-MAY-2016

Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

REPORT OF ANALYSIS

ACCREDITED FOR
TECHNICAL
COMPETENCE

This Report supersedes reports: RN1112148 RN1112288
Chemical Accreditation 198: 105 Delhi Road, North Ryde, NSW, 2133

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Cristal Pigment Australia LTD

Page 1 of 1

Lot 4 Old Old Coast Road
AUSTRALIND WA 6230

Attention: Benjamin Huxtable

NMI Job No: CRIS05_W/160422
Sample Matrix: Water
Sample LRN Range: W16/007603 - 007619

Analyte	LOR	Blank	Units	LRN	Duplicate	Recovery	Acceptability
				W16/007610	D	%	Limits
Bicarbonate as CaCO3	1	<1	mg/L	240	240	-	-
Carbonate as CaCO3	1	<1	mg/L	<1	<1	99%	80 - 110
Nitrate as NO3-N	0.2	<0.2	mg/L	<0.2	<0.2	105%	90 - 110
Sulfate	5	<5	mg/L	590	580	104%	85 - 115
Total Dissolved Solids (Evap)	10	<10	mg/L	5980	5930	97%	90 - 110

Signed:

David Lynch
Senior Environmental Chemist
NMI WA, Inorganic Section

Date: **10/05/2016**

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

Client: **CRISTAL PIGMENT AUSTRALIA LTD**

NMI QA Report No: **CRIS05_W/160422**

Sample Matrix: Water(Total)

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		mg/L	mg/L	mg/L	mg/L	%	%	%
Inorganics Section				**W16/007610**				
Boron Total	NT2.47	0.005	<0.005	0.31	0.30	3	110	ND
Cadmium Total	NT2.47	0.001	<0.001	<0.0001	<0.0001	ND	104	ND
Calcium Total	NT2.47	0.0001	<0.0001	570	540	5	113	ND
Chromium Total	NT2.47	0.005	<0.005	0.003	0.002	40	97	ND
Cobalt Total	NT2.47	0.001	<0.001	<0.001	<0.001	ND	99	ND
Copper Total	NT2.47	0.001	<0.001	<0.001	<0.001	ND	103	ND
Iron Total	NT2.47	0.005	<0.005	8.9	8.7	2	102	ND
Lead Total	NT2.47	0.001	<0.001	<0.001	<0.001	ND	106	ND
Magnesium Total	NT2.47	0.005	<0.005	600	570	5	104	ND
Manganese Total	NT2.47	0.001	<0.001	0.18	0.18	0	104	ND
Mercury Total	NT2.47	0.0001	<0.0001	<0.0001	<0.0001	ND	103	ND
Molybdenum Total	NT2.47	0.001	<0.001	0.003	0.003	0	104	ND
Nickel Total	NT2.47	0.001	<0.001	0.002	0.002	0	100	ND
Potassium Total	NT2.47	0.05	<0.05	22	21	5	100	ND
Sodium Total	NT2.47	0.001	<0.001	330	310	6	98	ND
Vanadium Total	NT2.47	0.05	<0.05	<0.001	<0.001	ND	98	ND

Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations >5 times LOR. Greater RPD may be expected at <5 times LOR.
LOR = Limit Of Reporting ND = Not Determined
RPD = Relative Percent Difference NA = Not Applicable
LCS = Laboratory Control Sample.
#: Spike level is less than 50% of the sample's concentration, hence the recovery data is not reliable.

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
This report shall not be reproduced except in full.

Signed:

Dr Michael Wu
Inorganics , NMI-North Ryde

Date: **2/05/2016**

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Client: CRISTAL PIGMENT AUSTRALIA LTD

NMI QA Report No: CRIS05_W/160422 QA

Sample Matrix: Water,

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix spk
		mg/L	mg/L	mg/L	mg/L	%	%	%
Inorganics Section				**W15/07603**				**W15/07603**
Chromium - Hexavalent	NW_D2	0.001	<0.001	<0.001	<0.001	ND	105	101
Chloride	NW_D3_B14	0.1	<0.1	210	210	0.0	100	80

Legend

Acceptable recovery is 80-120%.

Acceptable RPDs on duplicates is 30% at >5 times LOR. Greater RPD may be expected at <5 LOR.

LOR = Limit Of Reporting

RPD = Relative Percent Difference

LCS = Laboratory Control Sample

ND = Not Determined

NA = Not Applicable

Comments

This report shall not be reproduced except in full.

Results greater than ten times LOR have been rounded to two significant figures.

Signed:

Dr Michael Wu

Inorganics Manager, NMI-Pymble

Date: **3/05/2016**

SGS
NATA
Accredited Laboratory
No. 14174

Western Radiation Services
analytical laboratory & consulting

ABN: 44 000 964 278

25 May 2015

Ref: 9657
Order No: Andre
Page 1 of 2

Stass Environmental
PO Box 11
KALAMUNDA WA 6926

Attn: Mr. Andre Stass

ANALYTICAL REPORT

The result (to 95%, 2σ confidence level) for Radium-226, Radium-228 analyses of sixteen (16) liquid samples as received at our laboratory on 22nd April 2016 are detailed on page two of this report.

MDL:	Radium-226	100 mBq/l	Radium-228	100 mBq/l

Method: LTP No. 4(a) Gamma Spectrometry Analysis

Madassar A. Qureshi
Authorised Signatory

Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

Gamma Spectrometry Analysis

WRS No.	Client Sample ID	Ra-226 (mBq/l)	Ra-228 (mBq/l)
9657-1	DM 1A	210 ± 33	<MDL
9657-2	DM 1C	274 ± 34	<MDL
9657-3	MB 3	151 ± 19	<MDL
9657-4	DM 2A	<MDL	<MDL
9657-5	DM 2C	<MDL	102 ± 39
9657-6	MB4	158 ± 27	<MDL
9657-7	DM 4A	192 ± 23	<MDL
9657-8	DM 4C	<MDL	<MDL
9657-9	DM 7A	<MDL	<MDL
9657-10	DM 7C	126 ± 25	<MDL
9657-10D	DM 7C	136 ± 24	<MDL
9657-11	DM 8A	<MDL	<MDL
9657-12	DM 8C	122 ± 19	<MDL
9657-13	DM 9A	<MDL	<MDL
9657-14	DM 9C	<MDL	<MDL
9657-15	YB	533 ± 84	192 ± 51
9657-16	DM1AN	<MDL	<MDL

Gamma Spectrometry Analysis

The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

REPORT OF ANALYSIS

Page: 1 of 2
Report No. RN1121758

Client	:	STASS ENVIRONMENTAL PO BOX 11 KALAMUNDA WA 6926	Job No. Quote No. Order No. Date Sampled Date Received	: : : : :	STAS01_W/160708 QT-02002 7-JUL-2016 8-JUL-2016
Attention	:	ANDRE STASIKOWSKI	Sampled By	:	CLIENT
Project Name	:				
Your Client Services Manager	:	David Lynch	Phone	:	(08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/012376	YB	WATER 07/07/16

Lab Reg No.		W16/012376				Method
Sample Reference	Units	YB				
Inorganics						
Chloride	mg/L	200				WL119WL293
Sodium - Filterable	mg/L	100				WL272
Sodium:Chloride molar ratio		0.78				CALC

Elena McConville-Wolfe, Analyst
Inorganics - WA
Accreditation No. 2474

18-JUL-2016

Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

NATA
ACCREDITED FOR
TECHNICAL
COMPETENCE

Accredited for compliance with ISO/IEC 17025.
This report shall not be reproduced except in full.
Results relate only to the sample(s) tested.

Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

Stass Environmental

Page 1 of 1

PO BOX 11
Kalamunda WA 6926

Attention: Andre Stasikowski

NMI Job No: STAS01_W/160708
Sample Matrix: Water
Sample LRN Range: W16/012376

Analyte	LOR	Blank	Units	Recovery	Acceptability
				%	Limits
Chloride	10	<10	mg/L	102 %	90 - 110
Sodium - Filterable	10	<10	mg/L	102 %	85 - 110
Sodium:Chloride molar ratio	-	-	-	-	-

Signed: **Elena McConville-Wolfe**
Chemist
Inorganics WA

Date: **18/07/2016**

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

Client: **CRISTAL PIGMENT AUSTRALIA LTD**

NMI QA Report No: **CRIS05_W/160708**
CRIS05_W/160708_1

Sample Matrix: Water(Total)

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		mg/L	mg/L	mg/L	mg/L	%	%	%
Inorganics Section				**W16/012375**				**W16/012375**
Aluminium Total	NT2.47	0.005	< 0.005	0.34	0.35	3	103	103
Cadmium Total	NT2.47	0.0001	< 0.0001	< 0.0001	< 0.0001	ND	100	98
Calcium Total	NT2.47	0.005	< 0.005	4090	4140	1	103	113
Chromium Total	NT2.47	0.001	< 0.001	0.028	0.03	7	99	107
Copper Total	NT2.47	0.001	< 0.001	< 0.001	< 0.001	ND	102	99
Iron Total	NT2.47	0.005	< 0.005	0.73	0.75	3	99	102
Lead Total	NT2.47	0.001	< 0.001	< 0.001	0.001	0	102	97
Magnesium Total	NT2.47	0.005	< 0.005	45	45	0	105	106
Manganese Total	NT2.47	0.001	< 0.001	1.2	1.2	0	101	101
Mercury Total	NT2.47	0.0001	< 0.0001	< 0.0001	< 0.0001	ND	107	105
Molybdenum Total	NT2.47	0.001	< 0.001	0.13	0.14	7	95	105
Nickel Total	NT2.47	0.001	< 0.001	0.016	0.016	0	100	102
Phosphorus Total	NT2.47	0.05	< 0.05	0.055	0.057	4	96	101
Selenium Total	NT2.47	0.001	< 0.001	< 0.001	< 0.001	ND	101	93
Sodium Total	NT2.47	0.05	< 0.05	3300	3300	0	105	ND
Titanium Total	NT2.47	0.005	< 0.005	0.1	0.1	0	102	N/A
Vanadium Total	NT2.47	0.001	< 0.001	0.12	0.12	0	98	112
Zinc Total	NT2.47	0.001	< 0.001	0.006	0.005	18	103	102

Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations > 5 times LOR. Greater RPD may be expected at < 5 tim
LOR = Limit Of Reporting ND = Not Determined
RPD = Relative Percent Difference NA = Not Applicable
LCS = Laboratory Control Sample.
#: Spike level is less than 50% of the sample's concentration, hence the recovery data is not reliable.

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
This report shall not be reproduced except in full.

Signed:

Dr Michael Wu
Inorganics , NMI-North Ryde

Date: **18/07/2016**

SGS

NATA
Accredited Laboratory
No. 14174

Western Radiation Services
analytical laboratory & consulting

ABN: 44 000 964 278

23 August 2016

Ref: 9728
Order No: Andre
Page 1 of 1

Stass Environmental
PO Box 11
KALAMUNDA WA 6926

Attn: Mr. Andre Stass

ANALYTICAL REPORT

The result (to 95%, 2σ confidence level) for Radium-226, Radium-228 analyses of one (1) liquid sample as received at our laboratory on 8th July 2016 is detailed below.

WRS No.	Client Sample ID	Ra-226 (mBq/l)	Ra-228 (mBq/l)
9728-1	YB	232 ± 35	<MDL

Gamma Spectrometry Analysis

The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

MDL:	Radium-226	100 mBq/l	Radium-228	100 mBq/l
Method:	LTP No. 4(a)	Gamma Spectrometry Analysis		

Madassar A. Qureshi
Authorised Signatory

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SGS
NATA
Accredited Laboratory
No. 14174

Western Radiation Services
analytical laboratory & consulting

ABN: 44 000 964 278

23 August 2016

Ref: 9728
Order No: Andre
Page 1 of 1

Stass Environmental
PO Box 11
KALAMUNDA WA 6926

Attn: Mr. Andre Stass

ANALYTICAL REPORT

The result (to 95%, 2σ confidence level) for Radium-226, Radium-228 analyses of one (1) liquid sample as received at our laboratory on 8th July 2016 is detailed below.

WRS No.	Client Sample ID	Ra-226 (mBq/l)	Ra-228 (mBq/l)
9728-1	YB	232 ± 35	<MDL

Gamma Spectrometry Analysis

The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

MDL: Radium-226 100 mBq/l Radium-228 100 mBq/l

Method: LTP No. 4(a) Gamma Spectrometry Analysis

Madassar A. Qureshi
Authorised Signatory

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REPORT OF ANALYSIS

Report No. RN1131670

Client	: CRISTAL PIGMENT AUSTRALIA LTD	Job No.	:	CRIS05_W/160916
	LOT 4 OLD COAST ROAD	Quote No.	:	QT-01932
	AUSTRALIND WA 6233	Order No.	:	4500867576
		Date Sampled	:	15-SEP-2016
		Date Received	:	16-SEP-2016
Attention	: BENJAMIN HUXTABLE	Sampled By	:	CLIENT
Project Name :				
Your Client Services Manager	: David Lynch	Phone	:	(08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/016958	YB	DALYELLUP WATER 15/09/16
W16/016959	DM 1A	DALYELLUP WATER 15/09/16
W16/016960	DM 1C	DALYELLUP WATER 15/09/16
W16/016961	DM 2A	DALYELLUP WATER 15/09/16

Lab Reg No.		W16/016958	W16/016959	W16/016960	W16/016961	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method
Filtered Trace Elements by ICP						
Boron Filtered	mg/L	0.035	0.078	0.14	0.35	NT2_47
Cadmium Filtered	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT2_47
Calcium Filtered	mg/L	38	120	160	610	NT2_47
Chromium Filtered	mg/L	0.002	<0.001	0.015	0.4	NT2_47
Cobalt Filtered	mg/L	<0.001	<0.001	0.001	0.002	NT2_47
Copper Filtered	mg/L	<0.001	0.004	0.003	0.004	NT2_47
Iron Filtered	mg/L	23	1.1	4.4	1.7	NT2_47
Lead Filtered	mg/L	0.001	0.003	0.006	0.005	NT2_47
Magnesium Filtered	mg/L	12	31	52	350	NT2_47
Manganese Filtered	mg/L	0.13	0.23	0.38	0.63	NT2_47
Mercury Filtered	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT247_244
Molybdenum Filtered	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Nickel Filtered	mg/L	<0.001	0.001	0.004	0.01	NT2_47
Potassium Filtered	mg/L	8.4	7.9	14	12	NT2_47
Sodium Filtered	mg/L	90	220	330	290	NT2_47
Vanadium Filtered	mg/L	0.007	<0.001	0.005	0.11	NT2_47
Total Recoverable Trace Elements by ICP						
Chromium Trivalent	mg/L	0.002	<0.001	0.013	0.4	NT2_47

W16/016958
-W16/016974
Chromium Trivalent is calculated from the difference between Chromium Filtered and Chromium Hexavalent.

REPORT OF ANALYSIS

Lab Reg No.		W16/016958	W16/016959	W16/016960	W16/016961	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

Lab Reg No.		W16/016958	W16/016959	W16/016960	W16/016961	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method
Miscellaneous						
Chromium - Hexavalent	mg/L	<0.001	<0.001	0.002	<0.001	NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

Lab Reg No.		W16/016958	W16/016959	W16/016960	W16/016961	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method
Inorganics						
Bicarbonate as CaCO3	mg/L	73	340	340	290	WL122
Carbonate as CaCO3	mg/L	<1	<1	<1	<1	WL122
Chloride	mg/L	210	330	610	2100	WL119WL293
Nitrate as NO3-N	mg/L	<0.2	<0.2	2.8	0.3	WL119
Sodium:Chloride molar ratio	ratio	0.65	1.0	0.84	0.21	CALC
Sulfate	mg/L	19	110	130	480	WL119WL293
Total Dissolved Solids (Evap)	mg/L	510	1070	1590	7240	WL123

REPORT OF ANALYSIS

Lab Reg No.		W16/016958	W16/016959	W16/016960	W16/016961	
Sample Reference	Units	YB	DM 1A	DM 1C	DM 2A	Method

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

29-SEP-2016

REPORT OF ANALYSIS

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	Job No.	: CRIS05_W/160916
		Quote No.	: QT-01932
		Order No.	: 4500867576
		Date Sampled	: 15-SEP-2016
		Date Received	: 16-SEP-2016
Attention	: BENJAMIN HUXTABLE	Sampled By	: CLIENT
Project Name :			
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/016962	DM 2C	DALYELLUP WATER 15/09/16
W16/016963	MB 3	DALYELLUP WATER 15/09/16
W16/016964	DM 4A	DALYELLUP WATER 15/09/16
W16/016965	DM 4C	DALYELLUP WATER 15/09/16

Lab Reg No.		W16/016962	W16/016963	W16/016964	W16/016965	
Sample Reference	Units	DM 2C	MB 3	DM 4A	DM 4C	Method
Filtered Trace Elements by ICP						
Boron Filtered	mg/L	0.27	0.082	0.52	0.25	NT2_47
Cadmium Filtered	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT2_47
Calcium Filtered	mg/L	850	140	620	480	NT2_47
Chromium Filtered	mg/L	0.087	0.002	<0.001	<0.001	NT2_47
Cobalt Filtered	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Copper Filtered	mg/L	0.001	0.001	<0.001	<0.001	NT2_47
Iron Filtered	mg/L	0.16	0.15	0.11	5.1	NT2_47
Lead Filtered	mg/L	0.004	<0.001	<0.001	<0.001	NT2_47
Magnesium Filtered	mg/L	210	28	450	490	NT2_47
Manganese Filtered	mg/L	0.037	0.009	0.014	0.046	NT2_47
Mercury Filtered	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT247_244
Molybdenum Filtered	mg/L	0.002	<0.001	<0.001	0.002	NT2_47
Nickel Filtered	mg/L	0.001	<0.001	0.003	0.002	NT2_47
Potassium Filtered	mg/L	15	5.7	11	9.3	NT2_47
Sodium Filtered	mg/L	230	100	260	250	NT2_47
Vanadium Filtered	mg/L	0.004	0.002	<0.001	<0.001	NT2_47
Total Recoverable Trace Elements by ICP						
Chromium Trivalent	mg/L	<0.001	0.001	<0.001	<0.001	NT2_47

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

REPORT OF ANALYSIS

Lab Reg No.		W16/016962	W16/016963	W16/016964	W16/016965	
Sample Reference	Units	DM 2C	MB 3	DM 4A	DM 4C	Method
Miscellaneous						
Chromium - Hexavalent	mg/L	0.090	0.001	<0.001	<0.001	NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

Lab Reg No.		W16/016962	W16/016963	W16/016964	W16/016965	
Sample Reference	Units	DM 2C	MB 3	DM 4A	DM 4C	Method
Inorganics						
Bicarbonate as CaCO3	mg/L	250	370	53	240	WL122
Carbonate as CaCO3	mg/L	<1	<1	<1	<1	WL122
Chloride	mg/L	2200	160	2500	2300	WL119WL293
Nitrate as NO3-N	mg/L	3.1	11	0.8	<0.2	WL119
Sodium:Chloride molar ratio	ratio	0.16	0.96	0.16	0.17	CALC
Sulfate	mg/L	280	67	450	510	WL119WL293
Total Dissolved Solids (Evap)	mg/L	7450	790	8210	6640	WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

29-SEP-2016

REPORT OF ANALYSIS

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	Job No. Quote No. Order No. Date Sampled Date Received	: CRIS05_W/160916 : QT-01932 : 4500867576 : 15-SEP-2016 : 16-SEP-2016
Attention	: BENJAMIN HUXTABLE	Sampled By	: CLIENT
Project Name :			
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/016966	MB 4	DALYELLUP WATER 15/09/16
W16/016967	DM 7A	DALYELLUP WATER 15/09/16
W16/016968	DM 7C	DALYELLUP WATER 15/09/16
W16/016969	DM 8A	DALYELLUP WATER 15/09/16

Lab Reg No.		W16/016966	W16/016967	W16/016968	W16/016969	
Sample Reference	Units	MB 4	DM 7A	DM 7C	DM 8A	Method
Filtered Trace Elements by ICP						
Boron Filtered	mg/L	0.13	0.11	0.1	0.21	NT2_47
Cadmium Filtered	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT2_47
Calcium Filtered	mg/L	150	140	210	700	NT2_47
Chromium Filtered	mg/L	0.001	<0.001	0.005	<0.001	NT2_47
Cobalt Filtered	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Copper Filtered	mg/L	0.005	<0.001	<0.001	0.002	NT2_47
Iron Filtered	mg/L	6	0.29	0.28	13	NT2_47
Lead Filtered	mg/L	0.11	<0.001	0.007	<0.001	NT2_47
Magnesium Filtered	mg/L	32	46	70	700	NT2_47
Manganese Filtered	mg/L	0.11	0.061	0.099	1.3	NT2_47
Mercury Filtered	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT247_244
Molybdenum Filtered	mg/L	0.001	0.001	0.005	0.002	NT2_47
Nickel Filtered	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Potassium Filtered	mg/L	6.7	3.9	4.8	12	NT2_47
Sodium Filtered	mg/L	140	100	81	380	NT2_47
Vanadium Filtered	mg/L	0.002	<0.001	0.004	<0.001	NT2_47
Total Recoverable Trace Elements by ICP						
Chromium Trivalent	mg/L	0.001	<0.001	0.003	<0.001	NT2_47

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

REPORT OF ANALYSIS

Lab Reg No.		W16/016966	W16/016967	W16/016968	W16/016969	
Sample Reference	Units	MB 4	DM 7A	DM 7C	DM 8A	Method
Miscellaneous						
Chromium - Hexavalent	mg/L	<0.001	<0.001	0.002	<0.001	NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

Lab Reg No.		W16/016966	W16/016967	W16/016968	W16/016969	
Sample Reference	Units	MB 4	DM 7A	DM 7C	DM 8A	Method
Inorganics						
Bicarbonate as CaCO3	mg/L	370	360	360	200	WL122
Carbonate as CaCO3	mg/L	<1	<1	<1	<1	WL122
Chloride	mg/L	210	240	410	3400	WL119WL293
Nitrate as NO3-N	mg/L	3.6	<0.2	3.4	<0.2	WL119
Sodium:Chloride molar ratio	ratio	1.0	0.66	0.30	0.17	CALC
Sulfate	mg/L	110	86	80	640	WL119WL293
Total Dissolved Solids (Evap)	mg/L	920	910	1470	10700	WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

29-SEP-2016

REPORT OF ANALYSIS

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233	Job No.	: CRIS05_W/160916
		Quote No.	: QT-01932
		Order No.	: 4500867576
		Date Sampled	: 15-SEP-2016
		Date Received	: 16-SEP-2016
Attention	: BENJAMIN HUXTABLE	Sampled By	: CLIENT
Project Name :			
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/016970	DM 8C	DALYELLUP WATER 15/09/16
W16/016971	DM 9A	DALYELLUP WATER 15/09/16
W16/016972	DM 9C	DALYELLUP WATER 15/09/16
W16/016973	FB	DALYELLUP WATER 15/09/16

Lab Reg No.		W16/016970	W16/016971	W16/016972	W16/016973	
Sample Reference	Units	DM 8C	DM 9A	DM 9C	FB	Method
Filtered Trace Elements by ICP						
Boron Filtered	mg/L	0.24	0.047	0.068	0.037	NT2_47
Cadmium Filtered	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT2_47
Calcium Filtered	mg/L	590	63	91	0.062	NT2_47
Chromium Filtered	mg/L	0.008	<0.001	0.23	<0.001	NT2_47
Cobalt Filtered	mg/L	<0.001	<0.001	<0.001	<0.001	NT2_47
Copper Filtered	mg/L	<0.001	0.003	0.002	<0.001	NT2_47
Iron Filtered	mg/L	2.1	3.7	0.41	<0.005	NT2_47
Lead Filtered	mg/L	0.003	0.002	0.001	<0.001	NT2_47
Magnesium Filtered	mg/L	550	14	31	0.026	NT2_47
Manganese Filtered	mg/L	0.048	0.11	0.022	<0.001	NT2_47
Mercury Filtered	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NT247_244
Molybdenum Filtered	mg/L	0.037	0.002	<0.001	<0.001	NT2_47
Nickel Filtered	mg/L	<0.001	0.004	<0.001	<0.001	NT2_47
Potassium Filtered	mg/L	9.6	11	5.4	<0.05	NT2_47
Sodium Filtered	mg/L	330	120	84	<0.05	NT2_47
Vanadium Filtered	mg/L	0.002	<0.001	0.002	<0.001	NT2_47
Total Recoverable Trace Elements by ICP						
Chromium Trivalent	mg/L	0.008	<0.001	0.01	<0.001	NT2_47

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

REPORT OF ANALYSIS

Lab Reg No.		W16/016970	W16/016971	W16/016972	W16/016973	
Sample Reference	Units	DM 8C	DM 9A	DM 9C	FB	Method
Miscellaneous						
Chromium - Hexavalent	mg/L	<0.001	<0.001	0.22	<0.001	NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

Lab Reg No.		W16/016970	W16/016971	W16/016972	W16/016973	
Sample Reference	Units	DM 8C	DM 9A	DM 9C	FB	Method
Inorganics						
Bicarbonate as CaCO3	mg/L	290	120	280	2	WL122
Carbonate as CaCO3	mg/L	<1	<1	<1	<1	WL122
Chloride	mg/L	2600	240	150	<10	WL119WL293
Nitrate as NO3-N	mg/L	<0.2	0.7	1.7	<0.2	WL119
Sodium:Chloride molar ratio	ratio	0.20	0.77	0.86	<0.1	CALC
Sulfate	mg/L	570	40	68	<5	WL119WL293
Total Dissolved Solids (Evap)	mg/L	7520	630	650	<10	WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

29-SEP-2016

REPORT OF ANALYSIS

Client	: CRISTAL PIGMENT AUSTRALIA LTD LOT 4 OLD COAST ROAD AUSTRALIND WA 6233		Job No.	: CRIS05_W/160916
			Quote No.	: QT-01932
			Order No.	: 4500867576
			Date Sampled	: 15-SEP-2016
			Date Received	: 16-SEP-2016
Attention	: BENJAMIN HUXTABLE		Sampled By	: CLIENT
Project Name :				
Your Client Services Manager	: David Lynch		Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W16/016974	NG1C	DALYELLUP WATER 15/09/16

Lab Reg No.		W16/016974				
Sample Reference	Units	NG1C				Method
Filtered Trace Elements by ICP						
Boron Filtered	mg/L	0.14				NT2_47
Cadmium Filtered	mg/L	<0.0001				NT2_47
Calcium Filtered	mg/L	150				NT2_47
Chromium Filtered	mg/L	0.014				NT2_47
Cobalt Filtered	mg/L	0.001				NT2_47
Copper Filtered	mg/L	0.003				NT2_47
Iron Filtered	mg/L	3.8				NT2_47
Lead Filtered	mg/L	0.005				NT2_47
Magnesium Filtered	mg/L	51				NT2_47
Manganese Filtered	mg/L	0.28				NT2_47
Mercury Filtered	mg/L	<0.0001				NT247_244
Molybdenum Filtered	mg/L	0.004				NT2_47
Nickel Filtered	mg/L	0.004				NT2_47
Potassium Filtered	mg/L	14				NT2_47
Sodium Filtered	mg/L	330				NT2_47
Vanadium Filtered	mg/L	0.006				NT2_47
Total Recoverable Trace Elements by ICP						
Chromium Trivalent	mg/L	0.012				NT2_47

Fiona Zhang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

REPORT OF ANALYSIS

Lab Reg No.		W16/016974				
Sample Reference	Units	NG1C				Method
Miscellaneous						
Chromium - Hexavalent	mg/L	0.002				NW_D2

Wei Huang, Analyst
Inorganics - NSW
Accreditation No. 198

29-SEP-2016

Lab Reg No.		W16/016974				
Sample Reference	Units	NG1C				Method
Inorganics						
Bicarbonate as CaCO3	mg/L	340				WL122
Carbonate as CaCO3	mg/L	<1				WL122
Chloride	mg/L	610				WL119WL293
Nitrate as NO3-N	mg/L	2.8				WL119
Sodium:Chloride molar ratio	ratio	0.83				CALC
Sulfate	mg/L	130				WL119WL293
Total Dissolved Solids (Evap)	mg/L	1580				WL123

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

29-SEP-2016

Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

ACCREDITED FOR
TECHNICAL
COMPETENCE

This Report supersedes reports: RN1131149 RN1131309
Chemical Accreditation 198: 105 Delhi Road, North Ryde, NSW, 2133

Australian Government

National Measurement Institute

QUALITY ASSURANCE REPORT

Cristal Pigment Australia LTD

Lot 4 Old Old Coast Road
AUSTRALIND WA 6230

Attention: Benjamin Huxtable

NMI Job No: CRIS05_W/160916
Sample Matrix: Water
Sample LRN Range: W16/016958 - 016974

Analyte	LOR	Blank	Units	LRN	Duplicate	LRN	Duplicate	Recovery	Acceptability
				W16/016960	D	W16/016970	D	%	Limits
Bicarbonate as CaCO3	1	<1	mg/L	340	340	290	290	-	-
Carbonate as CaCO3	1	<1	mg/L	<1	<1	<1	<1	104%	80 - 110
Chloride	10	<10	mg/L	610	610	2600	2600	103%	90 - 110
Nitrate as NO3-N	0.2	<0.2	mg/L	2.8	2.8	<0.2	<0.2	97%	90 - 110
Sodium:Chloride molar ratio	-	-	ratio	0.84	0.86	0.20	-	-	-
Sulfate	5	<5	mg/L	130	130	570	560	100%	85 - 115
Total Dissolved Solids (Evap)	10	<10	mg/L	1590	1580	7520	7750	104%	90 - 110

Signed: **David Lynch**
Senior Environmental Chemist
NMI WA, Inorganic Section

Date: **29/09/2016**

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

Client: CRISTAL PIGMENT AUSTRALIA LTD

NMI QA Report No: CRIS05_W/160916 QA
Sample Matrix: Water,

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix spk
		mg/L	mg/L	mg/L	mg/L	%	%	%
Inorganics Section				**W16/016958**				**W16/016958**
Chromium - Hexavalent	NW_D2	0.001	<0.001	<0.001	<0.001	ND	112	NA

Legend
Acceptable recovery is 80-120%.
Acceptable RPDs on duplicates is 30% at > 5 times LOR. Greater RPD may be expected at < 5 LOR.
LOR = Limit Of Reporting
RPD = Relative Percent Difference
LCS = Laboratory Control Sample
ND = Not Determined
NA = Not Applicable

Comments
This report shall not be reproduced except in full.
Results greater than ten times LOR have been rounded to two significant figures.

Signed:

Dr Andrew Evans
Inorganics Manager, NMI-Pymble

Date: **28/09/2016**

Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

Client: **CRISTAL PIGMENT AUSTRALIA LTD**

NMI QA Report No: **CRIS05_W/160916**

Sample Matrix: Water (Filtered)

Analyte	Method	LOR	Blank	Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		mg/L	mg/L	mg/L	mg/L	%	%	%
Inorganics Section				**W16/016960**				**W16/016960**
Boron Filtered	NT2.47	0.005	0.005	0.13	0.14	7.4	94	105
Cadmium Filtered	NT2.47	0.0001	0.0001	< 0.0001	< 0.0001	ND	99	102
Calcium Filtered	NT2.47	0.005	0.005	150	160	6.5	101	94
Chromium Filtered	NT2.47	0.001	0.001	0.014	0.016	13.3	96	101
Cobalt Filtered	NT2.47	0.001	0.001	0.001	0.001	0.0	97	101
Copper Filtered	NT2.47	0.001	0.001	0.003	0.004	28.6	99	102
Iron Filtered	NT2.47	0.005	0.005	4.3	4.5	4.5	101	97
Lead Filtered	NT2.47	0.001	0.001	0.005	0.006	18.2	99	101
Magnesium Filtered	NT2.47	0.005	0.005	52	52	0.0	97	91
Manganese Filtered	NT2.47	0.001	0.001	0.37	0.39	5.3	101	101
Mercury Filtered	NT2.47	0.0001	0.0001	< 0.0001	< 0.0001	ND	98	105
Molybdenum Filtered	NT2.47	0.001	0.001	< 0.001	< 0.001	ND	103	91
Nickel Filtered	NT2.47	0.001	0.001	0.004	0.004	0.0	99	102
Potassium Filtered	NT2.47	0.05	0.05	14	14	0.0	111	118
Sodium Filtered	NT2.47	0.05	0.05	330	340	3.0	106	110
Vanadium Filtered	NT2.47	0.001	0.001	0.005	0.005	0.0	99	100

Legend:
Acceptable recovery is 75-120%.
Acceptable RPDs on duplicates is 44% at concentrations > 5 times LOR. Greater RPD may be expected at < 5 tim
LOR = Limit Of Reporting
ND = Not Determined
RPD = Relative Percent Difference
NA = Not Applicable
LCS = Laboratory Control Sample.
#: Spike level is less than 50% of the sample's concentration, hence the recovery data is not reliable.

Comments:
Results greater than ten times LOR have been rounded to two significant figures.
This report shall not be reproduced except in full.

Signed:

Dr Andrew Evans
Inorganics , NMI-North Ryde

Date: **27/09/2016**

SGS RADIATION SERVICES

Accredited Laboratory
No. 2562/14167

8th November 2016

Ref: 9822
Order No: 4500895971
Page 1 of 2

Cristal Millennium
c/- Stass Environmental
KALUMUNDA WA 6926

Attn: Benjamin Huxtable

ANALYTICAL REPORT

The results (to 95%, 2σ, confidence level) for Radium-226 and Radium-228 analyses of sixteen (16) liquid samples, as received at our laboratory on 16th September 2016, are detailed on page two of this report

MDL:	Radium-226	100 mBq/L	Radium-228	100 mBq/L
Method:	LTP No. 4(a)	Gamma Spectrometry Analysis		

Jacob Borger
Authorised Signatory

Accredited for compliance with ISO/IEC 17025 - Testing. This document shall not be reproduced, except in full.

WRS No.	Client Sample ID	Ra-226 (mBq/L)	Ra-228 (mBq/L)
9822-1	DM 1A	< MDL	< MDL
9822-2	DM 1C	547 ± 91	757 ± 157
9822-3	MB 3	< MDL	< MDL
9822-4	DM 2A	< MDL	< MDL
9822-5	DM 2C	< MDL	< MDL
9822-6	MB4	< MDL	< MDL
9822-7	DM 4A	< MDL	< MDL
9822-8	DM 4C	< MDL	< MDL
9822-9	DM 7A	< MDL	< MDL
9822-10	DM 7C	< MDL	< MDL
9822-10D	DM 7C	< MDL	< MDL
9822-11	DM 8A	< MDL	< MDL
9822-12	DM 8C	< MDL	< MDL
9822-13	DM 9A	< MDL	< MDL
9822-14	DM 9C	909 ± 114	574 ± 114
9822-15	YB	< MDL	< MDL
9822-16	NG1C	< MDL	< MDL

Gamma Spectrometry

The reported expanded uncertainty of measurement is stated as the standard uncertainty of the measurement ± 5.6 %, multiplied by the coverage factor k=2, which corresponds to a coverage probability of approximately 95%.

Ref: 9822

APPENDIX L

ENVIRONMENTAL MANAGEMENT PLAN
(proposed)

Cristal Pigment Australia Ltd

Environmental Management Plan

Lot 9077 on Deposited Plan 60716, Dalyellup

March 2015

Table of contents

Table index

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Appendices

1. Introduction

GHD Pty Ltd was engaged by Cristal Pigment Australia Ltd (Cristal) to prepare an Environmental Management Plan (EMP) for the former Dalyellup Waste Residue Facility (WRF), located at Lot 9077 on Deposited Plan 60716 (the Site), Maidment Parade, Dalyellup, Western Australia (Figure 1, Appendix A). Cristal is the land owner and proponent for a proposed staged rehabilitation project at the Site. This EMP has been prepared with reference to the Final Closure Plan Remediation Validation Ongoing Management Report (FCPROM) (Cristal Global 2013).

Future development plans, including proposed infrastructure plans were not available from the Shire of Capel (Shire) at the time of this EMP preparation. Therefore, broad management strategies have been outlined in some instances throughout this EMP.

1.1 Background

The Site was previously used to dispose treated solid residue (TSR) sourced from the processing of titanium dioxide. The Site operated from 1988 to 2013, at which time the Site was closed and disposal ponds were capped.

In December 2013, the Site was successfully capped with two metres of clean sand to meet the Closure Notice requirements. The validation results are documented in GHD (2015*) Dalyellup Facility – Rehabilitation Sand Stockpile Characterisation Program: Validation – Central Tailings Pond, Area 4, Area 5_Rev2 dated 18 February 2015*.

The FCPROM states that the closure period monitoring is scheduled to be completed within five years following Site validation. The Site was successfully validated via approval by the Site Auditor in January 2015 (AECOM, 9 February 2015). Therefore, the closure period will be completed in January 2020.

The Site is subject to Contaminated Site Audit. As part of the contaminated site assessment process, an EMP is required to be included as part of the final Mandatory Auditor’s Report.

1.2 Objectives

The objectives of the EMP are to:

- Detail ongoing monitoring and management of the Site in accordance with proposed closure and rehabilitation measures.
- Detail the restrictions on development of the Site to avoid compromising the Site’s validated status.
- Allocate responsibilities for effective implementation of the monitoring and management.

Cristal’s rehabilitation aims for the Dalyellup Waste Residue Facility are (Cristal 2013):

- No evidence of contamination into the Yarragadee aquifer.
- No evidence of adverse impact on the marine environment from the salt plume exiting the site.
- Contaminants of interest are fixed in TSR. The exception being molybdenum. Molybdenum concentrations in the ground water may be elevated above background concentrations, albeit below the adopted groundwater criteria.
- The rehabilitated ponds have reached equilibrium in the superficial groundwater for the majority parameters within five years of decommissioning the facility.

1.3 Scope of work

This EMP includes:

- Stakeholder identification including roles and responsibilities.
- Groundwater monitoring program – consistent with Auditor's requirements.
- Dust management program – consistent with the Shire of Capel's requirements.
- Weed management including spraying and slashing.
- Site access requirements including signage and fencing.
- Road maintenance – consistent with the Shire of Capel requirements.
- Radiation monitoring – consistent with the Radiological Council's requirements.
- Infrastructure construction processes – consistent with the Shire of Capel requirements.
- Sand slumpage monitoring including routine surveying.
- Reference to an irrigation plan – preparation of this plan is not part of the EMP scope.

This EMP has been developed according to Department of Environment Regulation (2014) Assessment and Management of Contaminated Sites, Contaminated Sites Management Series.

This EMP is relevant for all works that do not involve excavation of more than 1 m, or to within 1 m of the known top of the TSR. All works involving excavation of more than 1 m, or to within 1 m of the known top of the TSR will require a specific management plan.

1.4 Limitations

This report: *Environmental Management Plan – Lot 9077 on Deposited Plan 60716, Dalyellup* has been prepared by GHD for Cristal Pigment Australia Ltd and may only be used and relied on by Cristal Pigment Australia Ltd for the purpose agreed between GHD and the Cristal Pigment Australia Ltd as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Cristal Pigment Australia Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.5 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Cristal Pigment Australia Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.5 Assumptions

This EMP is relevant for all works that do not involve excavation of more than 1 m, or to within 1 m of the known top of the TSR. All works that do not comply with this will require a specific management plan.

2. Plan management and control

2.1 General

The EMP outlines Site management measures relating to the potential human health and environmental risks associated with soil and groundwater contamination identified at the Site.

2.2 Distribution

The EMP has been prepared by GHD for Cristal. The Safety, Health and Environment Manager (SHE Manager) at Cristal is responsible for the distribution of the EMP. The EMP will also be issued to the appointed Western Australian Department of Environment Regulation (DER) Contaminated Site Auditor (Jason Clay, AECOM) for review and comment.

2.3 Review and update

Any revisions to the EMP will be provided to the Contaminated Site Auditor for review and comment prior to implementation. Records of revision will be in accordance with Cristal's document control system.

2.4 Roles and responsibilities

While Cristal still occupies the Site for rehabilitation, the Cristal SHE Manager is responsible for the implementation of the EMP. This will transfer to the Site owner or developer after the rehabilitation and handover is complete.

As outlined in the FCPROM, Cristal will take into account nearby land users during the rehabilitation program, including alleviating disturbance and loss of amenity during the earthworks phase. This includes (but is not limited to) receiving nuisance complaints from surrounding residents, which may result from Site activities and notification of other parties where applicable.

Cristal's SHE Manager will ensure the EMP is implemented correctly. The Environmental Manager will also be responsible for keeping the following stakeholders informed of the rehabilitation program and works, as relevant:

- Dalyellup Beach Pty Ltd
- Shire of Capel

The following stakeholders will be asked for advice and assistance to manage the amenity of nearby land users during rehabilitation, for example in regards to heavy vehicle movement and impact:

- Department of Environment Regulation (DER)
- Shire of Capel
- LandCorp
- Other interested parties/stakeholders, as relevant

3. Groundwater management

3.1 Primary issues

Understanding the source of impacts is important if dewatering activities are required during future construction works on the Site, as these construction works would have the potential to mobilise, intersect and/or exacerbate groundwater impacts.

There are no sources of groundwater impact currently identified within the deep Yarragadee aquifer (Cristal 2013). The main source of contamination in the shallow aquifer is the salt plume from the TSR within the capped ponds.

The objective of the groundwater monitoring is to confirm that the groundwater quality is improving and moving towards background concentrations.

3.2 Monitoring

3.2.1 Groundwater sampling methodology

Groundwater sampling techniques will be consistent with AS/NZS 5667.11:1998 *Water quality - Sampling Part 11: Guidance on Sampling of Groundwaters* and standard low flow sampling techniques. Groundwater sampled from the Superficial and Yarragadee aquifers will be completed using the following methodology:

- Groundwater monitoring wells will be gauged using a water level meter to determine the depth to water.
- A low flow pump will be inserted into the monitoring well. In each well the pump inlet will be located in the centre of the well screened interval to ensure consistency in results between monitoring rounds. This is suitable for the contaminants of concern including metals and major ions.
- The well will be purged using the inserted low flow pump (at approximately 300-500 ml/min) until field parameters have stabilised to within approximately 10%. Field parameters including those listed in Section 3.2.2 will be recorded on the groundwater field record sheet (Appendix B).
- Following stabilisation field parameters, samples will be collected directly into laboratory supplied appropriately pre-treated sample bottles for the contaminants of potential concern identified in Section 3.2.2.
- Field duplicates will be collected at a rate of 1 in 20. Relative Percentage Difference (RPD) will be calculated to evaluate the variability in duplicates, using the following formula:
  %RPD = |A-B|/|A+B| x 200
  This will not be calculated if both sample results are below the detection limit. Where one is below the detection limit, the RPD will be calculated by assigning that sample half the detection limit.
- Rinsate blanks will be collected at the end of each day by pouring laboratory supplied rinsate water over reusable equipment that has undergone decontamination and collecting that water in laboratory bottles.
- Samples analysed for dissolved metals will be field filtered to 0.45 microns.
- Samples will be place directly into chilled eskies containing ice and forwarded to the NATA accredited laboratory for analysis along with a chain of custody form.

Table 1 presents the monitoring wells that will be sampled during the groundwater monitoring event. The well locations are presented on Figure 2 (Appendix A).

Table 1 Monitoring well network

Well Id	Targeted aquifer	Date drilled	Depth of well (m bgl)	Screened interval (m bgl)	Elevation (m AHD)	Top of Casing (mAHD)	Easting	Northing
Up-gradient wells								
DM1RS	Superficial	15.12.92	43	39 – 42	40.05	39.56	370837	6304504
DM1RD	Superficial	15.12.92	50	45 – 48	40.05	39.54	370837	6304504
DM9S	Superficial	23.7.96	36	32 – 35	33.8	34.35	370765.78	6304209.08
DM9D	Superficial	23.7.96	46	42 – 46	33.8	34.28	370765.78	6304209.08
Down-gradient wells								
DM2RS	Superficial	27.02.89	26.5	23.5 – 25.5	24.489	26.4	370525	6304503
DM2RD	Superficial	27.02.89	35.3	27 – 30	24.489	26.25	370525	6304503
DM4RS	Superficial	4.04.96	7.8	4.8 – 7.8	3.643	4.78	370364.96	6304368.66
DM4RD	Superficial	13.02.89	12.5	9.5 – 12.5	4.444	4.77	370364.96	6304368.66
DM7RS	Superficial	27.5.92	23	19 – 22	20.497	24.52	370479.84	6304180.9
DM7RD	Superficial	29.5.09	30.8	26 – 29	20.497	24.66	370479.84	6304180.9
DM8RS	Superficial	23.7.96	28	24 – 28	26.19	26.47	370506.9	6304410.2
DM8RD	Superficial	23.7.96	36	32 – 36	26.19	26.39	370506.9	6304410.2
Yarragadee well								
YBd	Yarragadee	24.03.05	72	66 – 72	26	27.2	370516	6304473

3.2.2 Groundwater analysis

Depth to water will be gauged in each well and the following parameters measured prior to sample collection:

- Depth to water (m top of PVC casing [TOC])
- pH
- Electric conductivity (mS/cm)
- Temperature (degrees Celsius)

The samples taken from the superficial aquifer will be analysed in a NATA accredited laboratory for the suite provided in Table 2.

Table 2 Superficial aquifer laboratory analysis suite

Parameter Group	Analytes
Inorganics	pH, electrical conductivity, total dissolved solids, bicarbonate, calcium, carbonate, chloride, potassium, sodium, sulphate
Filtered/dissolved metals	boron, cadmium, chromium (total, hexavalent and trivalent), cobalt, copper, iron, lead, magnesium, mercury, molybdenum, nickel, vanadium

The Yarragadee aquifer will be monitored for the superficial aquifer analytes, as well as radionuclides Radium-226 and Radium-228.

The Yarragadee bore, a control bore and a bore located closest to the northern ponds will also be analysed for Dioxins and Furans on an annual basis.

Locations of these bores are presented on Figure 2 (Appendix A).

3.2.3 Sampling frequency and duration

The groundwater sampling will occur for four years from decommissioning, as ponds are expected to have reached equilibrium with the superficial aquifer in this time (Cristal 2013). As the decommissioning was competed in May 2013, the sampling should be completed in May 2017.

The wells will be sampled at the following frequencies:

- Superficial aquifer – every six months in approximately April and October.
- Yarragadee aquifer – quarterly, in January, April, July and October.

3.2.4 Guidelines

Groundwater concentrations will be compared to the Australian and New Zealand Environment and Conservation Council (ANZECC) 95% Marine Waters guidelines, as the Site is directly upgradient from the Indian Ocean. The Indian Ocean is the primary receptor of groundwater quality at the Site.

3.3 Management

Groundwater may require further investigation and management if the following occurs:

- Increases in the concentration of an analyte
- An exceedance of a groundwater guideline

In the first instance, it will be noted in the annual environment report, which is to be completed by Cristal as per the DER Closure Notice (DER 2013). Should three exceedances of the guidelines and a rising trend in an analyte be observed, a groundwater investigation to delineate the contamination may be required.

4. Dust management

4.1 Primary issues

Dust monitoring was completed by Cristal until the ponds were covered in October 2013, eliminating the generation of TSR dust.

While the ponds remained uncovered, Cristal's SHE Manager completed dust monitoring using a TSP and PM10 high volume sampler for 24 hours, every six days at the southern and south eastern ends of the central ponds. This was completed between 1 October to 31 March each year and was completed according to the Australian Standard AS 3580.9.3:2003 *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method*.

As the ponds are now capped, dust monitoring is no longer required. Should construction works be undertaken on Site, a specific dust management plan should be developed as the surface of the Site has been noted to be dusty in the drier months (Cristal 2013). The FCPROM states:

"A Dust Management Plan shall be submitted by the contactor for approval by Cristal and the Shire of Capel. Any dust arising from the earthworks will be suppressed using a water tanker." (Cristal 2013).

4.2 Monitoring

Dust monitoring is no longer required on the Site. If the Site is redeveloped and a dust management plan is required, the following monitoring may be applicable:

- Visual monitoring for excessive dust generation. Where dust is observed, the area will be treated with dust suppression techniques.
- Physical air quality monitoring following nuisance dust complaints downwind of the Site during construction.

4.3 Management

If the Site is redeveloped and a dust management plan is required, the following methods of dust management may be used on the Site:

- Water sprayed by water tankers or similar, utilising non-potable or recycled water where possible.
- An adequate supply of water made available for dust suppression.
- Mobile plant movements to be restricted to designated routes and standing areas, minimising the disturbance of unsealed surfaces.
- Stockpiles that are to remain on Site for more than a few weeks to be stabilised where required.

5. Weed management

5.1 Primary issues

During revegetation, weed management will be required to allow the planted species to develop and prevent weeds from taking over the Site. The purpose of this is managing vegetation growth until planted species are matured to withstand weed species. Soil stabilisation is also a desired outcome to reduce wind blown and surface water erosion.

A weed management plan will be required to be developed considering the below issues.

Invasive species (including weeds) represent the biggest threat to biodiversity after habitat loss. Weeds are plants that grow in areas where they are not wanted and where they may have an environmental or economic impact. Weeds can impact on natural values by:

- Out-competing native species for nutrients, water, space and sunlight.
- Reducing the natural diversity by smothering native plants or preventing them from growing back.
- Reducing habitat for native animals.
- Altering fire regimes (Department of Parks and Wildlife (DPaW) 2014).

The major vectors for the introduction and spread of weeds at the Site include:

- Dumping of rubbish.
- Escape of garden plants, though this is unlikely as the nearest residential buildings are across Hutt Drive, 180 metres south of the central ponds.
- Human and animal transport.

Weed species may become a threat as they may spread into areas of newly revegetated native vegetation on top of the central and northern ponds, adjacent to the currently rehabilitated southern pond.

Should the Site be redeveloped as playing fields, care will be required to keep the grass within the sporting area and out of the native vegetation. This can become an issue where there is a lack of delineation between grassed areas and native vegetation, which allows the grasses to enter and smother the vegetation. Sporting field users may also walk from the sporting fields into the revegetated areas, which may track weeds between the two areas.

Significant weeds

No introduced weed species listed as a Declared Pest under Section 22 of the Department of Agriculture and Food Western Australia (DAFWA) *Biosecurity and Agriculture Management Act 2007* (BAM Act) or Weeds of National Significance (Australian Weeds Committee 2010) have been recorded by or reported to Cristal.

Introduced plants occur throughout the Site, with the primary weeds being veldt grass (*Ehrharta calycina*), couch grass (*Cynodon dactylon*) and onion weed (*Trachyandra divaricate*). These have thrived in the southern pond rehabilitation area (Cox et al 2005).

Reference should be made to the DPaW prioritised weed ranking sheets provided on their website (DPaW 2014).

5.2 Monitoring

Most of the Site is currently undergoing revegetation with native plants, with more established revegetation on the southern pond area. The Site is currently being assessed for redevelopment as recreational playing fields, including sporting facilities. Until the area for the playing fields has been confirmed, the entire Site should be monitored for weeds.

Weed species should be identified within the revegetated areas. As part of the weed management plan for the Site, the following objectives to manage weeds within the targeted areas mentioned above should include:

- Reduce the spread of weeds.
- Prevent the introduction of new weeds.
- Control and/or eliminate both noxious and environmental weeds.

As part of the weed management at the Site, annual monitoring of weeds in March-April should be completed. Any weeds observed will be sprayed with herbicide as per management practice outlined in Section 5.3.

5.3 Management

Weed spraying is required annually within the rehabilitation area. Weeds should be sprayed with an appropriate weed management poison according to the manufacturer's instructions during a period of dry, calm weather. This should be performed using a targeted approach if the weed issue is minor, but may require a broader application if there are significant numbers of weeds.

Restricting public access to revegetation zones will reduce the opportunity for weeds to be transported into these zones.

6. Site access management

6.1 Primary issues

Site access including the entrance road and Site security will require maintenance during the closure period to ensure that:

- Regular monitoring of the Site can be successfully completed, as outlined in this EMP.
- Minimisation of risk to the community.
- Maximise success of the Site closure and revegetation.

All signs, access roads for monitoring locations and fences surrounding the Site should be maintained by Cristal during the closure monitoring period, or until the Site is handed over.

Signage along public roads will require approval by Main Roads, and need to be in line with their requirements.

6.2 Monitoring

Monitoring of the condition of signs, fencing and the road should be completed as part of other routine monitoring. Any areas requiring maintenance should be recorded in the site notes and provided to the SHE Manager.

6.3 Management

Required maintenance reported to the SHE Manager should be attended to in a timely manner and recorded in the Annual Environmental Report.

Revegetation areas should be restricted to the public to ensure vegetation is not damaged and to reduce spread of weeds.

7. Radiation management

7.1 Primary issues

The FCPROM details radiation management measures, which are summarised in this section. No radiation monitoring is required for the Site, as the exposure pathway has been closed by covering the source material (TSR) with a minimum 2 m sand cap. Should this cap be removed or permanent excavations greater than 1 m planned, the Radiological Council should be contacted to assist with development of new management measures or review new management measures prior to implementation. Temporary excavations will not require new management measures, as radiation risk is based on long-term (years) exposure.

The following management measures are taken from the FCPROM.

The planning and rehabilitation of the solid residue disposal facility has been guided by the specification for Category A wastes in the Near-Surface Disposal Code. The Code specifies a two metre cover. The final capping structure will be consistent with maintaining the integrity of the radionuclide content.

The radiometric parameters of interest are:

- *Gamma radiation levels at the surface*
- *Radon and Thoron concentrations in air*
- *Radionuclides in groundwater*

The data from the operational radiation monitoring program at Dalyellup for 23 years, and data gathered from a series of pre rehabilitation studies, give support to the fact that two metres cover will be sufficient for the rehabilitation of the residue ponds. A further risk assessment [ERM 2010] concluded if the sporting fields option proceeds that a minimum of 0.25 metres of sand would be sufficient. The final contouring of the site will result in cover exceeding the two metres requirement over large areas.

Assessment of uptake of radionuclides of deep rooted plants on the rehabilitated southern ponds and adjacent reconstructed 2.5 hectare fore dunes will determine the risk of such plants being propagated in the rehabilitation program, or by natural seeding in future years, on the capped site.

Upon capping the site a survey will be conducted by qualified personnel to confirm radiological exposure levels are within acceptable levels. The radiological considerations are fully described in Radiation Professionals, 2012.

A radiation management plan is currently under review by the Radiological Council WA. Monitoring and management measures are outlined below and formally outlined in the radiation management plan.

7.2 Monitoring

Monitoring will only need to be considered for any open excavations greater than 1 metre depth or to within 1 metre of the top of the tailings. Should monitoring be required, it will involve radiation monitoring measurements of:

- adsorbed dose rates in air.
- alpha activity in airborne dust (Cristal Pigment 2012).

The monitoring will only be required during the time the excavation is open and within 1 metre of the top of the TSR. The monitoring should be carried out as described in “Operational Radiation Monitoring Program at Solid Residue Disposal Site, Dalyellup Annual Report: Year Ending 30 September 2012”.

Alpha activity in airborne dust will only be required if dust is observed to be generated from inside the excavation.

7.3 Management

Re-development works are likely to include excavation. Should open excavations reach within 1 metre of the top of the TSR or exceed 1 metre below the top of the cap, a specific radiation management plan may be required.

The radiation management plan may include:

- Application of water and dust reducing agents if the excavation is observed to be dusty.
- Disposal of material excavated from within 0.25 m above the top of the TSR at an approved facility; or re-burying the material elsewhere on Site below a minimum of 1 m of capping material.
- Personal monitoring of contractors to determine radiological exposure.

8. Infrastructure construction management

8.1 Primary issues

The primary concern for infrastructure development on the Site is impacts from radiation if excavation reaches within 0.25 m of the TSR. Liaison with the Shire of Capel has indicated that the infrastructure is likely to include:

- Services:
  - Reticulation
  - Electrical cabling
- Large infrastructure:
  - Light towers and footings
  - General use buildings
  - Goal posts and other sports related infrastructure

Site services are unlikely to require excavation for installation below a depth of 600 mm. The larger infrastructure may require excavations below 1 m depending on the geotechnical quality of the capped tailings ponds and surrounding soil.

8.2 Monitoring

Monitoring will only be required for any open excavations greater than 1 metre depth or to within 1 metre of the top of the TSR. This would follow the radiation monitoring outlined in Section 7.2.

8.3 Management

Re-development works are likely to include excavation. Should open excavations reach within 1 metre of the top of the TSR or exceed 1 metre below the top of the cap, a specific radiation management plan may be required.

The best management for the Site is to eliminate or minimise open excavations below 1 m of the top of the cap. Techniques such as piling, where cement is mixed into the ground in-situ, are preferred for the Site for deep footings. Design of footings to be wider and shallower rather than deeper will also reduce the requirement for further management of the Site.

9. Soil capping integrity management

9.1 Issues

Depressions from suspected slumpage of sand have been observed on the Site. The Southern Ponds subsided initially by 3 cm/year from 1992 then slowed over time.

Thompson Surveying Consultants surveyed the Site in November 2013 following completion of the capping. The Site was re-surveyed in February 2015 and confirmed that the cap had slumped up to 0.2 m (GHD 2015).

The primary risks of cap slumpage and settlement is reduced cap thickness and surface water pooling.

9.2 Monitoring

A survey of the Site should be completed annually until the end of the closure period (i.e. January 2020). An alternative is the installation or selection of settlement monitoring points across the cap, rather than a full survey of the Site each year.

9.3 Management

Should slumping or settlement of the Site be observed and be uneven, the following management may be implemented:

- Addition of clean fill to the sunken areas.
- Review of site drainage, and consideration of additional drainage infrastructure.
- Addition of stabilising vegetation where erosion is noted.

If the proposed sporting field development proceeds, the Site surface will be levelled and landscaped as part of the development works.

10. Irrigation management

10.1 Issues

The Site currently does not have irrigation infrastructure. It is expected that if the Site is re-developed into sporting fields, irrigation water will be supplied as treated wastewater from the Dalyellup wastewater treatment plant (WWTP). The WWTP is located adjacent to the northern Site boundary. If this occurs, the Shire will need to refer to Water Corporation guidelines for development of a nutrient and irrigation management plan (NIMP). The quality of irrigation water will need to comply with Department of Health (DoH) and national guidelines (NEPC 2013) for recreational use. The plan would be written once the final design is established. It is thought that water injection and subsequent recovery may be the most effective form of wastewater treatment to make it suitable for irrigation.

The NIMP should be written with reference to the following documents:

- Department of Water (DoW) 2010, *Water Quality Information Sheet 04 – Nutrient and irrigation management plan checklist.*
- Department of Health (DoH) 2011, *Guidelines for the Non-potable Uses of Recycled Water in Western Australia.*
- Western Australian Planning Commission (WAPC) 2008, *Better Urban Water Management.*
- DoW 2013, *Guideline for the approval of non-drinking water systems in Western Australia.*
- DoW 2008, *Water Quality Protection Note (WQPN) 22, Irrigation with nutrient-rich wastewater.*
- DoW 2010, *WQPN 33, Nutrient and irrigation management plans.*
- DoW 2011, *Operational policy 1.01 – Managed aquifer recharge in Western Australia.*

The following guidelines from outside Western Australia may also be referred to during the development of a NIMP for the Site:

- Department of Environment and Conservation (NSW) 2003, *Environmental Guidelines Use of Effluent by Irrigation.*
- Environment Protection Agency (SA) 2009, *Wastewater irrigation management plan (WIMP) – a drafting guide for wastewater irrigators.*

10.2 Monitoring

Irrigation water would need to be monitored for quality, with a focus on nutrients and microbiological analytes if treated wastewater is to be used. Water efficiency measures would also be monitored including not over watering during wet periods. These monitoring measures would be outlined in the NIMP that would be required should irrigation be implemented across the Site.

If water is treated by managed aquifer recharge (MAR), the groundwater will need to be monitored for impacts from the wastewater. A licensed groundwater extraction bore will be required to extract the water down-gradient of the recharge area. There are existing extraction bores on-Site which may be suitable.

10.3 Management

The water quality would be management by the Shire as per the measures outlined in the NIMP. Management measures may include the addition of treatment steps or mixing with potable water.

11. Reporting

Cristal will complete an Annual Environment Report describing the monitoring results and management activities completed for the Site as part of this EMP for the previous year. This will be provided to the Auditor and the DER by 30 June each year, with the last provided after final monitoring in 2020.

The report should address the following:

- Current operations at the Site
- Results of all monitoring for the previous year
- Licence compliance and incidences
- Ministerial conditions and company commitments

The DER Closure Notice which includes various monitoring and reporting conditions will be reviewed by DER on 1 October 2015.

12. EMP actions summary

Table 3 outlines the required roles, responsibilities and timeframes for the EMP to be implemented during the closure period (ends January 2020).

Table 3 EMP actions

Management item	Task	Timeframe	Responsible officer
Groundwater	Superficial aquifer monitoring	Six monthly (April and October)	Cristal SHE Manager
	Yarragadee aquifer monitoring	Quarterly	Cristal SHE Manager
Dust	Monitoring and suppression of dust	During redevelopment stage. A dust management plan is required.	Cristal SHE Manager
Weeds	Weed monitoring & spraying	Annually (Spring)	Cristal SHE Manager
Site access	Check signs, fencing and roads	Routinely (quarterly during Yarragadee aquifer monitoring)	Cristal SHE Manager
Radiation	Radiation monitoring	During construction if excavation are greater than 1 metre deep. Radiological Council WA approved radiation monitoring plan is required.	Cristal SHE Manager
Infrastructure construction	Excavation inspections	During redevelopment stage.	Site contractor, Cristal SHE Manager
Soil capping integrity	Site survey	Annually	Surveying consultants, Cristal SHE Manager
Irrigation	Nutrient management	Following redevelopment if waste water is proposed to be used to water the sporting fields.	Shire of Capel
Reporting	Annual Environmental Report preparation	Annually to include the previous years results of monitoring for items listed in this table.	Cristal SHE Manager

13. References

AECOM (2015) Interim Auditor Advice – Dalyellup Facility – Rehabilitation Sand Stockpile Characterisation Program: Validation – Central Tailings Pond, Area 4, Area 5.

Australian Standard AS 3580.9.3:2003 (2003) Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method.

Australian Weeds Committee 2010/Weeds of National Significance www.weeds.org.au/WoNS

Biosecurity and Agriculture Management Act (2007)

Cristal Global (2013) Dalyellup Facility Final Closure Plan Remediation-Validation-Ongoing Closure Report.

Cristal Pigment Australia Ltd (2012) 2012 Annual Report, Radiation Monitoring Dalyellup.

Cox, Yeomans and Fox (2005) Status of Three-year-old Coastal Vegetation on a Rehabilitated TSR Disposal Pond at Dalyellup, WA, Mulga Research Centre, Department of Environmental Biology, Curtin University, Report for Millennium Chemicals Western Australia.

Department of Environment and Conservation (NSW) (2003) Environmental Guidelines Use of Effluent by Irrigation.

Department of Health (DoH) (2011) Guidelines for the Non-potable Uses of Recycled Water in Western Australia.

Department of Parks and Wildlife (DPaW) (2014) *Weeds*, http://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds accessed 12/03/2015

Department of Environment Regulation (2013) Environmental Protection Act 1986 – Closure Notice [Licence No. 6130/1989/12]).

Department of Water (2013) Guideline for the approval of non-drinking water systems in Western Australia.

Department of Water (2011) Operational policy 1.01 – Managed aquifer recharge in Western Australia.

Department of Water (2010) WQPN 33, Nutrient and irrigation management plans.

Department of Water (DoW) (2010) Water Quality Information Sheet 04 – Nutrient and irrigation management plan checklist.

Department of Water (2008) Water Quality Protection Note (WQPN) 22, Irrigation with nutrient-rich wastewater.

Environment Protection Agency (SA) (2009) Wastewater irrigation management plan (WIMP) – a drafting guide for wastewater irrigators.

ERM (2010) Radiological Impacts of Proposed Site Rehabilitation for Dalyellup Tailings Facility.

GHD (2015) Dalyellup Facility- Rehabilitation Sand Stockpile Characterisation Program, Validation – Central Tailings Pond, Area 4, Area 5.

National Environment Protection Council (2013) National Environment Protection (Assessment of Site Contamination) Amendment Measure (No.1).

Radiation Professionals Pty Ltd (2012) Operational Radiation Monitoring Program at Solid Residue Disposal Site, Dalyellup – Annual Report: Year Ending 30 September 2012.

Western Australian Planning Commission (WAPC) (2008) Better Urban Water Management.

Appendices

Appendix A – Figures

LEGEND

Study Area

🟥 AREA 4	🟨 Deactivated central tailings pond
🟪 AREA 5	🟩 Eastern turning circle

1:10,000 (at A3)

0 50 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

Job Number	61-31953
Revision	0
Date	27 Mar 2015

Locality plan

Figure 1

G:\61\31953\GIS\Maps\MXD\6131953_G001_Rev0_Fig1.mxd

Data source: GHD: Study Area - 20130805; Landgate: Imagery - 2013, Road - 20150327. Created by: jcmatic, bflorczak, vdinh

LEGEND

Well location

- Decommissioned
- Off site Monitoring Well
- Superficial Aquifer Monitoring Well
- Yarragadee Aquifer Monitoring Well

1:2,500 at A3

0 10 20 40 60 80 100
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Cristal Pigment Australia Ltd
Dalyellup Waste Residue Disposal Facility

Job Number	61-31953
Revision	0
Date	27 Mar 2015

Well Locations

Figure 2

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1st Floor, 10 Victoria Street Bunbury WA 6230 Australia **T** 61 8 9721 0700 **F** 61 8 9721 0777 **E** bunmail@ghd.com **W** www.ghd.com

Data source: GHD: Well location - 20150312; Landgate: Bunbury 2013. Created by: vdinh

Appendix B – Field sheets

Groundwater Purging and Sampling Record

Bore ID: ……………..

Job Information	Sampling Information		Bore Information
Client:	Purge Method:		Standing Water Level (m BTOC):
Project:	Sample Method:		Bore Depth (m):
Project Number:	Water Level Meter Type: Dip / Interface / Other:		Screen (m) from: to:
Sampler:	Water Quality Meter Type:		Bore Diameter (mm):
Date:	Flow Cell: Y / N	Pump Depth:	Well Cap Secure: Y / N
Round:	Field Filtered: Y / N	Filter Type:	Other:

Time	Volume (L)	pH (pH units)	Elec Cond (µS / mS)	Temp (°C)	SWL (m BTOC)	Comments: (Colour, turbidity, sediment load, sheen, odour, flow rate, etc)
Stable when 3 consecutive readings:		+/- 0.05 pH	+/- 3%	-	stable	

Field QA Checks:
Air bubbles in vials? Y / N
Any violent reactions? Y / N
Decontamination as per procedure? Y / N
Was sampling equipment pre-cleaned? Y / N
COC Updated? Y / N

Purge Volumes

Casing int. dia. (mm)	50	100
Vol (L/m of casing)	2.0	7.9

(Double for gravel pack)

Comments: (Duplicate samples, access, condition of headworks, etc.)

GHD

1st Floor 10 Victoria Street
Bunbury WA 6230
T: 08 9721 0700   F: 08 9721 0777   E: bunmail@ghd.com.au

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	J Stegena	A Rentsch		F Hannon	Fionnuala Hannon	16.03.15
0	A Rentsch	F Hannon	Fionnuala Hannon	F Hannon	Fionnuala Hannon	27.03.15

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