Appendix I – Groundwater Abstraction for Dust Suppression & Surface Compaction (GWAMP)

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OPERATING STRATEGY

Groundwater Abstraction for Dust Suppression and Surface Compaction

Lot 20 Adelaide Street, Hazelmere

PREPARED FOR:

Wasterock Pty Ltd

Mobile Dewatering Environmental Services as trustee for
Mobile Dewatering Environmental Services Unit Trust
U1/22 Elmsfield Road, Midvale, Western Australia 6056
P: +61 (0) 8 9250 6960 F:+61 (0) 8 92508269
W: www.environmentalservices.com.au

MDW

Environmental Services

DOCUMENT DETAILS

Title:	Groundwater Abstraction for Dust Suppression and Surface Compaction
Author:	Nathan Fuser / Greg Watts
Status:	Draft
Job number:	E2012-031
Email:	greg@environmentalservices.com.au
Synopsis:	This document has been prepared to detail the management of proposed groundwater abstraction operations during proposed site works, of Acid Sulfate Soil treatment, remediation, waste excavation and inert fill importation at Adelaide Street, Hazelmere

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1	G. Watts 22/10/2012	G. Watts 22/10/2012	GRA Wasterock Stratagen VDM	email
Signed	G. J. Watts	G. J. Watts		

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1 Introduction

This Operating Strategy (OS) has been prepared to manage proposed groundwater abstraction, to obtain water for use in dust suppression and surface compaction during the development works taking place at Lot 20 Adelaide Street, Hazelmere (herein referred to as the Site). The proposed development involves the transformation of current land use at the Site - from a closed landfill facility into industrial / commercial use (lot subdivision).

The Site occupies an area of approximately 16.95 Ha. Surface and sub-soil consists of Bassendean sands, with limonite-cemented sand (coffee rock) occurring throughout most of the property near the water table. Groundwater abstraction will be required from three proposed abstraction bores planned for the south western corner of the Site. Groundwater levels obtained from existing site observation bores vary from approximately 5.8 to 11 mAHD. Groundwater abstraction of 300 ML/yr for a four to five year duration is required for dust suppression and surface compaction. Abstraction will be shared equally across the three locations, for storage in two 50,000 L tanks and discharge through a standpipe into water carts as needed.

Under Section 5C of the *Rights in Water and Irrigation Act 1914* (RIWI Act), the approval and granting of a groundwater abstraction licence is required from the Department of Water (DoW) before abstraction can commence from the new bores, and an OS must also be prepared, approved and implemented. MDWES was consequently engaged by Wasterock Pty Ltd (the Client) to prepare this report.

Reference is made to the following Groundwater Monitoring Events GME#1 and GME#2 undertaken by MDWES in May 2012 and September 2012 respectively. These reports should be read in conjunction with this operation strategy report.

2 Objectives

This OS has been prepared in order to minimise impacts to the local environment from dust suppression and surface compaction related activities, resulting in the abstraction and removal of groundwater from beneath the Site.

The objectives of this OS are to:

- Protect life and well-being of humans and other forms of life, aesthetic enjoyment and local amenity in the region of the Site;
- Ensure development is consistent with the principles of ecologically sustainable development and the rehabilitation schedule prescribed;
- Comply with relevant statutory environmental requirements; and,
- Provide strategies aimed at reducing avoidable environmental harm during site rehabilitation.

3 ADMINISTRATIVE REQUIREMENTS

3.1 Site Water License

There is currently no Section 5C (of the RWI Act) water license applicable to the Site. An application to acquire a water license to cover the proposed groundwater abstraction activities will accompany this OS for submission to the DoW for approval.

3.2 Development timeframe

There are no set stages for the remediation of the Site. It is anticipated that this will commence in early 2013. Construction and commission of abstraction bores (WRPB1, WRPB2 and WRPB3) is expected to take approximately 8 weeks, along with the equipping of bore head works, generators, pipes and water meters. Mobilisation of two 50,000 L storage tanks will also occur during this timeframe. Abstraction is assumed to be continuous for three (3) years.

3.3 Previous Investigations of the Water Source

In May 2012, six monitoring bores were installed by MDWES and two sampling rounds followed, as discussed in Section 2. A study of regional geology was completed by Davidson (1995) some of which is discussed in Section 2. A regional hydrogeological study by Davidson and Yu (2006) is referred to in Sections 2 and Section 3, along with a site investigation completed by Dames and Moore (2006). No hydrogeological investigation has been completed thus far for the Site. Groundwater modelling was completed by NTEC (2012).

3.4 Water Resource Management Plan

No plan is currently in place to manage abstracted water at the Site. This OS will be reviewed by the DoW following the approval of the Section 5C water license.

3.5 Responsible Contact for Implementing the Operating Strategy

Name: Peter Moltoni

Position: Director

Organisation: Wasterock Pty Ltd

Phone: 0403569546

Email: pmoltoni@moltoni.com.au

3.6 Reporting Dates for Meters and Compliance

At this stage, water quality data will be obtained monthly from monitoring bores and abstraction bores, as well as the storage tank outlet at the Site. Water meter totals will be captured monthly from the head works of the abstraction bores and also on the storage outlet line to the Standpipe. All results will be reported to the DoW within seven (7) days of the end to the annual groundwater licensing period. The water year is defined as 12 months from the last day in the month from when the water license is issued. Refer to Strategic policy 5.03: *Metering the taking of water* (2009) for further details. Monitoring/recording dates will be determined by the DoW.

Annual reports on compliance and commitments of the water license and the OS will be due within eight (8) weeks of the end to the annual groundwater licensing period. Refer to Operational Policy 5.12: *Hydrogeological reporting associated with a groundwater well licence (*2009) for further information. Reporting dates will be determined by the DoW.

3.7 Major Review of Operating Strategy

The review of the strategy is scheduled to occur three months before the end to the annual groundwater licensing term. Any changes to the OS approved by the DoW will be retained within the working file for the licence documentation. The exact details of the annual groundwater licensing term, expiry date and reporting date will be specified in the conditions of Section 5C water licence, once issued by the DoW.

4 WATER SOURCE DESCRIPTION

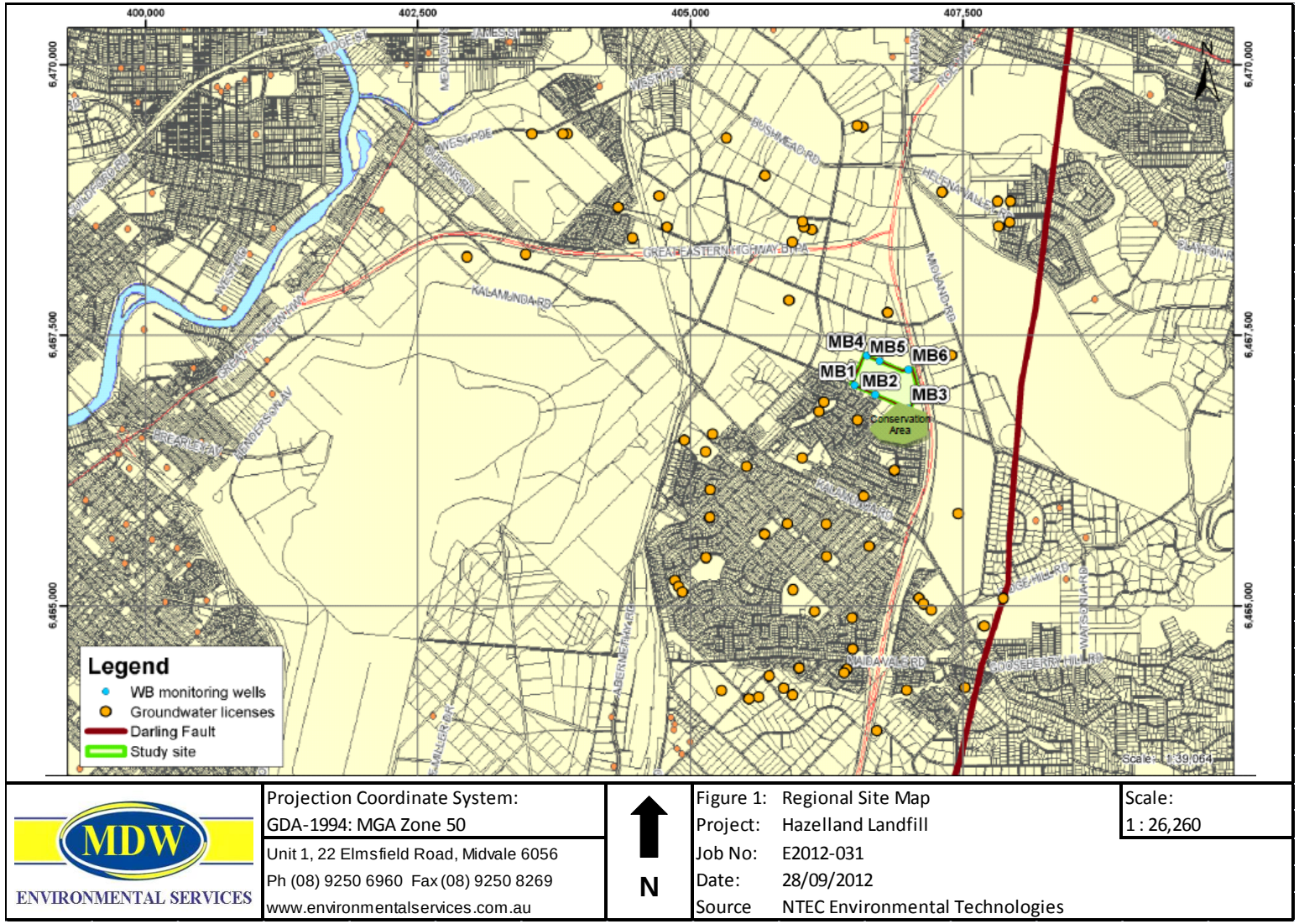
4.1 Site Location and Water Source Condition

The Site is located at Lot 20 Adelaide Street, Hazelmere within the City of Swan, approximately 14 km east north east of the Perth CBD, 6 km east of the Swan River and 1 km west of the Darling Fault (Figure 1). It is currently vested with Hazelland Pty Ltd and has been so since 2006 under the Land Title City of Swan Location Lot 20 Volume 2054 / Folio 299.

The Site covers an area of approximately 16.95 Ha, bounded by Adelaide Street to the south, and Roe Highway to the east (Figure 2). Semi-rural properties containing discarded farming, market gardens and horse trotting tracks/stables flank the Site to the north, with a small operational industrial site (ice works) functioning adjacent to the western boundary, adjacent to the newly proposed abstraction bores.

Current topography varies across the Site from approximately RL 33 mAHD at the top of the inert fill mounds in the north east sector, to approximately RL 27 mAHD at the south, adjacent to Adelaide Street.

Figure 1 Regional Site Map



MDW ENVIRONMENTAL SERVICES	Projection Coordinate System: GDA-1994: MGA Zone 50	N	Figure 1: Regional Site Map	Scale: 1 : 26,260
	Unit 1, 22 Elmsfield Road, Midvale 6056		Project: Hazelland Landfill	
	Ph (08) 9250 6960 Fax (08) 9250 8269		Job No: E2012-031	
	www.environmentalservices.com.au		Date: 28/09/2012	
			Source NTEC Environmental Technologies	

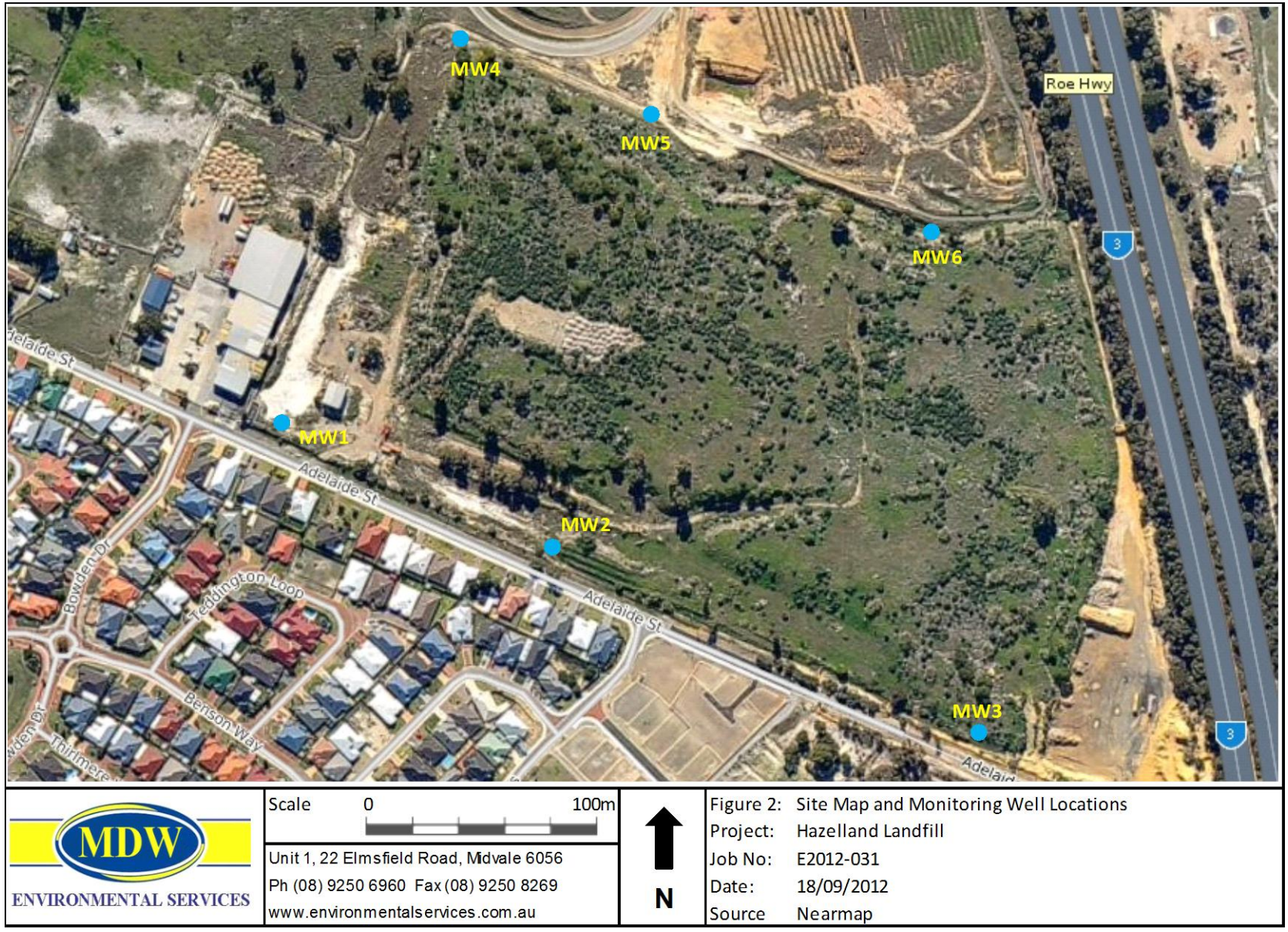


Figure 2 Site Map and Monitoring Well Locations

4.2 Geology

According to the Geological Survey of Western Australia (1986) *Perth part sheets 2034 I and 2034 II, 1:50,000 Environmental Geology Series*, surface geology of the Site is made up of Quaternary aged Bassendean Sand, interlayered with bands of Guildford Clay. The regional geology is described below in Table 1.

Table 1 Regional Geological Summary

Geological Unit	Description	Expected Depth Interval
Bassendean Sand	• Colour is pale grey to white; • Grain size is fine to coarse but mostly medium grained, with an upward progression of fines; • Sorting is moderate; • Rounding is subrounded to rounded (quartz sand).	Surface to 80 mBGL

The superficial geology of the Site is Bassendean Sand, unconformably overlying the Cretaceous and Tertiary units. Bassendean Sands interfinger Guildford Clays in the east and conformably overlie Gnangara Sands. Colluvium exists to the east of the Site at the edge of the Darling Fault. The stratigraphic configuration of the Bassendean Sand with the Guildford Clay and Gnangara Sand suggests the formation was deposited under changing conditions, most likely alternating between fluvial, estuarine and shallow-marine environments (Davidson, 1995). To the north and west, surface geology comprises Guildford Clay.

An *Initial Contamination Assessment of Inert Landfill* was conducted for the Site by Dames and Moore (1992). The results of this investigation are compiled in the report entitled *"Site Investigation, Former Adelaide Street Landfill Lot 20 Adelaide St, Hazelmere, Western Australia"* (Parsons and Brinkerhoff, 2006).

Drilling logs from boreholes completed as part of the Dames and More investigation identified subsurface ground conditions that confirmed the following:

- Sand occurs within 1.2 m or less of the surface in the western and northern areas of the Site, extending to depths of up to 12 m, and;
- Sandy clays and clayey sands were observed near the surface towards the south eastern end of the Site, underlain by sand.

4.3 Acid Sulfate Soils

The DEC ASS Risk Map obtained from the WA Groundwater Atlas (DoW, 2004) indicates that the entire Site is located within a Class 2 zone – designated as moderate to low risk of ASS occurring in the first 3 m of natural soil surface, and high to moderate risk of ASS occurring beyond 3 m of natural soil. An area of high to moderate ASS risk exists approximately 370 m west of the Site (Figure 3).

Field results indicate that the groundwater beneath the site varies from fresh to mildly acidic, with pH ranging from 5.83 to 7.41 (MDWES, 2012). This is an acceptable range of pH in groundwater, present within this locality.

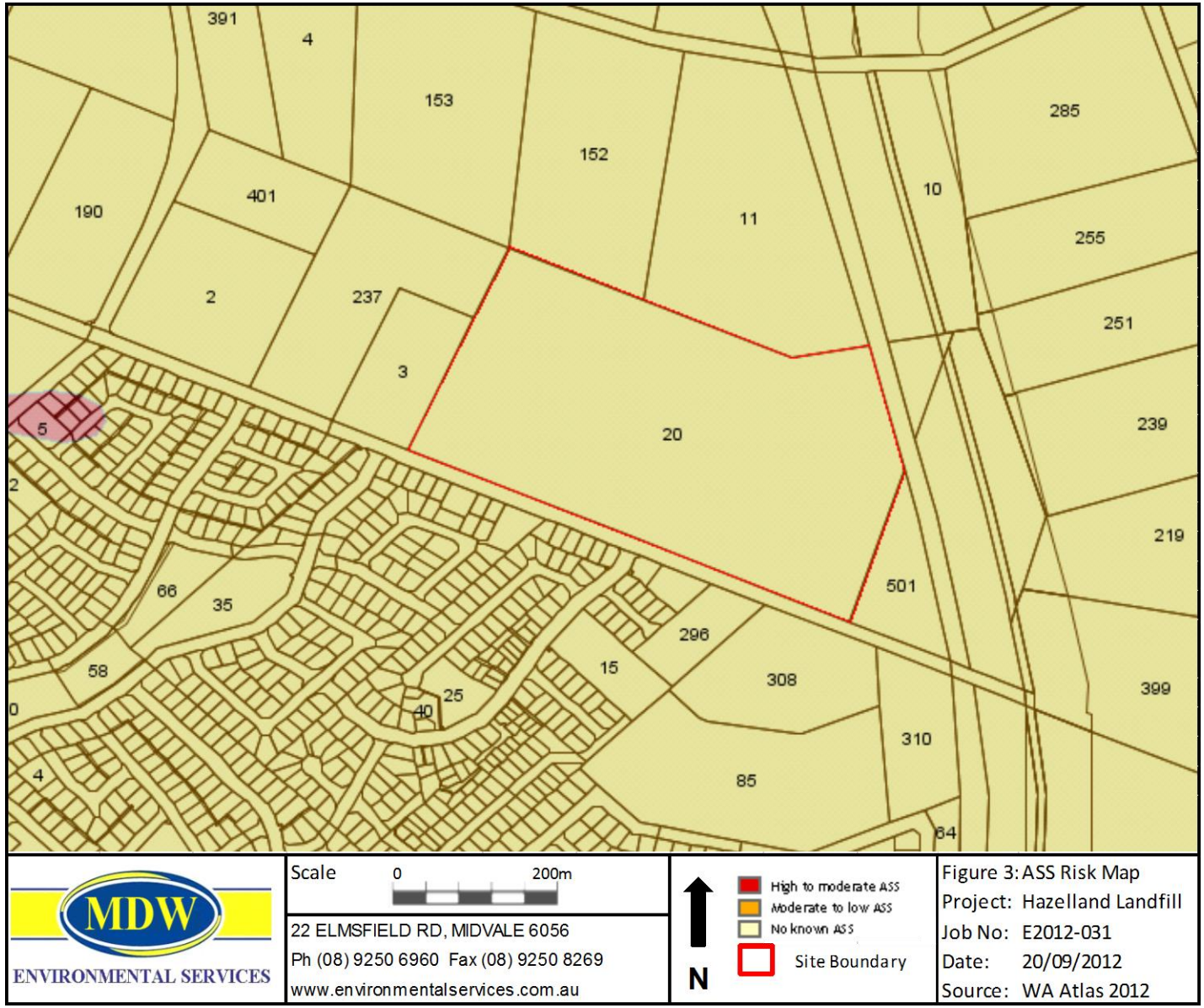


Figure 3 Acid Sulfate Soils Risk Map

4.4 Groundwater

Groundwater comprises the primary source of water at the Site as there are no intersecting streams or surface water bodies. The Perth Groundwater Atlas (2003 contours) indicate that groundwater is encountered on average at approximately RL 14 – 16 mAHD (DoE, 2004). Details of monitoring bore locations, proposed abstraction points, construction and geology are included in Table 2.

The water distribution network at the Site will comprise of the following components:

- Three (3) abstraction/pumping bores;
- Groundwater pumps (1.5 kW capacity) installed in each bore;
- Head works attached to each pumping bore, installed with water meters (with totaliser/rate) and outlets for groundwater quality/quantity monitoring if required;
- Individual generators for each head works - to provide power to each groundwater pump;
- Two (2) 50,000 L above groundwater storage tanks, with standpipe connected to an outlet junction from both, and;
- 150 mm pipe to direct abstracted water from bores to the storage tanks.

The abstracted groundwater is the only source of natural water at the Site.

Table 2 Groundwater Source Description

Bore name Monitoring Well (MW) or Production Bore (PB)	Locational Coordinates: Zone: GDA		Aquifer name	Elevation (mAHD) of TOC	Casing height (cm)	Depth to bottom (m)	Const. details (bore logs and geology attached in Appendix B)
	Easting	Northing					
1. WRMW1	406504.4	6467036.79	Superficial Swan Aquifer	27.281	45	6.650	Casing 0 – 3.0 mBGL Screen 3.0 – 6.0 mBGL
2. WRMW2	406693.90	6466947.24		30.607	68	10.443	Casing 0 – 6.0 mBGL Screen 6.0 – 9.5 mBGL
3. WRMW3	406997.15	6466823.95		34.622	51	14.580	Casing 0 – 6.0 mBGL Screen 6.0 – 14.5 mBGL
4. WRMW4	406617.75	6467311.73		27.751	64	11.122	Casing 0 – 6.0 mBGL Screen 6.0 – 10.0 mBGL
5. WRMW5	406731.40	6467262.78		29.034	56	12.162	Casing 0 – 6.0 mBGL Screen 6.0 – 12.0 mBGL
6. WRMW6	406998.45	6467183.20		31.611	65	9.895	Casing 0 – 6.0 mBGL Screen 6.0 – 10.0 mBGL
7. WRPB1	TBA	TBA		TBA	TBA	TBA	TBA
8. WRPB2	TBA	TBA		TBA	TBA	TBA	TBA
9. WRPB3	TBA	TBA		TBA	TBA	TBA	TBA

Groundwater levels measured in monitoring bores WRMW1- WRMW6 were RL 19.2 - 23.6 mAHD in May, 2012, with levels potentially varying by 0.1 – 0.7 m from May to August (Table 3). The most proximate WIN data site with historical groundwater monitoring data is 61610508, located over 8 km from the Site. Water levels fluctuated at this location by over 2.8 m during the year period 2000 – 2013 and show a declining trend from around year 1970.

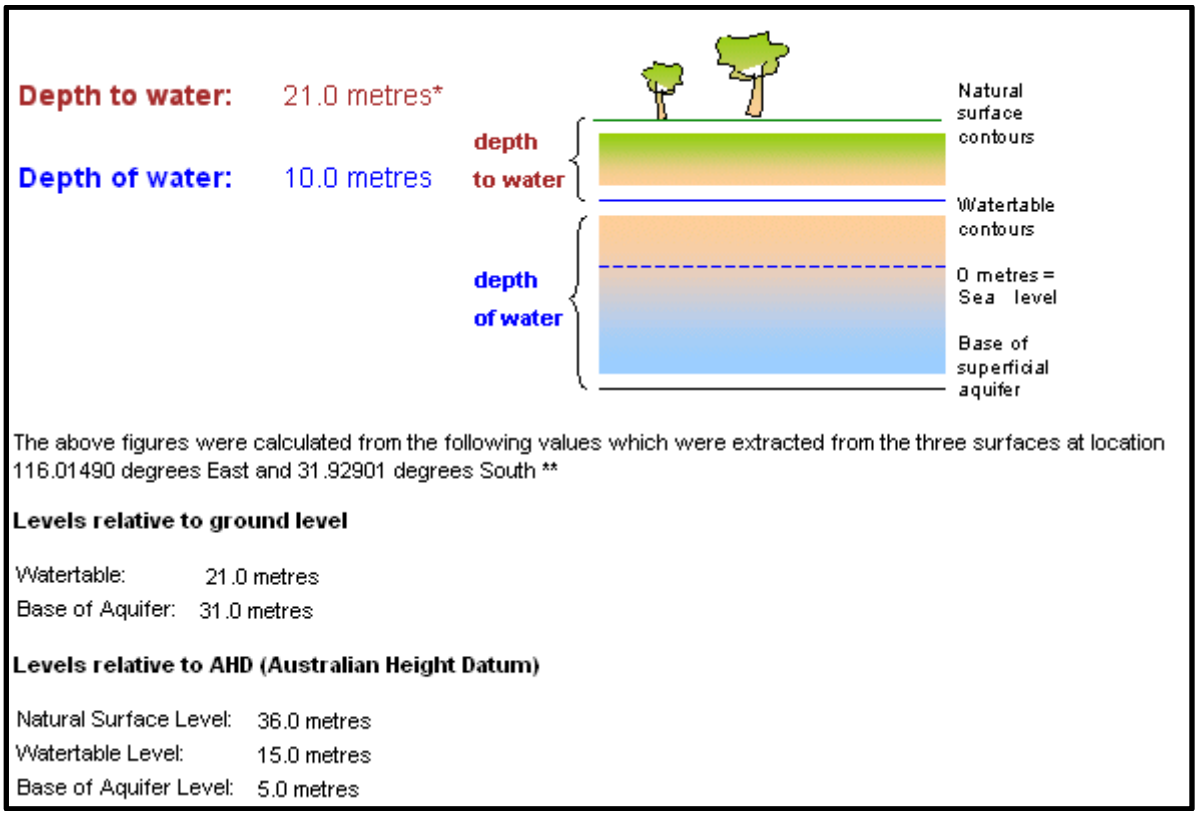
The natural topography of the Site is generally flat, with the lowest elevations in the west and north west, increasing in the east. Consequently, depths to water from the surface vary from 3.7 – 11.8 mBGL. Groundwater is predicted to flow in a north west direction,

originating from the Darling Ranges to the east. It passes beneath the Site, heading towards two wetlands, located approximately 1.5 km to the north west (DoE, 2004) and eventually reaches the Swan River, the most proximate river system located about 6 km to the east.

4.5 Hydrogeology

The uppermost aquifer underlying the region of the Site is the unconfined Superficial Swan Aquifer (Water Register, 2012). Leederville and Yarragadee North aquifers underlie the Superficial. The base of the Superficial Swan Aquifer is mapped (DoE, 2004) indicating a depth of 5 – 7 mAHD at the Site, sloping upwards towards the Darling Fault and downwards towards the Swan River in the west (NTEC, 2012) with an estimated thickness of 10 – 25 m (Davidson and Yu, 2006). The maximum thickness is around 26 m at the Site (Figure 4).

Figure 4 Groundwater and Aquifer Depths



Based on the groundwater levels (Table 3), the hydraulic gradient of the Superficial Swan Aquifer at the Site is approximately 0.01 (NTEC, 2012) sloping downwards along a transect - that dips in the direction of the flux (to the north west corner of the Site). Regional investigations (Davidson and Yu, 2006) indicate that groundwater flow rate (or transmissivity) travelling through the Superficial Swan Aquifer ranges from 50 m/yr to over 1000 m/yr, with Site conditions likely to comprise the lower end of this range. Salinity in the Cloverdale area of the Superficial Aquifer beneath the surface, ranges from 500 to 1000 mg/L (DoE, 2004 and MDWES, 2012) which classifies groundwater quality as being fresh to mildly acidic at the Site.

The Superficial Swan Aquifer is recharged by natural rainfall, with 192 mm/yr being the net rainfall recharge to the Bassendean Sands according to DoW modelling (Xu et al., 2008). The Superficial Swan aquifer recharge rate is expected to be very similar or even the same as those of other underlying aquifers (Davidson and Yu, 2006).

Previous investigations indicate that prior to land use as a sand mine in the late 1970s and as a waste transfer station in the early 1980s, there may be two distinct aquifers occurring at the Site - an upper unconfined superficial aquifer, overlying a deeper aquifer that is potentially confined in parts. The aquifers may have been separated by naturally occurring clay layers from approximately RL 6 and RL 1 mAHD. It is understood that due to sand mining and landfill operations, the surface substrate was excavated to a depth of approximately RL -2 mBGL. This is likely to have removed the upper aquifer and confining clay layers, to expose the lower aquifer at surface level in the central portion of the Site.

In the area proposed for abstraction, clay is still present in the ground. The monitoring bore installations completed by MDWES in May, 2012 revealed some red clay banding at depths below the current site surface RL at WRMW1, from 4 – 6 mBGL. These bands may still be acting as confining or semi confining layers between the yellow sands, creating multiple aquifers.

4.6 Nearby Groundwater Users and Receptors

A search was undertaken on 16th April, 2012 for existing groundwater abstraction licenses within a 5 km radius of the Site (Appendix C). Nine groundwater licenses were granted within 1.5 km of the Site:

- GWL 000061690(002), GWL 000110971(002) and GWL 000152680(003) are north of Adelaide Street, and;
- GWL 000074457(003), GWL 000153812(001), three under GWL 000158077(005), GWL 000167041(001) and GWL 169011(003) are south of Adelaide Street and north of Kalamunda Road.

Each of these licenses are for the purpose of abstraction from the Superficial Swan Aquifer except for GWL 000110971(002) which takes water from the Leederville Aquifer.

Bush Forever Site #122 (Government of Western Australia, 2000) is located south east of the Site that is outlined in red, beyond Adelaide Street (Figure 5). Despite not being identified as a groundwater dependent ecosystem, it is suggested to be a Flora Conservation Area for plant communities representative of the Swan Coastal Plain. Multiple Use Wetland (MUW) also intersects the north west corner of the Site (Figure 5) though this area has been largely modified by human activity and is not considered susceptible to the groundwater abstraction planned for the Site.

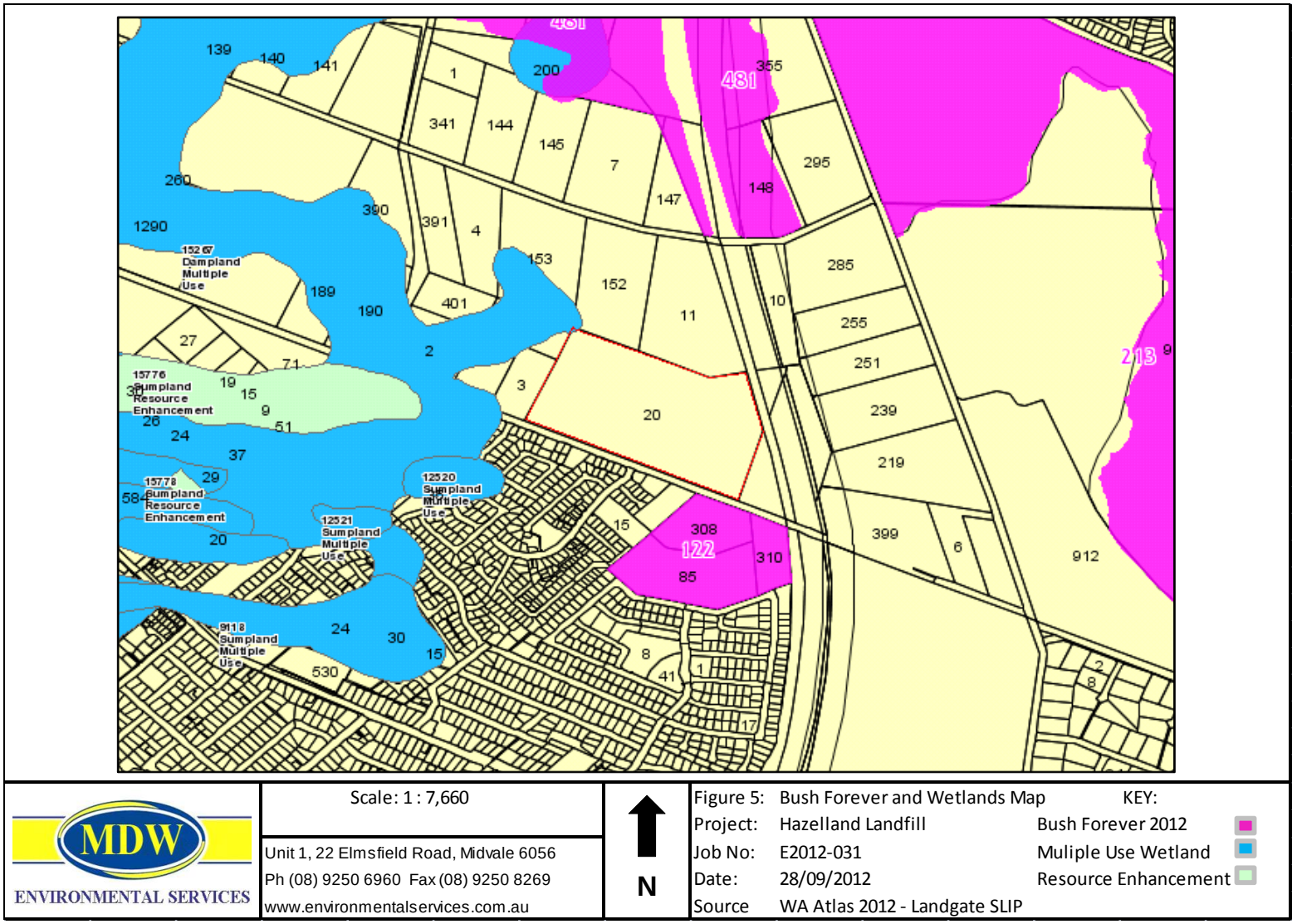


Figure 5 Bush Forever and Wetlands Map

4.7 Previous Groundwater Monitoring

A groundwater investigation was completed by MDWES on 18th October, 2012 (GME#1), with sampling completed from six groundwater wells, WRMW1 – WRMW6, also installed by MDWES (results in Table 4). The results of this investigation are compiled in the report entitled *"Groundwater Investigation Report –Lot 20 Adelaide Street Hazelmere"* (MDWES, 2012).

A second round of groundwater sampling (GME#2) followed on 30th August, 2012 (results in Table 5). The locations of the groundwater monitoring wells are shown in Figure 2.

4.8 Groundwater Monitoring Criteria

To determine background groundwater quality at the Site, and indication of the likely condition of groundwater proposed for abstraction, dust suppression and soil compaction, water quality results for GME#1 and GME#2 were compared against criteria outlined within the DEC's *Contaminated Site Management Series - Assessment Levels for Soil, Sediment and Water* (DEC, 2010).

Laboratory results were compared against the following criteria;

- Freshwater Ecosystem Trigger Values, Marine Ecosystem Trigger Values, Short-term Irrigation Water and the Long-term Irrigation Water from the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC, 2000);
- Drinking Water Health Value and Drinking Water Aesthetic Value from the *Australian Drinking Water Guidelines* (NHMRC & ARMCANZ, 2004); and,
- Domestic Non-potable Groundwater Use from the Department of Health's (DoH) Contaminated Sites Reporting Guideline for Chemicals in Groundwater (DoH, 2006).

On 18th August, 2011, WRMW1 – WRMW6 were analysed for water quality, total metals, nutrients, Organophosphate and Organochlorine (OP and OC) pesticides, Volatile Organic Compounds (VOCs), Monocyclic Aromatic Hydrocarbons (MAHs), oxygenated compounds, sulfonated compounds, halogenated aliphatic and aromatic compounds, trihalomethanes, phenolic compounds, Polynuclear Aromatic Hydrocarbons (PAHs), and Total Petroleum Hydrocarbons (TPHs).

Following a number of artificial exceedences for total metals (due to high suspended solids values), dissolved metals were included for a more representative metals analysis in GME#2 on 26th August, 2012.

4.9 Groundwater Monitoring Tables

Table 3 Groundwater Level Depths and Changes (May – August 2012)

Well I.D.	Date	Ground Level	Water Level	
		RL mAHD	mBGL	RL mAHD
WRMW1	18/05/2012	-0.245	3.700	23.581
	30/08/2012		3.455	23.826
WRMW2	18/05/2012	-0.406	7.666	22.941
	30/08/2012		7.260	23.347
WRMW3	18/05/2012	-0.121	11.846	22.776
	30/08/2012		11.725	22.897
WRMW4	18/05/2012	-0.719	8.509	19.242
	30/08/2012		7.790	19.961
WRMW5	18/05/2012	-0.556	8.836	20.198
	30/08/2012		8.280	20.754
WRMW6	18/05/2012	0.456	8.759	22.852
	30/08/2012		9.215	22.396

Table 4 Groundwater Results for GME#1

Analyte grouping/Analyte	Units	ANZECC & ARMCANZ (2000)[1]		ADWG (2004)[2]		DOH (2006)[3]	ANZECC & ARMCANZ (2000)[1]							
		Fresh Waters[4]	Marine Waters[4]	Drinking Water Health Value (HV)	Drinking Water Aesthetic Value (AV)	Domestic non-potable groundwater use	Short-term Irrigation Water	Long-term Irrigation Water[5]	18/05/2012 WRMW1	18/05/2012 WRMW2	18/05/2012 WRMW3	18/05/2012 WRMW4	18/05/2012 WRMW5	18/05/2012 WRMW6
pH Value	pH Unit	6.5-8.5	8.0-8.4		6.5-8.5			6.0-8.5	6.58	6.14	7.41	6.04	5.86	5.83
Electrical Conductivity	µS/cm								635	307	1070	354	449	808
Total Dissolved Solids	mg/L								434	244	704	226	341	492
Suspended Solids	mg/L								582	292	425	144	59	50
Turbidity	NTU								166	236	383	86.9	137	76.6
Total Alkalinity $CaCO_3$	mg/L								43	17	292	5	5	38
Acidity as $CaCO_3$	mg/L								15	26	16	8	13	22
Sulfate as SO_4^{2-}	mg/L			500	250	5000			105	13	40	17	19	173
Chloride	mg/L				250	2500			134	80	216	89	132	124
Total Metals														
Aluminium	mg/L	0.055			0.2	2	20	5	11.1	16.2	34.4	4.3	10	0.74
Arsenic	mg/L	0.013		0.01		0.07	2	0.1	<0.001	<0.001	0.01	0.001	0.001	<0.001
Cadmium	mg/L	0.0002	0.0007	0.002		0.02	0.05	0.01	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L						1	0.1	0.007	0.016	0.047	0.004	0.005	<0.001
Copper	mg/L	0.0014	0.0013	2	1	20	5	0.2	0.004	0.07	0.032	0.005	0.005	0.002
Lead	mg/L	0.0034	0.0044	0.01		0.1	5	2	0.013	0.017	0.087	0.011	0.015	0.007
Manganese	mg/L	1.9		0.5	0.1	5	10	0.2	0.006	0.026	0.191	0.016	0.01	0.034
Molybdenum	mg/L			0.05		0.5	0.05	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.011	0.02	0.02		0.2	2	0.2	0.002	0.005	0.014	0.001	0.003	0.002
Selenium	mg/L	0.005		0.01		0.1	0.05	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.00005	0.0014	0.1		1			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.008	0.015		3	30	5	2	0.008	0.08	0.068	0.017	0.011	0.012
Iron	mg/L	0.3	1.0 / 0.35		0.33	3	10	0.2	0.29	4.82	11.9	0.88	0.49	10.4
Mercury	mg/L	0.00006	0.0001	0.001		0.01	0.002	0.002	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nutrients														
Ammonia as N	mg/L	0.9	0.91						0.06	0.36	0.03	0.11	0.01	1.64
Nitrite as N	mg/L			3.0		30			0.03	0.02	<0.01	0.01	0.04	0.05
Nitrate as N	mg/L			50		500			5.15	0.62	0.17	3.75	0.45	0.17
Kjeldhal Nitrogen	mg/L								0.5	0.5	0.3	0.5	0.1	1.6
Total Nitrogen	mg/L	1.0 / 2.0[1]							5.7	1.1	0.5	4.3	0.6	1.8
Total Phosphorus	mg/L	0.1 / 0.2[1]							0.01	0.15	0.24	0.04	0.02	0.03
Reactive Phosphorus	mg/L								<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfide	mg/L	0.001							0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COD	mg/L								18	16	155	11	9	25
BOD	mg/L								<2	3	69	4	3	26
Organochlorine Pesticides (OC)														
alpha-BHC	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	µg/L	0.01							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	µg/L			0.05	0.3	3			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	µg/L	0.03 [2]		0.01	1	10			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
alpha-Endosulfan	µg/L	0.03 [3]	0.005 [3]	0.05	30	30			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	µg/L	0.03 [2]		0.01	1	10			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDE	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	µg/L	0.01	0.004						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	µg/L	0.03 [3]	0.005 [3]						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDD	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulfate	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDT	µg/L	0.006		0.06	30	0.1			<2	<2	<2	<2	<2	<2
Endrin ketone	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methoxychlor	µg/L								<2	<2	<2	<2	<2	<2
Aldrin plus dieldrin	µg/L			0.010	0.3	3			<1	<1	<1	<1	<1	<1
Organophosphorus Pesticides (OP)														
Dichlorvos	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Demeton-S-methyl	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	µg/L								<2	<2	<2	<2	<2	<2
Dimethoate	µg/L	0.15			50	50			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	µg/L	0.01		1	3	1			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-methyl	µg/L	0.01	0.009		10	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion-methyl	µg/L								<2	<2	<2	<2	<2	<2
Malathion	µg/L	0.05							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos	µg/L	0.01	0.009						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	µg/L	0.004			10	10			<2	<2	<2	<2	<2	<2
Pirimphos-ethyl	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorfenvinphos	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromophos-ethyl	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenamiphos	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Prothiofos	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethion	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbophenothion	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos Methyl	µg/L	0.02							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Monocyclic Aromatic Hydrocarbons														
Benzene	µg/L	0.95	0.5	0.001		0.01			-	-	-	-	-	-
Toluene	µg/L			0.80	0.025	0.025			-	-	-	-	-	-
Ethylbenzene	µg/L			0.30	0.003	0.003			-	-	-	-	-	-
meta- & para-Xylene	µg/L	200							-	-	-	-	-	-
Styrene	µg/L			0.03	0.004	0.004			<5	<5	<5	<5	<5	<5
ortho-Xylene	µg/L	350							-	-	-	-	-	-
Isopropylbenzene	µg/L								<5	<5	<5	<5	<5	<5
n-Propylbenzene	µg/L								<5	<5	<5	<5	<5	<5
1.3.5-Trimethylbenzene	µg/L								<5	<5	<5	<5	<5	<5
sec-Butylbenzene	µg/L								<5	<5	<5	<5	<5	<5
1.2.4-Trimethylbenzene	µg/L								<5	<5	<5	<5	<5	<5
tert-Butylbenzene	µg/L								<5	<5	<5	<5	<5	<5
p-Isopropyltoluene	µg/L								<5	<5	<5	<5	<5	<5
n-Butylbenzene	µg/L								<5	<5	<5	<5	<5	<5
Oxygenated Compounds														
Vinyl Acetate	µg/L								<50	<50	<50	<50	<50	<50
2-Butanone (MEK)	µg/L								<50	<50	<50	<50	<50	<50
4-Methyl-2-pentanone (MIBK)	µg/L								<50	<50	<50	<50	<50	<50
2-Hexanone (MBK)	µg/L								<50	<50	<50	<50	<50	<50

Sulfonated Compounds															
Carbon disulfide	µg/L								<5	<5	<5	<5	<5	<5	
Fumigants															
2.2-Dichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
1.2-Dichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
cis-1.3-Dichloropropylene	µg/L								<5	<5	<5	<5	<5	<5	
trans-1.3-Dichloropropylene	µg/L								<5	<5	<5	<5	<5	<5	
1.2-Dibromoethane (EDB)	µg/L								<5	<5	<5	<5	<5	<5	
Halogenated Aliphatic Compounds															
Dichlorodifluoromethane	µg/L								<50	<50	<50	<50	<50	<50	
Chloromethane	µg/L								<50	<50	<50	<50	<50	<50	
Vinyl chloride	µg/L			0.0003		0.003			<50	<50	<50	<50	<50	<50	
Bromomethane	µg/L								<50	<50	<50	<50	<50	<50	
Chloroethane	µg/L								<50	<50	<50	<50	<50	<50	
Trichlorofluoromethane	µg/L								<50	<50	<50	<50	<50	<50	
1.1-Dichloroethene	µg/L			0.03		0.3			<5	<5	<5	<5	<5	<5	
Iodomethane	µg/L								<5	<5	<5	<5	<5	<5	
trans-1.2-Dichloroethene	µg/L								<5	<5	<5	<5	<5	<5	
1.1-Dichloroethane	µg/L								<5	<5	<5	<5	<5	<5	
cis-1.2-Dichloroethene	µg/L								<5	<5	<5	<5	<5	<5	
1.1.1-Trichloroethane	µg/L								<5	<5	<5	<5	<5	<5	
1.1-Dichloropropylene	µg/L								<5	<5	<5	<5	<5	<5	
Carbon Tetrachloride	µg/L								<5	<5	<5	<5	<5	<5	
1.2-Dichloroethane	µg/L			0.003		0.03			<5	<5	<5	<5	<5	<5	
Trichloroethene	µg/L								<5	<5	<5	<5	<5	<5	
Dibromomethane	µg/L								<5	<5	<5	<5	<5	<5	
1.1.2-Trichloroethane	µg/L	6500	1900						<5	<5	<5	<5	<5	<5	
1.3-Dichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
Tetrachloroethene	µg/L			0.05		0.5			<5	<5	<5	<5	<5	<5	
1.1.1.2-Tetrachloroethane	µg/L								<5	<5	<5	<5	<5	<5	
trans-1.4-Dichloro-2-butene	µg/L								<5	<5	<5	<5	<5	<5	
cis-1.4-Dichloro-2-butene	µg/L								<5	<5	<5	<5	<5	<5	
1.1.2.2-Tetrachloroethane	µg/L								<5	<5	<5	<5	<5	<5	
1.2.3-Trichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
Pentachloroethane	µg/L								<5	<5	<5	<5	<5	<5	
1.2-Dibromo-3-chloropropane	µg/L								<5	<5	<5	<5	<5	<5	
Hexachlorobutadiene	µg/L								<5	<5	<5	<5	<5	<5	
Halogenated Aromatic Compounds															
Chlorobenzene	µg/L			0.30	0.01	0.01			<5	<5	<5	<5	<5	<5	
Bromobenzene	µg/L								<5	<5	<5	<5	<5	<5	
2-Chlorotoluene	µg/L								<5	<5	<5	<5	<5	<5	
4-Chlorotoluene	µg/L								<5	<5	<5	<5	<5	<5	
1.3-Dichlorobenzene	µg/L	0.26			0.02	0.02			<5	<5	<5	<5	<5	<5	
1.4-Dichlorobenzene	µg/L	0.06		0.04	0.003	0.003			<5	<5	<5	<5	<5	<5	
1.2-Dichlorobenzene	µg/L	0.16		1.5	0.001	0.001			<5	<5	<5	<5	<5	<5	
1.2.4-Trichlorobenzene	µg/L	0.085	80	0.03	0.005	0.005			<5	<5	<5	<5	<5	<5	
1.2.3-Trichlorobenzene	µg/L	0.003		0.03	0.005	0.005			<5	<5	<5	<5	<5	<5	
Trihalomethanes															
Chloroform	µg/L								<5	<5	<5	<5	<5	<5	
Bromodichloromethane	µg/L								<5	<5	<5	<5	5	<5	
Dibromochloromethane	µg/L								<5	<5	<5	**12**	**20**	<5	
Bromoform	µg/L								<5	<5	<5	**13**	**22**	<5	
Phenolic Compounds															
Phenol	µg/L	320	400						<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Chlorophenol	µg/L	340		300	0.1	3000			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Methylphenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
3- & 4-Methylphenol	µg/L								<2.0	**2.6**	<2.0	<2.0	<2.0	<2.0	
2-Nitrophenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4-Dimethylphenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4-Dichlorophenol	µg/L	120		200	0.3	2000			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.6-Dichlorophenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
4-Chloro-3-Methylphenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4.6-Trichlorophenol	µg/L	3		20	2	200			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4.5-Trichlorophenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Pentachlorophenol	µg/L	3.6	11						<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
Polynuclear Aromatic Hydrocarbons															
Naphthalene	µg/L	16	50						<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthylene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluorene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Phenanthrene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Anthracene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluoranthene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Pyrene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benz(a)anthracene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Chrysene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(b)fluoranthene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(k)fluoranthene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(a)pyrene	µg/L			0.01		0.1			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Indeno(1.2.3.cd)pyrene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Dibenz(a.h)anthracene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(g.h.i)perylene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Total Petroleum Hydrocarbons															
C6 - C9 Fraction	µg/L								<20	<20	<20	<20	<20	<20	
C10 - C14 Fraction	µg/L								<50	<50	<50	<50	<50	<50	
C15 - C28 Fraction	µg/L								<100	<100	<100	<100	<100	**260**	
C29 - C36 Fraction	µg/L								<50	<50	**270**	<50	<50	**60**	
C10 - C36 Fraction (sum)	µg/L	600 [4]							<50	<50	**270**	<50	<50	**320**	

NOTES:
1. SRT Healthy Rivers Action Plan Long Term / Short Term Targets
2. pH > 6 / pH < 6
3. Average EC threshold for pastures in sandy soils
4. Lower guideline limit (upper = 125)
5. Lower guideline limit (upper = 12)

Table 5 Groundwater Results for GME#2

Analyte grouping/Analyte	Units	ANZECC & ARMCANZ		ADWG		DoH	ANZECC & ARMCANZ		30/08/2012	30/08/2012	30/08/2012	30/08/2012	30/08/2012	30/08/2012
		Fresh Waters	Marine Waters	Drinking Water Health Value (HV)	Drinking Water Aesthetic Value (AV)	Domestic non-potable groundwater use	Short-term Irrigation Water	Long-term Irrigation Water	WRMW1	WRMW2	WRMW3	WRMW4	WRMW5	WRMW6
pH Value	pH Unit	6.5-8.5	8.0-8.4		6.5-8.5			6.0-8.5	6.77	5.72	7.83	5.96	5.72	5.87
Electrical Conductivity	µS/cm								716	292	901	144	97	914
Total Dissolved Solids	mg/L								474	169	567	83	56	578
Suspended Solids	mg/L								950	106	1610	9	660	6
Turbidity	NTU								202	32	1120	10.8	854	4
Total Alkalinity $CaCO_3$	mg/L								36	3	157	1	<1	10
Acidity as $CaCO_3$	mg/L								35	42	18	21	11	39
Sulfate as SO_4^{2-}	mg/L			500	250	5000			123	11	18	2	7	203
Chloride	mg/L				250	2500			138	82	219	30	17	153
Dissolved Metals														
Aluminium	mg/L	0.055			0.2	2	20	5	0.09	0.03	0.02	0.06	1.48	0.15
Arsenic	mg/L	0.013		0.01		0.07	2	0.1	<0.001	<0.001	0.002	<0.001	0.001	<0.001
Cadmium	mg/L	0.0002	0.0007	0.00		0.02	0.05	0.01	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
Chromium	mg/L						1	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	1.9		0.50	0.1	5	10	0.2	0.004	0.003	0.108	0.005	0.005	0.032
Nickel	mg/L	0.011	0.02	0.02		0.2	2	0.2	0.002	0.006	0.003	0.003	0.004	0.004
Selenium	mg/L	0.005		0.01		0.1	0.05	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.008	0.015		3	30	5	2	0.013	0.025	0.006	0.01	0.021	0.016
Iron	mg/L	0.3	1.0 / 0.3[5]		0.33	3	10	0.2	0.52	0.75	<0.05	<0.05	0.54	0.11
Ferrous Iron	mg/L								0.34	0.76	<0.05	<0.05	0.12	<0.05
Chromium VI	mg/L	0.001	0.0044	0.05		0.5			<0.010	<0.010	<0.010	<0.01	<0.010	<0.010
Total Metals														
Aluminium	mg/L	0.055			0.2	2	20	5	7.69	3.15	24.9	1.61	2.57	0.41
Arsenic	mg/L	0.013		0.01		0.07	2	0.1	<0.001	<0.001	0.007	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0002	0.0007	0.002		0.02	0.05	0.01	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001
Chromium	mg/L						1	0.1	0.005	0.003	0.044	0.001	0.001	<0.001
Copper	mg/L	0.0014	0.0013	2	1	20	5	0.2	0.002	0.005	0.036	0.003	0.015	0.003
Lead	mg/L	0.0034	0.0044	0.01		0.1	5	2	0.015	0.003	0.079	0.005	0.002	0.009
Manganese	mg/L	1.9		0.5	0.1	5	10	0.2	0.004	0.004	0.129	0.006	0.002	0.034
Molybdenum	mg/L			0.05		0.5	0.05	0.01	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.011	0.02	0.02		0.2	2	0.2	0.003	0.006	0.019	0.003	0.002	0.003
Selenium	mg/L	0.005		0.01		0.1	0.05	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	0.00005	0.0014	0.1		1			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	0.008	0.015		3	30	5	2	0.007	0.079	0.079	0.011	0.007	0.011
Iron	mg/L	0.3	1.0 / 0.35		0.33	3	10	0.2	0.21	2.12	12.4	0.4	0.13	3.21
Mercury	mg/L	0.00006	0.0001	0.001		0.01	0.002	0.002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nutrients														
Ammonia as N	mg/L	0.9	0.91						0.03	0.03	0.45	0.05	0.06	0.73
Nitrite as N	mg/L			3.0		30			0.02	0.01	0.02	<0.01	<0.01	0.02
Nitrate as N	mg/L			50		500			4.91	1.09	0.31	4.92	2.03	1.43
Kjeldhal Nitrogen	mg/L								1.4	0.3	1.4	1.1	1.5	1.1
Total Nitrogen	mg/L	1.0 / 2.0[1]							6.3	1.4	1.7	6	3.5	2.6
Total Phosphorus	mg/L	0.1 / 0.2[1]							0.19	0.03	0.51	0.12	0.23	0.02
Reactive Phosphorus	mg/L								<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulfide	mg/L	0.001							<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COD	mg/L								14	<5	21	7	<5	30
BOD	mg/L								<2	<2	5	<2	3	2
Organochlorine Pesticides (OC)														
alpha-BHC	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	µg/L	0.01							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	µg/L			0.05	0.3	3			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	µg/L	0.03 [2]		0.01	1	10			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
alpha-Endosulfan	µg/L	0.03 [3]	0.005 [3]	0.05	30	30			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	µg/L	0.03 [2]		0.01	1	10			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDE	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	µg/L	0.01	0.004						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	µg/L	0.03 [3]	0.005 [3]						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDD	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulfate	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDT	µg/L	0.006		0.06	30	0.1			<2	<2	<2	<2	<2	<2
Endrin ketone	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methoxychlor	µg/L								<2	<2	<2	<2	<2	<2
Aldrin plus dieldrin	µg/L			0.010	0.3	3			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Organophosphorus Pesticides (OP)														
Dichlorvos	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Demeton-S-methyl	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	µg/L								<2	<2	<2	<2	<2	<2
Dimethoate	µg/L	0.15			50	50			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	µg/L	0.01		1	3	1			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-methyl	µg/L	0.01	0.009		10	100			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion-methyl	µg/L								<2	<2	<2	<2	<2	<2
Malathion	µg/L	0.05							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos	µg/L	0.01	0.009						<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	µg/L	0.004			10	10			<2	<2	<2	<2	<2	<2
Pirimphos-ethyl	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorfenvinphos	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromophos-ethyl	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenamiphos	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Prothiofos	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethion	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbophenothion	µg/L								<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos Methyl	µg/L	0.02							<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Monocyclic Aromatic Hydrocarbons														
Benzene	µg/L	0.95	0.5	0.001		0.01			-	-	-	-	-	-
Toluene	µg/L			0.80	0.025	0.025			-	-	-	-	-	-
Ethylbenzene	µg/L			0.30	0.003	0.003			-	-	-	-	-	-
meta- & para-Xylene	µg/L	200							-	-	-	-	-	-
Styrene	µg/L			0.03	0.004	0.004			<5	<5	<5	<5	<5	<5
ortho-Xylene	µg/L	350							-	-	-	-	-	-
Isopropylbenzene	µg/L								<5	<5	<5	<5	<5	<5
n-Propylbenzene	µg/L								<5	<5	<5	<5	<5	<5
1.3.5-Trimethylbenzene	µg/L								<5	<5	<5	<5	<5	<5
sec-Butylbenzene	µg/L								<5	<5	<5	<5	<5	<5
1.2.4-Trimethylbenzene	µg/L								<5	<5	<5	<5	<5	<5
tert-Butylbenzene	µg/L								<5	<5	<5	<5	<5	<5
p-Isopropyltoluene	µg/L								<5	<5	<5	<5	<5	<5
n-Butylbenzene	µg/L								<5	<5	<5	<5	<5	<5

Oxygenated Compounds															
Vinyl Acetate	µg/L								<50	<50	<50	<50	<50	<50	
2-Butanone (MEK)	µg/L								<50	<50	<50	<50	<50	<50	
4-Methyl-2-pentanone (MIBK)	µg/L								<50	<50	<50	<50	<50	<50	
2-Hexanone (MBK)	µg/L								<50	<50	<50	<50	<50	<50	
Sulfonated Compounds															
Carbon disulfide	µg/L								<5	<5	<5	<5	<5	<5	
Fumigants															
2.2-Dichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
1.2-Dichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
cis-1.3-Dichloropropylene	µg/L								<5	<5	<5	<5	<5	<5	
trans-1.3-Dichloropropylene	µg/L								<5	<5	<5	<5	<5	<5	
1.2-Dibromoethane (EDB)	µg/L								<5	<5	<5	<5	<5	<5	
Halogenated Aliphatic Compounds															
Dichlorodifluoromethane	µg/L								<50	<50	<50	<50	<50	<50	
Chloromethane	µg/L								<50	<50	<50	<50	<50	<50	
Vinyl chloride	µg/L			0.0003		0.003			<50	<50	<50	<50	<50	<50	
Bromomethane	µg/L								<50	<50	<50	<50	<50	<50	
Chloroethane	µg/L								<50	<50	<50	<50	<50	<50	
Trichlorofluoromethane	µg/L								<50	<50	<50	<50	<50	<50	
1.1-Dichloroethene	µg/L			0.03		0.3			<5	<5	<5	<5	<5	<5	
Iodomethane	µg/L								<5	<5	<5	<5	<5	<5	
trans-1.2-Dichloroethene	µg/L								<5	<5	<5	<5	<5	<5	
1.1-Dichloroethane	µg/L								<5	<5	<5	<5	<5	<5	
cis-1.2-Dichloroethene	µg/L								<5	<5	<5	<5	<5	<5	
1.1.1-Trichloroethane	µg/L								<5	<5	<5	<5	<5	<5	
1.1-Dichloropropylene	µg/L								<5	<5	<5	<5	<5	<5	
Carbon Tetrachloride	µg/L								<5	<5	<5	<5	<5	<5	
1.2-Dichloroethane	µg/L			0.003		0.03			<5	<5	<5	<5	<5	<5	
Trichloroethene	µg/L								<5	<5	<5	<5	<5	<5	
Dibromomethane	µg/L								<5	<5	<5	<5	<5	<5	
1.1.2-Trichloroethane	µg/L	6500	1900						<5	<5	<5	<5	<5	<5	
1.3-Dichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
Tetrachloroethene	µg/L			0.05		0.5			<5	<5	<5	<5	<5	<5	
1.1.1.2-Tetrachloroethane	µg/L								<5	<5	<5	<5	<5	<5	
trans-1.4-Dichloro-2-butene	µg/L								<5	<5	<5	<5	<5	<5	
cis-1.4-Dichloro-2-butene	µg/L								<5	<5	<5	<5	<5	<5	
1.1.2.2-Tetrachloroethane	µg/L								<5	<5	<5	<5	<5	<5	
1.2.3-Trichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
1.1.2.2-Tetrachloroethane	µg/L								<5	<5	<5	<5	<5	<5	
1.2.3-Trichloropropane	µg/L								<5	<5	<5	<5	<5	<5	
Pentachloroethane	µg/L								<5	<5	<5	<5	<5	<5	
1.2-Dibromo-3-chloropropane	µg/L								<5	<5	<5	<5	<5	<5	
Hexachlorobutadiene	µg/L								<5	<5	<5	<5	<5	<5	
Halogenated Aromatic Compounds															
Chlorobenzene	µg/L			0.30	0.01	0.01			<5	<5	<5	<5	<5	<5	
Bromobenzene	µg/L								<5	<5	<5	<5	<5	<5	
2-Chlorotoluene	µg/L								<5	<5	<5	<5	<5	<5	
4-Chlorotoluene	µg/L								<5	<5	<5	<5	<5	<5	
1.3-Dichlorobenzene	µg/L	0.26			0.02	0.02			<5	<5	<5	<5	<5	<5	
1.4-Dichlorobenzene	µg/L	0.06		0.04	0.003	0.003			<5	<5	<5	<5	<5	<5	
1.2-Dichlorobenzene	µg/L	0.16		1.5	0.001	0.001			<5	<5	<5	<5	<5	<5	
1.2.4-Trichlorobenzene	µg/L	0.085	80	0.03	0.005	0.005			<5	<5	<5	<5	<5	<5	
1.2.3-Trichlorobenzene	µg/L	0.003		0.03	0.005	0.005			<5	<5	<5	<5	<5	<5	
Trihalomethanes															
Chloroform	µg/L								<5	<5	<5	<5	<5	<5	
Bromodichloromethane	µg/L								<5	<5	<5	<5	<5	<5	
Dibromochloromethane	µg/L								<5	<5	<5	<5	<5	<5	
Bromoform	µg/L								<5	<5	<5	<5	<5	<5	
Phenolic Compounds															
Phenol	µg/L	320	400						<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Chlorophenol	µg/L	340		300	0.1	3000			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Methylphenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
3- & 4-Methylphenol	µg/L								<2.0	<2.0	**3.3**	<2.0	<2.0	<2.0	
2-Nitrophenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4-Dimethylphenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4-Dichlorophenol	µg/L	120		200	0.3	2000			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.6-Dichlorophenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
4-Chloro-3-Methylphenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4.6-Trichlorophenol	µg/L	3		20	2	200			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4.5-Trichlorophenol	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Pentachlorophenol	µg/L	3.6	11						<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
Polynuclear Aromatic Hydrocarbons															
Naphthalene	µg/L	16	50						<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthylene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluorene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Phenanthrene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Anthracene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluoranthene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Pyrene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benz(a)anthracene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Chrysene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(b)fluoranthene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(k)fluoranthene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(a)pyrene	µg/L			0.01		0.1			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Indeno(1.2.3.cd)pyrene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Dibenz(a.h)anthracene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(g.h.i)perylene	µg/L								<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Total Petroleum Hydrocarbons															
C6 - C9 Fraction	µg/L								<20	<20	<20	<20	<20	<20	
C10 - C14 Fraction	µg/L								<50	<50	<50	<50	<50	<50	
C15 - C28 Fraction	µg/L								<100	<100	<100	<100	<100	**380**	
C29 - C36 Fraction	µg/L								<50	<50	<50	<50	<50	<50	
C10 - C36 Fraction (sum)	µg/L	600 [4]							<50	<50	<50	<50	<50	**380**	

NOTES:
1. SRT Healthy Rivers Action Plan Long Term / Short Term Targets
2. pH > 6 / pH < 6
3. Average EC threshold for pastures in sandy soils
4. Lower guideline limit (upper = 125)
5. Lower guideline limit (upper = 12)

4.10 Groundwater Monitoring Levels Summary

For the purposes of the OS, WRMW1 was the major location of focus considering that groundwater abstraction bores WRPB1, WRPB2 and WRPB3 are proposed for construction in the adjacent area.

Groundwater was intercepted for WRMW1 at a depth of 23.581 mAHD in GME#1, following the installation of the bore and logging of subsurface geology. In GME#2, some three months later, groundwater was recorded at 23.836 mAHD, a rise of some 0.255 m.

WRMW1 was installed to a depth of 6 m, constructed with screen from 3.0 – 6.0 mBGL and had a recorded stickup height of 0.45 mAGL. The mTOC RL surveyed was 27.281 m (Appendix D). The screened interval extends from approximately 3.0 mBGL to 6.0 mBGL (RL 23.831 to 20.831 mAHD), which consists of yellow sands/brown clay at 3.0 mBGL, tending to red clay at 5.0 – 6.0 mBGL.

4.11 Groundwater Monitoring Results Summary

The following notes are the summaries of laboratory results and the comparison to assessment criteria for GME#1 and GME#2:

Total Petroleum Hydrocarbons (TPH)
Laboratory results for GME#1 indicate the presence of TPHs in WRMW3 and WRMW6, however detections are below assessment criteria.

Results for GME#2 reveal presence of TPHs in WRMW6 only, and detections are also below assessment criteria.

Monocyclic Aromatic Hydrocarbons (MAH)
MAHs were not detected in any of the samples analysed for GME#1 or GME#2.

Polycyclic Aromatic Hydrocarbons
PAHs were not detected in any of the samples analysed for GME#1 or GME#2.

Phenols
Laboratory results for GME#1 indicate the presence of 3-&4-Methylphenol within WRMW2. All other sample detects were below laboratory detection limits.

Results for GME#2 revealed a detection of 3-&4-Methylphenol within WRMW3, with WRMW2 and all other samples being below laboratory detection limits.

Total Metals
The following total metals exceedances were detected:

- Aluminium exceeded the following assessment criteria at the associated locations in GME#1;
    - WRMW3 exceeded all assessment criteria;

    - WRMW1, WRMW2 and WRMW5 exceeded all assessment criteria excluding the Short-term Irrigation levels;
    - WRMW4 exceeded the Domestic Non-potable groundwater use, Drinking Water Aesthetic Values, Fresh Waters criteria, and;
    - WRMW6 exceeded Drinking Water Aesthetic Values and Fresh Waters criteria.
- Aluminium exceeded the following assessment criteria at the associated locations in GME#2;
    - WRMW3 exceeded all assessment criteria;
    - WRMW1 exceeded all assessment criteria excluding the Short-term Irrigation levels;
    - WRMW2 and WRMW5 exceeded all assessment criteria excluding both Short-term Irrigation and Long-term Irrigation levels, and;
    - WRMW4 and WRMW6 exceeded Drinking Water Aesthetic Values and Fresh Waters criteria.
- Copper exceeded the Fresh Waters and Marine Waters criteria for all locations in GME#1 and GME#2;
- Lead was exceeded for the following assessment criteria at the associated locations in GME#1;
    - WRMW1 – WRMW5 exceeded Drinking Water Health Values, Fresh Waters and Marine Waters criteria, and;
    - WRMW6 exceeded Marine Waters and Fresh Waters criteria.
- Lead was exceeded for the following assessment criteria at the associated locations in GME#2;
    - WRMW1 and WRMW3 exceeded Drinking Water Health Values, Fresh Waters and Marine Waters criteria, and;
    - WRMW4 and WRMW6 exceeded Marine Waters and Fresh Waters criteria.
- Manganese exceeded Drinking Water Aesthetic Values, Drinking Water Health Values, and Fresh Waters criteria at WRMW3 for GME#1 and GME#2;
- Nickel exceeded Fresh Waters criteria in WRMW3 in GME#1 and for GME#2;
- Zinc exceeded the following assessment criteria at the following locations in GME#1;
    - Fresh Waters and Marine Waters criteria was exceeded at WRMW2, WRMW3 and WRMW4, and;
    - Fresh Waters criteria were exceeded at WRWRMW5 and WRWRMW6.
- Zinc exceeded the following assessment criteria at the following locations in GME#2;
    - Marine Waters and Fresh Waters criteria was exceeded at WRMW2 and WRMW3, and;
    - Fresh Waters criteria was exceeded at WRMW4 and WRMW6.

- Iron exceeded assessment criteria at the following locations for the associated locations in GME#1;
    - WRMW3 and WRMW6 exceeded all assessment criteria,
    - WRMW2 exceeded all assessment criteria with the exception of Short-term Irrigation criteria;
    - Drinking Water Aesthetic Values, Long-term Irrigation, Fresh Waters and Marine waters criteria was exceeded at WRMW4 and WRMW5, and;
    - WRMW1 exceeded Short-term Irrigation criteria.
- Iron exceeded assessment criteria at the following locations for the associated locations in GME#2;
    - WRMW3 exceeded all assessment criteria;
    - WRMW6 exceeded all assessment criteria, excluding Short-term Irrigation;
    - WRMW2 and WRMW4 exceeded all assessment criteria, with the exception of Short-term Irrigation Water and Domestic non-potable groundwater use, and;
    - WRMW1 exceeded Long-term Irrigation Water criteria.
- Mercury exceeded Fresh Waters criteria at WRMW1 and WRMW2 in GME 1

Mercury was not detected in any locations during GME#2. Nickel exceeded Fresh Waters criteria in GME#2 but did not exceed it during GME#1. Total metals concentrations that exceeded relevant criteria in general were less in GME#2 than in GME#1.

Dissolved Metals

In GME#2, dissolved metals were selected for analysis in consideration of the elevated number of detects for total metals during GME#1. There was thought that higher than expected Total Suspended Solids (TSS) may have artificially increased these background results for total metals. The following dissolved metals exceeded assessment criteria in GME#2:

- Aluminium in WRMW5 exceeded Drinking Water Aesthetic Value and Fresh Waters criteria, with WRMW1, WRMW4 and WRMW6 exceeding Fresh Waters criteria only;
- Zinc in WRMW2, WRMW5 and WRMW6 exceeded Marine Waters criteria, whilst WRMW1 and WRMW4 exceeded Fresh Waters criteria only, and;
- Iron in WRMW1, WRMW2 and WRMW5 exceeded Fresh Waters criteria.

OC Pesticides

OC pesticides were below laboratory assessment criteria for all laboratory samples during GME#1 and GME#2.

OP Pesticides

OP pesticides were not detected in any of the samples analysed. It is noted that the primary laboratory detection limits were not low enough to detect methyl parathion at DNPGW trigger values during both GME#1 and GME#2.

Major Anions and Cations
No exceedances were identified in GME#1 or GME#2.

Nutrients
Ammonia (NH_3-N) exceeded Fresh and Marine Water criteria for WRWRMW6 in GME#1 but did not exceed any criteria in GME#2.

Total Nitrogen exceeded Fresh Waters assessment criteria for WRMW1, WRMW2, WRMW4 and WRMW6 in GME#1, with WRMW1 – WRMW6 all exceeding Fresh Waters criteria for GME#2.

Total Phosphorus exceeded Fresh Waters criteria at WRMW2 and WRMW3 in GME#1, with WRMW1, WRMW3, WRMW4 and WRMW5 all exceeding Fresh Waters criteria in GME#2.

WRMW1 exceeded Fresh Waters criteria for Sulphide in GME 1, with no exceedences reported for GME 2.

4.12 Groundwater Monitoring Discussion

Conductivity results from WRMW1 – WRMW6 indicate that water beneath the Site is Fresh, as does the regional salinity data (DoW, 2004). These results indicate that the clay layer between aquifers may not be complete, and there may be a connection between a shallow aquifer across the Site and the Superficial Swan Aquifer below.

pH levels are considered fresh to mildly acidic. pH was in the Fresh Waters and Drinking Water Aesthetic Value ranges for WRMW1 but values were below these ranges and also marginally below the range for Long-term Irrigation in WRMW2, WRMW4, WRMW5 and WRMW6. However this is considered to be an acceptable range for pH values for groundwater within this locality.

Metalloid results (dissolved) were considered more representative of the Site in GME#2 and of the water quality proposed for abstraction, as these may have been artificially elevated by suspended solids in total metals results for GME#1. Levels are considered suitable for groundwater abstraction.

Despite that nutrient levels were slightly elevated above ANZECC criteria, surface waters are not located in the immediate vicinity of the Site and downstream receptors of the groundwater flux are likely to be more significantly impacted by land uses to the north.

4.13 Previous Groundwater Modelling

A simplified numerical model of the groundwater conditions and abstraction regime proposed was constructed by NTEC (2012) to estimate drawdown at the Site. Differential results and estimates for environmental impacts were obtained, as a hydrogeological study has not yet been completed for the Site.

4.14 Groundwater Modelling Characteristics Adopted

The model consisted of the Superficial Swan Aquifer in the region of the site, consisting of the following characteristics:

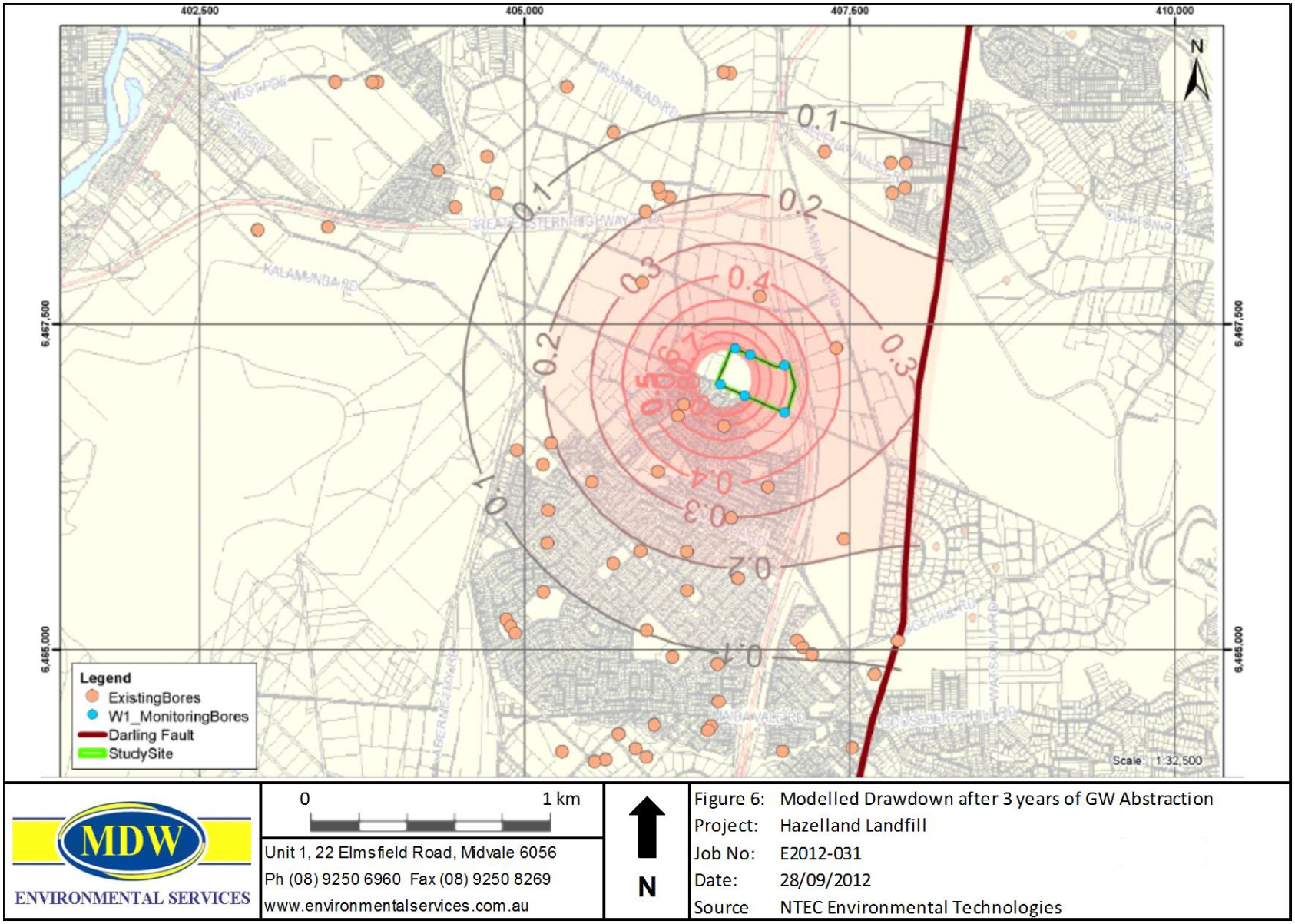
- An unconfined homogeneous aquifer (as water quality results and well logs have suggested that this is most likely to be the case);
- Horizontal ground surface at 27 mAHD;
- Horizontal water table at 22 mAHD;
- Horizontal base of aquifer at 5 mAHD for total depth of 22 m;
- Saturated thickness of 17 m;
- No connection to underlying aquifers;
- No net rainfall recharge (to provide conservative over-estimate of pumping impact); and,
- Horizontal and vertical hydraulic conductivity through the aquifer, and adopted yield values based on the PRAMS model.

Abstraction was represented with a single pumping bore located in the south west corner of the Site, although three separate bores will be used for the proposed abstraction, pumping simultaneously within 30 m of each other. The bore was screened at the bottom of the Superficial Swan Aquifer. Pumping rates were 300 ML/yr (or 821.3 m^3/day). Pumping was assumed to be continuous for three years in the scenario, with the model run for an additional 10 years in order to simulate the rates of groundwater recovery/aquifer recharge.

4.15 Groundwater Modelling Results

Figure 6 demonstrates the drawdown affect after three years of pumping from the water table. The monitoring bore adjacent to the pumping bore, WRMW1 experiences 1.40 m of drawdown, with a drawdown contour of 0.2 m stretching to a radius of approximately 1.6 km from the modelled pumping bore. Drawdown does not occur beyond the Darling Fault.

Figure 6 Modelled Drawdown after 3 years of GW Abstraction



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Since the precise geographic locations for nearby users are not available, it is not possible to quantify impacts. Twelve (12) licensed groundwater bores may encounter drawdown impacts of up to 0.2 m. Three (3) licensees will have impacts exceeding 0.6 m drawdown and five (5) licensees will sustain impacts up to 0.3 m. Twenty three (23) other licensed locations may have impacts exceeding 0.1 m of drawdown.

The conservation area has WRMW3 situated adjacent to the north. Drawdown of the water table at this bore is expected to be 0.56 m, with all of the conservation area lying within the 0. m drawdown contour, following three years of groundwater abstraction.

Figure 7 shows the drawdown from one, two, five and ten years after pumping ceases.

Figure 7 Drawdown Recovery: (A) One, (B) Two, (C) Five and (D) Ten - Years Following Abstraction

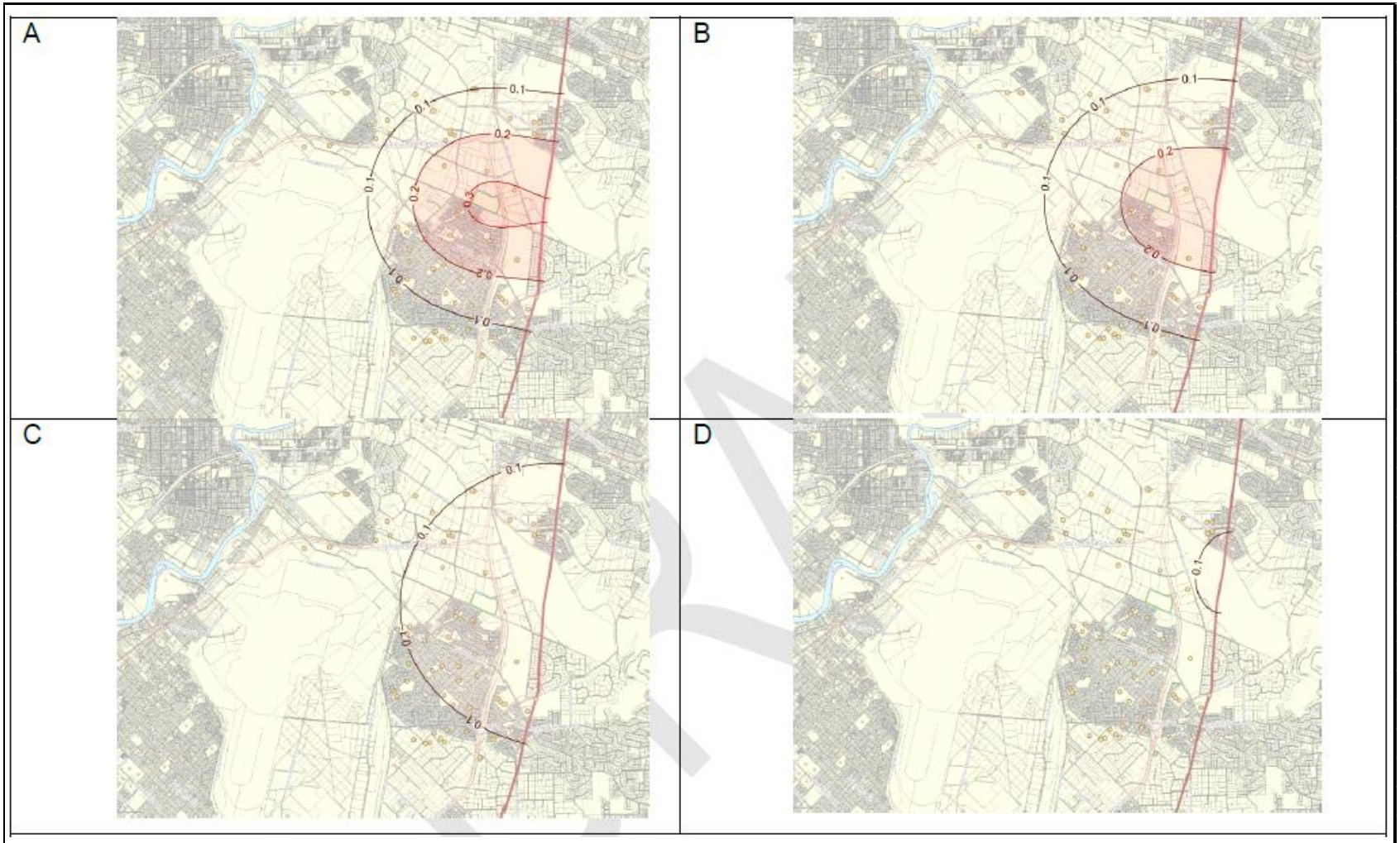

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Figure 7:	Groundwater Recovery after abstraction:	(A) 1 year
Project:	Hazelland Landfill	(B) 2 years
Job No:	E2012-031	(C) 5 years
Date:	28/09/2012	(D) 10 years
Source	NTEC Environmental Technologies	

4.16 Groundwater Modelling Discussion

Modelling results indicated that after three years, proposed abstraction induced up to 0.7 m of additional drawdown from nearby licensed groundwater users or conservation areas. This was dependent on the location of the three proposed pumping bores, in relation to the one used in the model. Groundwater levels are expected to recover quickly, with a drawdown of less than 0.2 m at all locations, following cessation of pumping. Variable aquifer thickness, groundwater flux in the region and rainfall recharge could be additional variables to consider, for a more representative outcome.

5 IDENTIFYING AND MANAGING IMPACTS

The anticipated impacts and risks likely to evolve from the proposed abstraction - to local groundwater, nearby users and local ecology are identified, discussed and addressed with management responses in Table 6.

Consultation with the DoW about each management objective will take place, before the groundwater license is issued. Any amendments to issues and strategies included in Table 6 will be included in the 5C water license and an amended version of this OS.

Table 6 Issues and Management Strategies for Proposed Abstraction

Issue	Management Objective	Measurement	Management Response
Reliable water supply for abstraction	• Maintain a supply of water that satisfies 300 ML/yr whilst not drawing down the groundwater level excessively	• Monthly groundwater level measurement of site monitoring wells	• Reduce the need for continuous groundwater abstraction once the water storage tanks are filled to a safe but sustainable level for site works • Only abstract 821.3 m3/day (across WRPB1, WRPB2 and WRPB3) to avoid excess drawdown of the aquifer, especially during drier months. • Abstract less water during rain periods and also if water storage tanks have a large surplus of water not being allocated for site use
Salinity and Water Quality	• Salinity of water abstracted to remain less than 1000 mg/L TDS • Groundwater quality to remain unchanged from the background readings obtained by MDWES (no additional exceedences of sampling criteria)	• Monitoring bores WRMW1 - WRMW6 and abstraction bores WRPB1 – WRPB3 sampled monthly for water quality • Monitoring of the standpipe water/outlet from Storage Tanks monthly to avoid stored water becoming stagnant	• Notify the DoW as specified in the water license - if any changes to groundwater are detected • Re-sample from the groundwater location where the change in water quality is detected, and consult the DoW for further recommendations
Other users	• Do not impact on neighbouring water availability • Keep drawdown to a minimum for neighbouring users	• Water level measured monthly from WRMW1 – WRMW6 • WRMW1-WRMW6 will be considered as observation bores for the abstraction	• Make other users aware of abstraction proposal • Reduce abstraction rate/frequency if drawdown exceeds those amounts anticipated to occur from modelling outcomes

Risk of flooding during abstraction	• Keep watertable below a specific level if possible • Have capacity to extract additional water or install additional production bores if required to lower groundwater RL	• Water levels measured monthly in monitoring bores (WRMW1 – WRMW6) but this can be increased to weekly if flooding or groundwater recharge becomes a concern	• Contact DoW in the event of flooding for approval to abstract additional groundwater or to install additional production bores if required, also if to monitor water levels more frequently
Disturbance to Flora	• Abstraction does not impact on the health of natural flora, especially in Bush Forever Site #122 • No natural flora remains at the Site	• Flora surveys, and water level monitoring monthly - for the Bush Forever Site #122	• Ecologist to examine trends in groundwater abstraction, comparing it to flora health • Abstraction volumes/frequency to be reduced if flora surveys reveals species declination as a result of site abstraction

5.1 Changes to Water Quality

Any alterations to the pH, salinity and chemistry of the groundwater during abstraction, may have an adverse impact on the quality of groundwater used for dust suppression and soil compaction within the vicinity of the Site. This will be monitored in monthly sampling rounds for monitoring (or observation) bores at the Site, and a monitoring well present in Bush Forever Site #122 to the south east.

The Client has been advised that these abstraction activities on Site will require a formal licence (according to Section 5C of the RWI Act) to take groundwater from the three newly proposed production bores, issued by the DoW. An application for this licence accompanies this OS.

5.2 Timeframe for Proposed Abstraction

Commencement of the abstraction proposal is expected in early 2013. Production bore installation and commissioning, as well as the mobilisation of bore head works, generators, piping and two (2) groundwater storage tanks for sustaining three (3) production bores is expected to take about 8 weeks. It is assumed that groundwater abstraction for dust suppression and soil compaction activities will be continuous for three years and pumping shared across each production bore, although this may change to an intermittent pumping schedule, based on weather conditions and the amount of drawdown/recharge experienced at the Site and surrounds once pumping commences.

5.3 Dewatering Rates

Groundwater abstraction rates for the duration of pumping are expected to be in the order of 300 ML/year, or 821.3 m3/day. Pumping may be allocated across either one, two or all three of WRPB1, WRPB2 and WRPB3 at any given time. A pumping schedule may be adopted to reprieve any tired or damaged bores and continue pumping others that are in more suitable working condition, but this is yet to be decided.

5.4 Radius of Influence

Based on the outcomes of NTEC (2012) the estimated ***maximum*** radius of influence is roughly 1.95 km meters for a maximum drawdown of 0.1 m, and estimated ***maximum*** drawdown for the proposal is approximately 1.2 m in WRMW2, the most proximate bore to the area on Site that is proposed for abstraction.

A search of the DoW online Water Register was conducted by MDWES to identify groundwater bores surrounding the Site (Appendix C). Twelve licensed groundwater bores may encounter drawdown impacts of up to 0.2 m. Three licensees will have impacts exceeding 0.6 m drawdown and five licensees will sustain impacts up to 0.3m. Twenty-three other licensed locations may have impacts exceeding 0.1 m drawdown. Levels in WRMW3 adjacent to Bush Forever Site number #122, are projected to fall by 0.4 m over the full 4 to 5 years of pumping.

Despite being within the radius of influence; no adverse environmental drawdown effects (for flora or water quality) are anticipated to be observed in the neighbouring licensee bores surrounding the Site, due to the minimal drawdown of the Superficial Swan Aquifer during abstraction and the rapid recharge anticipated to follow once pumping is complete. Even for the location revealing the greatest amount of drawdown (shown in the modelling), the quantity is considered representative of seasonal groundwater level change and may be offset by increased rainfall during winter months.

6 OPERATING RULES

6.1 Abstraction Bore Network

Most of the operating controls for this proposal are to govern the operation of the abstraction bore network. These will vary seasonally and under different operating conditions. One production bore may operate as a primary source, with secondaries or back-up bores on standby, but all are expected to operate simultaneously – at least for the commencement of groundwater abstraction at the Site.

Table 7 Rules for Operating Groundwater Abstraction bores

Bore name	Installed pumping capacity (L/sec)	Operating protocols	Bore abstraction strategy
WRPB1, WRPB2 and WRPB3	Max 15 L/sec	• Each bore is designed to pump at 3 x the rate required when all three abstraction bores are pumping simultaneously • Based on the number of bores utilised at a time, a rate of 9.505 L/sec, 821.3 m3/day or 300 ML/year is to be maintained under normal pumping conditions	• Bores may be turned on or off depending on amount of abstraction required and this could vary based on seasonal weather conditions, flood occurrence, if storage water supply reaches capacity, or if one or multiple bores go offline at once • Continuous abstraction is best suited to occur in winter and spring, so that water can be stored up for Summer and Autumn (when groundwater levels are anticipated to be at the lowest annually, and when aquifer stresses are considered to be the highest annually) • Winter is the period where an equilibrium could be met between natural drawdown and abstraction, meaning little change in water levels at the Site may result for continuous pumping at that time of the year

7 MONITORING AND REPORTING

Metering of all water abstracted, stored and used at the Site will be completed monthly for the duration of rehabilitation (Table 8). From 1st July 2010, the DoW specified that for sites abstracting 50 ML/year or greater must be metered at all abstraction points, in this case WRPB1, WRPB2 and WRPB3. The conditions of the future water license will specify the recording dates for totals, calibration of meters and forwarding dates for information to the DoW. Meters will be installed prior to groundwater abstraction commencing, with date and serial number noted. Meters approved for use in Western Australia are gazetted as the *Rights in Water and Irrigation (Approved Meters) Order* (2009).

Water level monitoring in the groundwater monitoring wells (WRMW1 – WRMW6) will also occur monthly (Table 9). Water quality monitoring will be completed for the duration of abstraction and in accordance with monitoring schedules detailed in Table 10. All monitoring of water quality will be completed by a suitably qualified person, using calibrated equipment, of samples that are representative of the aquifer, water stored or used.

At the conclusion of all required groundwater abstraction, a laboratory sample will be collected from each of the six monitoring wells - for comparison to background water quality readings obtained in the initial GME#1 investigation completed by MDWES.

Table 8 Water Use Measurement

Draw point	Meter description	Meter maintenance/calibration schedule	Frequency of recording meter data
WRPB1	ABB (Totaliser, rate) Run hours (headworks)	Bi-annually (At the start of May and November)	Monthly (last day of the month)
WRPB2	ABB (Totaliser, rate) Run hours (headworks)	Bi-annually (At the start of May and November)	Monthly (last day of the month)
WRPB3	ABB (Totaliser, rate) Run hours (headworks	Bi-annually (At the start of May and November)	Monthly (last day of the month)
Storage outlet	ABB (Totaliser, rate)	Bi-annually (At the start of May and November)	Monthly (last day of the month)
Standpipe	ABB (Totaliser, rate)	Bi-annually (At the start of May and November)	Monthly (last day of the month)

Table 9 Water Level Monitoring

Monitoring bore	Location		Frequency
	Easting	Northing	
WRMW1	406504.4	6467036.79	Monthly (around the 15th)
WRMW2	406693.90	6466947.24	Monthly (around the 15th)
WRMW3	406997.15	6466823.95	Monthly (around the 15th)
WRMW4	406617.75	6467311.73	Monthly (around the 15th)
WRMW5	406731.40	6467262.78	Monthly (around the 15th)
WRMW6	406998.45	6467183.20	Monthly (around the 15th)

Table 10 Water Quality Monitoring

Water quality sampling	Location		Parameters	Frequency
	Easting	Northing		
WRMW1	406504.4	6467036.79	**Field:** pH, EC, DO, Temperature, Redox, TTA, TALK **Laboratory:** pH, EC, TDS, TSS, Acidity, Alkalinity, SO_4^{-2}, S^{-2}, Cl^- Dissolved Al, As, Cd, Cr, Fe, Mn, Ni, Se, Zn TP, TN, FRP	Monthly (around the 15th)
WRMW2	406693.90	6466947.24		Monthly (around the 15th)
WRMW3	406997.15	6466823.95		Monthly (around the 15th)
WRMW4	406617.75	6467311.73		Monthly (around the 15th)
WRMW5	406731.40	6467262.78		Monthly (around the 15th)
WRMW6	406998.45	6467183.20		Monthly (around the 15th)
WRPB1	TBA	TBA	**Field:** pH, EC, DO, Temperature, Redox, TTA, TALK, Standing water level (from dip tube) **Laboratory:** pH, EC, TDS, TSS, Acidity, Alkalinity, SO_4^{2-}, S^{2-}, Cl^- Dissolved Ag, Al, As, Cd, Cr, Fe, Hg, Mo, Ni, Pb, Se, Zn, TP, TN, FRP	Monthly (around the 15th)
WRPB2	TBA	TBA		
WRPB3	TBA	TBA		
Storage Outlet	TBA	TBA	**Field:** pH, EC, DO, Temperature, Redox, TTA, TALK **Laboratory:** pH, EC, TDS, TSS, Acidity, Alkalinity, SO_4^{2-}, S^{2-}, Cl^- Dissolved Ag, Al, As, Cd, Cr, Fe, Hg, Mo, Ni, Pb, Se, Zn, TP, TN, FRP	Monthly (around the 15th)
Standpipe	TBA	TBA	**Field:** pH, EC, DO, Temperature, Redox, TTA, TALK **Laboratory:** pH, EC, TDS, TSS, Acidity, Alkalinity, SO_4^{2-}, S^{2-}, Cl^- Dissolved Ag, Al, As, Cd, Cr, Fe, Hg, Mo, Ni, Pb, Se, Zn, TP, TN, FRP, Nitrate and Iron	Monthly (around the 15th)

7.1 Environmental Performance Indicators

As the groundwater monitoring indicated in GME#1 that the water beneath the Site is fresh to mildly acidic, groundwater field and laboratory analysis results will be compared against the Freshwater and Marine Ecosystem Trigger Values for the duration of groundwater abstraction.

Although no ASS have been identified at the Site, areas of high risk are present to the west of the Site. Therefore groundwater field and laboratory results will be monitored against the DEC's treatment and ASS disturbance trigger values in the event that pH levels increase in acidity levels and drop outside the range acceptable for Freshwater criteria and Marine Ecosystem values.

Groundwater laboratory analysis results will also be compared against the background results from GME#1 - to monitor potential changes in groundwater quality due to drawdown effects from abstraction. A change in background concentrations of 10% will be used as a trigger value to prompt investigation into the cause of the results.

Table 11 summarises the assessment criteria that will be used as environmental performance indicators.

Table 11 Summary of Assessment Criteria

Application	Assessment Criteria	Source
Monitoring Wells Field Analysis	Freshwater and Marine Ecosystem Trigger Values	DEC (2010) *Contaminated Site Management Series - Assessment Levels for Soil, Sediment and Water*
	DEC Treatment Trigger Values (pH and TTA)	DEC (2011) *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes.* S5.3.6
	Chemical Indicators of ASS Disturbance (pH)	DEC (2011) *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes.* S5.3.1
Monitoring Well Laboratory Analysis	Freshwater and Marine Ecosystem Trigger Values	DEC (2010) *Contaminated Site Management Series - Assessment Levels for Soil, Sediment and Water*
	DEC Treatment Trigger Values (pH and TTA)	DEC (2011) *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes.* S5.3.6
	Chemical Indicators of ASS Disturbance (pH, Dissolved Aluminium, Alkalinity:Sulfate, Sulfate:Chloride)	DEC (2011) *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes.* S5.3.1
	10% Change in Background groundwater quality results	Golders (2011b) and MDWES sampling 5/7/12

8 CONTINGENCY PROGRAM

8.1 Groundwater Quality

In the event that groundwater quality of groundwater (either abstracted, stored or used) significantly breaches the environmental performance indicators, the relevant location will be re-sampled. If results indicate a continued breach, abstraction pumping rates and monitoring schedules will be revised.

If water quality results continue to indicate an impact on abstracted, stored or used groundwater – as a result of abstraction, pumping will be reduced (if safe to do so) and alternative management options explored.

8.2 Groundwater Drawdown

In the event that the groundwater levels in monitoring bores (WRMW1 – WRMW6) indicate possible offsite drawdown or potential impact on other users greater than those outcomes determined in the groundwater modelling by (NTEC 2012), the abstraction/water distribution network and bore abstraction rate will be revised.

8.3 Destruction of Groundwater Wells or Damage to Infrastructure

Should any groundwater monitoring wells or groundwater abstraction wells be destroyed during the Site works, replacement wells will be installed immediately.

It is recommended that the Site maintains a backlog supply of replacement groundwater pumps in the event that any working ones burn out or go offline. A supply of water meters, additional piping, gensets and headworks is also recommended, given the continuous regime of abstraction. Regular inspections of the water distribution network, storage tanks and standpipe are advised, to ensure no water abstracted is lost or wasted.

8.4 Dust Suppression/Soil Compaction or Discharge Effluent Quality

In the event that water quality from the storage tanks significantly exceeds the environmental performance indicators, an investigation will be conducted to determine the cause. The Storage Outlet or Standpipe will then be sampled to confirm compliance.

The following reporting will be undertaken:

- Monthly Monitoring Reports will be submitted by Wasterock.
- At the completion of site works, a Closure Report will be submitted to Wasterock. This report will summarise the management measures undertaken at the Site, the results of all monitoring programs and provide a discussion of the effectiveness of management strategies employed at the Site and of any potential risks to human health or the environment.

9 STATUTORY REQUIREMENTS

All construction personnel associated with the project are required to comply with provisions of this OS and the requirements of all applicable environmental legislation, regulations, codes of practice and standards. These include, but are not limited to:

- Rights in Water and Irrigation Act (1914);
- Environmental Protection Act (1986);
- WA DEC Acid Sulfate Soil Guideline Series “Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes” (2011).

10 COMMUNITY CONCERNS REPORTING

Wasterock or MDWES will manage and document a Community Concerns Reporting procedure. Where concerns are raised by the community or other third parties in relation to the redevelopment, these concerns will be immediately forwarded to the Project Manager and if of an environmental nature, be immediately forwarded to MDWES. The community concerns will be registered and documented, and where possible, an acknowledgement of the receipt of the community concern will be made.

11 WATER USE EFFICIENCY

A number of water use efficiency measures are proposed for the abstraction proposal:

- Weekly inspections of abstraction bores WRPB1, WRPB2 and WRPB3;
- Ongoing maintenance of water pipes and monitoring of any leaks between the abstraction points and storage tanks as required;
- Monitoring of valves at the Standpipe and around the Storage Outlet;
- Monthly recording of water use totals, abstraction totals/rates and portions stored and used – to track the water balance across the water distribution network and identify any loss of abstracted water - to the environment.

12 SUMMARY LIST OF COMMITMENTS

Wasterock (the proposed licensee) will comply with this OS as a condition that is to be specified in Section 5C Water Resource Licence.

The licensee will undertake and report to the DoW, concerning the monitoring program:

Summary Monitoring Program

Parameter measured	Sampling site	Frequency	Time
Water use measurement	WRPB1, WRPB2, WRPB3, Standpipe outlet, Discharge outlet (if required)	Monthly	By 3pm each day (or at the beginning and end of any water discharge event)
Water level monitoring	WRMW1, WRMW2, WRMW3, WRMW4, WRMW5 and WRMW6	Monthly	Monthly (around the 15th)
Water quality monitoring	WRMW1, WRMW2, WRMW3, WRMW4, WRMW5 and WRMW6, Storage Outlet and Standpipe	Monthly	Monthly (around the 15th)

Any breach in commitments of the OS, or implementation of any contingency response, must be reported to the DoW within fourteen (14) days of the breach becoming aware or contingency response being made.

An annual water use (meter totals) report along with a compliance (monitoring/water level) report will be submitted to the DoW within seven (7) days and twenty eight (28) days (respectively) of the end to the annual water year. Strategic Policy 5.03 and Operating policy 5.1.2 detail the required formats for compilation of these reports.

The OS is to be re-submitted to the DoW for review three (3) months prior to the expiry date.

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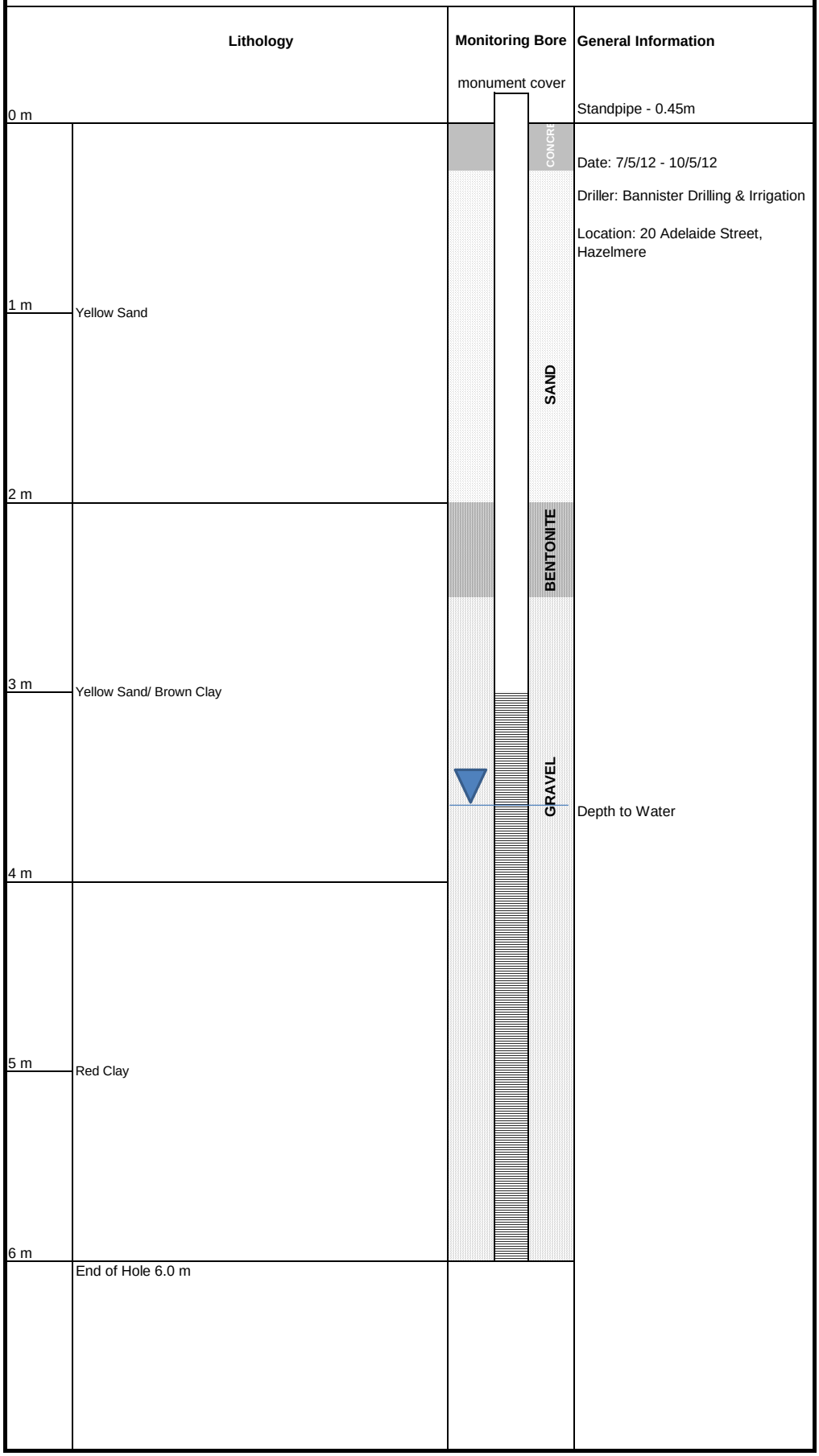
Appendix A – Soil Bore Logs

Bore Completion Details: MW1



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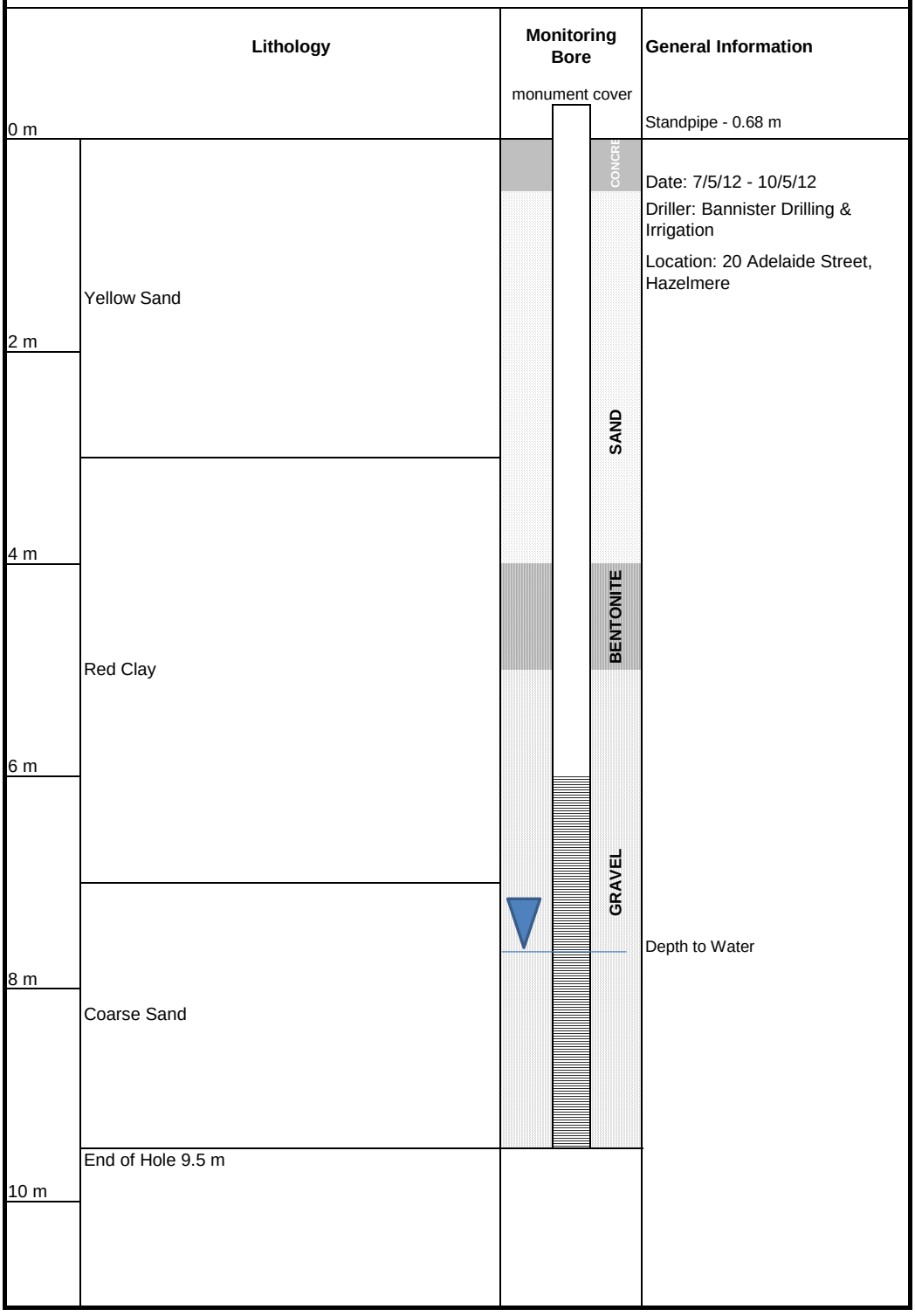

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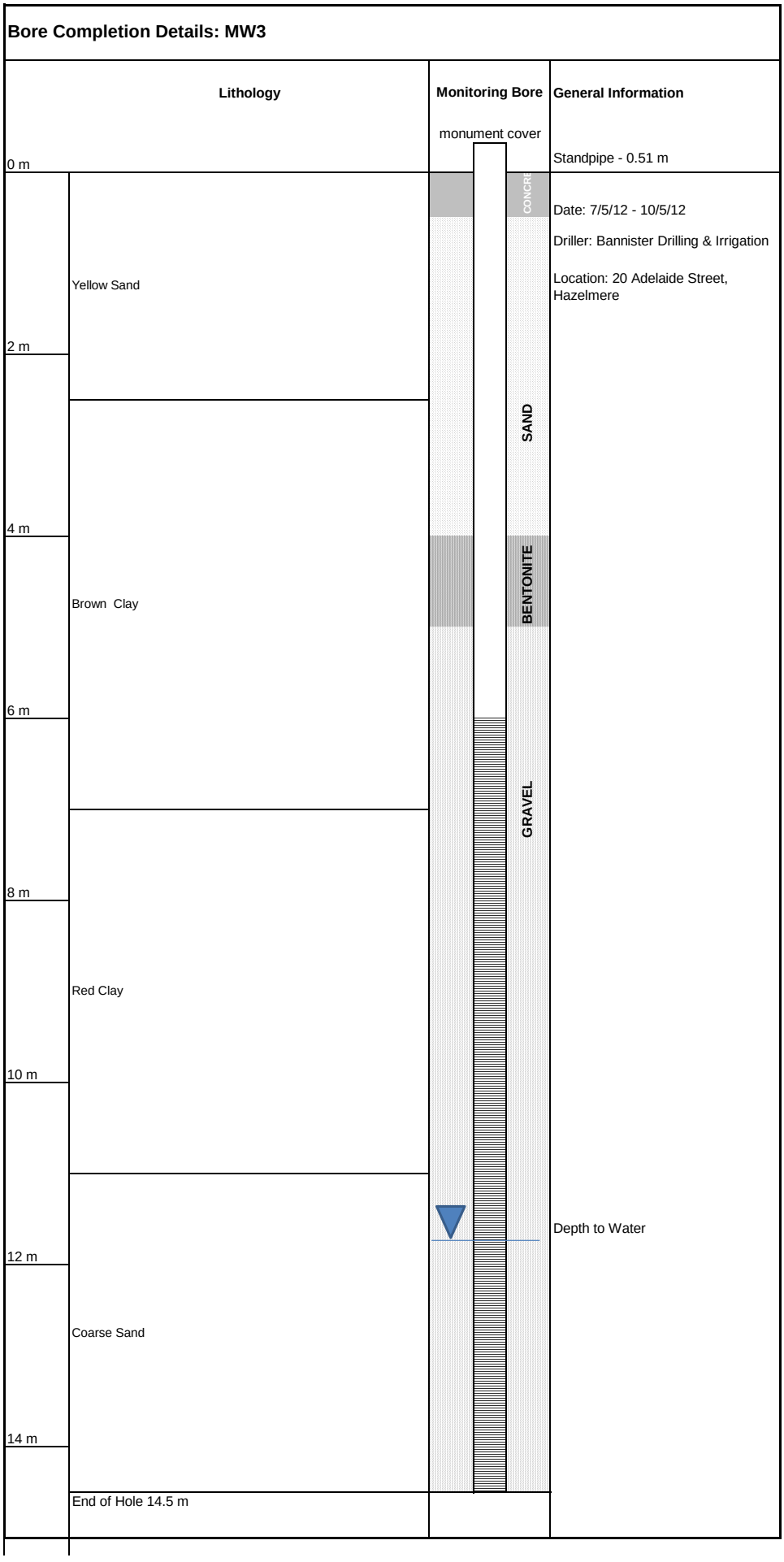


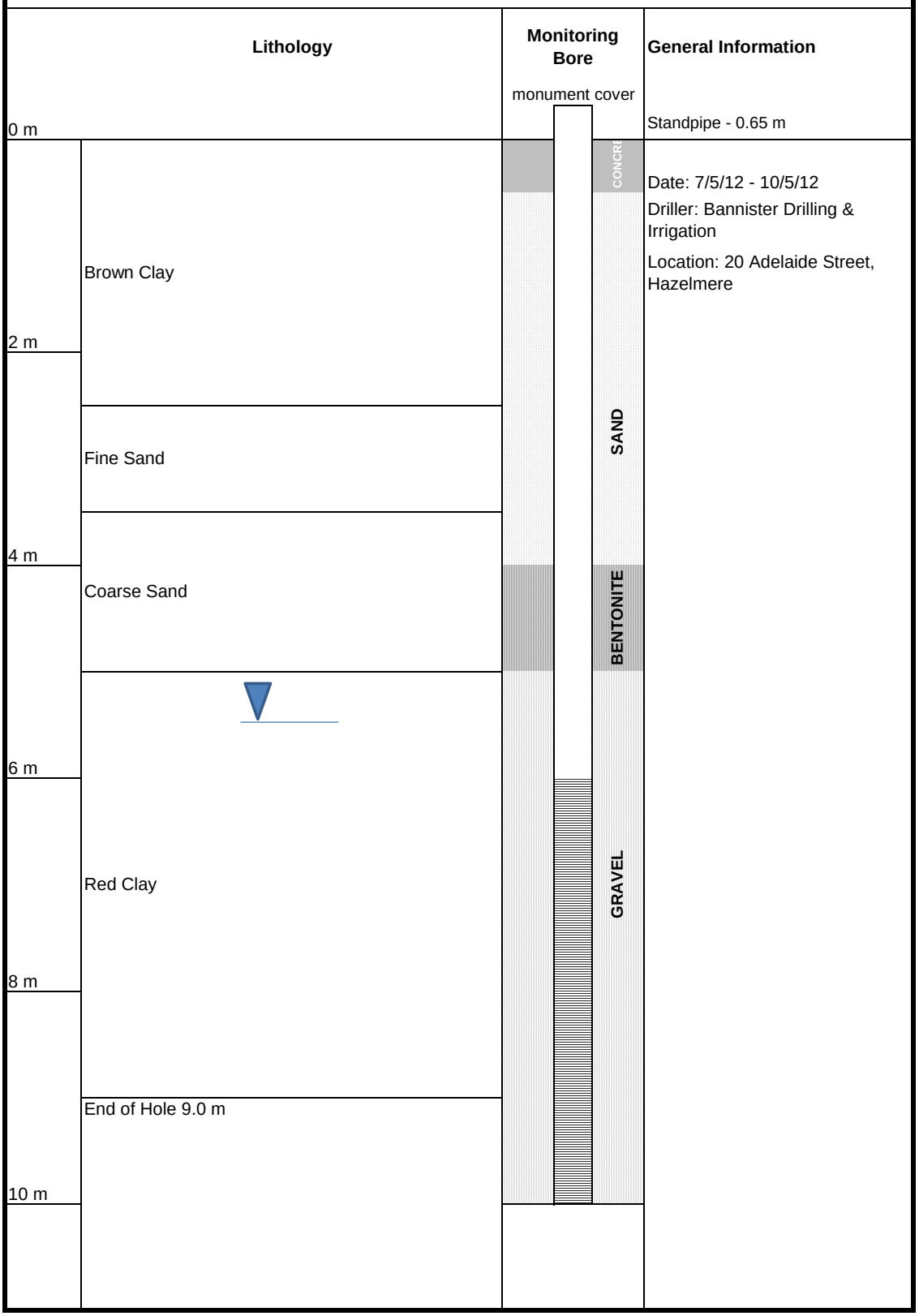
Bore Completion Details: MW4

Lithology	Monitoring Bore	General Information
0 m	monument cover	Standpipe - 0.64 m
2 m Brown Clay	CONCRETE / SAND	Date: 7/5/12 - 10/5/12 Driller: Bannister Drilling & Irrigation Location: 20 Adelaide Street, Hazelmere
4 m Fine Sand	BENTONITE	
6 m Coarse Sand	GRAVEL	
8 m Red Clay		Depth to Water
10 m End of Hole 10.0 m		

Bore Completion Details: MW5

Lithology	Monitoring Bore	General Information
0 m	monument cover	Standpipe -
Brown Clay (0 m – 2 m)	CONCRE	Date: 7/5/12 - 10/5/12
		Driller: Bannister Drilling & Irrigation
		Location: 20 Adelaide Street, Hazelmere
	SAND	
Fine Sand (2 m – 4 m)		
Coarse Sand (4 m – 6 m)	BENTONITE	
Red Clay (6 m – 10 m)	GRAVEL	
End of Hole 11.0 m (10 m – 12 m)		

Bore Completion Details: MW6



0892564460

BANNISTER DRILLING & IRRIGATION

ABN 59 776 488 257

LITHOLOGY & CONSTRUCTION REPORT

DRILLER: Philip DRILLER LICENCE NUMBER: 183

JOB LOCATION: Adelaide St. Hazelmere

DATE COMMENCED: 7-5-12 DATE COMPLETED: 10-5-12

DRILLING METHOD: Mud AIR DEVELOPMENT: Yes (1hr) GRAVEL PACK: Yes

STRATA DESCRIPTION

FROM	TO	
Bore no 1		
0mts	2 mts	Yellow Sand
2mts	4 mts	Yellow Sand / Brown Clay
4mts	6 mts	Red Clay
Bore no. 2		
0mts	3mts	Yellow Sand
3mts	7mts	Red Clay
7mts	9.5mts	Coarse Sand
Bore no. 3		
0mts	2.5 mts	Yellow Sand
2.5mts	7mts	Brown Clay
7mts	11mts	Red Clay
11mts	14.5mts	Coarse Sand

18 DORNOCH WAY CANNINGVALE 6155 PH/FAX 92564460 MOB 0410 422 006

0892564460

BANNISTER DRILLING & IRRIGATION

ABN 59 776 488 257

LITHOLOGY & CONSTRUCTION REPORT

DRILLER: Philip DRILLER LICENCE NUMBER: 183

JOB LOCATION: Adelaide St Hazelmere

DATE COMMENCED: 7-5-12 DATE COMPLETED: 10-5-12

DRILLING METHOD: mud AIR DEVELOPMENT: Yes (1hr) GRAVEL PACK: Yes

STRATA DESCRIPTION

FROM	TO	
Bore no. 4		
0mts	4 mts	Brown Clay
4 mts	5.5 mts	fine Sand
5.5 mts	7 mts	Coarse Sand
7 mts	10 mts	Red Clay
Bore no 5		
0 mts	3 mts	Brown Clay
3 mts	4 mts	fine Sand
4 mts	6 mts	Coarse Sand
6 mts	11 mts	Red Clay
Bore no. 6		
0 mts	2.5 mts	Brown Clay
2.5 mts	3.5 mts	fine Sand
3.5 mts	5 mts	Coarse Sand
5 mts	9 mts	Red Clay

18 DORNOCH WAY CANNINGVALE 6155 PH/FAX 92564460 MOB 0410 422 006

Appendix B – DoW Online Search for Groundwater Licenses

REGISTER EXTRACT INFORMATION

The Department of Water is committed to quality service to its customers and makes every attempt to ensure accuracy, currency and reliability of the data contained in this document. However changes in circumstances after time of publication may impact the

Information extracted from the Department of Water database at 13:45hrs on 16 April 2012

Instrument Version	Licence Allocation	GW Area	Sub Area	Aquifer	All Parties	Property	Licence Address	Issue Date	Expiry Date
GWL 000110971 (002)	29750	Perth	Perth South Confined	Perth - Leederville.	The Trustee For C & S Pucolo Family Trust	15, MIDLAND RD, HAZELMERE	Portion of Helena Location 20a and being Lot 15 the subject of Diagram 69971 and being the whole of the land comprised in Certificate of Title Volume 1777 Folio 497 Lot 15 Midland Road Hazelmere	10/05/2007	9/05/2017
GWL 000155795 (003)	198725	Perth	Shire of Swan South	Perth - Superficial Swan	Department of Education	14189, ARCHER ST, WOODBRIDGE	Lot 14189 On Plan 189860 Volume/Folio Lr3174/793 Lot 14189 Archer St Woodbridge Woodbridge Primary School	16/08/2007	16/08/2017
GWL 000155795 (003)	198725	Perth	Shire of Swan South	Perth - Superficial Swan	Department of Education	7576, CROSBIE RD, WOODBRIDGE	Crown Reserve 24093 - Lot 7576 Crosbie Rd Woodbridge and Lot 571 On Plan 70657 - Volume/Folio Lr3161/343 - Lot 571 Third Av Woodbridge - Governor Stirling Senior High School, Crown Reserve 29493 - Lot 570 On Plan 70657 - Volume/Folio Lr3161/342 - Lot 570	16/08/2007	16/08/2017
GWL 000155795 (003)	198725	Perth	Shire of Swan South	Perth - Superficial Swan	Department of Education	6318, CLAYTON ST, KOONGAMIA	Crown Reserve 31321 - Lot 6665 Kalara Wy Koongamia - Clayton View Primary School	16/08/2007	16/08/2017
GWL 000155795 (003)	198725	Perth	Shire of Swan South	Perth - Superficial Swan	Department of Education	Crown reserve 8804; Swan Location 10355- Clayton Street Bellevue	Crown reserve 8804; Swan Location 10355- Clayton Street Bellevue	16/08/2007	16/08/2017
GWL 000168263 (002)	217225	Perth	Shire of Swan South	Perth - Superficial Swan	City of Swan	9963, WEST PDE, HAZELMERE	Lot 9963 On Plan 4539 - Volume/Folio Lr3128/733 - Lot 9963 West Pde Hazelmere - Bruce Elliott Reserve (Hazelmere Reserve)	13/05/2010	31/05/2012
GWL 000168263 (002)	217225	Perth	Shire of Swan South	Perth - Superficial Swan	City of Swan	149, JAMES ST, GUILDFORD	Crown Reserve 21168 - Lot 149 James St Guildford	13/05/2010	31/05/2012
GWL 000168263 (002)	217225	Perth	Shire of Swan South	Perth - Superficial Swan	City of Swan	4616, FORD ST, WOODBRIDGE	Lot 6300 On Plan 165354 - Volume/Folio Lr3045/107 - Lot 6300 Ford St Woodbridge	13/05/2010	31/05/2012
GWL 000168263 (002)	217225	Perth	Shire of Swan South	Perth - Superficial Swan	City of Swan		Road Reserve - Terrace Road Guildford	13/05/2010	31/05/2012
GWL 000168263 (002)	217225	Perth	Shire of Swan South	Perth - Superficial Swan	City of Swan	14641, FERGUSON ST, MIDLAND	Lot 14641 On Plan 35576 - Volume/Folio Lr3129/491 - Lot 14641 Ferguson St Midland	13/05/2010	31/05/2012
GWL 000168263 (002)	217225	Perth	Shire of Swan South	Perth - Superficial Swan	City of Swan	266, CHARLES ST, MIDLAND	Lot 267 On Plan 1236 - Volume/Folio 1864/43 - Lot 267 Charles St Midland Lot 255 On Plan 1236 - Volume/Folio 1868/21 - Lot 255 North St Midland	13/05/2010	31/05/2012
GWL 000168263 (002)	217225	Perth	Shire of Swan South	Perth - Superficial Swan	City of Swan	12224, WATERHALL RD, SOUTH GUILDFORD	Lot 12224 On Plan 20182 - Volume/Folio Lr3120/168 - Lot 12224 Waterhall Rd South Guildford	13/05/2010	31/05/2012
GWL 000168263 (002)	217225	Perth	Shire of Swan South	Perth - Superficial Swan	City of Swan	10627, JOHN ST, MIDLAND	Lot 10627 On Plan 6074 - Volume/Folio Lr3146/714 - Lot 10627 John St Midland - John Street Playground	13/05/2010	31/05/2012
GWL 000041225 (002)	3000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Salama, Amir	6, SULTANA RD, FORRESTFIELD	Lot 6 On Plan 13574 Volume/Folio 1593/554 Lot 6 Sultana Rd Forrestfield	13/05/2010	31/05/2012
GWL 000045890 (003)	97500	Perth	City of Belmont	Perth - Superficial Swan	Westralia Airports Corporation Pty Limited	0, Horrie Miller Drive, Cloverdale	Lot 0 on Plan 6619 and being the whole of the land comprised in Certificate of Title Volume 2124 Folio 980 - Perth International Airport Horrie Miller Drive, Cloverdale	2/06/2004	1/06/2014
GWL 000017120 (002)	3650	Swan	South Swan	Perth - Mirrabooka	Smith, Graeme McDonald	2, HAMERSLEY RD, CAVERSHAM	Lot 2 on Diagram 14007; Certificate of Title Volume 1717 Folio 476 - Lot 2 Hamersley Road Caversham	2/06/2004	1/06/2014
GWL 000048642 (003)	21000	Perth	Perth South Confined	Perth - Leederville.	La Salle College	14, MURIEL ST, MIDDLE SWAN	Lot 10 on Diagram 39841; Certificate of Title Volume 1370 Folio 101; Lot 14 on Diagram 18328; Certificate of Title Volume 1169 Folio 518 - Lots 10 & 14 Muriel Street Viveash	22/01/2004	21/01/2014
GWL 000048634 (003)	35550	Swan	South Swan	Perth - Mirrabooka	Bond, Robert James	10, HAMERSLEY RD, CAVERSHAM	Lot 10 On Diagram 80707 - Volume/Folio 1913/961 - Lot 10 Hamersley Rd Caversham	30/03/2010	25/03/2014
GWL 000048834 (003)	35550	Swan	South Swan	Perth - Mirrabooka	Bond, Robert James	Lots 2976 & 10 Hamersley Road, Caversham.	Lots 2976 & 10 Hamersley Road, Caversham.	6/07/2011	6/07/2021
GWL 000048839 (003)	33750	Perth	Shire of Swan South	Perth - Superficial Swan	Swan Tafe	Lot 50 Lloyd Street, Midland.	Lot 50 Lloyd Street, Midland.	6/07/2011	6/07/2021
GWL 000051642 (002)	2230	Perth	Shire of Swan South	Perth - Superficial Swan	BGC (Australia) Pty Ltd	Lot 3 Bushmead Road Hazelmere	Lot 3 Bushmead Road Hazelmere	21/04/2010	1/06/2014
GWL 000053269 (002)	4800	Perth	Shire of Swan South	Perth - Superficial Swan	Swan Bowling & Recreation Club (Inc)	9, JAMES ST, GUILDFORD	Lot 9 On Plan 2237 Volume/Folio 1093/229 Lot 9 James St Guildford	9/11/2004	9/11/2014
GWL 000056787 (002)	6750	Perth	Shire of Kalamunda	Perth - Superficial Swan	Smith, S M; Smith, R	113, SULTANA RD, MAIDA VALE	Lot 113 on Diagram 85719; Certificate of Title Volume 1993 Folio 316 - Lot 113 Sultana Road Forrestfield	3/02/2005	3/02/2015
GWL 000058650 (003)	27000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Swanview Plant Farm Pty Ltd	Lot 399 Sorenson Road High Wycombe	Lot 399 Sorenson Road High Wycombe	21/04/2004	19/04/2014
GWL 000059059 (003)	15000	Perth	Shire of Swan South	Perth - Superficial Swan	St Brigid's School	67, TOODYAY RD, MIDDLE SWAN	67, TOODYAY RD, MIDDLE SWAN	2/11/2006	1/11/2016
GWL 000060942 (001)	46150	Perth	Shire of Kalamunda	Perth - Superficial Swan	Seventh-Day Adventist Church (Western Australian Conference) Limited	1, KALAMUNDA RD, MAIDA VALE	Lot 1 On Diagram 35591 - Volume/Folio 89/7a - Lot 1 Kalamunda Rd Maida Vale	30/03/2010	21/12/2016
GWL 000060942 (001)	46150	Perth	Shire of Kalamunda	Perth - Superficial Swan	Seventh-Day Adventist Church (Western Australian Conference) Limited	1, KALAMUNDA RD, MAIDA VALE	Lot 1 On Diagram 35591 - Volume/Folio 89/7a - Lot 1 Kalamunda Rd Maida Vale	20/04/2010	13/03/2018
GWL 000061690 (002)	21000	Perth	Shire of Swan South	Perth - Superficial Swan	Pioneer Road Services Pty Ltd	1, VALE RD, HAZELMERE	1, VALE RD, HAZELMERE	20/04/2010	13/03/2018
GWL 000062528 (003)	20625	Perth	Shire of Swan South	Perth - Superficial Swan	La Salle College	79, MURIEL ST, MIDDLE SWAN	Lot 79 on Diagram 1577; Certificate of Title Volume 1706 Folio 327 - Lot 79 Muriel Street Viveash	10/01/2008	10/01/2018
GWL 000062635 (001)	15750	Perth	Shire of Swan South	Perth - Superficial Swan	The Roman Catholic Archbishop of Perth		Lot 501 On Plan 35367 - Volume/Folio 2199/538 - Lot 501 Guildford	30/03/2010	25/03/2014
GWL 000063196 (002)	3260	Perth	Shire of Kalamunda	Perth Superficial Swan	Department of Agriculture and Food	11858, BOUGAINVILLEA AV, FORRESTFIELD	11858, BOUGAINVILLEA AV, FORRESTFIELD	20/05/2010	8/10/2018
GWL 000063807 (003)	39350	Perth	Shire of Kalamunda	Perth - Superficial Swan	Bacchion, David	22, DUNDAS RD, HIGH WYCOMBE	Lot 22 On Diagram 71134 - Volume/Folio 1791/535 - Lot 22 Dundas Rd High Wycombe	14/10/2008	14/10/2018
GWL 000063807 (003)	89350	Perth	Shire of Kalamunda	Perth - Superficial Swan	Bacchion, David	23, MILNER RD, HIGH WYCOMBE	Lot 23 On Diagram 71134 - Volume/Folio 1791/536 - Lot 23 Milner Rd High Wycombe	15/10/2009	15/10/2019
GWL 000063807 (003)	89350	Perth	Shire of Kalamunda	Perth - Superficial Swan	Bacchion, David	551, DUNDAS RD, HIGH WYCOMBE	Lot 551 On Plan 4684 - Volume/Folio 365/181a - Lot 551 Dundas Rd High Wycombe	15/10/2009	15/10/2019
GWL 000064694 (003)	74000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Matthew Gibney Catholic Primary School; The Roman Catholic Archbishop of Perth	7, MUNDAY RD, HIGH WYCOMBE	Lot 7 On Plan 16340 - Volume/Folio 1927/? - Lot 7 Munday Rd High Wycombe	15/10/2009	15/10/2019
GWL 000074457 (003)	196250	Perth	Shire of Kalamunda	Perth Superficial Swan	Hillview Public Golf Course Pty Ltd	Location 7652 Kalamunda Road Maida Vale	Location 7652 Kalamunda Road Maida Vale	30/03/2010	15/12/2018
GWL 000074457 (003)	196250	Perth	Shire of Kalamunda	Perth - Superficial Swan	Hillview Public Golf Course Pty Ltd	Location 7652 Kalamunda Road Maida Vale	Location 7652 Kalamunda Road Maida Vale	4/05/2010	31/07/2019
GWL 000089956 (001)	15550	Perth	Shire of Swan South	Perth - Superficial Swan	Swick, Randal Lloyd	12, STIRLING CR, HAZELMERE	Lot 12 on Plan 4556 - Volume/Folio 1827/283 - Lot 12 Stirling Cr Hazelmere	4/05/2010	31/07/2019
GWL 000099004 (001)	17250	Perth	Perth South Confined	Perth - Leederville	Midland Redevelopment Authority	9011, YELVERTON DR, MIDLAND	Lot 9011 On Plan 46323 - Volume/Folio Lr3158/180 - Lot 9011 Yelverton Dr Midland	14/05/2010	14/05/2020
GWL 000101500 (007)	66000	Perth	Perth South Confined	Perth Leederville.	Derby Industries Pty Ltd	115, LAKES RD, HAZELMERE	Lot 115 On Plan 4553 - Volume/Folio 1734/573 - Lot 115 Lakes Road Hazelmere	12/04/2011	31/12/2014
GWL 000101500 (002)	66000	Perth	Perth South Confined	Perth - Leederville.	Derby Industries Pty Ltd	114, LAKES RD, HAZELMERE	Lot 114 On Plan 4553 - Volume/Folio 1734/572 - Lot 114 Lakes Rd Hazelmere	11/11/2010	11/11/2020
GWL 000103034 (002)	28000	Perth	Shire of Swan South	Perth - Superficial Swan	Di Giuseppe, Antonio Giuseppe	25, STIRLING CR, HAZELMERE	Lot 25 On Plan 4556 - Volume/Folio 2122/183 - Lot 25 Stirling Cr Hazelmere	11/11/2010	11/11/2020
GWL 000103896 (005)	8500	Perth	Shire of Swan South	Perth - Superficial Swan	Austral Bricks (WA) Pty Ltd	1, MILITARY RD, MIDLAND	1, MILITARY RD, MIDLAND	2/08/2010	11/11/2012
GWL 000108239 (002)	16600	Perth	Shire of Swan South	Perth - Superficial Swan	Byron, William John	2, ARUM LILY PL, HAZELMERE	Lot 2 on Diagram 58229; Certificate of Title Volume 2130 Folio 641 - Lot 2 Arum Lily Place Hazelmere	4/03/2011	4/03/2021
GWL 000108850 (002)	1500	Perth	Shire of Kalamunda	Perth Superficial Swan	Powell, Baden Jones	148, ALMONDTREE L, MAIDA VALE	148, ALMONDTREE L, MAIDA VALE	3/07/2003	3/07/2013
GWL 000111079 (002)	4800	Perth	Shire of Mundaring	Perth - Superficial Swan	Shire of Mundaring	13293, , MIDVALE	Reserve No. 34196 of Swan Location 9502 - Lot 9502 Reserve 34196 Moir Place, Midvale	9/09/2010	10/09/2020
GWL 000151552 (001)	15750	Perth	Shire of Swan South	Perth - Mirrabooka	Westrac Equipment Pty Ltd	50, GREAT EASTERN HWY, SOUTH GUILDFORD	Portion of each of Swan Locations 22 and 23 and being Lot 50 on Diagram 13884 and being the whole of the land comprised in Cert. Title Volume 2133 Folio 699 - Lot 50 Great Eastern Highway South Guildford	30/03/2010	17/07/2012
GWL 000151578 (001)	7930	Perth	Shire of Kalamunda	Perth - Superficial Swan	Weissmann, P G & M C	1, BERKSHIRE RD, FORRESTFIELD	Portion of Swan Location 26 and being Lot 1 on Diagram 62944, and being the whole of the land comprised in Certificate of Title Volume 1661 Folio 472 - Lot 1 Berkshire Road, Forrestfield	20/11/2002	26/11/2012
GWL 000151772 (001)	3000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Rogan, Brett Norman	72, MULBERRY CT, MAIDA VALE	Portion of Swan Location 2089 and being Lot 72 on Plan 23199 and being the whole of the land comprised in Certificate of Title Volume 2171 Folio 24 - Lot 72 Mulberry Court Maida Vale	25/11/2002	25/11/2012
GWL 000151786 (001)	2000	Perth	Shire of Swan South	Perth - Superficial Swan	Watson, Debbie	508, NIRIMBA CL, SOUTH GUILDFORD	Lot 508 on Diagram 89700 and being the whole of the land comprised in Certificate of Title Volume 2067 Folio 988 - Lot 508 Nirimba Close South Guildford	6/01/2003	6/01/2013
GWL 000151796 (002)	3500	Perth	Shire of Kalamunda	Perth - Superficial Swan	Howe & Carter, Richard & Lynette	3, SULTANA RD, FORRESTFIELD	Lot 3 On Plan 13574 - Volume/Folio 159?/551 - Lot 3 Sultana Rd Forrestfield	7/01/2003	6/01/2013
GWL 000152091 (002)	3500	Perth	Shire of Kalamunda	Perth - Superficial Swan	Netherway, Trevor Noel	89, STEWART RD, HIGH WYCOMBE	Lot 89 on Plan 13420; Certificate of Title Volume 1581 Folio 996 - Lot 89 on Stewart Road High Wycombe	7/07/2005	7/07/2015
GWL 000152097 (001)	4600	Perth	Shire of Kalamunda	Perth - Superficial Swan	Arnold, Jean Winifred	49, MILNER RD, HIGH WYCOMBE	Lot 49 on Plan 13420; Certificate of Title Volume 2708 Folio 540 - Lot 49 Milner Road High Wycombe	9/09/2010	10/09/2020
GWL 000152099 (002)	3600	Perth	Shire of Kalamunda	Perth - Superficial Swan	Di Renzo, Giustina	5, HAWTIN RD, MAIDA VALE	Lot 5 on Diagram 20510; Certificate of Title Volume 1214 Folio 316 Lot 5 on Hawtin Road Forrestfield	17/07/2003	17/07/2013
GWL 000152102 (001)	30000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Forrestfield Bible Fellowship	525, BERKSHIRE RD, FORRESTFIELD	Lot 525 on Plan 4684; Certificate of Title Volume 1244 folio 38 - Lot 525 Berkshire Road Forrestfield	9/09/2010	10/09/2020
GWL 000152140 (001)	5000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Disisto, Michael; Disisto, Lilliana	4, SULTANA RD, FORRESTFIELD	Lot 4 on Plan 13574; Certificate of Title Volume 1595 Folio 532 - Lot 4 Sultana Road Forrestfield	28/02/2003	20/01/2013
GWL 000152215 (001)	23120	Perth	Shire of Kalamunda	Perth - Superficial Swan	Fagnani, Antonio (Tony)	1, MILNER RD, HIGH WYCOMBE	Lot 1 on Diagram 17430; Certificate of Title Volume 1324 folio 130 - Lot 1 Milner Road High Wycombe	2/09/2010	1/09/2020
GWL 000152744 (004)	75773	Perth	Shire of Swan South	Perth - Superficial Swan	Guildford Grammar School Inc	191, GREAT EASTERN HWY, GUILDFORD	Lot 191 On Diagram 4819 - Volume/Folio 1375/736 - Lot 191 Great Eastern Hwy Guildford - Guildford Grammar School	28/02/2003	12/09/2013
GWL 000152515 (001)	9000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Furfaro, M & A	415, PLOVER RD, HIGH WYCOMBE	Lot 415 on Plan 16088; Certificate of Title Volume 1789 Folio 22 - Lot 415 Plover Road High Wycombe	30/03/2010	11/11/2017
GWL 000152680 (003)	27750	Perth	Shire of Swan South	Perth - Superficial Swan	Di Giuseppe, Antonio Giuseppe	147, TALBOT RD, HAZELMERE	Lot 147 On Plan 4553 - Volume/Folio 2164/776 - Lot 147 Talbot Rd Hazelmere	25/03/2003	14/09/2013
GWL 000152817 (002)	4400	Perth	Shire of Kalamunda	Perth - Superficial Swan	Lush, Leonard James	26, BREWER RD, MAIDA VALE	Lot 26 on Plan 13588; Certificate of Title Volume 1597 Folio 415 - Lot 26 Brewer Road Forrestfield	8/11/2005	14/09/2015
GWL 000152906 (002)	30000	Perth	Shire of Swan South	Perth - Superficial Swan	BGC (Australia) Pty Ltd	80, BUSHMEAD RD, HAZELMERE	Lot 80 On Plan 4539 - Volume/Folio 1374/513 - Lot 80 Bushmead Rd Hazelmere	9/09/2010	10/09/2020
GWL 000153124 (001)	11450	Perth	Shire of Kalamunda	Perth - Superficial Swan	Ozanne, H.W. & J	1, RIDGE HILL RD, MAIDA VALE	Lot 1 on Plan 4326; Certificate of Title Volume 1416 Folio 481 - Lot 1 Ridge Hill Road Maida Vale	13/04/2005	15/04/2015
GWL 000153231 (001)	7250	Perth	Shire of Kalamunda	Perth - Superficial Swan	Porges, Bruce	105, OXFORD CT, MAIDA VALE	Lot 105 on Diagram 90357; Certificate of Title Volume 2114 Folio 155 - Lot 105 Oxford Court Maida Vale	12/06/2003	12/09/2013
GWL 000153597 (002)	6400	Perth	Shire of Kalamunda	Perth - Superficial Swan	Miles, Peter Leslie	82, BRAE RD, HIGH WYCOMBE	Lot 82 on Diagram 60280; Certificate of Title Volume 1591 Folio 203 - Lot 82 Brae Road High Wycombe	21/05/2003	24/05/2013
GWL 000153624 (001)	12000	Perth	Perth South Confined	Perth Leederville.	Metalic Investments Pty Ltd	134, GREAT NORTHERN HWY, MIDDLE SWAN	Lot 134 on Diagram 85619; Certificate of Title Volume 1987 Folio 666 Lot 134 Great Northern Highway Middle Swan	15/09/2010	15/09/2020
GWL 000153641 (001)	13950	Perth	Shire of Swan South	Perth - Superficial Swan	Wilcox, Sidney Alexander; Wilcox, Lynley Jane	15, STIRLING CR, HAZELMERE	Lot 15 on Plan 4556; Certificate of Title Volume 2002 Folio 816 - Lot 15 Stirling Crescent Hazelmere	10/07/2003	21/03/2013
GWL 000153765 (002)	3375	Perth	Shire of Kalamunda	Perth - Superficial Swan	Leisure Time Pty Ltd	10, MAIDA VALE RD, HIGH WYCOMBE	Lot 10 on Diagram 32130; Certificate of Title Volume 2023 Folio 709 - Lot 10 Maida Vale Road High Wycombe	29/08/2003	31/12/2013
GWL 000153812 (002)	5400	Perth	Shire of Kalamunda	Perth Superficial Swan	TTN Pty Ltd	11, KALAMUNDA RD, HIGH WYCOMBE	Lot 11 on Diagram 13889; Certificate of Title Volume 1670 Folio 694 Lot 11 Kalamunda Road High Wycombe	1/09/2010	1/09/2012
GWL 000153889 (002)	10000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Forrestfield Christian School	22, HAWTIN RD, FORRESTFIELD	Lot 22 on Diagram 70988; Certifiate of Title Volume 1751 Folio 759 - Lot 22 Hawtin Road Forrestfield - Forrestfield Christian School Inc	23/07/2003	6/10/2012
GWL 000154050 (001)	4000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Mallar, Shafik Ahmad	91, STEWART RD, HIGH WYCOMBE	Lot 91 on Plan 13420; Certificate of Title Volume 1581 Folio 968 - Lot 91 Stewart Road High Wycombe	30/03/2010	14/09/2013
GWL 000154091 (001)	4250	Perth	Shire of Kalamunda	Perth - Superficial Swan	Halse, O D	106, SADLER DR, GOOSEBERRY HILL	Lot 106 on Plan 13566; Certificate of Title Volume 1596 Folio 421 - Lot 106 Sadler Drive Gooseberry Hill	25/08/2003	3/11/2013
GWL 000154114 (001)	3750	Perth	Shire of Kalamunda	Perth - Superficial Swan	Hampson, William	11, SULTANA RD, FORRESTFIELD	Lot 11 on Plan 13574; Certificate of Title Volume 1595 Folio 558 - Lot 11 Sultana Road Forrestfield	16/10/2003	25/10/2013
GWL 000154241 (001)	250	Perth	Perth South Confined	Perth Leederville.	Swick, Rosanne	5, RIVER BANK BVD, SOUTH GUILDFORD	Lot 5 on Plan 19995; Certificate of Title Volume 2017 Folio 838 Lot 5 River Bank Bvd South Guildford	23/09/2003	22/09/2013
GWL 000154518 (001)	4000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Bennett, Stephen	8, BRUCE RD, MAIDA VALE	Lot 8 on Diagram 16758; Certificate of Title Volume 1865 Folio 502 - Lot 8 Bruce Road Forrestfield	30/09/2003	24/09/2013
GWL 000154520 (002)	7740	Perth	Shire of Kalamunda	Perth - Superficial Swan	Avery, Vernon Bruce	50, MILNER RD, HIGH WYCOMBE	Lot 50 on Plan 13420; Certificate of Title Volume 1584 Folio 959 - Lot 50 Milner Road High Wycombe	21/01/2004	19/01/2014
GWL 000154669 (001)	3500	Perth	Shire of Kalamunda	Perth - Superficial Swan	Patterson, N J	4, BRAND RD, HIGH WYCOMBE	Lot 4 on Diagram 69590; Certificate of Title 1723, Folio 473 - Lot 4 Brand Road High Wycombe	20/01/2004	19/01/2014
GWL 000154688 (001)	4000	Perth	Shire of Swan South	Perth - Superficial Swan	Racing and Wagering Western Australia	22, Kalamunda Road, Guildford	Swan Location 22 on Part Lot 2 on Diagram 26301; Certificate of Title Volume 1609 Folio 163 - Lot 22 Kalamunda Road Guildford	6/01/2004	6/01/2014
GWL 000155224 (002)	100000	Perth	Shire of Kalamunda	Perth - Superficial Swan	Western Australian Fire Brigades Board	10261, DUNDAS RD, FORRESTFIELD	Reserve 37260 on Plan 215367; Certificate of Title Volume LR3119 Folio 71 Reserve 37260 Dundas Road Forrestfield	15/06/2009	15/06/2019
GWL 000155429 (004)	162750	Perth	Shire of Kalamunda	Perth - Superficial Swan	Department of Education	3558, KALAMUNDA RD, MAIDA VALE	Crown Reserve 18689 - Lot 8558 Kalamunda Rd Maida Vale - Maida Vale Primary School	20/05/2010	25/03/2014
GWL 000155429 (004)	162750	Perth	Shire of Kalamunda	Perth - Superficial Swan	Department of Education	12500, NEWBURN RD, HIGH WYCOMBE	Crown Reserve 25959; Lot 12500 Newburn Road High Wycombe - High Wycombe Primary School	15/02/2012	23/02/2022
GWL 000155429 (004)	162750	Perth	Shire of Kalamunda	Perth - Superficial Swan	Department of Education	9109, BERKSHIRE RD, FORRESTFIELD	Crown Reserve 32845; Lot 9109 Berkshire Road Forrestfield - Darling Range Sports College	15/02/2012	28/02/2022
GWL 000155429 (004)	162750	Perth	Shire of Kalamunda	Perth - Superficial Swan	Department of Education	9101, BOUGAINVILLEA AV, FORRESTFIELD	Crown Reserve 29061; Lots 9101 & 10295 Dawson Avenue Forrestfield - Dawson Park Primary School	15/02/2012	28/02/2022
GWL 000155448 (005)	376875	Perth	Perth South Confined	Perth Leederville.	Department of Education	11688, WELLATON ST, MIDVALE	Lot 11688 On Plan 190653 Lot 11688 Wellaton St Midvale Midvale Primary School	15/07/2012	28/07/2022
GWL 000155694 (001)	7625	Perth	Shire of Kalamunda	Perth - Superficial Swan	Noske, Jeffrey John	3, BRAND RD, HIGH WYCOMBE	Lot 3 On Diagram 69590 - Volume/Folio 1723/472 - Lot 3 Brand Rd High Wycombe	21/02/2012	28/02/2022
GWL 000155696 (001)	2500	Perth	Shire of Kalamunda	Perth - Superficial Swan	De Haan, David; De Haan, Chrystine	5, SULTANA RD, FORRESTFIELD	Lot 5 On Plan 13574 - Volume/Folio 1593/553 - Lot 5 Sultana Rd Forrestfield	25/05/2004	20/05/2014
GWL 000156446 (005)	19000	Perth	Shire of Swan South	Perth - Superficial Swan	Brighton, Anthony		Lot 7 On Plan 30344 - Volume/Folio 2034/646 - Lot 7 Hazelmere	26/05/2004	21/05/2014
GWL 000156453 (001)	10300	Perth	Perth South Confined	Perth Leederville.	Shire of Kalamunda		Lot 2007 On Plan 26877 Volume/Folio 2713/141 Lot 2007 Forrestfield	23/02/2012	23/02/2022
GWL 000156772 (002)	103875	Perth	Perth South Confined	Perth Leederville.	Guildford Grammar School Inc	191, GREAT EASTERN HWY, GUILDFORD	Lot 191 On Diagram 4819 Volume/Folio 1375/236 Lot 191 Great Eastern Hwy Guildford Guildford Grammar School	19/07/2005	20/07/2015
GWL 000157266 (002)	15000	Perth	Shire of Mundaring	Perth - Superficial Swan	Shire of Mundaring	123, GREAT EASTERN HWY, MIDVALE	Lot 123 On Diagram 68478 - Volume/Folio 1712/10 - Lot 123 Great Eastern Hwy Midvale and Road verges on Great Eastern Hwy, Stanhope Gardens & Farrall Road Midvale	30/03/2010	11/12/2017
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	11583, KALAMUNDA RD, MAIDA VALE	Lot 11583 On Plan 217852 Volume/Folio Lr3122/450 Lot 11583 Kalamunda Rd Maida Vale Maida Vale Reserve/Tennis Club	22/06/2007	22/06/2017
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	9462, MARKHAM RD, HIGH WYCOMBE	Crown Reserve 36299 - Lot 9462 Markham Rd High Wycombe - High Wycombe Library	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	10427, SADDLEBACK CIR, MAIDA VALE	Crown Reserve 38271 - Lot 10427 Saddleback Cir Maida Vale - Saddleback Circle	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	14651, BENSON WY, HIGH WYCOMBE	Lot 14651 On Plan 33710 - Volume/Folio Lr3129/39 - Lot 14651 Benson Wy High Wycombe - Jacaranda 1 Lot 14650 On Plan 33710 - Volume/Folio Lr3130/410 - Lot 14650 Fulton Bvd High Wycombe - Jacaranda 1	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	13987, FRUIT TREE CR, FORRESTFIELD	Crown Reserve 46496 - Lot 13987 Fruit Tree Cr Forrestfield - Fruit Tree Way Lot 14509 On Plan 31502 - Volume/Folio Lr3128/106 - Lot 14509 Fruit Tree Cr Forrestfield - Fruit Tree Way	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	11887, WITTENOOM RD, HIGH WYCOMBE	Lot 11887 On Plan 18576 - Volume/Folio Lr3101/113 - Lot 11887 Wittenoom Rd High Wycombe - Vic Hobinson Park	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	13211, TREE FERN GRN, MAIDA VALE	Lot 13211 On Plan 22311 - Volume/Folio Lr3112/823 - Lot 13211 Tree Fern Grn Maida Vale - Pinker Reserve	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	7945, WITTENOOM RD, HIGH WYCOMBE	Crown Reserve 27815 - Lot 7945 Wittenoom Rd High Wycombe - Emms Reserve	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	15426, BOWDEN DR, HIGH WYCOMBE	Lot 15426 On Plan 38202 - Volume/Folio Lr3137/878 - Lot 15426 Bowden Dr High Wycombe - Jacaranda 2	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	11072, NEWBURN RD, HIGH WYCOMBE	Lot 11072 On Plan 188672 - Lot 11072 Newburn Rd High Wycombe - Fleming Reserve	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	570, NEWBURN RD, HIGH WYCOMBE	Lot 570 On Plan 15368 - Volume/Folio 1764/820 - Lot 570 Newburn Rd High Wycombe - Lot 570 Newburn Rd	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	15430, FRUIT TREE CR, FORRESTFIELD	Lot 15430 On Plan 40810 - Volume/Folio Lr3134/670 - Lot 15430 Fruit Tree Cr Forrestfield - Lot 15430 Fruit Tree Cres	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth Superficial Swan	Shire of Kalamunda	15405, WARDA CR, FORRESTFIELD	Lot 15405 On Plan 38797 Volume/Folio Lr3133/445 Lot 15405 Warda Cr Forrestfield Warda Est	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	601, HAWKEVALE RD, HIGH WYCOMBE	Lot 601 On Plan 24621 - Volume/Folio Lr3131/506 - Lot 601 Hawkevale Rd High Wycombe - Hawkevale Rd	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	10295, DAWSON AV, FORRESTFIELD	Crown Reserve 29061 - Lot 10295 Dawson Av Forrestfield - Dawson Park Crown Reserve 35618 - Lot 9685 Dawson Av Forrestfield - Dawson Park	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	11104, KOOKABURRA CR, HIGH WYCOMBE	Lot 11104 On Plan 16087 - Lot 11104 Kookaburra Cr High Wycombe - Peter Hegney Park	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	8295, NETHERWOOD RD, HIGH WYCOMBE	Crown Reserve 29104 - Lot 8562 Netherwood Rd High Wycombe - Mackenzie Park Crown Reserve 29104 - Lot 8295 Netherwood Rd High Wycombe - Mackenzie Park	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth Superficial Swan	Shire of Kalamunda	8927, DANDALONG WY, HIGH WYCOMBE	Crown Reserve 31571 Lot 8927 Dandalong Wy High Wycombe Progress Reserve	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	11956, WORRELL AV, HIGH WYCOMBE	Lot 11956 On Diagram 82220 - Volume/Folio Lr3103/241 - Lot 11956 Worrell Av High Wycombe - Ollie Worrell Reserve	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	11801, WYCOMBE RD, HIGH WYCOMBE	Lot 11801 On Plan 101250 - Volume/Folio Lr3101/134 - Lot 11801 Wycombe Rd High Wycombe - Scott Reserve	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	33, AGRAULIA CT, HIGH WYCOMBE	Lot 33 On Plan 49415 - Volume/Folio Lr3155/246 - Lot 33 Agraulia Ct High Wycombe - High Wycombe	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth Superficial Swan	Shire of Kalamunda	11856, O'CONNELL WY, HIGH WYCOMBE	Lot 11856 On Plan 14310 Volume/Folio Lr3100/842 Lot 11856 O'Connell Wy High Wycombe Pinetree Reserve	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	28, SWAN RD, HIGH WYCOMBE	Lot 28 On Plan 4666 Volume/Folio 1536/595 Lot 28 Swan Rd High Wycombe Rangeview Park Crown Reserve 36297 - Lot 9464 Swan Rd High Wycombe - Rangeview Park	3/02/2012	20/07/2015
GWL 000158077 (005)	893275	Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	10430, AKEBIA WY, FORRESTFIELD	Crown Reserve 34610 - Lot 9611 Akebia Wy Forrestfield - Akebia Way Reserve Crown Reserve 34610 - Lot 10430 Akebia Wy Forrestfield - Akebia Way Reserve	3/02/2012	20/07/2015
GWL 000158261 (002)	100500	Perth	Perth South Confined	Perth Leederville.	Shire of Mundaring	85, STANHOPE GDNS, MIDVALE	Lot 85 On Plan 15125 Volume/Folio 1702/343 Lot 85 Stanhope Gdns Midvale	8/12/2010	31/07/2012
GWL 000158261 (002)	100500	Perth	Perth South Confined	Perth - Leederville.	Shire of Mundaring	49, MUROS PL, MIDVALE	Lot 49 On Plan 1833 - Volume/Folio 1818/414 - Lot 49 Muros Pl Midvale	8/12/2010	31/07/2012
GWL 000159034 (003)	45400	Perth	Perth South Confined	Perth - Leederville.	Midland Redevelopment Authority		Lot 9014 On Plan 46737 - Volume/Folio 2739/400 - Lot 9014 Midland	12/04/2011	31/12/2014
GWL 000159397 (002)	12408	Perth	Shire of Kalamunda	Perth Superficial Swan	Mitchell, Maxwell John	22, BRUCE RD, MAIDA VALE	Lot 22 On Diagram 27388 Volume/Folio 1267/97 Lot 22 Bruce Rd Maida Vale	1/11/2007	1/11/2017
GWL 000159507 (003)	49900	Perth	Shire of Kalamunda	Perth - Superficial Swan	Hillview Lifestyle Village Pty Ltd		Lot 5 On Diagram 34820 - Volume/Folio 2183/887 - Lot 5 Kalamunda Road High Wycombe	16/03/2010	16/03/2020
GWL 000161194 (001)	8000	Perth	Perth South Confined	Perth - Leederville.	Guildford Grammar School Inc	24, TERRACE RD, GUILDFORD	Lot 24 On Plan 2315 - Volume/Folio 1071/570 - Lot 24 Terrace Rd Guildford	3/07/2006	13/12/2014
GWL 000161669 (003)	35250	Perth	Shire of Swan South	Perth Superficial Swan	Domain Project Development PTY LTD; Guilford Grammer School Foundation Inc.	PDE, SOUTH GUILDFORD	Lot 9003 On Plan 56679 Volume/Folio 2683/592 Lot 9003 South Guildford	20/05/2010	12/02/2019

GWL 000162380 (001)	2325 Perth	Shire of Mundaring	Perth - Superficial Swan	Shire of Mundaring	ENA VALLEY RD, HELENA VALLEY	Lot 207 On Plan 4633 - Volume/Folio 1626/767 - Lot 207 Helena Valley Rd Helena Valley	10/01/2010	22/12/2015
GWL 000163672 (002)	2021 Perth	Shire of Kalamunda	Perth - Superficial Swan	Kelly, Craig; Riley, Helen	LLIANA RD, MAIDA VALE	Lot 111 On Diagram 71401 - Volume/Folio 1727/988 - Lot 111 Sullaire Rd Maida Vale Lot 816 On Plan 53664 - Volume/Folio 2648/953 - Lot 816 Hazelmere	12/10/2004	12/10/2019
GWL 000164708 (003)	8700 Perth	Shire of Swan South	Perth - Superficial Swan	Rando, Stephen		Lot 816 On Plan 53664 - Volume/Folio 2648/953 - Lot 816 Hazelmere - Lot 816 Stirling Crescent, Hazelmere	26/11/2009	26/11/2019
GWL 000167016 (001)	7250 Perth	Shire of Kalamunda	Perth - Superficial Swan	Peters, Jennifer Ann	92, MILNER RD, HIGH WYCOMBE	Lot 92 On Plan 13420 Volume/Folio 1581/968 Lot 92 Milner Rd High Wycombe	17/10/2008	17/10/2018
GWL 000167041 (001)	3750 Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	28, NOTTINGHAM GRN, HIGH WYCOMBE	Lot 28 On Plan 49522 - Volume/Folio LR3139/210 - Lot 28 Nottingham Grn High Wycombe	17/10/2008	17/10/2018
GWL 000167147 (001)	11250 Perth	Perth South Confined	Perth - Leederville.	Shire of Mundaring	241, HELENA VALLEY RD, HELENA VALLEY	Lot 241 On Plan 4633 - Volume/Folio 1626/636 - Lot 241 Helena Valley Rd Helena Valley	8/12/2011	2/11/2016
GWL 000167785 (001)	3000 Perth	Shire of Kalamunda	Perth - Superficial Swan	Anstis, Rutika	220, NARDINE CL, FORRESTFIELD	Lot 220 On Plan 31168 Volume/Folio 2524/471 Lot 220 Nardine Cl Forrestfield	30/10/2008	30/10/2018
GWL 000167798 (001)	3740 Perth	Shire of Kalamunda	Perth - Superficial Swan	Miles, Peter Leslie	82, BRAE RD, HIGH WYCOMBE	Lot 82 on Diagram 60280; Certificate of Title Volume 1593 Folio 293 - Lot 82 Brae Road High Wycombe	16/04/2009	16/04/2019
GWL 000167912 (002)	1200 Perth	Shire of Kalamunda	Perth - Superficial Swan	Littlefield Development Pty Ltd	4, LITTLEFIELD RD, HIGH WYCOMBE	Lot 4 on Diagram 39161; Certificate of Title Volume 1308 Folio 640 - Lot 4 Littlefield Road High Wycombe	21/04/2010	19/02/2019
GWL 000168139 (002)	280775 Perth	Perth South Confined	Perth - Leederville.	City of Swan	98, HARPER ST, WOODBRIDGE	Lot 98 On Plan 76404 - Volume/Folio 2715/629 - Lot 98 Harper St Woodbridge - Ray Marshall Park Lot 183 On Plan 3387 - Volume/Folio 1112/502 - Lot 183 Crosbie Rd Woodbridge - Ray Marshall Park	30/06/2011	30/06/2016
GWL 000168139 (002)	280775 Perth	Perth South Confined	Perth - Leederville.	City of Swan	144, HELENA ST, GUILDFORD	Portion of Guildford Town Lot 144 and being the whole of the land comprised in Certificate of Title Volume 1228 Folio 232 - Lot 144 Helena Street Guildford	30/06/2011	30/06/2016
GWL 000168139 (002)	280775 Perth	Perth South Confined	Perth - Leederville.	City of Swan	9621, MORRISON RD, SWAN VIEW	Crown Reserve 35169 - Lot 9621 Morrison Rd Swan View - Sweetmore Oval	30/06/2011	30/06/2016
GWL 000168139 (002)	280775 Perth	Perth South Confined	Perth - Leederville.	City of Swan	52, MORRISON RD, MIDLAND	Lot 52 On Plan 3288 Volume/Folio 2156/711 Lot 52 Morrison Rd Midland Midland Oval	30/06/2011	30/06/2016
GWL 000168139 (002)	280775 Perth	Perth South Confined	Perth - Leederville.	City of Swan	10174, GRAY DR, MIDVALE	Crown Reserve 37372 - Lot 10174 Gray Dr Midvale - Ron Rose Oval	30/06/2011	30/06/2016
GWL 000168139 (002)	280775 Perth	Perth South Confined	Perth - Leederville.	City of Swan	13421, LEDDA BARRON DR, MIDDLE SWAN	Lot 13421 On Plan 220278 - Volume/Folio LR3119/605 - Lot 13421 Ledda Barron Dr Middle Swan - Velodrome	30/06/2011	30/06/2016
GWL 000168473 (001)	900 Perth	Shire of Kalamunda	Perth - Superficial Swan	O'Reilly, Peter Hamilton	32, HAWTIN RD, MAIDA VALE	Lot 32 On Diagram 52799 - Volume/Folio 1509/74 - Lot 32 Hawtin Rd Maida Vale	28/07/2009	28/07/2019
GWL 000168641 (007)	15875 Perth	Shire of Swan South	Perth - Superficial Swan	Metropolitan Cemeteries Board		Lot 501 On Plan 52787 - Volume/Folio 1831146/639 - Lot 501 South Guildford and Lot 502 On Plan 52787 - Volume/Folio 1831146/640 - Lot 502 South Guildford	21/04/2010	11/11/2017
GWL 000169011 (003)	12750 Perth	Shire of Kalamunda	Perth - Superficial Swan	Sandyvale Holdings Pty Ltd	15401, CLAIRE WY, HIGH WYCOMBE	Lot 15401 On Plan 39513 Volume/Folio LR3134/618 Lot 15401 Claire Wy High Wycombe	10/09/2010	9/09/2015
GWL 000169609 (001)	2850 Perth	Shire of Mundaring	Combined - Fractured Rock West - Fractured Rock	Tiang, Mohamad	19, SAMSON PL, HELENA VALLEY	Lot 19 On Plan 4508 - Volume/Folio 1661/753 - Lot 19 Samson Pl Helena Valley	20/01/2010	19/01/2020
GWL 000171848 (001)	4500 Perth	Shire of Kalamunda	Perth - Superficial Swan	Quaker Oats Australia Pty Ltd	3, DUNDAS RD, FORRESTFIELD	Lot 4 On Diagram 49722 - Volume/Folio 1430/986 - Lot 4 Dundas Rd Forrestfield	9/04/2010	8/01/2020
GWL 000173681 (001)	10600 Perth	Shire of Mundaring	Combined - Fractured Rock West - Fractured Rock	Helena Valley Residential Resort Pty Ltd	717, HELENA VALLEY RD, HELENA VALLEY	Lot 717 On Plan 4633 - Volume/Folio 1627/717 - Lot 717 Helena Valley Rd Helena Valley	20/10/2010	20/10/2020
GWL 000170758 (001)	3375 Perth	Shire of Kalamunda	Perth - Superficial Swan	Mulligan Nominees Pty Ltd	500, ABERNETHY RD, HIGH WYCOMBE	Lot 500 On Plan 57819 - Volume/Folio 2687/154 - Lot 500 Abernethy Rd High Wycombe	10/06/2010	10/06/2020
GWL 000174166 (001)	13500 Perth	Shire of Mundaring	Perth - Superficial Swan	Hemsley, Jeffrey	1, HELENA VALLEY RD, HELENA VALLEY	Lot 1 On Plan 51853 - Volume/Folio 2031/573 - Lot 1 Helena Valley Rd Helena Valley Lot 9000 On Plan 30961 - Volume/Folio 2223/565 - Lot 9000 West Poe South Guildford	28/07/2010	28/07/2015
GWL 000172101 (001)	168500 Perth	Shire of Swan South	Perth - Superficial Swan	Swift Investments Pty Ltd	9000, WEST PDE, SOUTH GUILDFORD	Lot 57 On Plan 30643 - Volume/Folio 2720/200 - Lot 57 West Pde South Guildford	20/10/2010	20/10/2020
GWL 000172128 (002)	19500 Perth	Shire of Mundaring	Combined - Fractured Rock West - Fractured Rock	Department of Education	6714, INNAMINCKA RD, GREENMOUNT	Lot 6714 On Diagram 23385 Volume/Folio L'3013/567 Lot 6714 Innaminckia Rd Greenmount Greenmount Primary School	21/02/2012	28/02/2022
GWL 000172312 (001)	13500 Perth	Shire of Kalamunda	Perth - Superficial Swan	Tyler, Donald	534, BERKSHIRE RD, FORRESTFIELD	Lot 534 On Plan 4984 - Volume/Folio 1219/69 - Lot 534 Berkshire Rd Forrestfield	30/11/2010	30/11/2020
GWL 000172424 (001)	94888 Perth	Perth South Confined	Perth - Leederville.	Mastmahon Contractors Pty Ltd		Lot 41 On Diagram 14646 - Volume/Folio 1130/502 - Lot 41 Mahole	4/01/2011	/01/2013
GWL 000172427 (001)	9175 Perth	Shire of Mundaring	Combined - Fractured Rock West - Fractured Rock	ROMAN CATHOLIC ARCHBISHOP OF PERTH	200, INNAMINCKA RD, GREEN MOUNT	Lot 200 On Diagram 61972 - Volume/Folio 1859/153 - Lot 200 Innaminckia Rd Greenmount - Saint Anthony's School Greenmount	2/12/2010	2/12/2020
GWL 000173875 (001)	19340 Perth	Shire of Mundaring	Perth - Superficial Swan	Whitehouse Nominees Pty Ltd	204, HELENA VALLEY RD, HELENA VALLEY	Lot 204 On Plan 4633 - Volume/Folio 1738/771 - Lot 204 Helena Valley Rd Helena Valley	23/06/2011	22/06/2021
GWL 000174323 (001)	5200 Perth	Shire of Kalamunda	Perth - Superficial Swan	Shire of Kalamunda	527, BERKSHIRE RD, FORRESTFIELD	Lot 527 On Plan 4684 Volume/Folio 1263/561 Lot 527 Berkshire Rd Forrestfield	13/01/2012	13/01/2014
GWL 000175090 (001)	750 Perth	Shire of Mundaring	Perth - Superficial Swan	Bulldon Group Pty Ltd	206, HELENA VALLEY RD, HELENA VALLEY	Lot 206 On Plan 4633 - Volume/Folio 1747/599 - Lot 206 Helena Valley Rd Helena Valley	23/02/2012	23/07/2012

MDW
ENVIRONMENTAL SERVICES

Appendix C – Site Survey Data

REPORT

Midland Survey Services
3 Victoria Street MIDLAND WA 6056
Tel: (08) 9374 7777 | Fax: (08) 9374 7799
E-Mail: survey@midlandsurveys.com.au

DATE	29th June 2012	**FAX No.**			
TO	**Environmental Services**	**ATTENTION**	**Greg Watts**		
FROM	Chew Chee Xun	**JOB - DOCUMENT No.**	**11460-W1**	**REV**	**0**
TOTAL PAGES INCLUDING THIS ONE	1	**REPLY REQUIRED**	No		

HEADING **Lot 20 Adelaide Street, Hazelmere**

CLIENT ORDER No.

1. Co-ordinates are in metres related to MGA on SSM MV75
2. Levels are in metres related to AHD based on SSM MV75 (RL: 23.0803m)
3. Levels are to **top of PVC pipe within outer casing**
4. Surveyor: **Chew Chee Xun**
5. Date of Survey: **29th June 2012**
6. Field Book Number: **1215**

Name	Easting	Northing	Casing RL(m)
MB1	406504.04	6467036.79	27.281
MB2	406693.90	6466947.24	30.607
MB3	406997.15	6466823.35	34.622
MB4	406617.75	6467311.73	27.751
MB5	406731.40	6467262.78	29.034
MB6	406998.45	6467183.20	31.611

Approved _____

Training Manager