Environmental Services

Specialising in:

Acid Sulphate Soils
Contaminated Site Assessment
Air Quality Investigations
Remediation Advice and Design
Groundwater Management
Facility Maintenance

ABN 36 835 856 256

ANNUAL GROUNDWATER SUMMARY REPORT

Lot 20 Adelaide Street Hazelmere

PREPARED FOR:

Wasterock Pty Ltd

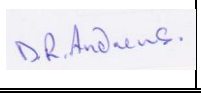
Mobile Dewatering Environmental Services Pty Ltd as trustee for
Mobile Dewatering Environmental Services Unit Trust
U1/22 Elmsfield Road, Midvale, Western Australia 6056
P: +61 (0) 8 9250 6960 F: +61 (0) 8 92508269
W: www.environmentalservices.com.au

Environmental Services

DOCUMENT DETAILS

Title:	Annual Groundwater Summary Report
Project Address	Lot 20 Adelaide Street, Hazelmere
Client	Wasterock Pty Ltd
Job Number	E2012-031
Author:	Dale Andrews
Project Manager	Greg Watts
Email:	greg@environmentalservices.com.au
Status:	Final
Synopsis:	This document and investigation has been prepared in accordance with the Contaminated Sites Act, Western Australia (2006) and Department of Environment and Conservation (DEC) Contaminated Sites Management Series guidelines. The Scope of Works lists the extent of the investigation undertaken.

DOCUMENT DISTRIBUTION

Version No	Written by Date	Reviewed by Date	Issued by Date	Distributed to	Copies
Final v1	Dale Andrews 9/08/13	Mathew Bulmer 03/09/13	Greg Watts 18/10/13	Hazelland Pty Ltd	Email
Signed					

Disclaimer

This document has been prepared in accordance with a scope of works, set out in a proposal, or as otherwise agreed, between the client and MDW Environmental Services (MDWES). The scope of work may have been limited by time, budget, access and or other constraints and has been prepared in the absence of any knowledge of the study area other than that stated in this document. This document has been prepared on behalf of and for the exclusive use of the client, and is subject to and issued in accordance with the agreement between MDWES and the client. MDWES accepts no liability or responsibility whatsoever in respect to its use, or reliance upon, by any third party outside of its intended use. This document has commercial confidence status. Copying of this report or any part thereof is not permitted without the authorisation of the client, for the expressed purpose of regulatory assessment. Unless specifically agreed otherwise, MDWES retains intellectual property rights over the contents of this document.

Unless otherwise stated, MDWES regards the extent of investigations and assessments reasonable in the context of the scope of works and the purpose of the investigation. The information contained in this document is provided in good faith in the general belief that no information, opinions, conclusions or recommendations made are misleading, but are reasonable and appropriate at the time of issue of this document. This document must be read in its entirety. Users are cautioned that assumptions made in this document may change over time and it is the responsibility of the user to ensure that assumptions remain valid. Reported results, while accurate at the time of reporting cannot be considered absolute or conclusive without long term follow up studies.

Comments and opinions presented in this document are based on the extent of the scope of works and / or on information supplied by the client, their agents and / or third parties. In preparing this document MDWES has relied upon reports, data, surveys, analyses, designs, plans and / or other information provided by the client and other individuals and organisations outside its control. Except as stated otherwise in the document MDWES has not verified the accuracy or completeness of this information. To the extent that the statements, opinions, facts, information, conclusions and / or recommendations in the document are based in whole or part on this information, those are contingent upon the accuracy and completeness of the information. MDWES will not be liable in relation to incorrect conclusions should any information be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed.

Within the limitations imposed by the scope of work, the assessment of the study area and preparation of this document have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants and occupational hygienists under similar circumstances. No other warranty, expressed or implied, is made. MDWES will not be liable to update or revise the document to take into account any events, circumstances or facts occurring or becoming apparent after the date of this document.

Specific warning is given that many factors, natural or artificial, may render conditions different from those that prevailed at the time of investigation and should they be revealed at any time, they should be brought to our attention so that its significance may be assessed and appropriate advice may be offered.

MDWES, its agents and employees, expressly disclaim any and all liability for representations, expressed or implied, contained in, or omissions from, this report or any of the written or oral communications transmitted to the client or any third party.

Acceptance of this document denotes acceptance of these terms.

Table of Contents

List of Tables in Report

List of Figures in Report

List of Attachments

Tables

Table 1 – Groundwater Analysis Results – WRMW1
Table 2 – Groundwater Analysis Results – WRMW2
Table 3 – Groundwater Analysis Results – WRMW3
Table 4 – Groundwater Analysis Results – WRMW4
Table 5 – Groundwater Analysis Results – WRMW5

Appendices

Appendix A – Certificate of Title
Appendix B – Groundwater Monitoring Event #1-4 Reports

EXECUTIVE SUMMARY

MDW Environmental Services (MDWES) was commissioned by Wasterock Pty Ltd to undertake groundwater investigations on the Hazelland site at Lot 20 Adelaide Street, Hazelmere (the Site). Groundwater monitoring events (GMEs) were completed on a quarterly basis to collect sufficient data to enable the interpretation of the annual fluctuations and trend of the groundwater beneath the Site.

A total of four (4) quarterly GMEs were completed during the months of May, August, January and June to capture seasonal variations in depth to water as well as chemical and physical properties of the groundwater. This Annual Groundwater Summary Report draws on the sampling and laboratory analysis completed during the GMEs and further information should be found within the following documents:

- *E2013-031 by MDWES – Groundwater Investigation Report – Hazelland Landfill Site, Lot 20 Adelaide Street, Hazelmere. (May 2012).*
- *E2013-031 Addendum 1 by MDWES – Groundwater Monitoring Event #2 – Hazelland Landfill Site, Lot 20 Adelaide Street, Hazelmere. (September 2012).*
- *E2013-031 Addendum 2 by MDWES – Groundwater Monitoring Event #3 – Hazelland Landfill Site, Lot 20 Adelaide Street, Hazelmere. (February 2013).*
- *E2013-031 Addendum 3 by MDWES – Groundwater Monitoring Event #4 – Hazelland Landfill Site, Lot 20 Adelaide Street, Hazelmere. (May 2013).*

Field results indicate that the groundwater flows in a north-north easterly direction and is intercepted between 18.6 RL mAHD (Relative Level metres Australian Height Datum) and 23.8 RL mAHD. Average groundwater flux across the Site during the 2012 -2013 test period was 0.8m.

Laboratory results indicate that total petroleum hydrocarbons (TPH) has impacted upon the groundwater below the Site. However, concentrations remain below assessment criteria and therefore not a concern at present. Current data does not accurately show the location and extent of the TPH impact.

Results indicate a seasonal fluctuation of nutrient concentrations which increase with the wet months and decrease during the dry months.

All other analytes do not exhibit tends or signs of seasonal fluctuation identifiable within the available data.

1 INTRODUCTION

This report has been prepared to summarise the annual trends and fluctuations of the groundwater at the Hazelland Landfill in Hazelmere, herein referred to as the Site. MDW Environmental Services (MDWES) were commissioned by Wasterock Pty Ltd to complete quarterly groundwater investigations and compile an Annual Groundwater Summary Report.

This report encompasses sampling and results from groundwater monitoring events (GME) completed during 2012 and 2013. This report should be read in conjunction with the following reports. For further information on the sampling events please refer to the following reports (Appendix B):

- *E2013-031 by MDWES – Groundwater Investigation Report – Hazelland Landfill Site, Lot 20 Adelaide Street, Hazelmere. (May 2012).*
- *E2013-031 Addendum 1 by MDWES – Groundwater Monitoring Event #2 – Hazelland Landfill Site, Lot 20 Adelaide Street, Hazelmere. (September 2012).*
- *E2013-031 Addendum 2 by MDWES – Groundwater Monitoring Event #3 – Hazelland Landfill Site, Lot 20 Adelaide Street, Hazelmere. (February 2013).*
- *E2013-031 Addendum 3 by MDWES – Groundwater Monitoring Event #4 – Hazelland Landfill Site, Lot 20 Adelaide Street, Hazelmere. (May 2013).*

2 SCOPE OF WORK

The Scope of Work for this project is as follows:

- Complete quarterly GME over a twelve (12) month period.
- Collect and analyse representative samples from six groundwater monitoring wells for each GME. Samples will be analysed by a NATA accredited laboratory for:
  - Total Petroleum Hydrocarbon / Total Recoverable Hydrocarbon (TPH/TRH);
  - Monocyclic Aromatic Hydrocarbons (MAH);
  - Polynuclear Aromatic Hydrocarbons (PAH;
  - Benzene, Toluene, Ethyl Benzene and Xylene (BTEX);
  - Phenolic Compunds;
  - Dissolved and Total Metalloids (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn); and
  - Organochlorine and Organophosphorous Pesticides (OC/OP).
- Using the data sets from each quarterly GME compare and identify seasonal and annual trends and fluctuations of the groundwater.
- Compile a detailed scientific report.

2.1 Objectives

The technical objectives of the investigation are to:

- Identify the annual directional flow of the groundwater below the site;
- Identify and determine the extent of the risk that any identified contamination may pose to human health and the environment;
- Identify seasonal fluctuations in groundwater depth and quality below the site;
- Establish groundwater data from the Site prior to the proposed remediation works;
- Determine the suitability of water abstraction from the superficial aquifer for the purposes of dust suppression and compaction.

3 SITE IDENTIFICATION

Information regarding the Site identification is presented in Table A below.

Table A: Site Summary Form

Site Location:	Lot 20 Adelaide Street, Hazelmere
Current Site Use:	Industrial
Total Site Area:	2054 m^2
Folio:	299
Certificates of Title:	20/D76128 (Appendix A)
Local Council:	City of Swan

The Site is bound by the coordinates as shown in Table B.

Table B: Site UTM coordinates

BOUNDARY CORNERS	**MGA94 Zone 50**	
	Easting (E)	**Northing (N)**
North west corner	406595	6467321
North east corner	407034	6467190
North east corner (mid)	406939	6467172
South east corner	407015	6466812
South west corner	406476	6467046
Eastern Corner	407078	6467020

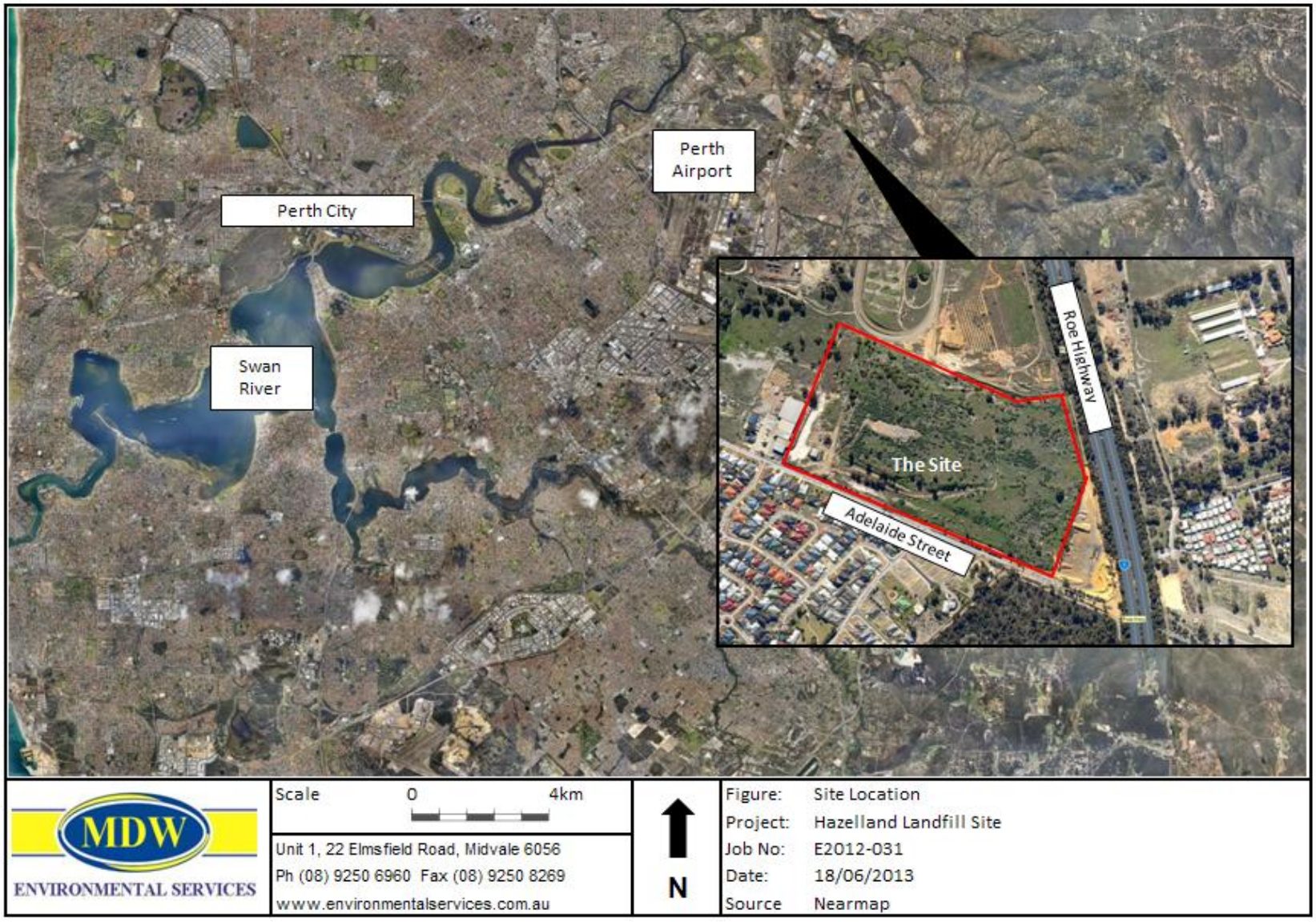


Figure 1 Site Location Map

4 BACKGROUND INFORMATION

The Site (Figure 1) is located within the City of Swan, approximately 14 km east north east of Perth CBD. Situated between Talbot Road and Adelaide Street access is gained from the south of the Site off Adelaide Street. Historically the Site was occupied and used as a licenced inert waste landfill in which potentially contaminating wastes were dumped. Following investigation by Parsons Brinckerhoff (2006) the Site was classified "Contaminated – Remediation Required" by the Department of Environment and Conservation (DEC). The Parsons Brinckerhoff report contains substantial amounts of background information regarding this property and the Groundwater Investigation Report should be read in conjunction with this previously completed soil investigation.

4.1 Site History

A detailed historical investigation was not completed as part of this GME.

4.2 Land Owner

The Site 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. A copy of the Certificate of Title is attached in Appendix A.

4.3 Land Use

The Site has been used for collection and storage of inert demolition waste as landfill with some potentially contaminating waste.

4.4 Site Boundary

The Site is surrounded by private land to the north and south with industrial proprieties to the west and Roe Highway runs along the eastern boundary.

4.5 Groundwater Use

The site does not currently make use of groundwater.

4.6 Previous Studies

Soil investigations were completed on Site during 1992 (Dames and Moore) and 2006 (Parsons Brinckerhoff).

4.7 Contaminated Sites Database

The site is currently classified as "*Contaminated – Remediation Required*" as per DEC Contaminated Sites Database.

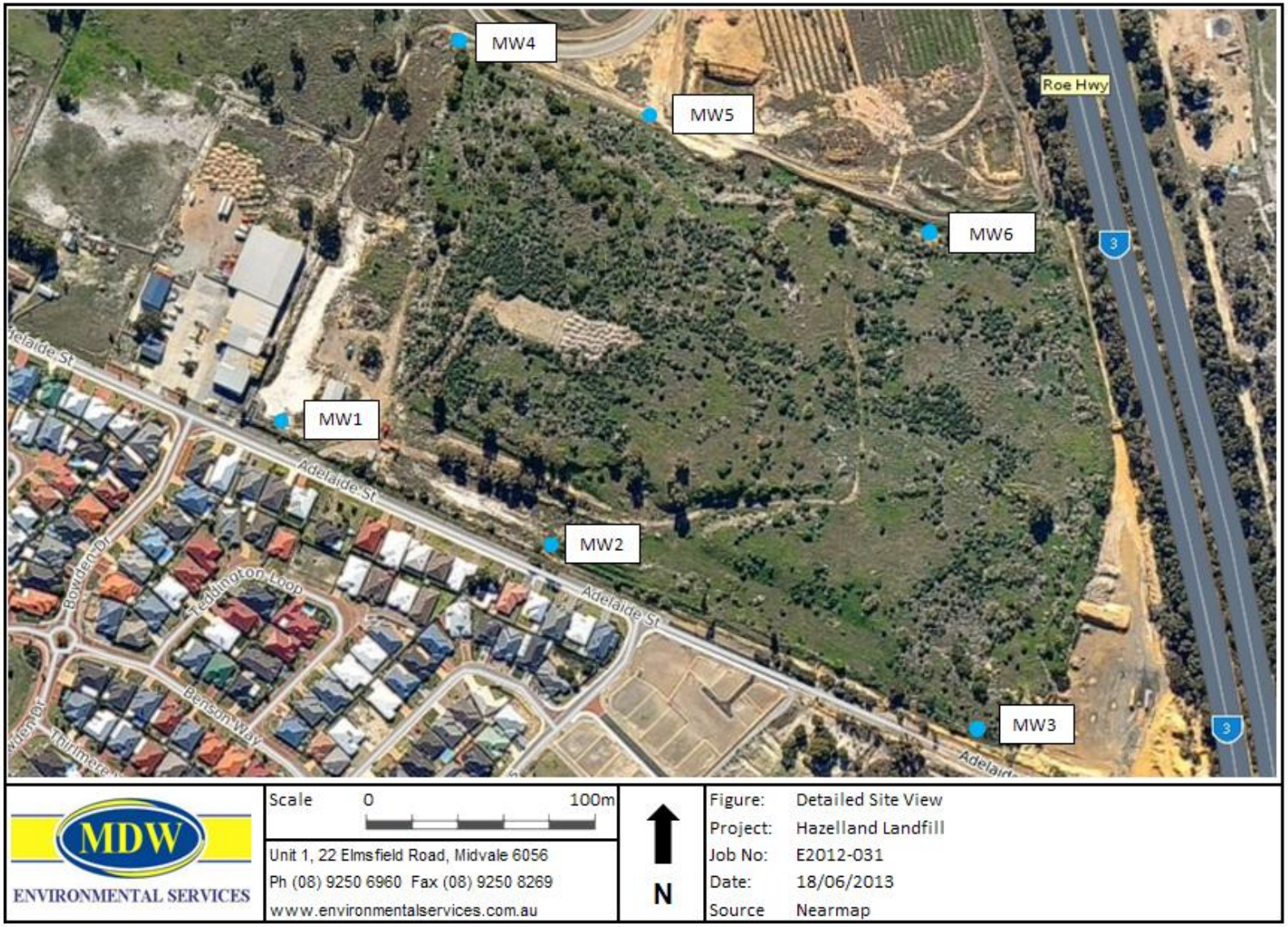


Figure 2 Monitoring Well Locations

5 POTENTIAL CONTAMINANTS OF CONCERN (PCOC)

The land is proposed for development into industrial lots. The following list of Potential Contaminants of Concern (PCOC) is based on the proposed use, historical and current Site activities, regional soil and related issues, proximity to classified contaminated sites and off-site sources of impacts:

- Dissolved and Total Metalloids: Arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), manganese (Mn), molybdenum (Mo), nickel (Ni), silver (Ag), selenium (Se), vanadium (V), zinc (Zn), and mercury (Hg);
- Benzene, Toluene, Ethyl Benzene, Xylene (BTEX);
- Polynuclear Aromatic Hydrocarbons (PAH);
- Monocyclic Aromatic Hydrocarbons (MAH);
- Phenolic compounds;
- Total Petroleum Hydrocarbons / Total Recoverable Hydrocarbons (TPH/TRH);
- Organochlorine and Organophosphorous Pesticides (OC/OP).

5.1 Preferential Contaminant Pathways

Many of the PCOC identified have the potential to impact soil and groundwater at the Site and surrounding areas. Listed above are the contaminants most likely to be found within the fill and most likely to present a risk to human health and the environment. The PCOC have been identified due to the wide range of inert demolition waste likely to have been deposited at the Site. The preferential contaminant pathways can be summarised as soil, air and groundwater; notwithstanding that the Scope of Works for this investigation only includes assessment of groundwater.

6 SAMPLING ANALYSIS PLAN AND METHODOLOGY

The Monitoring Well (MW) locations (on Site) are shown in Figure 2. The groundwater sampling conducted at the Site is summarised in Table C below.

The sampling and analysis of quarterly GME's was completed to determine whether imported fill on the site had adversely affected the groundwater and establish background groundwater quality. This report utilise the GME data to identify trends and fluctuations over the previous 12 months to create an insight into annual groundwater quality of the Site.

Table C: Groundwater Investigation Summary

Activity	Details
Date of Field Activity	18/5/2012, 30/8/2012, 15/1/2013 and 3/6/2013.
Investigation	A total of six groundwater wells located onsite and sampled during each groundwater sampling event.
Sampling Method	Monitoring wells were sampled via use of a 12V GeoTech Low Flow Bladder pump coupled to YSI Quattro low flow sampler
Samples	One sample is collected from each monitoring well during each GME and a total of six samples collected for each event.
Calibration	YSI Quattro low flow calibrated
Decontamination Procedure	Gloves were disposed of after each sample taken.
Analysis	• Dissolved and Total Metals • Nutrients • Groundwater Parameters • OC/OP • Phenolic Compunds • PAH • TRH/TPH • BTEX
Laboratory	Samples were sent to the primary laboratory, ALS Environmental. Secondary samples were sent to ARL, both NATA Accredited.
Sample Preservation	Samples were placed in laboratory supplied bottles. Samples were stored on ice (<4°C) in an esky while on site and in transit to the laboratory.

7 QUALITY ASSURANCE / QUALITY CONTROL

The following Quality Assurance / Quality Control (QA/QC) program was implemented throughout the investigations to ensure the accuracy and precision of the data obtained. QC measures the effectiveness of the procedures of the QA program.

7.1 Quality Assurance

All procedures including staff selection, sampling methodologies, equipment, analysis methods and data transfer were based on:

- Australian Standards AS-4482.1-2005 and AS-4482.2-1999: Guides to the Sampling and Investigation of Potentially Contaminated Soil.
- Australian/New Zealand Standard AS/NZS 5667.1:1998 Water Quality-Sampling.

Particularly, the following actions applied:

- Samples were collected by a trained, experienced field technician,
- Samples were collected by the same personnel, ensuring that techniques used were consistent across the sampling program.

7.2 Groundwater Sampling Procedure

All groundwater samples were subject to the following procedures:

- Dedicated tubing was used for each well and the pump and low flow cell were decontaminated between wells;
- Samples were collected into laboratory supplied sample bottles. Preservatives (if required) were provided by the laboratory in the appropriate sample bottle;
- Samples were filled to the top to ensure no headspace remained;
- All samples were marked in the field using permanent marker with a label showing sample location, date and job number;
- Samples were immediately placed on ice within an esky for transport to the laboratory.

For further details and laboratory certificates of analysis including sample receipt notification, chain of custody and laboratory quality control see the associated GME report.

7.2.1 Decontamination of Sampling Equipment

All sampling equipment was decontaminated prior to use and between each sample location. Decontamination was completed using the following procedure:

- Equipment washed in water;
- Equipment thoroughly scrubbed in water with Decon90;
- Equipment rinsed in tap water;
- Equipment rinsed in de-ionised water.

7.3 Laboratory

Two NATA certificated laboratories were selected to analyse the samples. ALS Laboratory Group was selected as the primary laboratory. ARL WA was the secondary laboratory used for the analysis to replicate samples and for inter-laboratory quality control (QC).

The laboratory conducts internal quality control analysis as part of their QA/QC Procedures. Following discussions with the laboratory and a review of their laboratory certificates of analysis, the following laboratory QC protocols occur:

- At least 10% of samples are split into internal laboratory duplicate samples. These samples are homogenised prior to splitting into sub samples;
- At least 5% of samples are run with Matrix Spikes of known additions;
- Laboratory Control Samples (LCS) are run at the required rate (minimum 1 LCS per batch of samples). The LCS results are reported in the laboratory certificates named 'Interpretive Quality Control Report' and the 'Quality Control Report'.

For further details and laboratory certificates of analysis including sample receipt notification, chain of custody and laboratory quality control see the associated GME report.

7.4 Quality Control

To ensure the quality of the sampling method and laboratory analysis Quality Control (QC) samples were collected for each GME consisting of one (1) Rinsate Blank, one (1) Field Blank, one (1) set of duplicate and triplicate samples of a groundwater sample.

The reproducibility of the sampling and analytical methodology is measured as precision. Laboratory and field precision is measured using the Relative Percent Difference (RPD) between the sample and its duplicates. For further details and internal and external QC information refer to the associated GME report.

For those RPD values which exceed a generally acceptable 30% - 50% (Australian Standard AS 4482.1), data precision is considered poor, however, consideration needs to be given to sample homogeneity and the concentrations detected. Therefore, the acceptable ranges adopted for the RPDs are based on the laboratories RPD acceptance criteria and are dependent on the magnitude of results in comparison to the limits of reporting (LOR) as follows:

Result < 10 times LOR = No limit

Result 10 – 20 times LOR = 0% - 50%

Result > 20 times LOR = 0% - 20%

Where values are reported below the laboratory LOR, RPDs are not calculated.

For further information and groundwater QC results review the report associated with each GME.

7.5 Waste Disposal

Sampling was completed in consultation with MDWES Standard Operating Procedure and all waste was disposed of appropriately as to not impose a risk or cause contamination.

8 ASSESSMENT CRITERIA

To assess the groundwater quality at the Site, water quality results were compared against the 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:

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC 2000) as reproduced in the DEC's *Contaminated Site Management Series - Assessment Levels for Soil, Sediment and Water* (DEC 2010):
    - Freshwater Ecosystems
    - Marine Ecosystems
    - Short-term Irrigation Water
    - Long-term Irrigation Water
- Department of Health *Contaminated Sites Reporting Guideline for Chemicals in Groundwater*, (DoH 2006):
    - Domestic Non-Potable groundwater use
- National Health and Medical Research Council and Agriculture and Resource Management Council of Australia and New Zealand *Australian Drinking Water Guidelines* (NHMRC & ARMCANZ 2004):
    - Drinking Water Health Value
    - Drinking Water Aesthetic Value

It should be noted that the purpose of this report is to summarise the groundwater on an annual basis rather that note individual exceedances of assessment criteria. Laboratory analyses of groundwater samples undertaken onsite are presented in Table 1 through to Table 5.

9 RESULTS

Full laboratory results for the GME's conducted by MDWES during 2012/2013 are presented in the attachment Tables. GME Reports #1-4 are included in Appendix B.

The following notes are the summaries of laboratory results for the annual testing and the comparison to assessment criteria.

9.1.1 Total Petroleum Hydrocarbons (TPH)

Each of the TPH fractions analysed were generally below the laboratory LOR. The following TPH fractions, indicated in Table D below, were above the LOR. However, none of the TPH analysed identified concentrations above the assessment criteria adopted during the year.

Table D: Summary of TPH against LOR

Analytes	LOR	Location and concentration of analytes above the LOR concentration
C_{15} – C_{28}	100	**WRMW1** (200µg/L)**, WRMW3** (110µg/L), **WRMW6** (260µg/L, 380µg/L, 380µg/L)
C_{29} – C_{36}	50	**WRMW3** (270µg/L, 100µg/L) , **WRMW6** (60µg/L, 60µg/L)
C_{10} – C_{36} (sum)	50	**WRMW1** (200µg/L)**, WRMW3** (270µg/L, 210µg/L), **WRMW6** (320µg/L, 380µg/L, 440µg/L)

9.1.2 Monocyclic Aromatic Hydrocarbons (MAH)

Each of the speciated MAH analysed were below the LOR for each location throughout the year.

9.1.3 Polycyclic Aromatic Hydrocarbons (PAH)

Each of the speciated PAH analysed were below the LOR for each location throughout the year.

9.1.4 Phenolic Compounds

Each of the speciated phenolic compounds analysed were below the LOR for each location throughout the year.

9.1.5 Benzene, Toluene, Ethyl Benzene, Xylene (BTEX)

Each of the speciated BTEX analytes analysed were below the LOR within those samples analysed for each location throughout the year.

9.1.6 Organochlorine Pesticides (OC)

Each of the speciated OC analysed were below the LOR for each location throughout the year.

9.1.7 Organophosphorus Pesticides (OP)

Each of the speciated OP analysed were below the LOR for each location throughout the year.

9.1.8 Major Anions and Cations

There were no elevated concentrations of the major anions and cations above the assessment criteria adopted throughout the year.

9.1.9 Metals

Many total and dissolved metals concentrations exceed the LOR, Table E details summaries and notes of analytes which exceed assessment criteria or considered elevated.

Table E: Summary of Total and Dissolved Metals Exceedances.

Location	Dissolved Metals	Total Metals
WRMW1	Aluminium, Zinc and Iron.	Aluminium, Copper, Lead, Nickel, Zinc and Iron.
WRMW2	Aluminium, Nickel, Zinc and Iron.	Aluminium, Copper, Lead, Zinc and Iron.
WRMW3	Aluminium, Zinc and Iron.	Aluminium, Copper, Lead, Managanese, Nickel, Zinc, Iron and Mercury.
WRMW4	Aluminium, Nickel, Zinc and Iron.	Aluminium, Copper, Lead, Nickel, Zinc and Iron.
WRMW5	Aluminium, Zinc and Iron,	Aluminium, Copper, Lead, Zinc and Iron.
WRMW6	Aluminium, Nickel, Zinc and Iron.	Aluminium, Copper, Lead, Nickel, Zinc and Iron.

9.1.10 Nutrients

Total Nitrogen and Total Phosphorus exceed Fresh Waters assessment criteria at all locations throughout the year.

9.2 Data Interpretation

Laboratory analyses of samples completed during the GME's are tabulated to identify changes in groundwater quality (attached Table 1 to Table 5). The following points are summarisations and identification of trends of the annual data.

- Laboratory results of MW1 samples indicate an increase in pH, Total Aluminium, Total Lead, Total Zinc, Total Lead, TRH ($<C_{16} – C_{34}$ Fraction), and TPH ($C_{15} – C_{28}$ Fraction). MW1 Decreased in levels observed for Dissolved Aluminium, Total Zinc, and Total Nitrogen. All other analytes remained relatively similar throughout monitoring events.
- MW2 laboratory results indicate that pH, Suspended Solids (SS), Turbidity, Dissolved and Total Iron and Total Aluminium have increased between monitoring events. Dissolved Aluminium, Dissolved Zinc, Dissolved Nickel, Total Copper and Total Nitrogen have decreased, whilst all other analytes have remained similar.
- Results for MW3 show that Dissolved Aluminium, Dissolved Manganese, Dissolved Iron, Total Nitrogen and Total Phosphorus have decreased. Turbidity, SS, Acidity, Dissolved Zinc, Total Aluminium, Total Copper, Total Lead, Total Manganese, Total Nickel, Total Zinc, Total Iron, TPH ($C_{15} – C_{28}$ Fraction and $C_{29} – C_{36}$ Fraction), and TRH ($>C_{16} – C_{34}$ Fraction) have increased. All other analytes remained similar throughout all monitoring events.
- Laboratory results of MW4 indicate a decrease in SS, Turbidity, Chloride, Dissolved Aluminium, Dissolved Nickel, Dissolved Zinc, Total Aluminium, Total Copper, Total Lead, Total Nickel, Total Zinc, Total Iron, Total Nitrogen and Total Phosphorus. An increase was only evident in TDS. All other analytes remained relatively similar over the monitoring events.
- Comparisons of MW5 results indicate a decrease in TDS, Dissolved Aluminium, Dissolved Zinc, Total Aluminium, Total Copper, Total Lead, Total Zinc and Total Iron, whilst increases were evident in pH, Acidity and Total Nitrogen. All other analytes remained relatively similar throughout previous monitoring events.
- MW6 was not sampled during GME #4 due to the monitoring well being dry.

9.3 Groundwater Levels

The depth to groundwater was measured during the GME's and tabulated with historical data (Table F). Commencement of monthly depth to groundwater measurements also occurred (March and ongoing) with groundwater depths presented in Table G.

An interface meter was used to verify the presence / absence of free phase hydrocarbon products over the groundwater with no free phase products detected. Groundwater is intercepted between 18.6 RL mAHD (Relative Level metres Australian Height Datum) and 23.8 RL mAHD. Average seasonal variation experienced within the well indicate groundwater changed 0.8m over the 2012-2013 test period.

Figure 3 illustrates annual fluctuations in groundwater depth beneath the site.

Plotting the water table values enable determination of groundwater direction. Figure 4 identifies a groundwater flux towards in north-north west direction.

Table F: Groundwater Levels

SAMPLE LOCATION		MW1				MW2				MW3				MW4				MW5				MW6			
		Standpipe (m):	0.45	Ground (RL mAHD):	26.84	Standpipe (m):	0.62	Ground (RL mAHD):	29.99	Standpipe (m):	0.51	Ground (RL mAHD):	34.11	Standpipe (m):	0.63	Ground (RL mAHD):	27.13	Standpipe (m):	0.56	Ground (RL mAHD):	28.47	Standpipe (m):	0.64	Ground (RL mAHD):	30.97
Date	**Day**	**Water Level (mm TOC)**	**Water Level Change (mm)**	**Water Level (mbgl)**	**Water Level (RL mAHD)**	**Water Level (mm TOC)**	**Water Level Change (mm)**	**Water Level (mbgl)**	**Water Level (RL mAHD)**	**Water Level (mm TOC)**	**Water Level Change (mm)**	**Water Level (mbgl)**	**Water Level (RL mAHD)**	**Water Level (mm TOC)**	**Water Level Change (mm)**	**Water Level (mbgl)**	**Water Level (RL mAHD)**	**Water Level (mm TOC)**	**Water Level Change (mm)**	**Water Level (mbgl)**	**Water Level (RL mAHD)**	**Water Level (mm TOC)**	**Water Level Change (mm)**	**Water Level (mbgl)**	**Water Level (RL mAHD)**
18/5/12	Fri	-3700	-3700	-3.26	23.58	-7666	-7666	-7.05	22.94	-11846	-11846	-11.34	22.78	-8509	-8509	-8.06	19.06	-8836	-8836	-8.22	20.25	-8759	-8759	-8.25	22.72
30/8/12	Thu	-3455	245	-3.01	23.83	-7260	406	-6.65	23.35	-11725	121	-11.22	22.90	-7790	719	-7.35	19.78	-8280	556	-7.67	20.81	-9215	-456	-8.71	22.27
15/1/13	Tue	-3646	-191	-3.20	23.64	-7682	-422	-7.07	22.93	-11858	-133	-11.35	22.76	-8289	-499	-7.84	19.28	-8641	-361	-8.03	20.45	-9312	-97	-8.80	22.17
21/3/13	Thu	-3870	-224	-3.43	23.41	-7530	152	-6.92	23.08	-12110	-252	-11.60	22.51	-8830	-541	-8.39	18.74	-9130	-489	-8.52	19.96	-9710	-398	-9.20	21.77
23/4/13	Tue	-4000	-130	-3.56	23.28	-7600	-70	-6.99	23.01					-8960	-130	-8.52	18.61	-9310	-180	-8.70	19.78	-9865	-155	-9.36	21.62
3/6/13	Mon	-3987	13	-3.54	23.29	-7924	-324	-7.31	22.68	-12197	-87	-11.69	22.43	-8872	88	-8.43	18.70	-9322	-12	-8.71	19.77	-9917	-52	-9.41	21.56
18/6/13	Tue	-4045	-58	-3.60	23.24	-7570	354	-6.96	23.04	-12230	-33	-11.72	22.39	-8865	7	-8.42	18.71	-9310	12	-8.70	19.78	-9917	0	-9.41	21.56

NOTES: 1. MW3 inaccessible 23/4/13

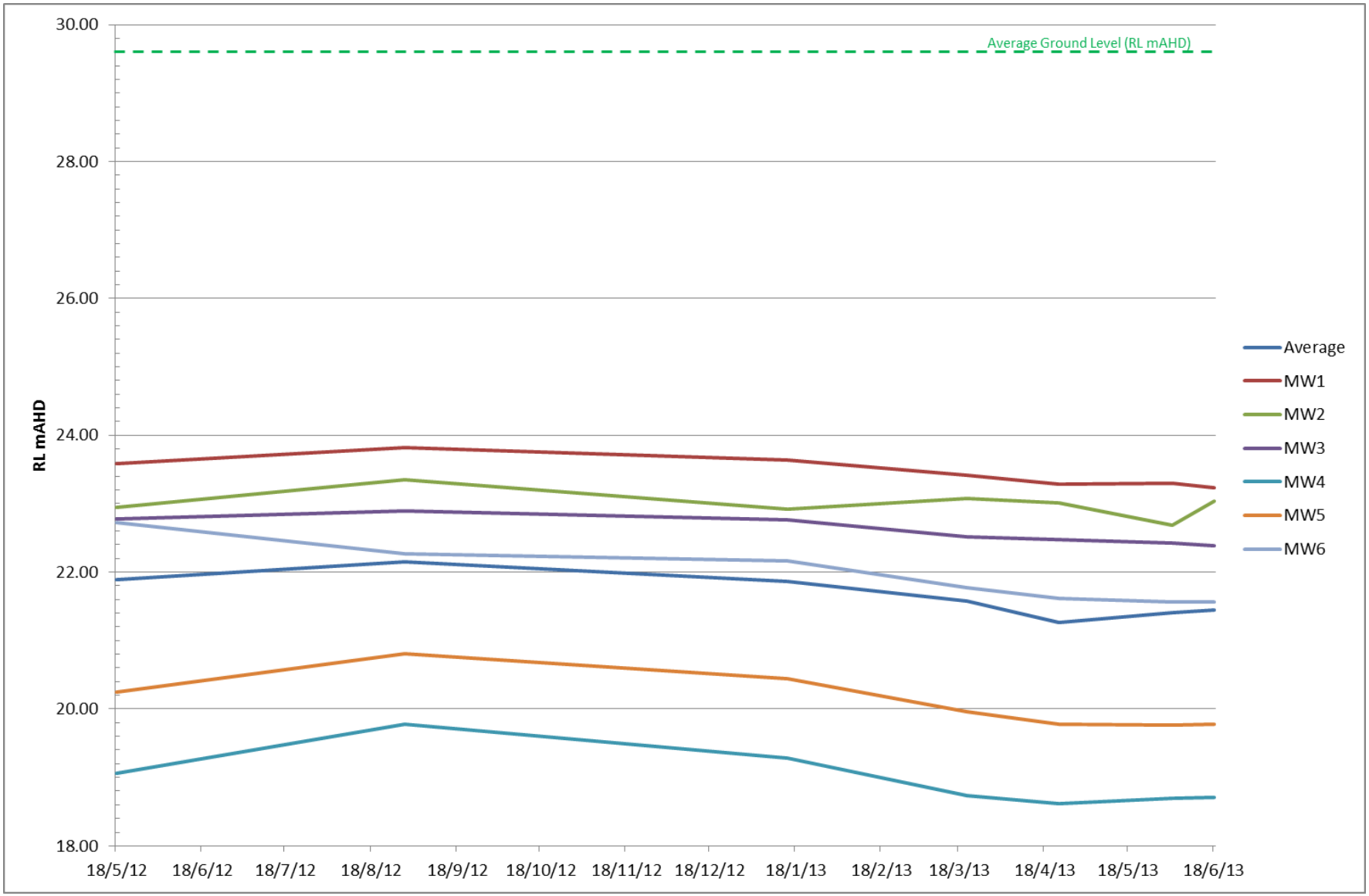


Figure 3 Annual Groundwater Fluctuations Across the Site

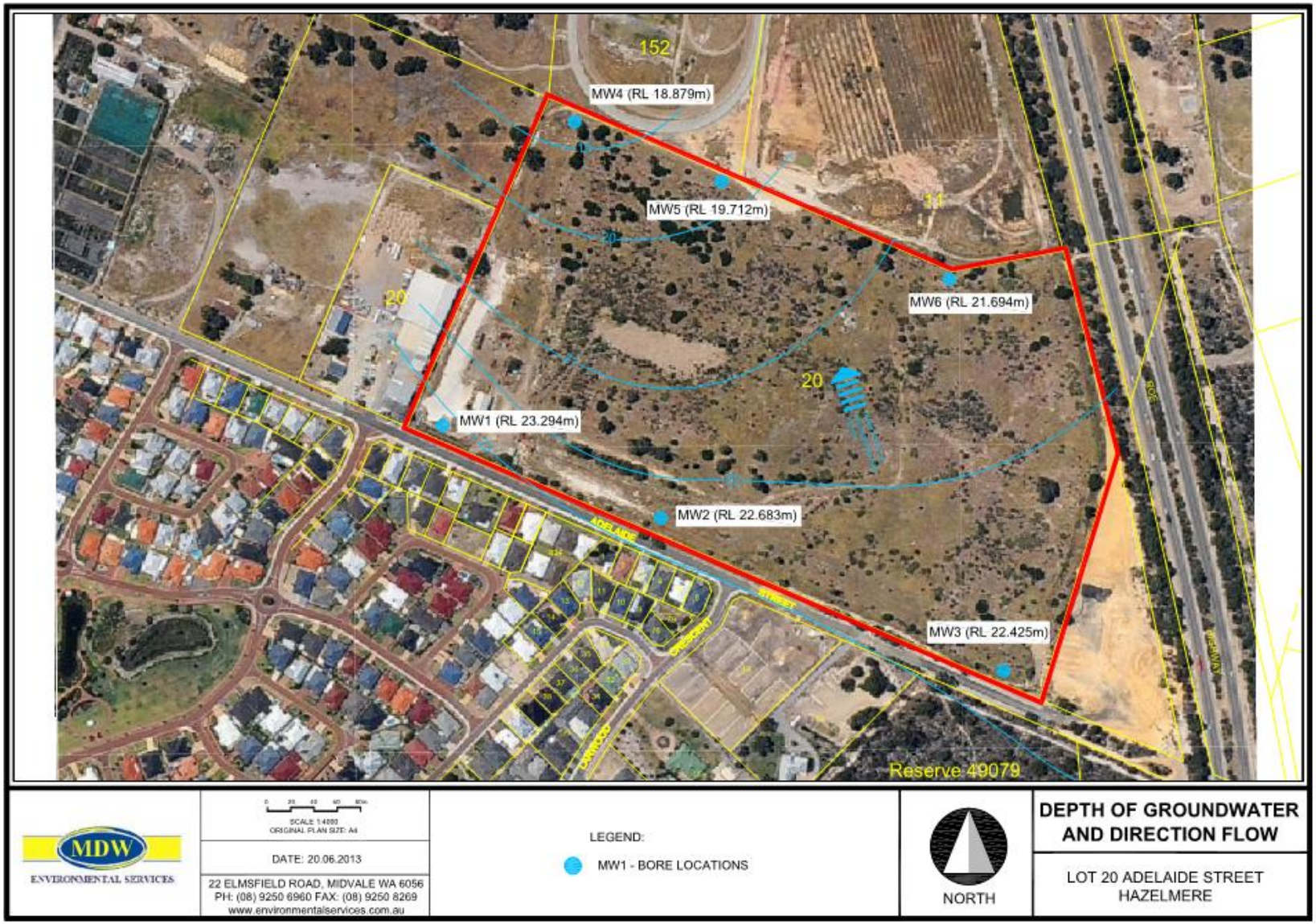


Figure 4 Groundwater Contours (GME #4 Data)

10 DISCUSSION & RECOMMENDATIONS

Standing water level measurements recorded by MDWES during the GME sampling indicate that groundwater is encountered between RL 18.6 mAHD and 23.8 mAHD beneath the Site. Groundwater levels are highest during August and lowest during April and flows in a general north-north west direction with an average seasonal fluctuation of 0.85m.

Laboratory results indicate that the groundwater beneath the site is fresh and mildly acidic to brackish with pH seasonal fluctuations appearing minimal with pH ranging from 5.15 to 7.83 across the site. This is an acceptable range of pH for groundwater within this locality.

Laboratory results do not show any real trends or identify seasonal fluctuations in metals results. Metalloid results could be considered higher than expected for background waters within this locality, however, elevated levels of suspended solids within majority of the samples could have contributed to artificially increasing the results.

Elevated nutrient levels are experienced across the site with concentrations peaking around August. This can be attributed to the higher groundwater table following the wet season. Although concentrations are elevated above ANZECC criteria, surface waters are not located in the immediate vicinity of the site and downstream receptors are likely to be more significantly impacted upon by land uses to the north of the site including rendering facilities.

Laboratory results show that TPH has impacted upon WRMW1, WRMW3 and WRMW6 throughout the year. Referring to the historical data, it is apparent that TPH has an intermittent presence in the groundwater at WRMW3. As the well is not in any landfill, it is likely that seasonal infiltration of rainfall from surface landfill material is the influential factor. TPH is considered a contaminant of high concern however concentrations remain below all assessment criteria.

With the exception of TPH concentrations, groundwater quality below the site appears relatively stable in all locations. At present sufficient data is not available to indicate the location and extent of TPH below the site. However, as concentrations remain below assessment criteria this is not of concern.

MDWES recommends that groundwater monitoring be scaled back to bi-annually sampling and annual reporting to track TPH concentrations until the commencement of remedial works.

11 REFERENCES

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

DEC (2010) *Assessment Levels for Soil, Sediment and Water*, Contaminated Sites Management Series, Contaminated Sites Branch

DEP (2004) Potentially Contaminating Activities, Industries and Land Uses, Contaminated Sites Management Series

DoH (2006) *Contaminated Sites Reporting Guideline for Chemicals in Groundwater*

DEP (2001) *Reporting on Site Assessments*, Contaminated Sites Management Series.