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ENVIRONMENTAL SITE MANAGEMENT PLAN

Lot 20, Adelaide St
Hazelmere

December 2014

PREPARED FOR:

Wasterock Pty Ltd

Environmental Services

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Synopsis:	This document has been prepared in accordance with the Contaminated Sites Act, Western Australia (2006) and Department of Environment and Regulation (DER) Contaminated Sites Management Series guidelines. This Environmental Site Management Plan (ESMP) details the management and monitoring requirements for the excavation/remediation of landfill soils during development works of Lot 20 Adelaide St Hazelmere.

DOCUMENT DISTRIBUTION

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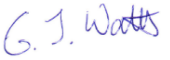
Signed					
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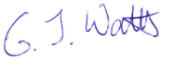
Signed					
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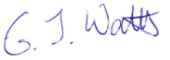
Signed					
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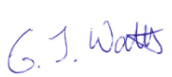
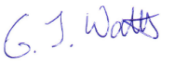
Signed					

NB: Nathan Major of MTOX has provided extensive consultation and peer review in preparation of this Human Health Risk Assessment (HHRA) v6 and v7. However, Mr Major is not directly employed by MDWES therefore his name cannot appear within the document distribution list for legal reasons and insurance liabilities.

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EXECUTIVE SUMMARY

This ESMP is for the proposed management, remedial works and regeneration of an historical landfill at Lot 20 Adelaide St, Hazelmere WA. It has been prepared in order to protect both workers operating at the Site and nearby residents from potential exposure to contaminated soils, nuisance dust, airborne particulate matter and asbestos fibres and odour.

After previously being mined for building and construction sands, the Site was operated by multiple proponents as a licensed "inert" landfill from c.1987 to c.1997. Sands were extracted down to the Guildford Clay layer and this geological boundary acts as an aquitard. The landfill has been operated, such that the current topography of the Site is unsuitable for development. It has been reported that the base depth of the landfill is approximately 6 metres below ground level (bgl). However, it has also been reported that the base maybe deeper.

The majority of fill material at the Site is inert construction and demolition waste in a sand matrix, but fragmented asbestos containing materials (ACM) has been identified at several surface locations across the site and it has been reported that sludges containing hydrocarbons, together with emulsified factory wastes were accepted and drums with unknown content, drums of kerosene, bitumen, pesticide-containing soils and hospital wastes are also known to have been accepted. The DER classified the site as "Contaminated – remediation required" in 2010.

Wasterock proposes to remediate the Site, an uncontrolled historical landfill, using conventional excavation techniques to reduce the current height and fill content of the site and make it suitable for "commercial / industrial" use.

The remedial works of the Site will involve the following stages:

1. Excavation, sorting and processing (screening and limited crushing) of existing material.
2. Acceptance of Acid Sulfate Soils (ASS) and Hydrocarbon Impacted Soils (HIS) (Class 1 only) for amendment, recycling and reuse. These soils will ultimately be used for the capping layer.
3. Processing (screening and / or crushing) of construction and demolition (C&D) waste for recycling and reuse on Site to engineer a physical warning barrier.
4. Engineered placement, compaction and construction of excavated remediated soil material to form a controlled engineered cell.
5. Placement of any ACM found, deep in the engineered cell.
6. Separation and removal of any drums with unknown contents, hydrocarbons, pesticides or putrescibles encountered, to an appropriate landfill facility.

Wasterock is proposing to redevelop the area by remediating the Site via excavation and repackaging of materials. An engineered barrier layer will then be placed over the repackaged materials. The remediation of the site will include the outsourcing and acceptance of external off-site soil material for the capping layer, sourced from local building and development projects within the Perth metropolitan area. This soil material will be remediated and validated on-Site to provide a layer of clean cover.

The use of the Site's own resources to remediate the Site itself, will minimise any unnecessary requirement to transport waste to appropriate waste facilities off-site, or to transport large quantities of sand to site. Although there may be a requirement for off-site disposal for this project, if a resource can be reused and does not have an environmental impact, then Site re-use is appropriate and should be paramount, as it is the only cost-effective mechanism for sustainable remediation of the site.

The project is expected to take approximately four to five years to complete the necessary works. The ultimate aim of the project is to rehabilitate the land, such that it can be utilised within the community, through subdivision into smaller light industrial / commercial lots.

1 INTRODUCTION

This Environmental Site Management Plan (ESMP) has been prepared by MDWES for Wasterock Pty Ltd (the Client) for the management of soil during the remediation of a former uncontrolled landfill and associated groundwater and air / dust monitoring. Consideration will also be given to post remediation ground gas monitoring as part of the ESMP. The Site is located at Lot 20 Adelaide Street, Hazelmere, Perth, herein referred to as 'the Site'

The ESMP has been written to detail management and identify the possible issues and potential risks that may exist / occur during the remediation of the subject Site. The management plan aims to present reasoned rationale and propose solutions to mitigate those identified risks.

1.1 Previous Reports

Several reports and investigations have been undertaken on the subject Site from c.2005 to present. The information and results of these investigations are compiled in the following documents and should be read in conjunction with this management plan:

- FOI 1233/05 by Department of Environment & Conservation (DEC) – Freedom of Information – Lot 20, Adelaide Street, Hazelmere (October 2005).
- 2145245A:PR2_16644.RevA by Parsons Brinckerhoff – Site Investigation (SI) – Hazelmere, WA (July 2006).
- 476300-0kjcv070709a by Burgess Rawson – Valuation Report – Lot 20 Adelaide Street, Hazelmere, WA (July 2007).
- V392/2007 grw4469 by Knight Frank – Valuation Report – Lot 20 Adelaide Street, Hazelmere, WA (July 2007).
- 60150301 by AECOM – District Storm water Management Strategy – Hazelmere Enterprise Area (June 2010).
- Drilling Logs by Banister Drilling & Irrigation for 20 Adelaide Street, WA. (May 2012).
- E2012-031 (GME) – MDWES – Groundwater Monitoring Event #1 – Adelaide Street Hazelmere (May 2012).
- E2012-031 (GME) – MDWES – Groundwater Monitoring Event #2 – Adelaide Street Hazelmere (August 2012).
- 15172-2-12131 by Herring Storer - Acoustic Assessment for Lot 20 Adelaide Street Hazelmere (September 2012).
- NTEC Environmental Technology – Groundwater Modeling for the Wasterock Hazelland Landfill Site in Hazelland. (September 2012).
- E2012-031 (GWAMP) – MDWES – Groundwater Abstraction for Dust Suppression & Surface Compaction v2 – Adelaide Street Hazelmere (October 2012).
- E2012-031 (GME) – MDWES – Groundwater Monitoring Event #3 – Adelaide Street Hazelmere (January 2013).
- E2013-031 – (SAMP) - MDWES – Soil Amendment Management Plan – Lot 20 Adelaide Street, Hazelmere (March 2013).
- E2012-031 (GME) – MDWES – Groundwater Monitoring Event #4 – Adelaide Street Hazelmere (June 2013).
- E2012-031 (GMES) – MDWES – Annual Groundwater Monitoring Event Summary Report (GMES) v2 – Adelaide Street Hazelmere, (October 2013).
- 6045.k.09_09082_SMP by Waste Rock Pty Ltd – Site Remediation Works Agreement and Site Management Plan (Final) – Lot 20 Adelaide Street. (March 2014).

- GRA 7729 by Greg Rowe & Assoc. – Community Management Strategy for Remediation of Former Landfill Site: Lot 20 Adelaide Street, Hazelmere. (March 2014).
- E2012-031 (AQMP) – MDWES – Air Quality Management Plan (AQMP) v5 – Adelaide Street Hazelmere, (October 2014).
- E2012-031 (HHRA) – MDWES – Human Health Risk Assessment (HHRA) v3 – Adelaide Street Hazelmere, (October 2014).

2 BACKGROUND

Stage I, Preliminary Site Investigation (PSI) and Stage II, Detailed Site Investigation (DSI), were undertaken by Parson Brinkerhoff (2006) and the following sections summarise the investigation information.

The Site is located at Lot 20 Adelaide Street, Hazelmere, Perth (herein referred to as 'the Site'), within the City of Swan, approximately 14 km east north east of the Perth CBD, 6km east of the Swan River and 1 km west of the Darling Fault (Figure 1). It is currently vested with Wasterock Pty Ltd and has been since 2006. The Site historically operated as a licensed uncontrolled inert landfill from c.1987 to c.1997, after first being mined for building and construction sand. Current Site owners Hazelland Pty. Ltd (Owner) have subcontracted Wasterock Pty Ltd (WRK) to undertake the required remediation work in order to make the Site developable for the future use (commercial / industrial).

The landfill covers the vast majority of the Site rising up to a maximum of eight metres above ground level in parts. Steep battered edges between 5m and 8m in height define the edge of the landfill. A shallow access ramp is located in the middle of the southern edge of the landfill which leads to the top of the landfill. The north western edge of the landfill has a slighter gradient than the other edges of the landfill.

A number of studies have taken place over the years upon the Site. These studies have identified varying levels of contamination primarily caused by Total Petroleum Hydrocarbon (TPH), Monocyclic Aromatic Hydrocarbons (MAH's), Heavy Metal impacts and potential Asbestos.

Based on the findings of the reports, the Department of Environment Regulation (DER) (formally DEC) classified the Site as *'Possibly contaminated – investigation required'* on 27 April 2007 (VDM, 2008). In November 2010 the DER revised this judgment and reclassified the Site to – *'Contaminated - remediation required'*.

2.1 Site History

The PSI reports that the Site was primarily mined (open cut) for sand between c.1978 and c.1982. The sand was mined up to a reported 6mbgl. However, this may have been deeper. The mined area was then utilised as an inert landfill which was common practice for this time period.

Although primarily licensed for inert waste during its operational cycle, a number of non-inert wastes were received at the landfill. The non-inert material was received with the knowledge and approval of the regulating authority, which at the time was the Shire of Swan. Records show that the received materials were described as inert building waste, car bodies and asbestos sheeting / pipes / tiles. In addition, it was reported that sludge's containing hydrocarbons, together with emulsified factory wastes, drums (unknown), drums of kerosene, bitumen, pesticide-contaminated soils and hospital wastes were also accepted. Based on the history of waste accepted on site it is possible the putrescible waste may have been accepted. However, this has not been confirmed and would only be identified during remediation of the Site.

The landfill recorded a finish level of approximately six to eight metres above surrounding surface levels (c.1990).

2.2 Development Scope of Works

Remediation and redevelopment of the Site will require excavation of the historical landfill, which will be repackaging and engineered to allow for an industrial / commercial end use. Excavated soil will be processed and screened on Site as part of the remediation. This material will then be returned to a deep cell on site and will be entombed below an engineered barrier layer. A capping layer will then cover the Site.
The project involves:

- Processing an approximate total of 1,500m^3 per day of historical landfill.
- The removal of timber, brick, concrete, ferrous and non ferrous metals for recycling as excavations progress.
- Management of any asbestos pockets encountered during earth works. These specific areas of asbestos will require immediate water saturation and special attention.
- Stable non-leaching remediated soils will be placed within a deep cell, 2mbgl to base depth of void. Any asbestos impacted soils encountered will be placed in the deep cell.
- The engineered barrier layer will consist of an inert marker layer of crushed compacted construction / demolition material (CDM). This will be recycled from the Site's CDM facility (also referred to as a Resource Recovery and Recycling facility (RRRF)). The barrier layer will be positioned 1.5m below finished level and will extend 2mbgl. The barrier will therefore, be a minimum of 0.5m thick.
- Material destined for the CDM resource recovery facility will be validated prior to acceptance and validated for asbestos, metals and hydrocarbons content, prior to placement in the barrier layer.
- Soil for the capping layer will be sourced from the Site's Soil Soil Acceptance and Amendment Facility (SAAF)which will receive Acid Sulfate Soil (ASS) impacted soils and Class I and / or hydrocarbon Impacted soils from the Perth region. These imported soils will be treated and validated to ensure suitability as a capping layer soil. The capping layer will be a minimum of 1.5 metres thick.

2.3 Geology

The underlying geology has been reported from the Geological Survey Western Australia (1986) 1:50,000 sheet number *2034 I and 2034 II* entitled "Perth" and Davidson (1995). These sources indicate that the Site's underlying natural geology comprises Bassendean Sand, inter-fingered with Guildford Clay.

Bassendean Sand is present over most of the central Perth Region and lithologically, it is readily identifiable from drill cuttings. The unit varies in known thickness and can extend to a maximum of approximately 80 mbgl, depending mainly on the topography.

Bassendean Sand is pale grey to white and is fine to coarse but predominantly medium grained. It consists of moderately sorted, sub rounded to rounded quartz sand and commonly has an upward fining progression in grain size. Fine-grained, black, heavy minerals are commonly scattered throughout the formation but in places are more concentrated in thin layers or lenses probably indicating a shallow-marine origin. A layer of friable, limonite-cemented sand, colloquially called 'coffee rock', occurs throughout the strata. The coffee rock is usually encountered near the water table.

Bassendean Sand unconformably overlies the Cretaceous and Tertiary strata and interfingers to the east with Guildford Clay, and conformably overlies the Gnangara Sand. To the west, it is unconformably overlain by the Tamala Limestone. The stratigraphic relationships of the Bassendean Sand with the Guildford Clay and Gnangara Sand indicate that the formation was deposited under changing and conceivably alternating fluvial, estuarine, and shallow-marine pre-historic time periods.

Guildford Clay is predominantly of fluvial origin and is restricted mainly to the areas of its outcrop. However, it is also found locally in areas removed from present drainages such as Menora (north of Perth) and Fremantle (southwest of Perth). To the south of Perth, in the Ferndale-Lynwood area, widespread thick, black, silty clay is possible and could be of a lacustrine or fluvial origin. This outcrop of Guildford Clay exists over much of the eastern Perth Region and unconformably

overlies the Jurassic and Cretaceous rocks, Kings Park Formation, Ascot Formation and Yoganup Formation.

The Guilford Clay consists of pale-grey, blue, but predominantly brown silty and slightly sandy clay, and interfingers to the west with the Gnangara Sand and Bassendean Sand. The geological unit can be observed up to 35 m thick. It commonly contains lenses of fine to coarse grained, very poorly sorted, conglomeratic and (in places) shelly sand at its base, particularly in the Swan Valley area. These basal lenses, which occur sporadically along the eastern margin of the coastal plain, are probably remnant deposits of the Ascot Formation or the Yoganup Formation which the Guildford Clay can overlay.

2.4 Hydrogeology

The uppermost aquifer underlying the region of the Site is the unconfined Superficial 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 5–7mAHD at the Site, sloping upwards towards the Darling Fault in the east and downwards towards the Swan River in the west (NTEC, 2012 – Appendix H), with an estimated thickness of 10–25m (Davidson and Yu, 2006). The maximum thickness is around 26m at the Site.

Based on the groundwater levels, the hydraulic gradient of the Superficial Swan Aquifer at the Site is approximately 0.01 (NTEC, 2012 – Appendix H) 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 50m/yr to over 1000m/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 500mg/L to 1000mg/L (DoW, 2004b) which classifies groundwater quality as being fresh to mildly acidic at the Site.

The underlying aquifer has a maximum saturated thickness of approximately 30 m (Davidson 1995). However, the Perth Groundwater Atlas (DoW 2004a) indicates that the aquifer depth may be approximately 22.0m to 31.0m beneath the Site. The upper portion of the aquifer is reported to be found at depths of between 12m to 21mbgl.

The Perth Groundwater Atlas (DoW 2004a) indicates that groundwater is encountered at approximately 4m to 5m (depending on topography) below the region of the Site, with levels potentially varying between 0.5m to 3.0m seasonally.

According to the online Perth Groundwater Atlas (Department of Water, 2009), the average groundwater table is at 15.0mAHD and flowing from south east to north-west.

Due to the unusual topography of the Site, the expected depth to groundwater ranges between 12mbgl in the west and 21mbgl in the east. Relative groundwater levels are 15mAHD over the majority of the Site. However, they may increase to 14mAHD in the north-west corner of the Site.

Groundwater levels were recorded as part of the monitoring events undertaken on site from 2012 through to 2013 by MDWES. In general, the groundwater levels recorded were between 3.60mbgl (23.2 mAHD) for MW1 (NW) and 11.72mbgl (22.39 mAHD) for MW3 (SE).

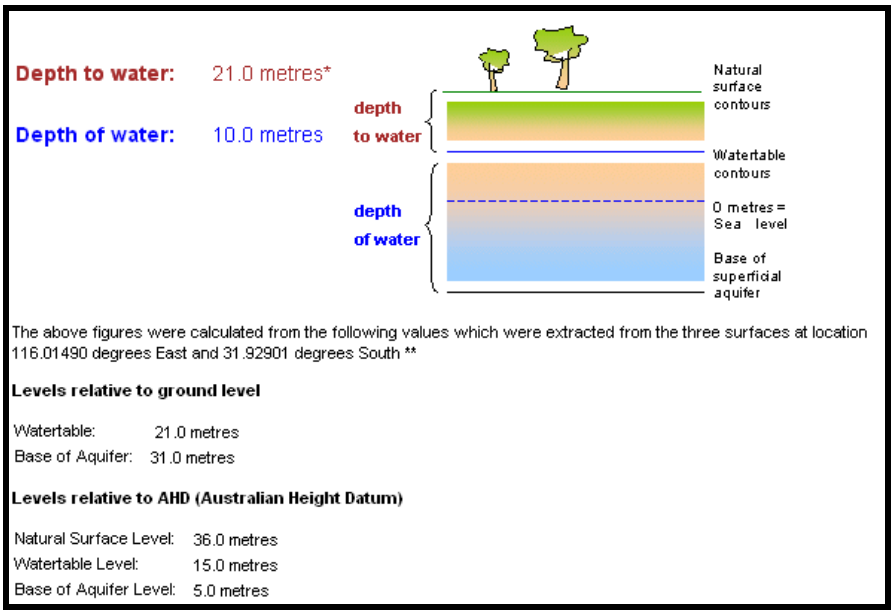
As part of the groundwater assessment, an approximate migration velocity of the groundwater through the natural underlying Bassendean sands and Guildford Clay is shown in Table A.

Table A: Groundwater Conductivity

Geology	Average[1] Groundwater Depth for MW3 (mbgl)	Average[2] Groundwater Depth for MW4 (mbgl)	Distance[3] Between wells MW3 and MW4 (m)	Effective Porosity [4] (θ)	Hydraulic Conductivity [5] (k)	Potential retention time and distance (Metres / year)
Bassendean Sands	11.48	8.14	623.5	Medium Sand 0.28	Medium Sand 16.5	115.2
Guildford Clay	11.48	8.14	623.5	Clay 0.03	Clay 0.4	3.4

[1] – The average groundwater level taken from **MW3** which is the *deepest* groundwater level recorded.
[2] - The average groundwater level taken from **MW4** which is the *shallowest* groundwater level recorded.
[3] - The approximate distance between the deepest and shallowest well.
[4] – The effective porosity is a general soil value. It is noted that Bassendean sands can be fine and coarse however a median value has been given. Altering the soil porosity for a fine and coarse sand gives a difference of +/- 5 days
[5] – Hydraulic conductivity is a general soil value. It should be noted that clays can be very soft to very stiff and can have a % of sand content. MDWES has modelled the site on clay with no inclusions.

Table B: Groundwater Information (DoW)



2.5 Hydrology

There are no surface water bodies on site or in close proximity to the Site. However, the Ollie Worrell Reserve is approximately 2.1km to the south-east and Kadina Brook is 2.2km to the east of the Site. Neither of these surface water features is likely to be affected by the groundwater flow, as they are considered to be up-gradient of the Site.

3 CONTAMINANTS OF POTENTIAL CONCERN

The following sections discuss the Contaminants of Potential Concern (CoPCs) associated with the remediation of the Site. The limited investigations to date have determined certain CoPCs within the soil and groundwater which maybe anticipated during excavation. However, there are also suggested CoPCs associated with land filling and the reported waste material accepted. The CoPCs developed within this section have been used to develop the Human Health Risk Assessment (HHRA) (separate report Appendix B). Further discussion of the risk potential to the site workers and local residents is discussed within the HHRA report.

3.1 Contaminants of Potential Concern - Soil

The Parsons Brinckerhoff DSI identified the following Contaminants of Potential Concern (CoPCs), based on the information obtained regarding the materials accepted into the landfill:

- Total Petroleum Hydrocarbons (TPH).
- Monocyclic Aromatic Hydrocarbons (MAH's).
- Asbestos.
- Heavy Metals.

3.2 Contaminants of Potential Concern - Groundwater

The groundwater monitoring program undertaken by MDWES, identified the following groundwater CoPCs. The identification of CoPCs was based on reported data, historical use, current Site activities, regional soils, proximity to sites classified as contaminated, off-site sources and impacts. The CoPCs comprised the following

- Dissolved and Total Metals: 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).
- Total PCB's.
- Organochlorine and Organ phosphorus Pesticides (OC/OP).

3.3 Contaminants of Potential Concern - Air

The proposed Site works has the potential to generate dust and other CoPCs identified within the landfill matrix. Therefore, monitoring is a fundamental requirement of the environmental site management plan (ESMP, this report), which is based on the MDWES AQMP report (Appendix C). During excavation and engineering of the landfill, dust and particulate matter has the potential to be emitted and released. As such, the following air quality CoPCs have been identified:

- Asbestos fibres.
- Particulate matter as: TSP, PM_{10}, respirable Crystalline Silica (RPS) and particles containing metal.

3.4 Contaminants of Potential Concern – Nuisance Odour

The proposed Site works has the potential to generate odour from the remediated soil within the SAAF area (Class I Hydrocarbon) and potentially from the landfill matrix as it is excavated. Odour is not anticipated to be a nuisance during the excavation and remediation of the historical landfill, however, should be assessed due to the locality of the residents and the health risks.

- Volatile Organic Hydrocarbons.
- Methane.
- Sulfur.

3.5 Contaminants of Potential Concern – Ground Gas

The proposed remediation of the site could give rise to ground gas generation once the site has been repackaged. All organic material encountered during excavated will be removed during the screening process which will reduce the potential for ground gas generation when. However, ground gas assessment will be conducted as cells are completed on site to develop a ground gas model.

The following ground gas CoPCs have been identified as a potential for concern and should be assessed.

- Methane (CH_4).
- Carbon Dioxide (CO_2).
- Carbon Monoxide (CO).
- Oxygen (O_2).
- Hydrogen Sulfide (H_2S).
- Total Volatile Organic Compound (VOC).

NB: the Ground gas monitoring will include readings for atmospheric pressure (mb) and ground gas flow (L/hr).

4 IDENTIFIED CONTAMINATION

4.1 DSI – Soil Results

As part of the Parsons Brinckerhoff report (2006), laboratory assessment of the soils was undertaken to determine the nature and extent of the fill currently present at the Site. Techniques used during their investigation included both a desktop study and the collection of limited soil samples through the excavation of fifteen (15) test pits to a depth of 5m below the surface of the landfill. (See figure 2) The location of the test pits was based on systematic grid sampling over the landfill area, with a bias to position locations within the north eastern corner where the Omex oil refinery waste was thought to be buried. Excavated material from each test pit was visually logged and soil samples were taken for laboratory analysis.

The Parsons Brinckerhoff report indicates that the majority of fill material was inert construction and demolition waste within a sandy soil matrix. Minor amounts of fragmented asbestos-containing materials (ACM) were identified in several test pit excavations within the superficial landfill horizons. It is possible that asbestos may be encountered within the deeper portions of the landfill this was not confirmed during the investigation. In addition, asbestos fragments are littered across the surface of the landfill area and ACM fragments appear to have been widely distributed across the site. However, the true extent of asbestos contamination will only be identified once the site remediation program begins.

Table C below, summerises the number of soil samples analysed, analytes tested for and minimum/maximum constituent concentrations. The table also denotes the identified samples that were identified as exceeding the investigation levels. *Note: the laboratory results were compared to the investigation levels (ILs) and Assessment Criteria (AC) at the time of writing the report (DoE July 2006).*

The soil investigation criteria adopted for the investigation was based on the Western Australian Department of Environment (DoE) *Assessment Levels for Soil, Sediment and Water*, Draft for Public comment, Contaminated Site Management Series, November 2003 V3 - "Table 1 Assessment Levels for Soils". At the time of writing the DSI report, the future use of the Site was unknown. However, as the Site was a landfill, Health Investigation Levels (HIL-Fs) for commercial/industrial land use were considered the most appropriate. Reference has also been made to the Ecological Investigation Levels (EILs), as a conservative measure.

Table C: Summary of Soil Laboratory Results (Table 6.2 Parsons Brinckerhoff, 2006)

Number of Samples Analysed	Analyte	Min Conc. (mg/kg)	Max Conc. (mg/kg)	Results Exceeding Investigation Levels	Samples Exceeding Class I Waste Classification
Metals					
20	Mercury	0.01	0.14	None	TP11-2, TP12-1
20	Arsenic	<2.0	6.8	None	None
20	Cadmium	<2.0	<2.0	None	None
20	Chromium	3.5	24	None	TP8-1, TP9-1, TP9-3, TP10-1, TP10-2, TP11-2, TP12-2.
20	Cobalt	<2.0	2.3	None	None
20	Copper	5.8	390	TP3-2, TP9-1, TP12-1	None
20	Lead	12	240	None	All Samples submitted
20	Manganese	14	220	None	None
20	Nickel	<2.0	31	None	TP3-2, TP8-1, TP8-2, TP9-1, TP9-2, TP9-3, TP10-1, TP10-2, TP11-2, TP12-1
20	Selenium	<2.0	<2.0	None	None
20	Zinc	18	770	TP6-1, TP9-1, TP9-3	None

Number of Samples Analysed	Analyte	Min Conc. (mg/kg)	Max Conc. (mg/kg)	Results Exceeding Investigation Levels	Samples Exceeding Class I Waste Classification
Hydrocarbon Results					
20	TPH C_{10} – C_{14}	<20	30	None	None
20	TPH C_{15} – C_{28}	30	710	None	None
20	TPH C_{29} – C_{35}	24	850	-	-
20	Benzene	<0.2	<0.2	None	None
20	Ethyl Benzene	<1.0	<0.1	None	None
20	Toluene	<1.0	<0.1	None	None
20	Xylenes	<3.0	<3.0	None	None
20	Total PCB's	<1.0	<5.7	TP9-2, TP9-3, TP11-2	None

NB: The information presented in the table above is taken from the Parsons Brinkerhoff DSI Report (2006). It is noted that within the report table TPH, BTEX, PCBs have an analysis count of 20. However the laboratory report details nine samples for each of the aforementioned analytes. MDWES has reported as per the PB report as we are unsure as to which is correct.

4.2 DSI – Asbestos Results

As part of the Parsons Brinckerhoff investigation, asbestos analyses were also undertaken. Table D below summarises the results of laboratory identification of potentially Asbestos Containing Materials (ACM) sampled. The table includes the test pit location, description of sample, whether asbestos was detected by polarised microscopy and, if positively identified, the type of asbestos present.

Table D: Summary of Asbestos Laboratory Results (Parsons Brinckerhoff)

Test Pit Location	Description	Type of Asbestos Detected
TP1	Grey Fibrous Sheeting Grey Fibrous Sheeting painted white	Chrysotile, Crocidolite Chrysotile, Amosite
TP3	Pale Brown Flooring White Fibrous backing Brown Fibrous sheeting (curved) Grey Fibrous Sheeting (Painted White)	No Chrysotile No Chrysotile
TP6	Brown Fibrous sheeting	No
TP7	Pale Brown Fibrous Sheeting, Painted Pale Yellow Pale Brown Fibrous Sheeting, Painted White	Chrysotile, Amosite No
TP8	Brown Fibrous sheeting (curved) Brown Fibrous sheeting (curved)	No No
TP9	Brown Fibrous sheeting (curved)	No
TP10	Brown Fibrous sheeting (curved)	No
TP11	Brown Fibrous sheeting (curved)	No
TP12	Grey Fibrous Sheeting painted white Grey Fibrous Sheeting painted white Off White-Flooring Off-White Fibrous backing	Chrysotile Chrysotile, Crocidolite, Amosite No No
TP13	Grey Fibrous Sheeting	Chrysotile, Amosite
TP14	Pale Brown Fibrous Sheeting, painted White Grey Fibrous Sheeting, Painted White	No Chrysotile, Crocidolite

4.3 MDWES Groundwater Monitoring Results

The groundwater results from four seasonal groundwater monitoring events (GME) are summarised in the following sections. The GME's were conducted by MDWES from May 2012 to June 2013, to capture seasonal variations and chemical and physical properties of the groundwater. The sampling program was completed within six groundwater wells strategically placed around the perimeter of the Site boundary (Figure 3). The groundwater flow has been calculated as flowing in a west to north westerly direction (Figure 4).

The groundwater analysis results were compared against Freshwater Ecosystems, Marine Ecosystems, DER Trigger values and Water Corporation Criteria. These guideline levels are presented in the Water Corporation document, "*Contaminated Site Management Series - Assessment Levels for Soil, Sediment and Water* "(DEC, 2010).

4.4 Metal

Metals were analysed as part of the groundwater monitoring program. Table E summarises dissolved and total metals that were detected above the limit of reporting (LOR). Metal results were considered higher than expected for background waters, but this could be due to elevated levels of suspended solids within a majority of the samples, which could have contributed to the artificial increase in the results.

It should also be noted that iron and aluminium results were elevated above short term and long term irrigation levels in Table 4.2.10 of the ANZECC & ARMCANZ (2000) *Australian Water Quality Guidelines for Fresh and Marine Water Quality*. However, the results were constant throughout the year's program, with no notable outlier peaks observed.

Table E: **Summary of Total and Dissolved Metals against LOR**

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, Manganese, 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.

4.5 Total Petroleum Hydrocarbons

Total Petroleum Hydrocarbons (TPH) were analysed as part of the groundwater monitoring program. Table F summarises TPH fractions above the LOR. However, none of the groundwater analysed for TPH during the year identified concentrations above the adopted assessment criteria.

Laboratory results from the GME's have shown that TPH has impacted within locations WRMW1, WRMW3 and WRMW6 throughout the year. The laboratory data also indicates that TPH has an intermittent presence within the groundwater at WRMW3. However, well WRMW3 is not located within the historical landfill, so it is likely that seasonal rainfall infiltration from the surface has potentially affected landfill material and could be considered the influential factor. This being said, the concentration levels are only slightly elevated and remain below assessment criteria.

Table F: 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)

4.6 Monocyclic Aromatic Hydrocarbons (MAH)

Each of the speciated MAH analysed was below the LOR for each location.

4.7 Polycyclic Aromatic Hydrocarbons (PAH)

Each of the speciated PAH analysed was below the LOR for each location.

4.8 Phenolic Compounds

Each of the speciated Phenolic compounds analysed was below the LOR for each location.

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

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

4.10 Organochlorine Pesticides (OC)

Each of the speciated OC analysed was below the LOR for each location.

4.11 Organophosphorus Pesticides (OP)

Each of the speciated OP analysed was below the LOR for each location.

4.12 Major Anions and Cations

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

4.13 Nutrients

Elevated nutrient levels were 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. Total Nitrogen and Total Phosphorus exceed 'Fresh Waters' assessment criteria at all locations.

4.14 Groundwater Summary

The laboratory results were generally consistent throughout the monitoring program, with the exception of TPH concentrations. Groundwater quality below the Site appears relatively stable within 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, impact is considered to be low. Groundwater will be continually monitored as part of the management plan and as part of the Site's remediation and redevelopment program.

5 ENVIRONMENTAL OBJECTIVES

This ESMP has been prepared in order to protect nearby residents and the surrounding environment from potential exposure to off-site emissions and protect workers operating at the Site from potential contaminants.

This management plan details proposed environmental procedures to be in place during the excavation, soil disturbance, crushing (RRRF) and soil amendment (SAAF) activities for remediating the Site. Further assessment is provided in the HHRA and AQMP with regards to health risk and air monitoring requirements. The environmental extent of the material within the landfill is not yet known and will only be known once excavated. It has been reported that accepted waste was inert material. However, there is evidence that contaminating waste streams were accepted. Consequently, odours may be possible, and volatiles, if encountered, are expected to be very localised and unlikely to travel off-Site. The management plan outlines activities and operations on Site have the potential to release airborne particulate matter and asbestos fibres which is seen as the primary risk concern. Wasterock Pty Ltd will ensure full compliance with the objectives set out within this ESMP.

The objectives of this ESMP are to:

- Protect life and the wellbeing of human and other forms of life from dust, possible ACM, odour and soil contamination exposure.
- Comply with relevant statutory environmental requirements – DEC (2011), NOHSC / Safe Work Australia (1995), WA EP Act (1986), Department of Health (DoH) and NEPM guidelines.
- Provide strategies and contingencies aimed at reducing environmental exposure during earthworks and soil removal activities to possible dust generation, addressing potential pathways and asbestos fibre inhalation.
- Provide strategies and contingencies aimed at reducing environmental exposure during earthworks, remediation and soil removal activities to odour.
- Provide strategies and contingencies aimed to assess potential ground gas generation as a result of repacking and remediation of the landfill material.
- Present contingencies and procedures to mitigate the risks to site workers and residents if there is an exceedance of assessment criteria.
- Provide Wasterock Pty Ltd with a framework to confirm compliance with relevant policies and requirements.
- Provide the community with evidence that the project is being managed in an environmentally acceptable manner.
- Remediate the site using best available techniques.
- Maintain a health and safety record.

The technical objectives of the management plan are to:

- Implement an air quality monitoring program that provides representative data capture for airborne particulate matter and fibre concentrations present at the Site i.e. Total Suspended Particulate (TSP), PM_{10}, airborne fibre (asbestos), Respirable Crystalline Silica (RCS) and airborne particulate matter containing metal (MDWES AQMP (Appendix C).
- Undertake soil monitoring during the screening of landfill material will be required due to the potential asbestos within the landfill. Samples will be taken from the oversize materials (Pre Crushing) then after crushing in accordance with DoH sampling guidelines. This will be required to determine that the crushed material is asbestos-free and suitable for incorporation into the barrier layer. The under sized materials and sand is assumed to contain asbestos and will be deposited as deep cell landfill material.

- Validate and qualify imported soils onto Site which are to be amended in the SAAF area. Soils accepted will comprise Acid Sulfate Soil and hydrocarbon impacted, Class I only. Ensure that once amended, soils are validated as suitable for use within the capping layer.
- Continue the ground water monitoring program, whilst excavation and remediation is in operation, to monitor any change in geological and environmental conditions with an effect on the localised groundwater.
- During the remediation develop a ground gas sampling program to assess potential ground gas generation from repackaged remediated Site.
- Employ safe practices to minimise generation of dust and in doing so, maintain safe airborne particulate matter and fibre concentrations both off-site and on-site.
- Employ safe practices to minimise generation of noise and, in doing so, maintain acceptable noise levels both off-site and on-site.
- Employ safe practices to minimise generation of odour and in doing so, maintain low odour concentration both off-site and on-site.
- Address stakeholder and community consultation.
- Provide solutions and a rationale for the solutions.

The ESMP will be reviewed and periodically updated, if necessary, to reflect knowledge gained during the course of operations. Changes to the ESMP will be implemented in consultation with the relevant authorities and audited by the Contaminated Sites Auditors.

6 PROPOSED SCOPE OF WORKS

The Site's operation will incorporate several environmental activities, MDWES will undertake the following environmental remediation and development scopes of work for the Site.

6.1 Landfill excavation and sorting Scope

- The project is the redevelopment and excavation of an uncontrolled historical landfill, which is to be remediated and engineered for an industrial / commercial end use.
- Approximately 1500 m^3 of historical landfill will be processed per day.
- The excavated soil (historical landfill) will be processed and screened. Soils will be managed and sampled in accordance with DoH guidelines. Analysis is for validatory purposes to determine suitability for on-site use or off-site disposal. The excavated soil (historical landfill) will be processed and screened and will comprise the following sampling requirements.
    - All under sized (<150mm) screened landfill material will be repacked and replaced within the deep cell of the newly engineered landfill (2.0 m to base depth).
    - The over sized will be screened for ACM material and will be removed as part of the screening and stockpiled.
    - The stockpiled over sized material will be sampled prior or crushing (x1 sample per 70m^3), to determine asbestos content. Stockpiles will be quarantined until laboratory analysis is completed. Sample density (DoH, 2009, Table 7 Section 4.1.6) will be in accordance with DoH stockpile sampling guidelines.
    - Once validated, stockpiles can be sent to be crushed on Site. Once crushed further sampling and analysis will be undertaken for asbestos (x5 samples per 1000m^3). Once clear the crushed material can be utilised within the barrier layer.
        - In the unlikely event of any that the post crushed results do not comply with assessment criteria the crushed material (batch) will not be used in the capping layer. The crushed material will be removed and placed within the deep cell being constructed on site.
    - If validation sampling provides a positive for ACM prior to crushing then the stockpile will be placed into the deep cell on site and not crushed.
- During excavation, it is possible that stained soils or odorous soils maybe encountered or obvious inclusions such as unknown drums are unearthed. These soils and/or inclusions will be managed and samples analysed for validatory purposes to determine off-site disposal requirements at a suitable landfill.
- Timber, brick, concrete, ferrous and non ferrous metals will be removed for recycling during excavation and screening.
- Discovery of larger pockets of ACM will be removed and stored (in a covered skip) prior to being removed from Site. The asbestos (ACM) will not be crushed.
- All excavated soil, once remediated, will be placed below an engineered barrier layer. The barrier will comprise an inert marker layer of crushed compacted construction / demolition material (CDM).
- The barrier layer will be a minimum of 0.5 metres thick. It will be positioned 1.5 metres below finished ground level and extend down to 2 mbgl.
- Any asbestos pockets encountered during earth works will be managed by applying immediate water saturation and special attention. Removal will be in accordance with the Site management plan and DoH Guidelines.
- Brick and concrete waste recovered during sorting may be crushed and used in the barrier layer provided if it meets appropriate validation criteria.

- Soil sampling and validation will be undertaken by an MDWES Environmental Scientist. All results will be reported in accordance with the DER Contaminated Sites Management Series and in accordance with current industry best management practice guidelines.
- Laboratory sample analysis will be undertaken by a NATA accredited laboratory.

6.2 Construction / Demolition Material Scope

Construction and Demolition material (CDM) will be accepted on site for the purpose of creating an engineered barrier layer above the deep cells containing potentially contaminated soil.

- CDM will be accepted on-site in the general vicinity of the crushing plant.
- CDM will only be accepted and crushed if it can be demonstrated that the material is free of ACM and is not hydrocarbon impacted.
- Brick and concrete waste recovered during sorting of the site's landfill material may be separated from material destined to be placed in deep cells and transported to the RRRF, provided it has been thoroughly washed down and inspected to ascertain no ACM is present.

6.3 Soil Acceptance and Amendment Facility Scope

As part of the remediation of the Site, soils are required to create the capping layer. The minimum thickness of the capping layer will be 1.5 metres.

The soils will be out sourced from the Perth Metropolitan area and will comprise amended Acid Sulfate Soils (ASS) and Hydrocarbon Impacted Soils (HIS), Class I. All imported capping soils will be processed through the Soil Acceptance and Amendment Facility (SAAF) located on site.

Imported soil will not be accepted unless certification (laboratory analysis) is provided prior to arrival. The soil will be validated suitable for use and be within the soil guidelines for a commercial / industrial end use.

- If required, soil sampling and validation will be undertaken by a MDWES Environmental Scientist. All results will be reported in accordance with the DER Contaminated Sites Management Series and in accordance with current industry best management practice guidelines.
- Laboratory sample analysis for validation will be undertaken by a NATA accredited laboratory.

Acid Sulfate Soils

As per the Soil Amendment Management Plan (Appendix D), ASS soils will be placed on a treatment pad and lime amending techniques used to neutralise the acidic capacity of the soils. Amended soils will be validated and tested prior to use to ensure they meet appropriate assessment criteria. It should be noted that soils may be accepted pre-treated with relevant certification. However, this soil will still be validated before re-use.

Hydrocarbon affected soils which meet current Class I - Waste Acceptance Criteria

Hydrocarbon impacted soils will be placed into a bunded treatment area in windrows. The soils will be inoculated with bio-active enzymes and turned / rotated regularly to ensure volatilisation of the hydrocarbon component. Soils will be validated and tested prior to use in the engineered capping layer.

- Soil sampling and validation will be undertaken by a MDWES Environmental Scientist. All results will be reported in accordance with the DER Contaminated Sites Management Series and in accordance with current industry best management practice guidelines.
- Laboratory sample analysis for validation will be undertaken by a NATA accredited laboratory.

- MDWES proposes to install an initial three groundwater monitoring wells along the western boundary of the SAAF area to monitor groundwater to ensure the SAAF area is not impacting on the local groundwater environment. This is further explained within this ESMP (Section 18.1: Future Environmental Management & Monitoring).

6.4 Air Monitoring Scope

A continuous daily dust monitoring program will be employed for the duration of the remediation and engineering program. The air monitoring will be used to validate the effectiveness of dust suppression and to validate that off-site and on-site emissions of airborne particulate matter and fibre meet appropriate assessment criteria. The monitoring and sampling program includes the following:

- Airborne fibre monitoring for asbestos.
- Real time and gravimetric TSP monitoring and sampling.
- Real time and gravimetric PM_{10} monitoring and sampling.
- Sampling of RCS and particulate matter containing metal.

Fourteen monitoring / sampling stations will be established across the site, with six around the boundary, three in the active remediation work zone and five personal exposure monitoring stations. The AQMP (MDWES) provides the rationale and discussion for the selection of monitoring station locations and equipment used.

6.5 Groundwater Monitoring Scope

- The groundwater monitoring program will continue for the duration of the project and post remediation. The monitoring program will utilise the established monitoring well network. To date, four groundwater monitoring events have occurred, these events will continue bi-annually for the duration of the remediation program.
- Temporary monitoring wells will be installed as the remediation progresses. The wells will extend to the base depth of the historical landfill (approximately 6mbgl), terminating in the aquitard below the Site (Guildford clay). This will enable assessment of groundwater levels (perched / ponded water) and to allow for ground water sampling to be facilitated. Analytes will be in accordance with the CoPC already identified within groundwater.
- Ponded or perched groundwater is anticipated during excavation and is expected to collect at the base of the excavation due to the presence of the underlying Guildford Clay aquitard. Samples will be collected and analysed for the CoPCs identified, to assess any potential for environmental impact through lateral or vertical migration. All perched or ponded waters will be evacuated and pumped out from the base of the excavation, to ensure no environmental impact occurs. Waters will be classified prior to disposal.
- Groundwater monitoring will continue beyond the completion of works to detect any environmental impact from the remediation program. Observations, variations or fluctuations within the groundwater data set will be reported, in accordance with the DER guidelines.
- Groundwater will be used as part of the dust suppression on site. As slightly elevated aluminium and iron concentrations have been recorded as part of the groundwater program to date, groundwater will continue to be monitored and sampled as part of the remediation works to ensure that it poses no impact or health risk to the site workers.
- The associated (attached) Works Approval Application document includes details of all four GMEs, along with the scope, methodology, duration and analytes.

6.6 Additional Environmental Scope

- Waste transfer notes for soils brought to site for soil amendment and those soils not suitable for use within the engineering of the landfill will be noted and reported as part of the document control process of reporting.
- Noise level assessment has been conducted by Herring Storer Acoustics (HSA) for each component of the Site operations (appendix G). Assessment of the site excavation works has been considered as 'construction activities', such as any other land development preparation for the use of residential, or commercial / industrial purposes (Regulation 13). The operation of the Waste Transfer Station component of the site remediation process has been considered as an individual component in regards to the noise emissions, and subsequently has been assessed against Regulation 7 in the Environmental Protection (Noise) Regulations 1997. A Noise Management Plan will be prepared, but can only be developed within a couple of weeks of operations starting, as it will contain details such as site contact numbers, operating times and information from the noise assessment.
- Odour from the SAAF and excavations will be assessed throughout the project's time frame (4-5 years) to ensure that unacceptable odour levels do not occur.
- Potential odour from the Site would be generated and limited to the material unearthed during the excavation. It is anticipated that odour generated would be localised and would remain on site. It is anticipated that the suppression proposed on Site will also retard the odour.
- A Sampling Analysis Program (SAP) will be developed for short, interim and long term monitoring programs, particularly for ground gas and groundwater. At this stage MDWES can only discuss monitoring in general terms as data for the initial phases of the remediation is limited. Information relating to landfill depth and perched groundwater are required so that a detailed monitoring plan can be developed. However, once the SAP is completed, it will be sent to the Auditor to be "endorsed" and agreed, before being adopted and implemented.

6.7 Roles and Responsibilities of the Site Contractor

As part of this environmental assessment, responsibilities of the Site contractor (related to environmental issues) are documented below. This is in accordance with the Adelaide Street, Wasterock, Site Management Plan (SMP) (Appendix E). The Site contractor will be responsible for:

- The day to day management of the Site works.
- Ensuring the safety and health of the site workers in addition to the local residents. This will be achieved through:
    - Pro-active implementation of site management procedures such as Site specific inductions and training.
    - Adherence to and continuous improvement of Site specific management plans.
    - Pro-active management of dust suppression.
    - Compliance with sampling and monitoring program presented in this ESMP, AQMP and HHRA reports.
- The application and establishment of all approvals required to carry out the remediation works including, but not limited to, importation of clean fill material to site for use within the capping layer.
- The establishment of a Category 62 'Solid Waste Depot', and a Class 12, and Class 67a resource recovery facility to process CDM waste, as per barrier layer requirements;
- The design of all waste recovery and processing activities to meet regulatory authority requirements for dust and noise control and state sustainability objectives;

- The completion of the remediation and bulk earthworks, including sand (capping) to completion;
- The employment of suitable qualified environmental and geotechnical consultants to monitor the works; and
- Reporting the ongoing status of the project and delivering a Final Report to certify the Site as *"remediated fit for designated use".*

6.8 Roles and Responsibilities of the Ambient Air Quality Contractor

The AQMP stipulates that a NATA accredited ambient air specialist organisation shall be contracted to install, calibrate service and ensure day to day air real-time monitoring operations conform to Australian Standards. Staff from the contracting organisation must demonstrate the following:

- Experience in installation, calibration and service of TEOMs.
- Understand the AS/NZS standard's relating to the sighting and operation of TEOM's.
    - A strong knowledge of ambient air quality monitoring.
- Previous experience using nephelometers and scaling data by applying custom calibration factors.

7 SITE IDENTIFICATION & INFORMATION

Site identification details are summarised in Table G below. An updated DER Site Summary Form and the Certificate of Title (CoT) for the Site are presented in Appendix A.

Table G: Site Identification

Site Name:	Adelaide Street Remediation (ASR).		
Site Location:	Lot 20 Adelaide Street, Hazelmere, Perth, WA.		
Certificate of Title:	Current Certificate of Title (CoT)		Vol: 2054 Folio: 299
Coordinates of Lot Boundaries ***(the Site is a unusual shape, see figure 1)*** **MGA94 Zone 50**	**Direction**	**Co-ordinates**	
	NW (corner)	Easting Northing	**0406595** **6467321**
	NE (corner)	Easting Northing	**0407034** **6467190**
	NE (Corner Mid)	Easting Northing	**0406939** **6467172**
	SE (corner)	Easting Northing	**0407015** **6466812**
	SW (corner)	Easting Northing	**0406476** **6467046**
	E (corner)	Easting Northing	**0407078** **6467020**
Site Area	The Site dimensions measure approximately 565 m (L) by 300 m (W) Approximately area 169,500m^2 (16.9ha).		
Site Owner	Wasterock Pty Ltd.		
Operations	The Site is a closed landfill.		
Local Government	City of Swan.		
DER Classification	Contaminated – Remediation Required.		
Current Zoning	The study site is currently zoned Rural.		
Proposed Zoning	The study site is proposed to be zoned Commercial / Industrial – Post Remediation.		
Locality Map	See Figure 1.		

7.1 Environmental Site Setting

The Site is an irregular shaped plot of land that has remained redundant and non-operational as a landfill since c.1997. The Site has been allowed to vegetate and stabilise from its closure to the present date. Much of the Site is overgrown, with a variety of persistent introduced flora and some juvenile and semi-mature trees. The Site could be described currently as waste land and undeveloped. The Site measures approximately 565 metres in length and 300 metres in width with a total combined area of approximately 16.9 ha.

Within the non-land filled area of the Site along the western boundary, the surface appears to have a generally flat topography that ranges between approximately 26.69 mAHD in the southwest

corner, sloping gently upwards to approximately 27.24 mAHD in the northwest corner (c.1990 site survey). The original surface levels have been altered, due to historic sand mining at the Site and its subsequent historical landfill (Parsons Brinkerhoff, 2006). The Site has been surveyed by the client (Figure 5).

In general, the surrounding environs of the Site are semi-rural. However, there are several neighboring operations and items of note which are discussed in the following sections of this report.

The Site is bound to the north by undeveloped land and an operational equestrian stable, which includes an oval trotting track, several stables and annex / out buildings. The grounds are not sealed. They are covered with rolled aggregate for vehicle access.

The east of the Site is bound by the Roe Highway (running north to south) and, on the south-east boundary of the Site, there is a small operational sand quarry and land filling operation.

To the south, Adelaide Street runs south-east to north-west, bounding the High Wycombe residential estate. Future Site operations will have the potential to impact on neighboring residents and are considered during the conceptual site model of the Site and at the environmental design stage for monitoring.

Immediately to the west of the Site is an ice works and meat processing works. There are also several undeveloped lots of land interspaced with small industrial / commercial premises surrounding the Site. At present, it is perceived that these industrial / commercial operations have little impact or influence on the subject Site. However, future operations on the subject Site may have the potential to impact on those neighboring sites and consideration will be applied during the conceptual site model of the Site and at the environmental design stage for monitoring.

8 ENVIRONMENTAL PERFORMANCE & ASSESSMENT LEVELS

The environmental management plan (as set out within this document) will be implemented for the full duration of the earthworks and remediation of the Site. MDWES will maintain a watching brief and execute the environment monitoring program. The Information and data obtained during the monitoring program with be presented periodically to the Client and this information will also be relayed to the appropriate authorities and appointed Contaminated Sites Auditor, ensuring environmental compliance throughout the project.

8.1 Reporting

The client has estimated that the operation to fully remediate the Site could take four to five years to complete. Therefore, as part of the environmental monitoring program, MDWES will periodically present reports based on the findings.

The periodical reports will be issued to the client and authorities overseeing the project for comment and consideration. If there are any environmental non-conformances or breaches outside these periodical reports (such as exceedance of assessment criteria), then an interim report will be issued. This report will detail the requirements and breaches of the management plan with recommendations and solutions.

8.2 Frequency of Sampling and Reporting

MDWES will periodically present reports of the results taken on site as the project progresses. The following discusses each report.

Monthly Environmental Site Report

This report will present information and results relating to soil and air for this period, plus bi-annual groundwater monitoring reports (when sampled). The report will include non-conformances or environmental issues that have arisen on site. It will collate and provide information on what has occurred on site, sample frequencies and observations from the month, inclusive of suggestions and conclusions.

The monthly Environmental Site Report will detail and include the following:

- ***Weekly Air Monitoring Report***

  This letter report will collate and report information and results from the daily air monitoring program. The results will be issued weekly to allow for the prompt review of monitoring data and site procedures and measures undertaken in response to any exceedances, should they occur. The report will detail both weather data and laboratory data. Air sample filters would be sent to a NATA accredited laboratory for certified analysis and reported daily.

- ***Weekly Noise Monitoring Report***

  This letter report will collate and report information and results from the daily noise monitoring on site. The report will be issued weekly. A review of site procedures and measures undertaken will be documented in the event of any noise exceedances or complaint.

- ***Weekly Soil Monitoring Report***

  This report will collate and report information and results from soil sampling activities across the Site. The report will be issued weekly to review the appropriate use of soils across the Site. Laboratory samples will be sent to a NATA accredited laboratory for certificated analysis and reporting.

- ***Bi-Annual Groundwater Monitoring Report***

  A continuation of the groundwater monitoring program will be presented in a bi-annual report that will collate and report information including results from the groundwater quality monitoring program. As part of the on-going groundwater program, any fluctuations or changes within the groundwater will be compared against established data. Laboratory samples will be sent to a NATA accredited laboratory for certificated analysis and reporting.

- ***Monthly Ground Gas Report***

  The Site will require ground gas assessment in the form of a monitoring program. The monitoring will be undertaken monthly which will collate and report information including field results. The on-going ground gas program will monitor any fluctuations or changes within the ground gas and compared against established data month on month.

- ***Site Validation and Audit Report (SVAR)***

  A Site Validation Audit Report (SVAR) will be undertaken to demonstrate the effectiveness of the implementation of the HHRA, ESMP and its suitability for the site at the end of the project. In conjunction with any necessary stakeholder communication, the SVAR will ensure regulators are satisfied with outcomes of the site remediation and management process. Should any outstanding issues be identified, appropriate action, documentation, and reporting will be undertaken to meet regulatory needs.

In the event that an exceedance of monitoring assessment criteria occurs, or breaches are observed, the client will be immediately advised so they can implement appropriate corrective actions. This advisement will be both informal (email and telephone) and formal (letter) and will state the nature if the issue and related requirements to address the issue. All Stakeholders will be informed of any exceedence, or breach during the monitoring program.

8.3 Adopted Environmental Assessment Criteria

The information gathered during the environmental monitoring program will be compared against chosen assessment criteria. Table H summarises the adopted environmental assessment criteria which will be used to assess environmental performance during the scope of works. It does not detail human health risk assessment criteria, as this is discussed later.

Table H: Environmental Performance: Soil and Groundwater.

Testing Media	Analytes	Comparable Assessment Criteria /Levels	Reference Document
Groundwater	**Chemical Properties** ▪ Metals ▪ TPH / TRH ▪ BTEX ▪ Phenols ▪ OC / OP	Fresh waters Domestic non-potable groundwater use. Short Term & Long term Irrigation. Drinking Water & Aesthetic Waste	Assessment Levels for soils, sediment and water (DER, 2010)
Soil Amendment	**Chemical Properties** ▪ Metals ▪ TPH / TRH ▪ BTEX ▪ Asbestos	Assessment Criteria - HIL (F) for Hydrocarbons & Metals Waste Acceptance Criteria (Accept Class I only) NEPM 2013 HILS for Metals CRC Care HSL for Volatiles Technical Report No.10.	Assessment Levels for soils, sediment and water (DER, 2010) Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (DER, 2004) NEPM 2013 (HILs) CRC Care Technical Report No.10
	Acid Sulfate Soils	SPOCAS or SCR analysis	Assessment Levels for Soils, Sediment and Water (DER, 2010)
	Volatile Organic Compounds (VOCs)	CRC Care HSL for Volatiles	NEPM (2011) Technical Report No.10.

Remediation of Landfill Soils	Chemical Properties ▪ Metals ▪ TPH / TRH ▪ BTEX ▪ Asbestos	Assessment Criteria - HIL (F) for Hydrocarbons & Metals Waste Acceptance Criteria (Accept Class I only)	Assessment Levels for soils, sediment and water (DER, 2010) and Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (DER, 2004)
	Asbestos	0.05% w/w (commercial)	Guideline for the Assessment, Remediation & Management of Asbestos Contaminated Sites WA (2012)
Offsite Air Quality	General Dust (TSP)	90 µg/m^3 (24-hour average)	A guideline for managing the impacts of dust and associated contaminants from land development sites … (DER 2011)
Noise	Noise Levels	60 dB(A)	Environmental Protection (Noise) Regulation 1997 (EPA, 1997)

8.4 Regulatory Guidelines

Relevant legislations, guidelines and standards used or referred to in preparation of the ESMP and SMP documents are:

- Environmental Protection Regulations 1987.
- Environmental Protection (Noise) Regulations 1997.
- Environmental Protection (Controlled Waste) Regulations 2004.
- Guidance Statement for Remediation Hierarchy for Contaminated Land (Environmental Protection Authority, 2000).
- Risk Assessment in Contaminated Site Assessment and Management (DER, 2006).
- Development of Sampling and Analysis Programs (DER, 2001).
- Assessment Levels for Soil, Sediment and Water (DER, 2010).
- Bioremediation of Hydrocarbon-contaminated Soils in Western Australia (DER, 2004)
- Reporting of Site Assessments (DER, 2001).
- Community Consultation Guideline (DER, 2006).
- Landfill Waste Classifications and Waste Definitions 1996 (As Amended DER 2009).
- Draft - A Guideline for the Development and Implementation of a Dust Management Program (DER, 2008).
- Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia (DoH, 2009, updated 2012).
- A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities. DEC 2011).
- Occupational Safety and Health Management and Contaminated Sites Work (Commission of Occupational Safety and Health, 2005).
- Australian Standard AS/NZS 4801-2001 Occupational health and safety management systems - Specification with guidance for use.
- Australian Standard AS 1319-1994 Safety signs for the occupational environment.
- Australian Standard AS 1940-2004 The storage and handling of flammable and combustible liquids.
- Australian Standard AS 3780-2008. The storage and handling of corrosive substances.
- CIRIA Guidelines C665 (UK) – Assessing Risk Posed by Hazardous Ground Gases to Buildings.
- CRC Care – Technical Report No.10 – Health Screening Levels for Petroleum hydrocarbons in soil and groundwater.
- NEMP Guidelines, Schedule B1 (2013) – Investigation Levels for Soil and Groundwater.

9 RISK ASSESSMENT

9.1 Human Health Risk Assessment

A Human Health Risk Assessment (HHRA) has been undertaken, utilising the NEPM Health Risk Assessment Framework, EnHealth (2012) and DoH (2009) as guiding documents. For the assessment of human health, the framework provides guidance on conducting HHRA in relation to contaminated land (See Appendix B).

It should be noted the NEPM, HHRA Framework was amended in May 2013, which saw a number of Schedule B Guidelines updated. There is a 12 month transition period for the implementation of the revised NEPM in Western Australia.

This risk assessment draws on the following Schedules for guidance:

- Schedule B4: Guideline on site-specific health risk assessments.
- Schedule B5: Guideline on ecological risk assessments.
- Schedule B7: Guideline on Community Engagement and Risk Communication.

9.2 Risk Assessment Methodology

The Risk Assessment Framework seeks to identify site issues such as:

- Why is the assessment being done?
- Is a risk assessment the right type of decision making tool?
- Who and what are stakeholder objectives?
- What information is needed?
- What are the sources of contamination and the hazards?
- What exposure pathways should be investigated?
- What decisions need to be made and when?

Given the age of the landfill and its uncontrolled nature, there is a risk of encountering contamination, in particular ACM, during the excavation and remediation of the landfill. Therefore, the development of a Human Health Risk Assessment (HHRA) is required to address the potential risks posed to the site workers and local residents from site operations. An HHRA has been prepared by MDWES, in consultation with MTOX, for Wasterock Pty Ltd (the Client), to address issues associated with the excavation, management and remediation of the Site.

Although primarily licensed for inert waste during its operational cycle, a number of non-inert wastes were understood to have been received at the landfill. The non-inert material was received with the knowledge and approval of the regulating authority, which at the time was the Shire of Swan. Records show that the received materials were described as inert building waste, car bodies/parts and asbestos sheeting / pipes / tiles. In addition, it was reported that sludge's containing hydrocarbons, together with emulsified factory wastes, were also accepted. Furthermore, drums (unknown), plus drums of kerosene, bitumen, pesticide-contaminated soils and hospital wastes are also known to have been accepted during its operational life.

Contamination of the site by ACM fragments, and potentially asbestos fibres, has occurred as a result of questionable historical land filling and waste handling. As a consequence, nearby residents are concerned regarding exposure to asbestos fibres potentially released during the remediation of the Site. However, the site currently exhibits asbestos at the surface and so also represents an environmental risk and human health risk, even if left as it is.

Community health concerns are exacerbated by the site being over the road from domestic housing, including young families. Their concerns appear primarily associated with potential asbestos fibre exposure, as a direct result of the excavation and remediation of the Site. A brief overview is presented in the following sections. However, the HHRA should be consulted for the full health risk assessment.

9.3 Risk Management

To minimise public exposure, site access will be restricted to personnel necessary for current remediation, monitoring, and reporting activities. Fencing, signage, and site entry protocols will be established to minimise unauthorised entry to the Site.

Similarly, dust suppression at the site will continue, as required, throughout the site remediation process. The maintenance of wind fencing will also assist in control of peak dust releases ('spikes'), while reducing the visual impact of site remediation to nearby residents. Within the summer months it is likely that surface soils will dry out quicker, therefore, dust suppression will be more frequent. The frequency will depend on air monitoring data and visual assessment.

Surface soils will be pre-wet during the initial stages of soil removal, to minimise dusts that may result from mechanical disturbance. Subsequent dust suppression will be informed by visual assessment during site activities and dust monitoring. As recognised by DoH (2009), dust monitoring provides a useful surrogate measure to evaluate the potential generation and distribution of airborne asbestos fibres. To demonstrate the effectiveness of the adopted site management measures and alleviate community concerns, a dust monitoring program will be implemented (MDWES AQMP). The approach outlined is considered to be consistent with the dust monitoring methods outlined by DoH (2009). The results of the monitoring will be presented in the periodic reports as outlined in section 8.2.

To validate the dust suppression measures, the on-Site air monitoring program will be implemented for the duration of the project (full details are in the MDWES AQMP). This will provide 'real time air quality data' during work hours, to identify any exceedance of adopted air assessment criteria. If any exceedances do occur, then a review of the site management plan and the AQMP may be required (DoH, 2009) and should be approved by the contaminated site auditor and DER.

All Site personnel and visitors will be required to undergo a site induction before being allowed entry to the Site. The induction will have a strong focus on risks posed from exposure to airborne contaminants. The Site Induction will reinforce the Site's primary objective to minimise potential emissions of airborne contaminants. All personnel will be instructed that visual assessment of dust levels is everyone's responsibility and that they are required to inform the Site Operations Manager of any increase in visual dust levels and take appropriate actions as per Site-specific management plans. The competency of site personnel undertaking remedial earth works to follow visual assessment of dust will be assessed by a competent person.

To further mitigate any risk to the site workers from dust, asbestos fibre and odour, it will be the responsibility of Site management to ensure that the prescribed PPE is worn at all times and that the decontamination procedures are adhered to. All Site workers will be required to participate in ACM hazard awareness and respirator protection training prior to commencing works on Site (Induction requirements)

DoH (2009) guidelines outline a process to address sites contaminated by ACM. The environmental management is presented within this document, while the MDWES HHRA has been prepared to address any risks to human health.

The issues identified above have been developed into a preliminary Conceptual Site Model (CSM). The CSM has been developed to identify potential sources of contamination, the pathway and receptors that may be susceptible.

The CSM is an identifier of potential risks that may be associated with the remedial works. The HHRA develops the CSM further to provide a more detailed exposure assessment and thereby further inform risk characterisation. This knowledge will be used to keep the local community and stakeholders appraised of the risks associated with the Site and its management.

10 CONCEPTUAL SITE MODEL & RISK ASSESSMENT

A Conceptual Site Modal (CSM) and Risk assessment is required to assess the interconnections between the Contaminants of Potential Concern (CoPC), exposure pathways and potential receptors (source > pathway > receptor model). A conceptual site model of the Site is presented in Figure 6.

A preliminary conceptual site model (CSM) has been developed to describe the possible pathways by which exposure to potential contamination may occur. For exposure to occur, a complete pathway must exist between the source of contamination and the receptor (Source-Pathway-Receptor) (i.e. the person or ecosystem components potentially affected or harm can be caused by the contamination).

A risk may only exist where a plausible SPR linkage is present, and where the quantity or concentration of a contaminant is sufficient to pose harm. Under the statutory definition, "contamination" may only strictly exist where contaminants pose a risk of harm to a receptor. Risk may be defined as a function of the magnitude and severity of any adverse effects arising from contamination. Where the exposure pathway is incomplete, exposure cannot occur, leaving no risk via that pathway.

An exposure pathway will typically consist of the following elements:

- A source of contamination (i.e. a leak or spill, particulates).
- A release mechanism (i.e. migration in soil, leaching to water, emission to air).
- Retention in the transport medium (i.e. soil, groundwater, surface water or air).
- An exposure point (i.e. where a person(s) come into contact with contaminated dust, soil or contaminated groundwater from a well or in a building overlying volatile contamination.
- An exposure route (i.e. inhalation, ingestion, absorption through the skin).

10.1 Contaminants of Potential Concern

As part of the CSM, consideration was given to Chemicals of Potential Concern (CoPC) which have been identified on site and is based on historical environmental information. The DER Contaminated Sites Management Series: *Potentially contaminating activities, industries and land uses (2004)* provides guidance as to possible CoPC's based on land-use. With reference to the DER document, the following Table (H) details the potential contaminants.

Table I: DER defined potential CoPC for a Landfill

Industry, Activity & Land Use	Common Contaminants that might be encountered
Remediated Material	Dependent on Landfill Type and waste disposed the following could be encountered: • Polychlorinated Biphenyl's • Alkanes • Sulfides • Metals • Organic Acids • Nutrients (i.e. nitrogen & phosphorus) • Total Petroleum Hydrocarbons/ Total Recoverable Hydrocarbons (TPH/TRH) • Polycyclic Aromatic Hydrocarbons (PAH) • Ammonia • Ground gasses (e.g.: methane) • Total Dissolved Solids (TDS) • Monocyclic Aromatic Hydrocarbons (MAH) (e.g.: benzene, toluene, ethyl benzene & xylene). • Asbestos • PCBs • PAHs in soil and groundwater • TDS, nutrients, organic acids and sulfides in groundwater

10.2 Identified Contaminants of Potential Concern

On the basis of the information detailed in Table H and the historical information obtained from site investigations, Parsons Brinckerhoff concluded that the CoPCs which will be monitored during the remediation works will be similar to those detailed in Sections 2.6 to 2.8 for Air, Soil and Groundwater.

Soil

- Total Petroleum Hydrocarbons (TPH).
- Monocyclic Aromatic Hydrocarbons (MAH's).
- Asbestos.
- Heavy Metals.

Groundwater

- 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, naphthalene (BTEXN).
- Polynuclear Aromatic Hydrocarbons (PAH).
- Monocyclic Aromatic Hydrocarbons (MAH).
- Phenolic compounds.
- Total Petroleum Hydrocarbons / Total Recoverable Hydrocarbons (TPH/TRH).
- Organochlorine and organophosphorus pesticides (OC/OP).

Air

- Asbestos fibres.
- Particulate matter as: TSP, PM_{10}, Respirable Crystalline Silica (RPS) and particles containing metalloids.
- Volatile Hydrocarbons - Monocyclic Aromatic Hydrocarbons (MAH).

Ground gases

Ground gases will be assessed upon completion of each newly engineered cell and post-remediation of the Site. As each of the remediated areas (cells) is completed, ground gas monitoring wells will be established and screened into the deep remediated engineered cell. Ongoing monitoring will continue through to the project as each cell is completed and through to post completion of the project (1 year). A sufficient time lapse will be given to allow the remediated cells to stabilise and to establish whether any ground gases are being generated. The ground gas well network will start in the west and will be developed through to the east of the site. This will allow for ground gas assessment and data to be gathered from 6-9 months from commencement of the project and until completion (4-5 years, +1 year post completion).

Through the remediation process, organic material such as trees, mulch, and garden waste will be removed during the screening process, therefore reducing or removing a point source for ground gas generation from organic matter. Ground gas generation will be assessed as part of the CSM, but is considered as 'low risk' at this stage, as the remediation and engineering of the material is designed to reduce the potential for ground gas generation.

Ground gases are also discussed in Section 18.2, where the inclusion of volatile chemicals in the monitoring program will be considered, dependant on findings (including any complaints from local residents), as work progresses.

10.3 Preliminary Risk Assessment

For the purpose of the Preliminary Risk Assessment, risk can be expressed as a function of the nature of the source, the sensitivity of a receptor and the magnitude or likelihood of any associated pathway(s) between the source and receptor.

In the chosen model, the source, pathway(s) and receptor are each rated on a five-point semi-qualitative scale, with the overall level of risk being expressed as a multiple of those ratings. The product of the risk assessment is that an overall risk rating can be provided through a scoring matrix. The values are based on a logical progression scoring. The ratings are subjective, but conservative, and based on professional opinion. The risk assessment scores and overall risk rating matrix is given in Table J (below):

Table J: Risk Assessment Matrix

Category	Individual Sources, Pathways and Receptors	Overall Risk Rating *(product of SxPxR)*
Negligible	0	0
Very Low	1	1-4
Very low to Low	1.5	5-7
Low	2	8-13
Low to Moderate	2.5	14-22
Moderate	3	23-35
Moderate to High	3.5	36-55
High	4	56-79
High to Very High	4.5	80-110
Very High	5	111-125

10.4 Site Risk Assessment – Sources

Possible sources of contamination have been identified or discounted as parts of the development of this ESMP. These are summarised on Table K below. This risk assessment is based on conservative values, presenting a worse case for the potential to encounter each source/media. The Site has historically been used as an inert landfill and although it is not currently in operation, there are several aspects of this commercial operation which could present a potential contamination source.

Table K: Risk Assessment Criteria

Source	Media	Description	Comments	Rating
Known Landfill / Made Ground (Inert)	Soil	General chemical quality of the filled ground. Which can cause human and environmental issues.	Possible contaminants include Metals, non-metals, asbestos, organics, (OC/OP), TPH / TRH, PAH and BTEX	High to Very High (4.5)
Potential spills or leaks from drums or fuels stored within landfill	Soil	Potential elevated organic contaminant levels. Which can cause human and environmental issues?	Possible contaminants include TPH/TRH BTEX and PAH, factory sludge's, pesticides and / or farming liquids.	High to Very High (4.5)
Asbestos Containing Material	Soil	Potential cells of asbestos within landfill. Which can cause human health issues?	Asbestos & asbestos fibres	High to Very High (4.5)
Asbestos Fibres	Air	During excavation the potential liberation of fibres. Which can cause human health issues?	Asbestos fibres	High to Very High (4.5)

Dust particulates containing metals and silica	Air	During excavation the potential liberation of dust and can cause respirable problems	Dust particulates, silica, $PM_{2.5}$ and PM_{10}	High to Very High (4.5)
Potential ground gases from on site - engineered landfill	Gas	Background levels of gases generated from engineered fill	Carbon Dioxide, Carbon Monoxide, depleted oxygen. Methane, VOC, Hydrogen Sulfide	Low (2)
Potential odour during excavation	Odour	Odour from excavated material	Possible sulphur odours – (Methane, VOC, Sulfides)	Low (2)

10.5 Potential Receptors

Potential receptors associated with the Site and its redevelopment, identified or otherwise discounted, are summarised in Table L.

Key receptors identified are those where human health may be impacted - in particular, the Site workers and the neighbouring residents to the Site. Environmentally, the groundwater will be considered, although the aquitard on which the engineered remediated cells will be constructed is providing a barrier to the underlying groundwater.

Table L: Possible Receptors of Contamination

Receptor	Description	Comments	Rating
Site workers	Persons involved in remediation.	Ground works involved.	High to Very High (4.5)
End users	Occupants of the proposed development. (remediated)	Development is to be zoned commercial/industrial.	Low (2)
Soft landscaping	Areas of planting including lawns, shrubs, trees, etc.	No areas of soft landscaping are planned or it would be very limited.	Low (2)
Building materials	Buried concrete and plastics (underground services) laid in contact with contaminated soils.	The Site will be remediated and the upper soils will be certified clean and below guideline criteria	Low (2)
Adjacent land users	Properties within immediate vicinity of Site.	Residential and commercial properties have been identified.	High to Very High (4.5)
Groundwater	Medium to high Permeability (Bassendean Sand) beneath the Site. However the underlying Guildford Clay acts as an aquitard to the aquifer.	The Site is located over the Leederville Aquifer. But the Guildford Clay restricts potential migration	Low (2.0)
Surface water	Controlled waters within lakes, rivers, and ponds, etc., or coastal waters	Nearest surface water is over 2.0km away and up-gradient	Very Low (1)
Ecological receptors	Sensitive areas of ecological significance as defined under Desk Study	No sensitive areas were identified. However, the Site its self has laid fallow for some time and wildlife may habitat the area.	Low (2)

10.6 Potential Exposure Pathways

The possible exposure pathways are identified as natural and / or man-made pathways for the preferential migration of chemicals of concern in the liquid and/or gaseous state. Potential contaminant migration pathways for the CoPC include:

- Trenches for underground utilities.
- Horizontal groundwater flow in the underlying aquifer.
- Vertical movement through the vadose zone, via seasonally induced aquifer fluctuation.
- Vapour migration from a hydrocarbon source.
- Movement of soil-gas through volatilisation from potentially impacted groundwater.
- Dust and fibre particulates being liberated during excavation.

Potential exposure routes for the CoPC with human health risks include:

- Dermal contact.
- Ingestion.
- Inhalation.

Table M: Potential Exposure Pathways

		Sources						
		Known Landfill / Made Ground (4.5)	**Potential spills or leaks from drums or fuels stored within landfill (4.5)**	**Asbestos Containing Material (4.5)**	**Dust Particulates PM_{10} & $PM_{2.5}$ (4.5)**	**Dust particulates containing metals & silica (4.5)**	**Potential ground gases (on Site Made Ground) (2.5)**	**Potential odour (on Site Made Ground) (2)**
Receptors	**Site Workers (4)**	Ingestion, dermal contact inhalation (3)	Ingestion, dermal contact inhalation (4)	Ingestion, dermal contact inhalation (4.5)	Ingestion, dermal contact inhalation (5)	Ingestion, dermal contact inhalation (5)	Asphyxiation poisoning explosion (4.5)	Lateral migration, asphyxiation, Inhalation (4.5)
	End Users (Remediated) (1)	Ingestion, dermal contact inhalation (1)	Ingestion, dermal contact inhalation (1)	Ingestion, dermal contact inhalation (1)	Negligible (0)	Negligible (0)	Asphyxiation poisoning explosion (1)	Negligible (0)
	Soft Landscaping (2)	Plant uptake of contamination (1)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)
	Building Materials (2)	Chemical attack (1)	Negligible (0)	Negligible (0)	Chemical attack (0)	Chemical attack (0)	Chemical attack (1)	Negligible (0)
	Adjacent Land Users (4.5)	Ingestion, dermal contact inhalation (5)	Leaching, Lateral Migration (3)	Ingestion, dermal contact inhalation (4)	Ingestion, dermal contact inhalation (5)	Ingestion, dermal contact inhalation (4)	Lateral migration, asphyxiation, poisoning, explosion (1)	Lateral migration, asphyxiation, inhalation (4.5)
	Groundwater (1.5)	Leaching, Vertical & lateral migration (3)	Leaching, Vertical & lateral migration (3)	Leaching, Vertical & lateral migration (1)	Leaching, Vertical & lateral migration (1)	Negligible (0)	Negligible (0)	Negligible (0)
	Surface water (1)	Leaching, Vertical & lateral migration (1)	Leaching, Vertical & lateral migration (1)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)	Negligible (0)
	Ecological Receptors (2)	Leaching, Lateral migration (3)	Leaching, Lateral migration (3)	Ingestion, dermal contact Inhalation (3)	Ingestion, dermal contact Inhalation (3)	Ingestion, dermal contact Inhalation (3)	Negligible (0)	Negligible (0)

10.7 CSM Conclusions

The conceptual site model identified several potential sources from the Site's historical land use as a landfill. Equally, several pathways were identified from potential leaks and migration from hydrocarbon sources through the soil matrix, which could migrate into the groundwater. In addition, inhalation, ingestion and dermal contact from dust particulates and asbestos fibres have also been identified.

A numerical analysis has been adopted for the assessment of risk (see Table J), expressed as the multiple of likelihood and severity (*Source x Pathway x Receptor*). The categories have been calculated and rated and are presented in Table N with regard to risk levels. A summary of the numeric risk assessment is given in the following matrix:

Table N: Summary Conceptual Model and Environmental Risk Assessment

		Sources						
		Known Landfill/ Made Ground (4.5)	**Potential spills or leaks from drums or fuels stored within landfill (4.5)**	**Asbestos Containing Material (4.5)**	**Dust particulates (4.5)**	**Dust particulates containing metals & silica (4.5)**	**Potential Ground gases (on Site Made Ground) (2.5)**	**Potential odour (on-Site Made Ground) (2)**
Receptors	**Site workers (4)**	High	High	High to very high	High to very high	High	High	High
	End users (Remediated) (1)	Very low to low	Very low to low	Very low to low	Negligible	Negligible	Very Low	Negligible)
	Soft landscaping (2)	Low	Negligible	Low	Low	Negligible	Negligible	Negligible
	Building materials (2)	Low	Negligible	Negligible	Negligible	Negligible	Very low to low	Negligible
	Adjacent land users (4.5)	High to very high	High	High to very high	High to very high	High to very high	Low	High
	Groundwater (1.5)	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Negligible	Negligible	Negligible
	Surface water (1)	Very low to low	Very low to low	Negligible	Negligible	Negligible	Negligible	Negligible
	Ecological receptors (2)	Moderate	Moderate	Moderate	Moderate	Moderate	Negligible	Negligible

Following this approach, it can be seen that a variety of potential risks may affect various targets. A detailed assessment has been made for each contaminant with a source-pathway-receptor linkage. `The aim of the ESMP and the sampling on-site is to reduce these risks from the model. The easiest way to limit the pathways to the receptor is to introduce control measures to reduce the environmental impact.

The overall qualitative risk designation of **high** has been assigned to the Site based on the potential sources, the evident pathways and very sensitive receptors. The ecological and environmental risks have been addressed as part of this assessment.

A review of the conceptual site model and matrix, in conjunction with limitations in the use of appropriate assessment criteria given the nature of the Site remediation approach, indicates that a Tier III site specific risk assessment is required (DoH, 2009). MDWES has undertaken an HHRA report which further explains these issues and expands on the risk to human health from on site processes. The HHRA develops the need for key hazards and exposure scenarios to be addressed in terms of dust, asbestos and odour and consequent management measures dictated according to the nature of the risks.

11 COMMUNITY CONSULTATION

A Community Management Report has been prepared by Greg Rowe & Associates (GRA) (August 2012) on behalf of Wasterock Pty Ltd, entitled *Community Management Strategy for Remediation of Site*. A fully copy of the Community Consultation Report is presented in appendix F, but the following sections highlight some of the points of the report.

The community consultation plan is in accordance with the DER's *Reporting of Site Assessments Guidelines* 2001 and the *Contaminated Sites Management Series Community Consultation Guidelines* 2006.

11.1 Deciding Stakeholders

Stakeholders will be invited to participate in the community consultation process. They have been identified based on the nature of contamination and the Site's location. The following factors have guided the choice of stakeholders:

- Proximity of the Site to local residents in High Wycombe.
- Known contaminants on site (i.e. asbestos, dust, hydrocarbons and heavy metals).
- Ground water flow direction (north west, away from High Wycombe residents).
- Location of the Site on the Municipal boundary of the City of Swan and Shire of Kalamunda.

11.2 Stakeholders

The following is a list of stakeholders who should be informed as to the remediation work being undertaken on site and be invited to participate in community consultation:

- Residents south of Adelaide Street and north of Benson Way, in the residential suburb of High Wycombe.
- Residents north of Adelaide Street, south of the Great Eastern Highway Bypass, east of Stirling Crescent and west of Roe Highway, in the suburb of Hazelmere.
- Residents on the eastern side of Roe Highway, north of Adelaide Street, west of Midland Road and south of Talbot Road, in the suburb of Hazelmere.
- Any resident groups / community associations within the above mentioned residential localities.
- The appointed contaminated sites (DER approved) auditor, Charlie Barber from Australian Environmental Auditors (AEA).
- City of Swan Technical Officers (Planning and Health Departments) and elected members (Ward Councilor/s and Mayor).
- Shire of Kalamunda Technical Officers (Planning and Health Departments) and elected members (Ward Councilor/s and Mayor).
- Technical Officers from the Department of Planning (DoP).
- State Government Midland electorate MLA (Michelle Roberts).
- State Government Forrestfield electorate MLA (Nathan Morton).
- State Government East Metropolitan Region electorate MLC (Ms. Donna Evelyn).
- Department of Environment Regulation (DER).
- Department of Health (DoH).

11.3 Level of Community Involvement

Table O below has been adapted from the WA DER (2006) Community Involvement Framework. The matrix can be used to help guide the selection of the appropriate level of consultation.

Table O: Selecting the Level of Community Involvement

Assessment Questions	V. Low	V. Low to Low	Low	Low to Moderate	Moderate	Moderate to High	High	High to Very High	Very High
Perceptions of persons external to the proposal (the community)									
What is the level of existing controversy (current) surrounding this type of facility?					■				
How significant are the potential impacts to the community?							■		
What is the level of significance of this issue to the major stakeholders?								■	
What level of involvement does the community appear to desire?								■	
What level of involvement do key stakeholders appear to desire?								■	
What is the probable level of difficulty in solving the issue?					■				
Perceptions of persons internal to the proposal (the proponent)									
What is the required level of public input?						■			
What is the potential for the number of actively involved stakeholders to balloon?					■				
To what degree does the public appear to want to be involved?							■		
What is the potential for the public to influence the potential outcome?							■		
How significant are the possible benefits of involving the public?								■	
How serious are the ramifications of not involving the public?									■
What is the possibility that the media will become interested?								■	
What is the likelihood that decision-makers will give full consideration to public input?							■		
What is the likelihood that adequate resources will be made available to support community involvement?									■
What is the likely level of political controversy on this issue?							■		

On the basis that the level of community consultation required is **high** and no off-site receptors have been confirmed as being affected (to date), a community consultation plan has been developed and has been issued by GRA (see Appendix F).

11.4 Consultation Strategy

The community consultation will take place over several phases, as per the (GRA) Community Consultation Plan.

The initial fact sheet or brochure will indicate the anticipated steps in the remediation process, work periods, and further community consultation. The fact sheet or brochure will be accompanied with a comment form to encourage two-way communication, allow comments on the proposed remediation strategy and determine the extent of future community consultation.

At the same time as the fact sheet is released, newspaper and online advertising on the City of Swan and Shire of Kalamunda websites will occur. Newspaper advertising will be brief and will direct stakeholders to the City and Shire's website for further information. Online advertising will provide the same information as the fact sheet and will allow stakeholders to make comments online that will be directed to Wasterock Pty Ltd for their consideration and response. If required, MDWES will be available for consultation by the landowners, with regards to environmental concerns and comments.

Feedback from stakeholders following initial consultation (i.e. fact sheet and advertising) will be used to assist and refine the remediation strategy. The consultation will also determine the next phase of consultation and may assist to determine points of contact within the community.

The next phase of consultation will involve either one relatively large public meeting or smaller meetings with specific stakeholder groups.

If a range of individuals with different issues respond to the fact sheet and advertisement, then one public meeting will likely be organised to allow all individuals to be involved. At the public meeting, the preliminary investigations and proposed remediation strategy will be discussed. Specialised members from the project team will attend the public meeting, present on certain aspects if necessary and then be available to answer questions from stakeholders. The feedback from this meeting will be documented and will be used to help refine the remediation strategy as required.

If it becomes clear following initial consultation (i.e. fact sheet and advertising) that there are certain groups or resident associations with similar issues, smaller meetings with specific stakeholder groups will be considered. Again, these meetings will be attended by members of the project team who will address any issues raised by stakeholders. Feedback from these meetings will be documented and used to modify the remediation strategy. If required, MDWES will liaise with the DER and auditor to update the remediation strategy, as required.

Following the public meeting or small stakeholder group specific meetings, a written and online update will be provided to summarise the results of the consultation sessions. Once the remediation works begin, periodic updates will be issued online and to specific points of contact within the community, on a regular basis (e.g. every 3 months). These updates will highlight the progress of remediation work and expected timeframes. During the remediation process, any complaints will be directed to the City of Swan and Shire of Kalamunda. All complaints will then be forwarded to Wasterock Pty Ltd, who will consult MDWES if environment-related. MDWES will register the complaints with the DER and local authority, take any necessary action and respond to all complainants.

Once the remediation process is complete, a final notice will be issued to stakeholders and confirmation will be advertised online. At this stage, a review of the community consultation process will be undertaken. Community feedback will be requested when the final notice of completion is issued to stakeholders, including at the online source.

11.5 Consultation Program

The Consultation Program has been prepared in accordance with the Contaminated Sites Management Series Community Consultation Guidelines (2006). Table P summarises the program set out by GRA.

Table P: Timetable of Community Consultation Program

Media	Process	Timeframe	Outcomes
Leaflet/Brochure	Initial fact sheet / brochure drop to selected stakeholders. Requesting comment regarding remediation process.	Allow 3 weeks for stakeholders to respond (writing) to fact sheet / brochure.	The comments received may impact the Site Remediation Program (SRP) and future consultation.
Advertisement	Advertise in local newspaper and on-line of proposed remediation works and request comments on proposed strategy.	Allow 3 weeks. To run concurrently with fact sheet / brochure release.	The comments received may impact the Site Remediation Plan (SRP) and future consultation.
Governmental & Local Authorities meeting	• SRP is finalised and lodged with the DER (if amendment is required). • An allowance of 3 working weeks to amend SRP and lodge with DER. • A 4 month allowance for the DER to assess and approve.		
Public meeting	Public meeting or stakeholder specific meetings to present on issues and address stakeholder concerns	Public meeting or stakeholder specific meetings to occur 7 weeks following fact sheet / brochure release. This will allow approximately 4 weeks to review initial comments received and organise meetings.	Comments and concerns raised during the meetings may impact the SRP
Governmental & Local Authorities Meeting	• Liaising with the DER regarding Community Consultation, SRP may be amended. • An allowance of 3 working weeks to liaise with the DER and amend SRP if required. • A 3-4 months allowance for the DER to assess and approve.		
Periodic community meetings	SRP is agreed and remediation of the Site begins. Updates on progress and timeframes are provided online and to points of contracts in the community.	Every 3 Months	Community Is Informed
On-line	Complaints register is made available to the community for comment	Duration of project (4-5 Years)	Stakeholders are Informed
Advertisement & on-line advertisement	Remediation is complete. Final notice is issued to stakeholders and advertised.	1 week	Confirms to stakeholders the completion of remediation
Public meeting	Community Review, a request for comments on consultation undertaken. Sent with final notice.	Allow 3 weeks for stakeholders comments	Comments will be taken under consideration for future projects with community consultation.

Note: These are approximate time frames and could be subject to change depending on any ongoing matters.
Note[2]: The Auditor will be provided with information and data received as part of the auditing process.

12 ENVIRONMENTAL MANAGEMENT – SITE

A Site Management Plan (SMP) has been developed by Wasterock Pty Ltd which is presented in Appendix E. The SMP details the roles and responsibilities of the parties involved and actions to be undertaken, for the duration of the Site remediation project.

The Wasterock SMP goes into more detail with regards to operational and regulatory procedures during the Sites operations. This includes, but is not limited to, responsibilities of managers, first aid procedures, occupational health management, site traffic management and site reporting procedures. For further information on site management, reference should be made to the Wasterock SMP in appendix E.

Within the SMP, reference is made to the environmental requirements. This ESMP by MDWES expands further on the environmental requirements, including the sampling program and methodologies required for the duration of the remediation project.

12.1 Mitigating Procedures

The main mitigation procedures for reducing the potential risks to site workers and off-site residents from exposure to ACM and / or contaminated soils include:

- Setting up “Red” and “Green” zones to denote “go” or “no-go” areas for certain site workers.
- Green areas will be areas where RPE and PPE will be standard site safety equipment that conforms to contractors’ Health and Safety requirements for site workers.
- Those site workers required to work within the Site where the excavation and remediation is taking place (Red Zone) will require full specific PPE requirements, as set out within this document (Section 11.3).

Further environmental mitigation of impacts from soils will come through dust suppression techniques and good soil management, directed by sampling of air, soil and water for the duration of the project. This is further expanded in the following sections.

12.2 Site Operation Hours

The Site will operate from Monday to Saturday each week. The Site will be closed on Sundays and public holidays. The following table Q denotes the operational hours of the Site.

Table Q: Operational Hours

Day	Opening Time	Closing Time
Monday to Friday	07:00 am	17:30 pm
Saturday	08:00 am	16:00 pm
Sunday	Closed	

12.3 Respiratory and Personal Protective Equipment (RPE & PPE)

To alleviate possible dust exposure to the Site workers and to mitigate taking any potential fibres off-site the following procedures should be in place. However, the primary precautionary measure for dust and asbestos fibre protection will be the dust suppression techniques adopted on site.

All site workers entering the **Red Zone** working in and around the excavation will be competent, fit tested for Respirable Protective Equipment (RPE) and trained with the required Personal Protective Equipment (PPE).

No site worker within the Red Zone should be without appropriate RPE and PPE. The recommended RPE and PPE will be worn at all times and will consist of the following:

- Fitted ½ face mask to be worn (P2 face masks with P3 filters).
- Steel toed wellington boots
- Safety glasses
- Coverall (disposable type 5 & 6 asbestos rated)
- Hard hat

All site workers required to work in the Red Zone must be clean shaven to ensure a good facial fit of their RPE.

As the use of coveralls on site for the site works may induce heat stress and restrict work movement during hotter days (summer and Spring), Red Zone areas will be kept to a minimum. Work time in Red Zone areas will be kept to a minimum and workers will be provided with plentiful supplies of water and electrolytes and their condition will be monitored.

After two months of daily fibre monitoring, data will be reviewed to assess the risk to site personnel working in Red Zones and within vehicles operating in the Red Zone. Based on the outcome of the risk assessment, the need for coveralls and half face respirators will be reviewed. If the risk is deemed sufficiently low, then the need for coveralls could be relaxed for vehicle operators, but it is unlikely the same would apply for site workers, due to likely exposure risk. Similarly, it may be possible to reduce RPE to P2 disposable masks. As per AS/NZS 1715: 2009 half face respirators provide a protection factor of 100 whereas P2 masks provide a protection factor of 10 i.e. ten times less particles in the breathing zone compared to ambient air. In order to reduce RPE requirements to P2 masks, monitoring data would have to be consistently below assessment criteria to demonstrate that workers were not being exposed to asbestos fibre concentrations above the para-occupational exposure limit.

Once a Site worker has completed their task, or if there is a requirement to leave the excavation zone, then the worker would be required to remove any potential ACM fibres that may have adhered to their clothing, before leaving the area. This should be in the form of a wash centre which should consist the following:

- The Site boots worn by the Site workers will be rinsed down or a foot bath will be available before entering the Red Zone shower block.
- A Red Zone will be set up to allow the Site worker to remove PPE (excluding RPE).
- There will be a receptacle for disposing of spent PPE, the contents of which will be considered ‘asbestos waste’ and disposed of at a suitable facility.
- The Site worker then takes a shower to remove any fibres (Amber Zone) (RPE remains on).
- Once the shower has been completed, the Site worker can leave the shower area, pick up a towel and enter a Green Zone. This area will be free from contamination, so the site worker can put on clean civilian clothes / or correct clean site PPE, to continue work in the Green Zone.
- Workers will be required de-contaminate fully for breaks (toilet / lunch / smoking) under the procedures outlined above, if moving in-and-out of the red and green zones.

NB: The zones (red/amber/green) will flow and there will be no break. Each zone will be separate and sectioned off to reduce the risk of cross-contamination within the decontamination zones. This will result in safe conditions for the site worker.

12.4 Site Workers Traveling to the Red Zone

Site workers will travel to the active work zone (Red Zone) by vehicle e.g. a ute. As such, this vehicle could potentially become contaminated and will therefore be permanently considered a "Red Zone" vehicle. The following conditions will apply to the "Red Zone - Site Ute":

- It will **not** be fitted with cloth seating, carpets or cloth appointments.
- It will be parked at the end of the work day, adjacent to the decontamination area, within the red-zone and not within the Green Zone.
- Only personnel wearing RPE and required PPE will be permitted to travel in the vehicle.
- Servicing of the vehicle will only be done in the Red Zone, by personnel wearing appropriate RPE and PPE. Should the vehicle require works that call for it to be attended to in the Green Zone or off-site, it will be washed down and remediated internally before being moved out of the red zone.

12.5 Hydration and Breaks

As part of the Site operations, it may be necessary for site workers to have breaks for hydration and sustenance.

Regardless of how site operations are planned with regards to staggered lunch breaks or 'en mass' crib breaks, any Site workers moving in and out of red / green zones will need to remove / replace all PPE and undertake the decontamination procedure described in section 12.3.

The following points will be adopted when hydrating and taking on board liquid, whilst working within the excavation areas:

- Site workers will be permitted to carry packaged water in the "Site Ute", in a dedicated cooler / esky, for the purposes of hydration. In order to have a drink, the worker must ensure the vehicle is upwind of current operations, which may require moving it. The worker must then ensure their breathing zone is free of fibre before they can access their water.
- Workers will ensure their breathing zone is free of fibre as follows:
    - Wash down the 'esky' using a pump spray pack containing potable water, located on the back of the ute.
    - Remove their gloves and wash their hands.
    - Wash down their hood by using a pump spray pack containing potable water located on the back of the ute. Their face and respirator would then be wiped over with an antiseptic wipe (also stored on the back of the ute) which would be stowed on the back of the ute as 'asbestos waste', in a dedicated covered container.
    - The worker could then remove their hood, allowing them to remove their respiratory protection. If the worker is using a disposable mask, then the mask would be disposed of similarly to the antiseptic wipe. The worker would then be free to open the 'esky' and retrieve their drink.
- After drinking, the worker would seal the drinks 'esky' and re-don RPE and PPE, as required.

12.6 Perimeter Fencing

A bunded fence will be established along Adelaide Street. The soil bund will be constructed approximately 2.0 metres high with a 1.8 metre high shrouded security fence on top of the earthen bund. Collectively, the bund and fence will reduce ground level wind speeds and assist in minimising off-site emissions of particulate matter and fibre, thus reducing potential exposure to nearby residents. It is anticipated that the earthen bund will assist in noise abatement during earthworks. The proposed bund / fence is shown in figure 7.

The fence has been designed to reduce wind flow from the Site onto publicly accessible areas and the properties of neighbouring residents.

- A soil bund will be engineered along Adelaide Street. The bund will be matted and allowed to "grass in" for additional stability and will be esthetically pleasing.
- Upon the bund, a fence / windscreen will be constructed with tied shade cloth or hessian on the 1.8 metre high security fence.
- The gaps under the fence will be closed off (e.g. sandbags or similar) to reduce the potential for particulates and fibres to be released off site.
- Periodical checks of the perimeter fence will be made and any rips that occur will be tended to immediately to repair the potential breach.
- The remainder of the Site will be fenced and secured from the general public. The fence will be shrouded and sandbagged to reduce windblown particulates dispersing off-Site.
- The perimeter fence will be signed appropriately to show that remediation and excavation works are occurring. Signage will show that asbestos and other contamination is potentially present on Site.

These steps will reduce the risk to human health by reducing off-site emissions of airborne particulate matter and fibre. In addition, an internal compound will separate the offices, car park and workers changing area. These areas will require the construction of shade or hessian cloth tied to fencing with no gaps, to assist in reducing dust-blown material from penetrating the green zones. Final design of the compound is still being considered and proposed. However, these principles will apply to the design.

It should be noted that within the southern portion of the Site there is an existing batter / bund which is part of the old landfill. This bund is approximately 5 to 7 metres in height and runs east to west through the site. During the remediation works, this batter / bund will remain in place as an additional barrier, to assist visual amenity, noise and wastewater control. As the remediation works move east this barrier will progressively be removed and remediated, as required.

12.7 Dust Suppression – excavation

Management of airborne particulate matter and fibre will incorporate surface stabilisation and dust suppression using water carts spraying 'Dust X' or similar. This will be made available for the entire earthworks phase. Dust suppression is seen to be the key to reducing airborne particulates and fibre and potential off-site migration. It is understood that a reduction in airborne particulates will also mean a reduction in airborne fibres. Consequently, if the results of the air monitoring program demonstrate that particulate matter concentrations are within assessment criteria, then it is likely that any potential asbestos fibre concentrations will also be low.

As an adjunct to water carts and sprinklers, misting units (fog cannons) will be sited in the work area, as close as practicable to the workface. This is designed to effectively control any emissions from excavation and screening processes by efficient and effective dust suppression. Hydraulic fog cannons are designed for low power and water use, combining a powerful fan with a high launch efficiency of between 20 m and 65 m and coverage of areas of up to 1,000 m^2. Micro

nozzles mounted on individual crowns atomise water into billions of micro-fine droplets that readily bond to similar sized airborne dust particles, resulting in an extremely effective means of dust suppression.

Variable water flow allows the user to manage the volume of mist to suit the current conditions and the intensity of the dust present. Water use is reduced dramatically when compared to the amount of water employed by traditional irrigation systems, sprinklers and handheld hoses.

The misting technology effectively captures dust particles of PM_{20} or less, significantly reducing breathable or fugitive dust in the surrounding air.

Photos and additional information about the fog cannons are detailed in the Works Approval Application.

MDWES has conducted a study and issued a report on groundwater abstraction through production bores (see MDWES report – Groundwater abstraction for Dust Suppression and Surface Compaction, Oct 2012). The Groundwater Abstraction report is presented in Appendix I. A total of three production bores flowing at a maximum of 15L/sec (a total of ~821 kL/day) is allowable for abstracted water from the deep aquifer.

The use of the production bore water will apply to the following:

- Major traffic routes into and around the Site will be paved with either bitumen or crushed concrete to minimise noise and dust generation. Dust suppression and / or cleaning will be practiced on a regular basis, to keep dust to a minimum.

- The landfill excavated area will be thoroughly wetted down every day and periodically with water carts and misting machines.

- Exposed construction areas subject to vehicle and machine movements (Red Zone) will have regular dust suppression. An increased program may be required, particularly in the hotter summer months (November to January), due to drying conditions.

- Before the Site is closed (Sundays and evenings) the last 'dampening down' of the day will occur when excavating has ceased and the workers are out of the excavation zone. There will also be a concentrated spray / dose of 'Dust-X'. This should be sufficient to limit the liberation of soil particles and any fibres whilst the Site is closed. However, complaints from residents will be monitored and additional soil wetting applied 'out of hours' if required.

- To ensure the landfill face is kept damp and limit the liberation of particulate matter and fibres when excavating and moving soils, the excavation face of the landfill will be dampened down periodically with a sprinkler system, as the excavation progresses. If required, a direct jet / sprinkler system will be used to provide water to a directed area. At the end of the shift, the next phase to be excavated will be wet down for the following day. Misting will also commence first thing before the shift commences, to ensure the landfill material is damp when encountered.

These processes are aimed at mitigating the effects of wind blown, dry, loose surface sand and particulate matter and fibre, from potentially becoming airborne and leaving the Site.

12.8 Dust Suppression – machines

The excavated landfill material will require screening to sort and sieve into the desired sizing. This process has the potential to generate dust. However, the triple deck screening machine proposed for use will be fitted with a misting system to dampen down the landfill material as it is being processed and sorted.

A number of restrictions will apply to loaders and excavators in the Red Zone, as follows:

- Site traffic movement in the Red zone will be limited to a maximum of 10 km/h or less to limit dust generation.
- When not operational, excavators and loaders working in the Red Zone will be parked up less than 50 metres upwind of the active work zone. This will ensure dust generation related to vehicle movements is kept to an absolute minimum.
- Site excavators and loaders will periodically be washed down and cleaned to reduce transposable dust and dust generation.
- Equipment requiring servicing will be only travel to the workshop once the route has been wet down.
- Operators will travel to and from the equipment either on foot or via the dedicated "Site Ute".

12.9 Vehicle Wash down

To remove debris and dust and minimise the transfer of any potentially contaminated soils, a wheeled vehicle wash down bay will be placed on-Site, to reduce and remove soils which have the potential to generate dust. Once a truck has unloaded, it will enter the wash down station before leaving site. The wash down is to be located at the exit, before entering public roads.

A wash down bay will also be used for any vehicles moving from the red zone to the green zone (for example, to repair a break down or when the vehicle needs to leave the area). The wash down will collect the waters from vehicles.

The waste water will then be disposed of, in accordance with licenses and guidelines for asbestos and contamination (DoH 2009). The wheel wash water will be changed on a regular basis to reducing the build up of particulate matter.

A geo protection mat or similar will be used to gather any resultant fibres from the wash down, before being disposed of as waste in accordance with licenses and guidelines for asbestos and contamination (DoH 2009). The mat will reduce the potential for fibres to be mobilised, if the wash down bay overflows.

12.10 Excessive Dust

Real-time boundary air quality monitoring will provide rapid feedback as to the success of the dust suppression and also highlight any failings that may occur. The AQMP details a number of escalating control measures based on dust concentration. In the event that the assessment criteria is exceeded the following measures will implemented

- Work will stop.
- Air quality data will be reviewed to ensure that the readings are accurate.
- Weather patterns will be reviewed to highlight high winds or the temperature of the day.
- The dust suppression program will be reviewed to determine when and how many times the surface is being suppressed.
- Recommendations and updated procedures will be developed.

- Relevant authorities will be informed regarding the findings.
- Once the revised procedures are in place and all relevant stakeholders at satisfied, then work can recommence with air quality and dust suppression monitored closely for further exceedances.

12.11 Loading and unloading of Soils

Precautions will be taken when loading and unloading soils into dump trucks, so as not to spill or over load the truck and bucket.

- The loading of soils will involve careful placement and movement of soils from the excavation.
- During loading, if dry, soils will be dampened, to reduce the likelihood of any fine particles becoming airborne.

12.12 Machine operators and Drivers

Machine operators and truck drivers will be required to minimise the need to get in and out of their cabs. If communication is required between site workers and machine operators, then a 2-way radio system will be adopted to reduce the risk of exposure.

The machines used to operate and excavate in the Red Zone will remain within this area. If the machines need to change or a breakdown occurs, then the vehicles will be washed down and cleaned of all debris, before leaving the Red Zone.

- Carted soils will be sufficiently dampened.
- Truck drivers will be required to deploy their cover before moving (if applicable), so that soils are not windblown during transit.
- If truck cover deployment is required in the Red Zone, the cover should be deployed by a site worker who is wearing appropriate RPE and PPE. There will be no deviation from this rule.
- All machines with a cab operating at the Site will be fitted with HEPA filtration systems to prevent ingress of fibres through the air-conditioning system. Cabs will periodically be checked to ensure the integrity of the systems, via in-cabin fibre monitoring, as per the AQMP.

12.13 Discovery

In the event that pockets of ACM, hydrocarbons or unidentified contamination are discovered during Site earthworks, consultation with the client and MDWES will follow and an appropriate course of action identified. This may result in the requirement for additional soil sampling to ensure any risks are identified before the soils are processed or re-used, which is extensively discussed in this ESMP. All sampling and reporting will be in accordance with current environmental guidelines for WA.

All contaminated soil will be kept on site, but placed into a covered or enclosed skip until appropriate action can be carried out. Soils will also be dampened down to reduce airborne particulate from being liberated from the surface, if exposed.

Discovery of potentially contaminated groundwater will be pumped to a holding tank until appropriate sampling and analysis can be carried out to determine disposal.

13 ENVIRONMENTAL MANAGEMENT – SOIL

13.1 Objective

The objective of the soil management is to manage excavation works so as to prevent environmental impact and human exposure to contaminated soils whilst soils are being processed. The main purpose of the environmental soil monitoring is to verify that there is no impact or exposure is not occurring, from a contamination source.

13.2 Overview

Soil management on site will be within two distinct areas. Firstly, soils that have been excavated and processed which will be repacked as part of the remediation. Secondly, those soils brought to the Soil Acceptance and Amendment Facility (SAAF) for capping.

13.3 Landfill Handling Procedures

Sands located along the western boundary of the historical landfill site have been reported as not being part of the landfill. These sands were not extracted as part of the historical sand mining operations and have remained part of the local natural geology (Bassendean Sands). These soils could be considered clean soils. However, validation of the sands is required before they can be removed from site. Once validated, the removal of these sands will create the first void or cell and begin the process and acceptance of remediated soil material.

The process will progress through the landfill site from west to east, systematically excavating and sorting landfill material. The sorted soil material will then be repackaged into the open deep cell; Section 12.5 and Figure 8 provide additional detail.

- Soils excavated at the face of the landfill will be pre-sorted by the operators with material too large for the screening plant set aside for alternative treatment. Material fed into the screening plant will be mechanically sorted into three fractions, dependent upon the size of the feed material.
- The size of various fractions can be adjusted by varying the aperture of the screens. The following three streams will be produced:
    - ‘Fines’, less than 30 mm in size with an option to rescreen to produce a smaller fraction of 5 mm;
    - ‘Middlings’, a middle size product smaller than 50 mm and larger than 30 mm; and ,
    - ‘Oversize’ material, larger than 150 mm, which was too large to pass through the first screen.
- An additional process allows ferrous material to be removed from the process stream by a magnetized conveying system.
- The excavated landfill material is placed in the steel pan apron feeder / hopper which has a capacity of approximately 7 m^3. Under vibration, coarse material is fed across the length of the upper deck. Middling’s (medium sized material) pass through the deck to a second deck with a smaller screen aperture, which allows fine material to pass through for collection.
- Each fraction is conveyed by hoppers, chutes and belts to separate discharge points.
- Oversize material is likely to contain large pieces of concrete, rubble and timber. Materials unsuitable for deep cell placement e.g. large pieces of dense plastic, timber and branches etc will be hand picked and placed in skip bins for alternative disposal.
- Dust suppression at the hopper and along various conveying points will minimise dust emissions.

The Site proposes to complete the following tasks on soil and materials currently onsite:

- All excavated soils will be re-packaged to provide the material for the deep cell (<2.0 mbgl).
- 'Middlings' and 'fines' will be placed into a deep cell in such a way as to minimise the total volume of void and ensure desired compaction.

Oversize inert material suitable for crushing will be washed down prior to being transported to the Resource Recovery and Remediation Facility (RRRF) to ensure it is free of superficial dust and fibres. Any oversize material that is suspected to be ACM will be separated for alternative treatment. Large sheeting fragments will be buried at the base of cells.

Oversized inert waste crushed at the RRRF will be used to construct the engineered barrier layer. Figure 9 shows the life cycle of the soils and the process flow chart.

During the excavation process, the environmental consultant will visually inspect the face of the landfill in the morning prior to work and during each tea and lunch break, whilst the Site workers are not working at the face. This is to assess the potential for ACM discovery, so the ACM can be diverted from the screening plant and treated as per above.

All excavated material will be assessed for visual and olfactory contamination. The material will be relocated to areas as specified on the Site classification map, based on this initial assessment.

The landfill face will also be assessed for volatile organic compounds (VOCs) and ground gases during the inspection. The inspection will be via olfactory and PID instrumentation. This is a precautionary measure to assess for ground gas from degrading organic material. The risk from Ground gas is seen as very low, given that the face will be gradually opened up and allowing a high rate of dispersion. Despite the risk of ground gas being seen as very low, this measure is seen as a worthwhile precaution.

All Stockpiled soils will be regularly suppressed (water, 'DustX') until visually wet, to reduce the risks of any errant dry fibres or particles becoming airborne.

13.4 Soil Acceptance and Amendment Facility Procedures

It is intended that Acid Sulfate Soils (ASS) and Class I hydrocarbon impacted soils be brought to the site for remediation, so that they can be later utilised in the capping layer (GL to 1.5 mbgl). Soils will be delivered to the transfer station and from there moved to the soil treatment pad, located on the eastern boundary of the Site (Cell 6), for appropriate treatment. The soil Amendment Report in Appendix D provides additional detail.

Acid Sulfate Soils

The soils accepted from the offsite source will require approved full laboratory documentation, to validate and certify concentration levels of the ASS.

The soils will then be transferred to the soil treatment pad located on the eastern boundary of the Site (Cell 6). The ASS soils will be lime-dosed and treated, to ensure neutralisation of soils. The soils will be tested and validated before use within the capping layer.

Class I Hydrocarbon Impacted Waste Soils

The soils provided from the offsite source will also require approved full laboratory documentation, to validate and certify that the soils are class I and possibly hydrocarbon-impacted.

The soils will then be sorted and transferred to the soil treatment pad located on the eastern boundary of the Site (Cell 6). The soils will be placed into windrows, inoculated with a bio-active enzyme to enhance bio-degradation and allowed to volatilise through solar energy gain. The

break down of the longer heavy hydrocarbons chains will occur until concentrations have sufficiently reduced (below assessment criteria). The soils will then be used within the capping later of the engineered landfill.

13.5 Engineered Landfill Construction

The proposed remediation follows the construction of the landfill and is detailed on Table R below. A detailed schematic of engineered landfill is shown in figure 10.

MDWES will liaise with the client and ensure that validated soils are assigned to the desired and correct layer.

Table R: Engineering Remediation & Construction

Depth (m)	Key	Description
G.L – 1.5		Capping Layer – Soil amended from imported soils (ASS + Class I). Only soils brought to site will be used for the capping layer. All soils will be verified and validated and ensured fit for use before being used
1.5 – 2.0		**Marker layer/ barrier (Crushed CD Waste)**
2.0 – to depth		Deep cells (stable & Non-Leaching Waste-Excavated landfill material)

13.6 Soil Tracking

The contractor will have a soil tracking form (STF), which will be used to manage and monitor the movement and placement of all material being brought into or moved on-site. The STF will:

- Record and document the internal transfer of each soil load, denoting approximate volumes being moved and notations of the origin and destination.
- Monitor movement of materials being brought onto the Site for the SAAF. It will record each soil load denoting approximate volumes being moved and notating the destination. Soil loads will be placed:
  - In a sorting area if the load is mixed or requires treatment (SAAF),
  - In a holding area if treatment or validation sampling is needed before movement or use.
  - At the appropriate area as designated by the Site Classification Plan, if validated prior to delivery to site and noted as clean by visual assessment on arrival.
- If double handling is required, both the initial and final locations will be noted.
- The SRT will provide a record of any accidental placement of contaminated material on natural or remediated ground. This includes soil movement, as well as chemical or waste spills on site. The corrective action undertaken is to be reported on an Environmental Incident Report form.

The following actions are to be used to effectively manage the movement of material across and into the Site:

- The Site will be classified, using a grid format system. The grids will be given relative numbers, with the numbers relating to origin and destination of the material being stated on the STF when soil is excavated or moved or brought onto site.
- An initial site induction will be mandatory for all personnel involved with the movement and relocation of the waste. They will be informed of the site / location of waste and transport

routes to be used, as well as the grid system and how this applies to different types of material.

- The boundary of the old landfill (as mapped out in the Site classification plan) will be identified at regular 10 metre intervals by survey pegs. This will ensure clean and remediated ground is not inadvertently covered with waste by nominating specific areas as "yet to be processed areas".

Each incoming truck load of soil (ASS and Class I) will be checked by the Site manager or their representative to classify material prior to deposition of material at the Site. A laboratory analysis will be required for each individual source of off-site soil. Only soil from off-site locations with a 'clean' laboratory analysis will be accepted.

Specific unloading instructions are described below:

- Once the material has been classified as clean soil material or soils needing further processing, it will be moved to the appropriate area as designated by the Site Classification Plan. Origin, destination, classification and amount of material being imported should be noted on the STF.
- Trucks are to use an internal track which is to be wide enough to allow the safe passing of vehicles, the track is to be clearly defined with signage where required and kept damp to prevent nuisance dust.
- A speed limit of 30 km/h will apply to all traffic on tracks or roads and 10 km/h for machinery operating off track to reduce dust.

13.7 Sampling of soils

A total of approximately 1.7 million m^3 of landfill soils is proposed to be processed, sorted and then repacked as remediated soils. A proposed total of 1500 m^3/day will be processed and the soils will be sorted into stockpiles. All soils processed will be re-used within the deep cell, as denoted in Table R. The following sections denote the sampling program for areas on Site.

13.7.1 Sampling of Landfill Soils

The landfill soils will not be sampled as part of the remediation process. Once it has been processed and screened, under size >150mm. All material are to be placed within the deep cell and will be separated by an engineered barrier.

13.7.2 Sampling Concrete for barrier layer

The excavated soil (historical landfill) will be processed and screened. Soils will be managed and sampled in accordance with DoH guidelines for asbestos. Analysis is for validatory purposes to determine suitability for on-site use or off-site disposal.

- The over sized will be screened for ACM material and ACM will be removed as part of the screening.
- The stockpiled over sized material will be sampled prior to crushing (x1 sample per 70m^3), to determine asbestos content. Stockpiles will be quarantined until laboratory analysis is completed. Sample density will be in accordance with DoH stockpile sampling guidelines.
- Once validated "clear", stockpiles can be sent to be crushed on Site. Once crushed further sampling and analysis will be undertaken for asbestos (x5 samples per 1500m^3). Once clear the crushed material can be utilised within the barrier layer.
- If validation sampling provides a positive for ACM prior to crushing then the stockpile will be placed into the deep cell on site and not crushed.

13.7.3 Sampling SAAF

Soils brought on-site for soil amendment (SAAF) will require laboratory validation to show that the soils are suitable for the topsoil capping layer and end use. Only soils that are Class I, ASS or Hydrocarbon Impacted will be accepted. All soils brought to site will have the correct documentation and laboratory (NATA) results showing concentrations. Once soils have been amended (ASS or HC impacted only), these soils will be validated though field screening and laboratory analysis, to ensure that they are suitable for use for the capping layer.

Verification of remediated soils will be undertaken for ASS and hydrocarbon validation only. Soils will be sampled as per the DER sampling density for stockpiled soils, soils will only be used once validated appropriate for use on site.

13.8 Exporting Soils from Site

The location of material that is odorous or aesthetically unappealing will be recorded and documented. Such material will be stockpiled in designated areas as depicted in the Site Classification Plan, so that classification can be performed and the soils remediation or disposed of. Whilst laboratory analysis is being undertaken the soils should be quarantined and covered to ensure residual odour is minimised. If classified as needing disposal, transportation off-site will be arranged to remove offending soils.

Stockpiles of material designated for off-site disposal, as determined by the Contractor or their representative, will be classified in accordance with Landfill Waste Classifications and Waste Definitions (2009). Material being loaded into trucks for off-site disposal will have to be verified and confirmed by the Contractor or their representative, as the material specified on the disposal forms, prior to removal from site.

All contaminated material will be removed from site in a damp condition, to reduce the potential for dust generation and adverse air quality, as per AQMP requirements. In addition, the truck drivers will deploy their rolled tarp to cover the load.

All truckloads are to be within legal weight limits when removed from site. Trucks will be required to be road worthy and be operated in accordance with transport regulations. Roadways will be kept clean and clear of soil and debris. The Contractor will continuously monitor the road condition at the entrance to the work site and sweep as necessary.

14 ENVIRONMENTAL MANAGEMENT – RESOURCE RECOVERY

14.1 Objective

The use of the Site's resources to remediate the Site itself will minimise any requirement to transport waste to appropriate waste facilities off-site, or to transport large quantities of sand to site. Although there may be a requirement for off-site disposal for this project, if a resource can be reused and does not have an environmental impact, then Site re-use should be paramount, as it is the only cost-effective mechanism for sustainable remediation of the site.

14.2 Overview

Achieving cost effective and environmentally sustainable waste management by:

- Maximising resource recovery and re-use from old landfill waste and incoming recyclables.
- Maximising recycling, particularly of concrete brick, steel and sand.
- Minimising waste generation and offsite disposal.
- Safe management and disposal of all unsuitable and non-recyclables.

14.3 Actions

All wastes produced across the Site will be identified, categorised and designated specific storage areas for each category of recovered resource or waste produced. Appropriate maintenance of these designated areas will be ensured, to prevent unnecessary environmental harm due to exposure to potentially hazardous substances and cross contamination.

The following resource recovery initiatives will be implemented:

- Identify and implement appropriate waste reduction strategies.
- Ensure appropriate re-use, storing, recycling and / or disposal of the following materials:
  - Concrete, brick, sand ferrous and non ferrous metals.
  - Waste oil will be collected for transport and disposed off-site at a suitable facility.
  - Batteries will be collected and transported off-site for disposal at a suitable facility.
  - Tires will be stockpiled for disposal to a suitable facility.
- Perform risk assessments on all storage, transport and disposal of all waste produced.

14.4 Monitoring and Reporting

Monitoring and reporting will include:

- The following resource recovery initiatives will be measured and reported:
  - Resource recovery and re-use from old landfill wastes.
  - On-site soil amendment / remediation of various waste streams.
  - Waste disposal, including the off-site facilities receiving site generated wastes.
  - Resource recovery from incoming industrial waste.
- During site works, the Site Manager will report at quarterly intervals to the Project Manager on the results of the resource recovery monitoring program and other relevant waste management issues.

15 ENVIRONMENTAL MANAGEMENT – ASBESTOS

15.1 Objective

Asbestos has been identified and discussed within each of the environmental management sections of this ESMP and the MDWES AQMP report (September 2014). However, it is felt that a dedicated section for Asbestos discussion is required, due to the high risk nature of the material. The objective of the asbestos management is to ensure that any asbestos excavated from the landfill is identified and dealt with in accordance with Department of Health (DoH) current guidelines and standards.

The contractor has a responsibility to ensure that no harm will come to either the Site workers or the neighbouring residents who could potentially be at risk from airborne fibres. Asbestos monitoring is incorporated within the air management plan. In addition, asbestos monitoring within soil is also discussed within the soils management plan.

15.2 Overview

The historical landfill is a known landfill which has accepted 'inert' construction and demolition waste. Although no known asbestos waste has been deposited, some asbestos could be considered present, although the extent and volume cannot be currently quantified. Therefore, the asbestos has to be managed and handled ad hoc, upon discovery, so no further environmental impact occurs. Management of all materials on-site is being classified as potentially containing asbestos or impacted with asbestos. Therefore, management is required to prevent any incidents of unsafe contact with asbestos during site work activities.

15.3 Asbestos Management

Strategies for the prevention of asbestos contact and containment of ACM material will include:

- The entire historical landfill area is assumed to be potentially impacted with asbestos.
- All asbestos and asbestos impacted soils will be placed on-Site as deep fill, to limit exposure opportunities and eliminate impact of offsite disposal.
- The Project Manager will check excavation areas daily confirm presence / absence of ACM, so as to ensure adequate asbestos controls are being initiated.
    - Any asbestos identified will be carefully removed, quarantined (skip bin) and disposed of.
    - In addition, ACM will be picked and sampled during the screening process, prior to any crushing. To ensure asbestos is removed from the barrier layer which may pose a health risk.
- All workers will undergo a site induction to inform them of the dangers of asbestos, how to recognise asbestos products and the procedures to follow should ACM be uncovered.
- Asbestos fibre monitoring will be conducted within the boundary of the Site. The monitoring will be in accordance with the approved dust monitoring procedures established for the Site works.
- Dust emissions will be prevented / minimised by constant wetting of the work area.
- Where ACM is visibly encountered during remedial activities, the ACM will be managed by wetting down the ACM and placing it as deep fill within the engineered landfill.
- The work area, being the excavation (recovery) area of the old landfill, will be cordoned off and declared as an exclusion (red) zone at all times. This will be achieved by constructing a physical barrier boundary to surround the work area, with coloured warning tape defining the restricted entry status of the work area. The barriers will be at least 10 metres away from the location of any other active excavations, with warning signs placed at the boundary of the exclusion zone.

- All site personnel will be required to inform the Project Manager immediately if works are not being undertaken according to the management plan and which may consequently have a likelihood of leading to an asbestos exposure incident at the Site.
- The Project Manager will maintain records of any contamination incidents or discovery of any other contaminants, as well as any containment and remediation procedures employed.

16 ENVIRONMENTAL MANAGEMENT – AIR MONITORING

16.1 Objective

The air quality monitoring program provides information to facilitate management of excavation works, in order to minimise the potential exposure of hazardous contaminants to on and off-site receptors. The program will have a strong focus on verifying that off-site receptors and on-site personnel are not being exposed to elevated airborne concentrations of CoPC as a result of excavation works.

The air quality monitoring program is intended to quickly identify if excavations, in possibly contaminated soils, result in airborne concentrations of CoPC exceeding adopted assessment criteria, so that mechanisms such as increased spraying with water or, if necessary, a "stop work" instruction can be implemented, until the levels are again found to be safe. The following sections present an overview of the AQMP. The complete AQMP is present in Appendix C

16.2 Overview

Particulates and fibres may be present in air if soils are exposed to drier moisture levels and strong prevailing winds. To validate exposure levels, a daily dust monitoring program will be employed for the duration of Site works. The air monitoring will be used to validate the effectiveness of dust suppression and to validate that off-site and on-site emissions of airborne particulate matter and fibre meet appropriate assessment criteria. The monitoring and sampling program includes the following:

- Airborne fibre monitoring for asbestos
- Real time and gravimetric TSP monitoring and sampling;
- Real time and gravimetric PM_{10} monitoring and sampling; and
- Sampling of RCS and particulate matter containing metalloids.

16.3 Monitoring Stations

Monitoring stations will be established to provide a mix of real-time and gravimetric monitoring and sampling across the Site. The AQMP provides rationale and discussion about the selection of monitoring station locations and equipment used.

Fourteen (14) monitoring / sampling stations will be established across the site: six (6) around the boundary, three (3) in the active remediation work zone and five (5) personal exposure monitoring stations.

16.4 Monitoring Schedule

Real-time monitoring (TEOM and nephelometers) will be undertaken for the duration of earth works at all boundary stations. The frequency and duration of time weighted sampling and analysis is detailed in the AQMP and is based on risk of exposure to CoCP and associated sampling methodology.

16.5 Responsibilities

Responsibility for the management and delivery of the AQMP will rest with the AQMP Manager. The AQMP manager will be an Environmental Scientist with air quality specialist knowledge, employed by MDWES. Implementation of site dust control measures is the responsibility of the Site Operations Manager. All Site personnel are responsible for visual assessment of dust levels across the Site and implementation of control measures appropriate to their role.

To ensure a high level of transparency, MDWES will engage a NATA certified specialist organisation to supervise the operation, service and calibration of the TEOM and provide oversight in application of calibration factors for the nephelometers.

16.6 Training

All Site personnel and visitors will be required to undergo a site induction before being allowed entry to the Site. The induction will have a strong focus on risks posed from exposure to CoPC. The Site Induction will reinforce the Site's primary objective to minimise potential emissions of CoPC. All personnel will be instructed that visual assessment of dust levels is everyone's responsibility and that they are required to inform the Site Operations Manager of any increase in visual dust levels and take appropriate actions as per Site specific management plans. All Site workers will be required to participate in ACM hazard awareness and respirator protection training.

16.7 Assessment Criteria

In developing appropriate assessment criteria the AQMP assumes that PM_{10} is a surrogate for all airborne particulate matter and then assumes, on a conceptual basis, that accurately measuring and managing the concentration of PM_{10} will ensure that the concentration of all particulate based CoCP remains within acceptable limits.

The AQMP provides rationale for the selection of appropriate assessment criteria. Three tiers of action criteria provide increasing levels of triggered action to ensure the likelihood of PM_{10} exceedance is minimised. Similarly a number of tiered action criteria dictate increasing levels of triggered action to ensure the likelihood of all CoPC exceedance is minimised. Table S summarises assessment criteria.

16.8 Weather Conditions

As part of the air quality monitoring program an on-site weather station will be installed. The station will assist in dust suppression management via current and historical data on wind direction and speed. The weather station will also assist in the selection of judgemental fibre sampling location at the active work zone. The AQMP Manager will be responsible for management of the weather station.

Table S: Assessment Criteria

CoPC	Limit	Trigger Values and Action
TSP	90 µg/m^3	Daily average > 75 µg/m^3 for more than two days per week:
		Increase dust suppression.
		Monthly average > 80 µg/m^3:
		Investigate additional dust suppression methods including use of ground covers.
PM_{10}	50 µg/m^3	Daily average >40 µg/m^3 at any of AMS1-6:
		Examine dust suppression regime, look at peaks and related site activity and undertake corrective actions as required.
		Daily average >40 µg/m^3 at any of AMS1-6 for two consecutive days:
		As per above, increase wetting down e.g. frequency of events and / or duration.
		Daily average >45 µg/m^3 at any of AMS1-6:
		As per above. Review wind speeds associated with exceedance and consider setting maximum wind speed threshold for reduced sorting throughput.
		Daily average >45 µg/m^3 at 1 pm at any of AMS1-6:
		As per above. Cease reclaimer and excavator operations.

CoPC	Limit	Trigger Values and Action
Asbestos Fibre	Off-site and green zone: 0.01 fibre/mL On-site, red zone: 0.1 fibres/mL	Daily average >6 fibres/100 fields at any station AMS1-6, AMS10:
		Investigate site conditions that were likely to have contributed to the result and take appropriate action e.g. increase dust suppression and wetting down. Recount sample. If at AMS10 check user behaviour, ensure boots cleaned before entry and decontamination procedures are being used.
		Daily average >8 fibres/100 fields at any station AMS1-6; AMS10:
		As per above, concurrently undertake SEM of sample to determine asbestos fibre content. Review wind speeds associated with works and consider setting maximum wind speed threshold for reduced sorting throughput until following result shows improvement or that SEM shows calculated asbestos fibres concentration is less than 0.006 fibres/ml. If at AMS10 as per above, Investigate integrity of crib room, look for uncontrolled opening, poor door and window seals, take corrective action.
		Daily average ≤0.01 fibres/ml at any station AMS1-6:
		As per above, significantly reduce reclaimer throughput, reduce amount of excavation undertaken.
		Daily average >0.01 fibres/ml at any station AMS1-6:
		Cease work, investigate source of fibre and rectify before works any remedial earthworks recommence.
		Shift average >0.02 fibres/ml at AMS7, 8 or 9:
		Location in vicinity of remedial earthworks likely to have elevated fibre count. Review dust control methodology, set maximum wind speed threshold for reduced sorting throughput until following result shows improvement or that SEM shows asbestos fibres concentration is less than 0.05 fibres/ml.
		Shift average ≥0.05 fibres/ml at AMS7, 8 or 9:
		As per above, significantly reduce sorting throughput until following result shows improvement or that SEM shows asbestos fibres concentration is less than 0.05 fibres/ml.
		Daily average > 0.01 fibres/ml in monitored vehicles:
		Investigate integrity of HEPA filter and cabin seals, take corrective action, recount sample, operator to wear P2 mask.
		Daily average > 0.02 fibres/ml in monitored vehicles:
		As per above, undertake SEM, operator to wear half face respirator.
		Daily average >0.01 fibres/ml in personnel monitoring samples:
		Investigate site conditions that were likely to have contributed to the result and take appropriate action. Limited access to operations excavation and resorting zone until reduction in concentration.
		Daily average >0.02 fibres/ml in personnel monitoring samples:
		As per above, concurrently undertake SEM scanning of sample to determine asbestos fibre content.
Silica	25 μg/m^3	Investigate dust suppression at crusher and increase dust suppression control measures as required
Arsenic	5 μg/m^3	Investigate potential sources of analyte and take appropriate action
Barium	50 μg/m^3	As per above
Cadmium	1 μg/m^3	As per above
Chromium	50 μg/m^3	As per above
Copper	100 μg/m^3	As per above
Manganese	100 μg/m^3	As per above
Nickel	100 μg/m^3	As per above
Lead	15 μg/m^3	As per above
Zinc	1 mg/m^3	As per above
Mercury	1 μg/m^3	As per above

16.9 Contingency Measures

In addition to the assessment criteria and escalating action requirements, the AQMP also details a series of contingencies measures for each of the CoPC.

17 ENVIRONMENTAL MANAGEMENT – WATER

During site works, groundwater will be monitored on a bi-annual basis to ensure no impact is caused above background concentrations. The results will be added to the background information collected from groundwater monitoring events already reported by MDWES.

The earthworks and engineering of the landfill may cause groundwater mobilisation due to the nature of the work. However, as the groundwater level is considerably lower than the finish level of the remediated site and there is a clay aquitard on which the landfill sits, vertical groundwater migration is restricted and it is anticipated that there is will a negligible impact on the underlying aquifer.

In the event that concentrations are noted above assessment criteria, another groundwater sampling event will be arranged for the following month and for the subsequent three (3) months thereafter, to confirm the results and to note any fluctuations or stabilisation.

The Site operator will maintain the six (6) groundwater wells currently located onsite. In the event that a monitoring well is damaged and rendered unusable it will be replaced immediately.

During the excavation program on site, a snapshot groundwater sample may be taken from within the Site through a temporary monitoring station. Due to the 'organic' nature of the Site and constant excavation and construction, the monitoring point will probably be a one-off sample. It is also proposed that during one of the bi-annual monitoring rounds, a set of temporary wells are set up to assess the groundwater quality.

Extensive sampling was completed prior to commencement of site-works to ensure adequate background information was available. A summary of groundwater results are detailed in Sections 3.4 to 3.6. For the full detailed sampling program and results, refer to the Annual Groundwater Summary Report – (MDWES, 2103).

17.1 Interim Perched Groundwater Monitoring

During the remediation of the project it is recommended that semi-permanent perched groundwater monitoring wells are constructed. These wells will be positioned in close proximity to the face of the excavation. The rationale behind these wells is to assess localised water quality and any likely impacts from the earthworks. The well installations will allow for groundwater quality assessment and allow for sampling.

17.2 Perched or leached Groundwater on site

The Site has been dormant for a considerable period of time. During this time, much rainfall has percolated and permutated through the landfill. Considering the nature of the fill, pockets of perched water may have accumulated and should be taken into account. Furthermore, the Site is underlain by a clay aquitard which has the potential to collected ponded waters within sink hole areas.

Consideration will therefore be given during excavation to the possibility that waters may be encountered and accumulate at the base of the excavation. If encountered, these waters will be pumped to a holding pond. Analysis will then be undertaken on holding pond waters to determine whether the waters are contaminated and the most appropriate method of disposal, as per DER guidelines and regulations.

18 ENVIRONMENTAL MANAGEMENT – NOISE

18.1 Noise Modelling and Assessment

Noise level assessment has been conducted by Herring Storer Acoustics (HSA) (Appendix G) for each component of the Site operations. Assessment of the site excavation works has been considered as construction activities, such as any other land development preparation for the use of residential, or commercial / industrial purposes (Regulation 13). The operation of the Waste Transfer Station component of the site remediation process has been considered as an individual component in regards to the noise emissions, and subsequently has been assessed against Regulation 7 in the Environmental Protection (Noise) Regulations 1997.

Noise received at the worst case neighbouring noise sensitive premises for noise emissions from the Waste Transfer Station has been calculated at 45 dB(A) for day time operations. This can be compared to the applicable assigned noise level criteria of 45 dB(A). This noise level allows for all equipment operating at the same time, i.e. crusher, rock-breaker, load, screen, excavator and truck operations, although this would be considered unlikely, as there would be limited operators available to allow for all the equipment to be operated at the same time.

Noise received at the residences for the site excavation component of the operations has been calculated at between 55 and 76 dB(A), dependent upon the location of equipment and the receivers. The site excavation, whilst operated simultaneously with the proposed Waste Transfer Station is deemed to be assessable as 'construction activities' and therefore will be managed through a Construction Noise Management Plan.

Given these operating parameters, noise levels received at the nearest neighbouring residence has been calculated to comply with the Environmental Protection (Noise) Regulations 1997 for the operating times specified in this assessment.

Since the commissioning of the HSA report, a number of changes to operations have been stipulated. Excavators and loaders will replace scrapers and dozers. As their noise output can be up to 15 dB(a) less, it is likely that these changes will result in a modest reduction of the worst case modelled data of 76 dB(A). Additionally it is noted that the worst case scenario assumes the CDM recovery facility will be run concurrently with excavations and sorting, and that all elements of the CDM facility such as the crushing plant and rock breakers will also be run concurrently. However, it is noted that the crusher is unlikely to run on a daily basis and, when operational, is likely to run for less than four hours per day; commencing after 9:30 am. As such, it is likely these measures will also see a further small to modest reduction in the worst case scenario result.

In determining worst case scenario for the remediation work, the HSA noise model has made no allowance for the earthen wall / mound than runs along much of the western and southern side of the landfill. This barrier sits higher in the landscape than the landfill behind it and will, with the exception of the western side, remain in place until the last stages of the Site are remediated. As such, this natural barrier is also likely to provide a significant level of noise attenuation for most of the project's duration.

18.2 Objective

Noise will be generated from vibrating machinery, the lateral movement of trucks, the operation of front end loaders and vehicle reversing alarms. In particular, earthmoving equipment have the potential to cause 'nuisance noise', especially if large numbers of the machinery used are in poor operating condition (i.e. noisy mufflers). The objective in this project is to minimise the generation of noise during the Site works, to prevent any potential noise impact to off-site receptors. The earthmoving activities associated with the excavation of contaminated waste have the potential to create a social disturbance, as a result of the generation of nuisance noise.

HSA has advised that the SAAF and RRRF should be assessed against Regulation 7 of the EPA Noise Regulations (1997). Modelling suggests the Site will comply with this regulation.

HSA has advised that earthworks associated with remediation of existing Landfill material should be assessed against Regulation 13 because this part of the Site is classed as a construction zone. Typically construction zones are managed by imposing limits on working hours and a requirement that all motorised equipment is muffled as per design standards.

18.3 Target

The Site will comply with the Environmental Protection (Noise) Regulations 1997. Landfill remediation activities will be limited to the hours considered within Regulation 13.

18.4 Action

A Construction Noise Management Plan (CNMP) will be developed prior to commencement of landfill remediation activities. HSA has advised this is typically not done until several weeks prior to works commencing, to ensure appropriate operational information is included (Appendix G).

Noise monitoring will be conducted daily at eleven (11) locations along the southern boundary, while landfill remediation activities are being undertaken. Noise monitoring locations will as per the locations selected in the HSA acoustic report.

18.5 Noise Complaints

If a noise complaint is received, then this will represent an incident, which will require investigation to identify potential issues and to propose any remedial action to resolve issues underlying complaint.

Should a failure to comply occur, the following steps will be taken:

- Site activities will be investigated to determine the cause of the problem. The time and duration of the noise emission will be compared to the Site monitoring program to ascertain any correlation. The investigation will also assess the activities taking place on site at that time causing the disturbance.
- Based on the validity of the complaint, control measures will be reviewed to prevent recurrences and, where necessary, additional control and mitigation measures will be investigated.

19 FUTURE ENVIRONMENTAL MANAGEMENT & MONITORING

The following recommendations are suggested as part of the ongoing environmental monitoring during the remediation of the Site. Although this ESMP report has specified that the soils used within the engineer fill, physical barrier layer and capping layer will be fit for purpose and ensure, as far as is possible that no impact to the environment will occur, MDWES recognises the potential for impact to the groundwater and generation of ground gas. This section discusses the need for short, interim and long term monitoring of the Site.

19.1 Groundwater Monitoring (During and Post-remediation)

To ensure there is no residual impact or risk to groundwater, the groundwater monitoring program will progress throughout the duration of Site operations and continue one year after the completion of the remediation project. The frequency of monitoring visits should remain and MDWES will provide bi-annual reports for the full duration of the program.

The current well network on site will be utilised (6 monitoring wells). If monitoring wells become destroyed they will be replaced to ensure continuity.

Groundwater levels and concentrations will be assessed and compared to the 'pre-remediation', 'during' and 'post-construction' results. The groundwater monitoring program will be in line with previous investigations, so that results can be compared 'like-for-like'. Further analytes are to be added to the suite of analysis, based on Auditors comments.

If there is a significant shift in the result and an impact is identified, a continued program, beyond what is proposed for groundwater monitoring, will be implemented. This may require further monitoring and / or an investigation to find the source, qualify and quantify the results and propose subsequent remediation.

The groundwater wells (described in section 5.3) that are to be installed along the boundary of the SAAF area, will allow monitoring of any impact to groundwater from the remediation of ASS and HI impacted soils. However, the soils from the SAAF will be treated on a limestone pad and therefore impact is expected to be negligible upon the underlying groundwater.

19.2 Remediation, Validation & ongoing Monitoring (RVOM)

A ground gas monitoring program will be implemented during the remediation of the Site. As each cell is completed west to east, (see figure 7) ground gas monitoring wells will be installed and screened into the engineered deep cell. The wells will be staggered across the Site to ensure good coverage. Once the ground gas monitoring wells are installed, the monitoring will begin and will continue through each phase of remediation, until completion and / or auditor and DER sign off.

Although the soils being used during remediation are expected to be inert and largely non-gas generating, the ground gas monitoring program / RVOM will be used to ascertain if any potential ground gases are being generated from the engineered fill. Organic matter or organic waste will also be screened as part of the remediation process and all organic matter will be removed at the screening stage.

The inclusion of volatile chemicals in the monitoring program will be considered, dependent on findings (including any complaints from local residents), as work progresses. It is anticipated that the 'first cell' (see figure 7) will be completed 6-9 months into the remediation program.

A suitable ground gas monitoring regime will be designed, utilising the CIRIA guidance C665 and UK Environment Agency LFTGNO2 and LFTN07, to provide significant guidance.

Upon complete remediation of the Site, and after post monitoring has been completed, the CSM will be revisited. Once remediated, the revised Site risk assessment CSM will presume to have a considerably lower risk rating, due to the sources of contamination being removed and operational works no longer a cause of dust generation. Assessing and reviewing this CSM will be beneficial to establish that, as expected, the remediation and engineering of the landfill has reduced the risk drivers and reduced the overall risk assessment of the Site.

19.3 Site Validation Audit Report

A Site validation Audit Report (SVAR) will from the closure report and will summarise site conditions at the completion of works. The closure report will summarise the remediation and project. The site closure report will provide a statement that dust and ACM contamination has been managed in accordance with the SMP, AQMP, ESMP and HHRA. That compliance with enHealth and DoH guidelines was adhered to and the remediation of the landfill has been completed professionally. The report will also detail any breaches or non-compliances and how they were managed and addressed, community consultation and resolutions. The details of the soil volumes processed and any asbestos encountered.

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).

BOM (2013) *Bureau of Meteorology* (Online), http://www.bom.gov.au.

Davidson, W.A. (1995) Hydrogeology and Groundwater Resources of the Perth Region Western Australia. Geological Survey of Western Australia. Department of Minerals and Energy.

Davidson, WA and X Yu (2006). *Perth regional aquifer modelling system (PRAMS) model development: Hydrogeology and groundwater modelling,* Western Australian Department of Water, Hydrogeological series HG20.

DEC (2010) *Contaminated Site Management Series - Assessment Levels for Soil, Sediment and Water*. Contaminated Sites Branch, Department of Environment and Conservation.

DEC (2009) Landfill Waste Classification and Waste Definitions 1996 (As amended December *2009)*. Department of Environment and Conservation.

DEC (2011) *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes.* Contaminated Sites Branch, Department of Environment and Conservation.

DEC (2011). *A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities. Department of Environment and Conservation - March 2011.*

Department of Environmental Protection (2000). Annual Summary of Ambient Air Quality Monitoring in Western Australia (Technical Series 111 – January 2002).

Department of Health (2006). *Health Risk Assessment in Western Australia.*

Department of Health (2009). *Guidelines for the Assessment Remediation and Management of Asbestos-Contaminated Sites in Western Australia – May 2009.*

DEP (2002) *Guidelines for Acceptance of Solid Waste to Landfill*, Department of Environmental Protection.

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

DoE (2004) *Perth Groundwater Atlas (Online),* Western Australian Department of Environment, Available at: http://www.water.wa.gov.au/idelve/gwa/index.jsp

DoW (2009) Operational policy 5.12: *Hydrogeological reporting associated with a groundwater well licence,* Western Australian Department of Environment

DoW (2009) *Strategic policy 5.03 – Metering the taking of water,* Western Australian Department of Environment

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

Environmental Protection Act 1986

FOI 1233/05 by Department of Environment & Conservation (DEC) – Freedom of Information – Lot 20, Adelaide Street, Hazelmere (October 2005).

Government of Western Australia (2000). Bush Forever Volume 2: Directory of Bush Forever Sites, Department of Environmental Protection, accessed 20th September 2012.

Greg Rowe & Assoc. – Community Management Strategy for Remediation of Site: Lot 20 Adelaide Street, Hazelmere. (August 2012).

IARC (2012) *A Review of Human Carcinogens: Arsenic, Metals, Fibres and Dusts.* Website: http://monographs.iarc.fr/ENG/Monographs/vol100C/index.php.

Landgate (2012) *WA Atlas (Online),* Western Australian Land Information Authority. Available at: http://www2.landgate.wa.gov.au/bmvf/app/waatlas/

MDW Environmental Services (2012). *Groundwater Investigation Report, Lot 20 Adelaide Street Hazelmere*, prepared for Wasterock Pty. Ltd.

National Environmental Protection Council (2003) *National environment protection (ambient air quality) measure – as amended*. Government of Australia: Canberra, ACT.

MDWES – Groundwater Monitoring Event #1 – Adelaide Street Hazelmere (June 2012).

MDWES – Groundwater Monitoring Event #2 – Adelaide Street Hazelmere (October 2012).

MDWES – Groundwater Monitoring Event #3 – Adelaide Street Hazelmere (February 2013).

MDWES – Groundwater Monitoring Event #4 – Adelaide Street Hazelmere (June 2013).

MDWES – Groundwater Abstraction Plan for Dust Suppression & Surface Compaction (GWAMP) v2 – Adelaide Street Hazelmere (October 2012).

MDWES – Air Quality Management Plan (AQMP) v2 – Adelaide Street Hazelmere, (October 2013).

National Occupational Health and Safety Commission (1995) *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003 (1995)].* Government of Australia: Canberra, ACT.

National Occupational Health and Safety Commission (2005) *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres, 2nd Edition [NOHSC:3003(2005)].* Government of Australia: Canberra, ACT.

National Environmental Protection Council (1998). *National Environmental Protection Measure for Ambient Air Quality.* Government of Australia: Canberra, ACT.

NIOSH (2003) *NIOSH Manual of Analytical Methods (NMAM), Fourth Edition - NIOSH Method 7500 - Silica, Crystalline, by XRD.*

NTEC Environmental Technology (2012) *Groundwater modelling for the Wasterock Hazelland Landfill site in Hazelmere, Western Australia*

Parsons and Brinkerhoff (2006). *Site Investigation, Former Adelaide Street landfill Lot 20 Adelaide Street, Hazelmere, Western Australia*

Rights in Water and Irrigation Act 1914

SLIP (2012). Shared Land Information Platform, Landgate on behalf of the State of Western Australia, https://www2.landgate.wa.gov.au/, accessed 18th and 28th September, 2012.

Standards Australia (2003). Australian/New Zealand *AS/NZS 3580.9.6:2003 Methods for sampling and analysis of Ambient Air – Method 9.3: Determination of Suspended Particulate Matte - PM10 – High Volume Sampler Gravimetric Method*. SAI Global.

Standards Australia (2007). Australian/New Zealand Standards AS 3580.1.1:2007 – Methods for Sampling and Analysis of Ambient - Air-Guide for Siting Air monitoring Equipment. SAI Global.

Standards Australia (2008). *Australian/New Zealand Standards AS 3580.9.11:2008 – Methods for Sampling and Analysis of Ambient – Determination of Suspended Particulate Matter – PM10 Beta Attenuation Monitors*. SAI Global.

Standards Australia (2011). *Australian/New Zealand Standards AS 3580.14-2011 – Methods for Sampling and Analysis of Ambient – Meteorological Monitoring for Ambient Air Quality Monitoring Applications.* SAI Global.

Water Register (2012). Water Register, Western Australian Department of water online resource at http://www.water.wa.gov.au/Tools/Maps+and+atlases/Water+Register/default.aspx.

Water Corp. (2007) *Industrial Waste Information Brochure – Acceptance Criteria for Industrial Waste – PUB 06.* Water Corporation.

Waste Rock Pty Ltd – Site Remediation Works Agreement and Site Management Plan (SMP) (draft) – Lot 20 Adelaide Street. (April 2013).

USEPA (2013) US EPA Code of Federal regulations – Protection of Environment 40 CFR part 53 Subpart D. United States of America.