Shire of Denmark

26 Hardy St Denmark - Remediation Project

Remediation and Validation Report

October 2020

Executive summary

The Shire of Denmark (the Shire) commissioned GHD Pty Ltd (GHD) to provide environmental consultancy services in relation to the remediation and reclassification of a former Shire Depot, located at Lot 3002 (26) Hardy St, Denmark, Western Australia (the Site).

The Site is just under 1 ha in area and is currently classified by Department of Water and Environmental Regulation (DWER) as 'Contaminated – Remediation Required' under the *Contaminated Sites Act 2003*. This classification reflects historical activities undertaken at the Site including the placement of uncontrolled fill and bulk storage of hazardous chemicals, during its operation as a former Shire Depot for around 20 years, from the early 1960's to 1984.

The uncontrolled fill on-site, containing rocks, tree stumps, gravel as well as anthropogenic wastes such as building rubble, wire, car parts, steel drums, glass, and plastics, is considered to be geotechnically unsuitable for any proposed future development that requires building structures.

GHD prepared a Remediation Action Plan (RAP) for the Site in June 2019, which provided a scope of work commensurate with the Shire's previous objective of pursuing residential (aged housing) redevelopment. The RAP outlined a remedial approach which provided for the excavation and off-site disposal of uncontrolled fill and associated soils as required to render the Site suitable for residential development and achieve a 'Decontaminated' classification under the *Contaminated Sites Act 2003.*

However, due to changing circumstances with regards to the saleability and value of the land, the financial viability of the project was diminished to a point where the Denmark Council opted to abandon the aged housing redevelopment plan altogether. As a result, the Denmark Council requested that an appropriate investigation and remedial strategy be undertaken to render the Site suitable for open space/parkland use and to facilitate an end-use classification under the *Contaminated Sites Act 2003*.

Objective

The objective of the project was to undertake additional investigation, remediation and validation works to effectively demonstrate the Site's suitability for ongoing open space/parkland land use and to achieve an end use classification under the *Contaminated Sites Act 2003*.

Scope of works

The scope of works undertaken to achieve the revised project objectives included the following key tasks (undertaken by GHD and the Shire appointed earthworks contractor):

- Removal and landfill disposal (or recycling where appropriate) of stockpiled and other wastes across the Site:
  - Removal and landfill disposal (Class 1) of 1,001 m^3 of stockpiled fill/wastes from the Site
  - Removal of 40 m^3 scrap metal and 72 m^3 of concrete and stockpiled at the landfill for recycling
  - Removal of the previously constructed lined containment pad area from the south-western corner (<2m^3)
- Removal of 3.125 kg of potential asbestos containing materials (ACMs) through a surface inspection and removal of a section of suspected ACM pipe length (600 mm x 100 mm) and disposal to landfill. The detailed site inspection of the finished site surface for asbestos containing materials (ACMs) was undertaken in accordance with the Department of Health (DoH) guidelines (2009)

- Re-profiling the landform including placing a layer of clean fill (derived from onsite) cover across the eastern and north-eastern portion of the Site
- Additional groundwater investigation comprising the installation of three additional groundwater monitoring wells and a monitoring event including all six groundwater wells in the monitoring network
- An assessment of residual risk, preparation of a post-remediation Conceptual Site Model (CSM) and determination of the Site's suitability for open space/ parkland land use
- Preparation of a remediation and validation report (this report)

Key outcomes

As a result of the remediation, validation and additional groundwater assessment undertaken, the following key outcomes are presented:

- Majority of the waste materials and uncontrolled fill currently remains onsite (insitu) at the conclusion of the works. The residual materials are predominately inert waste types including containing rocks, fill soil, gravel as well as anthropogenic wastes such as building rubble, wire, car parts, steel drums, glass, and plastics and are located in the north and eastern portions of the Site.
- Previous soil investigations at the Site have generally only reported minor concentrations of hydrocarbons, metals (copper, chromium, lead, nickel and zinc) and pesticides (aldrin, deildrin, DDT+DDD+DDE) above their respective limits of reporting (LORs). Concentrations of total recoverable hydrocarbons (TRH) recorded at various depths within the waste fill material exceeded the adopted ecological and human health (standard residential landuse) at six locations within the northern and eastern portions of the Site. Elevated zinc concentrations, exceeding the adopted ecological assessment criteria, were also recorded at three locations generally correlating with uncontrolled fill layers.
- Groundwater monitoring undertaken onsite and immediately offsite (eastern boundary) indicates that the historical use of the Site as a Shire depot and for depositing uncontrolled wastes and fill does not appear to have impacted, or continue to impact, the groundwater quality. In further support of this, leachability analysis undertaken as part of the landfill characterisation process, indicated that the waste materials have a low propensity to leach contaminants of concern into water. The groundwater and leachate results further support the characterisation of the waste fill materials as generally being inert.
- The residual waste fills within the north and eastern portions of the Site remaining insitu have been covered with a layer of clean fill (derived from onsite) and it is proposed to be landscaped with additional mulching and vegetation cover (i.e. grass). The Site surface has also been inspected and effectively remediated of suspected ACMs at the conclusion of the earthworks program. As a result, and in the context of the proposed future land use as open space/ parkland, direct access to the waste fill materials within the sub-surface is considered to be mitigated.
- GHD considers that due to the uncontrolled and heterogeneous nature of the waste fill material that remains onsite (insitu), including the confirmed presence of ACM and hydrocarbon impacts in soil, that there are potentially residual exposure risks (through either dermal contact, ingestion and/or inhalation) associated with disturbing the sub-surface material into the future and/or through altering the proposed land use (e.g. residential, building enclosed structures on the waste, etc).

Conclusions

GHD considers that the remediation, validation and additional groundwater assessment work undertaken, has effectively addressed the project objectives and the Site is now considered suitable for the intended future landuse i.e. public open space/ parkland land use.

Future disturbance and excavation onsite beneath the layer of clean fill and any future landscaped surface finishes (i.e. mulch, grass etc) into the underlying waste fill material, is considered to present a potential exposure risk for users onsite through either dermal contact, ingestion and/or inhalation (of asbestos fibres and vapour).

GHD considers that the mitigation of potential future exposure risks associated with sub-surface excavation and construction of buildings onsite requires mitigation through the provision of restrictions on use.

Recommendations

Based on the conclusions presented, GHD presents the following recommendations with regards to the Site:

- The Site surface should be stabilised (e.g. mulching, grassing, etc) to allow rehabilitation and long term protection of the surface fill to prevent exposure of the underlying waste fill profile.
- The Site should be reclassified to 'Remediated for Restricted Use' under the *Contaminated Sites Act 2003* as being suitable for the proposed end land use comprising open space/ parkland.
- In addition to the restrictions on future land use permitted on the Site, GHD considers that restrictions preventing sub-surface excavations and the construction of enclosed buildings (without further assessment of risk) should be applied in support of the new classification for the Site.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.6 and the assumptions and qualifications contained throughout the Report.

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1. Introduction

The Shire of Denmark (the Shire) commissioned GHD Pty Ltd (GHD) to provide environmental consultancy services in relation to the remediation and reclassification of a former Shire Depot, located at Lot 3002 (26) Hardy St, Denmark, Western Australia (the Site). The Site is shown on Figure 1 with site identification and general information presented in Section 2.

The Site is just under 1 ha in area and is currently classified by Department of Water and Environmental Regulation (DWER) as 'Contaminated – Remediation Required' under the *Contaminated Sites Act 2003*. This classification reflects historical activities undertaken at the Site including the placement of uncontrolled fill and bulk storage of hazardous chemicals, during use as a former Shire Depot.

This report presents the findings from the remediation, validation and risk assessment work undertaken to support more desirable reclassification of the Site under the *Contaminated Sites Act 2003*.

1.1 Background

The Site is understood to have been used as a Shire depot for around 20 years from the early 1960's to 1984 for uses including mechanical repairs, bulk fuel storage (underground tanks), pesticide storage and as a general laydown area.

Numerous investigations have been undertake across the Site between 1997 to 2019 for the purposes of characterising the nature and extent of contamination onsite. From the previous work undertaken, it is evident that the Site has received a significant amount of imported and uncontrolled fill prior to and /or during its use as a former Shire works depot.

The uncontrolled fill on-site, containing rocks, tree stumps, gravel as well as anthropogenic wastes such as building rubble, wire, car parts, steel drums, glass, and plastics, is considered to be geotechnically unsuitable for any proposed future development that requires building structures. Associated contamination issues identified during historical investigations has indicated isolated hydrocarbons, metals and pesticides impacts within the fill and underlying soil profile. Groundwater investigations to date have been limited in their scope but have not identified any significant impacts.

The Site was proposed to be redeveloped for medium density residential use (aged care housing) in line with the current adjacent land uses on the north and south sides of Lot 3002. To facilitate the land transfer associated with this proposed redevelopment, the Shire required the Site remediated from a geotechnical and contamination perspective and ultimately reclassified under the *Contaminated Sites Act 2003* to demonstrate the Site's suitability for proposed future medium density residential use (aged care housing).

GHD prepared a Remediation Action Plan (RAP) for the Site in June 2019, which outlined an appropriate strategy for pursuing the Shire's intended objectives. The RAP outlined a remedial approach comprising the excavation and off-site disposal of uncontrolled fill and any residual natural soils underlying the fill that may have been impacted.

However, due to changing circumstances with regards to the saleability and value of the land, the financial viability of the project was diminished to a point where the Denmark Council opted to abandon the aged housing redevelopment plan altogether. As a result of this, Council requested that an appropriate investigation and remedial strategy be developed at the Site to allow for an end classification to be achieved under the *Contaminated Sites Act 2003*.

1.2 Previous Investigations

There has been a number of previous investigations undertaken at the Site of varying purposes from the late 1990's to 2019, which have been documented in the following reports:

- *Lot 3002 Hardy Street, Denmark; Revised Detailed Site Investigation (on behalf of the Shire of Denmark)*, OPUS, 2015
- *Lot 3002 Hardy Street, Denmark; Remediation Action Plan (on behalf of the Shire of Denmark)*, OPUS, 2016. Additional investigation work (October 2016 and groundwater results from January 2017) is partly referenced in the 2016 RAP document with the remaining information (in raw data form i.e. test pit logs and analytical results) were provided to GHD by the Shire over email on 27 November 2017.
- *Lot 3002 Hardy Street Denmark, Cost Review* (GHD, 29 November 2017). This included generalised volumetric modelling of the Site (12D earthworks model) based on a review of previous test pitting and borehole drilling logs across the Site.
- *Shire of Denmark, Information Gap Assessment and Sampling and Analysis Quality Plan Report (R1)* prepared by GHD in January 2019a (SAQP).
- *Shire of Denmark, 26 Hardy St, Denmark – Remediation Project, Additional Investigations – Information Gap Resolution* (GHD, March 2019b).
- *Shire of Denmark, 26 Hardy St, Denmark – Remediation Project, Remediation Action Plan Rev 1* (GHD, June 2019c).

GHD has relied upon the previous investigation work to assist in characterising the overall residual contamination risk on and offsite.

1.2.1 Auditor involvement

Mr Jeremy Hogben of Senversa Pty Ltd, was appointed by the Shire in 2018 as the DWER accredited contaminated sites auditor for this project. However, due to the change in redevelopment intent on the Site, and in recognition of the low risk presented offsite from the Site, the Shire terminated the audit in pursuit of a less sensitive redevelopment outcome (i.e. there were no formal triggers for a Mandatory Auditors Report as a result of the Shire's change in approach).

The auditor's previous involvement on the project involved the review and endorsement of the GHD reports outlined in Table 1-1.

Table 1-1 Summary of audit trail for the project to date

GHD Document Title	Auditor Endorsement
Shire of Denmark, Information Gap Assessment and Sampling and Analysis Quality Plan Report (R1) GHD (January 2019)	Yes – 29 January 2019
Shire of Denmark, 26 Hardy St, Denmark – Remediation Project, Additional Investigations – Information Gap Resolution (March 2019)	Yes – 30 April 2019
Shire of Denmark, 26 Hardy St, Denmark – Remediation Action Plan Rev 1 (June 2019)	Yes – 17 June 2019

1.3 Project objective

The objective of the project was to undertake sufficient investigation, remediation and validation works to effectively demonstrate the Site's suitability for ongoing open space/parkland land use and to achieve an end classification under the *Contaminated Sites Act 2003*, with the preference being 'Remediated for Restricted Use'.

1.4 Extent of remediation

The GHD RAP (2019c) presented a remediation approach that sought to address all residual contamination risks (and geotechnical constraints) in support of reclassification of the Site and redevelopment of the Site for residential land use. To this end, the proposed remediation works included the full removal of all anthropogenic placed waste fills as well as removal of any impacted underlying natural soils and the reinstatement of site levels with suitable clean fill.

However, with the Denmark Council opting to abandon the aged housing redevelopment plan, the remediation extent was reduced in line with the revised approach to pursue a public open space land use scenario and achieve an end classification under the *Contaminated Sites Act 2003*.

To this end, the extent of remediation works undertaken included:

- Removal and landfill disposal (or recycling where appropriate) of stockpiled wastes across the Site
- Removal of the previously constructed lined containment pad area from the south-western corner
- Re-profiling the landform including placing a layer of clean fill cover across the eastern and north-eastern portion of the Site
- Surface inspection and removal of asbestos containing materials

1.5 Scope of works

The Shire procured a suitable civil earthworks contractor to undertake the earthworks required with GHD providing environmental consultancy support for the project for the following key aspects:

- Landfill classification of uncontrolled fill stockpiles for appropriate offsite disposal
- Landfill classification and validation sampling of the lined containment pad in the south-western corner of the Site
- Detailed site inspection of the finished site surface for asbestos containing materials (ACMs) in accordance with the Department of Health (DoH) guidelines (2009)
- Additional groundwater investigation comprising:
    - the installation of three additional groundwater monitoring wells
    - survey of groundwater well top of casing height and location
    - a groundwater monitoring event including the sampling and analysis of all six wells on site (three previous and three newly installed wells)
- An assessment of residual risk, preparation of a post-remediation Conceptual Site Model (CSM) and determination of the Site's suitability for ongoing public open space/ passive recreation land use.
- Preparation of a remediation and validation report (this report)

1.6 Limitations

This report: has been prepared by GHD for Shire of Denmark and *may only be used and relied on by Shire of Denmark for the purpose agreed between GHD and the Shire of Denmark as set out in section 1.3 of this report.*

GHD otherwise disclaims responsibility to any person other than Shire of Denmark arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

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

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

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

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

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

2. Site identification

2.1 Site identification

The Site is located within the main town centre of Denmark and is accessed from Hardy Street, which borders the western site boundary. Site identification details are summarised in Table 2-1 and the cadastral layout and the Site boundary are illustrated in Figure 1.

Table 2-1 Site details (GHD 2019b)

Attribute	Details
Street address	26 Hardy St, Denmark WA
Area	8,907 m^2
Title identification details	Lot 3002 on Plan 45104, Hardy St, Denmark WA
Primary interest holder	Shire of Denmark
Current/ future zoning	Residential R20
Town Planning Scheme	Town Planning Scheme No. 3 (TPS3)
Local government authority	Shire of Denmark
Coordinates of the Site boundary *	North-western corner: 531 883 E, 6 131 386 N North-eastern corner: 531 990 E, 6 131 404 N South-western corner: 531 729 E, 6 131 341 N South-eastern corner: 531 991 E, 6 131 296 N
Surrounding land users	North and South: immediately adjoining the Site boundaries on the north and south sides are fully occupied aged care developments West: immediately west is Hardy St and beyond that are large residential blocks East: adjoining the Site to the east is a strip of remnant bushland reserve with a small ephemeral creek line

* Coordinates are in Geocentric Datum of Australia (1994), MGA Zone 50 and are approximate only.

2.2 Environmental Setting

An overview of the environmental setting for the Site is presented in Table 2-2 below.

Table 2-2 Environmental setting (GHD 2019b)

Aspect	Details
Climate	The nearest Bureau of Meteorology weather station (site number 009581), indicates: Mean annual minimum temperature range (°C) = 6.1 (Jul & Aug) to 13.1 (Feb) Mean annual maximum temp range (°C) = 14.4 (Jul) to 26.3 (Jan) Annual rainfall (mm) = 730.5 (Annual number of rain days = 100.7)
Topography	Site elevation is at approximately 25-27 m AHD (west at Hardy St) to 19 - 24 m AHD at the eastern side (lowest point in the north-eastern corner). The region encompassing the Site has a slight gradient slope to the east/ north-east, towards Denmark River.
Geology	Due to the Site's development over time, there is currently imported uncontrolled fill placed directly onto the former soils surface up to 3 m deep in places; particularly in the north and north-eastern portions of the Site. Information obtained from recent investigations (GHD 2019b), indicates that the current on-site lithology for the made-ground broadly comprises: Light grey (fill) sands across the Site ranging from 300 mm up to 1200 mm in thickness (predominantly observed to be 300 to 500 mm in thickness) with fill depth reflecting the historical slope of the Site towards the north/

Aspect	Details
	north-eastern side. This fill layer appears to comprise a controlled fill in terms of its source and placement. Underlying the surface grey sand was unconsolidated and uncontrolled fill generally comprising gravelly sands with some clay fraction at certain locations, large boulders as well as tree branches and stumps, concrete, bricks, tyres, rubber, plastics, glass, metal, etc. was noted in the north-eastern test pits only. No ACM was observed during the investigation program. The natural soil profile beneath the imported fill on site is understood to comprise light grey topsoil over brown/grey loamy sand and white clay at depth (OPUS, 2015).
Hydrogeology	Information obtained from previous investigations (GHD 2019b), indicates the depth to groundwater was observed to be within 2 m of the ground level on-site (MW01 and MW02) and within 1 m of ground level at the off-site well MW03 (to the north-east). Using these heights and the depths to water measured, it is considered that groundwater flows in an approximate north-easterly direction. The field water quality was found to be slightly acidic and marginal / brackish in all three wells. No registered bore users are known to exist down-hydraulic gradient of the Site (i.e. to the east/ north-east).
Surface water and drainage	Surface water is expected to drain from the Site towards the parkland area (east) which is understood to be an ephemeral watercourse that discharges into a major tributary (200 m north of the Site) and then into the Denmark River located approximately 700 m east of the Site.

2.1 Site layout description

In general, the Site is a fenced vacant lot situated between two large aged care housing developments. The development on the southern boundary of the Site is built up using a large panel and post retaining wall system whilst the development on the northern boundary is slightly lower than the site surface. The Site surface grades towards the eastern bushland land area with topography in generally grading from south-west to north-east. The entrance to the Site is off Hardy St to the west.

Prior to the earthworks being undertaken, the Site surface was covered with grasses and weeds with 12 small stockpiles evident (refer to Figure 3) comprising:

- Two stockpiles of sand (assessed to be clean fill – GHD, 2019b)
- Seven stockpiles of mixed fill materials considered to be uncontrolled fill (GHD, 2019b)
- Three stockpiles of largely segregated bulk wastes comprising rocks, tree material and scrap metal etc).
- An open excavation was present (approximately 5 m x 5 m) in the north-eastern corner (the result of historical on-site works) partially backfilled with white/grey sands.
- A small rectangular shaped sand bund area on the southern boundary was present understood to be a HDPE lined area for placement of any hazardous materials/or bulk liquids that for temporary storage during historical excavation works on the Site. It currently has a rusted out oil drum on the pad.
- Concrete stormwater infrastructure, from the previous developer, was stored within the south-eastern corner and north-western corner.
- Two groundwater wells are installed onsite with another installed offsite towards the north-east (MW03).

3. Overview of Contamination Status

3.1 Contaminated sites database

The Site is currently classified by DWER as 'Contaminated – Remediation Required' under the *Contaminated Sites Act 2003*. This classification reflects historical activities undertaken at the Site including the placement of uncontrolled fill and bulk storage of hazardous chemicals, which were used by the former Shire Depot (historically located adjacent to the Site). A review of the Basic Summary of Record was included within the GHD, SAQP (2019a).

3.2 Previous investigations

There has been a number of previous investigations undertaken at the Site of varying purpose and extent from the late 1990's to 2019 as listed in Section 1.2. For the purposes of understanding the pre-remediation contamination status of the Site, and to inform the risk assessment in the post-remediation scenario, the primary documents refer too are the GHD 2019 assessments, including:

- *Shire of Denmark, Information Gap Assessment and Sampling and Analysis Quality Plan Report (R1)* prepared by GHD in January 2019a (SAQP).
- *Shire of Denmark, 26 Hardy St, Denmark – Remediation Project, Additional Investigations – Information Gap Resolution* (GHD, March 2019b).

3.3 Site developmental history

The GHD SAQP (2019a) report provides a succinct summary of the approximate timeline of site development activities, including the following:

- **Pre 1962:** There are no photographs or other sources of information to determine the exact date that the initial site clearing and development began. However, it is clear from the 1962 photograph that the Site was being used during 1962 (unclear of exact use) which contradicts previous assumptions of a 1965 initial development date.
- **1962 -1985:** Site depot activities in operation. Sometime between 1981 and 1985 the depot operations began to wind down
- **1969 -1975:** Majority of the filling occurred during this period in the east, north and north-eastern portions of the Site
- **1985 – 1995:** Depot operations appear to have ceased with buildings and other associated stockpiled and laid materials removed.

The historical aerial photograph review confirms the positioning of certain depot related activities as presented by OPUS (2016) and provided as Figure 2 in GHD SAQP (2019a).

3.1 Extent of contamination

3.1.1 Potential contamination sources

Using the information obtained from the site developmental review (GHD, 2019a), and test pitting assessment work completed by OPUS in 2015/2016, the Site has been separated into two overall areas of concern (spatially, temporally, and also based on expected contamination issues), including:

- **Area 1:** includes parts of the central, southern and western areas of the Site associated with the use as a depot for 20-30 years. This area appears to have been cleared and

levelled by 1962 with limited uncontrolled filling required. This area has historically contained all of the depot related infrastructure and use based on the aerial photograph review.

- **Area 2:** includes a triangular piece of the Site to the north, east and north-eastern. This area has not been involved with the depot operation per se but has received uncontrolled fill deposited between 1969 and 1975 (mostly).

A detailed review of all historical environmental assessments was undertaken as part of the GHD (2019a) report. A summary of the key potential sources of contamination (as presented in GHD 2019a) is summarised in Table 3-1.

Table 3-1 Overview of potential sources of contamination within each area

Area on Site	Potential Source of Contamination
Area 1 - comprises the southern, central and western portions of the Site	Historical underground storage tank (s)
	Historical mechanical workshop
	Bulk chemical storage
Area 2 – comprises a triangular piece of the Site including the north, north-eastern and eastern portion of the Site	Uncontrolled fill and anthropogenic wastes (received uncontrolled fill deposited between 1969 and 1975)

A summary of the contamination investigation findings, with regards to the concentrations of CoPCs observed onsite is provided through the following sections.

3.1.2 Soil/ fill characterisation

OPUS investigations between 2011 and 2016

As a result of successive investigations by OPUS between 2011 and 2016, a total of 10 boreholes, 14 test pits and nine trenches were progressed across the Site to ascertain fill extents and to characterise contamination. As a result of the extensive sampling and analytical program from these assessment, the following results were observed, including:

- **PCBs, Phenol and BTEX;** no recorded concentrations of above their respective LORs.
- **OC/OP Pesticides;** detections of aldrin and dieldrin in one location (0.8m depth) and detections of dieldrin and DDT+DDD+DDE at one location (0.8m depth) at concentrations above the LOR but not above the ecological and human health (standard residential landuse) assessment criteria.
- **PAH;** recorded concentrations of PAH compounds at two locations (within fill at 0.3m and natural topsoil at 1.3m) above the LOR but not above the ecological and human health (standard residential landuse) assessment criteria.
- **TRH;** concentrations of TRH F2 and F3 above the LOR were recorded in uncontrolled fill at 0.8m, 1.4m, 2.4m, 3.0m, natural sand layer at 1.4m, 1.1m, 2.0m and 3.3m. The concentrations recorded exceeded the ecological (ESLs) and human health (standard residential landuse) at six of these locations (all located in Area 2).
- **Metals;** concentrations of chromium, lead, copper, nickel and zinc above the LORs with zinc concentrations at three locations exceeding the adopted ecological assessment criteria. Elevated metal concentrations generally correlated with uncontrolled fill layers.
- **Asbestos;** no ACM fragments were visually observed during the test pitting and no fibres or asbestos fines were detected in the laboratory soil analysis. In addition, no observed surface ACM fragments were reported by OPUS.

GHD additional investigations (2019)

As a result of the previous information review and datagap assessment undertaken by GHD (2019a), additional targeted investigations were undertaken in January 2019. The work undertaken totalled an additional 13 test pits (insitu), 10 test pits into stockpiles above ground (eight uncontrolled fill and two in clean fill stockpiles) and two 40 m trenches perpendicular to each other. As a result of the additional onsite observations, sampling and analytical program undertaken assessment, the following results were observed, including:

- **PFAS;** out of the 20 samples analysed, there were no recorded concentrations of PFAS above their respective LORs.
- **TRH;** concentrations of TRH F3 and F4 were recorded above the LOR at three of the 12 samples analysed. The maximum concentrations recorded were: TRH (F3) 3,240 mg/kg and TRH (F4) 2,860 mg/kg which exceeded the ecological screening criteria (ESLs) for urban residential and public open space using a coarse textured soil criteria (most conservative). All of these detections were in the vicinity of the former UST location within Area 1.
- **Metals;** concentrations of arsenic, cadmium, chromium (total), copper, mercury, nickel and zinc were all recorded below their respective LORs with lead concentrations at five of the 12 locations above the LOR (maximum of 52 mg/kg) but below the adopted assessment criteria.
- **Asbestos;** no ACM fragments were visually observed during the test pitting (including sieving) and no fibres or asbestos fines were detected in the laboratory soil analysis.

Additional soil/fill characterisation is presented within the landfill classification work undertaken as outlined in Section 6.

3.1.3 Clean fill verification

As reported within the previous GHD (2019b) report, two more recent fill sources (visually distinctive) are present onsite and have been assessed with regards to their source and potential for contamination. The key findings from the GHD (2019b) report are outlined below:

- A layer of grey fill sand (approximately 300 to 500 mm in thickness from the surface) is present across majority of the Site on top of the underlying uncontrolled fill layer. Additional investigation work (GHD, 2019b), in conjunction with the findings from the previous OPUS investigation work on-site (2015/2016), indicated that the grey sand fill (described by OPUS as the “recent grey fill”) is not associated with the historical uncontrolled filling program (1969-1975) and is not considered contaminated.
- In addition to this, stockpiles of visually “clean” fill in the form of light grey/ white sand (comprising a total of approximately 200 m^3) are also present on-site. The sand has been confirmed (anecdotally from the Shire) to have been imported from a virgin sand quarry on McIntosh Road in Denmark (Shire operated quarry) and further verified through a limited, representative sampling and analysis program of a broad suite of potential contaminants. GHD therefore considered this material to be suitable for reuse onsite post-remediation.

3.1.4 Groundwater

The three existing groundwater monitoring wells (two on-site (MW01 and MW02 and one off-site (MW03) were observed to be in good working condition and holding sufficient standing water at the time of sampling (refer to Figure 4). Based on a north-easterly groundwater flow direction, MW01 (located west) is sufficiently up hydraulic gradient of any on-site impacts and MW03 (north-east) would be considered down hydraulic gradient of any on-site derived impacts.

Previous groundwater investigations have indicated that groundwater is shallow (within 2m of the finished site surface) and the water quality is considered marginal to brackish and slightly acidic (between pH 5.4 and 6.8).

OPUS investigation - 2016

Groundwater monitoring was undertaken by OPUS in 2016 on all three current wells (MW01-MW03) with the analytical results indicating:

- Concentrations of PCBs, TRH, PAH, pesticides, phenols and BTEX were all below their respective LORs
- Chromium (total), copper, nickel and zinc recorded concentrations above the fresh water guidelines (ANZECC & ARMCANZ, 2000[1]), with nickel concentrations also above the Australian Drinking Water Guidelines (ADWG, 2011[2]). Of the metals detected above LOR, only chromium was recorded at concentrations higher in the down hydraulic gradient well (in comparison to the up hydraulic gradient well – MW01).

GHD additional investigations (2019)

GHD undertook an additional groundwater monitoring round in January 2019 (GHD, 2019b) on all three current wells (MW01-MW03) with the analytical results indicating:

- Elevated chromium concentrations (total) and zinc were recorded on and off-site, above the fresh water guidelines (ANZECC & ARMCANZ, 2000), in addition to a minor detection of TRH (F3 and F4) off-site.
- Concentrations of PFAS, pesticides, BTEX and PAH were recorded at concentrations below their respective LORs during the groundwater sampling round.

The detection of TRH (above LOR) in groundwater well MW03 is located off-site and considered to be positioned down-hydraulic gradient of any possible on-site impacts. The concentrations observed at MW03 comprised:

  - TRH>C_{16} - C_{34} Fraction (F3) = 160 µg/L
  - TRH>C_{34} – C_{40} Fraction (F4) = 320 µg/L

In the absence of specific DWER screening criteria for TRH with regards to non-potable use of groundwater (and further to Auditor correspondence 30 April 2019), GHD compared the observed TRH concentrations against a modified version of the World Health Organisation (WHO) 2008 reference document entitled: *Petroleum Products in Drinking water, Background document for development of WHO Guidelines for Drinking-water Quality (WHO, 2008)*.

A comparison with the lowest relevant drinking-water value (WHO 2008) would provide a conservative assessment (i.e. 90 µg/L based on use of WHO derived criteria for the aromatic fraction of >TRH [EC] C_{16} – TRH [EC] C_{35}). Further to this, as per the DoH (2014) approach for non-potable use of groundwater, a factor of 10 times the drinking water guideline can be applied to derive a suitably conservative modified criteria for use in assessment (i.e. 900 µg/L: non potable use - sum of F3+F4). The recorded TRH concentrations in MW03 do not exceed this modified criteria.

[1] GHD notes the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (*ANZECC) and Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000), is now ANZAST (2018), which came into effect on 4 September 2018. However, preliminary review of these guidelines by GHD (and others) has identified a number of discrepancies with ANZECC (2000) which have yet to be clarified. As such, ANZECC (2000) criteria have been adopted for the purposes of this report until the issues with ANZAST (2018) have been resolved.

[2] GHD notes the updates to ADWG (2018) and has incorporated relevant changes to these guidelines (where appropriate) into the report.

3.2 Remaining datagaps

As identified in the GHD additional investigations report (2019b) remaining datagaps with regards to the Site contamination extent were considered to include the following:

- Collection of additional analytical data prior to complete the landfill waste classification process and allow for the appropriate documentation to be prepared for acceptance of the material for offsite disposal (in accordance with DWER, 2018).
- Delineation of the laterally and vertical extent of hydrocarbon impacts in soils at the inferred area of impact (as identified in GHD 2019b) in the vicinity of the former underground storage tank (UST) infrastructure and vertical extent of (localised) hydrocarbon impacts within the natural soil profile beneath fill at the Site as identified in GHD (2019a).
- Appropriate additional assessment of groundwater quality; in particular with regards to the former UST area and offsite groundwater quality.
- Presence of asbestos (as ACM) within the waste/ fill.

Based on the Shire's previously proposed intent to remove all of the uncontrolled fill from the Site, GHD (2019b) and the Auditor (Senversa Interim Audit Advice letter of 30 April 2019) recognised that the most practical approach for addressing the outstanding issues (where needed) was through the implementation of the remediation program and through a comprehensive validation program at the completion of the remedial works.

Consideration of these datagaps has been undertaken within this report as outlined in the following sections.

3.2.1 Landfill classification of uncontrolled fill materials

Collection of additional analytical data prior to the excavation works commencing to complete the landfill waste classification process and allow for the appropriate documentation to be prepared to allow for acceptance of the material for disposal (in accordance with DWER, 2018).

GHD has considered this data gap further in the Section 6.1.

3.2.2 Delineation of hydrocarbon impacts

Additional investigation (GHD 2019b) identified an inferred area of impact (evident hydrocarbon staining, odours, analytical detections of TRH and lead concentrations) in the vicinity of the former USTs in the southern-central portion of the Site (refer to Figure 2). The lines of evidence obtained indicated that historic remediation and validation of the area post-removal of the infrastructure was either limited or was not undertaken.

GHD also considered that the vertical extent of hydrocarbon impacts within the natural soil profile beneath the fill on-site has not been effectively delineated in certain locations (i.e. northern eastern corner, eastern end and central area of Site). However, a significant ongoing source has not been located during the extensive intrusive investigations undertaken on-site to date and therefore these impacts are likely to be localised in extent.

GHD has considered this data gap further in the Section 8.2.

3.2.3 Additional assessment of groundwater quality

GHD considered that additional assessment of groundwater quality was required to inform the following datagaps:

- Appropriate additional assessment of groundwater quality in the vicinity of the former USTs (in particular, appropriate locations for additional monitoring wells) was recommended by

GHD (2019b), and supported by the Auditor (Senversa Interim Audit Advice letter of 30 April 2019).

- Further consideration of potential offsite groundwater impacts down hydraulic gradient of the Site. In particular, further consideration of TRH (F3 and F4 fractions) detected in monitoring well MW3 located at least 70 m down gradient to the north-east of the Site and is situated within an ephemeral watercourse.

GHD has considered this data gap further in the Section 7.

3.2.4 Presence of asbestos as ACM

The results from the additional asbestos investigations, in conjunction with the findings from the previous OPUS investigation work on-site (2011-2016), indicate that ACM is not visually present on the Site's surface or within the grey sand fill layer on-site (an approximate 300 mm – 500 mm thick layer across the Site). Further to this, there was no evidence of asbestos identified within the uncontrolled fill across the north, north-east and eastern corner of the Site during GHD's additional investigations conducted in 2019. ACM does not therefore appear to be widely distributed within the uncontrolled fill layers on-site (insitu and stockpiled).

Whilst no evidence of asbestos was identified within the underlying uncontrolled fill across the Site during GHD's additional investigations conducted (in 2019), in 2016 OPUS did observe isolated occurrences of ACM in one stockpile (derived from excavations within the north-eastern corner) which were subsequently removed. As a result of this, and given the highly heterogeneous nature of uncontrolled fill, the potential presence of ACM within the underlying uncontrolled fill and stockpiles derived from the uncontrolled fill (i.e. SP02-SP08) could not be completely discounted during remediation.

GHD has considered this data gap further in the Section 6.5.

4. Pre-remediation conceptual site model

A Conceptual site Model (CSM) was developed for the Site (GHD 2019b) to reflect the status of the Site on completion of the additional site investigation works (GHD 2019b). From the data obtained, the Site was separated into two overall areas of concern based on land use (and associated contaminating activities). These areas are presented on Figure 2.

4.1 Potential sources of contamination and associated contaminants of concern

Through the additional investigations undertaken by GHD (2019b), a refined list of CoPCs for each source was put forward and carried through into the RAP. It is important to note that these reports were endorsed by the project auditor (refer to section 1.2.1).

The initial and refined suites of CoPCs for each potential contamination source is summarised in Table 4-1.

Table 4-1 Contaminants of potential concern for each source

Area on Site	Potential Source of Contamination	Refined CoPCs (GHD, 2019b)
Area 1 - comprises the southern, central and western portions of the Site	Former Shire works depot area (1960s to 1985) Historical underground storage tank (s)	TRH, BTEXN, PAH, Pb
	Former Shire works depot area (1960s to 1985) Historical mechanical workshop	TRH, BTEXN, PAH, Metals (chromium, lead, nickel and zinc),
	Former Shire works depot area (1960s to 1985) Bulk chemical storage	Pesticides (aldrin, deildrin, DDT+DDD+DDE), TRH, BTEXN, PAH
Area 2 – comprises a triangular piece of the Site including the north, north-eastern and eastern portion of the Site	Uncontrolled fill and anthropogenic wastes (received uncontrolled fill deposited between 1969 and 1975)	Metals (chromium, lead, nickel and zinc), Pesticides (aldrin, deildrin, DDT+DDD+DDE), TRH, BTEXN, PAH, Asbestos (as ACM)

Table notes: CoPCs - Contaminants of Potential Concern; TRH - Total Recoverable Hydrocarbons; BTEXN - Benzene, Toluene, Ethylbenzene, Xylene and Naphthalene; PAH - Polycyclic Aromatic Hydrocarbons; Pb - Lead; DDT - dichlorodiphenyltrichloroethane; DDD - dichlorodiphenyldichloroethane; DDE – dichlorodiphenyldichloroethylene; ACM – Asbestos Containing Materials

4.2 Potential pathways

Potential contaminant migration pathways for CoPC include:

- Vertical migration of contaminants within the fill into the underlying natural soils through rainfall infiltration.
- Lateral groundwater flow (expected to be related to the former drainage line) beneath the fill on the Site and into the adjacent creek line.
- Lateral and vertical migration of vapours through preferential pathways

- Contaminants liberated through disturbance and migration through dust generation from Site.

Potential exposure routes for CoPC include:

- Dermal/incidental contact with contaminated fill materials and underlying impacted soils.
- Ingestion and incidental contact with impacted surface water and groundwater off-site.
- Inhalation of soil vapours emitted and asbestos fibre generation.

4.3 Potential receptors

For the purpose of this assessment potential 'receptors' include persons, structures, utilities, ecological receptors that are, or may be, adversely affected by CoPCs and comprise the following:

- Future site users (based on residential redevelopment scenario)
- Current occupants off-site (immediately south and north of Site)
- Future remediation and utility/ intrusive maintenance workers conducting subsurface excavations during redevelopment on and off-site
- Users of groundwater bores located down-gradient of the Site
- Sensitive ecological receptors down-gradient of the Site (surface water receptors, flora and fauna present in adjacent reserve)

4.4 Summary of potential source-pathway-receptor linkages

The potential source-pathway-receptor linkages identified in the preliminary CSM, based on the pre-remediation scenario and based on a post-remediation scenario of residential (as originally proposed by the Shire), are summarised in Table 4-2.

Table 4-2 Revised conceptual site model – pre remediation scenario

Area	Landuse Description	Source	CoPC	Exposure route	Receptors
Area 1 - comprises the southern, central and western portions of the Site	Former Shire works depot area (1960s to 1985)	Historical UST infrastructure use and ineffective soil validation post-removal	TRH, BTEX, PAH, lead	Dermal/ incidental contact with impacted soils and groundwater/ stormwater runoff	Future site users Future utility/ intrusive maintenance workers Users of receiving surface water bodies located down-gradient of the Site Sensitive ecological receptors (particularly fresh water aquatic)
				Inhalation of vapours	Future site users Current occupants off-site Future utility/ intrusive maintenance workers
		Historical storage of chemicals	Metals, TRH, BTEX, PAH, pesticides	Dermal/ incidental contact with impacted soils and groundwater/ stormwater runoff	Future site users Future utility/ intrusive maintenance workers Users of groundwater bores located down-gradient of the Site Users of receiving surface water bodies located down-gradient of the Site Sensitive ecological receptors (particularly fresh water aquatic)
				Inhalation of vapours	Future site users Current occupants off-site Future utility/ intrusive maintenance workers
		Historical mechanical workshop areas	Metals, TRH, BTEX, PAH	Dermal/ incidental contact with impacted soils and groundwater/ stormwater runoff	Future site users Future utility/ intrusive maintenance workers Users of receiving surface water bodies located down-gradient of the Site Sensitive ecological receptors (particularly fresh water aquatic)
				Inhalation of vapours	Future site users Current occupants off-site Future utility/ intrusive maintenance workers
Area 2 – comprises a triangular piece of the Site including the north, north-eastern and eastern portion of the Site	This portion of the Site does not appear to have been directly involved with the depot operation per se but has received uncontrolled fill deposited between 1969 and 1975 (predominantly)	Uncontrolled fill	Metals, TRH, BTEX, PAH, pesticides, asbestos (in ACM form)	Dermal/ incidental contact with contaminated fill	Future site users Future utility/ intrusive maintenance workers Sensitive ecological receptors
				Inhalation of vapours	Future site users Current occupants off-site Future utility/ intrusive maintenance workers
				Inhalation of asbestos fibres	Future site users Current occupants off-site Future utility/ intrusive maintenance workers
				Groundwater migration and stormwater discharge into creek line	Off-site sensitive ecological receptors (ultimately Denmark River) Off-site human receptors e.g. bushwalkers, etc.

5. Remediation works

5.1 Objectives of Remediation

The overall objective of the remediation works is to render the Site suitable for the proposed open space/ parkland landuse. Specific objectives to achieve this are:

- Reduce the potential risks to human health and the environment associated with the contamination identified at the Site to acceptable levels to permit the proposed open space/ parkland land use.
- Achieve an outcome that allows the Site to be re-classified under the *Contaminated Sites Act 2003*, such that it is appropriate for the proposed open space/ parkland land use.
- Provide a cost effective and reliable/proven approach to remediation.

5.2 Remedial targets

Remedial targets are measureable and achievable characteristics that relate to the progress of remediation action towards the stated objectives of remediation (refer to Section 5.1). These need to be practically achievable and justified with respect to environmental, social and economic considerations (CRC CARE 2013) as considered in **Error! Reference source not found.**.

Table 5-1 Remedial targets

Target	Description
Site rendered suitable for the proposed future development	Site considered suitable for development from a human health risk and safety perspective in addition to onsite and offsite ecological receptors. Site final profile should be conducive to rehabilitation with sufficient clean cover over underlying fills.
Reclassification of Site	Site achieves reclassification under the Contaminated Sites Act 2003 to a classification (e.g. 'Remediated for Restricted Use') which will permit the proposed intended future landuse (open space/ parkland). Restrictions on use to be cognisant of sub-surface excavations into the uncontrolled fill.
Zero environmental incidents	No environmental incidences or complaints

5.3 Remediation end points

Remedial 'end points' applicable to the proposed site remediation works are presented in Table 5-2.

Table 5-2 Remedial end points

Media / Remediation Effort	End point
Removal of stockpiled segregated bulk materials, wastes and hazardous materials temporary storage pad	Bulk materials and anthropogenic wastes segregated from the uncontrolled fill including large rocks, pieces of wood, tree stumps, tyres, concrete and scrap steel, have been removed off-site and appropriately disposed of according to their waste stream and potential for recycling/ reuse (off-site).
Off-site disposal of contaminated materials	Impacted soil removed will be characterised in accordance with DWER Waste Classification guidance (2018) and disposed to an appropriate landfill facility on receipt of analytical results.

Media / Remediation Effort	End point
	The completeness of disposal will be achieved once all material is disposed to appropriate landfill facility, with recorded evidence of landfill receipt.
Site surface validation	Validation of site surface from residual contaminants from under the hazardous materials temporary storage pad and inspection/ removal of any residual ACM on the site surface
Creating a final surface profile that is safe to the general public, conducive to rehabilitation and the proposed future use	Creating a final surface profile that is safe and conducive to rehabilitation and the proposed open space/ parkland land use. The site surface should be flat with a gentle slope away from Hardy street towards the bushland to the east. There should be no visible wastes and rubbish above the finished surface. Clean fill (sourced from onsite) should be levelled out across the eastern portion of the site ensure all depressions are filled in and there is a sufficient cover (100 mm minimum) over underlying buried wastes.
Groundwater quality	Confirmation post-remediation that groundwater in the shallow aquifer (on and offsite) is not impacted from the Site historical land uses and/or onsite remedial works

5.4 Extent of remediation works

The extent of remediation works undertaken onsite included the following key aspects:

- Removal and landfill disposal (or recycling where appropriate) of stockpiled wastes across the Site (SP02 –SP08 as per Figure 3) comprising 112 m^3 of concrete and steel and 1,001 m^3 of Class 1 uncontrolled fill.
- Removal of the previously constructed lined containment pad area from the south-western corner (<2 m^3). Validation of soil underlying the containment pad.
- Re-profiling the landform including placing a layer of clean fill cover across the eastern and north-eastern portion of the Site. All clean fill was sourced and reused from onsite.
- Surface inspection and removal of asbestos containing materials (ACM)

5.5 Deviations from RAP (GHD, 2019c)

With the Denmark Council opting to abandon the aged housing redevelopment plan, the remediation extent and soil validation approach was reduced in line with the revised approach to pursue a public open space land use scenario and achieve an end classification under the *Contaminated Sites Act 2003*.

The GHD RAP (2019c) presented a remediation approach that sought to address all residual contamination risks (and geotechnical constraints) in support of the reclassification and redevelopment of the Site. To this end, the proposed remediation works included the full removal of all anthropogenic placed waste fills as well as removal of any impacted underlying natural soils and the reinstatement of site levels with suitable clean fill.

6. Remediation and validation program

6.1 Removal of waste stockpiles

Ten small stockpiles of waste materials/fill, as presented on Figure 3, partially segregated during historical remediation attempts, were removed from Site as part of the remediation works, including:

- Seven stockpiles (SP02 – SP08) of mixed fill materials considered to be uncontrolled fill (GHD, 2019b)
- Three stockpiles of largely segregated bulk wastes comprising rocks, tree material and scrap metal etc).

The landfill classification, removal and disposal activities undertaken in regards to the waste stockpiles are presented in the following sections.

6.1.1 Landfill classification

The stockpiled material was suitably classified for landfill disposal in accordance with *DWER Landfill Waste Classification and Waste Definitions* 1996 (as amended December 2018).

GHD prepared a landfill classification report for the Site entitled *Hardy St Denmark – Remediation Project; Landfill Classification and Disposal Advice for Waste Materials Onsite, GHD, October 2019* (GHD, 2019d). The GHD landfill classification report, as provided to the Shire in 2019, is provided as Appendix A.

The landfill classification report was originally undertaken to accommodate the full removal program (including both insitu and already stockpiled at the site) as per the RAP (GHD, 2019c) and therefore comprised a much more comprehensive waste characterisation program that allowed for classification of up 10,000 m^3 of material.

As part of the landfill classification work, GHD undertook the following assessment:

- A detailed review of all relevant available soil investigation data from previous investigations on site (2011-2019) against the landfill waste classification criteria outlined in DWER, 2018; and
- Further onsite investigation targeting key information gaps (leachabilty of lead, cadmium and chromium and TRH aromatic/ aliphatic speciation) to allow appropriate classification of the material in accordance with DWER 2018.

Through a detailed review of historical onsite investigations, and as a result of additional targeted onsite investigations undertaken, GHD concluded that the uncontrolled fill material to be removed and disposed from Site is deemed to be suitable for Class 1 landfill disposal.

6.1.2 Removal and offsite disposal

In line with the recommended landfill classification (GHD, 2019d), the Shire engaged a suitable earthworks contractor to remove the waste stockpiles offsite to the McIntosh Road Waste Facility. The dates and quantities of different material removed from Site is summarised in Table 6-1, with landfill disposal receipts provided in Appendix B.

Table 6-1 Summary of waste disposal activities

Date	Waste Stream	Quantity
26-May-2020 to 9-June-2020	Class 1 fill material	916 m^3
26-May-2020 to 9-June-2020	Metal	40 m^3

Date	Waste Stream	Quantity
26-May-2020 to 9-June-2020	Concrete	72 m^3
26-May-2020 to 9-June-2020	Potential asbestos pipe product (transported within a HAZMAT bag)	600 mm x 100 mm
09-June-2020 to 16-September-2020	Class 1 fill material	85 m^3

6.2 Removal and validation of containment pad

A small rectangular shaped sand bund area (with a black plastic liner) was present on the south-western boundary. The containment pad was constructed during historical excavation works on the Site by the Shire as temporary storage for the placement of any hazardous materials/or bulk liquids uncovered during remediation works. The containment pad was understood to have not been used other than for the placement one rusted out drum that was observed on the sand pad during remedial works.

The landfill classification, removal and disposal activities undertaken in regards to the containment pad are presented in the following sections.

6.2.1 Landfill classification

The sandy material on top of the containment pad was appropriately classified for landfill disposal by GHD in accordance with DWER, 2018.

Four soil samples were collected on the 27 May 2020 from the residual sandy material within the containment pad (Sample ID CP1 to CP4), including material stained by a visually distinctive dried hydrocarbon product (potentially bitumen) emanating from the rusted drum. The samples were analysed for metals, TRH, BTEXN and PAH. Two samples were also analysed for leachable lead concentrations based on the total lead results exceeding the screening criteria.

Through a review of the analytical results against the DWER 2018 guidelines, GHD concluded that the material on top of the containment pad was deemed to be suitable for Class 1 landfill disposal.

6.2.2 Removal of containment pad

In line with the recommended landfill classification (section 6.2.1), the Shire engaged a suitable earthworks contractor to remove the containment pad soil and liner offsite to the McIntosh Road Waste Facility. Approximately <2m^3 of material was removed on the 27 May 2020 through careful excavation and packaging into HAZMAT bulka bags. The receipt from landfill disposal is provided in Appendix B.

6.2.3 Validation of containment pad removal

During removal of the containment pad material on the 27 May 2020, GHD inspected the liner integrity and underlying soil for indications of liner failure. There were no indications of the liner being breached and/or discolouration of soils underlying the liner. GHD collected one confirmatory validation sample (Sample ID V1) from directly beneath the liner in the approximate location of where the rusted drum was situated on the containment pad.

The validation sample was analysed for metals, TRH and BTEXN and were found to not indicate any evidence of contamination from the containment pad and confirmed the visual observations by the GHD staff onsite.

The laboratory analytical results are provided in Appendix H.

6.3 Reinstatement and re-profiling works

Reinstatement works were carried out in June 2020 by a Shire appointed earthworks contractor. Two stockpiles of “clean” sand (determined to be “clean fill” as assessed in GHD, 2019b, refer to Section 3.1.3), from the centre and the north-western corner of the Site, were used to reinstate surface depressions along the north and eastern boundaries. The fill was also used to re-profile the Site surface allowing a layer of clean fill cover across the underlying uncontrolled fill in the eastern and north-eastern portions of the Site. The finished profile was required to better support Site rehabilitation efforts and provide a site surface more conducive to the proposed open space/ parkland land use.

The Shire propose to hydro-mulch the soil surface to promote vegetation cover to stabilise the loose fill. The addition of a shredded mulch product across the Site is also proposed, to support the rehabilitation of the Site and reduce the erosion potential from stormwater runoff.

6.4 Environmental incidences

As a result of the disturbance works undertaken and the re-profiling of the Site surface, stockpiles, vegetation and other ground surface imperfections that previously retained stormwater runoff and reduced the runoff velocity were no longer present. As a result heavy rainfall events during winter caused erosion of some of the surface cover fill and allowed greater accumulation of runoff at the north-eastern corner of the Site. Some localised flooding occurred at the north-eastern corner of the Site which in turn impacted the backyard of an adjacent residential house. In response, the Shire prepared additional sub-soil drainage within this area and increased stabilisation and rehabilitation efforts to the eastern Site boundary and the Site surface more broadly. Through hydro-mulching the cover fill and the inclusion of a shredded mulch product, the Site surface is expected to mitigate previously observed high velocity stormwater runoff events.

6.5 Surface asbestos inspection and removal

Following the completion of the contractor earthworks program, and following re-profiling of the Site surface, GHD conducted a detailed inspection (and removal) of the final surface for ACM on the 24 July 2020. The inspection of the Site surface was carried out in accordance with the Department of Health (2009) *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.*

A Senior GHD Environmental Scientist, Mr Jon Cramer, attended the Site on the 24 July 2020 to complete a detailed inspection. Jon is a Senior Environmental Scientist with a Bachelor of Science and over 14 years’ experience in the contaminated sites industry including the asbestos impacted sites. This selection of field personnel was undertaken in accordance of DoH (2014) requirements, which state *‘the lead consultant should normally have a minimum of 3 years continuous experience with asbestos soil contamination and relevant tertiary qualifications in environmental science, science or engineering’.*

The following methodology was implemented for the inspection:

- Systematic inspection (by two competent staff) of the Site surface including two passes of picking with 90 degree direction change between each pass on a 10m by 10m grid pattern
- Raking of the area to a maximum depth of 10 cm of the soil surface followed by another inspection pass

- Where Potential ACM (PACM) fragments were identified, the material was removed, the location was recorded with regards to the grid reference, along with the fragments description, number and weight.
- The % w/w of ACM was calculated in accordance with the DoH (2009) calculation to determine residual concentrations of ACM (if applicable).

6.5.1 Assessment criteria

The DoH (2009) guidelines provide assessment criteria for asbestos in soil based on an assessment of potential exposure via inhalation for various land uses including residential, recreational and commercial/industrial land uses. The adopted criteria for the inspection are presented in Table 6-2 and based on the proposed open space/ parkland land use.

Table 6-2 Adopted asbestos in soil assessment criteria

Asbestos form	Public open spaces
Bonded ACM	0.02% w/w
AF/FA	0.001% w/w
All forms of asbestos	No visible asbestos for surface soil (top 10 cm)
ACM = asbestos containing materials; FA = fibrous asbestos; AF = asbestos fines	

6.5.2 Findings

Through the detailed ACM inspection and removal program, GHD identified and removed 3.125kg of PACMs from across the Site. PACMs encountered during the inspection program were observed to be bonded ACM fragments which were in good condition and non-friable. As a conservative approach, GHD treated all PACM as being asbestos containing for the purpose of demonstrating adherence to the validation criteria.

The findings from the ACM inspection and removal program are presented on Figure 5 with a detailed overview of the PACMs removed including locations, descriptions, weights, calculated %w/w and photographs is provided in Appendix D.

The key findings from the inspection and removal program are summarised in Table 6-3 (below).

Table 6-3 Asbestos inspection and removal findings

GRID ID	Area [m2]	Pass 1		Pass 2		Pass 3		Meets Criteria
		Weight of ACM [g]	Asbestos conc [% w/w]	Weight of ACM [g]	Asbestos conc [% w/w]	Weight of ACM [g]	Asbestos conc [% w/w]	
C14	31.51	712	0.0205418	-	-	-	-	✔
H10	100	16	0.0001455	-	-	-	-	✔
H12	100	1	0.0000091	-	-	-	-	✔
I9	100	2	0.0000182	-	-	-	-	✔
J5	100	-	-	4	0.0000364	-	-	✔
J7	100	-	-	-	-	2	0.0000018	✔
J8	100	-	-	4	0.0000364	8	0.0000073	✔
J9	100	40	0.0003636	-	-	-	-	✔
J10	100	42	0.0003818	-	-	-	-	✔
J11	100	89	0.0008091	-	-	-	-	✔

GRID ID	Area [m2]	Pass 1		Pass 2		Pass 3		Meets Criteria
		Weight of ACM [g]	Asbestos conc [% w/w]	Weight of ACM [g]	Asbestos conc [% w/w]	Weight of ACM [g]	Asbestos conc [% w/w]	
K1	42.63	1,800	0.0383853	-	-	-	-	✔
K4	100	-	-	-	-	<1*	<0.0000009	✔
K5	100	140	0.0012727	-	-	-	-	✔
K7	100	32	0.0002909	-	-	-	-	✔
K8	100	22	0.0002000	-	-	-	-	✔
K9	75.42	-	-	3	0.0000362	-	-	✔
L6	100	113	0.0010273	94	0.0008545	-	-	✔
J1 (offsite)	-	75	-	-	-	-	-	NA
H1 (offsite)	-	-	-	20	-	-	-	NA

Table notes:

For the purposes of calculating asbestos in soil concentration [% w/w] it was presumed that the asbestos content within all identified ACM is 15%, and the soil density for Perth sandy soils as observed on Site is 1.65 kg/L. The depth of raking / investigation was 0.1 m for Pass 3. Pass 1 & Pass 2 involved visual inspection and hand-picking of ACM, therefore a soil depth of 0.01 m has been adopted as per DoH (2009) guidelines for the relevant calculations.

As presented in Table 6-3, through the progressive inspection and removal program, the Site is considered to meet the adopted assessment criteria and is suitable for the proposed open space/ parkland land use.

The receipt from landfill disposal of the removed PACM is provided in Appendix B.

7. Additional groundwater assessment

GHD undertook additional assessment of groundwater to address the data gaps with regards to potential onsite and offsite groundwater impacts. The additional work undertaken by GHD in relation to groundwater, included the following key aspects:

- Installation of an additional three groundwater wells (one onsite and two immediately offsite)
- Monitoring of the groundwater network comprising six wells in total (three new groundwater wells and three existing groundwater wells)
- Laboratory analysis of key contaminants of concern (refer to 7.3)

The methodology and key findings from the additional work undertaken is presented in the following sections.

7.1 Monitoring well installation

Three additional groundwater wells, one onsite (MW04) and two offsite (MW05 and MW06) were installed on the 17 and 18 March 2020 by GHD. Groundwater wells MW05 and MW06 were positioned along the eastern site boundary (immediately offsite) with groundwater well MW04 installed in the centre of the Site between MW01 and MW02.

The groundwater wells were installed by a licensed driller using the hollow stem auger installation approach with the following general specifications adhered to:

- 50 mm polyvinyl chloride (PVC) class 18 blank and screened casings (with screening slots no greater than 1 mm in width);
- Screened casing extending 1 m above the groundwater level and 2 m below the groundwater level (where possible);
- Blank and screened PVC casing attached to each other using flush mounted factory threaded joints;
- Primary filter pack material was a chemically inert material and well rounded, with a high coefficient of uniformity extending at least 0.5 m above the screened PVC casing;
- Bentonite pellets used as annular sealant and extended at least 0.5 m above the filter pack;
- Monitoring wells were finished above ground level with a lockable steel riser;
- Wells were developed following completion by purging at least four well volumes; and
- Monitoring wells were accurately surveyed to AHD and Geocentric Datum of Australia (GDA) by a licensed surveyor engaged by GHD.

A summary of the monitoring well network is provided in Table 7-1 with the locations in relation to the Site shown on Figure 4.

Table 7-1 Summary of monitoring well network

Well ID	Existing/ New	Location	Total Depth (m bgl)	Rationale for positioning
MW01	Existing	South-west corner	7.9	Capture up gradient groundwater conditions
MW02	Existing	Northern side of Site	7.76	Capture onsite groundwater conditions

Well ID	Existing/ New	Location	Total Depth (m bgl)	Rationale for positioning
MW03	Existing	Offsite – far north-east	5.51	Capture offsite down-gradient groundwater conditions
MW04	New	Centre of Site	3.97	Investigate onsite groundwater conditions in the vicinity of historical UST positioning
MW05	New	Offsite - east	2.96	Capture immediate offsite down gradient conditions
MW06	New	Offsite – north-east	2.93	

7.2 Groundwater sampling methodology

Following installation of the new groundwater wells in March 2020, the new groundwater wells were allowed to settle and connect hydraulically with the aquifer for a period of time prior to sampling by GHD on the 3 June 2020. The groundwater was sampled using a low flow peristaltic pump with disposable low-density poly-ethylene (LDPE) tubing. The slow pumping rate achieved is considered an appropriate method for the collection of representative samples for the required analytes. All six monitoring wells were found to be in good working order and able to be sampled at the time.

Prior to purging and sampling the wells, the standing water levels were gauged using an oil/water interface meter with capabilities for detecting any phase-separated hydrocarbons on the water. Field parameters were monitored during purging included temperature, pH, electrical conductivity (EC), Total Dissolved Salts (TDS), dissolved oxygen (DO) and oxidation reduction potential (ORP). The groundwater wells were purged until field parameters (in particular pH, TDS, temperature and EC) stabilised within an acceptable variance range (+/- 5% for three consecutive measurements).

Samples were collected using new disposable gloves and placed directly into labelled, laboratory provided sample bottles and put into a chilled esky. Sample details were entered onto a chain of custody (CoC) form that accompanied the samples to the laboratory.

7.3 Groundwater analysis

Collected groundwater samples were submitted to a National Association of Testing Authority (NATA) accredited laboratory for the required analysis.

The groundwater analytical suite was selected on the basis of the CSM (refer to section 4) which provided a refined suite of CoPCs derived from the previous work undertaken (GHD assessments 2019a and 2019b) and included the following:

- Dissolved metals: chromium (total, III and VI), lead, nickel and zinc
- Organochlorine pesticides: aldrin, deildrin, DDT+DDD+DDE
- Hydrocarbons: TRH, BTEXN and PAH

7.4 Groundwater assessment criteria

7.4.1 Ecological assessment criteria

It is acknowledged that the ephemeral creek line immediately to the east of the Site would ultimately discharge into the Denmark River. As a result of this potential receiving body, the

broader suite of contaminants in groundwater, were compared with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000[2]).

7.4.2 Human health assessment criteria

There is currently no evidence of groundwater abstraction for potable or non-potable purposes at the Site, however, future groundwater abstraction for non-potable uses cannot be precluded at the Site (and particularly off-site down hydraulic gradient). In order to assess the potential risk to human health, the broader suite of contaminants in groundwater have been compared to the Australian Drinking Water Guidelines (ADWG, 2011[3]) and the Non-potable Groundwater Use guidelines (NPUG – DoH, 2014).

In the interim auditor advice (received on the 30 April 2019) in regards to the review of the GHD, 2019b report, the Project Auditor recommended that a suitable reference for assessment of hydrocarbons in groundwater for non-potable use is a modified version of the *World Health Organisation (WHO), 2008; Petroleum Products in Drinking Water*. As per the reference document, in the absence of specific analysis (i.e. individual petroleum product speciation) a comparison with the lowest relevant drinking-water value (WHO 2008) would provide a conservative assessment (i.e. 90 µg/L based on use of WHO derived criteria for the aromatic fraction of >TRH [EC] C_{16} – TRH [EC] C_{35}). Further to this, as per the DoH (2014) approach for non-potable use of groundwater, a factor of 10 times the drinking water guideline can be applied to derive a suitably conservative modified criteria for use in assessment (i.e. 900 µg/L: non potable use - sum of TRH F3+F4).

7.5 Quality assurance/ quality control

The Quality Assurance/Quality Control (QA/QC) procedures incorporated within the groundwater assessment were based on the DWER *Assessment and management of contaminated sites, contaminated site guidelines* (2014), AS 4482.1 – 2005, AS 4482.2 – 1999 and NEPM (1999) *National Environment Protection (Assessment of site Contamination) Measure 1999* (*as amended 2013)*. QA involves all of the actions, procedures, checks and decisions, undertaken to ensure the representativeness and integrity of samples and accuracy and reliability of analytical results. QC involves protocols to monitor and measure the effectiveness of QA procedures.

A detailed description of the QA/QC methods, results and interpretation is provided within Appendix E. As concluded in Appendix E, GHD considers that the data obtained through the groundwater assessment (Section 7.2) is reliable and can be used in relation to the establishment of groundwater quality and interpreted risks. Aside from the LOR for the chromium speciation analysis not meeting the required adopted assessment criteria (discussed further in Section 8), aforementioned quality control breaches are minor and are unlikely to impact the overall interpretation of the analytical results.

7.6 Results

The results from the additional groundwater assessment, as monitored on the 3 June 2020, are presented within the following sections.

[2] GHD notes the ANZECC and ARMCANZ (2000), now ANZAST (2018), which came into effect on 4 September 2018. However, preliminary review of these guidelines by GHD (and others) has identified a number of discrepancies with ANZECC (2000) which have yet to be clarified. As such, ANZECC (2000) criteria have been adopted for the purposes of this report until the issues with ANZAST (2018) have been resolved.

[3] GHD notes the updates to ADWG (2018) and has incorporated relevant changes to these guidelines (where appropriate) into the report

7.6.1 Geological results from drilling

The groundwater well construction logs for the three new wells installed, including the geological conditions encountered, are provided in Appendix F, and generally indicated the following in terms of the hydrogeology on and offsite:

- **MW04** (installed within the former depot area in the vicinity of the former UST): reworked sandy and gravel fills down to around 1.8/2 m then clearly into natural silty sands. Groundwater present within 2 m bgl positioned in the natural soil profile.
- **MW05 and MW06** (installed offsite on the eastern boundary): organic rich silty sands over a semi-cemented sand layer (iron indurated sands) at around 1 m bgl and hard weather granite where the groundwater was observed to perch at approximately 1.5/1.6 m bgl.

There appeared to be evidence of seasonal perching systems in the geological layers observed in the wells on the eastern Site boundary. The cemented sand layers and hard weathered clay profile at depth appear to represent relatively impermeable layers that during storm events would be expected to result in saturation of the upper soil profile and formation of the ephemeral creek line.

7.6.2 Groundwater field results

The groundwater monitoring locations along with the groundwater height contours and inferred flow direction are presented in Figure 4. As presented on Figure 4, groundwater flow is expected to follow the grade of the topography and migrate from Site in a north-easterly direction towards the ephemeral creek line to the east.

The monitoring field sheets from the groundwater monitoring event are provided in Appendix G with a summary of the water level gauging and field parameters, as measured immediately before sample collection commenced, provided in Table 7-2.

Table 7-2 Groundwater field parameters

Well ID	DTW (m bTOC)	Temp (˚C)	pH	EC (µS/cm)	DO (mg/L)	ORP (mV)	TDS (mg/L)	Comments
MW01	2.33	19	5.3	1153	0.33	109.9	747.5	light brown colour, low sediment load, no sheen/odour
MW02	2.97	18.1	5.59	1789	0.8	44.5	1163.5	almost clear, no sheen/odour/ sediment load
MW03	1.33	17.6	6.03	1756	0.31	-39.9	1144	very light brown colour, slight to no sediment load, no sheen/odour
MW04	2.53	18	5.51	988	0.81	2.2	643.5	pale yellow colour, slight to no sediment load, slight organic odour, no sheen
MW05	2.06	17.4	5.55	1748	5.08	111.8	1137.5	very light pale yellow (almost clear), no sheen/odour/ sediment load
MW06	1.12	17.2	5.83	1508	0.36	99.6	981.5	almost clear, no sheen/odour/ sediment load

DTW = depth to water

bTOC = below Top of Casing

As presented in Table 7-2, the groundwater field results generally indicated the following:

- Groundwater was observed to be at a depth below the anticipated level of placed fill at Site (based on depths of fill observed in GHD, 2019b)
- Groundwater was found to be slightly acidic and marginally saline
- No hydrocarbon sheen or odour (hydrocarbon or otherwise) was observed in any of the six wells

7.6.3 Groundwater laboratory analytical results

A summary of the groundwater analytical results compared against the adopted assessment criteria is presented in Table 1, Appendix C with the laboratory certificates of analysis provided in Appendix H.

As presented in Table 1, Appendix C, the analytical results indicate that with the exception of reported detections of nickel, zinc and chromium (III+VI), all concentrations of CoPCs were below their respective LORs within the onsite and offsite groundwater wells. The reported detections of nickel, zinc and chromium are further discussed below:

- Zinc concentrations were reported above the LOR and the freshwater guideline (95% species protection limit) of 8 µg/L at all six groundwater wells. Spatially, the concentrations observed in the groundwater well located up-hydraulic gradient of the Site (MW01) are considered to be consistent with (and in some cases higher) than groundwater wells located within the Site and down-hydraulic gradient of the Site. The highest concentration was observed at MW05 (87 µg/L) which is located immediately offsite to the east of the Site.
- Chromium (III+VI) concentrations were reported at or above the LOR at three groundwater wells including MW03, MW04 and MW05. The concentration recorded at MW05 for Chromium (III+VI) 2 µg/L marginally exceeded the freshwater guideline (95% species protection limit) of 1 µg/L. Speciation of the chromium at MW05 indicated trivalent and hexavalent chromium forms to be below LOR however the LORs (10 µg/L) were unable to meet the freshwater guideline limit (1 µg/L) and are therefore the findings are inconclusive.
- Nickel concentrations were reported above the LOR but below the adopted assessment criteria at five of the six groundwater wells. The highest concentration was observed at MW01 (11 µg/L) which is located up-hydraulic gradient of the Site.

8. Discussion of residual risks

The full extent of remedial works proposed within the GHD RAP (2019c) was not undertaken due to the change in Shire prerogative with regards to the desired end landuse from residential to open space/ parkland. As a result, the remediation and validation works program undertaken, primarily involved the following key tasks:

- Removal and offsite disposal of surface waste stockpiles and a HDPE lined containment pad area (Class 1 landfill inert waste and segregated recyclable materials)
- Inspection and removal of surface ACMs (and suspected ACMs)
- Reinstatement of the Site with a clean fill covering layer to enable a suitable surface profile for rehabilitation and to support the proposed open space/ parkland land use.

As a result of the reduced remediation works program, the majority of the waste materials and uncontrolled fill proposed to be removed from Site, remains onsite. This is particularly relevant to the eastern and northern portions of the Site. With these materials remaining onsite, a risk assessment is required to demonstrate the suitability of the Site for the proposed open space/ parkland land use and with regards to offsite risk to the groundwater receptors.

8.1 Residual fill and soil contamination risks onsite

As outlined in Section 3.1.2 and presented within the CSM (Section 4), through extensive intrusive investigations undertaken by OPUS between 2011 and 2016, and again by GHD in 2019, the characterisation of the contamination associated with the uncontrolled fill onsite has been comprehensive. As a result of the previous investigation work completed, the following contamination characteristics of the uncontrolled fill and impacted soil can be presented:

- CoPCs including PCBs, phenols, BTEX, PFAS, OP pesticides, arsenic, beryllium, selenium, silver, molybdenum, and mercury have not been detected at concentrations above their respective LORs in any of the samples collected from Site.
- Detections of OC pesticides (aldrin, dieldrin and DDT+DDD+DDE), PAH compounds, metals (chromium, cadmium, lead, copper and nickel) have been recorded historically above their respective LORs but below the appropriate ecological and human health criteria for public open space land use.
- Isolated occurrences of TRH impacts have been observed across the Site in both Areas 1 and 2 at various depths below the surface in discrete locations. Concentrations of TRH F2, F3 and F4 have been reported to exceed the ecological assessment criteria (ESLs) for urban residential and public open space (using a coarse textured soil criteria). Concentrations of zinc in soil were also found to marginally exceed the adopted ecological assessment criteria at localised areas within the uncontrolled fill sampled.
- Fragments of ACM and/or asbestos fibres-in-soil have not historically been detected within the fill materials onsite. However, and as presented in Section 6.5.2, the post-remediation surface inspection did reveal suspected ACMs with a total of 3.125 kg of fragments identified and removed from across the Site surface. PACMs removed were present as bonded fragments in good condition and non-friable.

GHD recognises that the waste fills onsite have been reinstated with a covering layer of clean fill and will be landscaped with additional mulching and vegetation cover. As a result, direct access to the materials within the sub-surface is considered to be mitigated. Further to this, the Site surface has been inspected and effectively remediated of suspected ACMs.

Notwithstanding the above, given the heterogeneous nature of the waste fill materials that remain onsite, a potential contamination risk remains through various exposure pathways that require further consideration, including:

- Potential exposure pathways that *may* result from disturbing the waste materials beneath the soil surface, including:
    - Dermal contact and ingestion with waste materials from onsite users
    - Inhalation of asbestos fibres from ACM impacted fill materials
    - Inhalation of vapours from residual hydrocarbon impacted soils
- The potential for leachate to be generated from the waste fill material and migrate into the groundwater on and offsite impacting ecological receptors and down-gradient groundwater users

These potential source-pathway-receptor linkages are discussed further in the following sections.

8.2 Onsite exposure risk through disturbance of the insitu waste materials

Future disturbance and excavation onsite beneath the thin covering layer of clean fill and landscaped surface finishes (mulch, grass etc), presents a risk of exposure to the underlying fill materials through either dermal contact, ingestion and/or inhalation (of asbestos fibres and vapour) from the underlying fill/waste materials. GHD considers that while the risk of this exposure pathway is low-moderate (i.e. low risk of contamination and low likelihood of excavation occurring), it cannot be discounted (primarily asbestos driven) and requires further administrative measures applied to restrict this activity and prevent an unmanaged incident of this nature. It is considered that this could be achieved through applying restrictions on sub-surface excavations onsite. Further to this, damage to the covering fill layer through erosion and /or burrowing animals should also be considered as potential future disturbance scenarios.

8.2.1 Inhalation of vapours from residual hydrocarbon impacted soils

GHD considers that the waste fill and other areas where isolated hydrocarbon occurrences were noted onsite do not contain a significant volatile or semi-volatile hydrocarbon risk. This is demonstrated through the overall collated analytical dataset (as presented in GHD 2019a and GHD 2019d) where concentrations of BTEX and TRH C6-C9 were below their respective LOR (across >100 samples), and concentrations of the aromatic TRH fractions for volatile and semi-volatile TRH fractions were also below the LOR.

In addition to the above, the following information further supports the low vapour risk onsite with regards to the proposed open space/ parkland land use:

- The presence of TRH in the uncontrolled fill layer is not widespread and its distribution appears limited to very discrete areas of the Site.
- An ongoing source of TRH was not observed onsite during historical investigations (OPUS and GHD) with the former USTs concluded to have been removed.
- There were no exceedances of the human health vapour intrusion assessment criteria for public open space landuse recorded within the historically identified TRH soil concentrations.
- Discrete hydrocarbon impacted areas onsite will continue to degrade over time. Vapour accumulation is not expected to occur on or offsite given that the surface cover is highly permeable allowing for passive venting.

Notwithstanding the above, GHD considers that enclosed buildings /structures should not be constructed onsite without further assessment of the vapour intrusion risk specific to the building type and the area onsite where it is proposed to be constructed. Application of the proposed restriction regarding future sub-surface excavation and disturbance will also support mitigation of the potential vapour inhalation exposure pathway.

8.3 Risk to groundwater

Groundwater onsite and immediately offsite was observed to be within 2 m of the current soil surface but beneath the vertical extent of the uncontrolled fill and waste layer. However, there appeared to be evidence of a seasonal perching system in the natural geological profile (observed when installing the new wells adjacent to the eastern boundary). These relatively impermeable layers observed may result in temporary saturation of the upper soil profile during a storm event and formation of the ephemeral creek line present east of the Site. As a result, it is expected that in addition to the vertical infiltration of rainfall through the uncontrolled fill and waste profile there may also be a certain extent of lateral flow of water within the waste at times providing a propensity for mobilising CoPCs into groundwater.

However, the residual uncontrolled fill and wastes onsite have been characterised as being largely inert in terms of composition and ability to leach CoPCs into groundwater on and offsite. This has been demonstrated through the following lines of evidence:

- Visual characterisation of the waste and fill to predominately contain inert waste types e.g. containing rocks, fill soil, gravel as well as anthropogenic wastes such as building rubble, wire, car parts, steel drums, glass, and plastics
- Extensive soil investigations have revealed a waste mass that has only reported minor concentrations of long chain hydrocarbons (conducive to a diesel signature), metals (copper, chromium, lead, nickel and zinc) and OC pesticides (aldrin, deildrin, DDT+DDD+DDE) above their respective LORs. Further to this, specific leachability analysis on elevated metal concentrations observed (chromium and lead), indicated leachability concentrations below their respective LORs
- Historical groundwater monitoring events (OPUS 2016, GHD 2019b), in addition to the most recent GME (refer to section 7), indicate that the groundwater onsite and immediately offsite (eastern boundary) does not contain concentrations of the CoPCs above the LOR with the exception of nickel, zinc and chromium which marginally exceeded the adopted ecological assessment criteria (95% protection limit for fresh water species).

Spatially, the nickel and zinc concentrations observed in groundwater are considered to be consistent in wells located up and down-hydraulic gradient of the Site, indicating regionally present concentrations. Chromium (III+VI) concentrations, however, were reported above the LOR at one groundwater well located offsite marginally exceeded the freshwater guideline with no consistency in concentrations with up gradient well (MW01).

Hexavalent chromium is considered to present a greater toxicity risk than trivalent chromium to the receiving environment therefore speciation analysis of the chromium concentration recorded at the offsite groundwater well MW05 was undertaken. Unfortunately the result was inconclusive with the reported LOR being higher than the adopted assessment criteria. However, through referencing the chromium speciation analysis undertaken within the soil waste characterisation work (GHD, 2019d), it was shown that the elevated total chromium concentrations within the fill/solid waste were not comprised of hexavalent chromium with recorded detections below the LOR.

Further to the above with regards to overall chromium risk to groundwater from the Site, concentrations of total chromium within the groundwater wells located onsite and the other wells located offsite, were not reported to exceed the freshwater guidelines (95% protection limit).

8.4 Refined conceptual site model – post remediation scenario

A revised CSM has been presented as Table 8-1, incorporating all of the outcomes from the remedial effort undertaken and the findings from additional investigations completed and with consideration of the proposed change in end landuse (i.e. open space/ parkland use).

Table 8-1 Refined conceptual site model – post remediation scenario

Area	Source	CoPC	Exposure Route /Pathway	Receptors	S-P-R Linkage Risk	Comment
Area 1 - comprises the southern, central and western portions of the Site	Former Shire works depot area (1960s to 1985) - Historical UST infrastructure use and ineffective soil validation post-removal - Historical storage of chemicals - Historical mechanical workshop areas	Metals, TRH, BTEX, PAH, OC pesticides	Dermal/ incidental contact with impacted soils	Future site users (POS/ parkland)	Negligible	Current separation of underlying impacted soils onsite through the placement of clean fill, mulching and vegetation (grass) surface establishment
				Future utility/ intrusive maintenance workers	Low	Future disturbance onsite will likely exposure underlying TRH impacted soils onsite. TRH concentrations were not observed to be above the POS human health assessment criteria
			Groundwater migration and stormwater runoff	Users of groundwater bores located down-gradient of the Site and non-potable contact with water in ephemeral creek line	Negligible	Groundwater quality onsite and offsite did not exceed the adopted human health assessment criteria
			Groundwater migration and stormwater runoff	Sensitive ecological receptors (particularly fresh water aquatic)	Negligible	Groundwater quality offsite was considered to be of acceptable quality with regards to the adopted ecological assessment criteria
			Inhalation of vapours	Future site users (POS/ parkland)	Negligible	No significant ongoing source of hydrocarbons identified and occurrences were isolated and discrete in distribution. Historically recorded detections of hydrocarbons did not exceed the adopted human health vapour intrusion assessment criteria. Permeable soil cover allowing passive venting onsite if required
				Current occupants off-site (residential)	Negligible	
				Future utility/ intrusive maintenance workers/ onsite structures	Low	A vapour risk may be plausible in a situation where it accumulates in future sub-surface infrastructure and/or above ground infrastructure installed onsite
Area 2 – comprises a triangular piece of the Site including the north, north-eastern and eastern portion of the Site	This portion of the Site does not appear to have been directly involved with the depot operation per se but has received uncontrolled fill deposited between 1969 and 1975 (predominantly)	Metals, TRH, BTEX, PAH, OC pesticides, Asbestos (in ACM form)	Dermal/ incidental contact with contaminated fill and inhalation of asbestos fibres	Future site users (POS/ parkland)	Negligible	Current separation of underlying impacted soils onsite through the placement of clean fill, mulching and vegetation (grass) surface establishment
				Future utility/ intrusive maintenance workers	Moderate	Future disturbance onsite will likely exposure the underlying fill/wastes onsite. This risk is primarily driven by the presence of asbestos.
				Ecological receptors (onsite fauna)	Low	Disturbance of the cover fill layer onsite by burrowing fauna may exposure the underlying fill/wastes onsite
			Inhalation of vapours	Future site users (POS/ parkland)	Negligible	No significant ongoing source of hydrocarbons identified and occurrences were isolated and discrete in distribution. Historically recorded detections of hydrocarbons did not exceed the adopted human health vapour intrusion assessment criteria. Permeable soil cover allowing passive venting onsite if required
				Current occupants off-site (residential)	Negligible	
				Future utility/ intrusive maintenance workers/ onsite structures	Low	A vapour risk may be plausible in a situation where it accumulates in future sub-surface infrastructure and/or above ground infrastructure installed onsite
			Groundwater migration and stormwater runoff	Users of groundwater bores located down-gradient of the Site and non-potable contact with water in ephemeral creek line	Negligible	Groundwater quality onsite and offsite did not exceed the adopted human health assessment criteria
				Sensitive ecological receptors (particularly fresh water aquatic)	Negligible	Groundwater quality offsite was considered to be of acceptable quality with regards to the adopted ecological assessment criteria

9. Key outcomes and conclusions

9.1 Key outcomes

As a result of the remediation, validation and additional groundwater assessment work undertaken, the following key outcomes are presented:

- The reduced remediation program undertaken included the following key tasks:
    - Removal and landfill disposal (Class 1) of 1,001 m^3 of stockpiled fill/wastes from the Site
    - Removal of 40 m^3 scrap metal and 72 m^3 of concrete and stockpiled at the landfill for recycling
    - Removal of the previously constructed lined containment pad area from the south-western corner (<2 m^3)
    - Removal of 3.125 kg of PACMs (surface inspection) and a section of PACM pipe (600 mm x 100 mm) and disposal to landfill
    - Re-profiling the landform including placing a layer of clean fill (derived from onsite) cover across the eastern and north-eastern portion of the Site
- Majority of the waste materials and uncontrolled fill currently remains onsite (insitu) at the conclusion of the works. The residual materials are predominately inert waste types including containing rocks, fill soil, gravel as well as anthropogenic wastes such as building rubble, wire, car parts, steel drums, glass, and plastics and are located in the north and eastern portions of the Site.
- Previous soil investigations at the Site have generally only reported minor concentrations of hydrocarbons, metals (copper, chromium, lead, nickel and zinc) and pesticides (aldrin, deildrin, DDT+DDD+DDE) above their respective limits of reporting (LORs). Concentrations of TRH recorded at various depths within the waste fill material exceeded the adopted ecological and human health (standard residential landuse) at six locations within the northern and eastern portions of the Site. Elevated zinc concentrations, exceeding the adopted ecological assessment criteria, were also recorded at three locations generally correlating with uncontrolled fill layers.
- Groundwater monitoring undertaken onsite and immediately offsite (eastern boundary) indicates that the historical use of the Site as a Shire depot and for depositing uncontrolled wastes and fill does not appear to have impacted, or continue to impact, the groundwater quality. In further support of this, leachability analysis undertaken as part of the landfill characterisation process, indicated that the waste materials have a low propensity to leach contaminants of concern into water. The groundwater and leachate results further support the characterisation of the waste fill materials as generally being inert.
- The residual waste fills within the north and eastern portions of the Site remaining insitu have been covered with a layer of clean fill (derived from onsite) and it is proposed to be landscaped with additional mulching and vegetation cover (i.e. grass). The Site surface has also been inspected and effectively remediated of suspected ACMs at the conclusion of the earthworks program. As a result, and in the context of the proposed future land use as open space/ parkland, direct access to the waste fill materials within the sub-surface is considered to be mitigated.
- GHD considers that due to the uncontrolled and heterogeneous nature of the waste fill material that remains onsite (insitu), including the confirmed presence of ACM and

hydrocarbon impacts in soil, that there are potentially residual exposure risks (through either dermal contact, ingestion and/or inhalation) associated with disturbing the sub-surface material into the future and/or through altering the proposed land use (e.g. residential, building enclosed structures on the waste, etc).

9.2 Conclusions

GHD considers that the remediation, validation and additional groundwater assessment work undertaken, has effectively addressed the project objectives and the Site is now considered suitable for the intended future landuse of public open space/ parkland land use.

Future disturbance and excavation onsite beneath the layer of clean fill and any future landscaped surface finishes (i.e. mulch, grass etc) into the underlying waste fill material, is considered to present a potential exposure risk for users onsite through either dermal contact, ingestion and/or inhalation (of asbestos fibres and vapour).

GHD considers that the mitigation of potential future exposure risks associated with sub-surface excavation and construction of buildings onsite requires mitigation through the provision of restrictions on use.

10. Recommendations

Based on the conclusions presented, GHD presents the following recommendations with regards to the Site:

- The Site surface should be stabilised (e.g. mulching, grassing, etc) to allow rehabilitation and long term protection of the surface fill to prevent exposure of the underlying waste fill profile.
- The Site should be reclassified to 'Remediated for Restricted Use' under the *Contaminated Sites Act 2003* as being suitable for the proposed end land use comprising open space/ parkland.
- In addition to the restrictions on future land use permitted on the Site, GHD considers that restrictions preventing sub-surface excavations and the construction of enclosed buildings (without further assessment of risk) should be applied in support of the new classification for the Site.

11. References

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Figures

Paper Size ISO A3

0 50 100 150 200

Metres

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

N

Shire of Denmark
Remediation **Project**
Lot 3002 Hardy Street, Denmark, WA

Site Locality

Project No.	61-37639
Revision No.	1
Date	14/05/2019

FIGURE 1

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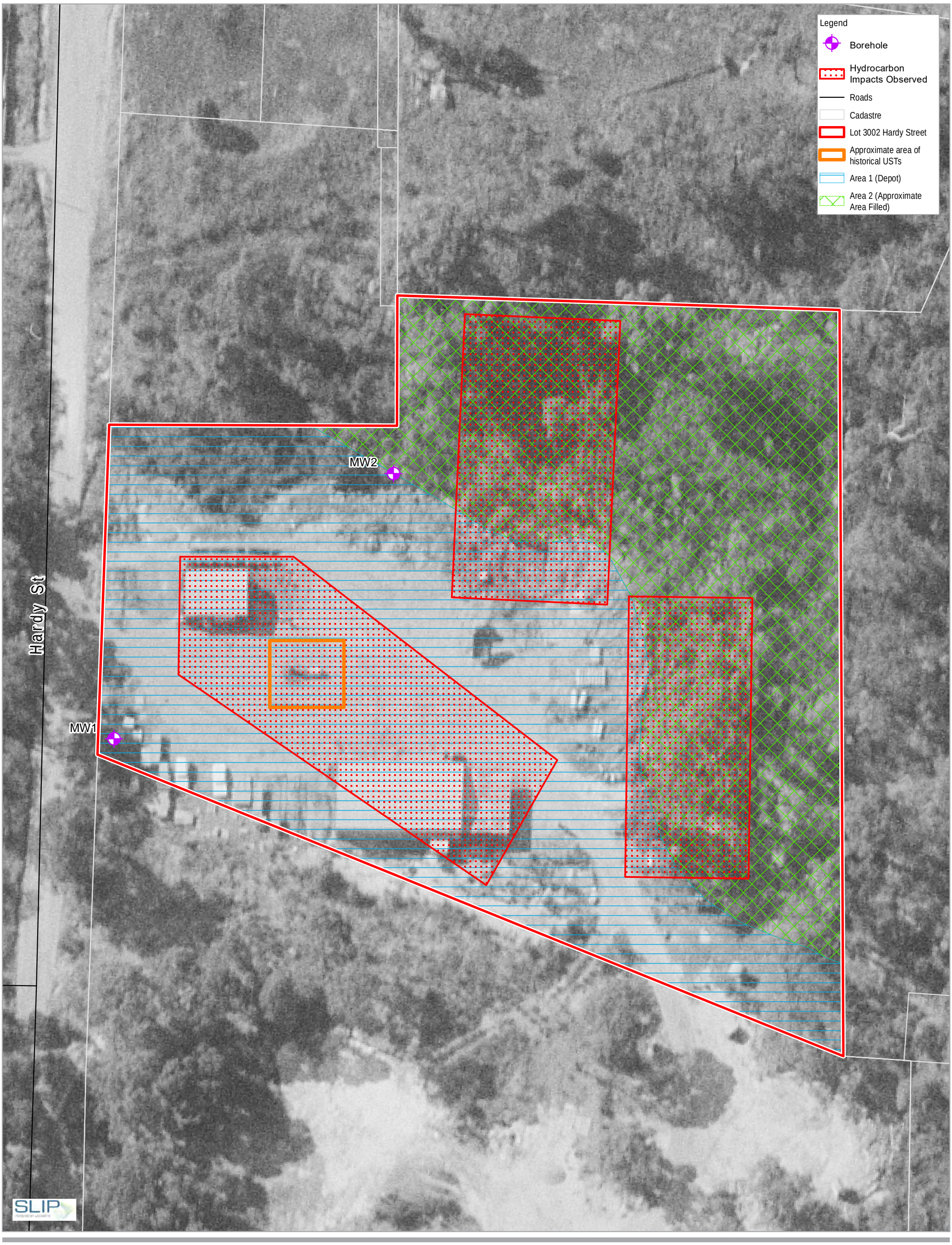
Print date: 14 May 2019 - 17:02

Data source: Landgate: Imagery (Feb 2017), Roads - 20181217, Cadastre - 20180709; GHD: Lot 3002 Hardy Street; Geoscience Australia: GeoData Topo 250k Series 3. Created by: kaadams



Paper Size ISO A3

0 5 10 15 20

Meters

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

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GHD

Shire of Denmark
Remediation **Project**
Lot 3002 Hardy Street, Denmark, WA

Key Findings from Previous Investigations

Project No. 61-37639
Revision No. 0
Date 13/05/2019

FIGURE 2

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Print date: 14 May 2019 - 17:04

Data source: Landgate: Imagery (1962), Roads - 20181217, Cadastre - 20180709; GHD: Lot 3002 Hardy Street, Approximate area of historical USTs - 20181122, Key Historical Development Findings - 20190312.
Created by: kaadams

Paper Size ISO A3

0 5 10 15

Metres

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

N

GHD

Shire of Denmark
Remediation **Project**
Lot 3002 Hardy Street, Denmark, WA

Project No. 61-12510838
Revision No. 2
Date 14 Oct 2020

Pre-remediation site layout

FIGURE 3

\\ghdnet\ghd\AU\Perth\Projects\61\37639\GIS\Maps\Working\6137639_002_Fig3_Pre-remediationSiteLayout_Rev2.mxd
Print date: 14 Oct 2020 - 14:09

Data source: Landgate: Imagery (Feb 2017), Roads - 20181217, Cadastre - 20180709; GHD: Lot 3002 Hardy Street - 20181122, Stockpile Investigation Point, Test Pit location, Trench investigation, Approx area of historical UST.. Created by: slei

Paper Size ISO A3

0 10 20 30

Metres

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

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GHD

Shire of Denmark
Remediation Environmental Support

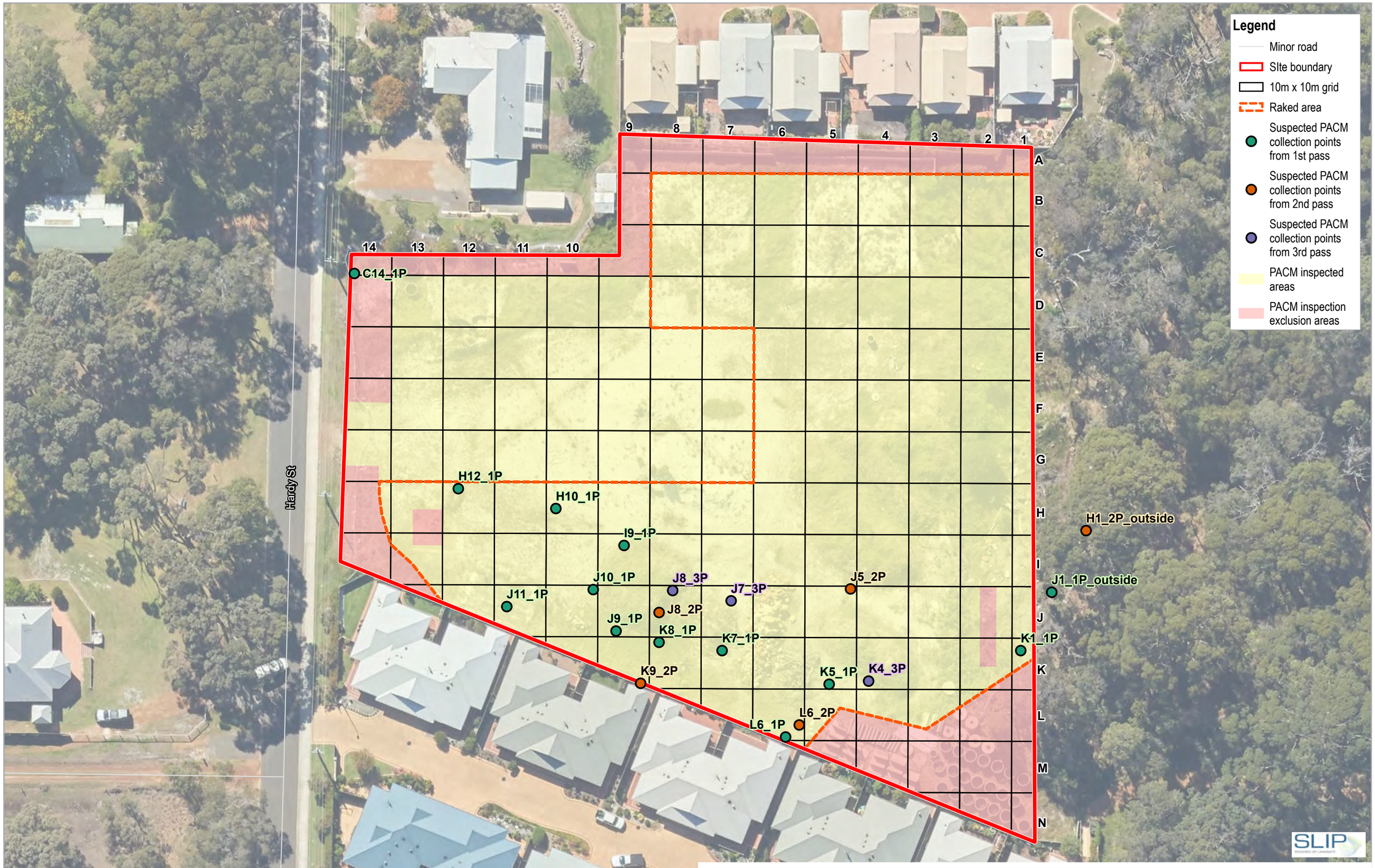
Groundwater well network, contours and inferred flow direction

Project No. **61-12510838**
Revision No. **0**
Date **14 Oct 2020**

FIGURE 4

S:\GIS\Temp\12510838\GIS\Maps\Working\12510838_Figures\12510838_Figures.aprx\12510838_004_GroundwaterContours_Rev0
Print date: 14 Oct 2020 - 14:03

Data source: GHD: Monitoring wells, Site boundary, Contours, Flow direction - 2020; Landgate: Roads, Imagery - Jan 2019 (accessed: 20201014); WMS: . Created by: slei



Paper Size ISO A3

0 5 10 15 20

Metres

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

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GHD

Shire of Denmark
Remediation Environmental Support

Surface Asbestos Inspection Findings

Project No. **61-12510838**
Revision No. **0**
Date **14 Oct 2020**

FIGURE 5

S:\GIS\Temp\12510838\GIS\Maps\Working\12510838_Figures\12510838_Figures.aprx\12510838_001_SurfaceAsbestosInspectionFindings_RevB
Print date: 14 Oct 2020 - 13:49

Data source: GHD: Monitoring wells, Site boundary, ACM inspection points and areas - 2020; Landgate: Roads, Cadastre, Imagery - Jan 2019 (accessed: 20201014); WMS: . Created by: slei

Appendices

Appendix A – GHD landfill classification report (2019)

28 October 2019

David King
Director Assets & Sustainable Development
Shire of Denmark
PO Box 183
Denmark WA 6333

Our ref: 12510838-66589
Your ref:

Dear David

Hardy St Denmark - Remediation Project
Landfill Classification and Disposal Advice for Waste Materials Onsite

1 Introduction

GHD Pty Ltd (GHD) has been engaged by the Shire of Denmark (the Shire) to provide the necessary environmental consultancy services associated with the remediation of the former Shire depot site located at Lot 3002 (26) Hardy St, Denmark. As part of the remediation process it is intended that all uncontrolled fill, considered unsuitable from a geotechnical and contamination perspective, will be excavated and removed offsite to an appropriately licensed landfill facility. Clean fill, to be won onsite and imported from a verified offsite source, will be used to reinstate the site levels.

Preliminary estimates of the volume of waste fill to be removed from the site, through the remediation phase, are around 6,000 m^3 (GHD, 2017). In order to determine the appropriate class of landfill for the material to be disposed to, GHD has classified the material in accordance with the Department of Water and Environmental Regulation guideline (DWER) *Landfill Waste Classification and Waste* Definitions (1996 – as amended 2018).

To complete this task, GHD undertook the following:

- A detailed review of all available insitu soil investigation data from previous investigations on site (2011-2019) against the landfill waste classification criteria outlined in DWER, 2018;
- Further onsite investigation targeting key information gaps to allow appropriate classification of the material in accordance with DWER 2018; and
- Determination of a recommended overall landfill classification outcome in accordance with DWER 2018.

This letter provides an overview of the process undertaken to appropriately classify the uncontrolled fill material requiring offsite landfill disposal and the recommended final classification.

2 Review of soil analytical data from previous investigations

2.1 Previous Investigations

There have been a number of previous investigations undertaken at the Site of varying purpose and extent from the late 1990's to 2019. The most relevant investigations that have been used for the purpose of landfill classification comprise the following:

- *Lot 3002 Hardy Street, Denmark; Contaminated Sites Detailed Site Investigation (on behalf of Lionsville Denmark Inc. & Amaroo Village Denmark), OPUS, 2011*
- *Lot 3002 Hardy Street, Denmark; Revised Detailed Site Investigation (on behalf of the Shire of Denmark), OPUS, 2015*
- *Lot 3002 Hardy Street, Denmark; Remediation Action Plan (on behalf of the Shire of Denmark), OPUS, 2016. Additional investigation work (October 2016 and groundwater results from January 2017) is partly referenced in the 2016 RAP document with the remaining information (in raw data form i.e. test pit logs and analytical results) were provided to GHD by the Shire over email on 27 November 2017.*
- *Lot 3002 Hardy Street Denmark, Cost Review (GHD, 29 November 2017). This included generalised volumetric modelling of the Site (12D earthworks model) based on a review of previous test pitting and borehole drilling logs across the Site.*
- *Shire of Denmark, Information Gap Assessment and Sampling and Analysis Quality Plan Report (R1) prepared by GHD in January 2019a (SAQP).*
- *Shire of Denmark, 26 Hardy St, Denmark – Remediation Project, Additional Investigations – Information Gap Resolution (GHD, March 2019b).*
- *Shire of Denmark, 26 Hardy St, Denmark – Remediation Project, Remediation Action Plan (GHD, June 2019c).*

2.2 Collation of available analytical data

As a result of the previous OPUS investigations onsite (2011-2016) and GHD investigations (2019), there is currently a significant amount of analytical data that can be relied upon for the classification of the material on-site. The relevant soil analytical data from the previous investigations (refer to section 2.1), in relation to samples targeting the uncontrolled fill only, insitu (i.e underlying the surface grey fill sands) and in stockpiled form (eastern portion of the Site), was collated and reviewed to provide an overview of the key contaminants of concern (CoC) as well as an assessment against the landfill classification guidelines (DWER, 2018). The data is presented for reference in Table 1, Attachment A.

A review of the historical data in Table 1, Attachment A identified the following:

- The key contaminants of concern (CoCs) at the site, not all necessarily detected at concentrations exceeding relevant environmental or human health guidelines, includes;
    - metals (chromium, lead, nickel and zinc)
    - benzene, ethylbenzene, toluene and xylene (BTEX)

    - polycyclic aromatic hydrocarbons (PAH)
    - total recoverable hydrocarbons (TRH)
    - pesticides (aldrin, deildrin, DDT+DDD+DDE)
- Class 1 landfill exceedances (DWER, 2018) were noted for concentrations of lead, chromium and total recoverable hydrocarbons within the historical data set. Further to this, the laboratory limit of reporting (LOR) for cadmium (1 mg/kg) was noted above the criteria of 0.4 mg/kg.
- As a result of the above exceedances, and based on the level of information at hand, the uncontrolled fill material currently meets Class 3 landfill definition (DWER, 2018).

Further detailed analysis of the exceeding CoCs was recommended within the *Remediation Action Plan (RAP) GHD, 2019c)* to allow for a more accurate comparison of the data against landfill classification criteria and potentially pursue a lower class of landfill acceptance. The additional analysis recommended included:

- chromium speciation (hexavalent form) to allow comparison to the corresponding Contaminant Threshold (CT) value
- total cadmium analysis at a lower LOR (<0.4 mg/kg) to allow comparison to the CT value
- leachability analysis for chromium, lead and cadmium where total concentrations exceed the CT values to allow comparison to the Concentration Limit (CL) values
- aromatic/aliphatic speciation of total TRH concentrations that exceed 450 mg/kg to allow an accurate comparison to the CL values (CL value based on the aromatic fraction of >C_{16}-C_{35})

In September 2019, the Shire engaged GHD to undertake these additional investigations with the findings presented in Section 3.

3 Additional targeted investigations – landfill classification

3.1 Methodology

Further intrusive investigations to gather additional chemical characterisation data, for the uncontrolled fill layer requiring offsite disposal, were undertaken by GHD on the 18 September 2019. The samples were excavated using a solid auger on a mini digger, progressed to a target depth that ensured a representative sample of the uncontrolled fill waste profile as determined through a review of previous onsite investigations.

To ensure that the soil sampling program achieved good representation (both spatially and vertically) within the uncontrolled fill material onsite, GHD progressed 12 evenly spaced boreholes in Area 1 (western portion of the site with shallow areas of fill), six evenly spaced boreholes in Area 2 (two samples collected at varying depths at each borehole) and six stockpile samples (samples collected from the centre of the stockpile).

The additional waste soil classification program undertaken is summarised in Table 1.

Table 1 Overview of the additional waste soil classification program

Material targeted	Volume of Material (estimated)	Number of samples collected	Analytical Suite
Uncontrolled fill (underlying the surface grey sands)	>5,500 m^3	24 (allows for classification up to 10,000 m^3 – DWER, 2018)	Total Pb and leachable Total Cr (VI) and leachable Total Cd (LOR< 0.4mg/kg) TRH (aromatic/aliphatic split)
Stockpiles(uncontrolled fill)	<500 m^3	6 (allows for classification up to 500 m^3 – DWER, 2018)	

Samples were collected in accordance with GHD's standard field sampling protocols and directly into laboratory supplied containers and immediately placed into chilled eskies for overnight transport to the nominated laboratory – ALS Environmental. The nominated laboratory is NATA accredited for the required analysis.

3.2 Field results

A summary of the key field observations from each sampling location, observed during the additional site investigation work, is presented in Table 2. The geological descriptions presented in Table 1, confirms that the uncontrolled fill material across the site was effectively targeted during the additional investigations and therefore the analytical results yielded from the sampling program can be considered representative of the uncontrolled fill material requiring offsite disposal.

Table 2 Summary of field observations

Site ID	Depth (m bgl)	Comments
Area 1 (Western Portion)		
A1-1	0.6m	Gravelly sand (fill) with grey staining
A1-2	0.6m	Gravelly sand (fill) with grey staining and slight hydrocarbon odour
A1-3	0.6m	Gravelly sand (fill)
A1-4	0.75m	Dark brown sand (fill)
A1-5	0.6m	Dark brown sand (fill)
A1-6	0.6m	Gravelly brown sand (fill)

Site ID	Depth (m bgl)	Comments
A1-7	0.6m	Gravelly fill (brown/orange colour), scrap metal, ironstone gravel
A1-8	0.6m	Gravelly sand (fill)
A1-9	0.6m	Light grey sand (fill) with some gravel (limestone fragments)
A1-10	0.6m	Black/dark brown sand (fill), hydrocarbon odour, staining, roots observed
A1-11	0.6m	Grey-black sand (fill) with limestone & granite gravel throughout
A1-12	0.6m	Dark black sandy fill with ironstone gravel fragments (appears oily, hydrocarbon odour noted)
Area 2 (Eastern Portion)		
A2-1	1.2m	Fine dark brown sand (fill)
	1.6m	Fine dark brown sand (fill)
A2-2	1.2m	Gravelly clay with sand fraction (fill)
	1.6m	Gravelly clay with sand fraction (fill)
A2-3	1.2m	Fine dark brown/brown sand (fill) with clay, bricks, rubble & glass noted
	1.6m	Fine dark brown/brown sand (fill) with clay podsols throughout
A2-4	1.2m	Dark brown sand with gravel and clay, glass observed throughout (fill)
	1.6m	Dark brown sand with gravel and clay fractions (fill)
A2-5	1.2m	Dark brown/dark grey clayey sand (fill)
	1.6m	Dark brown/dark grey clayey sand with gravels & rocks observed (fill)
A2-6	1.2m	Gravelly sand (fill)
	1.6m	Gravelly sand (fill)
A2-7	1.2m	Slightly indurated sand no other materials observed (clean fill?)
	1.6m	Slightly indurated sand with gravel observed
Stockpiles (Southern Portion)		
SP1	Into the centre of the stockpile	Fine grained sand with gravel, wood and scrap steel observed (fill)
SP2		Brown/dark brown sand (fill) with slight clay & gravel components
SP3		Fine dark brown clayey sand (fill) with a gravel component
SP4		Fine dark brown clayey sand (fill) with pieces of wood observed

Site ID	Depth (m bgl)	Comments
SP5		Fine dark brown sand (fill) with a small clay fraction
SP6		Dark brown sand (fill) with a gravel component

3.3 Analytical results

A summary of the analytical results from the additional onsite investigations is presented in Table 3, with a comparison of the relevant DWER (2018) waste classification criteria. The detailed results are presented in Table 1, Attachment A with the collated historical results and the Laboratory Certificates of Analysis for the additional investigation are presented in Attachment B.

Table 3 Summary of the analytical results from the additional investigation work against DWER, (2018) landfill classification criteria

Contaminant	Lead (total)	Lead (leachable)	Cadmium	Chromium (VI)	Benzene	Ethylbenzene	Toluene	Xylenes (total)	TRH C_6-C_9	TRH >C_{16}-C_{35}	TRH >C_{16}-C_{35} (aromatic)	TRH >C_{16}-C_{35} (aliphatic)
CT1 (mg/kg)	2	N/A	0.4	10	0.2	60	160	120	N/A	N/A	N/A	N/A
CL1 (mg/kg)	1,500	N/A	100	500	18	1,080	518	1,800	2,800	450	450	28000
ASLP 1 (mg/L)	NA	0.1	0.1	0.5	0.01	3	8	6	N/A	N/A	N/A	N/A
LOR (mg/kg)	**5**	**0.01**	**0.1**	**0.5**	**0.2**	**0.5**	**0.5**	**0.5**	**10**	**100**	**90**	**100**
A1-1-0.6m	7	<0.01	----	<2.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-2-0.6m	10	<0.01	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-3-0.6m	17	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-4-0.75m	<LOR	----	----	<2.5	<0.2	<0.5	<0.5	<0.5	<10	**880**	<90	<100
A1-5-0.6m	12	**0.01**	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	**290**	----	----
A1-6-0.6m	<LOR	----	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-7-0.6m	6	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-8-0.6m	6	<0.01	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-9-0.6m	<LOR	----	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-10-0.6m	<LOR	----	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-11-0.6m	<LOR	----	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A1-12-0.6m	5	----	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----

A2-1-1.2m	<LOR	----	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A2-2-1.2m	10	<0.01	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A2-3-1.2m	90	**0.02**	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	**100**	----	----
A2-4-1.2m	159	**0.05**	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	**310**	----	----
A2-5-1.2m	9	<0.01	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A2-6-1.2m	11	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A2-7-1.2m	<LOR	----	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A2-1-1.6m	<LOR	----	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	**150**	----	----
A2-2-1.6m	9	<0.01	----	<2.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A2-3-1.6m	48	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A2-4-1.6m	133	**0.03**	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	**520**	<90	<100
A2-5-1.6m	30	<0.01	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	**100**	----	----
A2-6-1.6m	11	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
A2-7-1.6m	8	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
SP1	9	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
SP2	8	<0.01	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
SP3	20	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
SP4	42	**0.03**	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
SP5	10	<0.01	<0.1	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----
SP6	10	<0.01	----	<0.5	<0.2	<0.5	<0.5	<0.5	<10	<100	----	----

As per Table 3, the additional investigation work has effectively resolved the outstanding information gaps with the following key findings and overall interpretations noted:

- Leachable lead concentrations were observed to be detected at an order of magnitude lower than the ASLP1 (Class 1) value. Further to this, the sample that recorded the highest total lead concentration (A2-4-1.2m at 159 mg/kg) reported a leachable concentration of 0.05 mg/L which is half the ASLP1 criteria indicating that overall lead in the material is not highly mobile.
- Chromium VI was reported at concentrations below the LOR for all samples analysed, indicating that elevated total chromium concentrations reported historically at the site are likely to have comprised low proportions of Cr VI (i.e. below the CT1 value)
- Cadmium concentrations were reported below the lowered LOR indicating that the historical dataset may have indicated false positives with regards to the CT1 value exceedances of cadmium (i.e. LOR>CT1).
- TRH concentrations were observed to be low with only seven of the 30 samples reporting a concentration equal to or above the LOR. Two samples exceeded the CL1 value (as total TRH) however through speciation analysis, the aromatic fraction of TRH C_{16}-C_{35} was reported at less than the LOR for both samples and therefore complying with Class 1 criteria.
- GHD acknowledges that the previous investigations recorded some total TRH results (between 1,600 and 3,500 mg/kg) which are more elevated than the results recorded in the additional investigation

work (<1,000 mg/kg). Whilst it is not possibly to undertake speciation of these previous samples to determine the aromatic fraction, GHD considers that the uncontrolled fill onsite does not contain a significant volatile or semi-volatile hydrocarbon risk. This is demonstrated through the overall dataset, as presented in Table 1, Attachment A, where concentrations of BTEX and TRH C_6-C_9 are below the LOR (across over 100 samples), and concentrations of aromatic TRH are below the LOR in the most recent investigations. Further to this, the presence of TRH in the uncontrolled fill layer is not widespread and its distribution appears limited to very discrete areas of the site.

4 Waste characterisation outcome

Through a detailed review of historical onsite investigations, and as a result of additional targeted onsite investigations undertaken, GHD concludes that the uncontrolled fill material to be removed and disposed from site (as described within the GHD RAP, 2019c) **is deemed to be suitable for Class 1 landfill disposal** in accordance with DWER, 2018. The work undertaken allows for classification of up 10,000 m^3 of material to be disposed of during the course of the remediation works (including both insitu and already stockpiled at the site).

4.1 Unexpected finds contingency protocols

Whilst the broad chemical characteristics of the uncontrolled fill are considered to have been investigated and classified in accordance with DWER, 2018 guidance, GHD acknowledges that due to the nature of uncontrolled fill, there is a potential for unexpected finds to exist, during the course of the remedial works, that potentially may trigger a higher class of landfill disposal and/ or further considerations with regards to disposal.

In line with Section 8.12 of the GHD RAP (2019c), the Environmental Consultant and Contractor will be required to visually assess the uncontrolled fill as it is excavated during the course of the remediation works to ascertain any other unexpected wastes or CoC including fragments of asbestos containing materials. Any unexpected finds are required to be managed in accordance with Section 8.12.1 of the GHD RAP (2019c).

5 Concluding comments

Based on the information presented in this letter, GHD concludes that the uncontrolled fill material at the former Shire Depot site located at Lot 3002 Hardy St, Denmark to be suitable for disposal at a Class 1 licensed waste facility. Documentation confirming weights and receipt of the material at the appropriate landfill facility is required to be documented within the Remediation and Validation Report at the completion of the remediation works.

Please contact the undersigned if you require any further information.

Sincerely
GHD

Pooranie Yoganathan
Graduate Environmental Scientist
08 9840 5106

Jon Cramer
Senior Environmental Scientist
08 9840 5102

Attachments:

A - Table 1 (collation of all analytical data)

B – Laboratory Certificates of Analysis

ATTACHMENT A

Table 1 (collation of all analytical data)

26 Hardy Street - Remediation Project

Historical Investigation Collation for Insitu Landfill Classification

			Contaminant of Concern	Metals													BTEX				TRH - NEPM 1999				PAHs		Chlorinated Organics	OC & OP Pesticides				Phenols	PFAS
				Arsenic	Beryllium	Cadmium	Chromium (Hexavalent)[1]	Chromium (total) - no contaminant threshold available[1]	Leachable Chromium (Hexavalent)	Lead	Leachable Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Benzene	Toluene	Ethylbenzene	Xylene Total	C6-C9 Fraction	>C16-C34 Fraction[2]	Aromatic C16-C35	Aliphatic C16-C35	Sum of polycyclic aromatic hydrocarbons	Benzo(a) pyrene	PCBs (Sum of total)	Aldrin	Trans-Chlordane	Dieldrin	Sum of DDD + DDE + DDT	Phenols (total)	Sum of PFAS (WA DER List)
			Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			WA DER 1996 (2018) Landfill Contaminant Threshold Class 1	14	2	0.4	10	10	-	2	-	0.2	10	4	2	20	0.2	160	60	120	-	-	-	-	-	-	-	-	-	-	-	-	-
			WA DER 1996 (2018) Landfill Contaminant Threshold Class 2	14	2	0.4	10	10	-	2	-	0.2	10	4	2	20	0.2	160	60	120	-	-	-	-	-	-	-	-	-	-	-	-	-
			WA DER 1996 (2018) Landfill Contaminant Threshold Class 3	140	20	4	100	100	-	20	-	2	100	40	20	200	2	1600	600	1200	-	-	-	-	-	-	-	-	-	-	-	-	-
			WA DER 1996 (2018) Landfill Contaminant Threshold Class 4	1400	200	40	1000	1000	-	200	-	20	1000	400	200	2000	20	16000	6000	12000	-	-	-	-	-	-	-	-	-	-	-	-	-
			WA DER 1996 (2018) Landfill Contaminant Limit Class 1	500	100	100	500	500	-	1500	-	75	1000	3000	50	180	18	518	1080	1800	2800	450	450	450	100	5	50	-	-	-	-	-	-
			WA DER 1996 (2018) Landfill Contaminant Limit Class 2	500	100	100	500	500	-	1500	-	75	1000	3000	50	180	18	518	1080	1800	2800	450	450	450	100	5	50	-	-	-	-	-	-
			WA DER 1996 (2018) Landfill Contaminant Limit Class 3	5000	1000	1000	5000	5000	-	15000	-	750	10000	30000	500	1800	180	5180	10800	18000	28000	4500	4500	4500	1000	50	50	-	-	-	-	-	-
			WA DER 1996 (2018) Landfill CL Class 4	20000	4000	4000	2000	2000	-	60000	-	3000	40000	120000	2000	7200	720				112000	18000	18000	18000	4000	200	50	-	-	-	-	-	-
			WA DWER (2018) Leachable Concentration ASLP1	-	-	-	-	-	0.5	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Previous work	Sampled_Date	Lab_ID	Field_ID																														
OPUS investigation - 2011 (April)	6/04/2011	EP1102197-003	Control (BH8 200mm)	<5	-	<1	-	2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-014	TT1_TP 1 400mm	<5	-	<1	-	6	-	11	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-015	TT1_TP 2 R	<5	-	<1	-	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-016	TT1_TP 2 400mm	<5	-	<1	-	3	-	7	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-017	TT1_TP 2 Random	<5	-	<1	-	14	-	22	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	240	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-026	TT3_TP 6 1100mm	<5	-	<1	-	6	-	11	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-034	TT6_TP 9 600mm	<5	-	<1	-	25	-	8	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-036	TT6_TP 10 700mm	<5	-	<1	-	9	-	6	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-037	TT6_TP 10 1100mm	<5	-	<1	-	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	180	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-039	TT6_TP 11 400mm	<5	-	<1	-	19	-	16	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-040	TT6_TP 11 1300mm	<5	-	<1	-	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	4	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-046	TT8_TP 13 1000mm	<5	-	<1	-	14	-	5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.1	<0.05	<0.05	<0.05	<0.3	<0.5	-
	6/04/2011	EP1102197-004	BH1 300mm	<5	-	<1	-	38	-	30	-	0.2	-	3	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	<0.05	<0.3	<0.5	-
	6/04/2011	EP1102197-005	BH1 2400mm	<5	-	<1	-	12	-	20	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	200	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	<0.05	<0.3	<0.5	-
	6/04/2011	EP1102197-*006	BH1 3000mm	<5	-	<1	-	16	-	27	-	<0.1	-	4	-	-	<0.2	<0.5	<0.5	<0.5	<10	360	-	-	4.4	<0.5	<0.10	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-011	Control (TT1_TP3 800mm)	<5	-	<1	-	16	-	20	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	650	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	0.1	0.33	<0.5	-
	7/04/2011	EP1102197-018	TT1_TP3 800mm	<5	-	<1	-	16	-	15	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	620	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-019	TT1_TP4 400mm	<5	-	<1	-	6	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-020	TT1_TP4 800mm	<5	-	<1	-	11	-	12	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.10	0.26	<0.05	0.26	<0.3	<0.5	-
	7/04/2011	EP1102197-027	TT4_TP7 1500mm	<5	-	<1	-	19	-	10	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-028	TT5_TP8 Uncontrolled	<5	-	<1	-	6	-	12	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	0.06	<0.3	<0.5	-
	7/04/2011	EP1102197-029	TT5_TP8 Uncontrolled	<5	-	<1	-	11	-	26	-	<0.1	-	5	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-030	TT4_TP7 2500mm	<5	-	<1	-	6	-	23	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<3.5	<0.5	<0.10	<0.05	<0.05	<0.05	<0.3	<0.5	-
	7/04/2011	EP1102197-042	TT7_TP 12 2000mm	<5	-	<1	-	2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	1620	-	-	<3.5	<0.5	<0.10	<0.25	<0.25	<0.25	<1.05	<0.5	-
OPUS Investigation - 2015 (July)	29/07/2015	EP1512580-002	Control 2 (TP16 0.8-1.0)	-	-	-	-	14	-	-	-	-	-		-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	29/07/2015	EP1512580-004	TP17 0.4-0.6	-	-	-	<0.5	10	<0.01	9	<0.01	-	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	29/07/2015	EP1512580-005	TP17 0.65	-	-	-	-	65	-	12	-	-	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	29/07/2015	EP1512580-009	TP16 0.8-1.0	-	-	-	-	18	-	6	-	-	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	29/07/2015	EP1512580-013	TP14 1.4-2.0	-	-	-	<0.5	15	<0.01	62	0.02	-	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	120	-	-	-	-	-	-	-	-	-	-	-
	29/07/2015	EP1512580-014	TP14 2.1-2.3	-	-	-	<0.5	26	<0.01	10	<0.01	-	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	29/07/2015	EP1512580-018	TP15 1.1-1.8	-	-	-	<0.5	20	<0.02	205	0.22	-	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	29/07/2015	EP1512580-019	TP15 1.8-2.4	-	-	-	-	<2	-	14	-	-	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
OPUS Investigation - 2016 (May)	9/05/2016		SP 1	<5	<1	<1	<0.5	<2	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		SP 2	<5	<1	<1	<0.5	<2	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		SP 3	<5	<1	<1	<0.5	<2	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		SP 4	<5	<1	<1	<0.5	5	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		SP 5	<5	<1	<1	<0.5	5	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		SP 6	<5	<1	<1	<0.5	5	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		SP 7	<5	<1	<1	<0.5	5	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		SP 8	<5	<1	<1	<0.5	5	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	120	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		Control (SP 8)	<5	<1	<1	<0.5	4	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		Control 2 (SP 8)	-	<1	<1	<0.5	5	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	<100	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
	9/05/2016		SP 8	-	<1	<1	<0.5	4	-	<5	-	<0.1	-	<2	<5	-	<0.2	<0.5	<0.5	<0.5	-	120	-	-	<0.5	<0.5	<0.05	<0.05	-	-	-	-	-
OPUS Investigation 2016 (October)	19/10/2016	EP1609934006	SPA1	<5	<1	<0.1	<0.5	-	-	12.7	-	<0.1	<2	<2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	<0.05	----	<1	-
	19/10/2016	EP1609934007	SPA2	<5	<1	<0.1	<0.5	-	-	14.0	-	<0.1	<2	<2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	<0.05	----	<1	-
	19/10/2016	EP1609934008	SPA4	<5	<1	<0.1	<0.5	-	-	13.3	-	<0.1	<2	<2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	0.1	----	<1	-
	19/10/2016	EP1609934009	SPA5	<5	<1	<0.1	<0.5	-	-	12.2	-	<0.1	<2	<2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	0.06	----	<1	-
	19/10/2016	EP1609934010	SPB1	<5	<1	<0.1	<0.5	-	-	27.8	-	<0.1	<2	<2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	0.08	----	<1	-
	19/10/2016	EP1609934011	SPB2	<5	<1	<0.1	<0.5	-	-	15.0	-	<0.1	<2	<2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	0.09	----	<1	-
	19/10/2016	EP1609934012	SPB3	<5	<1	<0.1	<0.5	-	-	14.5	-	<0.1	<2	<2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	0.07	----	<1	-
	19/10/2016	EP1609934013	SPB4	<5	<1	0.1	<0.5	-	-	24.0	-	<0.1	<2	2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	0.08	----	<1	-
	19/10/2016	EP1609934014	Control	<5	<1	<0.1	<0.5	-	-	24.7	-	<0.1	<2	<2	<1	<2	<0.2	<0.5	<0.5	<0.5	<10	210	-	-	<0.5	<0.5	<0.1	<0.05	<0.05	0.06	----	<1	-
OPUS Investigation 2016 (November)	01/11/2016	EP1610471012	TP19 S1	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471013	TP19 S2	<5	-	<1	<0.5	3	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471015	Control	<5	-	<1	<0.5	3	-	6	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471016	TP20 S1	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471017	TP20 S2	<5	-	<1	0.8	7	-	36	-	<0.1	-	2	-	-	<0.2	<0.5	<0.5	<0.5	<10	3570	-	-	<0.5	<0.5	<0.05	1.09	<0.05	-	-	-	-
	01/11/2016	EP1610471018	TP21 S1	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471019	TP21 S2	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471020	TP21 S3	<5	-	<1	<0.5	4	-	20	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	130	-	-	<0.5	<0.5	0.05	0.06	0.13	-	-	-	-
	01/11/2016	EP1610471021	TP22 S1	<5	-	<1	<0.5	4	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471022	TP22 S2	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471023	TP22 S3	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471028	TP24 S1	<5	-	<1	<0.5	25	-	27	-	<0.1	-	2	-	-	<0.2	<0.5	<0.5	<0.5	<10	170	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471029	TP24 S2	<5	-	<1	<0.5	20	-	14	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471030	TP24 S3	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471031	TP24 S4	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471032	TP25 S1	5	-	<1	<0.5	5	-	7	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471033	TP25 S2	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471034	TP25 S3	<5	-	<1	<0.5	10	-	17	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	100	-	-	<0.5	<0.5	1.33	1.24	<0.05	-	-	-	-
	01/11/2016	EP1610471035	TP26 S1	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	-	-	-	-
	01/11/2016	EP1610471015	Control	<5	-	<1	<0.5	<2	-	6	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	----	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	----	-	-	-
	01/11/2016	EP1610471024	TP23 S1	<5	-	<1	<0.5	21	-	34	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	240	-	-	<0.5	<0.5	<0.05	0.07	<0.05	<0.5	-	-	-
	01/11/2016	EP1610471025	TP23 S2	<5	-	<1	<0.5	6	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	140	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	<0.5	-	-	-
	01/11/2016	EP1610471026	TP23 S3	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	<0.5	-	-	-
	01/11/2016	EP1610471027	TP23 S4	<5	-	<1	<0.5	<2	-	<5	-	<0.1	-	<2	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	<0.5	<0.5	<0.05	<0.05	<0.05	<0.5	-	-	-
GHD Additional Investigation - 2019 (January)	24/01/2019	EP1900765-013	SP2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-014	SP3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-015	SP4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-016	SP5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-017	SP6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-018	SP7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-019	SP8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-022	TP1-1.4,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-023	TP2-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-024	TP3-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-025	TP4-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-026	TP5-1.0m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-027	TP6-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-028	TP7-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-029	TP8-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-030	TP9-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-031	TP10-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-032	TP11-1.5m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-033	TP12-1.0m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-034	TP13-1.0m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0002
	24/01/2019	EP1900765-049	T1-10m	-	-	-	-	-	-	18	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	620	-	-	-	-	-	-	-	-	-	-	-
	24/01/2019	EP1900765-048	T1-20m	-	-	-	-	-	-	10	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	170	-	-	-	-	-	-	-	-	-	-	-
	24/01/2019	EP1900765-046	T1-SW corner	-	-	-	-	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	24/01/2019	EP1900765-047	T1 - NE corner	-	-	-	-	-	-	6	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	24/01/2019	EP1900765-038	TP2-10m	-	-	-	-	-	-	13	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	3240	-	-	-	-	-	-	-	-	-	-	-
	24/01/2019	EP1900765-039	TP2-15m	-	-	-	-	-	-	52	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	24/01/2019	EP1900765-040	TP2-30m	-	-	-	-	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	24/01/2019	EP1900765-041	TP2-NW corner	-	-	-	-	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
GHD Additional Investigations- 2019 (September)	18/09/2019	EP1909576001	A1-1-0.6m	-	-	----	<2.5	-	-	7	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576002	A1-2-0.6m	-	-	<0.1	<0.5	-	-	10	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576003	A1-3-0.6m	-	-	----	<0.5	-	-	17	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576004	A1-4-0.75m	-	-	----	<2.5	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	880	<90	<100	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576005	A1-5-0.6m	-	-	<0.1	<0.5	-	-	12	0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	290	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576006	A1-6-0.6m	-	-	----	<0.5	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576007	A1-7-0.6m	-	-	----	<0.5	-	-	6	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576008	A1-8-0.6m	-	-	<0.1	<0.5	-	-	6	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576009	A1-9-0.6m	-	-	----	<0.5	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576010	A1-10-0.6m	-	-	----	<0.5	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576011	A1-11-0.6m	-	-	<0.1	<0.5	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576012	A1-12-0.6m	-	-	----	<0.5	-	-	5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576013	A2-1-1.2m	-	-	----	<0.5	-	-	<5		-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576014	A2-2-1.2m	-	-	<0.1	<0.5	-	-	10	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576015	A2-3-1.2m	-	-	----	<0.5	-	-	90	0.02	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576016	A2-4-1.2m	-	-	----	<0.5	-	-	159	0.05	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	310	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576017	A2-5-1.2m	-	-	<0.1	<0.5	-	-	9	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576018	A2-6-1.2m	-	-	----	<0.5	-	-	11	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576019	A2-7-1.2m	-	-	----	<0.5	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576020	A2-1-1.6m	-	-	<0.1	<0.5	-	-	<5	-	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	150	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576021	A2-2-1.6m	-	-	----	<2.5	-	-	9	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576022	A2-3-1.6m	-	-	----	<0.5	-	-	48	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576023	A2-4-1.6m	-	-	----	<0.5	-	-	133	0.03	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	520	<90	<100	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576024	A2-5-1.6m	-	-	<0.1	<0.5	-	-	30	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576025	A2-6-1.6m	-	-	----	<0.5	-	-	11	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576026	A2-7-1.6m	-	-	----	<0.5	-	-	8	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576027	SP1	-	-	----	<0.5	-	-	9	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576028	SP2	-	-	<0.1	<0.5	-	-	8	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576029	SP3	-	-	----	<0.5	-	-	20	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576030	SP4	-	-	----	<0.5	-	-	42	0.03	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576031	SP5	-	-	<0.1	<0.5	-	-	10	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-
	18/09/2019	EP1909576032	SP6	-	-	----	<0.5	-	-	10	<0.01	-	-	-	-	-	<0.2	<0.5	<0.5	<0.5	<10	<100	-	-	-	-	-	-	-	-	-	-	-

[1] Cr total concentrations have been adopted where chromium speciation was not undertaken.

[2] CL value for >C16-C34 aromatic fraction used in the absence of speciation data.

ATTACHMENT B

Laboratory Certificates of Analysis

CHAIN OF CUSTORDY RECORD AND ANALYSIS REQUEST

GHD House 999
Hay Street PO Box Y3106 Telephone 08 6222 8222
Perth WA 6000 Perth WA 6832 Facsimile 08 6222 8555

COC No.

Project Hardy St Remediation Project		Laboratory: ALS Environmental	
Client Shire of Denmark	**Job No.** 12510838	Address: 26 Rigali Way Wangara 6065	
Laboratory Quote No.	**Turnaround Time**	Laboratory Contact: Marnie Tomsett/ Lauren Biagioni	
Job Manager (Invoice) jon.cramer@ghd.com & GHD accounts	**Email Address (Results)** jon.cramer@ghd.com		

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix S-Soil/ SL-Sludge/ W-Water/ A-Air	Container: Type B-Bottle/J-Jar/V-Vial/Bag/G-Glass/P-Plastic	Container: Preservative Unpreserved/ HCl/ H2SO4/HNO3/Other	Container: No	Container: Total Volume (mL)	Analyses: Pb	Analyses: Cr(VI)	Analyses: Cd	Analyses: TRH	Analyses: HOLD	Remarks
A1-1-0.6m	1	18/09/2019							✓	✓		✓		* Cd LOR < 0.4mg/kg
A1-2-0.6m	2	18/09/2019							✓	✓	✓	✓		
A1-3-0.6m	3	18/09/2019							✓	✓		✓		
A1-4-0.75m	4	18/09/2019							✓	✓		✓		
A1-5-0.6m	5	18/09/2019							✓	✓	✓	✓		
A1-6-0.6m	6	18/09/2019							✓	✓		✓		
A1-7-0.6m	7	18/09/2019							✓	✓		✓		
A1-8-0.6m	8	18/09/2019							✓	✓	✓	✓		
A1-9-0.6m	9	18/09/2019							✓	✓		✓		
A1-10-0.6m	10	18/09/2019							✓	✓		✓		
A1-11-0.6m	11	18/09/2019							✓	✓	✓	✓		
A1-12-0.6m	12	18/09/2019							✓	✓		✓		
A2-1-1.2m	13	18/09/2019							✓	✓		✓		
A2-2-1.2m	14	18/09/2019							✓	✓	✓	✓		
A2-3-1.2m	15	18/09/2019							✓	✓		✓		

Environmental Division
Perth
Work Order Reference
EP1909576

Telephone : + 61-8-9406 1301

ALS 19/09/19 1230

P.T.O

A2-4-1.2m	16	18/09/2019							✓	✓		✓													
A2-5-1.2m	17	18/09/2019							✓	✓	✓	✓													
A2-6-1.2m	18	18/09/2019							✓	✓		✓													
A2-7-1.2m	19	18/09/2019							✓	✓		✓													
A2-1-1.6m	20	18/09/2019							✓	✓	✓	✓													
A2-2-1.6m	21	18/09/2019							✓	✓		✓													
A2-3-1.6m	22	18/09/2019							✓	✓		✓													
A2-4-1.6m	23	18/09/2019							✓	✓		✓													
A2-5-1.6m	24	18/09/2019							✓	✓	✓	✓													
A2-6-1.6m	25	18/09/2019							✓	✓		✓													
A2-7-1.6m	26	18/09/2019							✓	✓		✓													
SP1	27	18/09/2019							✓	✓		✓													
SP2	28	18/09/2019							✓	✓	✓	✓													
SP3	29	18/09/2019							✓	✓		✓													
SP4	30	18/09/2019							✓	✓		✓													
SP5	31	18/09/2019							✓	✓	✓	✓													
SP6	32	18/09/2019							✓	✓		✓													

Sampled by: JC + AY	Date/Time: 18/9/19 2pm	Relinquished by: JC + AY	Date/ Time: 18/9/19 3pm
Received by: AP	Date/Time: 19/9/19 1230	Relinquished by:	Date/ Time:
Received by Lab:	Date/Time:	Courier/ Transport Company:	
Sample Conditions:	Remarks:		

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP1909576**	Page	: 1 of 17
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JON CRAMER	Contact	: Marnie Thomsett
Address	: 999 HAY STREET PERTH WA, AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 9964 3677	Telephone	: 08 9406 1311
Project	: 12510838	Date Samples Received	: 19-Sep-2019 12:30
Order number	: 12510838	Date Analysis Commenced	: 23-Sep-2019
C-O-C number	: ----	Issue Date	: 27-Sep-2019 14:20
Sampler	: JC+PY		
Site	: Hardy St Remediation Project		
Quote number	: EN/005/19		
No. of samples received	: 32		
No. of samples analysed	: 32		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
David Viner	SENIOR LAB TECH	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG005T: Total lead for sample #15, 16, 22, 23, 24 and 30 confirmed by re-digestion and re-analysis.
- EG048G (Hexavalent Chromium): Poor Hexavalent Chromium spike recoveries possibly due to sample matrix effects. Confirmed by re-extraction and re-analysis.
- EG048G (Hexavalent Chromium): LOR for samples EP1909576-001, -004 and -021 raised due to possible sample matrix interference.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A1-1-0.6m	A1-2-0.6m	A1-3-0.6m	A1-4-0.75m	A1-5-0.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-001	EP1909576-002	EP1909576-003	EP1909576-004	EP1909576-005
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		12.8	15.5	11.4	19.2	8.9
EG005(ED093)T: Total Metals by ICP-AES									
Lead	7439-92-1	5	mg/kg		7	10	17	<5	12
EG020T: Total Metals by ICP-MS									
Cadmium	7440-43-9	0.1	mg/kg		----	<0.1	----	----	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<2.5	<0.5	<0.5	<2.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	750	230
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	310	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	1060	230
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	190	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	880	290
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	160	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	<50	1230	290
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	190	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		86.9	86.0	91.3	91.9	103

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A1-1-0.6m	A1-2-0.6m	A1-3-0.6m	A1-4-0.75m	A1-5-0.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-001	EP1909576-002	EP1909576-003	EP1909576-004	EP1909576-005
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		**97.7**	**91.4**	**95.5**	**92.5**	**101**
4-Bromofluorobenzene	460-00-4	0.2	%		**92.1**	**88.1**	**92.7**	**87.0**	**96.9**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	A1-6-0.6m	A1-7-0.6m	A1-8-0.6m	A1-9-0.6m	A1-10-0.6m
			Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EP1909576-006	EP1909576-007	EP1909576-008	EP1909576-009	EP1909576-010
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.6	8.6	9.2	4.7	22.1
EG005(ED093)T: Total Metals by ICP-AES								
Lead	7439-92-1	5	mg/kg	<5	6	6	<5	<5
EG020T: Total Metals by ICP-MS								
Cadmium	7440-43-9	0.1	mg/kg	----	----	<0.1	----	----
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	96.7	107	97.6	96.3	97.9

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A1-6-0.6m	A1-7-0.6m	A1-8-0.6m	A1-9-0.6m	A1-10-0.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-006	EP1909576-007	EP1909576-008	EP1909576-009	EP1909576-010
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		**93.1**	**107**	**97.0**	**101**	**94.6**
4-Bromofluorobenzene	460-00-4	0.2	%		**92.1**	**99.4**	**90.8**	**91.0**	**88.4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A1-11-0.6m	A1-12-0.6m	A2-1-1.2m	A2-2-1.2m	A2-3-1.2m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-011	EP1909576-012	EP1909576-013	EP1909576-014	EP1909576-015
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		11.6	10.8	18.0	10.4	15.1
EG005(ED093)T: Total Metals by ICP-AES									
Lead	7439-92-1	5	mg/kg		<5	5	<5	10	90
EG020T: Total Metals by ICP-MS									
Cadmium	7440-43-9	0.1	mg/kg		<0.1	----	----	<0.1	----
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		99.6	100	88.1	82.7	99.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A1-11-0.6m	A1-12-0.6m	A2-1-1.2m	A2-2-1.2m	A2-3-1.2m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-011	EP1909576-012	EP1909576-013	EP1909576-014	EP1909576-015
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		**98.8**	**96.0**	**93.8**	**67.1**	**94.4**
4-Bromofluorobenzene	460-00-4	0.2	%		**89.8**	**87.3**	**86.8**	**75.9**	**87.3**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A2-4-1.2m	A2-5-1.2m	A2-6-1.2m	A2-7-1.2m	A2-1-1.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-016	EP1909576-017	EP1909576-018	EP1909576-019	EP1909576-020
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		21.8	21.7	10.5	14.1	14.7
EG005(ED093)T: Total Metals by ICP-AES									
Lead	7439-92-1	5	mg/kg		159	9	11	<5	<5
EG020T: Total Metals by ICP-MS									
Cadmium	7440-43-9	0.1	mg/kg		----	<0.1	----	----	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		160	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		200	<100	<100	<100	130
^ C10 - C36 Fraction (sum)	----	50	mg/kg		360	<50	<50	<50	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		310	<100	<100	<100	150
>C34 - C40 Fraction	----	100	mg/kg		120	<100	<100	<100	190
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		430	<50	<50	<50	340
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		94.5	90.9	102	92.2	91.4

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A2-4-1.2m	A2-5-1.2m	A2-6-1.2m	A2-7-1.2m	A2-1-1.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-016	EP1909576-017	EP1909576-018	EP1909576-019	EP1909576-020
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		**108**	**103**	**101**	**96.6**	**95.5**
4-Bromofluorobenzene	460-00-4	0.2	%		**93.8**	**93.4**	**93.2**	**85.9**	**87.1**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A2-2-1.6m	A2-3-1.6m	A2-4-1.6m	A2-5-1.6m	A2-6-1.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-021	EP1909576-022	EP1909576-023	EP1909576-024	EP1909576-025
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		8.9	13.5	21.9	20.3	10.2
EG005(ED093)T: Total Metals by ICP-AES									
Lead	7439-92-1	5	mg/kg		9	48	133	30	11
EG020T: Total Metals by ICP-MS									
Cadmium	7440-43-9	0.1	mg/kg		----	----	----	<0.1	----
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<2.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	270	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	320	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	590	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	520	100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	200	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	720	100	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		100.0	100	98.7	95.4	91.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A2-2-1.6m	A2-3-1.6m	A2-4-1.6m	A2-5-1.6m	A2-6-1.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-021	EP1909576-022	EP1909576-023	EP1909576-024	EP1909576-025
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		**80.9**	**87.9**	**86.2**	**99.3**	**90.8**
4-Bromofluorobenzene	460-00-4	0.2	%		**110**	**83.6**	**78.4**	**89.6**	**83.7**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A2-7-1.6m	SP1	SP2	SP3	SP4
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-026	EP1909576-027	EP1909576-028	EP1909576-029	EP1909576-030
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		16.8	5.6	8.0	11.8	13.8
EG005(ED093)T: Total Metals by ICP-AES									
Lead	7439-92-1	5	mg/kg		8	9	8	20	42
EG020T: Total Metals by ICP-MS									
Cadmium	7440-43-9	0.1	mg/kg		----	----	<0.1	----	----
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		94.2	94.4	94.2	103	101

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A2-7-1.6m	SP1	SP2	SP3	SP4
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1909576-026	EP1909576-027	EP1909576-028	EP1909576-029	EP1909576-030
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		**95.0**	**101**	**92.5**	**92.5**	**88.0**
4-Bromofluorobenzene	460-00-4	0.2	%		**85.1**	**88.7**	**86.0**	**83.0**	**80.7**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	SP5	SP6	----	----	----
			Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EP1909576-031	EP1909576-032	--------	--------	--------
				Result	Result	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**8.3**	**14.1**	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Lead	7439-92-1	5	mg/kg	**10**	**10**	----	----	----
EG020T: Total Metals by ICP-MS								
Cadmium	7440-43-9	0.1	mg/kg	<0.1	----	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	----	----	----
C10 - C14 Fraction	----	50	mg/kg	<50	<50	----	----	----
C15 - C28 Fraction	----	100	mg/kg	<100	<100	----	----	----
C29 - C36 Fraction	----	100	mg/kg	<100	<100	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg	<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg	<10	<10	----	----	----
>C10 - C16 Fraction	----	50	mg/kg	<50	<50	----	----	----
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	----	----	----
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg	<50	<50	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg	<50	<50	----	----	----
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	----	----	----
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	----	----	----
^ **Sum of BTEX**	----	0.2	mg/kg	<0.2	<0.2	----	----	----
^ **Total Xylenes**	----	0.5	mg/kg	<0.5	<0.5	----	----	----
Naphthalene	91-20-3	1	mg/kg	<1	<1	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	**72.6**	**89.8**	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	SP5	SP6	----	----	----
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EP1909576-031	EP1909576-032	--------	--------	--------
					Result	Result	----	----	----
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		**92.6**	**88.5**	**----**	**----**	**----**
4-Bromofluorobenzene	460-00-4	0.2	%		**86.5**	**79.8**	**----**	**----**	**----**

Surrogate Control Limits

Sub-Matrix: **SOIL**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	63	132
Toluene-D8	2037-26-5	66	125
4-Bromofluorobenzene	460-00-4	60	124

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP1910161**	Page	: 1 of 13
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JON CRAMER	Contact	: Marnie Thomsett
Address	: 999 HAY STREET PERTH WA, AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 9964 3677	Telephone	: 08 9406 1311
Project	: 12510838	Date Samples Received	: 19-Sep-2019 12:30
Order number	: 12510838	Date Analysis Commenced	: 23-Sep-2019
C-O-C number	: ----	Issue Date	: 16-Oct-2019 15:44
Sampler	: ----		
Site	: Hardy St Remediation Project		
Quote number	: EN/005/19		
No. of samples received	: 24		
No. of samples analysed	: 24		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Vanessa Nguyen	Organic Chemist	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)			Client sample ID	**A1-1-0.6m**	**A1-2-0.6m**	**A1-3-0.6m**	**A1-5-0.6m**	**A1-7-0.6m**
			Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**EP1910161-001**	**EP1910161-002**	**EP1910161-003**	**EP1910161-005**	**EP1910161-006**
				Result	Result	Result	Result	Result
EG005(ED093)W: Water Leachable Metals by ICPAES								
Lead	7439-92-1	0.01	mg/L	<0.01	<0.01	<0.01	**0.01**	<0.01

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Client sample ID	A1-8-0.6m	A2-2-1.2m	A2-3-1.2m	A2-4-1.2m	A2-5-1.2m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1910161-007	EP1910161-008	EP1910161-009	EP1910161-010	EP1910161-011
					Result	Result	Result	Result	Result
EG005(ED093)W: Water Leachable Metals by ICPAES									
Lead	7439-92-1	0.01	mg/L		<0.01	<0.01	**0.02**	**0.05**	<0.01

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)				Client sample ID	A2-6-1.2m	A2-2-1.6m	A2-3-1.6m	A2-4-1.6m	A2-5-1.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1910161-012	EP1910161-013	EP1910161-014	EP1910161-015	EP1910161-016
					Result	Result	Result	Result	Result
EG005(ED093)W: Water Leachable Metals by ICPAES									
Lead	7439-92-1	0.01	mg/L		<0.01	<0.01	<0.01	**0.03**	<0.01

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)			Client sample ID	**A2-6-1.6m**	**A2-7-1.6m**	**SP1**	**SP2**	**SP3**
			Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	*CAS Number*	*LOR*	*Unit*	**EP1910161-017**	**EP1910161-018**	**EP1910161-019**	**EP1910161-020**	**EP1910161-021**
				Result	Result	Result	Result	Result
EG005(ED093)W: Water Leachable Metals by ICPAES								
Lead	7439-92-1	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Client sample ID	SP4	SP5	SP6	----	----
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	----	----
Compound	CAS Number	LOR	Unit		EP1910161-022	EP1910161-023	EP1910161-024	--------	--------
					Result	Result	Result	----	----
EG005(ED093)W: Water Leachable Metals by ICPAES									
Lead	7439-92-1	0.01	mg/L		**0.03**	<0.01	<0.01	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A1-1-0.6m	A1-2-0.6m	A1-3-0.6m	A1-4-0.75m	A1-5-0.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1910161-001	EP1910161-002	EP1910161-003	EP1910161-004	EP1910161-005
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		**----**	**----**	**----**	**19.3**	**----**
EN60: Bottle Leaching Procedure									
Final pH	----	0.1	pH Unit		**7.4**	**7.4**	**7.0**	**----**	**7.2**
EP070: Total Petroleum Hydrocarbons - Speciation									
Aliphatic C16-C35	----	100	mg/kg		**----**	**----**	**----**	<100	**----**
Aliphatic > C35	----	100	mg/kg		**----**	**----**	**----**	<100	**----**
Aromatic C16-C35	----	90	mg/kg		**----**	**----**	**----**	<90	**----**
Aromatic > C35	----	100	mg/kg		**----**	**----**	**----**	<100	**----**
EP070: Total Petroleum Hydrocarbons - Speciation									
2-Bromonaphthalene	580-13-2	1	%		**----**	**----**	**----**	**84.4**	**----**
2-Fluorobiphenyl	321-60-8	1	%		**----**	**----**	**----**	**96.0**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	A1-7-0.6m	A1-8-0.6m	A2-2-1.2m	A2-3-1.2m	A2-4-1.2m
			Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EP1910161-006	EP1910161-007	EP1910161-008	EP1910161-009	EP1910161-010
				Result	Result	Result	Result	Result
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	**7.1**	**7.4**	**7.2**	**7.1**	**7.4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	A2-5-1.2m	A2-6-1.2m	A2-2-1.6m	A2-3-1.6m	A2-4-1.6m
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit		EP1910161-011	EP1910161-012	EP1910161-013	EP1910161-014	EP1910161-015
					Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		----	----	----	----	**22.9**
EN60: Bottle Leaching Procedure									
Final pH	----	0.1	pH Unit		**7.7**	**7.5**	**7.6**	**7.7**	**7.7**
EP070: Total Petroleum Hydrocarbons - Speciation									
Aliphatic C16-C35	----	100	mg/kg		----	----	----	----	<100
Aliphatic > C35	----	100	mg/kg		----	----	----	----	<100
Aromatic C16-C35	----	90	mg/kg		----	----	----	----	<90
Aromatic > C35	----	100	mg/kg		----	----	----	----	<100
EP070: Total Petroleum Hydrocarbons - Speciation									
2-Bromonaphthalene	580-13-2	1	%		----	----	----	----	**83.8**
2-Fluorobiphenyl	321-60-8	1	%		----	----	----	----	**97.8**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	A2-5-1.6m	A2-6-1.6m	A2-7-1.6m	SP1	SP2
			Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00
Compound	CAS Number	LOR	Unit	EP1910161-016	EP1910161-017	EP1910161-018	EP1910161-019	EP1910161-020
				Result	Result	Result	Result	Result
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	**7.7**	**7.7**	**7.6**	**7.8**	**7.9**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	SP3	SP4	SP5	SP6	----
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	18-Sep-2019 00:00	----
Compound	CAS Number	LOR	Unit		EP1910161-021	EP1910161-022	EP1910161-023	EP1910161-024	--------
					Result	Result	Result	Result	----
EN60: Bottle Leaching Procedure									
Final pH	----	0.1	pH Unit		**8.1**	**7.1**	**7.2**	**7.9**	**----**

Surrogate Control Limits

Sub-Matrix: **SOIL**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP070: Total Petroleum Hydrocarbons - Speciation			
2-Bromonaphthalene	580-13-2	70	130
2-Fluorobiphenyl	321-60-8	70	130

Appendix B – Landfill disposal receipts

Shire of Denmark
South Coast Highway (PO Box 183), Denmark WA 6333
Ph: (08) 9848 0300 Fax: (08) 9848 1985
Email: enquiries@denmark.wa.gov.au
Website: www.denmark.wa.gov.au

WASTE DISPOSAL RECEIPT - Denmark Waste Management Reuse Facility

FEES PER CURRENT "SCHEDULE OF FEES AND CHARGES"

DEBTOR NUMBER:

BUSINESS NAME: Shire of Denmark

ADDRESS: 953 South Coast Highway Denmark

PHONE/FAX: 9848 0300

EMAIL: enquiries@denmark.wa.gov.au

Job Number	DATE	WASTE TYPE	QUANTITY	CHARGE ($ inc. GST)
1076002	26/05/2020 - 09/06/20	Class 1 inert fill	916 m3	NA
1076002	26/05/2020 - 09/06/20	Metal	40 m3	NA
1076002	26/05/2020 - 09/06/20	Concrete	72m3	NA
1076002	26/05/2020 - 09/06/20	Hazibag - pipe potentilly asbestos	600mm x 100mm	NA

TOTAL TO BE INVOICED $0

SHIRE OFFICER USE ONLY: (form enquiries to Debtors Officer 9848 0300)

AUTHORISING OFFICER Bohdan Davies - Manager Waste & Reserves

AUTHORISING OFFICER SIGNATURE:

DATE 22/6/2020

Shire of Denmark
South Coast Highway (PO Box 183), Denmark WA 6333
Ph: (08) 9848 0300 Fax: (08) 9848 1985
Email: enquiries@denmark.wa.gov.au
Website: www.denmark.wa.gov.au

WASTE DISPOSAL RECEIPT - Denmark Waste Management Reuse Facility

FEES PER CURRENT "SCHEDULE OF FEES AND CHARGES"

DEBTOR NUMBER:

BUSINESS NAME: Shire of Denmark

ADDRESS: 953 South Coast Highway Denmark

PHONE/FAX: 9848 0300

EMAIL: enquiries@denmark.wa.gov.au

Job Number	DATE	WASTE TYPE	QUANTITY	CHARGE ($ inc. GST)
1076002	09/06/20 - 16/09/20	Class 1 inert fill	85 m3	NA

TOTAL TO BE INVOICED $0

SHIRE OFFICER USE ONLY: (form enquiries to Debtors Officer 9848 0300)

AUTHORISING OFFICER Bohdan Davies - Manager Waste & Reserves

AUTHORISING OFFICER SIGNATURE:

DATE 6/10/2020

CITY OF
Albany

Tax Invoice

Hanrahan
PO Box 484 Albany WA 6331

Phone: 08 6820 3000

ABN: 94717875167

Ticket NO: 60114172-HR.0

Time In: 14/09/2020 3:44:29 PM
Time Out: 14/09/2020 3:50:12 PM

Vehicle Rego: 1GWC560

Client: Cash

Weighed Waste Asbestos		price NA
Each Items	Qty	Price
GROSS Weight:		1.22t
TARE Weight:		1.22t
NET Weight:		0.00t
Unit Cost:		$136.40/t
Council Fee:		$13.64
Each Items:		$0.00
GST :		$1.36
Total Price:		**$15.00**

The Total Price Includes GST

Payments:

EFTPOS	AUTH:998361	$15.00
Total Amount Tendered:		$15.00
Change Given:		$0.00

Driver:

Operator: Richard

Contract Notes

COMMONWEALTH BANK EFTPOS
CITY OF ALBANY
YAKAMIA WA

TERMINAL 16854501
REFERENCE 017134

CUSTOMER COPY
CARD NO: 0079(c)
EXPIRY DATE:
AID: A0000000041010
ATC:198 TVR:0000008001
CSN:01 9D1D9844B510CF0D
14 SEP 2020 15:49

DEBIT Mastercard
CREDIT
PURCHASE $15.00
TOTAL AUD $15.00

APPROVED
AUTH NO: 00
POS REF NO: 998361
THANK YOU 60135120

Appendix C – Laboratory analytical results

						SampleCode	EP2005871011	EP2005871002	EP2005871003	EP2005871004	EP2005871005	EP2005871006
						Field_ID	MW01	MW02	MW03	MW04	MW05	MW06
						Sampled_Date	03/06/2020	03/06/2020	03/06/2020	03/06/2020	03/06/2020	03/06/2020
						Sample_Type	Normal	Normal	Normal	Normal	Normal	Normal
ChemName	output unit	EQL	ADWG 2011 Health (v3.5 updated 2018)	ANZG (2018) - Freshwater - 95% level of species protection	DER 2014 Non-potable Groundwater Use (NPUG) &	NHMRC Recreational Guidelines 2008 - Health						
Metals												
Chromium (III+VI) (Filtered)	mg/L	0.001		0.001			<0.001	<0.001	0.001	0.001	0.002	<0.001
Chromium (hexavalent) (Filtered)	mg/L	0.01	0.05	0.001	**0.5**	*0.5*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium (Trivalent) (Filtered)	mg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (Filtered)	mg/L	0.001	0.01	0.0034	**0.1**	*0.1*	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (Filtered)	mg/L	0.001	0.02	0.011	**0.2**	*0.2*	0.011	<0.001	0.005	0.003	0.009	0.002
Zinc (Filtered)	mg/L	0.005		0.008	**3**		0.062	0.015	0.043	0.011	0.087	0.013
BTEXN												
Benzene	µg/L	1	1	950	**10**	*10*	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2	800		**25**	*8000*	<2	<2	<2	<2	<2	<2
Ethylbenzene	µg/L	2	300		**3**	*3000*	<2	<2	<2	<2	<2	<2
Xylene (o)	µg/L	2		350			<2	<2	<2	<2	<2	<2
Xylene (m & p)	µg/L	2					<2	<2	<2	<2	<2	<2
Xylene Total	µg/L	2	600		**20**	*6000*	<2	<2	<2	<2	<2	<2
BTEX (Sum of Total) - Lab Calc	µg/L	1					<1	<1	<1	<1	<1	<1
TRH - NEPM 2013												
F1 (C6-C10 minus BTEX)	µg/L	20					<20	<20	<20	<20	<20	<20
C6-C10 Fraction	µg/L	20					<20	<20	<20	<20	<20	<20
F2 (>C10-C16 minus Naphthalene)	µg/L	100			**1000**		<100	<100	<100	<100	<100	<100
>C10-C16 Fraction	µg/L	100					<100	<100	<100	<100	<100	<100
F3 (>C16-C34 Fraction)	µg/L	100			**900**		<100	<100	<100	<100	<100	<100
F4 (>C34-C40 Fraction)	µg/L	100			**900**		<100	<100	<100	<100	<100	<100
>C10-C40 (Sum of Total)	µg/L	100					<100	<100	<100	<100	<100	<100
TRH - NEPM 1999												
C6-C9 Fraction	µg/L	20					<20	<20	<20	<20	<20	<20
C10-C14 Fraction	µg/L	50					<50	<50	<50	<50	<50	<50
C15-C28 Fraction	µg/L	100					<100	<100	<100	<100	<100	<100
C29-C36 Fraction	µg/L	50					<50	<50	<50	<50	<50	<50
C10-C36 (Sum of Total)	µg/L	50					<50	<50	<50	<50	<50	<50
PAHs - standard 16												
Acenaphthene	µg/L	1					<1	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	1					<1	<1	<1	<1	<1	<1
Anthracene	µg/L	1					<1	<1	<1	<1	<1	<1
Benz(a)anthracene	µg/L	1					<1	<1	<1	<1	<1	<1
Benzo(a)pyrene	µg/L	0.5	0.01		**0.1**	*0.1*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo[b+j]fluoranthene	µg/L	1					<1	<1	<1	<1	<1	<1
Benzo(k)fluoranthene	µg/L	1					<1	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	1					<1	<1	<1	<1	<1	<1
Chrysene	µg/L	1					<1	<1	<1	<1	<1	<1
Dibenz(a,h)anthracene	µg/L	1					<1	<1	<1	<1	<1	<1
Fluoranthene	µg/L	1					<1	<1	<1	<1	<1	<1
Fluorene	µg/L	1					<1	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	1					<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	1		16			<1	<1	<1	<1	<1	<1
Phenanthrene	µg/L	1					<1	<1	<1	<1	<1	<1
Pyrene	µg/L	1					<1	<1	<1	<1	<1	<1
PAHs (Sum of total) - Lab calc	µg/L	0.5	0.01				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Calc	µg/L	0.5					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
OC Pesticides												
4,4'-DDE	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
a-BHC	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aldrin	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aldrin + Dieldrin	µg/L	0.01	0.3		**3**	*3*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
b-BHC	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane	µg/L	0.01	2	0.08	**20**		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane (cis)	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane (trans)	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
d-BHC	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4,4 DDD	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4,4 DDT	µg/L	0.01	9	0.01	**90**	*90*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDT+DDE+DDD - Lab Calc	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan	µg/L	0.01	20	0.2	**200**	*200*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I (alpha)	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II (beta)	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan Sulfate	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	µg/L	0.01		0.02			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin aldehyde	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin ketone	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
g-BHC (Lindane)	µg/L	0.01	10	0.2		*100*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	µg/L	0.005	0.3	0.09		*3*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor epoxide	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorobenzene	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	µg/L	0.01	300			*3000*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Oxychlordane	µg/L	0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

GW Chemistry_Output_Table1_rev2.xlsm , 8/10/2020
(Location_Code In('MW01' , 'MW02' , 'MW04' , 'MW05' , 'MW03' , 'MW06') AND

Sample_Type = 'Normal')

Appendix D – ACM inspection findings & photographs

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
C14	31.51	712	0.0205418	-	-	-	-	
H10	100	16	0.0001455	-	-	-	-	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
H12	100	1	0.0000091	-	-	-	-	
I9	100	2	0.0000182	-	-	-	-	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
J5	100	-	-	4	0.0000364	-	-	
J7	100	-	-	-	-	2	0.0000018	

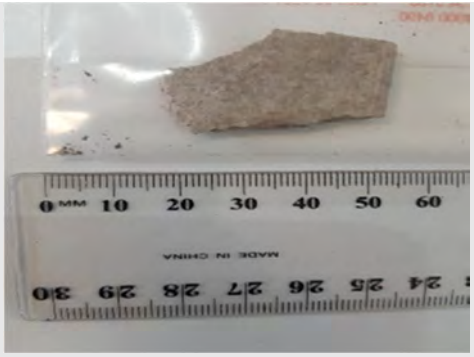
GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
J8	100	-	-	4	0.0000364	8	0.0000073	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
J9	100	40	0.0003636	-	-	-	-	
J10	100	42	0.0003818	-	-	-	-	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
J11	100	89	0.0008091	-	-	-	-	
K1	42.63	1,800	0.0383853	-	-	-	-	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
K4	100	-	-	-	-	<1*	0.0000009	
K5	100	140	0.0012727	-	-	-	-	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
K7	100	32	0.0002909	-	-	-	-	
K8	100	22	0.0002000	-	-	-	-	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
K9	75.42	-	-	3	0.0000362	-	-	
L6	100	113	0.0010273	94	0.0008545	-	-	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
								
J1 (offsite)	-	75	-	-	-	-	-	

GRID ID (with reference to Figure 5)	Area[m2]	Pass 1		Pass 2		Pass 3		Photo
		Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	Weight of PACM [g]	Asbestos concentration [% w/w]	
H1 (offsite)	-	-	-	20	-	-	-	

Table notes:

For the purposes of calculating asbestos in soil concentration [% w/w] it was presumed that the asbestos content within all identified ACM is 15%, and the soil density for Denmark sandy soils as observed on Site is 1.65 kg/L. The depth of raking / investigation was 0.1 m.

Appendix E – Quality Assurance / Quality Control

Quality Assurance and Quality Control

Field Work Program

Field Quality Assurance Procedures

All field work will be conducted with reference to the DWER Contaminated Sites Management Series Guidelines, National Environment Protection (Assessment of site Contamination) Measure 1999 (as amended 2013) and GHD's Standard Field Operating Procedures, which ensures all environmental samples are collected by a set of uniform and systematic methods, as required by GHD's QA system. Key requirements of these procedures are listed below.

- *Decontamination procedures:* included the use of new disposable gloves, new LDPE pump tubing for collecting of sampling equipment (water quality meter, interface meter, peristaltic pump) between each sampling event and the use of appropriate sampling containers, as provided by the NATA accredited laboratory.
- *Sample Identification Procedures*: Collected samples are immediately transferred to sample containers of appropriate composition and preservation for the required laboratory analysis. All sample containers are clearly labelled with a sample number, sample location, sample depth, sample date and sampler's initials. The sample containers are then transferred to a chilled esky for sample preservation prior to and during shipment to the testing laboratory.
- *Calibration of field equipment:* field equipment was calibrated to ensure accuracy of measurements taken in the field. Calibration was undertaken by the rental supplier and calibration certificates are provided in Appendix I.
- *Chain of custody (CoC) information requirements:* CoC forms were completed and forwarded to the testing laboratory accompanying each batch of samples. The CoCs are provided in Appendix H.
- *Quality control sampling frequency:* blind and split duplicate samples along with rinsate samples, field and transport blanks were collected and analysed at the frequencies in accordance with DWER (DER 2014) and NEPM (NEPM, 2013) guidance.

Sampling and Analysis Quality Control

The *Development of Sampling and Analysis Programs* Guideline (DEP 2001b) outlines QC sampling protocol. The QC samples collected during the investigation are described below and presented in:

- *Blind duplicates:* blind duplicate samples were used to identify the variation in the analyte concentration between samples from the same sampling point and the repeatability of the laboratory's analysis.
- *Split duplicates:* split duplicate samples were used to provide an indication of the repeatability of the analytical results between NATA accredited laboratories.
- *Rinsate blanks:* Rinsate blank samples are primarily used to assess whether the decontamination procedures implemented in the field were effective. The sample is collected by passing laboratory supplied deionised water over the specific piece of decontaminated field equipment.
- *Field blanks:* Field blank samples are used to assess the potential for introduction of contamination from ambient sources in the field during sampling and are collected using laboratory supplied deionised water.

- *Transport blanks:* Transport blank samples are used to assess the potential for introduction of contamination during the transport and storage of the field samples and are collected using laboratory supplied deionised water.

The quality control sampling and analysis program undertaken for the groundwater sampling are outlined in Table E-1.

Table E-1 Quality control sampling frequency

Sample	Sample Collection Frequency	Number of QC Samples collected
Blind Duplicate	1:20 samples	1
Split Duplicate	1:20 samples	1
Rinsate Blank	1 per matrix per piece of equipment per day	1
Field Blank	1 per matrix per day per collection apparatus	1
Transport Blank	1 per esky per day	1

Sample storage and transport

All samples were immediately placed into a chilled esky following sampling, but the SRN for the groundwater samples noted the samples were at temperature above 10°C when received. To aid sample integrity, samples were stored in a fridge and delivered promptly to the laboratory the following day with new ice bricks installed (to prevent samples being stored in transit). It is recognised that the ideal situation and aim of sample preservation is to store samples at low temperature in order to preserve sample integrity. As the samples were sealed and transported under suitable cooling conditions and delivered to the laboratory as soon as possible, it is not considered that esky temperatures being greater than 10°C when delivered to the laboratory had a significant effect on sample integrity.

Quality assurance blank sample results

A summary of the quality assurance blank samples collected and analysed for this assessment is provided in Table E-2. All samples reported concentrations below laboratory limits of reporting.

Quality control duplicate results

An overview of the quality control duplicate samples collected and analysed for this assessment is provided below with the laboratory certificate of analysis provided in Appendix H.

Relative percentage difference calculations

Blind and split duplicate samples were assessed by calculating the relative percentage difference (RPD) between the primary, blind and split samples.

A quantitative measure of the accuracy of the analytical results reported is made by calculating the RPDs between the primary, blind and split results in accordance with the procedure described in AS 4482.1 – 2005 (Standards Australia 2005). According to AS 4482.1 - 2005 typical RPDs are expected to range between 30% and 50%; however, this may be higher for organics and for low concentrations of analytes. GHD uses 30% as the general trigger level for further review.

Groundwater duplicate RPD results

A review of the calculated RPDs between the primary & blind sample and the primary and inter-laboratory split sample, revealed that there was two exceedances of the 30% adopted trigger level as summarised in Table E-2.

Table E-2 Summary of QA/QC samples and RPD exceedances

QA/QC Sample field ID	QC Sample Lab Sample ID	Sample Type	Analyte	RPD (%)	Discussion
FD01	EP2005871007	Blind	N/A	-	-
FS01	P20-Jn11077	Split	Nickel	67	Primary sample concentrations higher than the triplicates', however both concentrations are within the same order of magnitude and do not change the overall interpretation of the results. Therefore the higher value has been adopted for overall interpretation of results. Duplicate concentrations reported as LOR, therefore RPD exceedances appear exaggerated due to the low concentrations of the analytes. Overall interpretation of results remains unchanged.
			Zinc	89	
RB01	EP2005871008	Rinsate blank	-	-	Result below LOR
FB01	EP2005871009	Field blank	-	-	Result below LOR
TBW173	EP2005871010	Transport blank	-	-	Result below LOR

Laboratory program

The interpretive laboratory QA/QC report has been included with the laboratory certificates of analysis in Appendix H with a summary provided in Table E-4 below.

Table E-4 Summary of laboratory QA/QC compliance

QA/QC element	Requirement	Requirement adhered to?	Information/ data acceptable?
NATA accreditation	Analysis of COPCs performed under NATA accreditation or equivalent government-endorsed provider of accreditation.	Yes	Yes
Holding times	Laboratory to complete sample extraction and analysis of COPCs within method specifications.	Yes	Yes

QA/QC element	Requirement	Requirement adhered to?	Information/ data acceptable?
Analytical methods	Sample analyses are to use appropriate methods for each analyte with regard to Schedule B3 of the *ASC NEPM* (NEPC 1999) and in accordance with the laboratory's NATA accreditation.	Yes	Yes
Laboratory LORs	Laboratory LORs are below adopted assessment criteria.	Yes, with exceptions	Yes, see Section below
Laboratory QC results	Laboratory internal quality control results compliant with laboratory and industry standards, including laboratory duplicates, method blanks, laboratory control samples, matrix spikes and surrogate spikes.	Yes, with exceptions	Yes, see Section below

Laboratory Quality Control Procedures

The following laboratory QC procedures and compliance were used during the investigation:

Laboratory Duplicate Samples: Laboratory duplicate sample analysis is the analysis of a laboratory derived duplicate sample from the process batch, at a rate equivalent to one in twenty samples per analytical batch, or one sample per batch if less than twenty samples are analysed in a batch. A laboratory duplicate provides data on the analytical precision and reproducibility of the analytical results.

The permitted ranges for the RPD of Laboratory Duplicates, are dependent on the magnitude of results in comparison to the level of reporting. For RPD results that are less than ten times the Limit of Reporting (LOR) there are no limits, for results between ten and twenty times the LOR, the adopted criteria is 0% - 50% and for results greater than twenty times LOR, the criteria is 0% - 20%.

Method Blank Samples: Method or analysis blank sample analysis is the analysis of a sample that is as free as possible of the analytes of interest, but has been prepared the same as the samples under investigation. The analysis is to ascertain if laboratory reagents, glassware and other laboratory consumables contribute to the observed concentration of analytes in the process batch. If below the maximum acceptable method blank (20% of the practical quantitation limit), the contribution is subtracted from the gross analytical signal for each analysis before calculating the sample analyte concentration. GHD notes that the subtraction of the method blank concentration is not appropriate for some organic analytes.

Laboratory Control Spike Samples: Laboratory control spike analysis is the analysis of either a reference material or a control matrix fortified with analytes representative of the analyte class. The purpose of laboratory control spike samples is to monitor method precision and accuracy independent of the sample matrix. Typically, the percent recovery of the laboratory control spike sample is compared to the dynamic recovery limits based on the statistical analysis of the processed laboratory control spike sample analysis.

Matrix Spike Samples: Matrix spike sample analysis is the analysis of one or more replicate portions of samples from the batch, after fortifying the additional portion(s) with known quantities of the analyte(s) of interest. The percent recovery of target analyte(s) from matrix spike samples is used to determine the bias of the method in the specific sample matrix.

Surrogate Spike Samples: Surrogate spike samples are samples with known additions of known amounts of compounds, which are similar to the analytes of interests in terms of extractability, recovery through clean-up procedures and response to chromatographic or other measurement.

Surrogate compounds may be alkylated or halogenated analogues or structural isomers of analytes of interest. The purpose of surrogate spikes, which are added immediately before the sample extraction step, is to provide a check for every analysis that no gross processing errors have occurred, which could have led to significant analyte loss or faulty calculation.

Internal Standards: Internal standards are known additions of known amounts of compounds which are not found in real samples, will not interfere with quantification of analytes of interest and may be separately and independently quantified. The purpose of internal standards in instrumental techniques is to provide independent signals, which serve to check the consistency of the analytical step. Internal standards are often used for organic compounds and some inorganic compounds.

Laboratory limits of reporting

Laboratory LORs, which exceeded the adopted criteria for each medium have been identified in Table E-5 below:

Table E-5 Laboratory Limits of Reporting – Adopted Guideline Exceedances

Sampling medium	Analyte	LOR	Investigation levels	Comment
Groundwater	Chromium (hexavalent) (filtered)	0.01 mg/L	ANZG (2018) - Freshwater - 95% level of species protection (0.001 mg/L)	LOR was 10 times above the guidelines.
	PAHs (Sum of total) - Lab calc	0.5 µg/L	ADWG 2011 Health Guidelines (0.01 µg/L)	LOR was 50 times above the guidelines.
	Benzo(a) pyrene	0.5 µg/L	DWER 2014 NPUG Guidelines (0.1 µg/L); NHMRC Recreational Guidelines 2008 - Health (0.1 µg/L); ADWG 2011 Health Guidelines (0.01 µg/L)	LOR was 5 and 50 times above the respective guidelines.

With the chromium speciation LORs being higher than the FWG (95% species protection level), additional consideration is required in regards to the total chromium concentration that was reported at MW05 exceeding the FWG guideline. The laboratory error in meeting the requested LOR requires multiple lines of evidence to support the risk assessment of hexavalent chromium at the Site (refer to Section 8 of RVR). The PAH exceedances are not considered to influence the contamination risk assessment at the Site due to the minimal source having previously been identified within the waste fill materials onsite.

Laboratory QA/QC results

All laboratory quality control measures including laboratory duplicate, laboratory control spike (LCS), matrix spike and method blank recoveries were within ALS Environmental or Eurofins | mgt acceptable control limits, which are based on the *NEPM (2013).* All extraction and analysis holding-times were also within laboratory defined criteria.

The interpretive quality control report from the laboratory (only primary laboratory, ALS Environmental reviewed) is provided with the laboratory Certificate of Analysis in Appendix H.

Data quality indicator evaluation

The overall review of the QA/QC results indicates that the data are of an acceptable quality upon which to enable assessment of the Site. GHD considers that the quality control and quality assurance have been satisfied based on the following conclusions.

An evaluation of the data quality indicators set for this assessment was undertaken subsequent to field works and laboratory analysis, this evaluation is presented in Table E-6.

Table E-6 Data quality indicator evaluation

DQI	Evaluation criteria	Acceptable?
Completeness	All locations that were proposed to be sampled were sampled. Samples were analysed according to the proposed analysis. It is considered that the field QA procedures carried out, such as duplicate and inter-laboratory duplicate collection frequency and the analytes tested, provide completeness in terms of the required field duplicate samples. Laboratory QC sample analysis is considered sufficient to provide a complete overview of QA procedures.	Yes
	All field documentation is complete and correct, including chain of custody documentation for samples.	Yes
	Field forms and documentation capture all relevant important information.	Yes
	Samples were analysed within appropriate holding times.	Yes
	Appropriate laboratory limits of reporting for comparison to relevant assessment criteria.	Yes
Comparability	Standardised operating procedure for sampling was generally adhered to and is in line with relevant guidelines. All field work was undertaken with reference to the DWER *Contaminated Sites Management Series* Guidelines, GHD Standard Operating Procedures, which ensured all samples were collected by a set of uniform and systematic methods.	Yes
	Field staff were experienced in the sampling of soil and were appropriately trained. A small field team was used to ensure consistency in field procedures.	Yes
	Consistent laboratory use with consistent analytical methods used.	Yes
	Climatic conditions consistent and considered representative of region.	Yes
Representativeness	Samples were collected in a uniform and consistent manner, therefore representative of the media in the field. Field and laboratory QA procedures were carried out to ensure data representativeness. Appropriate media were identified and sampled according to the RAP (where applicable). The number and type of samples collected as part of the investigation works was considered to be representative of the areas of concern. Consequently, data representativeness is considered to have been satisfied.	Yes
Precision	Sufficient quantities of field blind and split duplicates were collected to enable comparison within and between laboratories.	Yes
	Sufficient quantities of internal laboratory duplicates were analysed to enable comparison within laboratories.	Yes

DQI	Evaluation criteria	Acceptable?
	Relative percentage difference calculations show that the vast majority of duplicate sample concentrations are within accepted difference limits. Field duplicate and inter-laboratory duplicate generally reported RPDs below the adopted 30% criteria (where both concentrations were above the LOR). Any exceedances of the adopted 30% criteria are discussed above. GHD considers that laboratory results are acceptable for interpretation with regards for assessing the risk of the residual contamination at the Site and the impact of contamination to affected properties.	Yes
	Field equipment was calibrated by equipment supplier.	Yes
Accuracy	Sufficient quantities of field blanks, rinsate blanks and transport blanks were collected and analysed, with results indicating no cross-contamination. Sampling procedures ensured that collection, preservation and laboratory analytical techniques were appropriate for analysis of environmental contaminants.	Yes
	Sufficient quantities of internal laboratory method blanks, surrogate spikes and laboratory control samples were analysed to determine laboratory accuracy, with the majority of samples within defined limits. Laboratory QA/QC samples were generally reported within the acceptance limits specified.	Yes

GHD considers that these data are reliable and can be used to enhance an understanding of the groundwater conditions and residual soil contamination conditions at the Site as the aforementioned quality control breaches are minor and are unlikely to impact the overall interpretation of the analytical results.

Data Management

All data was stored in an electronic format as well as produced in hard copy. The electronic data will be stored in an Environmental Data Management Software database (ESdat). This database will store all current and historic data for interpretation in the RVR. The hard copies will be stored along with chain of custody forms in the project file.

Summary

GHD considers that the data obtained through the groundwater assessment is reliable and can be used in relation to the establishment of groundwater quality and interpreted risks. Aside from the LOR for the chromium speciation analysis not meeting the required adopted assessment criteria (discussed further in Section 8), aforementioned quality control breaches are minor and are unlikely to impact the overall interpretation of the analytical results.

Appendix F – Groundwater well construction logs

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELL MW04

Client Shire of Denmark
Project Hardy Street Remediation Project
Project No. 6137639
Site Lot 3002, Hardy St
Location Centre of Site
Date Drilled 17/03/2020

Drill Co. SWD
Driller Ian MacPherson
Rig Type GeoProbe
Drill Method HA + HFA + Drill tubes
Total Depth (m) 4.5
Diameter (mm) 50

Easting, Northing 531918.314, 6131358.055
Grid Ref GDA94_MGA_zone_50
Elevation 25.9
Collar RL 26.39
Logged By PY
Checked By JC

B.C.L No. N/A **Casing** PVC **Screen** PVC slotted 0.4 **Surface Completion** Steel Riser

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	HA				Concrete		SILTY SAND, very dark brown/black, crumbly	D	MD	No odour, black staining, fill	25.8
0.8	HFA				Bentonite						
2				▽			SILTY SAND, light/dark brown/grey, dense, crumbly	SM	D	No odour, no staining, fill	23.8
2.8					Gravel						
3							SILTY SAND, very dark brown/black, moist	M	D	No odour, black staining, fill	22.8
4.5							Termination Depth at: 4.50 m				21.4

Notes

This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	**Granular Soils** VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	**Cohesive Soils** VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELL MW05

Client Shire of Denmark
Project Hardy Street Remediation Project
Project No. 6137639
Site Lot 3002, Hardy St
Location Offsite - north-east
Date Drilled 18/03/2020

Drill Co. SWD
Driller Ian MacPherson
Rig Type GeoProbe
Drill Method HA + Drill tubes
Total Depth (m) 3
Diameter (mm) 50

Easting, Northing 532003.599, 6131353.386
Grid Ref GDA94_MGA_zone_50
Elevation 20.37
Collar RL 20.835
Logged By PY
Checked By JC

B.C.L No. N/A **Casing** PVC **Screen** PVC slotted 0.4 **Surface Completion** Steel Riser

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	HA				Concrete		SILTY SAND, black/light grey, top soil, loose	D	L	No odour, no staining, leaf litter, natural soil	20.2
0.2											
0.4					Bentonite						20
0.6											19.8
0.8	PT						SAND, brown, hard cemented layer	D	H	No odour, no staining, natural	19.6
1							SILTY SAND, brown, crumbly, poorly sorted with traces of rock.	D	D	No odour, no staining, natural	19.4
1.2											19.2
1.4											19
1.6				▽			CLAY/ WEATHERED GRANITE, white, hard	D	H	No odour, no staining, natural	18.8
1.8					Gravel						18.6
2											18.4
2.2											18.2
2.4											18
2.6											17.8
2.8											17.6
3											17.4
3.2							Termination Depth at: 3.00 m				17.2
3.4											17
3.6											16.8
3.8											16.6
4											16.4
4.2											16.2
4.4											16
4.6											15.8
4.8											15.6
											15.4

Notes

This log is not intended for geotechnical purposes.

Drilling Abbreviations

AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler

Moisture Abbreviations

D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated

Consistency Abbreviations

Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense

Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELL MW06

Client Shire of Denmark
Project Hardy Street Remediation Project
Project No. 6137639
Site Lot 3002, Hardy St
Location Offsite - east
Date Drilled 18/03/2020

Drill Co. SWD
Driller Ian MacPherson
Rig Type GeoProbe
Drill Method HA + Drill tubes
Total Depth (m) 3
Diameter (mm) 50

Easting, Northing 531998.436, 6131385.626
Grid Ref GDA94_MGA_zone_50
Elevation 19.13
Collar RL 19.631
Logged By PY
Checked By JC

B.C.L No. N/A **Casing** PVC **Screen** PVC slotted 0.4 **Surface Completion** Steel Riser

Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	HA				Concrete		SILTY SAND, brown/orange, crumbly, poorly sorted with traces of roots.	D	D	No odour, no staining, leaf litter, natural soil	19
0.2											
0.4					Bentonite						18.8
0.6				▽			SILTY SAND, light brown/orange, crumbly, iron stained	D	D	Very little (not strong) odour from iron staining, natural	18.6
0.8	PT										18.4
1											18.2
1.2							SAND, brown, small cemented sand layer	D	VD	No odour, no staining, natural	18
1.4											17.8
1.6							CLAY/ WEATHERED GRANITE, white, iron staining (orange/red)	D	H	Very little (not strong) odour from iron staining, natural	17.6
1.8					Gravel						17.4
2											17.2
2.2							CLAY/ WEATHERED GRANITE, white, hard	D	H	No odour, no staining, natural	17
2.4											16.8
2.6											16.6
2.8											16.4
3							Termination Depth at: 3.00 m				16.2
3.2											16
3.4											15.8
3.6											15.6
3.8											15.4
4											15.2
4.2											15
4.4											14.8
4.6											14.6
4.8											14.4
											14.2

Notes

This log is not intended for geotechnical purposes.

Drilling Abbreviations

AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler

Moisture Abbreviations

D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated

Consistency Abbreviations

Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense

Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

Appendix G – GME field sheets

Groundwater Monitoring – Field Sheet

Client:			BORE ID: MB1
Project: Hardy St, Dunmark			Job No.: 12510838
Location:	Casing diameter: 50 mm		Date: 3/6/20.

BORE CONSTRUCTION

Head-works	☐ Flush-mount	☑ Monument	☐ Casing only	☐ Locked	Measurement Point	☐ Top of PVC Casing	Total Depth: 2.96–3.03 m (feels sludgy at bottom)

BORE DEVELOPMENT

Method:	Date:	Undertaken By:	Vol. Removed: L

Comments (e.g. sediment content):

PURGING DETAILS (measurement points in meters below top of casing as indicated above)

Method: Peri pump	Water Quality Meter used: YSI		Undertaken By: DY
Depth to water: 2.33 m	Water Column: 0.63 m	Req Purge Vol. [1]: — L	Flow Rate: — L/min
Presence of LNAPL ☐	Presence of DNAPL ☐	Thickness of NAPL: — cm	Depth to NAPL: — m
Pump intake: — m			

PURGING MEASUREMENTS [2]

Vol. Purged (L)	Elapsed Time (min)	EC (µS/cm)	Temp. (°C)	TDS (ppm|mg/L)	pH	DO %Sat	DO (ppm|mg/L)	Eh (mV)	Water Level (m b TOC)
AS 5667.11: 1998 (<+/-)		10%	0.2 °C	-	10%	10%	10%	-	-
0.5	1 min	1152	18.8	747.50	5.53	5.9	0.54	105.9	
1	2 min	1151	18.9	747.50	5.38	3.5	0.32	106.8	
1.5	2 min.	1152	18.9	747.50	5.33	3.7	0.34	109.6	
2	2 min.	1157	18.9	747.50	5.32	3.8	0.35	109.7	
2.5	2 min.	1153	18.9	747.50	5.31	3.7	0.34	109.8	
3	2 min	1153	19.0	747.50	5.30	3.6	0.33	109.9	

3L ~10min

Comments (e.g. condition of headworks, sheen, colour, odour, sediment load):

no sheen/odour. Low sed load, light brown colour.

SAMPLING DETAILS

Time: 2.15 pm	Vol. Removed: 3 L	Sample ID: MB1
		No of Sample Containers: 5

Type of Sample Containers (i.e. P = Plastic/G = Glass/V = Vial, volume and p = preserved/up = unpreserved):

P (up & p)

Field Filtered ☑	Duplicate Samples ☐	Duplicate Sample ID:

Comments:

CoC Number:	Checked by:	Date:

1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID – 2 L/m; 100 mm ID 8 L/m.

2 Calibration details to be recorded in the instrument –specific calibration book, or in field notes as required by local procedures.

Groundwater Monitoring – Field Sheet

Client:			BORE ID: MB2
Project: Hardy St, Denmark			Job No.: 12510838
Location:	Casing diameter: 50 mm		Date: 3/6/22

BORE CONSTRUCTION

Head-works	☐ Flush-mount	☑ Monument	☐ Casing only	☐ Locked	Measurement Point	☐ Top of PVC Casing	Total Depth: 8.33 m

BORE DEVELOPMENT

Method:	Date:	Undertaken By:	Vol. Removed: L

Comments (e.g. sediment content):

PURGING DETAILS (measurement points in meters below top of casing as indicated above)

Method: Peristaltic pump	Water Quality Meter used: YSI		Undertaken By: PY
Depth to water: 2.97 m	Water Column: 5.36 m	Req Purge Vol. [1]: L	Flow Rate: L/min
Presence of LNAPL ☐	Presence of DNAPL ☐	Thickness of NAPL: cm	Depth to NAPL: m
Pump intake: m			

PURGING MEASUREMENTS [2]

Vol. Purged (L)	Elapsed Time (min)	EC (µS/cm)	Temp. (°C)	TDS (ppm|mg/L)	pH	DO %Sat	DO (ppm|mg/L)	Eh (mV)	Water Level (m b TOC)
AS 5667.11: 1998 (<+/-)		10%	0.2°C	-	10%	10%	10%	-	-
1 L	2 min	1446	18.2	942.50	5.55	3.8	0.35	56.1	
2 L	4 min.	1450	18.1	942.50	5.55	3.7	0.36	57.4	
2.5 L	6 min.	1518	18.1	988.00	5.55	3.8	0.36	55.3	
3 L	8 min	1558	18.1	1014.00	5.56	4.3	0.41	53.6	
3.5 L	10 min	1654	18.1	1072.50	5.57	5.4	0.51	51.5	
4 L	12 min.	1669	18.1	1085.00	5.58	6.6	0.62	48.0	
4.5 L	13 min	1770	18.1	1150.00	5.58	8.1	0.76	46.3	
5 L	14 min	1789	18.1	1163.50	5.59	8.5	0.80	44.5	

Comments (e.g. condition of headworks, sheen, colour, odour, sediment load):

almost clear, no sheen/odour/sed load.

SAMPLING DETAILS

Time: 3.45 pm	Vol. Removed: 4 L	Sample ID: MB2
		No of Sample Containers: 5

Type of Sample Containers (i.e. P = Plastic/G = Glass/V = Vial, volume and p = preserved/up = unpreserved):

P (up & p)

Field Filtered ☑	Duplicate Samples ☐	Duplicate Sample ID:

Comments:

CoC Number:	Checked by:	Date:

1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID – 2 L/m; 100 mm ID 8 L/m.

2 Calibration details to be recorded in the instrument –specific calibration book, or in field notes as required by local procedures.

Groundwater Monitoring – Field Sheet

Client:			BORE ID: MB3
Project: Hardy St, Denmark			Job No.: 12510838
Location:	Casing diameter: 50 mm		Date: 3/6/20.

BORE CONSTRUCTION

Head-works	☐ Flush-mount	☑ Monument	☐ Casing only	☐ Locked	Measurement Point	☐ Top of PVC Casing	Total Depth: 6.03 m

BORE DEVELOPMENT

Method:	Date:	Undertaken By:	Vol. Removed: L

Comments (e.g. sediment content):

PURGING DETAILS (measurement points in meters below top of casing as indicated above)

Method: Peri pump	Water Quality Meter used: YSI		Undertaken By: DY
Depth to water: 1.33 m	Water Column: 4.7 m	Req Purge Vol. [1]: L	Flow Rate: L/min
Presence of LNAPL ☐	Presence of DNAPL ☐	Thickness of NAPL: cm	Depth to NAPL: m
Pump intake: m			

PURGING MEASUREMENTS [2]

Vol. Purged (L)	Elapsed Time (min)	EC (µS/cm)	Temp. (°C)	TDS (ppm|mg/L)	pH	DO %Sat	DO (ppm|mg/L)	Eh (mV)	Water Level (m b TOC)
AS 5667.11: 1998 (<+/-)		10%	0.2°C	-	10%	10%	10%	-	-
1L	2min	1764	17.6	1144.00	6.02	2.3	0.22	-16.7	
1.5L	4 min	1761	17.6	1144.00	6.02	1.7	0.16	-23.9	
2L	6 min.	1755	17.6	1144.00	6.02	2.1	0.21	-32.7	
2.5L	8 min.	1755	17.6	1144.00	6.02	3.1	0.30	-37.1	
3L	10 min	1756	17.6	1144.00	6.03	3.2	0.31	-39.9	

~3L in 12 min

Comments (e.g. condition of headworks, sheen, colour, odour, sediment load):

Very Light ~~yellow~~ brown colour, no sheen/odour, slight to no sed load.

SAMPLING DETAILS

Time: 1.30 pm	Vol. Removed: 3 L	Sample ID: MB3
		No of Sample Containers: 5

Type of Sample Containers (i.e. P = Plastic/G = Glass/V = Vial, volume and p = preserved/up = unpreserved):

P (up 4p)

Field Filtered ☑	Duplicate Samples ☐	Duplicate Sample ID:

Comments:

CoC Number:	Checked by:	Date:

1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID – 2 L/m; 100 mm ID 8 L/m.

2 Calibration details to be recorded in the instrument –specific calibration book, or in field notes as required by local procedures.

Groundwater Monitoring – Field Sheet

Client:			BORE ID: MW4
Project: Hardy St, Denmark			Job No.: 12510838
Location: "	Casing diameter: 50 mm		Date: 3/6/20.

BORE CONSTRUCTION

Head-works	☐ Flush-mount	☑ Monument	☐ Casing only	☐ Locked	Measurement Point	☐ Top of PVC Casing	Total Depth: 4.47 m

BORE DEVELOPMENT

Method:	Date:	Undertaken By:	Vol. Removed: L

Comments (e.g. sediment content):

PURGING DETAILS (measurement points in meters below top of casing as indicated above)

Method: Peri pump	Water Quality Meter used: YSI		Undertaken By: MY
Depth to water: 2.53 m	Water Column: 1.93 m	Req Purge Vol. [1]: L	Flow Rate: L/min
Presence of LNAPL ☐	Presence of DNAPL ☐	Thickness of NAPL: cm	Depth to NAPL: m
Pump intake: m			

PURGING MEASUREMENTS [2]

Vol. Purged (L)	Elapsed Time (min)	EC (µS/cm)	Temp. (°C)	TDS (ppm|mg/L)	pH	DO %Sat	DO (ppm|mg/L)	Eh (mV)	Water Level (m b TOC)
AS 5667.11: 1998 (<+/-)		10%	0.2 °C	-	10%	10%	10%	-	-
0.5	1 min	989	18.2	643.50	5.38	2.5	0.23	19.5	
1	1 min	990	18.1	643.50	5.38	3.4	0.32	15.4	
1.5L	1 min.	997	18.0	650.00	5.41	3.5	0.33	9.5	
2L	2 min	996	18.0	650.00	5.43	4.7	0.44	7.2	
2.5	1 min	991	17.9	643.50	5.46	5.5	0.52	4.4	
3	1 min.	991	17.9	643.50	5.49	7.8	0.73	3.1	
3.5	1 min.	988	18.0	643.50	5.51	8.6	0.81	2.2	
(NAL)									

Comments (e.g. condition of headworks, sheen, colour, odour, sediment load):

Slight Organic odour, no sheen, pale yellow colour, slight to no sed load.

SAMPLING DETAILS

Time: 3 pm.	Vol. Removed: 3.5 L	Sample ID: MW4.
		No of Sample Containers: 5

Type of Sample Containers (i.e. P = Plastic/G = Glass/V = Vial, volume and p = preserved/up = unpreserved):

P (up & p).

Field Filtered ☑	Duplicate Samples ☐	Duplicate Sample ID:

Comments:

CoC Number:	Checked by:	Date:

1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID – 2 L/m; 100 mm ID 8 L/m.

2 Calibration details to be recorded in the instrument –specific calibration book, or in field notes as required by local procedures.

Groundwater Monitoring – Field Sheet

Client:			BORE ID: MW5
Project: Hardy St, Denmark			Job No.: 12510838
Location: n.	Casing diameter: 50 mm		Date: 3/6/20

BORE CONSTRUCTION

Head-works	☐ Flush-mount	☑ Monument	☐ Casing only	☐ Locked	Measurement Point	☐ Top of PVC Casing	Total Depth: 3.425 m

BORE DEVELOPMENT

Method:	Date:	Undertaken By:	Vol. Removed: L

Comments (e.g. sediment content):

PURGING DETAILS (measurement points in meters below top of casing as indicated above)

Method: Peristaltic pump	Water Quality Meter used: YSI.		Undertaken By: PY
Depth to water: 2.055 m	Water Column: 1.37 m	Req Purge Vol. [1]: L	Flow Rate: L/min
Presence of LNAPL ☐	Presence of DNAPL ☐	Thickness of NAPL: cm	Depth to NAPL: m
Pump intake: m			

PURGING MEASUREMENTS [2]

Vol. Purged (L)	Elapsed Time (min)	EC (µS/cm)	Temp. (°C)	TDS (ppm|mg/L)	pH	DO %Sat	DO (ppm|mg/L)	Eh (mV)	Water Level (m b TOC)
AS 5667.11: 1998 (<+/-)		10%	0.2 °C	-	10%	10%	10%	-	-
1 L	1 min	1770	16.8	1202.50	6.73	19.3	1.85	82.9	
~~2~~ 1.5	2 min	1591	16.9	1183.00	6.23	19.5	2.05	91.2	
~~3~~ 2	3 min	968	17.1	624.00	5.96	37.6	3.78	98.1	
~~3~~ 2.5 L	.5 min	1799	17.1	1170.00	5.74	32.8	2.95	102.8	
3 L	7 min	1675	17.2	1085.50	5.59	43.6	4.17	106.8	
3.5 L	9 min	1743	17.2	1137.00	5.57	39.2	3.80	110.2	
4	11 min	1748	17.4	1137.50	5.55	52.7	5.08	111.8	2.695

2.5-3L 15-2min

Comments (e.g. condition of headworks, sheen, colour, odour, sediment load):

very light pale yellow (almost clear), no sheen/odour/sed load.

SAMPLING DETAILS

Time: 11 am	Vol. Removed: 3 L	Sample ID:
		No of Sample Containers: 5

Type of Sample Containers (i.e. P = Plastic/G = Glass/V = Vial, volume and p = preserved/up = unpreserved):

P (P & up)

Field Filtered ☑	Duplicate Samples ☐	Duplicate Sample ID:

Comments:

CoC Number:	Checked by:	Date:

1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID – 2 L/m; 100 mm ID 8 L/m.

2 Calibration details to be recorded in the instrument –specific calibration book, or in field notes as required by local procedures.

Groundwater Monitoring – Field Sheet

Client:			BORE ID: MW6
Project: Hardy St, Denmark			Job No.: 12510838
Location:	Casing diameter: 50 mm		Date: 3/6/20

BORE CONSTRUCTION

Head-works	☐ Flush-mount	☑ Monument	☐ Casing only	☐ Locked	Measurement Point	☐ Top of PVC Casing	Total Depth: 3.43 m

BORE DEVELOPMENT

Method:	Date:	Undertaken By:	Vol. Removed: L
Comments (e.g. sediment content):			

PURGING DETAILS (measurement points in meters below top of casing as indicated above)

Method: Peri pump	Water Quality Meter used: YSI		Undertaken By: PY
Depth to water: 1.115 m	Water Column: 2.31 m	Req Purge Vol. [1]: L	Flow Rate: L/min
Presence of LNAPL ☐	Presence of DNAPL ☐	Thickness of NAPL: cm	Depth to NAPL: m
Pump intake: m			

PURGING MEASUREMENTS [2]

Vol. Purged (L)	Elapsed Time (min)	EC (µS/cm)	Temp. (°C)	TDS (ppm|mg/L)	pH	DO %Sat	DO (ppm|mg/L)	Eh (mV)	Water Level (m b TOC)
AS 5667.11: 1998 (<+/-)		10%	0.2°C	-	10%	10%	10%	-	-
1L	2 min.	1520	17.1	988.00	5.84	3.3	0.32	102.0	
2L	4 min.	1514	17.1	981.50	5.84	3.2	0.31	101.5	
3L	6 min	1510	17.1	981.50	5.83	3.1	0.29	100.4	
4L	8 min.	1508	17.2	981.50	5.83	3.7	0.36	99.6	

3.5 L ~12 min

Comments (e.g. condition of headworks, sheen, colour, odour, sediment load):

Almost clear, no sheen/odour/sed load.

SAMPLING DETAILS

Time: 12.00 pm	Vol. Removed: 3.5 L	Sample ID: MW6
Type of Sample Containers (i.e. P = Plastic/G = Glass/V = Vial, volume and p = preserved/up = unpreserved):		No of Sample Containers: 5, 4, 4
P (up & p)		
Field Filtered ☑	Duplicate Samples ☑	Duplicate Sample ID: FD1, FS1., Lab QA/QC.
Comments:		

CoC Number:	Checked by:	Date:

1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID – 2 L/m; 100 mm ID 8 L/m.

2 Calibration details to be recorded in the instrument –specific calibration book, or in field notes as required by local procedures.

Appendix H – Laboratory certificates of analysis and Chain of custody

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD
Level 10, 999 Hay Street, Perth WA 6000 — PO Box 3106, Perth WA 6832 — Reception Ph: 08 6222 8222

Page 1 of 1

Project ID *(as per ESdat set up; no spaces)*: 12510838

PO Number (to be invoiced):

Laboratory Quote No.: EP/195/20 V3.

Turnaround Time: Standard

Job Manager (Invoice) & GHD accounts: jon.cramer@ghd.com

Email Address (Results): jon.cramer@ghd.com

Laboratory: ALS
Address: 26 Rigali Way, Wangara WA
Laboratory Contact: 94061301.

GHD Sample ID	Lab Sample ID	Date	Time	Sample Matrix S-Soil/SL-Sludge/W-Water/A-Air	Container Type B-Bottle/J-Jar/V-Vial/Bag/G-Glass/P-Plastic	Container Preservative Unpreserved/HCl/H2SO4/HNO3/Other	Container No	EG020F	EG050G-F	EG046G-F	EP131A	W-07	W-04	W-18	EN020T	HOLD	Remarks
MB1 11	~~SNR~~	3/6/20		W				✓	✓	✓	✓	✓					xPlease make sure the results can ~~meet the~~ fresh water guidelines at 95% ~~confidence~~ limit.
MB2	2							✓	✓	✓	✓	✓					
MB3	3							✓	✓	✓	✓	✓					
MW4	4							✓	✓	✓	✓	✓					
MW5	5							✓	✓	✓	✓	✓					
MW6	6							✓	✓	✓	✓	✓					
FD1	7							✓	✓	✓			✓				
RB1	8														✓		
FB1	9													✓			
TBW173	10																Please forward FS1 - split samples to Eurofins Lab. (2/91 Leach Highway, Kewdale).

Environmental Division
Perth
Work Order Reference
EP2005871

Telephone : 61-8-9406 1301

Sampled by: Pooranie Yogamenthan (PY).	Date/Time: 3/6/20	Relinquished by: M.	Date/Time: 4/6/20.
Received by: DUFFY	Date/Time: 9/6/20 1310	Relinquished by:	Date/Time:

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2005871**	Page	: 1 of 9
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JON CRAMER	Contact	: Marnie Thomsett
Address	: 999 HAY STREET PERTH WA, AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 9964 3677	Telephone	: 08 9406 1311
Project	: 12510838	Date Samples Received	: 08-Jun-2020 13:10
Order number	: 12510838	Date Analysis Commenced	: 09-Jun-2020
C-O-C number	: ----	Issue Date	: 15-Jun-2020 18:04
Sampler	: Pooranie Yoganathan		
Site	:		
Quote number	: EP/195/20 V3		
No. of samples received	: 10		
No. of samples analysed	: 10		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Vanessa Nguyen	Organic Chemist	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB2	MB3	MW4	MW5	MW6
				Client sampling date / time	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EP2005871-002	EP2005871-003	EP2005871-004	EP2005871-005	EP2005871-006
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Chromium	7440-47-3	0.001	mg/L		<0.001	**0.001**	**0.001**	**0.002**	<0.001
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L		<0.001	**0.005**	**0.003**	**0.009**	**0.002**
Zinc	7440-66-6	0.005	mg/L		**0.015**	**0.043**	**0.011**	**0.087**	**0.013**
EG049F: Dissolved Trivalent Chromium									
Trivalent Chromium	16065-83-1	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EG050F: Dissolved Hexavalent Chromium									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB2	MB3	MW4	MW5	MW6
				Client sampling date / time	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EP2005871-002	EP2005871-003	EP2005871-004	EP2005871-005	EP2005871-006
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP131A: Organochlorine Pesticides									
Aldrin	309-00-2	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
alpha-BHC	319-84-6	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
beta-BHC	319-85-7	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
delta-BHC	319-86-8	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
4.4`-DDD	72-54-8	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
4.4`-DDE	72-55-9	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
4.4`-DDT	50-29-3	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
Dieldrin	60-57-1	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
alpha-Endosulfan	959-98-8	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
beta-Endosulfan	33213-65-9	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
Endosulfan sulfate	1031-07-8	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
^ Endosulfan (sum)	115-29-7	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
Endrin	72-20-8	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
Endrin aldehyde	7421-93-4	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB2	MB3	MW4	MW5	MW6
				Client sampling date / time	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EP2005871-002	EP2005871-003	EP2005871-004	EP2005871-005	EP2005871-006
					Result	Result	Result	Result	Result
EP131A: Organochlorine Pesticides - Continued									
Endrin ketone	53494-70-5	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
Heptachlor	76-44-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Heptachlor epoxide	1024-57-3	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
Hexachlorobenzene (HCB)	118-74-1	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
gamma-BHC	58-89-9	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
Methoxychlor	72-43-5	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
cis-Chlordane	5103-71-9	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
trans-Chlordane	5103-74-2	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
^ Total Chlordane (sum)	----	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
Oxychlordane	27304-13-8	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.010	µg/L		<0.010	<0.010	<0.010	<0.010	<0.010
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1.0	%		**27.6**	**11.6**	**11.5**	**28.8**	**27.7**
2-Chlorophenol-D4	93951-73-6	1.0	%		**44.6**	**57.2**	**54.1**	**43.4**	**41.1**
2.4.6-Tribromophenol	118-79-6	1.0	%		**63.7**	**74.5**	**82.1**	**68.4**	**56.5**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1.0	%		**59.8**	**78.2**	**79.0**	**64.6**	**56.9**
Anthracene-d10	1719-06-8	1.0	%		**68.3**	**70.8**	**87.4**	**71.8**	**55.3**
4-Terphenyl-d14	1718-51-0	1.0	%		**114**	**112**	**125**	**114**	**95.8**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**72.7**	**71.4**	**71.4**	**74.0**	**75.2**
Toluene-D8	2037-26-5	2	%		**116**	**116**	**118**	**117**	**114**
4-Bromofluorobenzene	460-00-4	2	%		**83.0**	**79.4**	**79.5**	**79.4**	**81.0**
EP131S: OC Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.010	%		**104**	**105**	**95.7**	**91.5**	**99.6**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	FD1	RB1	FB1	TBW173	MB1
			Client sampling date / time	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2005871-007	EP2005871-008	EP2005871-009	EP2005871-010	EP2005871-011
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS								
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.002**	----	----	----	**0.011**
Zinc	7440-66-6	0.005	mg/L	**0.011**	----	----	----	**0.062**
EG020T: Total Metals by ICP-MS								
Lead	7439-92-1	0.001	mg/L	----	<0.001	----	----	----
Nickel	7440-02-0	0.001	mg/L	----	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	----	<0.005	----	----	----
EG049F: Dissolved Trivalent Chromium								
Trivalent Chromium	16065-83-1	0.01	mg/L	<0.01	----	----	----	<0.01
EG050F: Dissolved Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	----	----	----	<0.01
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	----	----	----	----	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	----	----	----	----	<1.0
Acenaphthene	83-32-9	1.0	µg/L	----	----	----	----	<1.0
Fluorene	86-73-7	1.0	µg/L	----	----	----	----	<1.0
Phenanthrene	85-01-8	1.0	µg/L	----	----	----	----	<1.0
Anthracene	120-12-7	1.0	µg/L	----	----	----	----	<1.0
Fluoranthene	206-44-0	1.0	µg/L	----	----	----	----	<1.0
Pyrene	129-00-0	1.0	µg/L	----	----	----	----	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	----	----	----	----	<1.0
Chrysene	218-01-9	1.0	µg/L	----	----	----	----	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	----	----	----	----	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	----	----	----	----	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	----	----	----	----	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	----	----	----	----	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	----	----	----	----	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	----	----	----	----	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	----	----	----	----	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	----	----	----	----	<0.5
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	----	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	<50

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	FD1	RB1	FB1	TBW173	MB1
				Client sampling date / time	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EP2005871-007	EP2005871-008	EP2005871-009	EP2005871-010	EP2005871-011
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons - Continued									
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	<100
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	----	----	----	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	----	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L		<100	----	----	----	<100
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	<100
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	----	----	----	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	----	----	----	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	----	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		<2	----	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	----	<2	<2	<2
^ Total Xylenes	----	2	µg/L		<2	----	<2	<2	<2
^ Sum of BTEX	----	1	µg/L		<1	----	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	----	<5	<5	<5
EP131A: Organochlorine Pesticides									
Aldrin	309-00-2	0.010	µg/L		----	----	----	----	<0.010
alpha-BHC	319-84-6	0.010	µg/L		----	----	----	----	<0.010
beta-BHC	319-85-7	0.010	µg/L		----	----	----	----	<0.010
delta-BHC	319-86-8	0.010	µg/L		----	----	----	----	<0.010
4.4`-DDD	72-54-8	0.010	µg/L		----	----	----	----	<0.010
4.4`-DDE	72-55-9	0.010	µg/L		----	----	----	----	<0.010
4.4`-DDT	50-29-3	0.010	µg/L		----	----	----	----	<0.010
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.010	µg/L		----	----	----	----	<0.010
Dieldrin	60-57-1	0.010	µg/L		----	----	----	----	<0.010
alpha-Endosulfan	959-98-8	0.010	µg/L		----	----	----	----	<0.010
beta-Endosulfan	33213-65-9	0.010	µg/L		----	----	----	----	<0.010

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	FD1	RB1	FB1	TBW173	MB1
				Client sampling date / time	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00	03-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EP2005871-007	EP2005871-008	EP2005871-009	EP2005871-010	EP2005871-011
					Result	Result	Result	Result	Result
EP131A: Organochlorine Pesticides - Continued									
Endosulfan sulfate	1031-07-8	0.010	µg/L		----	----	----	----	<0.010
^ Endosulfan (sum)	115-29-7	0.010	µg/L		----	----	----	----	<0.010
Endrin	72-20-8	0.010	µg/L		----	----	----	----	<0.010
Endrin aldehyde	7421-93-4	0.010	µg/L		----	----	----	----	<0.010
Endrin ketone	53494-70-5	0.010	µg/L		----	----	----	----	<0.010
Heptachlor	76-44-8	0.005	µg/L		----	----	----	----	<0.005
Heptachlor epoxide	1024-57-3	0.010	µg/L		----	----	----	----	<0.010
Hexachlorobenzene (HCB)	118-74-1	0.010	µg/L		----	----	----	----	<0.010
gamma-BHC	58-89-9	0.010	µg/L		----	----	----	----	<0.010
Methoxychlor	72-43-5	0.010	µg/L		----	----	----	----	<0.010
cis-Chlordane	5103-71-9	0.010	µg/L		----	----	----	----	<0.010
trans-Chlordane	5103-74-2	0.010	µg/L		----	----	----	----	<0.010
^ Total Chlordane (sum)	----	0.010	µg/L		----	----	----	----	<0.010
Oxychlordane	27304-13-8	0.010	µg/L		----	----	----	----	<0.010
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.010	µg/L		----	----	----	----	<0.010
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1.0	%		----	----	----	----	**10.4**
2-Chlorophenol-D4	93951-73-6	1.0	%		----	----	----	----	**52.0**
2.4.6-Tribromophenol	118-79-6	1.0	%		----	----	----	----	**63.1**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1.0	%		----	----	----	----	**70.1**
Anthracene-d10	1719-06-8	1.0	%		----	----	----	----	**68.6**
4-Terphenyl-d14	1718-51-0	1.0	%		----	----	----	----	**118**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**71.6**	----	**68.5**	**68.9**	**69.8**
Toluene-D8	2037-26-5	2	%		**117**	----	**118**	**121**	**113**
4-Bromofluorobenzene	460-00-4	2	%		**79.0**	----	**78.1**	**80.0**	**79.5**
EP131S: OC Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.010	%		----	----	----	----	**98.1**

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	67
2-Chlorophenol-D4	93951-73-6	29	120
2.4.6-Tribromophenol	118-79-6	10	131
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	34	131
Anthracene-d10	1719-06-8	43	126
4-Terphenyl-d14	1718-51-0	41	142
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	61	141
Toluene-D8	2037-26-5	73	126
4-Bromofluorobenzene	460-00-4	60	125
EP131S: OC Pesticide Surrogate			
Dibromo-DDE	21655-73-2	14	166

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2005871**	Page	: 1 of 6
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JON CRAMER	Telephone	: 08 9406 1311
Project	: 12510838	Date Samples Received	: 08-Jun-2020
Site	:	Issue Date	: 15-Jun-2020
Sampler	: Pooranie Yoganathan	No. of samples received	: 10
Order number	: 12510838	No. of samples analysed	: 10

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count QC	Count Regular	Rate (%) Actual	Rate (%) Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
Organochlorine Pesticides (Ultra-trace)	0	9	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	0	16	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	18	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Organochlorine Pesticides (Ultra-trace)	0	9	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	0	16	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	18	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG020A-F)							
MB2, MB3, MW4, MW5, MW6, FD1, MB1	**03-Jun-2020**	**----**	----	----	**10-Jun-2020**	30-Nov-2020	✓
EG020T: Total Metals by ICP-MS							
Clear HDPE (U-T ORC) - Unfiltered; Lab-acidified (EG020A-T)							
RB1	**03-Jun-2020**	**09-Jun-2020**	30-Nov-2020	✓	**09-Jun-2020**	30-Nov-2020	✓
EG050F: Dissolved Hexavalent Chromium							
Clear Plastic Bottle - NaOH Filtered (EG050G-F)							
MB2, MB3, MW4, MW5, MW6, FD1, MB1	**03-Jun-2020**	**----**	----	----	**10-Jun-2020**	01-Jul-2020	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM))							
MB2, MB3, MW4, MW5, MW6, MB1	**03-Jun-2020**	**10-Jun-2020**	10-Jun-2020	✓	**12-Jun-2020**	20-Jul-2020	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
MB2, MB3, MW4, MW5, MW6, FD1, MB1	**03-Jun-2020**	**10-Jun-2020**	10-Jun-2020	✓	**12-Jun-2020**	20-Jul-2020	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
MB2, MB3, MW4, MW5, MW6, FD1, FB1, TBW173, MB1	**03-Jun-2020**	**10-Jun-2020**	17-Jun-2020	✓	**10-Jun-2020**	17-Jun-2020	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071)							
MB2, MB3, MW4, MW5, MW6, FD1, MB1	**03-Jun-2020**	**10-Jun-2020**	10-Jun-2020	✓	**12-Jun-2020**	20-Jul-2020	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
MB2, MB3, MW4, MW5, MW6, FD1, FB1, TBW173, MB1	**03-Jun-2020**	**10-Jun-2020**	17-Jun-2020	✓	**10-Jun-2020**	17-Jun-2020	✓
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080)							
MB2, MB3, MW4, MW5, MW6, FD1, FB1, TBW173, MB1	**03-Jun-2020**	**10-Jun-2020**	17-Jun-2020	✓	**10-Jun-2020**	17-Jun-2020	✓
EP131A: Organochlorine Pesticides							
Amber Glass Bottle - Unpreserved (EP131A)							
MB2, MB3, MW4, MW5, MW6, MB1	**03-Jun-2020**	**09-Jun-2020**	10-Jun-2020	✓	**09-Jun-2020**	19-Jul-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Discrete Analyser - Dissolved	EG050G-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	0	9	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	16	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	3	**66.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	18	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Discrete Analyser - Dissolved	EG050G-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Discrete Analyser - Dissolved	EG050G-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Discrete Analyser - Dissolved	EG050G-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organochlorine Pesticides (Ultra-trace)	EP131A	0	9	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	16	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	18	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Trivalent Chromium - Dissolved	EG049G-F	WATER	In house: Referenced to APHA 3500 Cr-B & 3120/3125. Trivalent Chromium is the difference between total dissolved and dissolved hexavalent chromium.
Hexavalent Chromium by Discrete Analyser - Dissolved	EG050G-F	WATER	In house: Referenced to APHA 3500 Cr-A & B. Samples are 0.45µm filtered prior to analysis. Hexavalent chromium is determined directly on water sample by Descrete Analyser as received by pH adjustment and colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270E Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260D Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
Organochlorine Pesticides (Ultra-trace)	EP131A	WATER	In house: Referenced to USEPA Method 3640 (GPC cleanup),3620 (Florisil), 8081/8082 (GC/µECD/uECD). This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

Preparation Methods	Method	Matrix	Method Descriptions
Sep. Funnel Extraction of Liquids (Ultra-trace pesticides.)	ORG14-UTP	WATER	In house: Referenced to USEPA 3510 Samples are extracted into dichloromethane, concentrated and exchanged into an apporpriate solvent for GPC and florisil cleanup as required. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD
Level 10, 999 Hay Street, Perth WA 6000 — PO Box 3106, Perth WA 6832 — Reception Ph: 08 6222 8222

Page 1 of 1

Project ID *(as per ESdat set up; no spaces)*: 12510838

PO Number (to be invoiced):

Laboratory: Eurofins

Address: 2/91 Leach Highway, Kewdale WA 6105

Laboratory Contact: Robert Johnston 08 9251 9605

Laboratory Quote No.:

Turnaround Time: Standard

Job Manager (Invoice) & GHD accounts: jon.cramer@ghd.com

Email Address (Results): jon.cramer@ghd.com

GHD Sample ID	Lab Sample ID	Date	Time	Sample Matrix S-Soil/ SL-Sludge/ W-Water/ A-Air	Container: Type B-Bottle/J-Jar/V-Vial/Bag/G-Glass/P-Plastic	Container: Preservative Unpreserved/ HCl/ H2SO4/HNO3/Other	Container: No	Analyses: Dissolved Metals by ICP/MS - Cr, Pb, Ni, Zn	Analyses: Dissolved Hexavalent Chromium	Analyses: Dissolved Trivalent Chromium by FCP & DA	Analyses: TRH/BTEXN	HOLD	Remarks
FS1		3/6/20		W	B(G,P)		4*	✓	✓	✓	✓		1 of the 4 is *(2 x 40mL Amber VOC Vial)

Please make sure the results can meet the 95% freshwater guideline limit (95% Confidence limit)

Date/Time: 8/6/20 15:51

Chilled Temp: 19.0 18.5 18.5

Correction: -0.2

Final Temp: 18.3°C

#724234

Sampled by: Pouranie Yoganathan.

Date/Time: 3/6/20

Relinquished by: PY.

Date/Time: 4/6/20.

Received by: Rob Johnston Eurofin

Date/Time: 8/6/20 15:51

Relinquished by:

Date/Time:

GHD Pty Ltd WA
999 Hay Street Perth
Perth
WA 6004

NATA Accredited
Accreditation Number 1261
Site Number 23736

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Jon Cramer**

Report **724234-W**
Project name
Project ID 12510838
Received Date Jun 08, 2020

Client Sample ID			**FS1**
Sample Matrix			**Water**
Eurofins Sample No.			**P20-Jn11077**
Date Sampled			**Jun 03, 2020**
Test/Reference	LOR	Unit	
Total Recoverable Hydrocarbons - 1999 NEPM Fractions			
TRH C6-C9	0.02	mg/L	< 0.02
TRH C10-C14	0.05	mg/L	< 0.05
TRH C15-C28	0.1	mg/L	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1
TRH C10-C36 (Total)	0.1	mg/L	< 0.1
BTEX			
Benzene	0.001	mg/L	< 0.001
Toluene	0.001	mg/L	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002
o-Xylene	0.001	mg/L	< 0.001
Xylenes - Total*	0.003	mg/L	< 0.003
4-Bromofluorobenzene (surr.)	1	%	123
Total Recoverable Hydrocarbons - 2013 NEPM Fractions			
Naphthalene[N02]	0.01	mg/L	< 0.01
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	< 0.05
TRH C6-C10	0.02	mg/L	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02
Total Recoverable Hydrocarbons - 2013 NEPM Fractions			
TRH >C10-C16	0.05	mg/L	< 0.05
TRH >C16-C34	0.1	mg/L	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1
TRH >C10-C40 (total)*	0.1	mg/L	< 0.1
Chromium (trivalent filtered)	0.005	mg/L	< 0.005
Hexavalent Chromium Set (filtered)			
Chromium (hexavalent filtered)	0.005	mg/L	< 0.005
Heavy Metals			
Chromium (filtered)	0.001	mg/L	< 0.001
Lead (filtered)	0.001	mg/L	< 0.001
Nickel (filtered)	0.001	mg/L	< 0.001
Zinc (filtered)	0.005	mg/L	< 0.005

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Eurofins | mgt Suite B1			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Perth	Jun 08, 2020	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Perth	Jun 08, 2020	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Perth	Jun 08, 2020	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Perth	Jun 08, 2020	
- Method: LTM-ORG-2010 TRH C6-C40			
Chromium (speciated, filtered Cr)			
Hexavalent Chromium Set (filtered)	Melbourne	Jun 10, 2020	28 Days
- Method: LTM-INO-4100 Hexavalent Chromium in water			
Heavy Metals (filtered)	Perth	Jun 08, 2020	180 Days
- Method: HEAVY METALS			

eurofins | Environment Testing

ABN – 50 005 085 521 web : www.eurofins.com.au e.mail : EnviroSales@eurofins.com

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Site # 1254 & 14271

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Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

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NATA # 1261 Site # 20794

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IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: GHD Pty Ltd WA
Address: 999 Hay Street Perth
Perth
WA 6004

Project Name:
Project ID: 12510838

Order No.:
Report #: 724234
Phone: 08 6222 8222
Fax: 08 9429 6555

Received: Jun 8, 2020 3:51 PM
Due: Jun 15, 2020
Priority: 5 Day
Contact Name: Jon Cramer

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail						Lead (filtered)	Nickel (filtered)	Zinc (filtered)	Chromium (speciated, filtered Cr)	Eurofins | mgt Suite B1
Melbourne Laboratory - NATA Site # 1254 & 14271									X	
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736						X	X	X	X	X
External Laboratory										
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**					
1	FS1	Jun 03, 2020		Water	P20-Jn11077	X	X	X	X	X
Test Counts						1	1	1	1	1

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram | **mg/L:** milligrams per litre | **ug/L:** micrograms per litre

ppm: Parts per million | **ppb:** Parts per billion | **%:** Percentage

org/100mL: Organisms per 100 millilitres | **NTU:** Nephelometric Turbidity Units | **MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
Method Blank							
BTEX							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total*	mg/L	< 0.003			0.003	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.01			0.01	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
Hexavalent Chromium Set (filtered)							
Chromium (hexavalent filtered)	mg/L	< 0.005			0.005	Pass	
Method Blank							
Heavy Metals							
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Lead (filtered)	mg/L	< 0.001			0.001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	112			70-130	Pass	
TRH C10-C14	%	93			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	88			70-130	Pass	
Toluene	%	103			70-130	Pass	
Ethylbenzene	%	112			70-130	Pass	
m&p-Xylenes	%	115			70-130	Pass	
Xylenes - Total*	%	113			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	108			70-130	Pass	
TRH C6-C10	%	105			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
TRH >C10-C16	%	82			70-130	Pass	
LCS - % Recovery							
Hexavalent Chromium Set (filtered)							

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chromium (hexavalent filtered)			%	102			80-120	Pass	
LCS - % Recovery									
Heavy Metals									
Chromium (filtered)			%	94			80-120	Pass	
Lead (filtered)			%	101			80-120	Pass	
Nickel (filtered)			%	91			80-120	Pass	
Zinc (filtered)			%	91			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	P20-Jn11177	NCP	%	127			70-130	Pass	
TRH C10-C14	P20-Jn15719	NCP	%	100			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	P20-Jn11177	NCP	%	104			70-130	Pass	
Toluene	P20-Jn11177	NCP	%	111			70-130	Pass	
Ethylbenzene	P20-Jn11177	NCP	%	106			70-130	Pass	
m&p-Xylenes	P20-Jn11177	NCP	%	113			70-130	Pass	
o-Xylene	P20-Jn11177	NCP	%	110			70-130	Pass	
Xylenes - Total*	P20-Jn11177	NCP	%	112			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	P20-Jn11177	NCP	%	109			70-130	Pass	
TRH C6-C10	P20-Jn11177	NCP	%	127			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	P20-Jn15719	NCP	%	94			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Chromium (filtered)	P20-Jn11086	NCP	%	99			70-130	Pass	
Lead (filtered)	P20-Jn11086	NCP	%	103			70-130	Pass	
Nickel (filtered)	P20-Jn11086	NCP	%	94			70-130	Pass	
Zinc (filtered)	P20-Jn11086	NCP	%	100			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	P20-Jn11176	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH C10-C14	P20-Jn11176	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH C15-C28	P20-Jn11176	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH C29-C36	P20-Jn11176	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	P20-Jn11176	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Toluene	P20-Jn11176	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Ethylbenzene	P20-Jn11176	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
m&p-Xylenes	P20-Jn11176	NCP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
o-Xylene	P20-Jn11176	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Xylenes - Total*	P20-Jn11176	NCP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	P20-Jn11176	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
TRH C6-C10	P20-Jn11176	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	

Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
TRH >C10-C16	P20-Jn11176	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH >C16-C34	P20-Jn11176	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH >C34-C40	P20-Jn11176	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Chromium (filtered)	P20-Jn11084	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Lead (filtered)	P20-Jn11084	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Nickel (filtered)	P20-Jn11084	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc (filtered)	P20-Jn11084	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.

Authorised By

Robert Johnston	Analytical Services Manager
Elden Garrett	Senior Analyst-Metal (WA)
Patrick Patfield	Senior Analyst-Organic (WA)
Patrick Patfield	Senior Analyst-Volatile (WA)
Scott Beddoes	Senior Analyst-Inorganic (VIC)

Glenn Jackson
General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD House 999
Hay Street PO Box Y3106 Telephone 08 6222 8222
Perth WA 6000 Perth WA 6832 Facsimile 08 6222 8555

Page 1 of 1 COC No.

Project Hardy St Remediation Project		Laboratory: ALS Environmental	
Client Shire of Denmark	**Job No.** 12510838	Address: 26 Rigali Way Wangara 6065	
		Laboratory Contact: Marnie Tomsett/ Lauren Biagioni	
Laboratory Quote No.	**Turnaround Time**		
Job Manager (Invoice) jon.cramer@ghd.com & GHD accounts	**Email Address (Results)** jon.cramer@ghd.com		

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix S-Soil/ SL-Sludge/ W-Water/ A-Air	Container: Type B-Bottle/J-Jar/V-Vial/Bag/G-Glass/P-Plastic	Container: Preservative Unpreserved/ HCl/ H2SO4/HNO3/Other	Container: No	Container: Total Volume (mL)	Analyses: S-26 (TRH/ BTEXN/PAH/B Metals)	Analyses: S-5 (TRH/BTEXN/B Metals)	Analyses: TRH Speciation (Aro/ Ali)*	Analyses: HOLD	Remarks
CP1 (Containment Pad)	1	27/05/2020		S					✓		✓		*only perform speciation if total TRH concentrations are detected
CP2 (Containment Pad)	2	27/05/2020		S					✓		✓		
CP3 (Containment Pad)	3	27/05/2020		S					✓				
CP4 (Containment Pad)	4	27/05/2020		S					✓				
V1 (Validation Sample 1)	5	27/05/2020		S						✓			
V2 (Validation Sample 1)	6	27/05/2020		S						✓			

Sampled by:	JON CRAMER	Date/Time: 27/5/20	Relinquished by: JON CRAMER	Date/ Time: 27/5/20
Received by:	ALS	Date/Time:	Relinquished by:	Date/ Time:
Received by Lab:		Date/Time: 29/5/2020 1pm	Courier/ Transport Company:	
Sample Conditions:		Remarks:		

Environmental Division
Perth
Work Order Reference
EP2005623

Telephone : +61-8-9406 1301

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2005623**	Page	: 1 of 8
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JON CRAMER	Contact	: Rebecca Shaw
Address	: 999 HAY STREET PERTH WA, AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 6222 8222	Telephone	: +61-8-9406 1301
Project	: 12510838	Date Samples Received	: 29-May-2020 13:00
Order number	: 12510838	Date Analysis Commenced	: 04-Jun-2020
C-O-C number	: ----	Issue Date	: 08-Jun-2020 17:20
Sampler	: JON CRAMER		
Site	: Hardy St Remediation Project		
Quote number	: EN/005/19		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
David Viner	SENIOR LAB TECH	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- EG005T: Total metals for sample #2 confirmed by re-extraction and re-analysis.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	CP1 (Containment Pad)	CP2 (Containment Pad)	CP3 (Containment Pad)	CP4 (Containment Pad)	V1 (Validaton Sample 1)
			Client sampling date / time	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00
Compound	CAS Number	LOR	Unit	EP2005623-001	EP2005623-002	EP2005623-003	EP2005623-004	EP2005623-005
				Result	Result	Result	Result	Result
EA055: Moisture Content								
Moisture Content	----	1.0	%	----	----	----	----	8.0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	23.4	14.0	21.8	22.4	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	5	6	5	5	4
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg	<5	13	<5	<5	<5
Nickel	7440-02-0	2	mg/kg	<2	<2	<2	<2	<2
Zinc	7440-66-6	5	mg/kg	<5	54	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg	0.6	0.6	0.6	0.6	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg	1.2	1.2	1.2	1.2	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	CP1 (Containment Pad)	CP2 (Containment Pad)	CP3 (Containment Pad)	CP4 (Containment Pad)	V1 (Validaton Sample 1)
				Client sampling date / time	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00
Compound	CAS Number	LOR	Unit		EP2005623-001	EP2005623-002	EP2005623-003	EP2005623-004	EP2005623-005
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		**96.7**	**85.7**	**92.4**	**118**	----
2-Chlorophenol-D4	93951-73-6	0.5	%		**110**	**101**	**109**	**100**	----
2.4.6-Tribromophenol	118-79-6	0.5	%		**110**	**109**	**112**	**122**	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		**122**	**108**	**119**	**115**	----
Anthracene-d10	1719-06-8	0.5	%		**108**	**104**	**110**	**109**	----
4-Terphenyl-d14	1718-51-0	0.5	%		**110**	**107**	**111**	**116**	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**71.0**	**73.5**	**71.4**	**90.4**	**90.2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	CP1 (Containment Pad)	CP2 (Containment Pad)	CP3 (Containment Pad)	CP4 (Containment Pad)	V1 (Validaton Sample 1)
				Client sampling date / time	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00	27-May-2020 00:00
Compound	CAS Number	LOR	Unit		EP2005623-001	EP2005623-002	EP2005623-003	EP2005623-004	EP2005623-005
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		**74.1**	**78.2**	**74.1**	**85.2**	**87.6**
4-Bromofluorobenzene	460-00-4	0.2	%		**75.7**	**77.8**	**74.0**	**88.5**	**91.1**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	V2 (Validaton Sample 1)	----	----	----	----
				Client sampling date / time	27-May-2020 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EP2005623-006	--------	--------	--------	--------
					Result	----	----	----	----
EA055: Moisture Content									
Moisture Content	----	1.0	%		**8.9**	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	5	mg/kg		<5	----	----	----	----
Cadmium	7440-43-9	1	mg/kg		<1	----	----	----	----
Chromium	7440-47-3	2	mg/kg		**4**	----	----	----	----
Copper	7440-50-8	5	mg/kg		<5	----	----	----	----
Lead	7439-92-1	5	mg/kg		<5	----	----	----	----
Nickel	7440-02-0	2	mg/kg		<2	----	----	----	----
Zinc	7440-66-6	5	mg/kg		<5	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	----	----	----	----
C10 - C14 Fraction	----	50	mg/kg		<50	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg		<100	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg		<100	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg		<10	----	----	----	----
>C10 - C16 Fraction	----	50	mg/kg		<50	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg		<100	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg		<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg		<50	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg		<50	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg		<0.5	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	----	----	----	----
^ **Sum of BTEX**	----	0.2	mg/kg		<0.2	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	V2 (Validaton Sample 1)	----	----	----	----
				Client sampling date / time	27-May-2020 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EP2005623-006	--------	--------	--------	--------
					Result	----	----	----	----
EP080: BTEXN - Continued									
^ **Total Xylenes**	----	0.5	mg/kg		<0.5	**----**	**----**	**----**	**----**
Naphthalene	91-20-3	1	mg/kg		<1	**----**	**----**	**----**	**----**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**81.1**	**----**	**----**	**----**	**----**
Toluene-D8	2037-26-5	0.2	%		**84.0**	**----**	**----**	**----**	**----**
4-Bromofluorobenzene	460-00-4	0.2	%		**83.7**	**----**	**----**	**----**	**----**

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	57	119
2-Chlorophenol-D4	93951-73-6	52	130
2.4.6-Tribromophenol	118-79-6	40	132
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	53	139
Anthracene-d10	1719-06-8	68	124
4-Terphenyl-d14	1718-51-0	66	132
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	63	132
Toluene-D8	2037-26-5	66	125
4-Bromofluorobenzene	460-00-4	60	124

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2005623**	Page	: 1 of 5
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JON CRAMER	Telephone	: +61-8-9406 1301
Project	: 12510838	Date Samples Received	: 29-May-2020
Site	: Hardy St Remediation Project	Issue Date	: 08-Jun-2020
Sampler	: JON CRAMER	No. of samples received	: 6
Order number	: 12510838	No. of samples analysed	: 6

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Soil Glass Jar - Unpreserved (EA055) V1 (Validaton Sample 1), V2 (Validaton Sample 1)	**27-May-2020**	**----**	----	----	**04-Jun-2020**	10-Jun-2020	✓
EA055: Moisture Content (Dried @ 105-110°C)							
Snap Lock Bag (EA055) CP2 (Containment Pad)	**27-May-2020**	**----**	----	----	**04-Jun-2020**	10-Jun-2020	✓
Soil Glass Jar - Unpreserved (EA055) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad)	**27-May-2020**	**----**	----	----	**04-Jun-2020**	10-Jun-2020	✓
EG005(ED093)T: Total Metals by ICP-AES							
Snap Lock Bag (EG005T) CP2 (Containment Pad)	**27-May-2020**	**05-Jun-2020**	23-Nov-2020	✓	**05-Jun-2020**	23-Nov-2020	✓
Soil Glass Jar - Unpreserved (EG005T) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad), V1 (Validaton Sample 1), V2 (Validaton Sample 1)	**27-May-2020**	**05-Jun-2020**	23-Nov-2020	✓	**05-Jun-2020**	23-Nov-2020	✓
EG035T: Total Recoverable Mercury by FIMS							
Snap Lock Bag (EG035T) CP2 (Containment Pad)	**27-May-2020**	**05-Jun-2020**	24-Jun-2020	✓	**05-Jun-2020**	24-Jun-2020	✓
Soil Glass Jar - Unpreserved (EG035T) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad), V1 (Validaton Sample 1), V2 (Validaton Sample 1)	**27-May-2020**	**05-Jun-2020**	24-Jun-2020	✓	**05-Jun-2020**	24-Jun-2020	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Snap Lock Bag (EP075(SIM)) CP2 (Containment Pad)	**27-May-2020**	**04-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	14-Jul-2020	✓
Soil Glass Jar - Unpreserved (EP075(SIM)) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad)	**27-May-2020**	**04-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	14-Jul-2020	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Snap Lock Bag (EP071) CP2 (Containment Pad)	**27-May-2020**	**04-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	14-Jul-2020	✓
Snap Lock Bag (EP080) CP2 (Containment Pad)	**27-May-2020**	**05-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	10-Jun-2020	✓
Soil Glass Jar - Unpreserved (EP071) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad), V1 (Validaton Sample 1), V2 (Validaton Sample 1)	**27-May-2020**	**04-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	14-Jul-2020	✓
Soil Glass Jar - Unpreserved (EP080) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad), V1 (Validaton Sample 1), V2 (Validaton Sample 1)	**27-May-2020**	**05-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	10-Jun-2020	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Snap Lock Bag (EP071) CP2 (Containment Pad)	**27-May-2020**	**04-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	14-Jul-2020	✓
Snap Lock Bag (EP080) CP2 (Containment Pad)	**27-May-2020**	**05-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	10-Jun-2020	✓
Soil Glass Jar - Unpreserved (EP071) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad), V1 (Validaton Sample 1), V2 (Validaton Sample 1)	**27-May-2020**	**04-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	14-Jul-2020	✓
Soil Glass Jar - Unpreserved (EP080) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad), V1 (Validaton Sample 1), V2 (Validaton Sample 1)	**27-May-2020**	**05-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	10-Jun-2020	✓
EP080: BTEXN							
Snap Lock Bag (EP080) CP2 (Containment Pad)	**27-May-2020**	**05-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	10-Jun-2020	✓
Soil Glass Jar - Unpreserved (EP080) CP1 (Containment Pad), CP3 (Containment Pad), CP4 (Containment Pad), V1 (Validaton Sample 1), V2 (Validaton Sample 1)	**27-May-2020**	**05-Jun-2020**	10-Jun-2020	✓	**05-Jun-2020**	10-Jun-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055	3	28	**10.71**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH/Phenols (SIM)	EP075(SIM)	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH/Phenols (SIM)	EP075(SIM)	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH/Phenols (SIM)	EP075(SIM)	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 6.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40. Compliant with NEPM amended 2013.
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270E. Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 502 and 507)
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260D. Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. Compliant with NEPM amended 2013.

Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.

RECIEVED 9/6/2020
8:56AM RSTEERE

Rhiannon Steere

From: Rebecca Shaw
Sent: Tuesday, 9 June 2020 8:56 AM
To: Samples Perth
Cc: ALS Enviro Perth; Rebecca Shaw
Subject: FW: [EXTERNAL] - FW: RESULTS & EDD & INVOICE for ALS Workorder : EP2005623 | Your Reference: 12510838
Attachments: 12510838.ESDAT_EP2005623_0.Chemistry2e.CSV; 12510838.ESDAT_EP2005623_0.Header.XML; 12510838.ESDAT_EP2005623_0.Sample2e.CSV; EP2005623_0_COA.pdf; EP2005623_COC.pdf; EP2005623_0_QC.pdf; EP2005623_0_QCI.pdf; EP2005623_0_ENMRG.CSV; EP2005623_0_XTAB.XLS; 1151089282_INV.pdf

Good morning,

Please see below rebatch request for EP2005623.

Kind Regards,

Rebecca Shaw
Client Services Officer, Environmental - Perth
Western Australia

T +61 08 9406 1301
D +61 08 9406 1311
Rebecca.Shaw@Alsglobal.com
26 Rigali Way (Advantage Way entrance)
Wangara WA 6065
Australia

Environmental Division
Perth
Work Order Reference
EP2005895

Telephone : +61-8-9406 1301

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From: Jon Cramer [mailto:Jon.Cramer@ghd.com]
Sent: Tuesday, 9 June 2020 8:53 AM
To: Rebecca Shaw <rebecca.shaw@ALSGlobal.com>
Subject: [EXTERNAL] - FW: RESULTS & EDD & INVOICE for ALS Workorder : EP2005623 | Your Reference: 12510838

Hi Rebecca,

Can I please rebatch samples CP1 and CP2 from the above work order for leachable lead concentrations?

D1

Thank you,
Jon

Jon Cramer
Senior Environmental Scientist

GHD
Proudly employee owned
T: 61 8 98405102 | M: +61 438746559 | E: jon.cramer@ghd.com
166 Stirling Terrace Albany WA 6330 | www.ghd.com

Connect

From: angel-no-reply@alsglobal.com <angel-no-reply@alsglobal.com>
Sent: Monday, 8 June 2020 5:21 PM
To: Jon Cramer <Jon.Cramer@ghd.com>
Subject: RESULTS & EDD & INVOICE for ALS Workorder : EP2005623 | Your Reference: 12510838

Deliverables for ALS Workorder EP2005623

Project: 12510838

Dear JON CRAMER,

Please find enclosed the following deliverables for **EP2005623**:

- 12510838.ESDAT_EP2005623_0.Chemistry2e.CSV
- 12510838.ESDAT_EP2005623_0.Header.XML
- 12510838.ESDAT_EP2005623_0.Sample2e.CSV
- EP2005623_0_COA.pdf
- EP2005623_0_ENMRG.CSV
- EP2005623_0_QC.pdf
- EP2005623_0_QCI.pdf

- EP2005623_0_XTAB.XLS
- 1151089282_INV.pdf
- EP2005623_COC.pdf

Report Recipients

- GHD LAB REPORTS
  - EP2005623_0_COA.pdf (Email)
  - 12510838.ESDAT_EP2005623_0.Chemistry2e.CSV (Email)
  - 12510838.ESDAT_EP2005623_0.Header.XML (Email)
  - 12510838.ESDAT_EP2005623_0.Sample2e.CSV (Email)
  - EP2005623_0_QC.pdf (Email)
  - EP2005623_0_QCI.pdf (Email)
  - EP2005623_COC.pdf (Email)
- ACCOUNTS PAYABLE
  - 1151089282_INV.pdf (Email)
  - EP2005623_COC.pdf (Email)
- JON CRAMER
  - 12510838.ESDAT_EP2005623_0.Chemistry2e.CSV (Email)
  - 12510838.ESDAT_EP2005623_0.Header.XML (Email)
  - 12510838.ESDAT_EP2005623_0.Sample2e.CSV (Email)
  - EP2005623_0_COA.pdf (Email)
  - EP2005623_0_ENMRG.CSV (Email)
  - EP2005623_0_QC.pdf (Email)
  - EP2005623_0_QCI.pdf (Email)
  - EP2005623_0_XTAB.XLS (Email)
  - 1151089282_INV.pdf (Email)
  - EP2005623_COC.pdf (Email)
- Accounts Payable Australia
  - 1151089282_INV.pdf (Email)
  - EP2005623_COC.pdf (Email)

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2005895**	Page	: 1 of 4
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JON CRAMER	Contact	: Rebecca Shaw
Address	: 999 HAY STREET PERTH WA, AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 6222 8222	Telephone	: +61-8-9406 1301
Project	: 12510838	Date Samples Received	: 29-May-2020 13:00
Order number	: 12510838	Date Analysis Commenced	: 10-Jun-2020
C-O-C number	: ----	Issue Date	: 12-Jun-2020 18:44
Sampler	: JON CRAMER		
Site	: Hardy Street Remediation Project		
Quote number	: EN/005/19		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	CP1 (Containment Pad)	CP2 (Containment Pad)	----	----	----
			Client sampling date / time	27-May-2020 00:00	27-May-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EP2005895-001	EP2005895-002	--------	--------	--------
				Result	Result	----	----	----
EG005(ED093)W: Water Leachable Metals by ICPAES								
Lead	7439-92-1	0.01	mg/L	<0.01	<0.01	**----**	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	CP1 (Containment Pad)	CP2 (Containment Pad)	----	----	----
			Client sampling date / time	27-May-2020 00:00	27-May-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EP2005895-001	EP2005895-002	--------	--------	--------
				Result	Result	----	----	----
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	**9.0**	**8.8**	**----**	**----**	**----**

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2005895**	Page	: 1 of 4
Client	: **GHD PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JON CRAMER	Telephone	: +61-8-9406 1301
Project	: 12510838	Date Samples Received	: 29-May-2020
Site	: Hardy Street Remediation Project	Issue Date	: 12-Jun-2020
Sampler	: JON CRAMER	No. of samples received	: 2
Order number	: 12510838	No. of samples analysed	: 2

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL** Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EN60: Bottle Leaching Procedure							
Non-Volatile Leach: 180 day HT (e.g. PFAS, metals ex.Hg) (EN60-Dla)							
CP1 (Containment Pad), CP2 (Containment Pad)	**27-May-2020**	**10-Jun-2020**	23-Nov-2020	✓	**----**	----	----

Matrix: **WATER** Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG005(ED093)W: Water Leachable Metals by ICPAES							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005W)							
CP1 (Containment Pad), CP2 (Containment Pad)	**10-Jun-2020**	**12-Jun-2020**	07-Dec-2020	✓	**12-Jun-2020**	07-Dec-2020	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Water Leachable Metals by ICPAES	EG005W	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Water Leachable Metals by ICPAES	EG005W	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Water Leachable Metals by ICPAES	EG005W	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Water Leachable Metals by ICPAES	EG005W	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Water Leachable Metals by ICPAES	EG005W	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals in DI Water Leachate	EN25W	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Deionised Water Leach	EN60-Dla	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates

Appendix I – Calibration certificates

Multi Parameter Water Meter

airmet

Air-Met Scientific Pty Ltd
1300 137 067

Instrument YSI Quatro Pro Plus
Serial No. 18G 103 114

Item	Test	Pass	Comments
Battery	Capacity	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
	Seal		
Connectors	Condition	✓	
Sensor	1. pH	✓	
	2. ORP in mV	✓	
	3. EC/Temp.	✓	
	4. D.O.	✓	
Alarms	Beeper		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Value	Standard		Instrument Reading
Temperature			*Checked*	15.8 °C
pH	pH 7	344904	Calibrated	7.01
pH	pH 4	345749	Calibrated	4.00
EC	Zero	Air	*Checked*	0.001 mS/cm
EC	2.76mS/cm	326685	Calibrated	2.76 mS/cm
ORP (mV)	240mV at 20°C	335411 / 335412	Calibrated	243.7 mV
DO Zero	Zero	5928	*Checked*	0.00 %
DO 100%	100%	Water saturated air	Calibrated	100 %

Calibrated by: **Bianca Mcnair**

Calibration date: **18-May-20**

Next calibration due 18-Jun-20

GHD

166 Stirling Terrace
T: 61 8 9840 5100 F: 61 8 9463 6012 E: albmail@ghd.com

24DJSZNHUEPC-1850682920-13/Document1

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J.Cramer	K.Skippings	On file	J.Foley		16.10.20

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