REPORT

Proposed Southdown Magnetite Project- Slurry Pipeline Phase 2 Site Investigation

Prepared for

Grange Resources Limited

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Contents

Contents

Tables, Figures and Appendices

Tables (in text)

Tables (appended)

Figures

Tables, Figures and Appendices

Appendices

Section 1 Introduction

1.1 Introduction and Background

URS Australia Pty Ltd (URS) was commissioned by Grange Resources Limited (GRL) to complete a Phase 2 Detailed Site Investigation (DSI) for a section of the proposed Southdown Magnetite Project Slurry Pipeline (the Pipeline), Albany (see **Figure 1**).

GRL, in conjunction with the Albany Port Authority, are proposing to develop a magnetite iron ore mine approximately 90km to the north east of Albany (Southdown Magnetite Project). The project will include the mining and ore concentrating facilities near Wellstead, a slurry pipeline for transporting the ore concentrate from the mine site to Albany Port and a new ship loading berth to the east of the existing Berth 6. The proposed route of the pipeline takes it along the Albany Port foreshore where a number of potential contaminative activities have been undertaken over a number of years.

It is proposed that the slurry pipeline will be buried to a depth of about 1 to 2 m below ground level (m bgl) within a 10 to 5m easement corridor and will consist of two parallel pipelines; a slurry pipeline and water return pipeline. The proposed route passes through the Albany Port foreshore, roughly parallel to Princess Royal Drive (see **Figure 2**).

The Phase 2 DSI carries on from the Phase I Environmental Site Assessment (ESA) completed by URS Australia Pty Ltd (URS) for the proposed slurry pipeline route. The Phase I ESA report entitled *'Phase I Environmental Site Assessment and Sampling and Analysis Plan – Slurry Pipeline Southdown Magnetite Project Albany, Port Section (URS Job No. 42906009/624-F7433.1),* identified a number of potentially contaminative historical and current operations along the pipeline route. The operations have the potential to have adversely impacted the soil and groundwater along the proposed route, which in turn may have impacts on construction of the pipeline through health and safety issues and disposal of contaminated materials.

The sampling and analysis plan (SAP), produced in response to the findings of the Phase 1 ESA, identified 8 main areas of concern which included the port end of the pipeline (Vital foods), the area to the south of the fuel depots and former Borthwicks facility (including the Summit Fertilizer facility, the area to the south of CBH, which also includes the area around the former petrol pump house, adjacent to the south of the current and former rail depot and re-fuelling facility, the area impacted by the former City of Albany Landfill, the area impacted by the former gasworks, the zone potentially impacted by the CSBP facility, the current City of Albany Landfill and the Ideal Business Park and the area potentially impacted by the former Sales Yard, metal scrap yard and acid sulphate soils (referred to as Sections A to H) (see **Figure 3**).

The section of the Pipeline investigated as part of this Phase 2 DSI was contained to three (3) primary sample locations (total of 20 soil bores) (see Figure 4) identified during the Phase 1 ESA as the current train re-fuelling facility and former train depot (Section D), the Former City of Albany Landfill and a former maintenance shed (Section E) and former gas works area and cannery (Section F).

It should be noted that soil and groundwater intrusive works were abandoned for Section F as the proposed route alignment intends the pipeline, in this section, to either be suspended along Princess Royal Drive or buried in clean fill and hence no investigation was required.

In addition to the URS Phase I ESA report, a number of previous soil and groundwater investigations have been conducted in areas of concern along the proposed pipeline route, however, were not available for use/review for the related to areas of concern.

Section 2 Site History Review

1.2 Project Objectives

Areas of contamination (soil and water) have the potential to impact construction of the pipeline through contamination risks associated with human health. In addition, the construction activities, such as dewatering, have the potential to mobilise contaminants that may impact sensitive receptors, such as the Albany Port Harbour.

Based on findings of the outline Phase I ESA and the URS proposal (reference number 3027853/610-F8181), dated 4 April 2007, the objectives of the proposed Phase 2 DSI include:

- Investigate the presence of chemicals of potential concern (COPC) in soil and groundwater along Sections D (zone to the south of the current and former rail depot and re-fuelling facility), E(area impacted by the former City of Albany Landfill) and F (former gas works and cannery) beneath the route of the proposed pipeline route resulting from historical and current operations along the Pipeline; and
- Compile information on soil and groundwater quality along the proposed pipeline route, in a suitable format anticipating that this information will be used as part of the Public Environmental Review (PER).

1.3 Changes to Scope of Work

During the field investigation a number of on-site amendments to the URS proposal were implemented. The following changes were made and approved by an authorised GRL representative during the field investigation:

- The abandonment of soil bore advancement and groundwater grab samples along Section F of the Pipeline. Field investigation was abandoned for Section F as the proposed route alignment intends the pipeline, in this Section, to either be suspended along Princess Royal Drive or buried in clean fill and hence no investigation was required.
- Increase sampling intensity along Section D from 10 soil bores to 13 soil bores;
- Increase sampling intensity along Section E from 5 soil bores to 7 soil bores;
- Groundwater grab samples were abandoned along Section D based on soil bore integrity; and
- Conduct opportunistic groundwater sampling at 3 pre existing shallow groundwater monitoring wells located on the perimeter boundary of Westrail Depot at the time of the investigation.

Section 2 Site History Review

2.1 General Information

The proposed slurry pipeline route originates from a site to the east of Berth 6 in Albany Port. The route passes generally parallel to Princess Royal Drive and the Rail Corridor, with a preferred and alternative route westwards to George Street (see **Figure 2**).

The preferred route continues westward, within the Rail Corridor, from Frenchman Bay Road to George Street, then runs northwards to Cuming Road. The alternative route from Frenchman Bay Road is northwards along Hanrahan Road then westwards along Cuming Road to join up to the preferred route.

The pipeline route proceeds a short distance further westwards along Cuming Road then northwards to Gunn Road across freehold land. From a proposed pump station at Gunn Road, the pipeline runs northeastwards over rural land to the mine-site.

The main subject area of the Albany Port foreshore is predominantly owned by the Albany Port Authority, the Public Transport Authority and the City of Albany and sub-let to various companies. Surrounding the foreshore area, to the east and north are various freehold properties, owned by various companies over time and representing a whole range of operating activities.

2.2 Areas of Interest

The following summary of historical data for land development between 1957 and 2003 of interest was extracted from the Phase 1 ESA and is summarised as follows in **Table 1**. The areas of interest that are of concern for this Phase 2 DSI (Sections D and E) have been highlighted.

Table 1

Summary of Land Development

Land and Facilities of Interest in Subject Area

Site	Land Development
Shell Depots	Two buildings are visible on the 1957 aerial photographs. At least one building and two tanks appear on an area to the west of these two buildings. There is also a white line joining Brunswick Road to Princess Royal Drive, which could represent a pipeline. On the 1997 aerial photograph, the two buildings have been replaced by the present Shell Depot layout. The site to the west of the Shell Depot appears to be largely revegetated.
Caltex Depot	On the 1957 aerial photograph, the Caltex Depot site is vacant, with the exception of one building and what looks to be two tanks. The 1997 aerial photograph shows the Caltex Depot as it appears today.
Vital Foods	One building was located on the Vital Foods site in 1957. It could be accessed by road via Brunswick Road and by sea via two jetties located to the west and east of the building. Between 1957 and 1997, the Albany Port was extended further to the east with additional berths. Princess Royal Drive was built along the north boundary of the Harbour to connect with Brunswick Road north of the Vital Foods site. A new facility was built between 1957 and 1997. No change was noted between the 1997 and the 2003 aerial photographs.
Former Borthwicks meat works	A pond appears on the former Borthwicks site on the 1957 aerial photograph. It is not apparent on the 1997 aerial photograph. However, a building, as it appears

Section 2 Site History Review

Site	Land Development
	today is located on the site.
PPT and Toll woodchip	The PPT and Toll woodchip sites appear on the 1997 aerial photograph as vacant. A conveyor from the site to Berth 6 is visible on the 2003 aerial photograph.
Summit Fertiliser	One building is visible on the 1997 aerial photograph on the Summit Fertiliser site, which is located on the part of the harbour that was extended in the late 1990s to form Berth 6. It is surrounded by vacant land. On the 2003 aerial photograph, the building located on the woodchip site has been extended to the north.
CBH facility	On the 1957 aerial photograph, one large grain storage building is visible to the west of the CBH site, with a conveyor linking the western side of the grain storage building to Berth 2. It appears that the building was demolished between 1957 and 1997 and the new storage facility constructed. A conveyor is visible between the first and the second building from the west to Berth 3. The facility does not appear to have undergone major changes between 1997 and 2003.
Cold storage and incinerator – historical fuel pumping station	The site appears vacant on the 1957 aerial photograph. One large building is apparent on the 1997 and 2003 aerial photographs.
Former City of Albany Landfill	On the 1957 aerial photograph, land appears to have been partially reclaimed. Princess Royal Drive was located at that time to the north of the reclaimed land. On the 1997 aerial photograph, the landfill appears to have been extended to the south and further land reclamation seems to have been undertaken to the west of the former landfill site. Princess Royal Drive has been diverted to the new foreshore to the west of the former landfill site and runs across the landfill. No change to the former landfill site is apparent between the 1997 and 2003 aerial photographs.
Former and current Railway Depot (including Southern Distribution Centre)	On the 1957 aerial photograph, the Railway Depot site appears to contain a large building at the eastern end with a maintenance depot further to the west. On the 1997 aerial photograph the 1957 buildings are still present and Princess Royal Drive appears to have been diverted to the north of the site. The remaining of the site appears to be vacant. There is no visible change to the site between the 1997 and 2003 aerial photographs.
Former gasworks and cannery	Two buildings are visible on the 1957 aerial photograph on the former cannery site. A series of smaller buildings and what looks like a round tower are apparent to the west of the two buildings, on the former gasworks site. On the 1997 aerial photograph, Princess Royal Drive is apparent to the south of the former cannery and gasworks sites. The former cannery site has been redeveloped to blocks of units, while the former gasworks site remains vacant. There is no visible change to the two sites between the 1997 and 2003 aerial photographs.

Section 2 Site History Review

Site	Land Development
CSBP	Seven large (fuel) tanks are visible to the east of Hanrahan Road on the 1957 aerial photograph. A large plant including approximately 10 buildings is apparent in place of the present CSBP site. A series of smaller buildings are located to the west of Hanrahan Road. An area to the south of the Rail Corridor has been cleared. On the 2003 aerial photograph, the large tanks are surrounded by trees. Hanrahan Road has been deviated to the western boundary of the site comprising the large tanks. The series of small buildings to the west of Hanrahan Road have been demolished and land revegetated. The large plant has been demolished and a new facility constructed. The cleared area to the south of Lower Denmark Road has been revegetated.
Current City of Albany Landfill	On the 1957 aerial photograph, the site appears as bushland. On the 1997 and 2000 aerial photographs, the landfill appears as a grass area to the north and a cleared are to the south.
Ideal Business Park	As the 1997 aerial photograph does not extend as far to the west as to show the Ideal Business Park site, it does not give any information on land development of the site at that time. However, on the 1957 aerial photograph, the site was covered with bushland. On the 2000 aerial photograph, the Ideal Business Park site appears to comprise of five buildings.
Former Sales Yard	The only map to extend as far to the west as to show the former Sales Yard is the 1957 aerial photograph. The site appeared then as a cleared area linked to Lower Denmark Road by different tracks.

Section 2 Site History Review

2.3 Potential Areas of Concern

The Phase 1 ESA identified a vast number of past and present activities in the subject area. To provide meaningful and accurate information, selections of areas of concern were identified based on their potential to have impacted the natural environmental along the Albany Port Pipeline Route. A total of eight areas of concern were identified along the proposed pipeline route(s) and are identified and presented in **Table 2.** The potential areas of concern that have been targeted for the Phase 2 DS1 have been highlighted.

Table 2

Potential Areas of Concern

Area Identification	Potential Activities of Concern
A	Port end of the pipeline – Vital Foods.
B	Area to the south of the fuel depots and former Borthwicks facility. This also includes the Summit Fertilizer facility.
C	To the south of CBH, which also includes the area around the former petrol pump house
D	Zone to the south of the current and former rail depot and re-fuelling facility.
E	Area impacted by the former City of Albany Landfill.
F	Area impacted by the former gasworks.
G	Zone potentially impacted by the CSBP facility, the current City of Albany Landfill and the Ideal Business Park.
H	Area potentially impacted by the former Sales Yard, metal scrap yard and acid sulphate soils.

2.4 Potential Contaminants of Concern

Based on past and present activities the following potential contaminants of concern were identified during the Phase 1 ESA and are summarised in **Table 3.** The potential activities of concern and hence contaminants of concern, that have been targeted for this Phase 2 DS1, have been highlighted.

Section 2 Site History Review

Table 3

Potential Contaminants of Concern

Pipeline Area Identification	Potential Activities of Concern	Potential Contaminants of Concern
A	Vital Foods - Production of food products for over 30 years immediately adjacent to the proposed pipeline route. Potential for storage and use of hydraulic oils and potentially solvents.	TPH, VOCs and metals
B	Shell/Caltex depot, former Borthwick facility and Summit fertilizer – area of known contamination in the vicinity of the former Borthwicks facility, located up-hydraulic gradient and area of significant petroleum storage which appears to be without secondary containment and is located up-hydraulic gradient from the proposed pipeline route. This also includes petroleum distribution pipes running through the proposed easement corridor.	TPH,BTEX, VOCs and SVOCs, metals, pH,
C	The current CBH facility, former petrol pump house and area of fertiliser washdown and transformers located to the north-east of the current cold storage unit. Generally this area of the proposed pipeline route passes through areas of potential hydrocarbon storage and use and of known historical petroleum distribution.	TPH, BTEX, VOCs (50 % frequency), PCBs,
D	Current train re-fuelling facility and former train depot with known area of hydrocarbon contamination as identified through previous intrusive investigations. Also passes through an area of historic fill material, where materials such as asbestos containing materials could potentially have been deposited.	TPH, BTEX, phenols, metals, asbestos, pesticides, creosote,
E	Former City of Albany Landfill – known area of contamination from historical landfilling operations as identified from previous intrusive investigations in the area and from anecdotal evidence. A wide range of potential contaminating substances may have been placed in the landfill, which was more than likely not lined or managed.	TPH, VOCs and SVOCs metals, pH, asbestos, PCBs,
F	Former gasworks – known area of soil and groundwater contamination through numerous previous intrusive investigations. Residential development of the area has been stopped due to identified contamination and until a suitable remedial programme is completed.	TPH, VOCs and SVOCs metals, cyanide

Section 2 Site History Review

Pipeline Area Identification	Potential Activities of Concern	Potential Contaminants of Concern
G	CSBP fertiliser facility, current City of Albany Landfill and Ideal Business Park – Significant manufacture, storage and distribution of fertilizer including raw materials for over 50 years in the CSBP facility, including known pollution incidents to local water courses and Princess Royal Bay. City of Albany Landfill is also a known area of soil and groundwater contamination, with known pollution incidents to local water courses. Ideal Business Park has potentially contributed to pollution events in the local water courses due to observations made during the site reconnaissance. .	TPH, VOC and SVOCs pH, metals, OC/OP pesticides, calcium phosphate , calcium sulphate, nitrates,
H	Former Sales Yard – known area of contamination associated mainly with the drainage ditches and retention pond to the south of the former Sales yard site. Current scrap yard to the east of Roundhay Road, which although relatively recent in operation, has the potential to introduce oils, metals and PCBs into the surrounding environment. One of the proposed pipeline routes passes within 10 m of this facility. In addition, the area to the west of the CSBP facility and around Roundhay Road is considered to be an area with high potential for acid sulphate soils.	TPH, metals, OC/OP pesticides, pH, PCBs, VOCs

NOTES:

TPH = total petroleum hydrocarbons
BTEX = benzene, toluene, ethyl-benzene, xylenes (total)
VOCs = volatile organic compounds
SVOCs = semi-volatile organic compounds
Phenols = phenolic compounds
PCBs = polychlorinated bi-phenyls

Section 3 Site Setting and Sensitivity

The Site Setting and Sensitivity information has been extracted from the Phase 1 ESA and provides a general overview and description of the subject area associated with the Albany Port pipeline route and foreshore, in particular the intersection of Bolt Terrace and Princess Royal Drive near Albany Port running west parallel to Princess Royal Drive to where it intersects with Residency Road.

Areas and items of note are shown on **Figure 3.**

3.1 Environmental Receptors

The main environmental receptor of concern is the Albany Port Harbour which is located down gradient of the proposed pipeline and is subject to migration of contaminants identified during the Phase 2 DSI.

3.2 Topography

The topography along the proposed pipeline route is varied, with the Albany Port area being flat at an average height of 5 metres Australian Height Datum (m AHD). The land immediately to the north of the port area rises steeply up to approximately 180m AHD forming Mount Clarence. The pipeline route itself is situated in a flat zone until it crosses Frenchman Bay Road. Hanrahan Road slopes gently from 10m AHD in the south to approximately 20m AHD at Cuming Road, while the majority of the Rail Corridor is generally flat.

3.3 Regional Geology

The regional solid geology comprises bedrock of granite within the Albany-Fraser Orogen. Granite is exposed along the former shoreline to the immediate north of Albany Port, forming Mount Clarence and to the north of the former gasworks site forming nearby Mount Melville. Sediments comprising silty to sandy marine, fluvial and terrestrial deposits infill depressions between areas of granite outcrop.

Reclamation of the foreshore began in the late 1940's using fill material of varying types and quality. In general land to the west of the current Albany Port consists of a mixture of industrial and domestic wastes, dredged sediments and coal fired boiler wastes from shipping operations and building rubble. Redevelopment of the Albany Foreshore Precinct began in 1996, with the port expansion (Berths 4, 5 and 6) consisting of clean calcareous quartzose sand from local sand quarrying operations.

Granite is outcropping along the southern part of Hanrahan Road, after which granite is overlain by alluvial sand and sandy marine, fluvial and terrestrial deposits. The Rail Corridor, Georges St and Roudhay Rd are located on alluvial sand.

In addition, ground conditions along Hanrahan Road/Cuming Road and the Rail Corridor to George Street have the potential for acid sulphate soil generation. Acid sulphate soils (ASS) are soils that contain iron sulfide minerals, particularly the mineral pyrite, and occur naturally over extensive low-lying coastal areas, tidal floodplains and estuarine systems where sources of sulfates, iron and other salts originate from seawater, which are predominantly less than 5 m (AHD).

Many Western Australian peat deposits contain sulfides and high levels of arsenic, heavy metals and are predominantly inundated by groundwater of high iron concentrations. Disturbance of these sulfidic peaty wetland sediments through earthwork activities such as dewatering and excavation have the potential to cause sulfide minerals in the sediments to oxidise and leach acidity, arsenic and metals into groundwater. In situations where peat has been drained, groundwater has been recorded with pH values as low as 2.4.

Additionally, the discharge of acidic contaminated groundwater to nearby wetlands or waterways can affect aquatic ecosystems and may make these water features unsuitable for recreational use.

Although not all peat is of estuarine origin or has a history involving iron sulfides, and therefore is not technically ASS, the soils still have potential to oxidise and leach acidity and therefore some management of acidity is still required.

Section 3 Site Setting and Sensitivity

According to Planning Bulletin No.64 (WAPC, 2003) the Albany Port Area and the area around Hanrahan Road/Lower Denmark Road are classified as high risk for ASS material from the surface to a depth of approximately 3m. It should be noted however that the propose pipeline route through the main Port area is predominantly through reclaimed land at the proposed depth (1-2m).

3.4 Regional Hydrogeology

Minor groundwater may exist within the weathered and fractured bedrock. However, along the proposed pipeline route, groundwater is likely to occur within an unconfined sandy aquifer formed from sedimentary deposits.

Depth to groundwater along the proposed route is generally shallow, ranging from 2 to 3 metres below ground level (m bgl) along the reclaimed section of the port, through to 0.5m bgl along Princess Royal Drive opposite the former gasworks and along the Rail Corridor.

3.5 Groundwater Bore Records Search

A search for registered groundwater users along the proposed pipeline route was undertaken by the Department of Environment, Water Information Branch. The results of the search, as attached in **Appendix A,** indicate that there are more than 100 registered bores in the vicinity of the proposed pipeline route. There is a cluster of registered bores located at the old Railway Depot, adjacent historical landfill, and on the former gasworks and cannery sites. A number of registered bores are also located within the CSBP facility west of Mount Melville. The elevation of the groundwater table recorded from the bores located on the former gasworks, cannery and landfill sites ranges from approximately 0.5 to 1.0 m AHD.

Section 4 Fieldwork

The following Section describes the fieldwork conducted as part of the proposed Phase 2 DSI.

4.1 Scope of Fieldwork

The following tasks were completed as part of the Phase 2 DSI for Sections D and E (As discussed in **Section 1.2**, Section F of the pipeline was abandoned due to amendments to the pipeline route, however soil survey points were still completed along this section of the pipeline route):

- Development of a site-specific and task-specific Health & Safety Plan for distribution to all subcontractors;
- Completion of a full and detailed underground services clearance programme along the proposed sampling areas. This involved utilising existing plans (GRL, Rev E) of the main service corridor in the Port area and plans along the main roads (Princess Royal Drive, Hanrahan Road, Lower Denmark Road, Roundhay Road etc), as well as using specialist non-intrusive radio-detection equipment to attempt to identify the presence of underground power lines and main service pipelines;
- Surveying and pegging of 35 soil sampling locations on a 20 m spaced sampling grid along the Pipeline (Sections D, E and F);
- Obtain relevant clearance and or/permits to excavate in proposed areas from the following:
    a. Albany Main Roads Department;
    b. City of Albany; and
    c. Public Transport Authority/Westnet Rail (not required as sample points were offset so intrusive works were conducted outside the boundary).
- Drilling and excavation in accordance with standard URS operating procedures supervised by a suitably qualified URS field technician at all times. A photoionisation detector (PID) was used to assist in the visual and olfactory identification of impact at the investigation locations;
- Collection of one soil sample per soil bore guided by PID concentrations and visual and olfactory identification of impact;
- Conduct asbestos survey at each soil bore location and at depth;
- Collection of nominal groundwater grab samples (frequency 50 %) from soil bores with the objective of providing indications on groundwater quality in the area which will be potentially encountered by the pipeline contractors. It should be noted that groundwater grab samples could not be obtained along Section D due to the soil bore integrity at the point of interception with groundwater. A field inspection of Section D located three pre existing shallow monitoring wells located on the outside boundary of the Westnet Rail corridor. Opportunistic sampling was conducted at these locations and samples were submitted to ALS for groundwater quality analysis; and
- Transportation of samples to NATA accredited laboratory for subsequent soil and groundwater analysis.

4.2 URS Health, Safety and Environment Plan (HSEP)

Prior to commencing fieldwork, a site specific URS Health, Safety and Environment Plan (HSEP) was prepared for the investigation. The plan detailed potential hazards associated with the investigation, the minimisation of those hazards, and plans for implementation of emergency procedures in case of incident or accident involving URS personnel and subcontractors.

Section 4 Fieldwork

As part of Albany Main Roads (AMRD) approval process, a traffic management plan (TMP) was required prior to the commencement of intrusive works. Albany Traffic Control (ATC) produced a TMP for works to be carried out 17 to 18 April 2007, working hours 7.0 am to 5.0 pm which was submitted and approved by AMRD prior to the commencement of intrusive works. The TMP is attached as **Appendix B**.

4.3 Underground Utility Search

Prior to the commencement of instrusive works at Sections D and E, URS site personnel met with J&SDoyle underground service locator representative on 15 April 2007 to review *Dial Before You Dig WA* plans and current survey plans of the proposed pipeline route (Rev.E) to identify and mark underground service location of utilities along with the Pipeline.

Further, URS personnel met with Albany Water Corporation to delineate any sewage or water services in the area. All services were marked with high visibility spray paint prior to the commencement of intrusive works

4.4 Survey

Prior to the commencement of the intrusive fieldworks the Harley Survey Group set out soil sampling locations on a 20 m grid spacing along Sections D, E and F. Where underground services were idientified survey points were offset by 6 m. Flagged wooden pegs were used to mark each sampling location. Surveying was conducted two days prior to fieldwork so as to minimise trip hazards, prevent people from removing them and to allow an easy sighting of the sampling locations. Each sampling location was surveyed to +/-1m in the horizontal plane and +/-50mm in the vertical plane. Thirty five soil sampling locations were pegged and surveyed between locations D,E and F on 12 April 2007. Survey results are included in **Appendix C**.

4.5 Soil Investigation Methodology

The following procedures were conducted for the Phase 2 DSI (Sections D and E).

The advancement of 20 soil bores (Section E: O21 (previously Section F), O24, O25, O27, O28, O29 and O75) (Section D: O32, O35, O37, O39, O41, O45, O46, O47, O48, O50, O52, O54 and O55) was conducted by geoprobe in macro-coring mode between 17 and 18 April 2007 (see **Figure 4**). This comprised the advancement of a 50mm outside diameter core barrel fitted with an inner dedicated, disposable, plastic or acetate liner to preserve a relatively undisturbed sample minimising the potential for cross-contamination and enabling the field technician to log the geological profile in detail along with enabling visual and olfactory observations of potential impacts to be noted. The acquired soil sample comprised of a continuous sample with dimensions approximating those of the sample tube. Soil bores were advanced to an average depth of 3.0 m below ground level (bgl).

Soil bores were hand augured to a depth of 1 m bgl at all soil bore locations to ensure unidentified underground services were not intercepted.

During soil sampling, selected soil samples were screened in the field using a PID monitor to aid in the detection of VOCs. Headspace screening tests were conducted on soil samples at various intervals. PID concentrations were recorded on soil bore logs and are presented as **Appendix D**. PID calibration certification is attached as **Appendix E.**

Collection of one soil sample per soil bore was conducted at various depths throughout the soil profile based on subsurface composition, visual and olfactory observations and PID values conducted during the field investigation ensuring representative soil samples sent for laboratory analysis.

The quality control samples obtained during sampling included two soil field duplicate, two rinsate blanks and one trip blank.

Section 4 Fieldwork

Geological strata was logged in the field (to Unified Soil Classification System) and graphically transcribed in hard copy and presented in this report. In each soil bore the following data was clearly presented on the logs:

- Name of the field engineer supervising the investigation along with the names of the crew and the rig type and the sampling method;
- Date of sampling, unique sampling location number, depth of sampling and sample type; and
- All field records comprise of field observations of colour, odour, field-screening photo-ionisation detector (PID) results and details of any unnatural material encountered.

Completed graphic logs are presented with surface elevations (to an accuracy +/-10mm), depth scale in metres and coordinates. Soil bore logs are presented in **Appendix D.**

Soil samples were collected directly from the drilling (plastic liner or split-spoon sampler) using suitable sampling tools, and placed into laboratory provided sterile glass jars with Teflon seals. Sample containers were labelled with a unique sample number and other information such as depth and location the sample.

Following sample collection, soil samples were placed in ice packed coolers, prior to transport to the laboratories, under full chain of custody procedures.

All excess soil cuttings will be returned to soil bores following sample acquisition. On conlcusion of task bores where drilling through concrete was required, the bore was grouted up to the ground surface and capped with concrete.

4.6 Asbestos Survey and Sampling

An asbestos screening survey of the ground surface and at depth was undertaken at each proposed sampling location for suspected asbestos containing material (ACM). A total of 10 nominal soil samples were submitted for ACM presence/absence analysis. These included 6 primary samples from Section D (O46_2.6-2.8, O32_1.6-2.0, O47_1.0-1.5, O48_2.2-2.5, O55_0.0-0.5 and O39_1.6-2.0) and 4 from Section E (O24_2.5-2.6, O27_1.8-2.3, O29_1.0-1.3 and O75_2.5-2.7) (see **Figure 5**).

Asbestos samples were collected using disposible nitrile gloves and transferred to ALS provided sealable plastic bags. Samples were labelled with the date, URS specific job number, the samplers id, and the location of the sample. Samples were placed in hard containers, prior to transport to ALS Environmental.

ALS subcontracted asbestos analyitcal tests to NATA accredited Australian Safer Environment and Technology Pty Ltd for analyses under ALS chain of custody procedures.

4.7 Groundwater Investigation Methodology

The following procedures were completed for groundwater sampling:

As previously discussed in **Section 4.1**, groundwater grab samples could not be extracted along Section D due to soil bore integrity at the point of groundwater interception. After a field inspection along Section D, 3 shallow groundwater monitoring wells were located on the perimeter boundary of the Westrail corridor. The location of the wells were retrieved using a hand held GPS unit and are presented as **Figure 3** and have been labeleld MW01, MW02 and MW03.

The sampling procedures for the extraction of groundwater at monitoring well locations MW01, MW02 and MW03 on 18 April 2007 are summarised as follows:

Section 4 Fieldwork

- Wells were purged and sampled in general accordance with URS QA/QC protocols which were developed in accordance with Australian Standards and the DEC guidelines for the sampling and analysis of groundwater;
- All groundwater collected during the purging of wells was disposed of to the ground;
- All groundwater collected during sampling was done so with dedicated disposable bailers;
- All groundwater samples for dissolved metals were pre-filtered in the field using designated disposable filters with 45um filters;
- No field water quality parameters were recorded as sampling of MW01, MW02 and MW03 was opportunistic and hence appropriate instrumentaion for measuring water quality parameters was not avaliable at the time of sampling;
- 5 times the bore volume was purged to ensure stabilisation of water quality parameters;
- Samples recovered for analysis were labelled in accordance with the well location and I.D, the name of the person sampling and the date of sampling, placed in chilled coolers for transportation to ALS under full chain of custody procedures; and
- The quality control samples obtained during sampling included two groundwater field duplicate, two rinsate blanks and one trip blank.

Collection of groundwater grab samples was conducted prior to backfilling at 3 sample locations along Section E (GWO24, GWO27 and GWO28) on 17 April 2007, using a dedicated disposable bailer. Pre filtering of groundwater grab samples could not be conducted in the field due to the high silt and organic content of the groundwater and was therefore filtered at ALS laboratory.

Samples recovered for analysis were labelled in accordance with the well location and I.D, the name of the person sampling and the date of sampling, placed in chilled coolers for transportation to ALS under full chain of custody procedures.

4.8 Decontamination Procedures

Down-hole tools (geoprobe tools and hand augers) were washed with a laboratory grade detergent between sampling locations and rinsed with potable water. Soil boring was completed using a disposable plastic/acetate liner to house the soil core to further minimise the potential for cross-contamination between locations.

All groundwater sampling equipment was decontaminated between sample locations using laboratory grade detergent (Decon 90) mixed with potable water, followed by a potable water rinse. Disposable nitrile gloves were also used during sample handling, with a new pair of gloves used for the collection of each water sample.

Asbestos samples were collected using disposible nitrile gloves and transferred directly in to laboratory provided sealable plastic bags.

4.9 Field Observations

The following observations were recorded during the soil and groundwater field investigation component of the Phase 2 DSI.

Section 4 Fieldwork

4.9.1 Geological Information

Information obtained from the collation of soil bore logs and the collection of soil samples during completion of the field works has been summarised below for each corresponding section of the Pipeline investigated (Section D and Section E). Generalised subsurface profile for Section D is summarised in **Table 4** and generalised subsurface profile for Section E is summarised in **Table 5.** Soil Bore logs are attached as **Appendix D.**

Observations of actual or potential impact in the form of visual, olfactory or based on instrumental readings (head-space tests undertaken using a PID monitor) were recorded and are presented on the soil bore logs.

Table 4

Field Observations-Subsurface Profile

(Section D)

Location	Soil Type	General Depth	Soil Description
SECTION D (Former and current Railway Depot (including Southern Distribution Centre)	**Gravely SAND/SAND with gravels**	From 0.0m bgl to between 0.4 and 2.2m bgl	Loose, red brown grading light brown and/or cream with depth, fine grained, damp, some rootlets no odour. Gravels generally ~5 mm diameter. Hydrogen sulphide odour as groundwater is intercepted. Generally located at all soil bore locations.
	SAND	From between 0.4 and 1.10m bgl to between 1.5 and 2.5m bgl	Loose, cream to light brown to grey, fine to medium grained, damp, no odour to hydrogen sulphide odour (generally as groundwater is intercepted), some shell fragments at depth. Some minor clay at depth. Generally located at all soil bore locations.
	SAND/Clayey SAND/Silty SAND	From between 1.0 and 2.5 m bgl to depth undetermined (limit of investigation)	With organic matter, loose, clayey SAND is medium dense, grey and black, fine to medium grained, wet, hydrogen sulphide odour. Generally located at all soil bore locations

Field observations along Section D are summarised as follows:

Section D

- Subsurface profile generally comprises a gravely sand layer overlying a loose, fine to medium grained sand layer. Alluvial material (sand/clayey sand/silty sand) was located at depths of between approximately 1.0 and 2.5m bgl, generally at or below the predicted groundwater level;
- No visual staining was recorded;
- No hydrocarbon odours were detected. A hydrogen sulphide odour was noticed at all soil bores where groundwater was intercepted; and
- Recorded PID values were generally below 50 ppm (0.0 ppm (O45_1.5 m) to 50.5 ppm (O52_0.5-0.6)).

Section 4 Fieldwork

Table 5

Field Observations-Subsurface Profile

(Section E)

Location	Soil Type	General Depth	Soil Description
SECTION E (Former City of Albany Landfill)	**TOPSOIL**	From 0.0m bgl to between 0.4 and 0.6m bgl	Loose, brown, fine grained, some gravels, rootlets, damp, no odour. Generally located at all soil bores except O28.
	SAND	From 0.0m bgl to 1.0m bgl	With coal, loose, black, very fine grained, coal fragments, rootlets, no odour. Located at soil bore O28 only.
	SAND	From between 0.3 and 2.0m bgl to 1.8 and 3.0m bgl	Loose, cream, grey to light brown, fine to medium grained, damp to wet, generally no odour unless below watertable then hydrogen sulphide odour. Some shell fragments Generally located at soil bores O25, O21, O24, O27, O28, O29 and O75.
	SAND (FILL)	From 1.0m bgl to 2.8m bgl	Loose, light yellow, fine grained, damp, no odour. Located at soil bore O21 only.
	Clayey SAND/Sandy CLAY	From between 0.9 and 1.0m bgl to between 1.1 to 2.0m bgl	Red brown and/or brown with orange mottling, fine to medium grained, damp. Some fine limestone gravels. Clay is medium plasticity, soft to firm. Located at soil bores O25, O24, O28 and O29.
	Silty SAND/ Clayey SAND/SAND	From between 1.6 and 2.8m bgl to between 2.0 and 3.0m bgl.	Black to grey black, very soft, fine to medium grained. Sand is fine grained. Some LANDFILL (wood and glass) (O25), slight landfill odour (O25, O24 and O27). Some shell fragments. Generally located at soil bores O25, O21, O24, O27 and O75.
	Sandy CLAY	2.5m bgl to undetermined depth (limit of investigation)	Firm to hard, medium to high plasticity. Light grey, wet, no odour, Sand is coarse grained. Located at soil bores O27 and O28.

Section E

Filed observations along Section E are summarised as follows:

- The subsurface profile running along Section E was variable with lenses of, for example, clayey sand and silty sands intersecting a sand layer. The general subsurface profile comprise topsoil overlying a loose, cream to grey to light brown, fine to medium grained sand layer with variable amounts of shell fragments. The sand layer was intersected with a red brown clayey sand/sandy clay lenses. Very soft, fine to medium grained, black to grey black alluvial material (silty sand/clayey sand/sand) was intersected at depths ranging between 1.6 and 2.8m bgl;
- No visual staining was recorded;

- No hydrocarbon odours were detected A hydrogen sulphide odour was noticed at all soil bores where groundwater was intercepted;
- An odour typical of landfill was noticed at soil bore locations O25, O24 and O27 within the alluvial profile. Landfill (glass and wood) was intersected at soil bore O25 at approximately 1.6m bgl; and
- Relatively high PID values were recorded within the top 1.0m of the subsurface profile at soil bore locations O24 (442 to 300 ppm), O28 (590 ppm), O29 (105.5 to 215 ppm) and O75 (250 to 400ppm), although it is thought this is due to natural processes.

4.9.2 Hydrogeological Information

Section D

Approximate depth to groundwater (m bgl) was based on observations recorded during soil bore advancement, approximately at depths ranging between 1.1 m bgl (O24) and 2.9 m bgl (O21) with corresponding elevation levels of 0.759 m AHD and -0.403 m AHD. Approximate groundwater depths are presented on the soil bore logs attached as **Appendix D.**

Opportunistic groundwater sampling was conducted at 3 shallow monitoring well locations (MW01, MW02 and MW03) (see **Figure 4**), identified during a field inspection of Section D. No field water quality parameters were recorded for the extracted samples as appropriate instrumentation was not available. For this reason 5 times the calculated bore volume was purged to ensure that groundwater conditions were stabilised.

Depth to groundwater ranged between 3.1 m bgl (MW02) and 3.27 m bgl (MW01). All samples emitted a strong hydrogen sulphide odour. Field observations are presented in **Table 6.**

Table 6

Field Observations

Shallow Groundwater Monitoring Wells

Well Location	Easting*	Northing*	Date Sampled	Measured Bore Depth (mbtoc)	Depth to Groundwater (mbtoc)	Comments
MW01	580944	6123179	18/04/2007	4.75	3.27	H2S odour, silty, grey
MW02	580876	6123213	18/04/2007	4.89	3.1	H2S odour, silty, grey
MW03	580717	6123298	18/04/2007	4.65	3.15	H2S odour, silty, grey

* Wells surveyed using hand held GPS unit

Section E

Approximate depth to groundwater (m bgl) was based on observations recorded during soil bore advancement and was recorded at depths ranging between 1.1 m bgl (O37 and O41) and 2.2 m bgl (O47). Groundwater elevation ranged between 1.042 m AHD (O37) and 0.407 m AHD (O32). Approximate groundwater depths are presented on the soil bore logs attached as **Appendix D.**

Groundwater grab samples (GW024, GW027 and GW028) (see **Figure 4**) were extracted at three soil bore locations (O24, O27 and O28) along Section E. The groundwater grab samples emitted a strong hydrogen sulphide odour and were high in fibrous organic matter and silt. Field observations are presented in **Table 7.**

Table 7

Field Observations

Groundwater Grab Sample

Sample ID	Easting	Northing	Elevation (m AHD)	Date Sampled	Depth to Groundwater (Approximate m bgl)	Depth to Groundwater (m AHD)	Comments
GW024	580482.318	6123464.038	1.859	17/04/2007	0.8	1.059	H2S odour, black, silty, high organics
GW027	580542.699	6123478.046	2.042	17/04/2007	1.5	0.542	H2S odour, black, silty, high organics
GW028	580562.555	6123480.393	2.112	17/04/2007	1.9	0.247	H2S odour, black, silty, high organics

4.9.3 Asbestos Survey

During the advancement of soil bores, an asbestos survey as conducted and sample locations are presented on Figure 5

Recorded field observations indicate no suspected ACM's were identified on the surface or at depth along Section D and E of the Pipeline. Regardless of the field observations, nominal soil samples (10) were submitted for analysis in order to eliminate, by confirmation, ACM's as a potential source of contamination.

Section 5 Analytical Results

5.1 Adopted Investigation Guidelines

The draft Department of Environment and Conservation (DEC) guideline, *Assessment Levels for Soil, Sediment and Water* (WA DEC, November 2003) have been adopted for the assessment of the Pipeline. These guidelines are aimed at providing parties with a document that outlines the criteria utilised by DEC in assessing contamination along the length of the Pipeline and the need for further investigation. In general, the guidelines reflect usage of those criteria presented in the National Environmental Protection Measure (NEPM, December 1999) for the assessment of site contamination.

It should be noted that these guidelines have been used as an initial comparison to assess the potential degree of impact and do not reflect clean-up criteria.

5.2 Soil Investigation Guidelines

Based on past landuse practices along the route of the Pipeline and the future excavation works proposed along this route, soil analytical results have been compared against the Health Investigation Levels for landuse intended for parks, recreational open space and playing fields use (HIL-E) as adopted by the DEC in the draft guidelines for the *Assessment Levels for Soils, Sediment and Water (DEC, 2003).*

5.3 Groundwater Investigation Guidelines

As discussed in **Section 3.1** it has been identified that the Albany Port Harbour is the main environmental receptor of concern, therefore the groundwater analytical results have been compared with the Marine Water Ecosystems (ANZECC 2000) as adopted by the DEC in the draft guidelines for the *Assessment Levels for Soil, Sediment and Water* (DEC, 2003).

5.4 Laboratory Schedule

The laboratory schedule and itinerary of tests for soil, groundwater and asbestos are attached as **Appendix F**. All soil and groundwater samples were analysed by a NATA certified laboratory ALS for the required analyses.

In addition to the standard soil and groundwater testing, sufficient samples were provided for quality assurance/quality control (QA/QC) requirements and were submitted as follows:

1. Duplicate soil samples at a frequency of 2 in 20 of the total soil samples obtained;
2. Duplicate grab groundwater samples at a frequency of 2 in 6 of the total samples obtained;
3. Two trip blanks for every esky of samples; and
4. Three field blanks for the duration of the works.

The field sampling methodology, QA/QC samples and the internal laboratory derived QA/QC samples were then used to assess the accuracy of the data received from the laboratory with data quality objectives and data precision. This was completed in general accordance with the guidance documents published by the United States Environmental Protection Agency (USEPA), including the US EPA Contract laboratory Programme for Organic Data Review, October 1999; US EPA Contract Laboratory Programme or Inorganic Data Review, July 2002; and the US EPA Guidance on Environmental Data Verification and Data Validation, November 2002. The process involved the checking of analytical procedure compliance and an assessment of the accuracy and precision of the analytical data from a range of quality control measurements, generated from both the field sampling and analytical programmes.

The results of the data validation are presented in **Section 5.7.**

Section 5 Analytical Results

5.5 Soil Analytical Results

The advancement of 20 soil bore locations was conducted between 17 and 18 April 2007 to a depth of 3 m bgl. In total, 13 primary soil samples from Section D were submitted for 12-suite metals, TPH, BTEX, phenols, OC/OP pesticides and creosote and a total of 7 primary samples from Section E were submitted for 12-suite metals, pH, VOCs, SVOCs and PCB's.

Complete analytical results for soils are presented in appended **Table A** and **Table B.** Laboratory certificates and supporting documentation are presented in **Appendix G**. The full QA/QC analysis and data validation report is discussed in **Section 5.7** and complete reports are attached as **Appendix H**.

5.5.1 Soil Metals

Table 8 presents a summary of the analytical results for soil metal concentrations of Section D and E. **Figure 6** presents the soil metal exceedances of the adopted HIL-E trigger values.

Table 8

Analytical Results Summary – Soils - Metals

No. of Primary Samples	Analyte (mg/kg)	Min (mg/kg)	Max (mg/kg)	Human Health Investigation Level (HIL)-E	Samples Exceeding HIL Assessment Criteria
SECTION D					
13	All				**No HIL Exceedances**
SECTION E					
7	Lead	ND	1270	600	O25_1.6-2.0 (**1,270),** O27_1.8-2.3 **(829).**
7	Zinc	ND	18300	14,000	O24_2.0-2.4 **(344),** QC01 **(553),** O25_1.6-2.0 **(18,300),** O27_1.8-2.3 **(2,460).**

NOTES
ND = non detect
(282) = metal concentration value (mg/kg)

The following comments can be made:

Section D

- None of the 13 primary samples exceeded the adopted WA DEC HIL-E guideline;
- Trace metal concentrations for arsenic, barium, chromium, copper, led, manganese, vanadium and zinc were reported at depths between 0.1 and 2.8 m bgl for soil bores located along the boundary perimeter of the Westrail depot; and
- Low metal concentrations for arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium and zinc were identified at O52 which is located at shallow depths (O52_0.5-0.6) to the eastern end of Section D.

Section E

- pH values ranged between 6.3 pH units (O28_0.2-0.5) and 8.1 pH units (O29_0.5-0.8) indicating the subsurface profile is neutral to slightly alkaline;
- Reported lead concentrations were above the adopted WA DEC (2003) HIL-E guideline of 600 mg/kg at soil bore locations O25_1.6-2.0 (1,270 mg/kg) and O27_1.8-2.3 (829 mg/kg (see **Figure 6**);

- Reported zinc concentrations were above the adopted WA DEC (2003) HIL-E guideline of 14,000 mg/kg at soil bore location O25_1.6-2.0 (18,300 mg/kg) (see **Figure 6**);
- Depth of impacted soil was variable ranging from 1.6m bgl (O25) to 2.3m bgl (O27); and
- Low metal concentrations for arsenic, barium, chromium, copper, led, manganese, vanadium and zinc were reported at depths between 0.2 and 3.0 m bgl along the Former Albany Landfill.

5.5.2 Soil TPH, BTEX, VOCs and SVOCs

The following comments can be made:

Section D

- All BTEX, TPH fraction C_6-C_9 , phenol and creosote (as creosols) compound concentrations were below the reported LOR;
- Low concentrations for TPH fraction C_{10}-C_{36} TPH were reported at soil bores O39_1.6-2.0 (1000 mg/kg) and O52_0.5-0.6 (160 mg/kg) (see **Figure 7**) ; and
- All OC/OP Pesticide concentrations were below the reported LOR with the exception of O34_0.5-0.7 for Dieldren (0.08 mg/kg) and O36_1.6-2.0 for Diazinon (0.06 mg/kg).

Section E

- All TPH fraction C_6-C_9 , PCB, phenol and SVOC concentrations were below the reported LOR;
- Low concentrations for TPH fraction C_{10}-C_{36} TPH were reported at soil bores O21_2.8-3.0 (180 mg/kg), O27_1.8-2.3 (250 mg/kg) and O28_0.2-0.5 (410 mg/kg) (see **Figure 7**);
- Low VOC concentrations were reported for methylene chloride at all soil bores ranged between 0.6 mg/kg (O21-2.8-3.0 and O75_2.0-2.4) and 1.4 mg/kg (O27_1.8-2.3). This is with the exception of O29_0.5-0.8 whose concentrations were below the LOR;
- Low VOC concentrations were reported for 2-Butanone (O21, O25 and O27) ranging between (6 and 10 mg/kg) and 2-Propanone (Acetone) 12 mg/kg(O27);
- Low total PAH concentrations ranging between 1.4 mg/kg and 22 mg/kg were reported at O21, O24 (QC01), O75 and O27; and
- O21_2.8-3.0 reported PAH concentrations for benzo(a)pyrene (2.6 mg/kg) slightly in exceedance of the adopted HIL-E trigger value of 2 mg/kg.

5.5.3 Soil Asbestos Survey

A total of 10 primary soil samples were submitted to NATA accredited Australian Safer Environment and Technology Pty Ltd (as subcontracted by ALS) for analyses. These samples included 6 primary samples from Section D (O46_2.6-2.8, O32_1.6-2.0, O47_1.0-1.5, O48_2.2-2.5, O55_0.0-0.5 and O39_1.6-2.0) and 4 from Section E (O24_2.5-2.6, O27_1.8-2.3, O29_1.0-1.3 and O75_2.5-2.7)

Samples were examined under a stereo microscope and selected fibres were analysed by polarized light microscopy in conjunction with dispersion staining method (as per Safer Environment Method 1 and Australian Standard AS 4964-2004).

The laboratory certificates and supporting documentation are presented in **Appendix G**. The results of the analyses for asbestos screening are presented in appended **Table C**.

Of the 10 samples submitted for analyses, none were positively identified as containing ACM's.

Section 5 Analytical Results

5.6 Groundwater Analytical Results

3 primary samples from shallow monitoring wells (MW01, MW02 and MW03) (see **Figure 4**) along Section D, were sampled on 18 April 2007 and submitted for 12-metals suite, TPH, BTEX, phenols, creosote, and OC/OP pesticide analysis.

3 primary groundwater grab samples (GW024, GW027 and GW08) (see **Figure 4**) from corresponding soil bores along Section E, were sampled on 17 April 2007 and submitted for 12-metals suite, TPH, VOCs, SVOCs, PCBs and pH analysis.

Complete analytical results for groundwater are presented in appended **Table D** and **Table E.** Laboratory certificates and supporting documentation are presented in **Appendix G**. The full QA/QC analysis and data validation report is discussed in **Section 5.7** with complete reports attached as **Appendix H**.

Table 9 presents a summary of the analytical results for groundwater metal, TPH and BTEX concentrations for Section D and E. **Figure 8** presents groundwater metal exceedances of the adopted guideline for Marine Water Ecosystems (DEC 2003) **Figure 9** presents TPH and BTEX concentrations.

Table 9

Analytical Results Summary – Groundwater- Metals, TPH and BTEX

No. of Primary Samples	Analyte (mg/L)	Min (mg/L)	Max (mg/L)	Marine Waters Ecosystem Criteria (mg/L)	Samples Marine Waters Ecosystem Assessment Criteria
SECTION D					
3	cobalt	ND	0.002	0.001	MW02 (QC02) **(0.002)**
3	copper	ND	0.006	0.0013	MW01 **(0.006),** MW02 **(0.002)**
3	zinc	ND	0.193	0.015	MW01 **(0.024),** MW02 **(0.018),** MW03 (**0.021)**
3	TPH (all fractions)	ND	ND	-	All non detect
3	BTEX	ND	ND	-	All non detect
SECTION E					
3	cadmium	ND	0.0006	0.0055	GW024**(0.006)**
3	cobalt	ND	0.001	0.001	GW027 (QC06) **(0.001),** GW028 **(0.001)**
3	copper	ND	0.013	0.0013	GW024 **(0.013),** GW027 **(0.005),** GW027 (QC06) **(0.004),** GW028 **(0.002)**
3	lead	ND	0.007	0.0044	GW028**(0.007)**
3	zinc	ND	0.233	0.015	GW024 **(0.15),** GW027 **(0.073),** GW027 (QC06) **(0.233),** GW028 **(0.193)**
3	C_6-C_9	ND	ND	-	All non detect
2	C_{10}-C_{36}	ND	560 (ug/L)	-	No Criteria

NOTES
ND = non detect
(282) = reported concentration (mgL)

Section 5 Analytical Results

Section D

Based on analytical results the following comments can be made:

- All TPH, BTEX, creosote, phenols and OC/OP pesticide concentrations were below the reported LOR;
- Low metal concentrations for arsenic, barium and manganese were reported at all monitoring wells; and
- Exceedances of the Marine Water Ecosystem Guideline (DEC, 2003) were reported at monitoring wells MW01 (cobalt and zinc), MW02 (cobalt and zinc) and MW03 (zinc), although all are of the same order of magnitude.

Section E

Based on analytical results the following comments can be made:

- Reported pH values (6.39 pH units (GW028) to 7.46 pH units (GW024)) indicate groundwater is neutral to slightly alkaline;
- All TPH (C_6-C_9 fraction), VOC, SVOC and PCB concentrations were below the reported LOR;
- Low TPH (C_{10}-C_{36} fraction) concentrations were reported in groundwater grab sample GW028 (560 ug/L);
- Low metal concentrations for arsenic, barium, lead, manganese and nickel were reported at all monitoring wells;
- Exceedances of the Marine Water Ecosystem Guideline (DEC, 2003) were reported in groundwater grab samples GW024 (cadmium, copper and zinc), GW027 (copper and zinc) and GW028 (cobalt, copper, lead and zinc); and
- In general, groundwater exceedances are of the same order of magnitude with the adopted guideline; this is with the exception of zinc, whereby exceedances are in the order of 1 magnitude greater.

5.7 Analytical Data Validation

Analytical data validation is the process of assessing whether data are in compliance with method requirements and project specifications. The primary objectives of this process are to ensure that data of known quality are reported, and to identify if the data can be used to fulfil the overall project objectives.

The data validation guidelines adopted by URS provide a consistent approach for the evaluation of analytical data. These guidelines are based upon data validation guidance documents published by the United States Environmental Protection Authority (USEPA) and National Environment Protection Council (NEPC). The process involves checking the analytical procedure compliance and assessment of the accuracy and precision of analytical data from a range of QA/QC measures, generated from both sampling and analytical programs. Laboratory QA/QC certificates are presented as **Appendix H.**

The following points summarise the findings of the data quality review undertaken:

- **Field Sampling Procedures:** All soil and groundwater field samples were collected in accordance with standard URS field sampling procedures. The sampling methods employed are considered sufficient in order to meet the data quality objectives of this investigation.
- **Sample Preservation and Handling:** All soil and groundwater field samples were handled and preserved in accordance with standard URS quality procedures. All sample handling and

preservation methods employed are considered sufficient in order to meet the data quality objectives of this investigation.

- **Sample Holding Times:** All soil and groundwater field samples were tested within acceptable holding times for the relevant analysis requested, based on holding times recommended by the USEPA with the following exceptions:
  - **Soil:** The holding time for moisture content was exceeded by 1-2 days for all samples. The extraction/preparation time was exceeded by 6 days for 8 samples for pH.
  - **Water:** The analysis holding time for pH by PC titrator was exceeded by 10 days, the results should be treated with caution. The extraction and preparation time for PCBs, Pesticides, TPH fraction C10-C36, PAH/Phenols and semi volatile organic compounds was exceeded by 1-2 days.

  URS submitted all samples with ample time allowed for extraction/preparation and analysis by the laboratory within the recommended time frames (except for pH by PC titrator which requires analysis on the same day as sampling). URS does not believe the 1 and 2 day exceedences will significantly affect the results.
- **Required Limits of Reporting:** All limits of reporting for the various analyses undertaken were found to be consistent between all samples and analysis batches performed. The limits of reporting were sufficiently low to enable a meaningful comparison between results and contamination guideline values, where applicable, with the following exception:
  - **Water:** LOR for Chromium for some samples was raised by a factor of 5 due to matrix interferences. The raised LOR did not exceed the adopted criteria.
- **Frequency of Quality Control Measurements:** The frequency of quality control measurements was deemed to be acceptable for this project's requirements.
- **Rinsate Blank and Trip Blank Sample Results:** The three rinsate blank and two trip blank samples collected during soil and groundwater sampling activities returned results that were below the relevant laboratory LOR for all analytes tested. This indicates that cross-contamination of samples during field sampling, in transit to the laboratory, or within the laboratory was unlikely to have occurred.
- **Field and Lab Duplicate Results:** Where relative percentage differences (RPDs) calculation was applicable, RPDs were within acceptable limits of 30 % and 20 % respectively. Some elevated RPDs were reported, however the results were less than 10 times the limits of reporting and are not considered to impact on the quality of the data set. The following exceptions should be noted:
  - Elevated RPDs were calculated between GW027 and its field duplicate QC06 (water samples) for Manganese and Zinc this was due to results > 20 times LOR and greater than the RPD acceptance criteria of 30%. These results should be treated with caution and the highest values should be used for interpretative use (QC06 in both cases).
  - Elevated RPDs were calculated between 024_2.0-2.4 and its field duplicate QC01 (soil samples) for Arsenic and Zinc this was due to results > 20 times LOR and greater than the RPD acceptance criteria of 30%. These results should be treated with caution and the highest values should be used for interpretative use (QC01 in both cases).
- **Matrix Spike and Surrogate Recoveries:** Matrix spikes and surrogate recoveries were reported within the acceptance laboratory guideline limit, suggesting that analyte loss during extraction/analysis steps did not occur, the following exceptions should be noted:
  - **MS:** Low recovery was observed for various OC and OP pesticide analytes in water sample MW02. Insufficient sample for re-analysis. Low recovery observed for Phenolic compound 4-chloro-3-methylphenol in soil sample 035_0.4-0.7. Any reported concentrations for these analyte should be considered underestimated. For non-detects the true matrix specific detection limit will be higher than the method default value.

Section 5 Analytical Results

- **Surrogates:** High recovery observed for OP Surrogate DEF for soil samples 039_1.6-2.0 and 046_2.6-2.8. High recovery observed for acid extractable surrogate 2-fluorophenol in soil samples 025_1.6-2.0, 021_2.8-3.0 and QC01. Any reported concentrations for these analyte should be considered overestimated. For non-detects the true matrix specific detection limit will be lower than the method default value.

Section 6 Conclusions and Recommendations

6.1 Conclusions

Based on field observations, analytical results and the objectives of this report, the following can be concluded regarding impacted soil and groundwater along the Section D and Section E of the Pipeline:

Section D

In general, impacted soil identified along the length of Section D is negligible and is not considered a potential risk to human health during construction works for this Section.

Groundwater is impacted to some extent although exceedances are generally within the same order of magnitude as the adopted Marine Water Ecosystem guideline values.

The extent of impact can be summarised as follows:

- Low metal and TPH concentrations reported for soil bore O52_0.5-0.6 m bgl can be attributed to the presence of road base materials identified at this depth during soil bore advancement. The road base materials may have been graded over during historical construction works associated with Royal Princess Drive or the adjacent carpark and hence the impacted area is considered relatively isolated;
- Some contamination was detected at soil bore location O39 at a depth of between 1.6 and 2.0 m bgl for semi volatile TPH fraction;
- No material containing asbestos was identified along Section D; and
- Elevated metal concentrations for cobalt, copper, zinc, greater than the adopted Marine Water Ecosystem Guidelines (DEC, 2003), were reported for the shallow monitoring wells along Section D. Exceedances, were of the same order of magnitude.

Section E

In general, impacted soil identified along the length of Section E seems to be contained to the profile containing landfill or near the intersection of landfill material of the subsurface profile comprising black silty sand, potentially posing risks to human health during construction work of the Pipeline along this Section.

Impacted groundwater generally corresponds to elevated metal concentrations for soil indicating there is a strong probability that migration of contaminants of concern is occurring into the groundwater.

The extent of impact can be summarised as follows:

- Profiles comprising black silty sand/clayey sand with landfill or with landfill odour was identified at depths ranging between 1.6 and 3.0 mbgl and of varying thickness at soil bores O21, O24, O25, O27 and O75;
- Elevated lead and zinc concentrations, greater than the adopted human health guidelines, were identified at soil bore locations O25 and O27 at depths corresponding with the intersection of landfill material or a profile emitting a landfill odour, generally at depths ranging between 1.6 to 2.3 m bgl;
- Further, elevated PAH concentration reported for benzo(a)pyrene (2.6 mg/kg) for soil bore O21_2.8-3.0, is located at depths greater than the proposed excavation depth of 1 to 2 m bgl;
- Low metal concentrations were reported for all soil bores between depths of 0.2 and 3.0 m bgl;
- Low TPH fractions were reported in soil bores at depths ranging between 1.8 and 3.0 m bgl. Low TPH concentrations in the groundwater below O28 indicate migration of contaminants may be occurring from the impacted soils to the groundwater;

- No material containing asbestos was identified along Section E; and
- Groundwater grab samples GW024 (cadmium, copper and zinc), GW027 (copper and zinc) and GW028 (cobalt, copper, lead and zinc) exceeded the adopted Marine Water Ecosystems guideline and generally correspond with soil metal concentrations.

6.2 Recommendations

Given the desired objectives of the report to determine areas of soil and groundwater contamination along Section D and E of the Pipeline, the following has been recommended based on specific issues:

Section D

- No management is required for the excavation of soil material along Section D of the Pipeline; and
- Management of groundwater during dewatering activities will be required to ensure metal concentrations greater than the adopted Marine Water Ecosystems guidelines are not discharged into Albany Port Harbour

Section E

- Based on the variable nature of the subsurface profile along this Section, the identification of landfill at relatively shallow depths, and elevated concentrations of lead and zinc above the adopted HIL-E , it is recommended that a management plan for soil excavation is completed prior to the commencement of excavation works along this Section; and
- Management of groundwater during dewatering activities will be required to ensure metal concentrations greater than the adopted Marine Water Ecosystems guidelines is not discharged into Albany Port Harbour.

Section 7 References

Albany Foreshore Redevelopment Project. Report and Recommendations of the Environmental Protection Authority, Environmental Protection Authority, Perth, dated December 1995.

Australian and New Zealand Environment and Conservation Council (ANZECC) (1992) *Australian Water Quality Guidelines for Fresh and Marine Waters*

Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) *Australian Water Quality Guidelines for Fresh and Marine Waters*

CSBP, Media Statement dated 17 March 2004

Department of Environment and Conservation (WA DEC) (2003), *Contaminated Sites Management Series, "Contaminated Site Assessment Criteria:*

National Environment and Protection Council (NEPC) (1999) National Environment Protection Measure, Assessment of Site Contamination, NEPC December 1999

Town of Albany, Albany Foreshore Redevelopment Project, Consultative Environmental Review by ERM Mitchell McCotter Pty Ltd, dated February 1995.

Section 8 Limitations

This Phase 2 environmental site assessment addresses the likelihood of environmental liability resulting from past and current known uses of the property and the immediately adjacent properties.

This investigation is limited to interview(s) with personnel and a review of reports and literature, visual observation of surface conditions at the property, sampling and analysis of soil and groundwater The sampling and/or laboratory analysis undertaken as part of this investigation is confined to a limited number of surface and near surface soil samples.

Opinions and recommendations contained in this report are based upon data provided by representatives of Grange Resources Limited (GRL) and analytical data supplied by ALS Environmental, information gained during site inspection and fieldwork, employee interviews and information provided from government authorities' records and other third parties. This approach reflects current professional practice for Phase 2 environmental site assessments.

This investigation addresses the likelihood of hazardous substance contamination resulting from past and current known uses of the subject facility. Given the limited and mutually agreed scope of work, URS does not guarantee that hazardous materials do not exist at the subject property. Similarly, a property which appears to be unaffected by hazardous materials at the time of our assessment may later, due to natural phenomena or human intervention, become contaminated.

As a result, certain conditions such as those listed hereafter may not have been revealed:

- naturally occurring toxins in the sub-surface soils, rocks, water or the toxicity of the on-site flora;
- toxicity of substances common in current habitable environments such as stored household products, building materials and consumables;
- sub-surface contaminant concentrations that do not exceed present regulatory standards but may exceed future standards; and/or
- unknown site contamination such as dumping or accidental spillage which may occur following the site visit by URS.

Subsurface conditions can vary across a particular site and cannot be explicitly defined by these investigations. It is unlikely therefore that the results and estimations expressed in this report will represent the extremes of conditions within the site or the conditions at any location removed from the specific points of sampling. Subsurface conditions including contaminant concentrations can also change in a short time.

The information in this report is considered to be accurate at the date of issue and is in accordance with conditions at the site at the dates sampled.

This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this report.

No warranty or guarantee of property conditions is given or intended. URS makes no determination or recommendation regarding a decision to provide or not to provide financing with respect to the site.